Audi e-tron (type GE)

Self-study programme 675

For internal use only

Audi Service Training

Contents

High-voltage system

Air conditioning and thermal management

Safety and driver assist systems

Infotainment and Audi connect

Servicing, inspection & roadside/breakdown assistance

This self-study programme teaches a basic knowledge of the design and functions of new models, new vehicle components or new technologies.

It is not a Workshop Manual. Any figures given here are for explanatory purposes only and refer to the data valid at the time of writing. Content is not updated.

It is essential that you refer to the latest technical literature when carrying out maintenance and repair work.

Note

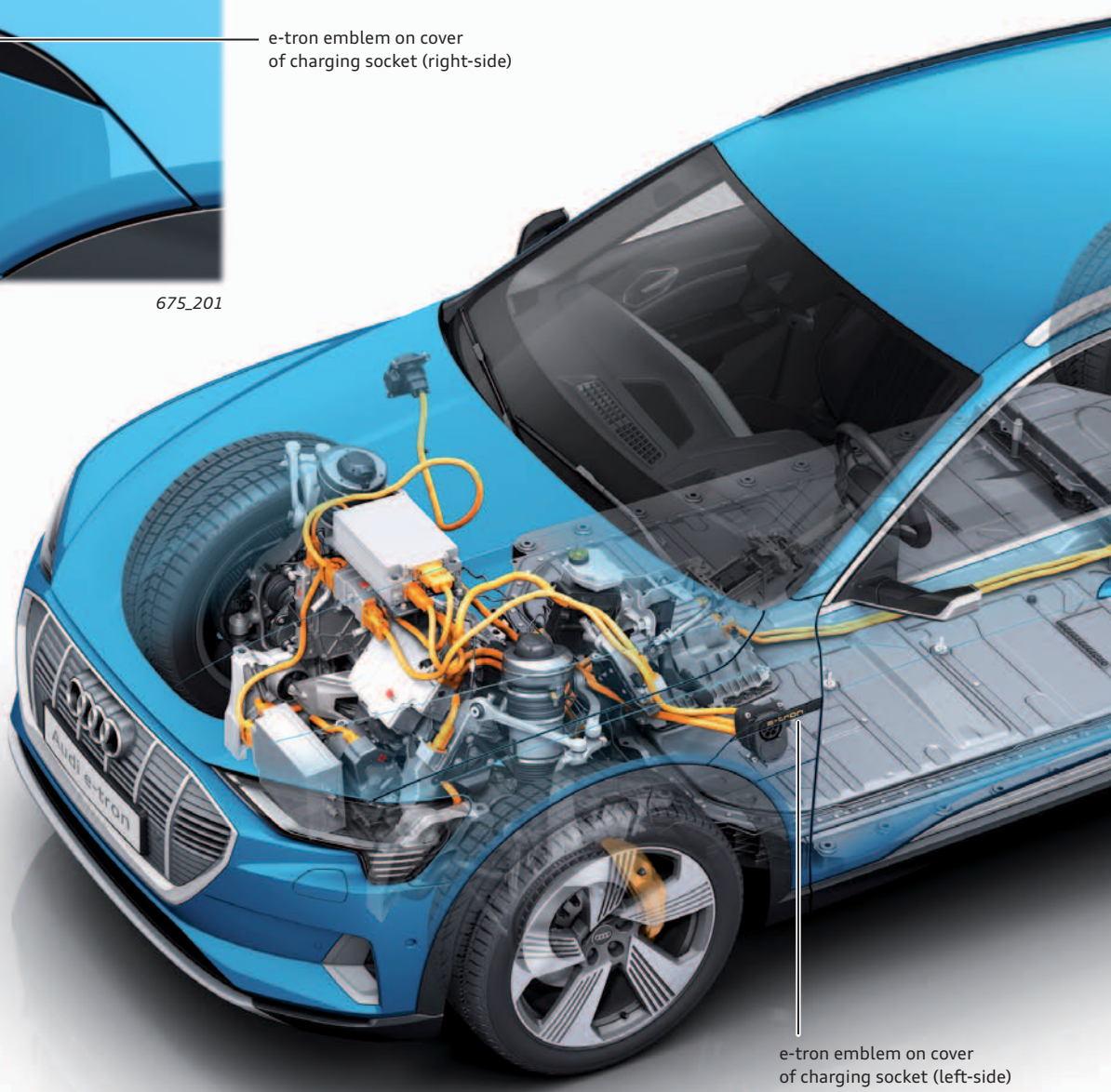
Reference

Introduction

Distinguishing features of the vehicle

e-tron emblem on cover of charging socket (right-side)

675_201



> Vehicle key with e-tron emblem

e-tron emblem on cover of charging socket (left-side)

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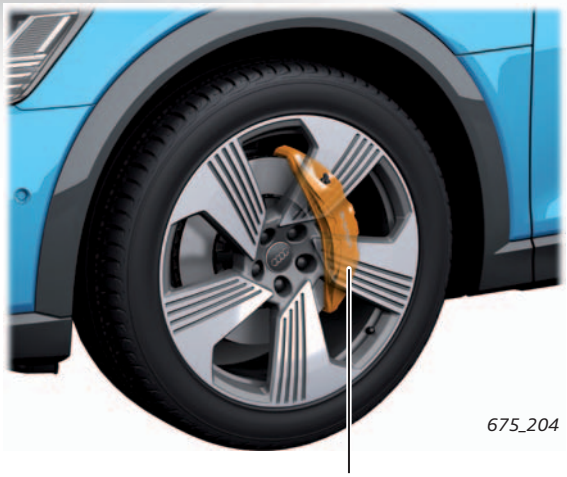
e-tron emblem



675_204

Brake caliper with e-tron emblem

675_151

On rear of vehicle

675_202

e-tron emblem on rear lid

In interior

› Audi virtual cockpit in dash panel insert with e-tron emblem

MMI system with e-tron displays

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e-tron emblem on dash panel

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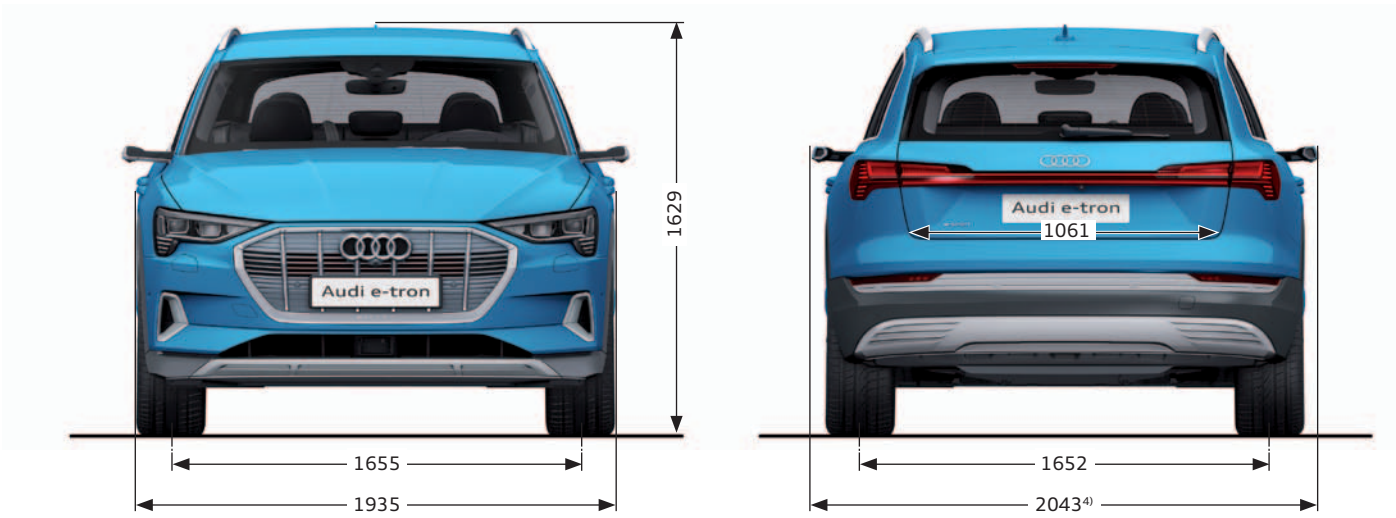
Dimensions



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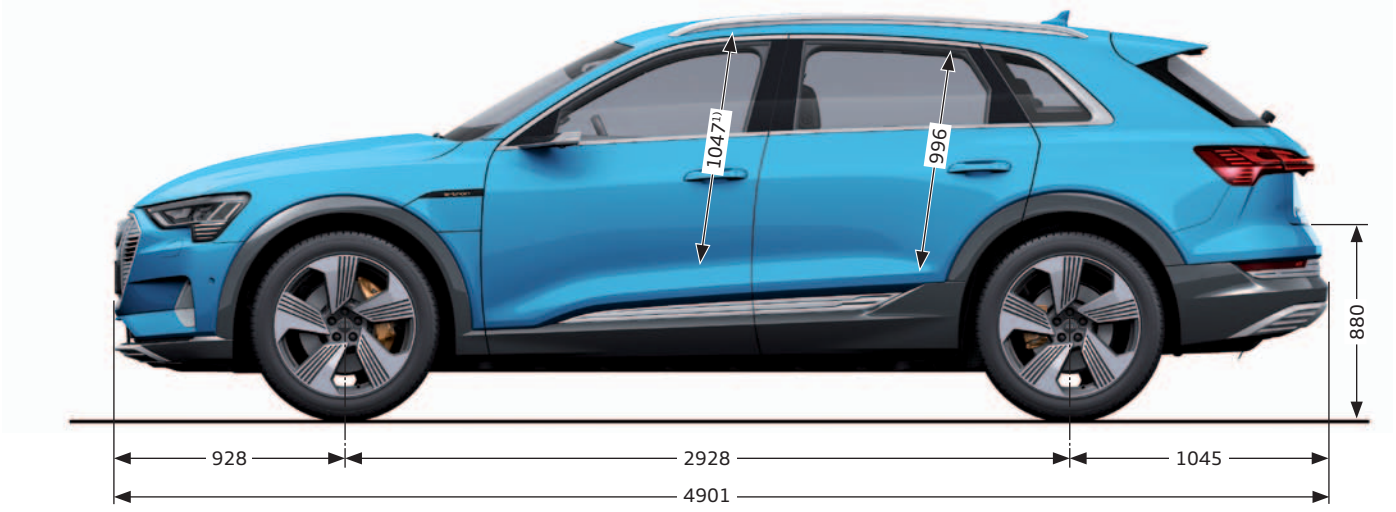

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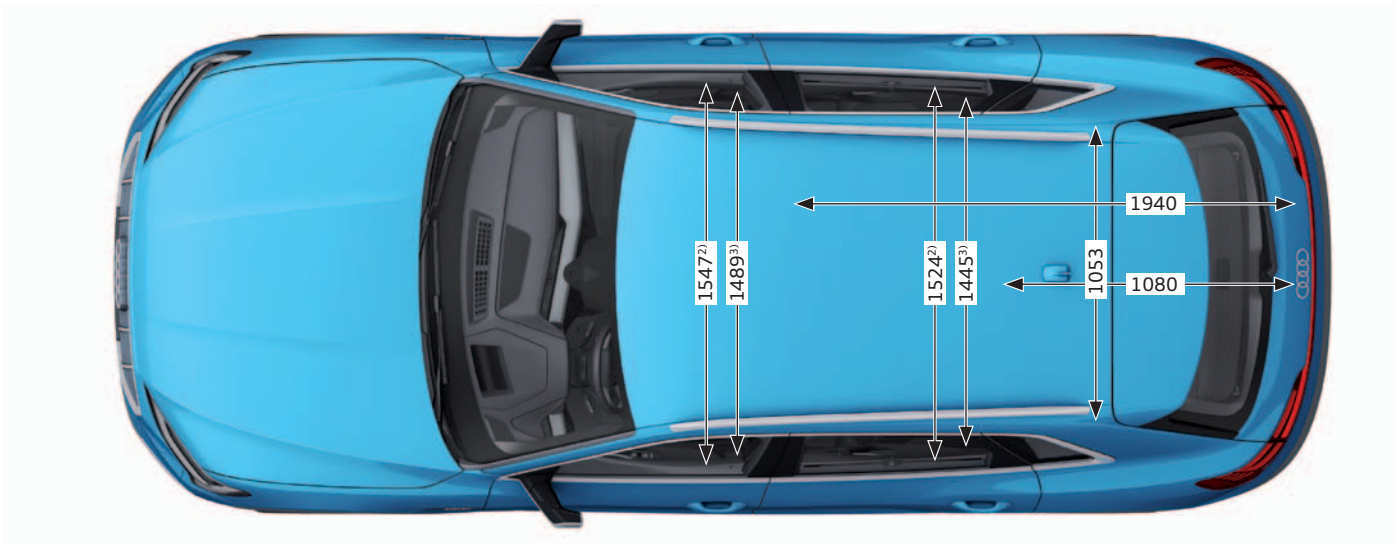

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Exterior dimensions and weights

Length in mm	4901
Width (not incl. mirrors) in mm	1935
Width (incl. mirrors) in mm	2043[4)]
Height in mm	1629
Front track in mm	1655
Rear track in mm	1652
Wheelbase in mm	2928
Unladen weight in kg	2565
Max. gross weight in kg	3140
Drag coefficient	0.27[5)]

Interior dimensions and other specifications

Front cabin width in mm	1547[2)]
Front shoulder width in mm	1489[3)]
Rear cabin width in mm	1524[2)]
Rear shoulder width in mm	1454[3)]
Through-loading width in mm	1061
Load sill height in mm	800
Luggage compartment capacity in ltr.	600
Front storage compartment in ltr.	60

[1)] Maximum headroom
[2)] Elbow room width
[3)] Shoulder room width
[4)] Vehicle width with exterior mirrors +146 mm
[5)] 0.28 with exterior mirrors

All dimensions are given in millimetres and refer to the unladen weight of the vehicle.

Body

Overview

The body of the Audi e-tron (type GE) is a modern composite construction using various materials. In addition to various grades of steel, sheet aluminium is used in the rear part of the underbody and die-cast aluminium is used for the front suspension turrets.

The bumper carriers with crash boxes, the suspension strut cross member and the reinforcement struts between the two front longitudinal members are manufactured from extruded aluminium profiles.

Outer skin:

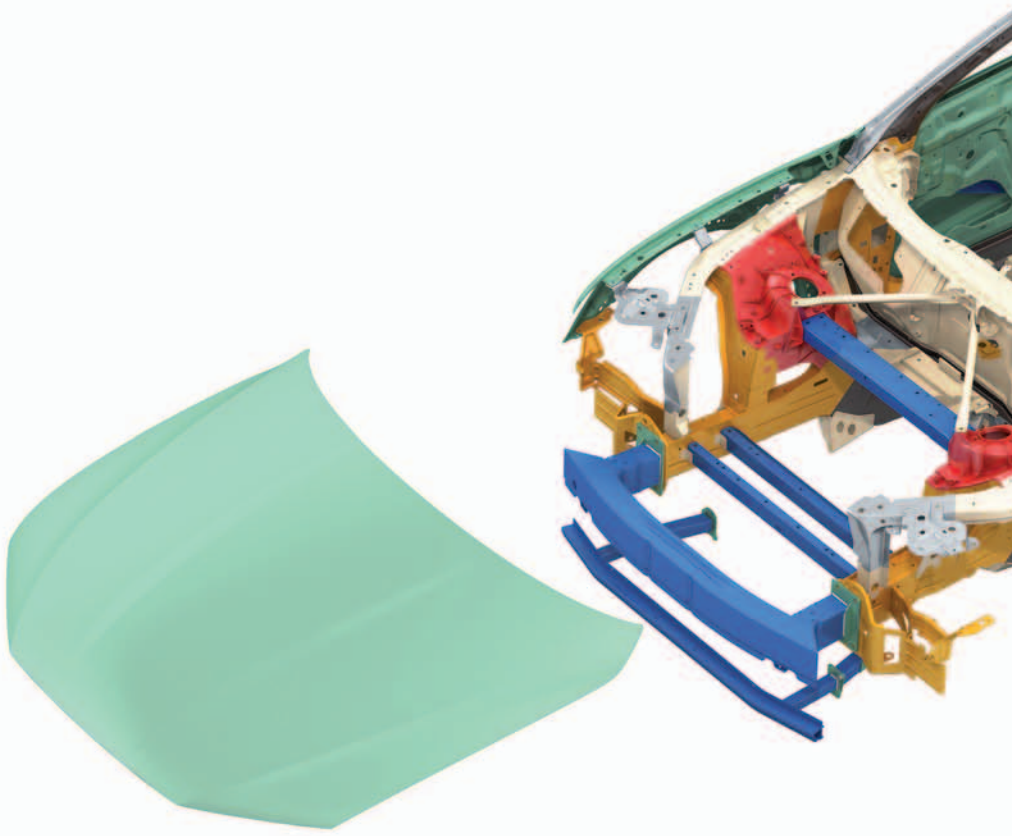
- Side panels
- Roof

are made of steel.

Attachments:

- Bonnet
- Rear lid
- Doors
- Wings

are made of aluminium.



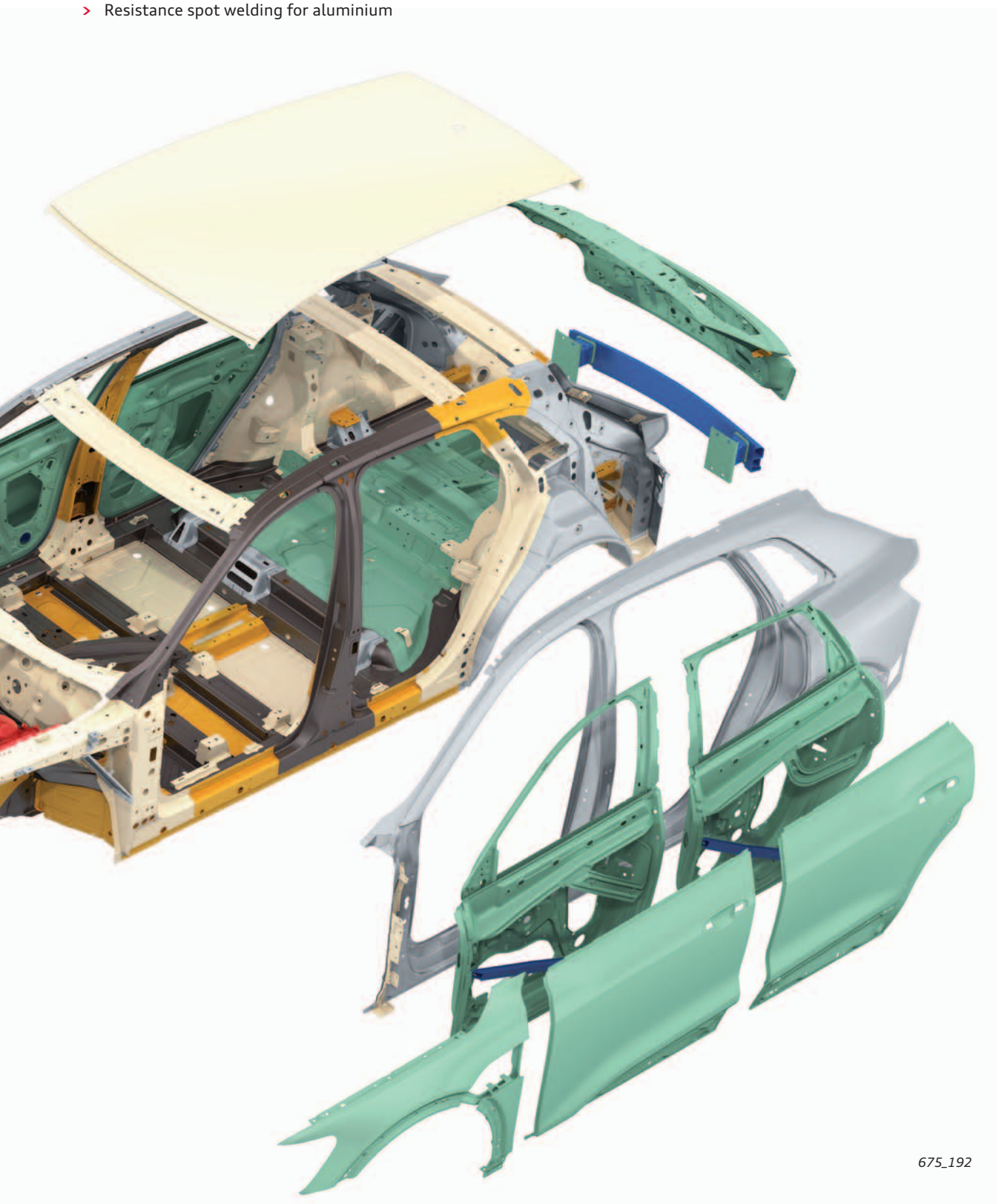
Key:

- Sheet aluminium
- Die-cast aluminium
- Aluminium section
- Ultra-high-strength steel (hot-formed)
- Modern high-strength steel
- High-strength steel
- Soft steel

Joining techniques

A number of different joining technologies are used for the vehicle body of the Audi e-tron (type GE). In addition to classic resistance spot welding for steel, the following technologies are primarily used:

- Laser welding for steel
- MAG welding
- Laser soldering/brazing
- MIG soldering/brazing for steel
- Friction element welding
- Resistance spot welding for aluminium
- Seaming
- Bonding
- Semi-tubular punch riveting
- Flow-drill screws
- Pop rivets



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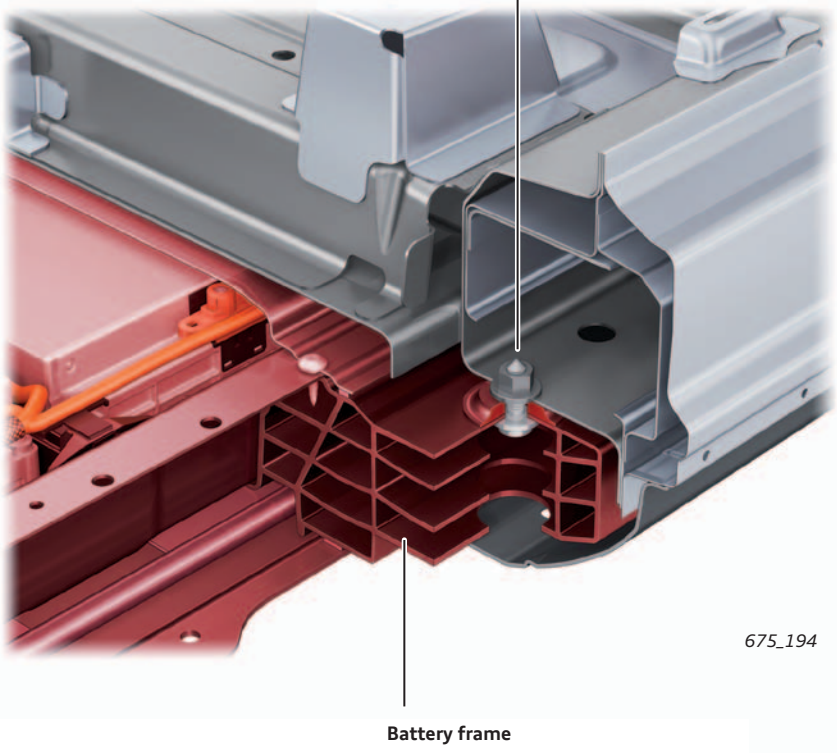
Underbody structure

One of the innovative features of the Audi e-tron is the way in which the high-voltage battery is fully integrated in the load-bearing structure of the underbody. This requires considerable constructive effort and a high level of precision when fitting the battery. The underbody structure of the Audi e-tron (shown in red) consists primarily of ultra-high-strength hot-formed sheet steel parts. It not only provides the body with the necessary rigidity in the event of a side-on collision but also increases its strength, particularly in areas that are especially relevant for safety, such as the high-voltage battery.



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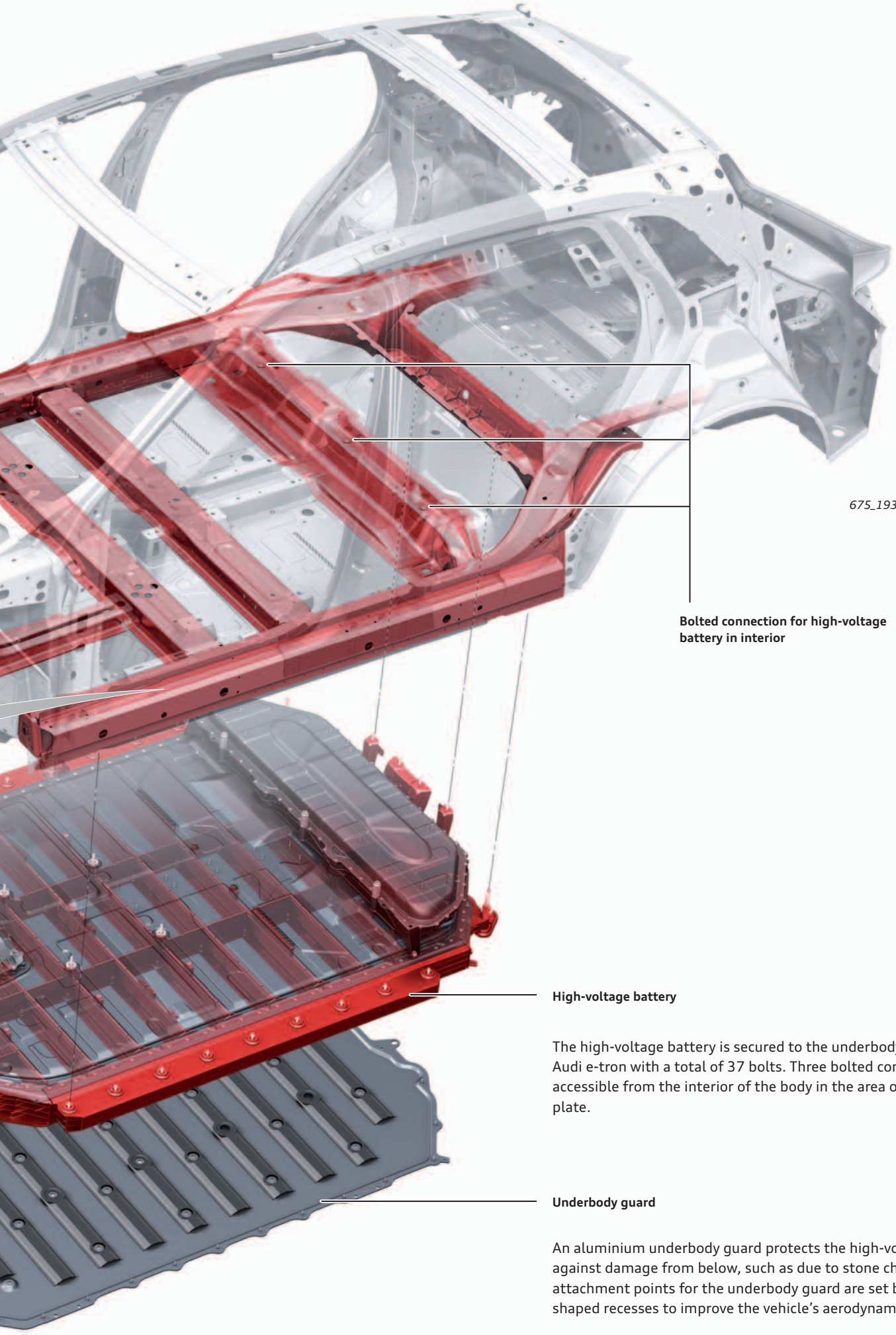
During the development of the high-voltage battery, great importance was placed on safe construction of the battery frame. The aluminium construction with a frame consisting of extruded profiles and node castings not only provides the highest possible protection in the event of an accident but also increases the body's torsional rigidity.



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Bolted connection for high-voltage battery in interior

High-voltage battery

The high-voltage battery is secured to the underbody of the Audi e-tron with a total of 37 bolts. Three bolted connections are accessible from the interior of the body in the area of the heel plate.

Underbody guard

An aluminium underbody guard protects the high-voltage battery against damage from below, such as due to stone chipping. The attachment points for the underbody guard are set back in dish-shaped recesses to improve the vehicle's aerodynamics.

Body assembly

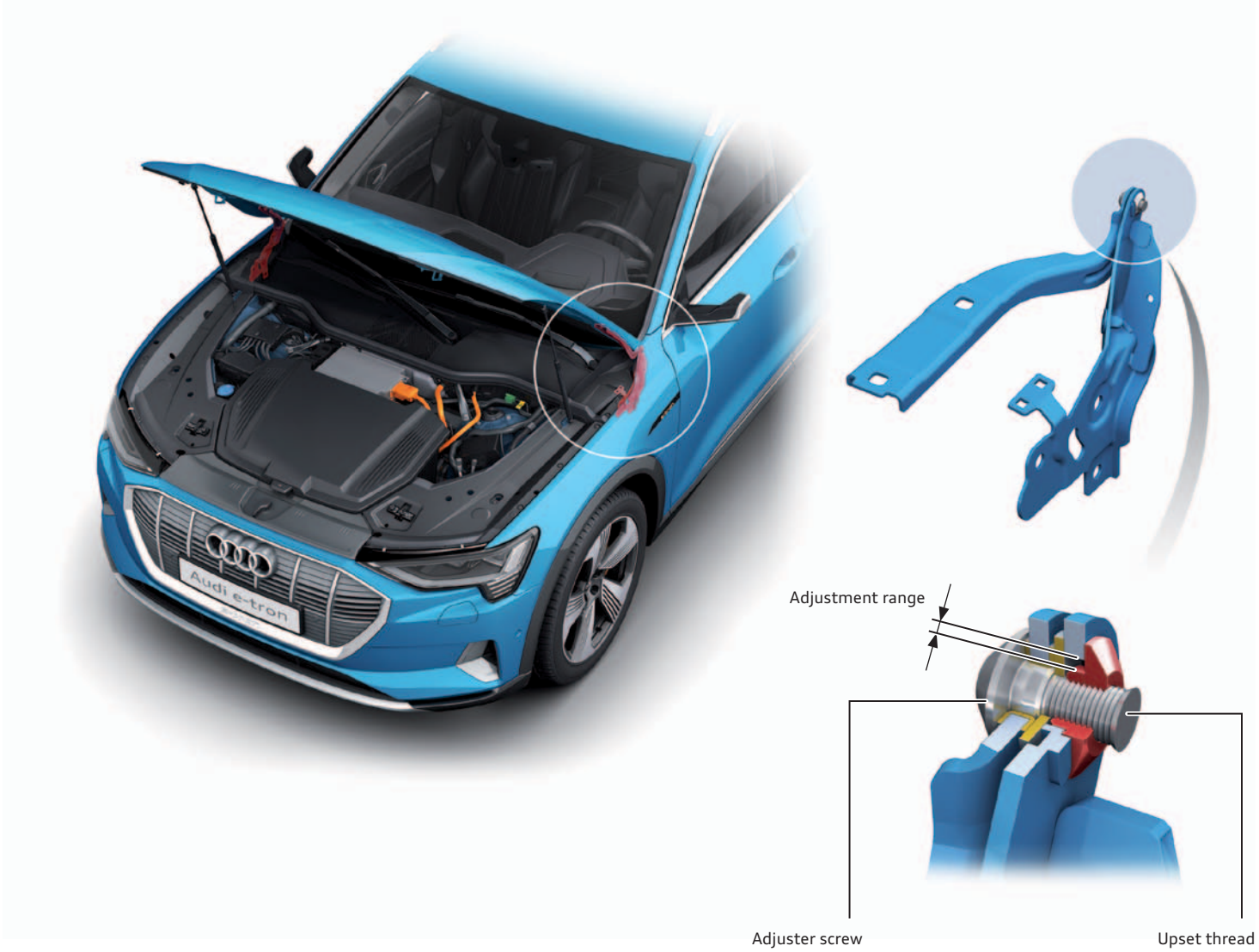
Bonnet

Similarly to the Audi Q8 (type 4M), the Audi e-tron (type GE) does not have a wrap-around bonnet. As a result, it was possible to install a more simply constructed bonnet hinge on these models. On the Audi e-tron, the hinge is secured to the side of the wing mounting flange with three bolts. Elongated holes in the bottom part of the hinge allow the longitudinal positioning (X) and the height (Z) to be adjusted so that the bonnet can be aligned with the door and the wing. The e-tron, unlike the Q8, has an outward opening hinge with the pivot point under the wing. As it is hidden under the water deflector strip, no hinge cover is required.

The bonnet is secured to the top part of the hinge with two studs. This part also has elongated holes to enable the longitudinal and lateral positioning (X and Y) to be adjusted.

The axis of the hinge is formed by a bolt. The nut for this bolt has a flange with an outside diameter that is smaller than the inner diameter of the mounting in the bottom part of the hinge. This allows the axis of the hinge to be moved slightly while it is installed, enabling further fine adjustments to be made to the bonnet in the Z direction while the installed bonnet is closed.

To ensure that the bolt cannot be removed when the bonnet is closed and to therefore enable access to the motor compartment, the thread is upset by the manufacturer after installation. The bolt can therefore only be loosened by a few turns.



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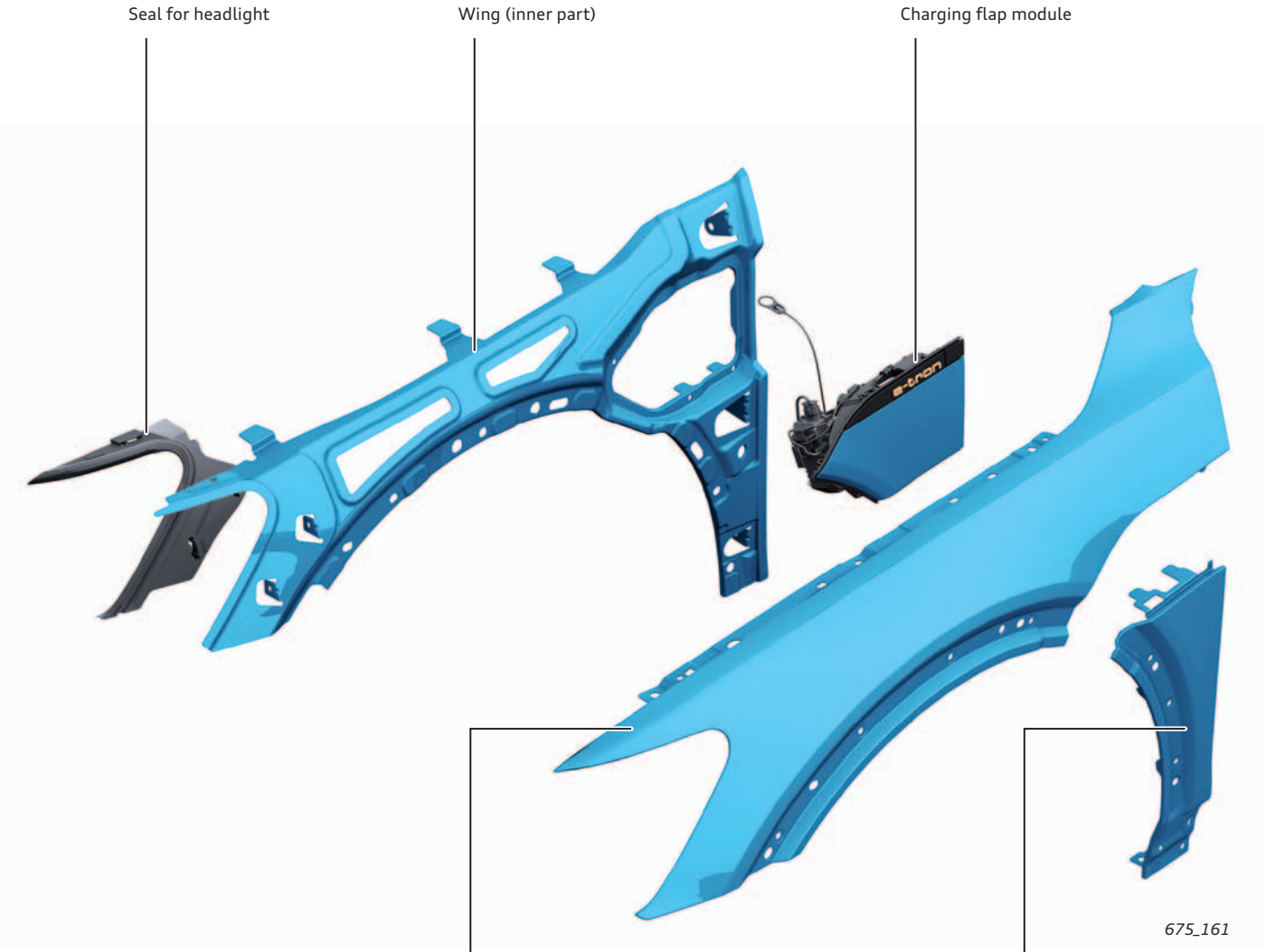
Wings

Three-part wings are fitted on the Audi e-tron (type GE). They each consist of an upper and lower outer part which are joined to an inner part that acts as a carrier. These three aluminium parts are seamed, bonded and clinched together. The seal installed at the front acts as a stop for the headlight and seals the point where it meets the wing.

The charging flap module is engaged in the space between the upper and lower outer parts. If the vehicle is not equipped with a charging flap on one side, the opening between the upper and lower part of the wing is sealed with a carrier part.

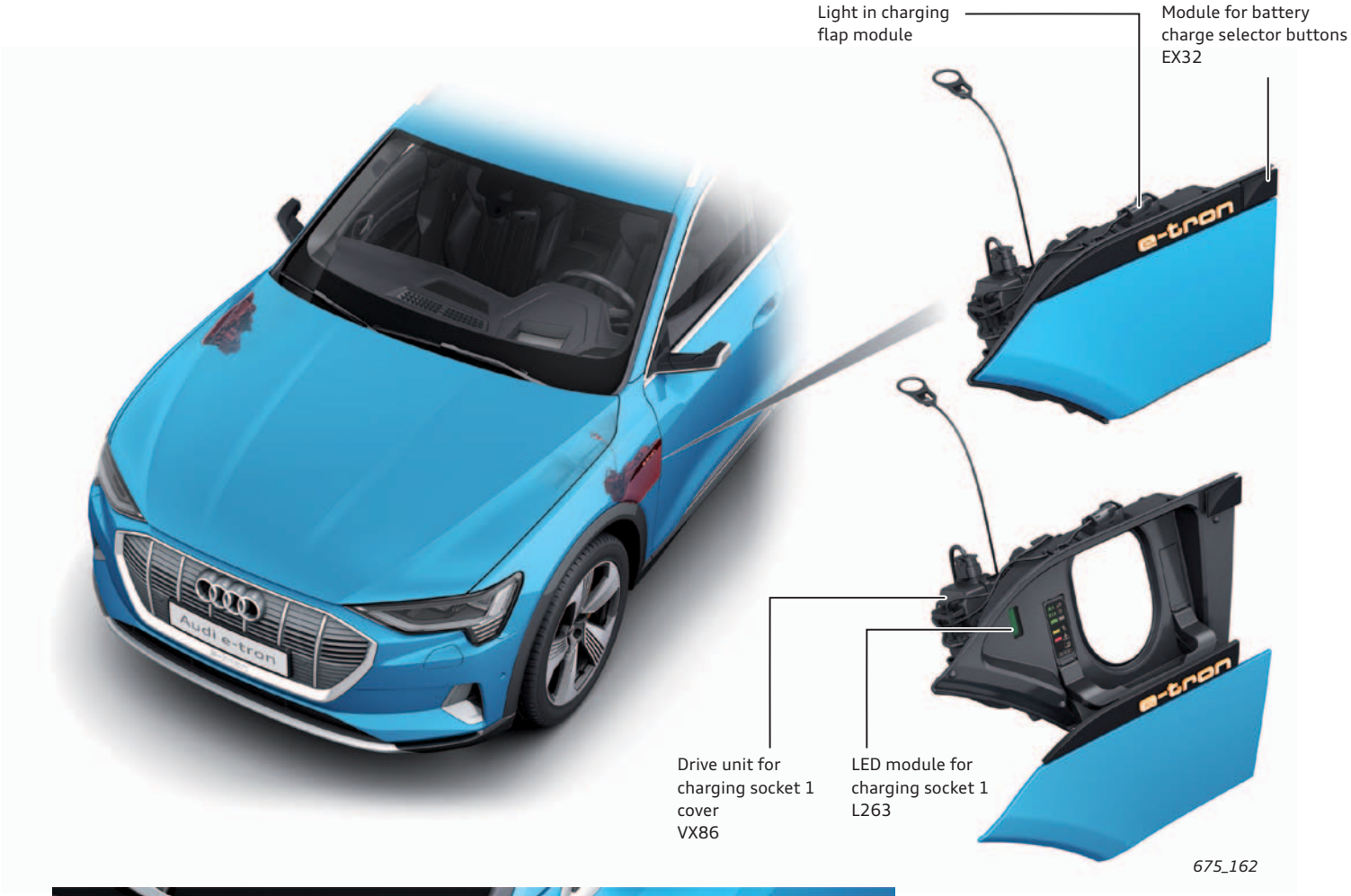


Charging flap module

Depending on the vehicle equipment and country, the Audi e-tron (type GE) is either equipped with one (on the driver side) or two (on both sides) high-voltage battery charging sockets. They are located in charging flap modules behind the front wheels in the spaces in the wings. When the vehicle is unlocked, the cover for the charging flap module moves downwards when the button in the module for battery charge selector buttons EX32 or module 2 for battery charge selector buttons EX40 is pressed briefly to allow access to the charging socket. If the vehicle is equipped with a convenience key, the vehicle does not have to be unlocked if the vehicle key is in the vicinity of the charging unit. The charging flaps move downwards to save space when they are opened. This ensures that there is enough space to easily plug in and unplug the charging cable.

Depending on the vehicle equipment, the button in the module for selector buttons is also used to unlock the charging connector to allow the charging cable to be unplugged from the vehicle after charging is completed.

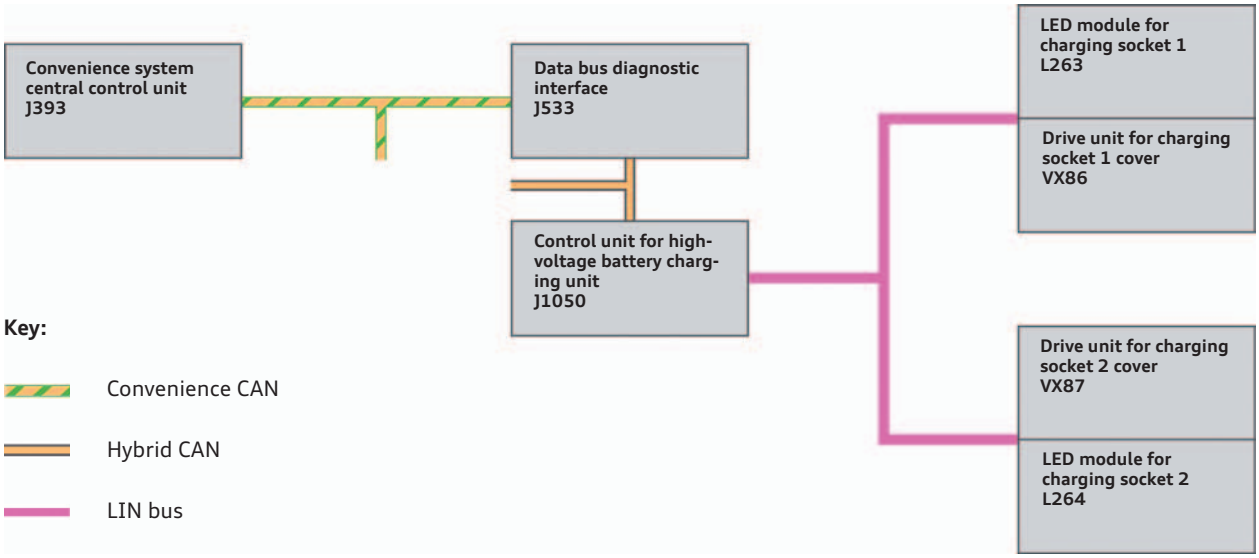
When the charging flap is open, the control unit for high-voltage battery charging unit J1050 actuates a light in the charging flap module via a discrete wire.



Charging flap manual release

Reference
For further information on the charging flap, refer to page 107.

The charging indicator is integrated into the charging flap module as an LED module and shows the charging status. A sticker on the inside of the charging flap module explains how different statuses are indicated. As the LIN slave, the charging flap module receives the command to open or close the drive unit for charging socket cover from its LIN master, the control unit for high-voltage battery charging unit J1050. In addition, the command for how the LED module for charging socket should be actuated is also transmitted via LIN. If a second charging flap module is also installed (PR number: JS1), it is connected to the control unit for high-voltage battery charging unit J1050 via the same LIN connection.



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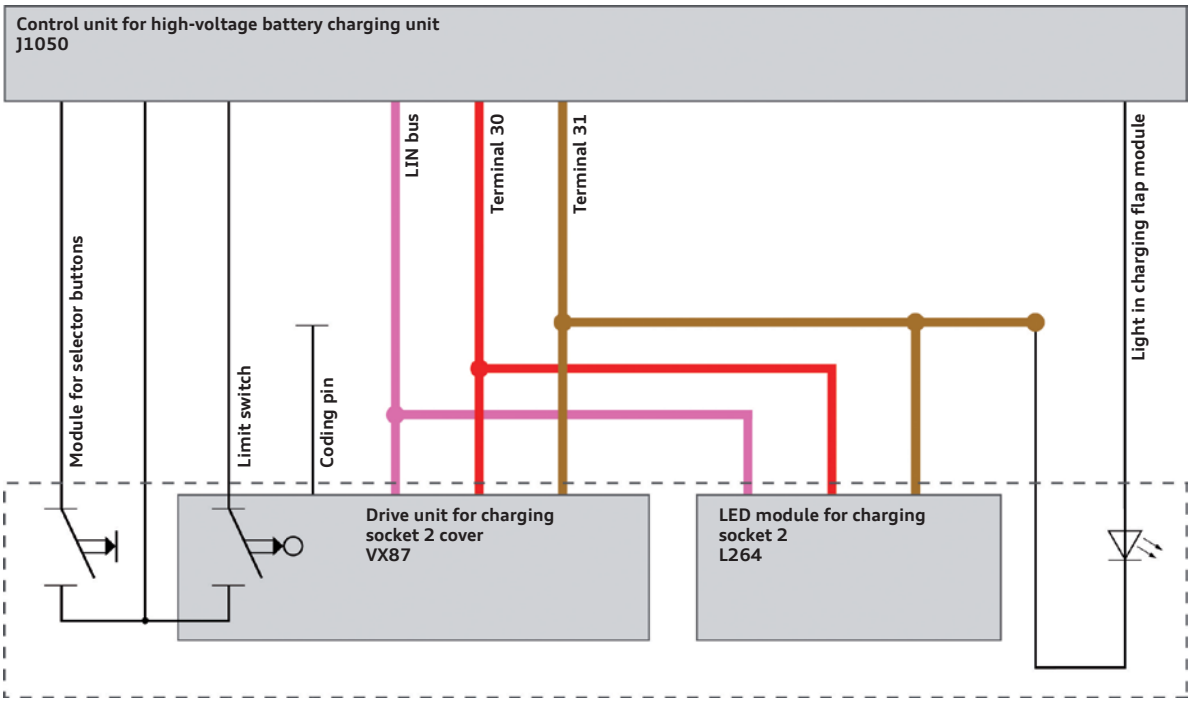
The drive unit for charging socket cover is assigned to the side of the vehicle via a ground coding pin. On drive units on the right side of the vehicle, this pin is connected to ground.
The control unit for high-voltage battery charging unit receives feedback on whether the charging flap is closed via a microswitch. The electric motor in the drive unit is self-locking. It was therefore not necessary to include an active locking mechanism for the charging flap.

If the drive unit no longer opens the charging flap module electrically, such as in the event of a fault, the charging flap can be released manually. To do so, the red loop under the cover in the motor compartment on the side of the affected charging connection must be pulled carefully. The charging flap can then be pushed downwards manually.



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Audi e-tron driving strategy

Drive

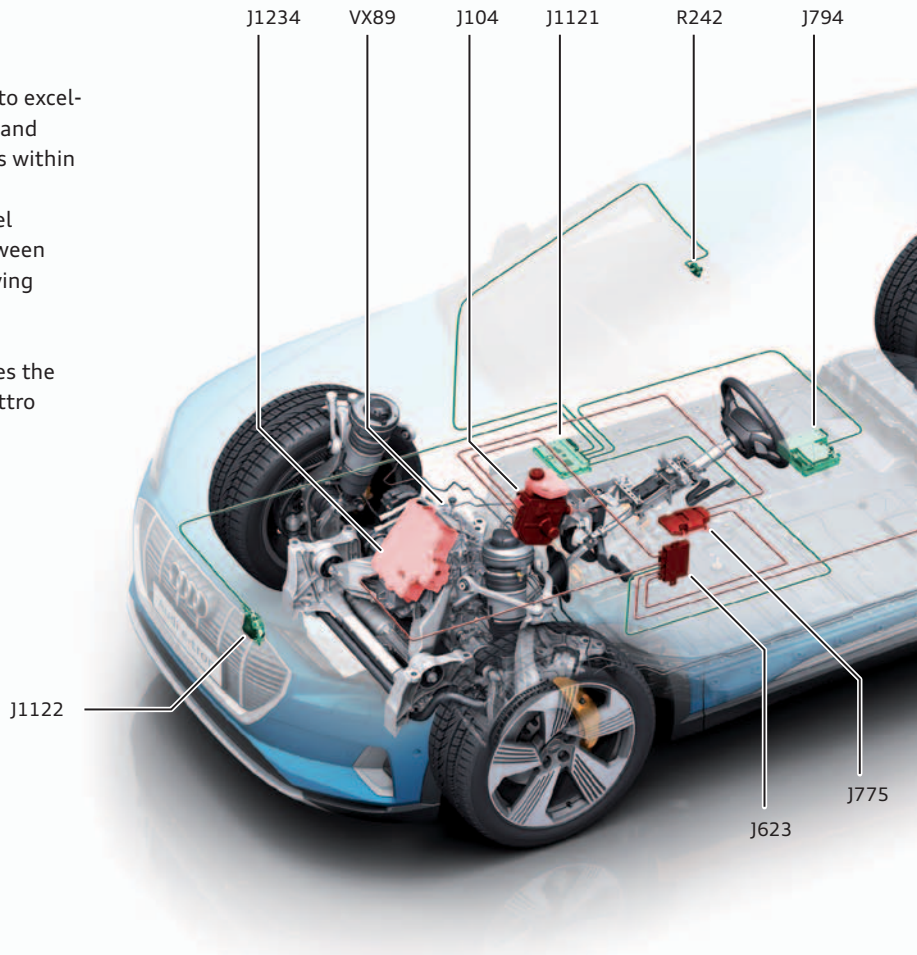
The Audi e-tron has two electric drive units, one on the front and one on the rear axle. The distribution of the drive and recuperation torques between the two drive units is controlled by the motor control unit J623. For this purpose, the motor control unit receives torque specifications from other control units so that it can always distribute the drive and recuperation torques accurately under consideration of the traction and dynamic conditions or specifications. Refer to figures 675_174, 175 and 176.

Simulations of the drive have shown that primarily transmitting the drive torque to the rear axle is advantageous for the overall drive efficiency. The drive torque is therefore mainly transmitted by the electric drive motor on the rear axle. Recuperation is also carried out primarily via the rear axle.
For further information refer to page 18 onwards.

quattro with e-tron technology

The fast responsiveness of the electric motors can be used to excellent effect for the distribution of torque between the front and rear axles. They can react to changing friction on the wheels within a fraction of a second.
The electronic differential lock (EDL) and the selective wheel torque control regulate the distribution of drive power between the wheels of an axle and thereby improve traction and driving dynamics.

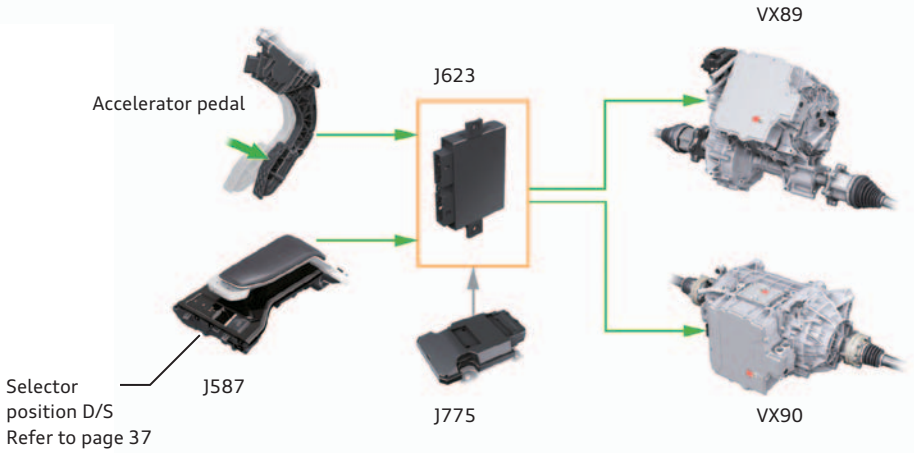
The sophisticated Audi four-wheel drive strategy coordinates the torque distribution within a few milliseconds, bringing quattro with e-tron technology to a new level.
For further information refer to page 39.



Key:

J104	ABS control unit
J587	Selector lever sensors control unit
J623	Motor control unit
J775	Running gear control unit
J794	Control unit 1 for information electronics
J1121	Driver assist systems control unit
J1122	Control unit for laser distance control
J1234	Electric drive control unit for front axle
J1235	Electric drive control unit for rear axle
R242	Front camera for driver assist systems
VX89	Front three-phase current drive
VX90	Rear three-phase current drive

Acceleration – power transmission



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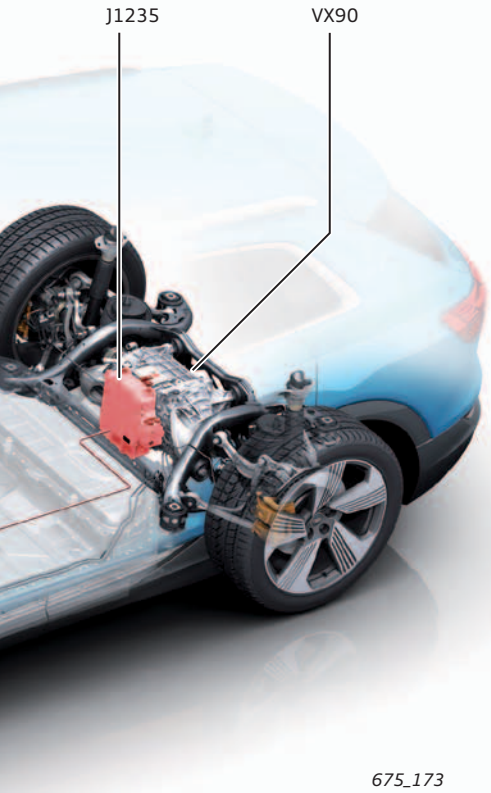
Recuperation (energy recovery)

With its recuperation concept, the Audi e-tron is able to recover a considerable amount of kinetic energy under braking (recuperation – electric motors in generator mode). Three types of recuperation are combined for this purpose: manual overrun recuperation via the paddle levers, automatic overrun recuperation via the efficiency assist and brake energy recuperation. Depending on the battery's charge level and the driving situation, deceleration of approximately 0.3 g can be generated by brake energy recuperation.

On average, over 90 percent of all braking deceleration is below 0.3 g, depending on the driving style and the driving situation. This allows a large amount of the kinetic energy during braking to be returned to the battery via brake energy recuperation.

The transition between brake energy recuperation (electrical deceleration) and deceleration using the hydraulic brake system is seamless and is not felt by the driver. This is made possible by sophisticated and precise regulation with the new electrohydraulic brake regulation system MK C1.
For further information refer to page 63 onwards.



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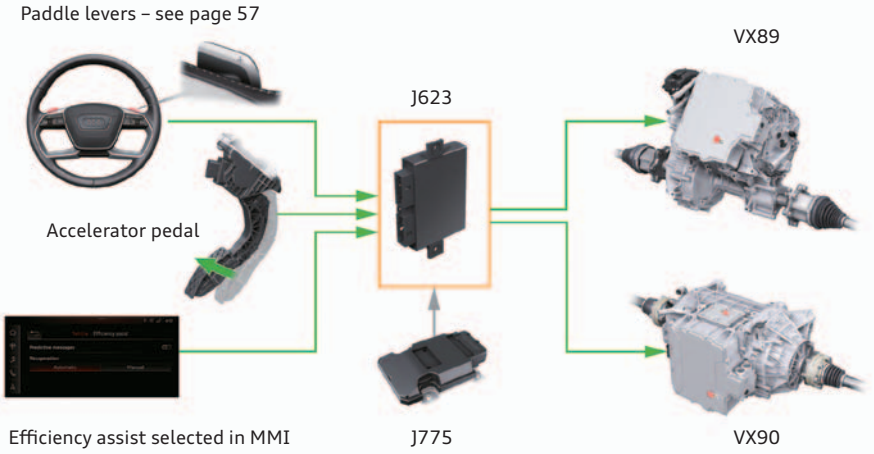
Manual and automatic overrun recuperation



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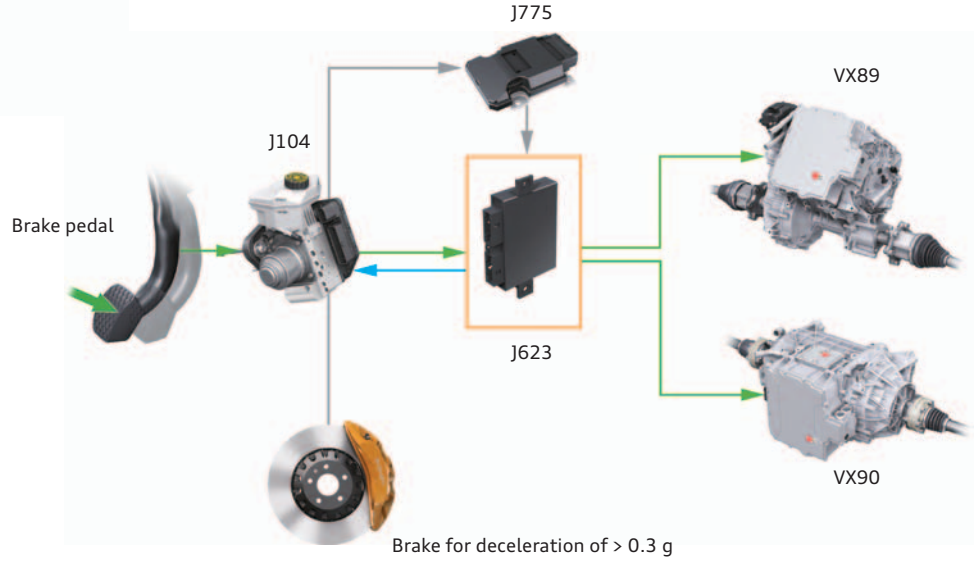
Brake energy recuperation



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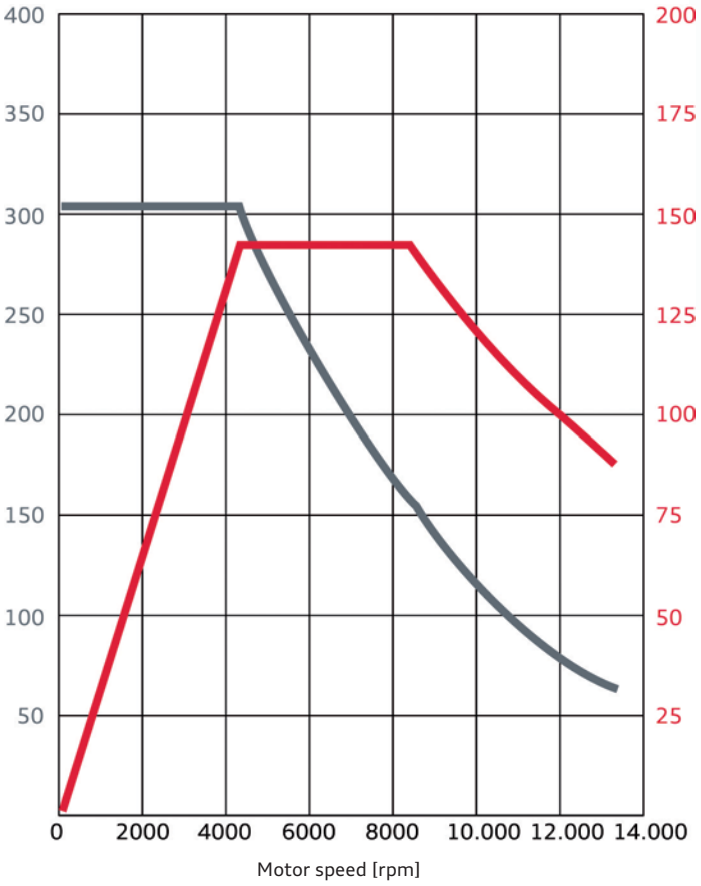
Power units

Electric drive motor for front axle

Torque/power curve

Motor with code EASA



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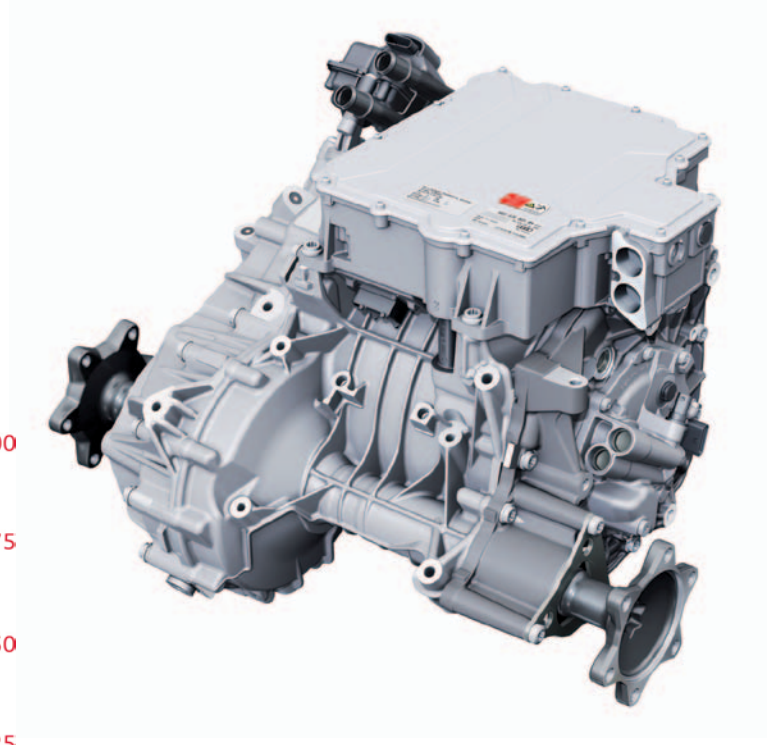


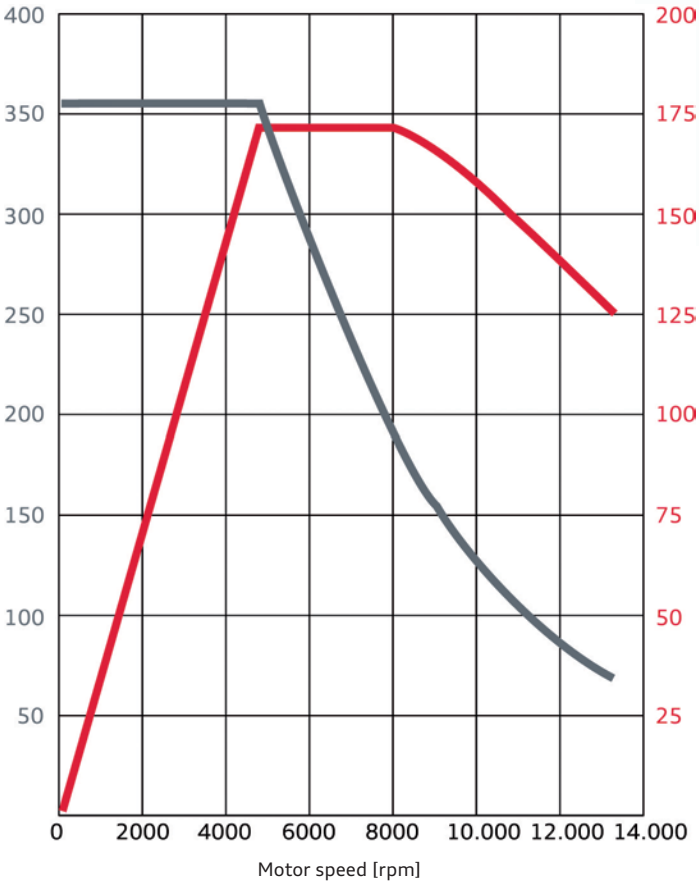
675_035

Features	Technical data
Motor code	EASA
Type	Parallel-axis asynchronous motor
Type of rotor	Internal rotor
Cooling	Water cooling
Coolant	G12evo
Voltage rating (DC)	360 Volt
Continuous power output (30 min) in kW at 7,000 rpm	70
Peak power output (10 sec) in kW	135
Torque in Nm at continuous power output (30 min)	95
Torque in Nm at peak power output (10 sec)	309

Electric drive motor for rear axle

Torque/power curve

Motor with code EAWA



675_092

675_036

Features	Technical data
Motor code	EAWA
Type	Coaxial asynchronous motor
Type of rotor	Internal rotor
Cooling	Water cooling
Coolant	G12evo
Voltage rating (DC)	360 Volt
Continuous power output (30 min) in kW at 7,000 rpm	95
Peak power output (10 sec) in kW	165
Torque in Nm at continuous power output (30 min)	130
Torque in Nm at peak power output (10 sec)	355

Electric drive motor

Design

The electric drive motors in the Audi e-tron are asynchronous. The main components of each electric drive motor are the stator with its three copper windings (U, V, W), which are 120° apart, and the rotor (an aluminium cage rotor). The rotor transmits the rotational movement to the transmission unit. The air gap between the stationary stator and the rotating rotor is very small in order to achieve a high power density. The electric drive motor and the transmission are combined in a single axle drive unit. There are two different versions of the axle drive. The difference relates to the axial orientation of the motors. A parallel-axis electric drive motor (APA250) drives the wheels on the front axle. A coaxial electric drive motor (AKA320) performs this task on the rear axle. Each of the three-phase drives on the front and rear axles is connected to the body via a potential equalisation line.

Front three-phase current drive VX89
- Axle drive

Electric drive control unit
for front axle
J1234
- Power electronics

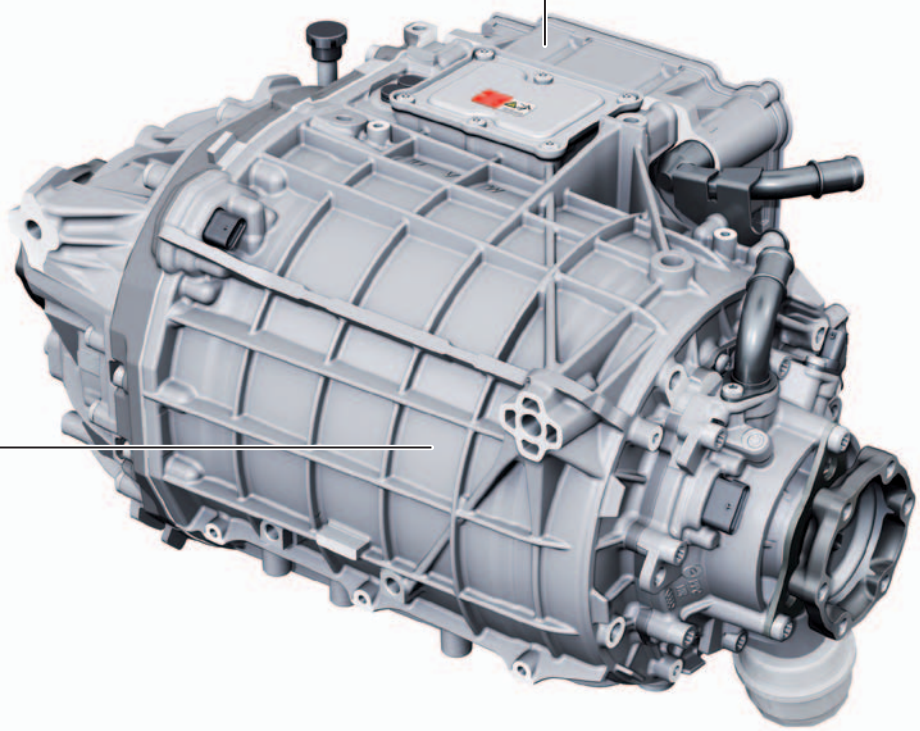
Electric drive motor for front axle
V662
- Electric motor

Electric drive control unit
for rear axle
J1235
- Power electronics

675_035

Rear three-phase current drive VX90
- Axle drive

Electric drive motor for rear axle
V663
- Electric motor



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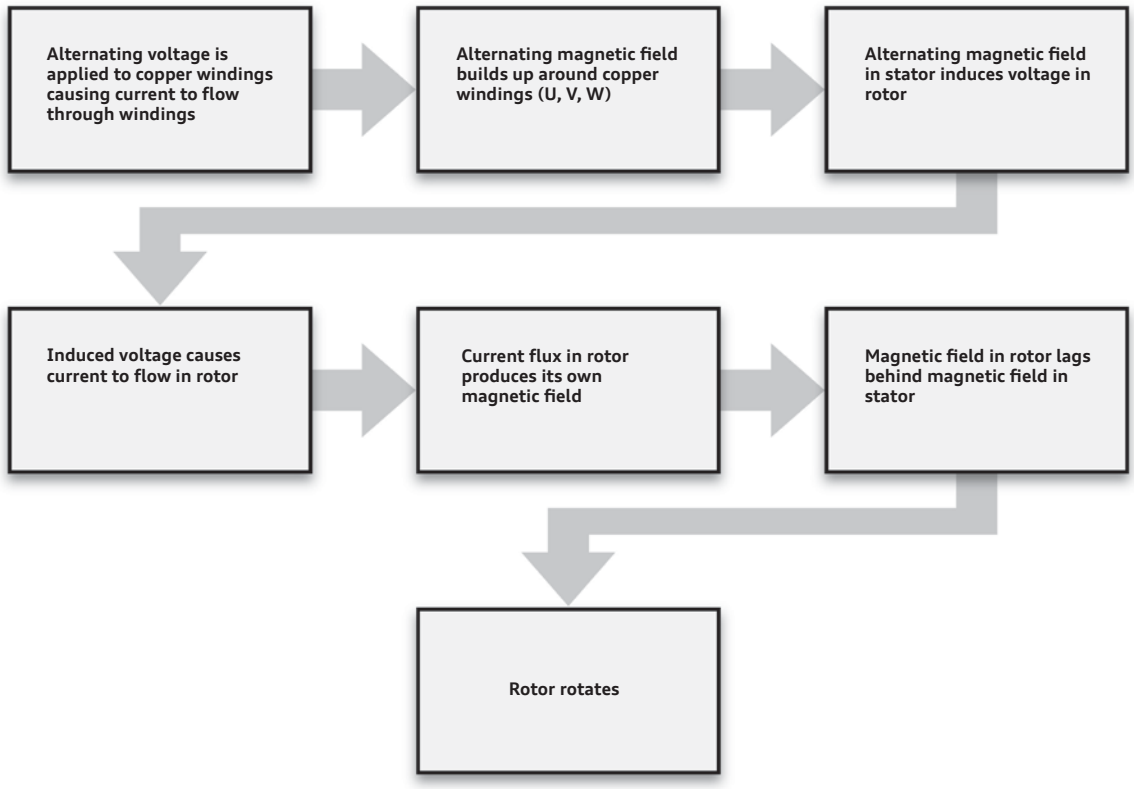
Function

Three-phase current is fed to the stator from the power electronics unit. The current in the copper windings generates a rotating magnetic flux in the stator (rotating magnetic field) which then passes the rotor. The rotor in an asynchronous motor rotates more slowly than (i.e. asynchronously to) the rotating magnetic field of the stator. This difference is known as slip[1]. This causes a current to be induced in the aluminium rotor cage. The resulting magnetic field in the rotor generates a force around its circumference and ultimately causes the rotor to rotate. The torque is produced by the overlapping magnetic fields.



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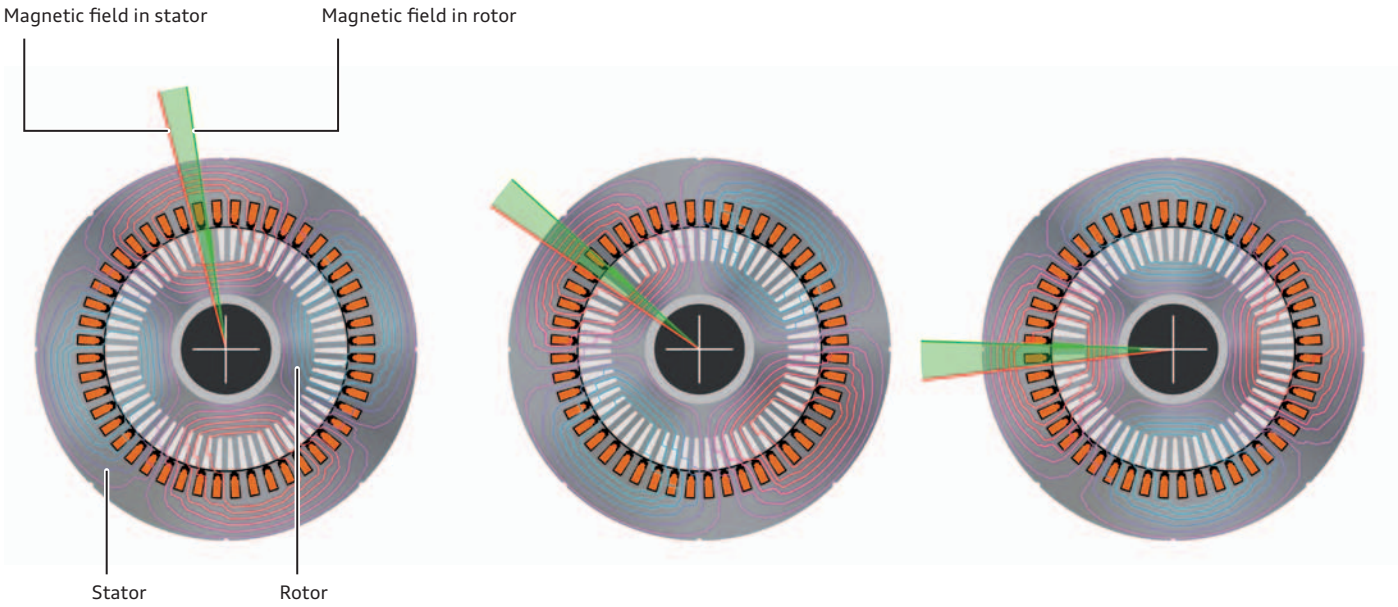


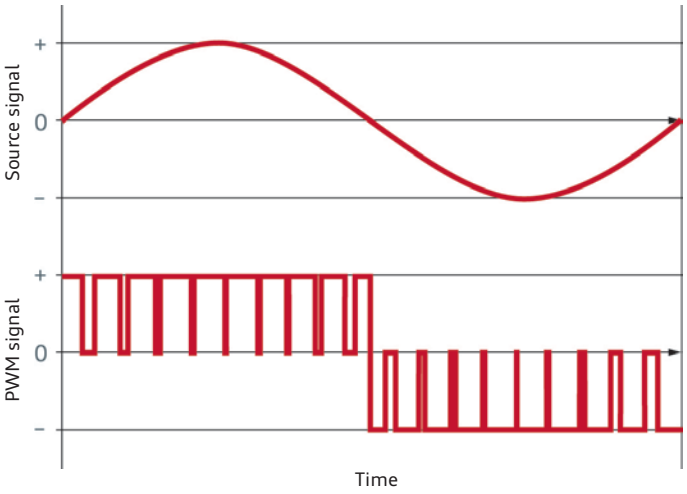
675_130

[1)] The slip describes the difference in rotation speed between the magnetic fields in the rotor and stator.

Torque/speed generation

In electric drive mode, the power electronics unit converts the DC current from the high-voltage battery into a three-phase current (AC current). The conversion is performed by means of pulse width modulation. The speed is regulated by changing the frequency while the torque of electric drive motors V662 and V663 is regulated by changing the activation times of the individual pulse widths.

The higher the frequency, the higher the speed.



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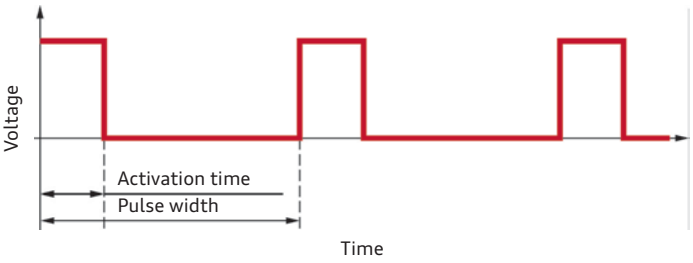
The longer the activation time of the PWM signal, the higher the torque.



675_168

Example for illustration purposes:
An alternating current with 33.34 Hz is required to achieve a magnetic field rotation speed of 1000 rpm on an asynchronous motor with two pole pairs. Due to the slip on the asynchronous motor, the rotor rotates correspondingly slower.

Reference
For more information about torque and speed generation, please refer to self-study programme 650 "Audi Q7 e-tron".

Drive dynamics

Start response
There are two types of start response for standing starts in the Audi e-tron. In the “normal” driving mode, the complete drive control system strives for a balanced set-up. If transmission position S is selected and the accelerator and brake pedals are pressed simultaneously, the power meter starts to flash. In this case, it makes no difference if the ESC is switched on or off. The drive is then “pre-tensioned” so that the electric drive motor can overcome the breakaway torque even more quickly. A creep response, as on automatic gearboxes, was not implemented in the Audi e-tron.

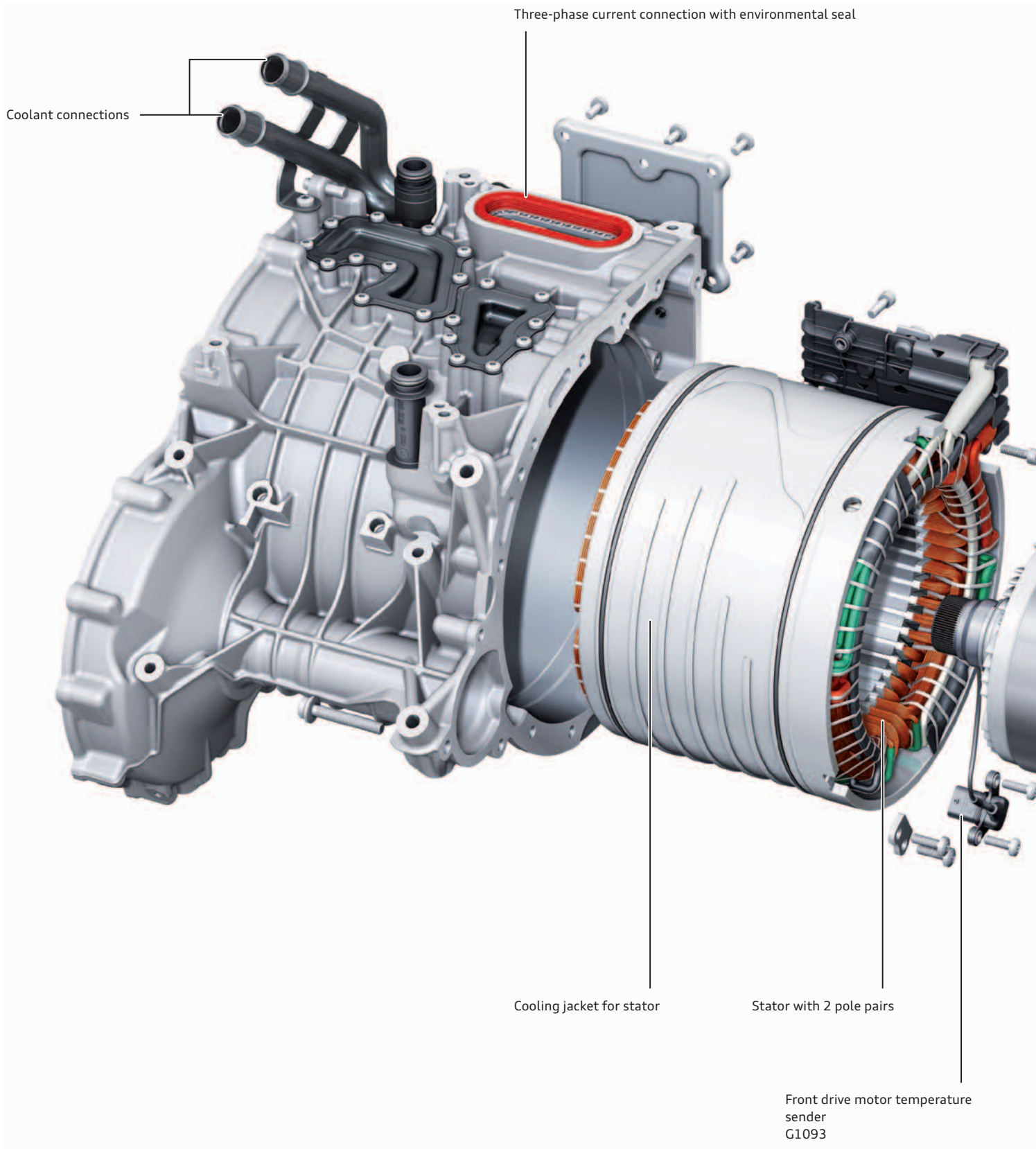
Hill starts
The following applies when the hold assist on the Audi e-tron is switched off: if the vehicle is stopped on a gradient and a gear is engaged, the vehicle starts to roll when the brake is released. If the vehicle rolls in the opposite direction to the gear engaged, the ESC control unit restricts the rolling speed to 1 km/h. If the vehicle moves in the same direction as the gear engaged, the brakes are not applied.
The vehicle is held by the ESC system when the hold assist is switched on.

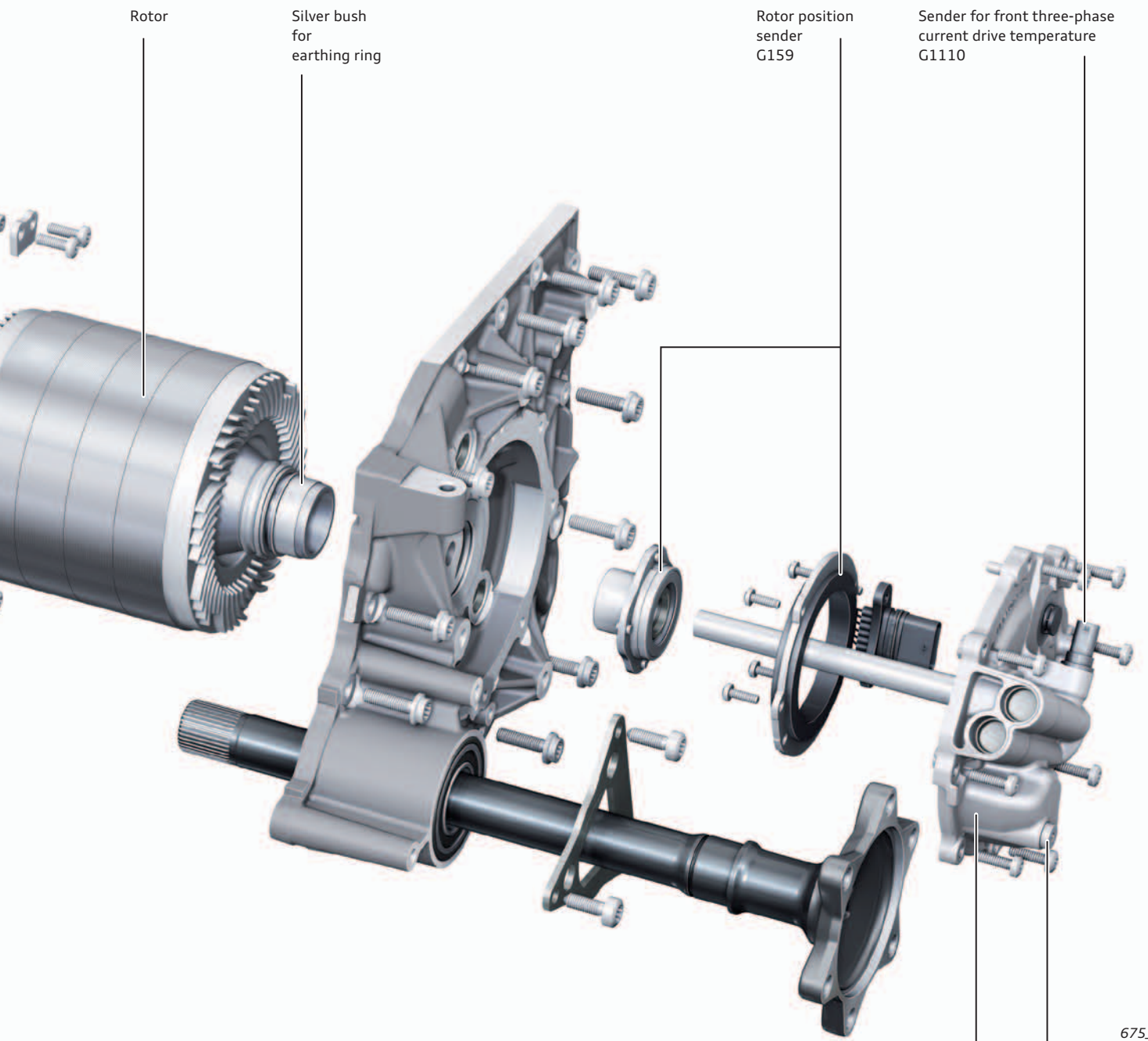
Reversing
When transmission position R is engaged, the power electronics unit initiates the rotation of the electric field (see page 32) and thus of the magnetic field. The electric drive motors rotate in reverse. The maximum speed is restricted by limiting the drive torque. This is based on the speed signal from the ESC (ABS control unit J104).

Electric drive operating as motor
When the electric drive is operating as a motor, the motor control unit J623 relays traction requests to the power electronics units for the front and rear axles. These deliver the required alternating voltage to the electric motors. The rear three-phase current drive VX90 is more efficient and is used as the main axle in both recuperation and drive modes.

Electric drive as generator
To enable the electric drive to generate a charging current while driving, it is used as a generator in overrun mode and under braking. In overrun mode, the power electronics unit lets the rotor run faster than the stator’s magnetic field (negative slip). This causes an alternating voltage to be induced in the stator. The power electronics unit uses this to generate the charging current for the high-voltage battery.

Electric drive in coasting mode
In order to switch to coasting mode, the front and rear electric drives are regulated to 0 Nm in order to compensate for drag losses.


Three-phase current connection with environmental seal
Coolant connections
Cooling jacket for stator
Stator with 2 pole pairs
Front drive motor temperature sender
G1093

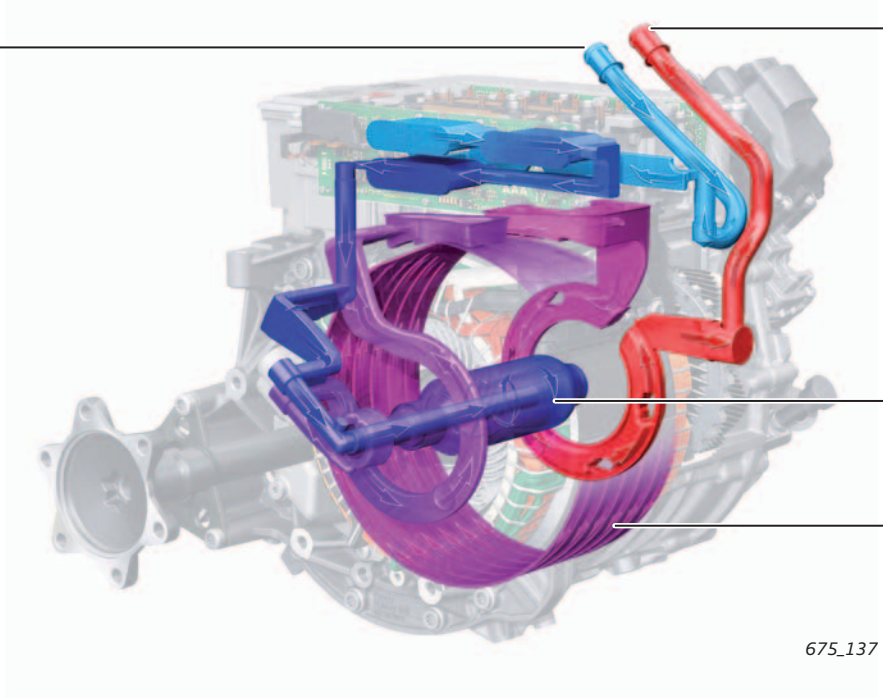

Rotor
Silver bush for earthing ring
Rotor position sender G159
Sender for front three-phase current drive temperature G1110
675_134
Resolver cover
Service drain plug

Electric drive cooling system

The electric drive motors for the front and rear axles are cooled by a low-temperature cooling fluid circuit. The coolant stream flows through both the stator and the rotor. The additional internal rotor cooling, in particular, has significant benefits in terms of continuous power output and reproducible peak output. The complete coolant circuit was moved into the electric drive motor to facilitate servicing work.

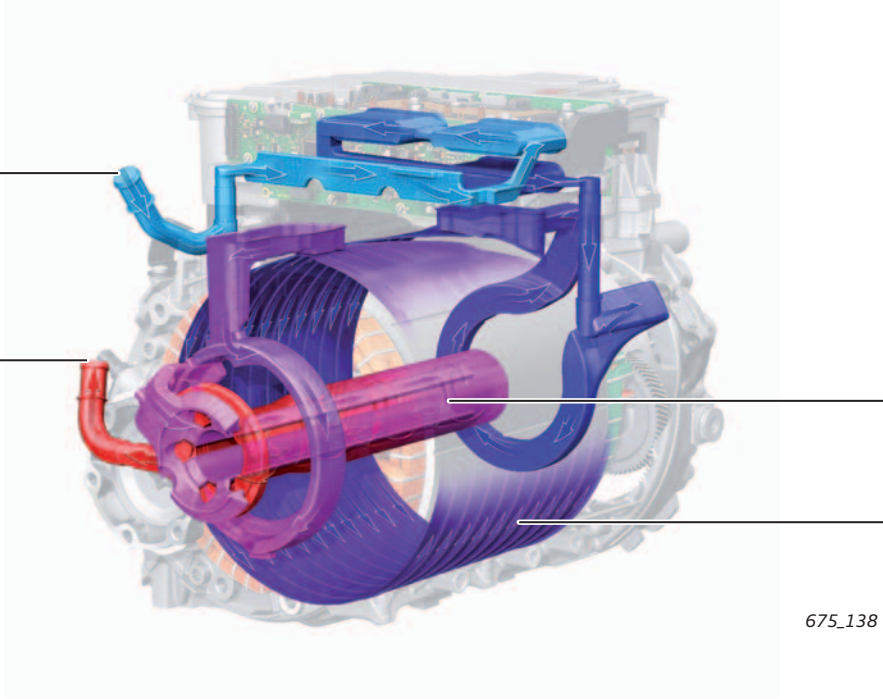
Front axle

The power electronics and the electric drive motor are connected in series within the coolant circuit. The coolant flows first through the power electronics and then through the “water lance” on the front axle to enable the internal rotor cooling. The coolant subsequently flows through the stator cooling jacket and back into the circuit.



Rear axle

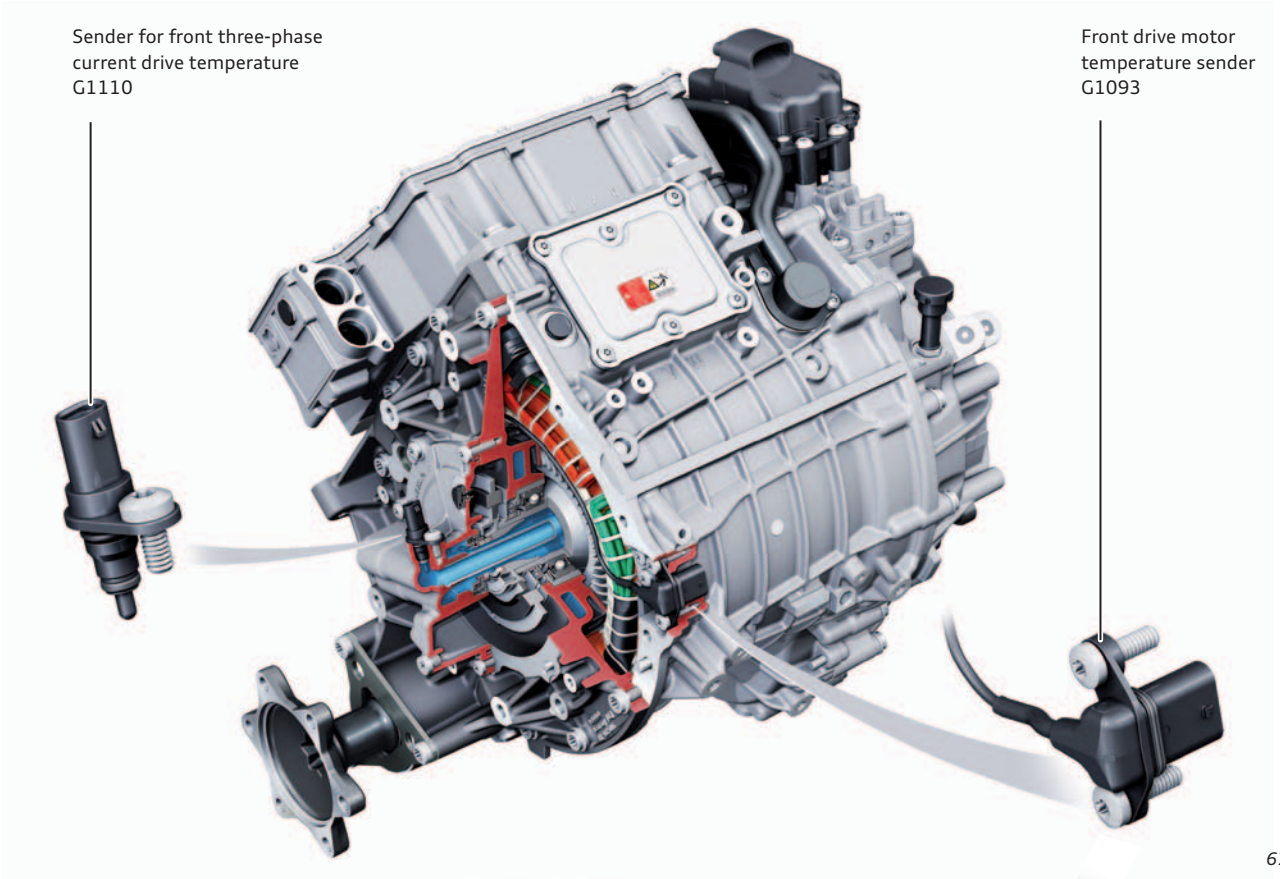
The coolant also flows through the power electronics first on the rear axle; however the stream then continues around the stator cooling jacket. After this, the coolant flows through the water lance into the rotor, and back into the circuit from there.



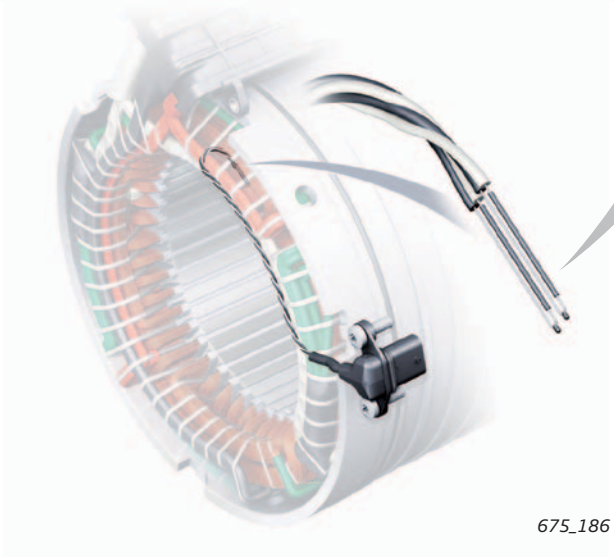
Temperature sensors

Each electric drive motor has two different temperature sensors. On the front electric drive motor, these are the sender for front three-phase current drive temperature G1110 and the front drive motor temperature sender G1093.
The sender for front three-phase current drive temperature G1110 monitors the coolant temperature in the inlet stream.
The front drive motor temperature sender G1093 measures the stator temperature. This sender is permanently integrated in the stator winding for accurate measurement, and has a redundant design (i.e. two sensors are integrated in the stator winding, although only one sensor is required). If the first sensor for the stator temperature fails, the second sensor takes over the temperature monitoring function. Only if both sensors no longer work does the electric drive motor have to be replaced. If one of the two sensors fails, this does not cause an entry in the event memory. Only the front drive motor temperature sender G1093 is shown in the measured values.

The configuration on the rear axle is the same. The rear drive motor temperature sender G1096 is in the stator. The coolant is measured by the sender for rear three-phase current drive temperature G1111.



675_196

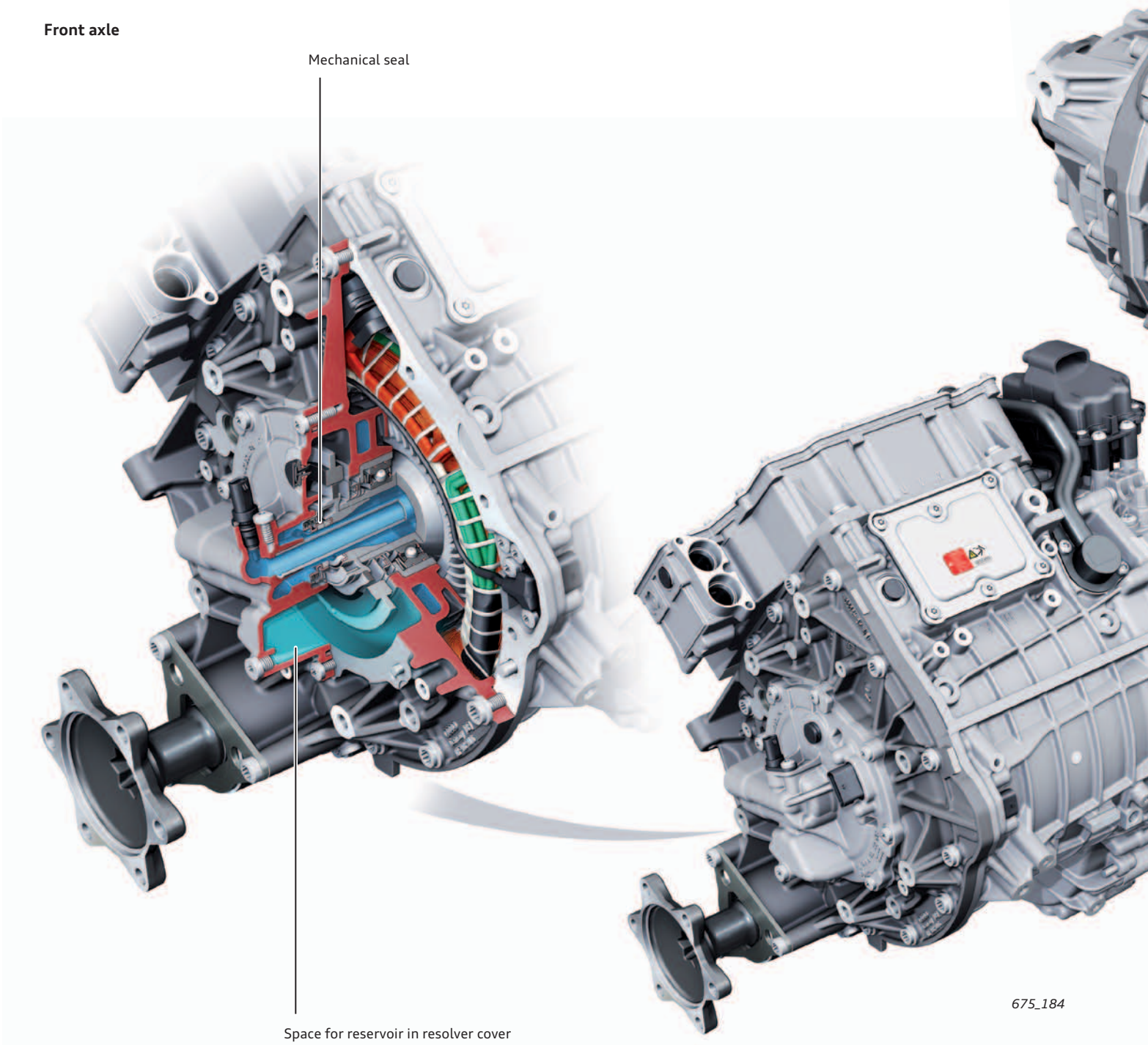


675_186

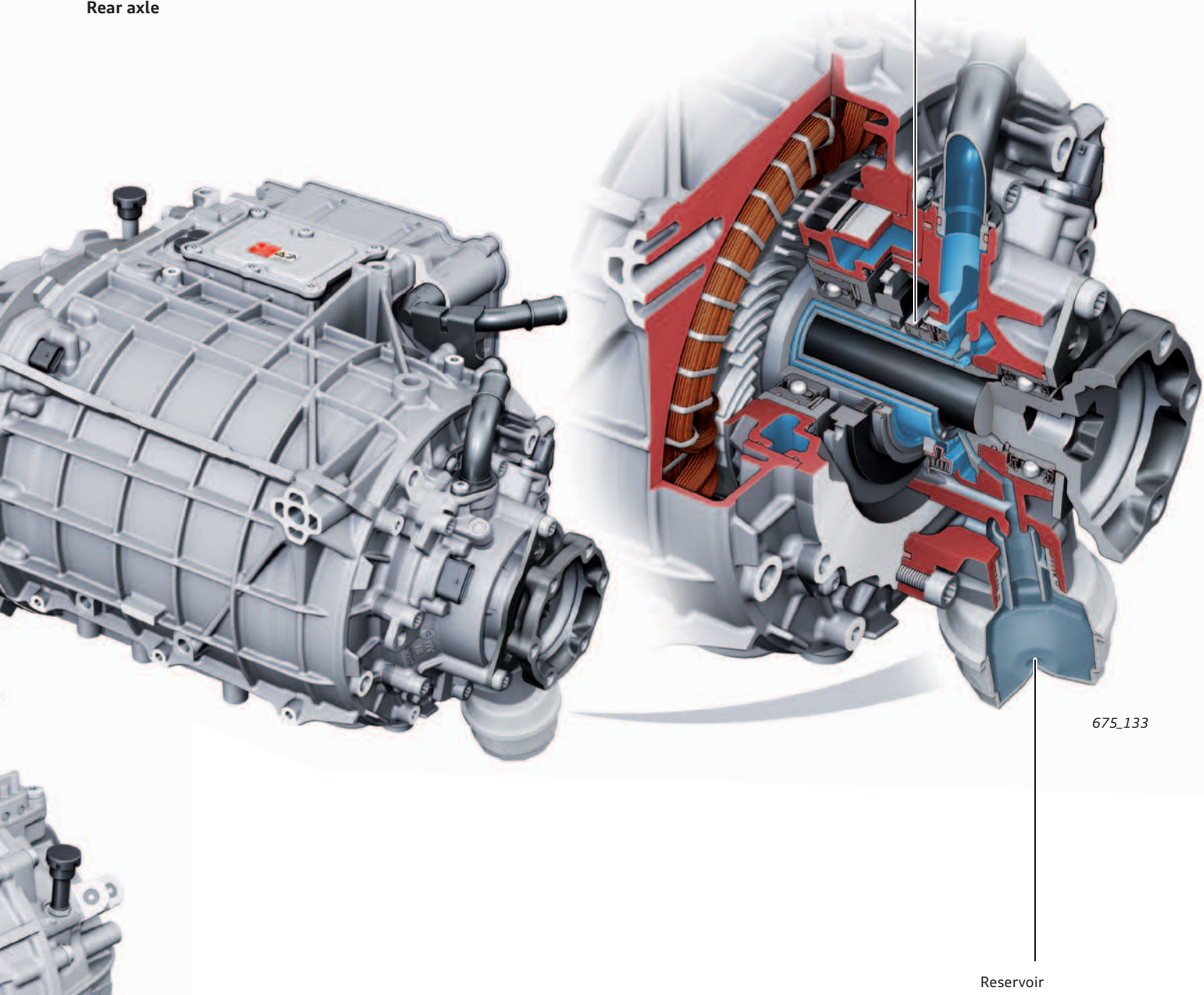
Mechanical seal

Due to their power requirements inside the rotor shafts, the electric drive motors are cooled by the internal rotor cooling system using coolant. To prevent coolant from getting into the stator in the electric drive motor, the rotating rotor shaft is sealed against the stationary housing by mechanical seals. These mechanical seals provide an axial seal and are designed for higher rotation speeds than radial seals. Due to the design, the front electric drive motor has one mechanical seal and the rear electric drive motor has two.

Front axle



Rear axle

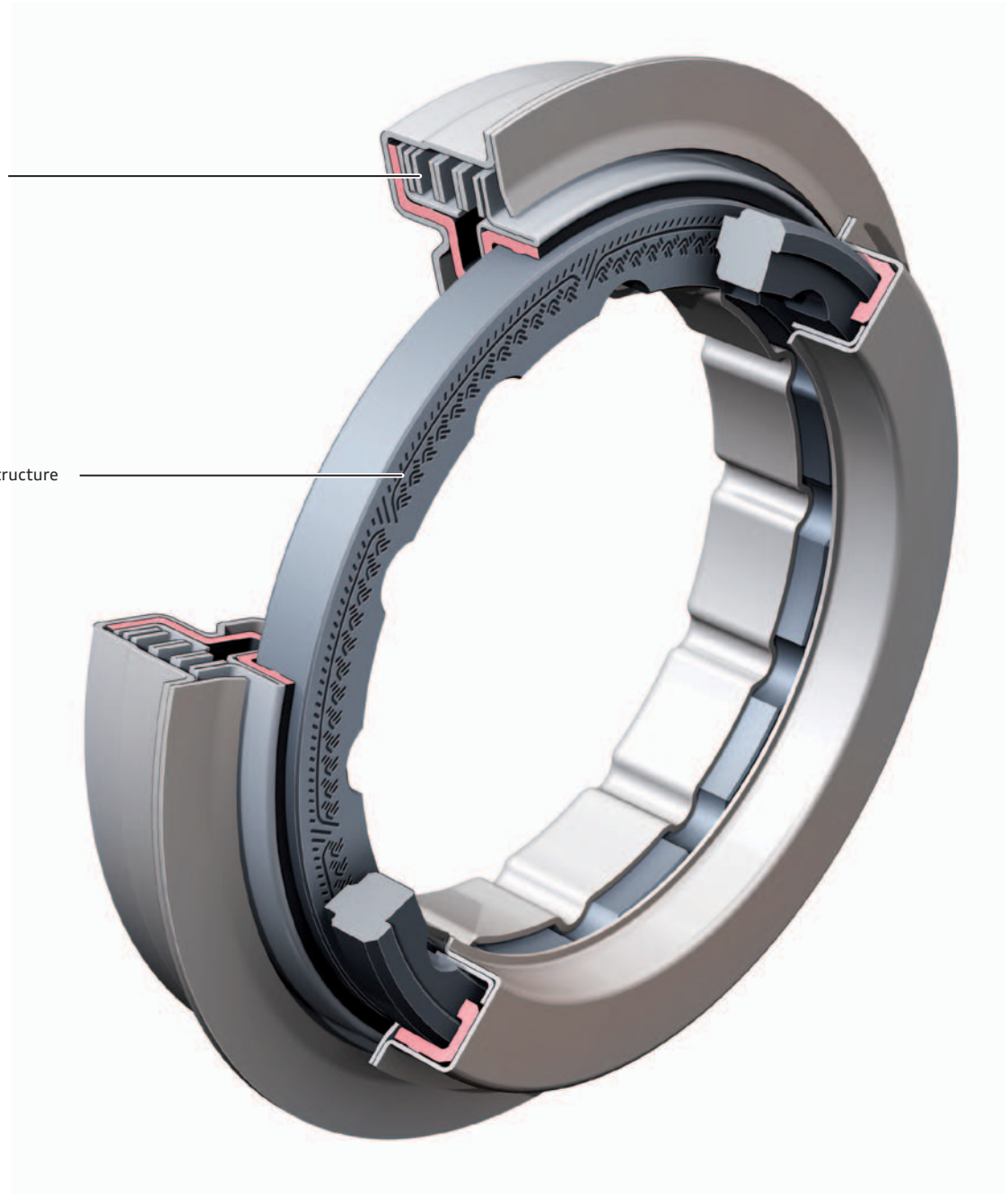


Note
The front reservoir must be emptied every 30,000 km or 2 years during a service.
The rear reservoir is replaced at the same intervals.
Always follow the instructions in the current service literature.

Cooling and lubrication of the sealing gap between the mechanical seals is required so that the seals can perform their function. To ensure that this is the case under all operating conditions, the mechanical seal is structured by laser during manufacture. This laser structure is also designed to press the coolant back into the rotor shaft; however a small amount of leakage cannot be prevented. The escaping coolant is collected in a reservoir which is bolted onto the electric drive. A recess to collect the coolant is located in the resolver cover on the front axle. Here, a drain plug is provided.

IMPORTANT:
Due to the special manufacturing process, the two parts of the same mechanical seal only fit each other. They cannot be interchanged.

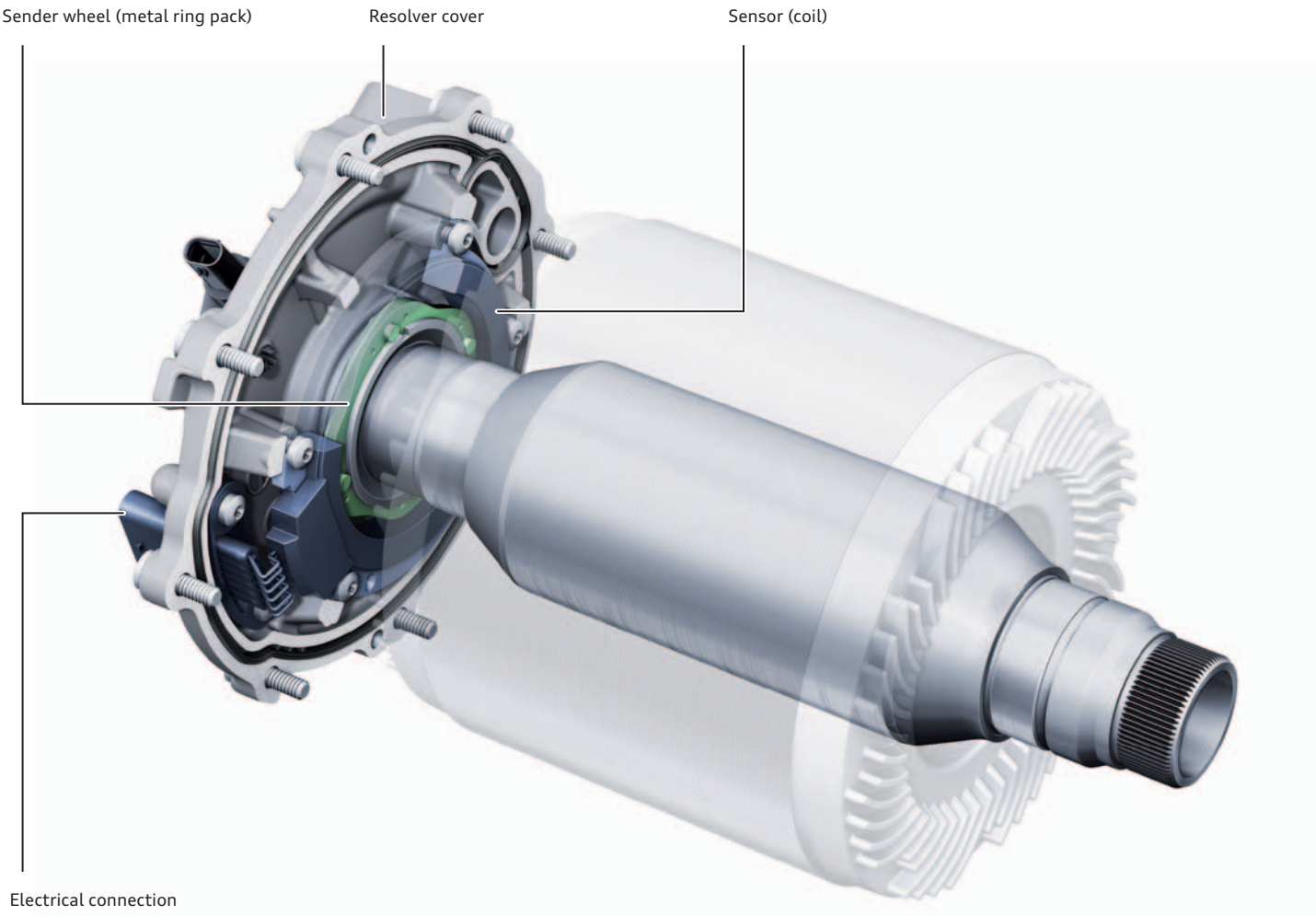
To protect the mechanical seal against damage, the vehicle must only be moved when the coolant circuit has been filled. Dry-running the mechanical seal will destroy it.



675_185

Rotor position sender G159

The function of the rotor position sender G159 is based on the resolver principle and allows the detection of the smallest changes in the rotor shaft position. It consists of two parts: a stationary sensor in the resolver cover and a sender wheel mounted on the rotor shaft. From the rotor position signal, the power electronics unit calculates the speed signal required for the activation of the asynchronous motor. The current speed is indicated in the measured data.



675_132

Reference
For further information on rotor position sender G159, refer to self-study programme 615 “Audi A6 hybrid and Audi A8 hybrid”.

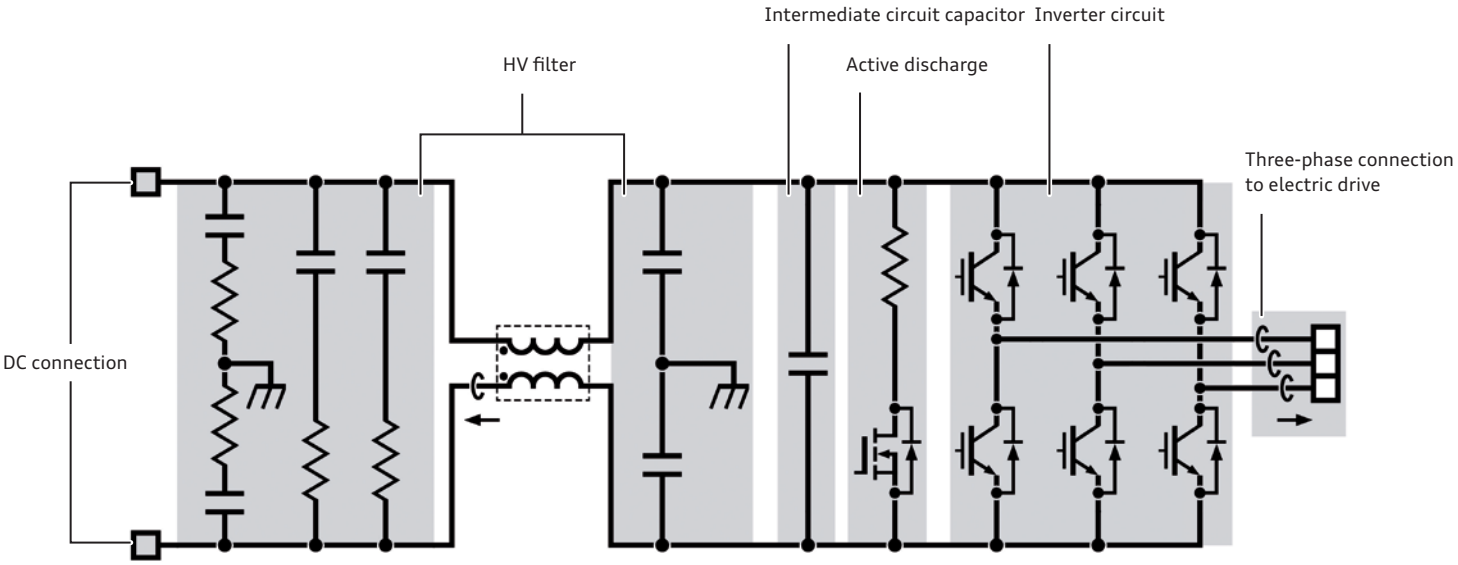
Electric drive control unit

General information

The task of the electric drive control unit (power electronics) is to provide the electric drive with the required three-phase current. A power electronics unit is fitted on each electric drive: the electric drive control unit for front axle J1234 and the electric drive control unit for rear axle J1235. These have diagnostic addresses 0051 and 00CE. The power electronics units are bolted directly onto the electric drive motor. Three-phase contact is made. The coolant flows from the power electronics unit via a coolant connection into the electric drive.

Function

Inside the power electronics unit, the DC current provided by the high-voltage battery is converted to three-phase AC current. This is performed by 6 semiconductor switching modules (2 per phase). Each of the module pairs switches the positive and negative sides.



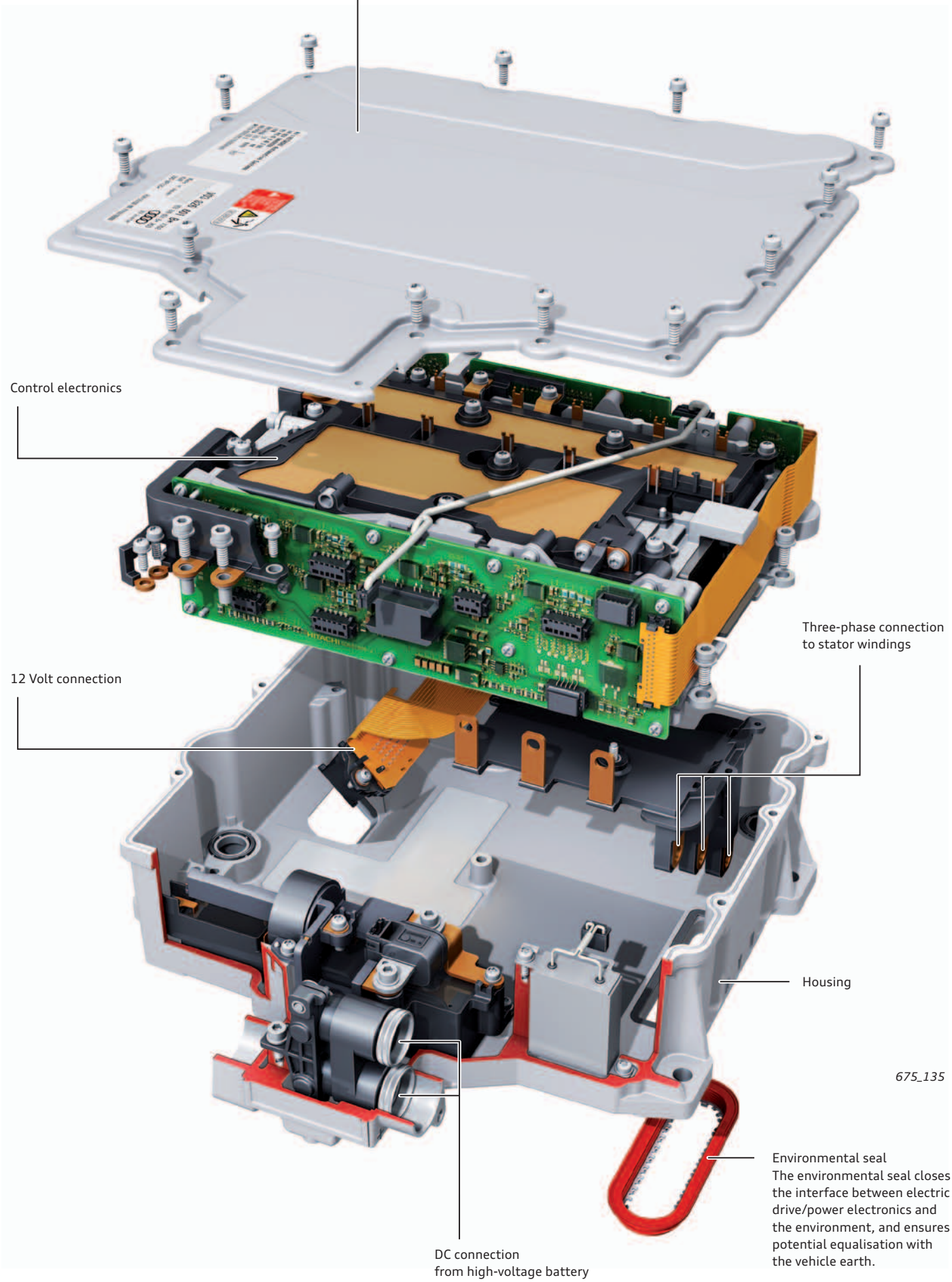
675_131

Cooling

The power electronics units on the front and rear axles are connected to the low-temperature cooling circuit. This ensures optimum cooling of the individual components inside the power electronics unit.

Service

In the event of damage, the power electronics units can only be replaced as complete units. The measured values for each axle, e.g. temperature, power output, torque, etc., can be read out from the power electronics unit (address word 51 front, address word CE rear)


Cover
Control electronics
12 Volt connection
Three-phase connection
to stator windings
Housing
675_135
Environmental seal
The environmental seal closes the interface between electric drive/power electronics and the environment, and ensures potential equalisation with the vehicle earth.
DC connection
from high-voltage battery

Power transmission

Overview

At market launch, the Audi e-tron has an electric drive motor on the front and rear axles. Each of the electric motors uses a separate transmission unit to transfer torque to the road.

The electric motors can reach speeds of up to 15,000 rpm when the vehicle is driven. The transmission units are required to provide a high torque conversion level (reduction ratio approx. 9:1) with high-efficiency performance in an extremely compact space. As there is no background noise from the combustion engine to mask the sound of the transmission, the gearing has to be particularly quiet during operation to meet the acoustic requirements for the vehicle.

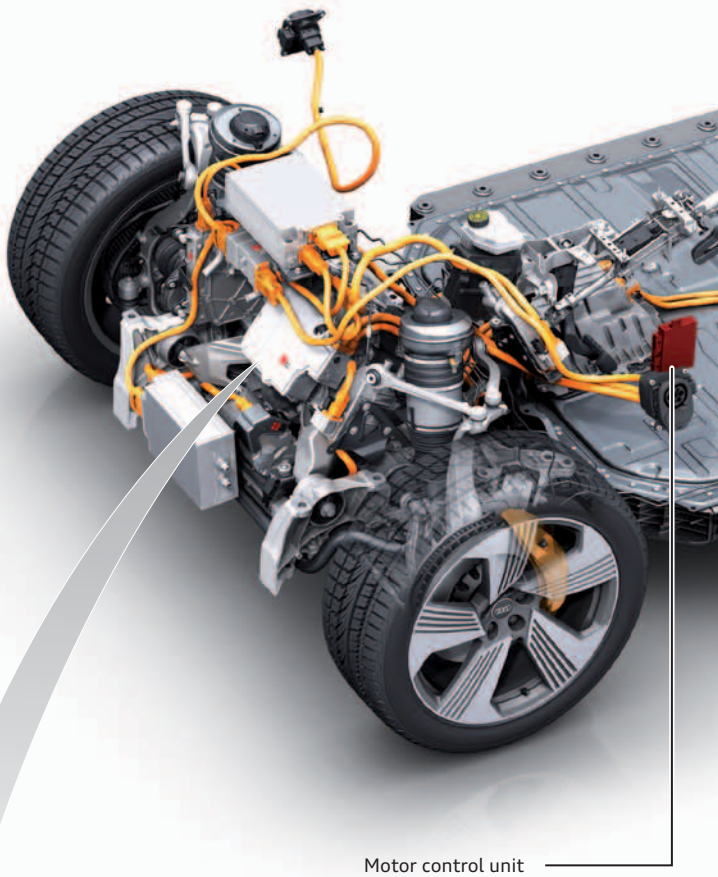
The input and output shafts for torque transmission on the front axle are arranged in a parallel axis configuration. A coaxial design is implemented on the rear axle.

A single-speed transmission unit with two reduction stages is used to increase the torque through speed reduction on the front and rear axles.

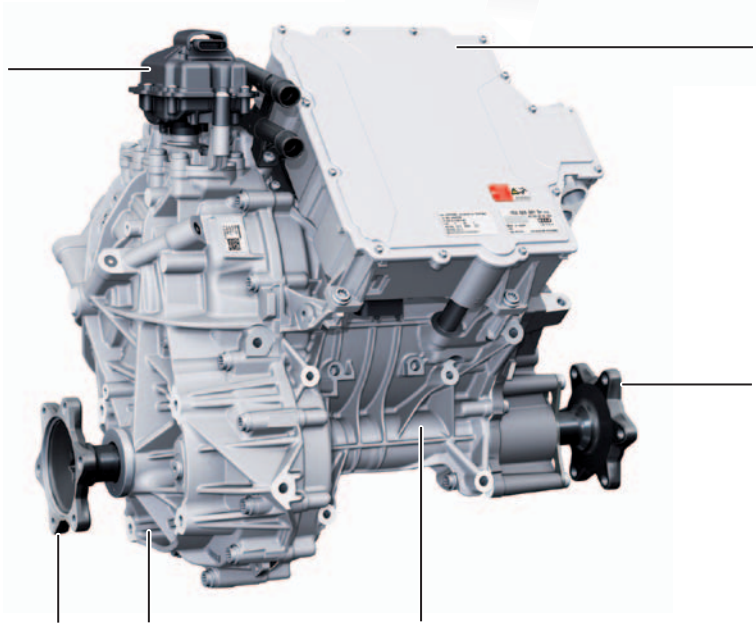
In both transmission units, a newly developed lightweight planetary gear differential compensates for differences in rotation speed between the wheels on the same axle.

The transmission units have no neutral gear position and so there is a constant power flow between the wheels and the rotor shafts of the electric drive motors.

The 0MA transmission on the front axle is equipped with an electro-mechanical parking lock (see page 40).

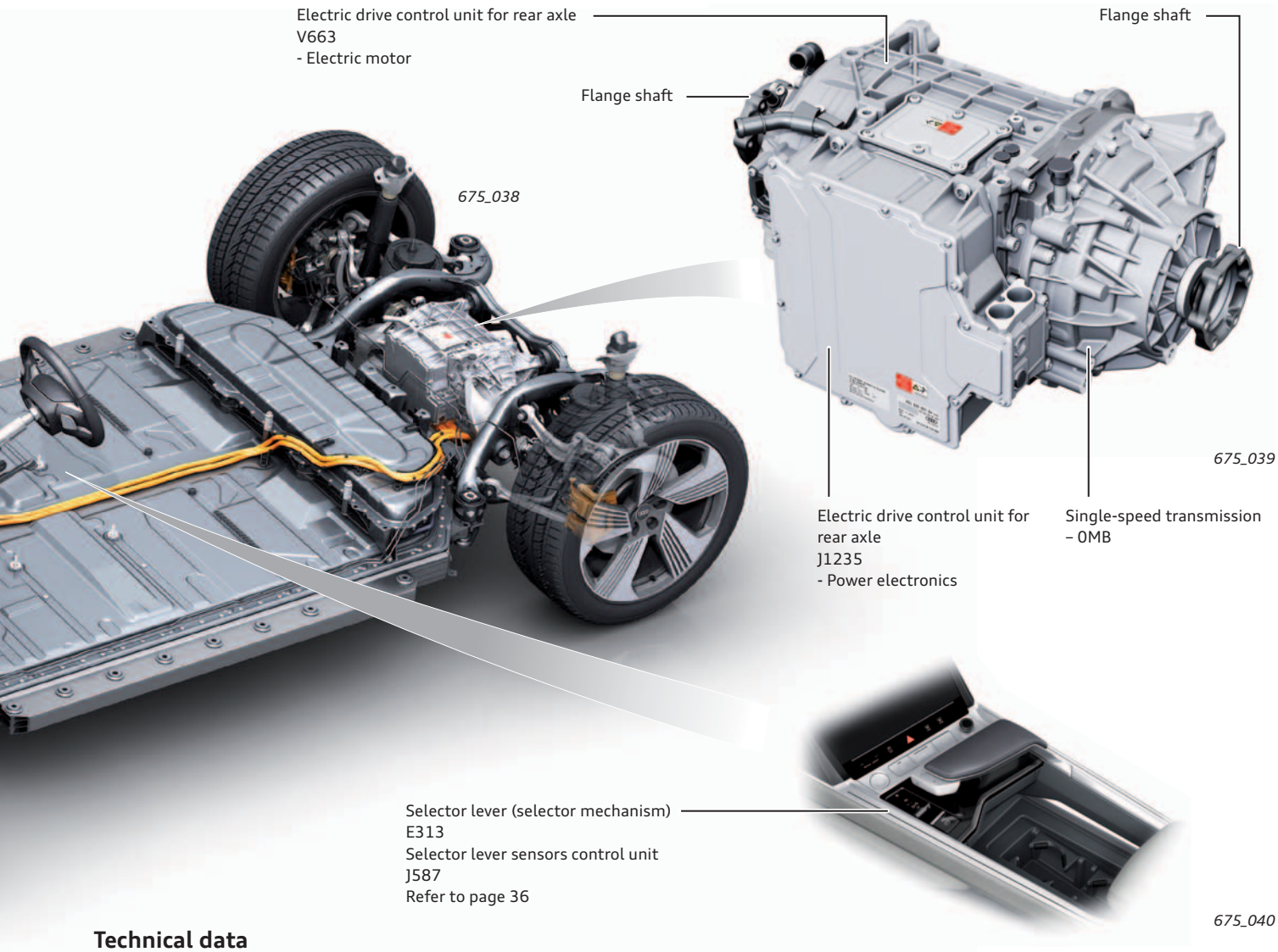


Front three-phase current drive VX89



675_037

Rear three-phase current drive VX90



Technical data

Service designation	Single-speed transmission – 0MA	Single-speed transmission – 0MB
Audi-internal designation / manufacturer's designation	EQ400-1P Electric transverse 400 Nm 1-speed parallel axis design	EQ400-1K Electric transverse 400 Nm 1-speed coaxial design
Designation in Workshop Manual	Single-speed transmission – 0MA	Single-speed transmission – 0MB
Part number (status 08/18)	0MA.300.040.D	0MB.300.040.C
Developed/manufactured by:	SCHAEFFLER	SCHAEFFLER
Max. input torque	400 Nm	400 Nm
Max. input speed	18,000 rpm	18,000 rpm
Number of gears	1 (fixed)	1 (fixed)
Number of ratio steps	2 1st stage: i_planetary_gear_set i_1 5.870 2nd stage: i_spur_gear_stage i_2 1.568	2 1st stage: i_sun – planet (stepped, large) i_1 1.917 2nd stage: i_planet (stepped, small) – annulus i_2 4.217
Total ratio	9.204 – $i_{total} = i_1 \times i_2$	9.083 – $i_{total} = (i_1 \times i_2) + 1$
Differential	Lightweight planetary gear differential	Lightweight planetary gear differential
Weight not including oil	approx. 31.5 kg	approx. 16.2 kg
Gear oil volume	See Workshop Manual	See Workshop Manual

Selector mechanism

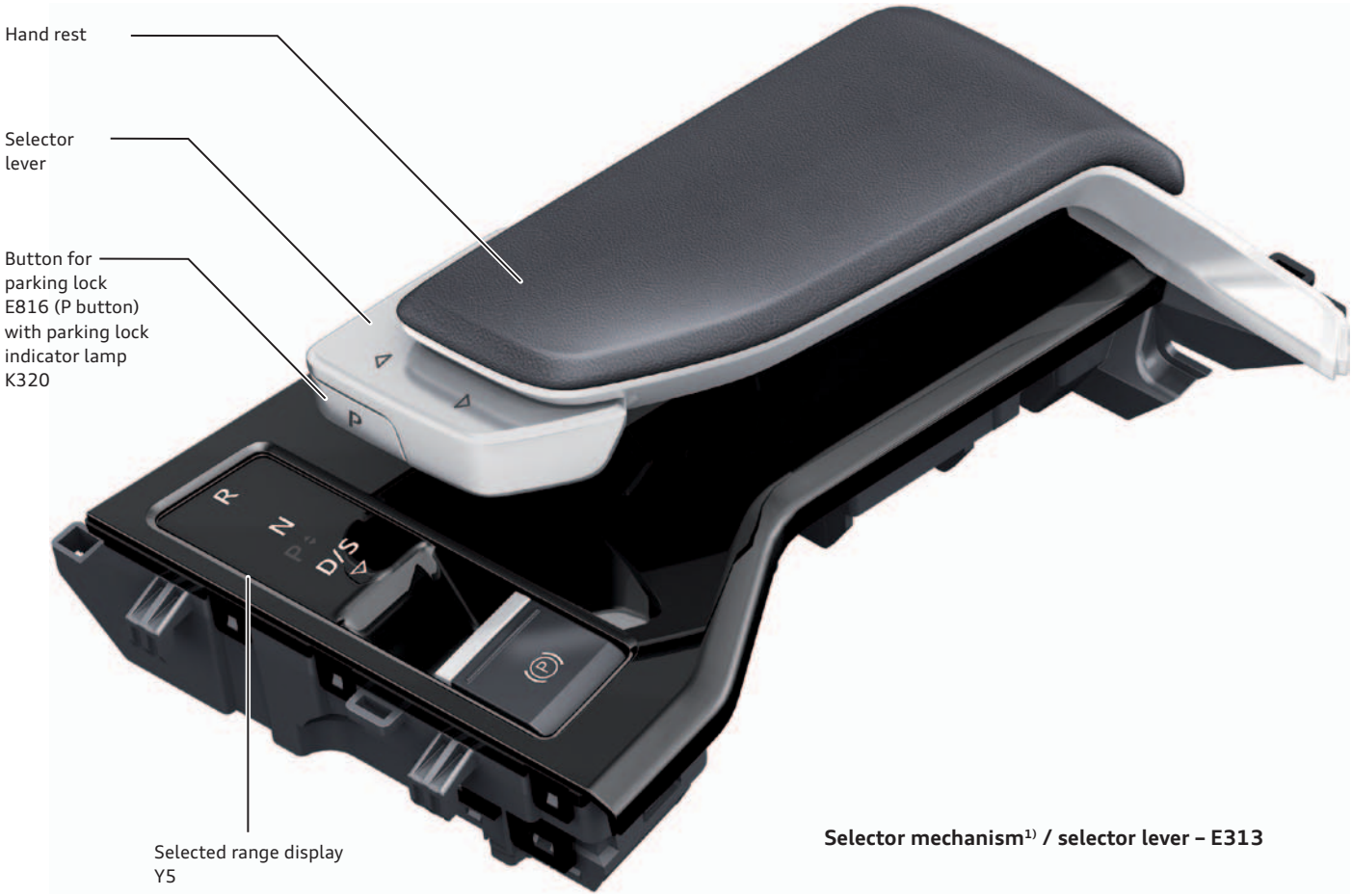
As the first purely electrically driven model from Audi, the Audi e-tron (type GE) has an exclusive shift-by-wire selector mechanism in yacht design.

Operation is basically the same as the current selector mechanisms for automatic gearboxes.

The selector lever with parking lock button is placed ergonomically in the rigid hand rest. The selector lever and the parking lock button can thus be operated intuitively with the thumb and index finger.

To protect the components, it is only possible to change the direction of travel from forwards to reverse and vice versa up to a defined speed of approx. 10 km/h.

The Audi e-tron has a parking lock, as commonly found on vehicles with automatic gearbox. The parking lock normally engages and disengages automatically via the Auto-**P** function (see page 39), but can also be engaged manually using the P button.

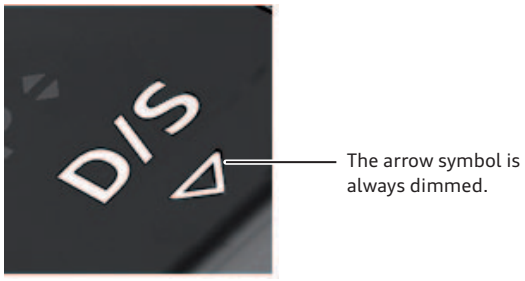


Selector mechanism[1] / selector lever – E313

675_041

Displays / illumination

The illumination of the **R**, **N** and **D/S** symbols is based on the search/activation principle, which means that when terminal 15 is active, the symbols are illuminated by a dimmed orientation light, while the activated transmission position is illuminated with maximum intensity.



675_042

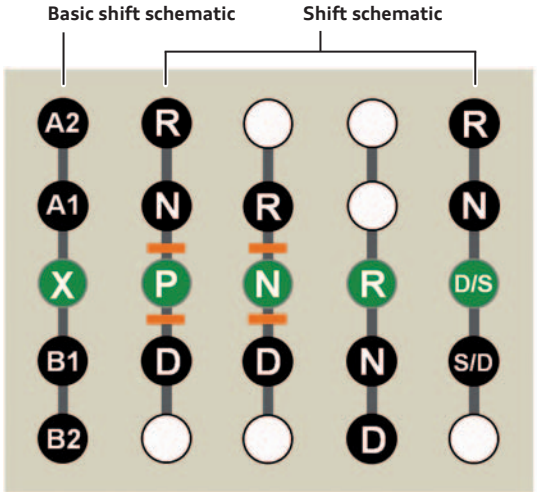
The **P** symbol in the selector lever position display is only illuminated (in red) when the parking lock is on.
When the parking lock is off, this position is not illuminated and remains virtually invisible since it has no relevance for the activation of the selector lever. The gears cannot be changed when the selector lever is in P; they can only be changed in transmission positions **N**, **R**, **D** and **S**.

The illumination of the **P** symbol in the **P** button is always dimmed when terminal 15 is active and is always lit with maximum intensity when the parking lock is on.

The direction arrows on the selector lever are not illuminated.

Shift schematic

675_044



675_043

From the basic position – X – there are two forward positions (A1, A2) and two rearward positions (B1, B2). The selector lever returns to the basic position – X – after every operation.

- Basic selector lever position & current transmission position
- Selectable positions which change the transmission position
- Selectable positions which do not change the transmission position
- Software lock – deactivation by pressing the brake pedal

The software lock is activated in transmission position N after approx. one second. This allows rapid changing of the transmission position from **D** to **R** and vice versa without applying the brake. This allows a vehicle which has become stuck to be freed by rocking it backwards and forwards, and makes it easier to change gear when manoeuvring the vehicle.

Note:
A tone will sound when **R** is selected.
Transmission positions N (parking lock off) and P (parking lock on) can be engaged when terminal 15 is active.

Parking lock button E816 / P button

The P button is for manually activating the parking lock. Activation is possible only at a speed of < 1 km/h. Parking lock button E816 actuates three selector elements for reliability and diagnostics. Its selector status is transferred to the selector lever sensors control unit J587 via two interfaces. In the event of a fault in E816, a message appears in the instrument cluster and the parking lock can only be engaged with the Auto-P function.

Transmission position S / driving program S

The boost function is available when transmission position **S** is selected. The boost function is activated when the kickdown is operated. When this happens, the highest system performance is made available for up to eight seconds for maximum vehicle acceleration.
The availability of the boost function depends on conditions such as the charge level of the high-voltage battery and the temperature of the electric drive components, etc.
The very high electric current causes the system components involved to heat up rapidly. The time is limited to a maximum of ten seconds to protect the system components. If the component temperatures exceed defined limits, the boost function is deactivated until the system components have cooled down.

In transmission position **S** and in Audi drive select mode **dynamic**, driving program **S** is selected in the motor control unit J623. A dynamic accelerator pedal map and sporty response are activated on the motor control unit.

Transmission position **S** must also be selected in order to use the launch control function. See Owner's Manual.

[1)] The selector mechanism can only be replaced as a complete unit; only the hand rest is available separately as a Genuine Part.

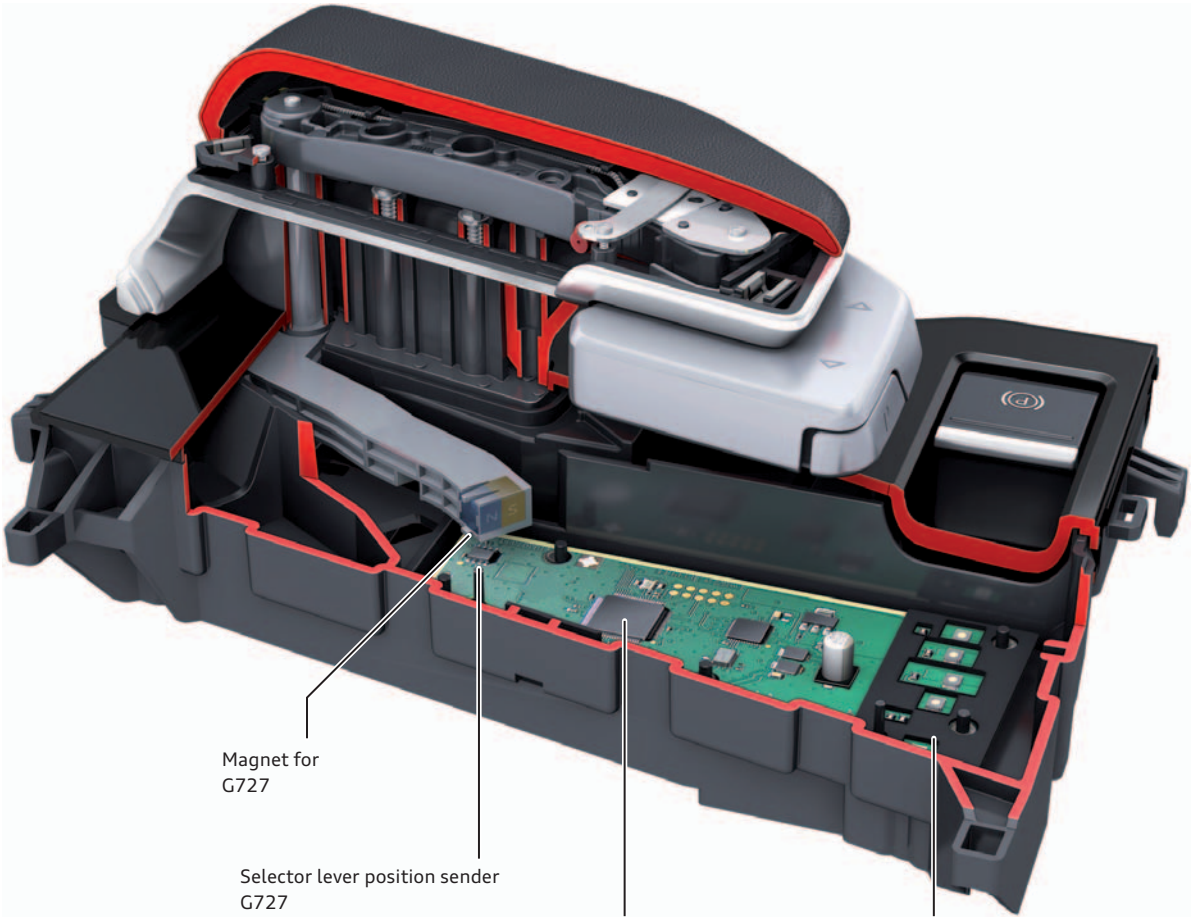
Selector lever sensors control unit J587

The selector lever sensors control unit J587

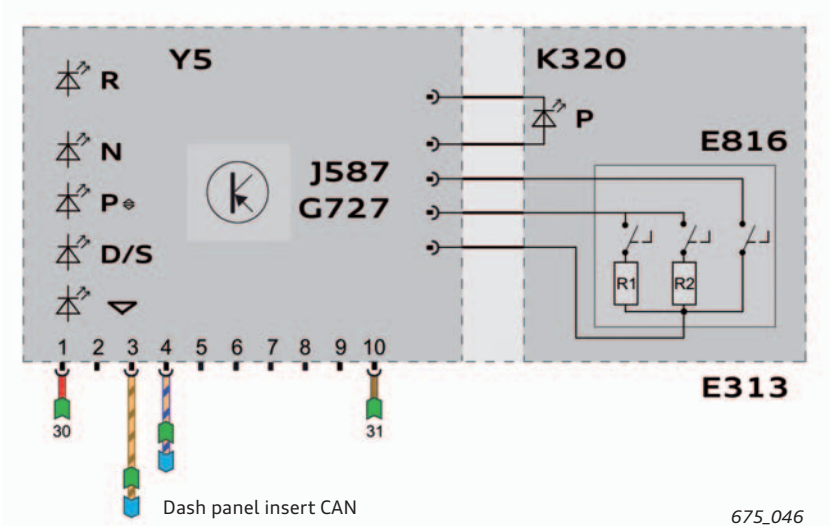
- detects driver inputs / positions of the selector lever as shown in Fig. 675_043 (A2, A1, X, B1, B2) and transmits this information to the motor control unit J626.
- processes the signal from the parking lock button E816.
- handles the activation of the LEDs on the selector lever position display Y5 and parking lock button E816.
- is combined as a single function unit with the selector lever position sender G727 and selector lever position display Y5.

Data communication with the motor control unit J623 takes place via the gateway (data bus diagnostic interface J533). The selector lever sensors control unit J587 uses the CAN dash panel insert to communicate with the gateway. See Fig. 675_046 and Fig. 675_077 on page 41.

The sensor lever sensors control unit J587 has the address word 0081 and its own self-diagnostics.



675_045



675_046

Key:

E313 Selector lever (selector mechanism)
E816 Parking lock button
G727 Selector lever position sender
J587 Selector lever sensors control unit
K320 Parking lock indicator lamp
Y5 Selected range display

Selector lever - Functions

Auto-P function

The parking lock on the Audi e-tron is operated electro-mechanically (see page 40). The motor control unit J623 is therefore able to operate the parking lock automatically, thus enhancing user convenience.

The parking lock is engaged automatically (P position is ON) if the following conditions are met:

- The vehicle is stationary – travelling at a speed of less than 1 km/h.
- Transmission position D or R is active.
- Driving mode is deactivated – terminal 15 is off.

The parking lock is deactivated automatically (P position is OFF) if:

- Transmission position N is selected when terminal 15 is active. See "Activating transmission position N".

or

- If transmission position **D** or **R** is selected when driving mode is ON.

[1)] The vehicle cannot be locked in the P-OFF position.

Selector lever – System fault

If the transmission positions can no longer be engaged using the selector mechanism, it is possible to select transmission positions **P**, **R**, **N** and **D** by pulling both paddle levers simultaneously with the vehicle stationary and the brakes applied.

Activating the P-OFF position (transmission position N)

To be able to move the vehicle for a limited time without the parking lock, e.g. in a car wash, automatic activation of the parking lock can be suppressed or the parking lock can be deactivated (P-OFF position). This requires the correct operation of the shift-by-wire and park-by-wire functions.

To activate the P-OFF position, transmission position **N** must be selected with terminal 15 active. If terminal 15 is subsequently deactivated, the activation of the parking lock is suppressed for a period of 30 minutes[1)]. After 29 minutes the following message is displayed in the instrument cluster:
"Switch on ignition to stay in **N**" (a warning tone will also sound). If this instruction is not followed, the parking lock engages after one minute (i.e. a total of 30 minutes) and the system shuts down.

If a speed signal (v > 1 km/h) is detected during this time, the period is extended according to the driving time of the vehicle until the system detects that the vehicle has been stationary for at least 5 minutes.

quattro with e-tron technology

On the Audi e-tron, the four-wheel drive control software is integrated in the running gear control unit J775. This open and closed-loop control software is part of the quattro software kit which is also used for quattro ultra, Audi TT and Audi R8.

The torque vectoring software is integrated in the four-wheel drive controller (and is thus also contained in the control unit J775).

The software for the electronic differential lock (EDL) and electronic stabilisation control (ESC) is integrated in the ABS control unit J104. Refer to page 59.

The motor control unit J623 handles the efficient distribution of the drive and recuperation torque to both axles and receives input from the running gear control unit J775 according to the vehicle handling and traction requirements. Approx. 400 data sources are used on the Audi e-tron to calculate the drive and recuperation torque. This enables the torque to be distributed between the two drive units in order to meet the torque demand as accurately as possible.

Effect of Audi drive select on drive torque distribution

The four-wheel drive control system applies two different strategies for torque distribution to the front and rear axles.

Strategy 1 – all modes except dynamic
The distribution of drive torque is balanced for the best possible traction with neutral handling.

Strategy 2 – dynamic
More drive torque is transmitted to the rear axle for agile performance and a slight oversteer bias in handling.

If a system fault causes one or or both drive units to fail, the following message appears:

Four-wheel drive: fault. Restricted stability.
Please contact workshop.

Park-by-wire parking lock

The Audi e-tron has an electro-mechanically operated parking lock. The parking lock is integrated in the drive/transmission on the front axle and is operated via an electric actuator, the parking lock actuator V682.

The parking lock actuator operates a conventional parking lock mechanism as commonly used on automatic gearboxes.

An electric motor is used to engage the locking pawl electro-mechanically. A two-stage gear set provides the required reduction ratio and is self-locking. The mechanism used to actuate the locking pawl is also self-locking. This dually stable system ensures that the parking lock remains in the P-OFF and P-ON positions on its own.

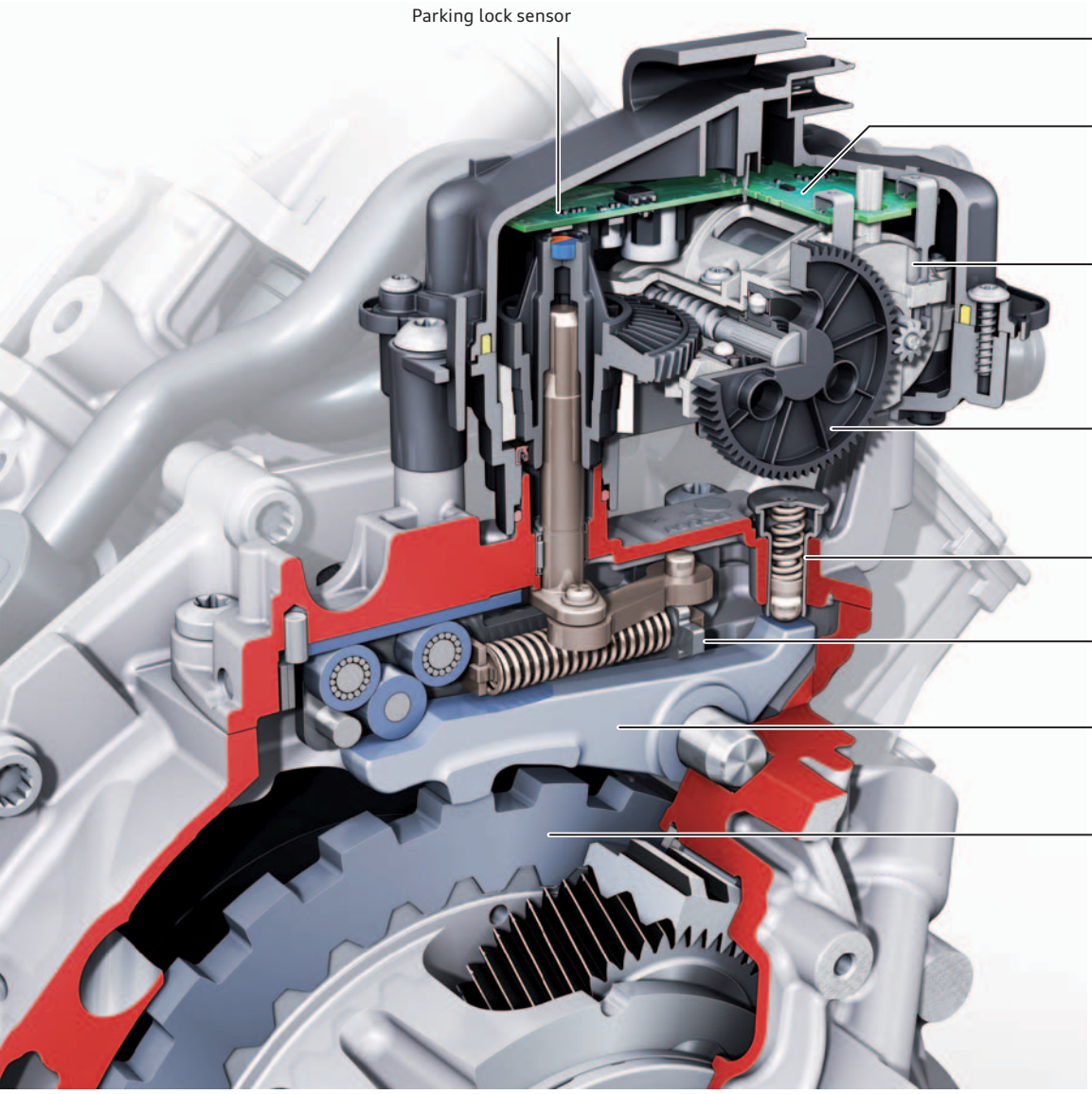
The parking lock positions are monitored by the parking lock actuator control unit using the parking lock sensor.

The parking lock comprises three modules:

- Parking lock actuator
- Mechanical parking lock operating components
- Parking lock (locking pawl and parking lock gear)

675_047

Front three-phase current drive VX89

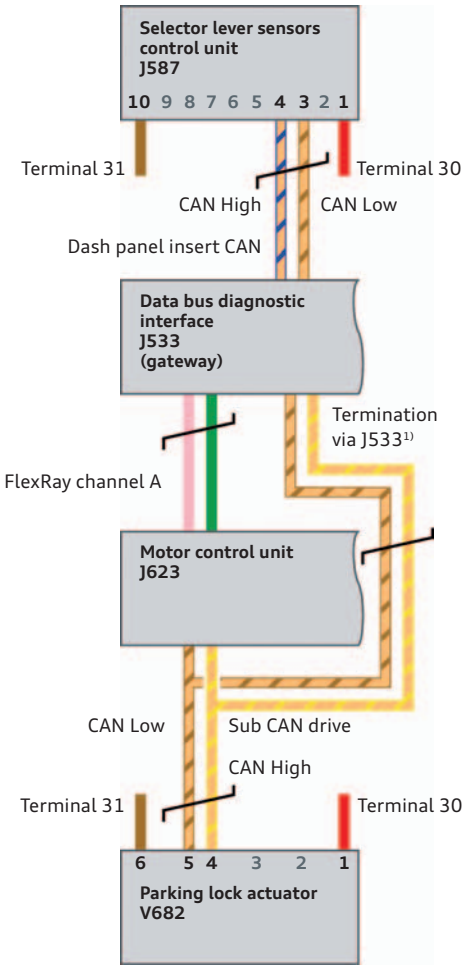


675_048

Parking lock actuator V682 (address word 0742)

The parking lock actuator V682 uses its own control unit to actuate the electric motor and a sensor for accurate detection of the P-ON and P-OFF positions.

The parking lock actuator operates according to the master/slave principle in conjunction with the motor control unit J623 (drive control unit). Communication between the motor control unit and the actuator V682 takes place via a sub CAN drive. The motor control unit J623 generates the bus status P-ON or P-OFF and transmits it via the sub CAN drive to the actuator V682. The actuator executes the instructions from the motor control unit and checks their execution. All diagnostic data are exchanged via the bus systems and can be read out from the motor control unit.



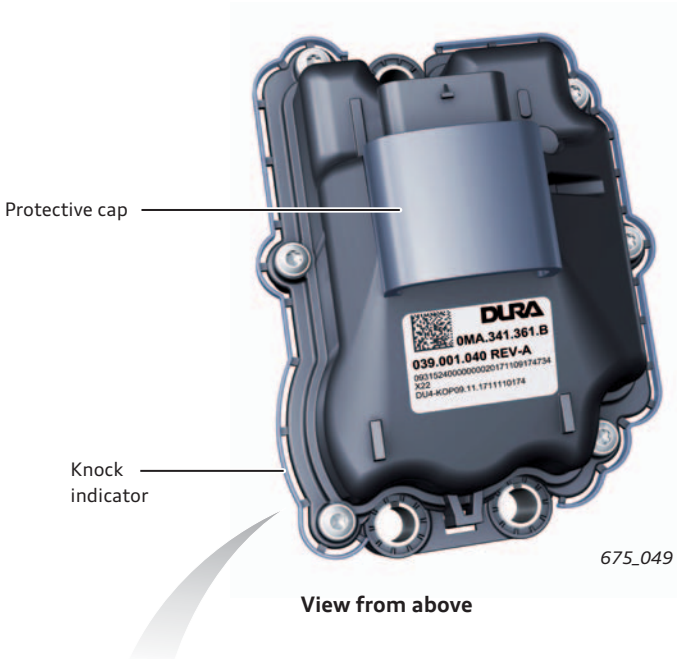
675_077

Special features / service information

The parking lock actuator V682 can be activated via the motor control unit using a diagnostic tester for test purposes.
The parking lock actuator requires neither initialisation nor a basic setting procedure.

There is no mechanical emergency release mechanism for the parking lock. A software function (software emergency release), which keeps the parking lock in the P-OFF position, is provided in order to prevent the parking lock from being activated while in the workshop and to enable the car to be moved while the 12 Volt on-board supply is disconnected.

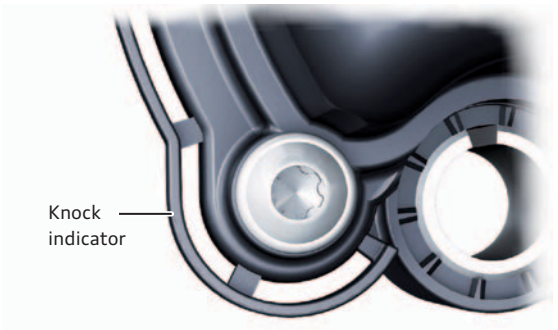
Danger **Caution!** Before disengaging/deactivating the parking lock, the vehicle must be secured to prevent it from rolling away. Please observe the safety precautions on the diagnostic tester. The software emergency release function for the parking lock must be deactivated again before the vehicle is handed over to the customer.
The parking lock actuator is a safety-related component to which special safety standards apply.
If the actuator drops down, this can cause internal mechanical damage which may not be immediately apparent. In order to prevent such cases, the actuator has two special features which indicate a dropped component and protect against mechanical damage.
A special protective cap is fitted on top of the connector to protect the electrical connector against mechanical impacts. An actuator must not be used if this protective cap is damaged or missing.
A knock indicator is fitted around the circumference of the housing flange. This indicator is damaged if an actuator drops down from a critical height. Also in this case, an actuator must not be used if this indicator is damaged.



675_049

View from above

As a basic rule:
Actuators which have dropped once must be scrapped.



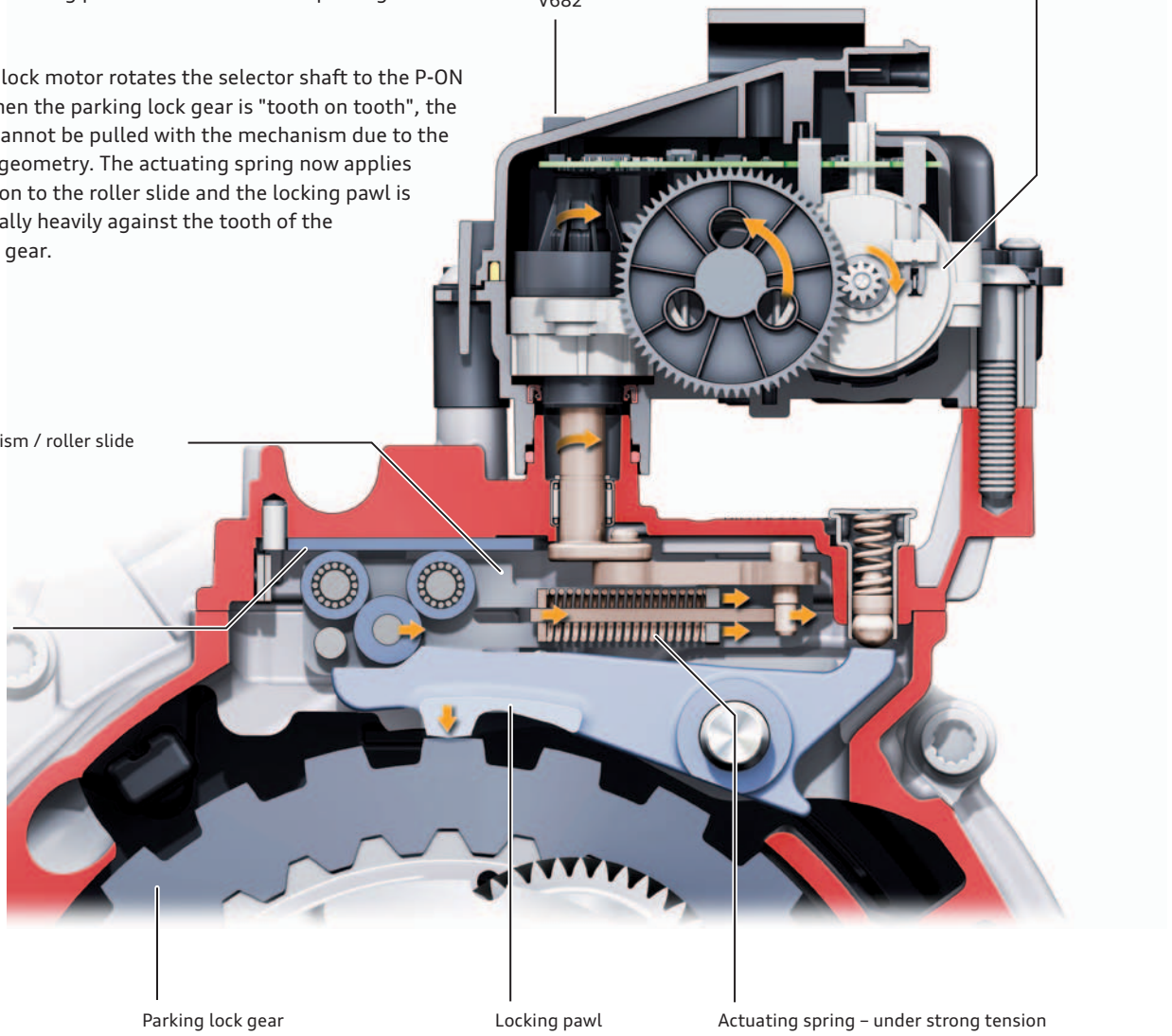
675_050

[1)] "Termination" refers to the termination of the bus system with a terminating resistor. Data are not transmitted over this bus connection.

Parking lock mechanism

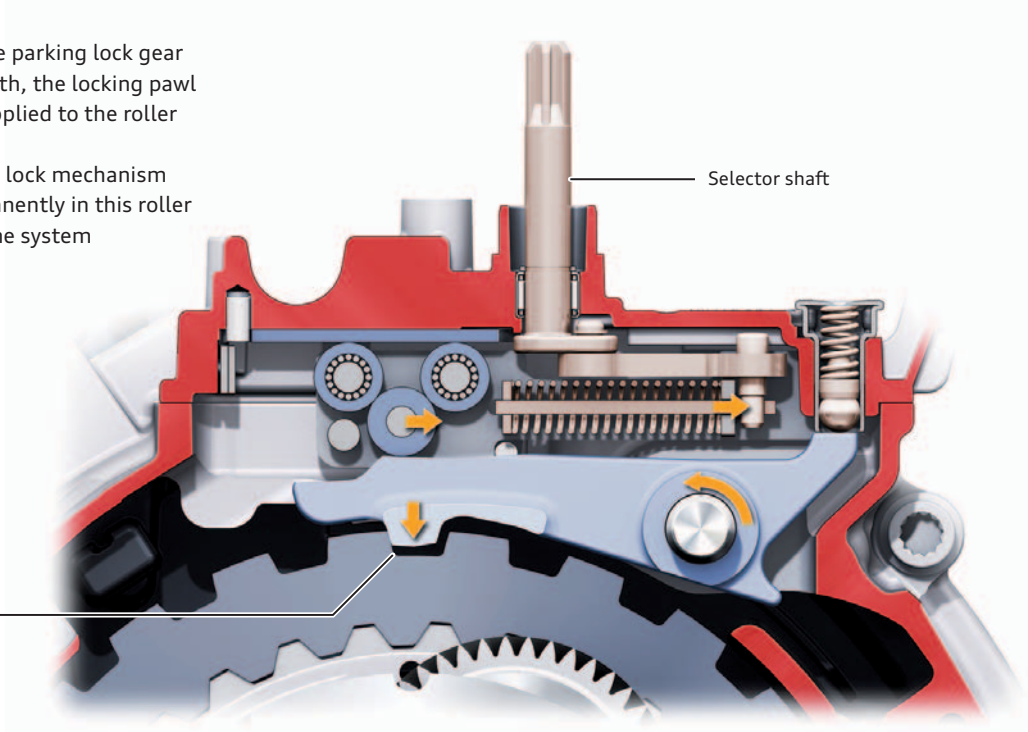
P-ON position – Locking pawl is on a tooth of the parking lock gear

1. The parking lock motor rotates the selector shaft to the P-ON position. When the parking lock gear is "tooth on tooth", the roller slide cannot be pulled with the mechanism due to the component geometry. The actuating spring now applies strong tension to the roller slide and the locking pawl is pressed equally heavily against the tooth of the parking lock gear.



675_052

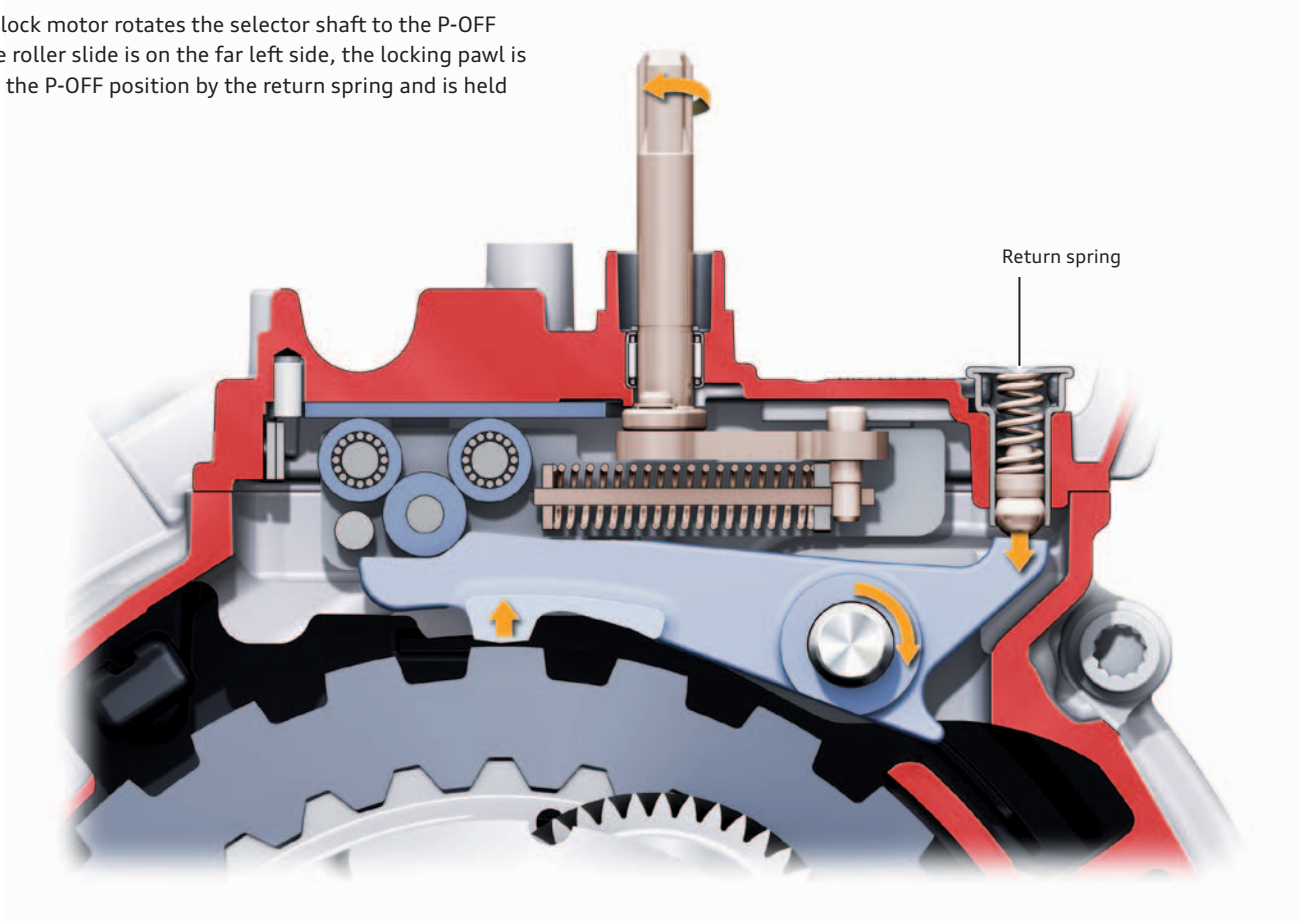
2. As soon as the vehicle moves slightly, the parking lock gear rotates. At the next gap between the teeth, the locking pawl snaps into the gap, due to the tension applied to the roller slide, and the parking lock is engaged.
The self-locking geometry of the parking lock mechanism causes the locking pawl to remain permanently in this roller slide position and thus securely blocks the system (mechanical latch).



675_053

P-OFF position

The parking lock motor rotates the selector shaft to the P-OFF position. The roller slide is on the far left side, the locking pawl is pressed into the P-OFF position by the return spring and is held there.



675_054

Mechanical latch

The positions of the parking lock are held by the self-locking gear in the actuator and the self-locking parking lock mechanism. The positions P-ON and P-OFF are monitored by the parking lock actuator control unit. Refer to page 40. The actuator does not have to be actively driven in order to hold each position.

Note:
If the parking lock is inadvertently operated at higher speeds, the locking pawl ratchets across the parking lock gear teeth. If this situation persists for a long period, the parking lock gear teeth and the tooth on the lock can become so damaged that the parking lock may not be able to block the transmission.

Danger **Caution!** The parking lock gear blocks the planet carrier for the planetary gearing. If the vehicle is raised on one side at the front, there is no locking effect at the opposite wheel because of the compensation by the differential.

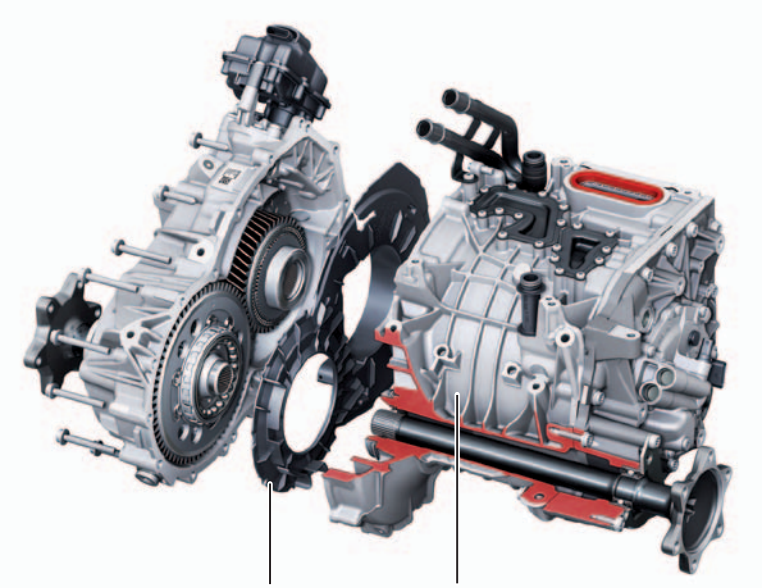
Single-speed transmission – 0MA

The single-speed transmission 0MA has a two-stage reduction ratio and a modern lightweight planetary gear differential. It is equipped additionally with an electro-mechanical parking lock.

Torque conversion takes place in two stages. The first reduction stage is achieved via a single planetary gear set from the sun gear to the planetary gear and planet carrier. In the second reduction stage, a spur gear drive transmits the torque from the planet carrier to the differential.

A special feature of the lightweight planetary gear differential is its extremely compact axial design. Refer to page 47 for further information.

The planet carrier in the first reduction stage can be blocked by the parking lock. The parking lock gear wheel interlocks with the planet carrier for this purpose. Refer to page 45 for further information.



675_056

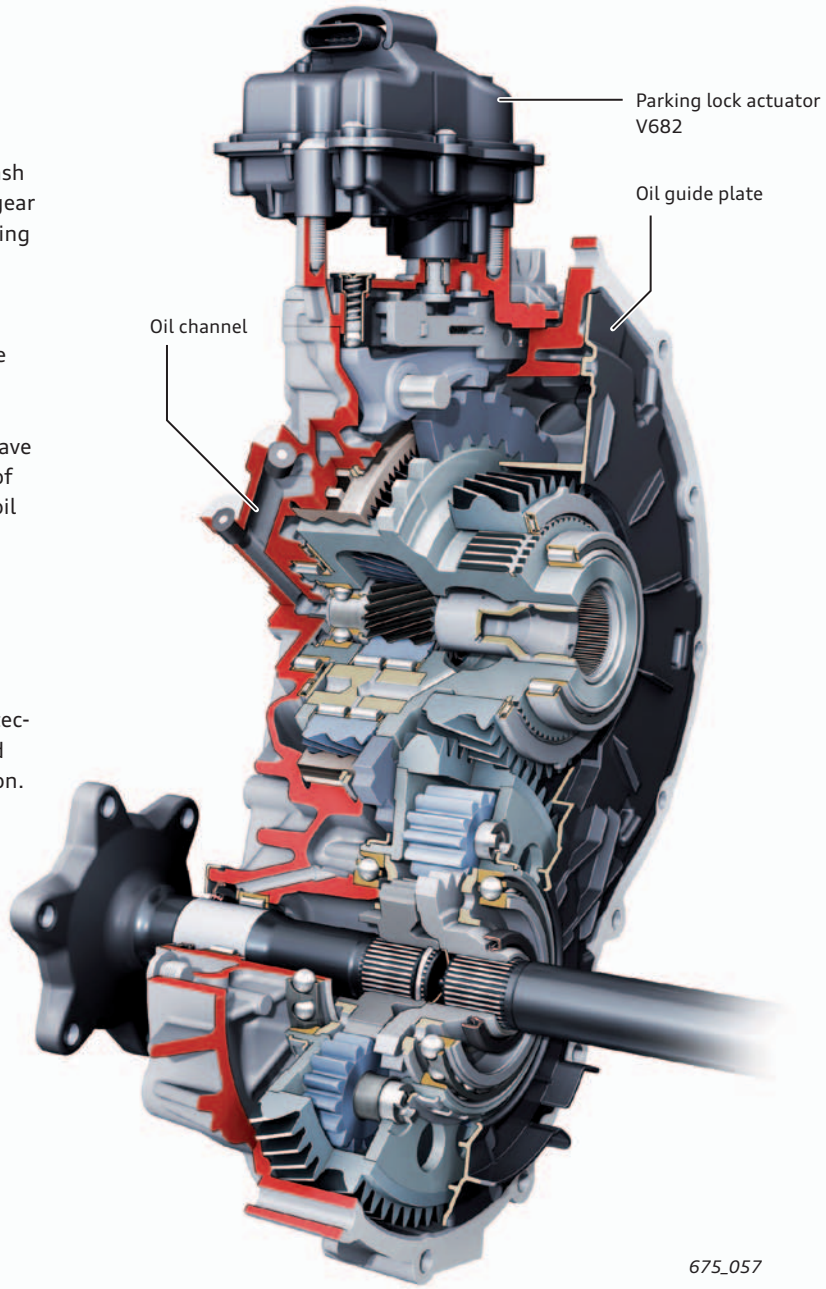
The 0MA transmission has its own oil system. The bath and splash lubrication system utilises the displacement effect of the spur gear stage. The oil guide plate and an ingenious oil supply system using various channels and contours ensure that all parts requiring lubrication are adequately supplied and splashing losses are minimised. Heat is dissipated by convection to the vehicle's air-stream and via a water-cooled bearing plate on the electric drive motor.

The 0MA transmission is a complete unit; however it does not have a self-contained housing. Only when connected to the housing of the electric drive motor does it form a closed unit with its own oil system.

Note:
When the transmission is detached, the side facing the electric drive motor is open. Only the oil guide plate provides some protection against foreign bodies. Particular care and attention should therefore be paid to cleanliness when detaching the transmission.

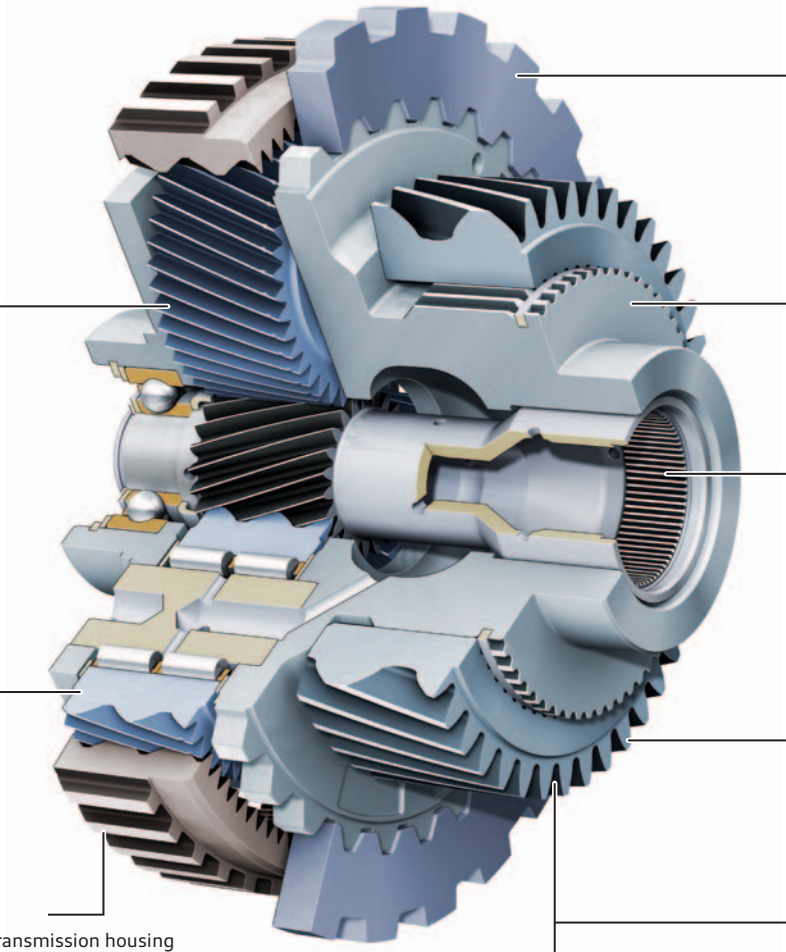
Note:
A specific adjustment procedure must be followed when replacing the transmission or electric drive motor. Refer to page 50 for further information.

Note:
Observe the information in the Workshop Manual for handling the transmission as a separate part.



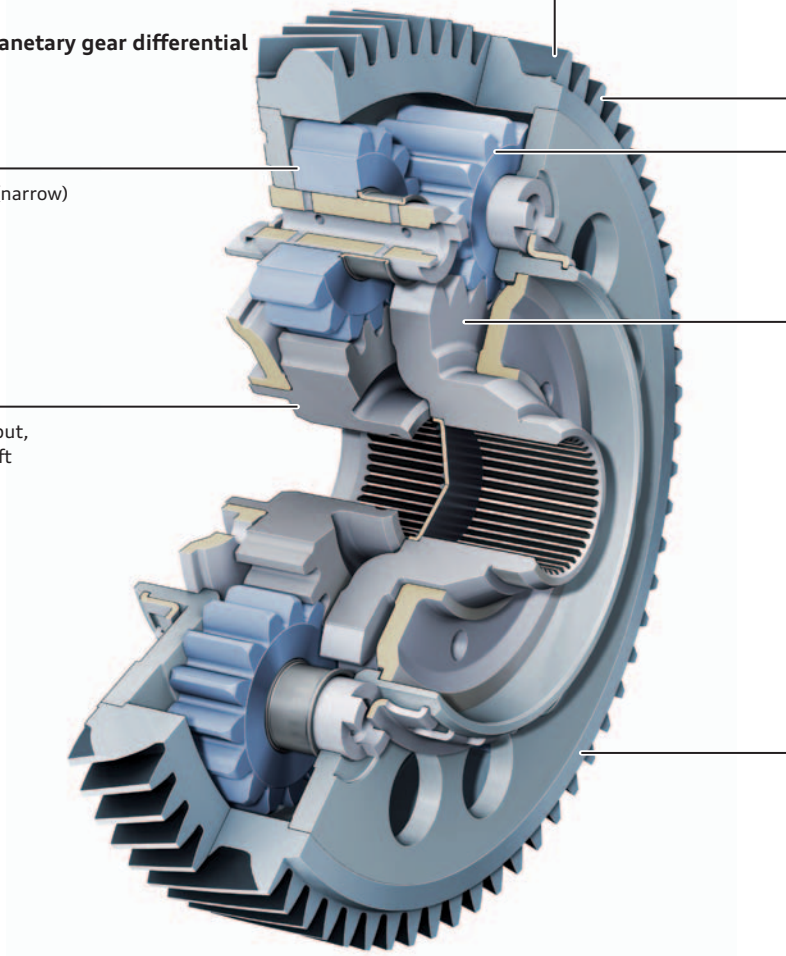
675_057

Single planetary gear set (i – 5.870)



675_058

Lightweight planetary gear differential



675_059

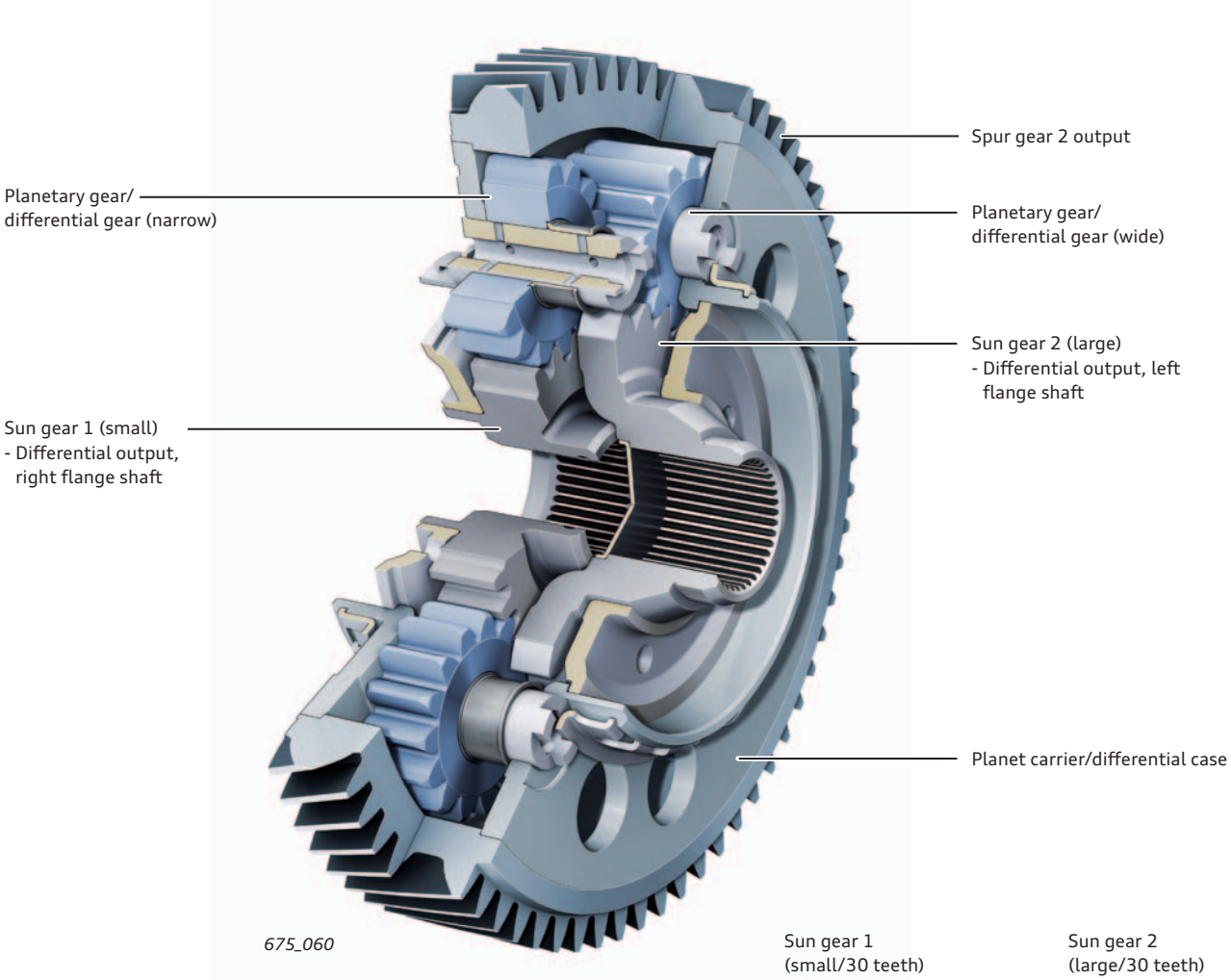
Lightweight planetary gear differential

For the first time, Audi is using a lightweight planetary gear differential from SCHAEFFLER. The advantages of this design are highly beneficial when used together with the electric drives in the Audi e-tron.

- High torque transmission in very compact axial space
- Significant weight savings compared with conventional bevel gear differentials

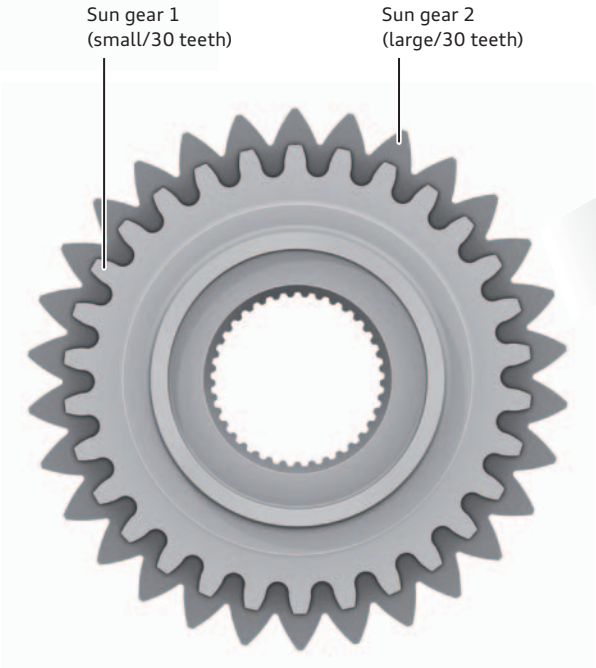
It is designed as an open spur gear differential which distributes the input torque equally (50 : 50) to both outputs.

The drive torque is transmitted to the differential case via spur gear 2. The differential case acts as a planet carrier, which in turn transmits the torque equally to the planetary gears. The wide and narrow planetary gears engage with each other. These serve as differential gears to distribute the torque to the two sun gears and ensure the necessary compensation for different wheel speeds when cornering. The narrow differential gear engages in the smaller sun gear 1; the wide differential gear engages in sun gear 2.



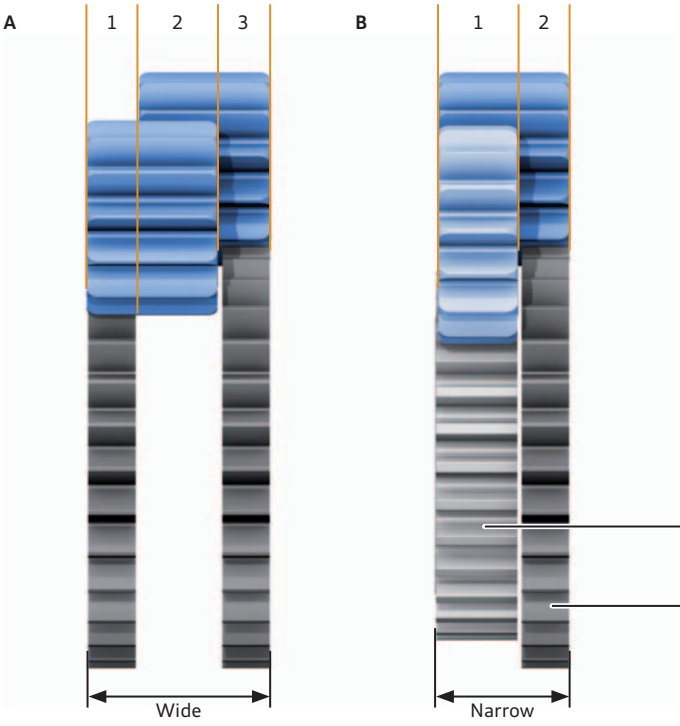
675_060

An essential feature of the lightweight planetary gear differential is its very small width. This was achieved by using two sun gears of different sizes. To ensure that the torque distribution is equal between both sides, the tooth geometry was designed so that both sun gears have the same number of teeth. Since this causes the tooth roots to be comparatively narrow on the small sun gear, this gear was made slightly wider in order to withstand the loads placed on it.



675_061

Toothing levels

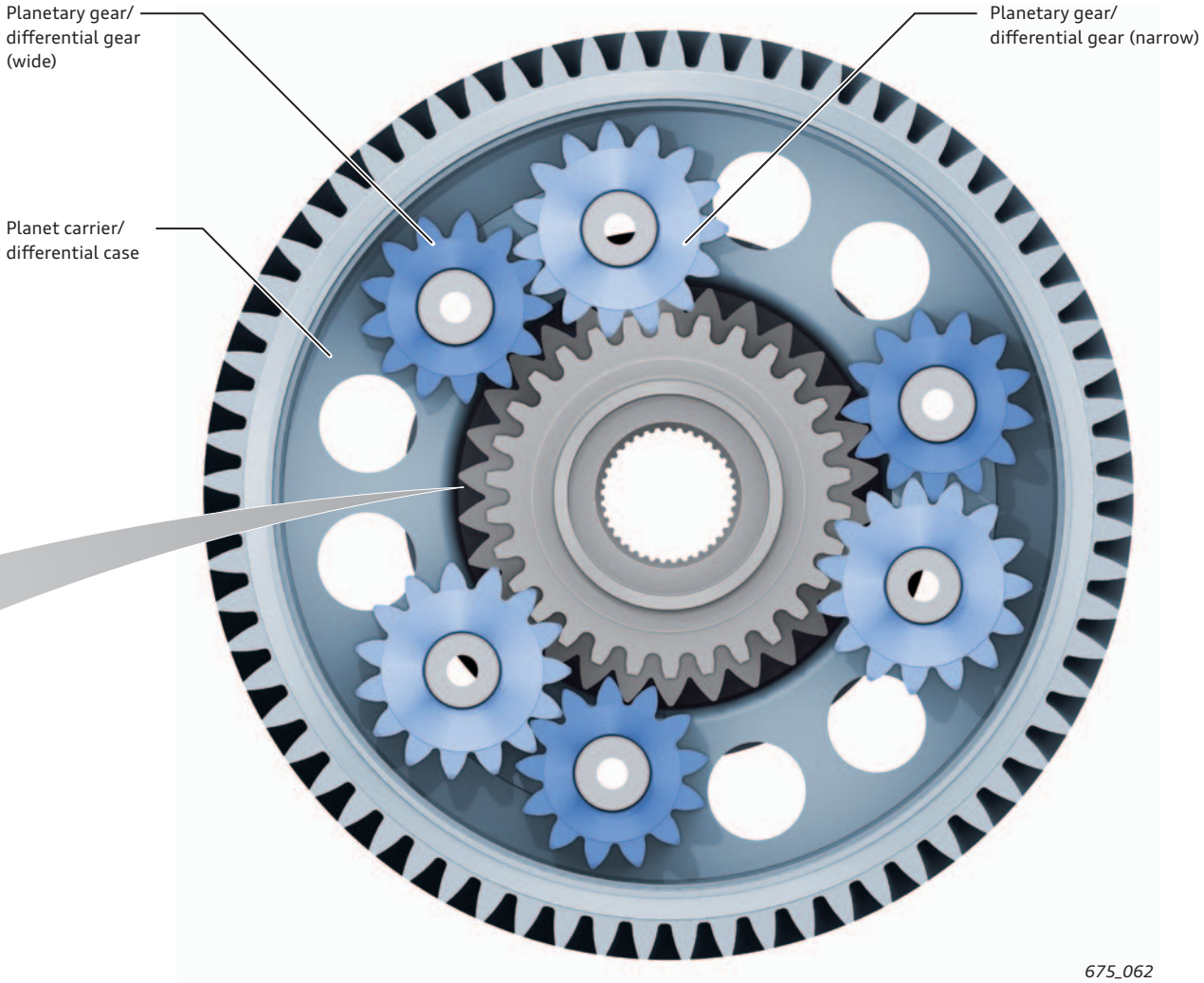


675_063

Comparison of designs

A – Version with sun gears of equal size
A design with equally large sun gears requires three toothing planes (1, 2, 3) and adequate axial space.

B – Version with two sun gears of different sizes
(lightweight planetary gear differential from SCHAEFFLER)
In a design with two sun gears of different sizes, the planetary gear pairs mesh within the small sun gear's toothing plane. This means that only two toothing planes (1, 2) are required, which significantly reduces the axial space.



675_062

Note
The function and design of the lightweight planetary gear differentials in the 0MA and 0MB transmissions are virtually identical (except for small adjustments for the installation situation).

Single-speed transmission – 0MB

The single-speed transmission 0MB has a two-stage reduction ratio in a coaxial design and a lightweight planetary gear differential. This differential is largely identical to the differential in the 0MA transmission described on page 46.

The two-stage torque conversion (reduction) is achieved using a stepped planetary gear set. The first reduction stage is from the sun gear to the large spur gears in the stepped planetary gear set (i – 1.917).

The second reduction stage is from the small spur gears of the stepped planetary gear set, which are supported by the fixed annulus and which drive the planet carrier (i – 4.217). The torque is transmitted directly to the lightweight planetary gear differential via the planet carrier.

The planet carrier is subdivided into two stages. The first stage contains the stepped planetary gears of the planetary gear set and the second contains the planetary gears (narrow and wide) of the differential, thereby forming its differential cage.

The 0MB transmission has its own oil system.
A bath and splash system is used for lubrication. Thanks to the coaxial design, no special parts are required for oil distribution (like the oil guide plate on the 0MA transmission, for example).

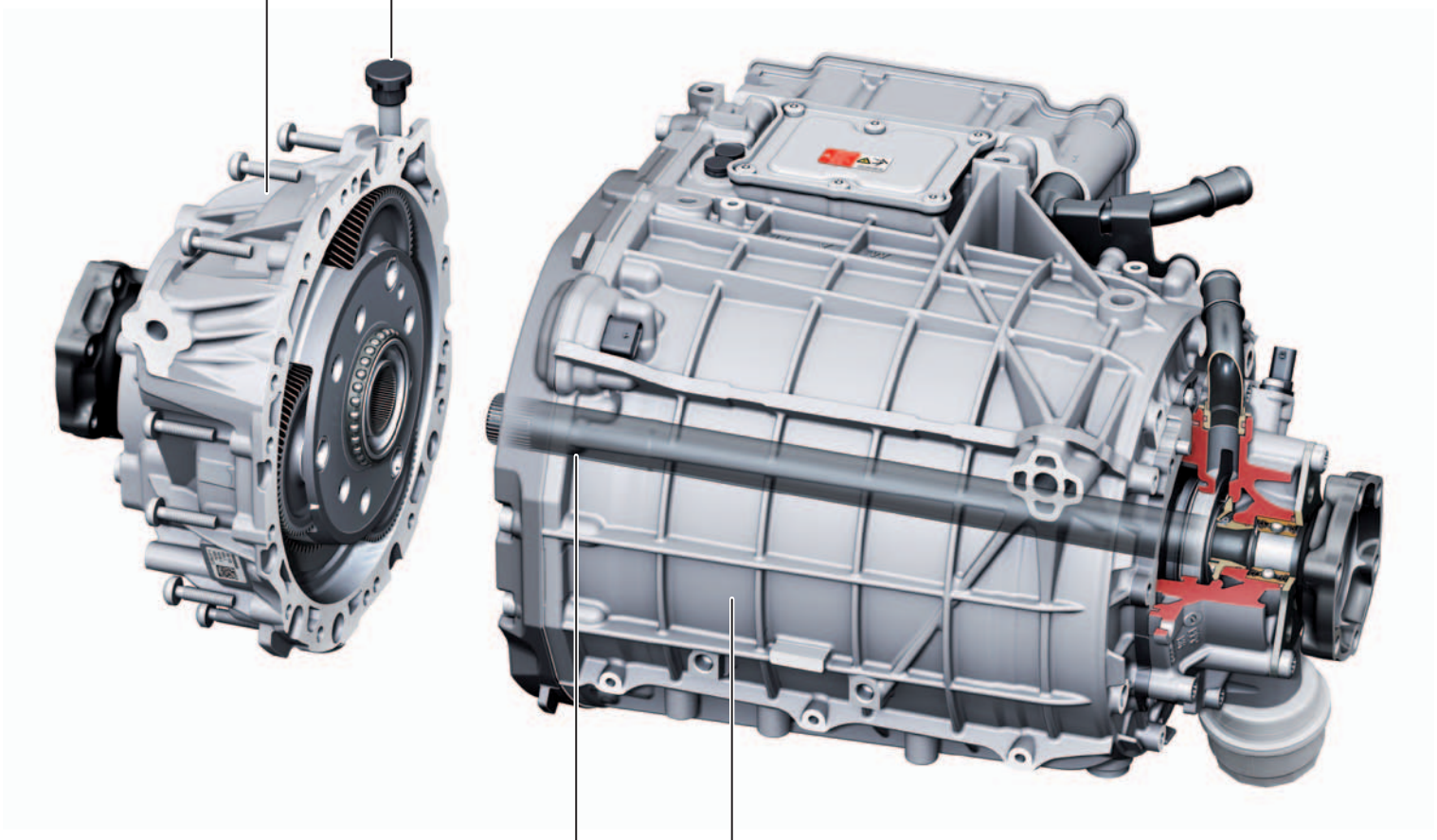
Heat is dissipated by convection to the vehicle's airstream and via a water-cooled bearing plate on the electric drive motor.

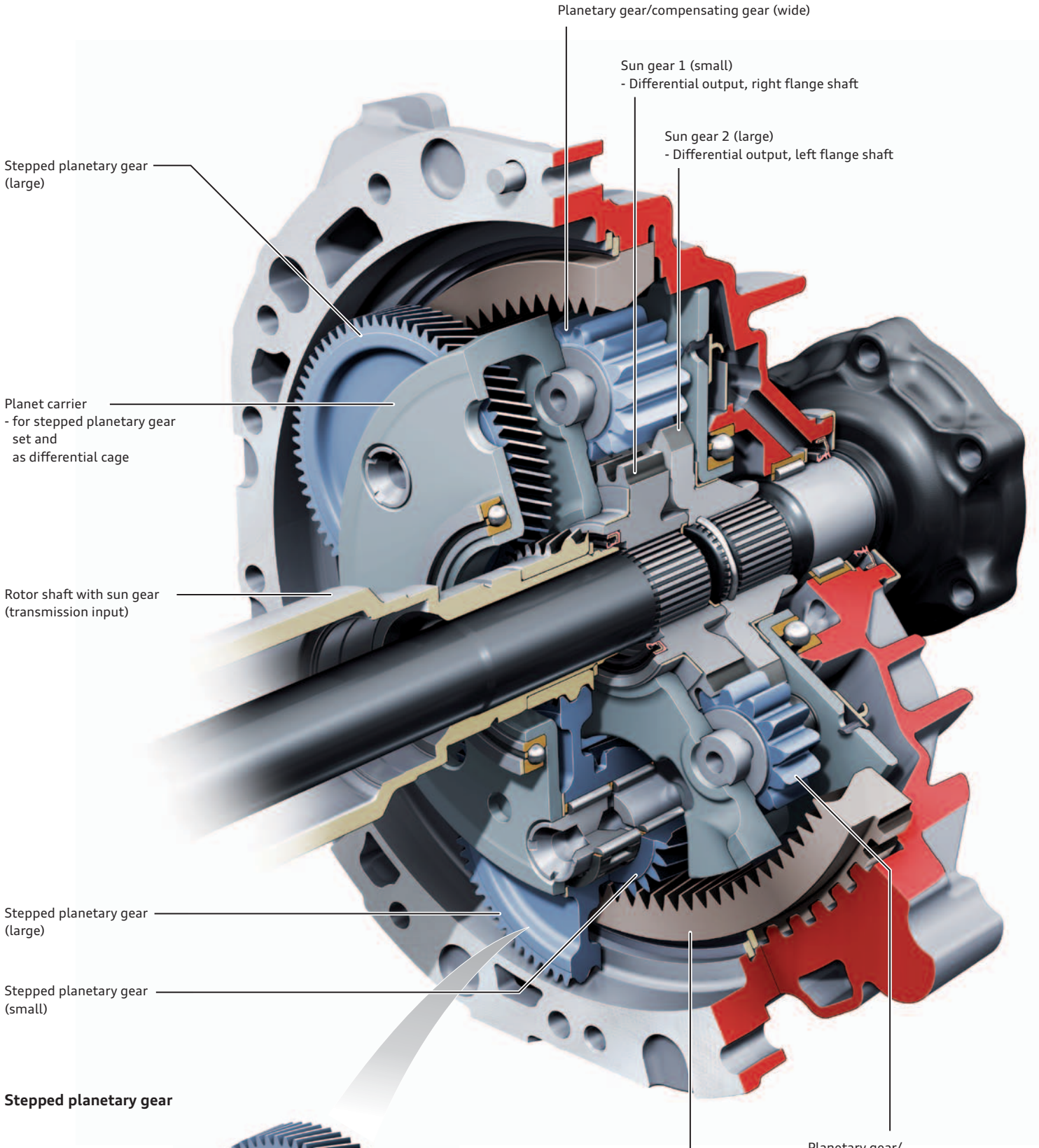
The 0MB transmission is a complete unit; however it does not have a self-contained housing. Only when connected to the housing of the electric drive motor does it form a closed unit with its own oil system.

Note:
When the transmission is detached, the side facing the electric drive motor is open. Particular care and attention should therefore be paid to cleanliness when detaching the transmission.

Note:
A specific adjustment procedure must be followed when replacing the transmission or electric drive motor. Refer to page 50 for further information.

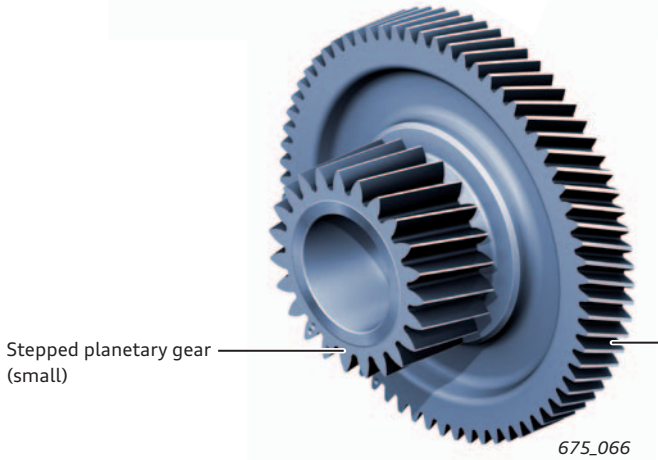
Note:
Observe the information in the Workshop Manual for handling the transmission as a separate part.





675_065

Stepped planetary gear



675_066

Service information

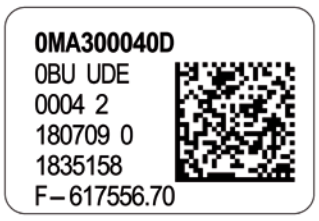
Single-speed transmission – 0MA

The oil systems of the 0MA and 0MB transmissions do not have servicing intervals. They are maintenance-free.

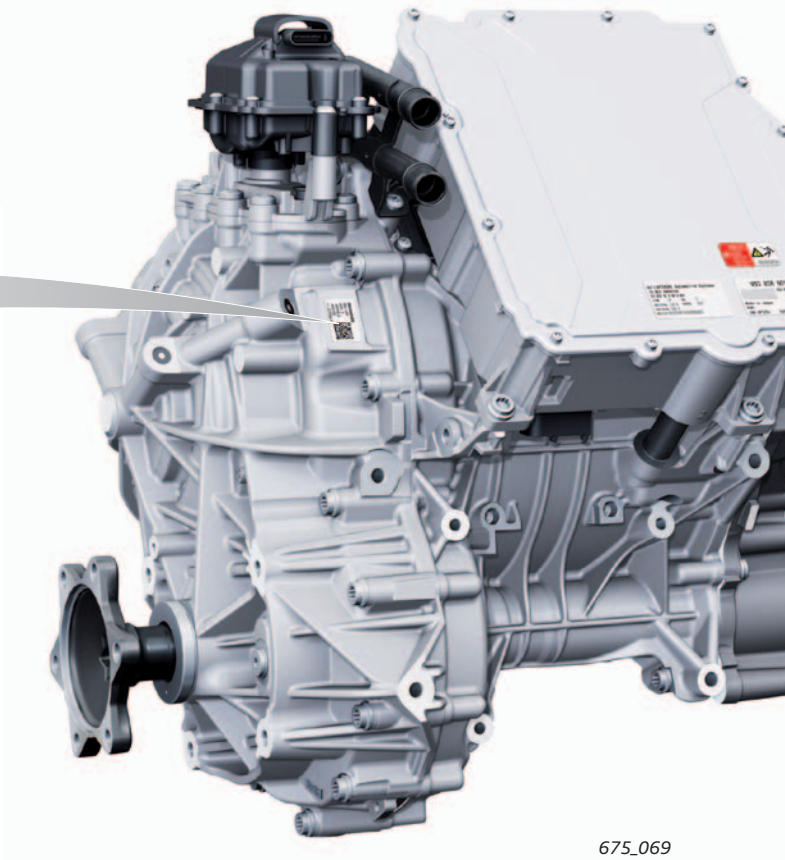
675_073

675_067

Transmission data sticker



675_068

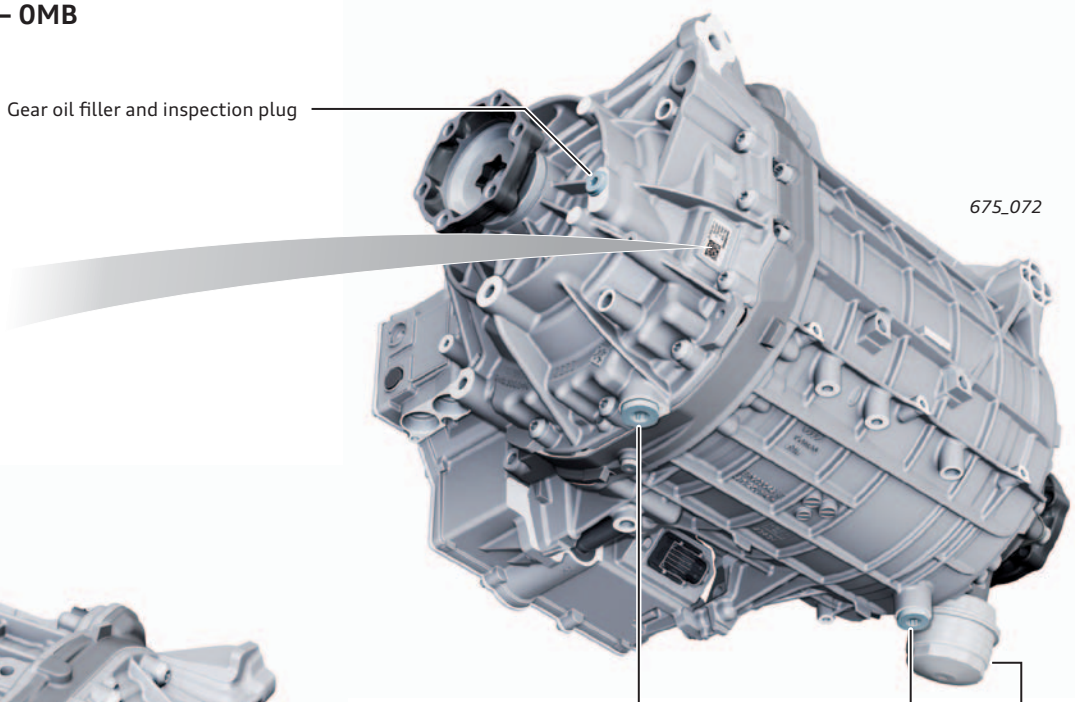


675_069

The shims for the transmission mountings must be identified and calculated when replacing the transmission or electric drive motor. This requires measurements to be made at the mounting points in the electric motor housing. It is not currently possible to measure the dimension on the transmission side using workshop equipment; it must be taken from the transmission data sticker.
The transmission dimension is determined by the manufacturer under a defined load and printed on the transmission data sticker. Refer to the legend for the transmission data sticker. The thickness of the shim can be calculated based on the measurement data from the electric motor housing and the data on the transmission data sticker. For further information, please refer to the Workshop Manual.

Single-speed transmission – 0MB

Gear oil filler and inspection plug



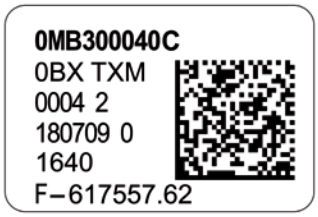
675_072

Gear oil drain plug

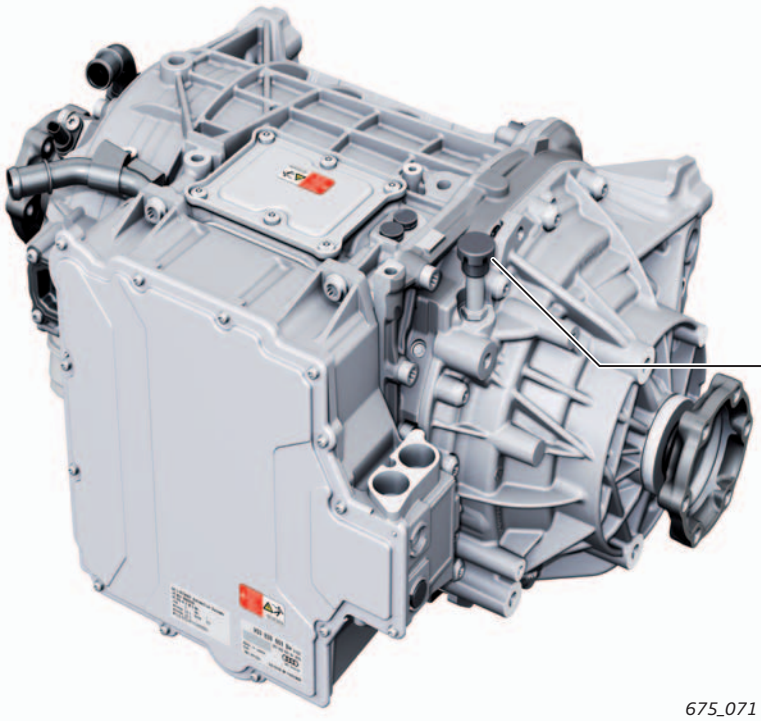
Inspection plug for electric drive motor

Reservoir – For servicing purposes, see page 25

Transmission data sticker



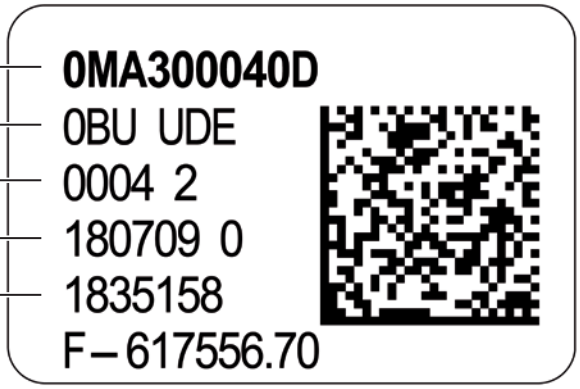
675_070



675_071

Transmission breather and ventilation

Legend for transmission data sticker (0MA transmission)



675_068

Gearbox part number

Assembly no. / gearbox code

Gearbox serial no. / manufacturer's code

Date of manufacture / test symbol

Data for determining shims

18.35 mm — 1835158 — 1.58 mm

Dimension for calculating shim for differential mounting[1)]

Dimension for calculating shim for planetary gear set mounting[1)]

The data sticker for the 0MB transmission has only four digits. A shim must only be determined for one mounting point.
The dimension for calculating the shim for the planetary gear set/ differential mounting can be calculated from these four digits.[1)]

1640 — 16.40 mm
Example for 0MB transmission

[1)] For further information, please refer to the current Workshop Manual.

Running gear

Overview

The running gear on the Audi e-tron is based on the MLBevo platform, which was also the basis for development of the A4, A5, Q5, A6, A7, Q7 and A8. Due to the axle loads and vehicle dimensions, the Audi e-tron uses major MLBevo system components from the Audi Q7.
The only running gear systems used feature air springs and electronic damping control (adaptive air suspension).

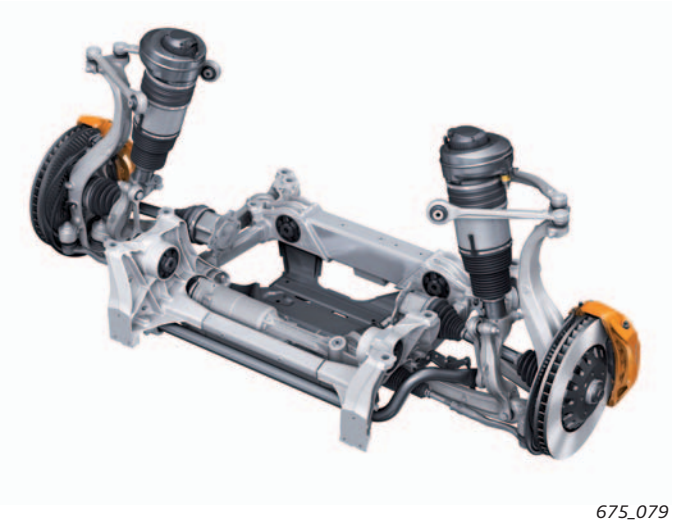
Depending on the country, the Audi e-tron is fitted with an 18” or 19” brake system. If the required conditions have been met, recuperation takes place via the electric motor’s generator mode. The total braking power is then obtained from the hydraulic braking power and the braking power provided by the electric motor. To regulate these complex processes efficiently, a new brake regulation system (MK C1) is being used in an Audi model for the first time. This integrates the brake master cylinder, brake servo, ESC and active brake pressure accumulator in one module. The driver can set the level of recuperation by pulling the paddle levers on the steering wheel. The range of wheels extends from 19” in the basic specification through to optional 21” wheels.

675_078

The following versions can be ordered:
Standard running gear with air springs and damping control (adaptive air suspension - 1BK)
This is the standard running gear.
Sport running gear with air springs and adaptive damping (adaptive air suspension sport - 2MB)
This running gear version is optional. The hardware corresponds to the standard running gear 1BK.
As the name suggests, the suspension is configured to suit a dynamic/sporty driving style.

Axles

Front axle
The front axle is based on the proven design principle of the five-link suspension. The main system components are identical parts to those on the Audi Q7 (type 4M). The subframe is a new construction made from aluminium.



675_079

Rear axle
The Audi e-tron has a five-link rear axle. Like on the front axle, the main system components are identical parts to those on the Audi Q7 (type 4M).
The new subframe construction was necessary to meet the vehicle's special packaging requirements (integration of high-voltage battery and electric motor).

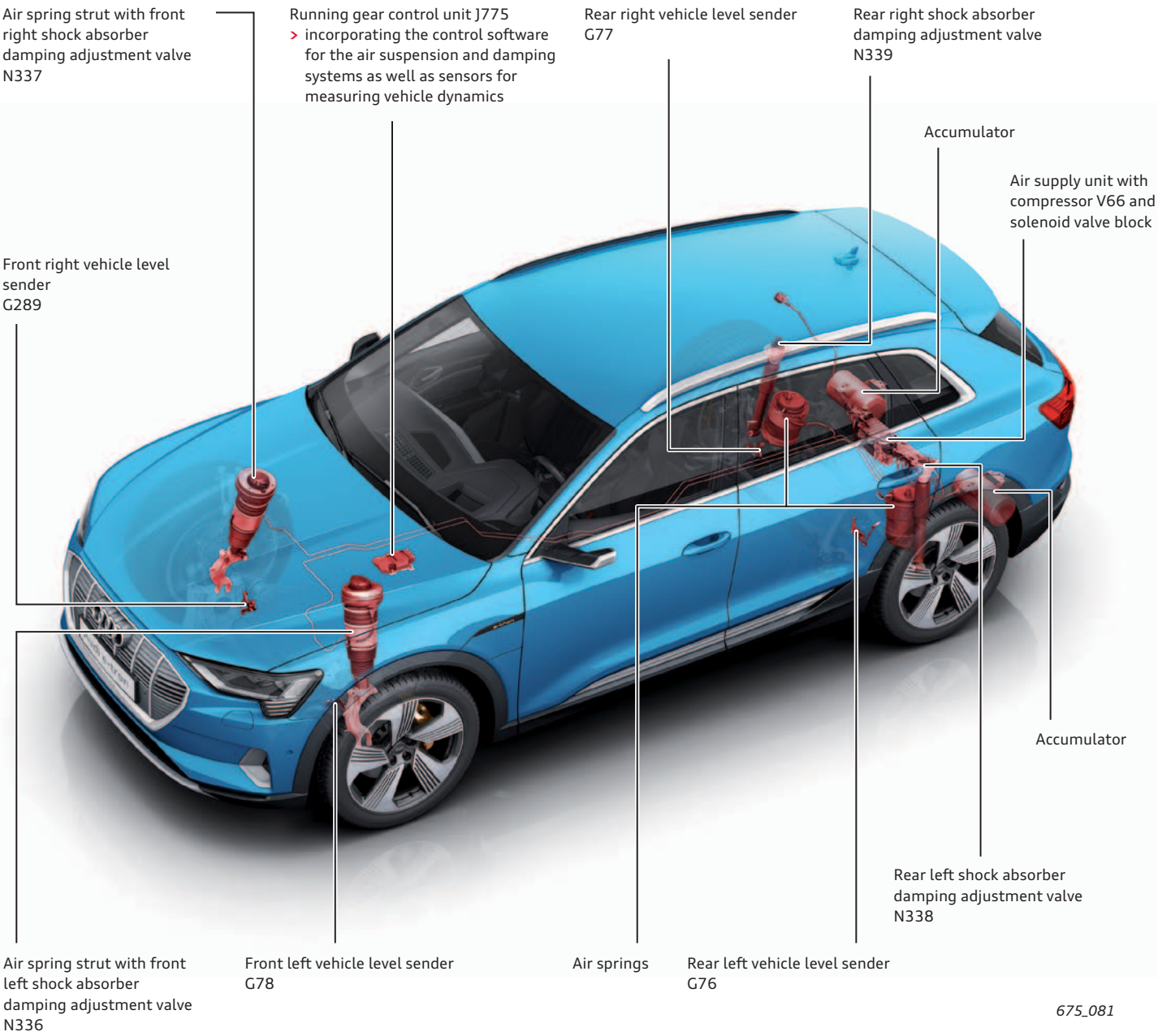
675_080

Reference
For detailed information on the system components and the running gear setup, please refer to self-study programme 633 "Audi Q7 (type 4M) Chassis".

Adaptive air suspension

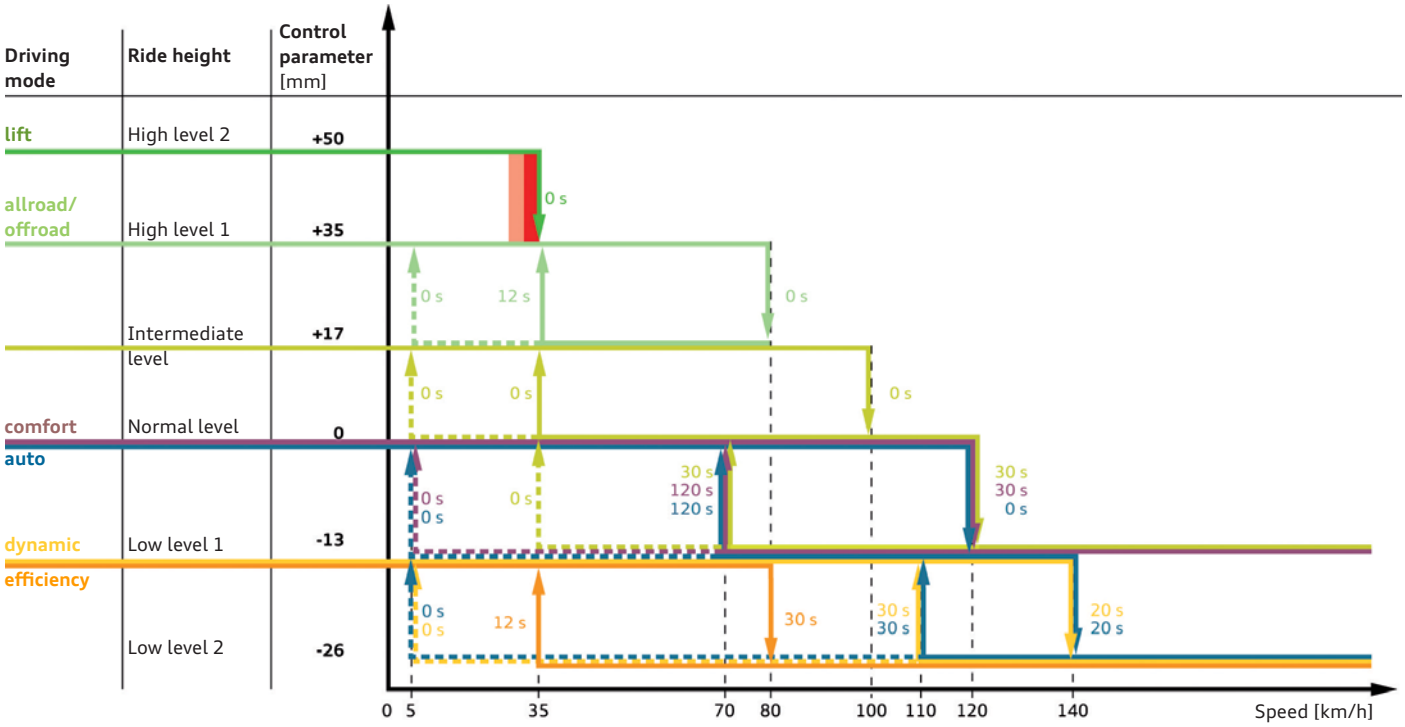
Adaptive air suspension with electronic damping control is standard equipment on the Audi e-tron. The type of damping control provided varies between the two running gear versions, adaptive air suspension and adaptive air suspension sport. The regulating characteristics (regulation of ride heights depending on vehicle speed and mode) are identical on both versions. The system's construction corresponds to that of the adaptive air suspension systems on the Audi Q7 (type 4M). The system components are carry-over features. The running gear control unit J775 is likewise fitted as a control centre.

The control unit is from the Audi A8 (type 4N) and the software has been adapted to the requirements of the Audi e-tron regarding regulating characteristics and electronic damping control. In terms of operation and servicing requirements, the adaptive air suspension system is also identical to that used in the Audi Q7 (type 4M).



Reference
For detailed information, please refer to self-study programme 633 "Audi Q7 (type 4M) Chassis."

Regulating characteristics of adaptive air suspension (1BK) and adaptive air suspension sport (2MA)



675_093

Key:

Selection lock

Hysteresis of selection lock

The illustration shows the control strategy for the air suspension systems. By selecting the preferred driving mode in Audi drive select, the driver determines the vehicle's ride height and dynamic characteristics. At the same time, different ride heights are also automatically set within the selected driving mode, depending on the current vehicle speed. An example of this can be seen in the control strategy when "auto" mode is selected: If the vehicle is currently set to a different ride height, the normal level is set by changing the volume of air in the air springs if the mode is selected when the vehicle is stationary or travelling at a speed below 120 km/h. If the vehicle subsequently exceeds a speed of 120 km/h, the ride height will immediately be lowered by 13 mm to low level 1. If the speed then increases further to at least 140 km/h and remains there for 20 seconds, the ride height will be lowered again by a further 13 mm to motorway level.

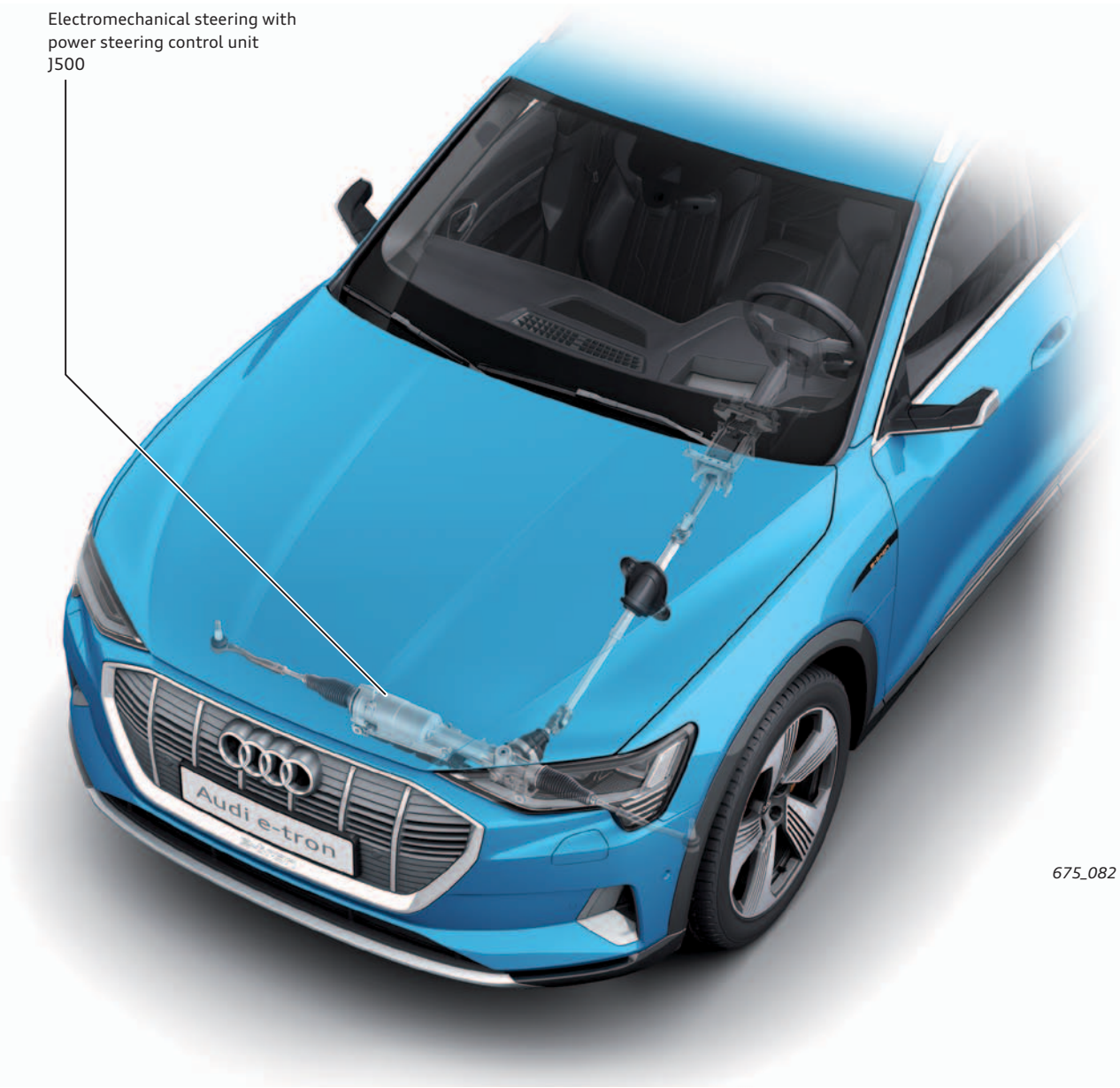
If the speed is subsequently reduced again and the vehicle is driven at a speed of 110 km/h or lower for a duration of 30 seconds, the ride height is raised by 13 mm to the ride height previously set. If the speed is reduced further to 5 km/h, the vehicle is immediately raised to the original level (normal level).

A different regulating strategy is applied in towing mode. If driving modes "comfort" or "auto" are selected before towing mode is activated, the system will not regulate under the normal level. Low level 1 is only set if the driving modes "dynamic" or "efficiency" are selected before towing mode is activated. Vehicle levels above the normal level can be set.

Steering system

The steering system of the Audi e-tron implements the same electromechanical power steering (EPS) used in the Audi A8 (type 4N). In terms of design, operation and servicing requirements, the EPS on the Audi e-tron corresponds to that used on the Audi A8.
The steering ratio has been modified to suit the requirements specific to the Audi e-tron. Progressive steering is fitted as standard equipment.
The characteristic curves for manual torque (power steering) vary depending on the running gear version and the setting in Audi drive select. Depending on the driving program selected, a dynamic, balanced or comfortable steering response is achieved.

Manual adjustment for the steering column is included in the standard equipment. An electrically adjustable steering column is available as an optional extra. It can be adjusted approx. 68 mm horizontally and approx. 40 mm vertically.
Both steering columns are taken from the Audi Q5 (type FY). The crash detection has been modified for the Audi e-tron. Because of the car's special drive technology, both steering columns are fitted with an electronic steering column lock.
The four-wheel steering available as an option on the Audi A8 is not available on the Audi e-tron.



675_082

The steering wheels available for the Audi e-tron are from the Audi A6/A7.

Leather double-spoke steering wheels, leather sport steering wheels and a sport contour steering wheel are available.

The double-spoke steering wheel with 12 multi-function buttons is the standard version.

Steering wheel heating is available optionally. The optionally available steering wheels may also have the S diamond on the centre spoke. This depends on the vehicle equipment (S line).

The sportiest version, the sport contour steering wheel, has a more contoured rim and is flattened at the bottom.

Basic equipment

Leather sport steering wheel

Vehicles equipped with the adaptive cruise assist have a capacitive steering wheel.
This steering wheel is a new development which allows for even more precise hands-off detection.
For detailed information on this steering wheel version, refer to page 152.

Sport contour steering wheel

675_090

The double-spoke basic steering wheel is equipped with paddle levers so that the driver can adjust the recuperation function in overrun mode manually. The operating logic from vehicles with conventional drive systems has been used:
When the (-) paddle lever is operated, the vehicle is decelerated by shifting down in overrun mode. The Audi e-tron decelerates when the electric motor recuperates more energy while it is in generator mode. The driver can increase/reduce the level of recuperation in three stages using the (+) or (-) paddle lever respectively. The menu option for manual recuperation must be set in the MMI to do this. The maximum rate of deceleration in overrun mode at level 1 (when the (-) paddle lever is operated once) is 0.5 m/s². At level 2, the maximum rate of deceleration is 1.0 m/s².
The paddle lever can also be used to select the desired recuperation capacity for a deceleration procedure when the system is set to automatic.

675_143

Brake system

The brake system on the Audi e-tron is based on the 18” brake system used on the Audi Q7 (type 4M). The front and rear right brakes are fitted with brake pad wear indicators.
The components and dimensions of the brake system may vary from those shown in the overview in some markets (e.g. North America, China). 19” brakes are used in these markets.

The electromechanical parking brake (EPB) on the Audi e-tron is also from the Audi Q7 (type 4M). Another similarity to this model is that the control software and the output stages of the power supply are also located in the ABS control unit J104. The controls and service requirements relevant to the EPB are therefore identical on both models.

Brake system

Motor 50 e-tron: 230 kW 55 e-tron: 265 kW	Front axle	Rear axle
Minimum wheel size	18"	18"
Type of brakes	ATE fixed caliper brakes	TRW floating caliper brakes PC 44 HE
Number of pistons	6	1
Piston diameter (mm)	30-36-38	44
Brake disc diameter	375 mm	350 mm
Brake disc thickness	36 mm	28 mm

AKE fixed caliper brake used on the front axle

TRW floating caliper brake used on the rear axle

Brake regulation system MK C1

Overview

On the Audi e-tron, the brake regulation system MK C1 is being used on an Audi model for the first time. This system represents a further level of development of existing (conventionally constructed) brake regulation systems.
The main new feature is the integration of a tandem brake master cylinder, brake servo (via electromechanical components incl. regulation), ESC regulating systems (including ABS, EDL, TCS etc.) and brake blending in one module. This achieves a significant weight reduction (about 30%) compared to conventionally constructed brake systems. In addition, system availability is improved thanks to the reduced number of individual components. From a functional perspective, the system offers dynamic advantages when building up pressure. It also provides the driver with a brake pedal feeling which remains constant, even when recuperation is taking place.

Tandem brake master cylinder

Electric brake servo

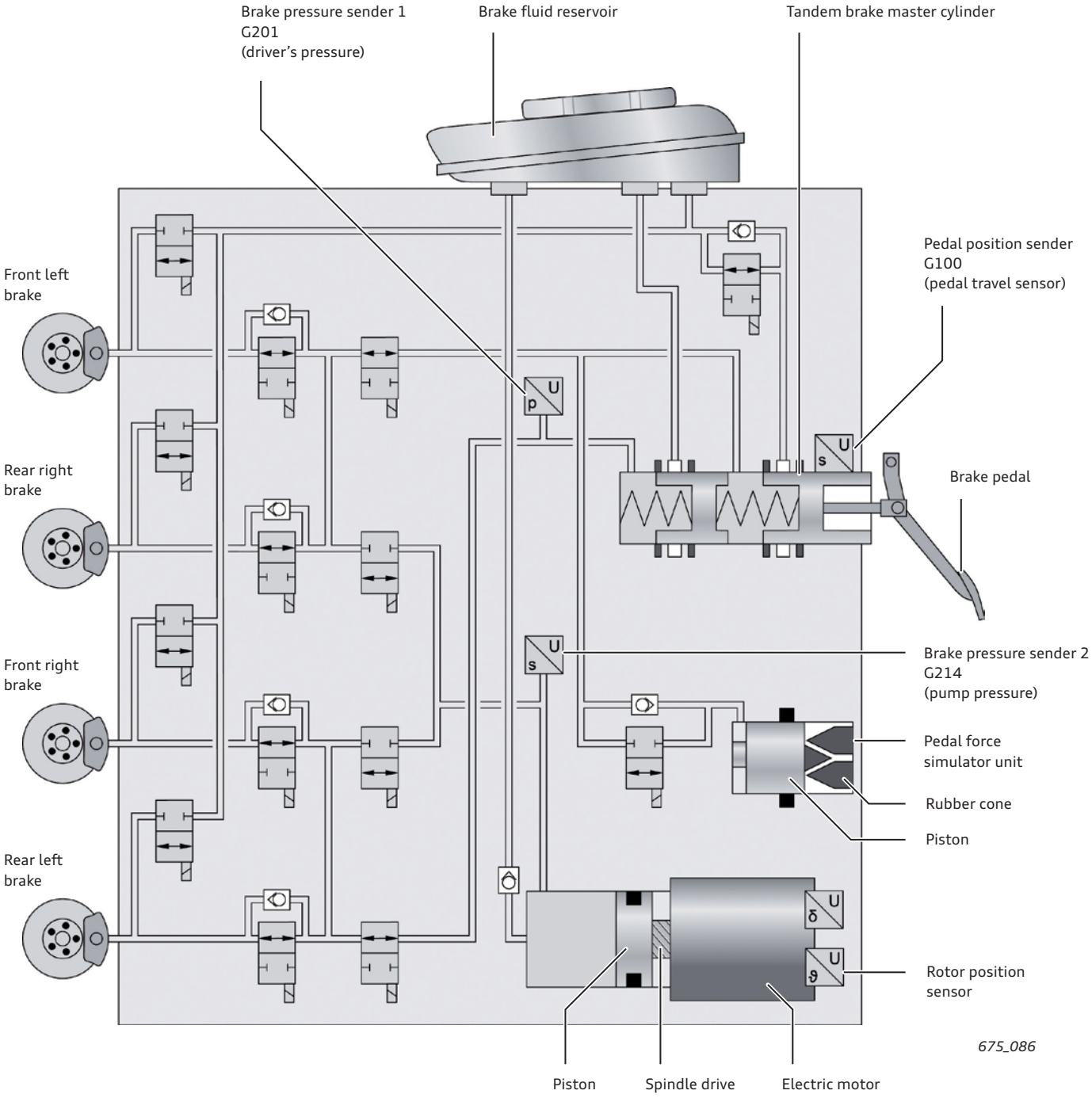
ESC/brake regulation system
(hydraulic unit + control unit J104)

Pressure accumulator
(for brake blending)

675_085

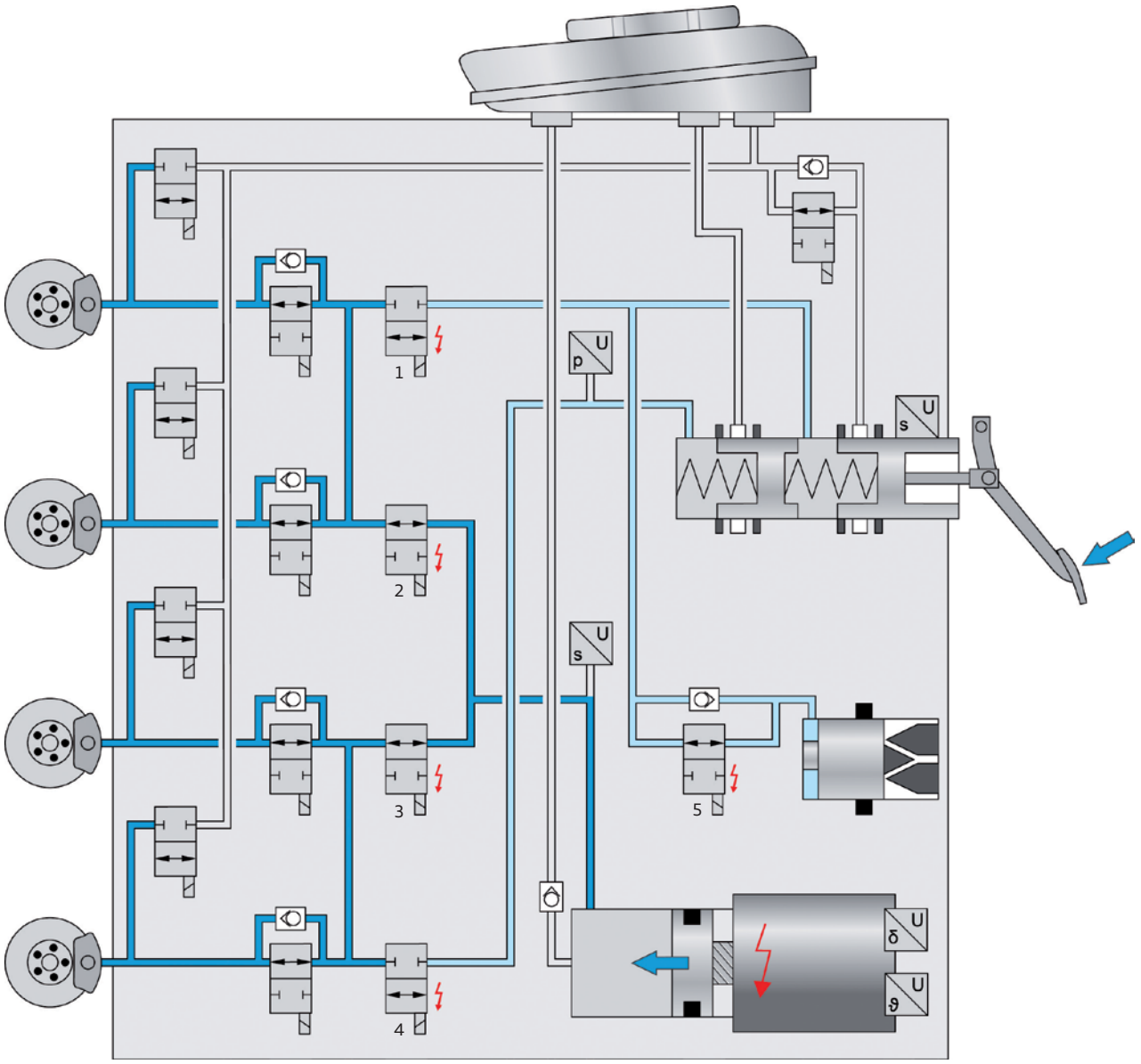
Design and function

The image shows a diagram of the layout of the hydraulic unit for the brake regulation system. The ABS control unit J104 is also part of the module.



- Piston
- Spindle drive
- Electric motor
- Rotor position sensor

→ Linear actuator

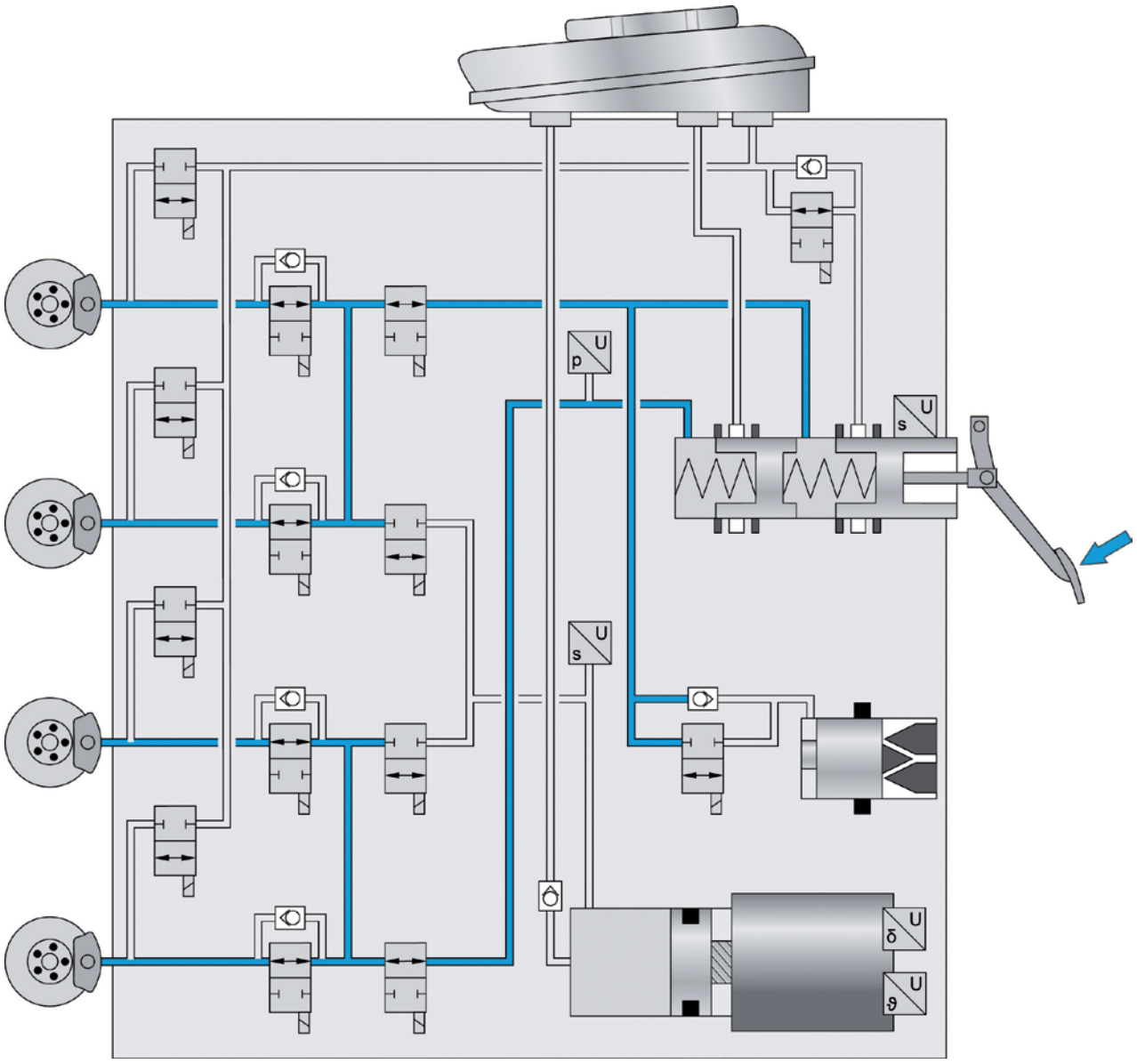


675_087

Brake pressure build-up phase via electric motor pump unit (linear actuator), driver presses the braking force simulator (normal braking procedure)

The module includes a “classic” tandem brake master cylinder whose piston is operated by the driver via the brake pedal. The pedal/plunger travel is registered by the pedal position sender G100. If pedal operation is detected, the control unit J104 actuates isolating valves 1 and 4, which then block the relevant wire. At the same time, solenoid valve 5 is energised, thereby allowing energy to pass through. Because the isolating valves have blocked the wires, the “brake pressure” initiated by the driver does not reach the brakes. Instead, the pressure acts on the piston of the pedal force simulator unit due to valve 5 being open. The piston is pressed against a rubber cone and a steel spring which take up the force progressively. The counter force which the driver feels on the pedal corresponds to the force which would be felt with a conventional brake regulation system.

The force applied by the driver is measured by a pressure sensor (brake pressure sender 1 G201) and the pedal travel by a movement sensor. Depending on these measured values, the control unit J104 energises the electric motor, whose rotational movement is transmitted to the pump piston via a spindle drive. Because the pressure supply valves 2 and 3 are open, the pressure built up by the piston movement reaches the brakes. The pressure built up by the electric motor/piston unit is measured at a second location (brake pressure sender 2 G214) and reported to the control unit. The synchronous electric motor features electronic commutation and is therefore equipped with a rotor position sender. The control unit uses the the spindle drive ratio to calculate the piston position on the basis of the rotor position and the number of rotations.



675_088

Brake pressure build-up by the driver in the hydraulic fallback level

Control processes involving building up, holding and dissipating brake pressure on individual wheels via corresponding actuation of the solenoid valves and the electric motor are performed by the ABS control unit J104.
If the driver switches off the ignition before the vehicle has come to a stop, the brake servo remains available even after the vehicle has stopped. Once the vehicle is stationary with the ignition off, the brake servo remains available for approx. 1 minute (if the brake pedal is not pressed) or 3 minutes (if the brake pedal is pressed). After this time, a warning for the driver appears on the display and the brake servo is switched off.

Immediately after the ignition is switched on and after the vehicle "goes to sleep" after terminal 15 is switched off, a self-test is run in which the valves are actuated and the linear actuator is run. As this happens when the vehicle is stationary, it can be heard (quiet clicking and scraping noises).
In the event of total system failure, the brakes work like a conventionally constructed brake regulation system when the brake servo fails. The non-activated valves establish a direct hydraulic connection from the brake master cylinder to the brakes, thereby allowing brake pressure to be generated at all four brakes solely via the driver's pedal operation.

Integration of hydraulic brake regulation system in vehicle's recuperation system

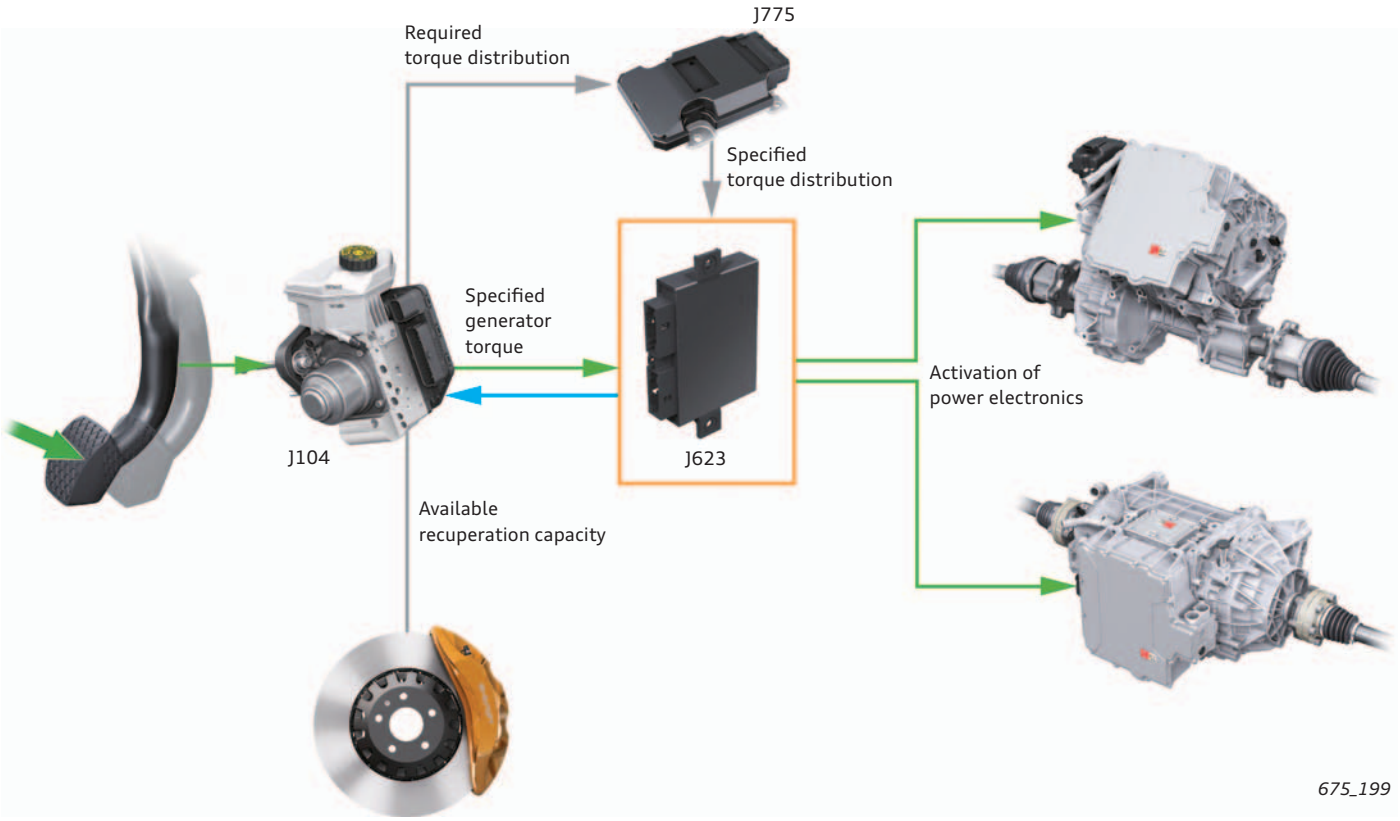
If an electric motor is operated as an generator in overrun mode, the vehicle is braked. The braking power generated depends on the recuperation level. If the driver or the adaptive cruise assist brakes the vehicle, braking is usually partly electrical and partly hydraulic. The motor control unit J623 permanently transmits information on the maximum recuperation capacity (braking power) currently available to the ABS control unit J104 of the MK C1 brake regulation system. If the driver presses the brake pedal or the adaptive cruise assist requests braking, the control unit J104 determines whether braking is possible and sufficient if performed solely by the electric motor(s) or whether additional hydraulic brake pressure needs to be generated. It sends the specified generator torque to the motor control unit.

At the same time, J104 sends the required distribution of the recuperation torque for both driving axles to the running gear control unit J775. J775 coordinates the transition between linear, overrun and recuperation distribution and sends this specification to the motor control unit. This then implements the request at the electric motors on the axles. The aim is to achieve the optimum compromise between efficiency and driving stability in all situations.

If the recuperation torque potentially available is not sufficient to achieve the deceleration required by the driver, the ESC additionally activates the electrically driven pump to generate the necessary brake pressure. The pressure accumulator function required for brake blending on previous electric or hybrid vehicles is not required on the MK C1 and is provided by the electric motor pump unit.

Dynamic driving control processes, such as ABS, EDL and ESC interventions, usually work in the same way as on vehicles with a conventional brake system.

The motor braking torque control (MSR) is also correspondingly implemented by having the electric motor(s) generate drive torque. Corresponding interventions are implemented at the wheels using the brake hydraulics as their forces act on the wheels directly and without drive shaft torsion. To do this, the recuperation torque is "reflected" onto the brake.



Service operations

The diagnosis address is “0003-Brake electronics-J104 (MK C1)”.
If necessary, the entire module must be renewed. However, renewing the brake fluid reservoir separately is possible. It is not possible to renew control unit J104 separately.
After the control unit has been coded online, various basic settings must be performed for:

- Brake pedal position sender G100
- Brake pressure senders 1 and 2, G201 and G214
- EPB (control unit for electromechanical parking brake J540)
- Tyre Pressure Loss Indicator

In addition, the corresponding final control diagnosis must be performed to ensure that the hydraulic lines are connected correctly and have not been interchanged.
Further final control diagnoses can be used to check the EPB and warning/indicator lamp functions.
The information given by the vehicle diagnostic tester must be noted in particular when the function “Change pad” (replacing brake pads on the rear axle) is performed.
Special bleeding routines must be performed after brake components are renewed or brake fluid is changed (refer to Workshop Manual).
The brake must be pressed several times after repairs have been performed to ensure that the brake pads make contact with the brake discs.
After doing this, the brake fluid reservoir must always be filled up to the MAX marking.

675_085

Wheels, tyres and tyre pressure monitoring

The Audi e-tron comes with 19" cast aluminium wheels as standard. Wheels with size 19" to 21" are available as optional extras. The available tyres range from 255/55 R19 to 265/45 R21. Run-flat tyres are not available.

Depending on the country, the tyre mobility system or a temporary spare wheel are standard equipment. A temporary spare wheel (5.5Jx19 with 185/70-19 tyre) is available as an option if the vehicle is equipped with the tyre mobility system.
A jack is available as an option and if the vehicle is equipped with a temporary spare wheel.

The second generation of the Tyre Pressure Loss Indicator is standard equipment. The third generation of the tyre pressure monitoring system is available as an option. The system has the same construction and works in the same way as the system in the Audi Q7 (type 4M).
The aerial is integrated in the control unit and the unit is fitted on the underbody centrally behind the rear axle.

Standard wheels	Optional wheels		Winter wheels
			
Cast aluminium wheel Flow form 8.5J x 19 255/55 R19	Cast aluminium wheel Flow form 8.5J x 19 255/55 R19	Forged aluminium wheel 9.5J x 21 265/45 R21	Cast aluminium wheel Flow form[2)] 8.0J x 19 255/55 R19
			
	Cast aluminium wheel Flow form[1)] 9.0J x 20 255/50 R20	Forged aluminium wheel 9.5J x 21 265/45 R21	Cast aluminium wheel Flow form 9.0J x 20 255/50 R20
			
	Cast aluminium wheel Flow form 9.0J x 20 255/50 R20	Forged aluminium wheel 9.5J x 21 265/45 R21	

[1)] Standard wheel for the North American region
[2)] Compatible with snow chains

Electrics and electronics

Power supply

12 Volt electrical system

As can be seen in the illustration, the Audi e-tron is equipped with a 12 Volt battery and the wiring required for the 12 Volt electrical system. All control units work with a 12 Volt power supply. Just like all other Audi models, the Audi e-tron is therefore dependent on a functioning 12 Volt electrical system, even when its high-voltage battery is 100% charged.

Without an intact 12 Volt power supply, the vehicle cannot be opened using the central locking system, the ignition cannot be switched on, the drive system cannot be activated and no communication between the numerous control units can take place.

As the Audi e-tron does not, as a fully electric vehicle, have a combustion engine, it is also not fitted with an alternator in the traditional sense. The 12 Volt battery is charged from the high-voltage battery via the voltage converter while the vehicle is moving.

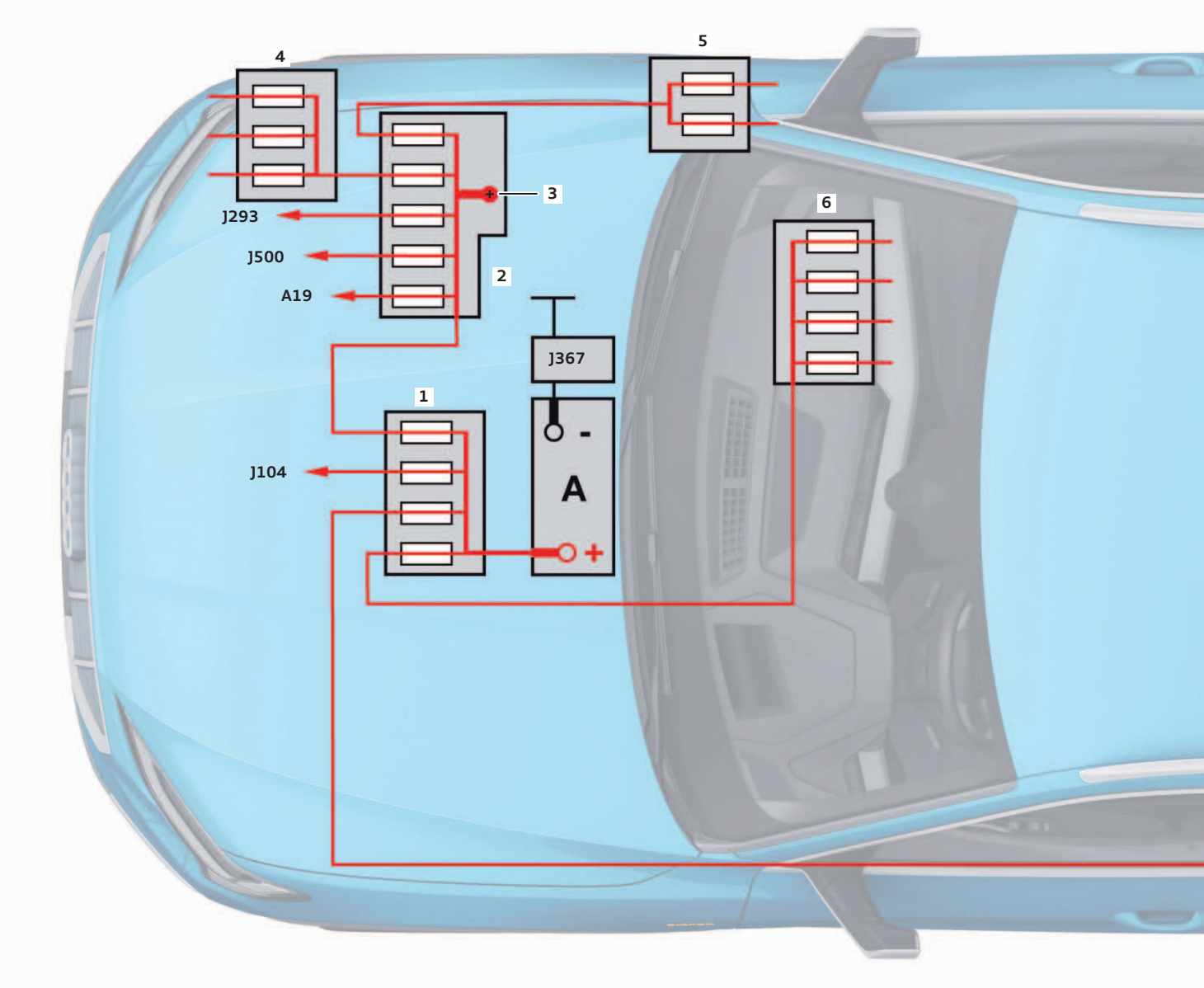
The 12 Volt battery is a lead battery and is fitted in the plenum chamber. It is an AGM battery with a capacitance of 68 Ah.

675_116

Power supply structure

This schematic diagram gives an overview of the 12 Volt power supply structure of the Audi e-tron (type GE).
For precise information on fuse and relay assignment and wiring routing, please refer to the applicable service literature.

The installation positions of the fuse and relay carriers are identical on left-hand drive and right-hand drive vehicles, with one exception. The fuse and relay carrier at number 6 on the diagram is always in the front passenger's footwell (on the right in a left-hand drive vehicle and on the left in a right-hand drive vehicle).



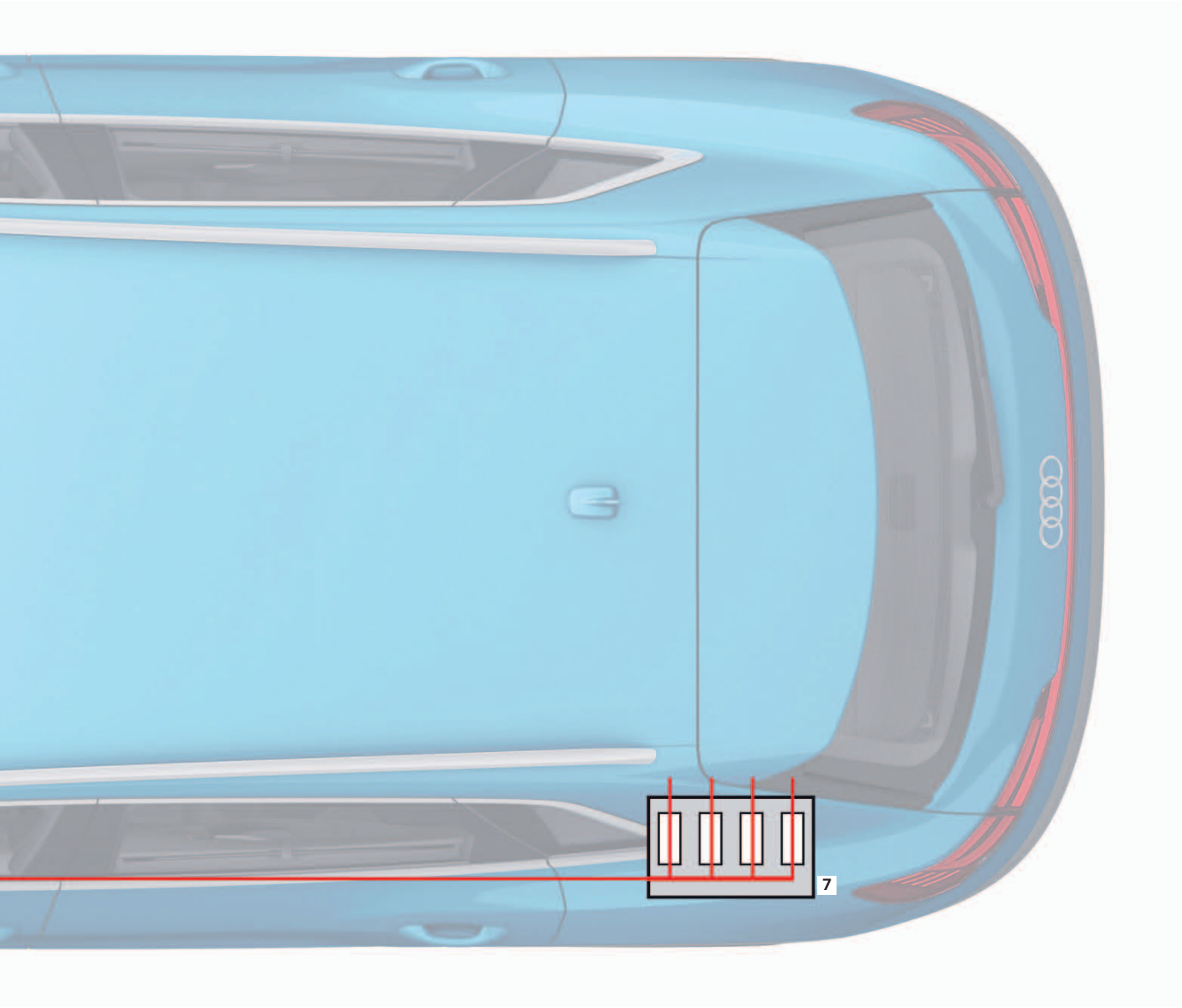
Key:

A	Battery
A19	Voltage converter
J104	ABS control unit
J293	Radiator fan control unit
J367	Battery monitor control unit
J500	Power steering control unit

1	Main fuse carrier 1 on 12 Volt battery
2	Main fuse carrier 2 in motor compartment (right-side)
3	12 Volt charging terminal (plus) in main fuse carrier 2
4	Fuse and relay carrier in motor compartment (right-side)
5	Fuse and relay carrier on lower section of right A-pillar
6	Fuse and relay carrier in front passenger's footwell
7	Fuse and relay carrier in luggage compartment (left-side)

Unlike on other Audi vehicles, the 12 Volt charging terminal on the Audi e-tron (type GE) is only intended for charging/buffering the 12 Volt battery in the workshop. Under no circumstances must this connection be used to jump-start another vehicle or maintain its battery power.

The Audi e-tron cannot be used if the 12 Volt battery is discharged. Because the 12 Volt battery is supported by the high-voltage battery, even when the vehicle is stationary, a discharged 12 Volt battery always means that the high-voltage battery is also discharged (approx. 10% remaining capacity).



675_117

Networking

Fitting locations of control units

Some of the control units shown in this overview are optional and/or country-specific equipment. For reasons of clarity, not all control units fitted in the vehicle can be shown here.

Refer to the current service literature for details of the exact control unit fitting locations, as well as instructions for installation and removal.

Key:

A19 Voltage converter
A27 Output module 1 for right LED headlight
A31 Output module 1 for left LED headlight

J104 ABS control unit
J136 Seat and steering column adjustment control unit with memory
J234 Airbag control unit
J245 Sliding sunroof adjustment control unit
J285 Control unit in dash panel insert
J345 Trailer detector control unit
J386 Driver door control unit
J387 Front passenger door control unit
J393 Convenience system central control unit
J428 Adaptive cruise control unit
J500 Power steering control unit
J502 Tyre Pressure Monitoring System control unit
J519 Onboard supply control unit
J521 Front passenger seat adjustment with memory control unit
J525 Digital sound package control unit
J527 Steering column electronics control unit
J533 Data bus diagnostic interface
J605 Rear lid control unit
J623 Motor control unit
J764 Control unit for electronic steering column lock
J769 Lane change assist control unit

A left-hand drive vehicle is shown in the illustration. Apart from a small number of exceptions, the fitting locations of the control units are identical for left-hand drive and right-hand drive vehicles. For example, the onboard supply control unit J519 is always fitted in the front passenger's footwell.

This means that J519 is fitted on the right side of a left-hand drive vehicle and the left side of a right-hand drive vehicle. The control units J136, J521, J386 and J387 also change their position accordingly.

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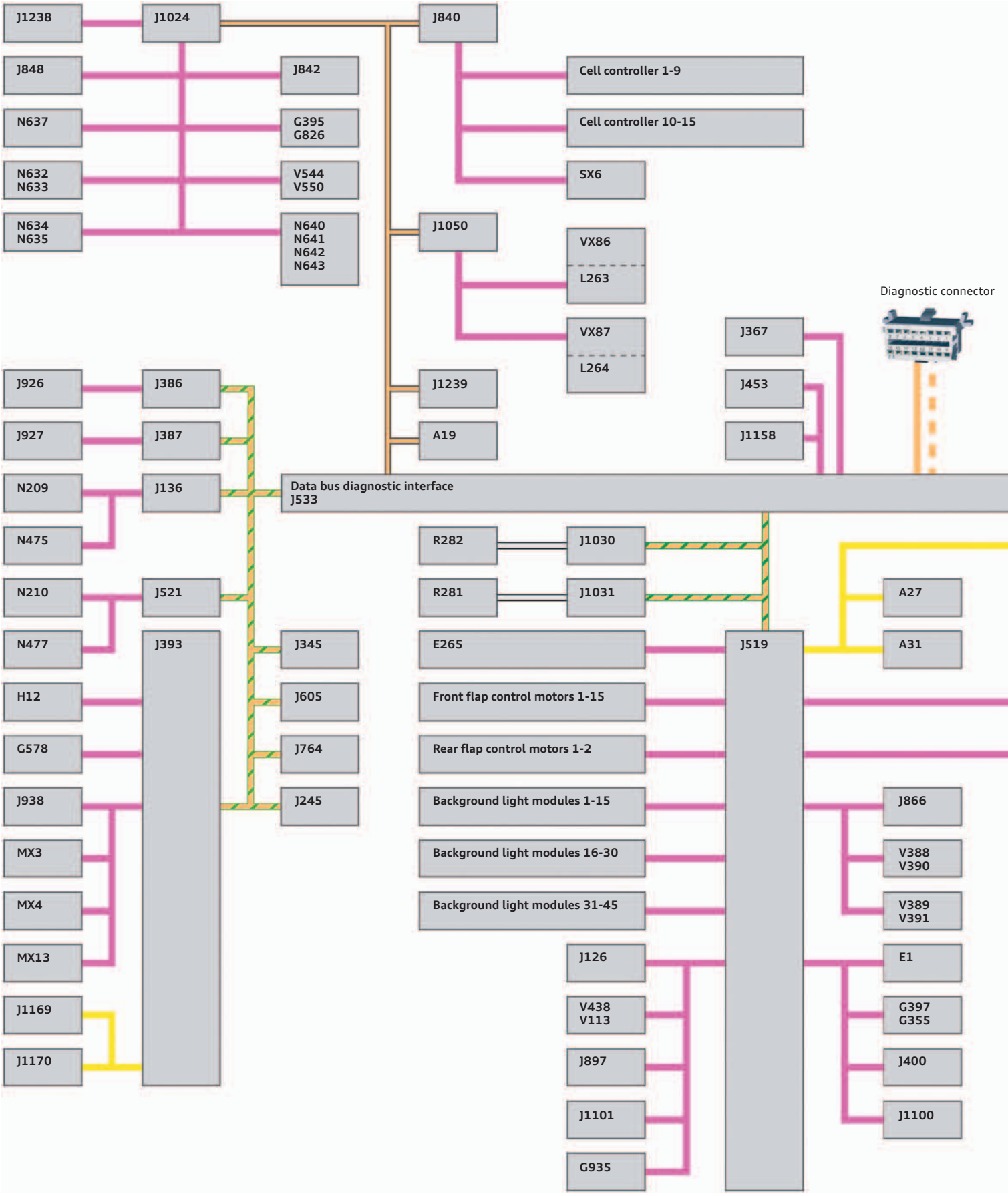
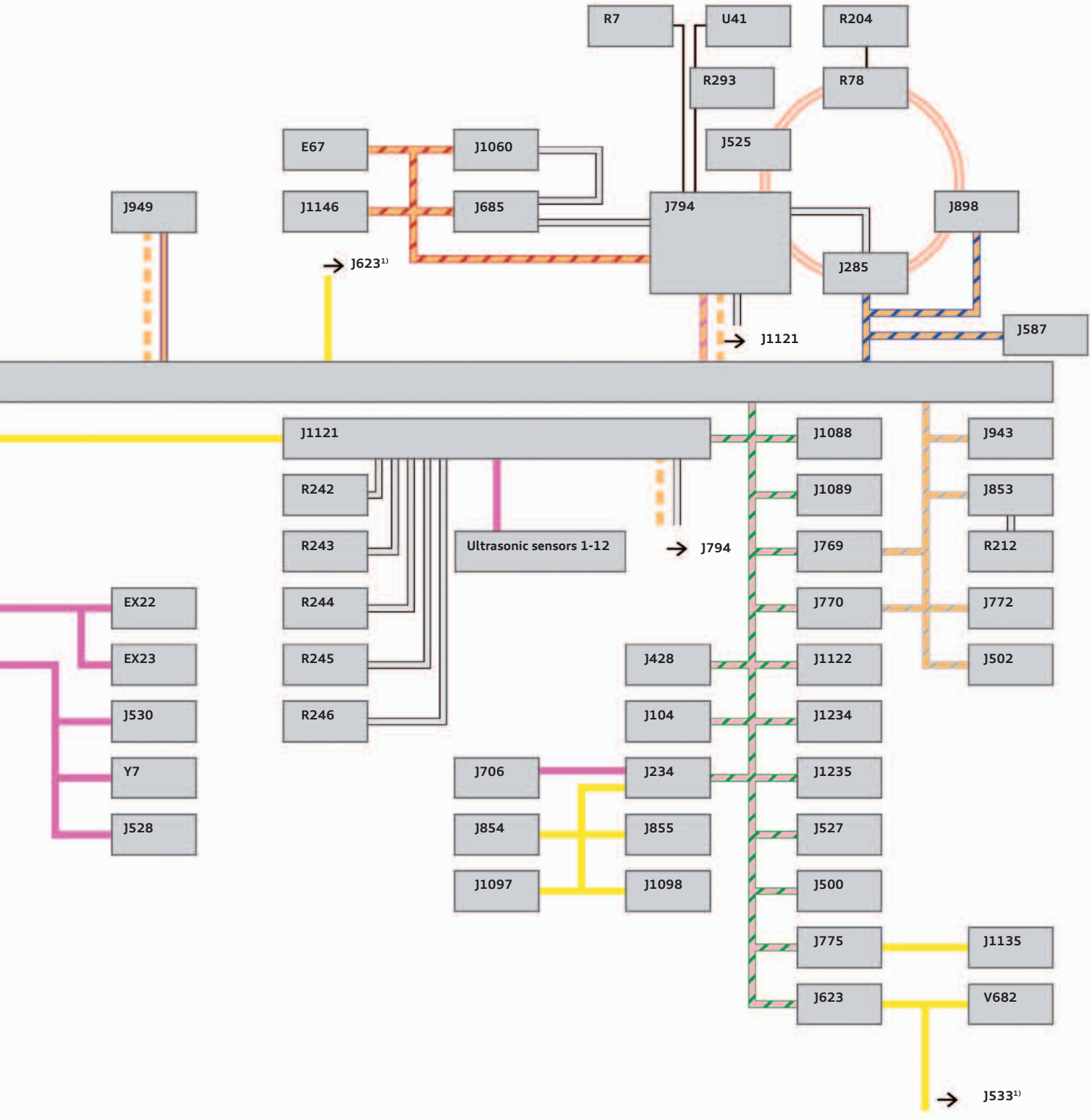
J770 Lane change assist control unit 2
J772 Reversing camera system control unit
J775 Running gear control unit
J794 Control unit 1 for information electronics
J840 Battery regulation control unit
J853 Control unit for night vision system
J898 Control unit for head-up display
J926 Rear driver side door control unit
J927 Rear passenger side door control unit
J943 Engine sound generator control unit
J949 Emergency call module control unit and communication unit
J1024 Thermal management control unit
J1030 Digital exterior mirror control unit 1
J1031 Digital exterior mirror control unit 2
J1050 Control unit for high-voltage battery charging unit
J1088 Front left radar sensor control unit for object detection
J1089 Front right radar sensor control unit for object detection
J1121 Driver assist systems control unit
J1122 Control unit for laser distance control
J1234 Electric drive control unit for front axle
J1235 Electric drive control unit for rear axle
J1239 Control unit for high-voltage battery charging unit 2

R78 TV tuner

Topology


J1238
J1024
J840
J848
J842
Cell controller 1-9
N637
G395
G826
Cell controller 10-15
N632
N633
V544
V550
SX6
N634
N635
N640
N641
N642
N643
J1050
VX86
L263
Diagnostic connector
VX87
L264
J367
J926
J386
J1239
J453
J927
J387
A19
J1158
N209
J136
Data bus diagnostic interface
J533
N475
R282
J1030
N210
J521
R281
J1031
A27
N477
J393
J345
E265
J519
A31
H12
J605
Front flap control motors 1-15
G578
J764
Rear flap control motors 1-2
J938
J245
Background light modules 1-15
J866
MX3
Background light modules 16-30
V388
V390
MX4
Background light modules 31-45
V389
V391
MX13
J126
E1
J1169
V438
V113
G397
G355
J1170
J897
J400
J1101
J1100
G935

Some of the control units shown in this overview are optional and/or country-specific equipment. The control units shown here relate to the equipment and motor versions available at the time of publication of this self-study programme.



675_119

[1] The sub-bus wire to the gateway is not used for data transfer. The gateway, like the motor control unit J623, accommodates a termination resistance of 120 Ω.

Key:

A19 Voltage converter
A27 Output module 1 for right LED headlight
A31 Output module 1 for left LED headlight

E1 Light switch
E67 Driver side volume regulator
E265 Operating and display unit for rear air conditioning system
EX22 Centre switch module in dash panel
EX23 Switch module 1 in centre console

G355 Humidity sender
G395 Refrigerant pressure and temperature sender 1
G397 Rain and light sensor
G578 Anti-theft alarm sensor
G826 Refrigerant pressure and temperature sender 2
G935 External air quality and air humidity sensor

H12 Alarm horn

J104 ABS control unit
J126 Fresh air blower control unit
J136 Seat and steering column adjustment control unit with memory

J234 Airbag control unit
J245 Sliding sunroof adjustment control unit
J285 Control unit in dash panel insert

J345 Trailer detector control unit
J367 Battery monitor control unit
J386 Driver door control unit
J387 Front passenger door control unit
J393 Convenience system central control unit

J400 Wiper motor control unit
J428 Adaptive cruise control unit
J453 Multifunction steering wheel control unit

J500 Power steering control unit
J502 Tyre Pressure Monitoring System control unit
J519 Onboard supply control unit
J521 Front passenger seat adjustment with memory control unit
J525 Digital sound package control unit
J527 Steering column electronics control unit
J528 Roof electronics control unit
J530 Garage door operation control unit
J533 Data bus diagnostic interface
J587 Selector lever sensors control unit

J605 Rear lid control unit
J623 Motor control unit
J685 MMI display

J706 Seat occupied recognition control unit
J764 Control unit for electronic steering column lock
J769 Lane change assist control unit
J770 Lane change assist control unit 2
J772 Reversing camera system control unit
J775 Running gear control unit
J794 Control unit 1 for information electronics

J840 Battery regulation control unit
J842 Control unit for air conditioning compressor
J848 High-voltage heater (PTC) control unit
J853 Control unit for night vision system
J854 Control unit for front left belt tensioner
J855 Control unit for front right belt tensioner
J866 Control unit for electrically adjustable steering column
J897 Control unit for air ionisation system
J898 Control unit for head-up display

J926 Rear driver side door control unit
J927 Rear passenger side door control unit
J938 Rear lid power opening control unit
J943 Engine sound generator control unit
J949 Emergency call module control unit and communication unit

J1024 Thermal management control unit
J1030 Digital exterior mirror control unit 1
J1031 Digital exterior mirror control unit 2
J1050 Control unit for high-voltage battery charging unit
J1060 Lower touch display
J1088 Front left radar sensor control unit for object detection
J1089 Front right radar sensor control unit for object detection
J1097 Control unit for rear left belt tensioner
J1098 Control unit for rear right belt tensioner

J1100 Windscreen washer pump control unit
J1101 Control unit for fragrance diffuser system
J1121 Driver assist systems control unit
J1122 Control unit for laser distance control
J1135 Adaptive suspension compressor electronics
J1146 Charging unit 1 for mobile devices
J1158 Control unit for steering wheel contact detection
J1169 Near field communication control unit
J1170 Near field communication control unit 2

J1234 Electric drive control unit for front axle
J1235 Electric drive control unit for rear axle
J1238 High-voltage heater 2 (PTC) control unit
J1239 Control unit for high-voltage battery charging unit 2

L263 LED module for charging socket 1
L264 LED module for charging socket 2

MX3 Left tail light
MX4 Right tail light
MX13 Centre tail light

N209 Lumbar support adjustment valve block on driver side
N210 Lumbar support adjustment valve block on front passenger side
N475 Valve block 1 in driver seat
N477 Valve block 1 in front passenger seat
N632 Coolant changeover valve 1
N633 Coolant changeover valve 2
N634 Coolant changeover valve 3
N635 Coolant changeover valve 4
N637 Refrigerant expansion valve 2
N640 Refrigerant shut-off valve 2
N641 Refrigerant shut-off valve 3
N642 Refrigerant shut-off valve 4
N643 Refrigerant shut-off valve 5

R7 DVD player
R78 TV tuner
R204 TV card reader
R212 Camera for night vision system
R242 Front camera for driver assist systems
R243 Front overhead view camera
R244 Left overhead view camera
R245 Right overhead view camera
R246 Rear overhead view camera
R281 Camera for left digital exterior mirror
R282 Camera for right digital exterior mirror
R293 USB hub

SX6 Switching unit for high-voltage battery

U41 USB connection 1

V113 Air recirculation flap control motor
V388 Driver seat backrest fan
V389 Front passenger seat backrest fan
V390 Driver seat cushion fan
V391 Front passenger seat cushion fan
V438 Fresh air flap control motor
V544 Radiator blind control motor
V550 Radiator blind control motor 2
V682 Parking lock actuator

VX86 Drive unit for charging socket 1 cover
VX87 Drive unit for charging socket 2 cover

Y7 Automatic anti-dazzle interior mirror

Bus systems

Bus system	Wire colour	Configuration	Data transfer rate
Convenience CAN		Electrical bus system	500 kbit/s
Convenience CAN 2		Electrical bus system	500 kbit/s
Extended CAN		Electrical bus system	500 kbit/s
Infotainment CAN		Electrical bus system	500 kbit/s
Modular infotainment matrix (MIB) CAN		Electrical bus system	500 kbit/s
Diagnostics CAN		Electrical bus system	500 kbit/s
Dash panel insert CAN		Electrical bus system	500 kbit/s
Hybrid CAN		Electrical bus system	500 kbit/s
FlexRay		Electrical bus system	10 Mbit/s
MOST bus		Fibre optic bus system	150 Mbit/s
LIN bus		Electric single wire bus system	20 kbit/s
Sub-bus system		Electrical bus system	500 kbit/s 1 Mbit/s
LVDS[1)]		Electrical bus system	200 Mbit/s
Ethernet		Electrical bus system	100 Mbit/s

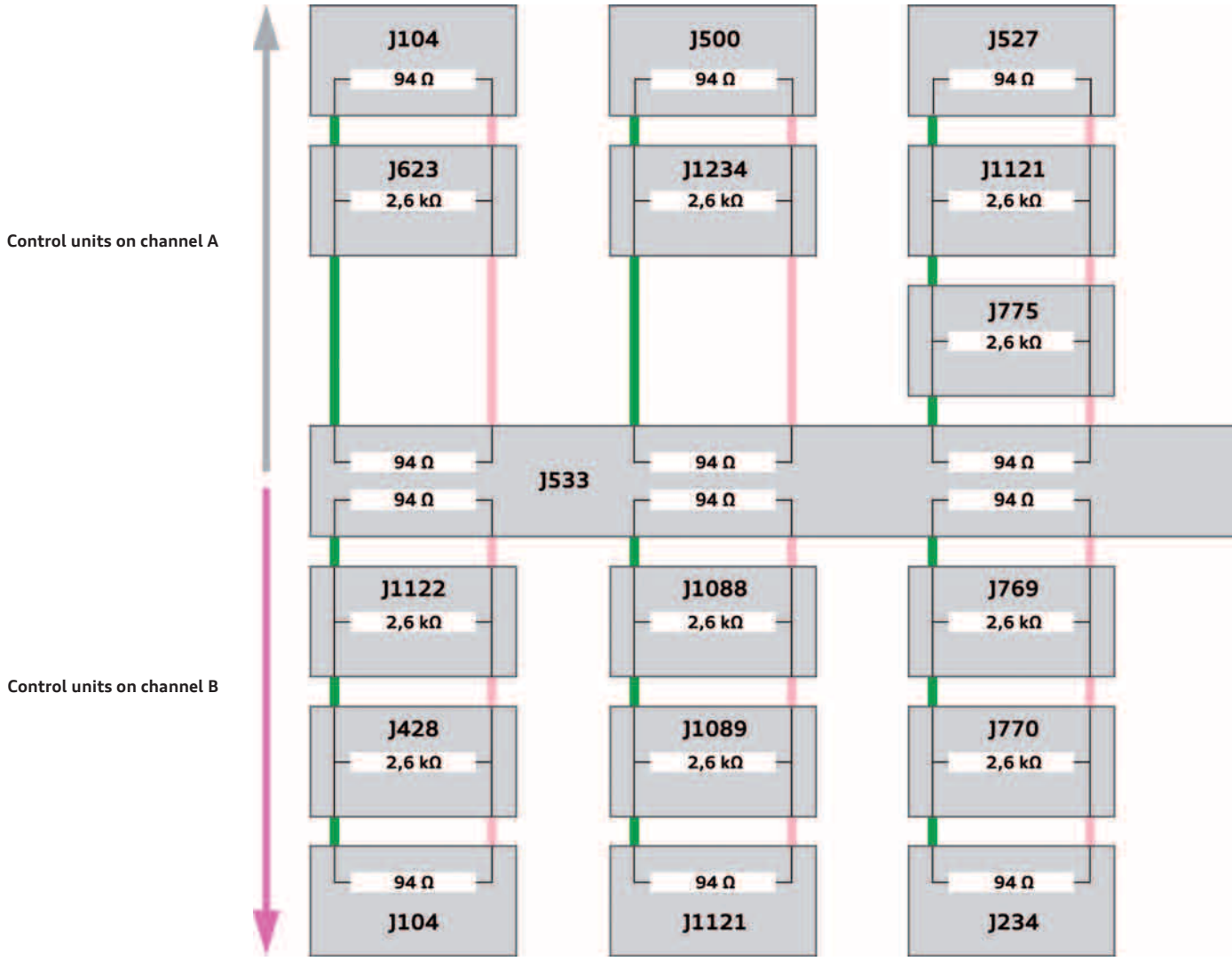
[1)] **LVDS** = **L**ow **V**oltage **D**ifferential **S**ignalling

FlexRay

As it is not possible to illustrate the allocation of the FlexRay control units realistically in the topology as a whole, the following images show the distribution of the control units on the individual FlexRay branches. All the control units of a fully equipped Audi e-tron (type GE) are shown here. As always with FlexRay, the control units connected at the end of a branch have a resistance of 94 ohms. The control units fitted in-between have a resistance of 2.6 kiloohms.

The FlexRay technology provides the opportunity to use two channels on one branch. Audi did this for the first time on the Audi A8 (type 4N). The two channels are designated using the letters “A” and “B”.

The second channel offers two main options:
- The data are sent as redundant data, or
- The amount of data transmitted is doubled.



The “B” channel on the Audi e-tron is used to increase the amount of data that can be transmitted. If the same control unit is connected to both channels, the diagnostic data of this control unit are transmitted via channel “A”. If one channel of a branch fails, for example due to a short circuit in the FlexRay wiring, the vehicle diagnostic tester also shows which channel is affected by the fault. This allows the specific control units/wiring to be checked accordingly.

As FlexRay is a time-controlled data transfer system, a start-up procedure (i.e. starting a network) may only be performed by “cold-start” control units.
On the Audi e-tron, these control units are:

- Data bus diagnostic interface J533
- ABS control unit J104
- Airbag control unit J234

Key:

J104 ABS control unit
J234 Airbag control unit
J428 Adaptive cruise control unit
J500 Power steering control unit
J527 Steering column electronics control unit
J533 Data bus diagnostic interface
J623 Motor control unit
J769 Lane change assist control unit
J770 Lane change assist control unit 2
J775 Running gear control unit
J1088 Front left radar sensor control unit for object detection
J1089 Front right radar sensor control unit for object detection
J1121 Driver assist systems control unit
J1122 Control unit for laser distance control
J1234 Electric drive control unit for front axle
J1235 Electric drive control unit for rear axle

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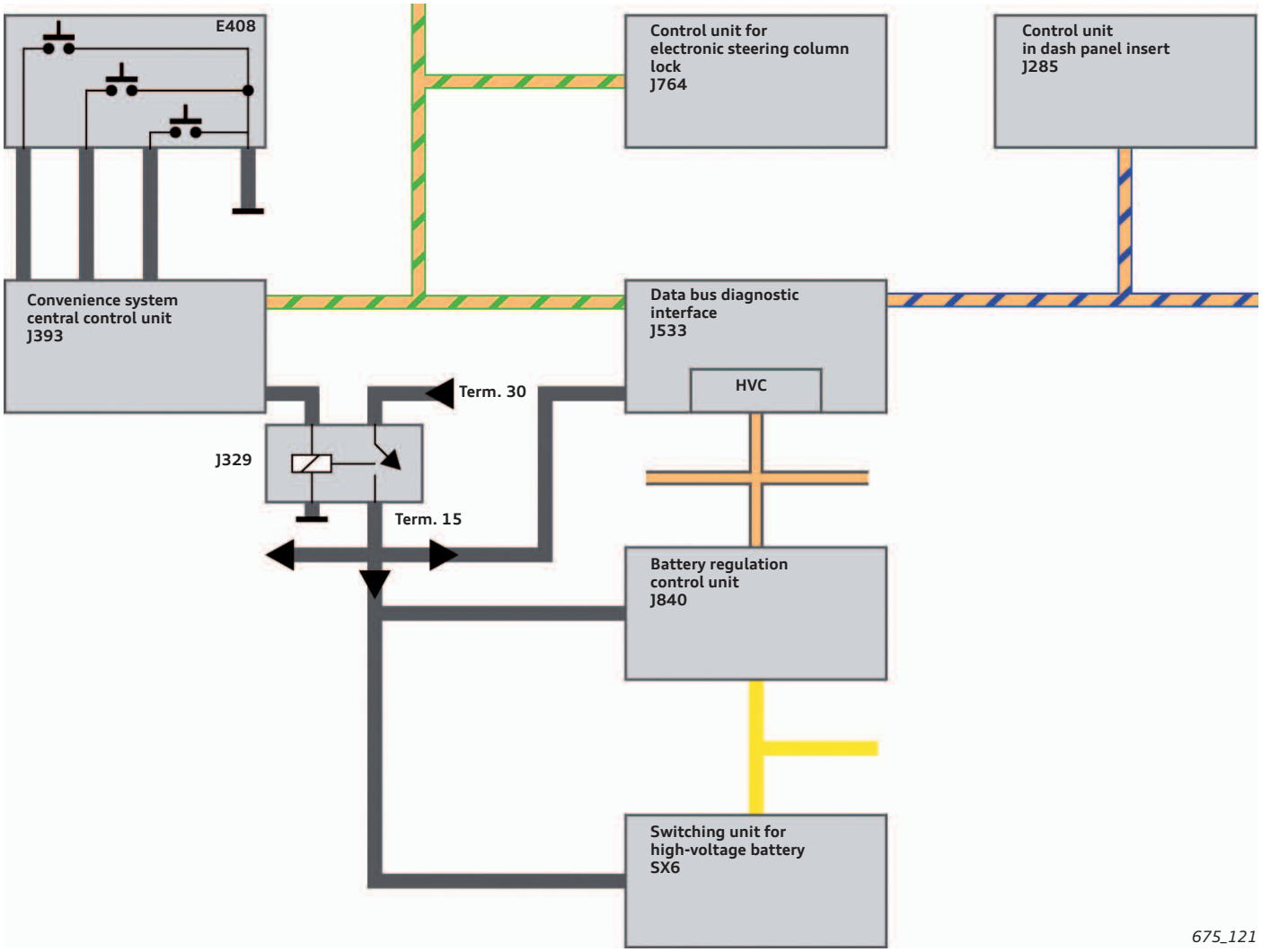
Terminal management

Terminal 15 active

Scenario:

1. Entry and start authorisation button E408 is pressed when terminal 15 is switched off.
2. The signal from the pressed button E408 is transmitted to the convenience system central control unit J393 via discrete wires.
3. J393 checks whether there is an authorised car key inside the vehicle. Steps 4 and 6 are performed while the key verification check is in progress.
4. A command to unlock the steering column is sent from J393 to the control unit for electronic steering column lock J764, which then releases the steering column lock.
5. J393 activates the terminal 15 voltage supply relay J329. The control units are now supplied with power via J329.
6. J393 sends a "virtual" terminal 15 signal to the data bus diagnostic interface J533 via the convenience CAN.
7. The high-voltage coordinator in J533 sends an activation message for the high-voltage system to the battery regulation control unit J840 via the hybrid CAN. J840 sends a signal via a sub-bus system instructing the switching unit for high-voltage battery SX6 to close the power contactors.

The high-voltage system then becomes active. From this point onward, the warning lamps in J285 are lit and the high-voltage battery is discharged.



Key:

E408 Entry and start authorisation button
J329 Terminal 15 voltage supply relay
HVC High-voltage coordinator

Convenience CAN
Hybrid CAN
Dash panel insert CAN
Sub-bus systems
Discrete wires

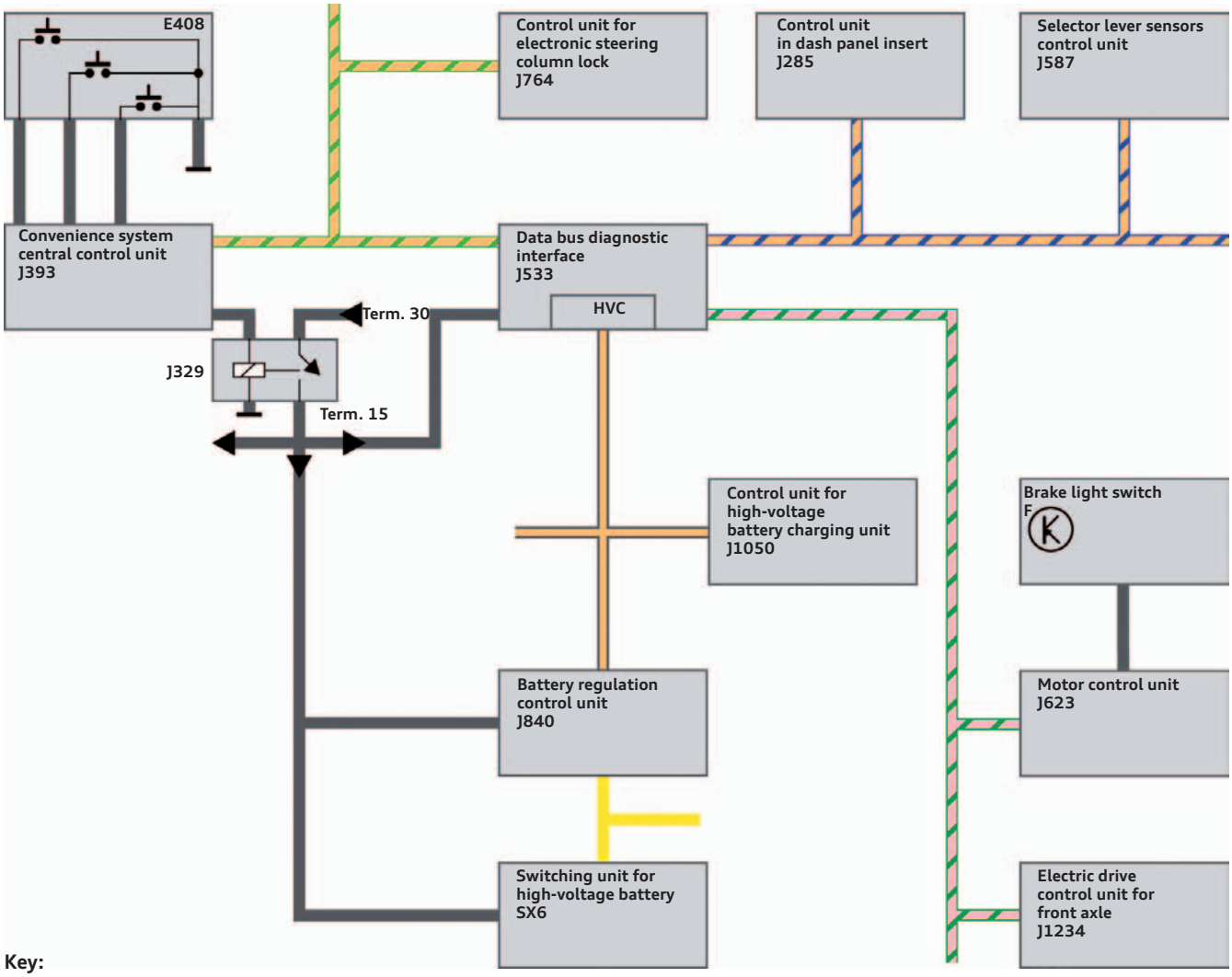
Activating the drive system

Scenario:

1. The entry and start authorisation button E408 and the brake pedal are pressed when terminal 15 is off.
2. The signal from the pressed button E408 is transmitted to the convenience system central control unit J393 via discrete wires.
3. J393 checks whether there is an authorised car key inside the vehicle. Steps 4 and 6 are performed while the key verification check is in progress.
4. A command to unlock the steering column is sent from J393 to the control unit for electronic steering column lock J764, which then releases the steering column lock.
5. J393 activates the terminal 15 voltage supply relay J329. The control units are now supplied with power via J329. The motor control unit J623 processes the signal from the brake light switch F.

The drive system is now activated and "READY" appears in the power meter.

6. J393 sends a "virtual" terminal 15 signal to the data bus diagnostic interface J533 via the convenience CAN. The high-voltage coordinator in J533 sends an activation message for the high-voltage system to the battery regulation control unit J840 via the hybrid CAN. J840 sends a signal via a sub-bus system instructing the switching unit for high-voltage battery SX6 to close the power contactors. At the same time, the high-voltage coordinator sends an activation message via FlexRay.
7. The motor control unit J623 checks whether the following signals are present:
   - "Brake pedal pressed" from brake light switch F
   - "Selector lever in position P or N" signal from selector lever sensors control unit J587
   - "No charging cable connected" signal from the control unit for high-voltage battery charging unit J1050
8. If these signals are present, J623 sends the "activate drive system" command to the electric drive control unit for front axle J1234 via FlexRay.



675_122

Key:

E408 Entry and start authorisation button
J329 Terminal 15 voltage supply relay
HVC High-voltage coordinator

Convenience CAN
Hybrid CAN
Dash panel insert CAN
FlexRay
Sub-bus systems
Discrete wires

Data bus diagnostic interface J533

Brief description

The data bus diagnostic interface J533 (gateway) is one of the standard control units and is therefore always fitted. On the Audi e-tron (type GE), it is fitted under the left seat. It can be reached via diagnosis address 0019 using the vehicle diagnostic tester.

The gateway performs the following functions:

- Network system gateway
- High-voltage coordinator
- Controller for FlexRay bus
- Diagnostic master
- Energy manager for low-voltage electrical system (12 Volt)
- Interface for various connect services

It is a node of the following data bus systems:

- Hybrid CAN
- Convenience CAN
- Convenience CAN 2
- Infotainment CAN
- Dash panel insert CAN
- Extended CAN
- Connect CAN
- FlexRay
- Diagnostics CAN
- Ethernet

It is not a node of:

- Modular infotainment matrix (MIB) CAN
- MOST bus

It is the LIN master for:

- J367 Battery monitor control unit
- J453 Multifunction steering wheel control unit
- J1158 Control unit for steering wheel contact detection

Special feature:

- The gateway manages the diagnostic firewall.

Data bus diagnostic interface J533

675_123

Onboard supply control unit J519 (BCM1)

Brief description

As on many other vehicles, the onboard supply control unit J519 is one of the main control units in the Audi e-tron. The tasks of J519 include reading in numerous sensors and activating actuators, the exterior lights and the wipers. Numerous integrated functions, such as the park assist or the activation of the seat heating, are also implemented in the onboard supply control unit.
As on the Audi A8 (type 4N), the onboard supply control unit J519 also activates the air conditioning on the Audi e-tron. J519 is accessible using diagnostic address 0009. This also applies to the diagnosis functions of the air conditioner components.

The onboard supply control unit is a node of convenience CAN 2. In addition, it is connected to the driver assist systems control unit J1121 and the output modules for the headlights (output module 1 for headlight) via a private CAN. J519 is also the master control unit for numerous LIN slaves.

Special feature:
The interior lighting modules of the background lighting and the air conditioner control motors can be connected both as a LIN series or parallel on the corresponding LIN branch. This must be noted when performing fault finding.

The onboard supply control unit performs the following functions:

- Exterior lighting master
- Interior lighting master
- Diagnostic gateway for the light control units

Integrated functions:
- Parking
  - Parking aid
  - Park assist
- Background lighting
  - Activating the interior light modules
- Climate control

675_124

Onboard supply control unit J519

Fitting location:

The onboard supply control unit J519 is always fitted in the front passenger's footwell directly next to the fuse and relay carrier. It is therefore one of the few control units which are fitted in a different location on left-hand drive and right-hand drive vehicles.
The same applies to the fuse and relay carrier.

Convenience electronics

The vehicle networking system of the Audi e-tron (type GE) for convenience electronics is based on the network architecture of the MLBevo generation 2 platform. The vehicle features the two bus systems convenience CAN and convenience CAN 2 known from previous models.

New additions are the optional virtual exterior mirrors on which the image from a camera is visualised on a monitor in the relevant door trim.

The following convenience equipment/control units are available for the Audi e-tron and are nodes of the vehicle networking system, some directly via the convenience system central control unit J393 and others via the convenience CAN and convenience CAN 2 data bus systems.

- J345 Trailer detector control unit
- J136 Seat and steering column adjustment control unit with memory
- J521 Front pass. seat adjustment with memory control unit
- J605 Rear lid control unit
- J245 Sliding sunroof adjustment control unit
- J393 Convenience system central control unit
- J1030 Digital exterior mirror control unit 1
- J1031 Digital exterior mirror control unit 2
- J1169 Near field communication control unit
- J1170 Near field communication control unit 2
- J938 Rear lid power opening control unit
- J764 Control unit for electronic steering column lock

Further partially optional convenience features are:

- Anti-theft alarm system (may have safelock function depending on country)
- Background lighting (with the three PR numbers: QQ0, QQ1 and QQ2 known from previous models)
- Audi connect key
- Head-up display
- Garage door opener
- Opening/closing rear lid electrically with foot gesture
- Convenience key
- Massage function for front seats
- Seat ventilation

675_222

Convenience system central control unit J393

The convenience system central control unit J393 is fitted on the left side as seen in the direction of travel. It is behind the luggage compartment side trim (left side), as on the various Q models.

On the Audi e-tron, the convenience system central control unit J393 is integrated in the vehicle in a standing position using a bracket.

The convenience system central control unit J393 has the following master functions:

- Central locking system master
- Immobiliser master

It is the LIN master for:

- J505 Heated windscreen control unit
- G578 Anti-theft alarm sensor
- H12 Alarm horn
- J938 Rear lid power opening control unit
- Tail lights MX3, MX4, MX13

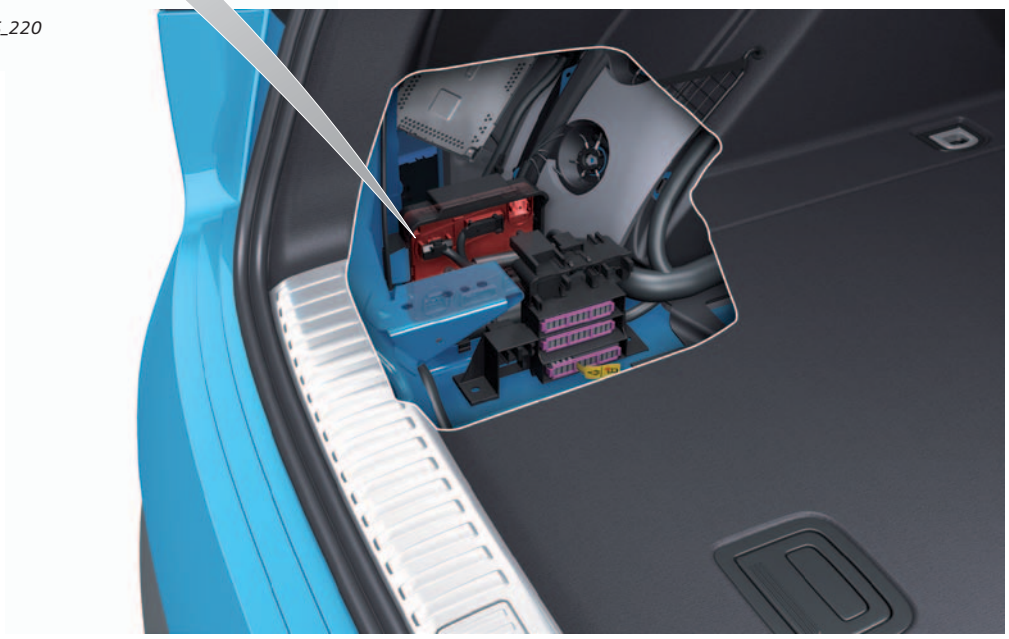
Both near field communication control units are connected to J393:

- J1169 Near field communication control unit
- J1170 Near field communication control unit 2

Convenience system central control unit J393

675_220

The J393 hardware is used on all vehicle models with MLBevo architecture.



675_219

Reference
For further information about the convenience system central control unit J393, refer to self-study programme 664 “Audi A8 (type 4N) Electrics and electronics”.

Virtual exterior mirrors

The Audi e-tron (type GE) can be ordered with virtual exterior mirrors as optional equipment. The PR number is PAF.

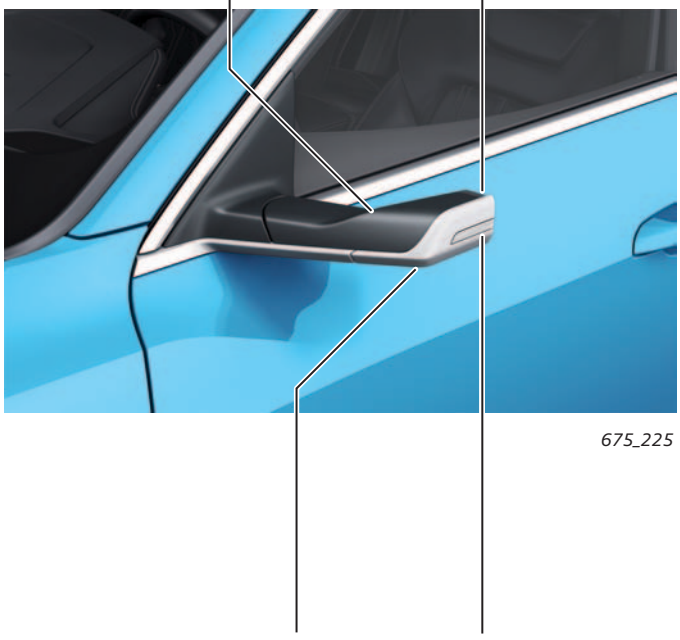
They are significantly smaller than the standard exterior mirrors. Thanks to their new form, they reduce both aerodynamic drag (improve the drag coefficient) and the already low levels of wind noise (improve aerodynamic acoustics). A small camera is integrated in each of the flat carriers. The images captured appear on OLED displays at the transition between the dash panel and the door.

The virtual exterior mirrors can be adjusted for different driving situations. If a turn signal is activated or a lane change/exit warning is shown, this can be indicated at the edge of the display.

The virtual exterior mirrors cannot be switched on/off separately. When the vehicle is unlocked, the digital exterior mirror control units J1030 and J1031 are started up. As soon as the driver's door or front passenger's door is opened in the next step, the image from the camera is shown on the displays for a specified period. The image from the camera is shown permanently when the ignition is switched on.
The system continues to display the image from the camera for approximately two minutes after the ignition is switched off. The system shuts down as soon as the vehicle is locked.

Additional settings, e.g. for the brightness of both displays, can be made via an MMI menu.
Various view settings are available if desired:

- The kerb view - the field of vision shown is extended downwards and enlarged
- The intersection view - the blind spot is reduced on the side of a turn-off manoeuvre during the manoeuvre
- The motorway view - improved view on motorways thanks to camera zooming



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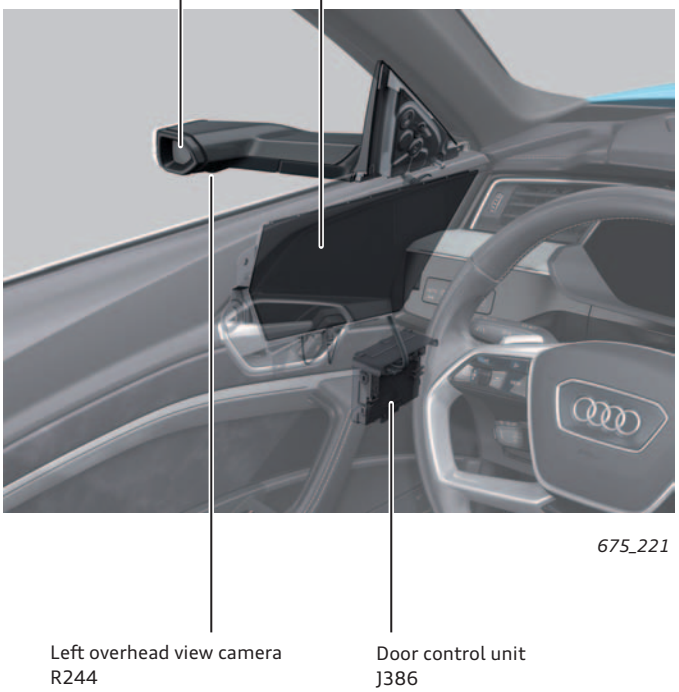


675_221

Electric connections of virtual exterior mirrors

The virtual exterior mirrors – digital exterior mirror control unit 1 J1030 (right virtual exterior mirror) and digital exterior mirror control unit 2 J1031 (left virtual exterior mirror) – are nodes in the convenience CAN 2 data bus.

The two virtual exterior mirror control units form a unit with the two displays in the door trim. J1030 with R284 and J1031 with R283 form one component assembly each.

The two control units can be reached at the following diagnostic addresses:

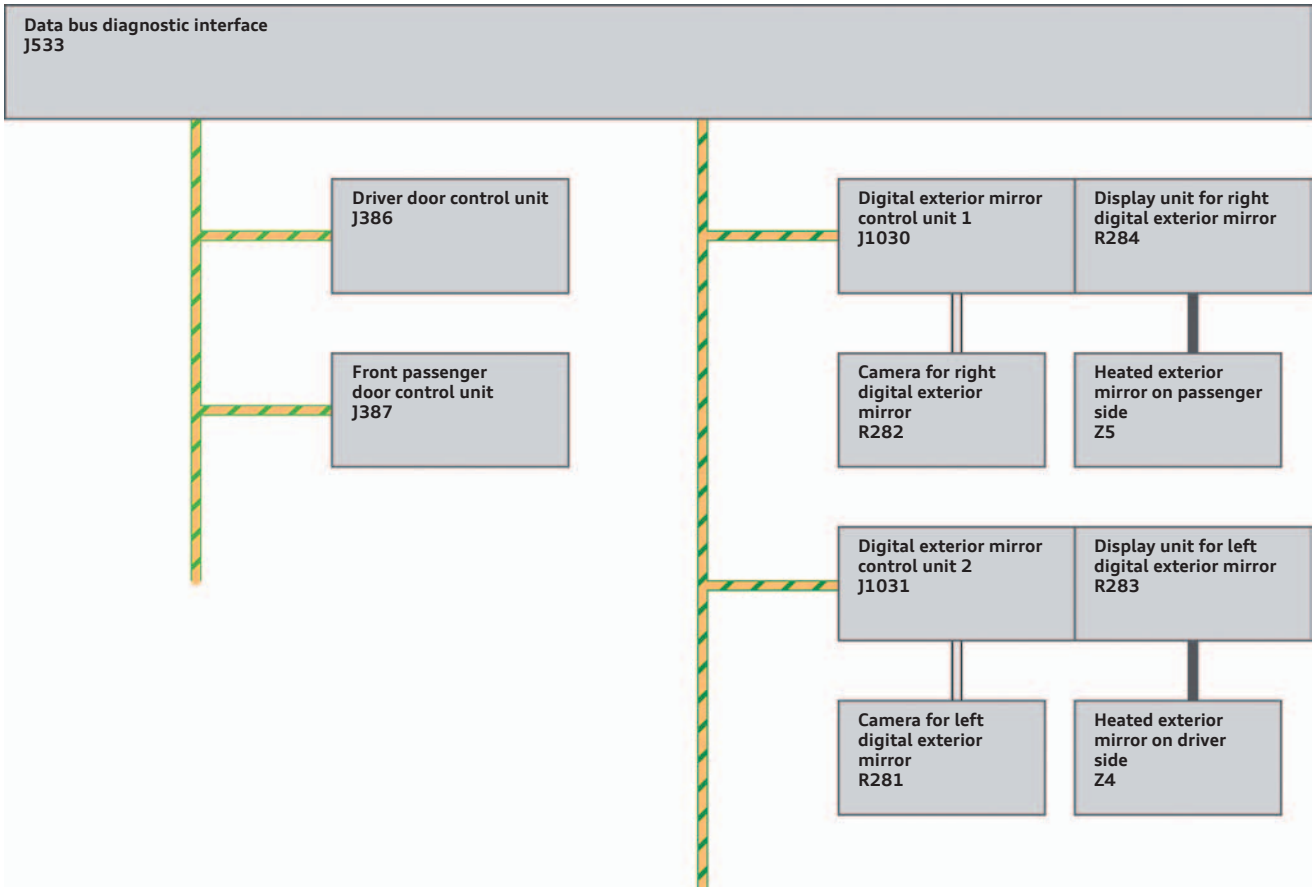
- J1030 Diagnostic address 8111
- J1031 Diagnostic address 8112

The virtual exterior mirrors are still equipped with the function to electrically heat the two cameras R282 and R281. Unlike for the heating function for conventional exterior mirrors, the camera heating is activated automatically.
This happens depending on the outside temperature, whether the wipers or the rear window heating are on, or if the mirrors detect dirt. The heating works in the same way as on conventional exterior mirrors. According, for example, to the outside temperature, the heating is initially actuated at 100 %. After a programmed heating period, the actuation of the heating output is reduced.

Both overhead view cameras (left overhead view camera R244 and right overhead view camera R245) are integrated in the housings of both virtual exterior mirrors.

In addition, both side turn signals (left/right turn signal repeater bulb M18/M19) are integrated in the mirror housing.

Networking diagram



Key:

Convenience CAN

Convenience CAN 2

LVDS

Discrete wires

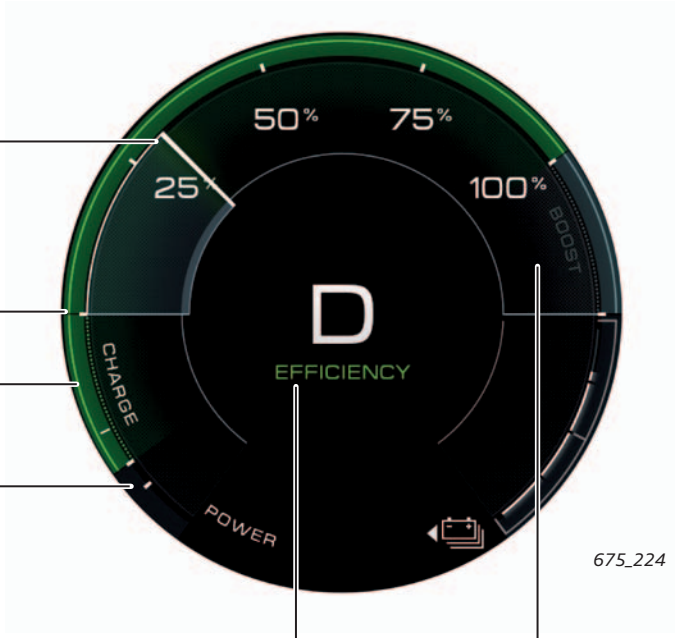
675_027

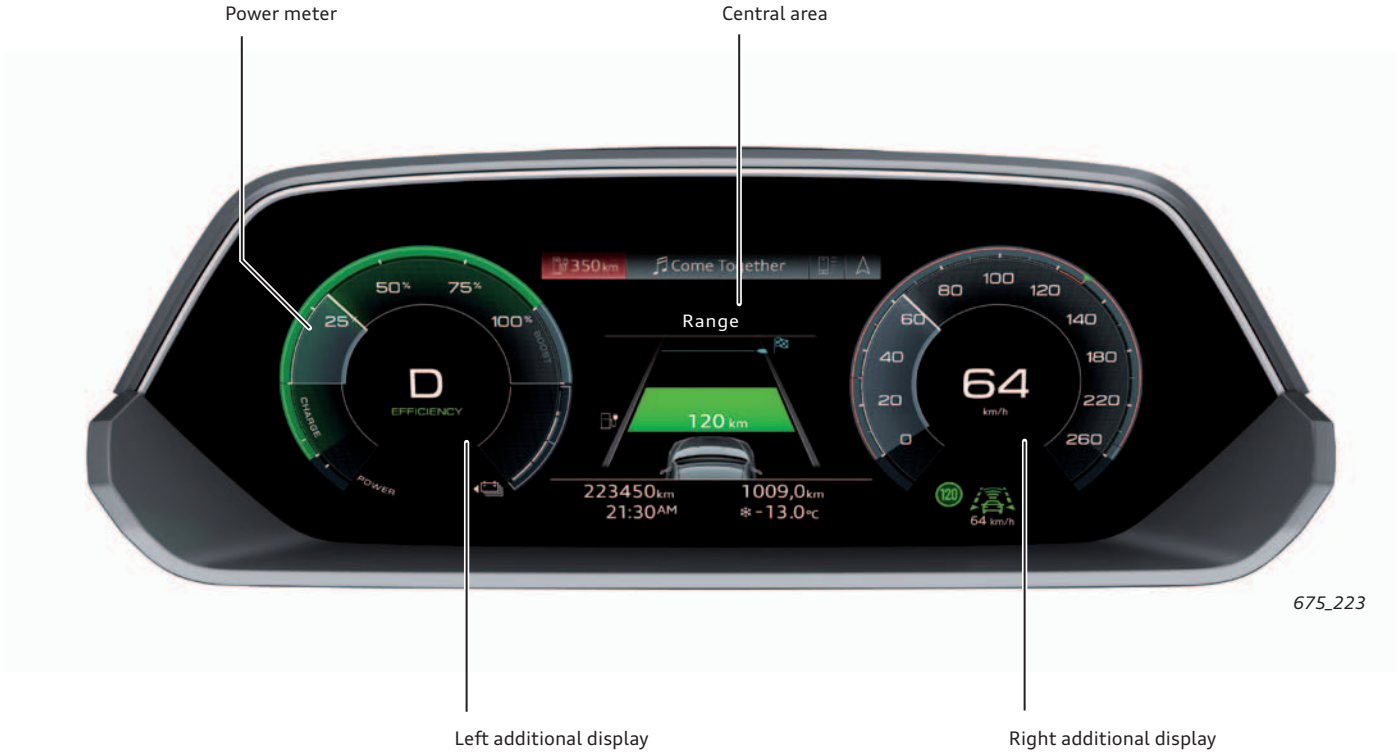
Control unit in dash panel insert J285

The Audi e-tron (type GE) has a virtual cockpit as standard. The Audi virtual cockpit (PR number 9S8) is a fully digital 12.3” instrument cluster which displays the relevant information flexibly according to the driver’s needs.
Information is organised in various tabs in the instrument cluster. The contents of the tabs are shown in the central area. Audi virtual cockpit settings can be changed using the buttons and thumbwheel on the left side of the multi-function steering wheel.
It may be possible to select different additional displays depending on the vehicle equipment.

The Audi virtual cockpit plus (PR number 9S9) is available as an option. It is also a fully digital 12.3” instrument cluster and has an additional more sporty view/presentation of the display content (in addition to the regular instrument displays).

The power meter replaces the rev counter.
The driver receives feedback on the load on the drive system via the power meter. Its pointer shows the current load and a coloured border shows how much of the drive system capacity can currently be utilised.
The coloured borders may vary depending on the driving program selected and the electrical power currently available.





Motor control unit J623

The motor control unit J623 is fitted in the A-pillar (left-side) and is a FlexRay node. The accelerator pedal module GX2 is connected to the motor control unit and the parking lock actuator V682 is connected via a sub-CAN. The motor control unit receives information on the transmission position selected from the selector lever sensors control unit J587 via the dash panel insert CAN.

The battery regulation control unit J840 uses the hybrid CAN to send information to the motor control unit regarding the charge level of the high-voltage battery and current limitations.

Based on both this information and the position of the accelerator pedal module GX2, the motor control unit J623 transmits the rotational speed and torque specifications for electric driving and recuperation to the front and rear three-phase current drives via FlexRay.

If the driver presses the brake pedal, the motor control unit is informed of this by J104 via FlexRay.

According to the recuperation setting, the braking power is split between the three-phase current drives and the vehicle's service brakes.

The recuperation capacity is reduced as the speed drops. It is not possible to brake the vehicle to a stop without the service brakes.

The level of recuperation is shown on the power meter in the CHARGE section of the dial.

The driver can set the recuperation capacity via the paddle levers on the steering wheel.

Motor control unit J623

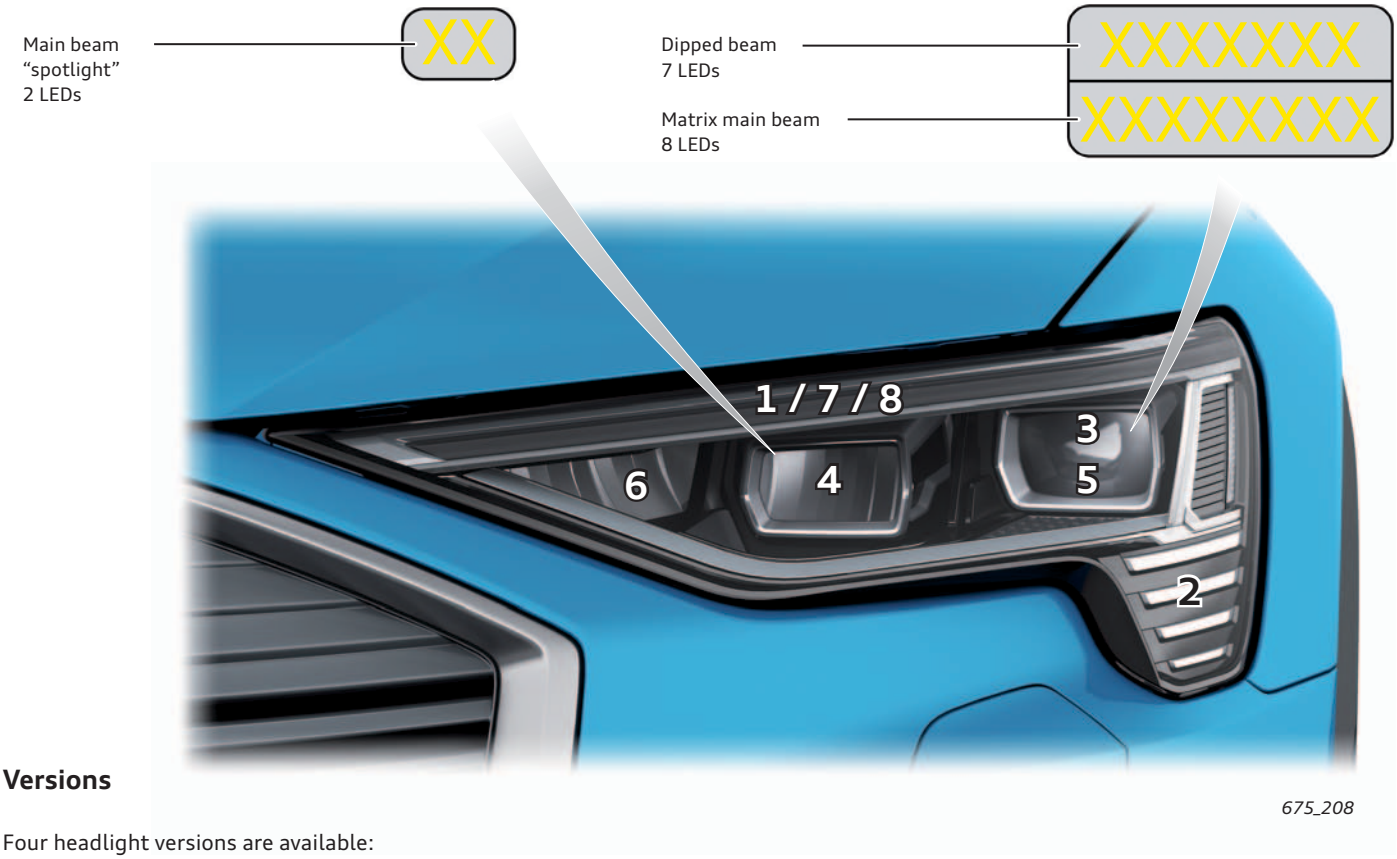
675_207

Exterior lighting

Headlights

Seen from a technical perspective, the headlights on the Audi e-tron (type GE) are matrix LED headlights. These headlights are sometimes also known as smart matrix LED headlights because the LEDs for the dipped beams and the LEDs for the matrix main beams are fitted in one projection module. The one-row matrix main beam is generated by eight LEDs per headlight.

According to the traffic situation detected, individual LEDs can be switched off individually to avoid dazzling vehicles ahead or oncoming vehicles. A main beam “spotlight”, consisting of two LEDs per headlight, supports the main beams. The main beam “spotlight” also works as a matrix segment (if the vehicle has the corresponding equipment, e.g. 8G4) and is switched on and off according to the traffic situation.



Versions

Four headlight versions are available:

- PR number 8G0: LED headlights without light assist
- PR number 8G9: LED headlights with preparation for additional lighting functions
- PR number 8G1: LED headlights with main beam assist
- PR number 8G4: Matrix LED headlights with dynamic lighting and dynamic turn signals at front and rear

Lighting functions

Light functions with PR no.: 8G9

- Daytime running light (1)
- Marker light (1)
- Dipped beam (3)
- Main beam (4 + 5)
- Static turn signal (7)
- Coming/leaving home (3)
- Manoeuvring light (3 + 6), when reverse gear is selected
- All-weather light (6)
- Side marker light (SAE only[1)], not illustrated)

Light functions with PR no.: 8G1

- Daytime running light (1)
- Marker light (1)
- Signature light (2), operated together with daytime running light/marker light
- Dipped beam (3)
- Main beam/main beam assist (4 + 5), function only main beams on/off
- Static turn signal (7)
- Coming/leaving home (3)
- Manoeuvring light (3 + 6), when reverse gear is selected
- All-weather light (6)
- Side marker light (SAE only[1)], not illustrated)

[1)] SAE = for the North American market

Light functions with PR no.: 8G9

- Daytime running light (1)
- Marker light (1)
- Signature light (2), operated together with daytime running light/marker light
- Dipped beam (3)
- Main beam (4 + 5)
- Static turn signal (7)
- Coming/leaving home (3) with dynamic activation/deactivation of marker light and tail light
- Manoeuvring light (3 + 6), when reverse gear is selected
- All-weather light (6)
- Side marker light (SAE only[1)], not illustrated)

Light functions with PR no.: 8G4

- Daytime running light (1)
- Marker light (1)
- Signature light (2), operated together with daytime running light/marker light
- Dipped beam (3)
- Matrix beam main beam (4 + 5)
- Dynamic turn signal (8)
- All-weather light (6)
- Dipped beam (6)
- Intersection light (6)
- Coming/leaving home (3) with dynamic activation/deactivation of marker light and tail light
- Motorway light (3), dipped beam light raised by headlight range control
- Synthetic cornering light
- Intersection light (6) (in combination with navigation system)
- Manoeuvring light (3 + 6), when reverse gear is selected
- Side marker light (SAE only[1)], not illustrated)

Coming home/leaving home function

The dipped beam headlights are switched on for the entry/exit lights on Audi e-tron vehicles equipped with PR numbers 8G0 or 8G1.

Coming home/leaving home function with dynamic activation/deactivation

On Audi e-tron vehicles with PR number 8G9 or 8G4, the entry/exit lighting involves the dipped beam being switched on as well as dynamic activation/deactivation of the marker light and the tail light, with the marker light and tail light LEDs being activated/deactivated at different moments.

Adjusting headlights for driving on other side of road

It is not necessary to adjust the headlights. The legal requirements are met without additional measures. When driving on motorways, the dipped beam headlights setting should be set at the light switch.

This stops the light level from being raised by the headlight range control and thereby prevents you from dazzling oncoming road users.

Headlight range adjustment

All headlight versions on the Audi e-tron are equipped with automatic dynamic headlight range adjustment.

Equipment

The matrix LED headlights on the Audi e-tron are equipped with a headlight washer system as standard.

Service/repairs

The control units fitted on the headlight housings, the control motors for the headlight range control and the LED modules for the daytime running lights and signature lighting can be renewed in the event of a fault.
In the event of damage to the upper and inner headlight attachments, repair tabs can be attached to the headlight housing.

Service/adjustment and calibration

As on all headlights in Audi vehicles, the dipped beams are adjusted using two adjuster screws. However, the matrix beam main beams on the Audi e-tron are not calibrated by measuring a reference segment. On the headlights of the Audi e-tron, the inflection point of the dipped beam is measured. These values are entered in the test program of the diagnostic tester and the correction value for the matrix beam main beams is calculated.

Note
The headlight versions available vary from market to market. This is not the topic of the descriptions on these pages.

A new light switch and thereby a new operating concept was introduced with the Audi A8 (type 4N). This concept is also used for the Audi e-tron. The operating concept allows, for example, the dipped beam headlights and the daytime running lights to be switched off at speeds below 10 km/h. If this speed is exceeded, the light switch changes to the “AUTO” position. Furthermore, the light switch is always in the “AUTO” position after the ignition has been switched off and on again, regardless of what was selected prior to the ignition being switched off.

Tail lights

The tail lights on the Audi e-tron (type GE) are in three sections; one tail light each on the left and right sides and a light unit which covers the entire width of the boot lid.

Only LED lights are used. The tail lights are activated by the convenience system central control unit J393.

Rear fog light

The rear fog light function has been moved to the bumper on the Audi e-tron. The fog light is fitted on one side only; the side nearest the centre of the road. On left-hand drive vehicles, this means that the rear fog light is on the left of the bumper cover and a reflector is on the opposite side. On right-hand drive vehicles, the opposite is true.

675_209

High-level brake light

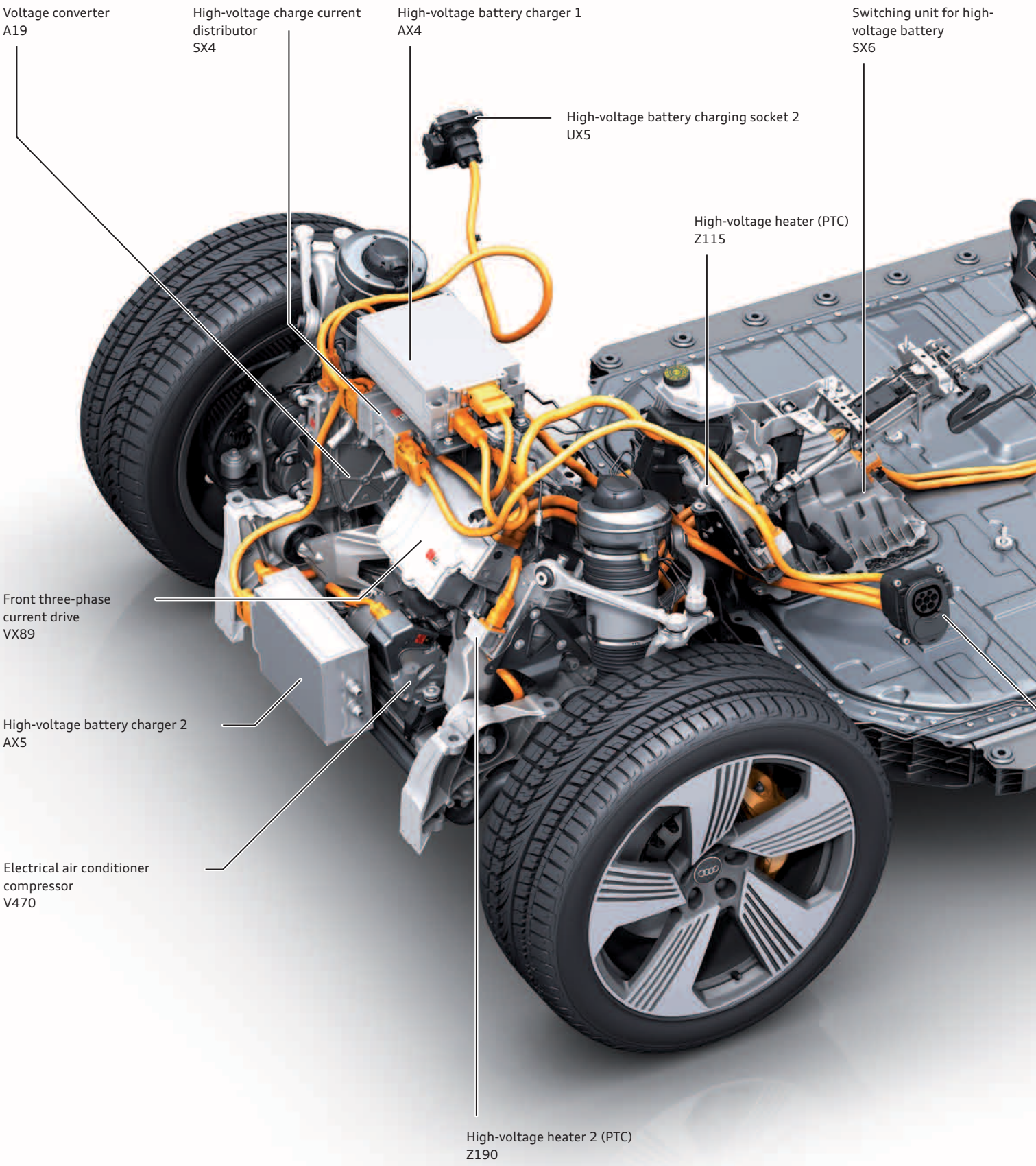
On the Audi e-tron, the high-level brake light is integrated in the rear spoiler. It is not possible to renew individual LEDs.

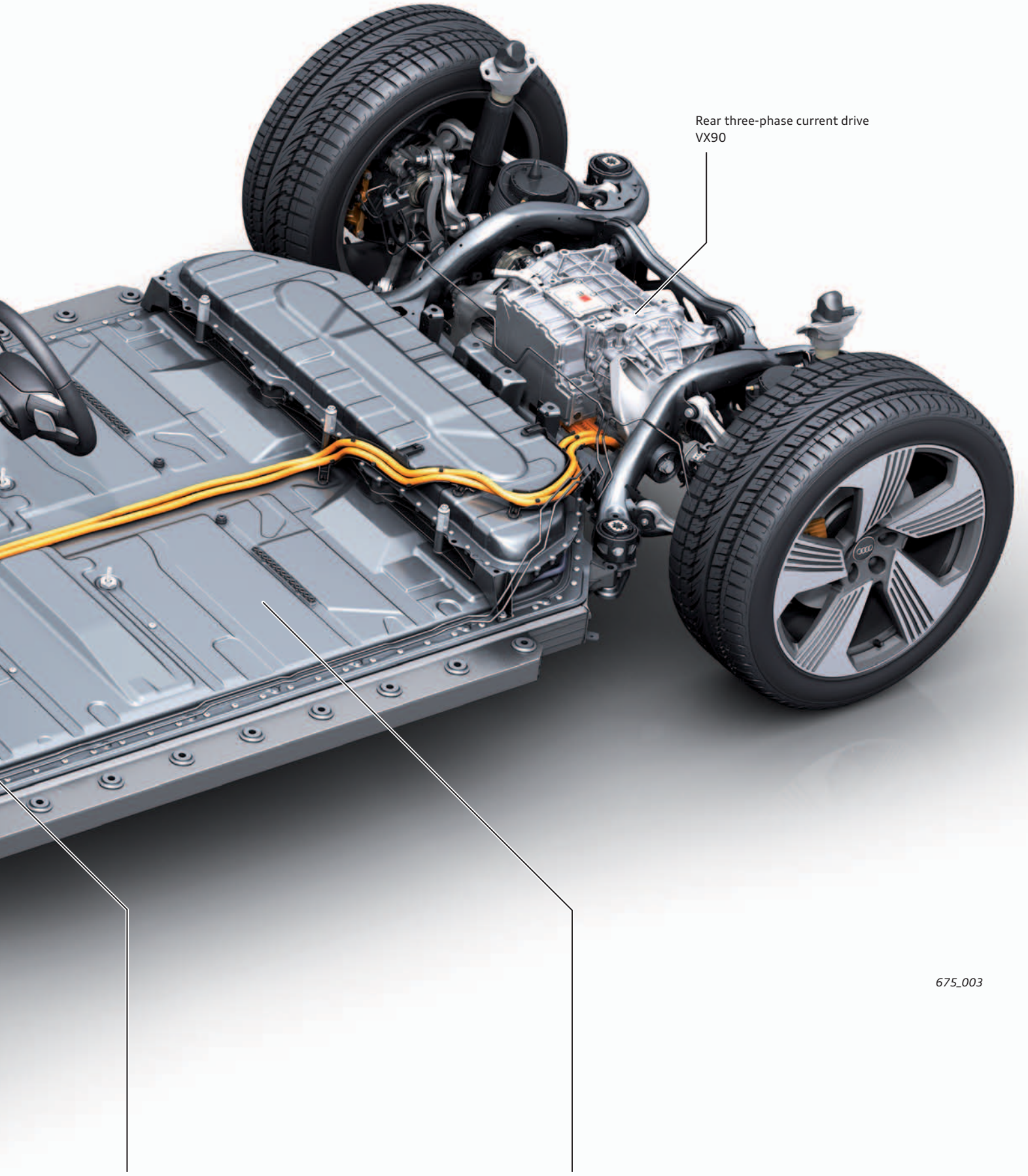
Lighting functions in the tail lights

The tail light, turn signal and brake light functions are split between the three tail light sections. The reversing light is fitted in the tail light cluster on the rear lid on both sides.
On Audi e-tron vehicles equipped with PR number 8G4, dynamic turn signals in addition to dynamic activation of the tail lights are included in the tail light functions.

High-voltage system

Overview of the high-voltage components




Rear three-phase current drive
VX90
675_003
High-voltage battery charging socket 1
UX4
High-voltage battery 1
AX2

Safety regulations

Direct current of up to approx. 450 Volts is present in the high-voltage system.

Please note:
The high-voltage system may also be energised when the vehicle is parked.

For example:
- When the high-voltage battery is being charged.
- When auxiliary air conditioning is active.
- When the 12 Volt battery is being recharged by the high-voltage battery.

Work on components of the vehicle's high-voltage system must only be performed when the system is not energised.

To achieve this, the high-voltage system must be de-energised and the mechanic must then check that the system is de-energised.

The de-energisation procedure is performed according to the five safety rules for electrical technology.

These three work steps must be performed.

1. **De-energise the system**
2. **Ensure the system cannot be reactivated**
3. **Check that no voltage is present**

These two work steps are not relevant for high-voltage vehicles.

4. **Ground and short-circuit vehicle**
5. **Cover or shield adjacent live components**

Note
Alternating current of 25 Volts and above and direct current of 60 Volts and above are hazardous to human beings. It is therefore crucial to follow the safety instructions given in the service literature and Guided Fault Finding, as well as the warnings displayed on the vehicle.

Note
Always de-energise the system according to the test plan in the vehicle diagnostic tester.
The high-voltage system must only be de-energised and worked on by qualified staff.

Warning labels

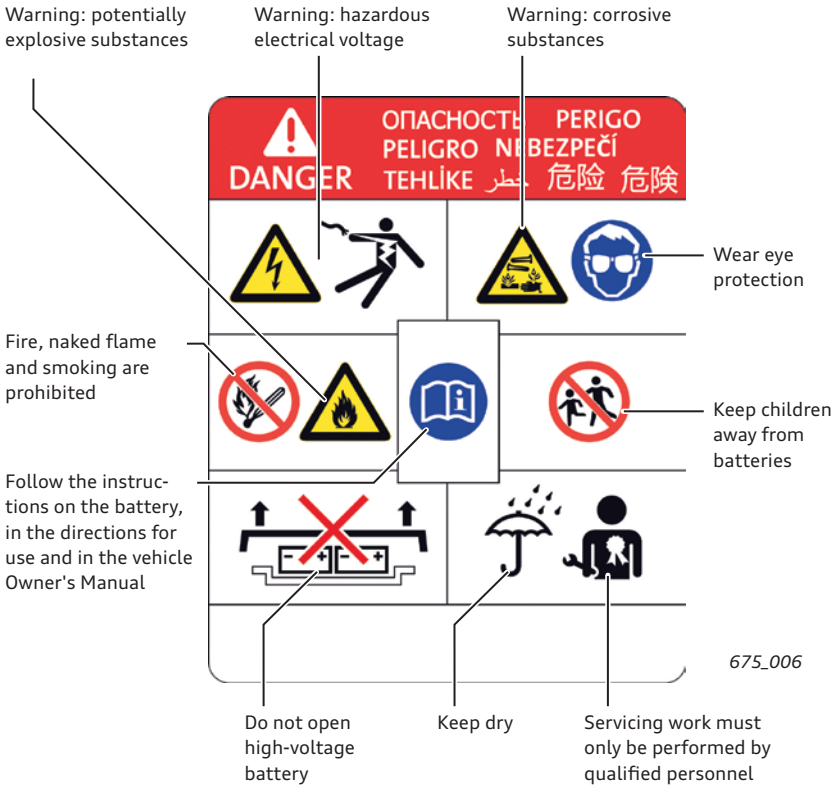
Warning labels are fitted to the vehicle to indicate the danger caused by electrical current.

These must be observed in all circumstances to avoid endangering users, workshop staff and technical & medical emergency response personnel. The general occupational health and safety regulations for work on high-voltage vehicles apply.

Warning label in motor compartment

The warning labels marked "Danger" identify high-voltage components or components conducting high-voltage.

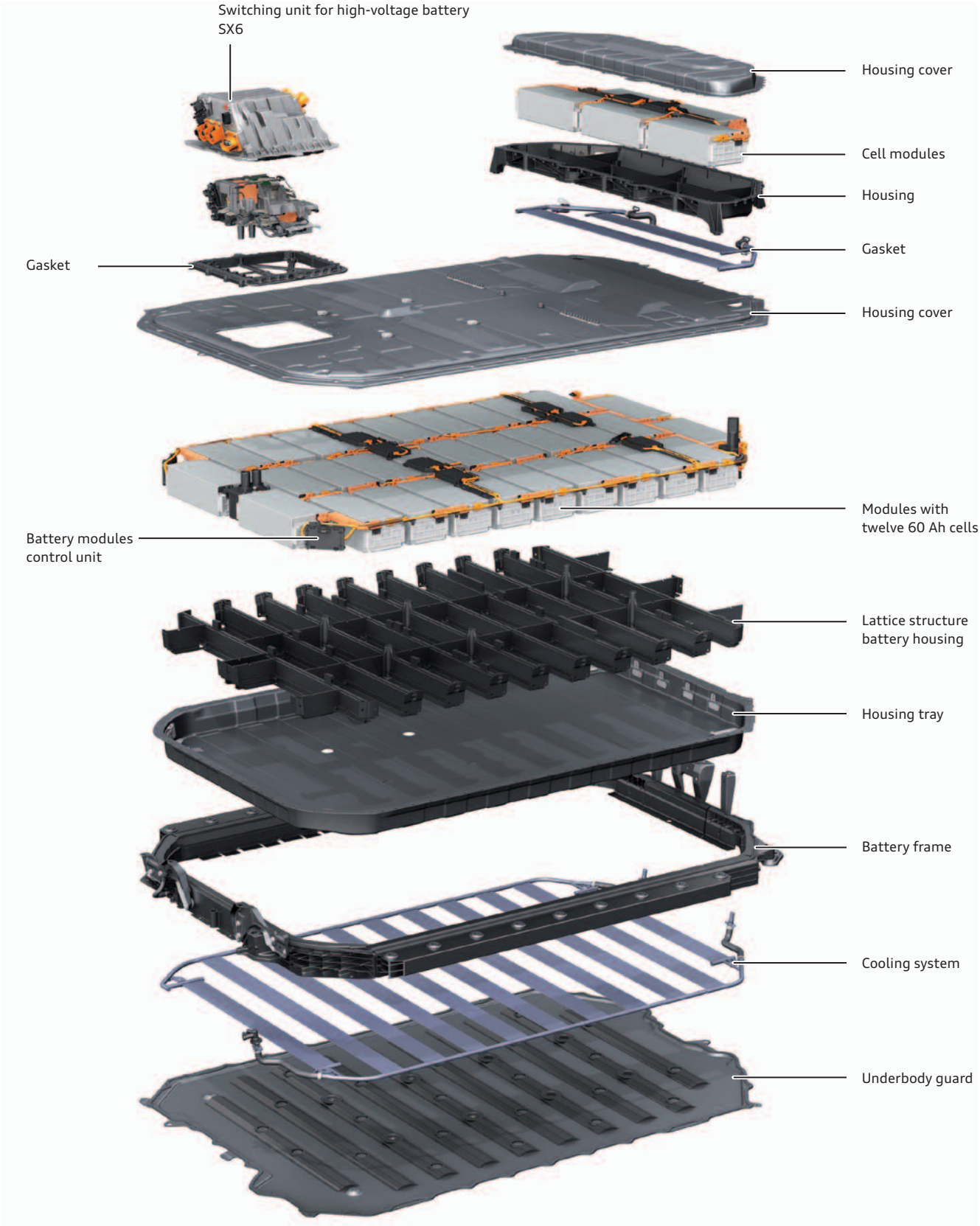
Special warning label for the high-voltage battery:



Note
Other/additional warning/information labels may be attached to the vehicle, depending on the country.

High-voltage battery 1 AX2

High-voltage battery 1 AX2 is bolted on centrally under the vehicle as a component supporting the body. The 36 battery modules are fitted on two levels. The battery housing is connected to the body via a live potential equalisation line. The switching unit for high-voltage battery SX6 is fitted on the high-voltage battery. The battery module control units are fitted inside the high-voltage battery. The battery regulation control unit J840 is located in the A-pillar (right-side).



675_007

Technical data

Designation	High-voltage battery 1 AX2
Nominal voltage	396
Capacitance in Ah	240
Number of battery cells	432 in 36 modules
Operating temperature	- 28 °C to + 60 °C
Energy content	95 kWh
Usable energy content in kWh[1)]	83.6 kWh
Charging capacity	150 kW
Weight in kg	699
Approx. size in mm	1630 x 340 x 2280 (W x H x L)
Cooling[2)]	Fluid cooling

[1)] At actual charge levels of between 8 % and 96 %. The charge level display shows the driver whether the battery is empty or full.

[2)] At low temperatures, the battery can also be heated.

Note:
If the vehicle is parked for a long period, the charge level of the high-voltage battery is reduced because the 12 Volt battery is automatically recharged. If the charge level of the high-voltage battery goes below approx. 10%, the 12 Volt battery is no longer recharged. It is not possible to activate the vehicle's drive system under -30 °C. Above 60 °C, the power contactors are opened/not closed when the ignition is on. The high-voltage battery provides full battery power to the three-phase current drives at temperatures between -8 and 56 °C.

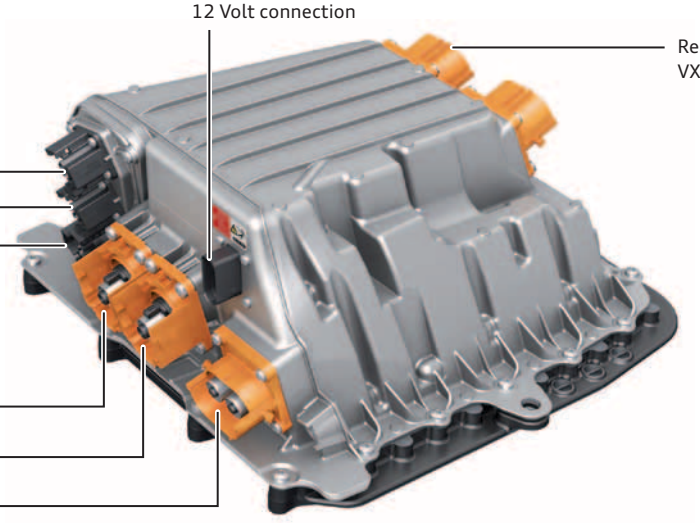
Cooling

The battery is cooled in the coolant circuit. The battery modules release heat to the battery housing via heat conducting material. The coolant flows through a heat sink bonded to the battery housing with a heat conducting adhesive. Coolant temperature sender 1 for high-voltage battery G898 and coolant temperature sender 2 for high-voltage battery G899 measure the temperature of the coolant before and after the high-voltage battery. The coolant in the high-voltage battery is circulated by the coolant pump for high-voltage battery V590. At low temperatures, the high-voltage battery can be heated up while charging via the high-voltage heaters (PTC).

Switching unit for high-voltage battery SX6

The switching unit for high-voltage battery SX6 is bolted to the high-voltage battery from above and contains the following components:

- Controller for voltage measurement and insulation testing
- Fuse for high-voltage battery charging unit
- Fuses for high-voltage system
- Current sensor for high-voltage battery G848
- Protection resistor for high-voltage battery N662 (15 Ω)
- High-voltage battery power contactor 1 J1057 (HV positive)
- High-voltage battery power contactor 2 J1058 (HV negative)
- Precharge contactor for high-voltage battery J1044 (HV positive)
- DC charge contactor 1 J1052 (DC positive with fuse for charging current)
- DC charge contactor 2 J1053 (DC negative)
- High-voltage battery isolation igniter N563



When the ignition is switched on, high-voltage battery power contactor 2 J1058 connects HV negative and precharge contactor for high-voltage battery J1044 connects HV positive. After this, a small amount of current flows to the voltage converter and the power electronics of the three-phase current drives via the protection resistor N662. As soon as the intermediate circuit capacitors in these components are charged up, the high-voltage battery power contactor 1 J1057 (HV positive) is closed and the precharge contactor for high-voltage battery J1044 (HV positive) is opened. The switching unit for high-voltage battery SX6 communicates with the battery regulation control unit J840 and the battery module control units via a sub CAN bus. The DC charge contactors are only closed when the high-voltage battery is being charged at a DC charging station.

The power contactors are opened if the following conditions are met:

- The ignition is switched off.
- A crash signal is sent from the airbag control unit J234 via a data bus.
- A crash signal is sent from the airbag control unit J234 to the high-voltage battery isolation igniter N563 via a discrete wire.
- The maintenance connector TW is opened.
- The fuse for power supply to terminal 30c of the power contactors is disconnected or faulty.

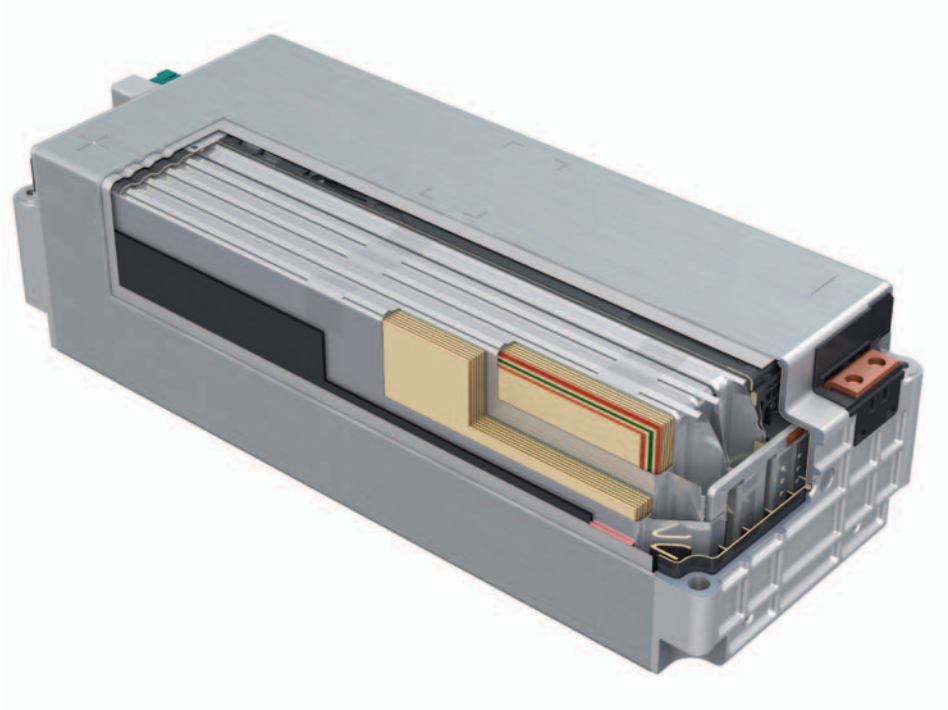
High-voltage battery isolation igniter N563

The switching unit for high-voltage battery SX6 is connected to the airbag control unit J234 by a discrete wire. The high-voltage battery isolation igniter N563 is a piece of software which evaluates the crash signal electronically and ensures that the power contactors are opened. The igniter is not a physical component and does not have to be replaced after a crash.

Reference
For further information on the power contactors, please refer to self-study programme 615 “Audi A6 hybrid and Audi A8 hybrid”.

Battery module

A battery module consists of 12 cells. Groups of four cells are connected in parallel, which creates a total capacitance of 240 Ah. Three of these cell groups are connected in series, which creates a voltage of 11 Volts for each battery module. Two temperature sensors on the top of the cells measure the temperature of the battery cells. The battery module is connected to the battery modules control unit with an orange wire.



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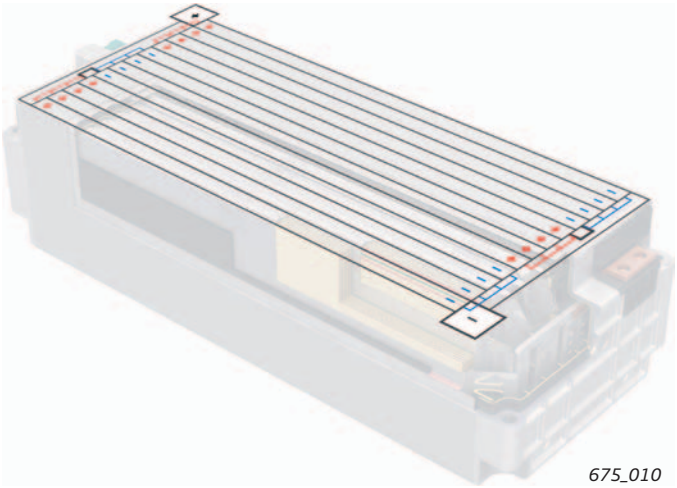


675_010

Module interconnections:

When connected in parallel, the cell capacitances are added together and when connected in series, the cell voltages are added together.

Connection in parallel
60 Ah + 60 Ah + 60 Ah + 60 Ah = 240 Ah

Connection in series
3.67 V + 3.67 V + 3.67 V = 11 V

675_011

Battery modules control unit J1208

Three battery modules are connected to one battery modules control unit.

The battery modules control unit has the following functions:

- Voltage measurement of the three battery modules
- Temperature measurement of the battery cells
- Cell group balancing

The battery modules control unit communicates with the battery regulation control unit J840 and the switching unit for high-voltage battery SX6 via a sub CAN.

Battery regulation control unit J840

The battery regulation control unit J840 is fitted in the A-pillar (right-side) in the interior and has the following functions:

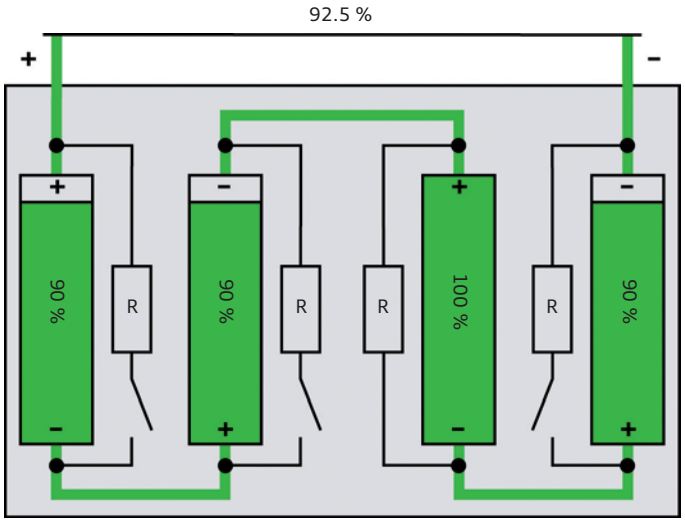
- Determining the charge level of the high-voltage battery
- Specifying and monitoring the permissible charging and discharging currents in electric driving mode, in generator mode and when recuperating, and the voltage and power when the high-voltage battery is being charged.
- Evaluating the isolation resistance in the high-voltage system measured by the switching unit for high-voltage battery SX6
- Monitoring safety circuit 1
- Evaluating cell voltage and balancing
- High-voltage battery heating request to thermal management control unit J1024
- Activating coolant pump for high-voltage battery V590 according to specifications from thermal management control unit J1024
- Triggering opening of power contacts in the event of a crash

The control unit communicates with the switching unit for high-voltage battery SX6 and the battery modules control unit J1208 via a sub CAN. It is a hybrid CAN node.

675_012

Cell balancing

In this example, a cell is 100% charged and the charging procedure is complete. However, the high-voltage battery charge level is only 92.5 %. Balancing means that this cell is now discharged via a resistor and can thereby continue to be charged until all cells have reached the same charge level. This allows the high-voltage battery to achieve its maximum capacitance.
To do this, the battery regulation control unit J840 compares the voltages of the cell groups. If cell groups have a high cell voltage, the battery modules control unit responsible receives the balancing information. Balancing is performed when voltage differences of greater than approx. 1% occur when the high-voltage battery is being charged. After the ignition has been switched off, the battery regulation control unit J840 checks whether balancing is necessary and triggers it if necessary. Only the control units on the sub CAN are active when this is done. Balancing is performed at charge levels greater than 30%.



675_013

Isolation monitoring

When the high-voltage system is active, the switching unit for high-voltage battery SX6 runs an isolation test every 30 seconds. The isolation resistance between the high-voltage conductors and the housing of the high-voltage battery 1 AX2 is measured with the current battery voltage. The system detects insufficient isolation resistances in the components and wiring of the high-voltage system. The AC connections in the high-voltage battery charging sockets and the AC/DC converter in the high-voltage battery charging units are not checked due to the electrical isolation of the charging socket to the high-voltage system. The switching unit sends the isolation value to the battery regulation control unit J840 for evaluation. If a low isolation resistance is detected, the control unit sends a message to the data bus diagnostic interface J533 via the hybrid CAN. The diagnostic interface directs, via the dash panel insert CAN, the control unit in dash panel insert J285 to show a message to the driver in the display in the dash panel insert. If the warning is yellow, the driver can continue driving and the drive system can be reactivated. If the isolation resistance is too low, a red warning is given. The journey can be completed, but it will not be possible to reactivate the drive system.

Voltage converter A19

The voltage converter A19 is fitted at the front right of the vehicle and is cooled in the coolant circuit.

It converts the DC voltage (396 Volt) of the high-voltage battery 1 AX2 into the 12 Volt DC voltage of the vehicle's electrical system. The transmission is achieved using induction coils (electrical isolation). As a result, there is no conducting connection between the high-voltage system and the 12 Volt electrical system.

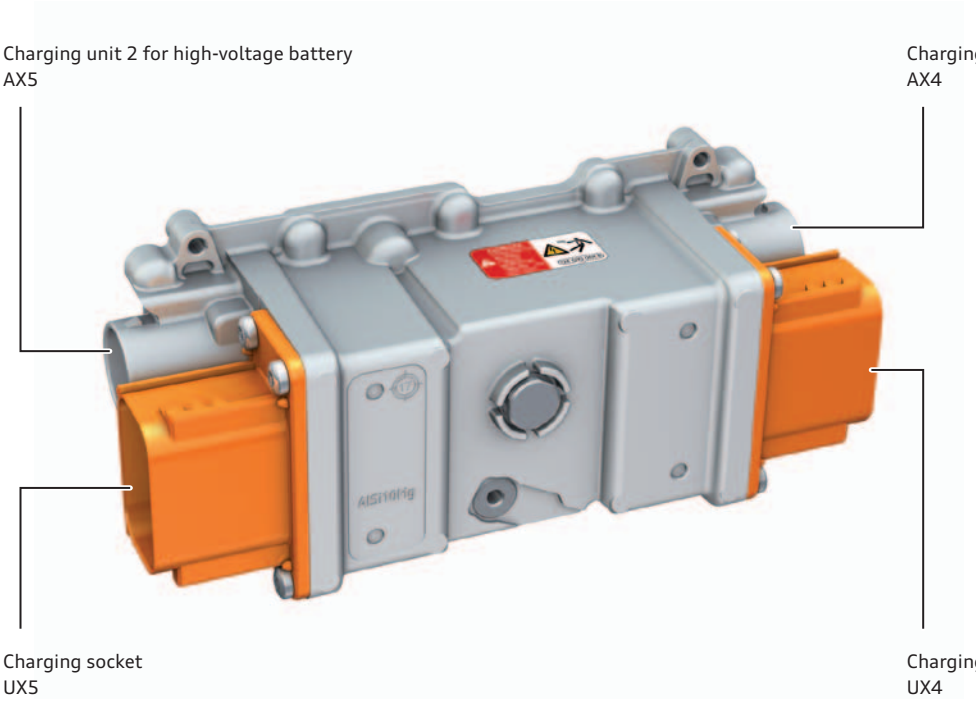
The voltage converter A19 is connected to the high-voltage battery via a fuse in the switching unit SX6.

It has a power of up to 3 kW. If the vehicle is stationary for a longer period and the high-voltage battery is sufficiently charged, the high-voltage battery will charge the 12 Volt battery.

Note:
This charging procedure starts automatically. When it is running, the high-voltage system is active and the high-voltage components are energised.
The voltage converter A19 is connected to the body via a live potential equalisation line.
The intermediate circuit capacitor is discharged actively and passively.

High-voltage charge current distributor SX4

On vehicles with a second AC charging socket or a second charging unit for high-voltage battery, the charging sockets and charging units are connected via the high-voltage charge current distributor SX4.



Charging unit 1 for high-voltage battery AX4

Charging unit 2 for high-voltage battery AX5

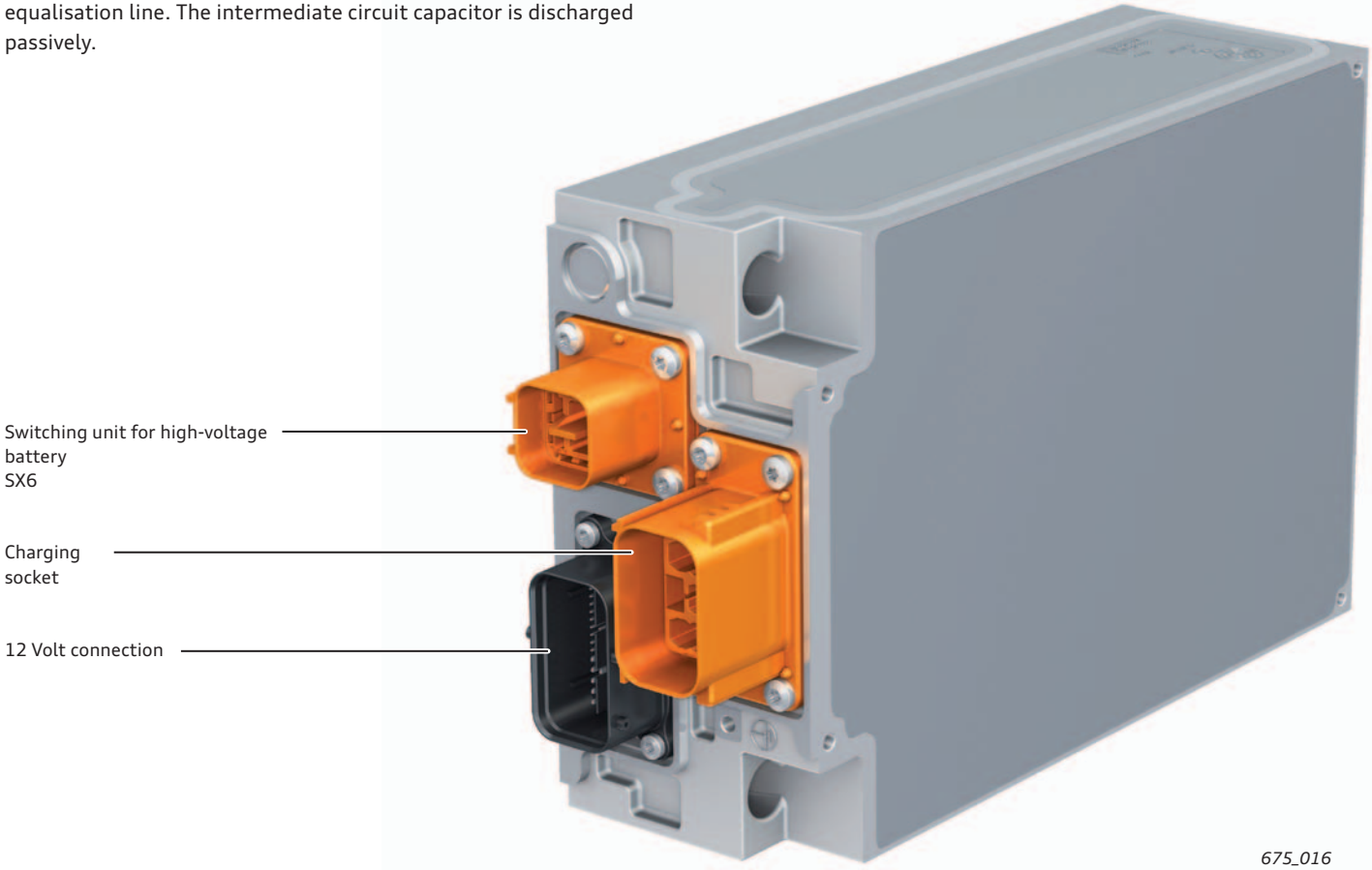
The charging units are fitted at the front of the vehicle in front of/above the electric drive motor on the front axle. Charging unit 2 is available as optional equipment to charge at 22 kW.

Three rectifiers convert the AC voltage of the operating unit/charging station to DC voltage so that it can charge the high-voltage battery 1 AX2. Each rectifier has a maximum performance of 16 A. The charging currents are allocated depending on the actual charging current availability. The transmission into the high-voltage system is achieved using induction coils (electrical isolation). As a result, there is no conducting connection between the AC power supply and the vehicle's high-voltage system. The charging units are connected at the switching unit for high-voltage battery SX6. The charging current is supplied to the high-voltage battery via a fuse in the switching unit. Cooling takes place in the coolant circuit.

The charging units are connected to the body via a live potential equalisation line. The intermediate circuit capacitor is discharged passively.

Components connected

- High-voltage battery charging socket 1 UX4
- High-voltage battery charging socket 2 UX5
- LED module for charging socket 1 L263
- LED module for charging socket 2 L264
- Actuator for high-voltage charging socket lock 1 F498
- Actuator for high-voltage charging socket lock 2 F499
- Drive unit for charging socket 1 cover VX86
- Drive unit for charging socket 2 cover VX87
- Temperature sender for charging socket 1 G853
- Temperature sender for charging socket 2 G854



675_016

Communication

The integrated control unit for high-voltage battery charging unit J1050 and control unit for high-voltage battery charging unit 2 J1239 are hybrid CAN nodes. The control unit for high-voltage battery charging unit J1050 is the master and the control unit for high-voltage battery charging unit 2 J1239 is the slave. Communication with the Audi e-tron charging system or a charging station takes place via the CP and PE connections using a PWM signal or power-line communication. When charging with direct current via a CHAdeMO or China DC charging socket, the system communicates with the charging station via CAN. The rectifiers are not active during AC charging. The timer settings for charging and air conditioning are stored in the control unit for high-voltage battery charging unit J1050.

Electrical air conditioner compressor V470

The electrical air conditioner compressor V470 is fitted at the front of the vehicle. It is supplied with high voltage via a fuse in the switching unit for high-voltage battery SX6.

The integrated control unit for air conditioning compressor J842 is connected to the thermal management control unit J1024 via a LIN bus. The air conditioner compressor is connected to the body via a live potential equalisation line.

The intermediate circuit capacitor is discharged passively.

Note:
When the auxiliary air conditioning is active, the high-voltage system is active and the high-voltage components are energised.

The timer settings for charging and air conditioning are stored in the control unit for high-voltage battery charging unit J1050.

675_017

High-voltage heater (PTC) Z115

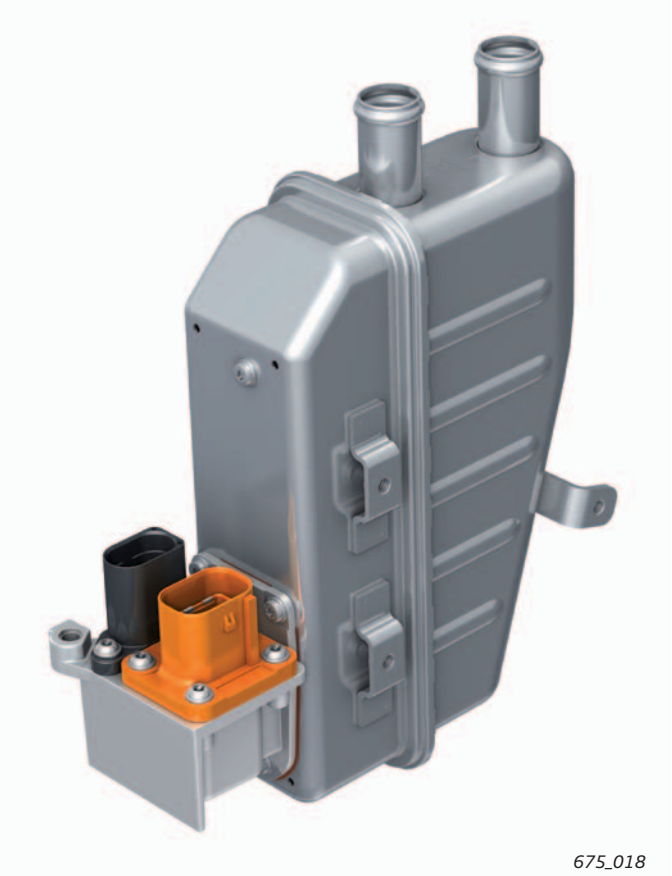
High-voltage heater 2 (PTC) Z190

The high-voltage heaters are fitted in the front of the vehicle and are supplied with high voltage via a fuse in the switching unit for high-voltage battery SX6. They heat up the coolant so that it can warm up the vehicle interior and the high-voltage battery. The integrated control units J848/J1238 are connected to the thermal management control unit J1024 via a LIN bus.

The high-voltage heaters are connected to the body via a live potential equalisation line.

Note:
When the auxiliary air conditioning is active, the high-voltage system is active and the high-voltage components are energised.

The timer settings for charging and air conditioning are stored in the control unit for high-voltage battery charging unit J1050.

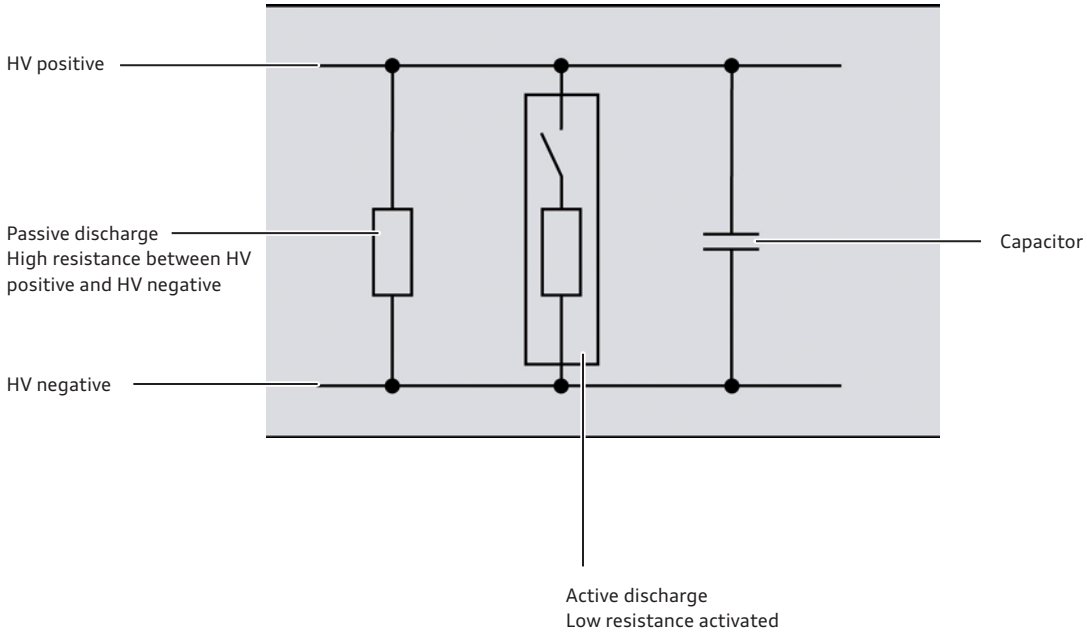


675_018

Intermediate circuit capacitors

A capacitor serving as an energy store and a voltage stabiliser may be fitted between HV positive and HV negative in high-voltage components. In addition, a resistor which discharges the capacitor when the ignition is off is connected parallel to the capacitor.

When the ignition is off, the capacitor on some high-voltage components is actively discharged by a switch and resistor.



High-voltage component	Passive discharge	Active discharge
Front three-phase current drive VX89	X	X
Rear three-phase current drive VX90	X	X
Voltage converter A19	X	X
Charging units 1 and 2 for high-voltage battery AX4 and AX5	X	
Electrical air conditioner compressor V470	X	

Note
A capacitor is fitted in some high-voltage components to store power. It must be discharged when the system is de-energised. You should therefore always de-energise the system according to the test plan in the vehicle diagnostic tester as this takes the discharging times into account.
The high-voltage system must only be de-energised and worked on by qualified staff.

Crash signal

In the event of a crash, the airbag control unit J234 sends a signal to the battery regulation control unit J840 via the hybrid CAN and to the high-voltage battery isolation igniter N563 in the switching unit for high-voltage battery SX6 via a discrete wire. The power contacts are opened and the high-voltage system is deactivated.

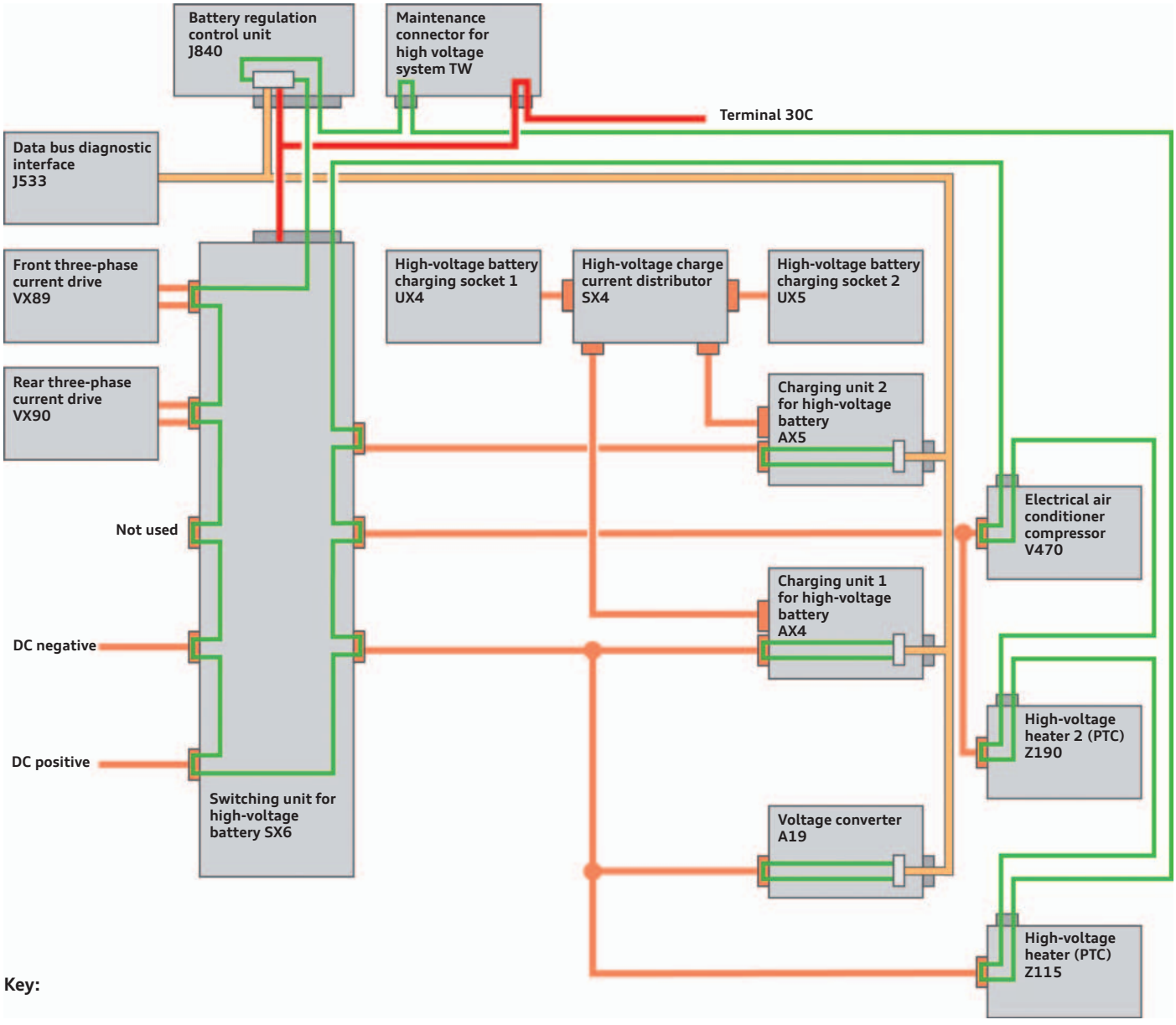
Depending on the severity of the crash, it may be possible to reactivate the high-voltage system by switching the ignition off and on again or, in certain circumstances, using the vehicle diagnostic tester.

Safety circuit

The vehicle has four safety circuits.

- Safety circuit 1 passes through the battery regulation control unit J840, electrical air conditioner compressor V470, high-voltage heater 2 (PTC) Z190, high-voltage heater (PTC) Z115, maintenance connector TW and switching unit for high-voltage battery SX6.
- Safety circuit 2 is within voltage converter A19.
- Safety circuit 3 is in charging unit 1 for high-voltage battery AX4.
- Safety circuit 4 is in charging unit 2 for high-voltage battery AX5.

These safety circuits are 12 Volt loop lines which pass through the high-voltage components. The battery regulation control unit J840, voltage converter A19, charging unit 1 for high-voltage battery AX4 and charging unit 2 for high-voltage battery AX5 report the status to the data bus diagnostic interface J533. If a safety circuit is interrupted, e.g. when a connector is unplugged, the data bus diagnostic interface J533 receives a message from the control unit affected and the control unit in dash panel insert J285 is instructed to display a message to the driver by the dash panel insert CAN. It is possible to continue driving until the ignition is switched off. It is not possible to reactivate the drive system.

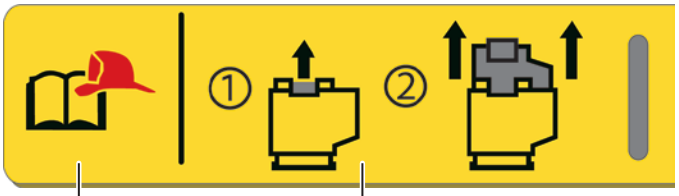


Maintenance connector TW

The maintenance connector TW is located in the front left of the vehicle. It is both an electrical connection in the 12 Volt control circuit for the high-voltage battery power contactors and a component part of the safety circuit. Opening the maintenance connector TW opens the safety circuit and breaks the 12 Volt control circuit of the power contactors. The maintenance connector serves to de-energise the high-voltage system. Please use the relevant program in the vehicle diagnostic tester to properly open and de-energise the high-voltage system. After being opened, the maintenance connector TW is secured from being switched back on by the padlock T40262/1.

675_020

An information label is affixed to the maintenance connector TW.



675_021

Follow note on rescue card

Unplug connector

Fuse for power supply

The fuse for the power supply of the control current for the power contactors is located in the fuse carrier in the luggage compartment (left-side) and is identified by a label.

675_022

The fuse is identified by a label.

675_023

Follow note on rescue card

Removing a fuse

Charging socket cover

The charging socket for charging the high-voltage battery is located behind the cover for the charging socket.
The vehicle must be unlocked and the button pressed to open the cover. The drive unit for charging socket 1 cover VX86 moves the cover outwards and downwards, making the charging socket accessible.
The drive unit is activated via LIN by the charging unit 1 for high-voltage battery AX4 and the position of the cover is transmitted to the charging unit.

If the charging connector is plugged in, the cover cannot be closed. The charging socket cover is closed automatically when the charging connector is unplugged after charging is ended.
Depending on the country and the vehicle equipment, the vehicle may have a second charging socket.

675_155

Note
Vehicles with convenience key do not need to be unlocked if the convenience key is near the vehicle.

Charging sockets on the vehicle

The charging socket, the LED module and a description of the LED are located under the cover. Lighting is present to assist with orientation in the dark.

The charging sockets can be used to charge the vehicle with alternating current (AC) or direct current (DC).

Combined charging sockets for AC and DC or charging sockets for AC or DC are fitted on the vehicle.

675_155

	USA	EU	China	Japan
Type 1	○ PS			● DS
Type 2		○ PS		
CCS 1	● DS			
CCS 2		● DS		
China AC			● DS	
China DC			● PS	
CHAdeMO				● PS

Key

●	Standard
○	Optional
DS	Driver side
PS	Passenger side

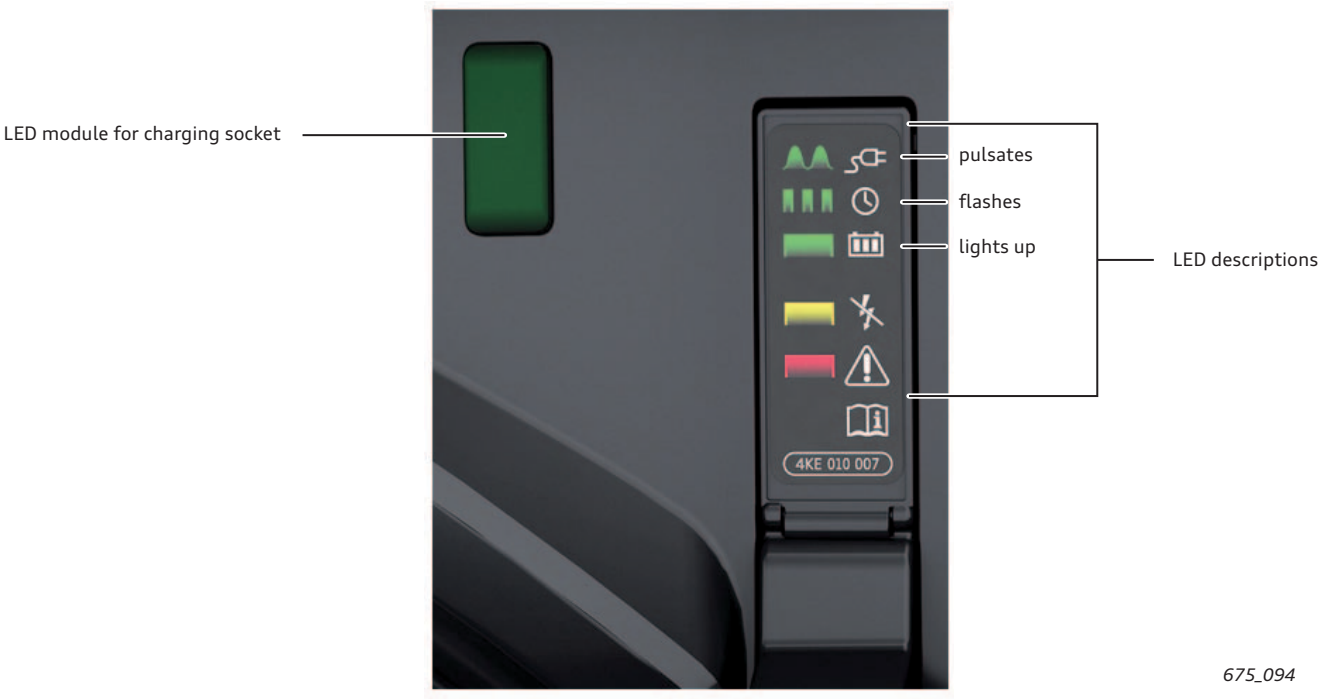
The table shows the allocation of charging sockets for some countries.

Note
Vehicles with two charging sockets can only be charged by one charging socket at a time.

LED module for charging socket

The LED module shows the status of the charging process using various colours and light modes.

A description of the display can be found next to the LED module.



Overview of displays on LED module for charging socket

LED on charging unit		Meaning
off		Vehicle's charging system is in sleep mode. A timer may be active, but charging has not yet begun.
		Charging has been interrupted.
green	pulsates	High-voltage battery is being charged.
	flashes	Timer is active, but charging has not yet begun.
	lights up	High-voltage battery charging is complete.
yellow	lights up	No charging current has been detected, although the charging cable is plugged in. Check the power supply of the charging source. If using the Audi e-tron charging system, check the status displays on the operating unit. Refer to page 121.
	flashes	The vehicle is not secured against rolling away. Check that transmission position P is selected and the parking brake is applied.
red	lights up	Vehicle may not have been able to lock charging connector in charging connection properly. Check that the charging connector is plugged in correctly. Unplug the charging connector and plug it into the charging connection again or try using a different charging station. If the LED remains lit, there is a malfunction in the vehicle charging system or power source.
		Both charging unit covers are open. Try to close the cover of the charging unit not in use. If the LED remains lit, the high-voltage battery cannot be charged.
		The outside temperature is too low or too high.

Overview of the charging sockets

Depending on the version, the vehicles may have different charging sockets on the driver/passenger side.

The charging unit 1 for high-voltage battery AX4 monitors the temperature of the charging sockets via temperature senders. In the event of high temperatures, it gradually reduces the charging current and eventually stops charging. If the temperature is going down, the charging current is gradually increased.

Combined Charging System Type 1 (CCS 1 or Combo 1) High-voltage battery charging socket 1 UX4

This charging socket can be used to charge the high-voltage battery with alternating current or direct current.
The DC contacts are protected by a flap.

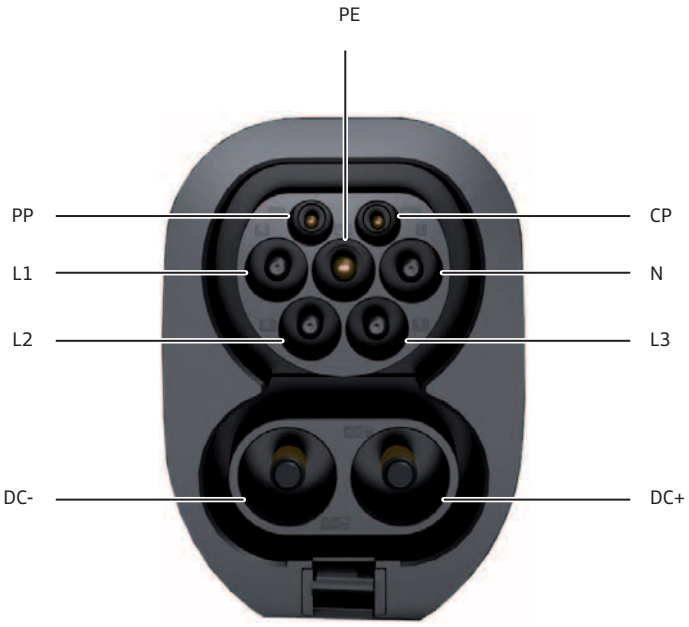
Communication between the charging station and charging unit 1 for high-voltage battery AX4 takes place via contacts CP and PE.

675_099

Combined Charging System Type 2 (CCS 2 or Combo 2) High-voltage battery charging socket 1 UX4

This charging socket can be used to charge the high-voltage battery with alternating current or direct current.
The DC contacts are protected by a flap.

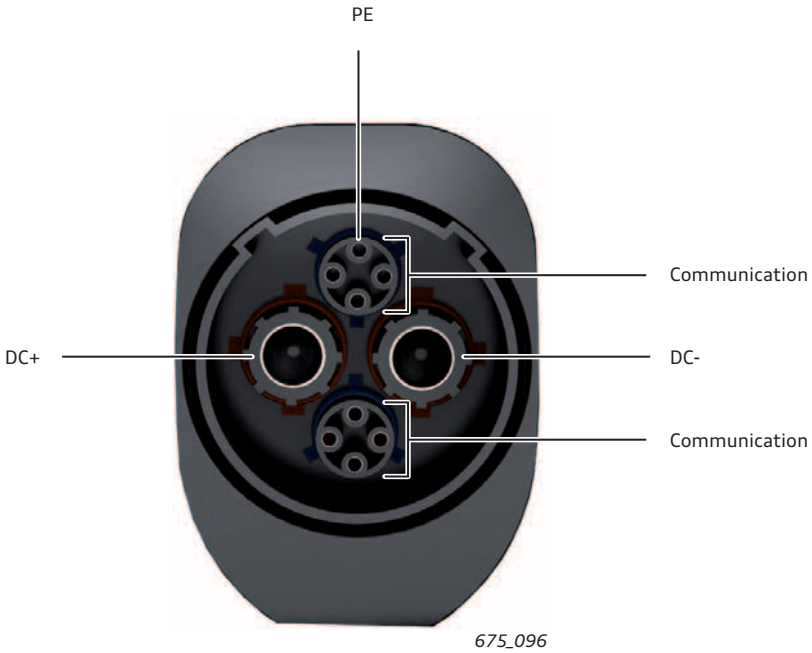
Communication between the charging station and charging unit 1 for high-voltage battery AX4 takes place via contacts CP and PE.



675_095

Charge de Move (CHAdeMO) High-voltage battery charging socket 1 UX4

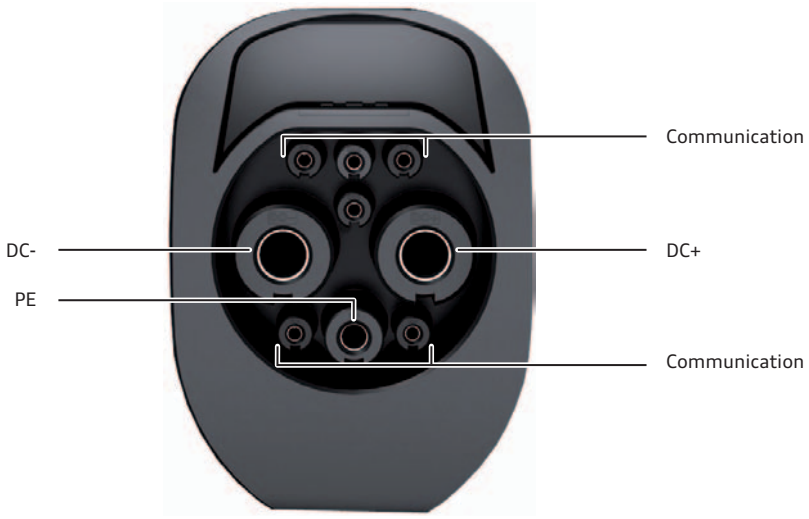
Can be used to charge the high-voltage battery with direct current (DC). Communication between the charging station and charging unit 1 for high-voltage battery AX4 takes place via the communication contacts.



675_096

China DC
High-voltage battery charging socket 1 UX4

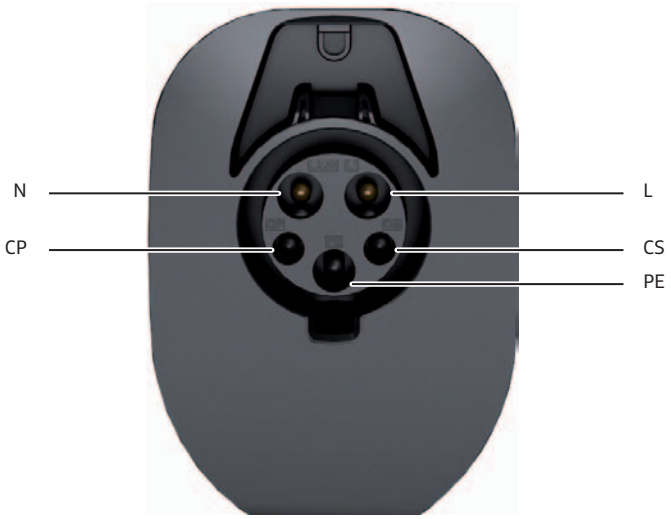
Can be used to charge the high-voltage battery with direct current (DC). Communication between the charging station and charging unit 1 for high-voltage battery AX4 takes place via the communication contacts.



675_097

Type 1
High-voltage battery charging socket 2 UX5

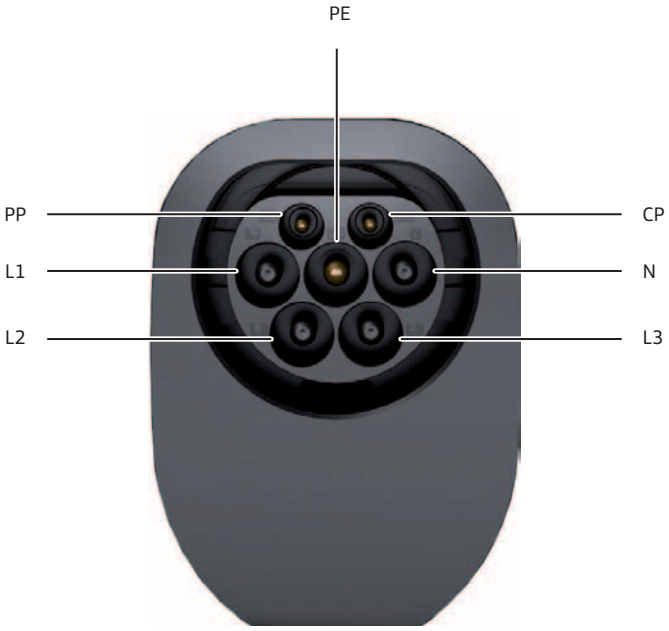
This charging socket can be used to charge the high-voltage battery with alternating current. Communication between the charging station and charging unit 1 for high-voltage battery AX4 takes place via contacts CP and PE.



675_098

Type 2 Mennekes
High-voltage battery charging socket 2 UX5

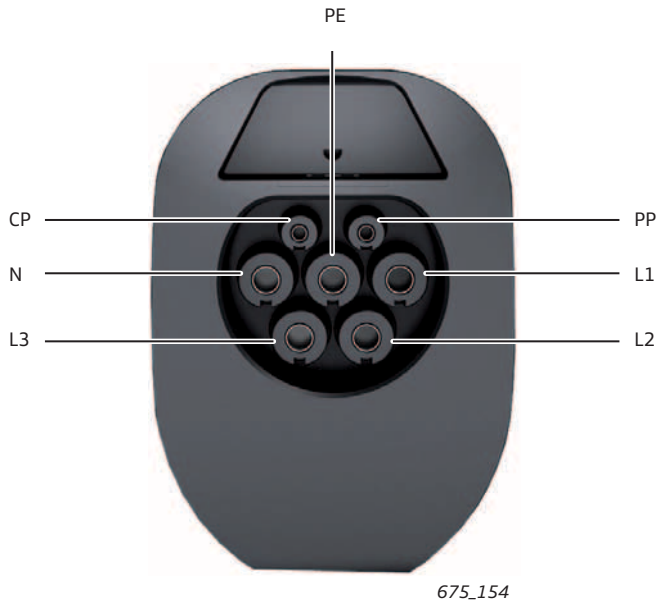
This charging socket can be used to charge the high-voltage battery with alternating current. Communication between the charging station and charging unit 1 for high-voltage battery AX4 takes place via contacts CP and PE.



675_100

China AC
High-voltage battery charging socket 2 UX5

This charging socket can be used to charge the high-voltage battery with alternating current. Communication between the charging station and charging unit 1 for high-voltage battery AX4 takes place via contacts CP and PE.



675_154

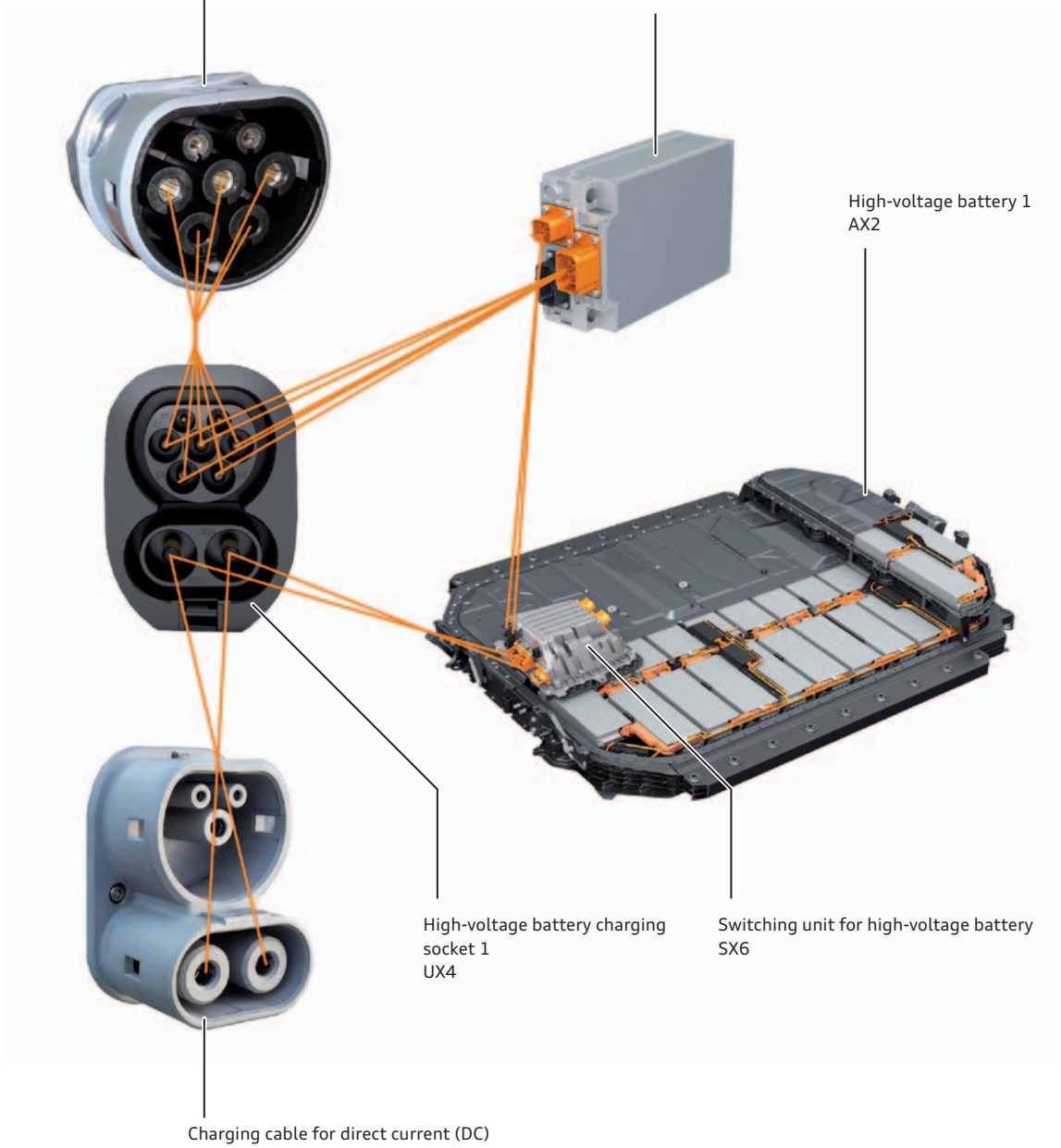
Charging the high-voltage battery

The vehicle can be connected to AC or DC power sources to charge the high-voltage battery.

The charging socket's DC connection is connected to the switching unit. The direct current is supplied to the high-voltage battery directly.

The charging socket's AC connection is connected to the charging unit for high-voltage battery.

In the charging unit, the alternating current is converted into direct current and supplied to the high-voltage battery via the switching unit.



675_183

Note
During charging, the high-voltage system is active and the high-voltage components are energised.

Charging with alternating current (AC)

The charging units in the vehicle convert the alternating current (AC) into direct current (DC) according to the specifications of the battery regulation control unit J840. The voltage and the current rating are continually adjusted during charging.

The charging performance is 11 kW with one charging unit (AX4) and 22 kW with two charging units (AX4 and AX5).

When the vehicle charging connector is plugged in, the vehicle is initially connected to the power source's protective earth via the PE contact. PP is then contacted and the charging unit detects the connector via a resistor[1)] between PE and PP and applies the parking brake. The L phases and the neutral conductor are then contacted. CP is contacted last, at which point the communication between the power source and the vehicle begins and the charging connector is locked. If communication is successful, the high-voltage system is activated and charging is started. The LED in the module pulsates in green.

The power source provides information on the maximum current rating. The battery regulation control unit J840 specifies the charging rate and the charging voltage for the charging unit, monitors charging and updates the specified values.

The power contactors in the high-voltage battery are opened when charging is complete.

If the LED lights up in yellow, no active power source has been detected.
If the LED does not light up, no connector has been detected.

[1)] The resistor is required to detect the connector and as coding for the current rating.

Charging with direct current (DC)

The high-voltage battery is connected directly to the power source if it is being charged with direct current (DC). To do this, it must adjust the voltage and current rating for charging according to the specifications from the battery regulation control unit J840.

The vehicle's charging performance is limited by the high-voltage battery. Charging can be performed at a maximum of 150 kW. In this case, the charging unit's only task is to communicate with the power source.

When the vehicle charging connector is plugged in, the vehicle is initially connected to the power source's protective earth via the PE contact. PP is then contacted and the charging unit detects the connector via a resistor[2)] between PE and PP and applies the parking brake. DC+ and DC- are then contacted. CP is contacted last, at which point the communication between the power source and the vehicle begins and the charging connector is locked. If communication is successful, the high-voltage system is activated, the power contactors for direct current are closed and charging starts. The LED in the module pulsates in green.

The power source provides information on the maximum voltage and current rating to the charging unit.

The battery regulation control unit J840 specifies the charging rate and the charging voltage for the power source, monitors charging and updates the specified values.

The DC charge contactors and the power contactors in the high-voltage battery are opened when charging is complete.

If the LED lights up in yellow, no active power source has been detected.
If the LED does not light up, no connector has been detected.

Note:
With CHAdeMO and China DC, connector detection and communication are performed via the communication contacts.

[2)] The resistor is required to detect the connector.

Vehicle communication with the power source

The vehicle communicates with the power source to charge the high-voltage battery. The vehicle must first detect the charging connector and lock it before communication can be established. The charging connector is detected via a resistor in the connector. The charging connector may be locked by hand or automatically by the vehicle. This depends on the connector.

Communication between the power source and the vehicle begins once the charging connector is locked. Pulse-width modulation, power-line communication or a CAN bus are used for communication. Communication between the power source and the battery regulation control unit J840 takes place via the control unit for high-voltage battery charging unit J1050.

Connector locking methods:

Charging connector locks	Type 1	CCS 1	Type 2	CCS 2	CHAdeMO	China AC	China DC
automatically			X	X			
by hand	X	X			X	X	X

Connector communication methods:

Communication	Type 1	CCS 1	Type 2	CCS 2	CHAdeMO	China AC	China DC
PWM via CP	X		X			X	
PLC via CP		X		X			
CAN bus					X		X

Immediate charging

If no charging timer is active, charging starts immediately.

Note:
CHAdeMO charging requires charging to be started at the charging station.

Autonomous operating states

In autonomous operating states, the high-voltage system is active when the ignition is off; it is not monitored by the driver.

For example:
- When the high-voltage battery is being charged.
- When auxiliary air conditioning is active.
- When the 12 Volt battery is being recharged by the high-voltage battery.

Data bus diagnostic interface J533

The data bus diagnostic interface J533 monitors the high-voltage system.

It is responsible for controlling the following functions:
- Monitoring the safety circuits
- Monitoring the isolation value
- Authorising closure of the charge and power contactors in the high-voltage battery
- Displaying system messages via control unit in dash panel insert J285

External sound

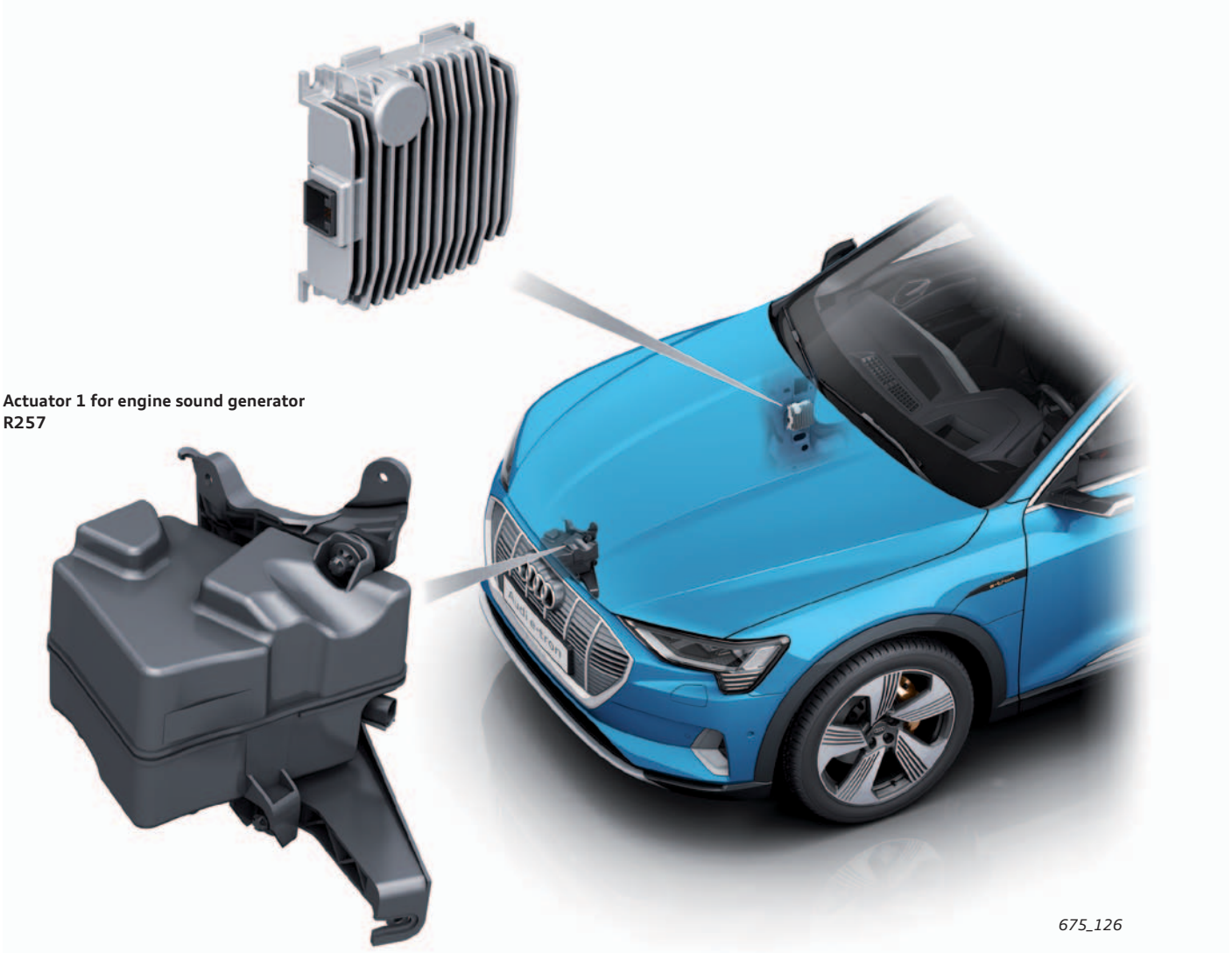
When travelling at lower speeds, the vehicle produces less noise than a vehicle with a combustion engine. Some countries require the vehicle to make an external sound so that they can be noticed more easily.

The following components are fitted in the vehicle for this purpose:

- Engine sound generator control unit J943
- Actuator 1 for engine sound generator R257

Engine sound generator control unit J943

Actuator 1 for engine sound generator R257



675_126

The engine sound generator control unit J943 activates the actuator 1 for engine sound generator R257. It is a node of the extended CAN and evaluates the following information to produce the sound:

- Speed
- Load torque

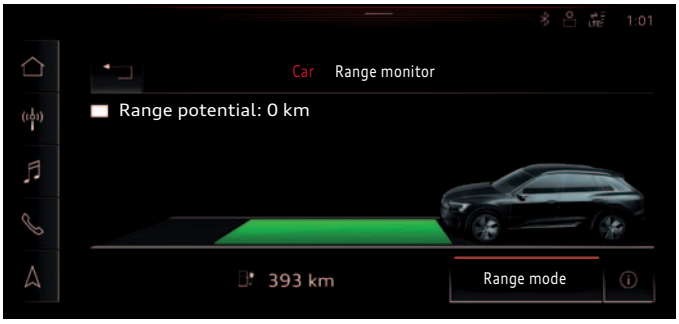
During electric driving, the actuator generates a noise which is reduced at speeds of 30 km/h and above.
If the vehicle is stationary or travelling at speeds of approx. 50 km/h or more, the actuator 1 for engine sound generator R257 does not generate any noise.
The noise generated sounds similar to that of a vehicle with a running combustion engine.

Display and range settings

The range monitor can be found in the Car menu > Vehicle information. The range potential shows the driver the additional distance that could be driven if the convenience functions were switched off.

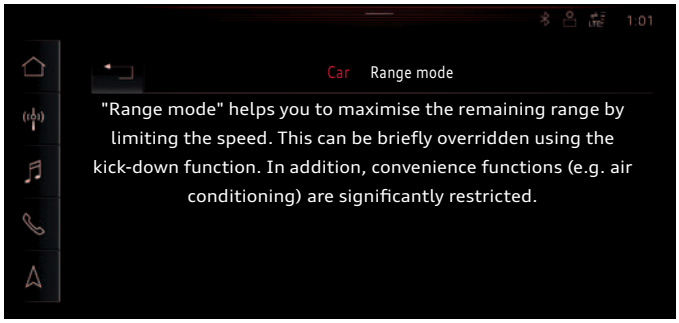
675_139

If the driver activates range mode, these functions are switched off, the display is reduced to 0 km and the range increases.



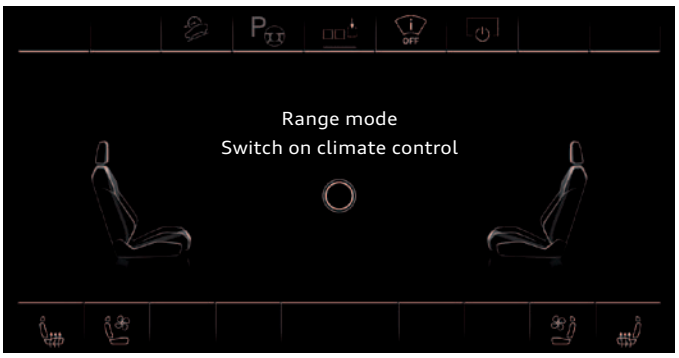
675_141

The driver receives information about restrictions to functions and vehicle speed.



675_140

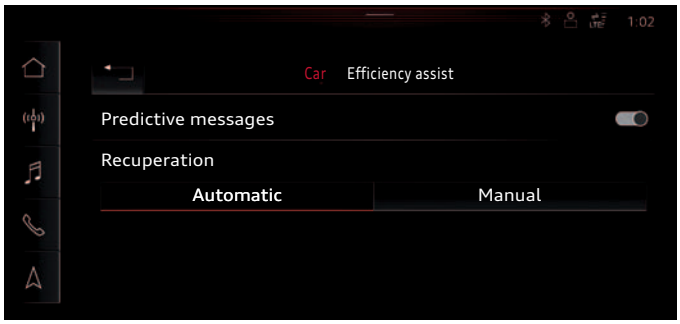
The speed is limited to 90 km/h (55 mph). This limit can be exceeded at any time using the kickdown function. A range mode notification appears on the lower touch display.



675_142

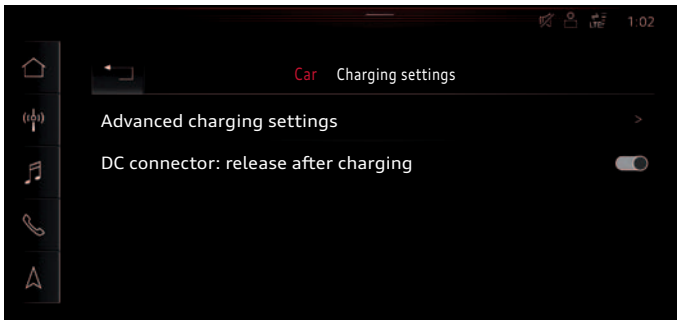
Charging settings

The predictive messages can be activated and the recuperation switched between automatic and manual in the Car menu > Charging & efficiency > Efficiency assist.



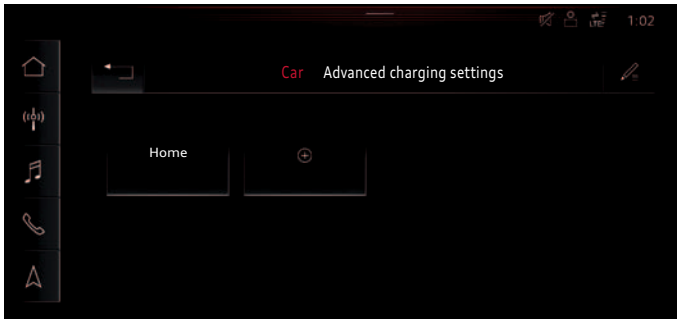
675_143

The option to release the DC charging connector after charging has finished can be activated in the Car menu > Charging & efficiency > Charging settings.



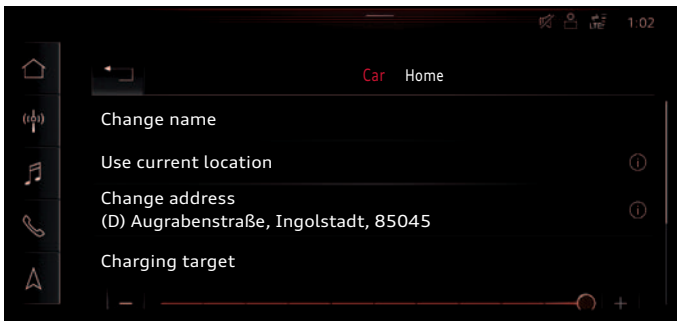
675_144

Charging locations can be named and charging settings specified in the Car menu > Charging & efficiency > Charging > Advanced charging settings.



675_145

To do this, the address must be entered so that the vehicle can detect the charging location using GPS data.



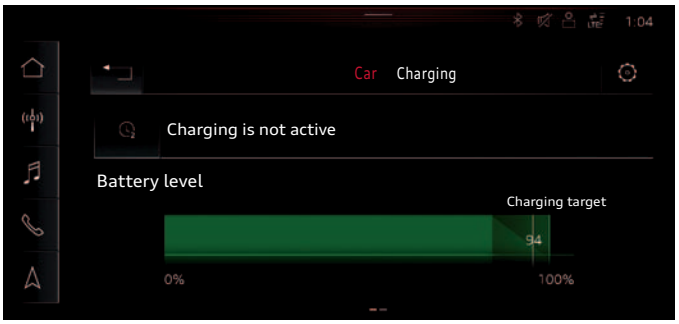
675_146

A charging target and a preferred charging time can be set for the high-voltage battery.
If the minimum charge level option is activated, the high-voltage battery is charged to 25% regardless of the settings for the timer or preferred charging time.

675_147

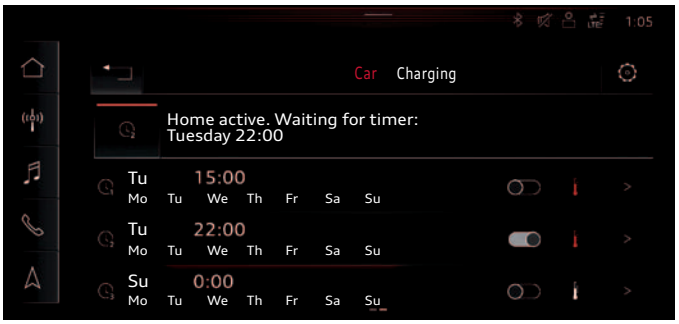
Battery level and timer display

The current high-voltage battery charge level and the charging status are shown in the Car menu > Charging & efficiency > Charging. A charging target for the high-voltage battery of between 50 % and 100 % can be set for the charging procedure.



675_148

The timer settings can be accessed by swiping the battery level display to the left.
Five different timers can be programmed. This involves selecting a day or days and setting the departure time.



675_149

Air conditioning of the vehicle interior can also be activated in the timer function.

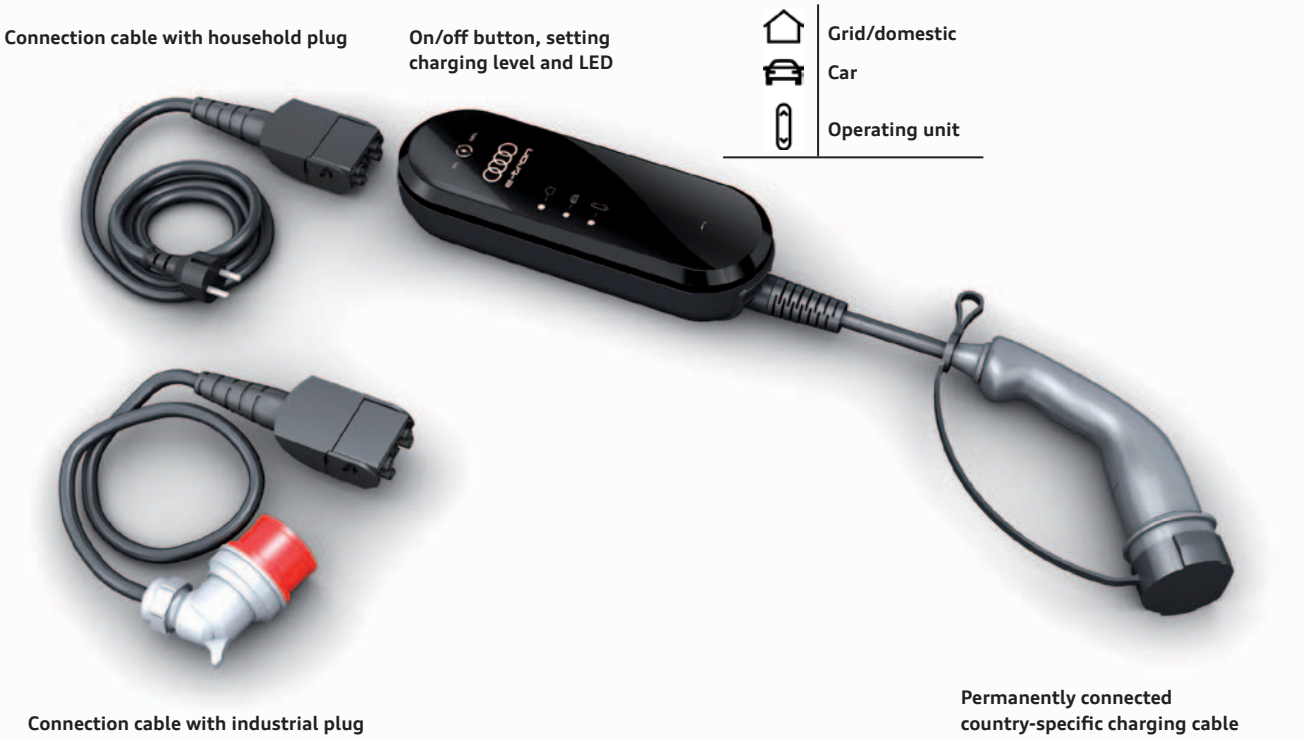
675_150

Audi e-tron charging system (compact)

Operating unit for high-voltage charging system E943

The Audi e-tron is supplied with the second generation Audi e-tron charging system. This is located in the motor compartment in the storage compartment.
The operating unit is activated when the Audi e-tron charging system is connected to the AC power supply. The internal contactors are open in this situation so that the vehicle charging connector is not live. The contactors are only closed during charging.

A country-specific charging cable for connecting to the vehicle is permanently attached to the operating unit.
One country-specific connection cable with a household plug and one with an industrial plug are also provided for connection to the AC power supply.Communication with charging unit 1 for high-voltage battery AX4 takes place via contacts CP and PE using a PWM signal.



675_127

Maximum charging level if connected to AC power:

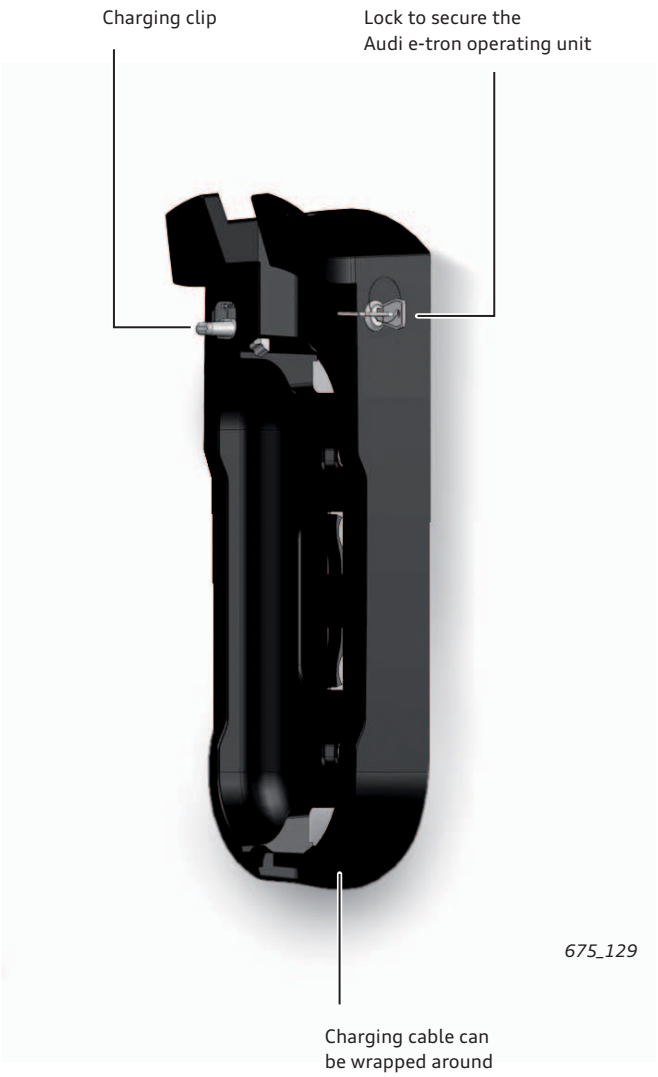
- Household socket 1.8 kW (8 A)
- Industrial socket[1)] 11 kW (48 A, single-phase or three-phase)

The charging level can be set to 50% or 100%.
The operating unit is country-specific. Please only use the Audi e-tron charging system approved for your country.

[1)] The charging level is set to 50% when the system is connected to an industrial socket.
The charging level can be increased to 100%. This setting is maintained until the operating unit is disconnected from the power supply.

Charging clip and connector mounting

The charging clip and the connector mounting can, for example, be secured on a garage wall.
The operating unit is fitted in the charging clip and locked in place. When the vehicle is not being charged, the charging cable can be wrapped around the charging clip and the vehicle charging connector can be placed in the connector mounting.



Diagnosis

The operating unit uses the LEDs to indicate detected faults. Fault finding is possible using the vehicle diagnostic tester and the adapter VAS 611 009.

Air conditioning and thermal management

Thermal management

From a thermodynamic perspective, thermal management refers to the control of energy flows, and heat flows in particular. From an automotive perspective, it refers to the energy-related optimisation of the vehicle's thermal efficiency. The aim of thermal management in an electric vehicle is to reduce power consumption and thereby increase the range. In addition, temperature control of electric components such as the high-voltage battery, charging units, electric motors and their feeder components must be ensured by the thermal management system. Ensuring a comfortable temperature in the vehicle interior is also a task of the thermal management system. The aim is not to allow heat from the electrical components to dissipate unused into the atmosphere, but to check beforehand whether vehicle components have thermal requirements. This is even more important because the difference between the exhaust gas temperature of a combustion engine and the ambient temperature is much greater than the corresponding temperature differences produced by the electric drive motor.

The thermal management system should, for example, keep the high-voltage battery within its optimum efficiency range of approx. 25 to 35 °C in all situations. This can mean operating conditions ranging from cold starts in the winter months to driving fast on the motorway on hot summer days.

The thermal management system on the Audi e-tron consists of four circuits which can be interconnected in different ways, as necessary, in order to heat or cool the interior and the electrical powertrain. Thanks to intelligent interconnections of these four circuits, it collects residual heat from the electric motor, power electronics and high-voltage battery. The heat pump can bring this up to a higher temperature and make it usable for the interior. The heating circuit is not, for example, intended to only warm up the interior, but can provide the high-voltage battery with heat as well.

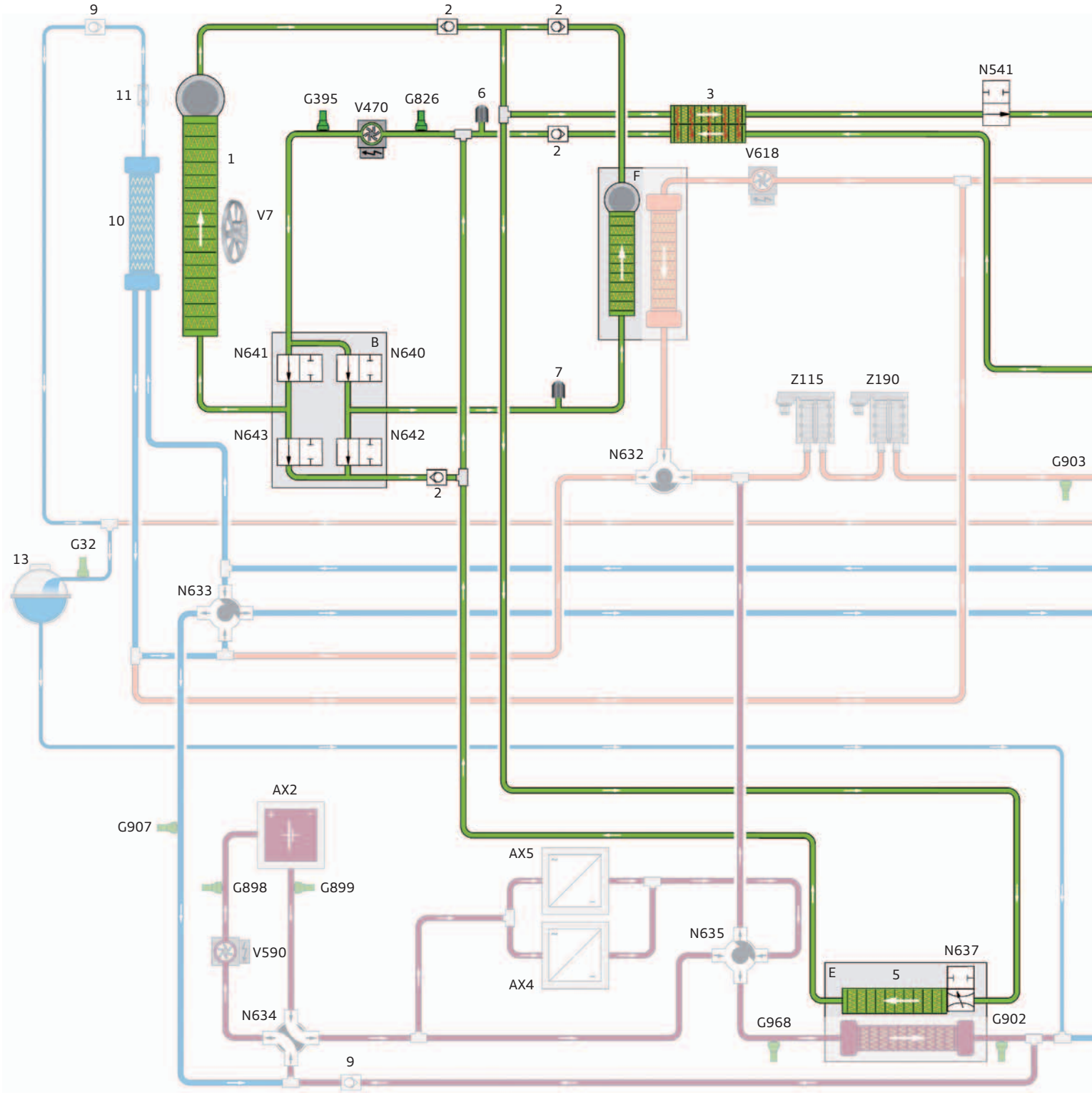
The four thermal management circuits

The four different refrigerant and coolant circuits for cooling and heating are shown one after the other in the following with functional descriptions and illustrations. Some scenarios/functional descriptions are provided later in this chapter (Air conditioning and thermal management).

Refrigerant circuit

There are two branches of the refrigerant circuit: one for interior air conditioning and one for high-voltage battery cooling via the heat exchanger for high-voltage battery (E). The components of the interior air conditioning system (beginning with the refrigerant circuit) can also be seen using the key of the following diagram: electrical air conditioner compressor V470, refrigerant pressure and temperature sender 1 G395, refrigerant pressure and temperature sender 2 G826, valve block (B), condenser (1) in addition to non-return valve for refrigerant circuit (2), internal heat exchanger (3) and heater and air conditioning unit (A), where its pressure is dissipated in the thermal expansion valve. It can then absorb heat from the interior and guide it away. It then returns to the electrical air conditioner compressor.

The refrigerant circuit elements for cooling the high-voltage battery via the heat exchanger for high-voltage battery (E) are as follows (in their functional sequence): after refrigerant has once again passed through the condenser (1) and the non-return valve in the refrigerant circuit (2), the compressed and cooled refriger-



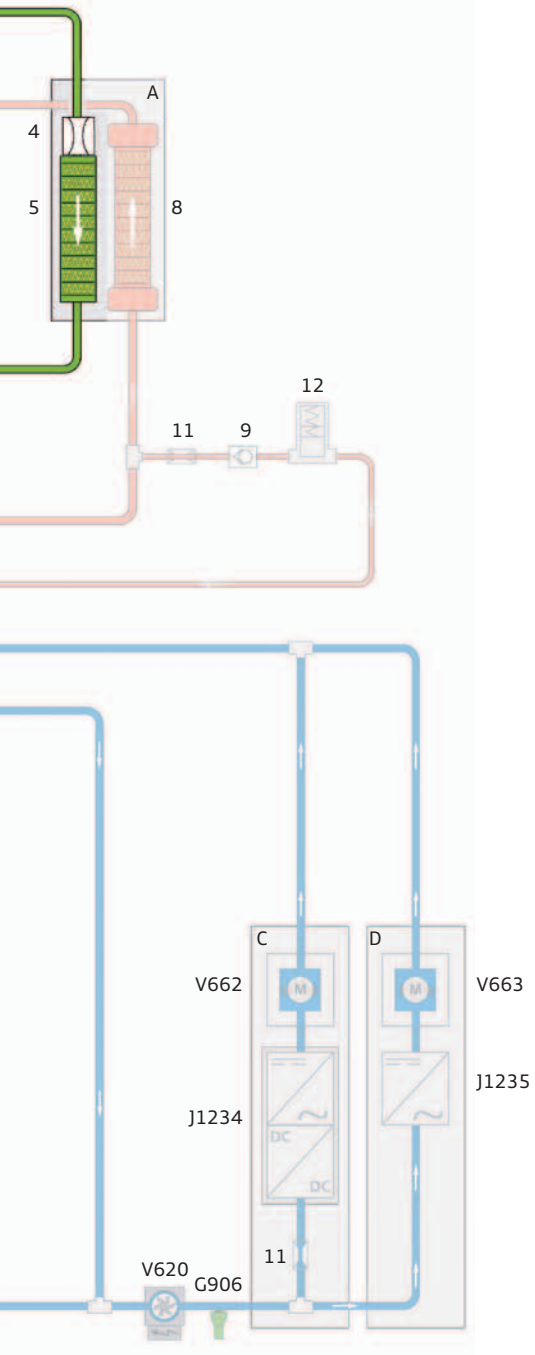
Refrigerant circuit

Heating circuit

Coolant circuit for electric powertrain

Coolant circuit for high-voltage battery

ant reaches the chiller (E), is expanded in the refrigerant expansion valve 2 N637 and cools significantly as this happens (as in the air conditioning unit), can absorb heat from the coolant circuits and is returned to the electrical air conditioner compressor V470. The refrigerant currently used is R1234yf.
A third way of interconnecting the refrigerant circuit is via the heat pump. In this circuit, thermal energy is absorbed in the heat exchanger for high-voltage battery (E). It is then compressed in the electrical air conditioner compressor V470 and warmed up further (no pressure expansion) so that the heat can be provided to the heating circuit for the interior in the heat exchanger for heat pump operation with the condenser (F) so that the interior can be warmed up.



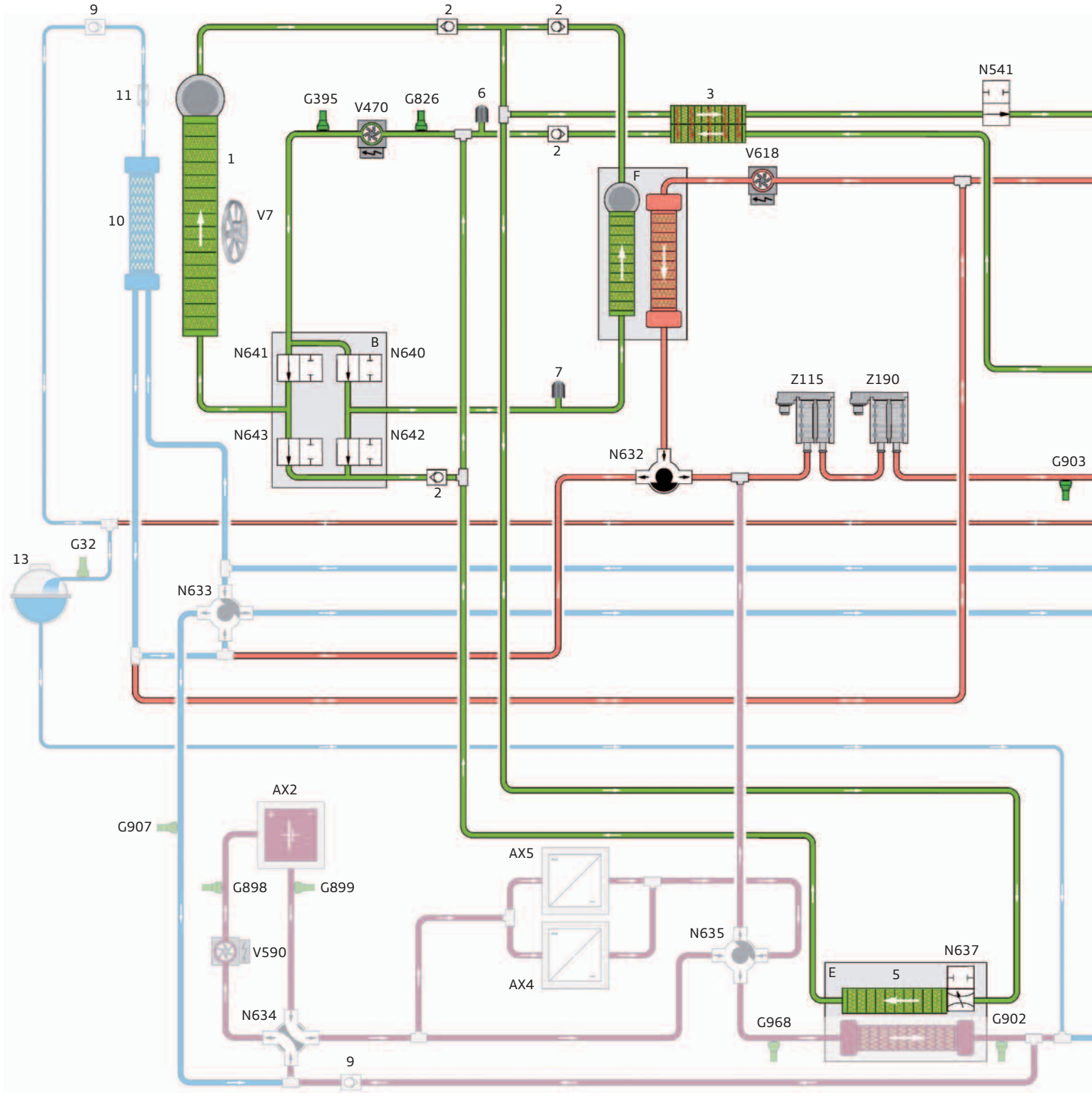
675_101

Key:

1	Condenser
2	Non-return valve in refrigerant circuit
3	Internal heat exchanger
4	Thermal expansion valve
5	Evaporator
6	Service connection for low-pressure side
7	Service connection for high-pressure side
8	Heat exchanger for heater
9	Non-return valve
10	Low-temperature radiator
11	Restrictor
12	Thermostat
13	Coolant expansion tank 2 (for high-voltage system)
A	Heater and air conditioning unit
B	Valve block
C	Front axle
D	Rear axle
E	Heat exchanger for high-voltage battery (chiller)
F	Heat exchanger for heat pump operation with condenser (iCond)
AX2	High-voltage battery 1
AX4	Charging unit 1 for high-voltage battery
AX5	Charging unit 2 for high-voltage battery
G32	Coolant shortage indicator sender
G395	Refrigerant pressure and temperature sender 1
G826	Refrigerant pressure and temperature sender 2
G898	Coolant temperature sender 1 for high-voltage battery
G899	Coolant temperature sender 2 for high-voltage battery
G902	Coolant temperature sender 1 for thermal management
G903	Coolant temperature sender 2 for thermal management
G906	Coolant temperature sender 5 for thermal management
G907	Coolant temperature sender 6 for thermal management
G968	Coolant temperature sender 8 for thermal management
N541	Refrigerant shut-off valve for heater and A/C unit
N632	Coolant changeover valve 1
N633	Coolant changeover valve 2
N634	Coolant changeover valve 3
N635	Coolant changeover valve 4
N637	Refrigerant expansion valve 2
N640	Refrigerant shut-off valve 2
N641	Refrigerant shut-off valve 3
N642	Refrigerant shut-off valve 4
N643	Refrigerant shut-off valve 5
J1234	Electric drive control unit for front axle
J1235	Electric drive control unit for rear axle
V7	Radiator fan
V470	Electrical air conditioner compressor
V590	Coolant pump for high-voltage battery
V618	Thermal management coolant pump 2
V620	Thermal management coolant pump 4
V662	Electric drive motor for front axle
V663	Electric drive motor for rear axle
Z115	High-voltage heater (PTC)
Z190	High-voltage heater 2 (PTC)

Refrigerant circuit and heating circuit

There are two heating circuits: one to warm up the interior using the high-voltage heater or the heat pump and another to heat up the high-voltage battery when it is charging. The high-voltage heater (PTC) Z115 (a second high-voltage heater 2 (PTC) Z190 arranged in series is available optionally) heats up the coolant flowing through, which, via the coolant temperature sender 2 for thermal management G903, reaches the heat exchanger for heater (8) where it provides heat to the interior. The warmed up coolant is transported by the thermal management coolant pump 2 V618 and flows through the heat exchanger for heat pump operation with condenser (F). The coolant changeover valve 1 N632 can switch between various heating circuit combinations.

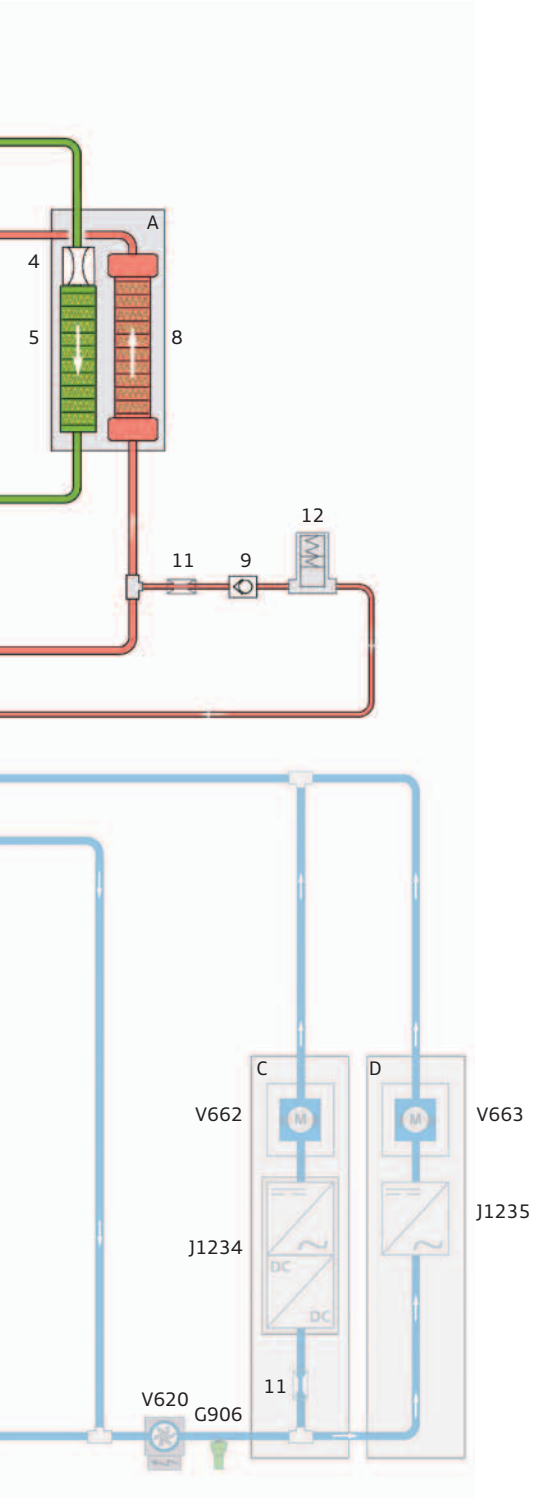


Refrigerant circuit

Heating circuit

Coolant circuit for electric powertrain

Coolant circuit for high-voltage battery



675_102

Key:

1 Condenser
2 Non-return valve in refrigerant circuit
3 Internal heat exchanger
4 Thermal expansion valve
5 Evaporator
6 Service connection for low-pressure side
7 Service connection for high-pressure side
8 Heat exchanger for heater
9 Non-return valve
10 Low-temperature radiator
11 Restrictor
12 Thermostat
13 Coolant expansion tank 2 (for high-voltage system)

A Heater and air conditioning unit
B Valve block
C Front axle
D Rear axle
E Heat exchanger for high-voltage battery (chiller)
F Heat exchanger for heat pump operation with condenser (iCond)

AX2 High-voltage battery 1

AX4 Charging unit 1 for high-voltage battery
AX5 Charging unit 2 for high-voltage battery

G32 Coolant shortage indicator sender
G395 Refrigerant pressure and temperature sender 1
G826 Refrigerant pressure and temperature sender 2
G898 Coolant temperature sender 1 for high-voltage battery
G899 Coolant temperature sender 2 for high-voltage battery
G902 Coolant temperature sender 1 for thermal management
G903 Coolant temperature sender 2 for thermal management
G906 Coolant temperature sender 5 for thermal management
G907 Coolant temperature sender 6 for thermal management
G968 Coolant temperature sender 8 for thermal management

N541 Refrigerant shut-off valve for heater and A/C unit
N632 Coolant changeover valve 1
N633 Coolant changeover valve 2
N634 Coolant changeover valve 3
N635 Coolant changeover valve 4
N637 Refrigerant expansion valve 2
N640 Refrigerant shut-off valve 2
N641 Refrigerant shut-off valve 3
N642 Refrigerant shut-off valve 4
N643 Refrigerant shut-off valve 5

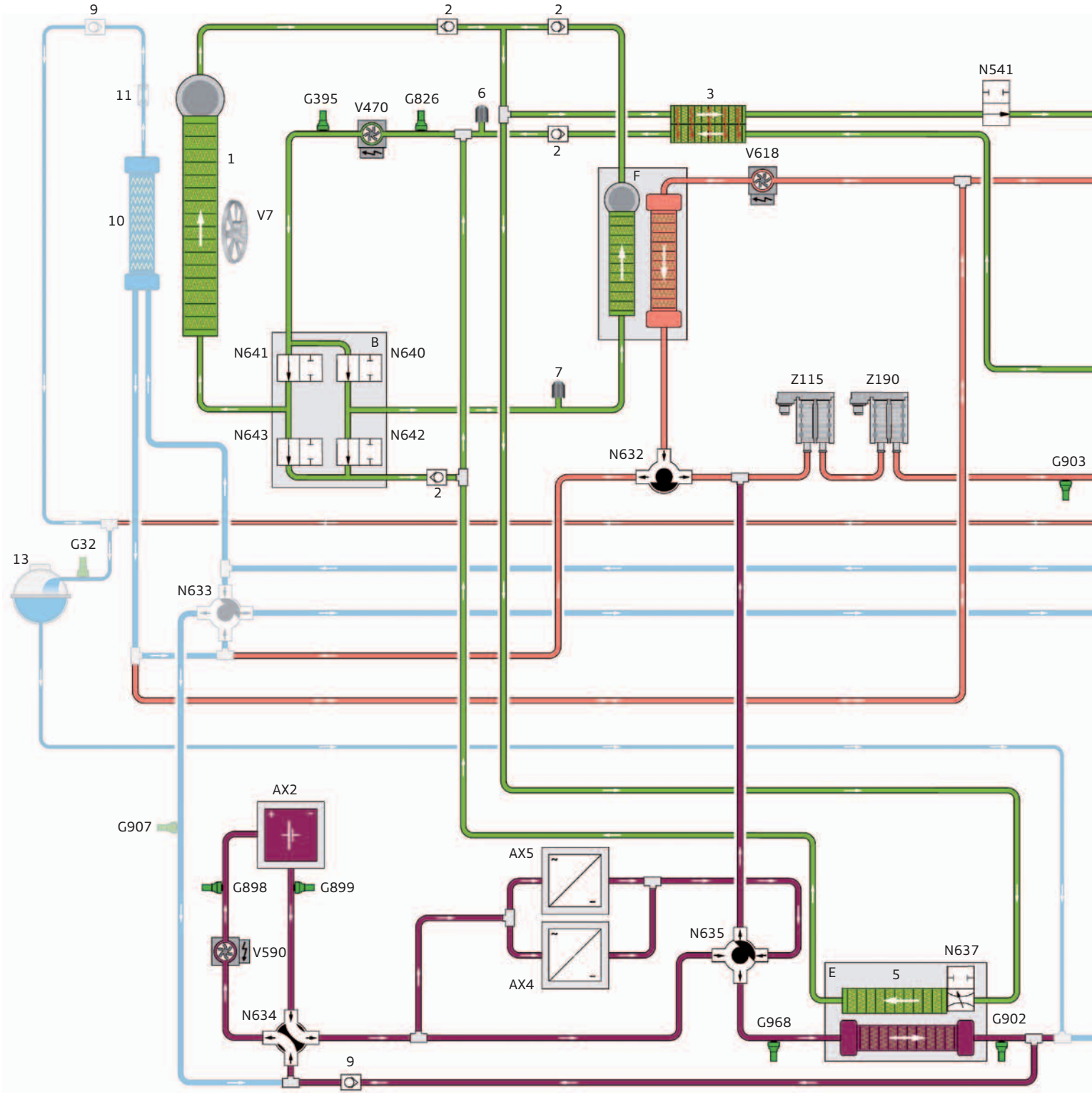
J1234 Electric drive control unit for front axle
J1235 Electric drive control unit for rear axle

V7 Radiator fan
V470 Electrical air conditioner compressor
V590 Coolant pump for high-voltage battery
V618 Thermal management coolant pump 2
V620 Thermal management coolant pump 4
V662 Electric drive motor for front axle
V663 Electric drive motor for rear axle

Z115 High-voltage heater (PTC)
Z190 High-voltage heater 2 (PTC)

Refrigerant circuit, heating circuit and coolant circuit for high-voltage battery

The coolant circuit for high-voltage battery cools high-voltage battery 1 AX2 and charging units 1 and 2 for high-voltage battery AX4 and AX5 during AC charging. The high-voltage battery can be cooled both passively via the low-temperature radiator and actively via the refrigerant circuit using the chiller. The charging units 1 and 2 for high-voltage battery 1 AX4 and AX5 are cooled by the low-temperature radiator. The two coolant changeover valves N634 and N635 regulate whether the coolant circuit for the high-voltage battery is activated for the electric powertrain individually or in combination with the heating circuit or the coolant circuit shown in the following. The coolant currently in use is G12evo. Depending on the country, this is a mix of 40 % coolant additive and 60 % distilled water, or 50 % coolant additive and 50 % distilled water.

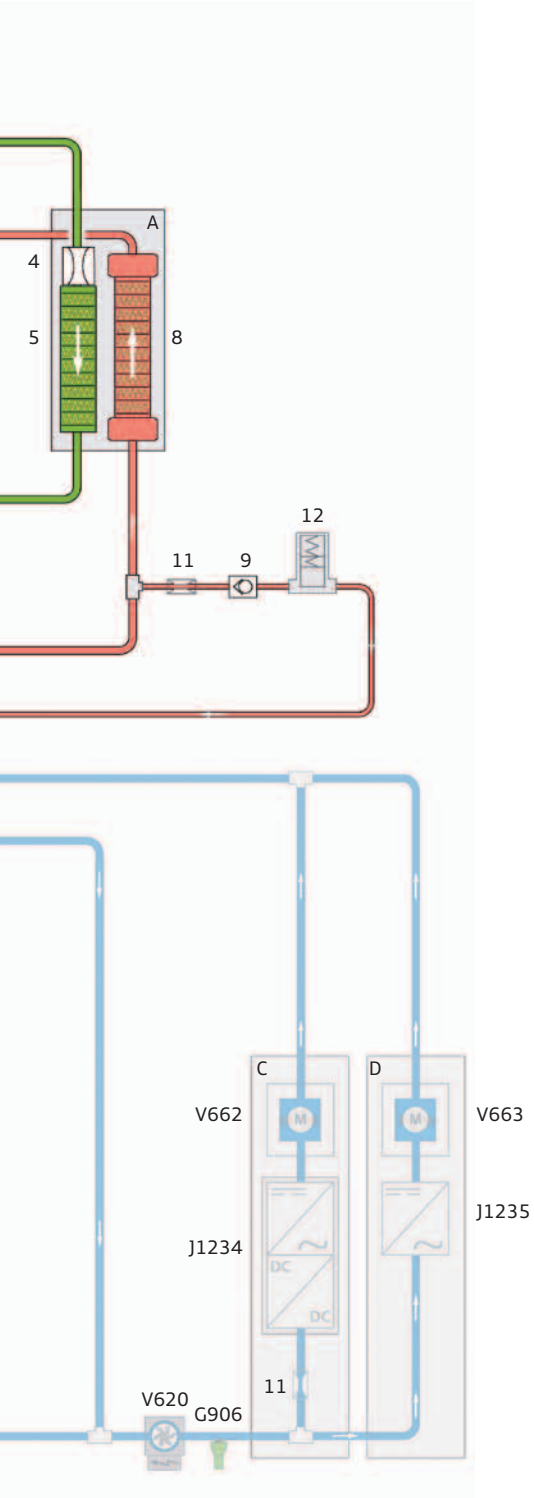


Refrigerant circuit

Heating circuit

Coolant circuit for electric powertrain

Coolant circuit for high-voltage battery



675_103

Key:

1	Condenser
2	Non-return valve in refrigerant circuit
3	Internal heat exchanger
4	Thermal expansion valve
5	Evaporator
6	Service connection for low-pressure side
7	Service connection for high-pressure side
8	Heat exchanger for heater
9	Non-return valve
10	Low-temperature radiator
11	Restrictor
12	Thermostat
13	Coolant expansion tank 2 (for high-voltage system)

A	Heater and air conditioning unit
B	Valve block
C	Front axle
D	Rear axle
E	Heat exchanger for high-voltage battery (chiller)
F	Heat exchanger for heat pump operation with condenser (iCond)

AX2	High-voltage battery 1

AX4	Charging unit 1 for high-voltage battery
AX5	Charging unit 2 for high-voltage battery

G32	Coolant shortage indicator sender
G395	Refrigerant pressure and temperature sender 1
G826	Refrigerant pressure and temperature sender 2
G898	Coolant temperature sender 1 for high-voltage battery
G899	Coolant temperature sender 2 for high-voltage battery
G902	Coolant temperature sender 1 for thermal management
G903	Coolant temperature sender 2 for thermal management
G906	Coolant temperature sender 5 for thermal management
G907	Coolant temperature sender 6 for thermal management
G968	Coolant temperature sender 8 for thermal management

N541	Refrigerant shut-off valve for heater and A/C unit
N632	Coolant changeover valve 1
N633	Coolant changeover valve 2
N634	Coolant changeover valve 3
N635	Coolant changeover valve 4
N637	Refrigerant expansion valve 2
N640	Refrigerant shut-off valve 2
N641	Refrigerant shut-off valve 3
N642	Refrigerant shut-off valve 4
N643	Refrigerant shut-off valve 5

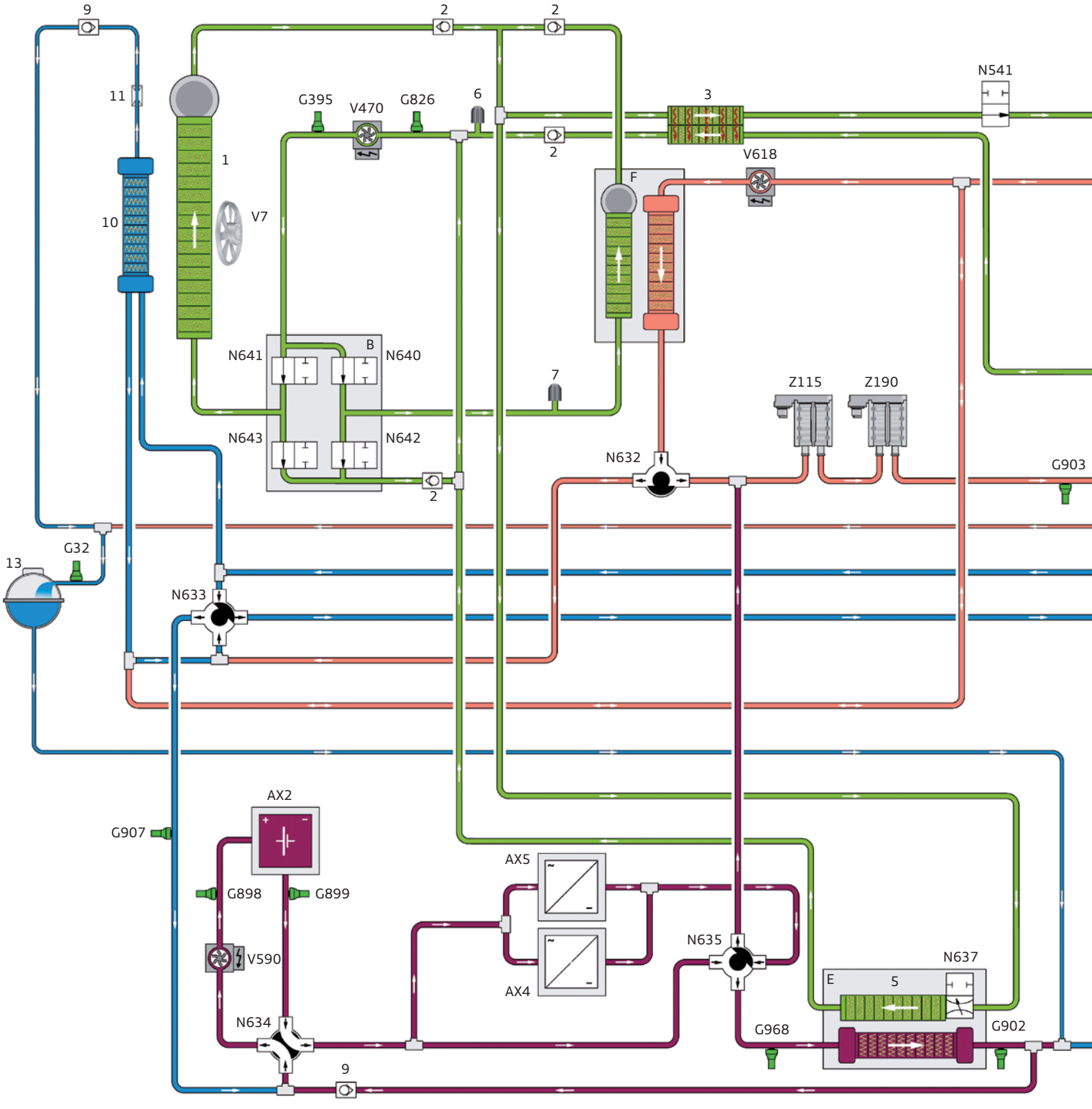
J1234	Electric drive control unit for front axle
J1235	Electric drive control unit for rear axle

V7	Radiator fan
V470	Electrical air conditioner compressor
V590	Coolant pump for high-voltage battery
V618	Thermal management coolant pump 2
V620	Thermal management coolant pump 4
V662	Electric drive motor for front axle
V663	Electric drive motor for rear axle

Z115	High-voltage heater (PTC)
Z190	High-voltage heater 2 (PTC)

Refrigerant circuit, heating circuit, coolant circuit for high-voltage battery and coolant circuit for electric powertrain

The thermal management coolant pump 4 V620 transports the coolant flow via the front axle and rear axle, electric drive control units J1234 and J1235 and electric drive motors V662 and V663. From here, the coolant reaches the low-temperature radiator (10) with the radiator fan V7. A breather line goes from the radiator into the expansion tank via the coolant shortage indicator sender 2 G32. After flowing through the low-temperature radiator, the coolant is taken back to the thermal management coolant pump 4 V620 via the coolant changeover valve 2 N633.

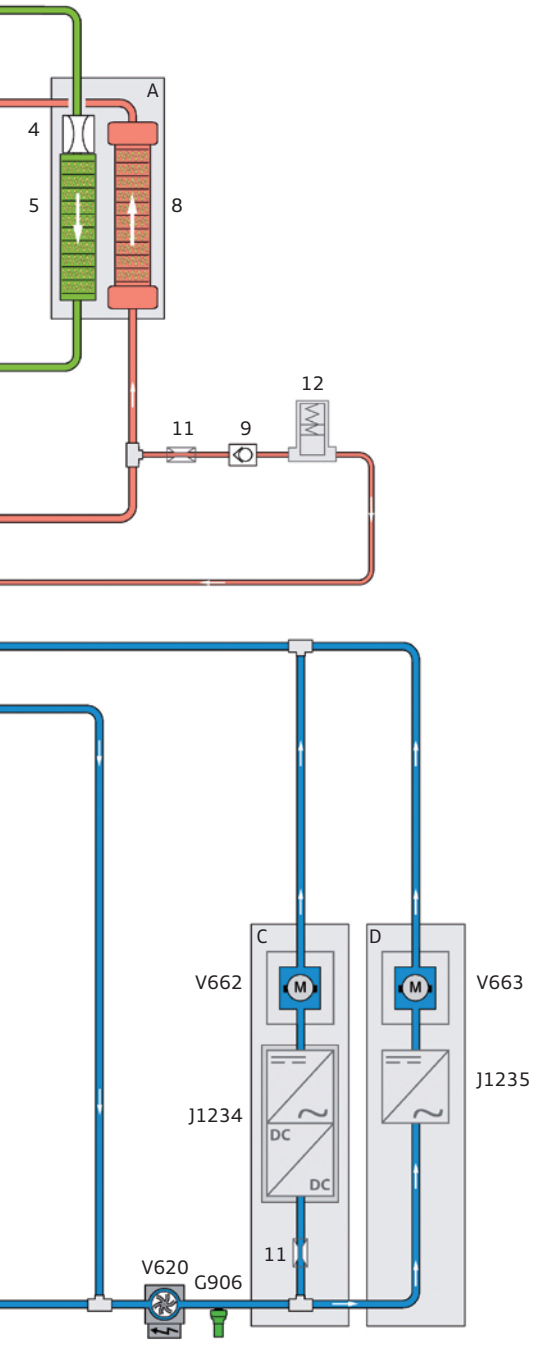


Refrigerant circuit

Heating circuit

Coolant circuit for electric powertrain

Coolant circuit for high-voltage battery



675_104

Key:

1	Condenser
2	Non-return valve in refrigerant circuit
3	Internal heat exchanger
4	Thermal expansion valve
5	Evaporator
6	Service connection for low-pressure side
7	Service connection for high-pressure side
8	Heat exchanger for heater
9	Non-return valve
10	Low-temperature radiator
11	Restrictor
12	Thermostat
13	Coolant expansion tank 2 (for high-voltage system)

A	Heater and air conditioning unit
B	Valve block
C	Front axle
D	Rear axle
E	Heat exchanger for high-voltage battery (chiller)
F	Heat exchanger for heat pump operation with condenser (iCond)

AX2	High-voltage battery 1

AX4	Charging unit 1 for high-voltage battery
AX5	Charging unit 2 for high-voltage battery

G32	Coolant shortage indicator sender
G395	Refrigerant pressure and temperature sender 1
G826	Refrigerant pressure and temperature sender 2
G898	Coolant temperature sender 1 for high-voltage battery
G899	Coolant temperature sender 2 for high-voltage battery
G902	Coolant temperature sender 1 for thermal management
G903	Coolant temperature sender 2 for thermal management
G906	Coolant temperature sender 5 for thermal management
G907	Coolant temperature sender 6 for thermal management
G968	Coolant temperature sender 8 for thermal management

N541	Refrigerant shut-off valve for heater and A/C unit
N632	Coolant changeover valve 1
N633	Coolant changeover valve 2
N634	Coolant changeover valve 3
N635	Coolant changeover valve 4
N637	Refrigerant expansion valve 2
N640	Refrigerant shut-off valve 2
N641	Refrigerant shut-off valve 3
N642	Refrigerant shut-off valve 4
N643	Refrigerant shut-off valve 5

J1234	Electric drive control unit for front axle
J1235	Electric drive control unit for rear axle

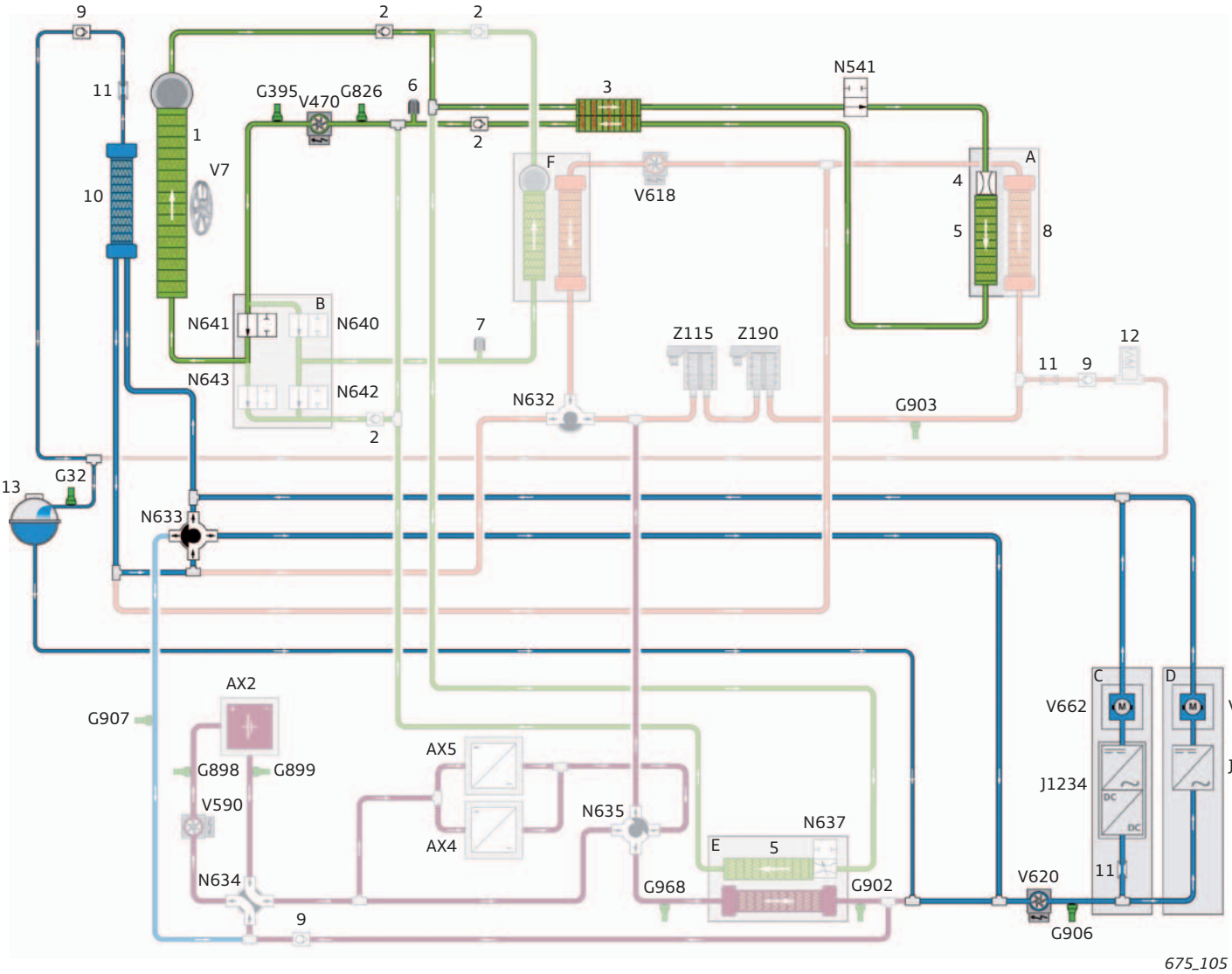
V7	Radiator fan
V470	Electrical air conditioner compressor
V590	Coolant pump for high-voltage battery
V618	Thermal management coolant pump 2
V620	Thermal management coolant pump 4
V662	Electric drive motor for front axle
V663	Electric drive motor for rear axle

Z115	High-voltage heater (PTC)
Z190	High-voltage heater 2 (PTC)

Thermal management system scenarios

Which situation occurs, when and if it occurs, and for how long it occurs in the following scenarios is measured by the thermal management control unit J1024 using sensors. The control unit then activates the coolant pumps, coolant changeover valves, refrigerant shut-off valves, air conditioner compressor etc. and switches between the various scenarios correspondingly. These scenarios do not encompass all possible interconnections of the four circuits described at the beginning of this chapter. The following scenarios illustrate the typical interconnections of the vehicle's thermal management system. The precise designations of the components can be found in the key to the four thermal management circuits described at the beginning of this chapter.

Cooling interior and electric drive motors

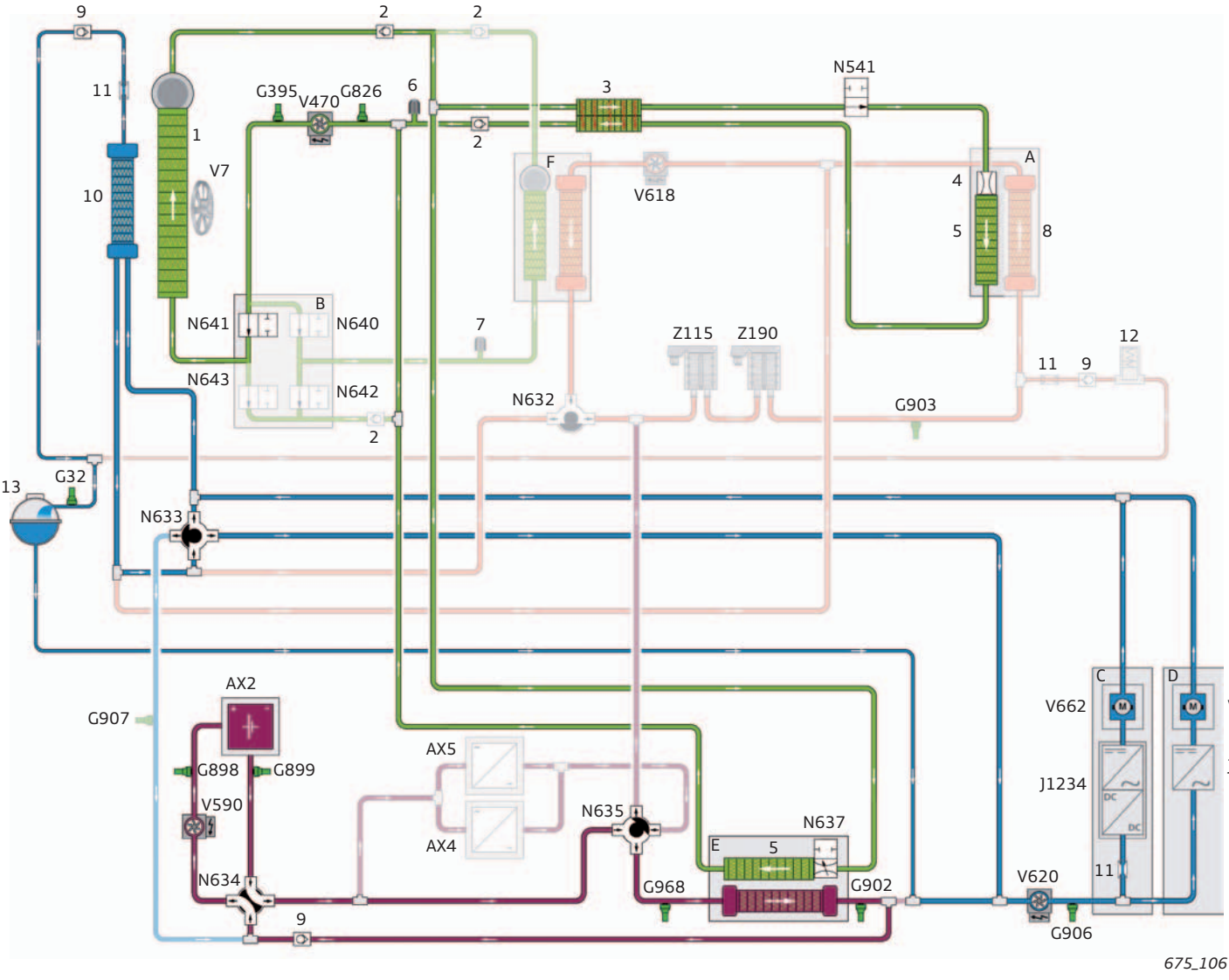


675_105

In this example scenario, the interior and the electric drive motors (together with their electric drive control units) are cooled at both the front and rear axles. The electric drive control units and the electric drive motors on the front and rear axles are cooled passively via the low-temperature radiator. "Passively" means without cooling via a thermal refrigerant interface up to a temperature difference of approximately 5 to 10 °C above the outside temperature.

The vehicle interior is actively cooled (i.e. by the regular refrigerant circuit using compression, pressure expansion of refrigerant and cooling in air conditioning unit). This allows heat to be absorbed from the vehicle interior and dissipated.

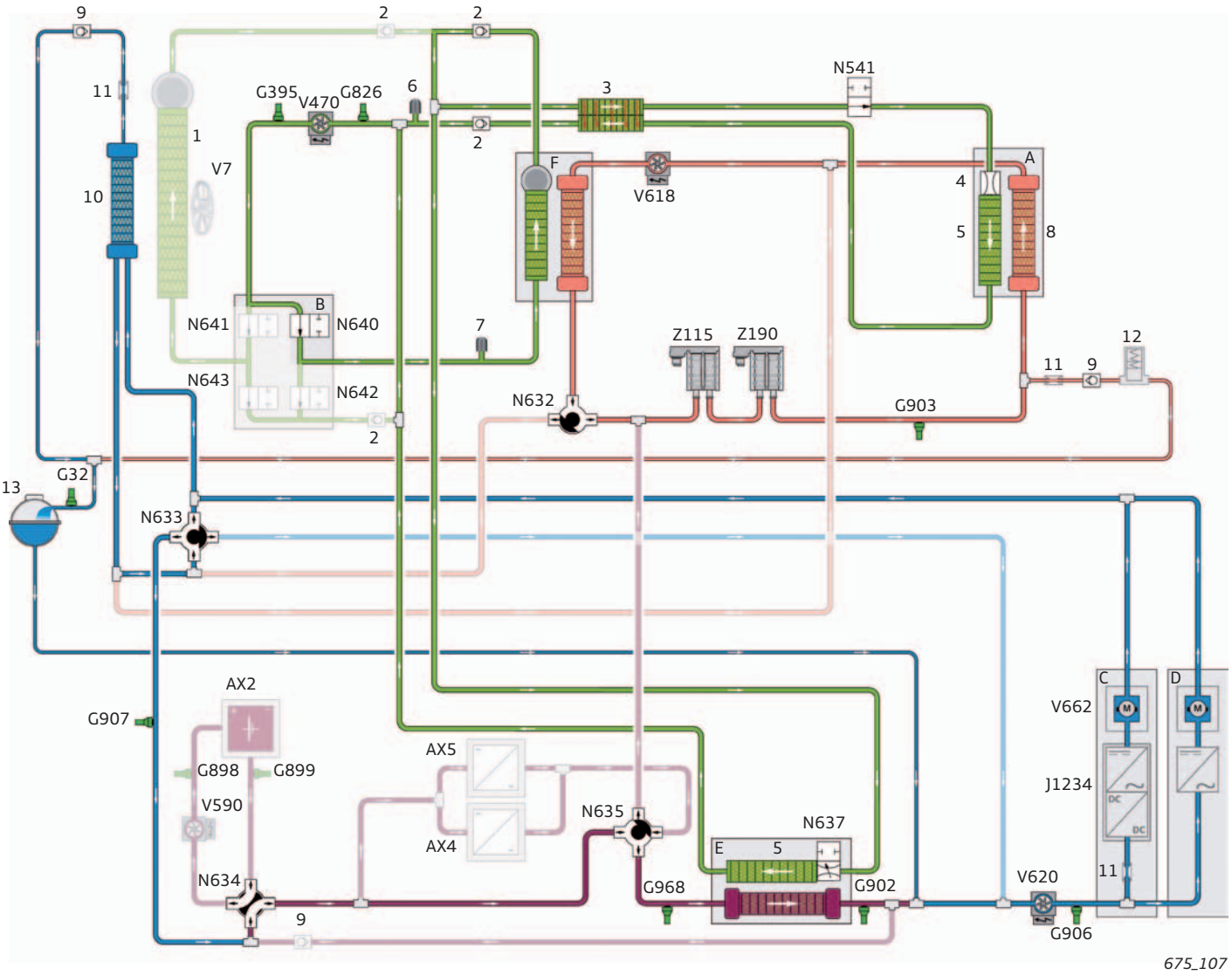
Cooling interior, electric drive motors and high-voltage battery



675_106

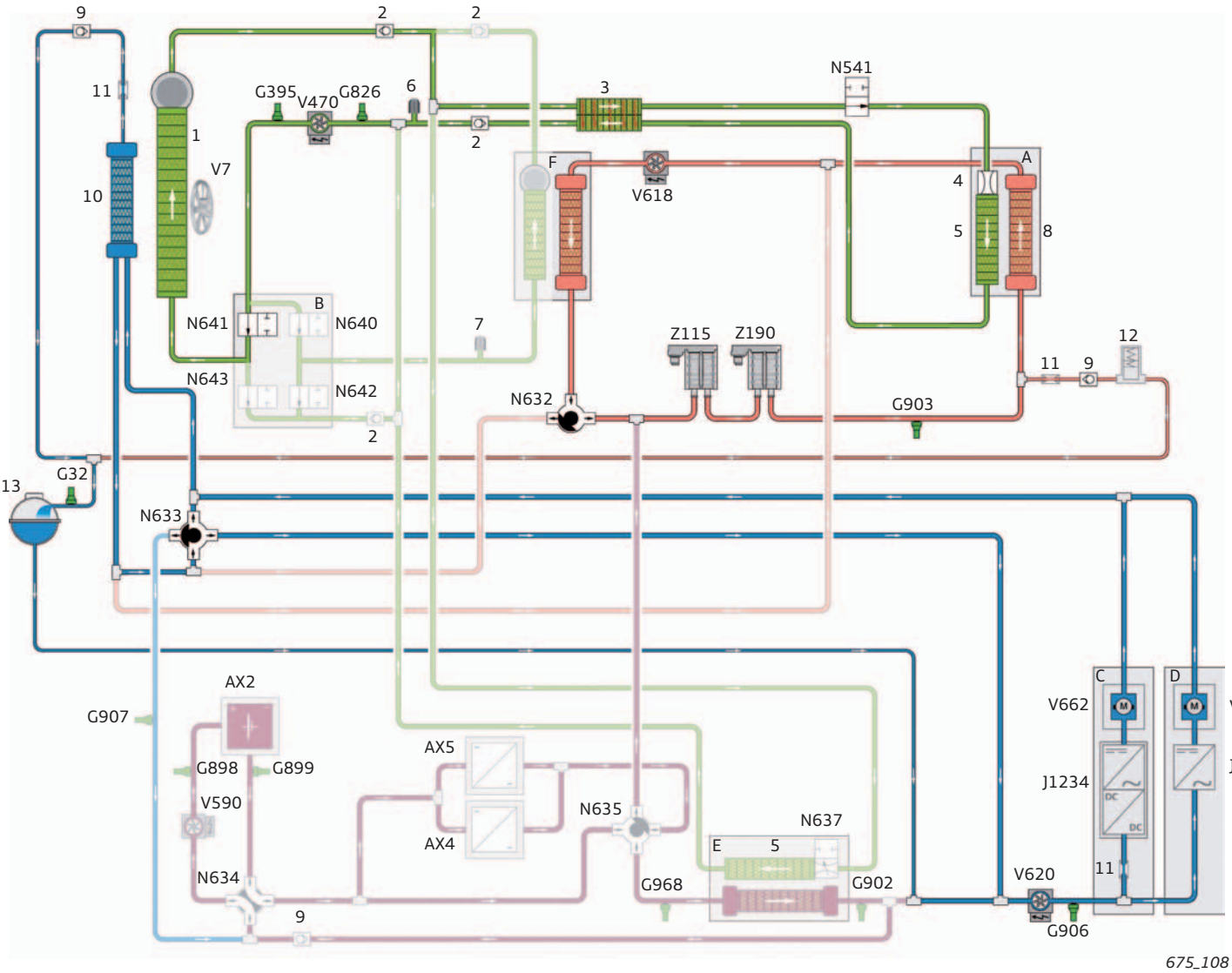
The scenario shown in the diagram describes the cooling of the interior, the electric drive motors and the high-voltage battery. The interior and the electric drive motors are cooled as described in the previous example. In addition, the high-voltage battery is actively cooled via the thermal interface of the heat exchanger for the high-voltage battery (chiller). This involves sending compressed refrigerant to the chiller via the refrigerant expansion valve using the same principle as for the refrigerant circuit for the interior, which runs at the same time. The refrigerant is expanded in the chiller and is therefore able to absorb heat from the high-voltage battery from the coolant circuit for the high-voltage battery and guide it away with the refrigerant. The optimum temperature for the high-voltage battery is between approx. 25 °C and approx. 35 °C. It is cooled at temperatures above approx. 35 °C.

Reheating interior and heat pumps (cooling, dehumidifying, heating)



Reheat means that the air is initially cooled (and thereby also dehumidified) so that it can then be warmed up to heat the interior. This prevents the windows and windscreen from misting up. This involves the refrigerant absorbing heat from the coolant circuit for the electrical powertrain via the heat exchanger for the high-voltage battery (E). This warmed up refrigerant is then brought to a higher temperature level by passing through the electrical air conditioner compressor. The hot refrigerant (without pressure expansion) flows through the heat exchanger for heat pump operation with condenser (F) and can then transmit the previously absorbed and multiplied heat to the heating circuit for the interior. The heat is given off to the vehicle interior by the heater and air conditioning unit. This function is activated at outside temperatures of between approx. 5 °C and approx. 20 °C.

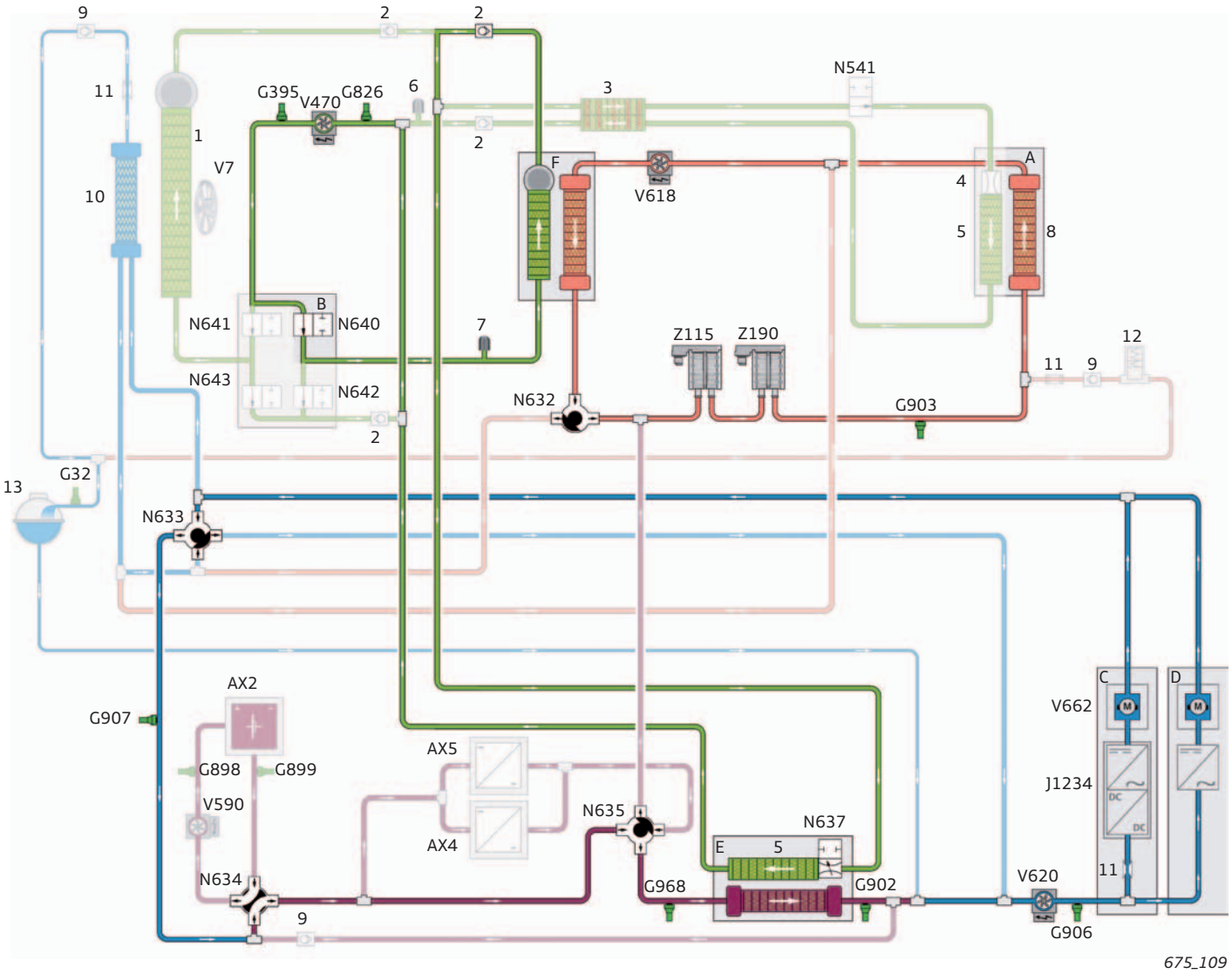
Reheating interior (cooling, dehumidifying, heating)



675_108

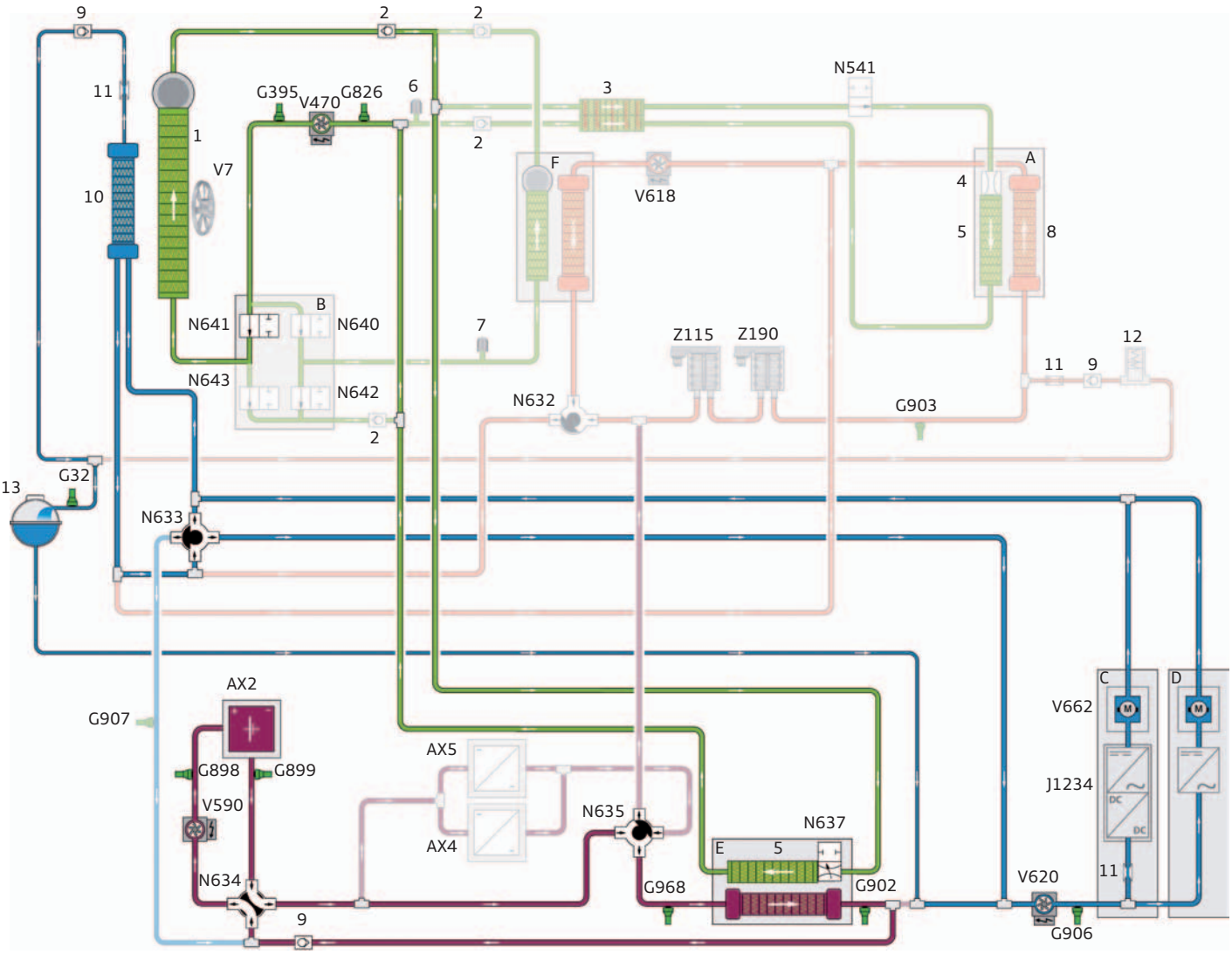
This scenario describes the same reheat principle as the previous thermal management example. The difference is that the interior heating is achieved via activation of the high-voltage heater(s). The heat pump is not used. The coolant circuit for the electric power-train also runs via the low-temperature radiator in passive cooling mode, but does not have a thermal effect on the interior heating.

Heating interior with heat pump



This involves residual heat from the coolant circuit for the electric powertrain being transferred to the refrigerant of the air conditioning circuit without activation of the low-temperature radiator in the heat exchanger for the high-voltage battery (E). The refrigerant is compressed in the electrical air conditioner compressor, thereby bringing the previously gained heat up to a higher temperature level. The hot refrigerant transfers the heat energy to the heating circuit for the vehicle interior in the heat exchanger for heat pump operation with condenser (F). For efficiency reasons, the heat pump is only active at outside temperatures of between approx. -20 °C and approx. 20 °C.

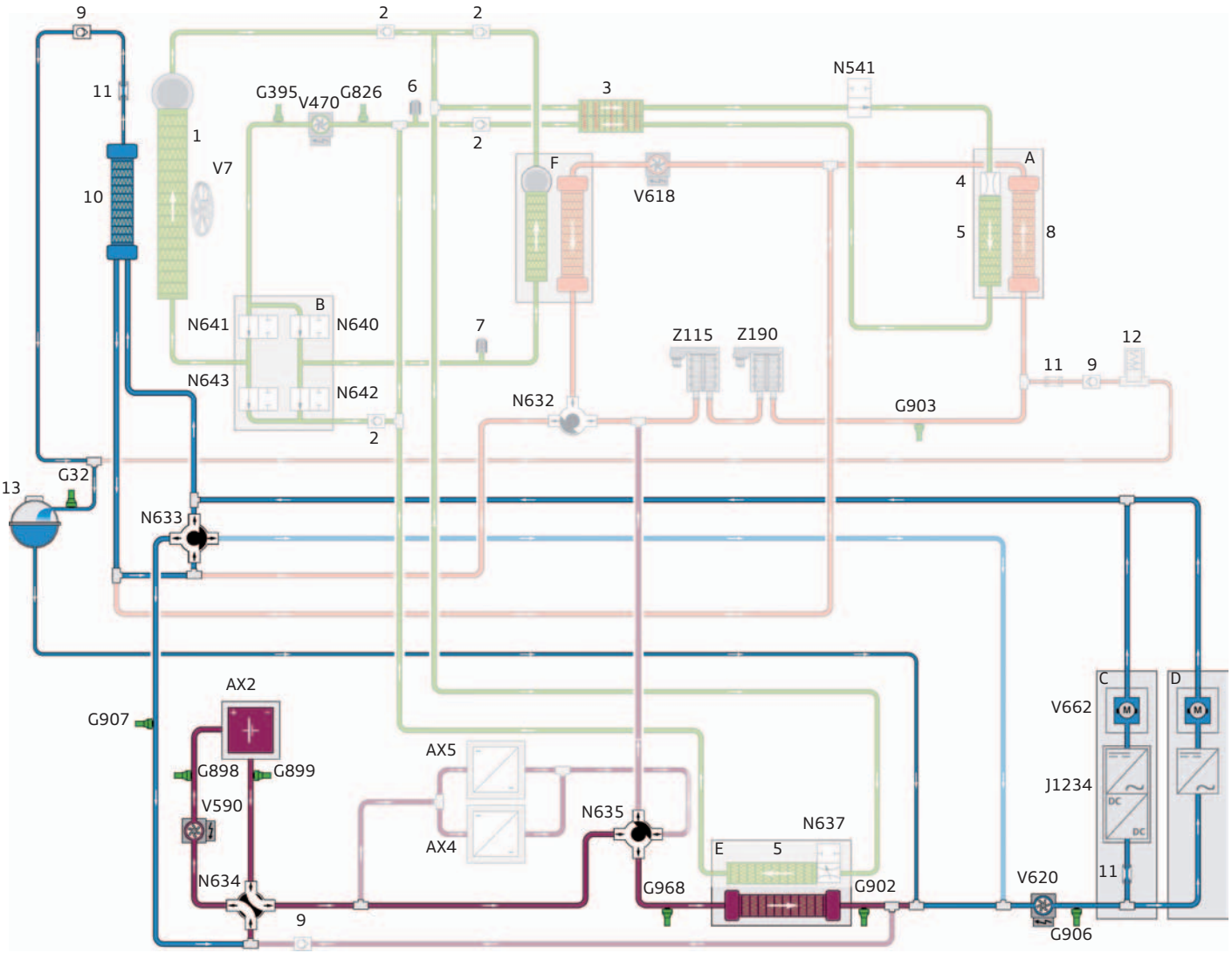
Cooling high-voltage battery via chiller (DC charging)



675_110

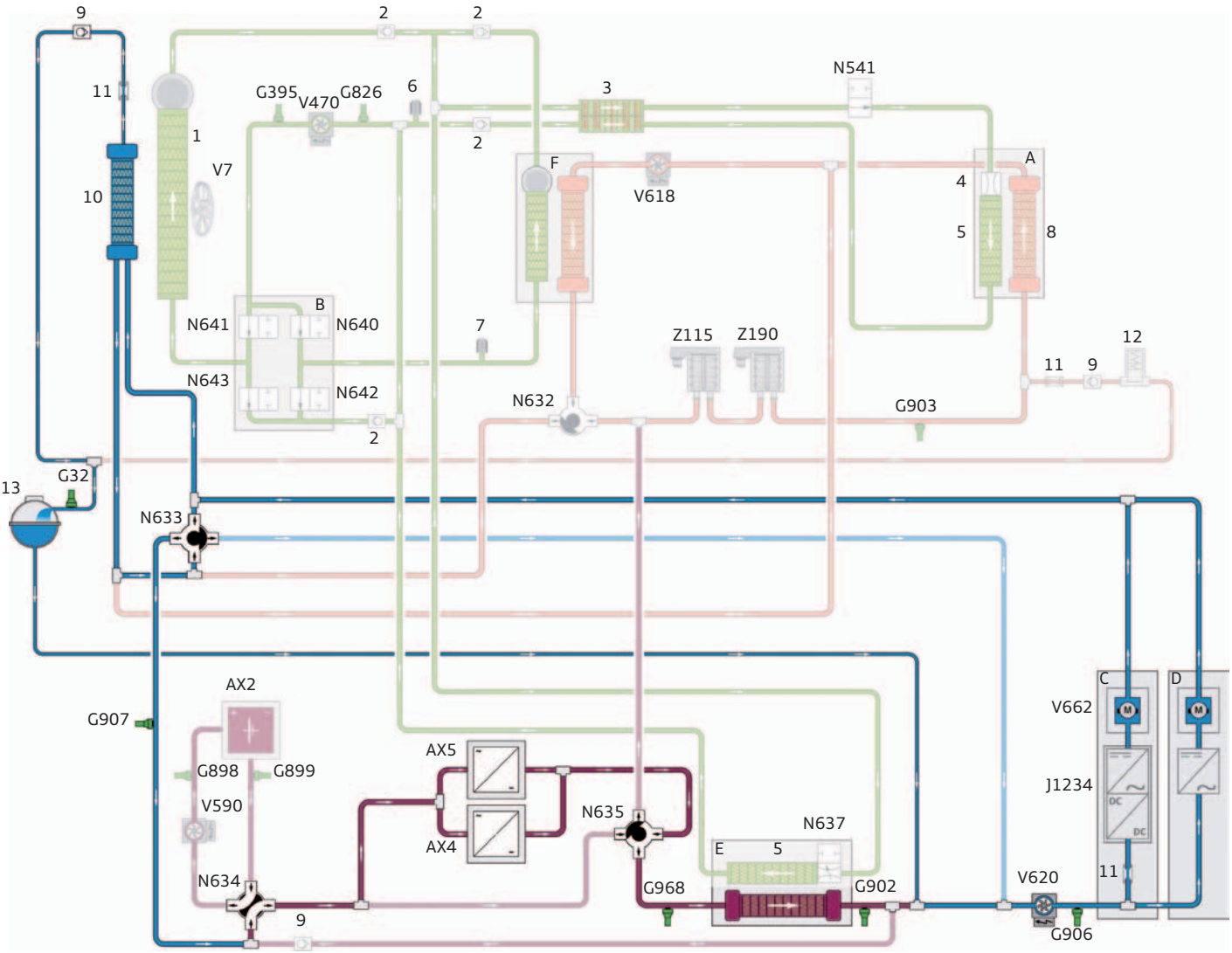
This scenario relates to charging with direct current. The refrigerant is compressed in the electrical air conditioner compressor, cooled in the condenser and sent to the heat exchanger for high-voltage battery (E), where its pressure is dissipated in the refrigerant expansion valve. Due to the significant cooling this causes, residual heat from the coolant circuit for the high-voltage battery can be absorbed and guided away with the refrigerant when the battery is charging. The passive cooling function for the coolant circuit for the electric powertrain continues running separately at the same time. The high-voltage battery is cooled at component temperatures of approx. 35 °C and above. Interior cooling initially has priority over battery cooling.

Cooling high-voltage battery via low-temperature radiator (DC charging)



This scenario also relates to charging with direct current. The coolant circuit for the high-voltage battery and the coolant circuit for the electric powertrain are connected together. Residual heat from the high-voltage battery is absorbed and, after passing the electric drive motors and their electric drive control units, sent to the low-temperature radiator where the coolant releases the absorbed heat into the atmosphere.

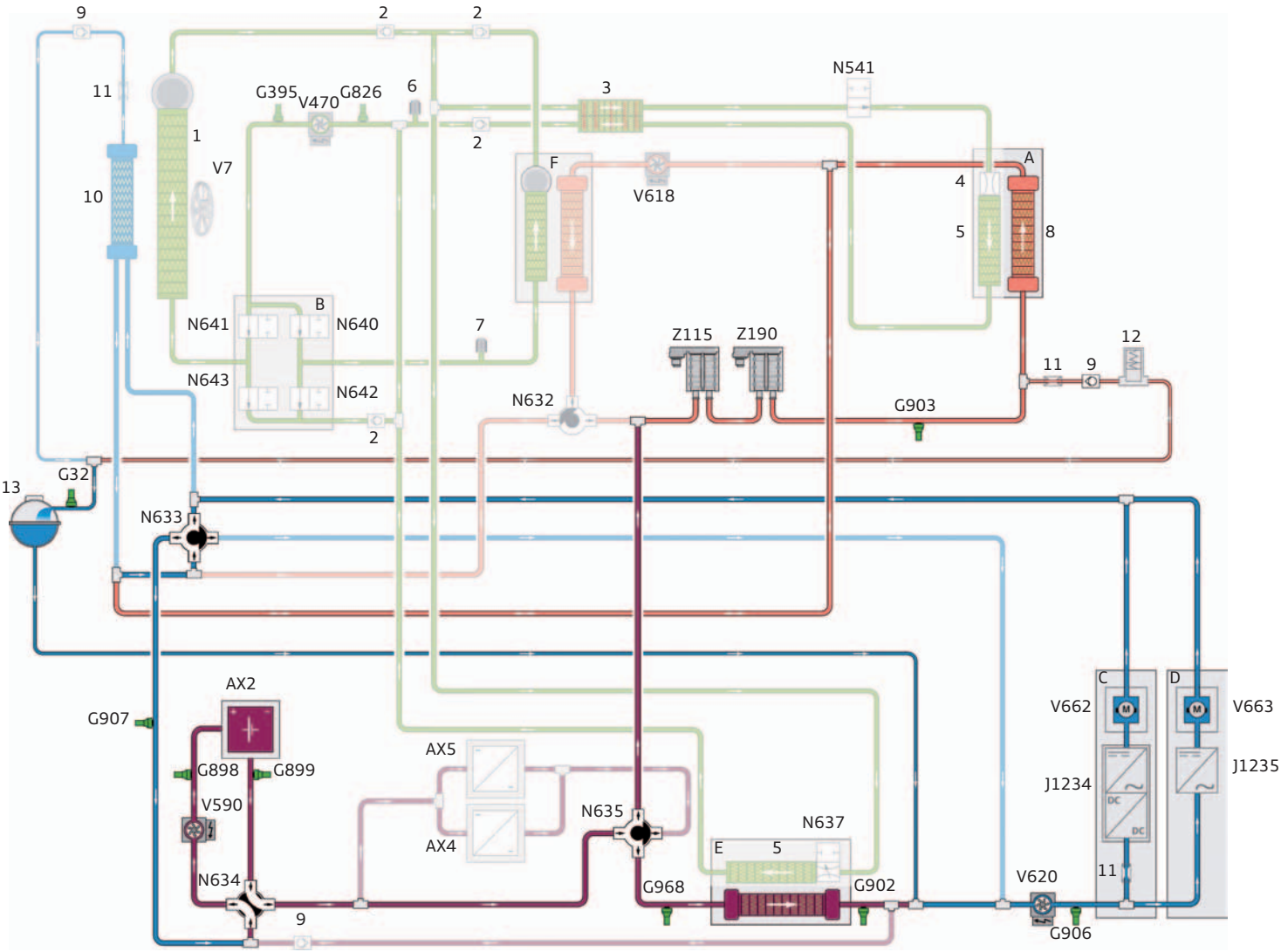
Cooling charging unit via low-temperature radiator (AC charging)



675_112

This scenario relates to charging with alternating current. The coolant circuit for the high-voltage battery and the coolant circuit for the electric powertrain are interconnected. The charging unit(s) heat up during AC charging. The heat produced is absorbed by the coolant circuit for the high-voltage battery via the charging units 1 and 2 for high-voltage battery AX4 and AX5. After flowing through the electric drive motors and their electric drive control units, the coolant flow reaches the low-temperature radiator, where the heat energy absorbed during charging can be released into the atmosphere and the circuit closed.

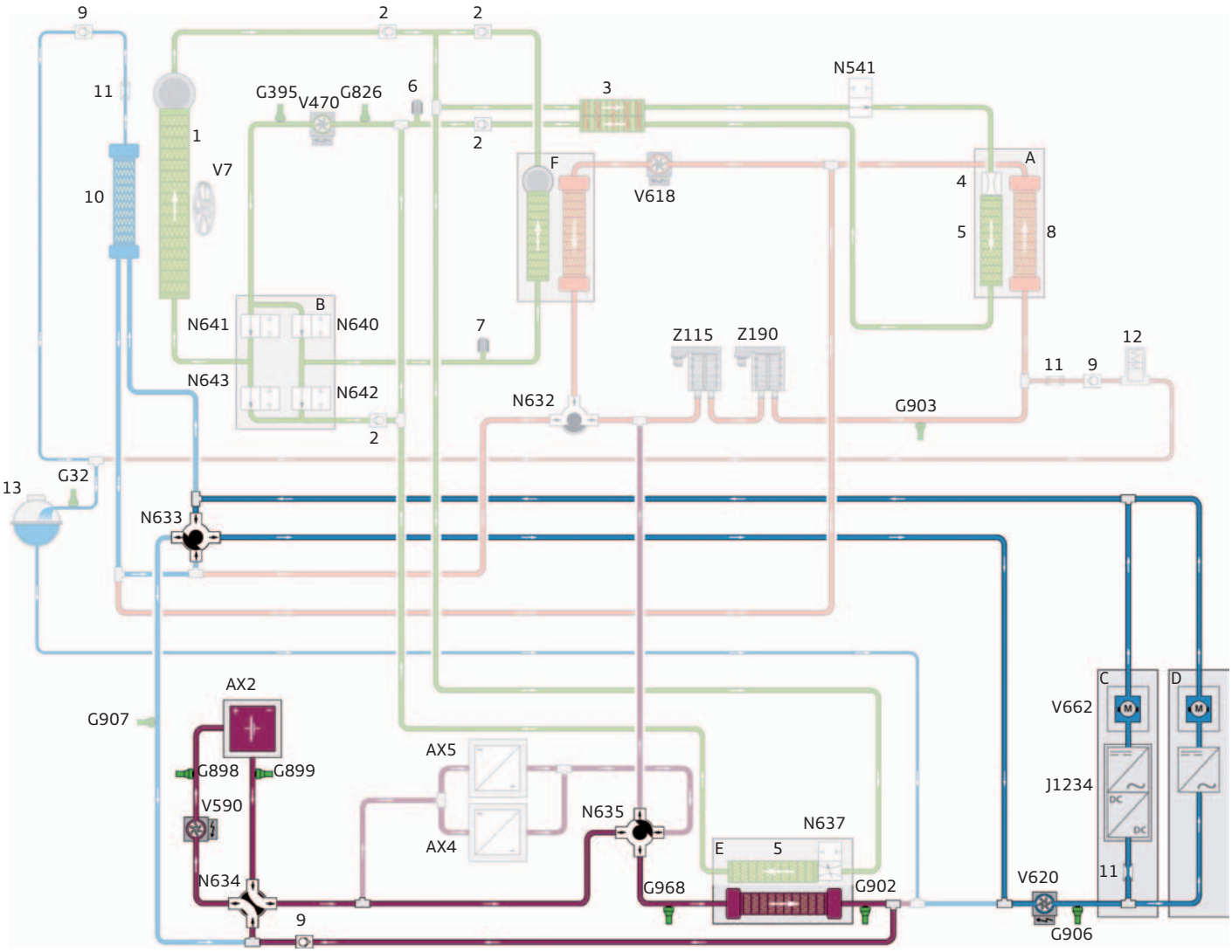
Heating high-voltage battery (DC charging)



675_113

During DC charging, the high-voltage heater can heat the coolant if necessary. After passing through the heater and air conditioning unit, the heated coolant flows to the coolant changeover valve 2 N633, which sends it to the high-voltage battery, where its heat energy can be given off to the high-voltage battery. The heating circuit repeats after the coolant has flowed through the high-voltage battery. In addition, a minimum volume of coolant always flows through the coolant circuit for the electric powertrain. The high-voltage battery is heated at temperatures below approx. -10 °C.

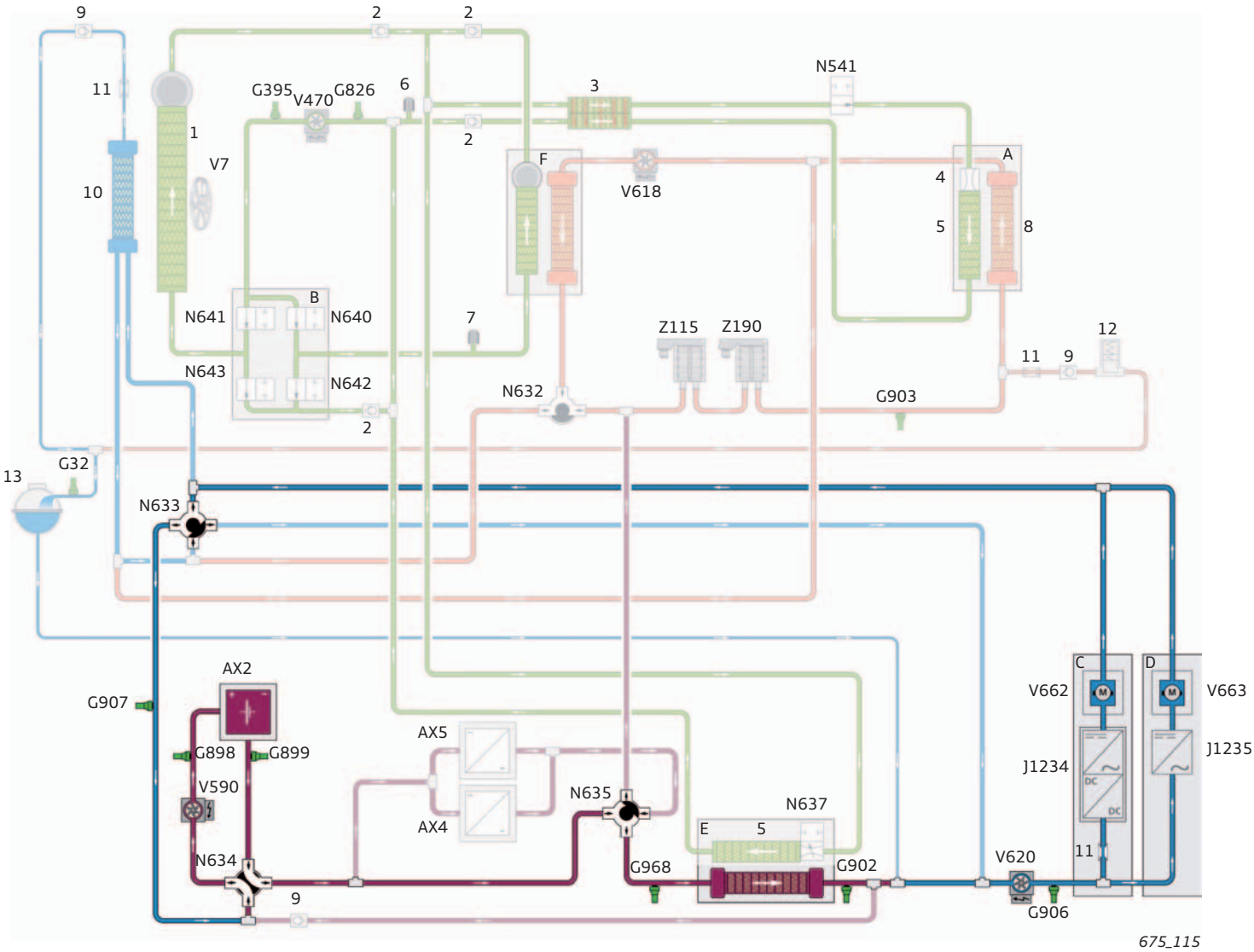
Flushing coolant circuit for high-voltage battery and coolant circuit for electric powertrain as separate circuits



675_114

During flushing, the coolant simply circulates in the coolant circuits; it is not heated or cooled. Flushing is used for thermal homogenisation of the components in a coolant circuit. This means that the temperatures in, for example, the high-voltage battery or the electric drive motors can be equalised. The coolant circuit for the high-voltage battery and the coolant circuit for the electric powertrain can be flushed individually as separate circuits (refer to figure 675_114) or together as a combined circuit (refer to figure 675_115).

Flushing coolant circuit for high-voltage battery and coolant circuit for electrical powertrain as a combined circuit



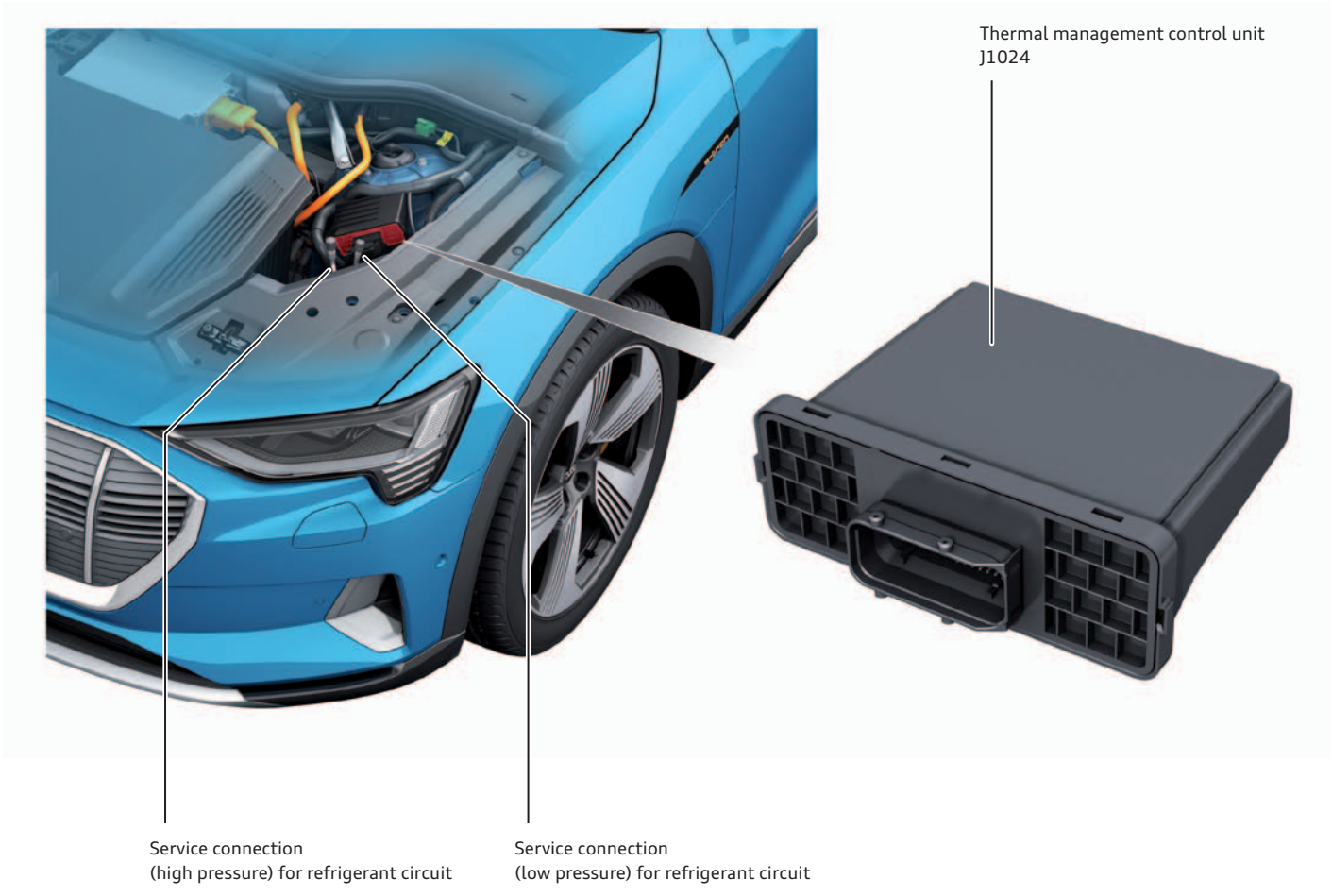
Thermal management control unit J1024

The thermal management control unit J1024 uses various sensors to measure the actual conditions in the four circuits of the thermal management system and, after evaluating them, controls the target states via the actuators in the vehicle's refrigerant and coolant circuits.

The sensors are, for example, the refrigerant pressure and temperature sender and the various coolant temperature senders.

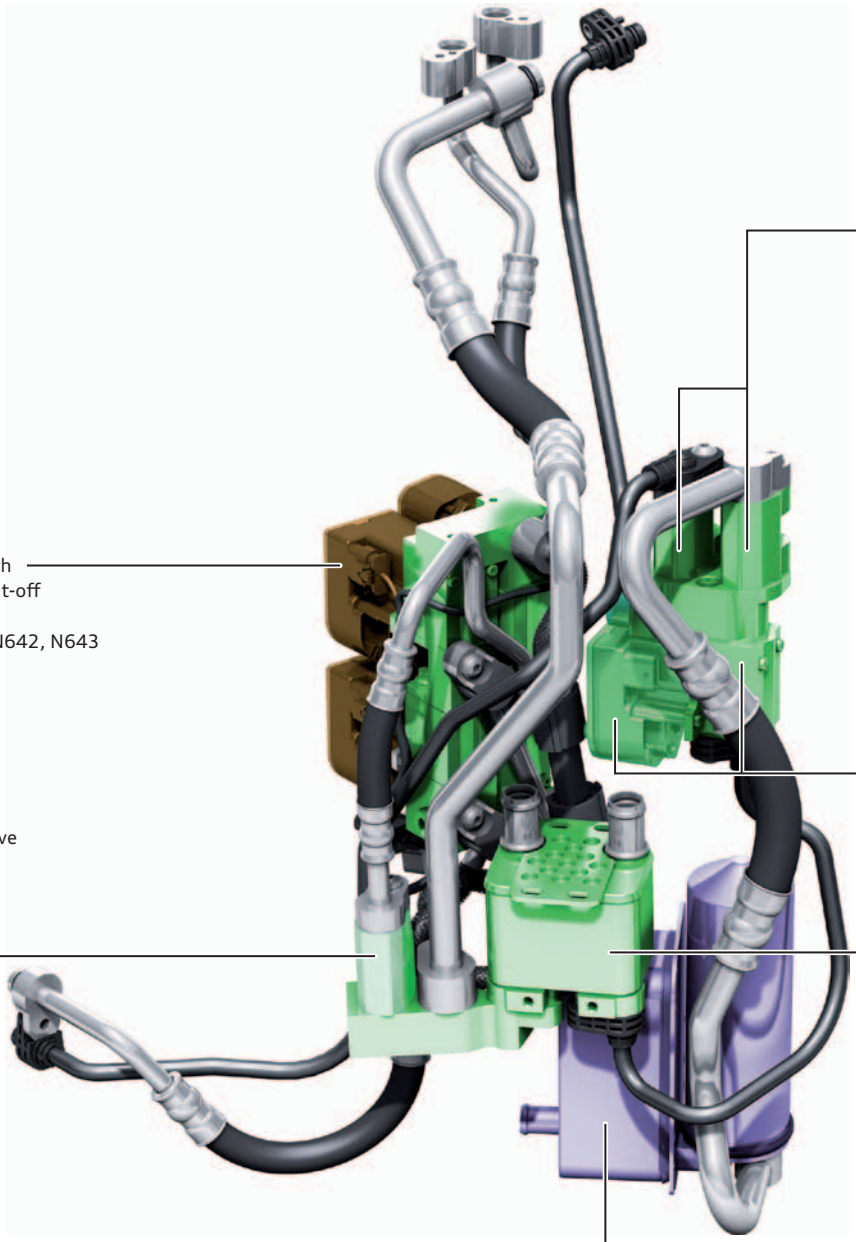
The actuators are, for example, the electrical air conditioner compressor, refrigerant shut-off valves, coolant pumps, coolant changeover valves, non-return valves and radiator fans.
For the exact designations of the components, sensors and actuators, refer to the keys of the circuits previously described.
The input values of the sensors are translated into and controlled as output values at the actuators.

This means that the thermal management control unit J1024 uses input parameters and a defined algorithm to consistently control the optimum state of the vehicle's thermal management system and adjusts the energetically best possible operating states in the vehicle.
In practice, this is done by the various interconnections of the refrigerant and coolant circuits described above, the separation of the circuits or their combination.



675_157

Assembly group - heat exchanger for heat pump operation and for high-voltage battery, refrigerant circuit valves



Primarily the following components are fitted on carriers, brackets and base plates in one assembly group:

- Valve block with refrigerant shut-off valves N640, N641, N642, N643
- Non-return valves for refrigerant circuit
- Heat exchanger for high-voltage battery
- Heat exchanger for heat pump operation with condenser
- Refrigerant expansion valve 2 N637

In the vehicle, the approximate location of the assembly group is in front of the front left wheel behind the bumper (as seen in direction of travel). For greater clarity, the carriers and brackets that the components are fitted on are not shown in the illustration.

Coolant expansion tank

The maximum coolant filling level is approx. 2.0 ltr.; the minimum level is approx. 1.57 ltr.
The coolant level warning is activated via the coolant shortage indicator sender G32 at a level of approx. 0.4 ltr. in the coolant expansion tank.

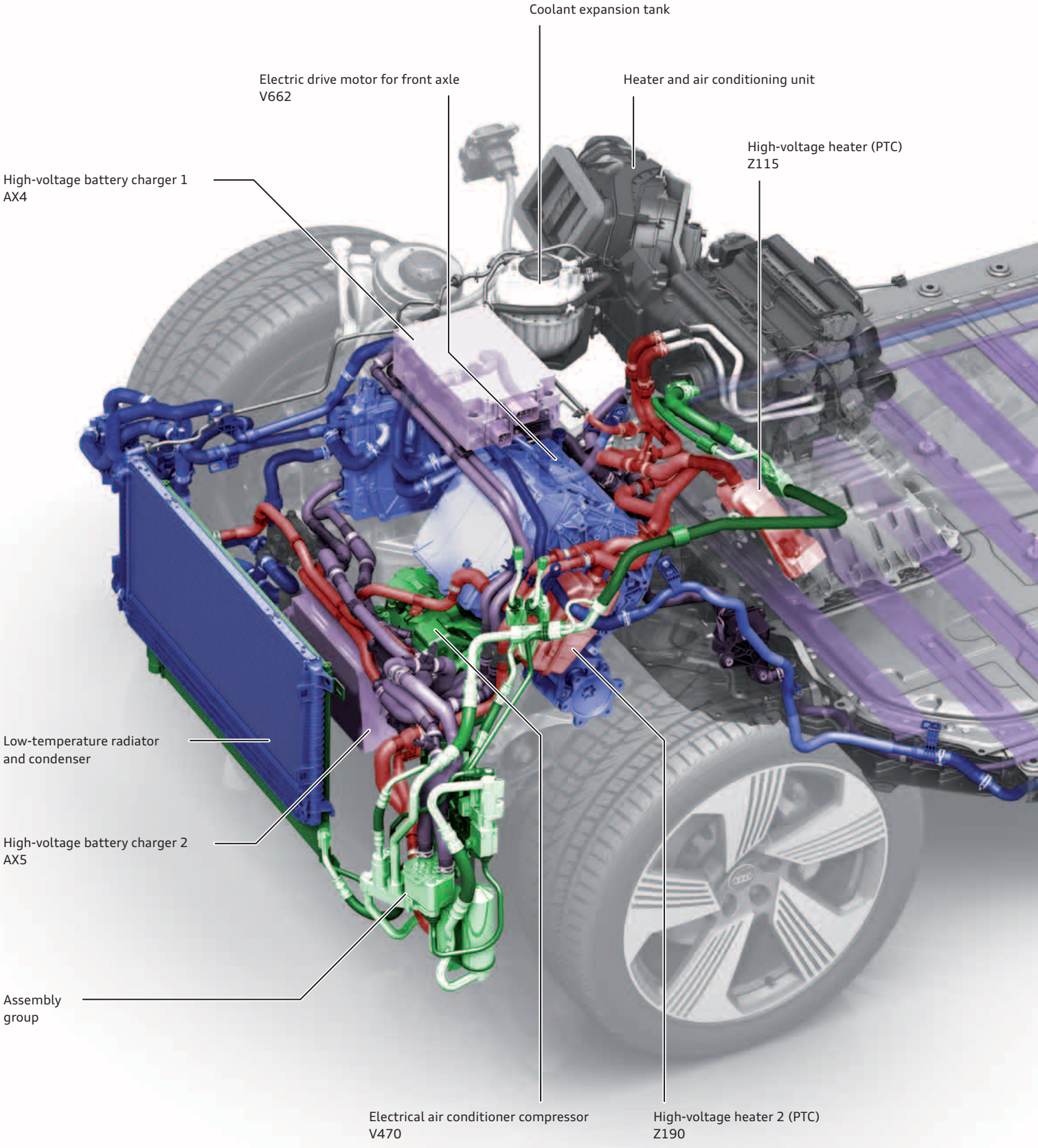
The theoretical overall volume of the expansion tank is approx. 3.0 ltr. Due to the air cushion that forms when the sealing cap is unscrewed, the expansion tank can be filled with a maximum of approx. 2.7 ltr. of coolant.

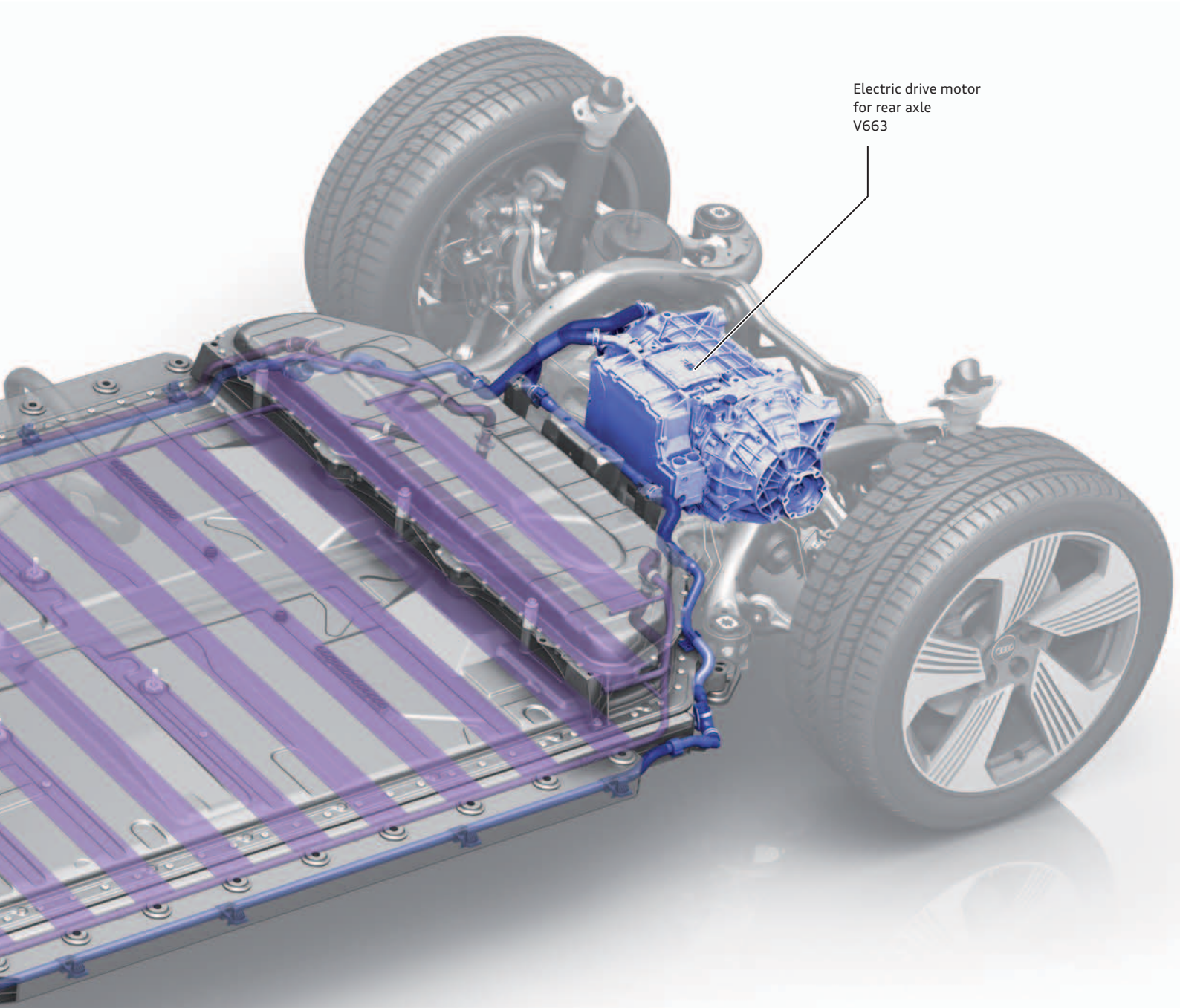
675_159

Note
The vehicle must NOT be operated, moved or towed if the cooling system is not filled and has not been bled – risk of damage to vehicle components. The cooling system must also be bled if small amounts of coolant are added after repair work.

Overview and position of refrigerant circuit, heating circuit and coolant circuits

The illustration shows the complexity and routing of the lines and hoses of the refrigerant circuit, heating circuit and the coolant circuits for the high-voltage battery and for the electric powertrain in the vehicle. For a better understanding of the complex system, the previous sections have detailed the layout of the individual refrigerant and coolant circuits and the resulting various applications of the thermal management system in 2D diagrams and explanations.





Key:

675_182

- Refrigerant circuit
- Heating circuit
- Coolant circuit for high-voltage battery
- Coolant circuit for electric powertrain

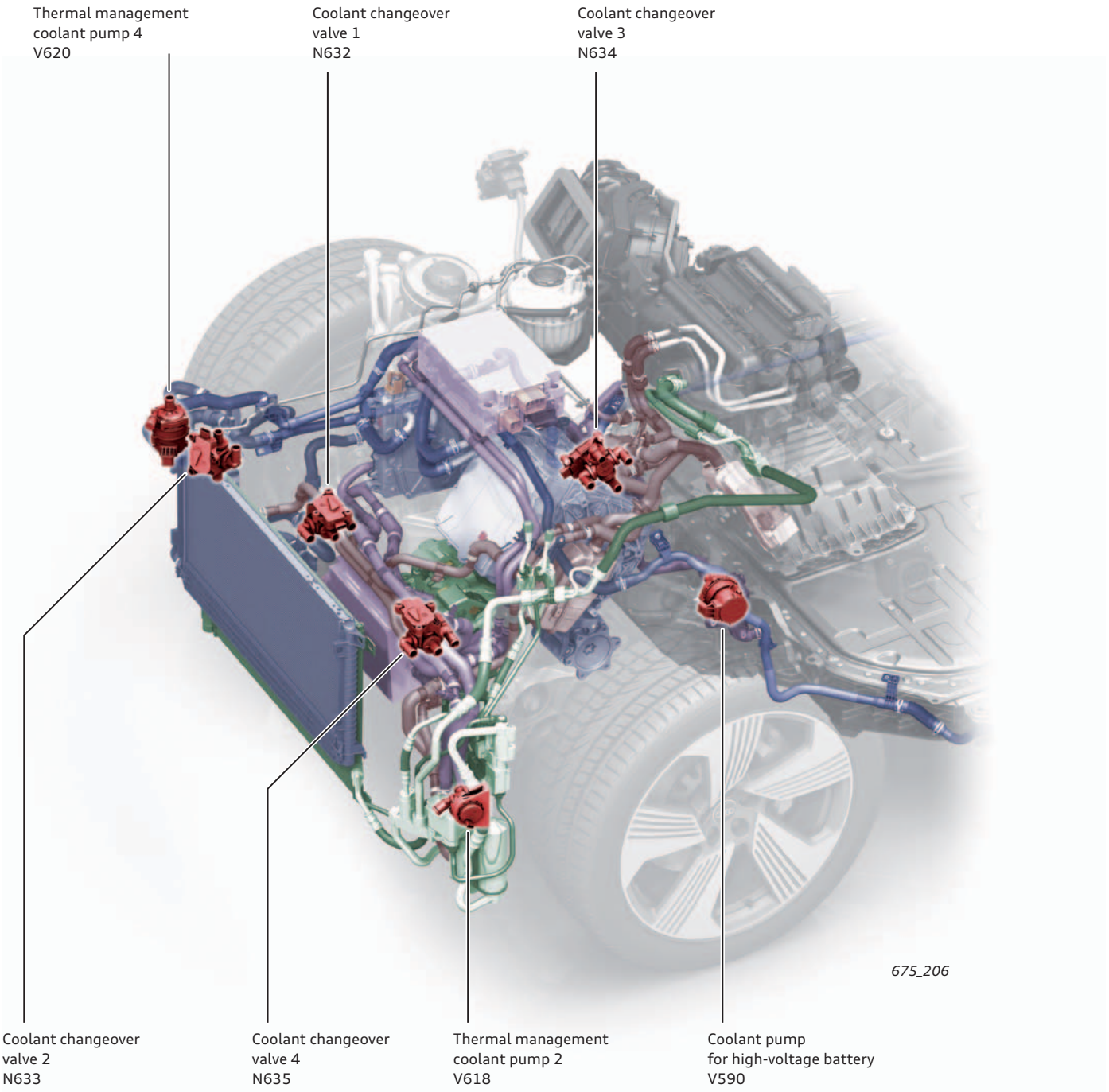
This illustration does not present functional descriptions or applications. It is supposed to illustrate the possible filling of lines with refrigerant and coolant.

Fitting locations of coolant changeover valves and coolant pumps

Due to the different possible switch positions, the coolant changeover valves allow for various combinations and separations of the heating circuit, the coolant circuit for the high-voltage battery and the coolant circuit for the electric powertrain. This way, the thermal management application scenarios described above are implemented.

The coolant pumps generate the volume flow of the coolant in the heating circuit, the coolant circuit for the high-voltage battery and the coolant circuit for the electric powertrain.

This illustration shows the layout of the components in the vehicle.



Safety and driver assist systems

Driver assist systems

Necessary system changes as a result of ECE R79

In order to sell a new vehicle model in a country, it must be certified by the government authorities. The certification requirements for a new vehicle type are country-specific. In order to make these certification requirements more standardised across countries, regulations are developed by an international commission. These regulations exist for all relevant vehicle systems. They are used as a template for national legislation in the participating countries.

ECE stands for the United Nations Economic Commission for Europe. This commission is responsible for developing the regulations. A total of 62 countries around the world currently use these ECE regulations as a basis for their national regulations. These include most European nations, but also countries such as Brazil, Argentina, Australia, New Zealand, South Korea, Japan, Israel and Mexico.

The regulations for the steering system of a vehicle are referred to by the code R79. Some of the conditions specified in R79 also affect various driver assist systems, specifically driver assist systems which intervene in the vehicle's steering.

At Audi, these include the following systems:

- Lane centre guidance (part of the adaptive cruise assist)
- Lane departure warning
- Emergency assist

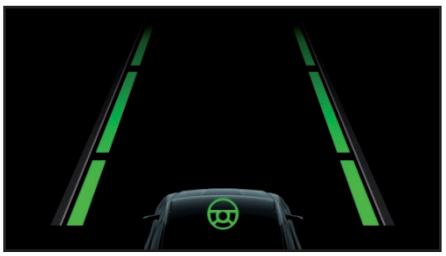
Since the revised ECE R79 was adopted in 2018, new requirements have applied that have made it necessary to make changes or adjustments to driver assist systems that intervene in the steering. These are described below.

New displays for lane centre guidance and lane departure warning

The new ECE R79 specifies which system displays the lane guidance must have. This means that there are now standardised displays used by all manufacturers for certain system statuses and warnings. The Audi e-tron is the first model based on the second-generation modular longitudinal matrix in which these requirements have been implemented.

The following changes to the displays have been made in order to comply with the new ECE R79 regulation:

When the lane centre guidance is active, this is shown by a green steering wheel in the driver assist system display in the instrument cluster. The previous display with two green triangles on the left and right of the vehicle is therefore no longer used.



675_200

The prompt to take over the steering of the vehicle is issued with a standardised symbol depicting two hands on a steering wheel. The prompt appears if the hands-off detection no longer detects hands on the steering wheel over a specified period when the lane centre guidance is active, or when the lane departure warning starts the second steering intervention. In addition to the symbol, a message is also shown.

675_030

675_031

If the emergency assist is active, this is shown by a standardised symbol and a corresponding message.

675_032

New procedure for switching lateral guidance on and off

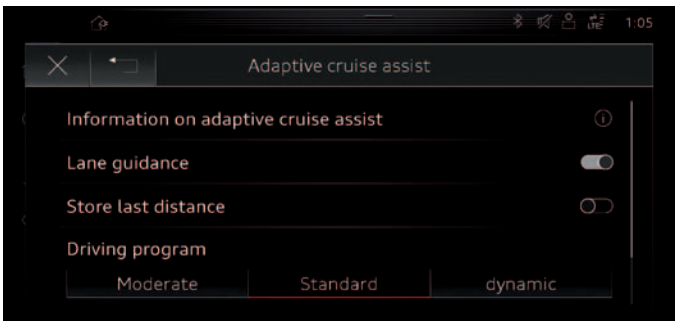
The Audi e-tron is the first model based on the second generation modular longitudinal matrix in which the new operating principle for switching the lateral guidance on and off has been introduced. The operating principle affects the following two systems:

- The lane departure warning (steering interventions by the lane departure warning system are not made until shortly before the vehicle crosses a lane marking)
- The lane centre guidance of the adaptive cruise assist (steering interventions by the lane centre guidance system are made continuously with the aim of keeping the vehicle in the centre of the lane)

Button for steering assist on turn signal lever

675_034

Setting for lane guidance (lane centre guidance) of adaptive cruise assist in MMI



675_029

The button for steering assist on the end of the turn signal lever is a higher-level switch that is used to turn lateral guidance on and off. The button is located on the end of the turn signal lever. Depending on the initial status, it activates the lane departure warning and the lane centre guidance of the adaptive cruise assist or deactivates both systems. However, whether or not the lane centre guidance is activated also depends on whether the lane guidance in the MMI menu of the adaptive cruise assist is set to “on” or “off”. This setting enables the lane centre guidance to be deactivated independently of the lane departure warning. If the lane centre guidance is deactivated, this means that when the adaptive cruise assist is active only the longitudinal guidance is active and the lateral guidance is not.

In vehicles intended for the EU28+5 states, the lane departure warning is always active each time the ignition is switched on. It cannot be switched off permanently as this assist system is included in the Euro NCAP assessments. If the driver does not wish to be supported by the system, he/she can switch it off at any time via the button for steering assist. However, the system is reactivated the next time the ignition is switched on.

In vehicles intended for markets other than the EU28+5 states, the last system status for lateral guidance is stored. The system retains the stored status the next time the ignition is switched on. It is therefore possible to switch the lane departure warning off permanently in these markets.

Due to the implementation of this procedure for switching the lateral guidance on and off, the following three system statuses are possible in all countries:

1. Driving with active lane departure warning and active lane centre guidance
   - Lateral guidance is switched on – lane guidance is set to “on” in MMI and adaptive cruise assist is active.

2. Driving with active lane departure warning but with the lane centre guidance deactivated (also with active adaptive cruise assist)
   - Lateral guidance is switched on – lane guidance is set to “off” in MMI or adaptive cruise assist is not active.

3. Driving with the lane departure warning deactivated and the lane centre guidance deactivated
   - Lateral guidance is switched off; the activation status of the adaptive cruise assist and the lane guidance setting in the MMI have no effect in this case.

Changes to the activation of the emergency assist by the lane departure warning

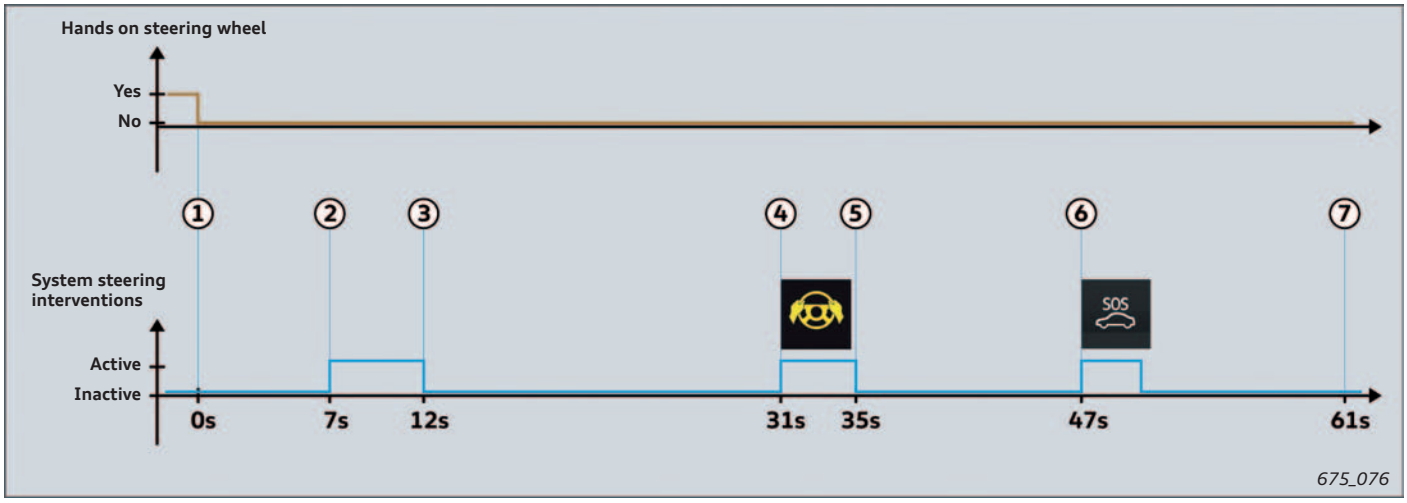
When assist systems for lateral guidance are used, it must be ensured that the driver keeps his/her hands on the steering wheel even when the system is active. It is not permitted to leave the task of steering entirely to the system. The assist system supports the driver with steering the vehicle, but his/her hands must stay on the steering wheel. The driver still retains full responsibility for steering the vehicle.

To prevent the driver assist system from being misused, it is checked whether the driver's hands are on the steering wheel. If no hands are detected on the steering wheel, the driver is prompted to take over the steering again. If he/she does not respond to this prompt, the assist system deactivates itself. If the vehicle is equipped with the emergency assist, it is subsequently activated. It brakes the vehicle to a standstill in its lane.

The software routine for detecting whether or not the driver's hands are on the steering wheel is called the hands-off detection. The status "hands off" means that no hands are detected on the steering wheel, while "hands on" means that hands are detected on the steering wheel.

The revised ECE R79 specifies that when assist systems for keeping the vehicle in lane are active, the hands-off detection may only be active while the system in question is actually actively intervening in the steering. This change has consequences for the lane departure warning. This assist system only intervenes in the steering when it assumes that the vehicle is going to leave its lane unintentionally. This is assumed to be the case if the corresponding turn signal is not operated when the vehicle approaches a lane marking. If the system makes two steering interventions within a period of 180 seconds during which no active steering movements by the driver are detected, the driver is prompted to take over the steering. If still no reaction is detected from the driver, the emergency assist is activated at the end of the second steering intervention. If still no steering input is detected from the driver at the start of the third steering intervention, a corresponding message appears in the instrument cluster and the emergency assist begins braking the vehicle to a standstill.

Specific example of activation of the emergency assist by the lane departure warning



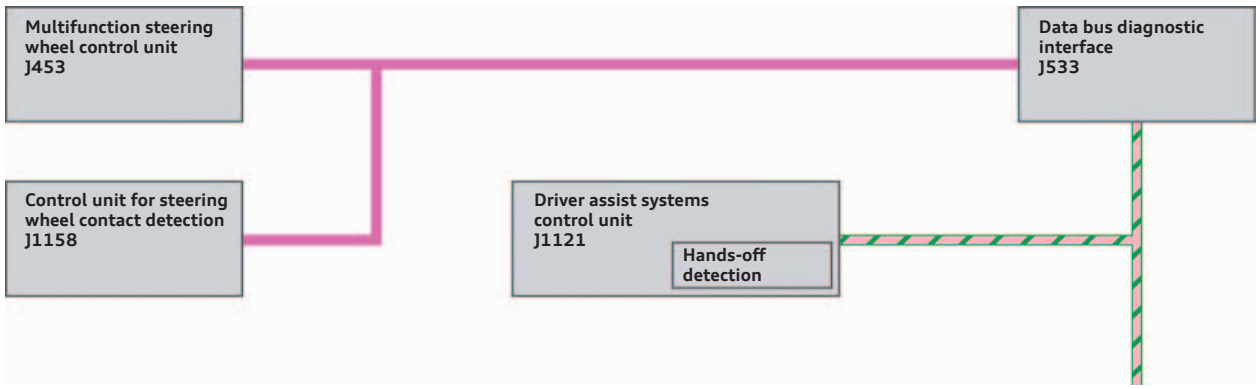
In the example shown, while driving with the lane departure warning activated and the adaptive cruise assist deactivated, the driver takes his/her hands off the steering wheel (1). This happens at time t = 0 s. After 7 seconds, the vehicle has drifted so far towards the lane marking that the lane departure warning starts a steering intervention towards the centre of the lane (2). In this specific case the steering intervention last 5 seconds. The hands-off detection does not detect any active steering movements by the driver during the steering intervention. The first steering intervention ends at t =12 s (3). At t = 31 s the vehicle has drifted so far towards the lane marking again that a second steering intervention is made. The driver is now prompted to take over the steering (4). During the second steering intervention the system once again does not detect any hands on the steering wheel. The second steering intervention ends at t =35 s (5). As the interval between the first and the second steering intervention was shorter than 180 seconds and during both interventions no steering input from the driver was detected, the lane departure warning now deactivates itself and activates the emergency assist in the background. At the start of the third steering intervention, which is now requested by the emergency assist, the symbol indicating that the emergency assist has been activated appears in the instrument cluster (6). The cascade of acoustic, visual and haptic warnings now begins. As the driver does not react, the vehicle is braked to a standstill. At t =61 s the vehicle has been braked to a standstill (7).

Capacitive steering wheel for hands-off detection

The Audi e-tron is the first Audi model to be fitted with a capacitive steering wheel, depending on the vehicle equipment. If the Audi e-tron is equipped with the adaptive cruise assist, it also has a capacitive steering wheel; otherwise it does not. The capacitive steering wheel makes an even more direct hands-off detection possible.

For the hands-off detection, capacitive sensors have been incorporated into the steering wheel, the data from which are evaluated by a separate electronic system in the steering wheel. This electronic system is referred to as the control unit for steering wheel contact detection J1158 in after-sales service and is a LIN bus node. Another bus node on this LIN bus branch is the multifunction steering wheel control unit J453. The master of this LIN bus system is the data bus diagnostic interface J533.

The control unit for steering wheel contact detection J1158, to which the capacitive sensors are connected, uses the measurement signals to generate LIN bus messages which are sent to the data bus diagnostic interface J533. This then transmits the information to the FlexRay to which the driver assist systems control unit J1121 is connected. The control unit J1121 contains the hands-off detection software.



675_028

Key:

FlexRay

LIN bus - channel A

Standard procedure for hands-off detection

Previously the hands-off detection was carried out by evaluating the data from the steering torque sensor. This procedure does not result in any additional costs due to additional hardware as all steering systems have a steering torque sensor. Due to the increased requirements for the hands-off detection, a capacitive steering wheel is now being used for the first time. If an Audi e-tron does not have the adaptive cruise assist, the hands-off detection is still carried out on the basis of the steering torque sensor. In this case the hands-off detection software is also in the driver assist systems control unit J1121.

Sensor technology for the adaptive cruise assist

Control unit for laser distance control J1122

The laser scanner first introduced for the Audi A8 (type 4N) is also fitted on the Audi e-tron. The sensor unit from the Audi A8 is used.

The laser scanner is located in the centre of the front bumper below the number plate holder. As the height of the scanner is almost exactly the same as it is on the Audi A8, the process for adjusting the scanner and the equipment required are identical. The other service operations are also the same as for the system in the Audi A8.

Adaptive cruise control unit J428 (ACC)

As on the Audi A8 (type 4N), only one radar unit is fitted on the Audi e-tron. The laser scanner takes over the functions previously provided by the second radar unit. The fourth-generation system used in the Audi e-tron has the same layout and works in the same way as the system in the Audi A8 (type 4N) and Audi Q7 (type 4M); it is also serviced in the same manner.
The radar unit is fitted underneath a plastic cover on the left side of the front bumper (as seen in direction of travel) next to the Audi rings.
The adaptive cruise control unit J423 also communicates via FlexRay channel B in the Audi e-tron. In the application, particular emphasis was placed on the way in which the predictive efficiency assist interacts with the recuperation that depends on the driving program. The aim here was to ensure high energy efficiency through frequent recuperation phases that are initiated at a relatively early point in time.

675_051

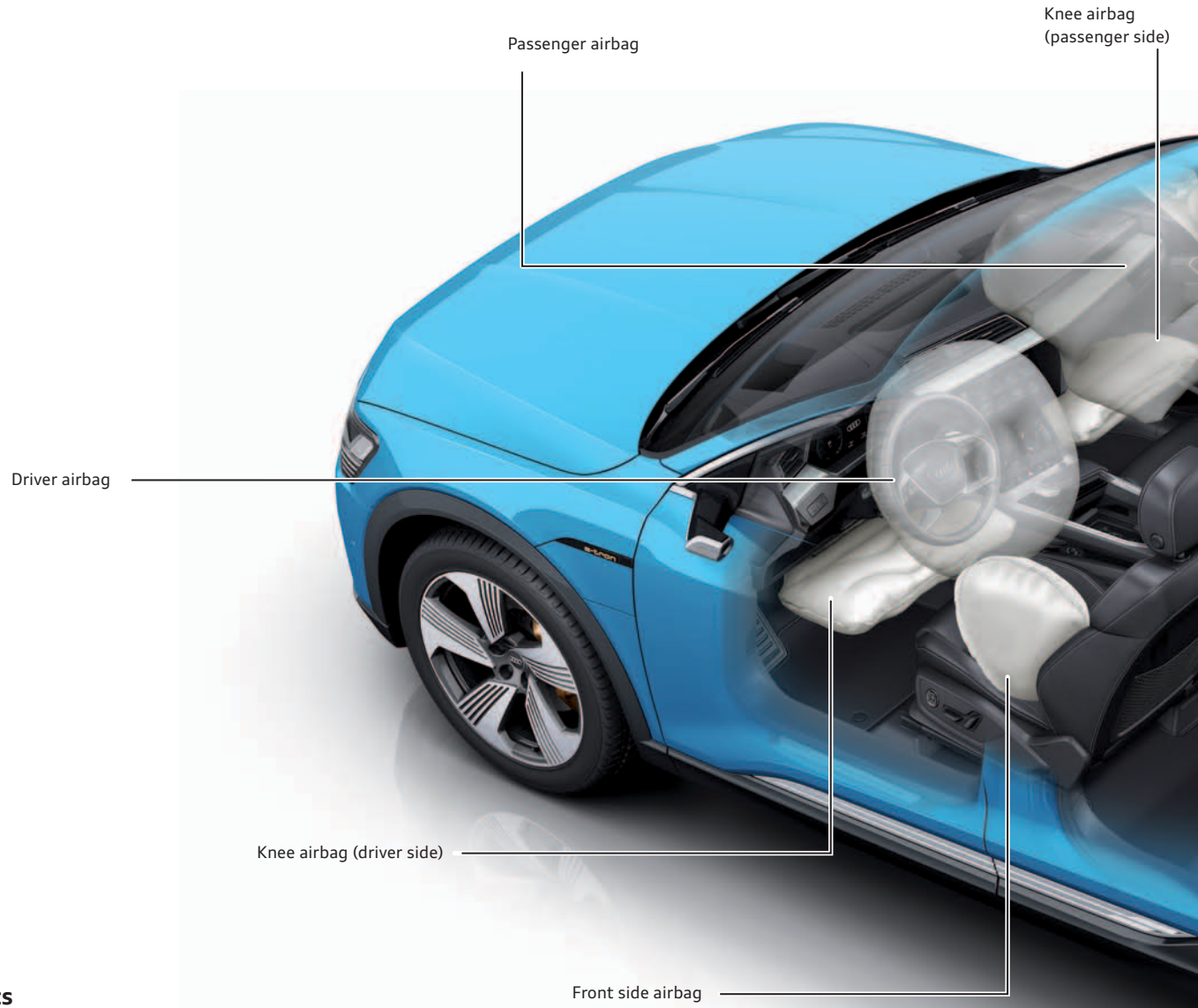
Reference
For detailed information on the design and function, please refer to self-study programme 668 “Audi A8 (type 4N) Driver assist systems” and Service TV programme 0515.
Detailed information on the adjustment procedure is available in the Service TV programme 0516.

Reference
For further information on the radar unit, please refer to self-study programmes 668, 633 and 620, the current Workshop Manual and the relevant information shown on the wheel alignment computer and the vehicle diagnostic tester.

Passive safety

The following pages provide an overview of the occupant protection system in the Audi e-tron (Typ GE).

Airbags in vehicle



Components

Depending on country version and vehicle equipment, the passive occupant and pedestrian protection system in the Audi e-tron (Typ GE) may be comprised of the following components:

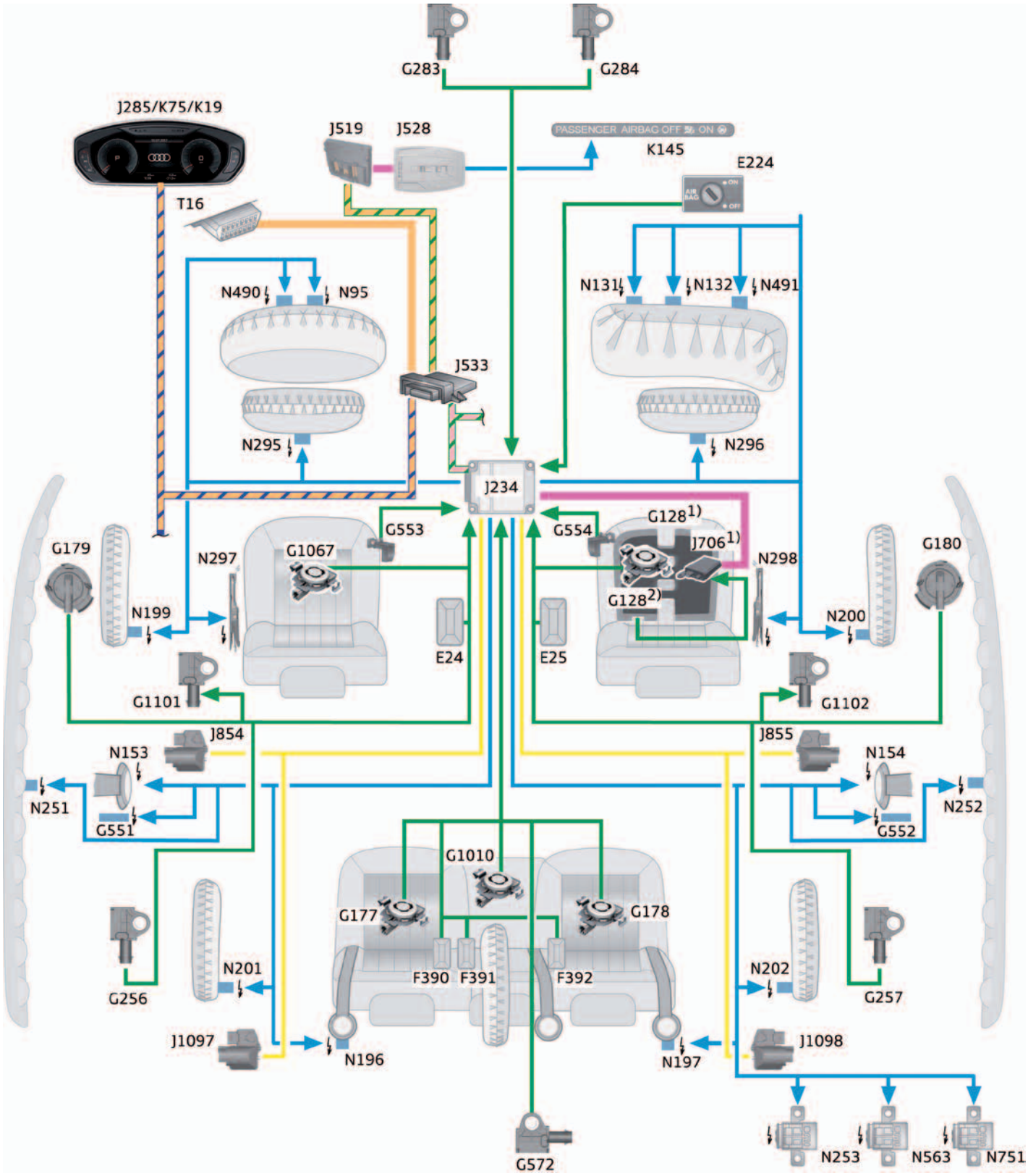
- Airbag control unit
- Adaptive driver airbag
- Adaptive passenger airbag (two-stage passenger airbag)
- Front side airbags
- Side airbags for seat row 2
- Curtain airbags
- Knee airbags
- Crash sensors for front airbags
- Crash sensors for side impact detection in doors
- Crash sensors for side impact detection in C-pillars
- Crash sensors for side impact detection in B-pillars
- Crash sensor for rear impact detection in rear cross panel
- Front belt retractors with pyrotechnic belt tensioners
- Front belt retractors with electric belt tensioners
- Front belt retractors with switchable belt force limiters
- Belt retractors for seat row 2 with pyrotechnic belt tensioners for driver and passenger side
- Belt retractors for seat row 2 with electric belt tensioners for driver and passenger side
- Front lap belt tensioners for driver and passenger sides
- Seat belt warning for all seats
- Seat-occupied recognition system in driver seat
- Seat-occupied recognition system in passenger seat
- Seat-occupied recognition system for seat row 2
- Key-operated switch to deactivate airbag on front passenger side
- Front passenger airbag warning lamp (OFF and ON)
- Seat position detection for driver and passenger
- Battery isolator, 12 Volt electrical system
- Battery isolator, 48 Volt sub-system
- Battery isolator, high-voltage system

675_025

Note
The images in the “Passive safety” chapter are schematic diagrams and are provided to aid understanding.

System overview

The system overview shows the components for all markets. Keep in mind that this constellation is not possible in a production model.



675_026

Additional equipment

Equipment may vary due to different requirements and country-specific regulations.

Key to illustration on page 156:

E24 Driver side belt switch
E25 Front passenger side belt switch
E224 Key operated switch to deactivate airbag on front passenger side

F390 Belt switch for seat row 2, driver side
F391 Belt switch for seat row 2, middle
F392 Belt switch for seat row 2, passenger side

G128 Seat occupied sensor, front passenger side
G177 Rear seat occupied sensor on driver side
G178 Rear seat occupied sensor on passenger side
G179 Side airbag crash sensor on driver side
G180 Side airbag crash sensor on front passenger side
G256 Rear side airbag crash sensor on driver side
G257 Rear side airbag crash sensor on passenger side
G283 Front airbag crash sensor for driver side
G284 Front airbag crash sensor for front passenger side
G551 Driver side belt force limiter
G552 Front passenger side belt force limiter
G553 Driver side seat position sensor
G554 Front passenger side seat position sensor
G572 Crash sensor for rear-end collision
G1010 Rear seat occupied sensor, centre
G1067 Seat occupied sensor on driver side
G1101 Crash sensor for side airbag in B-pillar, driver side
G1102 Crash sensor for side airbag in B-pillar, passenger side

J234 Airbag control unit
J285 Control unit in dash panel insert
J519 Onboard supply control unit
J528 Roof electronics control unit
J533 Data bus diagnostic interface (gateway)
J706 Seat occupied recognition control unit
J854 Control unit for front left belt tensioner
J855 Control unit for front right belt tensioner
J1097 Control unit for rear left belt tensioner
J1098 Control unit for rear right belt tensioner

K19 Seat belt warning system warning lamp
K75 Airbag warning lamp
K145 Warning lamp for airbag deactivated on front passenger side (both ON and OFF status of passenger airbag is indicated)

N95 Airbag igniter on driver side
N131 Airbag igniter 1 on front passenger side
N132 Airbag igniter 2 on front passenger side
N153 Driver seat belt tensioner igniter 1
N154 Front passenger seat belt tensioner igniter 1
N196 Rear belt tensioner igniter on driver side
N197 Rear belt tensioner igniter on passenger side
N199 Side airbag igniter on driver side
N200 Side airbag igniter on front passenger side
N201 Rear side airbag igniter on driver side
N202 Rear side airbag igniter on passenger side
N251 Driver side curtain airbag igniter
N252 Front passenger side curtain airbag igniter
N253 Battery isolation igniter
N295 Driver side knee airbag igniter
N296 Front passenger side knee airbag igniter
N297 Igniter for driver side seat belt tensioner 2
N298 Igniter for front passenger side seat belt tensioner 2
N490 Igniter for exhaust valve for driver airbag
N491 Igniter for exhaust valve for front passenger airbag
N563 High-voltage battery isolation igniter
N751 Battery isolation igniter, 48 V

T16 16-pin connector, diagnostic connection

Wiring colours:

- Diagnostics CAN
- Dash panel insert CAN
- Sub-bus system
- FlexRay
- LIN bus
- Convenience CAN 2
- Input signal
- Output signal

Connection for seat occupied sensor, front passenger side G128

The connection for the seat occupied sensor, front passenger side G128 varies depending on the market version.

[1)]Vehicles for the North American region (NAR):
The seat occupied sensor, front passenger side G128 is connected to the seat occupied recognition control unit J706 via a discrete wire. The control unit communicates with the airbag control unit J234 via a LIN bus wire.

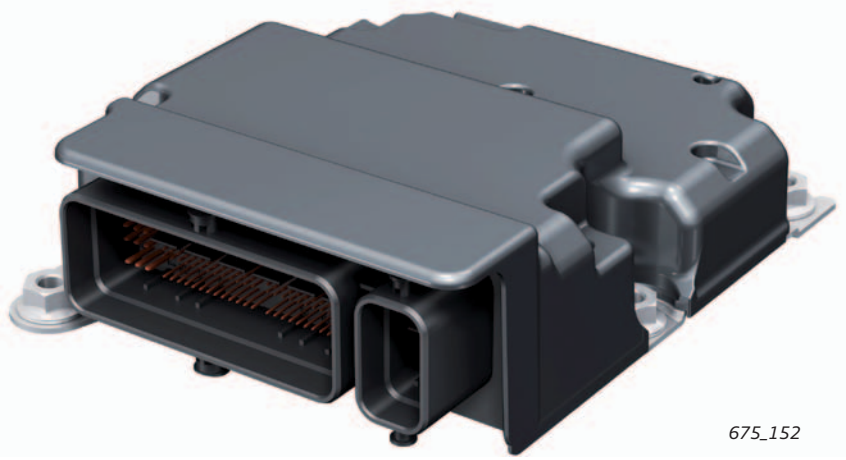
[2)]Vehicles for rest of world (ROW):
The seat occupied sensor, front passenger side G128 is connected directly to the airbag control unit J234 via a discrete wire. A seat occupied recognition control unit J706 is not fitted.

Airbag control unit J234

Crash signal

The airbag control unit J234 registers a collision based on the information supplied by internal and external crash sensors. The airbag control unit classifies a collision as “minor” or “severe” depending on the severity of the collision. A minor collision is further subdivided into multiple crash levels depending on the severity. A severe collision is registered if restraint systems, such as seat belt tensioners and airbags, are deployed. The airbag control unit sends information on the severity of the collision (including the crash levels) to the data bus. Other bus nodes receive these crash signals and can then take various types of action, e.g. turn on the interior lighting.

Airbag control unit J234



Reaction of high-voltage battery to crash signals

When the airbag control unit detects a collision which meets the relevant criteria, the high-voltage battery is isolated for safety reasons. In the event of a collision, the airbag control unit sends collision signals to the data bus. The gateway (data bus diagnostic interface J533) relays the signal to the battery regulation control unit J840.

Minor collision

In the event of a minor collision with a corresponding crash level, the battery regulation control unit J840 isolates the high-voltage battery. If the high-voltage battery has been isolated due to a minor collision, it can be reactivated by resetting terminal 15.

Severe collision

In the event of a severe collision, the signal to isolate the high-voltage battery is transmitted by two different pathways. This provides redundant (multiple) backup for signal transmission.

> Pathway 1:

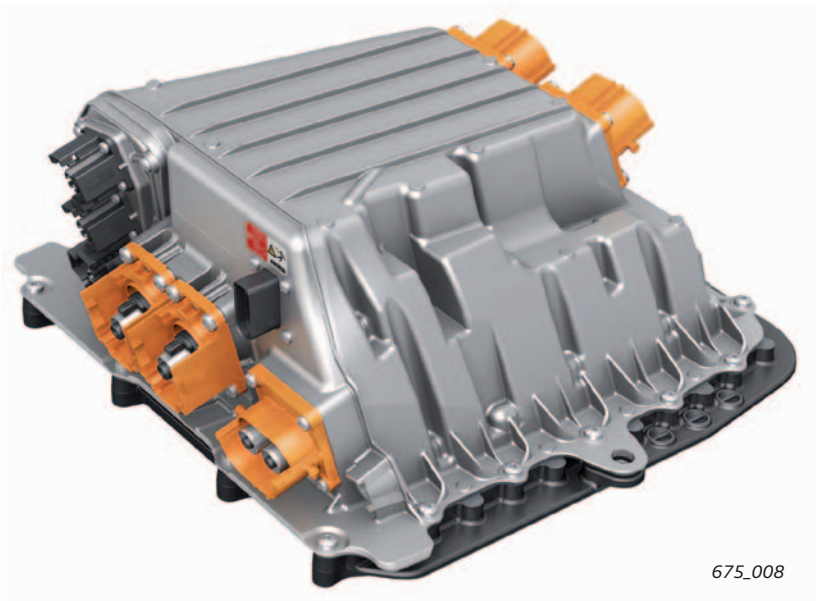
As in the event of a minor collision with a corresponding crash level, the battery regulation control unit J840 isolates the high-voltage battery.

> Pathway 2:

The airbag control unit J234 is wired discretely to the high-voltage battery isolator igniter N563. The igniter is installed in the switching unit for high-voltage battery SX6. The igniter and the switching unit are combined as one unit. Contrary to what the name might suggest, the high-voltage battery isolator igniter N563 is not a pyrotechnic component[1]. In the event of a severe collision, the airbag control unit sends a current of around 1.75 A to 2 A to the igniter (switching unit). The switching unit evaluates the signals (current) and triggers the isolation of the high-voltage battery by opening the power contactor. If the high-voltage battery has been isolated due to a severe collision, it cannot be activated by resetting terminal 15. In the event of a severe collision, the high-voltage battery must be classified using Guided Fault Finding. If the high-voltage battery is classified as OK, the igniter and therefore the switching unit do not need to be renewed due to the electronic isolation.

[1)] It is planned to convert the high-voltage battery isolation igniter N563 into a pyrotechnic component at a later point in time. In this case, the high-voltage battery is no longer isolated electronically but is instead isolated physically by shutting off the current supply (in a comparable way to battery isolation igniter N253). As the igniter and the switching unit are combined as one unit, in this case the switching unit has to be renewed. Please refer to the technical literature such as ETKA, Workshop Manuals and Guided Fault Finding.

Switching unit for high-voltage battery SX6 including high-voltage battery isolation igniter N563



675_008

Reference
For further information on the high-voltage battery, refer to page 98.

Sensors

Crash sensors

In order to detect collisions, the Audi e-tron (type GE) is equipped with the nine external crash sensors listed. In addition, the airbag control unit J234 contains further internal crash sensors. Unlike the external crash sensors, the internal crash sensors in the airbag control unit cannot be renewed separately.

- Side airbag crash sensor on driver side G179
- Side airbag crash sensor on front passenger side G180
- Rear side airbag crash sensor on driver side G256
- Rear side airbag crash sensor on passenger side G257
- Front airbag crash sensor for driver side G283
- Front airbag crash sensor for front passenger side G284
- Crash sensor for rear-end collision G572
- Crash sensor for side airbag in B-pillar, driver side G1101
- Crash sensor for side airbag in B-pillar, passenger side G1102

675_153

The two crash sensors G179 and G180 are pressure sensors and are installed in the front doors. The pressure sensors measure the pressure/pressure change inside the door.

If a door is struck during an accident, the pressure inside the door changes abruptly as a result of deformation (change in volume). The signals from the crash sensors are used to determine the severity of the collision and as a plausibility check for side collisions.

The five crash sensors G283, G284, G1101, G1102 and G572 are biaxial acceleration sensors that measure the vehicle's acceleration or deceleration. In the Audi e-tron (type GE), the acceleration sensors listed above are combined sensors and therefore measure the movement of the vehicle not only in one direction (X or Y) but in two directions (X and Y). The signals from these five acceleration sensors are used to determine the severity of the collision and as a plausibility check for side and longitudinal collisions. The two remaining crash sensors G256 and G257 are uniaxial acceleration sensors that measure the vehicle's acceleration or deceleration in the Y direction. The signals from these two acceleration sensors are used to determine the severity of the collision and as a plausibility check for side collisions.

The nine external crash sensors are required because the temporal requirements for deactivating the high-voltage battery are higher than the temporal requirements for triggering the restraint systems (e.g. airbags, belt tensioners), among other reasons.

Coordinates

675_033

Crash sensor for rear-end collision G572

Fitting location

The crash sensor for rear-end collision G572 is fitted in the area of the striker on the rear cross panel.

Crash sensor for rear-end collision G572

675_164

Seat occupied sensor on driver side

The Audi e-tron (type GE) is also fitted with a seat occupied sensor on the driver seat. This seat occupied sensor has the following designation:

- Seat occupied sensor on driver side G1067

Seat occupied sensor on driver side G1067

675_165

675_166

Fitting location

The seat occupied sensor on driver side G1067 takes the form of a button and is clipped into the wire frame of the driver seat frame.

Driver-leaves-vehicle concept

Unlike the following seat occupied sensors:

- Seat occupied sensor, front passenger side G128
- Rear seat occupied sensor on passenger side G178
- Rear seat occupied sensor on driver side G177
- Rear seat occupied sensor, centre G1010

the seat occupied sensor on driver side G1067 is not part of the seat belt warning system. Instead, the seat occupied sensor on driver side is required for the “driver-leaves-vehicle concept”. The seat occupied sensor on driver side is used in the Audi e-tron because the vehicle does not creep. This means that the vehicle would not begin to move when it is on a level surface, the brake is not applied and the drive is active with a gear selected.
The seat occupied sensor on driver side is able to detect whether the driver is sitting on the seat or has left the vehicle. The airbag control unit J234 reads the signal from the seat occupied sensor on driver side and provides the information on whether the seat is occupied to the data bus. Other control units evaluate the information and can trigger appropriate actions if necessary. The information on whether the seat is occupied is evaluated together with other signals by the function logic, in order to activate the electromechanical parking brake and the electromechanical parking lock, and in order to request that the warning when leaving the vehicle is displayed in the instrument cluster, for example.

Seat occupied sensor, front passenger side and rear seat occupied sensors

The seat occupied sensor, front passenger side and the rear seat occupied sensors are part of the seat belt warning system as is customary. For details on the equipment, please also refer to the system overview on page 156.

Diagnosis

The seat occupied sensors on the driver side and front passenger side are diagnosed via the airbag control unit J234. The control unit can diagnose the following events for both seat occupied sensors:

- 00 = No text is displayed for this event. This entry appears in the event memory if the component in the airbag control unit is not encoded (should not have been installed) but has been detected by the control unit (component is connected). The reason for this may be that the airbag control unit is not the correct control unit for the vehicle (e.g. control units have been mixed up).
- 01 = Electrical fault
- 11 = Short to earth
- 12 = Short to positive
- 13 = Open circuit
- 53 = Deactivated

For the seat occupied sensor on driver side, the event “07 = Mechanical fault” can also be diagnosed. This entry appears in the event memory if the seat occupied sensor on driver side has been detected as permanently activated for five driving cycles, whereby a driving cycle is defined as a complete journey (with the driver entering the vehicle, driving, stopping and exiting the vehicle).
Note: The event “07 = Mechanical fault” can also be diagnosed for the driver side belt switch E24 in the driver’s belt buckle. In this case, the entry appears in the event memory if the driver side belt switch has been detected as permanently activated for five driving cycles.

The rear seat occupied sensors are connected in series to the corresponding belt buckles. The rear seat occupied sensors do not have separate diagnostic paths. In this case, the airbag control unit J234 diagnoses the rear belt buckles. The control unit can diagnose the following events for the rear belt buckles:

- 00 = Refer to page 162
- 11 = Short to earth

Reference
For further information on the seat occupied sensors, refer to the following self-study programmes:
- Self-study programme 609 “Audi A3 ’13”
- Self-study programme 644 “Audi A4 (type 8W)”
- Self-study programme 669 “Audi A7 (type 4K)”

For further information on the seat occupied sensors, refer to the Service TV programme STV_0397_Audi TT “Seat belt warning system/seat occupied sensor”.

Active safety

Audi pre sense

Be it Audi pre sense basic, pre sense rear, pre sense side, pre sense front or the Audi pre sense swerve assist or turn-off assist: The Audi e-tron has the same pre sense functions as the Audi A8 (type 4N). The components and specifications have of course been adapted to suit the Audi e-tron. The following changes have been made to Audi pre sense on the Audi e-tron compared to the Audi A8 (type 4N):

- On the Audi e-tron, the Audi pre sense swerve assist does not trigger braking on individual wheels.

Audi pre sense swerve assist procedure

675_178

Key:

	Supporting steering torque		Visual pre-warning and/or intervention display		Acoustic signal
1	Vehicle that wants to swerve	2	Obstacle (vehicle being approached)	A	Driver’s steering/swerving movements

Reference
For further information on the airbag control unit J234 and Audi pre sense, please refer to self-study programme 662 “Audi A8 (type 4N)”.

Infotainment and Audi connect

Introduction and overview of versions

The Audi e-tron features the MIB2+ version of the modular infotainment matrix infotainment system. Customers can choose between two MMI versions:

- MMI radio plus with MMI touch response
- MMI navigation plus with MMI touch response

Both versions are based on the high version of MIB2+ and have the same two MMI displays.

In certain countries, customers receive the Audi connect emergency call (eCall) and all vehicle-specific connect services, including the Audi connect e-tron services, as standard. The emergency call module control unit and communication unit J949 (also referred to internally as the connectivity box) is responsible for transmitting the information for these features.
This control unit, which controls vehicle-specific services together with the gateway, was first introduced in the North American market with the Audi A7 (type 4K) and is now being introduced for the EU and other markets.

At the time of market launch, Audi connect infotainment services are only available to customers with the MMI navigation plus with MMI touch response if they order the PR number combination I8T + 7UG when ordering the vehicle.

[1] Depending on country
[2] The Audi connect data module becomes a full telephone module with SAP.
[3] For markets in which no storage compartment with interface for mobile telephone (smartphone connection to exterior aerial) is available.
[4] IT1 means a three-year Audi connect licence (plus services) without an Audi connect SIM card.
IT3 means a three-year Audi connect licence (plus services) with an Audi connect SIM card.

Reference
For further information on the emergency call module control unit and communication unit J949, please refer to self-study programme 669 “Audi A7 (type 4K)”.

Reference
For further information on MIB2+, refer to self-study programme 666 “Audi A8 (type 4N) Infotainment and Audi connect”.

MMI radio plus with MMI touch response (I8T + 7Q0)	MMI navigation plus with MMI touch response (I8T + 7UG)
	
10.1” touch display with 1540 x 720 pixels	10.1” touch display with 1540 x 720 pixels
8.6” touch display with 1280 x 660 pixels	8.6” touch display with 1280 x 660 pixels
12.3” Audi virtual cockpit (9S1)	12.3” Audi virtual cockpit (9S1)
	3D navigation system on SSD (7UG)
FM radio	FM radio
Audi music interface with 2 USB A sockets and 1 SDXC card reader (UF7)	Audi music interface with 2 USB A sockets, 1 SIM card reader[1)] and 1 SDXC card reader (UF7)
Bluetooth interface (9ZX)	Bluetooth interface (9ZX)
	UMTS/LTE data module (EL3)
Audi connect emergency call & Audi connect vehicle-specific services including Audi e-tron services (IW3)[1)]	Audi connect emergency call & Audi connect vehicle-specific services including Audi e-tron services (IW3)[1)]
	Audi connect (IT1/IT3)[4)]
Basic sound system (8RM)	Audi sound system (9VD)
Optional equipment	
Digital radio (QV3)	Digital radio (QV3)
Single DVD drive (7D5)	Single DVD drive (7D5)
Audi music interface in rear with 2 USB A sockets (UF8)	Audi music interface in rear with 2 USB A sockets (UF8)
	Audi smartphone interface (IU1)
Audi phone box including wireless charging (9ZE) [1) 2)]	Audi phone box including wireless charging (9ZE) [1) 2)]
Audi phone box light (for wireless charging only) (9ZV)[1) 3)]	Audi phone box light (for wireless charging only) (9ZV)[1) 3)]
	12.3” Audi virtual cockpit plus (9S9)
Audi sound system (9VD)	
Bang & Olufsen Premium Sound System with 3D sound (9VS)	Bang & Olufsen Premium Sound System with 3D sound (9VS)
Audi connect key (2F1)[1)]	Audi connect key (2F1)[1)]
	TV tuner[1)]
Preparation for Rear Seat Entertainment (9WQ)	Preparation for Rear Seat Entertainment (9WQ)

Sound

The Audi e-tron is fitted with different sound systems as standard depending on the MMI version.

The basic sound system (8RM) is fitted in the Audi e-tron for the MMI radio plus with MMI touch response. This sound system delivers 80 watts to 8 loudspeakers over 4 channels.
The Audi sound system (9VD) is fitted as standard for the optional MMI navigation plus. This has 10 loudspeakers and delivers 180 watts over 6 channels.

Audi sound system (9VD)

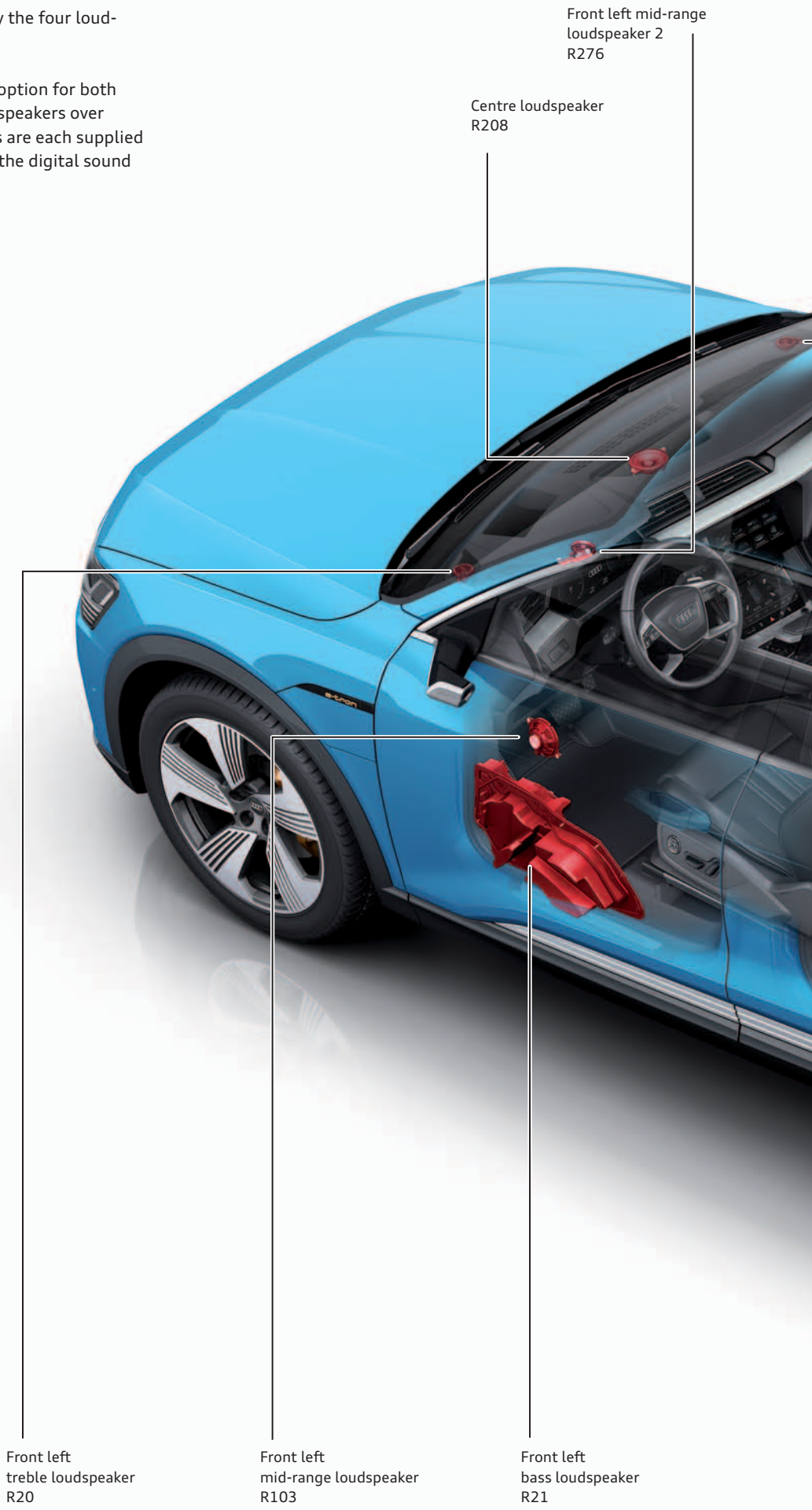

Front right
treble loudspeaker
R22
Front right
bass loudspeaker
R23
Rear right
treble loudspeaker
R16
Rear right
bass loudspeaker
R17
Rear left
bass loudspeaker
R15
Rear left
treble loudspeaker
R14
Subwoofer
R211

675_171

Bang & Olufsen Premium Sound System with 3D sound (9VS)

The vehicle occupants can experience exceptional soundscapes with the Bang & Olufsen Premium Sound System with 3D sound (9VS). The additional sound level is produced by the four loudspeakers integrated in the A and D-pillars.

This sound system, which can be ordered as an option for both MMI systems, delivers 705 watts to its 16 loudspeakers over 15 channels. The loudspeakers in the rear doors are each supplied by one channel. The subwoofer is connected to the digital sound package control unit J525 via two channels.




Front right mid-range loudspeaker 2 R277
Front right mid-range loudspeaker R104
Right effect loudspeaker R210
Front right treble loudspeaker R22
Front right bass loudspeaker R23
Rear right treble loudspeaker R16
Rear right bass loudspeaker R17
Rear left bass loudspeaker R15
Rear left treble loudspeaker R14
Left effect loudspeaker R209
Digital sound package control unit J525
Subwoofer R211

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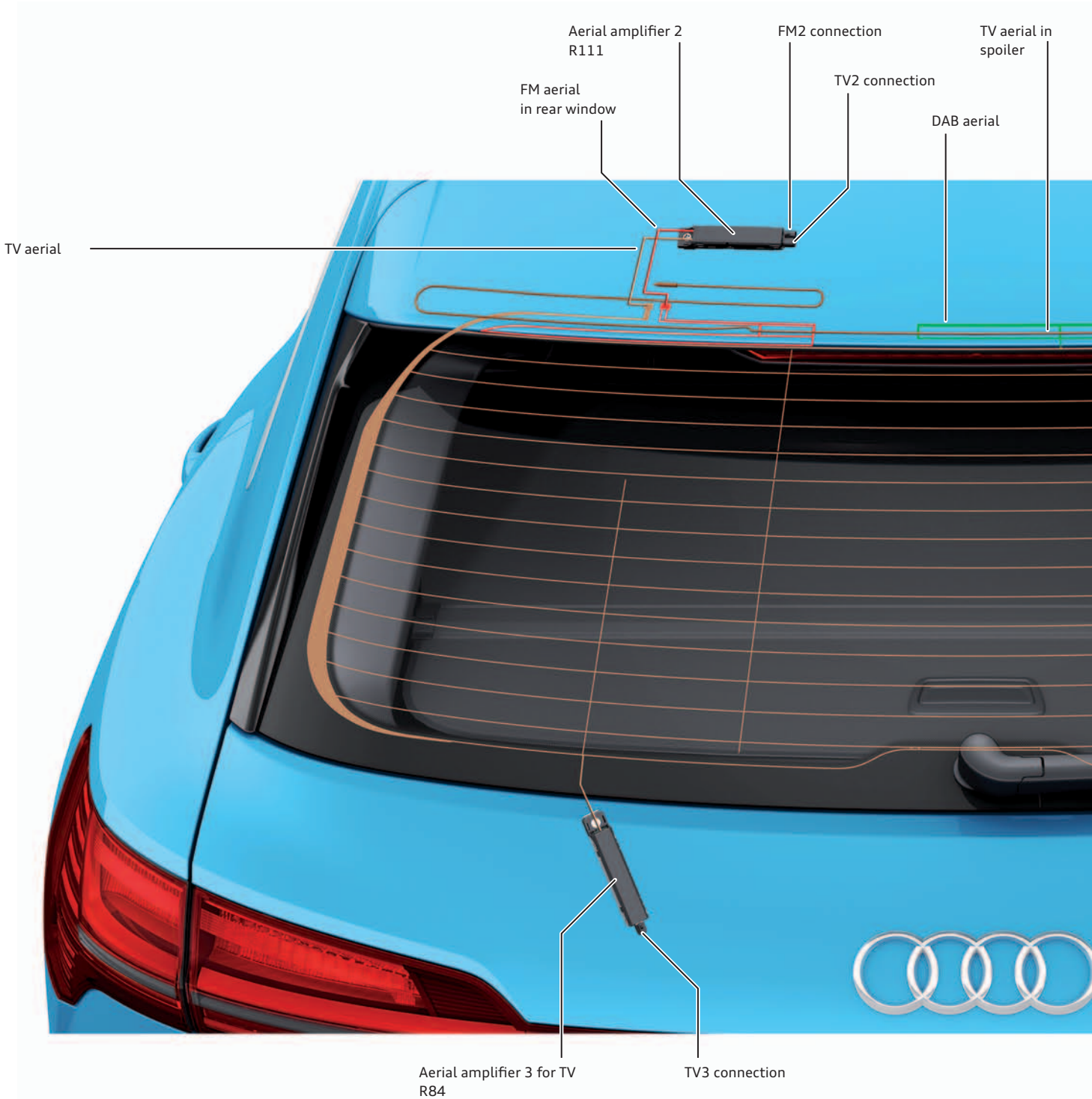
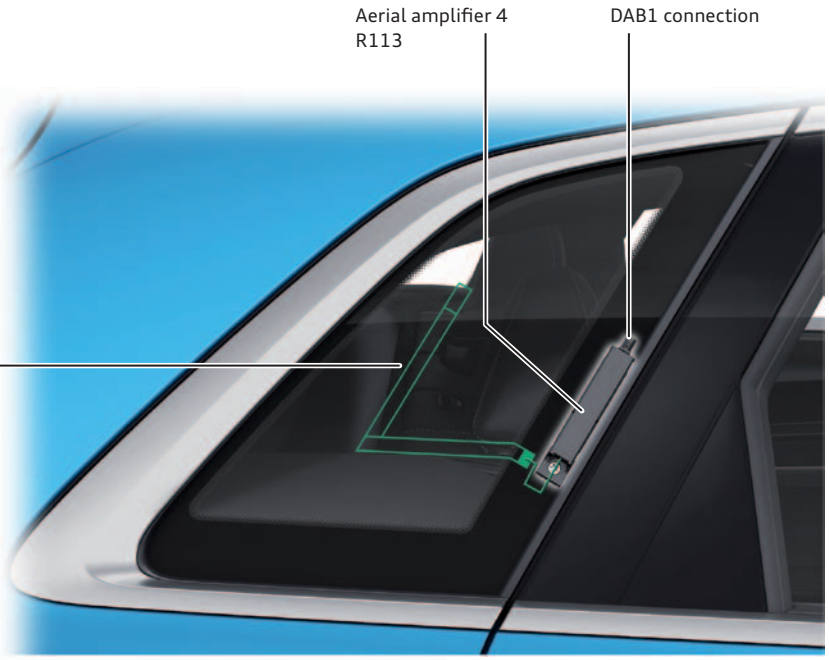
Aerials

In the Audi e-tron, the mobile telephone, GPS and radio aerials are located in the rear bumper, on the roof, in the area of the rear left automatic belt retractor, in the rear spoiler on the rear window and on the rear right side window.

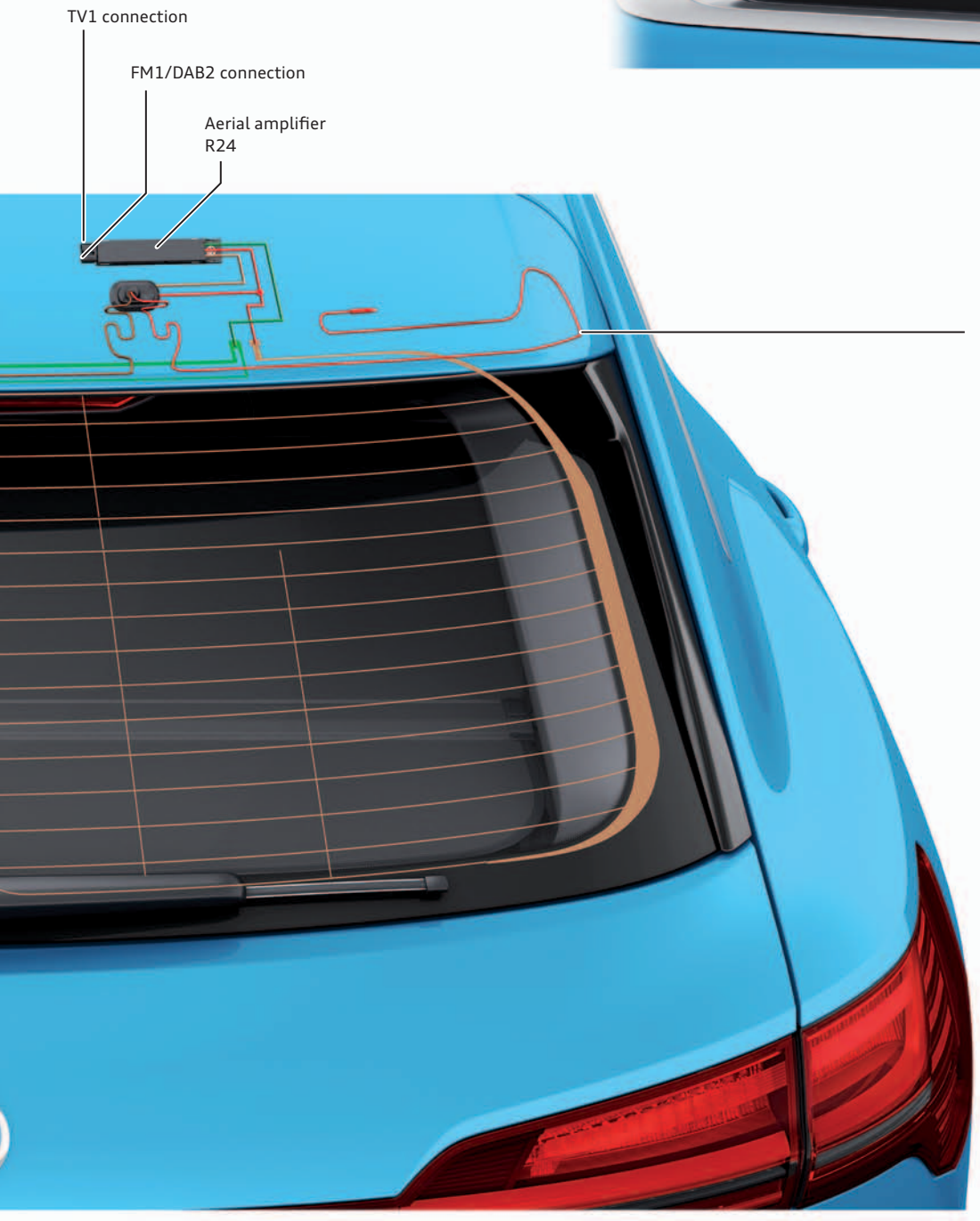
Radio and TV aerials

The aerials for radio and TV reception are integrated in the rear window, the rear right side window and the rear spoiler.





675_169



675_170

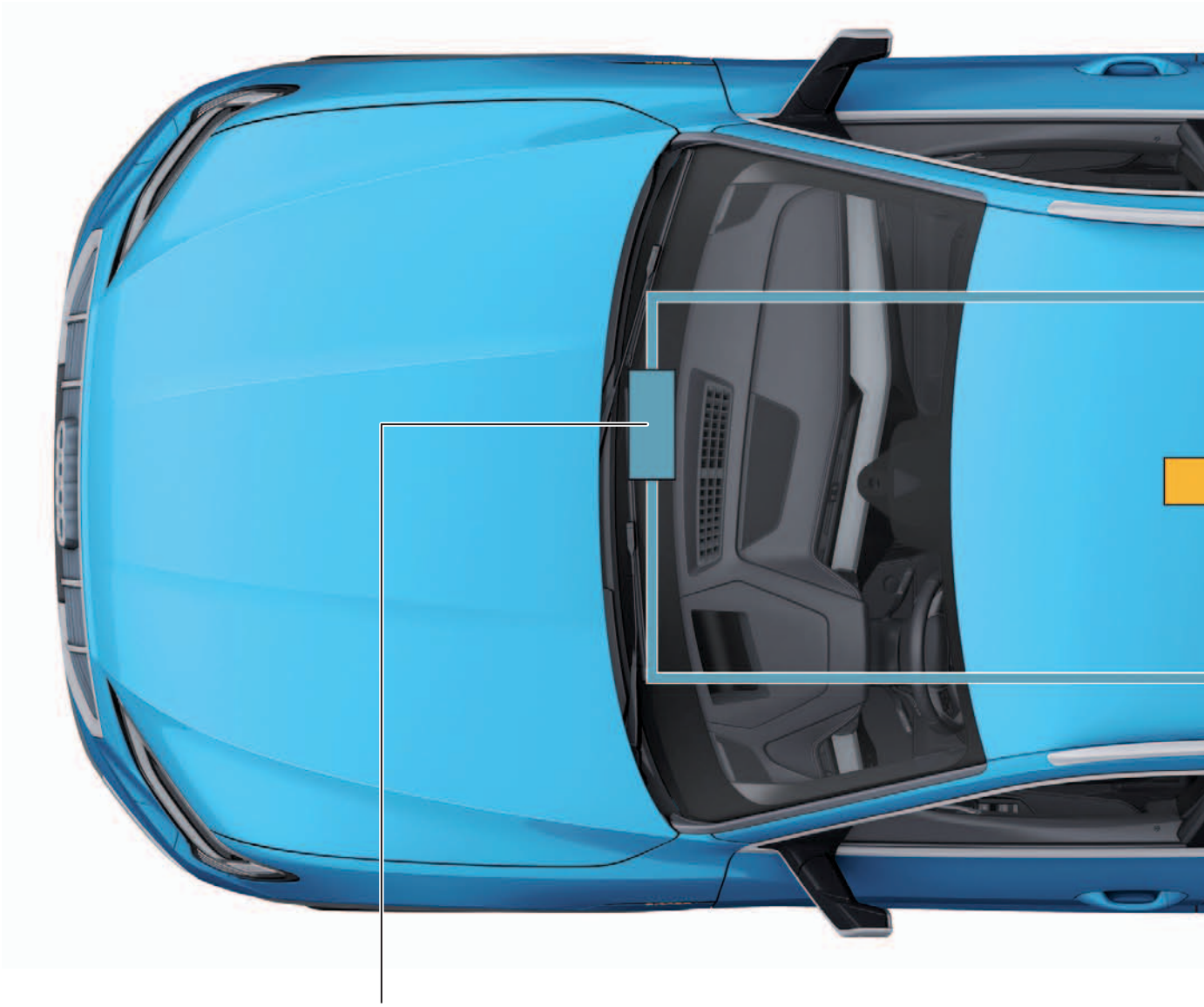
Mobile phone aerials

In the European market, the Audi e-tron comes with the Audi connect emergency call and Audi connect vehicle-specific services (IW3) as standard. The emergency call module control unit and communication unit J949, which is responsible for these services, is located under the rear seat bench. It is permanently connected to the emergency call module aerial R263 (main aerial in rear bumper) and the emergency call module aerial 2 R322 in the area of the rear left belt retractor.

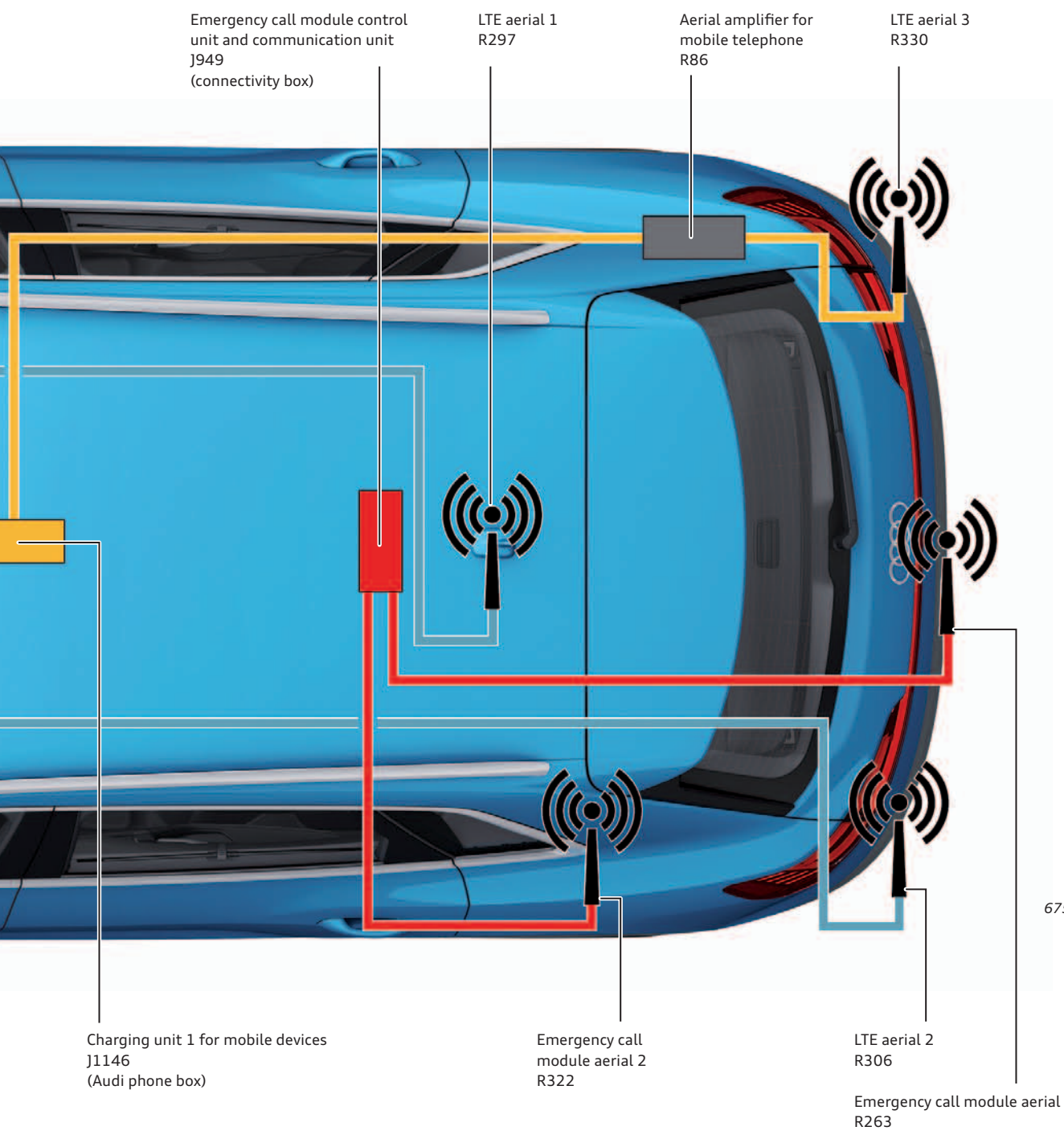
If the vehicle is fitted with the Audi phone box, an LTE-enabled aerial integrated in the rear bumper (right-side) is responsible for communication. The aerial amplifier for mobile telephone R86 ensures the necessary compensation for the telephone signal as is customary. It is located in the luggage compartment (right-side).

The two LTE aerials for J794 are located in the rear bumper (left-side) and on the roof (depending on country). The Audi connect infotainment services are run via these aerials, whereby the aerial in the bumper is only designed for receiving.

Mobile phone aerials (example: EU market)



Control unit 1 for information electronics J794


Emergency call module control unit and communication unit J949 (connectivity box)
LTE aerial 1 R297
Aerial amplifier for mobile telephone R86
LTE aerial 3 R330
675_195
Charging unit 1 for mobile devices J1146 (Audi phone box)
Emergency call module aerial 2 R322
LTE aerial 2 R306
Emergency call module aerial R263

Servicing, inspection & roadside/breakd. assistance

Service interval display

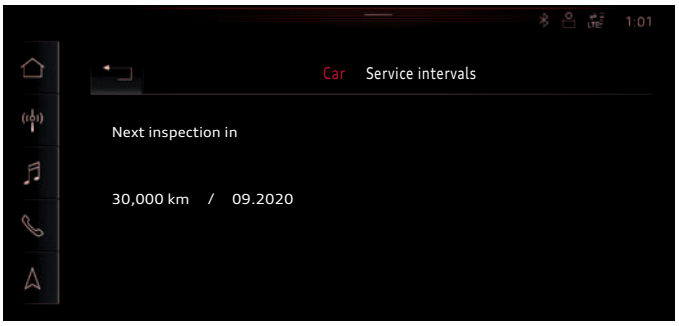
The following service intervals are displayed:

- Mileage-based service events
- Time-based service events

The value displayed in the mileage-based service events field is 30,000 km for new vehicles and is counted down in 100 km blocks.

The field for the time-based service events shows the month and the year.
Thirty days before the service event is due, the number of days remaining until the service event is due are shown in the instrument cluster and the MMI.

The service interval display must be reset using the vehicle diagnostic tester.



675_140

Roadside/breakdown assistance

Important notes on

- safety regulations
- charging
- manual release mechanisms
- activating the P-OFF position
- warning labels
- the maintenance connector
- the crash signal

can be found in the relevant chapters of this self-study programme and in the Owner's Manual.

Towing:

- If the motor coolant circuits are not charged, the vehicle may be pushed a maximum of 700 metres at a maximum of 7 km/h.
- If the red coolant warning lamp is not lit, the vehicle may be towed a maximum of 50 km at a maximum speed of 50 km/h.

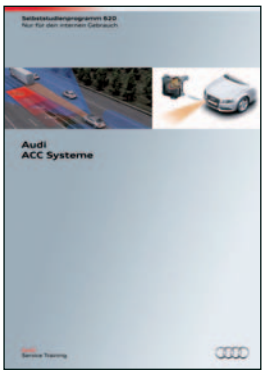
Jump-starting:

- The vehicle must not be used to jump-start another vehicle.

Note
It is not permitted to "miss out" service events.
The information provided in the up-to-date service literature applies. Maintenance intervals are displayed when the maintenance tables are created.

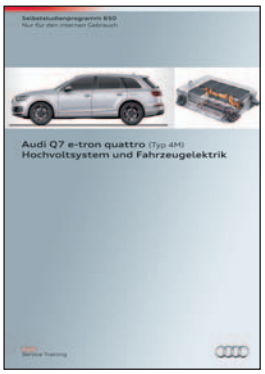
Self-study programmes

For more information on the technology featured on the Audi e-tron, please refer to the following self-study programmes.

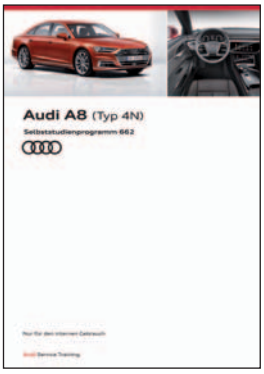


SSP 620 Audi ACC systems

SSP 633 Audi Q7 (type 4M)
Chassis

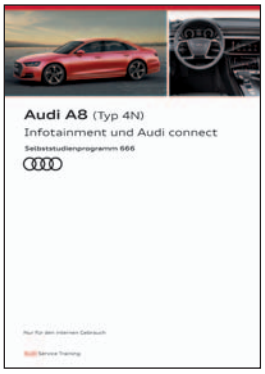


SSP 650 Audi Q7 e-tron quattro (type 4M)
High-voltage system and vehicle electrics

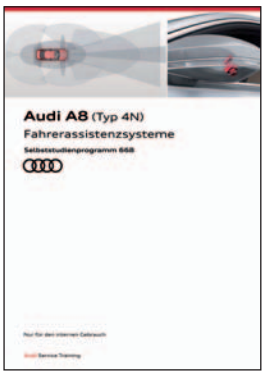


SSP 662 Audi A8 (type 4N)

SSP 664 Audi A8 (type 4N)
Electrics and electronics



SSP 666 Audi A8 (type 4N)
Infotainment and Audi connect



SSP 668 Audi A8 (type 4N)
Driver assist systems

SSP 669 Audi A7 (type 4K)

Reference
The following self-study programme also contains further information on the technology featured on the Audi e-tron:
> SSP 615 “Audi A6 hybrid and Audi A8 hybrid”

AUDI AG
D-85045 Ingolstadt
Technical status 10/18