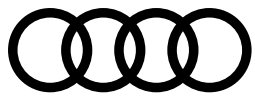




The 2019 Audi e-tron Introduction

eSelf-Study Program 990993



Audi of America, LLC
Service Training
Created in the U.S.A.
Created 01/2019
Course Number 990993

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Always check Technical Bulletins and the latest electronic service repair literature for information that may supersede any information included in this booklet.

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The eSelf-Study Program (eSSP) teaches a basic understanding of the design and mode of operation of new models, new automotive components or new technologies.

It is not a repair manual! Figures are given for explanatory purposes only and refer to the data valid at the time of preparation of the SSP.

For further information about maintenance and repair work, always refer to the current technical literature.



Note



Reference

Introduction

The brand with the four rings presents its first fully electric series-production model, the Audi e-tron. The full-size SUV combines sportiness and everyday usability. Its two electric motors together with electric all-wheel drive provide for awesome performance and agile handling.

Efficiency, performance and quiet tranquility – the Audi e-tron exemplifies the driving experience of a new technological era. Two electric motors drive the electric SUV powerfully, free of emissions, and almost silently, with a system output of up to 300 kW and 664 Nm (489.7 lb-ft) of torque.

The maximum drive torque is available within fractions of a second and provides enormous pulling power. The Audi e-tron completes the standard sprint in 5.7 seconds. Top speed is an electronically-limited 124.3 mph (200 km/h).



A new quattro generation – electric all-wheel drive – provides for superlative traction and handling on any terrain and in any weather conditions. It ensures the continuous and fully variable regulation of the ideal distribution of drive torque between the two axles – within a fraction of a second. In most cases, the electric SUV tends to use its rear electric motor to achieve the highest efficiency.

The Audi e-tron is an SUV for sport, family and leisure. It combines the practical requirements for an automobile with the comfort of the full-size class and the efficiency of an electric drive system. At the same time it offers the premium experience that is expected from the brand with the four rings.

The Audi e-tron comes off the line at the Brussels plant, the world's first CO₂-neutral certified volume production facility in the premium segment.



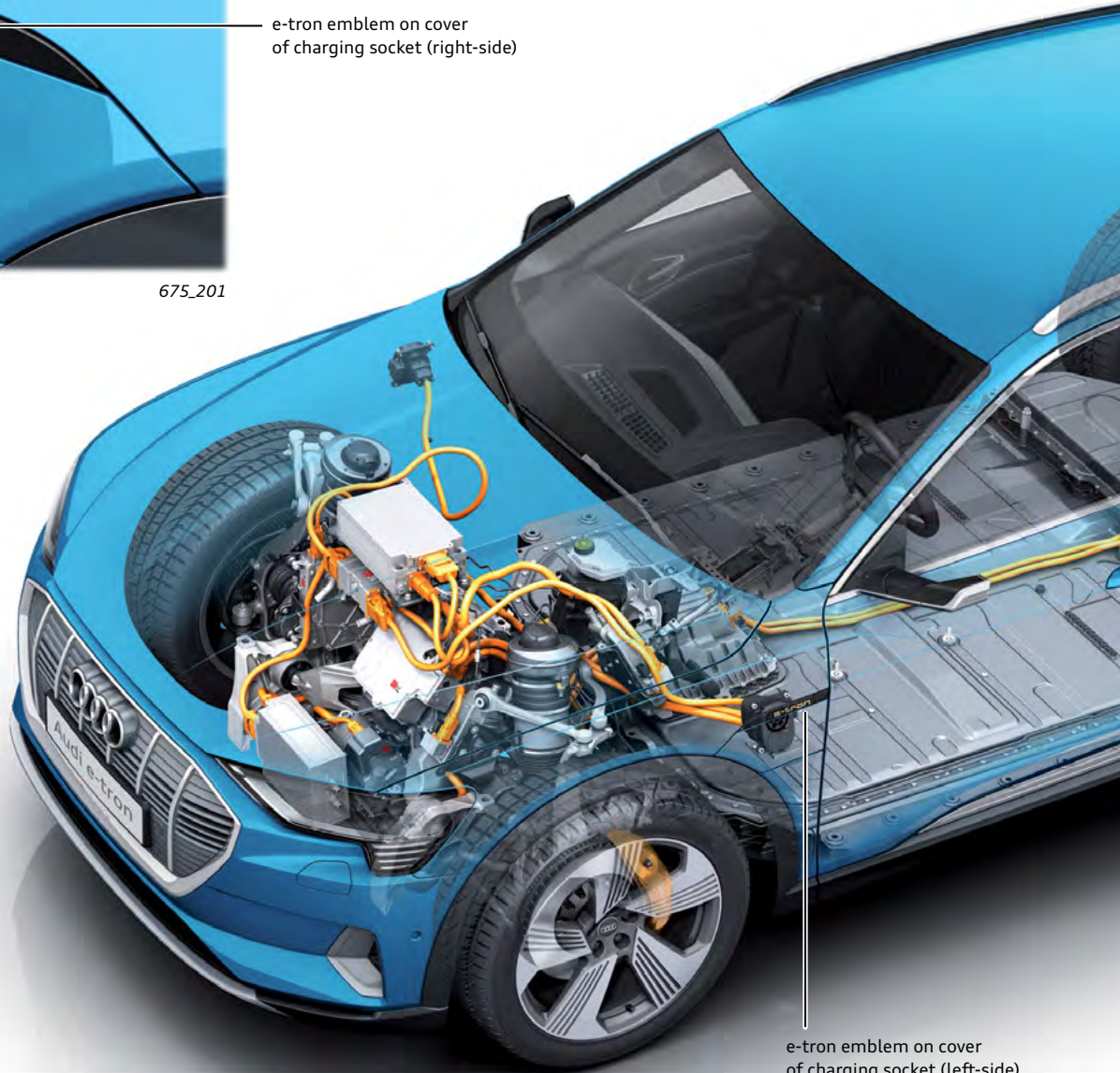
Overview

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)



e-tron emblem
(may not be used in all markets)

675_205



Brake caliper with e-tron emblem

675_204



675_151

On rear of vehicle



675_202

e-tron emblem on rear lid

Interior

- > Audi virtual cockpit in instrument panel insert with e-tron emblem

MMI system with e-tron displays



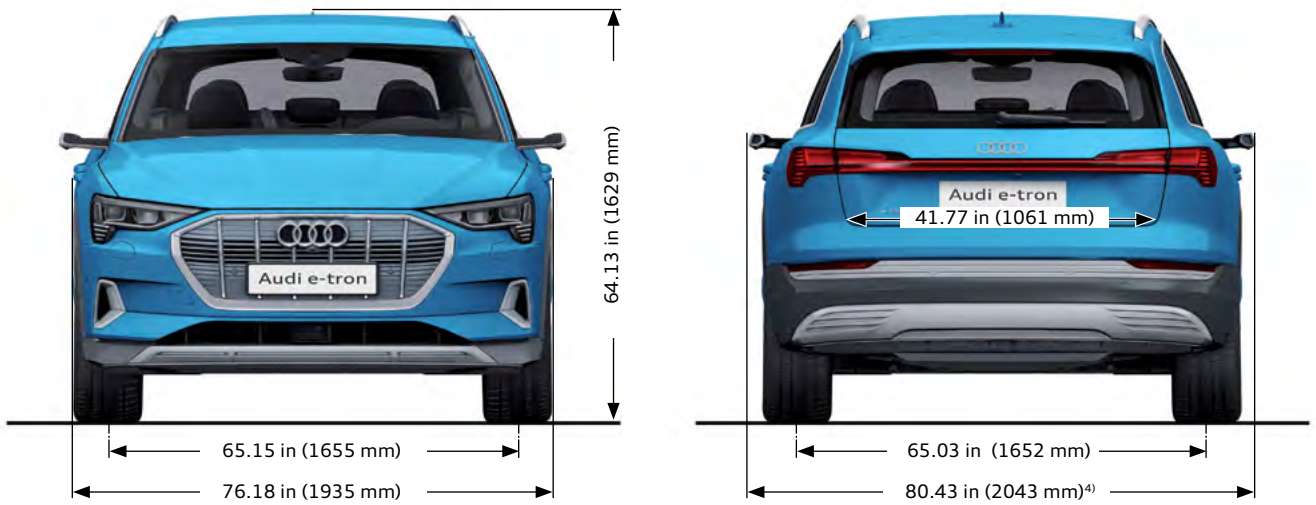
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e-tron emblem on instrument panel

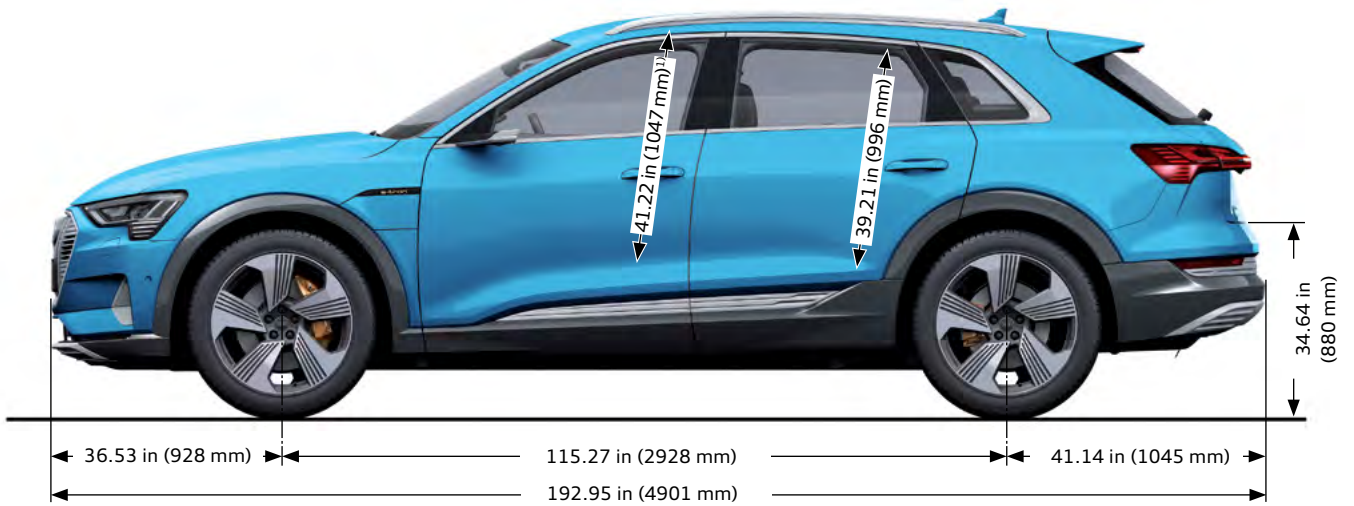


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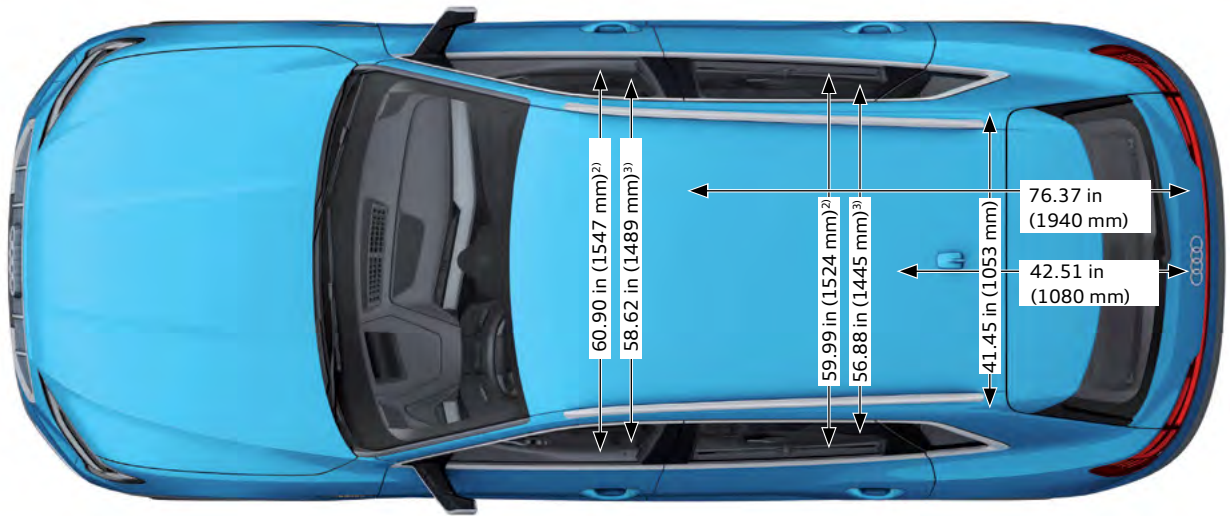
Dimensions



675_187



675_188



675_189

Exterior dimensions and weights

Length	192.95 in (4901 mm)
Width (not including mirrors)	76.18 in (1935 mm)
Width (including mirrors)	80.43 in (2043 mm) ⁴⁾
Height	64.13 in (1629 mm)
Front track	65.15 in (1655 mm)
Rear track	65.03 in (1652 mm)
Wheelbase	115.27 in (2928 mm)
Unladen weight	5654.85 lb (2565 kg)
Maximum gross weight	6922.50 lb (3140 kg)
Drag coefficient	0.27 ⁵⁾

Interior dimensions and other specifications

Front cabin width	60.90 in (1547 mm) ²⁾
Front shoulder width	58.62 in (1489 mm) ³⁾
Rear cabin width	59.99 in (1524 mm) ²⁾
Rear shoulder width	57.24 in (1454 mm) ³⁾
Through-loading width	41.77 in (1061 mm)
Load sill height	31.49 in (800 mm)
Luggage compartment capacity	21.88 cu ft (600 l)
Front storage compartment	2.11 cu ft (60 l)

¹⁾ Maximum headroom

²⁾ Elbow room width

³⁾ Shoulder room width

⁴⁾ Vehicle width with exterior mirrors + add 146 mm

⁵⁾ 0.28 with exterior mirrors

Body

Overview

The body of the Audi e-tron is a modern composite construction using various materials. In addition to various grades of steel, sheet aluminum is used in the rear part of the underbody and die-cast aluminum is used for the front suspension strut towers.

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 aluminum profiles.

Outer skin:

- > Side panels
- > Roof

are made of steel.

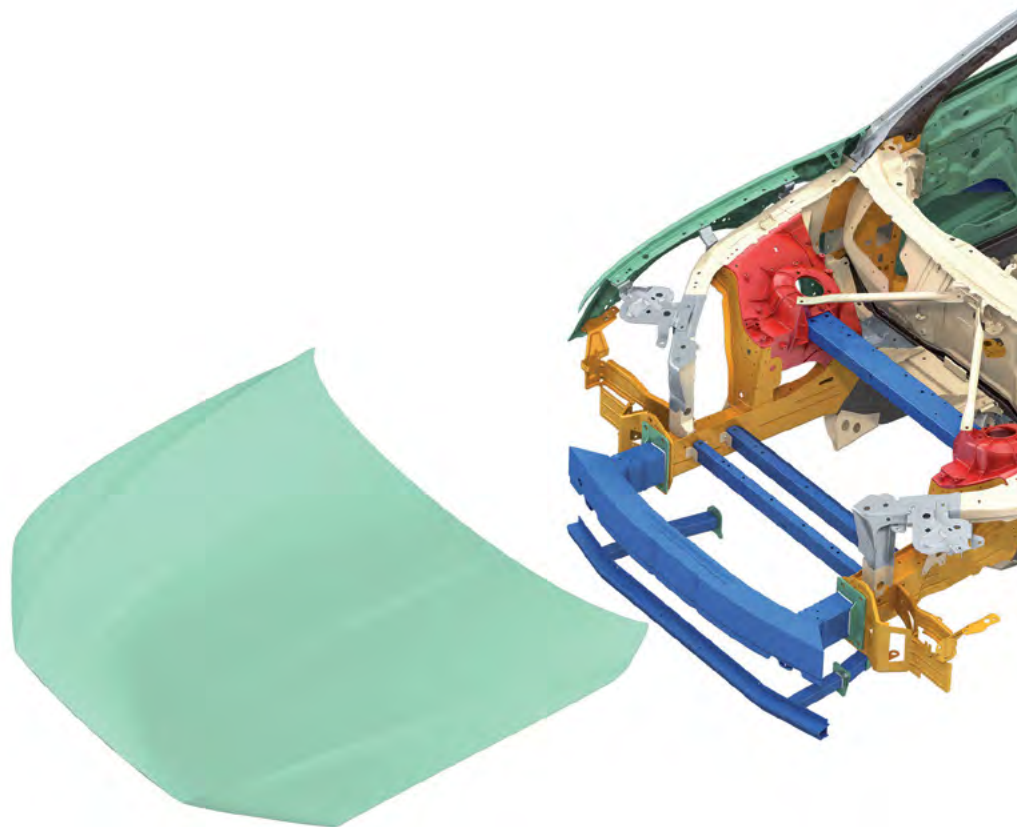
Attachments:

- > Hood
- > Rear lid
- > Doors
- > Fenders

are made of aluminum.

Key:

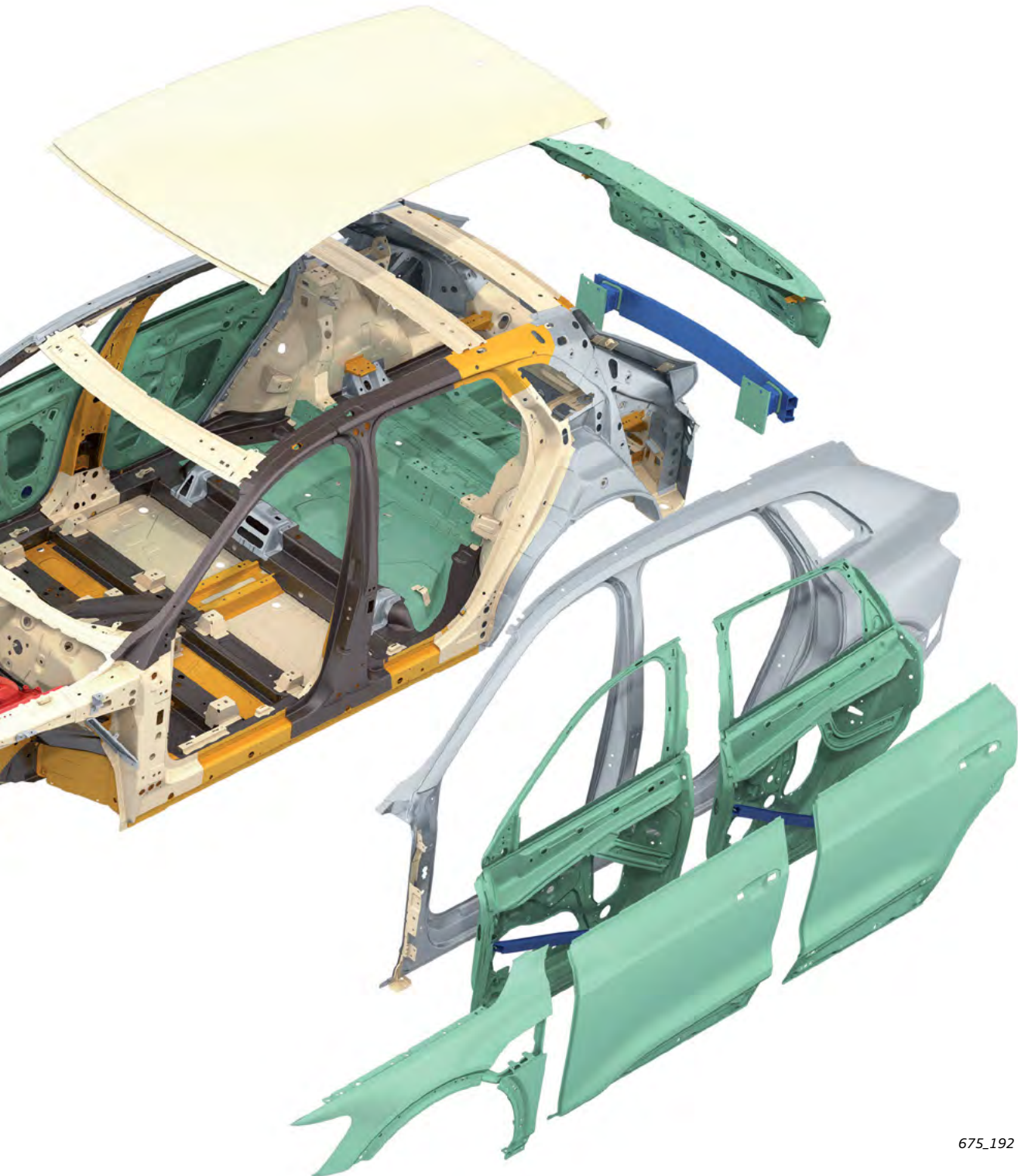
- Sheet aluminum
- Die-cast aluminum
- Aluminum section
- Ultra-high-strength steel (hot-formed)
- Modern high-strength steel
- High-strength steel
- Soft steel



Joining techniques

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

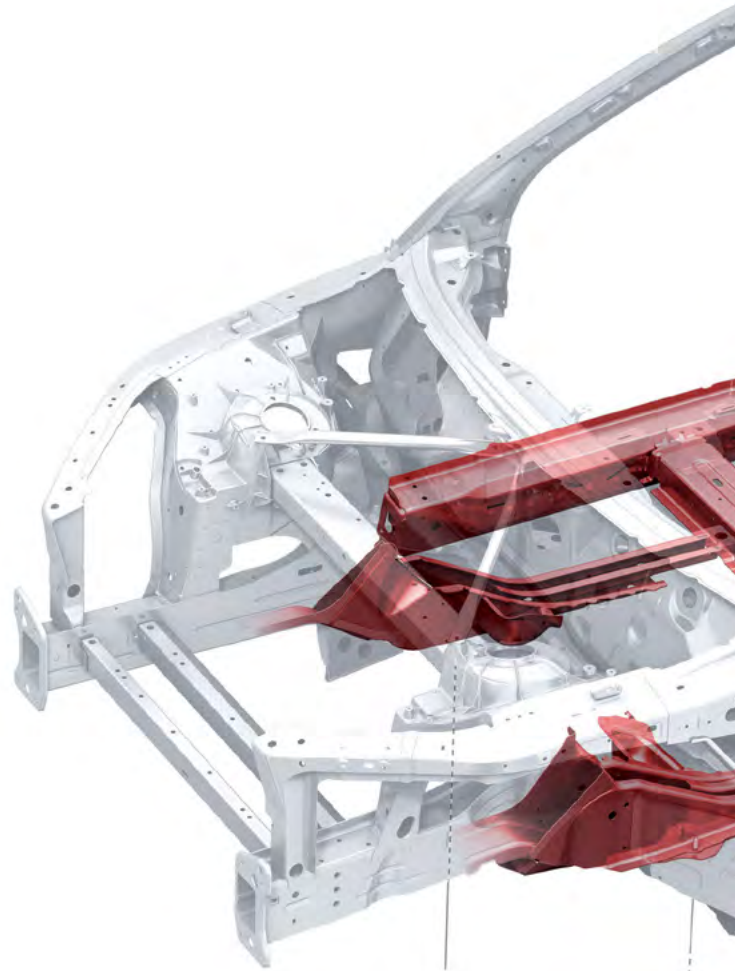
- > Laser welding for steel
- > MAG welding
- > Laser soldering/brazing
- > MIG soldering/brazing for steel
- > Friction element welding
- > Resistance spot welding for aluminum
- > Seaming
- > Bonding
- > Semi-tubular punch riveting
- > Flow-drill screws
- > Pop rivets



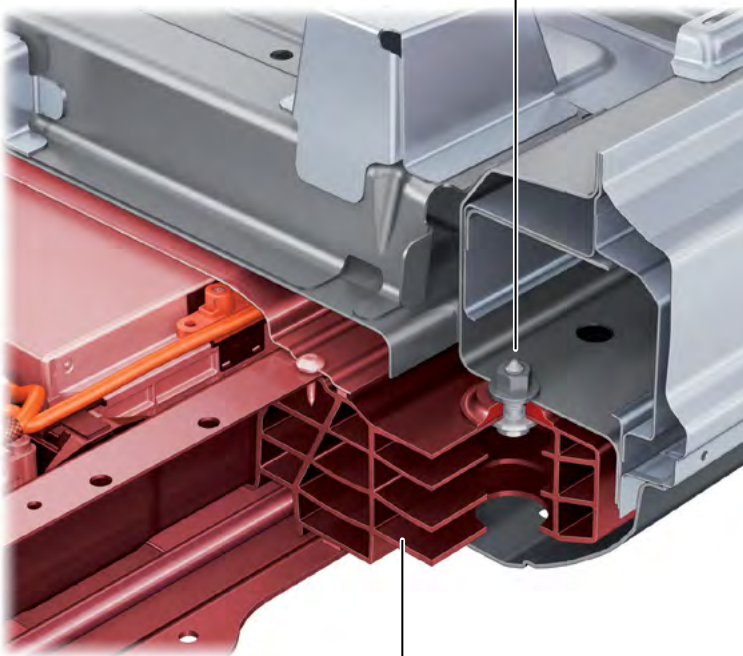
675_192

Underbody structure

One of the innovative features of the Audi e-tron is how the high-voltage battery is fully integrated in the load-bearing structure of the underbody. This requires a high level of precision when installing 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 impact collision but also increases its strength, in areas that are critical for safety, such as the high-voltage battery.



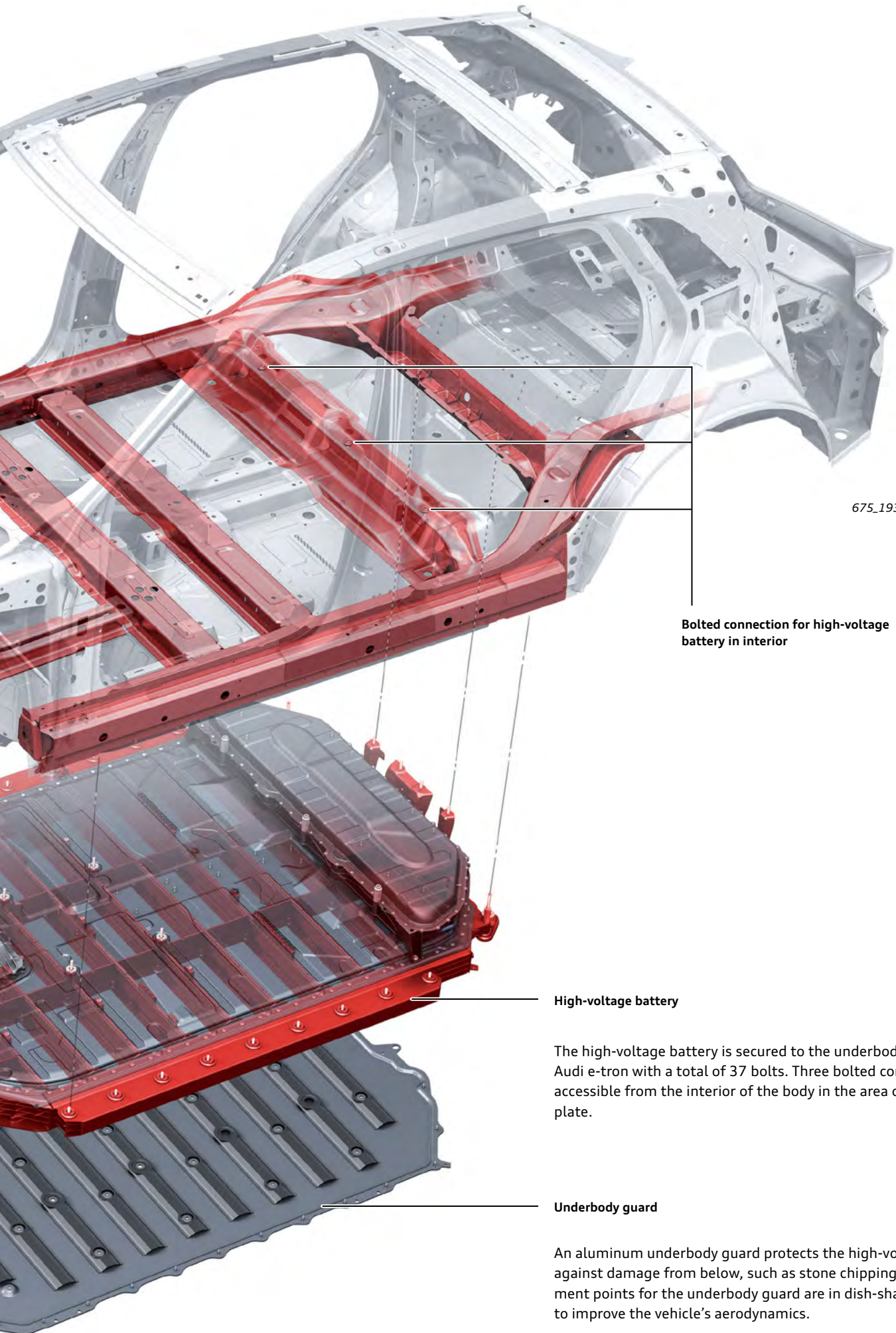
Bolted connection between high-voltage battery and side member/sill panel



Battery frame

675_194

During the development of the high-voltage battery, importance was placed on safe construction of the battery frame. The aluminum 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.



675_193

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

Body assembly

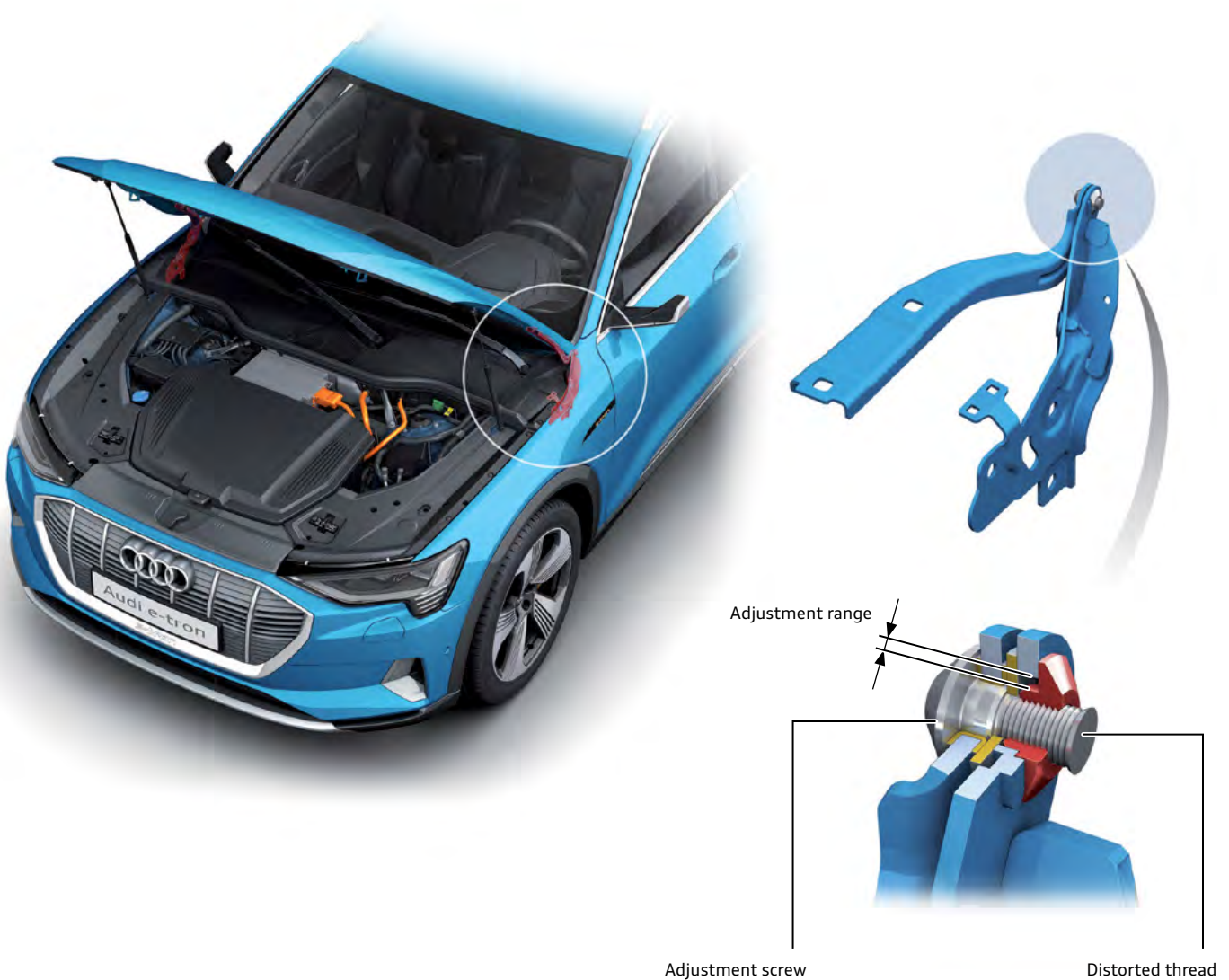
Hood

The Audi e-tron does not have a wrap-around hood. As a result, it was possible to install a simpler hood hinge on these models. On the Audi e-tron, the hinge is secured to the side of the fender 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 hood can be aligned with the door and the fender. The e-tron, unlike the Q8, has an outward opening hinge with the pivot point under the fender. Because it is hidden under the water deflector strip, no hinge cover is required.

The hood is secured to the top part of the hinge with two studs. The top part of the hinge 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 hood in the Z direction while the installed hood is closed.

To ensure the bolt cannot be removed (enabling access to the engine compartment), the thread is distorted after installation.

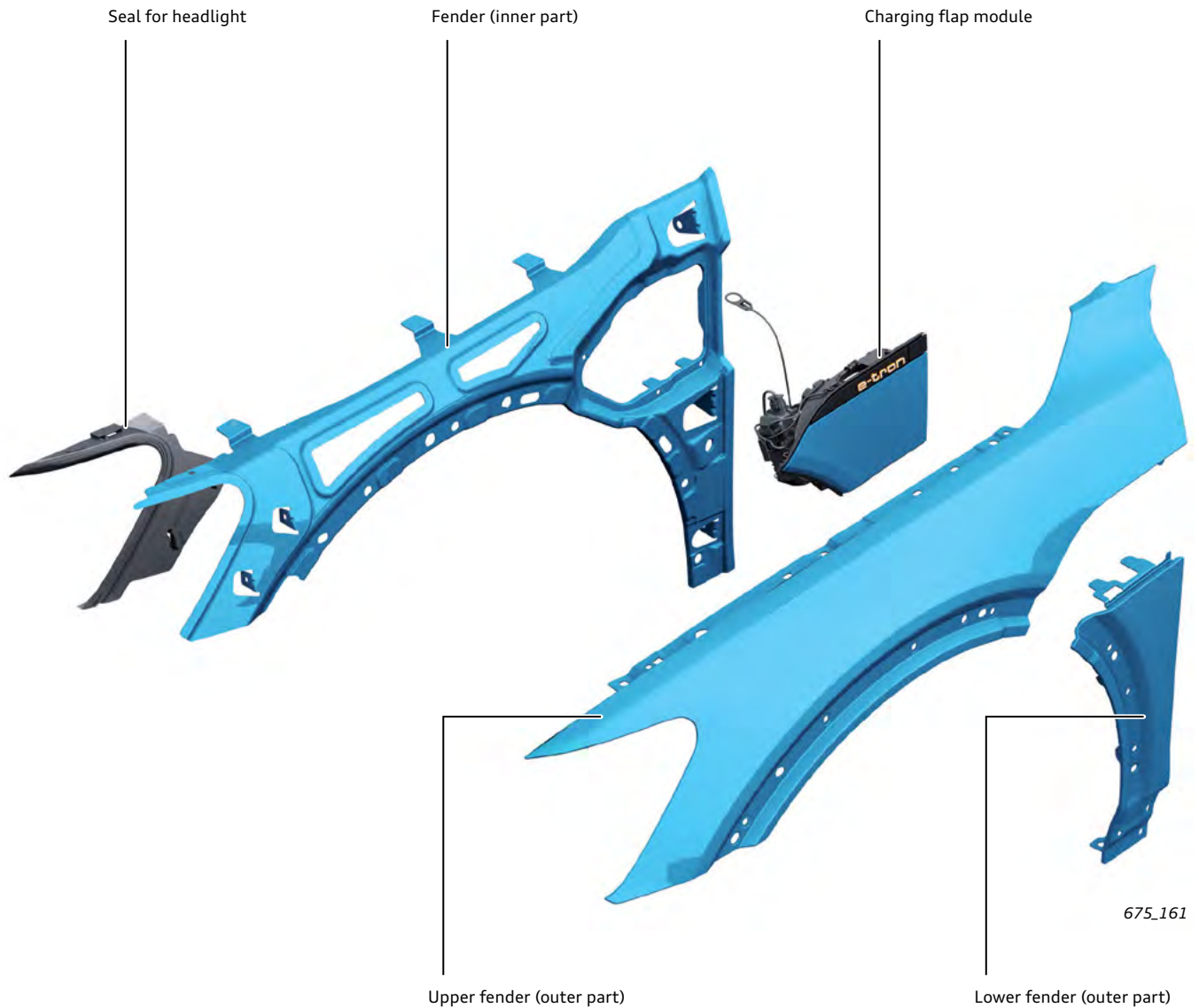


675_160

Fenders

The fenders of the Audi e-tron are made from three parts. Each fender has an upper and lower outer part joined to an inner part that acts as a carrier. These three aluminum 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 fender.

The charging flap module is attached 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 fender is sealed with a carrier part.



Charging flap module

Depending on the vehicle equipment and country, the Audi e-tron 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 fenders. When the vehicle is unlocked, the cover for the charging flap module will move downwards when Battery Charging Button Module EX32 or EX40 is pressed.

This allows access to the charging socket. If the vehicle is equipped with a convenience key, it does not have to be unlocked if the 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, a button in Battery Charging Button Module EX32 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, High-Voltage Battery Charger Control Module J1050 actuates a light in the charging flap module via a discrete wire.



Charging flap manual release

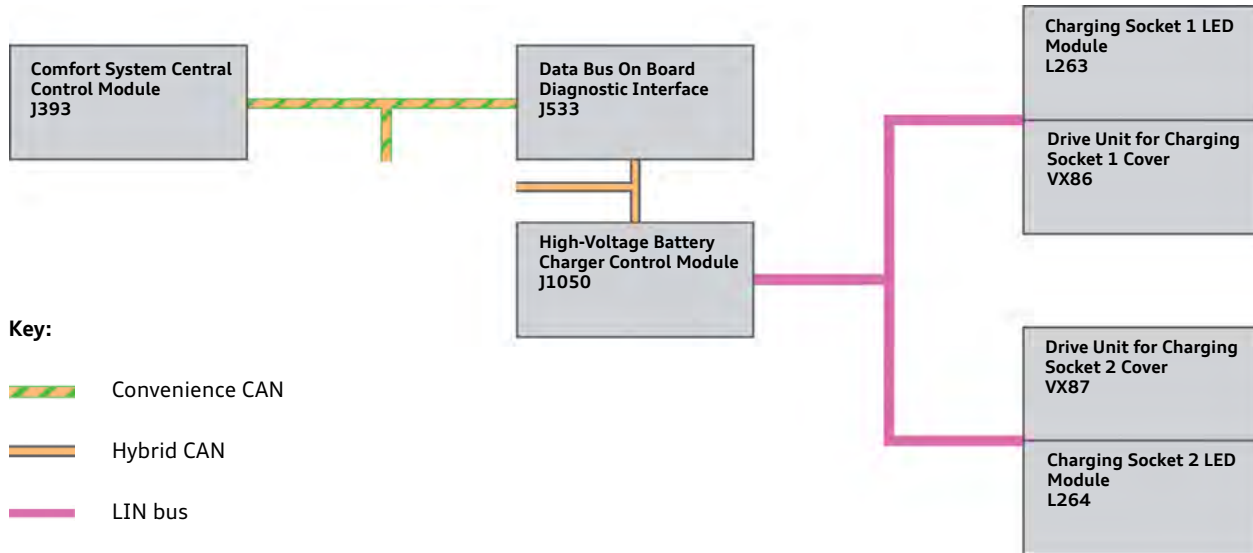


Reference

For further information on the charging flap, refer to page 104.

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 a LIN slave, the charging flap module receives the command to open or close the charging socket cover from its LIN master, High-Voltage Battery Charger Control Module J1050.

In addition, the command for how Charging Socket 1 LED Module should be actuated is also transmitted via LIN. If a second charging flap module is also installed (PR number: JS1), it is connected to High-Voltage Battery Charger Control Module J1050 via the same LIN connection.



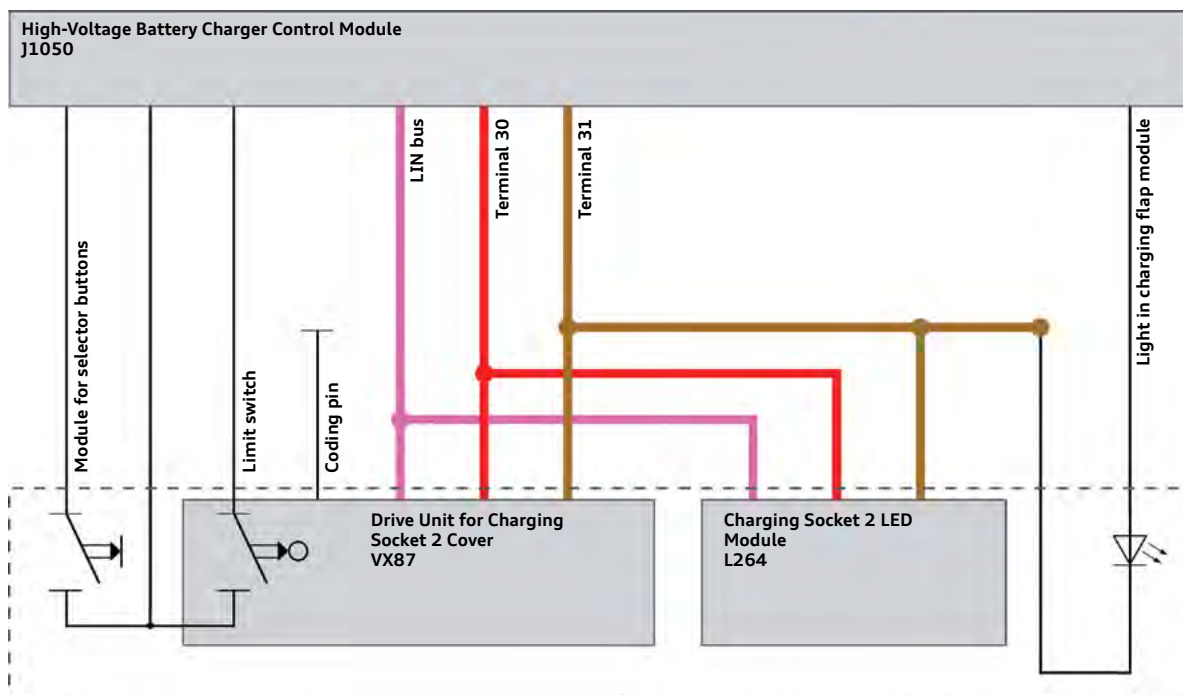
675_074

The drive unit for the 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 electric motor in the drive unit is self-locking. It was therefore not necessary to include an active locking mechanism for the charging flap.

High-Voltage Battery Charger Control Module J1050 receives feedback on whether the charging flap is closed via a microswitch.

If the drive unit no longer opens the charging flap module electrically, the charging flap can be released manually. 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.



675_075

Audi e-tron driving strategy

Drive

The Audi e-tron has an electric drive unit for both the front and rear axles. The distribution of the drive and recuperation torque between the units is controlled by Engine/Motor Control Module J623. J623 receives torque specifications from other modules so it can always distribute drive and recuperation torque values based on required traction and dynamic conditions or specification. (Refer to illustrations 675_174, 675_175, and 675_176.)

Drive simulations 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 16.

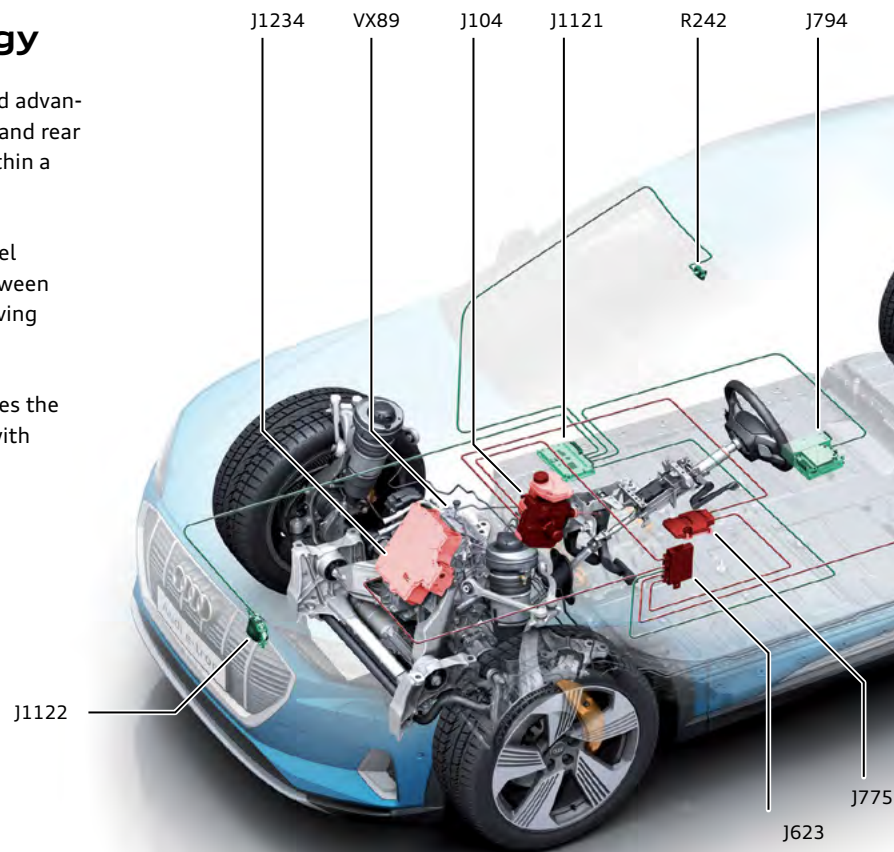
quattro with e-tron technology

The quick responsiveness of the electric motors can be used advantageously 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 milliseconds, bringing quattro with e-tron technology to a new level.

For further information refer to page 37.



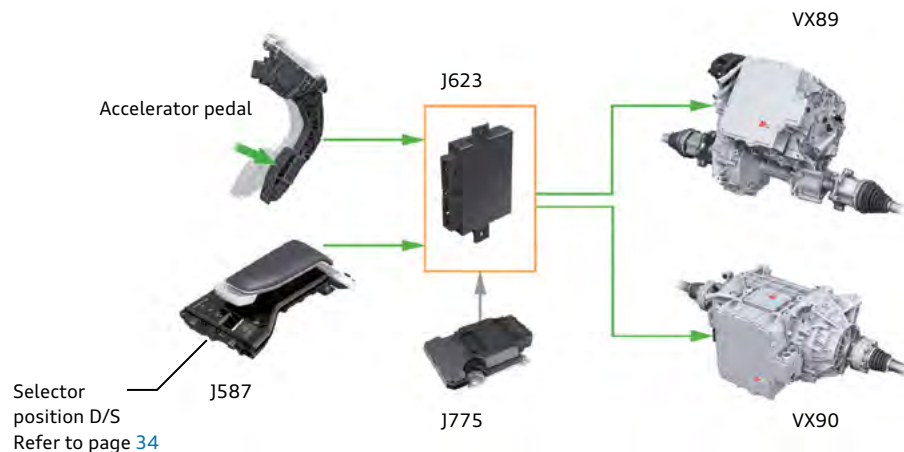
Key:

- J104** ABS Control Module
- J587** Selector Lever Sensor System Control Module
- J623** Engine/Motor Control Module
- J775** Drivetrain Control Module
- J794** Information Electronics Control Module 1
- J1121** Driver Assistance Systems Control Module
- J1122** Laser Distance Regulation Control Module
- J1234** Electric Drive Control Module on Front Axle
- J1235** Electric Drive Control Module on Rear Axle

- R242** Driver Assistance Systems Front Camera

- VX89** Front Three-Phase Current Drive
- VX90** Rear Three-Phase Current Drive

Acceleration – power transmission



Recuperation (energy recovery)

With its recuperation concept, the Audi e-tron is able to recover a 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 0.3g can be generated by brake energy recuperation. (Note: The letter 'g' in this case refers to the force of gravity.)

On average, over 90 percent of all braking deceleration is below 0.3g, 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.

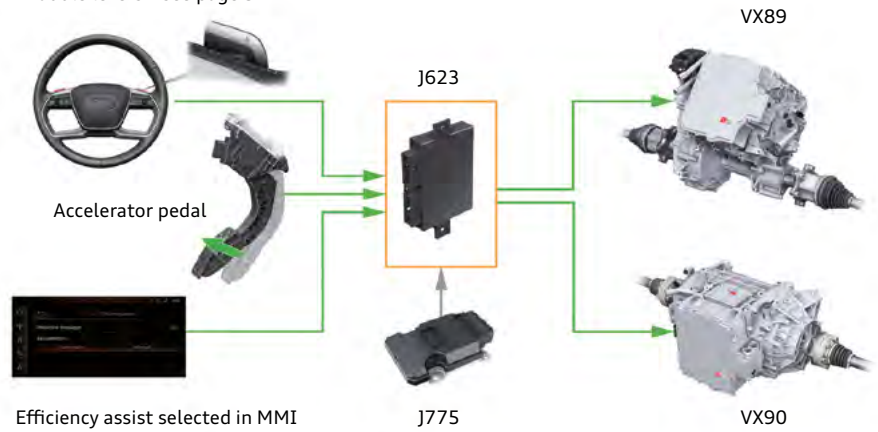
The transition between brake energy recuperation (electrical deceleration) and deceleration using the hydraulic brake system is seamless and is not felt by the driver. This is made possible by the precise regulation with the new electrohydraulic brake regulation system MK C1.

For further information refer to page 61.



Manual and automatic overrun recuperation

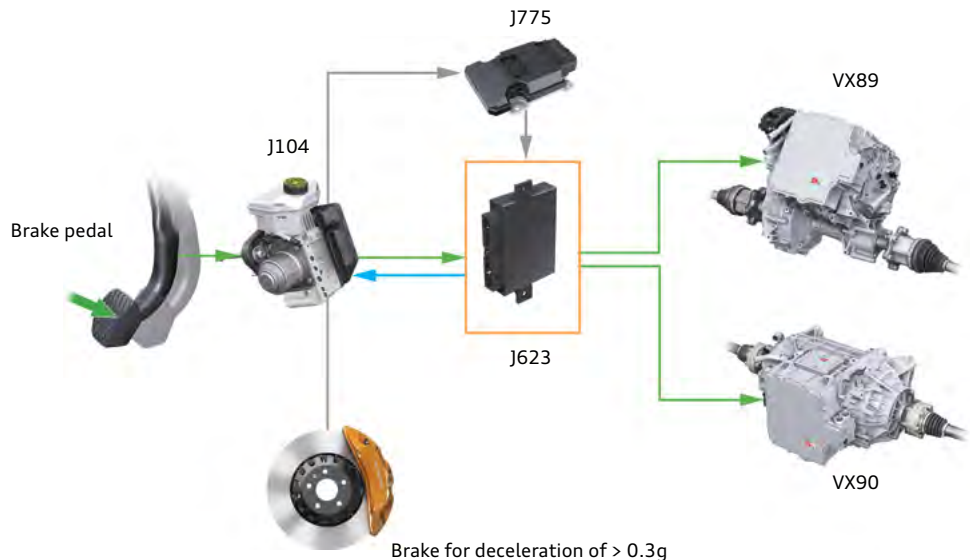
Paddle levers – see page 57



675_173

675_175

Brake energy recuperation



675_176

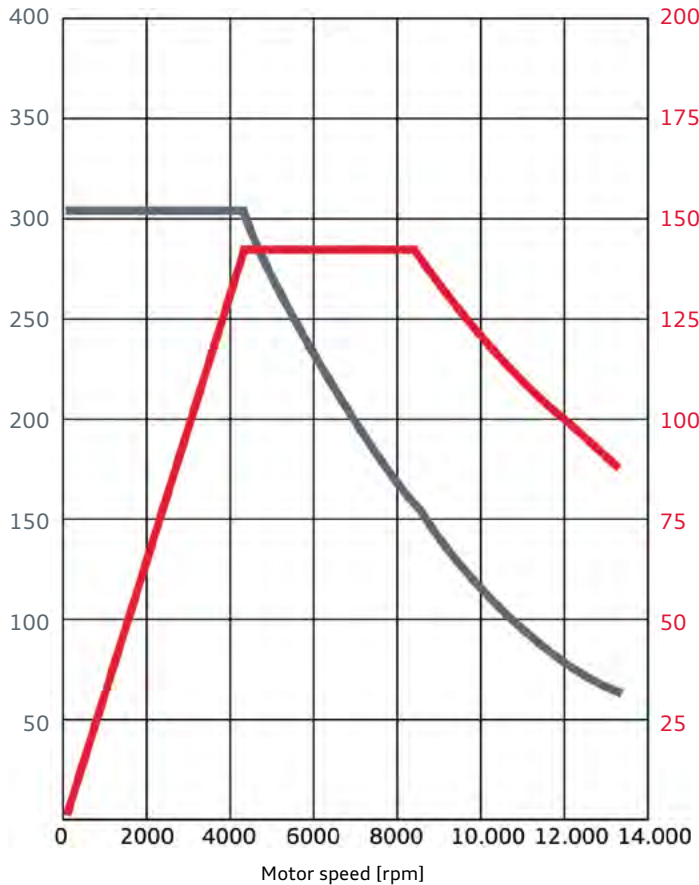
Power units

Electric drive motor for front axle

Torque/power curve

Motor with code EASA

— Power in kW
— Torque in Nm



675_035

675_091

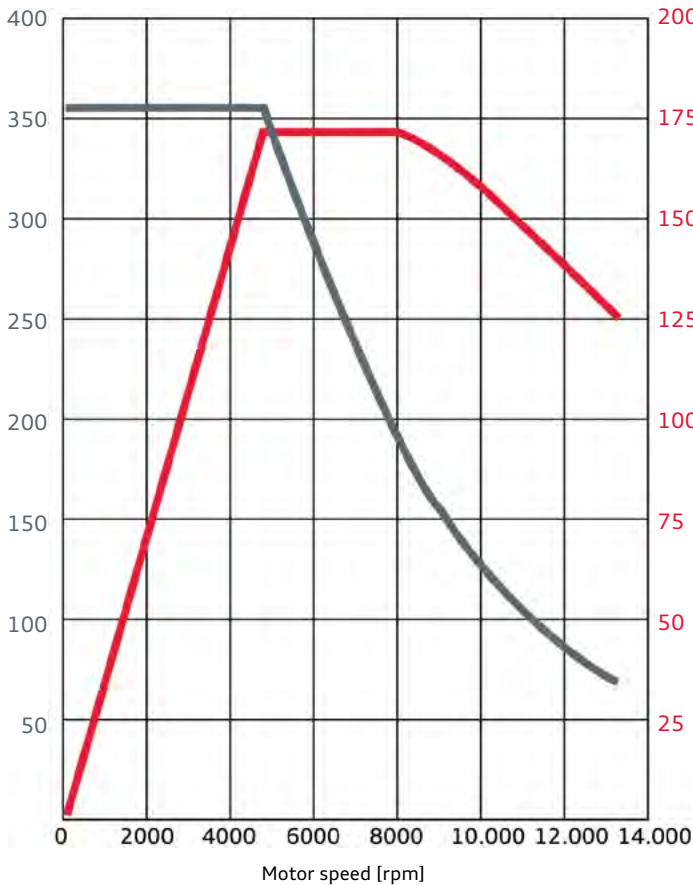
Features	Technical data
Motor code	EASA
Type	Parallel-axis asynchronous motor
Type of rotor	Internal rotor
Cooling	Water cooling
Coolant	G12evo
Voltage rating (DC)	360 Volt
Continuous power output (30 min) in kW at 7,000 rpm	70
Peak power output (10 sec) in kW	135
Torque in Nm at continuous power output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

— Power in kW
— Torque in Nm



675_036

675_092

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

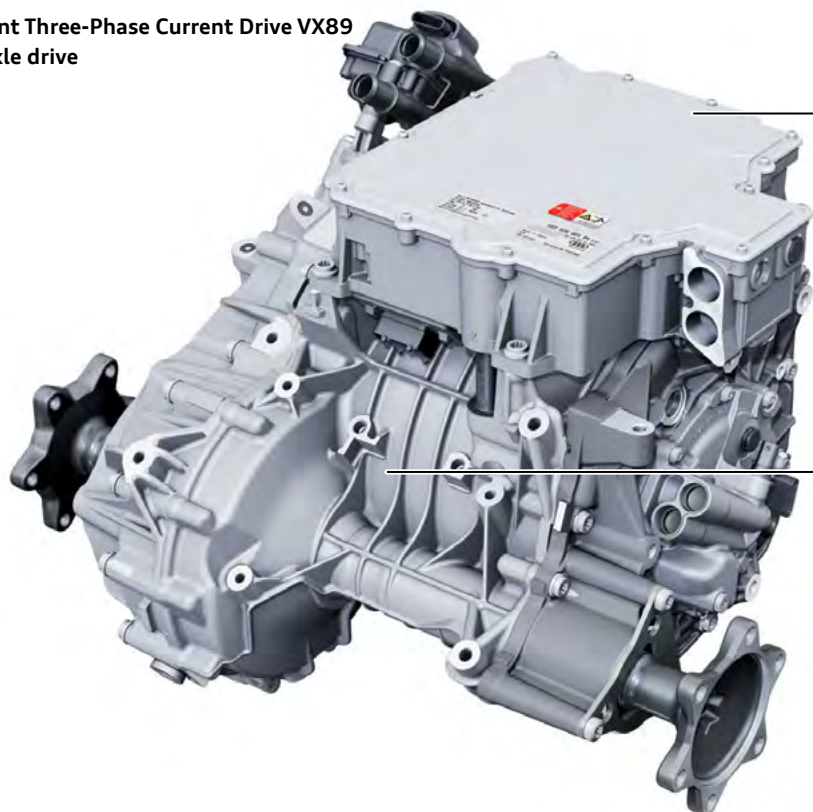
Electric drive motor

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 aluminum cage rotor). The rotor transmits the rotational movement to the transmission. The air gap between the stator and the 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 is 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 equalization line.

Front Three-Phase Current Drive VX89 - Axle drive



Electric Drive Control Module on Front Axle
J1234
- Power electronics

Front Axle Electric Drive Motor
V662
- Electric motor

Electric Drive Control Module on Rear Axle
J1235
- Power electronics

675_035

Rear Three-Phase Current Drive VX90 - Axle drive

Rear Axle Electric Drive Motor
V663
- Electric motor

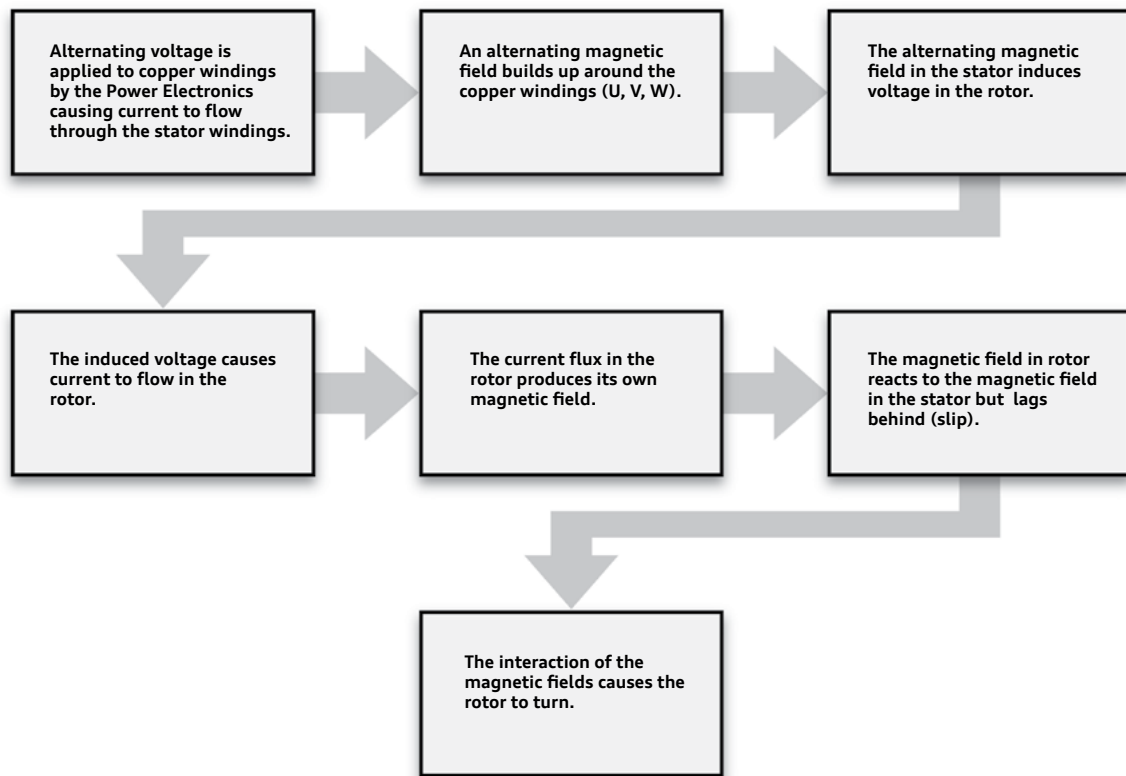


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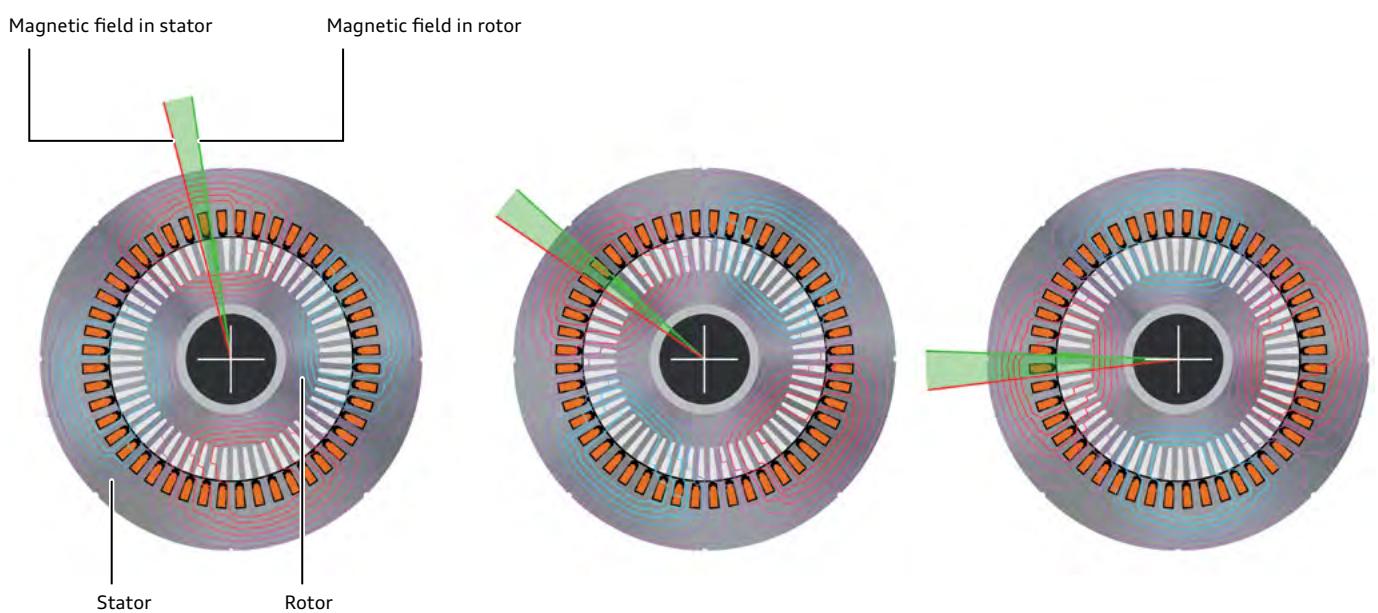
Function

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 (that is, asynchronously to) the rotating magnetic field

of the stator. This difference is known as slip¹. This causes a current to be induced in the aluminum 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.



675_024



675_130

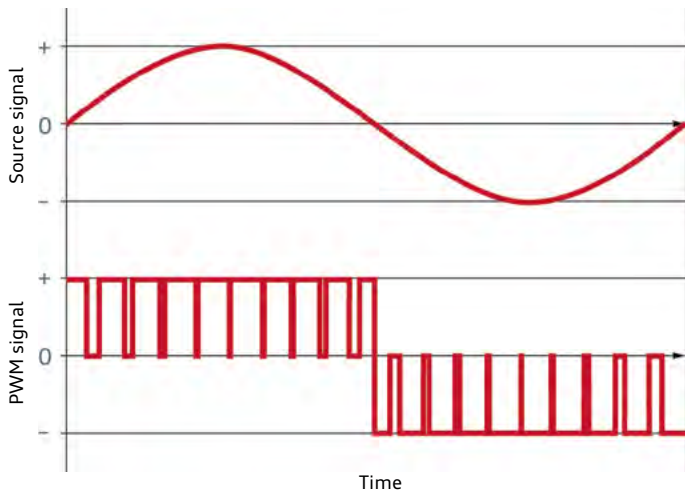
¹⁾ The slip describes the difference in rotation speed between the magnetic fields in the rotor and stator.

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.

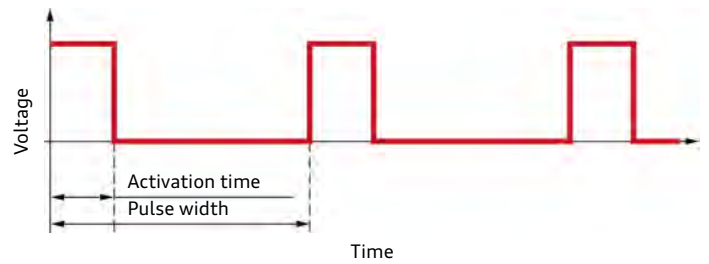
The speed is regulated by changing the frequency while the torque of Front and Rear Axle Electric Drive Motors V662 and V663 is regulated by changing the activation times of the individual pulse widths.

The higher the frequency, the higher the speed.



675_167

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.

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 transmissions, 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 (ABS Control Module J104) restricts the rolling speed to 0.6 mph (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.

Reverse

When transmission position R is engaged, the power electronics unit initiates the rotation of the electric field (see page 30) and thus 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 Module J104.)

Electric drive operating as motor

When the electric drive is operating as a motor, Engine/Motor Control Module 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. Rear Three-Phase Current Drive VX90 is more efficient and is used as the main axle in both recuperation and drive modes.

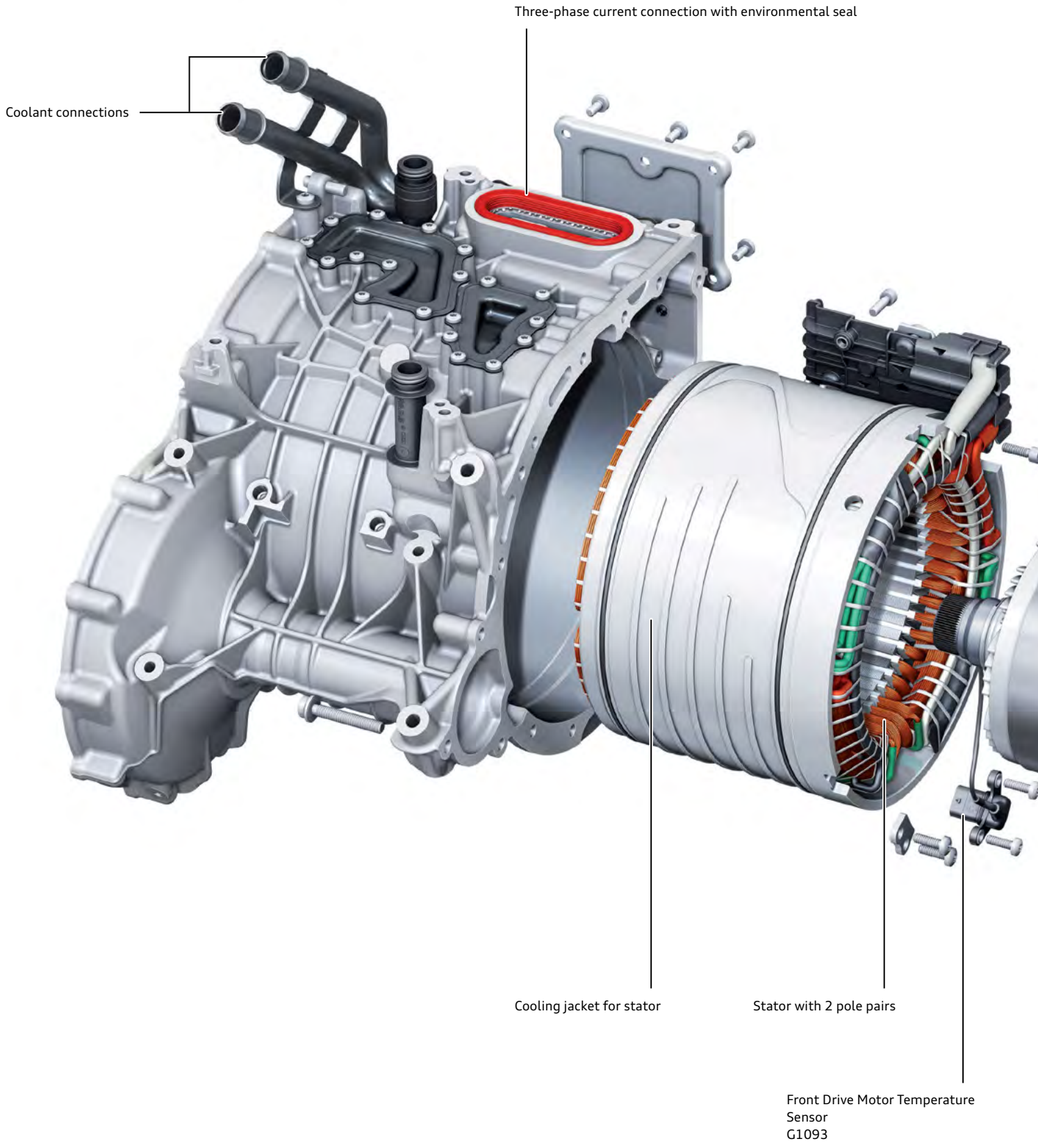
Electric drive as generator

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 to compensate for drag losses.



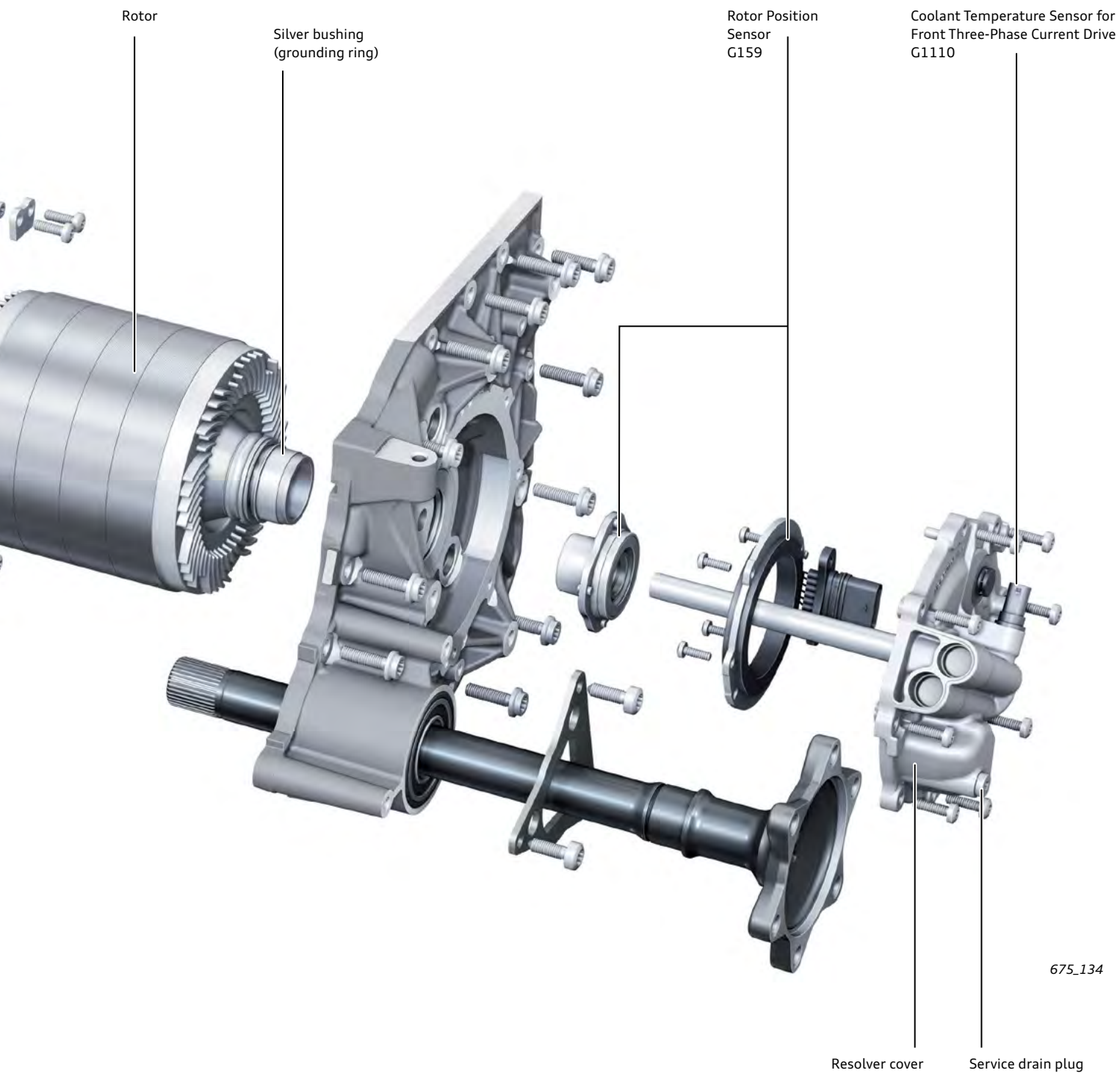
Coolant connections

Three-phase current connection with environmental seal

Cooling jacket for stator

Stator with 2 pole pairs

Front Drive Motor Temperature
Sensor
G1093



Rotor

Silver bushing
(grounding ring)

Rotor Position
Sensor
G159

Coolant Temperature Sensor for
Front Three-Phase Current Drive
G1110

Resolver cover

Service drain plug

675_134

Electric drive cooling system

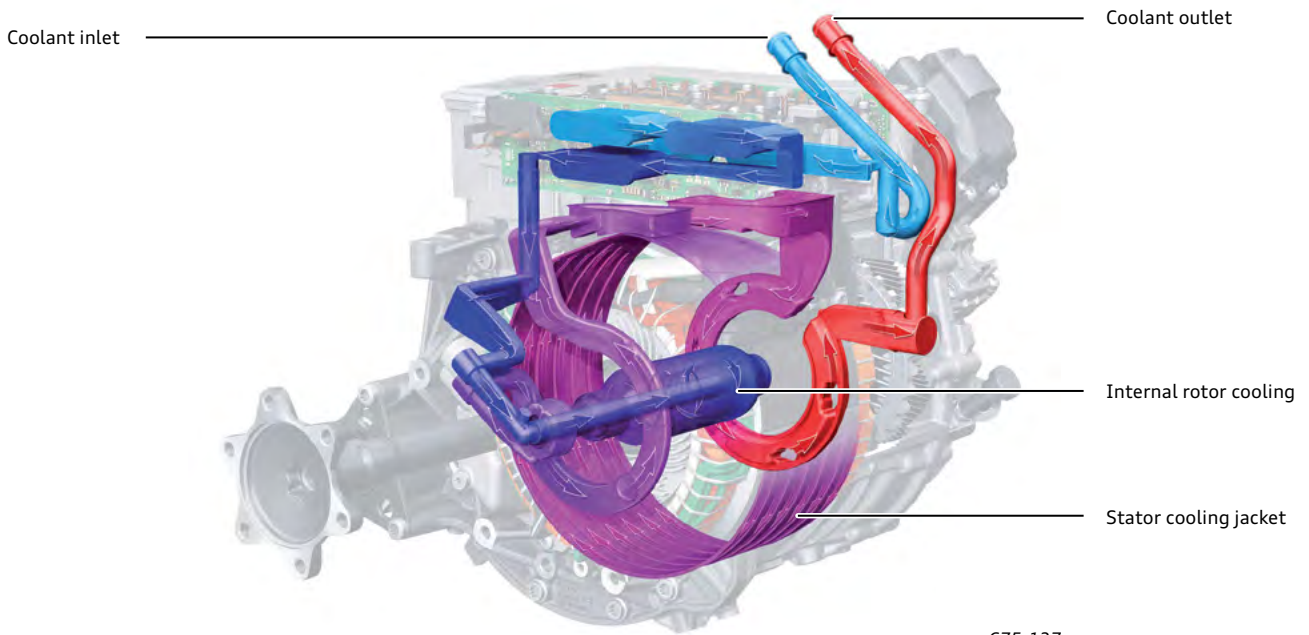
The electric drive motors for the front and rear axles are cooled by a low-temperature cooling fluid circuit. The coolant stream flows through both the stator and the rotor.

The additional internal rotor cooling 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 service work.

Front axle

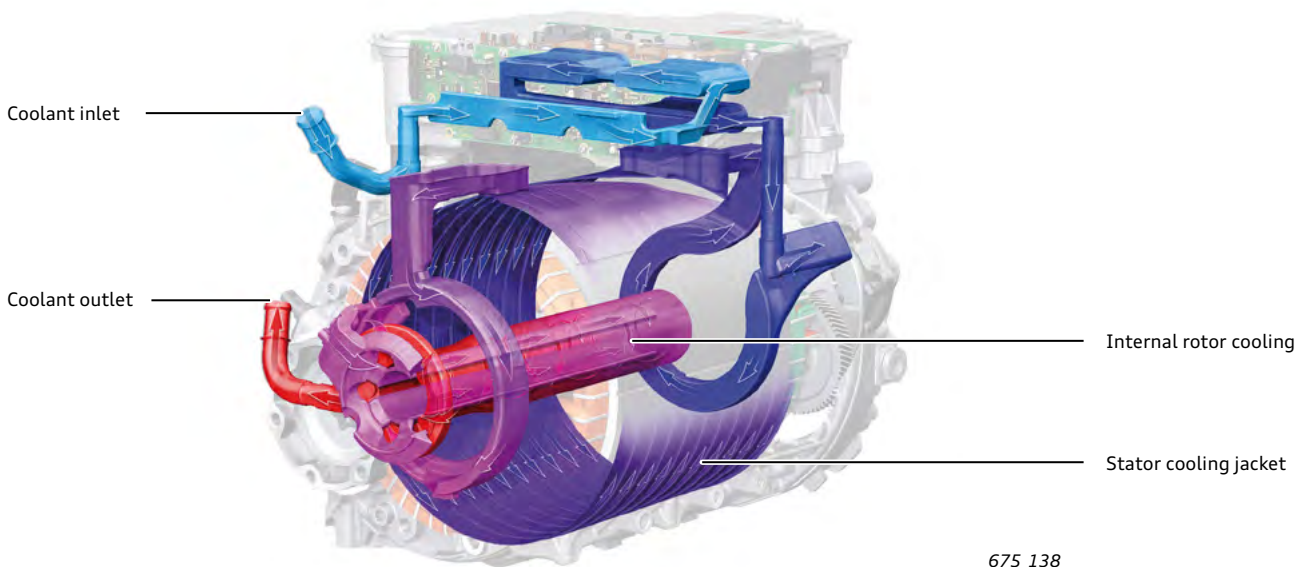
The power electronics and the electric drive motor are connected in series within the coolant circuit. The coolant flows first through the power electronics and then through the “water lance” on the

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

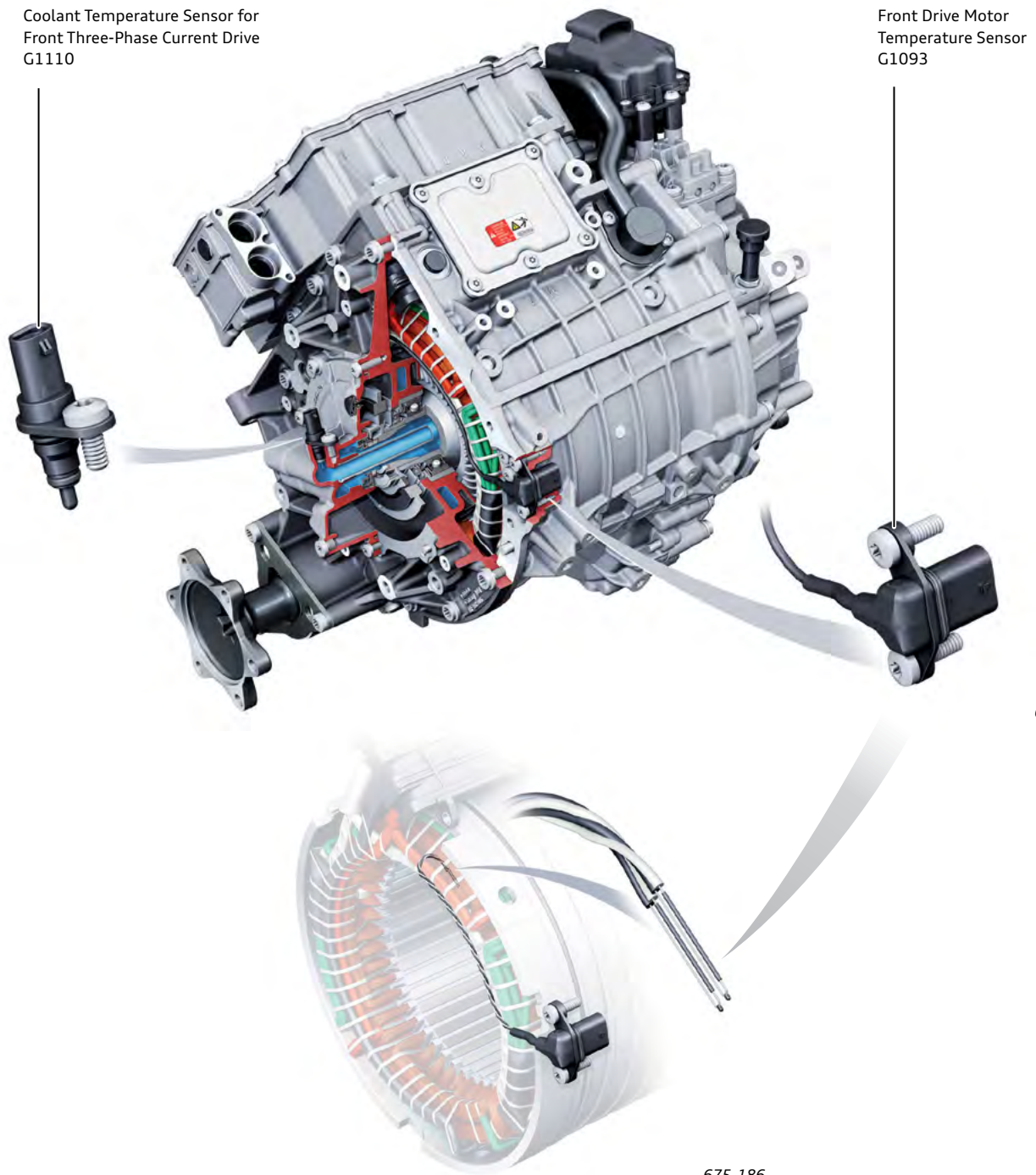
Each electric drive motor has two different temperature sensors. On the front electric drive motor, these are Coolant Temperature Sensor for Front Three-Phase Current Drive G1110 and Front Drive Motor Temperature Sensor G1093.

G1110 monitors the coolant temperature in the inlet stream.

G1093 measures the stator temperature. This sensor is permanently integrated in the stator winding for accurate measurement, and has a redundant design (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 only one of the two sensors fails, a DTC is not generated. Only Front Drive Motor Temperature Sensor G1093 is shown in the Measuring values.

The configuration on the rear axle is the same. Rear Drive Motor Temperature Sensor G1096 is in the stator. The coolant is measured by Coolant Temperature Sensor for Rear Three-Phase Current Drive G1111.



675_196

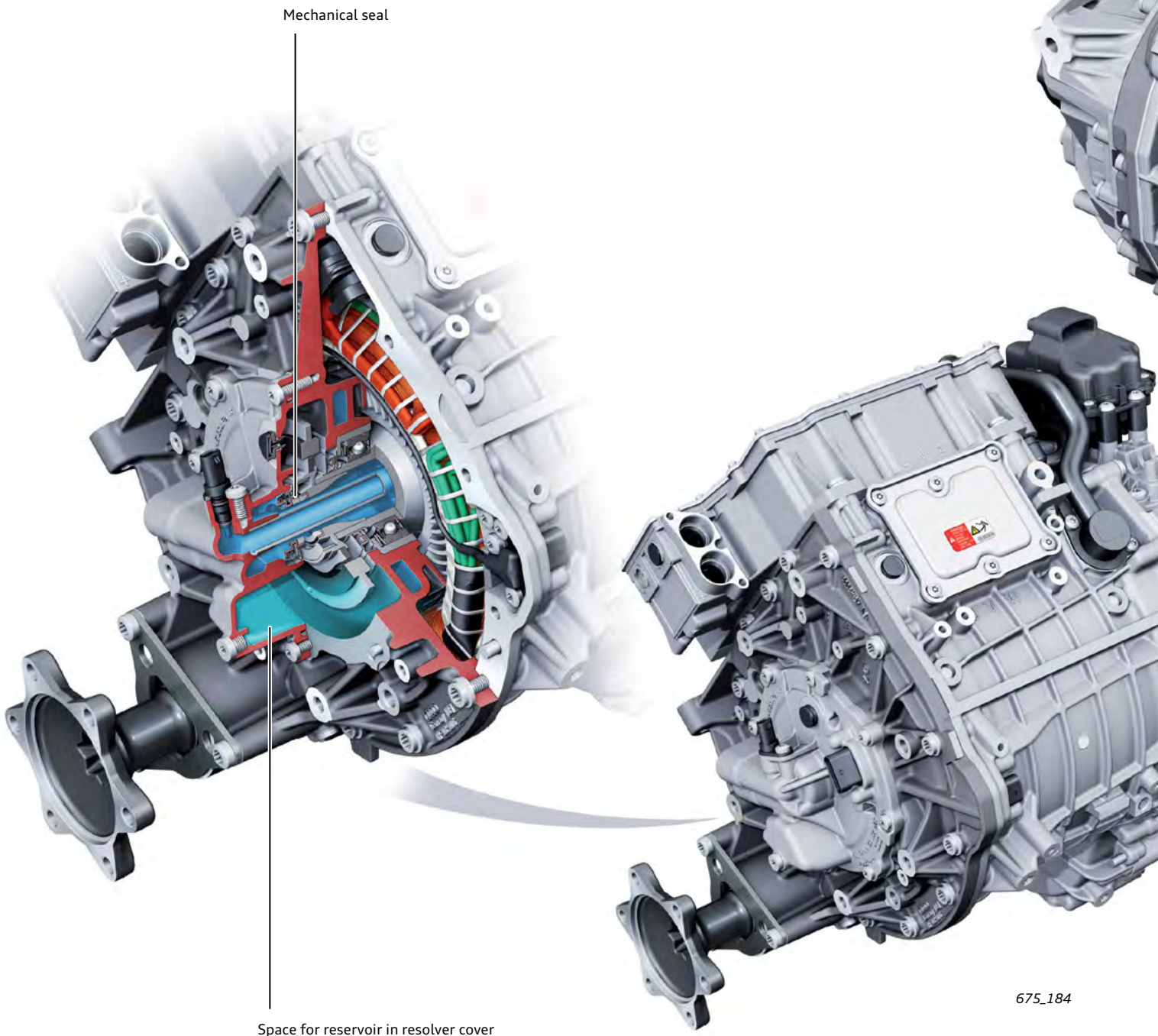
675_186

Mechanical seal (sliding ring gasket)

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 two-piece mechanical seals.

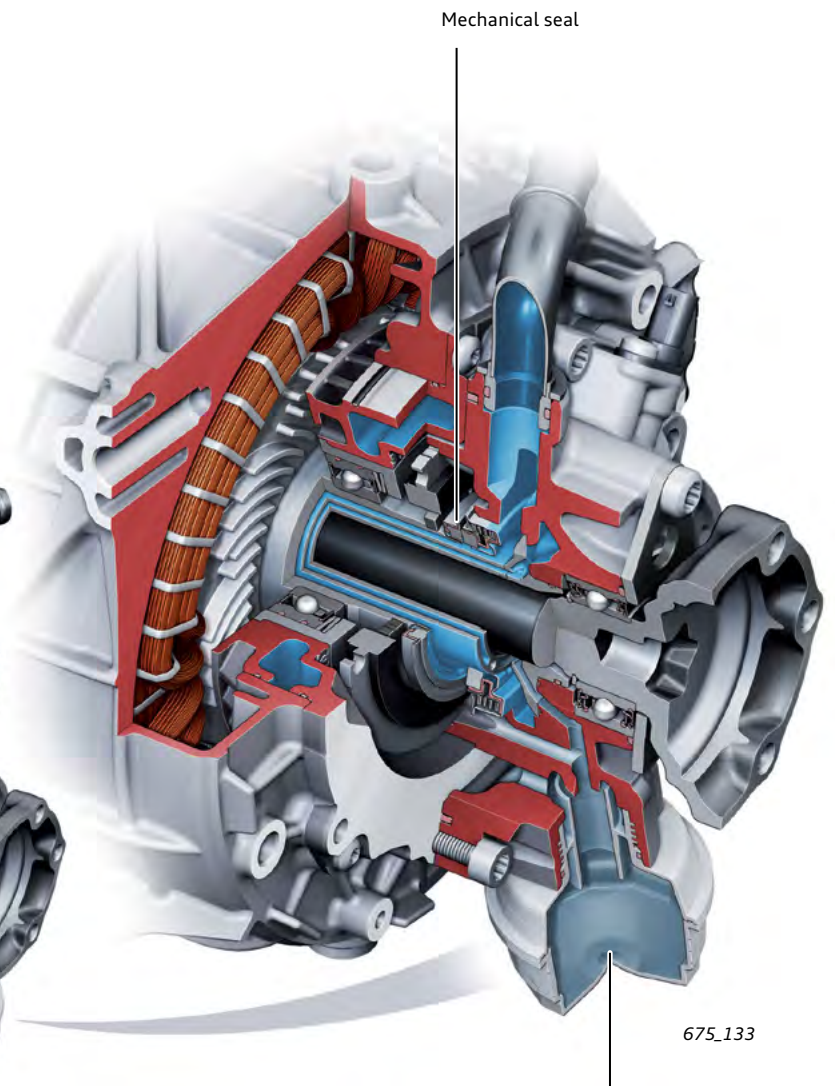
These mechanical seals provide an axial seal and are designed for higher rotation speeds than radial seals. Due to the design, the front electric drive motor has one mechanical seal and the rear electric drive motor has two separate mechanical seals.

Front axle



675_184

Rear axle



Mechanical seal

675_133

Reservoir



Note

The front reservoir must be emptied approximately every 20,000 mi (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 happens under all operating conditions, the mechanical seal is etched by laser during manufacture. This laser etching 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.

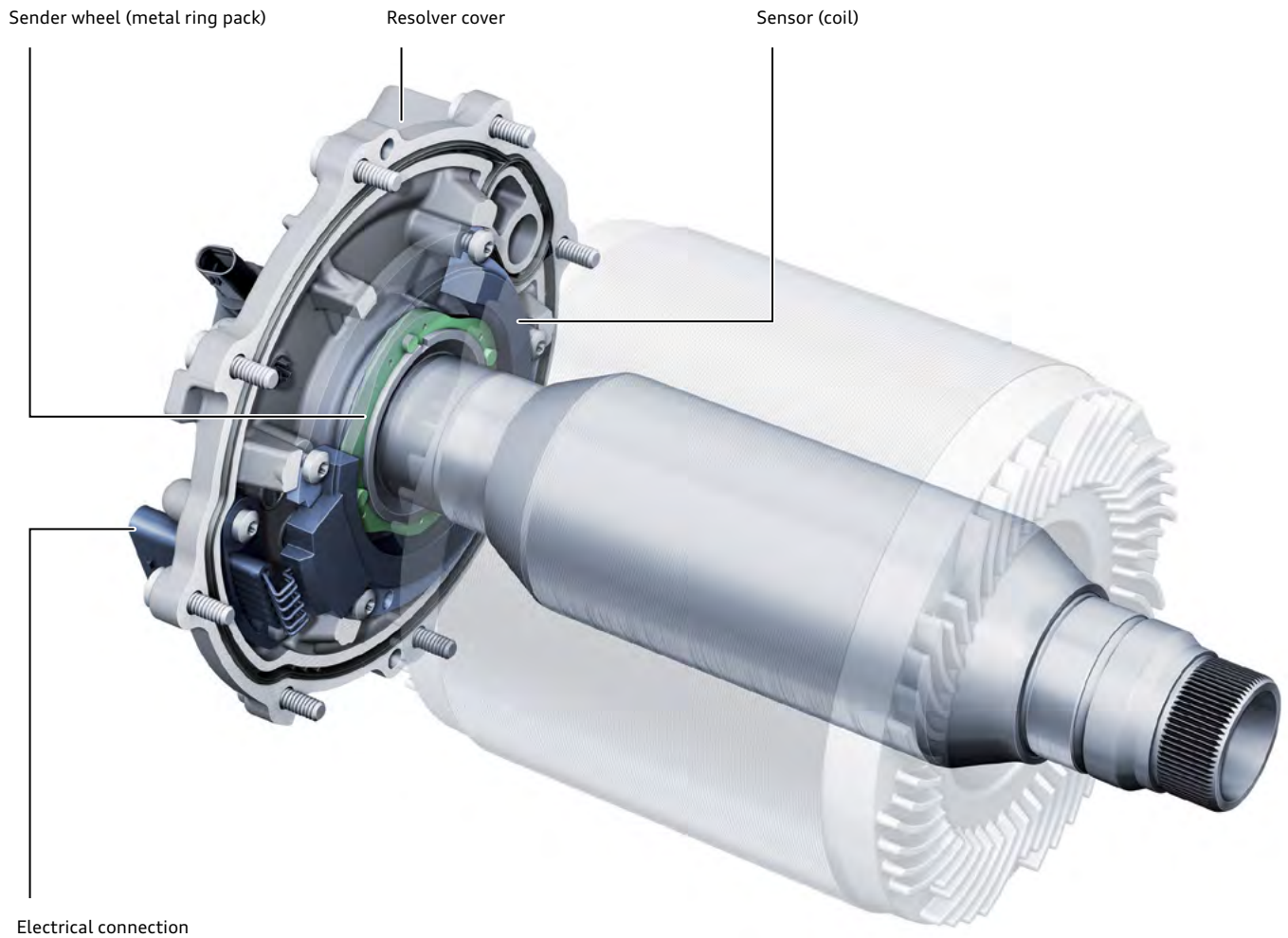


675_185

Rotor Position Sensor G159

The function of the Rotor Position Sensor 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 viewable in the Measuring Values.



675_132

*Resolvers work using the same basic physical principles as an electrical transformer. A resolver typically uses copper windings in its stator and a machined metal rotor. The inductive coupling between the windings varies according to the angular position of the rotor. The resolver is energized with an AC signal and the resulting output from the transformer windings is measured to provide an electrical signal which is proportional to angle.

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 installed on each electric drive: Electric Drive Control Module on Front Axle J1234 and Electric Drive Control Module on Rear Axle J1235.

They have the Address Words 0051 and 00CE respectively. 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

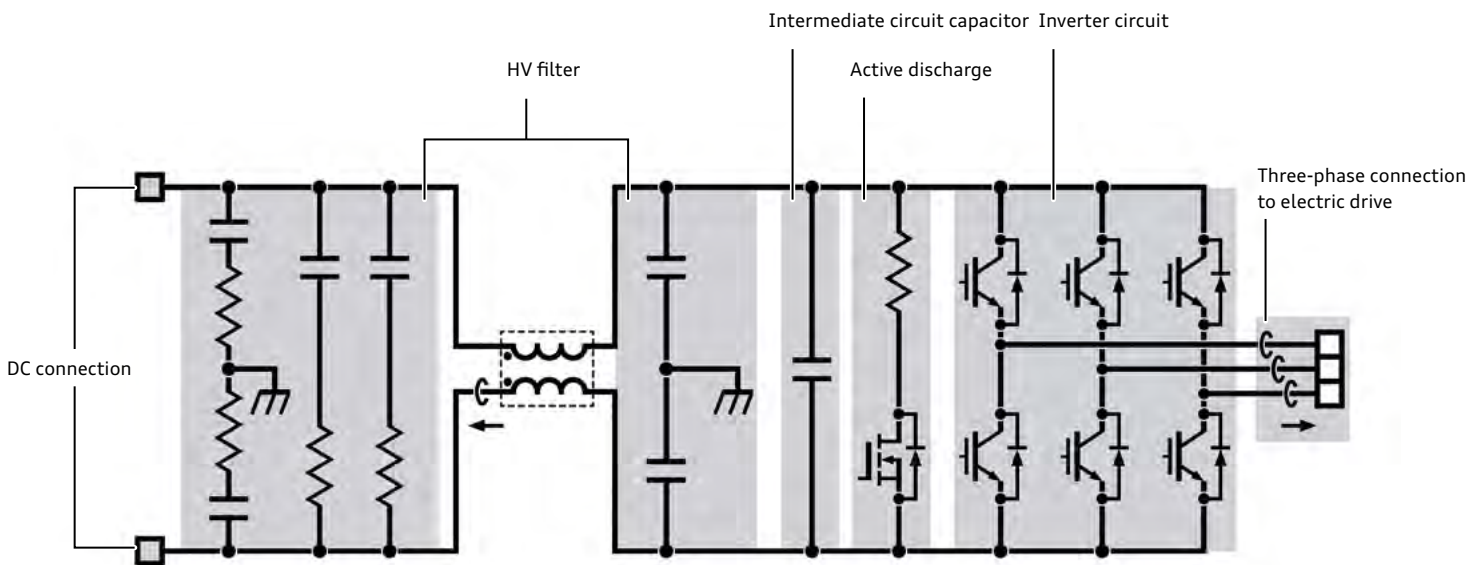
Inside the power electronics unit, the DC current provided by the high-voltage battery is converted to three-phase AC current. This is performed by six semiconductor switching modules (two per phase). Each of the module pairs switches the positive and negative sides.

Cooling

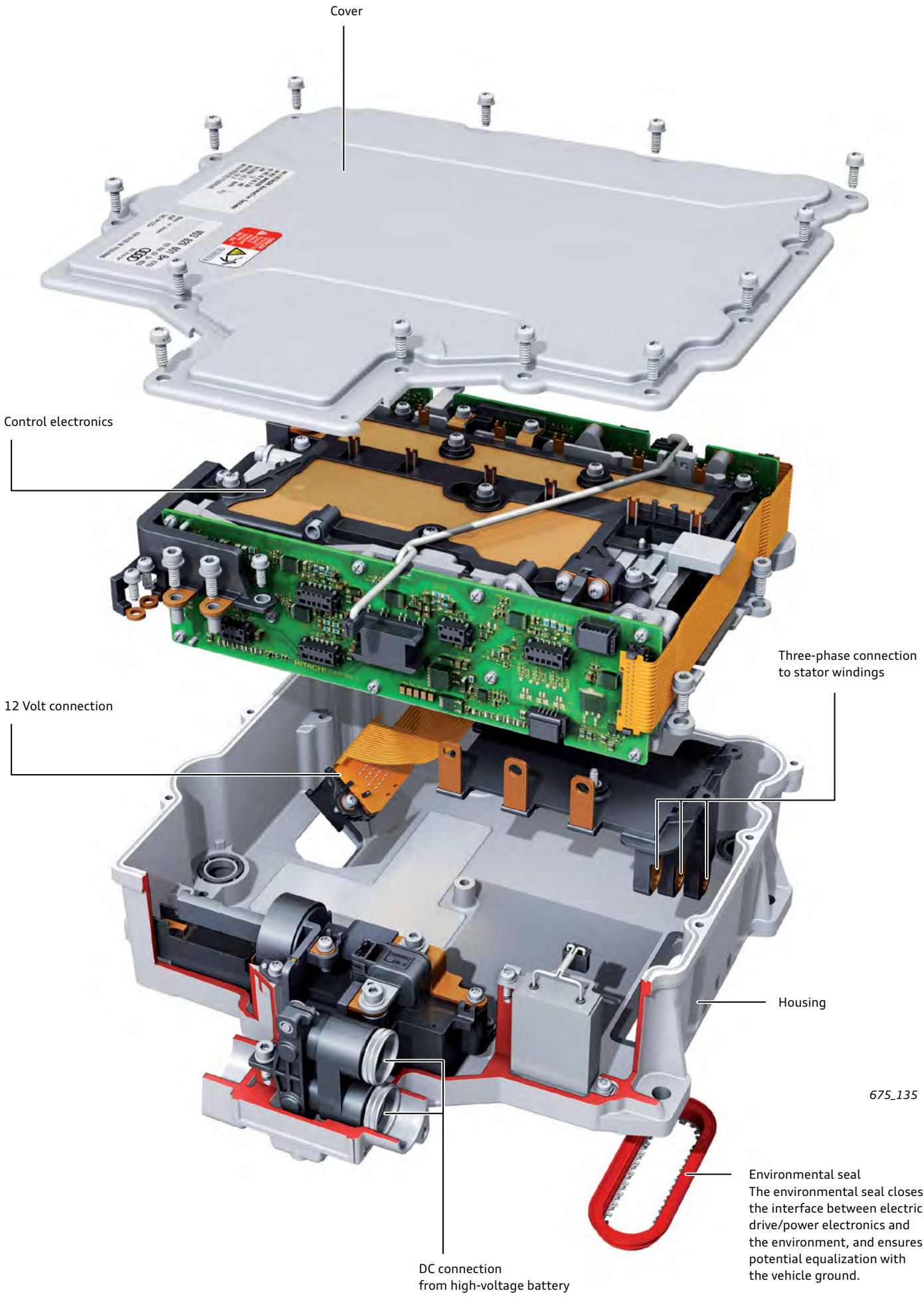
The power electronics units on the front and rear axles are connected to the low-temperature cooling circuit. This ensures optimum cooling of the individual components.

Service

In the event of damage, the power electronics units can only be replaced as complete units. The Measuring Values for each axle, for example, temperature, power output, torque, etc., can be read using the VAS Scan Tool.



675_131



675_135

Environmental seal
 The environmental seal closes the interface between electric drive/power electronics and the environment, and ensures potential equalization with the vehicle ground.

Power transmission

Overview

The Audi e-tron has an electric drive motor on the front and rear axles. Each of the electric motors uses a separate transmission 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 approximately 9:1) with high-efficiency performance in an extremely compact space. Because there is no background noise from a combustion engine to mask the sound of the transmission, the gearing has to be particularly quiet during operation to meet the desired acoustic requirements for the vehicle.

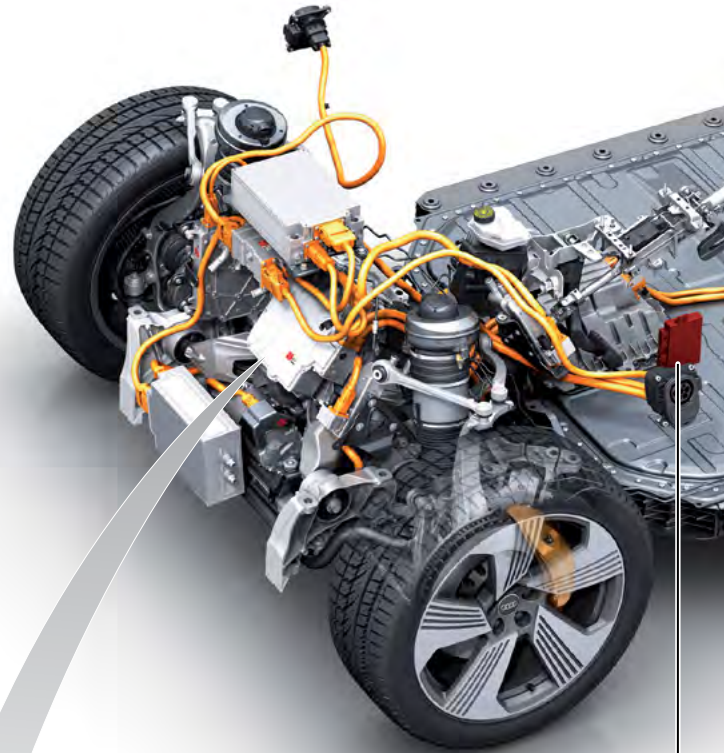
The input and output shafts for torque transmission on the front axle are arranged in a parallel axis configuration. A coaxial design is implemented on the rear axle.

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.

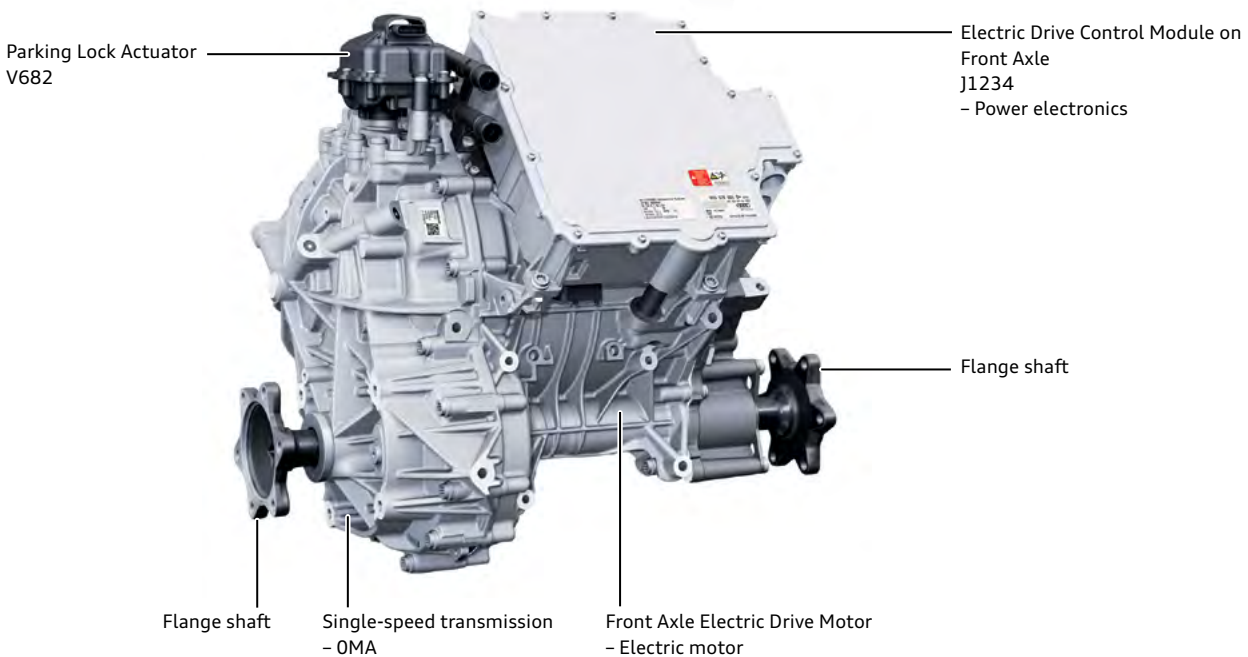
The transmission units have no neutral gear position so there is a constant power flow between the wheels and the rotor shafts of the electric drive motors.

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



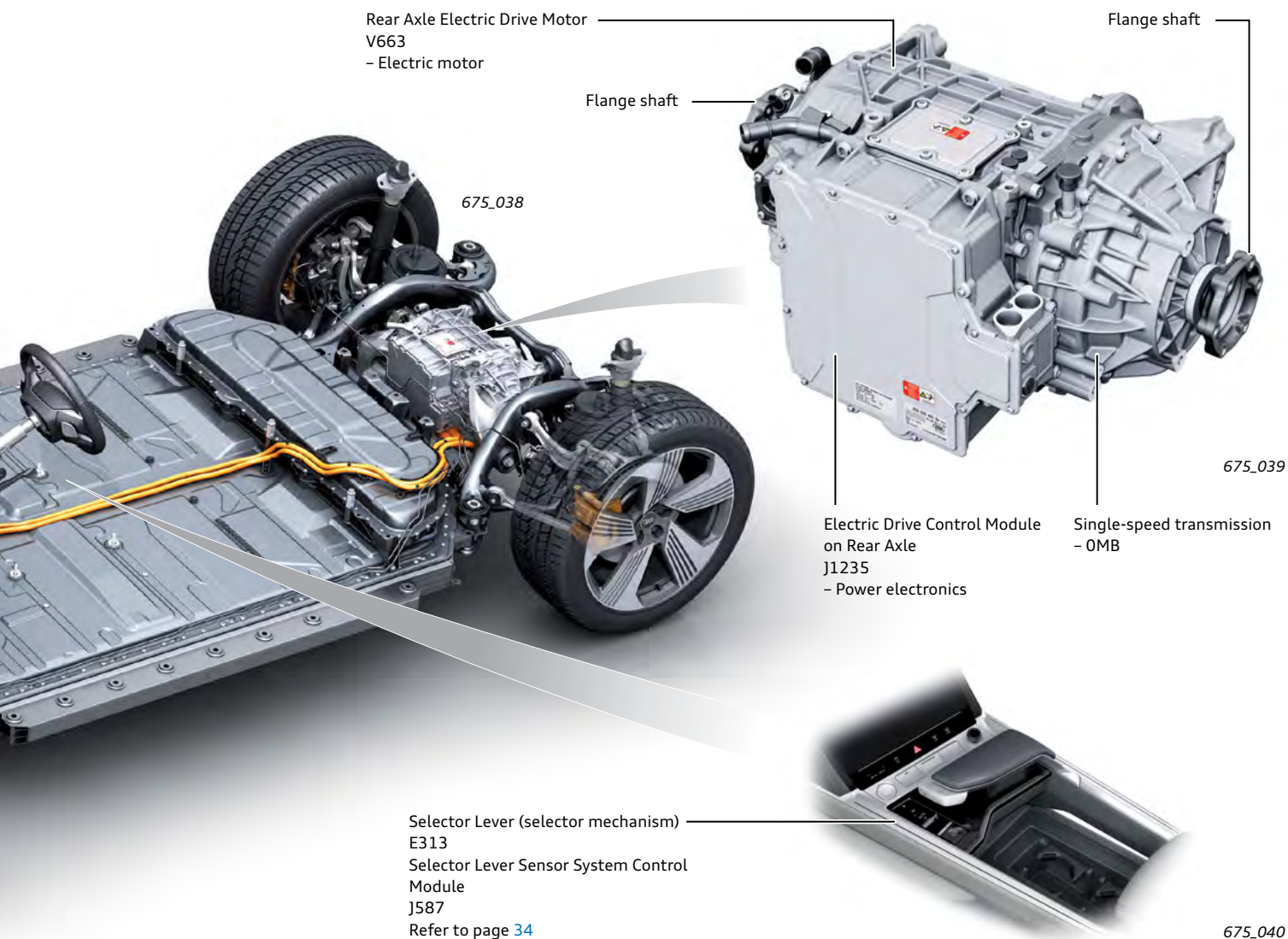
Engine/Motor Control Module
J623

Front Three-Phase Current Drive VX89



675_037

Rear Three-Phase Current Drive VX90



Technical data

Service designation	Single-speed transmission – OMA	Single-speed transmission – OMB
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 ElsaPro	Single-speed transmission – OMA	Single-speed transmission – OMB
Part number (status 08/18)	OMA.300.040.D	OMB.300.040.C
Developed/manufactured by:	SCHAEFFLER	SCHAEFFLER
Maximum input torque	400 Nm	400 Nm
Maximum input speed	18,000 rpm	18,000 rpm
Number of gears	1 (fixed)	1 (fixed)
Number of ratio steps	2 1st stage: $i_{\text{planetary_gear_set } i_1} 5.870$ 2nd stage: $i_{\text{spur_gear_stage } i_2} 1.568$	2 1st stage: $i_{\text{sun - planet (stepped, large) } i_1} 1.917$ 2nd stage: $i_{\text{planet (stepped, small) - annulus } i_2} 4.217$
Total ratio	$9.204 - i_{\text{total}} = i_1 \times i_2$	$9.083 - i_{\text{total}} = (i_1 \times i_2) + 1$
Differential	Lightweight planetary gear differential	Lightweight planetary gear differential
Weight not including oil	Approximately 69.4 lb (31.5 kg)	Approximately 35.7 lb (16.2 kg)

Selector mechanism

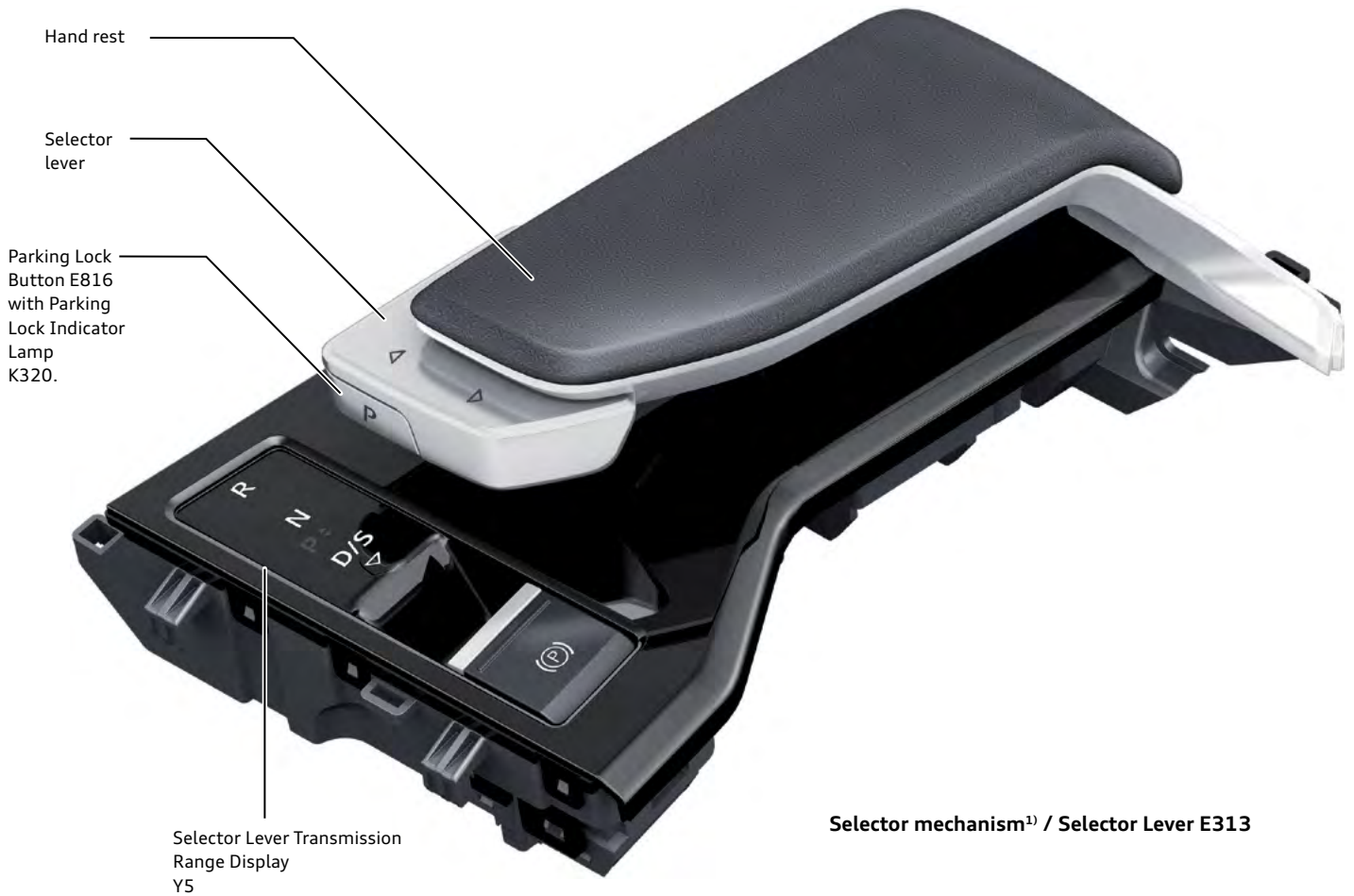
The Audi e-tron has an exclusive shift-by-wire selector mechanism in yacht design.

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

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

To protect the power train components, it is only possible to change the direction of travel from forwards to reverse and vice versa up to a defined speed of approximately 6.2 mph (10 km/h).

The Audi e-tron has a parking lock similar to those found on vehicles with automatic transmissions. The parking lock normally engages and disengages automatically via the Auto-P function (see page 38), but can also be engaged manually using the P button.



Selector mechanism¹⁾ / 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.



The arrow symbol is always dimmed.

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.

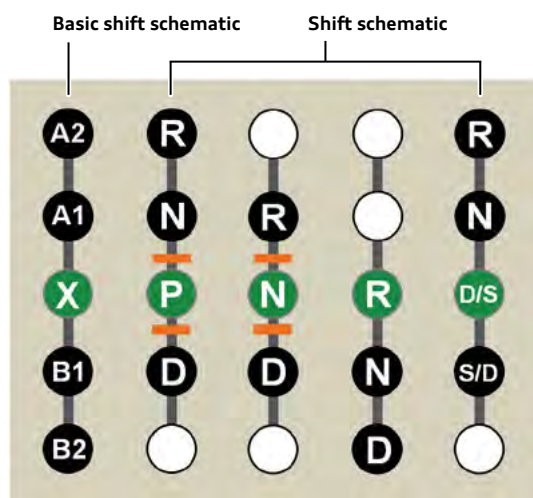
The illumination of the **P** symbol in the **P** button is always dimmed when Terminal 15 is active and is always lit with maximum intensity when the parking lock is on.

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 approximately 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 direction when maneuvering 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 less than 6.2 mph (10 km/h). Parking Lock Button E816 actuates three selector elements for reliability and diagnostics. Its selector status is transferred to Selector Lever Sensor System Control Module 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 by Engine/Motor Control Module J623. A dynamic accelerator pedal map and sporty response are activated.

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.

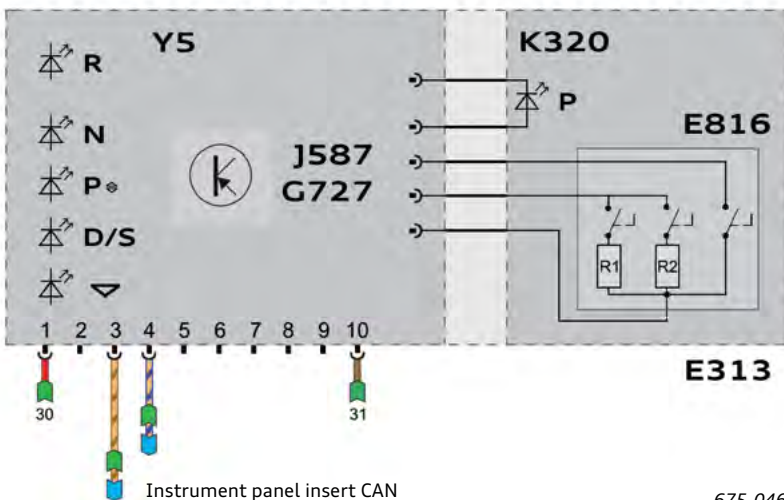
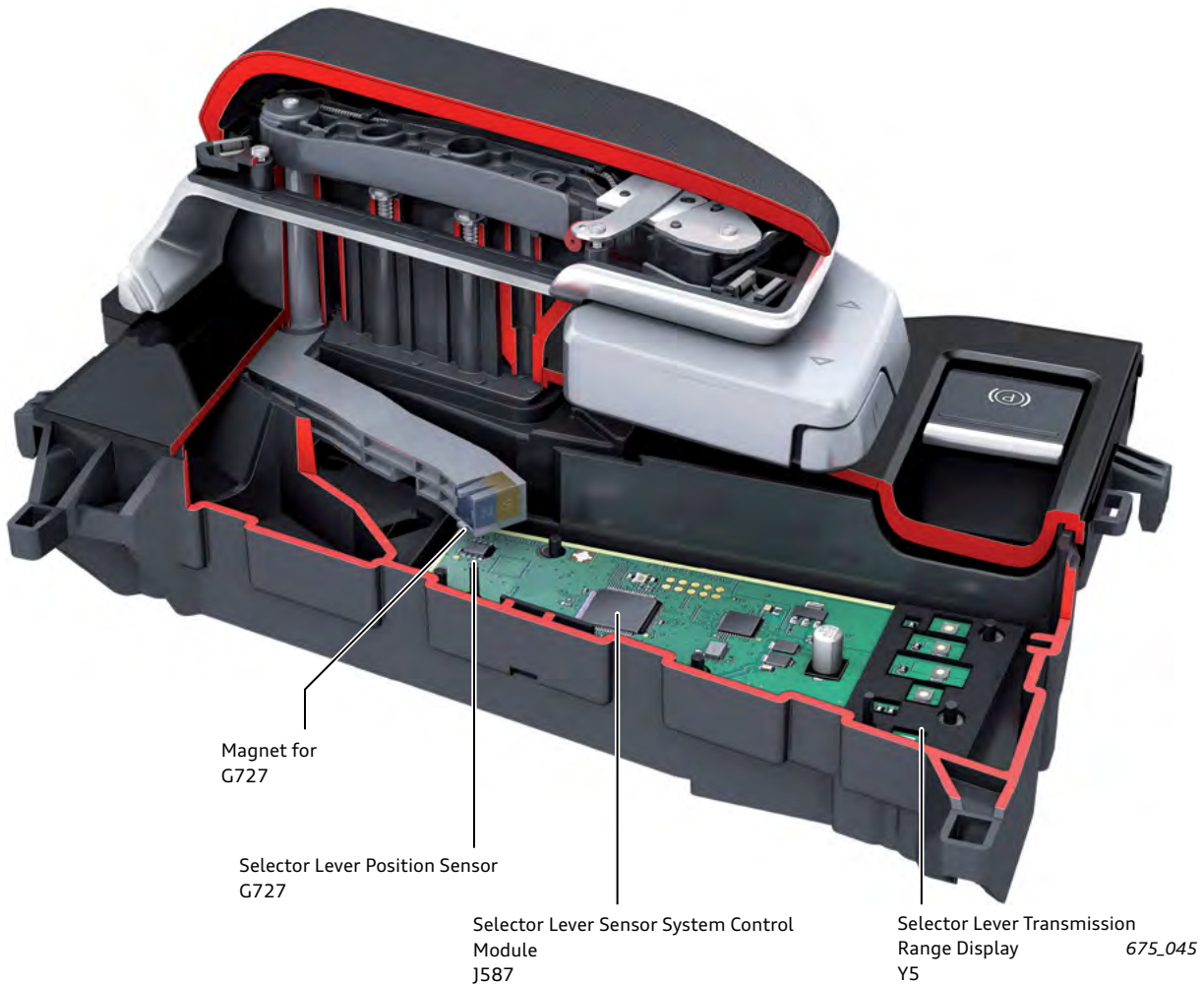
Selector Lever Sensor System Control Module J587

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 Engine/Motor Control Module J623.
- > Processes the signal from the Parking Lock Button E816.
- > Handles the activation of the LEDs on Selector Lever Transmission Range Display Y5 and Parking Lock Button E816.
- > Is combined as a single functional unit with Selector Lever Position Sensor G727 and Selector Lever Transmission Range Display Y5.

Data communication with J623 takes place via the gateway. Selector Lever Sensor System Control Module J587 uses the instrument panel insert CAN to communicate with the gateway. See Figures 675_046 and 675_077.

J587 can be accessed and diagnosed using Address Word 0081.



Key:

- E313** Selector Lever (selector mechanism)
- E816** Parking Lock Button
- G727** Selector Lever Position Sensor
- J587** Selector Lever Sensor System Control Module
- K320** Parking Lock Indicator Lamp
- Y5** Selector Lever Transmission Range Display

675_046

Selector lever - Functions

Auto-P function

The parking lock on the Audi e-tron is operated electro-mechanically (see page 38). Engine/Motor Control Module J623 is 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 0.6 mph (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.

quattro with e-tron technology

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

The torque vectoring software is also integrated in J775.

The software for the electronic differential lock (EDL) and electronic stabilization control (ESC) is integrated in ABS Control Module J104. Refer to page 56.

Engine/Motor Control Module J623 handles the efficient distribution of the drive and recuperation torque to both axles and receives input from Drivetrain Control Module J775 according to the vehicle handling and traction requirements. Approximately 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 to meet the torque demand as accurately as possible.

Activating the P-OFF position (transmission position N)

To be able to move the vehicle for a limited time without the parking lock, for example, 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 minutes¹⁾. 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 (that is, a total of 30 minutes) and the system shuts down.

If a speed signal 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.

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 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 by Parking Lock Actuator V682.

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

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 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 module using the parking lock sensor.

The parking lock has three modules:

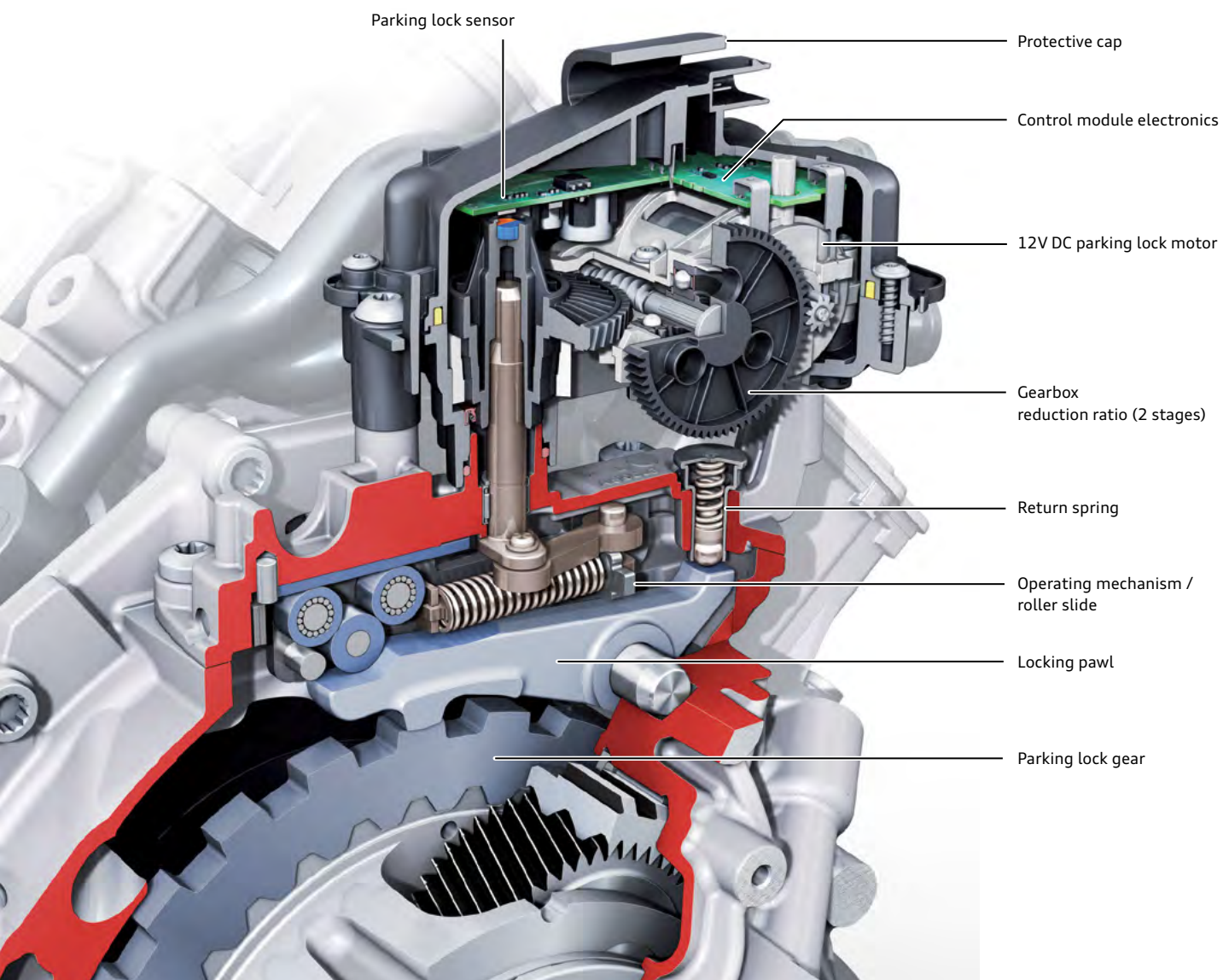
- > Parking lock actuator.
- > Mechanical parking lock operating components.
- > Parking lock (locking pawl and parking lock gear).



Parking Lock Actuator V682

675_047

Front Three-Phase Current Drive VX89



Parking lock sensor

Protective cap

Control module electronics

12V DC parking lock motor

Gearbox reduction ratio (2 stages)

Return spring

Operating mechanism / roller slide

Locking pawl

Parking lock gear

675_048

Parking Lock Actuator V682

(Address Word 0742)

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 Engine/Motor Control Module J623. Communication between J623 and V682 takes place via a sub CAN drive. J623 generates the bus status P-ON or P-OFF and transmits it via the sub CAN drive to V682. The actuator executes the instructions and checks their execution. All diagnostic data are exchanged via the bus systems and can be read from J623.

Special features / service information

Parking Lock Actuator V682 can be activated via J623 using the Output Check Diagnosis with the VAS Scan Tool.

The parking lock actuator requires neither initialization 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 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 VAS Scan Tool. The software emergency release function for the parking lock must be deactivated again before the vehicle is returned to the customer.

The parking lock actuator is a safety-related component to which special safety standards apply.

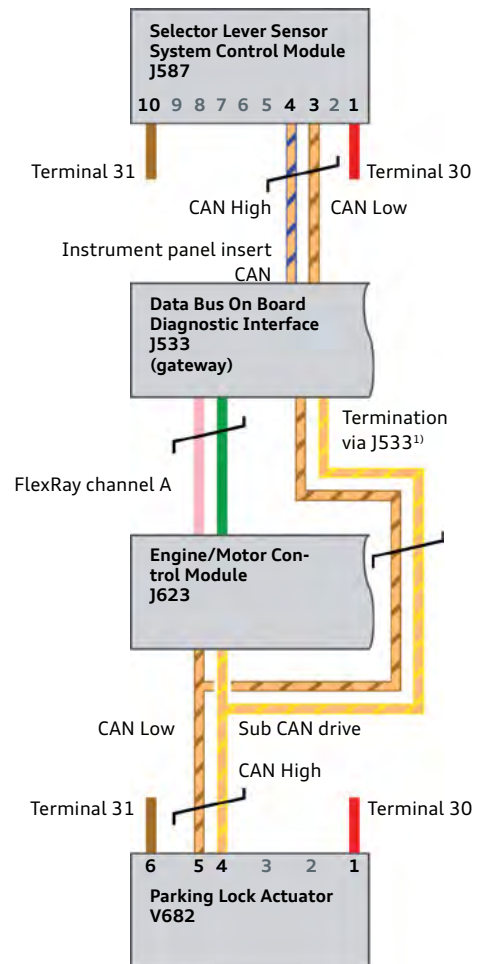
If the actuator is dropped, internal mechanical damage may occur that may not be immediately apparent. To prevent such incidents, the actuator has two special features which indicate a damaged component and protect against mechanical damage.

A special protective cap is installed on top of the connector to protect it against mechanical impacts. An actuator must not be used if this protective cap is damaged or missing.

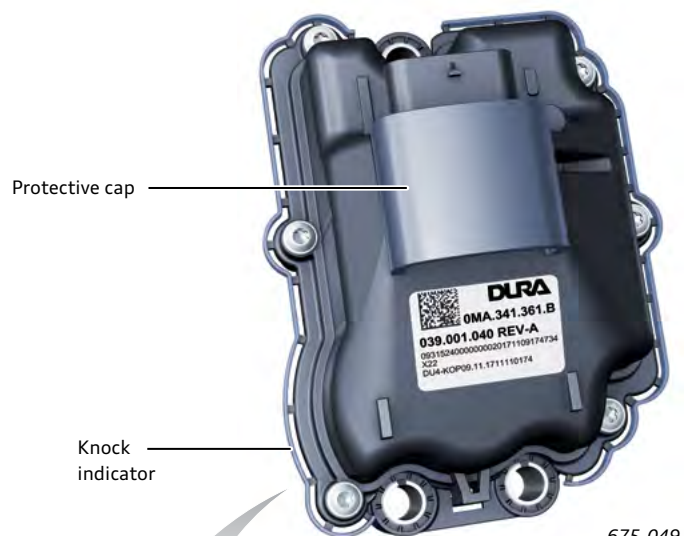
A knock indicator is installed around the circumference of the housing flange. This indicator is damaged if an actuator falls from a critical height. Dropped components must not be used if the indicator is damaged.

As a basic rule:

Actuators which have dropped once must be scrapped.



675_077



675_049

View from above



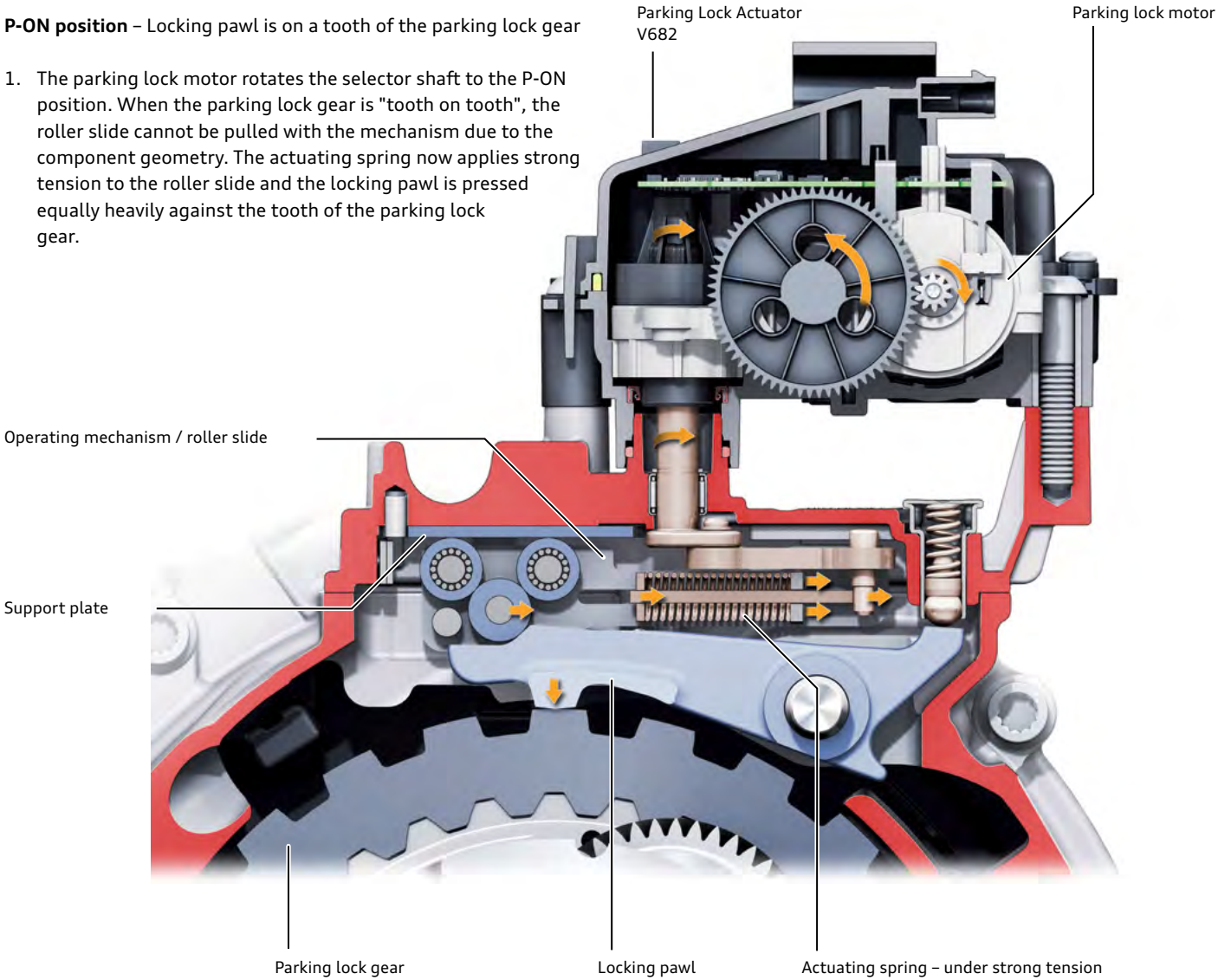
675_050

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.

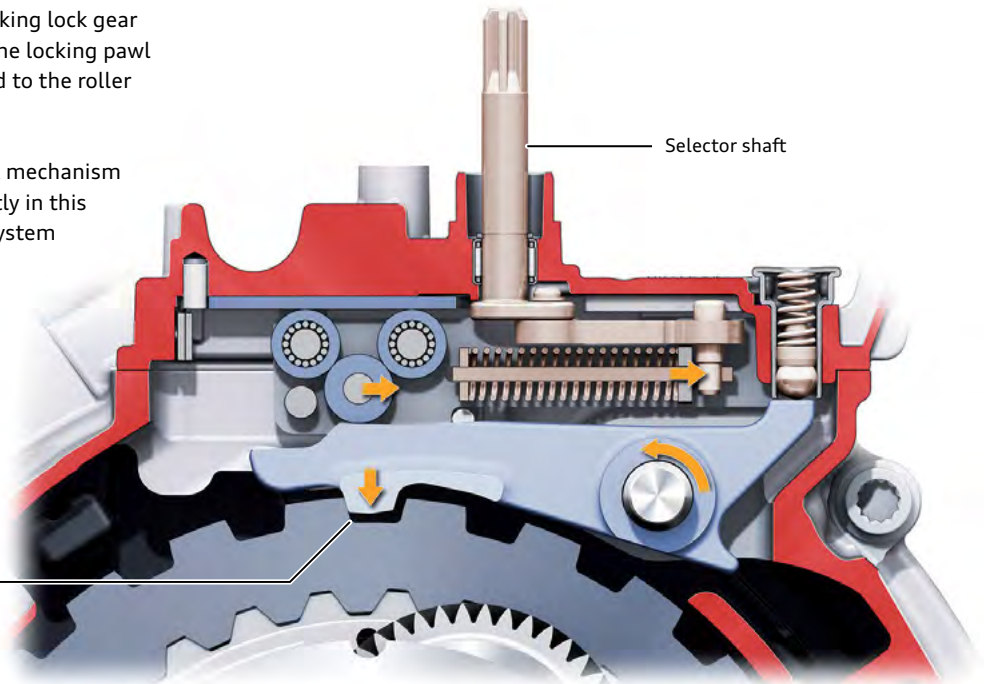


675_052

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 securely blocks the system (mechanical latch).

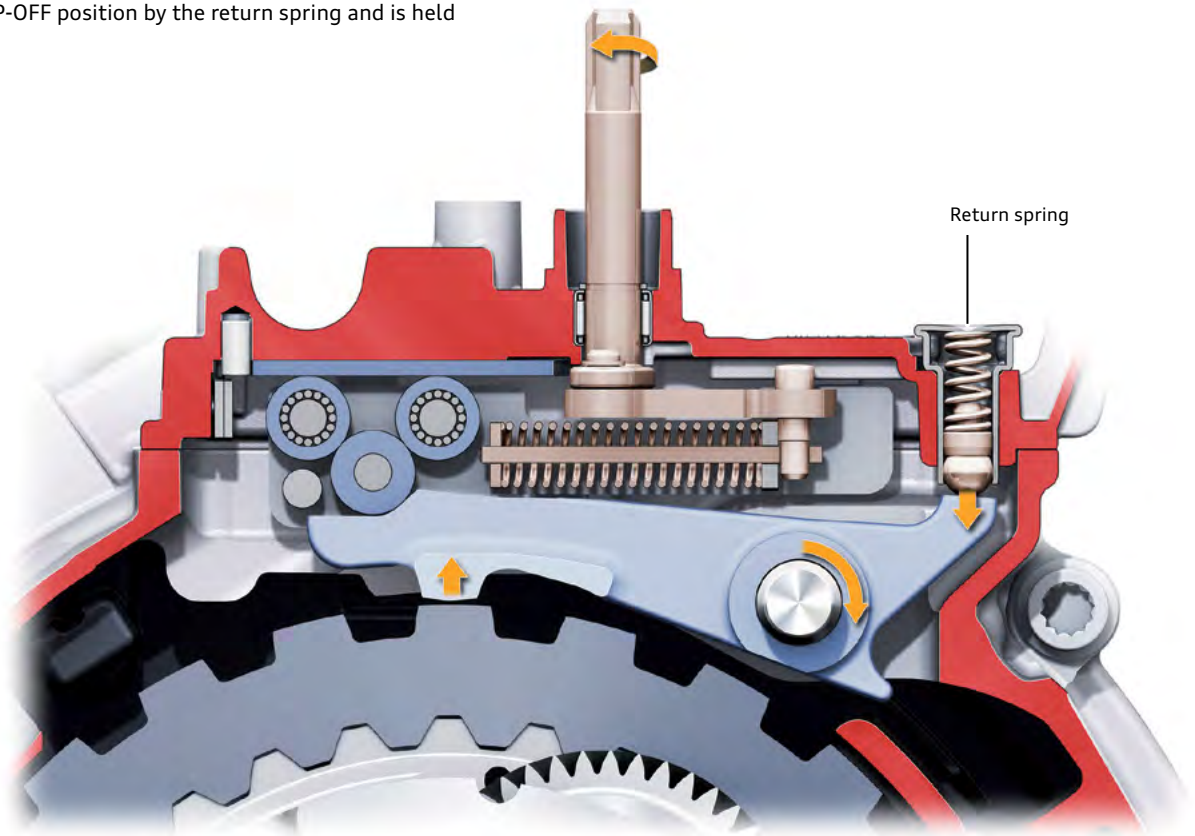
For safety reasons, the tooth geometry on the parking lock gear and the locking pawl are designed to prevent the locking pawl from engaging at speeds above approximately 1.8 mph (3 km/h).



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 electronic system. Refer to page 34. 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.

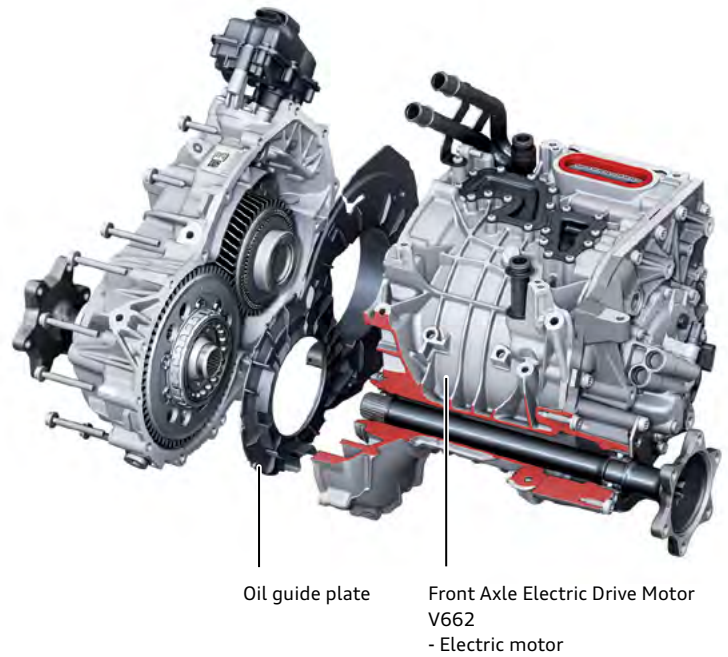
Single-speed transmission – OMA

The single-speed transmission OMA has a two-stage reduction ratio and a modern lightweight planetary gear differential. It is equipped additionally with the 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 44 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 42 for further information.



675_056

The OMA transmission has its own oil system. The bath and splash lubrication system uses 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 minimized. Heat is dissipated by convection to the vehicle's air-stream and via a water-cooled bearing plate on the electric drive motor.

The OMA 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:

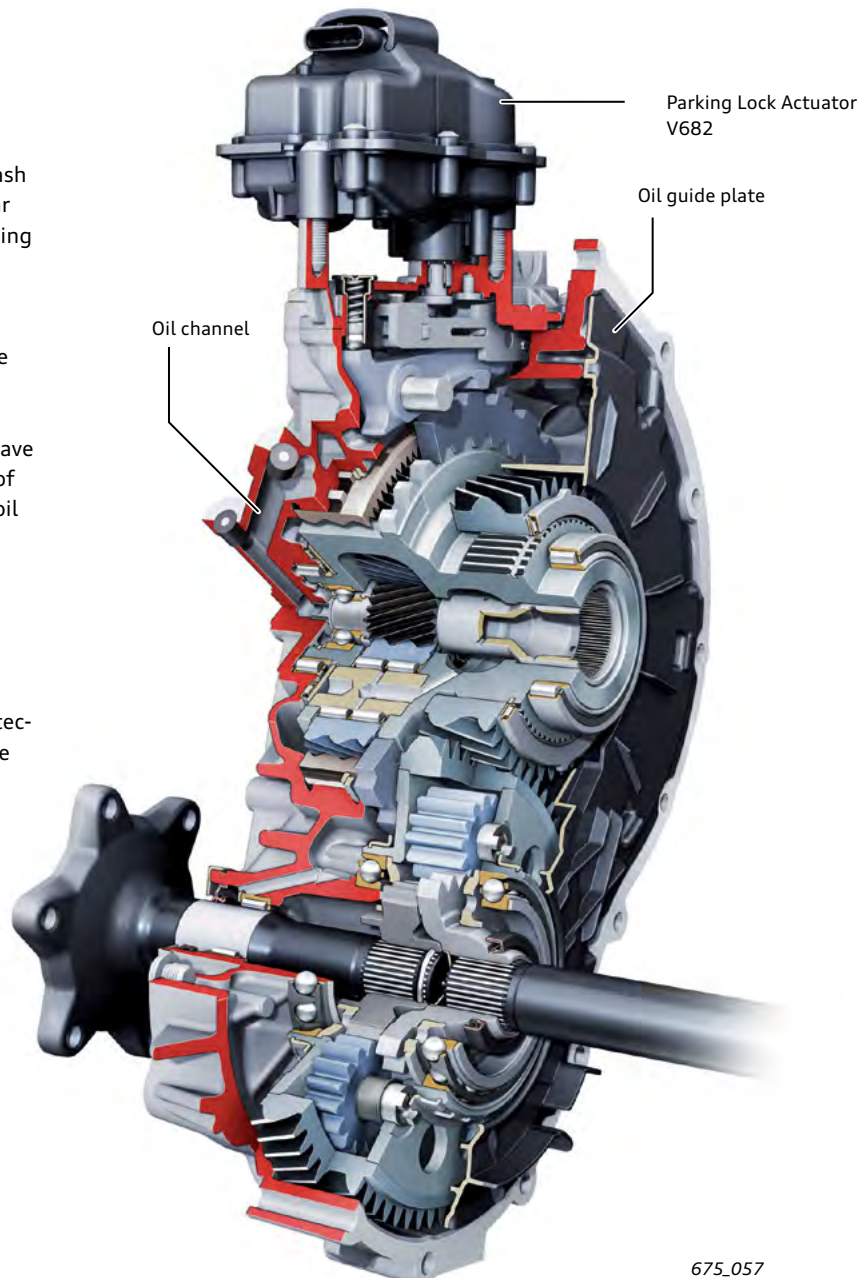
When the transmission is removed, the side facing the electric drive motor is open. Only the oil guide plate provides some protection against foreign bodies. Special care and attention should be paid to cleanliness when removing the transmission.

Note:

A specific adjustment procedure must be followed when replacing the transmission or electric drive motor. Refer to page 48 for further information.

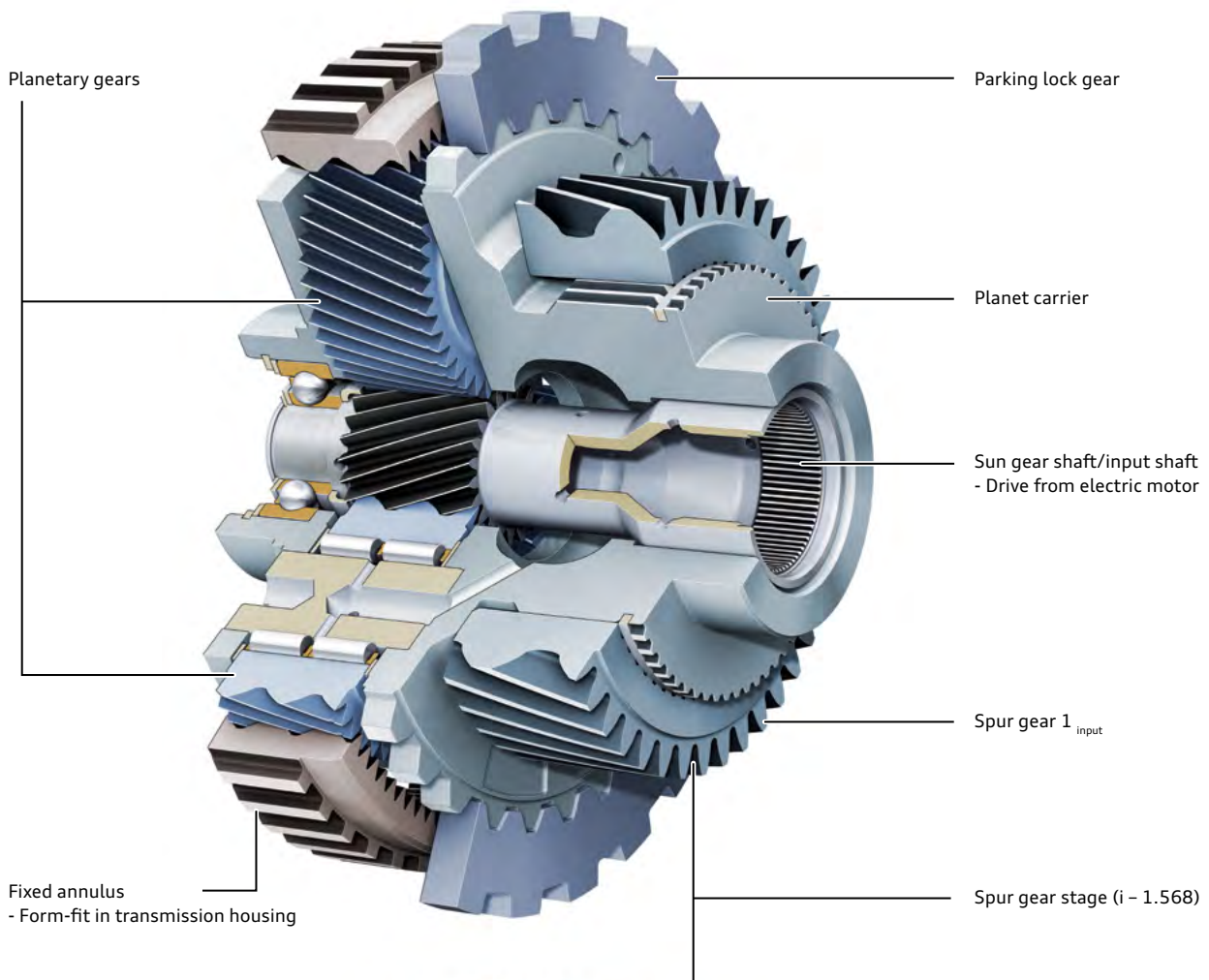
Note:

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

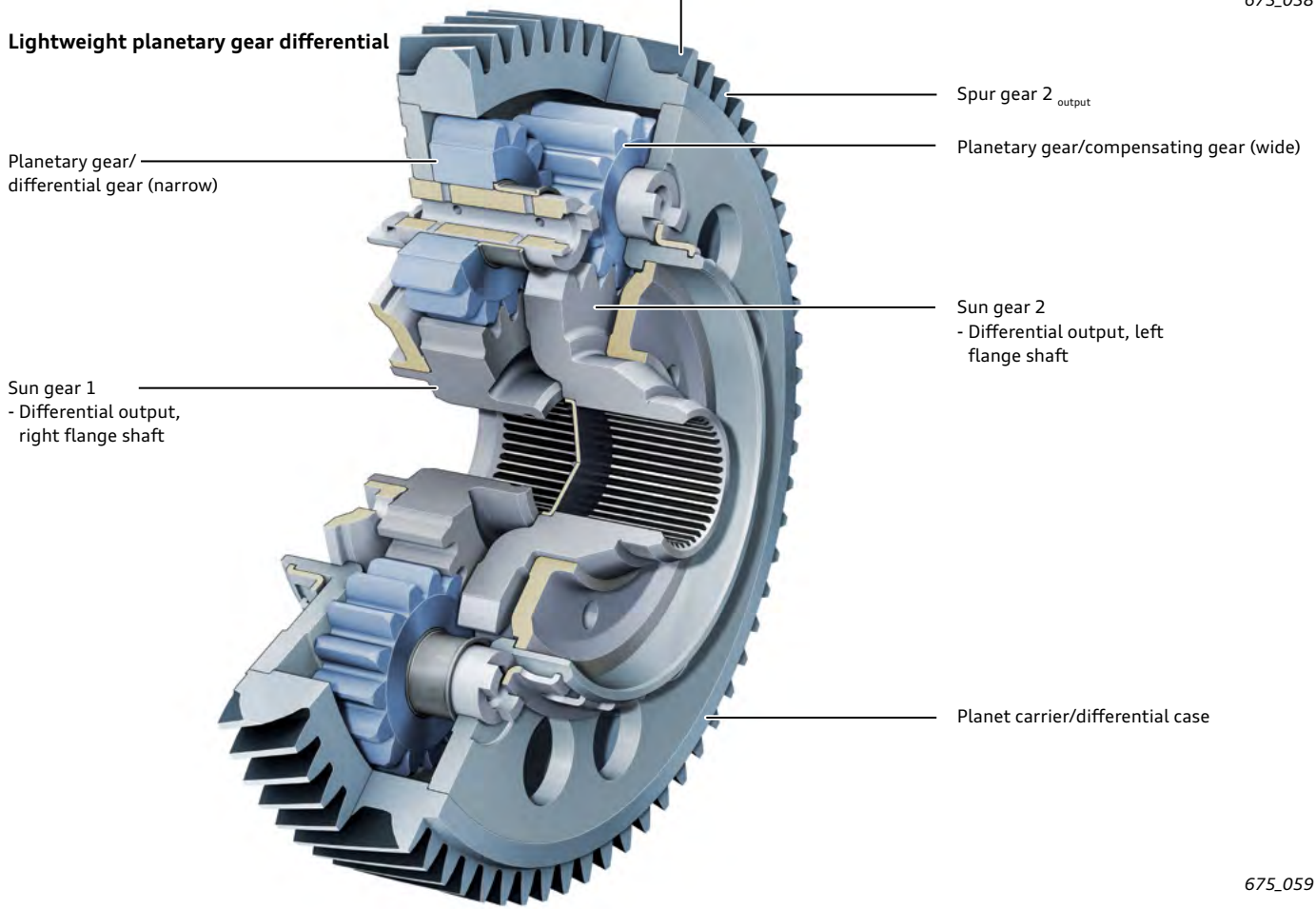


675_057

Single planetary gear set (i - 5.870)



Lightweight planetary gear differential



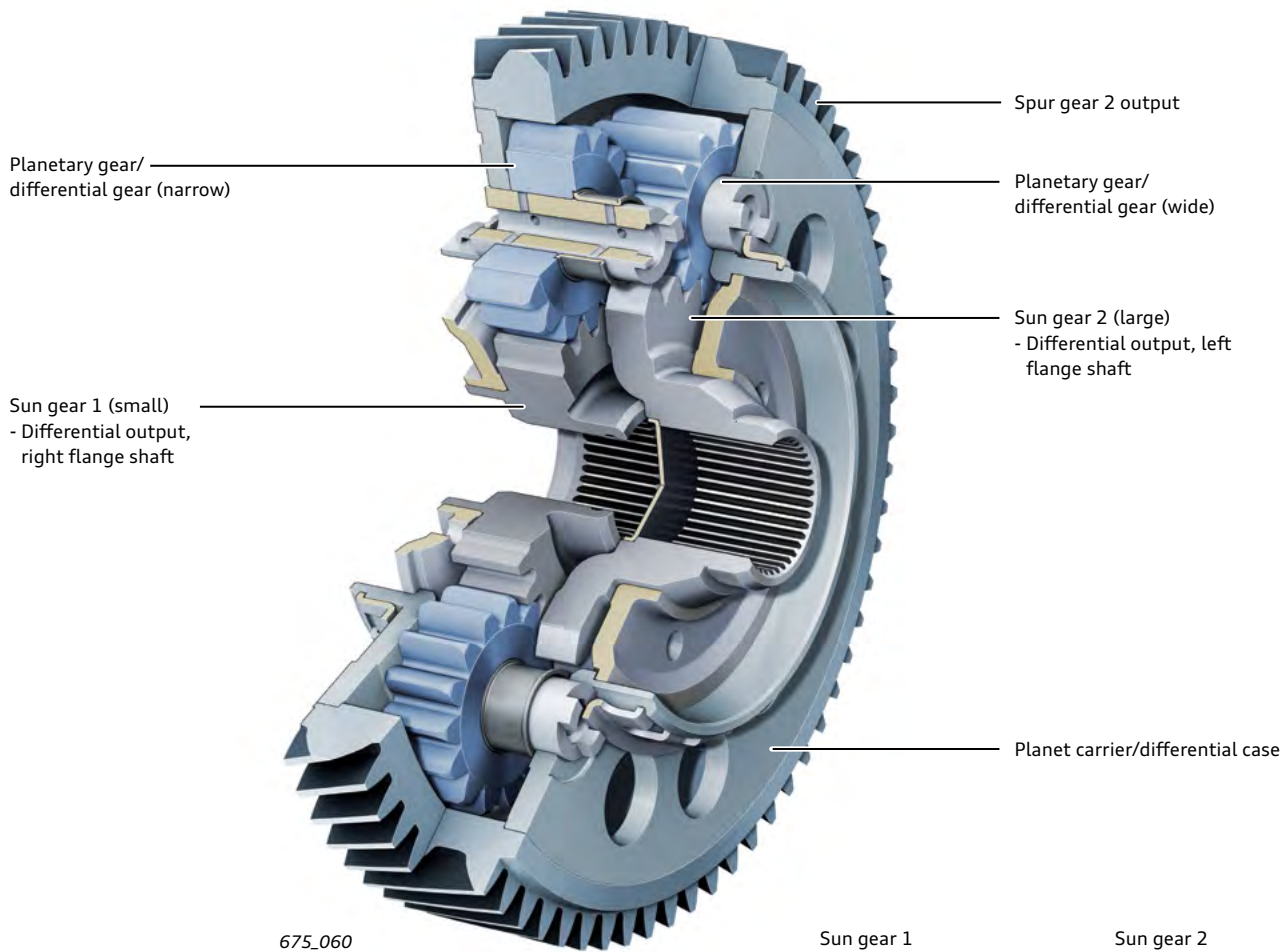
Lightweight planetary gear differential

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.

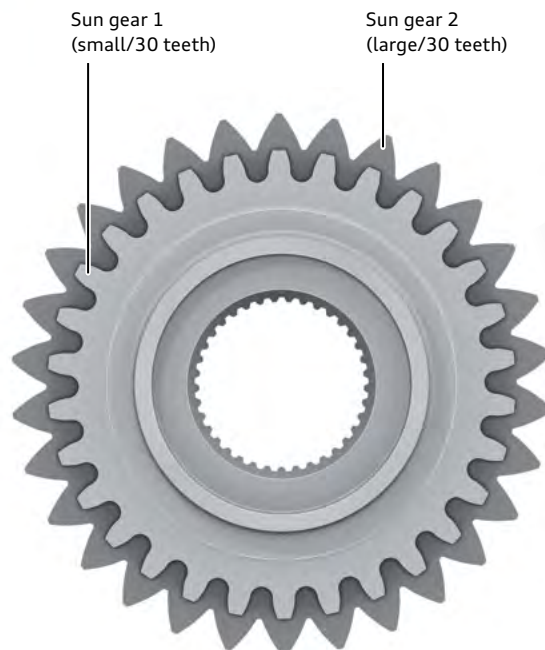
- > High torque transmission in very compact axial space.
- > Significant weight savings compared with conventional bevel gear differentials.

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.

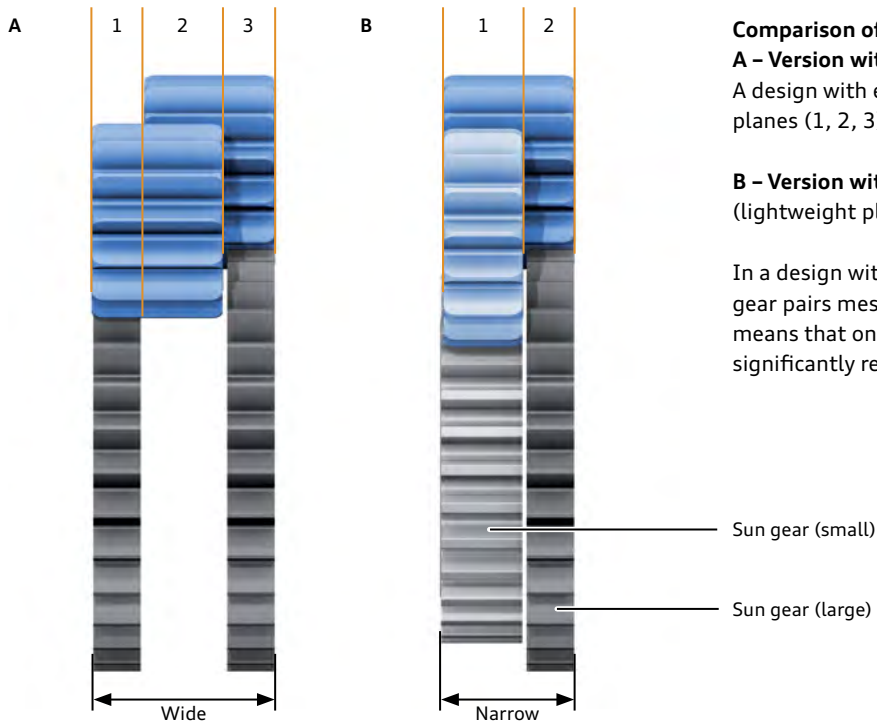


An essential feature of the lightweight planetary gear differential is its very small width. This was achieved by using two sun gears of different sizes. To ensure that the torque distribution is equal between both sides, the tooth geometry was designed so that both sun gears have the same number of 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



Comparison of designs

A – Version with sun gears of equal size

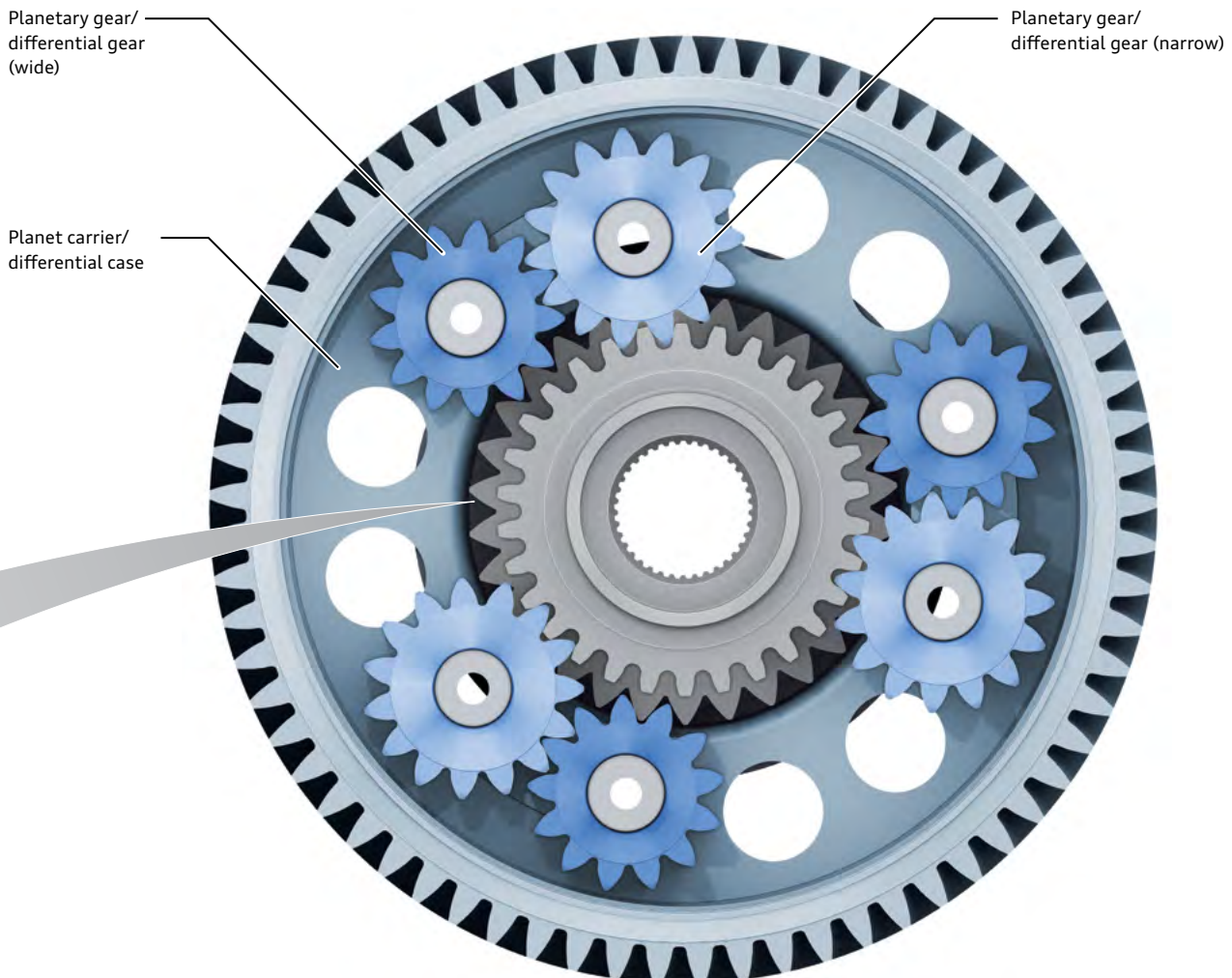
A design with equally large sun gears requires three tooting planes (1, 2, 3) and adequate axial space.

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 tooting plane. This means that only two tooting planes (1, 2) are required, which significantly reduces the axial space.

675_063



675_062



Note

The function and design of the lightweight planetary gear differentials in the OMA and OMB transmissions are virtually identical (except for small adjustments for the installation differences).

Single-speed transmission – OMB

The single-speed transmission OMB 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 OMA transmission described on page 48.

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 OMB 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 OMA 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 OMB 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:

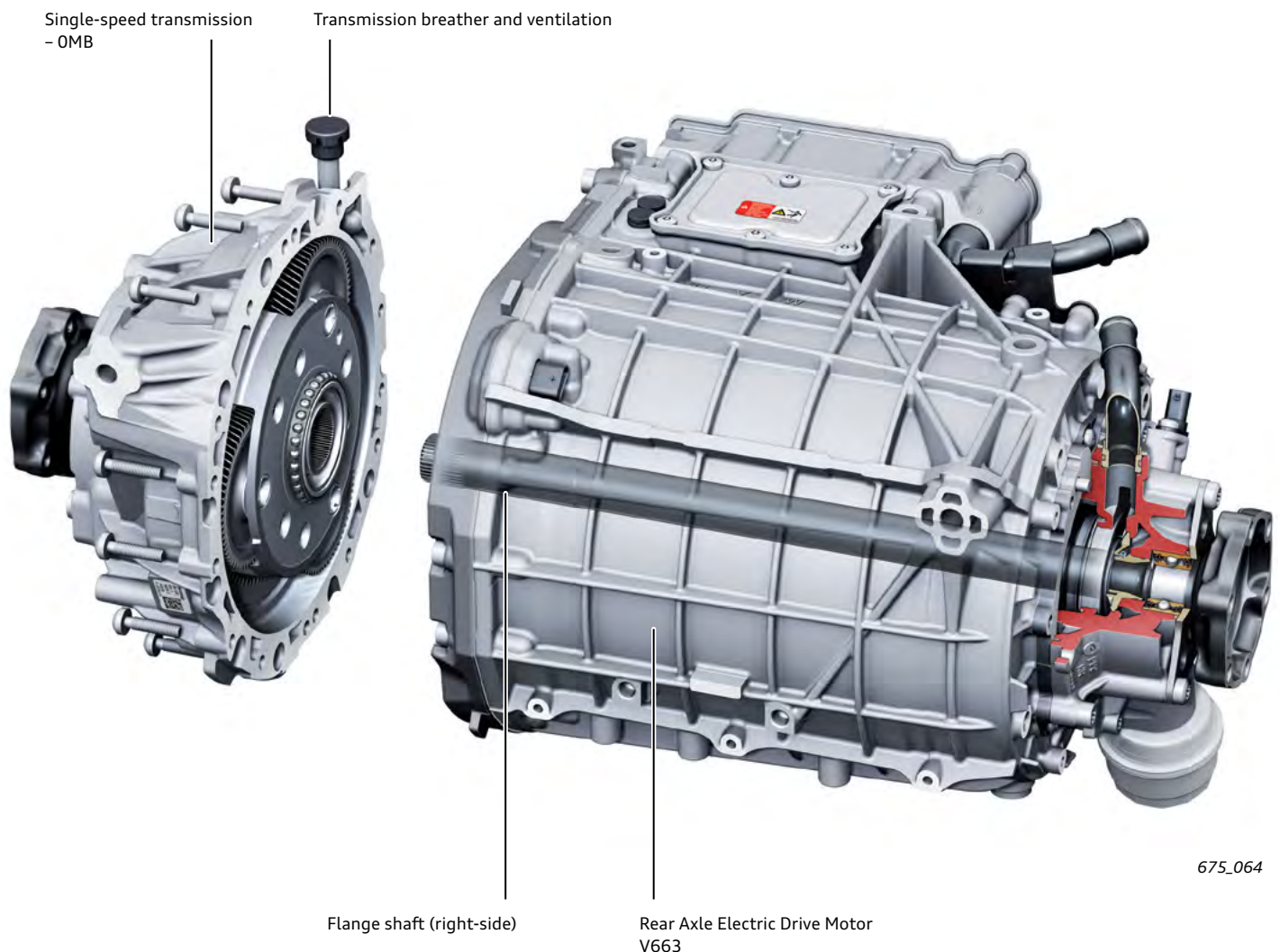
When the transmission is detached, the side facing the electric drive motor is open. Special care and attention should be paid to cleanliness when detaching the transmission.

Note:

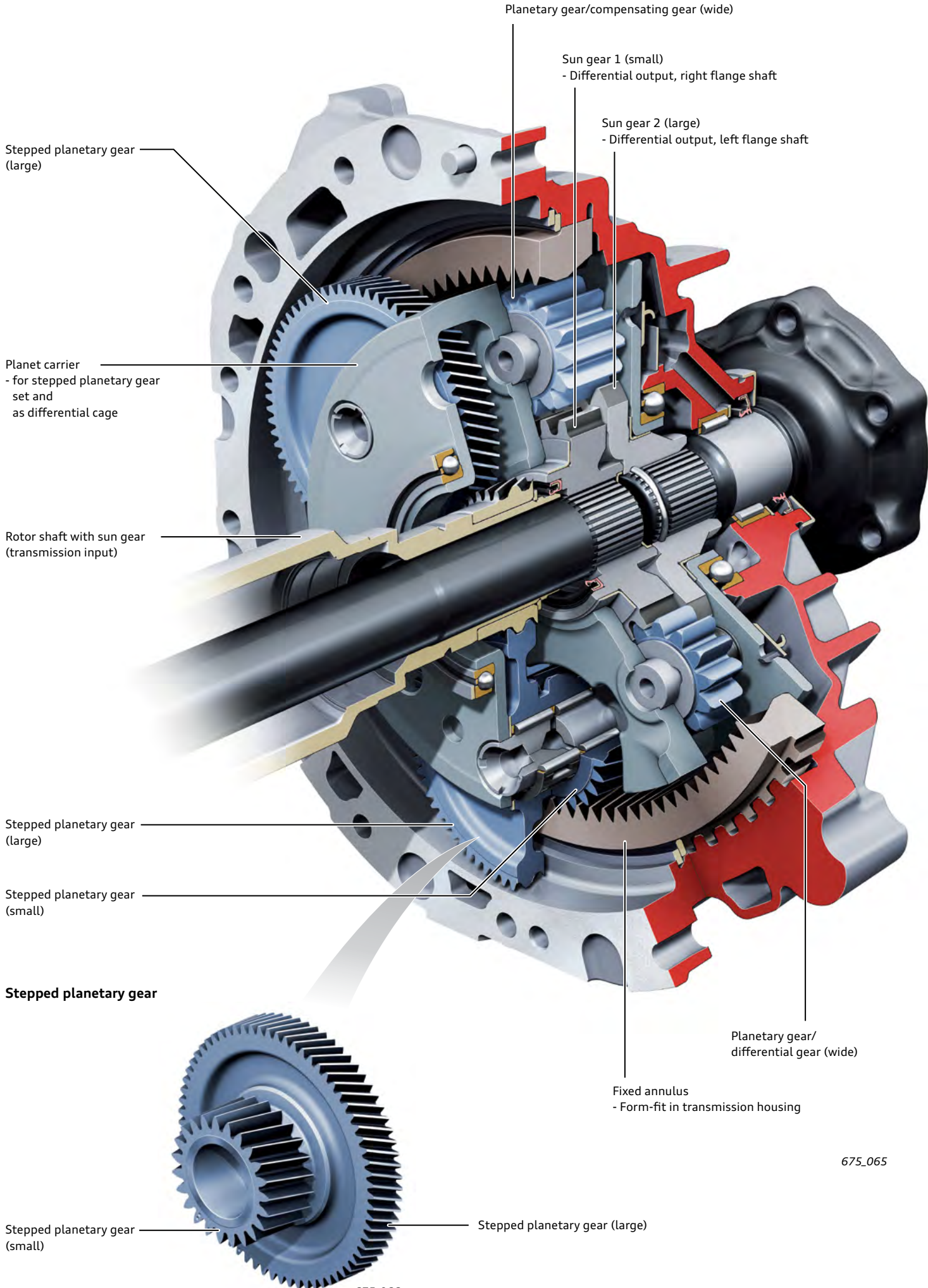
A specific adjustment procedure must be followed when replacing the transmission or electric drive motor. Refer to page 48 for further information.

Note:

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



675_064



Stepped planetary gear (large)

Planet carrier
- for stepped planetary gear set and as differential cage

Rotor shaft with sun gear (transmission input)

Stepped planetary gear (large)

Stepped planetary gear (small)

Stepped planetary gear

Stepped planetary gear (small)

Planetary gear/compensating gear (wide)

Sun gear 1 (small)
- Differential output, right flange shaft

Sun gear 2 (large)
- Differential output, left flange shaft

Planetary gear/differential gear (wide)

Fixed annulus
- Form-fit in transmission housing

Stepped planetary gear (large)

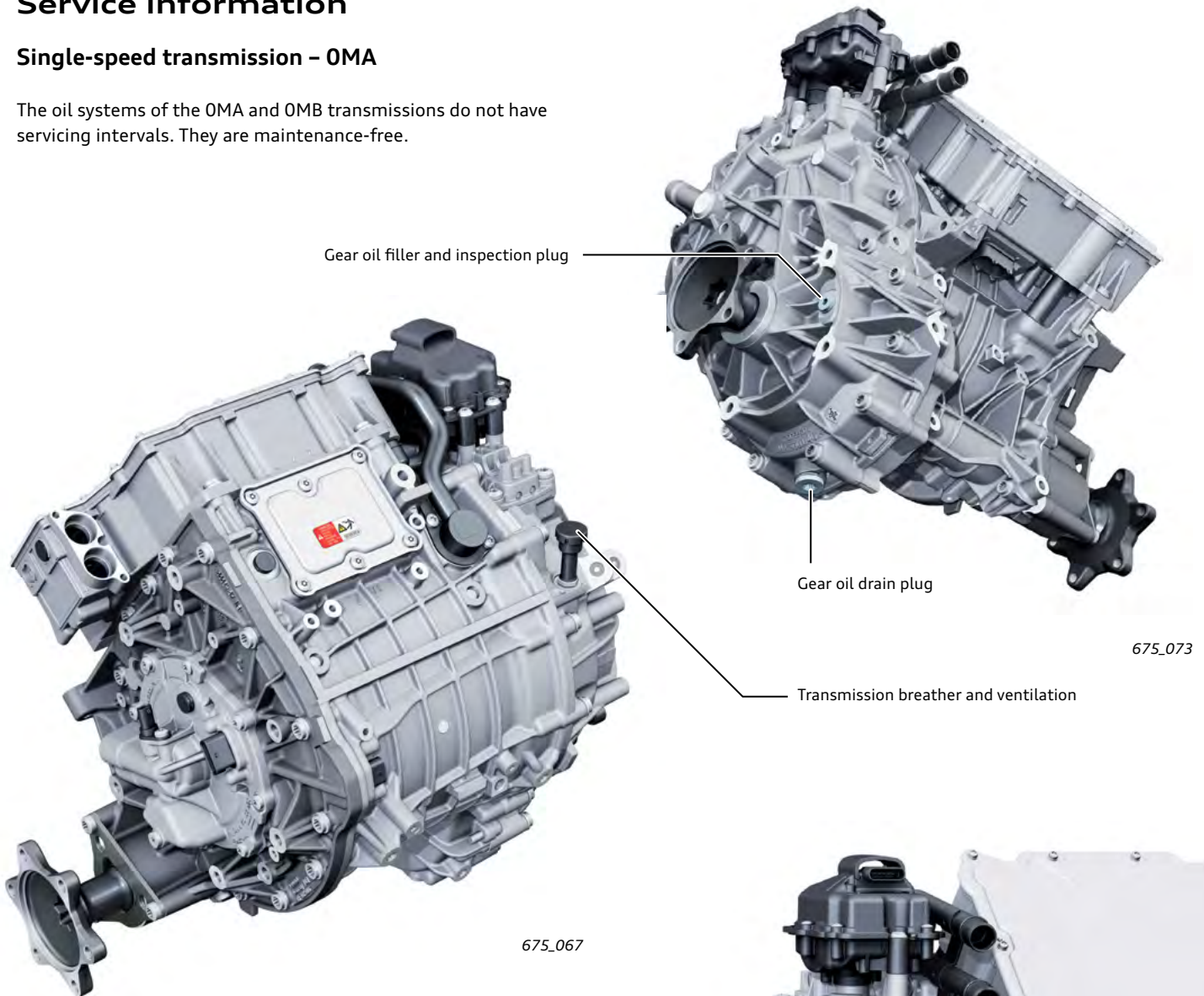
675_066

675_065

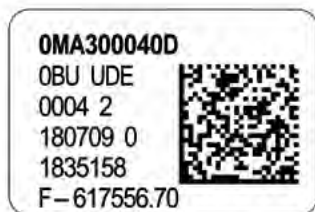
Service information

Single-speed transmission – OMA

The oil systems of the OMA and OMB transmissions do not have servicing intervals. They are maintenance-free.



Transmission data sticker



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 mounting 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 – OMB

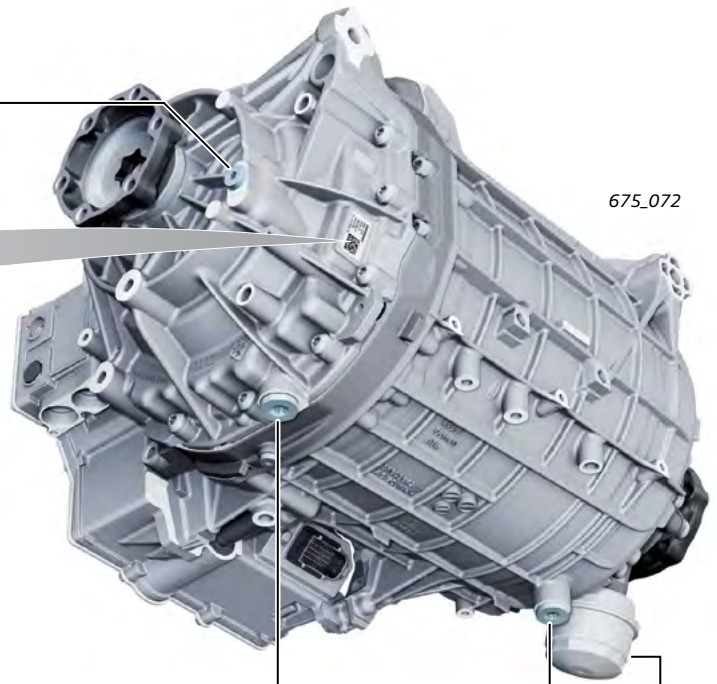
Transmission data sticker



675_070

Gear oil filler and inspection plug

675_072



Gear oil drain plug

Inspection plug for electric drive motor

Transmission breather and ventilation

Reservoir
– For servicing purposes, see page 24



Legend for transmission data sticker (OMA transmission)

675_071

Gearbox part number

Assembly no. / gearbox code

Gearbox serial no. / manufacturer's code

Date of manufacture / test symbol

Data for determining shims



675_068

18.35 mm

1835158

1.58 mm

Dimension for calculating shim for differential mounting¹⁾

Dimension for calculating shim for planetary gear set mounting¹⁾

The data sticker for the OMB 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 OMB 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.

All running gear systems will have air springs and electronic damping control.

A sport suspension (2MA) will be offered at a later date.

Depending on the country, the Audi e-tron has an 18" or 19" brake system. When 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. 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.



675_078

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 (not available at market introduction). The hardware corresponds to the standard running gear 1BK. 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 2017 Q7. The subframe is a new construction made from aluminum.



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.

A new subframe construction was necessary to meet the vehicle's special packaging requirements (integration of high-voltage battery and electric motor).



675_080



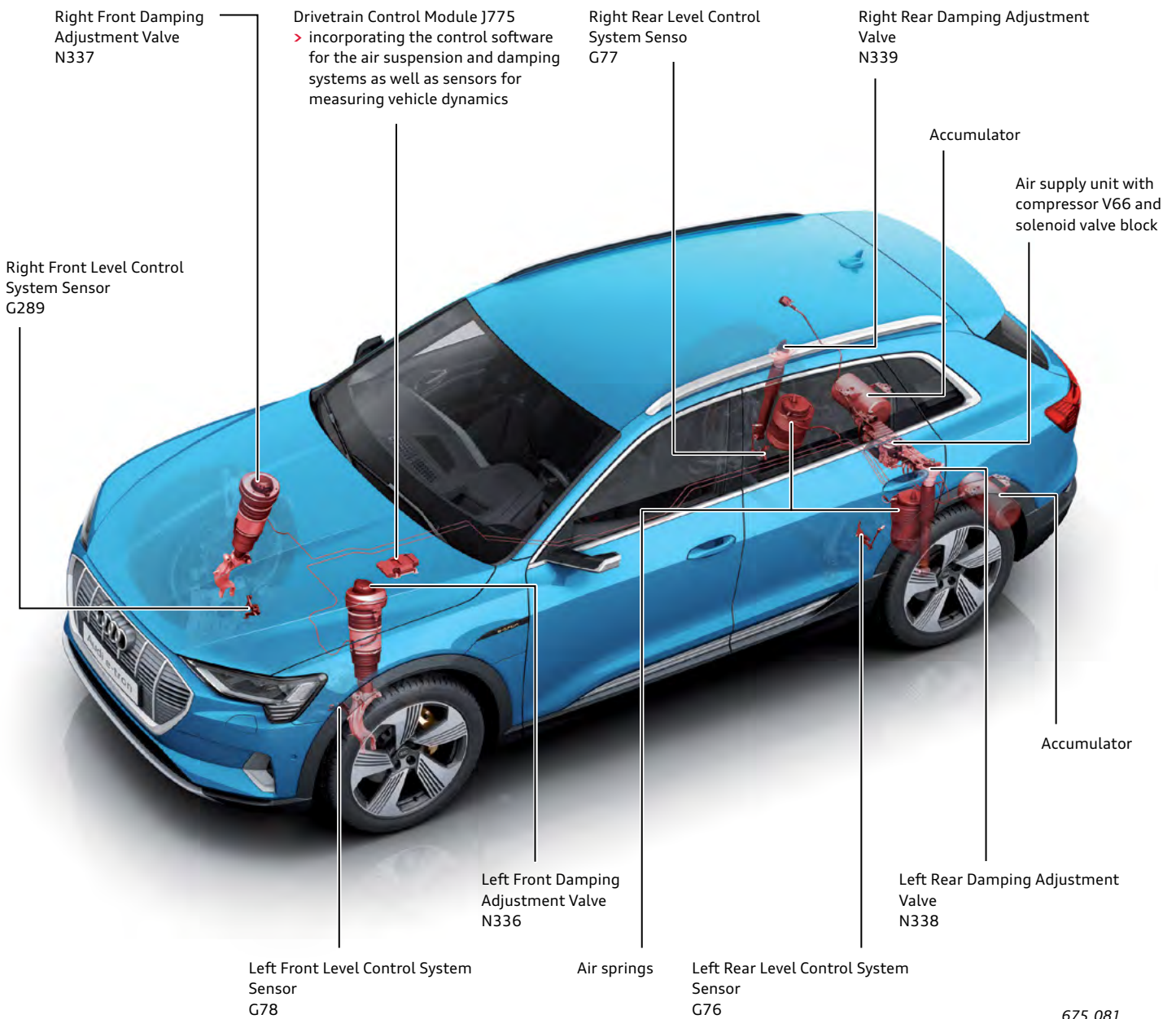
Reference

For detailed information on the system components and the running gear, please refer to eSelf-Study Program [960163, The 2017 Audi Q7 Running Gear and Suspension System](#).

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. 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 2017 Audi Q7. The system components are carry-over including Drivetrain Control Module J775.

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.



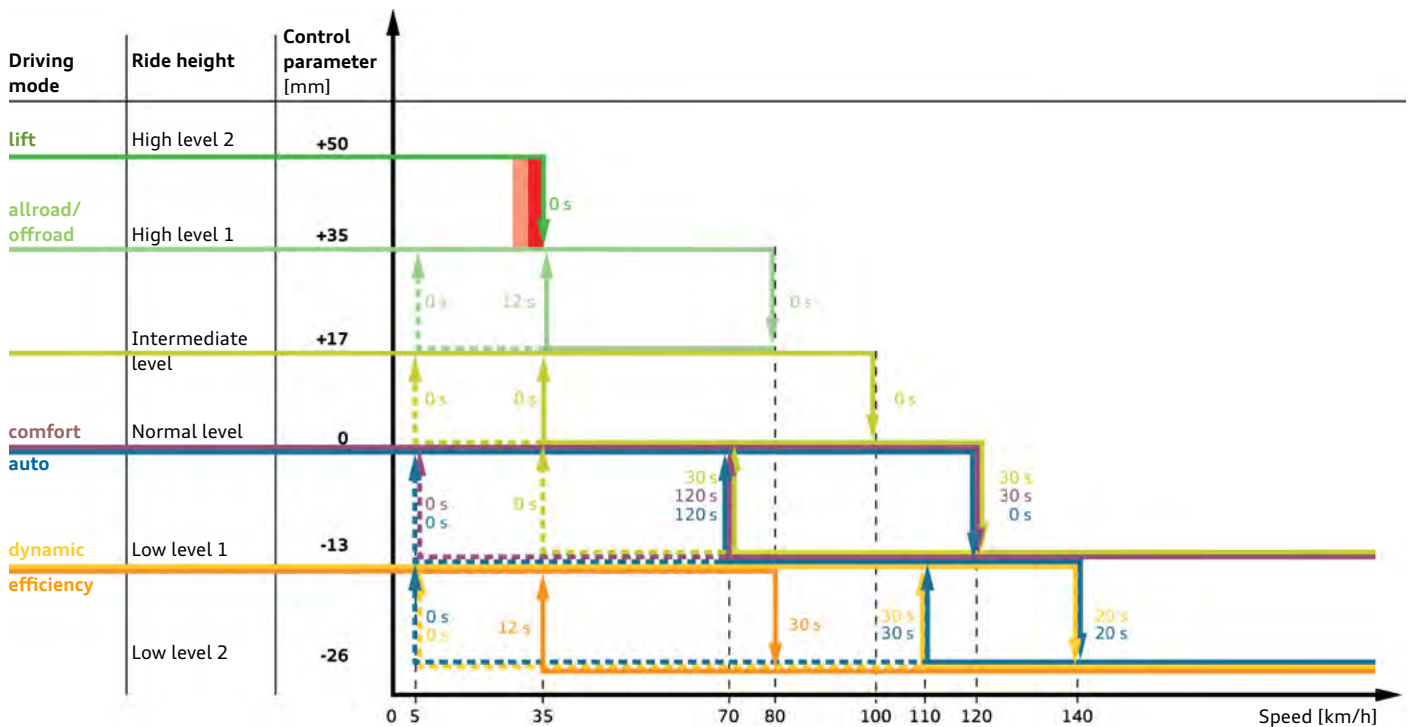
675_081



Reference

For detailed information, please refer to eSelf-Study Program [960163, The 2017 Audi Q7 Running Gear and Suspension System.](#)

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 traveling at a speed below 74.5 mph (120 km/h). If the vehicle subsequently exceeds a speed of 74.5 mph (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 86.9 mph (140 km/h) and remains there for 20 seconds, the ride height will be lowered again by a further 13 mm to highway level.

If the speed is subsequently reduced again and the vehicle is driven at a speed of 68.3 mph (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 3.1 mph (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 2019 A8. In terms of design, operation and servicing requirements, the EPS on the Audi e-tron also corresponds to that of the Audi A8. The steering ratio has been modified to suit the requirements specific to the Audi e-tron. Progressive steering is installed as standard equipment.

The characteristic curves for 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.

An electrically adjustable steering column is standard equipment for the e-tron. It has been adapted from the 2018 Audi Q5. It can be adjusted approximately 2.6 in (68 mm) horizontally and approximately 1.5 in (40 mm) vertically.

The crash detection has been modified for the Audi e-tron. Because of the car's special drive technology, the steering column has an electronic steering column lock.

Dynamic steering and all-wheel-drive steering are not available on the Audi e-tron.

Electromechanical steering with
Power Steering Control Module
J500



675_082

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

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 146.



Standard steering wheel

The steering wheel is equipped with paddle levers so the driver can adjust the recuperation function in over-run 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 2017 Audi Q7. The front and rear right brakes have 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. Another similarity to the Q7 is that the control software and the output stages of the power supply are located in ABS Control Module J104. The controls and service requirements relevant to the EPB are therefore identical on both models.

Brake system

Motor	Front axle	Rear axle
55 e-tron: 265 kW		
Minimum wheel size	19"	19"
Type of brakes	ATE fixed caliper brakes	TRW floating caliper brakes PC 44 HE
Number of pistons	6	1
Piston diameter	1.18 1.41 1.49 in (30 36 38 mm)	1.73 in (44 mm)
Brake disc diameter	14.76 in (375 mm)	13.77 in (350 mm)
Brake disc thickness	1.41 in (36 mm)	1.10 in (28 mm)



AKE fixed caliper brake used on the front axle



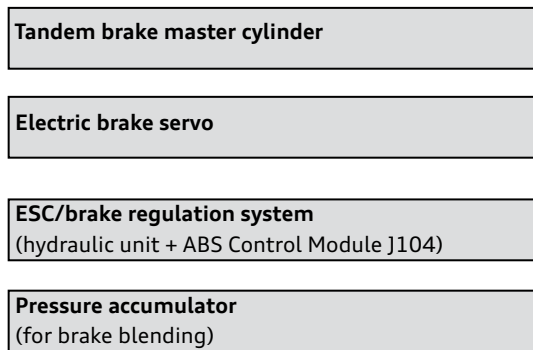
TRW floating caliper brake used on the rear axle

Brake regulation system MK C1

Overview

The MK C1 brake regulation system 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.

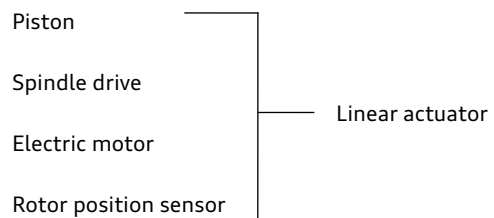
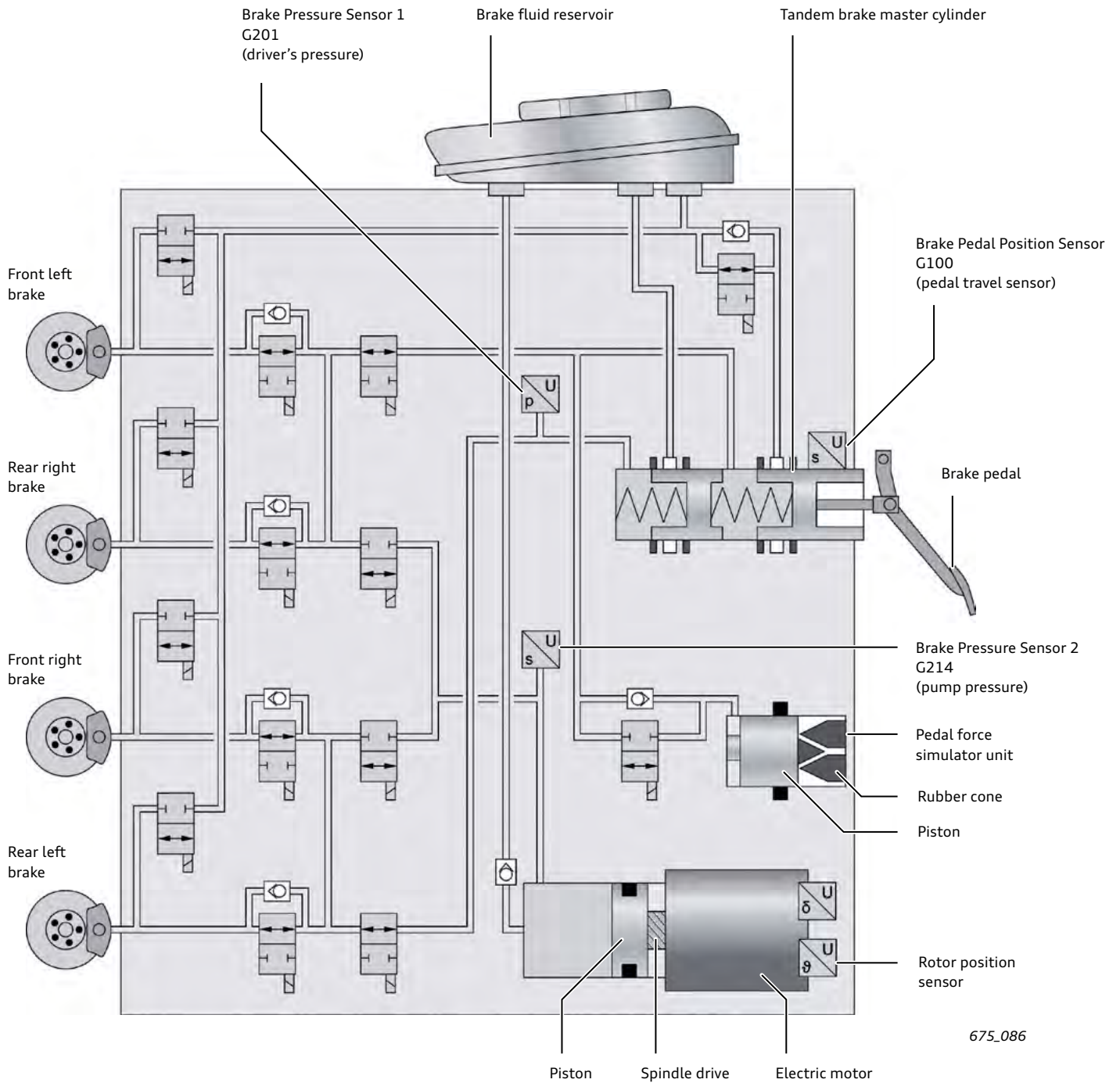
The main new feature is the integration of a tandem brake master cylinder, brake servo (via electromechanical components including regulation), ESC regulating systems (including ABS, EDL, TCS etc.) and brake blending in one module. This achieves a significant weight reduction (about 30%) compared to conventionally constructed brake systems. 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.

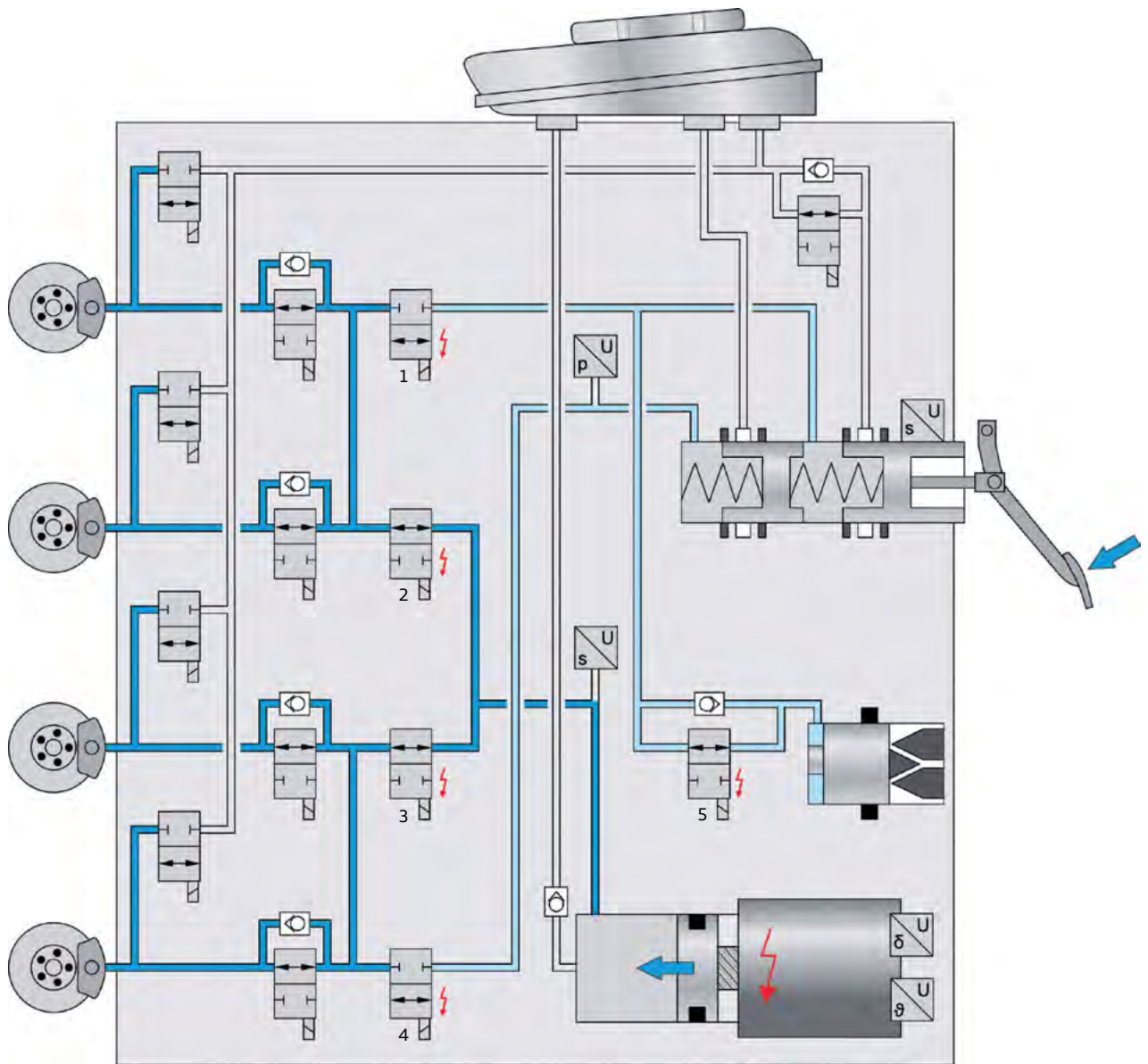


675_085

Design and function

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





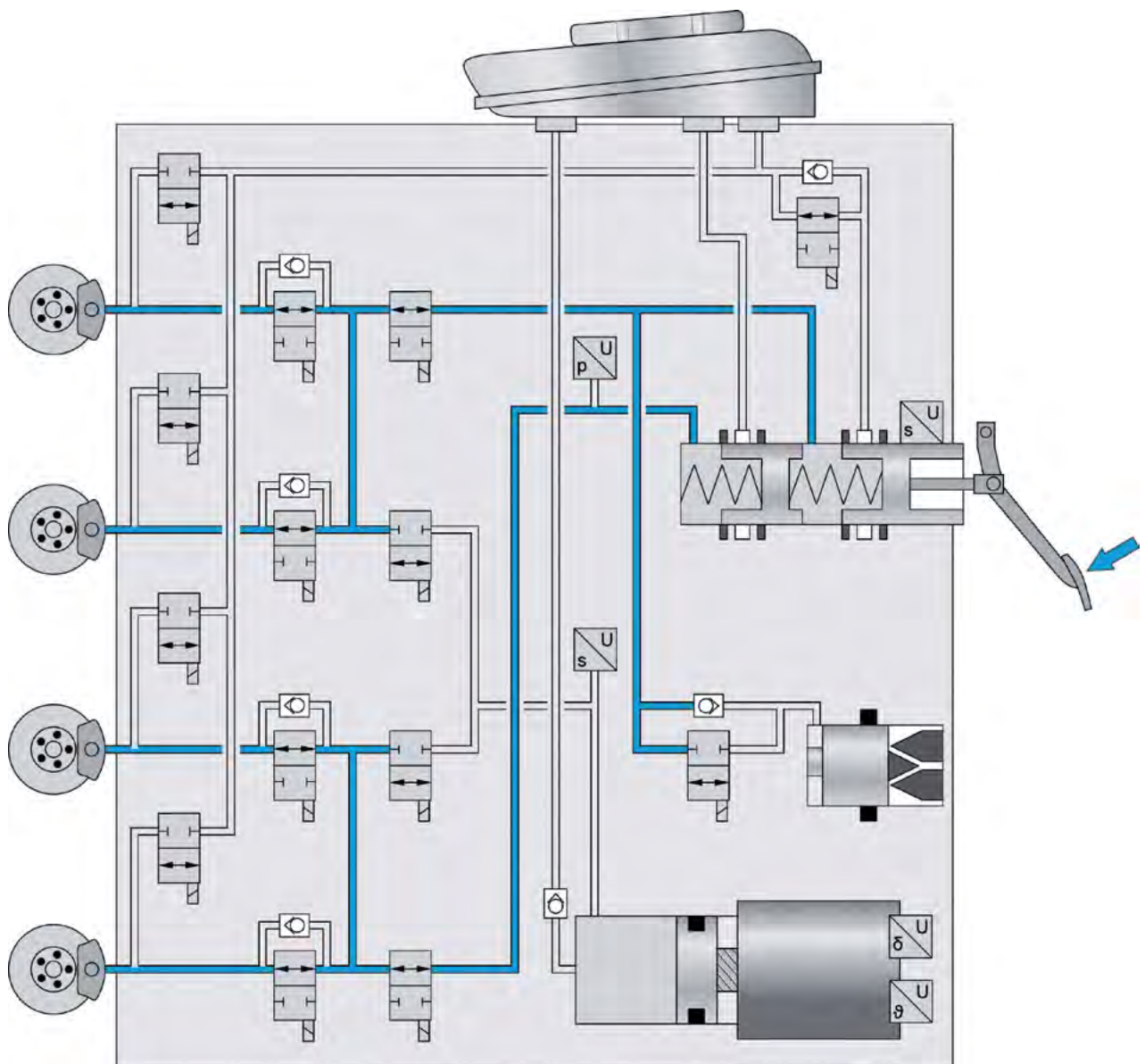
675_087

Brake pressure build-up phase via electric motor pump unit (linear actuator), driver presses the brake pedal (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 Brake Pedal Position Sensor G100. If pedal operation is detected, ABS Control Module J104 actuates isolating valves 1 and 4, which then block the relevant circuit.

At the same time, solenoid valve 5 is energized, thereby allowing energy to pass through. Because the isolating valves have blocked the circuits, 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 Brake Pressure Sensor 1 G201 and the pedal travel by a movement sensor. Depending on these measured values, J104 energizes 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 Sensor 2 G214) and reported to J104. The synchronous electric motor features electronic commutation and is equipped with a rotor position sensor. The control module uses 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 ABS Control Module J104.

If the driver switches off the ignition before the vehicle has come to a stop, the brake servo remains available. Once the vehicle is stationary with the ignition off, the brake servo remains available for approximately 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 or when 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. Because 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, which allows 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 drive motor is operated as a 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.

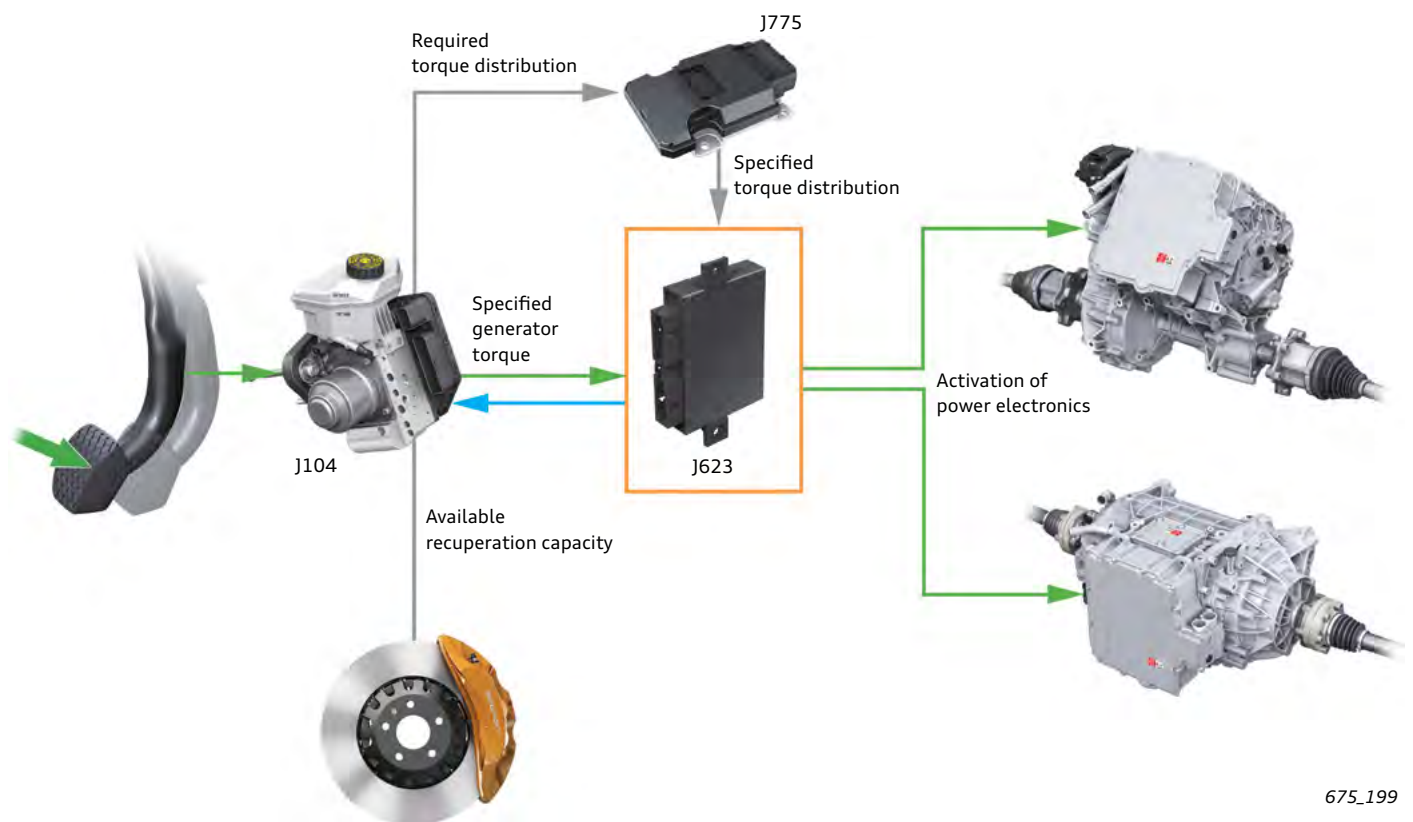
Engine/Motor Control Module J623 continuously transmits information on the maximum recuperation capacity (braking power) currently available to ABS Control Module J104 of the MK C1 brake regulation system. If the driver presses the brake pedal or the adaptive cruise assist requests braking, J104 determines 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 Engine/Motor Control Module J623.

At the same time, J104 sends the required distribution of the recuperation torque for both driving axles to Drivetrain Control Module J775. J775 coordinates the transition between linear, overrun and recuperation distribution and sends this specification to the J623. 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.



675_199

Service operations

ABS Control Module J104 is accessible via Address Word 0003. No repairs can be made to the brake module with the exception of replacing the brake fluid reservoir.

After the control module has been coded online, various basic settings must be performed for:

- > Brake Pedal Position Sensor G100
- > Brake Pressure Sensors 1 and 2, G201 and G214
- > Electromechanical Parking Brake Control Module J540)
- > Tire Pressure Monitoring System

In addition, Output Checks must be performed to ensure that the hydraulic lines are connected correctly and have not been interchanged.

Further Output Checks can be used to check the EPB and warning/indicator lamp functions.

Instructions given by the Scan Tool must be carefully followed when the procedure "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 to the MAX marking.







675_085

Wheels, tires and tire pressure monitoring

The Audi e-tron comes with 20" cast aluminum wheels as standard. 19" and 21" wheels are available as optional extras. The available tires range from 255/50 R20 to 265/45 R21.

The e-tron uses an indirect Tire Pressure Monitoring System. It has the same construction and functionality as the system in the 2017 Audi Q7.

A temporary spare wheel (5.5J x 19 with 185/70 tire) is standard equipment on the e-tron.

Standard wheels	Optional wheels		Available wheel
			
Cast aluminum wheel Flow form ¹⁾ 9.0J x 20 255/50 R20	Cast aluminum wheel Flow form 8.5J x 19 255/55 R19	Forged aluminum wheel 9.5J x 21 265/45 R21	Forged aluminum wheel 9.5J x 21 265/45 R21

Electric system and electronics

Power supply

12 Volt electrical system

The e-tron is equipped with a 12 volt battery and electrical system. All control modules operate on a 12 volt power supply even when its high-voltage battery is 100% charged.

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

The Audi e-tron does not have 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.

A 12 Volt, 68 Ah AGM battery is installed in the plenum chamber.

12 Volt battery in plenum chamber





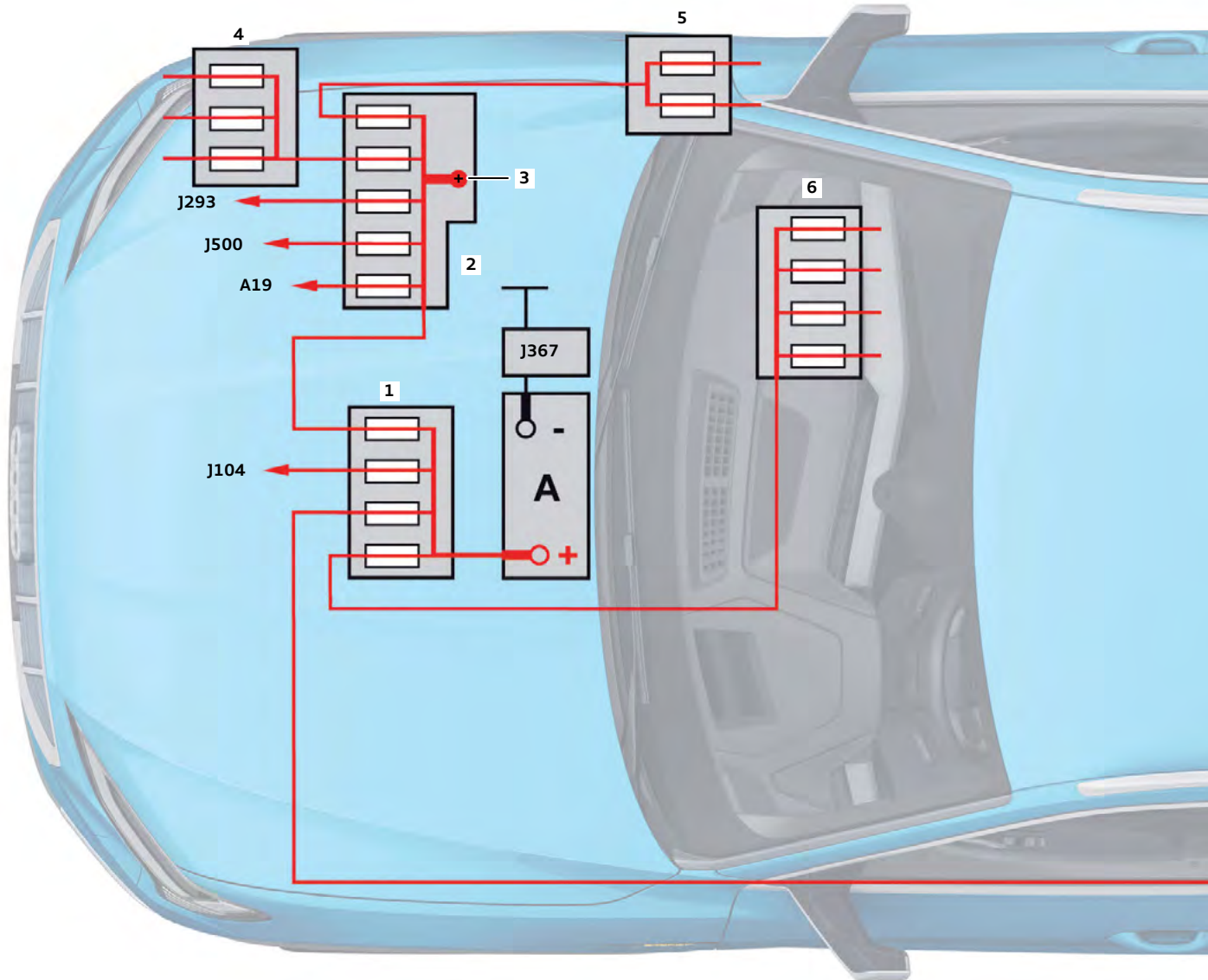
675_116

Power supply structure

This illustration shows a general overview of the 12 volt power supply structure. Please refer to ElsaPro for the exact location and descriptions of these components.

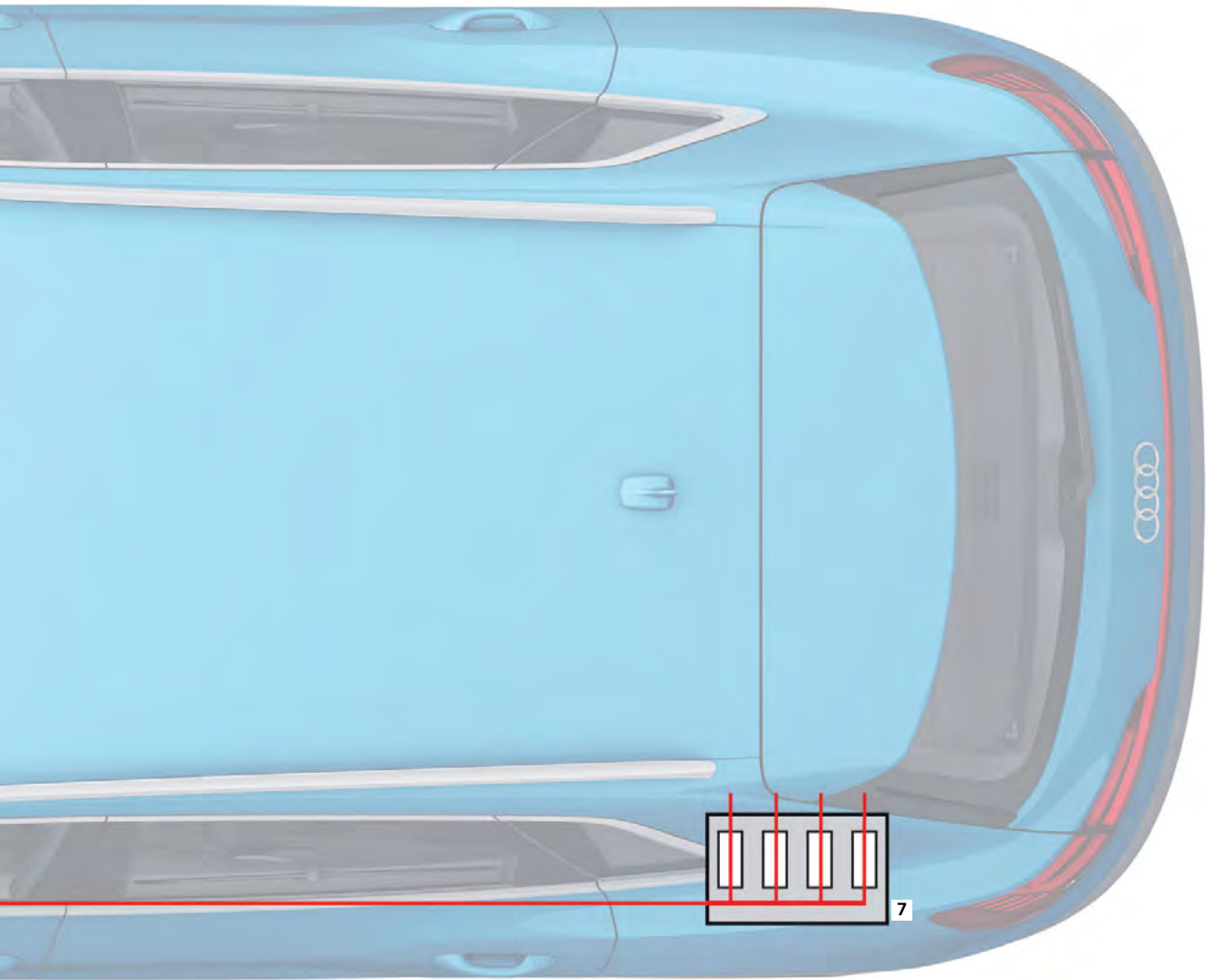
Unlike other Audi vehicles, the 12 Volt charging terminal on the Audi e-tron is only intended for charging/buffering the 12 Volt battery in the workshop. **Under no circumstances must this connection be used to jump-start another vehicle or maintain that vehicle's battery power.**

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 (approximately 10% remaining capacity).



Key:

A	Battery	1	Main fuse carrier 1 on 12 Volt battery
A19	Voltage Converter	2	Main fuse carrier 2 in motor compartment (right-side)
J104	ABS Control Module	3	12 Volt charging terminal (plus) in main fuse carrier 2
J293	Radiator Fan Control Module	4	Fuse and relay carrier in motor compartment (right-side)
J367	Battery Monitoring Control Module	5	Fuse and relay carrier on lower section of right A-pillar
J500	Power Steering Control Module	6	Fuse and relay carrier in front passenger's footwell
		7	Fuse and relay carrier in luggage compartment (left-side)



Networking

Installation locations of control modules

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

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



Key:

- | | |
|---|--|
| A19 Voltage Converter | J393 Comfort System Central Control Module |
| A27 Right Led Headlamp Power Output Module 1 | J428 Control Module for Adaptive Cruise Control |
| A31 Left Led Headlamp Power Output Module 1 | J500 Power Steering Control Module |
| J104 ABS Control Module | J502 Tire Pressure Monitoring System Control Module |
| J136 Memory Seat/Steering Column Adjustment Control Module | J519 Vehicle Electrical System Control Module |
| J234 Airbag Control Module | J521 Front Passenger Memory Seat Control Module |
| J245 Sunroof Control Module | J525 Digital Sound System Control Module |
| J285 Instrument Cluster Control Module | J527 Steering Column Electronics Control Module |
| J345 Towing Recognition Control Module | J533 Data Bus On Board Diagnostic Interface |
| J386 Driver Door Control Module | J605 Rear Lid Control Module |
| J387 Front Passenger Door Control Module | J623 Engine/Motor Control Module |
| | J685 Front Information Display Control Head |
| | J764 Electronic Steering Column Lock Control Module |
| | J769 Lane Change Assistance Control Module |

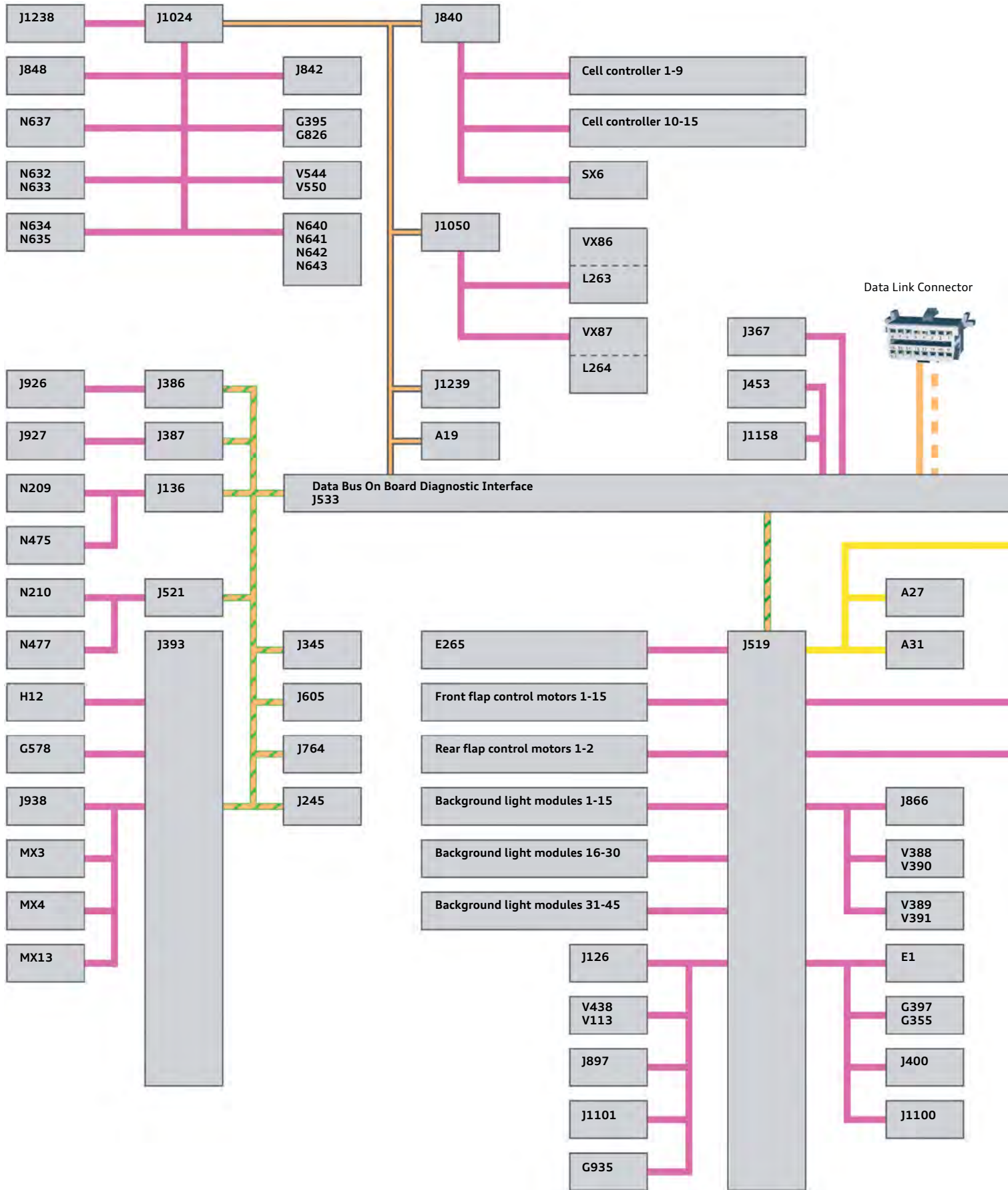


675_118

- J770** Lane Change Assistance Control Module 2
- J772** Rearview Camera System Control Module
- J775** Drivetrain Control Module
- J794** Information Electronics Control Module 1
- J840** Battery Regulation Control Module
- J853** Night Vision System Control Module
- J898** Windshield Projection Head Up Display Control Module
- J926** Driver Side Rear Door Control Module
- J927** Passenger Side Rear Door Control Module
- J943** Engine Sound Generator Control Module
- J949** Control Module for Emergency Call Module and Communication Unit

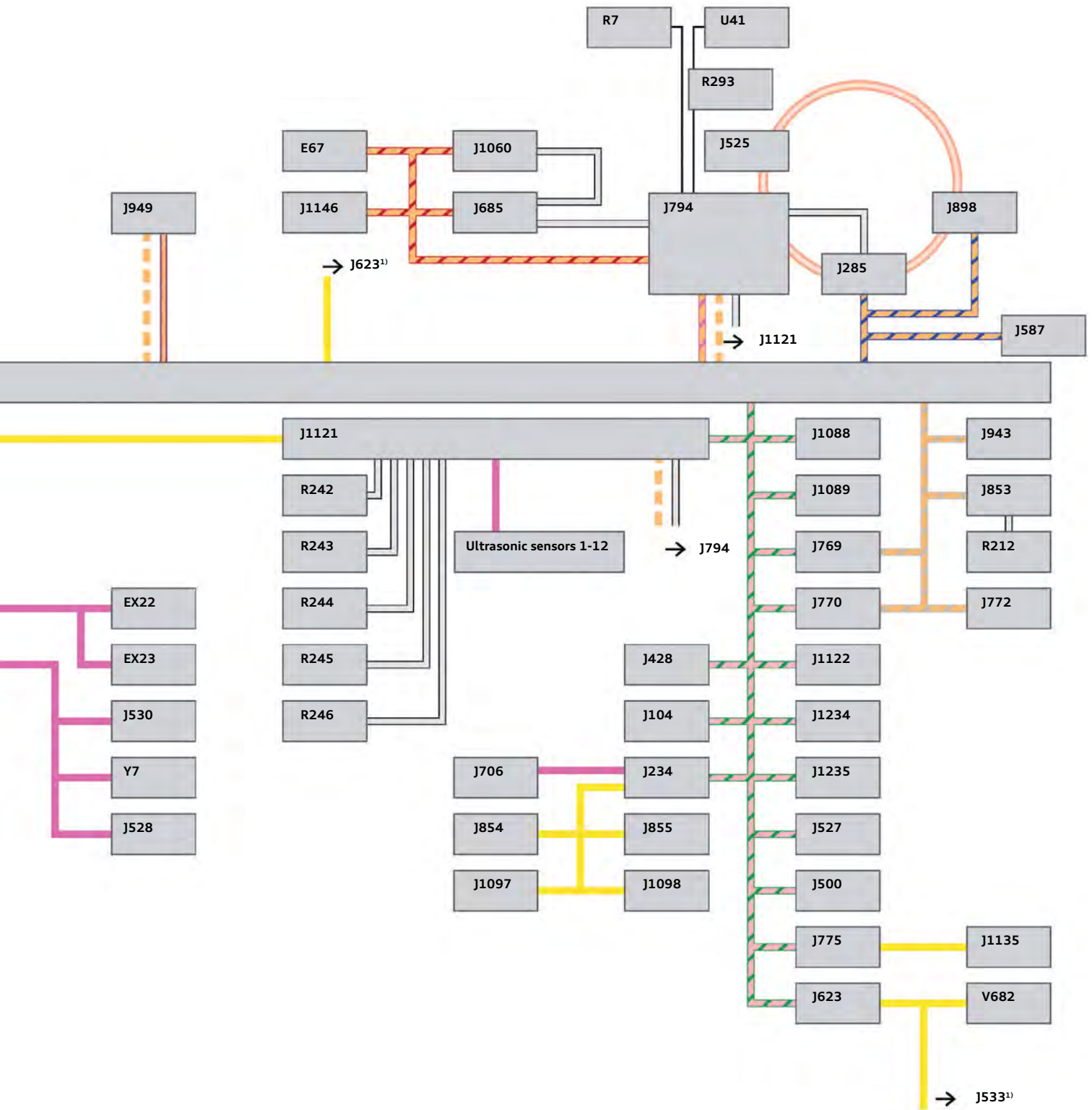
- J1024** Thermal Management Control Module
- J1050** High-Voltage Battery Charger Control Module
- J1088** Control Module for Left Front Object Detection Radar Sensor
- J1089** Control Module for Right Front Object Detection Radar Sensor
- J1121** Driver Assistance Systems Control Module
- J1122** Laser Distance Regulation Control Module
- J1234** Electric Drive Control Module on Front Axle
- J1235** Electric Drive Control Module on Rear Axle
- J1239** High-Voltage Battery Charger Control Module 2

Topology



Some of the control modules shown in this overview are optional and/or country-specific equipment.

Those shown here relate to the equipment and motor versions available at the time of publication of this eSelf-Study Program.

















¹⁾ The sub-bus wire to the gateway is not used for data transfer. The gateway, like Engine/Motor Control Module J623, accommodates a termination resistance of 120 Ω.

Key:

A19	Voltage Converter	J840	Battery Regulation Control Module
A27	Right Led Headlamp Power Output Module 1	J842	A/C Compressor Control Module
A31	Left Led Headlamp Power Output Module 1	J848	High-Voltage Heater (PTC) Control Module
E1	Light Switch	J853	Night Vision System Control Module
E67	Driver Volume Control	J854	Left Front Seat Belt Tensioner Control Module
E265	Rear A/C Display Control Head	J855	Right Front Seat Belt Tensioner Control Module
EX22	Switch Module in Instrument Panel, Center	J866	Power Adjustable Steering Column Control Module
EX23	Center Console Switch Module 1	J897	Ionizer Control Module
G355	Humidity Sensor	J898	Windshield Projection Head Up Display Control Module
G395	A/C Pressure/Temperature Sensor 1	J926	Driver Side Rear Door Control Module
G397	Humidity Sensor	J927	Passenger Side Rear Door Control Module
G578	Anti-Theft Alarm System Sensor	J938	Power Rear Lid Opening Control Module
G826	A/C Pressure/Temperature Sensor 2	J943	Engine Sound Generator Control Module
G935	Exterior Air Quality and Humidity Sensor	J949	Control Module for Emergency Call Module and Communication Unit
H12	Alarm Horn	J1024	Thermal Management Control Module
J104	ABS Control Module	J1050	High-Voltage Battery Charger Control Module
J126	Fresh Air Blower Control Module	J106	Front Information Display Control Head 2
J136	Memory Seat/Steering Column Adjustment Control Module	J1088	Control Module for Left Front Object Detection Radar Sensor
J234	Airbag Control Module	J1089	Control Module for Right Front Object Detection Radar Sensor
J245	Sunroof Control Module	J1097	Left Rear Seat Belt Tensioner Control Module
J285	Instrument Cluster Control Module	J1098	Right Rear Seat Belt Tensioner Control Module
J345	Towing Recognition Control Module	J1100	Windshield Washer Pump Control Module
J367	Battery Monitoring Control Module	J1101	Fragrance Diffuser System Control Module
J386	Driver Door Control Module	J1121	Driver Assistance Systems Control Module
J387	Front Passenger Door Control Module	J1122	Laser Distance Regulation Control Module
J393	Comfort System Central Control Module	J1135	Level Control System Compressor Electronics
J400	Wiper Motor Control Module	J1146	Mobile Device Charger 1
J428	Adaptive Cruise Control Module	J1158	Steering Wheel Touch Recognition Control Module
J453	Multifunction Steering Wheel Control Module	J1234	Electric Drive Control Module on Front Axle
J500	Power Steering Control Module	J1235	Electric Drive Control Module on Rear Axle
J519	Vehicle Electrical System Control Module	J1238	High-Voltage Heater 2 (PTC) Control Module
J521	Front Passenger Memory Seat Control Module	J1239	High-Voltage Battery Charger Control Module 2
J525	Digital Sound System Control Module	L263	Charging Socket 1 LED Module
J527	Steering Column Electronics Control Module	L264	Charging Socket 1 LED Module 2
J528	Roof Electronics Control Module	MX3	Left Tail Lamp
J530	Garage Door Opener Control Module	MX4	Right Tail Lamp
J533	Data Bus On Board Diagnostic Interface	MX13	Center Tail Lamp
J587	Selector Lever Sensor System Control Module	N209	Driver Lumbar Support Adjustment Valve Block
J605	Rear Lid Control Module	N210	Front Passenger Lumbar Support Adjustment Valve Block
J623	Engine Control Module	N475	Valve Block 1 in Driver Seat
J685	Front Information Display Control Head	N477	Valve Block 1 in Front Passenger Seat
J706	Passenger Occupant Detection System Control Module	N632	Coolant Change-Over Valve 1
J764	Electronic Steering Column Lock Control Module	N633	Coolant Change-Over Valve 2
J769	Lane Change Assistance Control Module	N634	Coolant Change-Over Valve 3
J770	Lane Change Assistance Control Module 2	N635	Coolant Change-Over Valve 4
J772	Rearview Camera System Control Module	N637	Refrigerant Expansion Valve 2
J775	Drivetrain Control Module	N640	Refrigerant Shut-Off Valve 2
J794	Information Electronics Control Module 1	N641	Refrigerant Shut-Off Valve 3
		N642	Refrigerant Shut-Off Valve 4
		N643	Refrigerant Shut-Off Valve 5

R7	DVD Player	VX86	Drive Unit for Charging Socket 1 Cover
R212	Night Vision System Camera	VX87	Drive Unit for Charging Socket 2 Cover
R242	Driver Assistance Systems Front Camera		
R243	Front Peripheral Camera	Y7	Automatic Dimming Interior Rearview Mirror
R244	Left Peripheral Camera		
R245	Right Peripheral Camera		
R246	Rear Peripheral Camera		
R293	USB Distributor		
SX6	High-Voltage Battery Control Module		
U41	USB Connection 1		
V113	Recirculation Door Motor		
V388	Driver Seat Backrest Blower Fan		
V389	Front Passenger Seat Backrest Blower Fan		
V390	Driver Seat Cushion Blower Fan		
V391	Front Passenger Seat Cushion Blower Fan		
V438	Fresh Air Door Motor		
V544	Radiator Shutter Motor		
V550	Radiator Shutter Adjustment Motor 2		
V682	Parking Lock Actuator		

Bus systems

Bus system	Wire color	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
Instrument 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		Fiber 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 = Low Voltage Differential Signalling

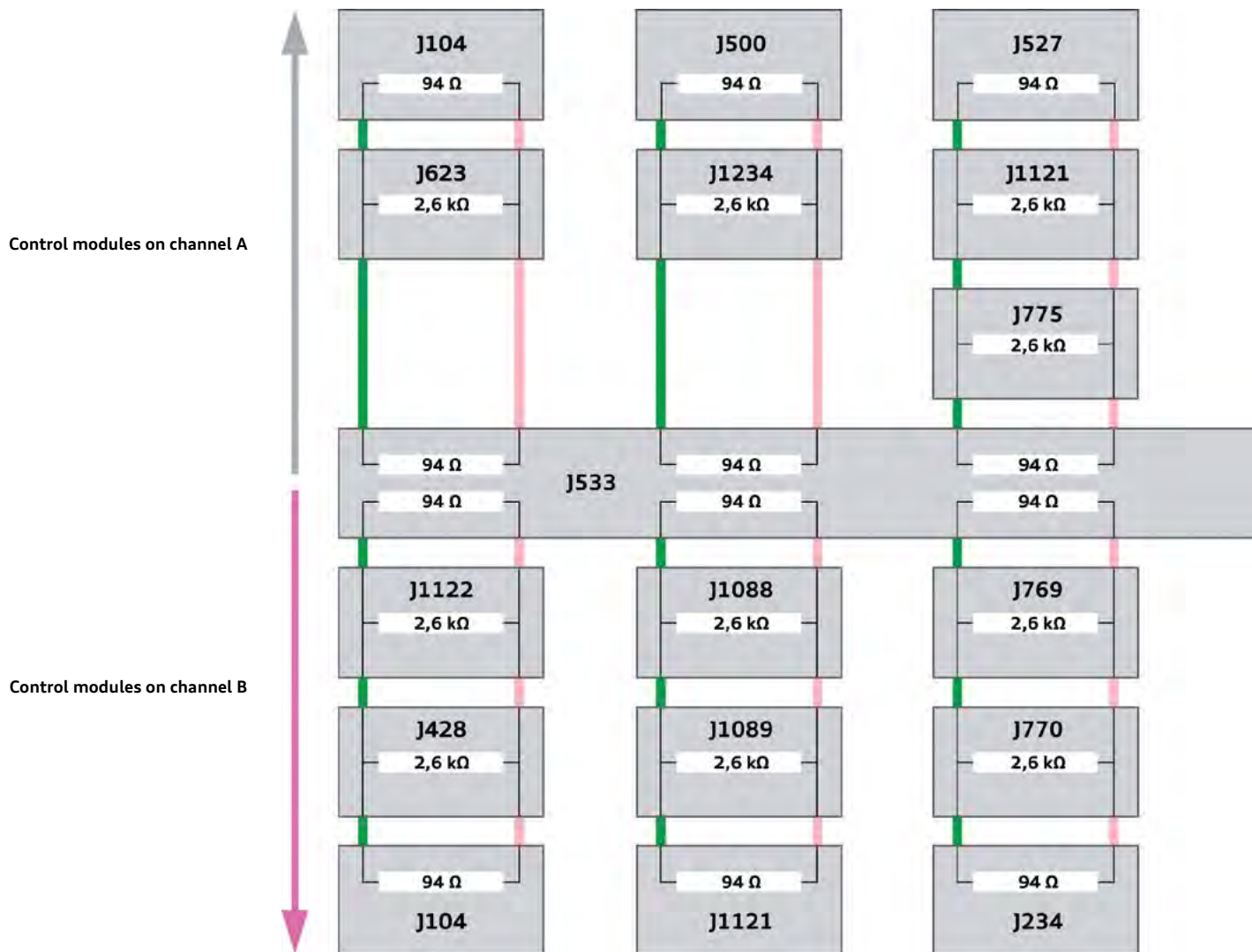
FlexRay

Because it is not possible to illustrate the allocation of the FlexRay control modules realistically in the topology as a whole, the following illustrations show the distribution of the control modules on the individual FlexRay branches. All the control modules of a fully equipped Audi e-tron are shown here. As always with FlexRay, the control modules connected at the end of a branch have a resistance of 94 ohms. The control modules installed in-between have a resistance of 2.6 k ohms.

The FlexRay technology provides the opportunity to use two channels on one branch. 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.

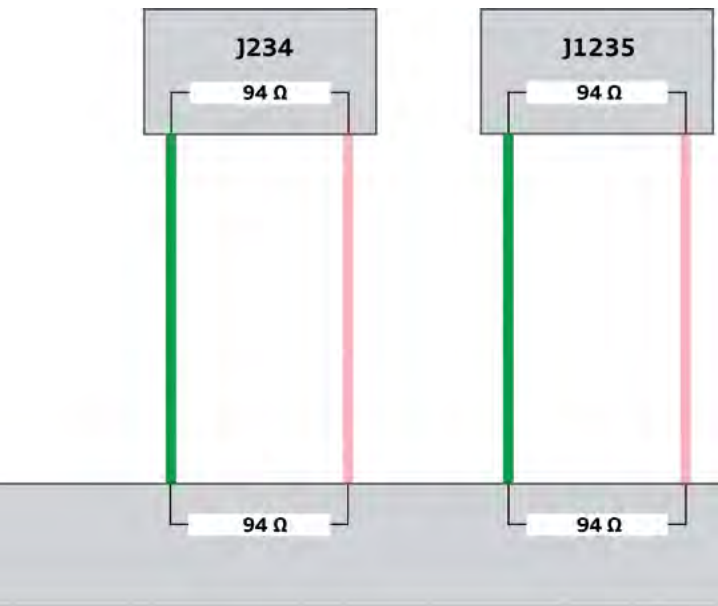


The “B” channel on the Audi e-tron is used to increase the amount of data that can be transmitted. If the same control module is connected to both channels, the diagnostic data of this control module are transmitted via channel “A”. If one channel of a branch fails, for example due to a short circuit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

Because FlexRay is a time-controlled data transfer system, a start-up procedure (starting a network) may only be performed by “cold-start” control modules.

On the Audi e-tron, these are:

- > Data Bus On Board Diagnostic Interface J533
- > ABS Control Module J104
- > Airbag Control Module J234



Key:

- J104** ABS Control Module
- J234** Airbag Control Module
- J428** Control Module for Adaptive Cruise Control
- J500** Power Steering Control Module
- J527** Steering Column Electronics Control Module
- J533** Data Bus On Board Diagnostic Interface
- J623** Engine/Motor Control Module
- J769** Lane Change Assistance Control Module
- J770** Lane Change Assistance Control Module 2
- J775** Drivetrain Control Module
- J1088** Control Module for Left Front Object Detection Radar Sensor
- J1089** Control Module for Right Front Object Detection Radar Sensor
- J1121** Driver Assistance Systems Control Module
- J1122** Laser Distance Regulation Control Module
- J1234** Electric Drive Control Module on Front Axle
- J1235** Electric Drive Control Module on Rear Axle

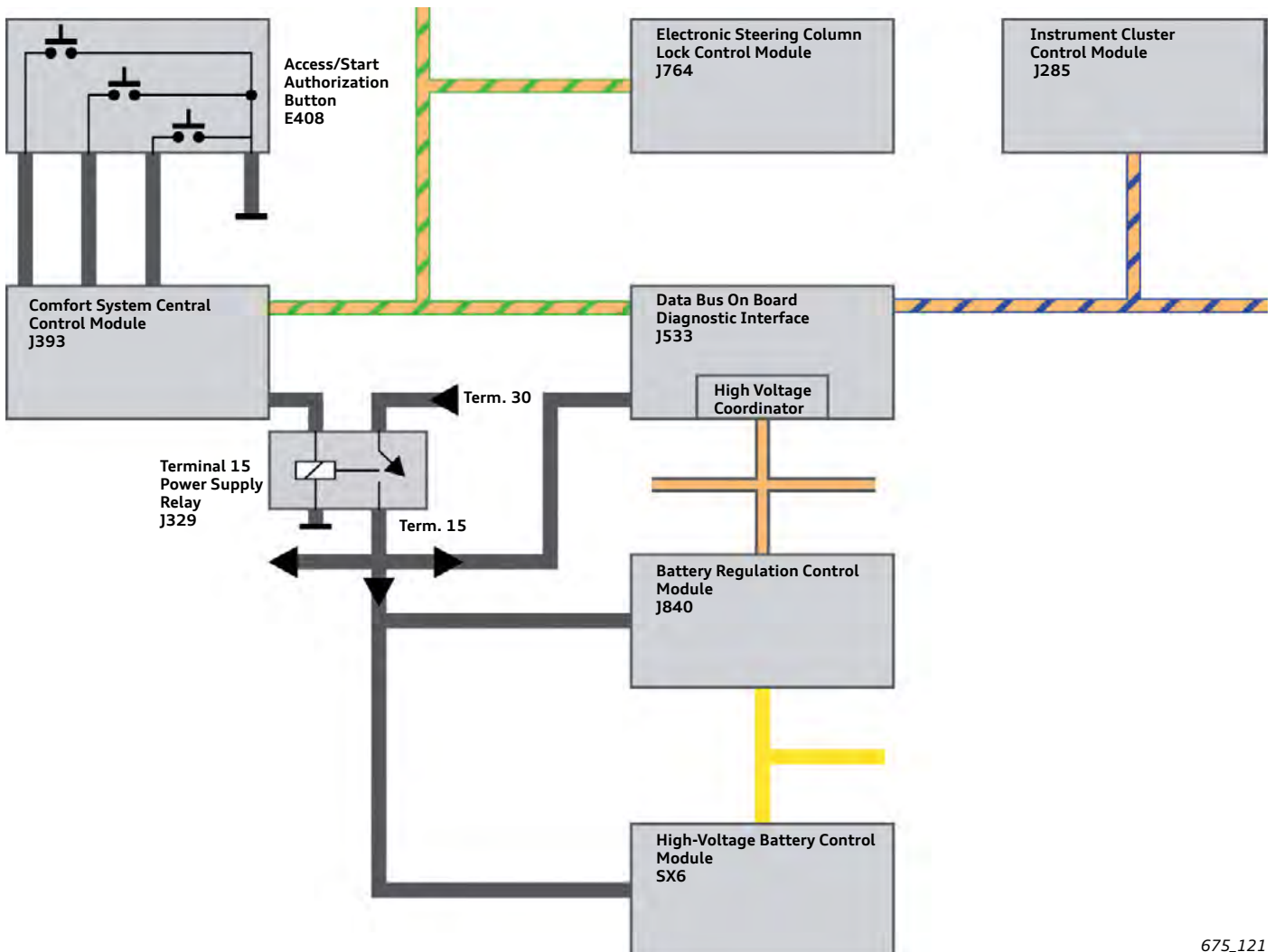
Terminal management

Terminal 15 active

Scenario:

1. Access/Start Authorization Button E408 is pressed when Terminal 15 is switched off.
2. The signal from E408 is transmitted to Comfort System Central Control Module J393 via discrete wires.
3. J393 checks whether there is an authorized 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 Electronic Steering Column Lock Control Module J764, which then releases the steering column lock.
5. J393 activates Terminal 15 Power Supply Relay J329. The control modules are now supplied with power via J329.
6. J393 sends a "virtual" Terminal 15 signal to Data Bus On Board Diagnostic Interface J533 via the convenience CAN.
7. The high-voltage coordinator in J533 sends an activation message for the high-voltage system to Battery Regulation Control Module J840 via the hybrid CAN. J840 sends a signal via a sub-bus system instructing High-Voltage Battery Control Module SX6 to close the power contactors.

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



Key:

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

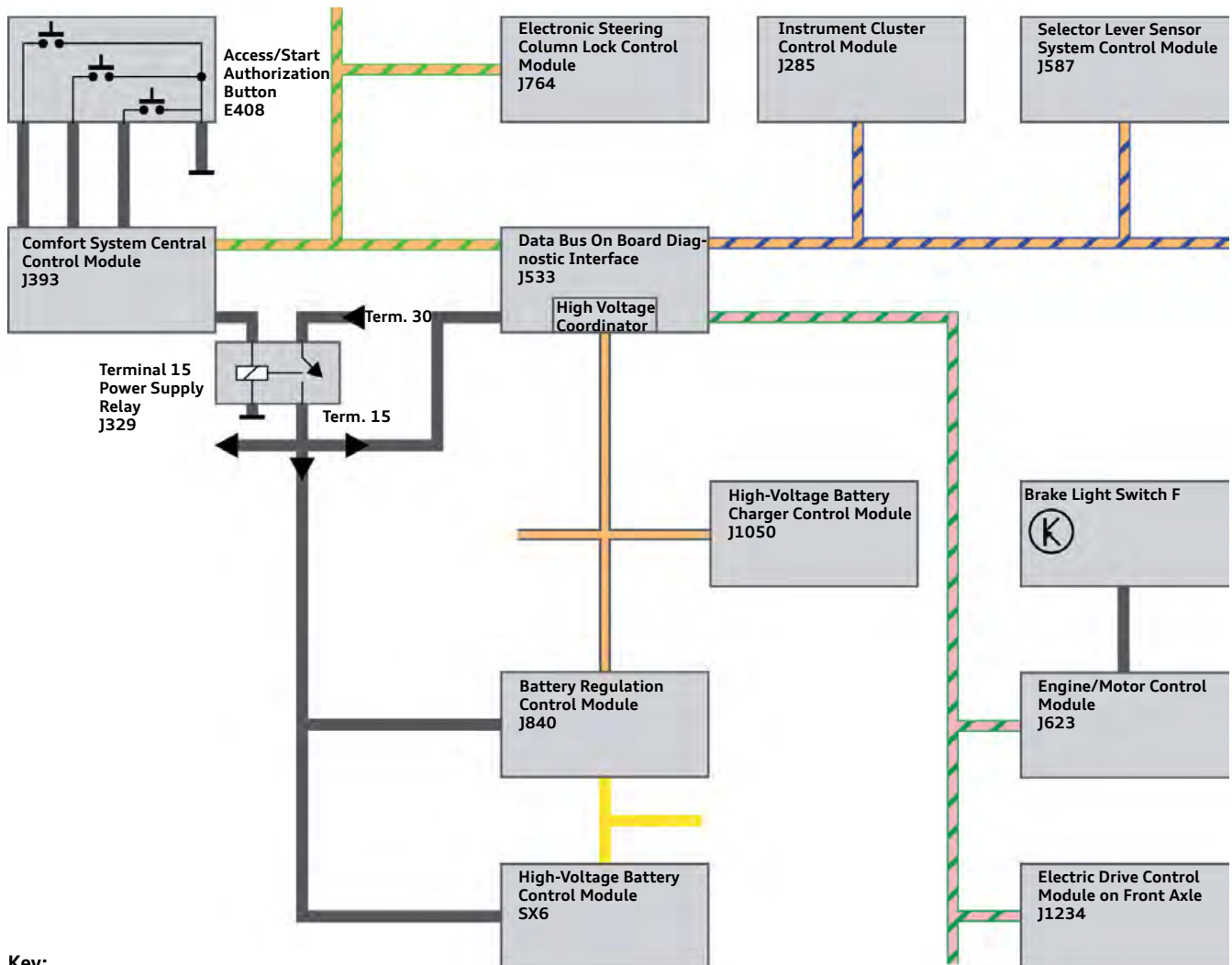
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Activating the drive system

Scenario:

1. Access/Start Authorization Button E408 and the brake pedal are pressed when Terminal 15 is off.
2. The signal from E408 is transmitted to Comfort System Central Control Module J393 via discrete wires.
3. J393 checks whether there is an authorized 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 Electronic Steering Column Lock Control Module J764, which then releases the steering column lock.
5. J393 activates the Terminal 15 Power Supply Relay J329. The control modules are now supplied with power via J329. Engine/Motor Control Module J623 processes the signal from Brake Light Switch F.
6. J393 sends a "virtual" Terminal 15 signal to Data Bus On Board Diagnostic Interface J533 via the convenience CAN. The high-voltage coordinator in J533 sends an activation message for the high-voltage system to Battery Regulation Control Module J840 via the hybrid CAN. J840 sends a signal via a sub-bus system instructing High-Voltage Battery Control Module SX6 to close the power contactors. At the same time, the high-voltage coordinator sends an activation message via FlexRay.
7. 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 Sensor System Control Module J587.
 - > "No charging cable connected" signal from High-Voltage Battery Charger Control Module J1050.
8. If these signals are present, J623 sends the "activate drive system" command to Electric Drive Control Module on Front Axle J1234 via FlexRay.

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



Key:

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

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Data Bus On Board Diagnostic Interface J533

Brief description

Data Bus On Board Diagnostic Interface J533 (gateway) is always installed. It is located under the left front seat and can be accessed via Address Word 0019 with the VAS Scan Tool.

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
- > Instrument 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 Monitoring Control Module
- > J453 Multifunction Steering Wheel Control Module
- > J1158 Steering Wheel Touch Recognition Control Module

Special feature:

- > The gateway manages the diagnostic firewall.

J533



Vehicle Electrical System Control Module J519 (BCM1)

Brief description

The tasks of J519 include evaluating 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 by J519. Control and diagnosis of the Climate Control system is also done via J519.

J519 is accessible via Address Word 0009 using the VAS Scan Tool.

J519 is a node of convenience CAN 2. In addition, it is connected to Driver Assistance Systems Control Module J1121 and the output modules for the headlights via a private CAN. J519 is also the master control module for numerous LIN slaves.

Vehicle Electrical System Control Module J519 performs the following functions:

- > Exterior lighting master.
- > Interior lighting master.
- > Diagnostic gateway for the light control modules.

Special feature:

The interior lighting modules of the background lighting and the climate control system control motors can be connected both as a LIN series or parallel on the corresponding LIN branch. This must be noted when diagnosing DTCs.

Integrated functions:

- > Parking
 - > Parking aid
 - > Park assist
- > Background lighting
 - > Activating the interior light modules
- > Climate control



Installation location:

J519 is always installed in the front passenger foot well directly next to the fuse and relay carrier.

J519

675_124

Convenience electronics

The networking system for convenience electronics is based on the network architecture of the MLBevo generation 2 platform. The vehicle features two bus systems: convenience CAN and convenience CAN 2.

The following convenience equipment/control modules are available for the Audi e-tron and are nodes of the vehicle networking system, some directly via Comfort System Central Control Module J393 and others via the convenience CAN and convenience CAN 2 data bus systems.

- > J345 Towing Recognition Control Module
- > J136 Memory Seat/Steering Column Adjustment Control Module
- > J521 Front Passenger Memory Seat Control Module
- > J605 Rear Lid Control Module
- > J245 Sunroof Control Module
- > J393 Comfort System Central Control Module
- > J938 Power Rear Lid Opening Control Module
- > J764 Electronic Steering Column Lock Control Module

Other partially optional convenience features are:

- > Anti-theft alarm system
- > Background lighting (with the three PR numbers: QQ0, QQ1 and QQ2 known from previous models)
- > 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

Comfort System Central Control Module J393

J393 is installed 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.

It is installed in a standing position using a bracket.

J393 has the following master functions:

- > Central locking system master
- > Immobilizer master

It is the LIN master for:

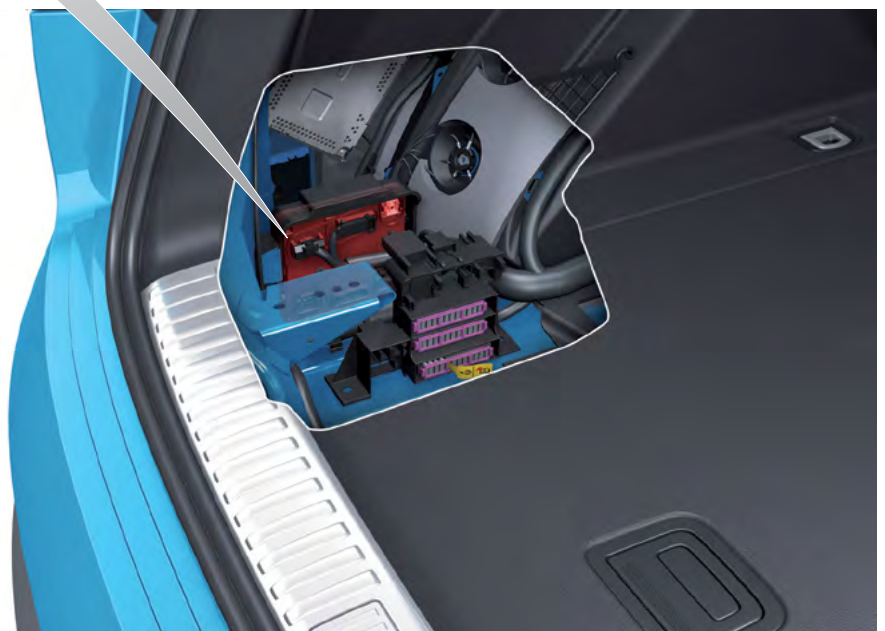
- > G578 Anti-Theft Alarm System Sensor
- > H12 Alarm Horn
- > J938 Power Rear Lid Opening Control Module
- > Tail lights MX3, MX4, MX13

J393



675_220

J393 is used on all vehicle models with MLBevo architecture.



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Reference

For further information about Comfort System Central Control Module J393, refer to eSelf-Study Program [970293, The 2019 Audi A8 Electrics and Electronics.](#)

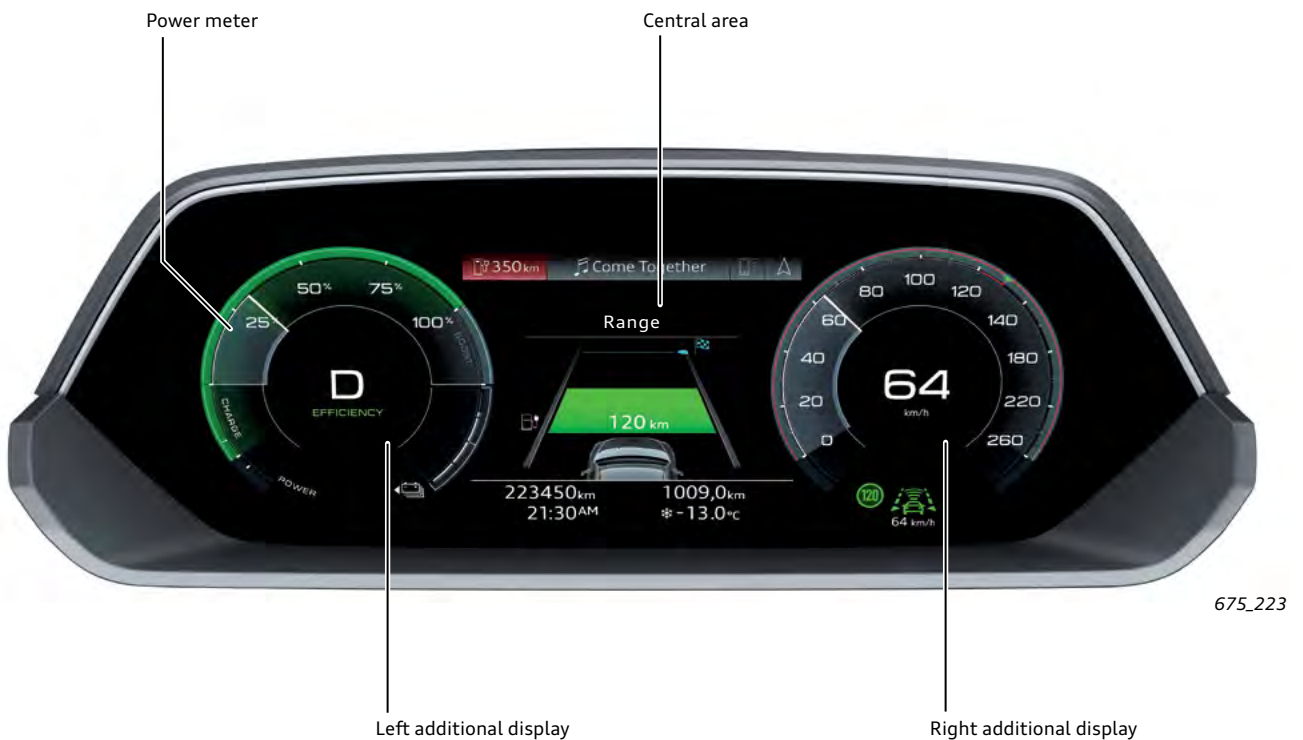
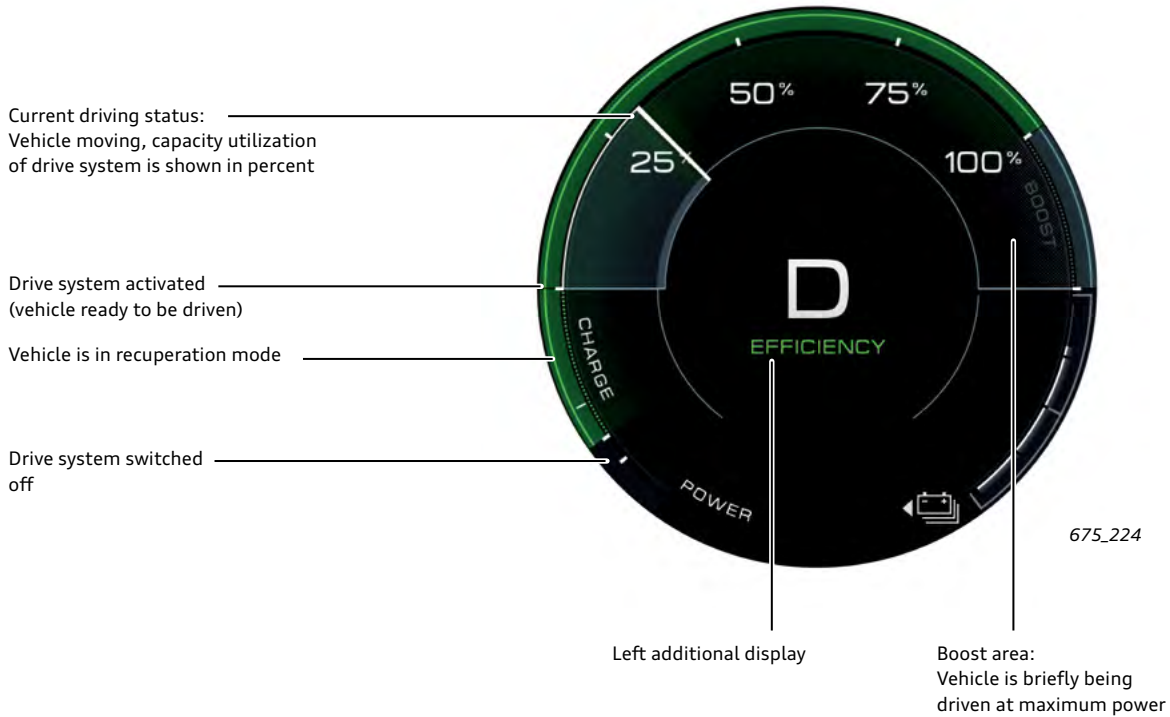
Instrument Cluster Control Module J285

The Audi virtual cockpit plus (PR number 9S9) is standard equipment on the Audi e-tron. It is 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 tachometer.

The driver receives feedback on the load on the drive system via the power meter. Its pointer shows the current load and a colored border shows how much of the drive system capacity can currently be utilized.

The colored borders may vary depending on the driving program selected and the electrical power currently available.



Engine/Motor Control Module J623

J623 is installed at the lower left A-pillar and is a FlexRay node. Accelerator Pedal Module GX2 and Parking Lock Actuator V682 are connected to J623 via a sub CAN. J623 receives information on the transmission position selected from Selector Lever Sensor System Control Module J587 via the dash panel insert CAN..

Battery Regulation Control Module J840 uses the hybrid CAN to send information to J623 regarding the charge level of the high-voltage battery and current limitations.

Based on both this information and the position of GX2, 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, J623 is informed by ABS Control Module J104 via the 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.

Engine/Motor Control Module J623



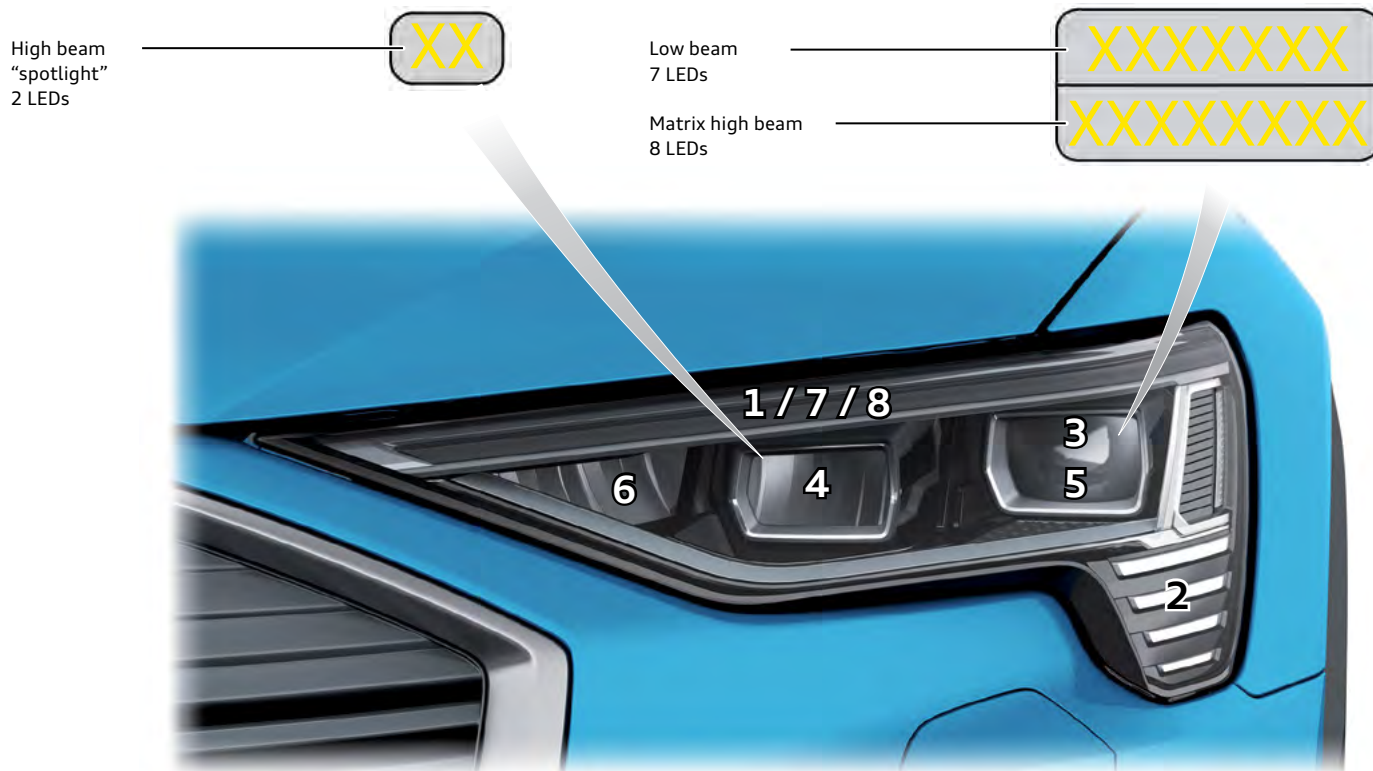
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Exterior lighting

Headlights

The headlights on the Audi e-tron are matrix LED headlights. These headlights are sometimes also known as smart matrix LED headlights because the LEDs for the low beams and the LEDs for the matrix high beams are installed in one projection module. The one-row matrix high beam is generated by eight LEDs per headlight.

According to the traffic situation detected, individual LEDs can be switched off selectively to avoid blinding vehicles ahead or oncoming vehicles. A high beam "spotlight", consisting of two LEDs per headlight, supports the high beams. The high beam "spotlight" also works as a matrix segment (if the vehicle has the corresponding equipment, for example, 8G4) and is switched on and off according to the traffic situation.



675_208

Versions

- > PR number 8G1: LED headlights with high 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.: 8G1

- > Daytime running light (1)
- > Marker light (1)
- > Signature light (2), operated together with daytime running light/marker light
- > Low beam (3)
- > High beam/high beam assist (4 + 5), function only high beams on/off
- > Static turn signal (7)
- > Coming/leaving home (3)
- > Maneuvering light (3 + 6), when reverse is selected
- > All-weather light (6)
- > Side marker light (SAE only¹⁾, not illustrated)

¹⁾ SAE = for the North American market

Light functions with PR no.: 8G4

- > Daytime running light (1)
- > Marker light (1)
- > Signature light (2), operated together with daytime running light/marker light
- > Low beam (3)
- > Matrix beam high beam (4 + 5)
- > Dynamic turn signal (8)
- > All-weather light (6)
- > Intersection light (6)
- > Coming/leaving home (3) with dynamic activation/deactivation of marker light and tail light
- > Highway light (3), low beam light raised by headlight range control
- > Intersection light (6) (in combination with navigation system)
- > Maneuvering light (3 + 6), when reverse is selected
- > Side marker light (SAE only¹⁾, not illustrated)

Coming home/leaving home function

The low beam headlights are switched on for the entry/exit lights on Audi e-tron vehicles equipped with PR number 8G1.

Coming home/leaving home function with dynamic activation/deactivation

On Audi e-tron vehicles with PR number 8G4, the entry/exit lighting involves the low 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.

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 modules installed 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 replaced 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 low beams are adjusted using two adjuster screws. However, the matrix beam high 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 low beam is measured. These values are entered in a Test Plan using the VAS Scan Tool and the correction value for the matrix beam high beams is calculated.



Note

A new light switch and operating concept was introduced with the 2019 Audi A8. This concept is also used for the Audi e-tron. The operating concept allows, for example, the low beam headlights and the daytime running lights to be switched off at speeds below 6.2 mph (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 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 trunk lid.

Only LED lights are used. The tail lights are activated by Comfort System Central Control Module J393.



Rear fog light

The rear fog light function has been moved to the bumper on the Audi e-tron. The fog light is installed on one side only; the side nearest the center of the road.



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 replace individual LEDs.

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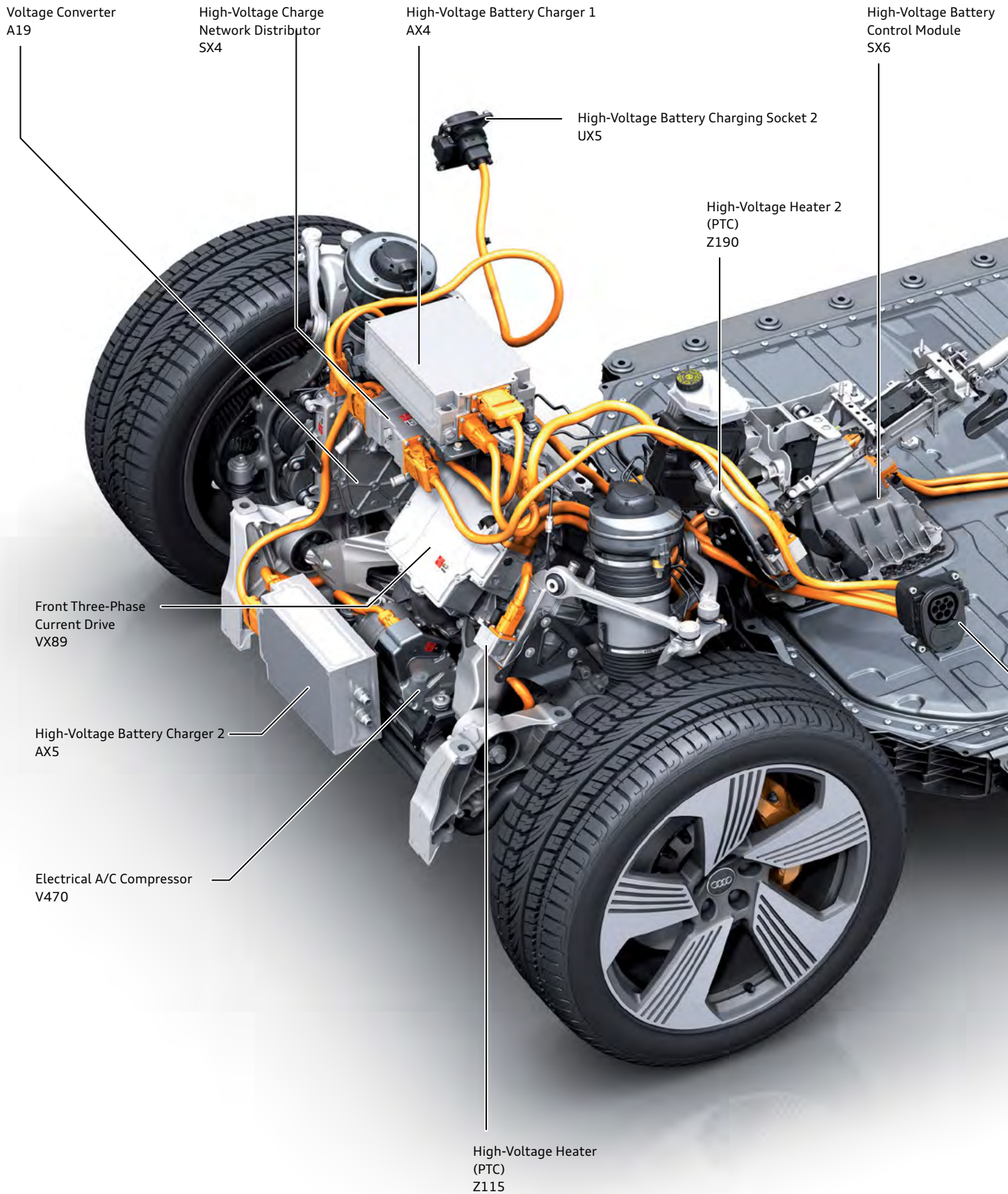
Lighting functions in the tail lights

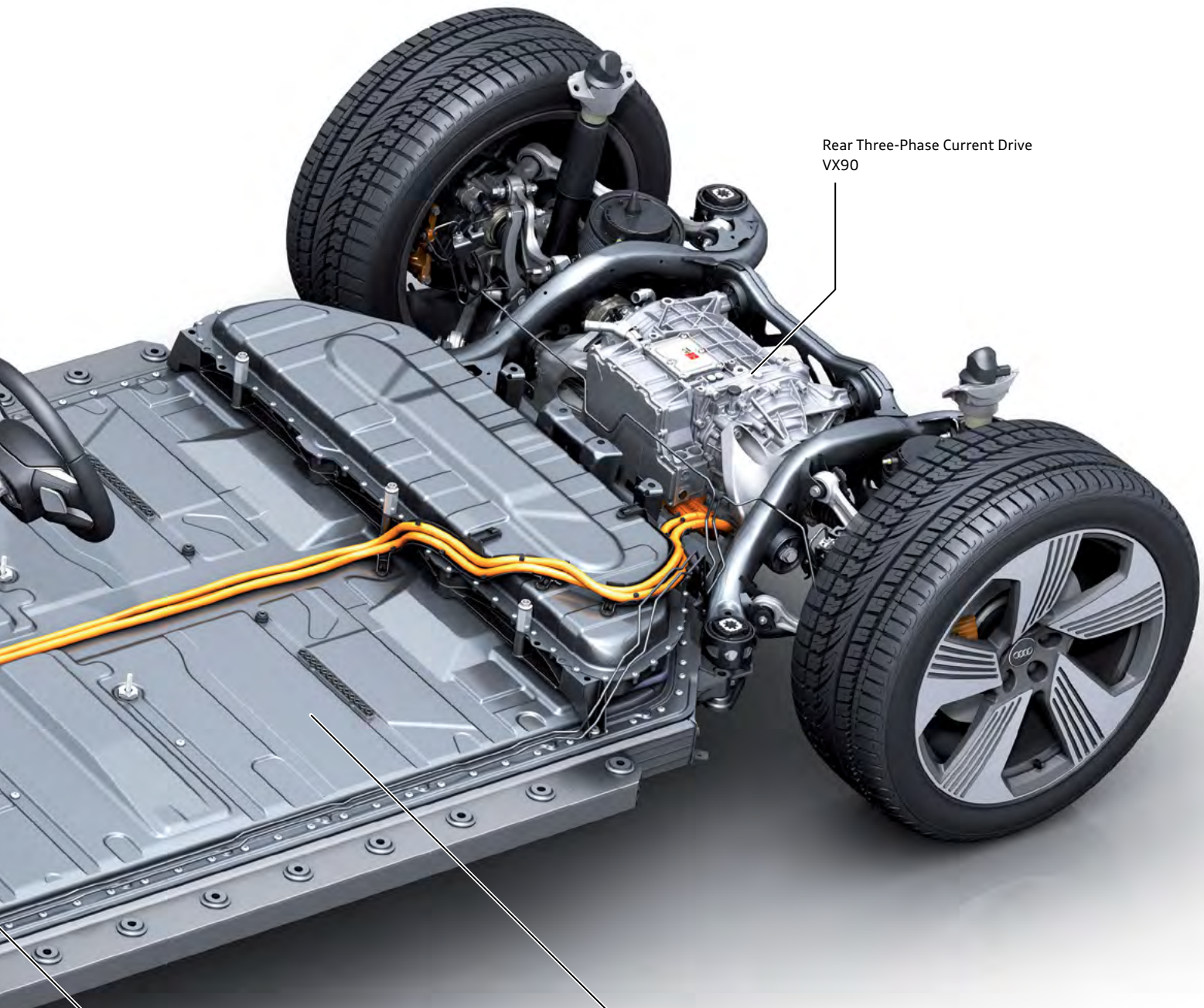
The tail light, turn signal and brake light functions are split between the three tail light sections. The back-up light is installed in the tail light cluster on the rear lid on both sides.

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

High-Voltage Battery Charging Socket 1
UX4

High-Voltage Battery 1
AX2

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Safety regulations

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

Please note:

The high-voltage system could also be energized when the vehicle is parked.

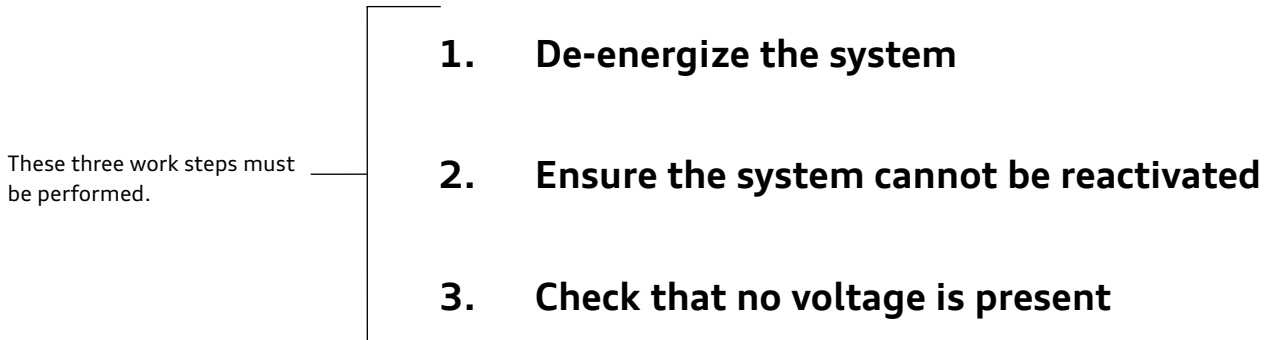
For example:


- > 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 energized.

To achieve this, the Technician must de-energize the system then check that it has been de-energized.

The de-energization procedure is performed according to the three safety rules for electrical technology.



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

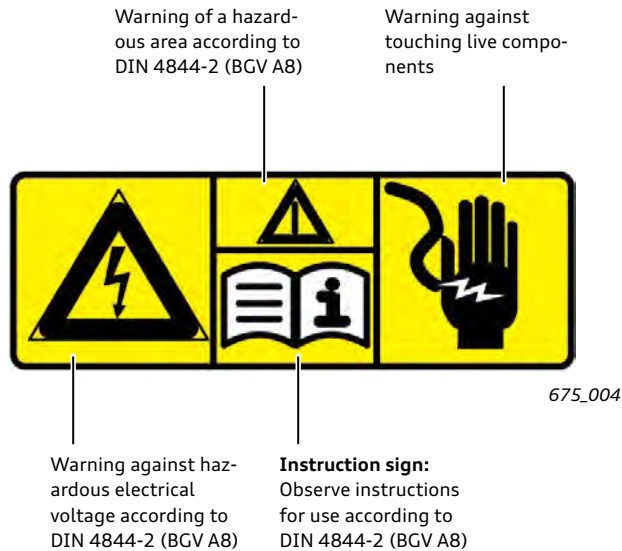
 **Note**
Always de-energize the system according to the Test Plan in the VAS Scan Tool.
The high-voltage system must only be de-energized and worked on by qualified staff.

Warning labels

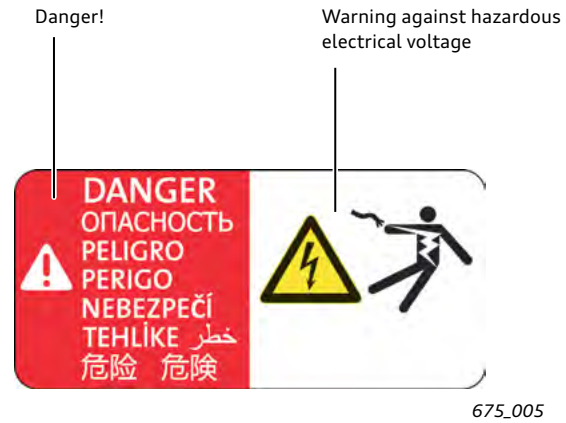
Warning labels are placed on the vehicle to indicate the danger caused by electrical current.

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.

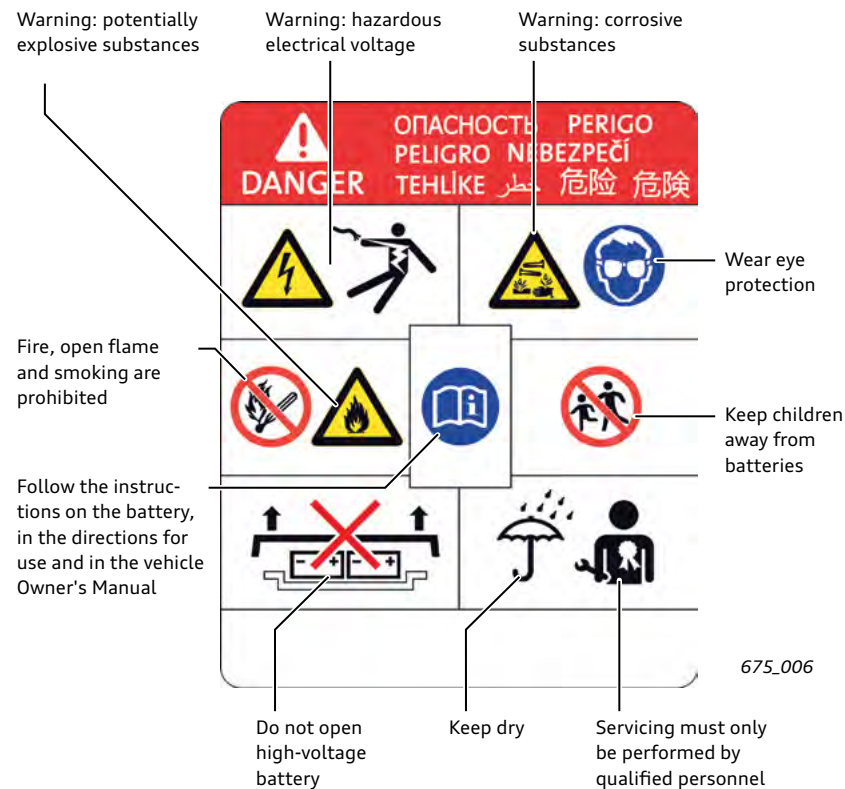
Warning label in motor compartment



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



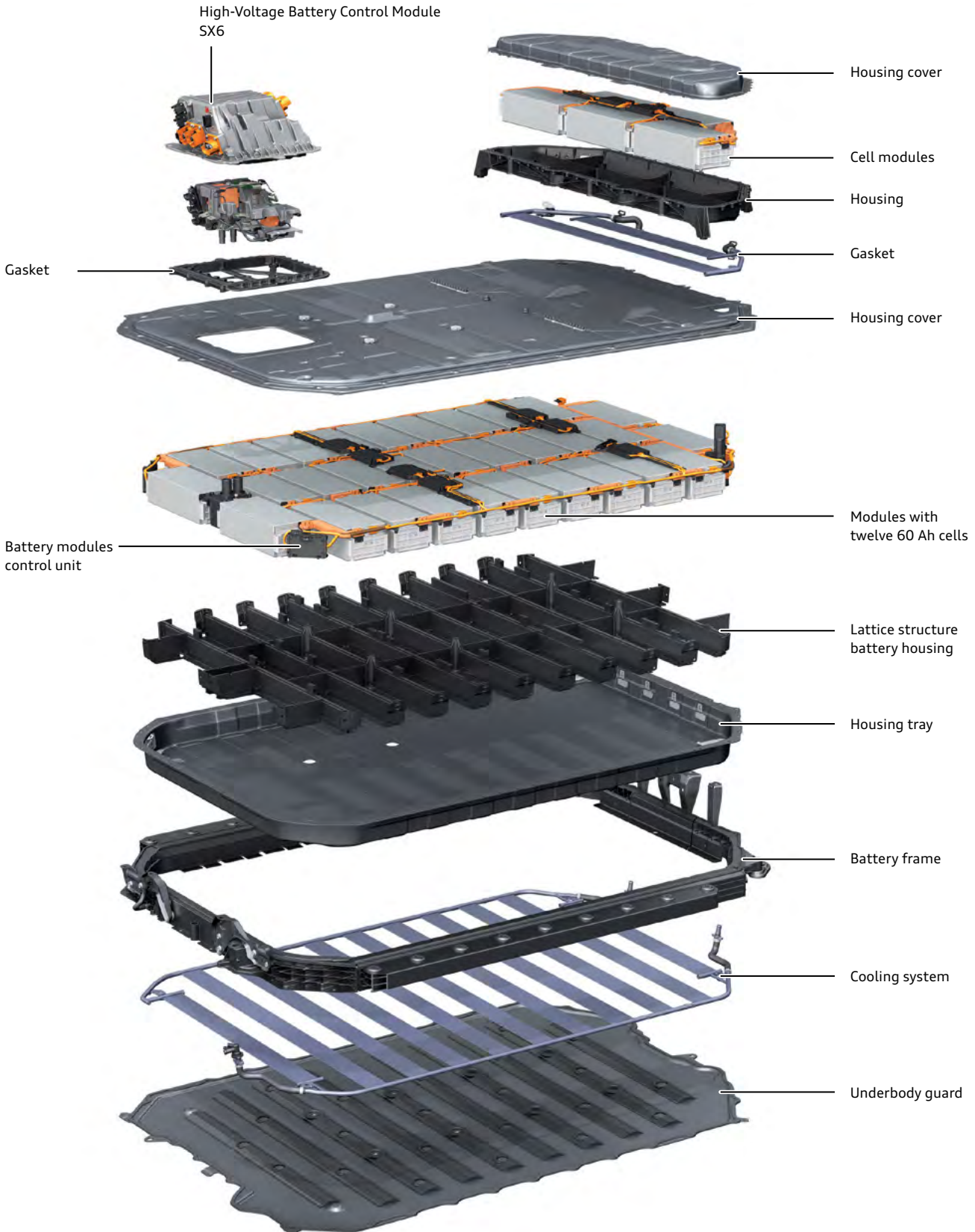
Special warning label for the high-voltage battery



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 installed on two levels. The battery housing is connected to the body via a live potential equalization line.

High-Voltage Battery Control Module SX6 is installed on the high-voltage battery. The battery module control units are installed inside the high-voltage battery. Battery Regulation Control Module J840 is located in the A-pillar (right-side).



Technical data

Designation	High-Voltage Battery 1 AX2
Nominal voltage	396
Capacity in Ah	240
Number of battery cells	432 in 36 modules
Operating temperature	-18 to 140 °F (-28 to 60 °C)
Energy content	95 kWh
Usable energy content in kWh ¹⁾	83.6 kWh
Charging capacity	150 kW
Weight	1541 lb (699 kg)
Approximate 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 discharged or fully charged.

²⁾ When necessary 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 approximately 10%, the 12 Volt battery is no longer recharged.

It is not possible to activate the vehicle's drive system under -22 °F (-30 °C). Above 140 °F (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 17.6 °F and 132.8 °F (-8 °C and 56 °C).

Cooling

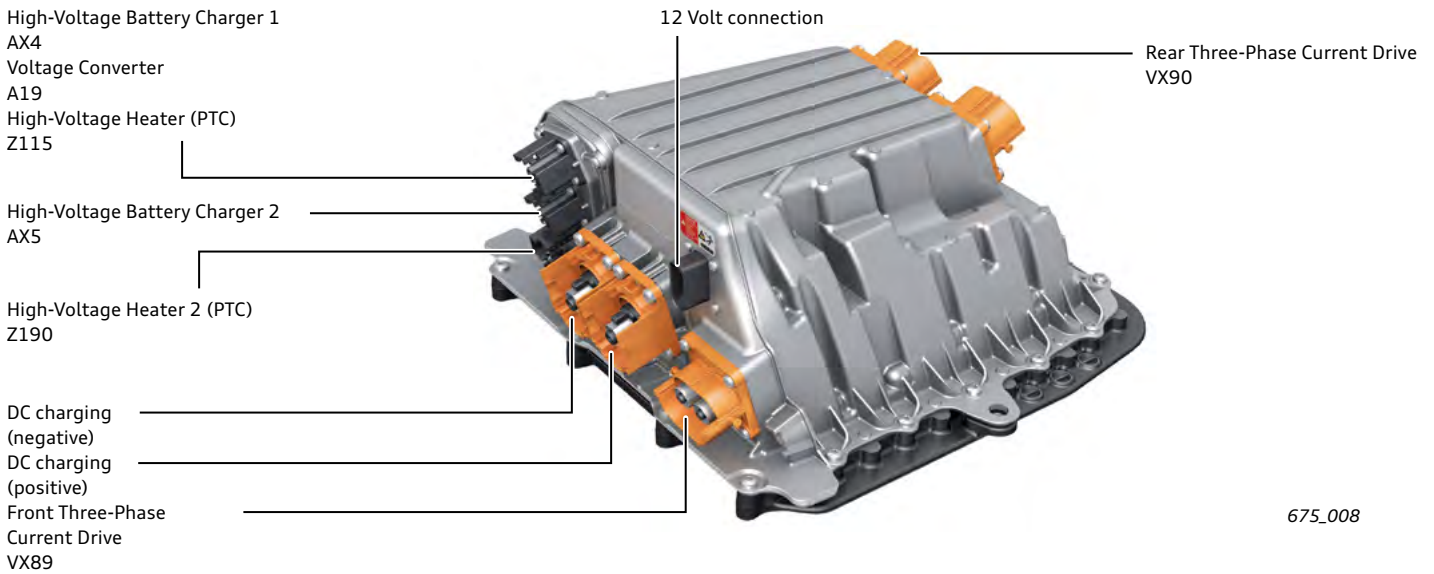
The battery is cooled by the coolant circuit. The battery modules release heat to the battery housing via heat conducting material. The coolant flows through a heat sink bonded to the battery housing with a heat conducting adhesive. High-Voltage Battery Coolant Temperature Sensor 1 G898 and High-Voltage Battery Coolant Temperature Sensor G899 measure the temperature of the

coolant before and after the high-voltage battery. The coolant in the high-voltage battery is circulated by High-Voltage Battery Coolant Pump V590. At low temperatures, the high-voltage battery can be heated up while charging via the high-voltage heaters (PTC).

High-Voltage Battery Control Module SX6

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.
- > High-Voltage Battery Voltage Sensor G848.
- > Protection for High-Voltage Battery Protection Resistor N662 (15 Ω).
- > High-Voltage Battery Power Output Protection 1 J1057 (HV positive).
- > High-Voltage Battery Power Output Protection 2 J1058 (HV negative).
- > High-Voltage Battery Pre-Load Protection J1044 (HV positive).
- > DC Current Charge Protection 1 J1052 (DC positive with fuse for charging current).
- > DC Current Charge Protection 2 J1053 (DC negative).
- > High-Voltage Battery Interrupt Igniter N563.
- > Connection for High-Voltage Battery Charger 1 AX4, High-Voltage Heater (PTC) Z115 and Voltage Converter A19.



675_008

When the ignition is switched on, High-Voltage Battery Power Output Protection 2 J1058 connects HV negative and High-Voltage Battery Pre-Load Protection 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 High-Voltage Battery Protection Resistor N662. As soon as the intermediate circuit capacitors in these components are charged, High-Voltage Battery Power Output Protection 1 J1057 (HV positive) is closed and High-Voltage Battery Pre-Load Protection J1044 (HV positive) is opened. High-Voltage Battery Control Module SX6 communicates with Battery Regulation Control Module 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.

High-Voltage Battery Interrupt Igniter N563

High-Voltage Battery Control Module SX6 is connected to Airbag Control Module J234 by a discrete wire. High-Voltage Battery Interrupt Igniter N563 is software which evaluates the crash signal

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

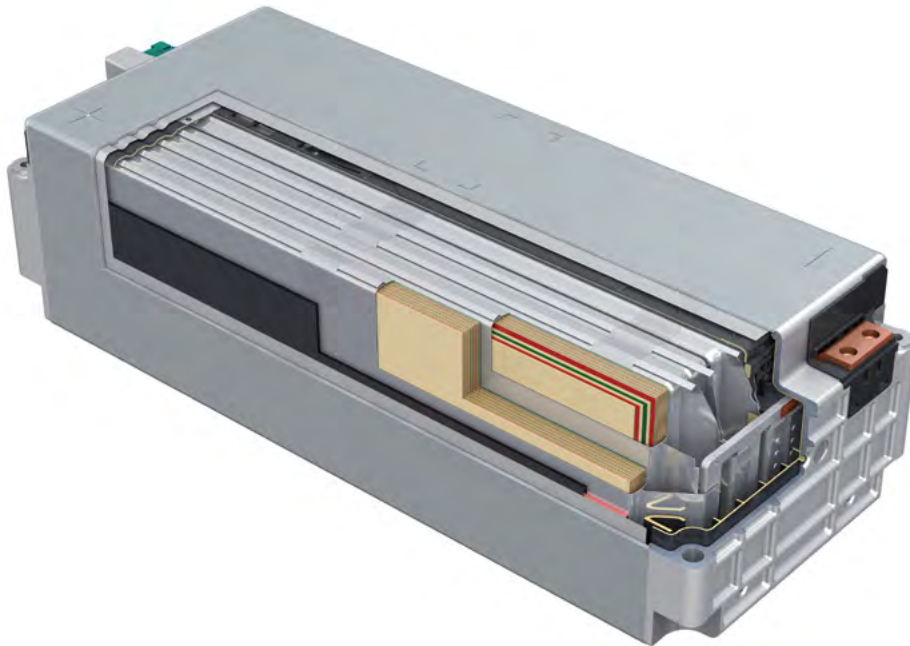
- > The ignition is switched off.
- > A crash signal is sent from Airbag Control Module J234 via a data bus.
- > A crash signal is sent from the Airbag Control Module J234 to High-Voltage Battery Interrupt Igniter N563 via a discrete wire.
- > The maintenance connector TW is opened.
- > The fuse for power supply to Terminal 30c of the power contactors is disconnected or faulty.

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.

Battery module

A battery module consists of 12 cells. Groups of four cells are connected in parallel, which creates a total capacity 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 module with an orange wire.



675_009



675_010

Module interconnections:

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

Connection in parallel

$$60 \text{ Ah} + 60 \text{ Ah} + 60 \text{ Ah} + 60 \text{ Ah} = 240 \text{ Ah}$$

Connection in series

$$3.67 \text{ V} + 3.67 \text{ V} + 3.67 \text{ V} = 11 \text{ V}$$



675_011

Battery Module Control Modules 1 - 12 (J1208 - J1219)

Three battery modules are connected to each individual Battery Module Control Module. There are a total of 12 Battery Module Control Modules in the e-tron.

Each Battery Module Control Module has the following functions:

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

They all communicate with Battery Regulation Control Module J840 and High-Voltage Battery Control Module SX6 via a sub CAN.

Battery Regulation Control Module J840

J840 is installed 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 High-Voltage Battery Control Module SX6.
- > Monitoring safety circuit 1.
- > Evaluating cell voltage and balancing.
- > High-voltage battery heating request to Thermal Management Control Module J1024.
- > Activating High-Voltage Battery Coolant Pump V590 according to specifications from Thermal Management Control Module J1024.
- > Triggering opening of power contacts in the event of a crash.

J840 communicates with High-Voltage Battery Control Module SX6 and Battery Module Control Module J1208 via a sub CAN. It is a hybrid CAN node.

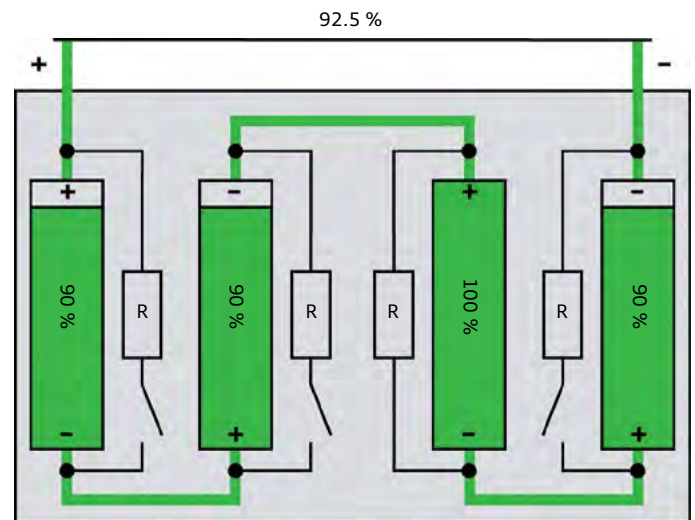


675_012

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 thus continue to be charged until all cells have reached the same charge level. This allows the high-voltage battery to achieve its maximum capacity.

To do this, Battery Regulation Control Module J840 compares the voltages of the cell groups. If cell groups have a high cell voltage, the Battery Module Control Module (J1208 - J1219) responsible receives the balancing information. Balancing is performed when voltage differences of greater than approximately 1% occur when the high-voltage battery is being charged. After the ignition has been switched off, J840 checks whether balancing is necessary and triggers it if required. Only the control modules 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, High-Voltage Battery Control Module SX6 runs an isolation test every 30 seconds. The isolation resistance between the high-voltage conductors and the housing of 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.

SX6 sends the isolation value to Battery Recognition Control Module J840 for evaluation. If a low isolation resistance is detected, J840 sends a message to Data Bus On Board Diagnostic Interface J533 via the hybrid CAN. J533 directs (via the instrument panel insert CAN) Instrument Cluster Control Module J285 to show a message to the driver in the display in the instrument cluster. 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

A19 is installed at the front right of the vehicle and is cooled in the coolant circuit.

It converts the DC voltage (396 Volt) of High-Voltage Battery 1 AX2 into the 12 Volt DC voltage of the vehicle's electrical system. This 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.

Voltage Converter A19 is connected to the high-voltage battery via a fuse in High-Voltage Battery Control Module 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 energized.

Voltage Converter A19 is connected to the body via a live potential equalization line.

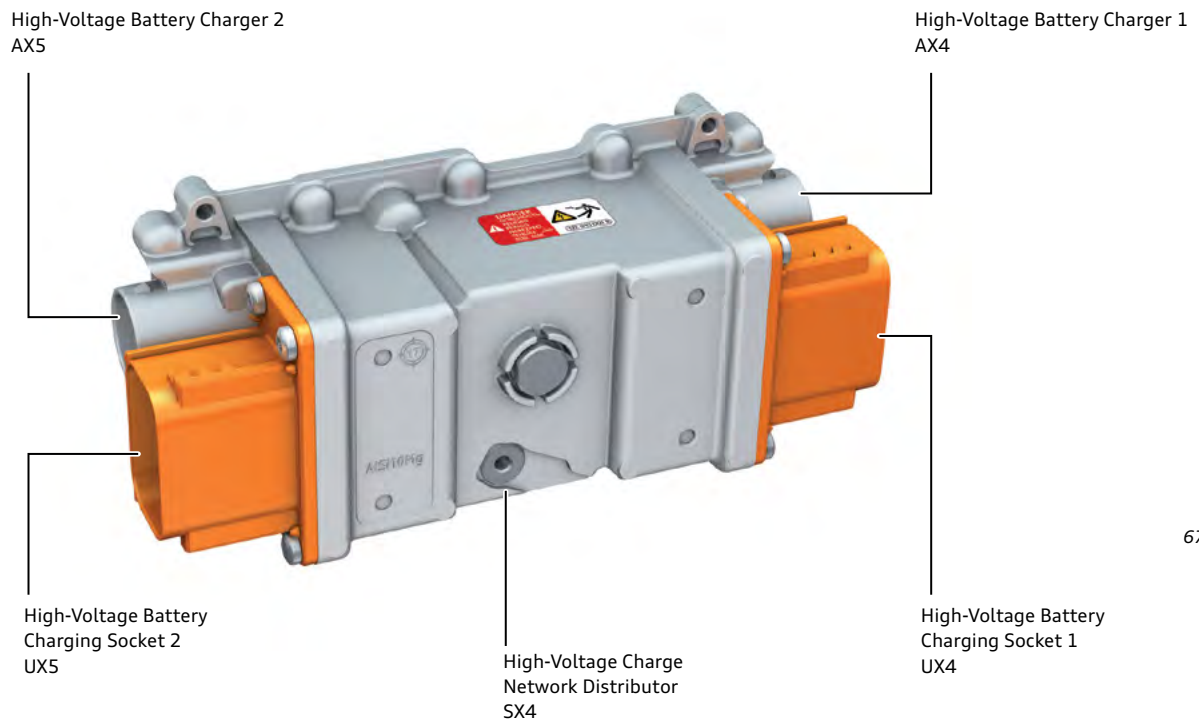
The intermediate circuit capacitor is discharged actively and passively.



675_015

High-Voltage Charge Network Distributor SX4

On vehicles with a second AC charging socket or a second charging unit for the high-voltage battery, the charging sockets and charging units are connected via High-Voltage Charge Network Distributor SX4.



675_014

High-Voltage Battery Charger 1 AX4

High-Voltage Battery Charger 2 AX5

The charging units are installed 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 19.2 kW.

Three rectifiers convert the AC voltage of the operating unit/charging station to DC voltage so that it can charge 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 High-Voltage Battery Control Module 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 equalization line. The intermediate circuit capacitor is discharged passively.

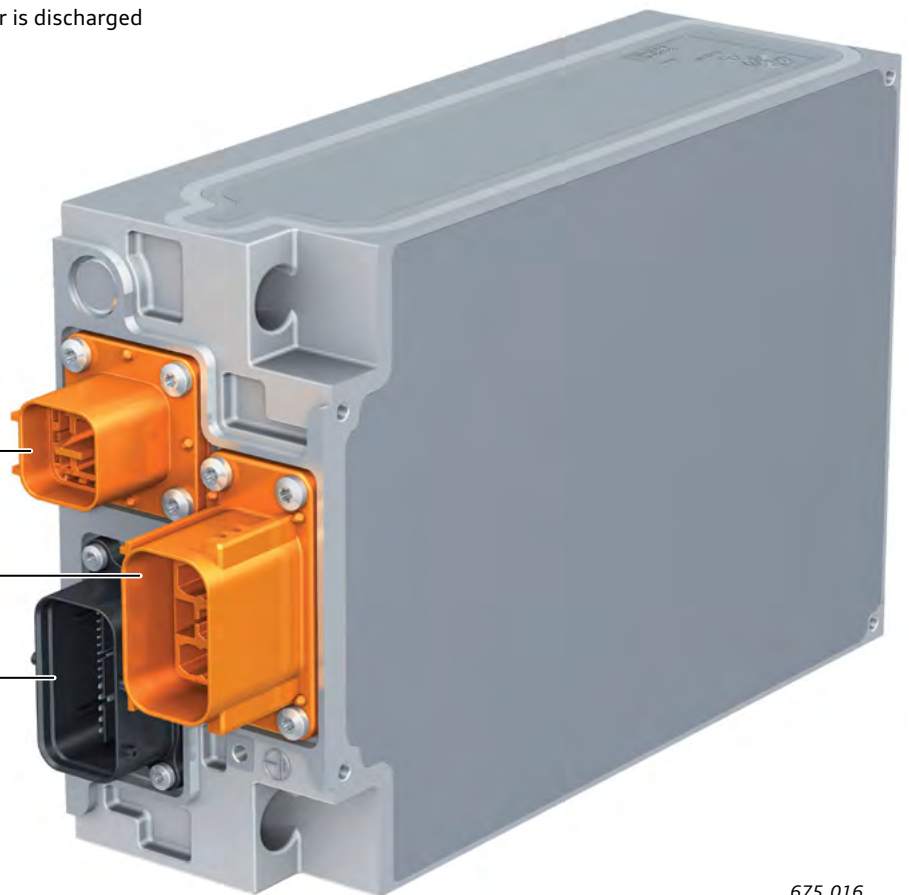
Components connected

- > High-Voltage Battery Charging Socket 1 UX4
- > High-Voltage Battery Charging Socket 2 UX5
- > Charging Socket 1 LED Module L263
- > Charging Socket 2 LED Module L264
- > High-Voltage Charging Connector Lock 1 Adjuster F498
- > High-Voltage Charging Connector Lock 2 Adjuster F499
- > Drive Unit for Charging Socket 1 Cover VX86
- > Drive Unit for Charging Socket 2 Cover VX87
- > Charging Socket Temperature Sensor 1 G853
- > Charging Socket Temperature Sensor 2 G854

Switching unit for High-Voltage
Battery Control Module
SX6

Charging
socket

12 Volt connection



675_016

Communication

High-Voltage Battery Charger Control Module J1050 and High-Voltage Battery Charger Control Module 2 J1239 are hybrid CAN nodes. J1050 is the master and 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.

The rectifiers are not active during DC charging. The timer settings for charging and climate control are stored in J1050.

Electrical A/C Compressor V470

V470 is installed at the front of the vehicle. It is supplied with high voltage via a fuse in High-Voltage Battery Control Module SX6.

The integrated A/C Compressor Control Module J842 is connected to Thermal Management Control Module J1024 via a LIN bus. The air conditioner compressor is connected to the body via a live potential equalization 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 energized.

The timer settings for charging and air conditioning are stored in High-Voltage Battery Charger Control Module J1050.



675.017

High-Voltage Heater (PTC) Z115

High-Voltage Heater 2 (PTC) Z190

The high-voltage heaters are installed at the front of the vehicle and are supplied with high voltage via a fuse in High-Voltage Battery Control Module SX6. They heat up the coolant so that it can warm up the vehicle interior and the high-voltage battery. The integrated High-Voltage Heater (PTC) Control Module J848 and High-Voltage Heater 2 (PTC) Control Module J1238 are connected to Thermal Management Control Module J1024 via a LIN bus.

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

Note:

When the auxiliary climate control is active, the high-voltage system is active and the high-voltage components are energized.

The timer settings for charging and climate control are stored in High-Voltage Battery Charger Control Module J1050.

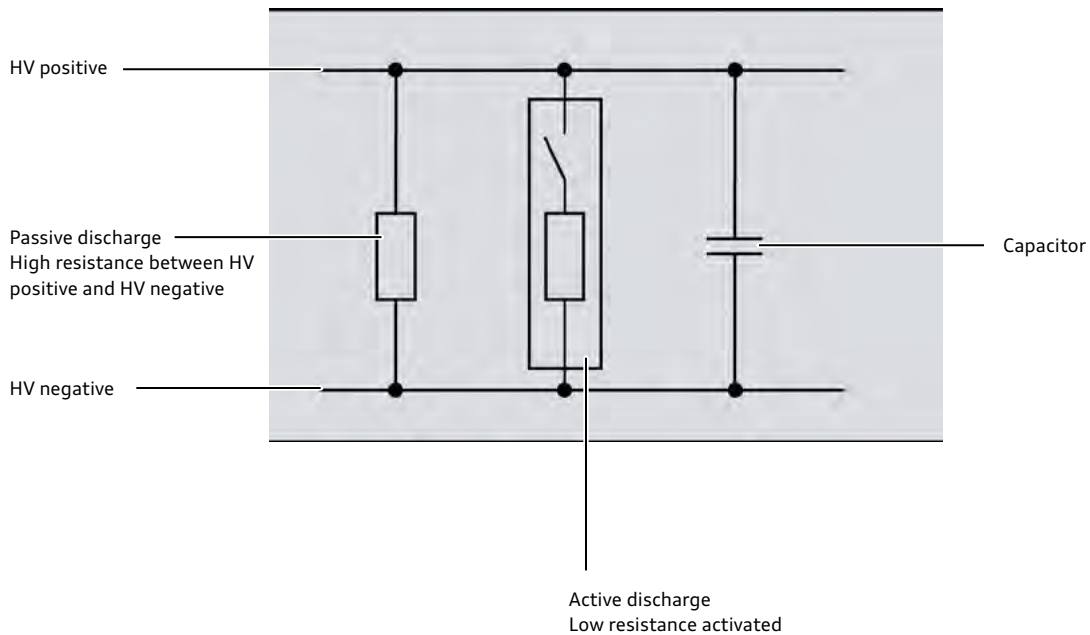


675.018

Intermediate circuit capacitors

A capacitor (serving as energy storage) and a voltage stabilizer may be installed 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.



675_019

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
High-Voltage Battery Chargers 1 and 2 AX4 and AX5	X	
Electrical A/C Compressor V470	X	



Note

A capacitor is installed in some high-voltage components to store power. It must be discharged when the system is de-energized. You should therefore always de-energize the system according to the Test Plan using the VAS Scan Tool because it takes into account the capacitor discharge times. The high-voltage system must only be de-energized and worked on by qualified personnel.

Crash signal

In the event of a crash, Airbag Control Module J234 sends a signal to Battery Regulation Control Module J840 via the hybrid CAN and to High-Voltage Battery Interrupt Igniter N563 in High-Voltage Battery Control Module SX6 via a discrete wire. The power contacts are opened and the high-voltage system is deactivated.

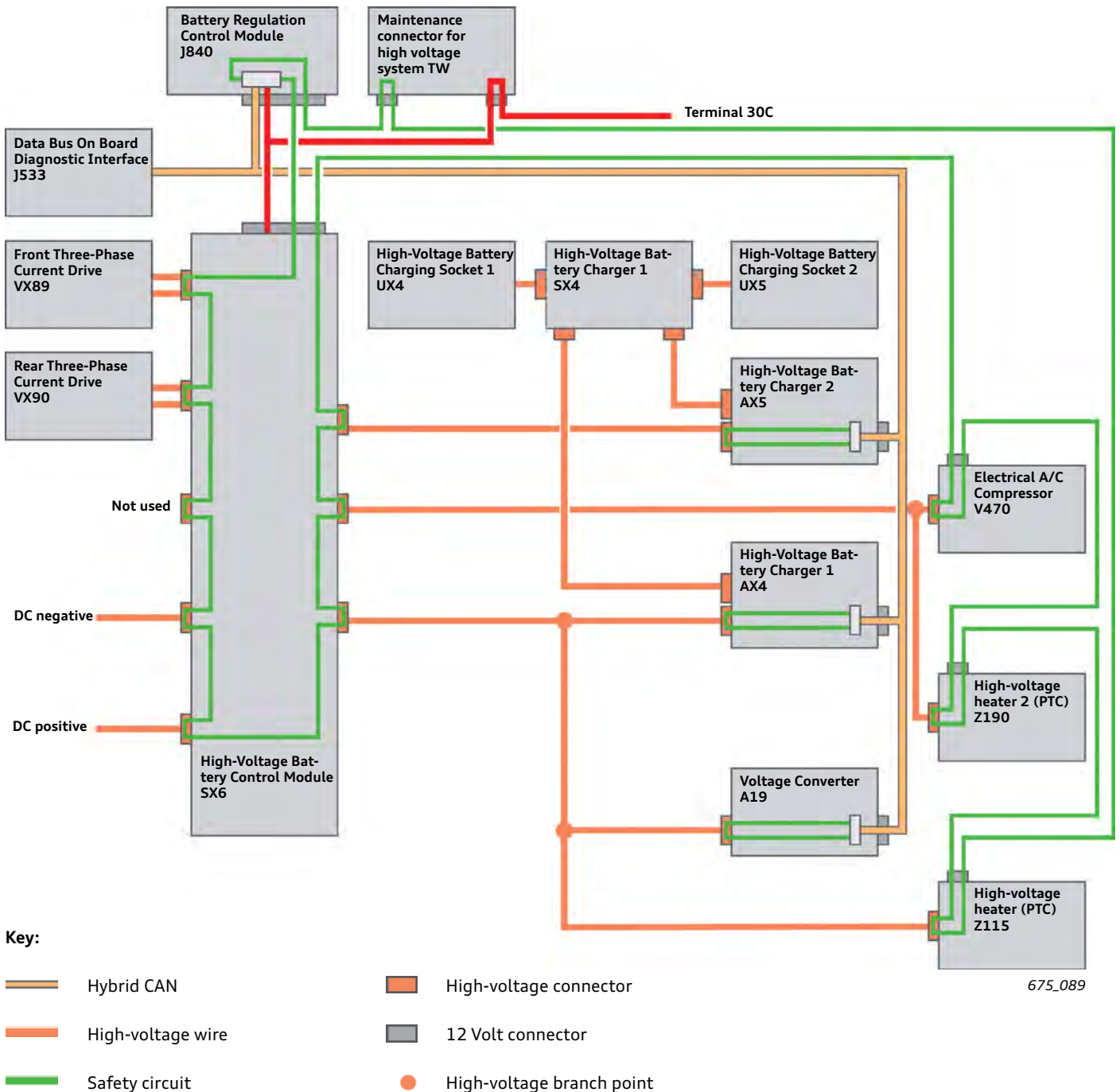
Safety circuit

The vehicle has four safety circuits.

- > Safety circuit 1 passes through Battery Regulation Control Module J840, Electrical A/C Compressor V470, High-Voltage Heater 2 (PTC) Z190, High-Voltage Heater (PTC) Z115, maintenance connector TW and High-Voltage Battery Control Module SX6.
- > Safety circuit 2 is within Voltage Converter A19.
- > Safety circuit 3 is in High-Voltage Battery Charger 1 AX4.
- > Safety circuit 4 is in High-Voltage Battery Charger 2 AX5.

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 VAS Scan Tool.

These safety circuits are 12 Volt looped lines which pass through the high-voltage components. Battery Regulation Control Module J840, Voltage Converter A19, High-Voltage Battery Charger Units 1 and 2 (AX4 and AX5) report their status to Data Bus On Board Diagnostic Interface J533. If a safety circuit is interrupted, for example, when a connector is unplugged, J533 receives a message via the dash panel insert CAN from the control module affected and Instrument Cluster Control Module J285 is instructed to display a message to the driver. It is possible to continue driving until the ignition is switched off. It is not possible to reactivate the drive system.



Maintenance connector TW

Maintenance connector TW is located in the front left air plenum chamber. 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-energize the high-voltage system. You must use the relevant Test Plan to properly de-energize the high-voltage system. After being opened, the maintenance connector TW is secured from being switched back on by padlock T40262/1.



675_020

An information label is attached to maintenance connector TW.



675_021

Follow note on rescue card

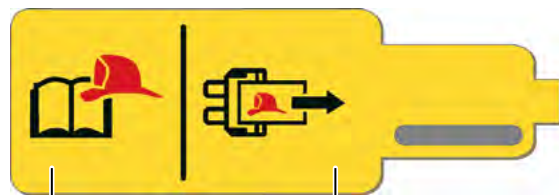
Unplug connector

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



675_023

Follow note on rescue card

Removing a fuse

Charging sockets on the vehicle

The charging socket for 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. 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 High-Voltage Battery Charger 1 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.

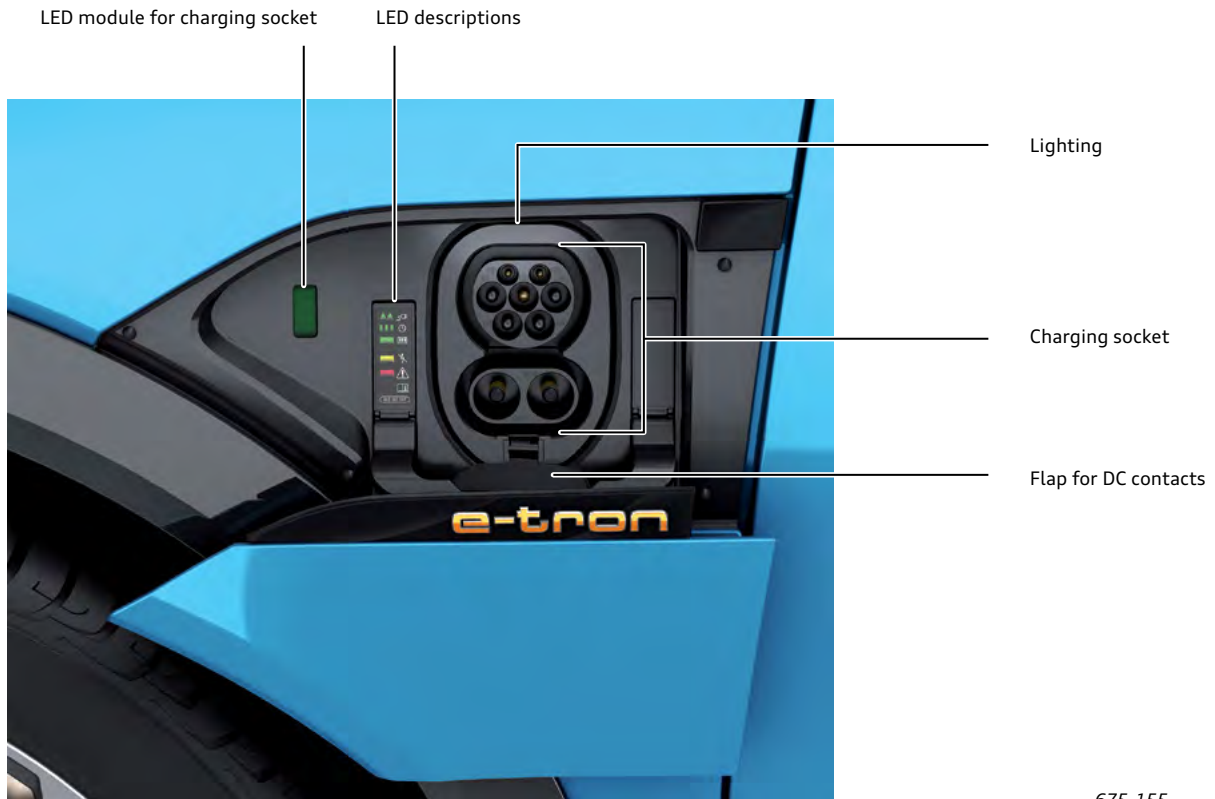


Note

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

The charging socket, the LED module and a description of the LED are located under the cover. They are lit 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).



675_155

		USA
Type 1	○	PS
CCS 1	●	DS

Key

- Standard
- Optional
- DS Driver side
- PS Passenger side

The table shows the allocation of charging sockets.



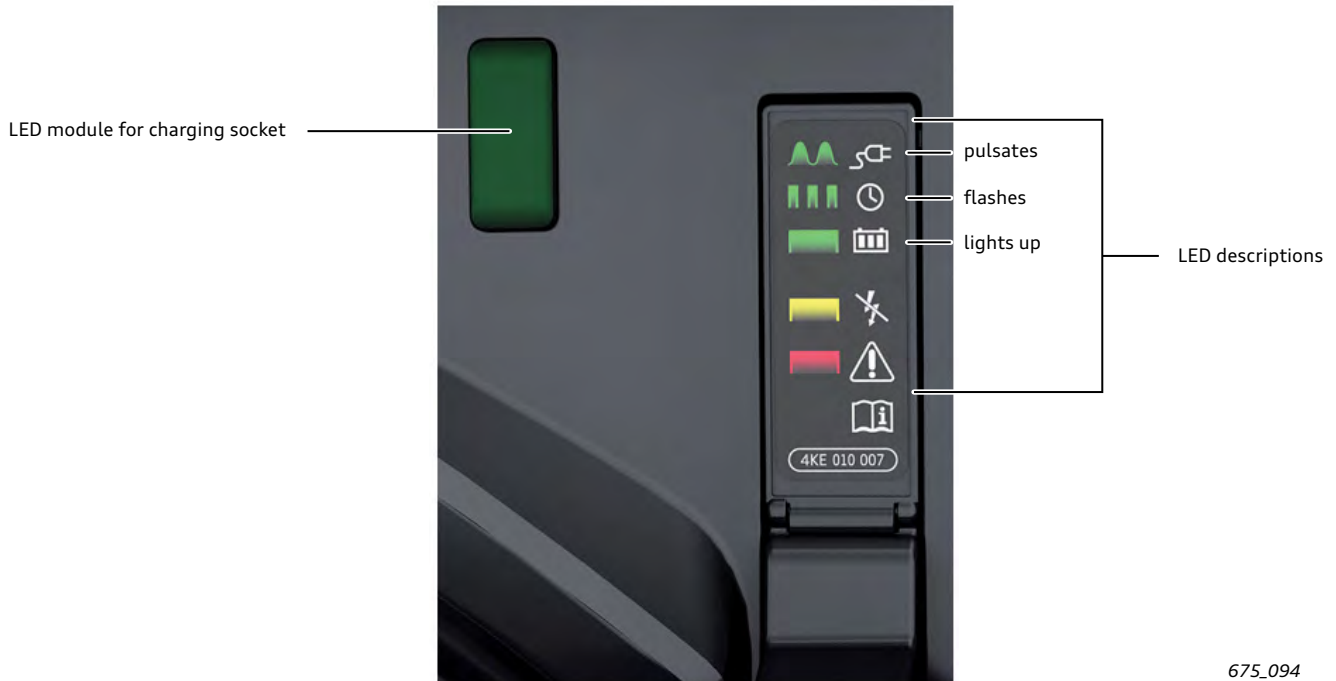
Note

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 colors and light modes.

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



675_094

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 114.
	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.

High-Voltage Battery Charger 1 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.

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 AX4 takes place via contacts CP and PE.



675_098

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 AX4 takes place via contacts CP and PE.



675_099

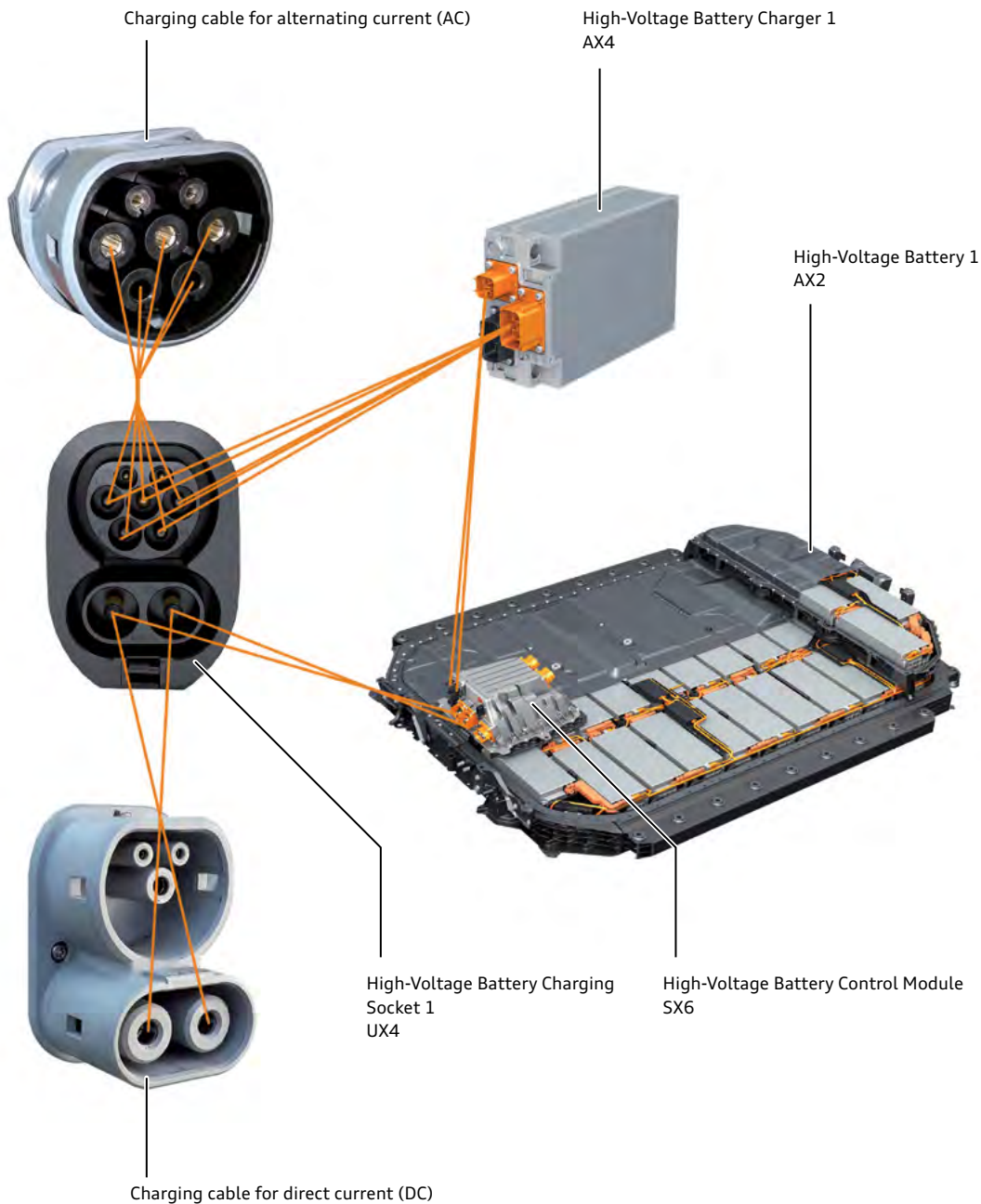
Charging the high-voltage battery

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 energized.

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 Battery Regulation Control Module J840. The voltage and the current rating are continually adjusted during charging.

The charging performance is 9.6 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 ground via the PE contact. PP is then contacted and the charging unit detects the connector via a resistor¹⁾ 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. Battery Regulation Control Module 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.

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 Battery Regulation Control Module 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 ground via the PE contact. PP is then contacted and the charging unit detects the connector via a resistor²⁾ 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.

Battery Regulation Control Module 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.

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

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 Battery Regulation Control Module J840 takes place via High-Voltage Battery Charger Control Module J1050.

Connector locking methods:

Charging connector locks	Type 1	CCS 1
automatically		
by hand	X	X

Connector communication methods:

Communication	Type 1	CCS 1
PWM via CP	X	
PLC via CP		X
CAN bus		

Immediate charging

If no charging timer is active, charging starts immediately.

Data Bus On Board Diagnostic Interface J533

J533 monitors the high-voltage system.

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.

It is responsible for controlling the following functions:

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.

- > Monitoring the safety circuits.
- > Monitoring the isolation value.
- > Authorizing closure of the charge and power contactors in the high-voltage battery.
- > Displaying system messages via Instrument Cluster Control Module J285.

External sound

When traveling 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 installed in the vehicle for this purpose:

- > Engine Sound Generator Control Module J943
- > Engine Sound Generator Actuator 1 R257

Engine Sound Generator Control Module J943



Engine Sound Generator Actuator 1 R257



675_126

J943 activates Engine Sound Generator Actuator 1 R257. It is a node of the extended CAN and evaluates the following information to produce the sound:

- > Speed
- > Load torque

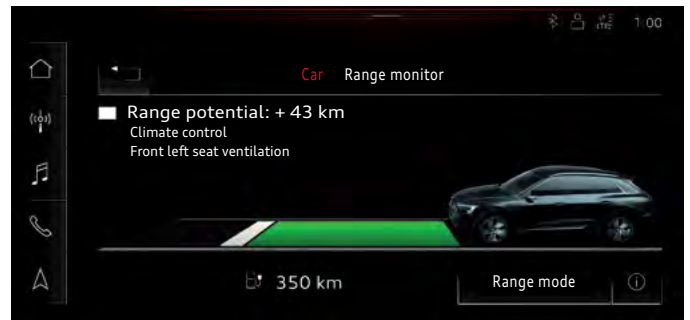
During electric driving, the actuator generates a noise which is reduced at speeds of 18.6 mph (30 km/h) and above.

If the vehicle is stationary or traveling at speeds of approximately 31 mph (50 km/h) or more, 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.



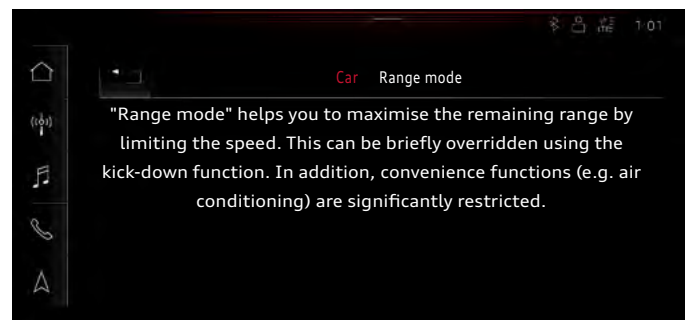
675_139

If the driver activates range mode, these functions are switched off, the display is reduced to 0.0 mi (0.0 km) and the range increases.



675_141

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



675_140

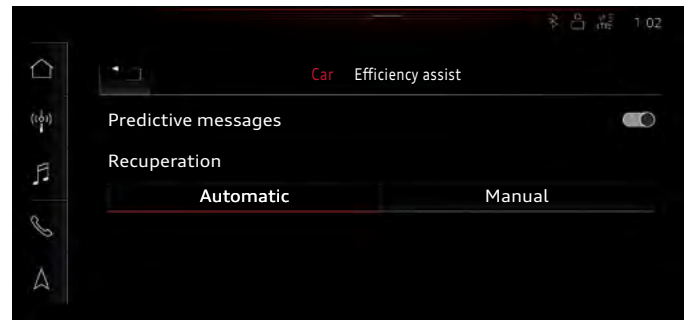
The speed is limited to 55.9 mph (90 km/h). This limit can be exceeded at any time using the kickdown function. A range mode notification appears on the lower touch display.



675_142

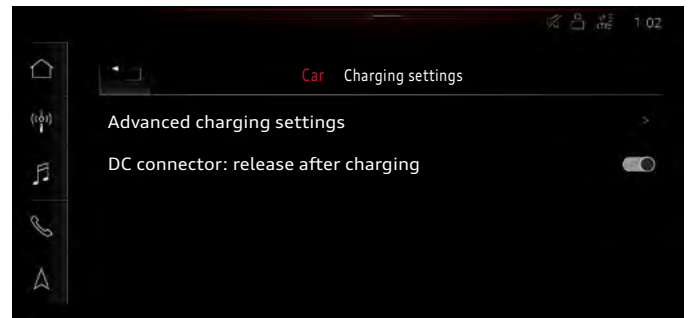
Charging settings

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



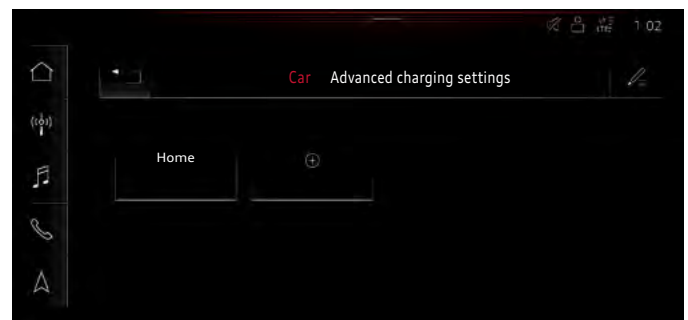
675_143

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



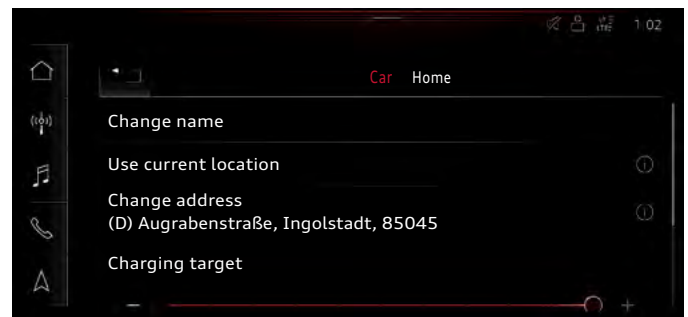
675_144

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.

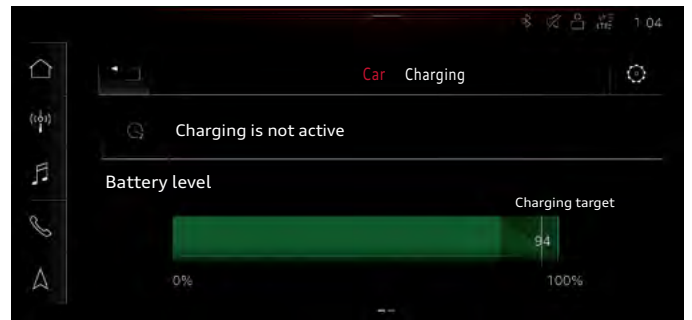
If the minimum charge level option is activated, the high-voltage battery is charged to 25% regardless of the settings for the timer or preferred charging time.



675_147

Battery level and timer display

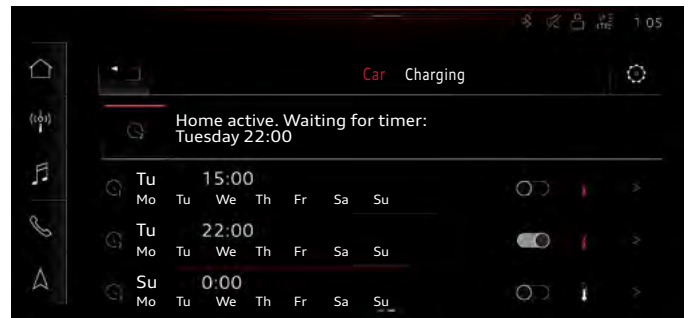
The current high-voltage battery charge level and the charging status are shown in the Car menu > Charging & efficiency > Charging. A charging target for the high-voltage battery of between 50 % and 100 % can be set for the charging procedure.



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

Climate control of the vehicle interior can also be activated in the timer function.



675_150

Audi e-tron charging system (compact)

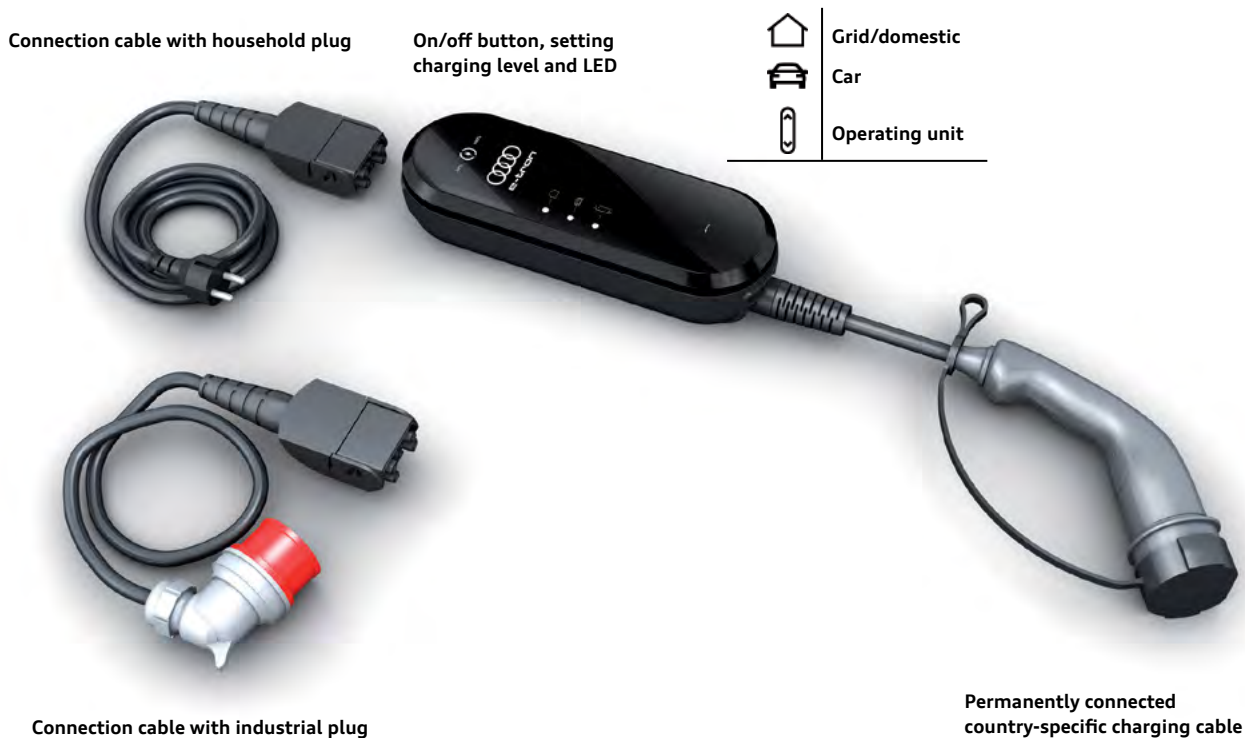
High-Voltage Charging System Control Head E943

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 so 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 a 240V "Level 2" circuit socket are also provided for connection to the AC power supply. Communication with High-Voltage Battery Charger 1 AX4 takes place via contacts CP and PE using a PWM signal or PLC signal.



Maximum charging level if connected to AC power:

675_127

- > Household socket 0.8 kW (8 A)
- > 240V "Level 2" circuit socket¹⁾ 9.6 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 a 240V "Level 2" circuit 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 installed 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 VAS Scan Tool and special tool VAS 611 009.



Climate control and thermal management

Thermal management

From a thermodynamic perspective, thermal management refers to the control of energy flows; heat flows in particular. From an automotive perspective, it refers to the energy-related optimization of the vehicle's thermal efficiency. The aim of thermal management in an electric vehicle is to reduce power consumption and increase the range. In addition, temperature control of electric components such as the high-voltage battery, charging units, electric motors and their supply 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.

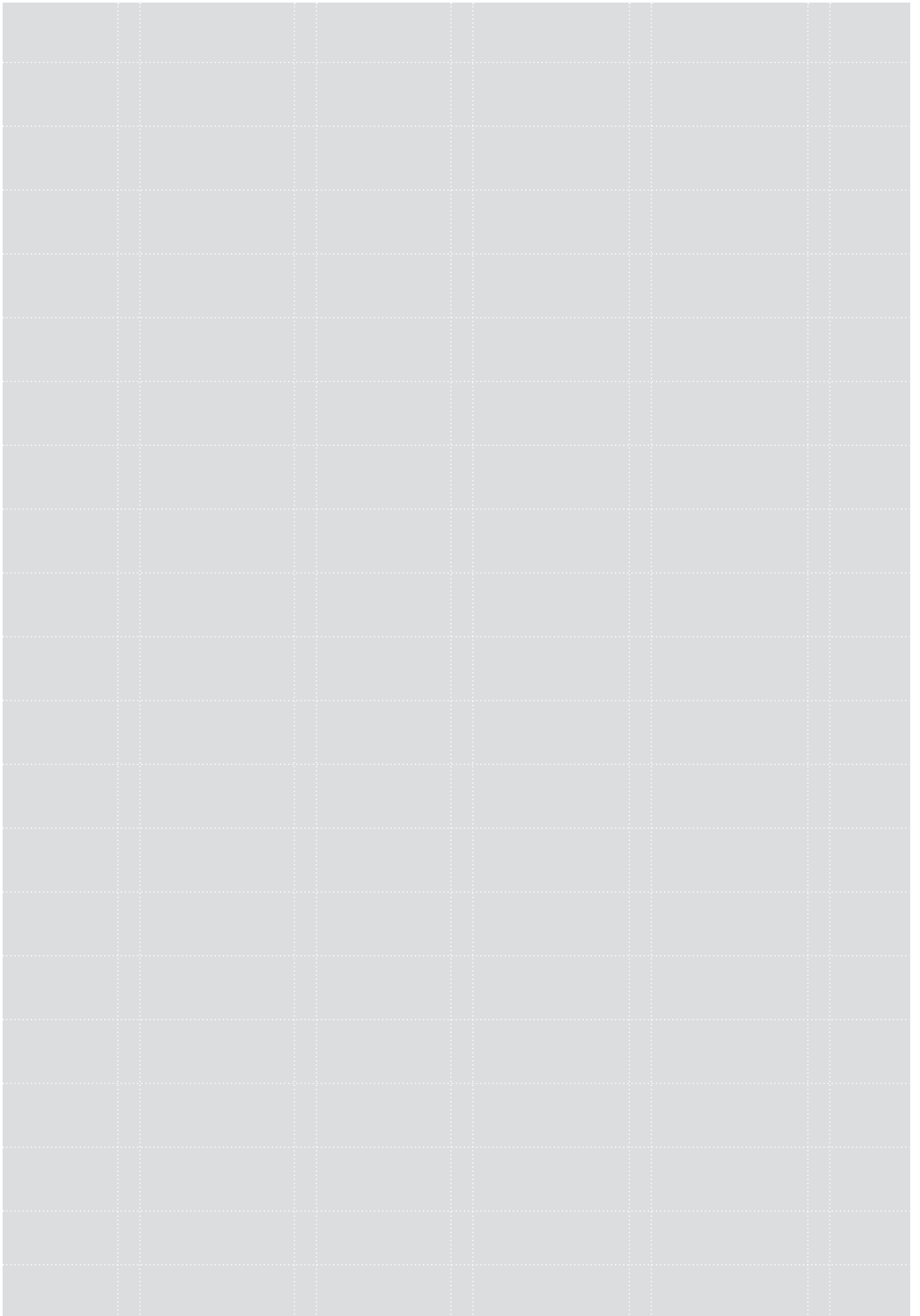
The thermal management system should, for example, keep the high-voltage battery within its optimum efficiency range of approximately 77 ° to 95° F (25° to 35° C) in all situations. This can mean operating conditions ranging from cold starts in the winter months to driving fast on the highway on hot summer days.

The thermal management system on the Audi e-tron consists of four circuits that can be interconnected in different ways, 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 (Climate control and thermal management).

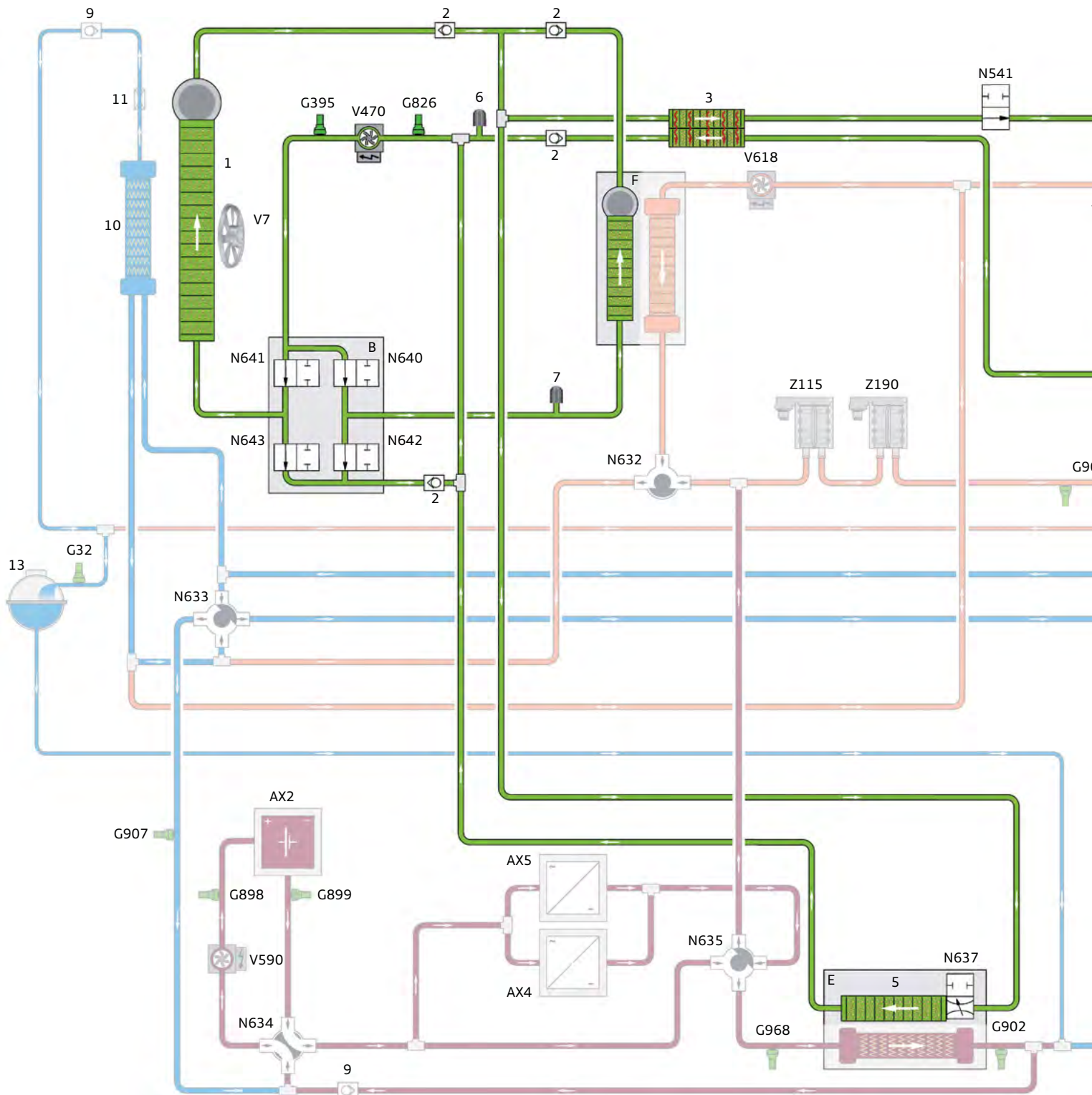
Notes



Refrigerant circuit

There are two branches of the refrigerant circuit: one for interior climate control and one for high-voltage battery cooling via the heat exchanger for high-voltage battery (E). The components of the interior climate control system (beginning with the refrigerant circuit) can also be seen using the key of the following diagram:

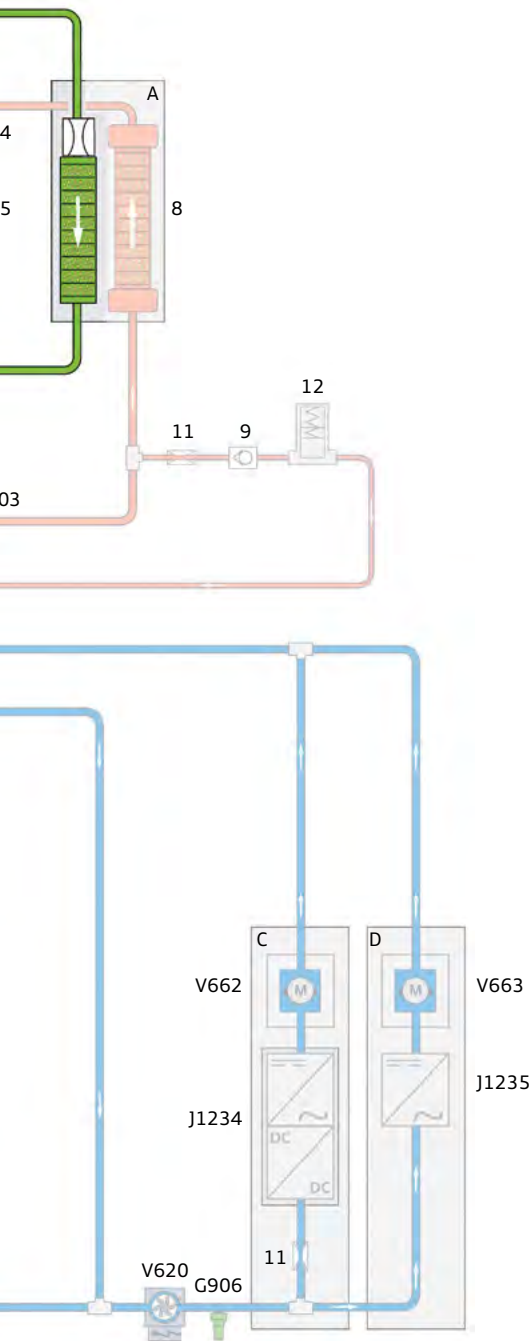
Electrical A/C Compressor V470, A/C Pressure/Temperature Sensor 1 G395, A/C Pressure/Temperature Sensor 2 G826, valve block (B), condenser (1) in addition to non-return valve for refrigerant circuit (2), internal heat exchanger (3) and heater and climate control unit (A), where its pressure is dissipated 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.



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

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 refrigerant reaches the chiller (E), is expanded in 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 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 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 1

- AX4** High-Voltage Battery Charger 1
- AX5** High-Voltage Battery Charger 2

- G32** Engine Coolant Level Sensor
- G395** A/C Pressure/Temperature Sensor 1
- G826** A/C Pressure/Temperature Sensor 2
- G898** High-Voltage Battery Coolant Temperature Sensor 1
- G899** High-Voltage Battery Coolant Temperature Sensor 2
- G902** Thermal Management Coolant Temperature Sensor 1
- G903** Thermal Management Coolant Temperature Sensor 2
- G906** Thermal Management Coolant Temperature Sensor 5
- G907** Thermal Management Coolant Temperature Sensor 6
- G968** Thermal Management Coolant Temperature Sensor 8

- N541** Heater and A/C Unit Refrigerant Shut-Off Valve
- N632** Coolant Change-Over Valve 1
- N633** Coolant Change-Over Valve 2
- N634** Coolant Change-Over Valve 3
- N635** Coolant Change-Over 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 Module on Front Axle
- J1235** Electric Drive Control Module on Rear Axle

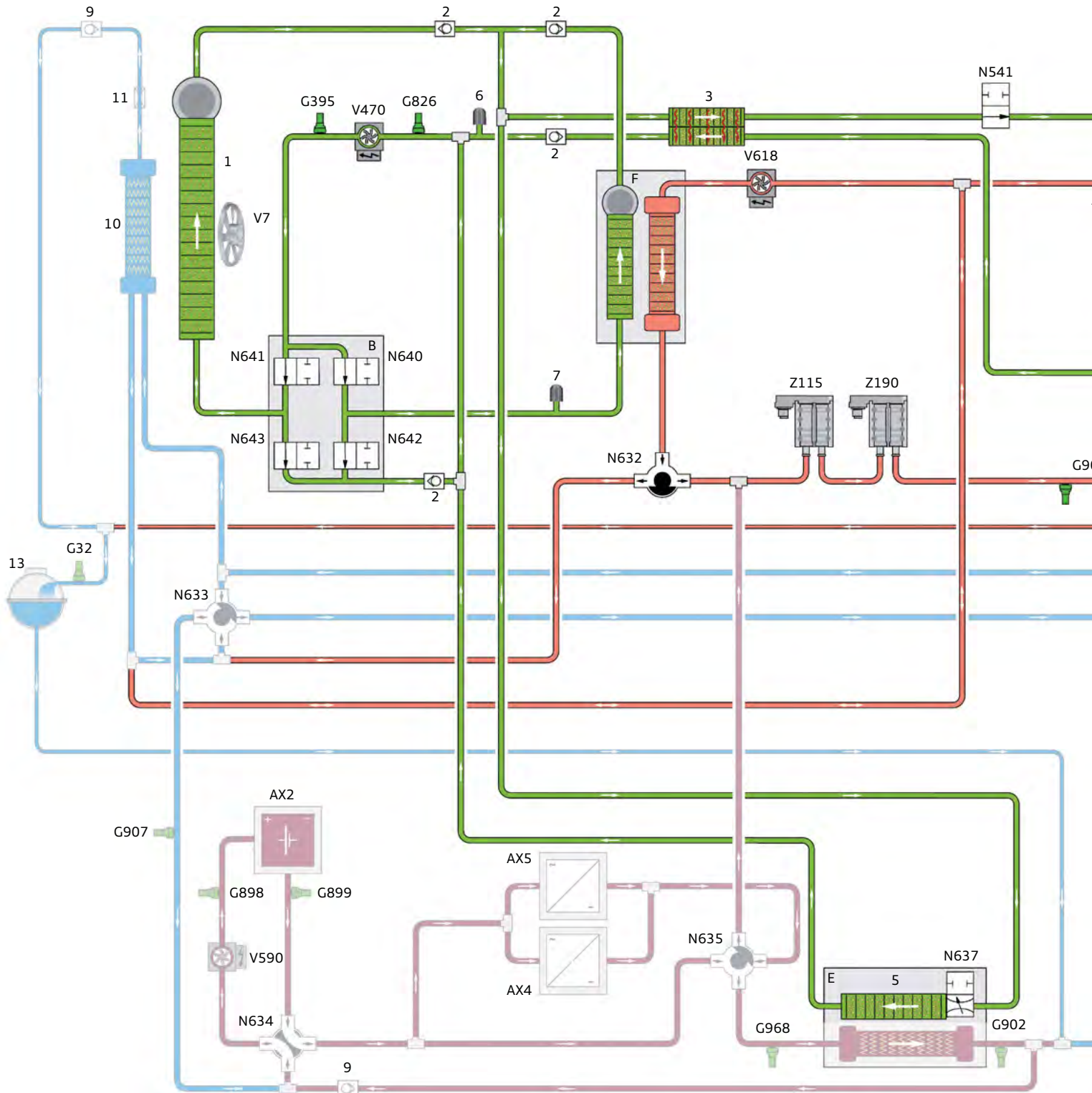
- V7** Radiator Fan
- V470** Electrical A/C Compressor
- V590** High-Voltage Battery Coolant Pump
- V618** Thermal Management Coolant Pump 2
- V620** Thermal Management Coolant Pump 4
- V662** Front Axle Electric Drive Motor
- V663** Rear Axle Electric Drive Motor

- Z115** High-Voltage Heater (PTC)
- Z190** High-Voltage Heater 2 (PTC)

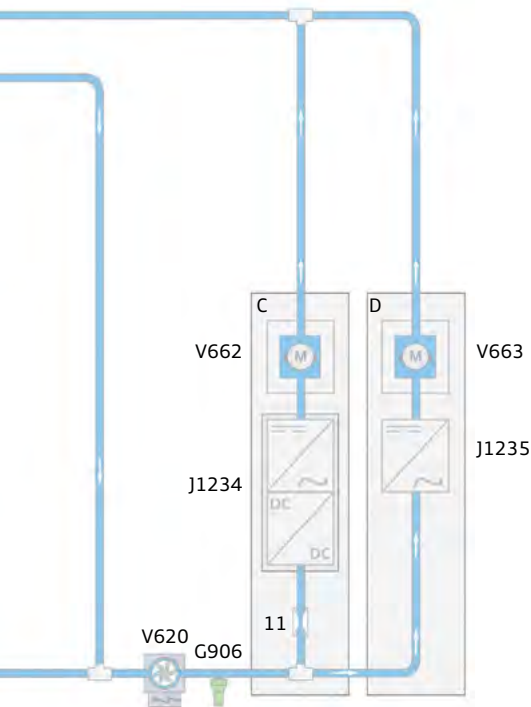
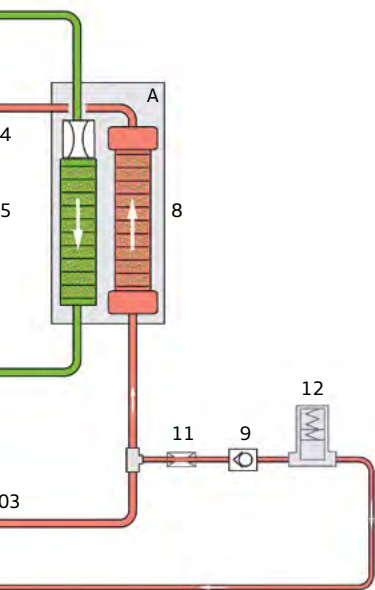
Refrigerant circuit and heating circuit

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. High-Voltage Heater (PTC) Z115 (High-Voltage Heater 2 (PTC) Z190 arranged in series is available optionally) heats up the coolant flowing through, which, via Thermal Management Coolant Temperature Sensor 2 G903, reaches the heat exchanger (8) where it provides heat to the interior.

The warmed up coolant is transported by Thermal Management Coolant Pump 2 V618 and flows through the heat exchanger for heat pump operation with condenser (F). Coolant Change-Over 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 1

AX4 High-Voltage Battery Charger 1

AX5 High-Voltage Battery Charger 2

G32 Engine Coolant Level Sensor

G395 A/C Pressure/Temperature Sensor 1

G826 A/C Pressure/Temperature Sensor 2

G898 High-Voltage Battery Coolant Temperature Sensor 1

G899 High-Voltage Battery Coolant Temperature Sensor 2

G902 Thermal Management Coolant Temperature Sensor 1

G903 Thermal Management Coolant Temperature Sensor 2

G906 Thermal Management Coolant Temperature Sensor 5

G907 Thermal Management Coolant Temperature Sensor 6

G968 Thermal Management Coolant Temperature Sensor 8

N541 Heater and A/C Unit Refrigerant Shut-Off Valve

N632 Coolant Change-Over Valve 1

N633 Coolant Change-Over Valve 2

N634 Coolant Change-Over Valve 3

N635 Coolant Change-Over 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 Module on Front Axle

J1235 Electric Drive Control Module on Rear Axle

V7 Radiator Fan

V470 Electrical A/C Compressor

V590 High-Voltage Battery Coolant Pump

V618 Thermal Management Coolant Pump 2

V620 Thermal Management Coolant Pump 4

V662 Front Axle Electric Drive Motor

V663 Rear Axle Electric Drive Motor

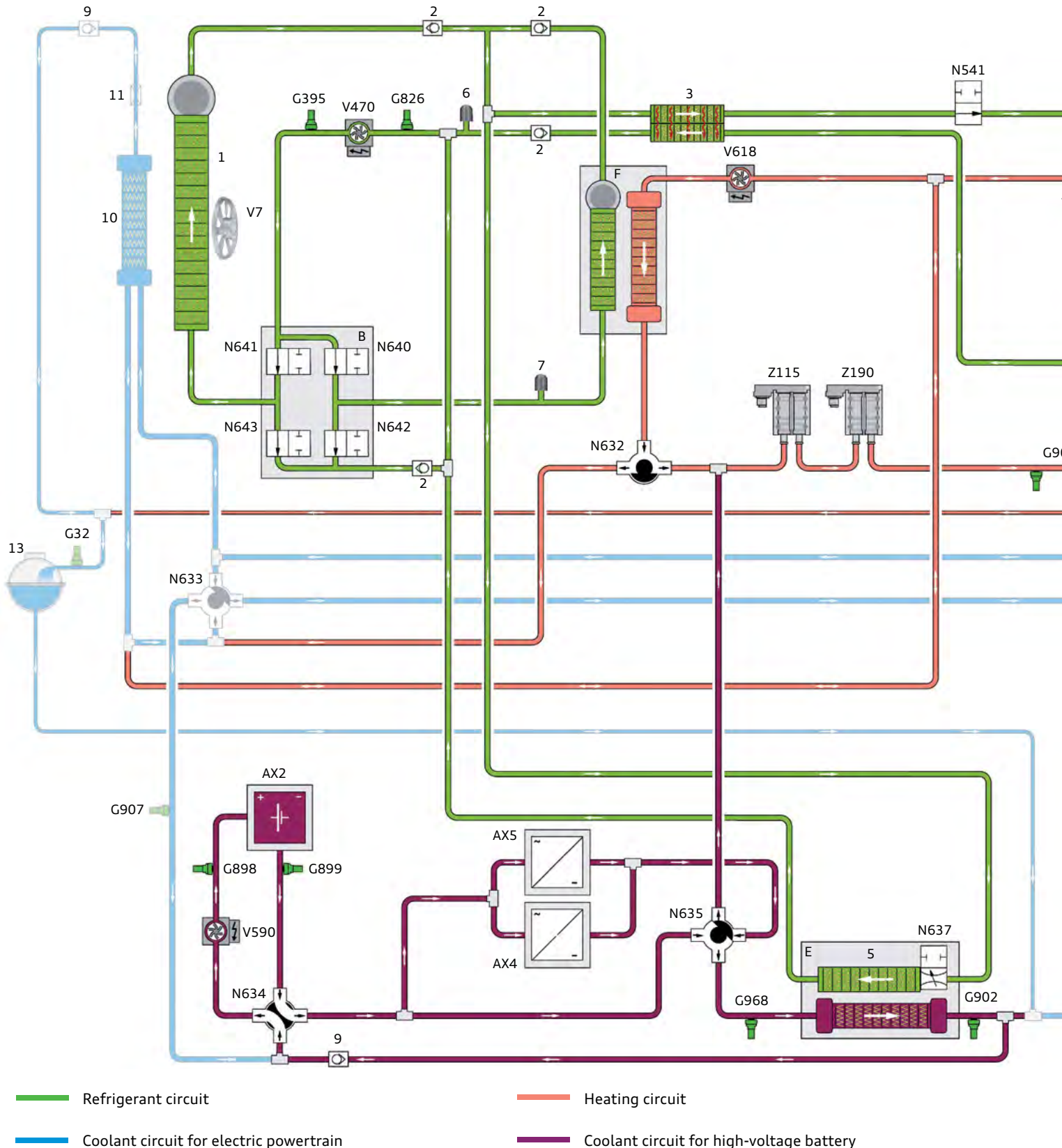
Z115 High-Voltage Heater (PTC)

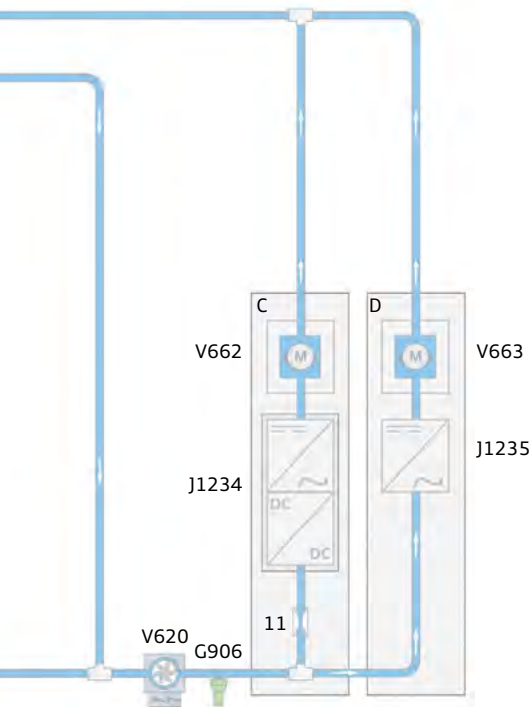
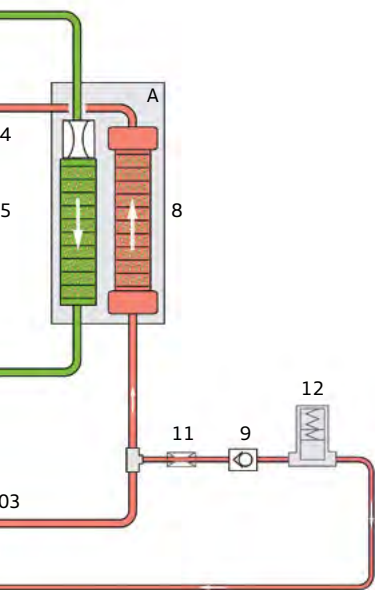
Z190 High-Voltage Heater 2 (PTC)

Refrigerant, heating and coolant circuits for high voltage battery

The coolant circuit for the high voltage battery cools High-Voltage Battery 1 AX2 and High-Voltage Battery Chargers 1 and 2 AX4 and AX5. The high-voltage battery can be cooled both passively via the low-temperature radiator and actively via the refrigerant circuit using the chiller. 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 G12 evo. This is a mix of 40% coolant additive and 60% distilled water, or 50% coolant additive and 50% distilled water.





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 1
- AX4** High-Voltage Battery Charger 1
- AX5** High-Voltage Battery Charger 2

- G32** Engine Coolant Level Sensor
- G395** A/C Pressure/Temperature Sensor 1
- G826** A/C Pressure/Temperature Sensor 2
- G898** High-Voltage Battery Coolant Temperature Sensor 1
- G899** High-Voltage Battery Coolant Temperature Sensor 2
- G902** Thermal Management Coolant Temperature Sensor 1
- G903** Thermal Management Coolant Temperature Sensor 2
- G906** Thermal Management Coolant Temperature Sensor 5
- G907** Thermal Management Coolant Temperature Sensor 6
- G968** Thermal Management Coolant Temperature Sensor 8

- N541** Heater and A/C Unit Refrigerant Shut-Off Valve
- N632** Coolant Change-Over Valve 1
- N633** Coolant Change-Over Valve 2
- N634** Coolant Change-Over Valve 3
- N635** Coolant Change-Over 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 Module on Front Axle
- J1235** Electric Drive Control Module on Rear Axle

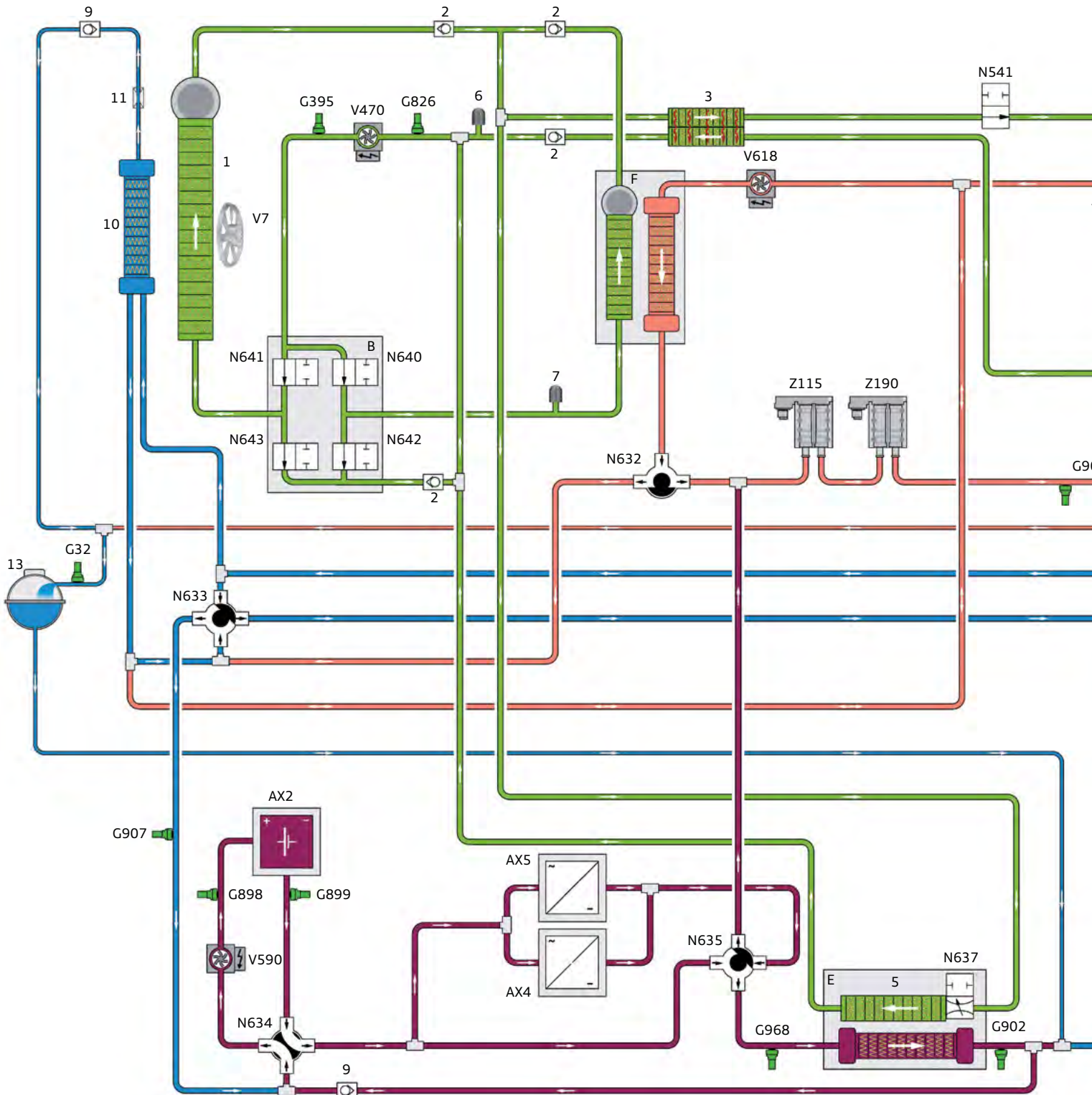
- V7** Radiator Fan
- V470** Electrical A/C Compressor
- V590** High-Voltage Battery Coolant Pump
- V618** Thermal Management Coolant Pump 2
- V620** Thermal Management Coolant Pump 4
- V662** Front Axle Electric Drive Motor
- V663** Rear Axle Electric Drive Motor

- Z115** High-Voltage Heater (PTC)
- Z190** High-Voltage Heater 2 (PTC)

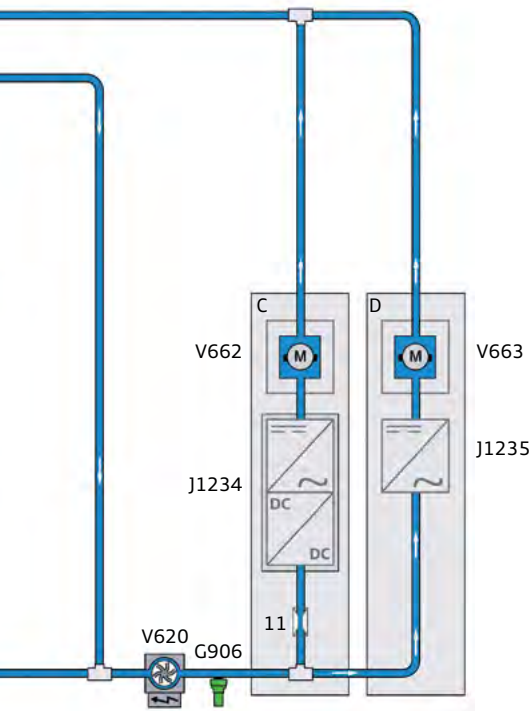
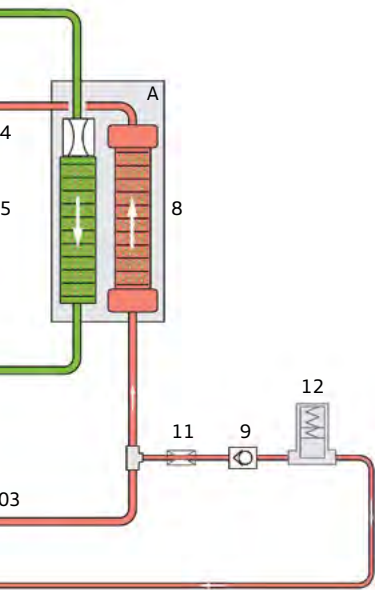
Refrigerant circuit, heating circuit, coolant circuit for high-voltage battery and coolant circuit for electric powertrain

Thermal Management Coolant Pump V620 transports the coolant flow via Front and Rear Electric Drive Control Modules J1234 and J1235 and Front and Rear Axle Drive Motors V662 and V663. From here, the coolant reaches the low-temperature radiator (10) with Radiator Fan V7.

A breather line goes from the radiator into the expansion tank with Engine Coolant Level Sensor G32. After flowing through the low-temperature radiator, the coolant is taken back to Thermal Management Coolant Pump 4 V620 via Coolant Change-Over 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 1

- AX4** High-Voltage Battery Charger 1
- AX5** High-Voltage Battery Charger 2

- G32** Engine Coolant Level Sensor
- G395** A/C Pressure/Temperature Sensor 1
- G826** A/C Pressure/Temperature Sensor 2
- G898** High-Voltage Battery Coolant Temperature Sensor 1
- G899** High-Voltage Battery Coolant Temperature Sensor 2
- G902** Thermal Management Coolant Temperature Sensor 1
- G903** Thermal Management Coolant Temperature Sensor 2
- G906** Thermal Management Coolant Temperature Sensor 5
- G907** Thermal Management Coolant Temperature Sensor 6
- G968** Thermal Management Coolant Temperature Sensor 8

- N541** Heater and A/C Unit Refrigerant Shut-Off Valve
- N632** Coolant Change-Over Valve 1
- N633** Coolant Change-Over Valve 2
- N634** Coolant Change-Over Valve 3
- N635** Coolant Change-Over 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 Module on Front Axle
- J1235** Electric Drive Control Module on Rear Axle

- V7** Radiator Fan
- V470** Electrical A/C Compressor
- V590** High-Voltage Battery Coolant Pump
- V618** Thermal Management Coolant Pump 2
- V620** Thermal Management Coolant Pump 4
- V662** Front Axle Electric Drive Motor
- V663** Rear Axle Electric Drive Motor

- Z115** High-Voltage Heater (PTC)
- Z190** High-Voltage Heater 2 (PTC)

Thermal management system scenarios

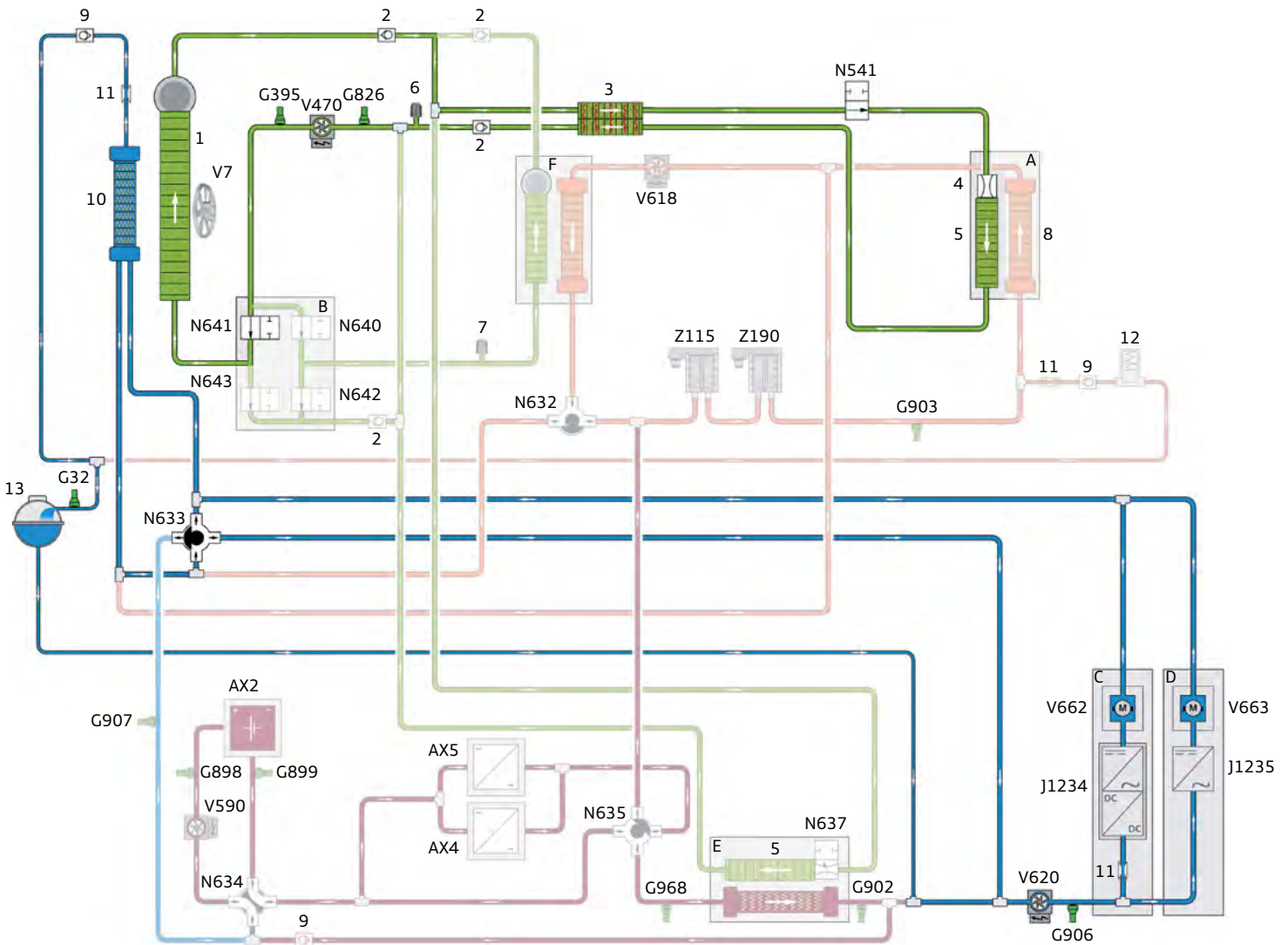
Which situation occurs, when and if it occurs, and for how long it occurs in the following scenarios is measured by Thermal Management Control Module J1024 using sensors. The control module then activates the coolant pumps, coolant changeover valves, refrigerant shut-off valves, air conditioner compressor 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

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 9 to 18 degrees °F (5 to 10 degrees °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.

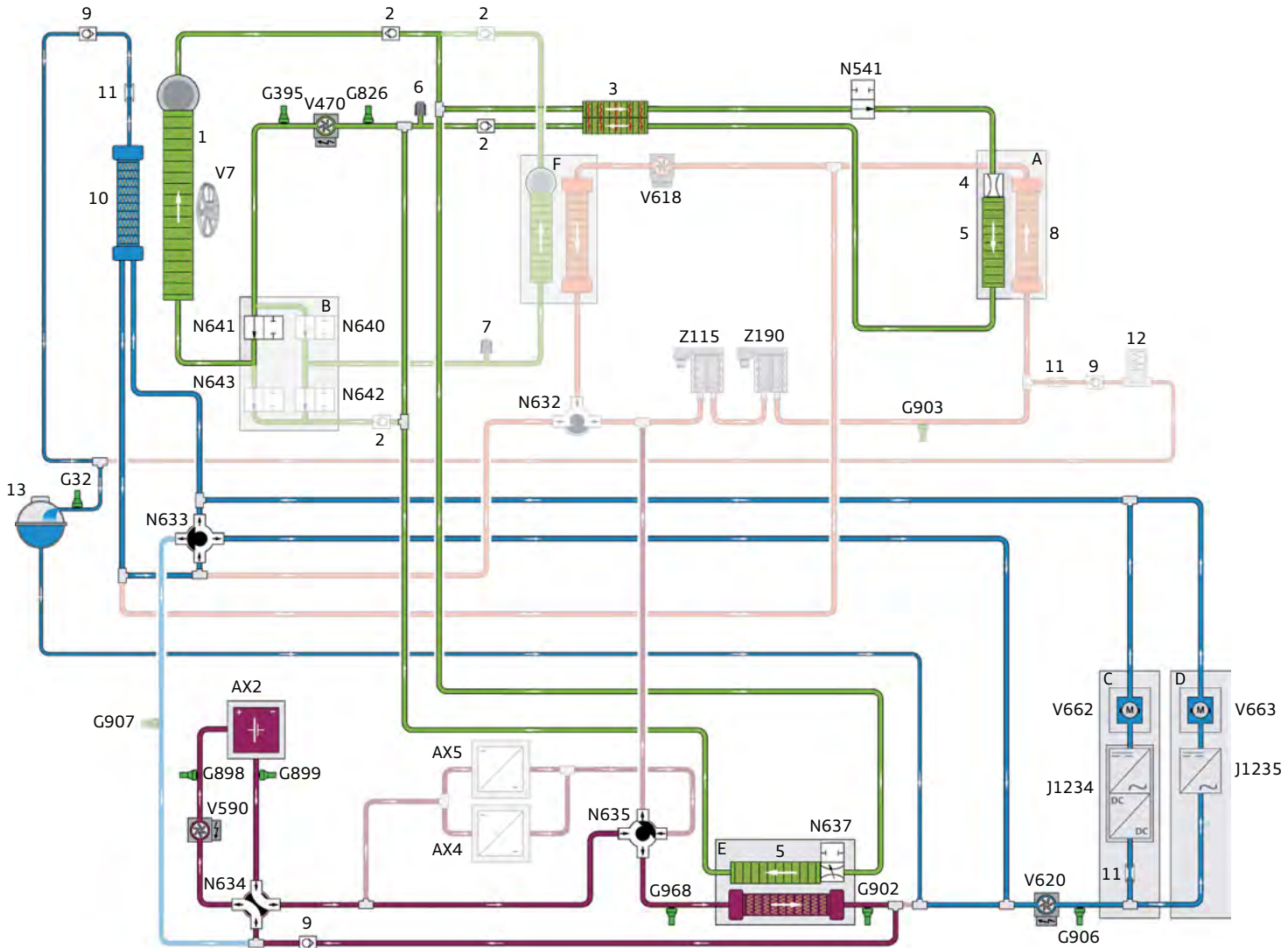


675_105

Cooling interior, electric drive motors and high-voltage battery

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 approximately 77 to 95 °F (25 to 35 °C). It is cooled at temperatures above approximately 95 °F (35 °C).

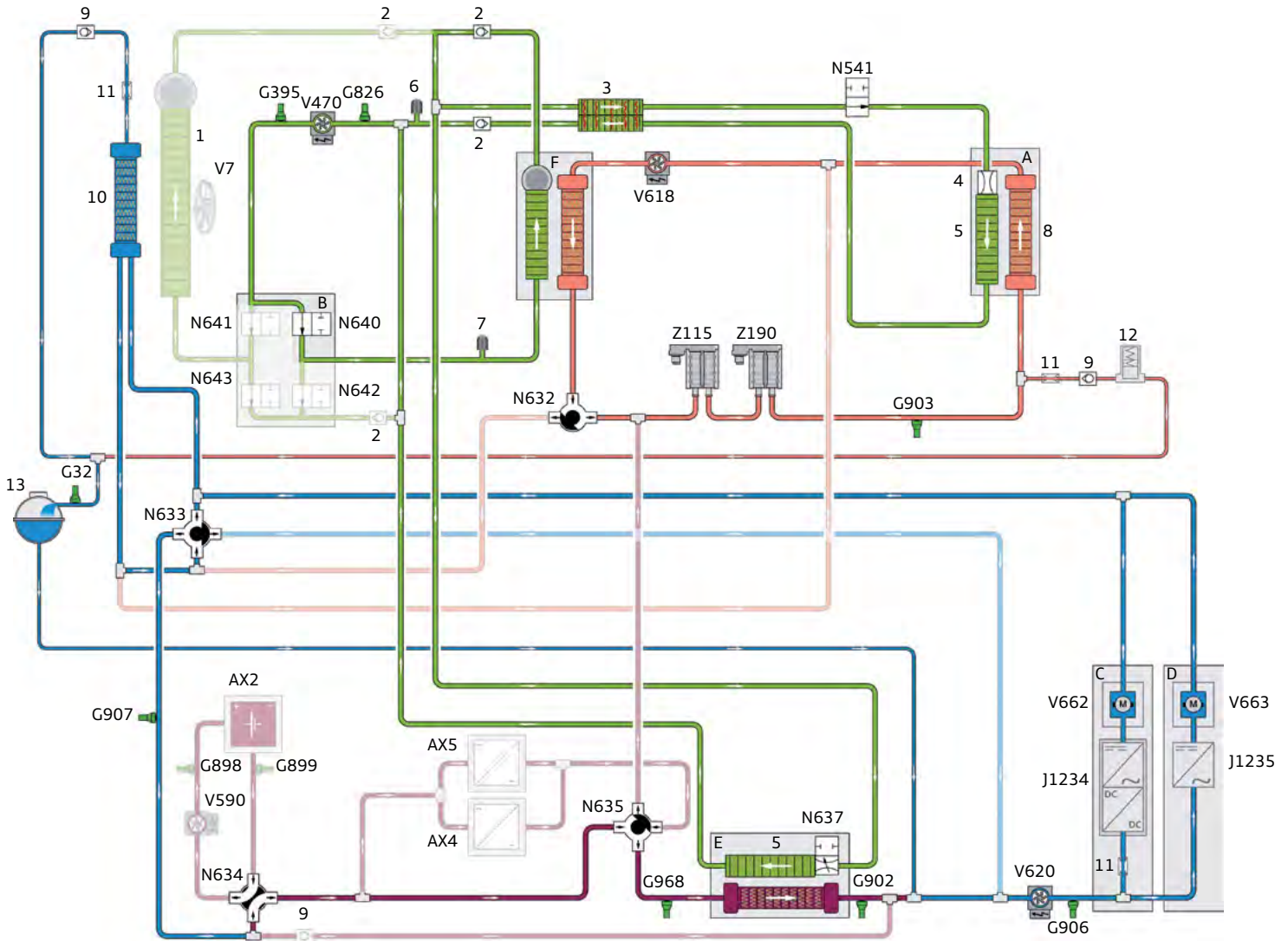


675_106

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

Reheat means that the air is initially cooled (and also dehumidified) so that it can then be warmed up to heat the interior. This prevents the windows and windshield from fogging. This involves the refrigerant absorbing heat from the coolant circuit for the high-voltage battery (E) 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 A/C 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 approximately 41 to 68 °F (5 to 20 °C).

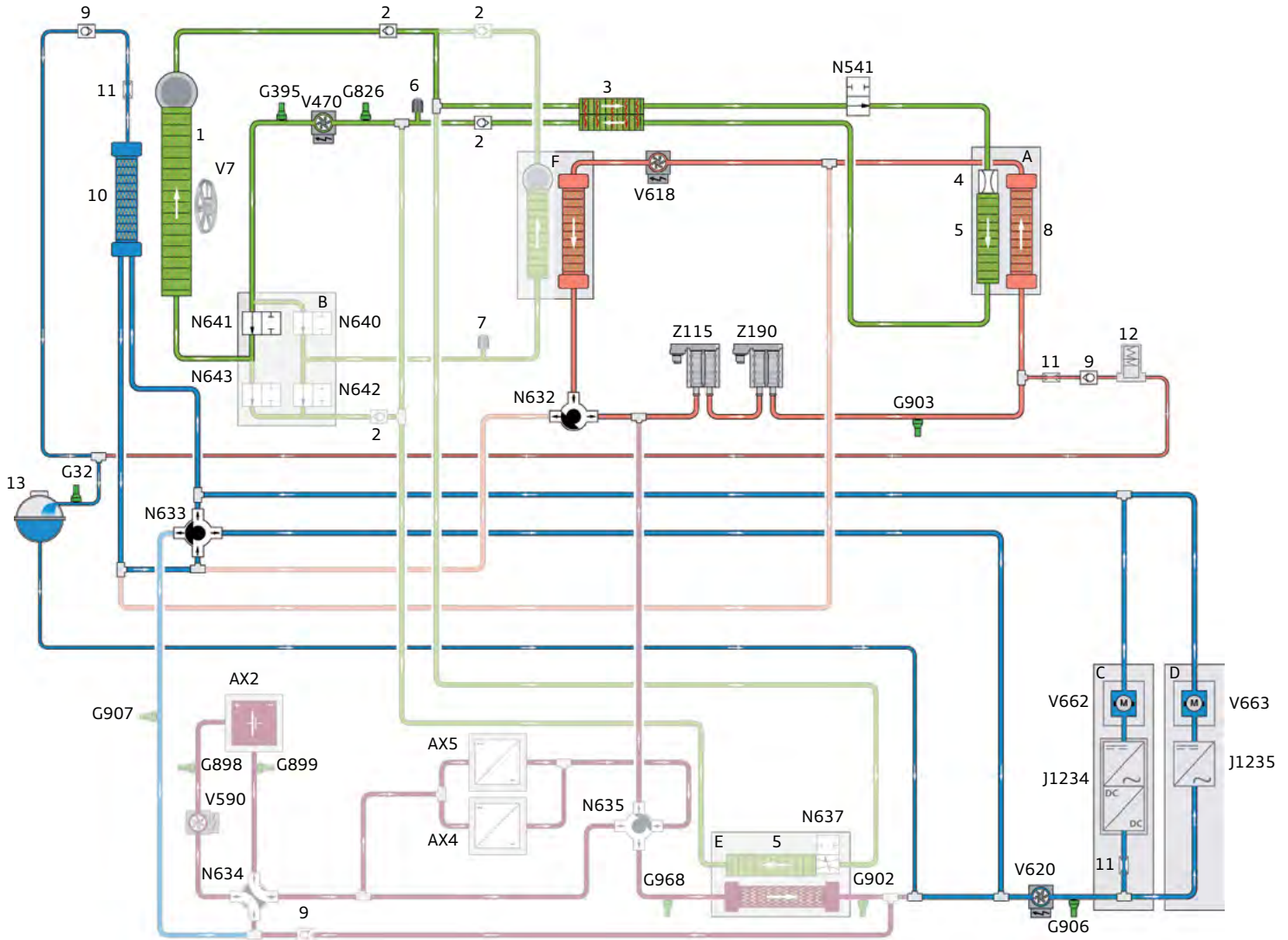


675_107

Reheating interior (cooling, dehumidifying, heating)

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 powertrain also runs via the low-temperature radiator in passive cooling mode, but does not have a thermal effect on the interior heating.

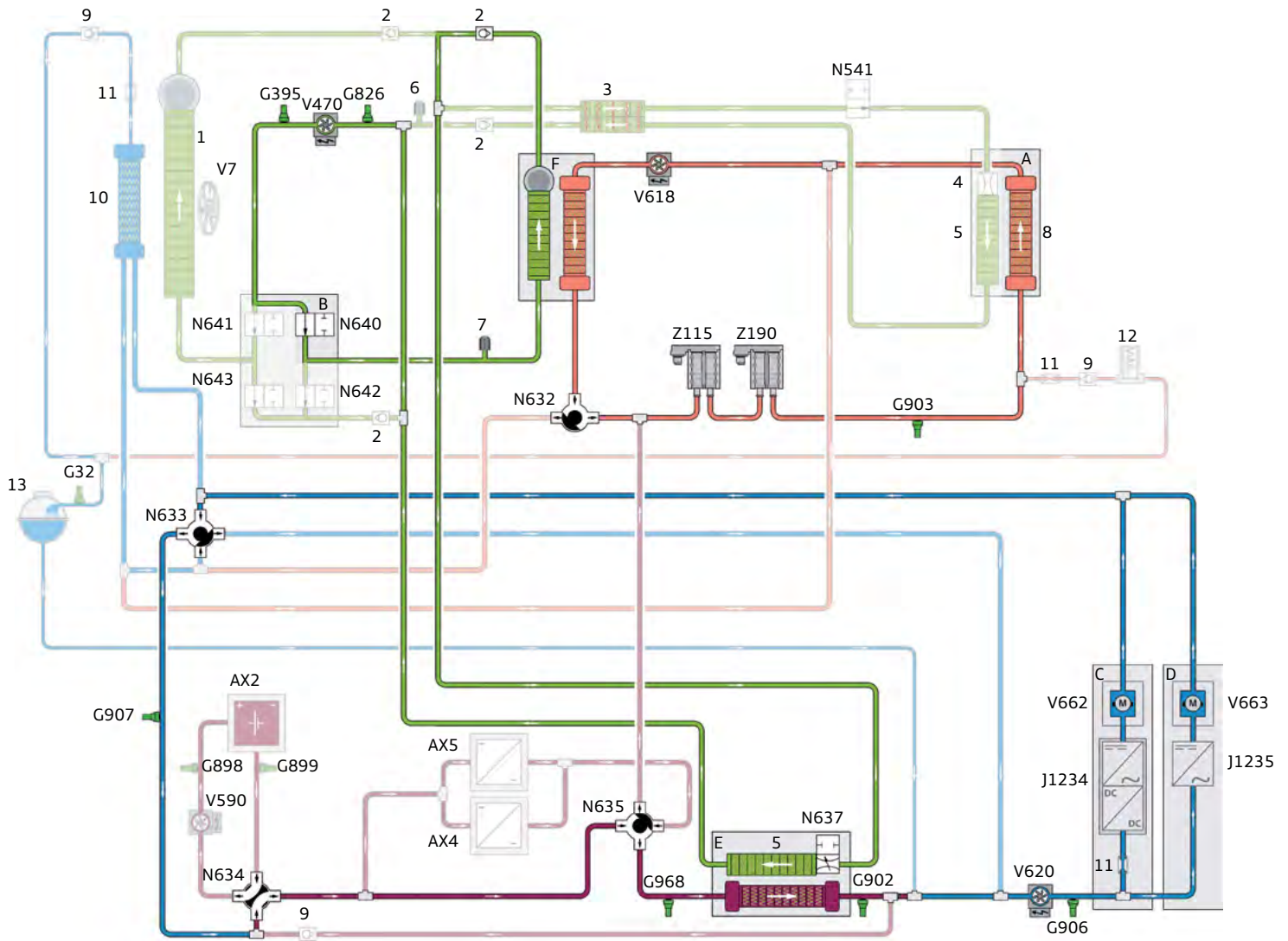


675_108

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 by the A/C compressor 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 approximately -4 to 68 °F (-20 to 20 °C).

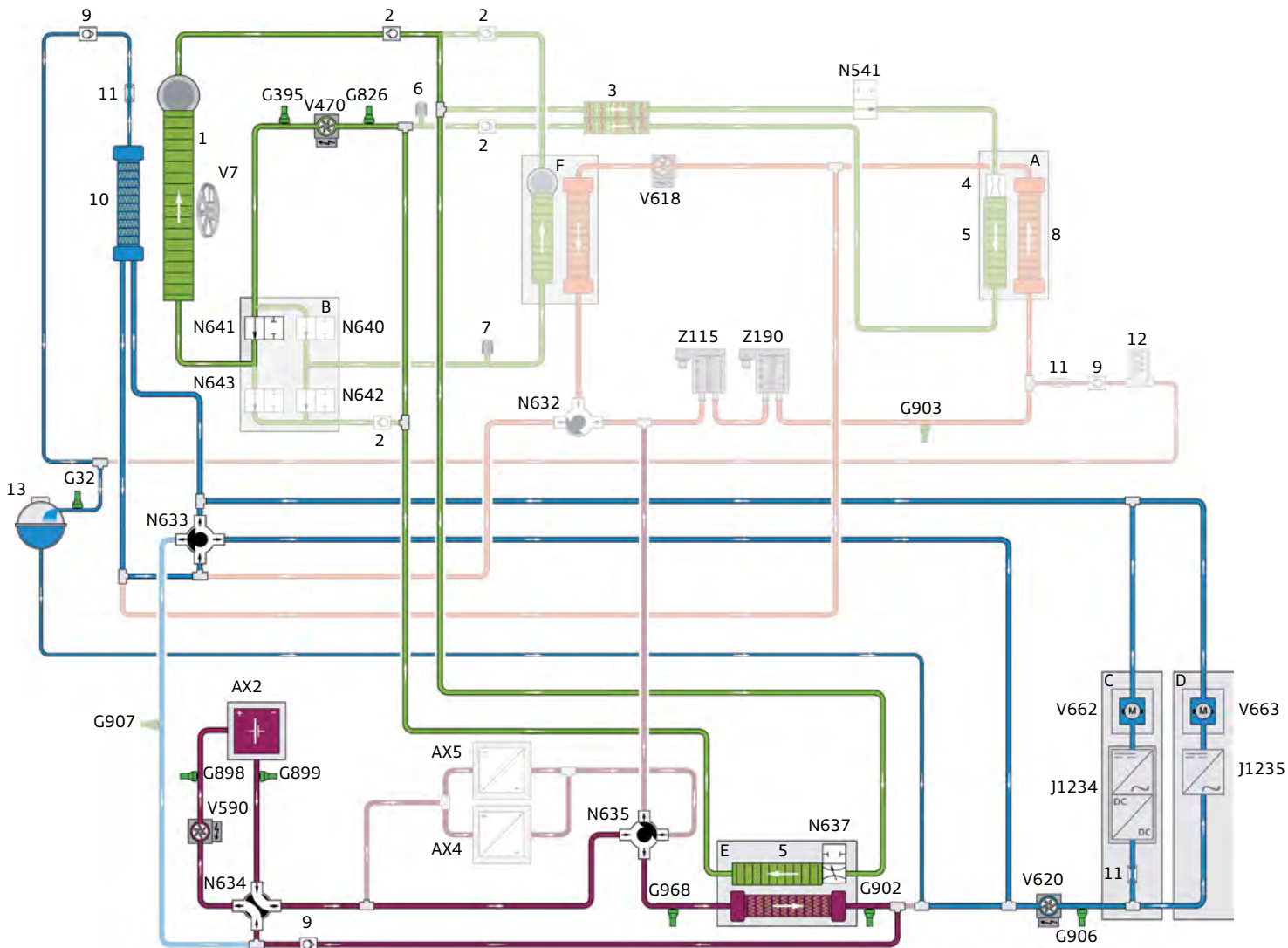


675_109

Cooling high-voltage battery via chiller (DC charging)

This scenario relates to charging with direct current. The refrigerant is compressed by the A/C 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. approximately 95 °F (35 °C). Interior cooling initially has priority over battery cooling.

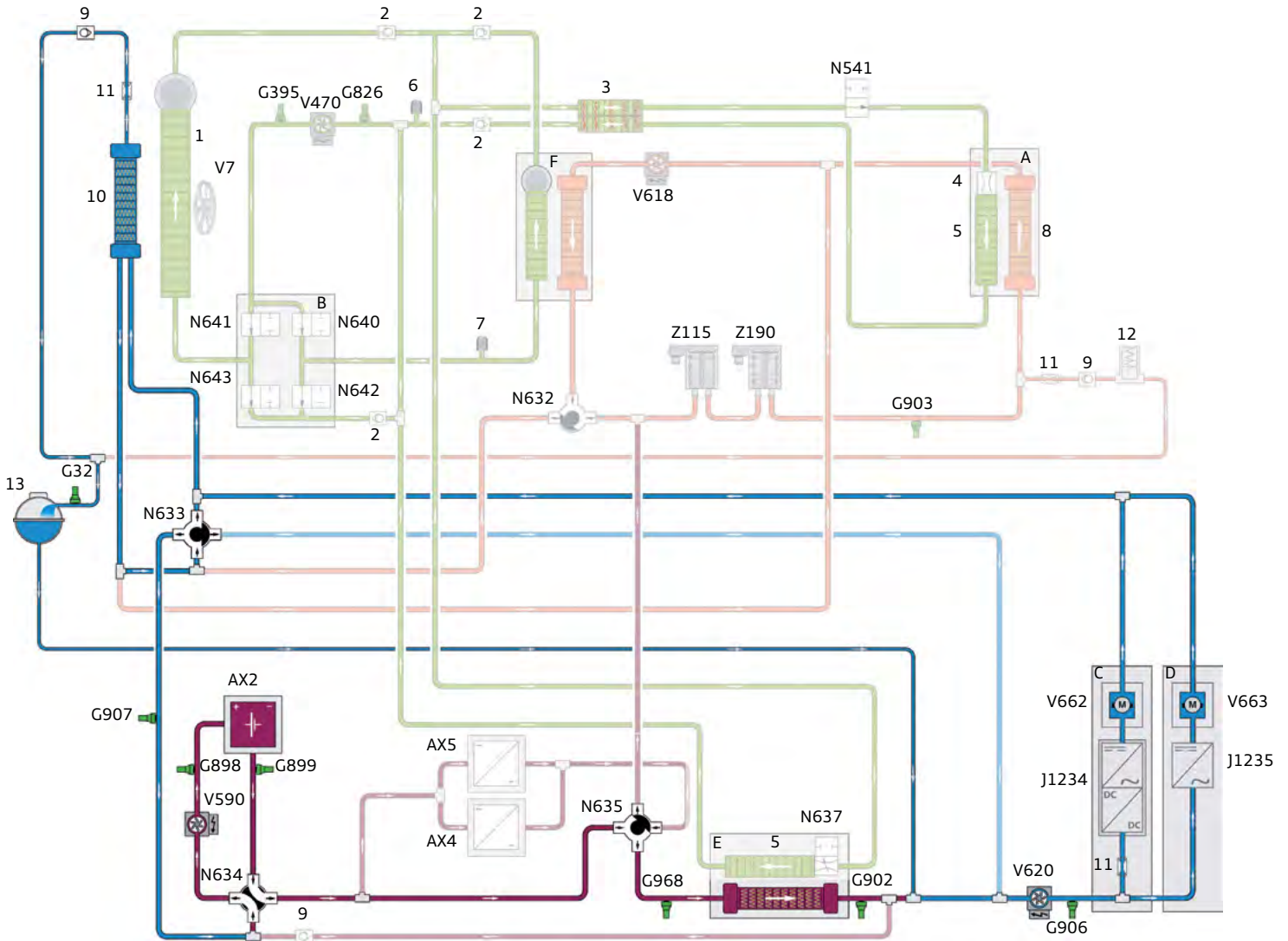


675_110

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 modules, sent to the low-temperature radiator where the coolant releases the absorbed heat into the atmosphere.

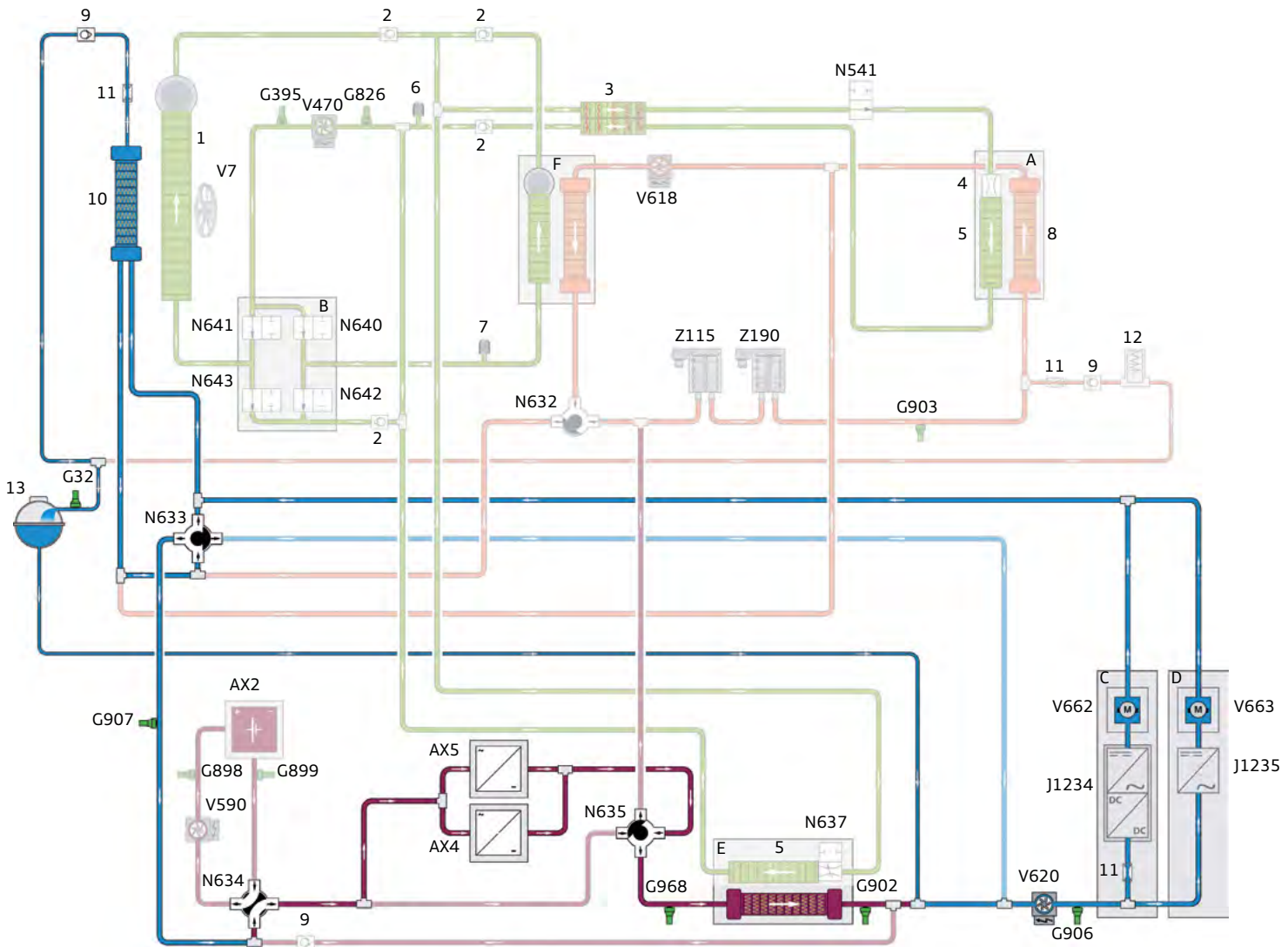


675_111

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

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 High-Voltage Battery Chargers 1 and 2 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.

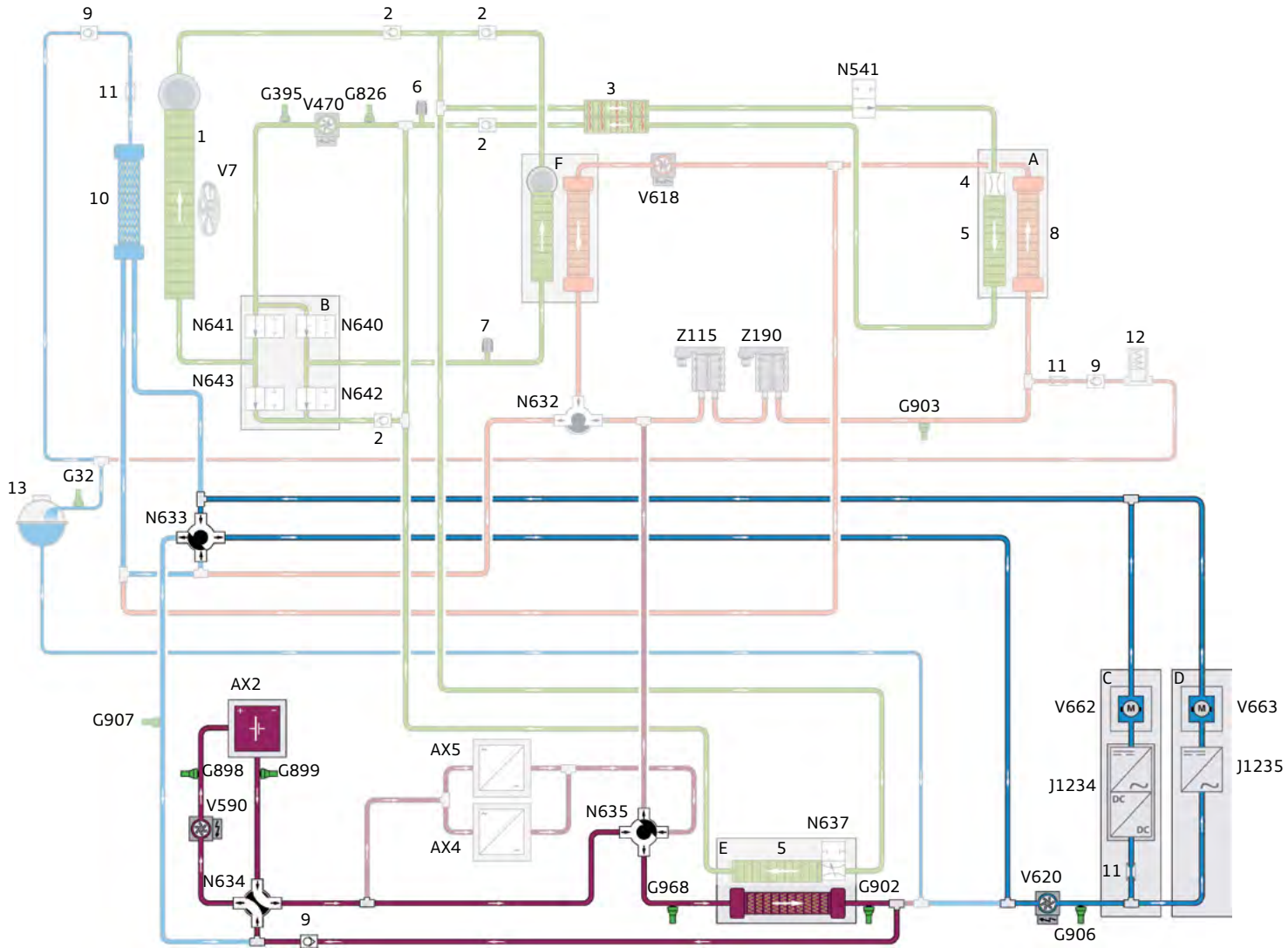


675_112

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

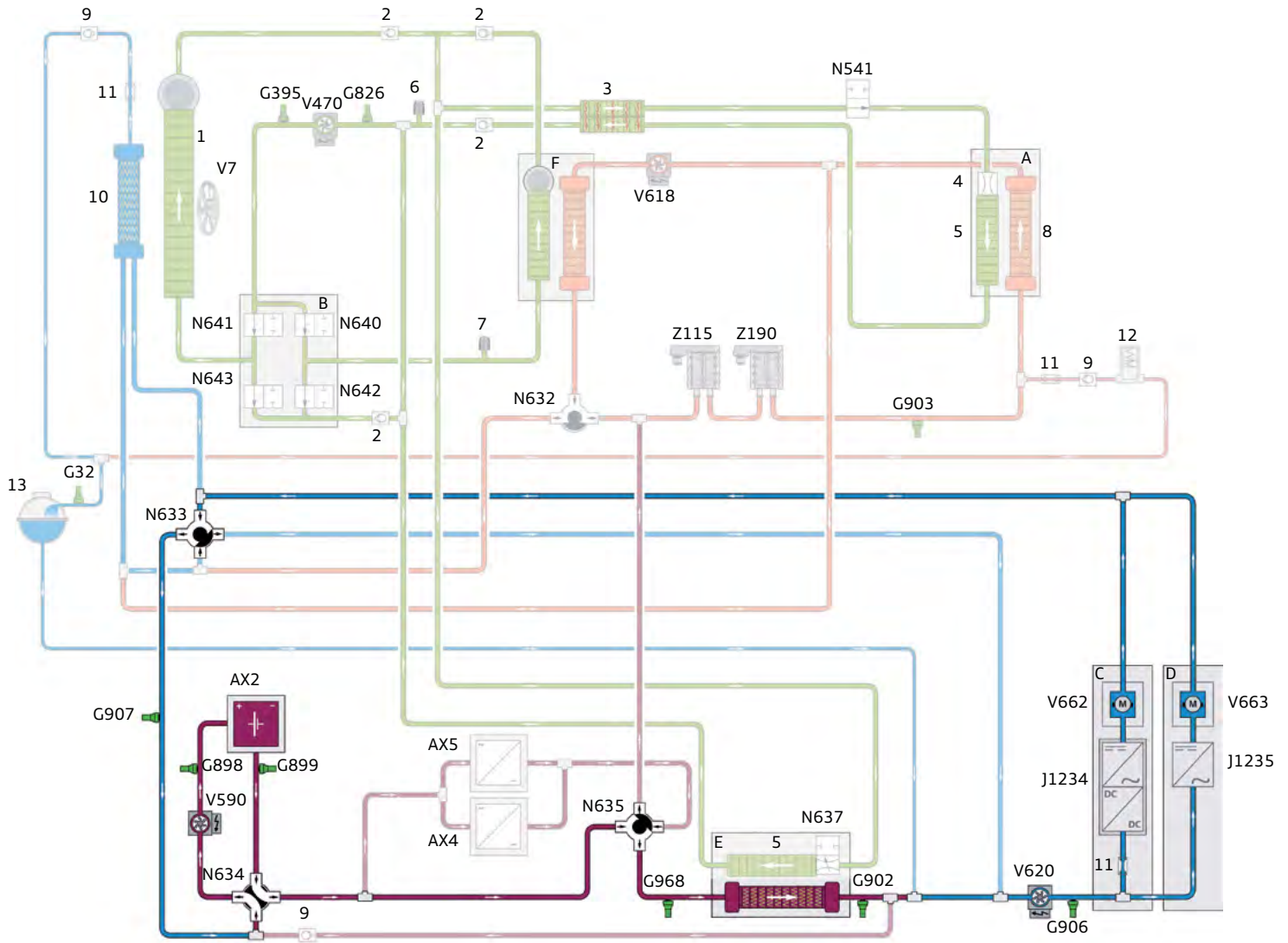
During flushing, the coolant simply circulates in the coolant circuits; it is not heated or cooled. Flushing is used for thermal homogenisation of the components in a coolant circuit. This means that the temperatures in, for example, the high-voltage battery or the electric drive motors can be equalised.

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).



675_114

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



675_115

Thermal Management Control Module J1024

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.

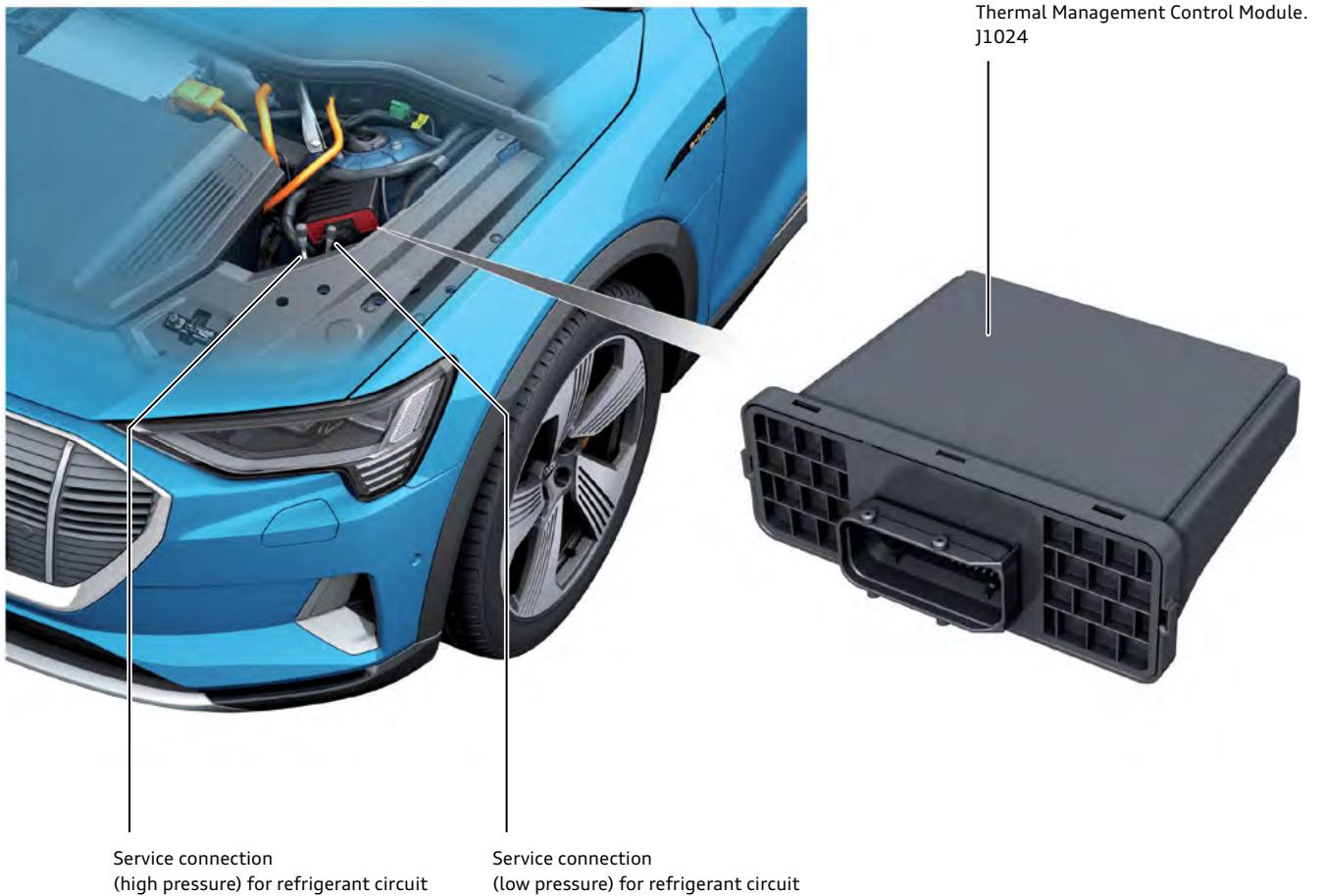
The sensors are, for example, the refrigerant pressure and temperature sensor and the various coolant temperature sensors.

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.

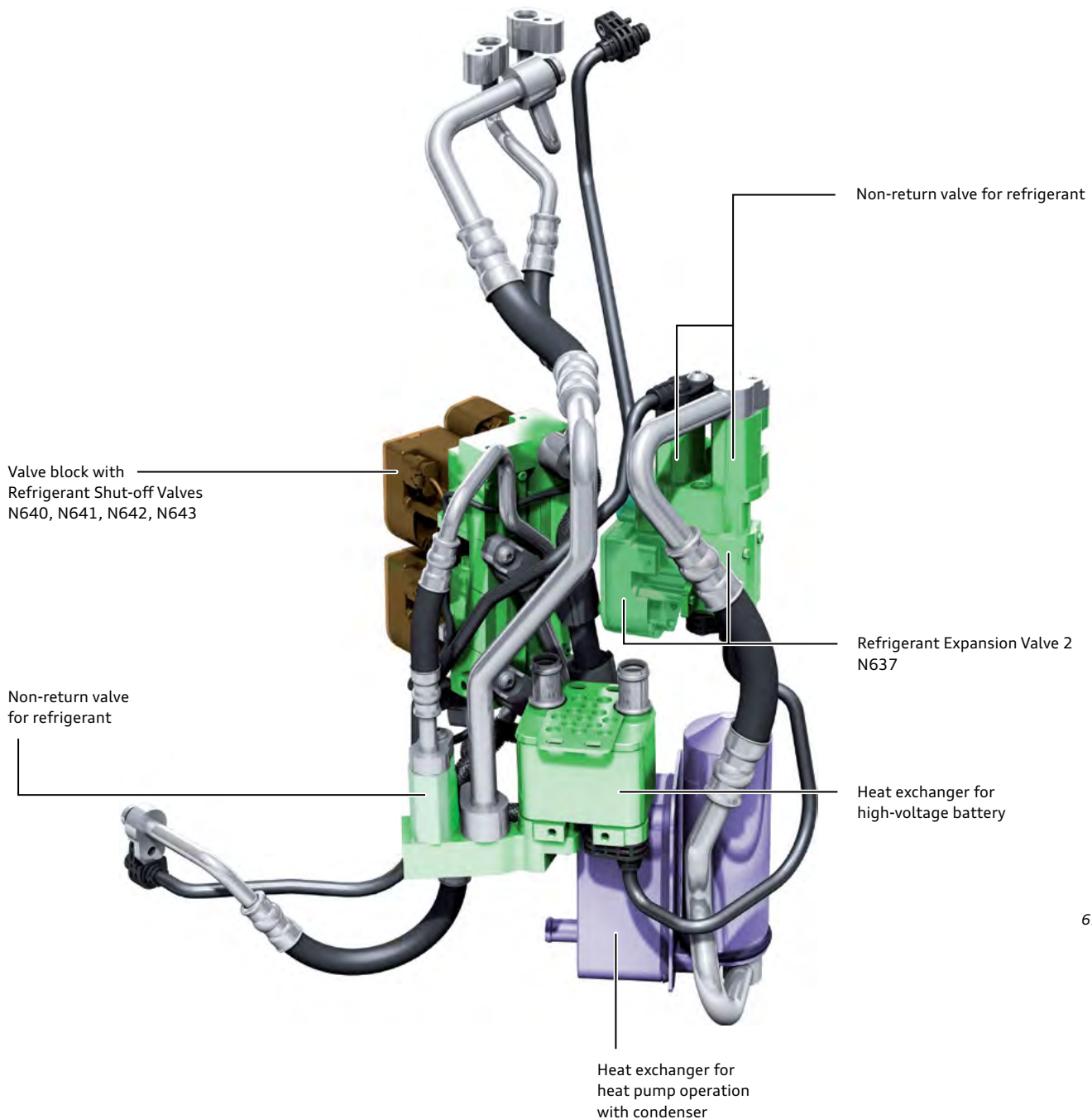
This means that J1024 uses input parameters and a defined algorithm to consistently control the optimum state of the vehicle's thermal management system and adjusts the energetically best possible operating states in the vehicle.

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



The following components are installed 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).

Coolant expansion tank

The maximum coolant filling level is approximately 2.1 qt (2.0 l); the minimum level is approximately 1.6 qt (1.57 l).

The coolant level warning is activated via Engine Coolant Level Sensor G32 at a level of approximately 0.42 qt (0.4 l) in the coolant expansion tank.

The theoretical overall volume of the expansion tank is 3.1 qt (3.0 l). Due to the air cushion that forms when the sealing cap is removed, the expansion tank can be filled with a maximum of 2.8 qt (2.7 l) of coolant.



675_159



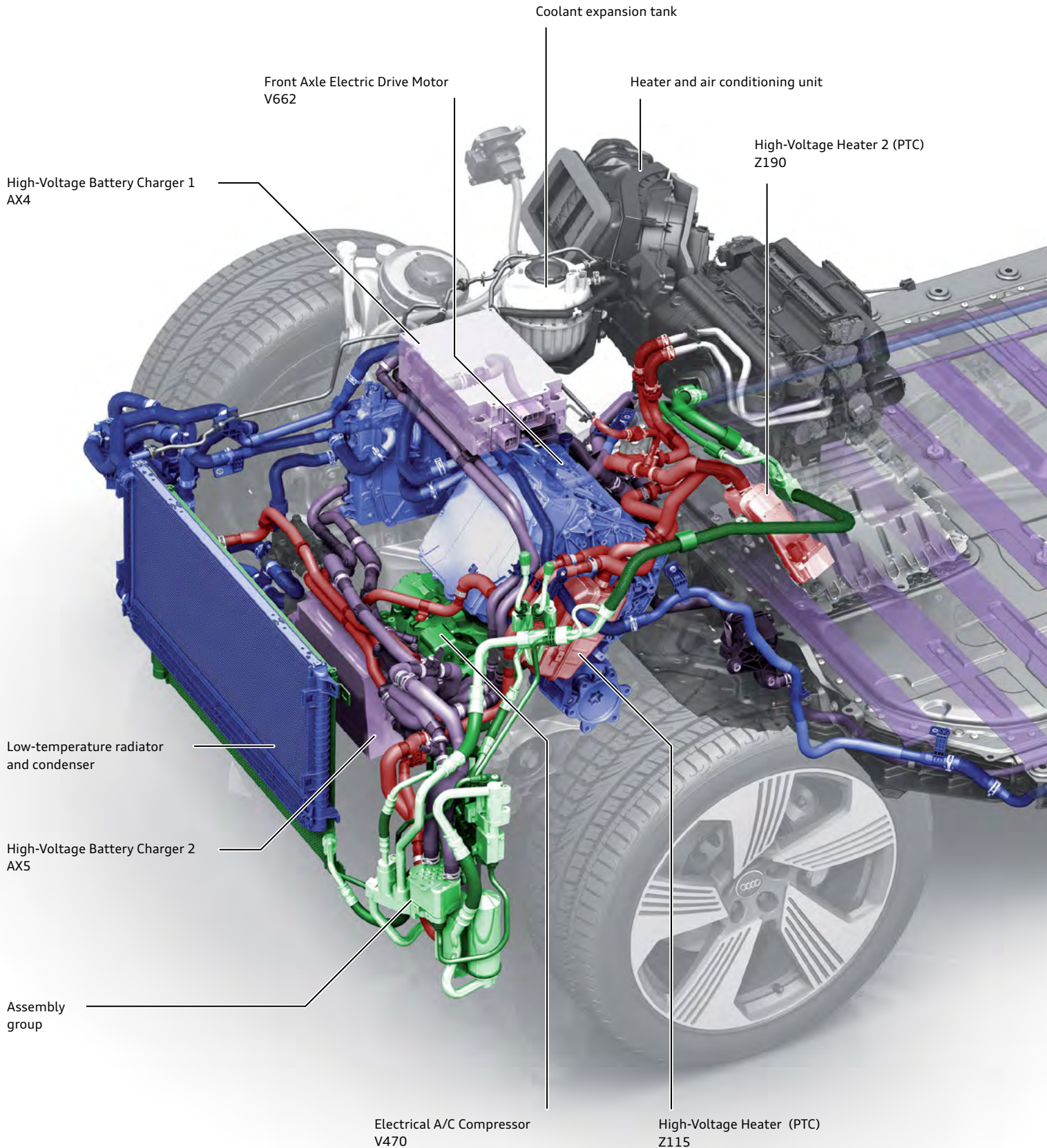
Note

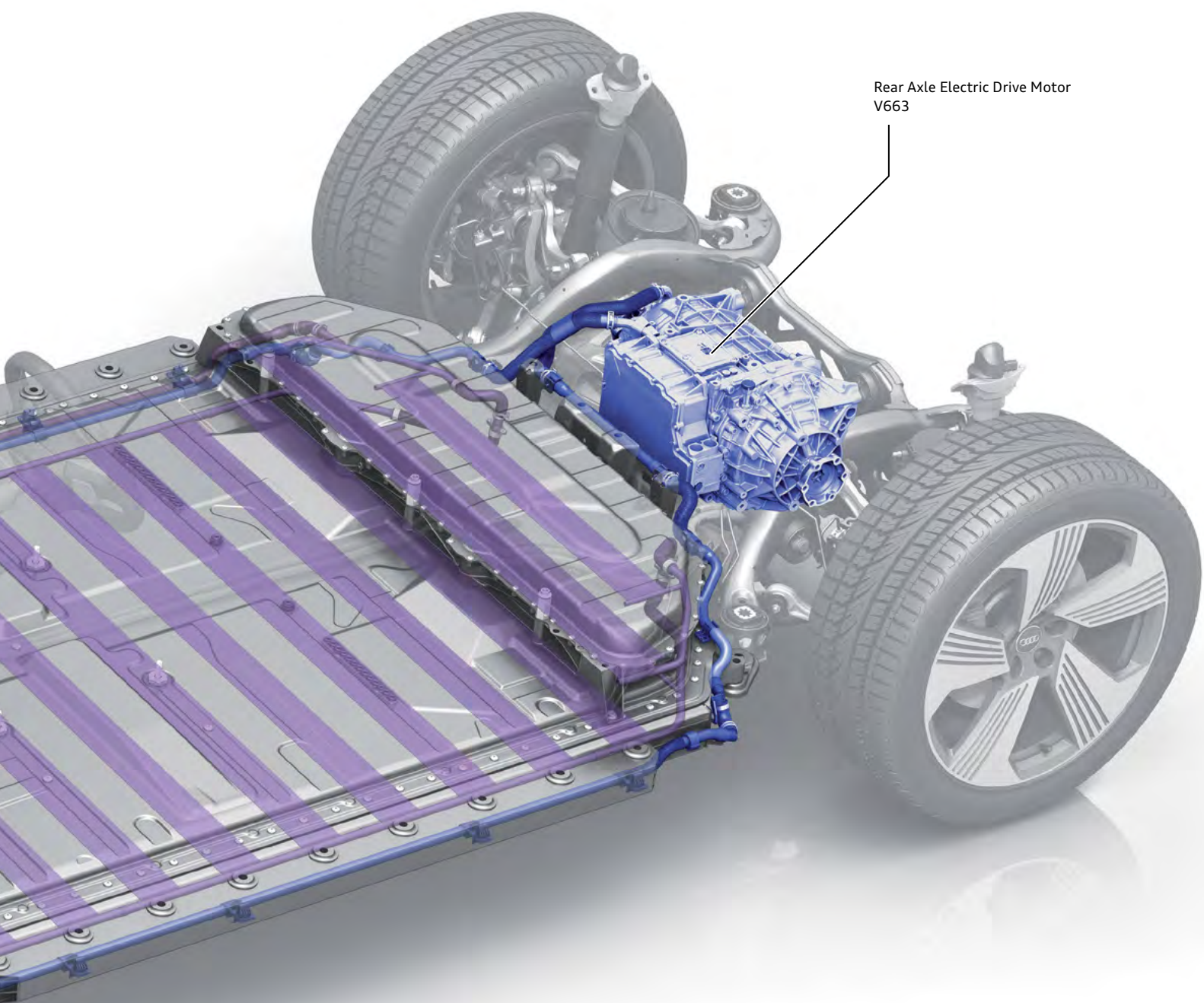
The vehicle must NOT be operated, moved or towed if the cooling system is not filled and has not been bled – risk of damage to vehicle components. The cooling system must also be bled if small amounts of coolant are added after repair work.

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 diagrams and explanations.





Rear Axle Electric Drive Motor
V663

Key:

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

675_182

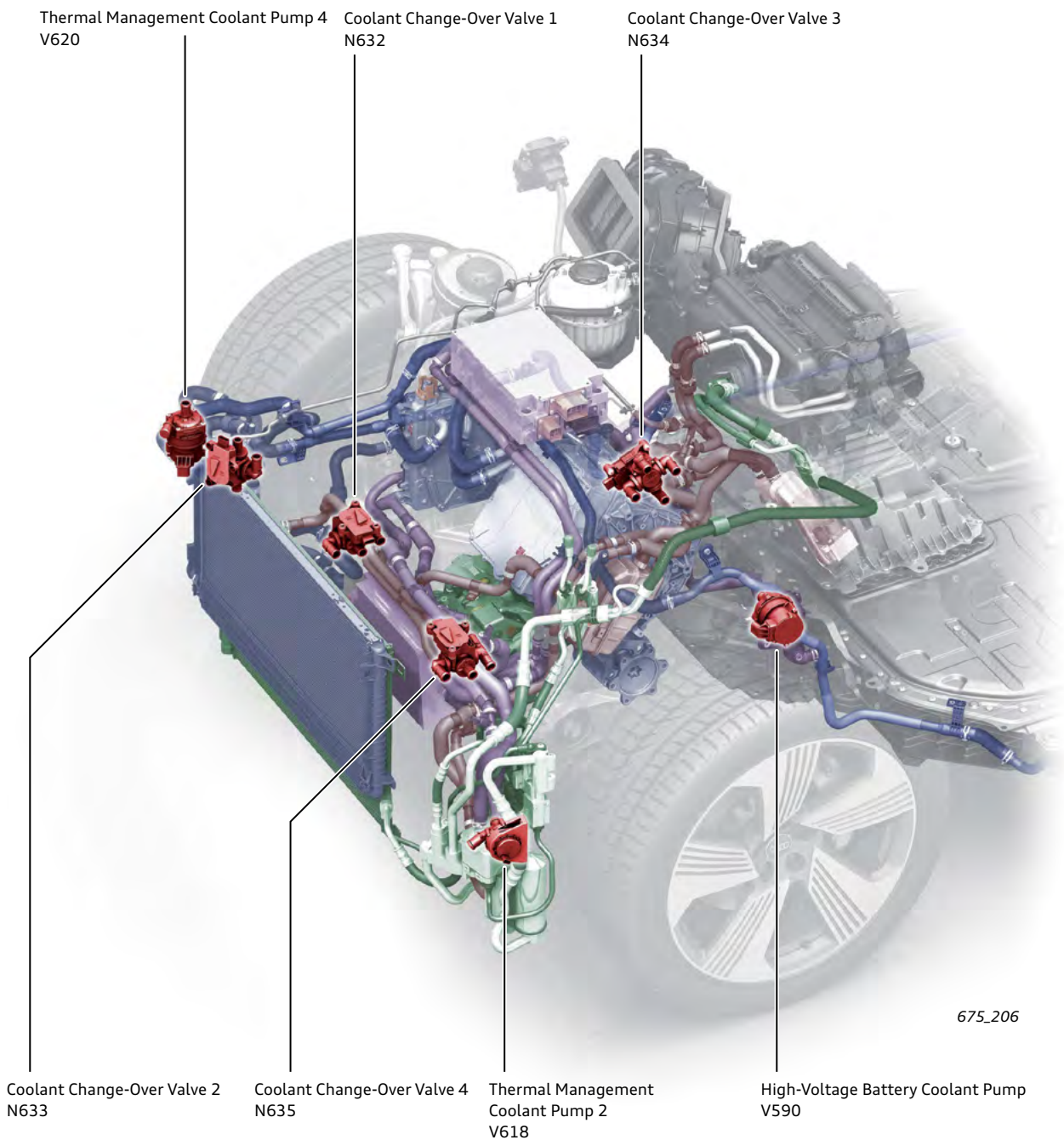
This illustration does not present functional descriptions or applications. It depicts the possible filling of lines with refrigerant and coolant.

Installation locations of coolant changeover valves and coolant pumps

Due to the different possible switch positions, the coolant change-over 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.

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 standardized 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 NAR is not legally bound by ECE R79 regulations but does comply to its standards and will adapt the display symbols shown below.

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 center 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 center guidance and lane departure warning

The new ECE R79 specifies which system displays the lane guidance must have. This means that there are now standardized 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 center 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.

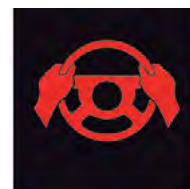


675_200

The prompt to take over the steering of the vehicle is issued with a standardized 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 center guidance is active, or when the lane departure warning starts the second steering intervention. In addition to the symbol, a message is also shown.

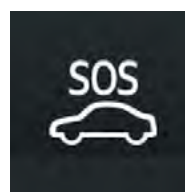


675_030



675_031

If the emergency assist is active, this is shown by a standardized 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 center guidance of the adaptive cruise assist (steering interventions by the lane center guidance system are made continuously with the aim of keeping the vehicle in the center of the lane).

Button for steering assist on turn signal lever



675_034

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 center guidance of the adaptive cruise assist or deactivates both systems. However, whether or not the lane center 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 center guidance to be deactivated independently of the lane departure warning. If the lane center 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.

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



675_029

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 center 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 center 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 center 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

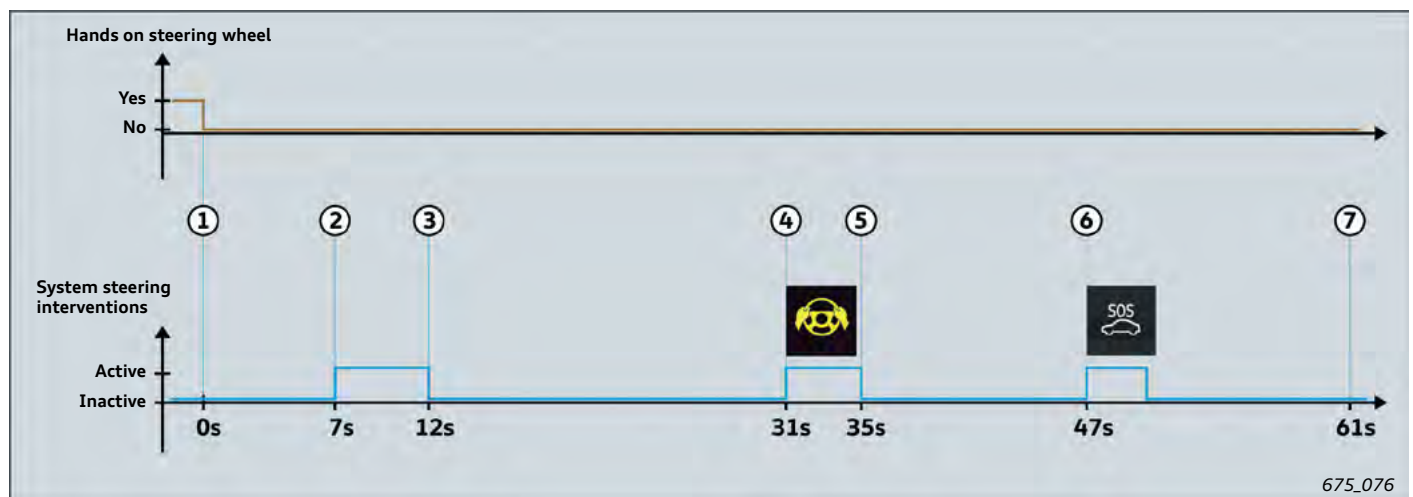
When assist systems for lateral guidance are used, it must be ensured that the driver keeps his/her hands on the steering wheel even when the system is active. It is not permitted to leave the task of steering entirely to the system. The assist system supports the driver with steering the vehicle, but 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 the driver 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 center of the lane (2). In this specific case the steering intervention lasts 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 acoustic, visual and haptic warnings now begin. 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).

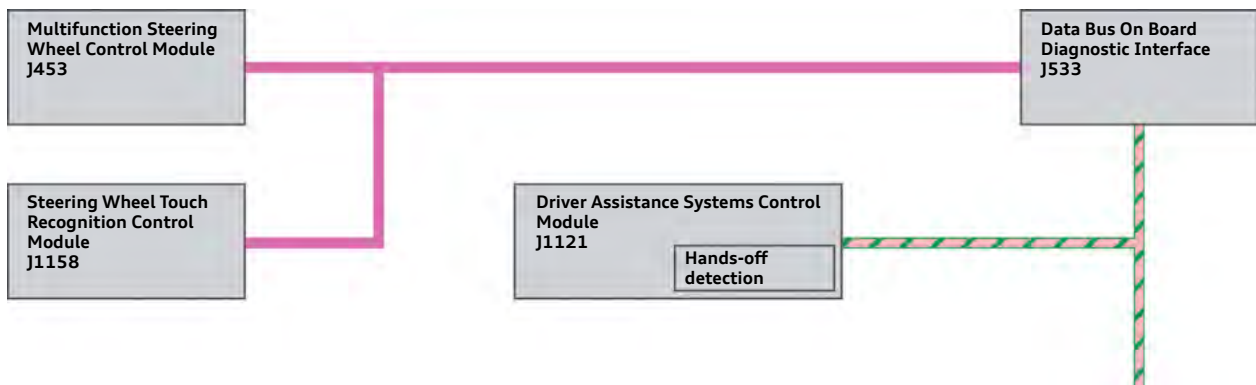
Capacitive steering wheel for hands-off detection

If the Audi e-tron is equipped with the adaptive cruise assist, it also has a capacitive steering wheel. The capacitive steering wheel makes an even more direct hands-off detection possible.

Capacitive sensors have been incorporated into the steering wheel. The data from the sensors is evaluated by Steering Wheel Touch Recognition Control Module J1158. Another bus node on this LIN bus branch is Multifunction Steering Wheel Control Module J453. The master of this LIN bus system is Data Bus On Board Diagnostic Interface J533.



The measurement signals from the capacitive sensors of J1158 are sent by LIN bus to J533. J533 then transmits the information via the FlexRay to Driver Assistance Systems Control Module J1121 which has the hands-off detection software.

If an Audi e-tron does not have adaptive cruise assist, the hands-off detection is carried out on the basis of the steering torque sensor. The detection software in Driver Assistance Systems Control Module J1121 is used as in a vehicle with Adaptive cruise assist.



675_028

Key:

-  FlexRay
-  LIN bus - channel A

Sensor technology for the adaptive cruise assist

Laser Distance Control Module J1122

The laser scanner first introduced for the 2019 Audi A8 is also installed on the Audi e-tron. The sensor unit from the Audi A8 is used.

The laser scanner is located in the center of the bumper below where a license plate would be installed. Because the height of the scanner is almost exactly the same as on the 2019 A8, the calibration process and required special tools are identical. The other service operations are also the same.

Control Module for Adaptive Cruise Control J428 (ACC)

Only one radar unit is installed 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 2019 A8, and 2017 Q7 and is serviced in the same manner.

The radar unit is installed underneath a plastic cover on the left side of the front bumper (as seen in direction of travel) next to the Audi rings.

J428 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 eSelf-Study Program [990393, The 2019 Audi A8 Driver Assistance Systems](#).



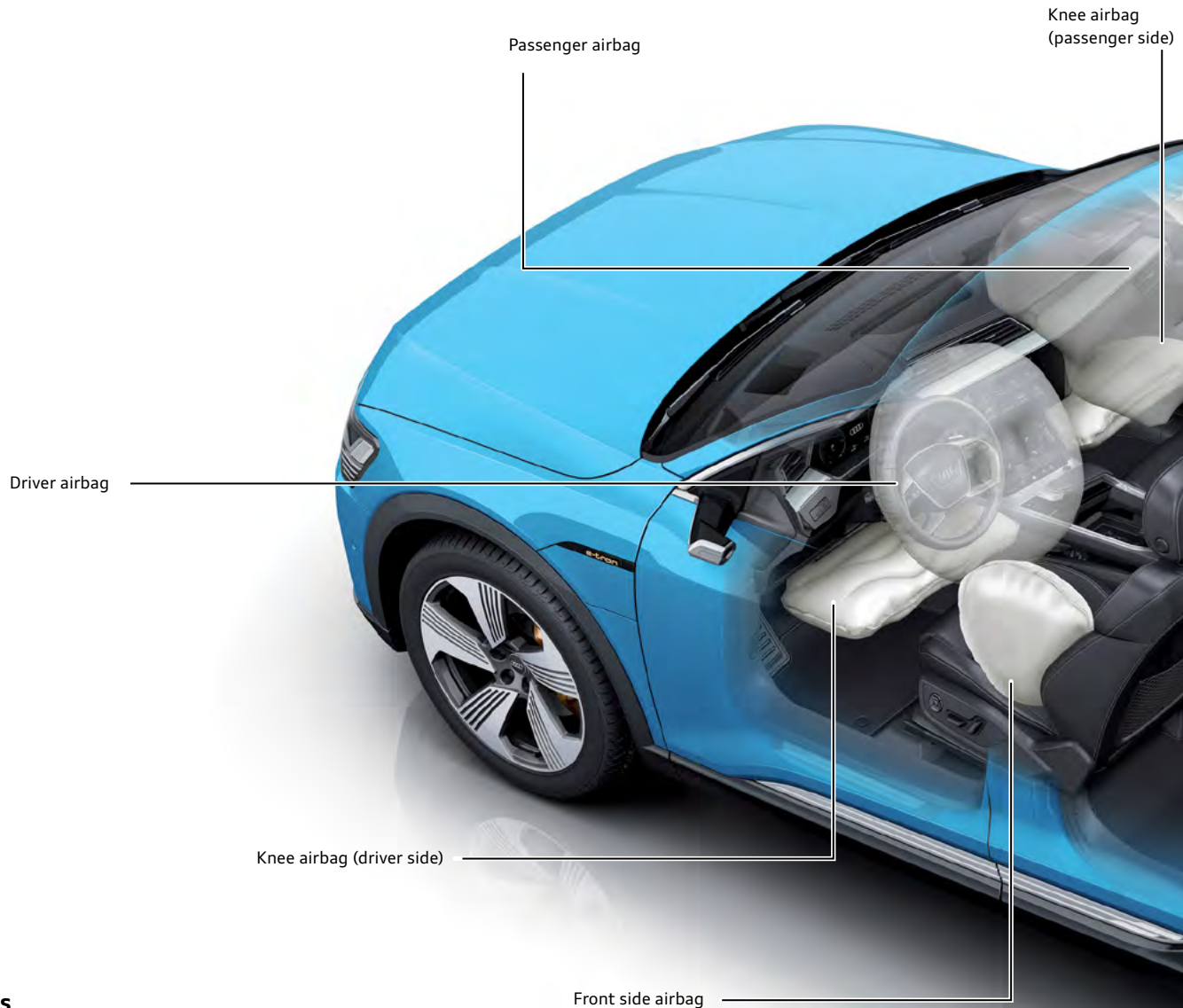
Reference

For further information on the radar unit, refer to eSelf-Study Programs [979443 Audi ACC Systems](#), [960163 The 2017 Audi Q7 Running Gear and Suspension System](#), [990393 The 2019 Audi A8 Driver Assistance Systems](#), 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.

Airbags in vehicle



Components

Depending on the vehicle options, it may have the following components:

- > Airbag control module
- > 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
- > Front passenger airbag warning lamp (OFF and ON)
- > Seat position detection for driver and passenger
- > Battery isolator, 12 Volt electrical system
- > Battery isolator, high-voltage system



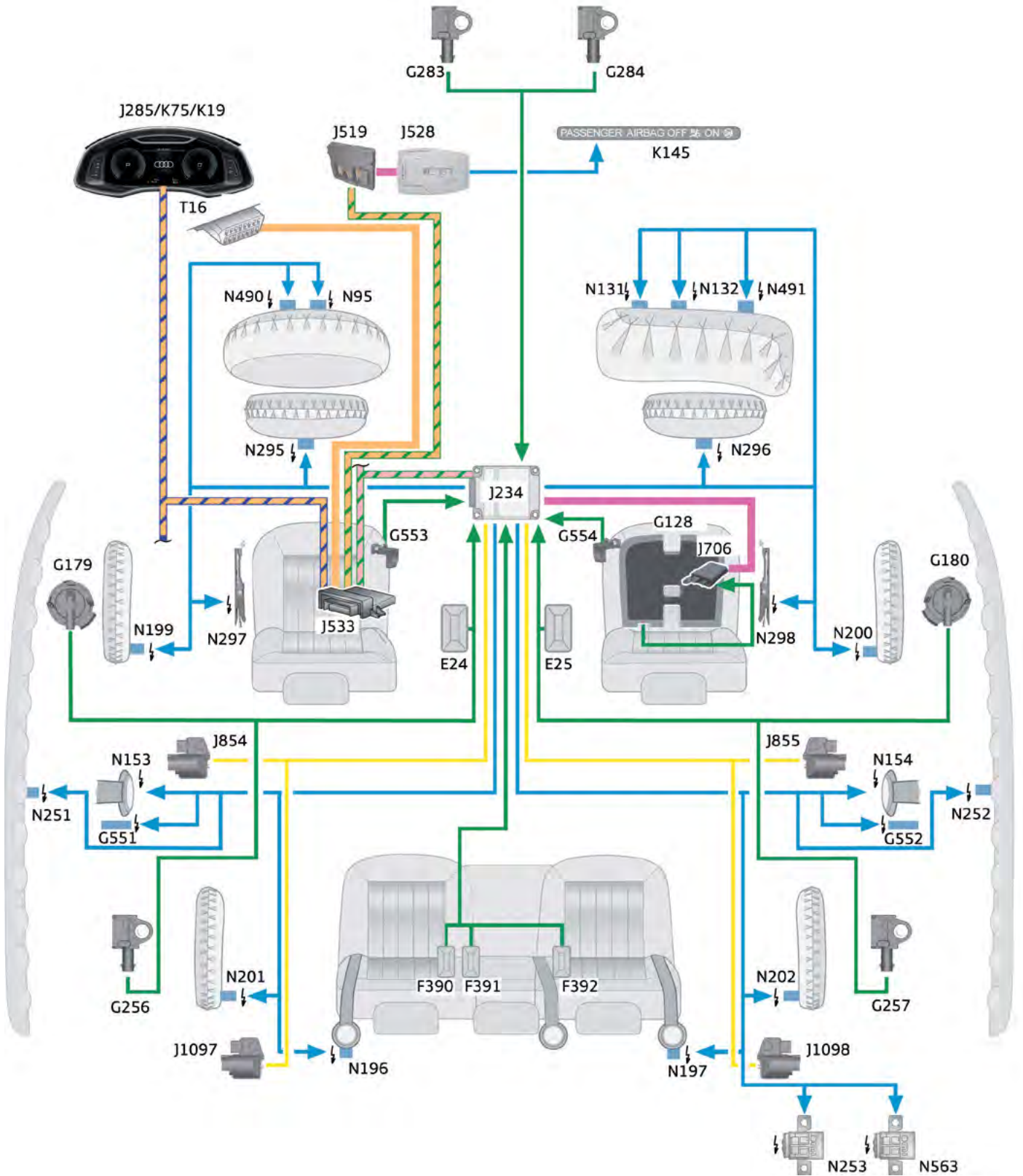
675_025



Note

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

System overview











Additional equipment

Key to diagram:

E24	Driver Seat Belt Switch	N95	Driver Airbag Igniter
E25	Front Passenger Seat Belt Switch	N131	Front Passenger Airbag Igniter 1
F390	Driver Side Second Row Seat Belt Switch	N132	Front Passenger Airbag Igniter 2
F391	Center Second Row Seat Belt Switch	N153	Driver Seat Belt Tensioner Igniter 1
F392	Passenger Side Second Row Seat Belt Switch	N154	Front Passenger Seat Belt Tensioner Igniter 1
G128	Passenger Seat Occupant Detection Sensor	N196	Driver Side Rear Seat Belt Tensioner Igniter
G179	Driver Thorax Airbag Crash Sensor	N197	Passenger Side Rear Seat Belt Tensioner Igniter
G180	Front Passenger Thorax Airbag Crash Sensor	N199	Driver Thorax Airbag Igniter
G256	Driver Side Rear Thorax Airbag Crash Sensor	N200	Front Passenger Thorax Airbag Igniter
G257	Passenger Side Rear Thorax Airbag Crash Sensor	N201	Driver Side Rear Thorax Airbag Igniter
G283	Driver Front Airbag Crash Sensor	N202	Passenger Side Rear Thorax Airbag Igniter
G284	Passenger Side Front Airbag Crash Sensor	N251	Driver Head Curtain Airbag Igniter
G551	Driver Belt Force Limiter	N252	Front Passenger Head Curtain Airbag Igniter
G552	Front Passenger Belt Force Limiter	N253	Battery Interrupt Igniter
G553	Driver Seat Position Sensor	N295	Driver Knee Airbag Igniter
G554	Front Passenger Seat Position Sensor	N296	Front Passenger Knee Airbag Igniter
J234	Airbag Control Module	N297	Driver Seat Belt Tensioner Igniter 2
J285	Instrument Cluster Control Module	N298	Front Passenger Seat Belt Tensioner Igniter 2
J519	Vehicle Electrical System Control Module	N490	Driver Airbag Release Valve Igniter
J528	Roof Electronics Control Module	N491	Front Passenger Airbag Release Valve Igniter
J533	Data Bus on Board Diagnostic Interface	N563	High-Voltage Battery Interrupt Igniter
J706	Passenger Occupant Detection System Control Module	T16	Data Link Connector
J854	Left Front Seat Belt Tensioner Control Module		
J855	Right Front Seat Belt Tensioner Control Module		
J1097	Left Rear Seat Belt Tensioner Control Module		
J1098	Right Rear Seat Belt Tensioner Control Module		
K19	Seat Belt Indicator Lamp		
K75	Airbag Indicator Lamp		
K145	Front Passenger Airbag -Disabled- Indicator Lamp		

Wiring colors:

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

Connection for Passenger Seat Occupant Detection Sensor G128

The connection for G128 varies depending on the market version.

¹⁾Vehicles for the North American region (NAR):

G128 is connected to Passenger Occupant Detection System Control Module J706 via a discrete wire. The control unit communicates with the Airbag Control Module J234 via a LIN bus wire.

²⁾Vehicles for rest of world (ROW):

G128 is connected directly to Airbag Control Module J234 via a discrete wire. Passenger Occupied Detection System Control Module J706 is not installed.

Airbag Control Module J234

Crash signal

Airbag Control Module J234 registers a collision based on the information supplied by internal and external crash sensors. It classifies a collision as “minor” or “severe”. 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. J234 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.

Reaction of high-voltage battery to crash signals

When the airbag control module detects a collision which meets the relevant criteria, the high-voltage battery is isolated for safety reasons. In the event of a collision, it sends collision signals to the data bus. Data Bus On Board Diagnostic Interface J533 relays the signals to Battery Regulation Control Module J840.

Minor collision

In the event of a minor collision with a corresponding crash level, the J840 isolates the high-voltage battery. If the high-voltage battery has been isolated due to a minor collision, it can be reactivated by cycling the ignition switch (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.

Airbag Control Module J234



675_152

Pathway 1:

As in the event of a minor collision with a corresponding crash level, Battery Regulation Control Module J840 isolates the high-voltage battery.

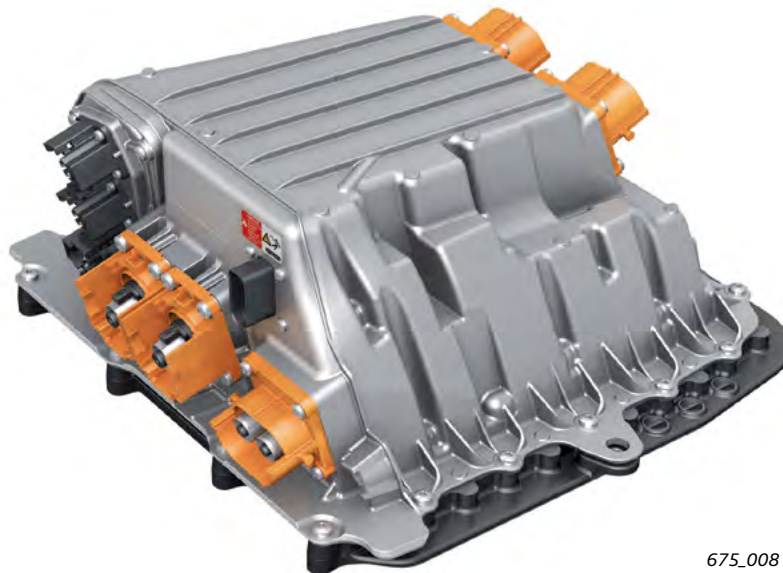
Pathway 2:

Airbag Control Module J234 is wired discretely to High-Voltage Battery Interrupt Igniter N563. The igniter is installed in High-Voltage Control Module SX6. Contrary to the name, N563 is not a pyrotechnic component. In the event of a severe collision, J234 sends a current of approximately 1.75A to 2.0A 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 switching the ignition on and off (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 the switching unit do not need to be replaced due to the electronic isolation.

¹⁾ It is planned to convert High-Voltage Battery Isolation Igniter N563 to 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 Interrupt Igniter N253). Please refer to the technical literature and ETKA, Workshop Manuals and Guided Fault Finding.

**High-Voltage Battery Control Module SX6
including High-Voltage Battery Interrupt Igniter N563.**



675_008

**Reference**

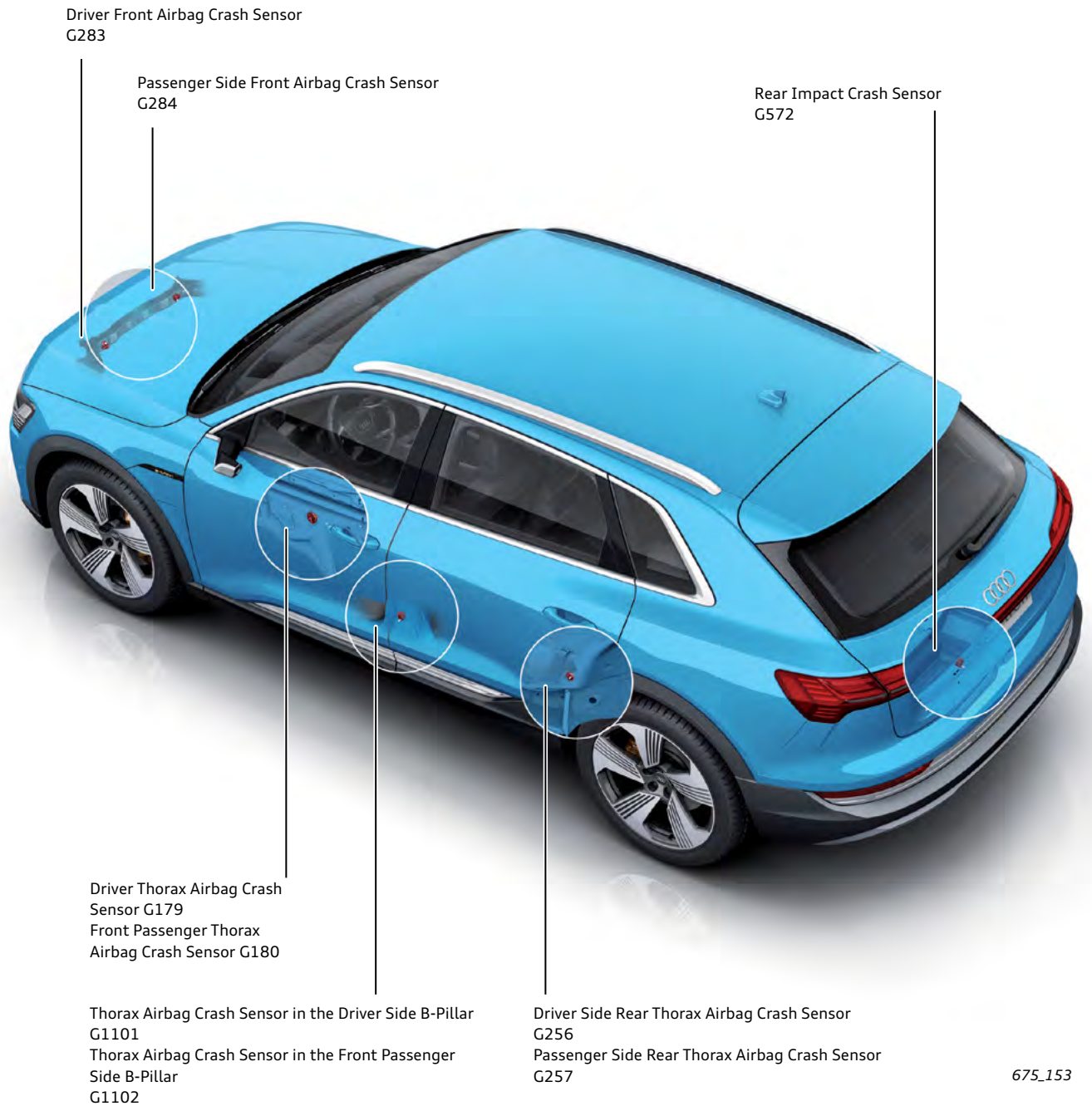
For further information on the high-voltage battery, refer to page 94.

Sensors

Crash sensors

To detect collisions, the Audi e-tron is equipped with the nine external crash sensors listed. In addition, Airbag Control Module J234 has its own internal crash sensors. Unlike the external crash sensors, the internal crash sensors in the airbag control module cannot be renewed separately.

- > Driver Thorax Airbag Crash Sensor G179
- > Front Passenger Thorax Airbag Crash Sensor G180
- > Driver Side Rear Thorax Airbag Crash Sensor G256
- > Passenger Side Rear Thorax Airbag Crash Sensor G257
- > Driver Front Airbag Crash Sensor G283
- > Passenger Side Front Airbag Crash Sensor G284
- > Rear Impact Crash Sensor G572
- > Thorax Airbag Crash Sensor in the Driver Side B-Pillar G1101
- > Thorax Airbag Crash Sensor in the Front Passenger Side B-Pillar G1102



675_153

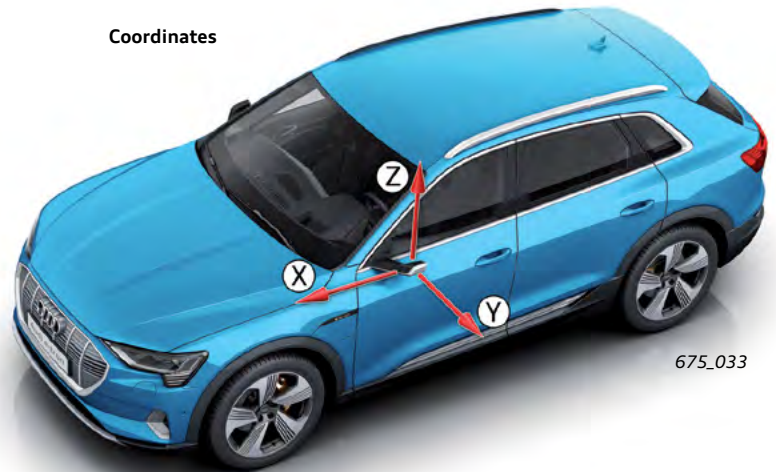
The two crash sensors G179 and G180 are pressure sensors and are installed in the front doors. The pressure sensors measure the pressure/pressure change inside the door.

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

The five crash sensors G283, G284, G1101, G1102 and G572 are bi-axial acceleration sensors that measure the vehicle's acceleration or deceleration. In the Audi e-tron, 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.

Coordinates

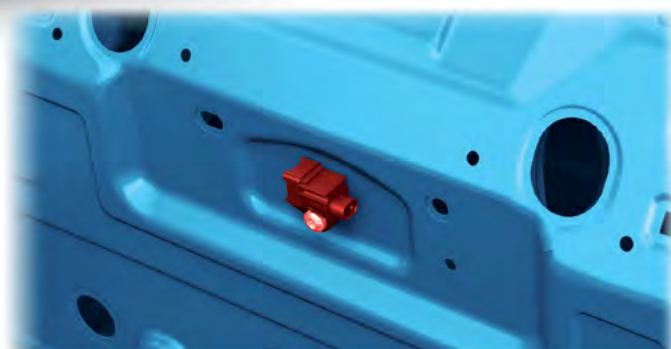


675_033

Rear Impact Crash Sensor G572

G572 is installed in the area of the striker on the rear cross panel.

G572



675_164

Seat occupied sensor on driver side

The driver's seat occupied sensor has the following designation:

- > Driver Side Seat Occupant Detection Sensor G1067.

Installation location

G1067 is in the form of a button and is clipped into the wire frame of the driver seat frame.

Driver-leaves-vehicle concept

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. Airbag Control Module 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 modules 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, is part of the seat belt warning system as is customary. For details on the equipment, please also refer to the system overview on page 150.

Diagnosis

The seat occupied sensors on the driver side and front passenger side are diagnosed via Airbag Control Module J234. J234 can diagnose the following events for both seat occupied sensors:

- > 00 = No text is displayed for this event. This entry appears in the DTC memory if the component in the airbag control module is not encoded (should not have been installed) but has been detected by the control module (component is connected). The reason for this may be that the airbag control module is not the correct one for the vehicle (for example, control modules have been mistakenly switched).
- > 01 = Electrical fault
- > 11 = Short to ground
- > 12 = Short to positive
- > 13 = Open circuit
- > 53 = Deactivated

Driver Side Seat Occupant Detection Sensor G1067



For the seat occupied sensor on driver side, the event "07 = Mechanical fault" can also be diagnosed. This entry appears in the DTC memory if the seat occupied sensor on driver side has been detected as permanently activated for five driving cycles. Note: The event "07 = Mechanical fault" can also be diagnosed for Driver Seat 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.



Reference

For further information on the seat occupied sensors, refer to the following eSelf-Study Programs: [990143, The 2015 Audi A3 Introduction](#), [990263, The 2017 Audi A4 Introduction](#), and [990593, The 2019 Audi A7 Introduction](#).

Active safety

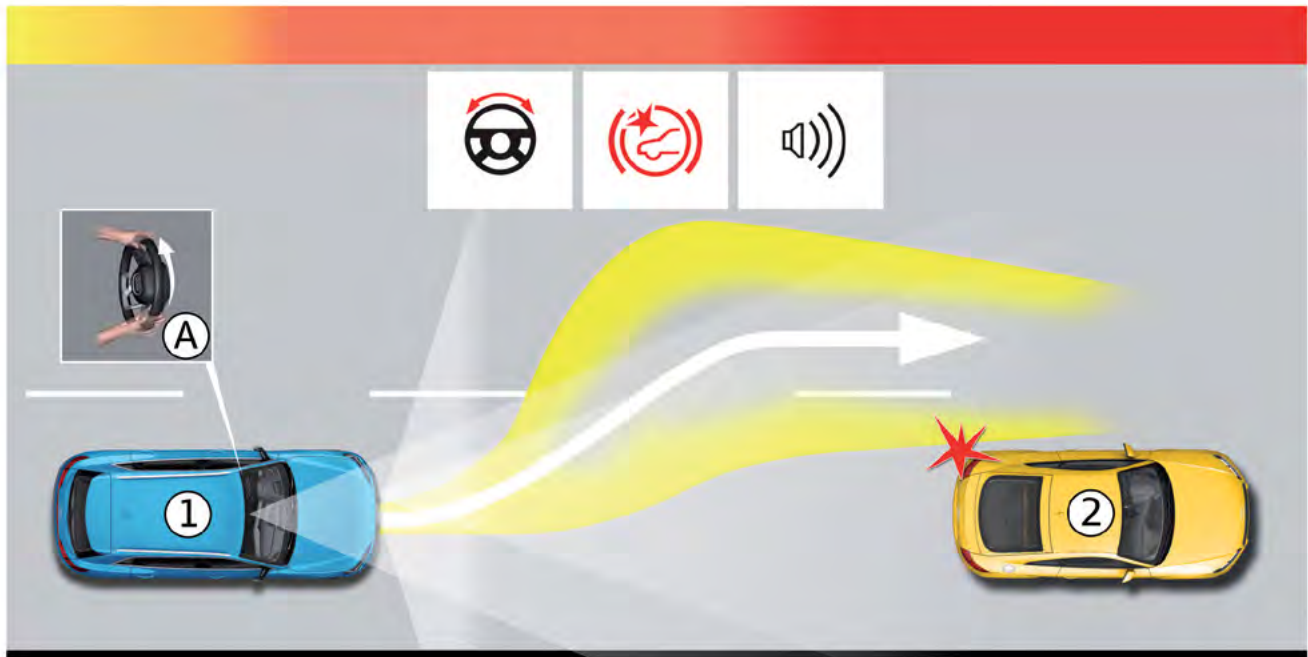
Audi pre sense

The Audi e-tron has the same pre sense functions as the 2019 Audi A8. 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:

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

Audi pre sense collision avoidance assist



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)	Ⓐ	Driver's steering/swerving movements



Reference

For further information on the Airbag Control Module J234 and Audi pre sense, please refer to eSelf-Study Program 990493, [The 2019 Audi A8 Introduction](#).

Infotainment and Audi connect

Introduction and overview of versions

The Audi e-tron features the MIB2+ version of the modular infotainment matrix infotainment system. Only one version will be available in the North American Region:

- > MMI navigation plus with MMI touch response.

It is based on the high version of MIB2+ and has the same two MMI displays.

In the North American Region customers receive the Audi connect emergency call (eCall) and all vehicle-specific connect services, including the Audi connect e-tron services, as standard. Control Module for Emergency Call Module and Communication Unit J949 (also referred to internally as the connectivity box) is responsible for transmitting the information for these features.

This control module, which controls vehicle-specific services together with the gateway, was first introduced in the North American market with the 2019 Audi A7 and is now being introduced for the EU and other markets.

MMI navigation plus with MMI touch response (I8T + 7UG)



10.1" touch display with
1540 x 720 pixels

8.6" touch display with
1280 x 660 pixels

12.3" Audi virtual cockpit plus (9S9)

3D navigation system on SSD (7UG)

FM radio

Audi music interface with 2 USB A sockets, 1 SIM card reader¹⁾
and 1 SDXC card reader (UF7)

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 sound system (9VD)

Digital radio (QV3)

Single DVD drive (7D5)

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 light (for wireless charging only) (9ZV)^{1) 3)}

12.3" Audi virtual cockpit (9S1) (Future availability)

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

Preparation for Rear Seat Entertainment (9WQ)

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 antenna) is available.



Reference

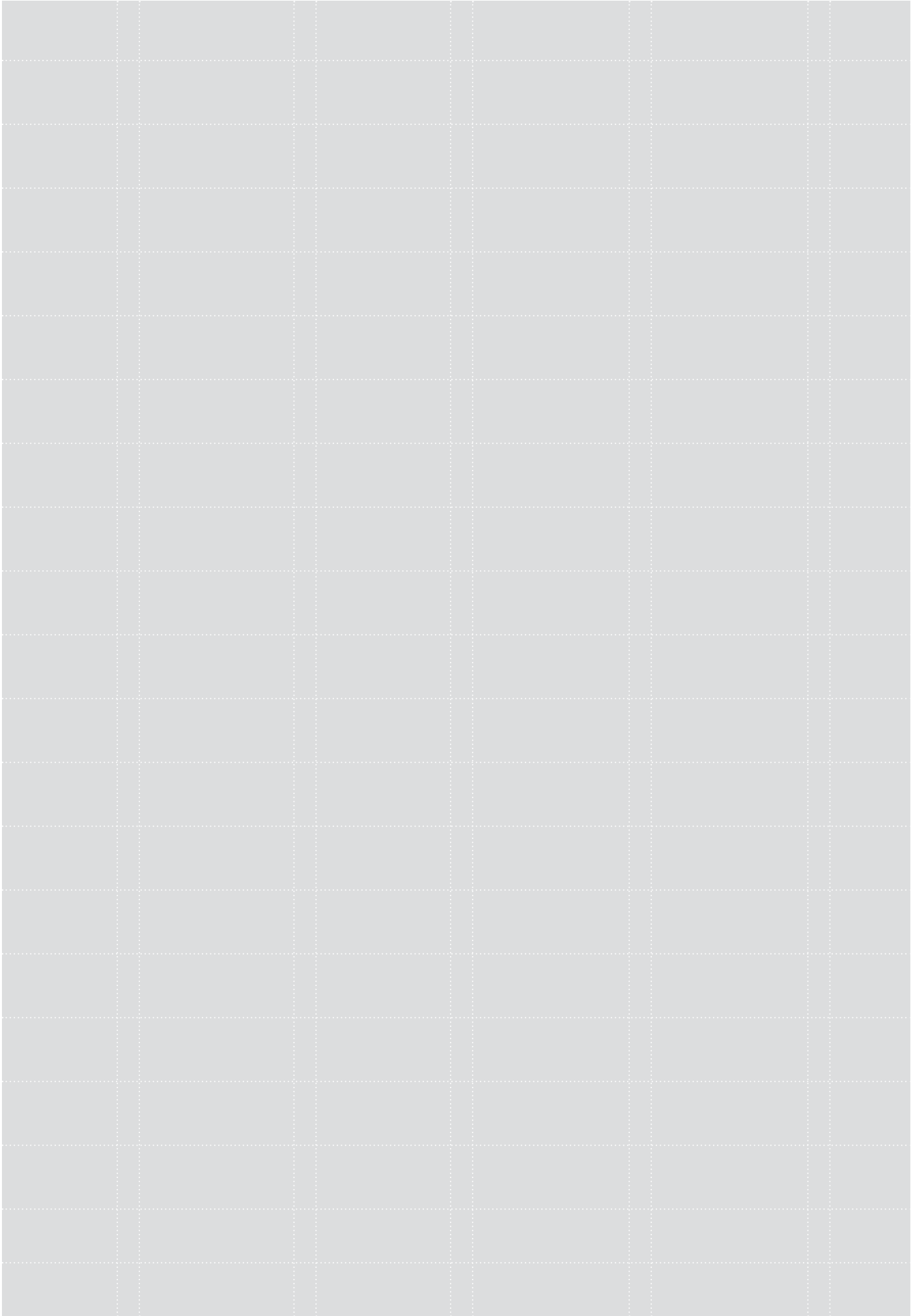
For further information on Control Module for Emergency Call Module and Communication Unit J949, please refer to eSelf-Study Program [990593, The 2019 Audi A7 Introduction](#).



Reference

For further information on MIB2+, refer to eSelf-Study Program [990293, The 2019 Audi A8 Infotainment and Audi Connect Systems](#).

Notes



Sound systems

The Audi sound system (9VD) is standard for the Audi e-tron. This has 10 loudspeakers and delivers 180 watts over 6 channels.

Audi sound system (9VD)



Center Speaker
R208

Left Front
Treble Speaker
R20

Left Front
Bass Speaker
R21



Right Front
Treble Speaker
R22

Right Front
Bass Speaker
R23

Right Rear
Treble Speaker
R16

Right Rear
Bass Speaker
R17

Left Rear
Bass Speaker
R15

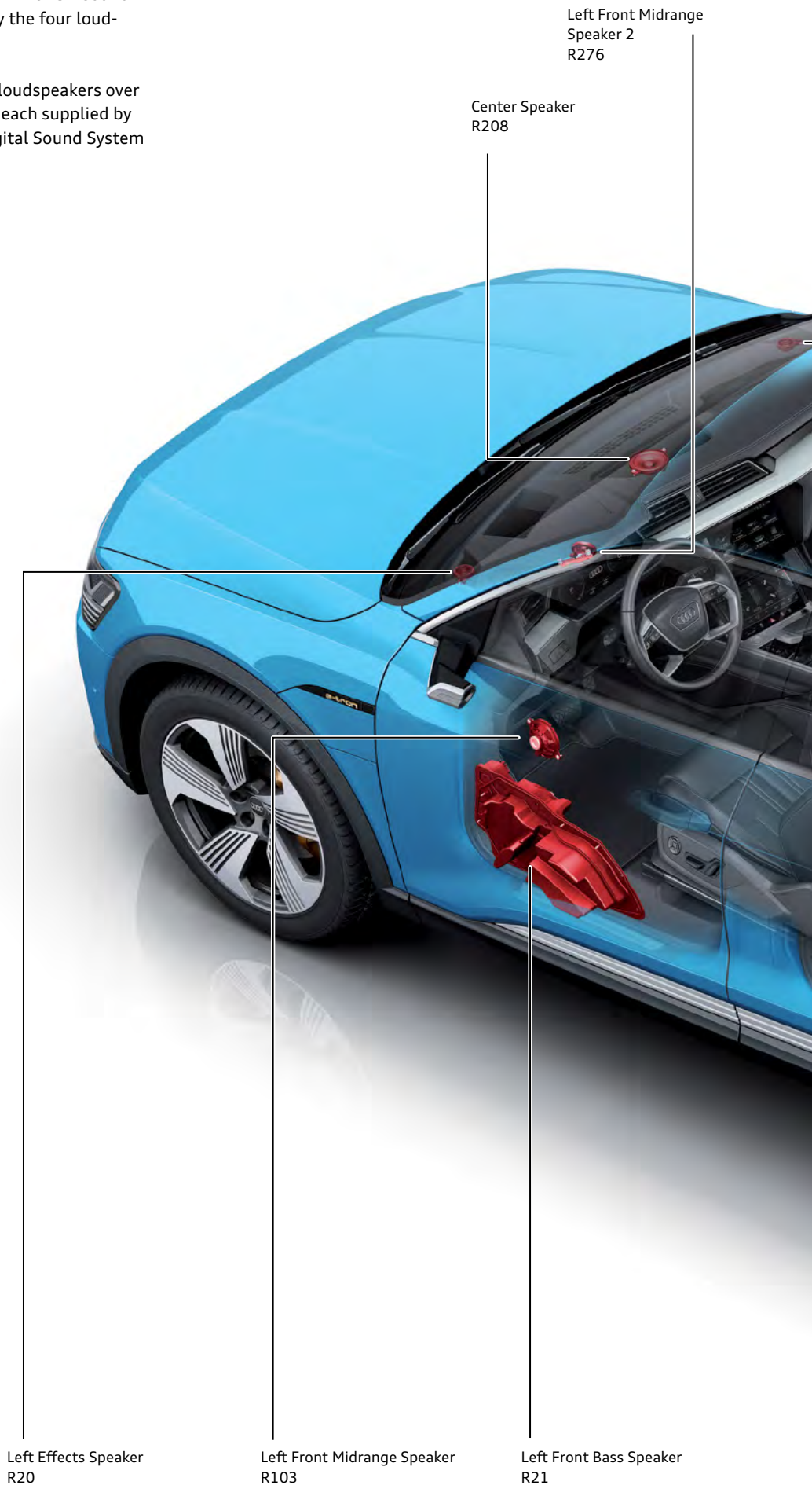
Left Rear
Treble Speaker
R14

Subwoofer
R211

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 delivers 705 watts to its 16 loudspeakers over 15 channels. The speakers in the rear doors are each supplied by one channel. The subwoofer is connected to Digital Sound System Control Module J525 via two channels.





Right Front Midrange Speaker 2
R277

Right Front Midrange Speaker
R104

Right Effects Speaker
R210

Right Front Treble Speaker
R22

Right Front Bass Speaker
R23

Right Rear Treble Speaker
R16

Right Rear Bass Speaker
R17

Left Rear Bass Speaker
R15

Left Rear Treble Speaker
R14

Left Effects Speaker
R209

Digital Sound System Control Module
J525

Subwoofer
R211

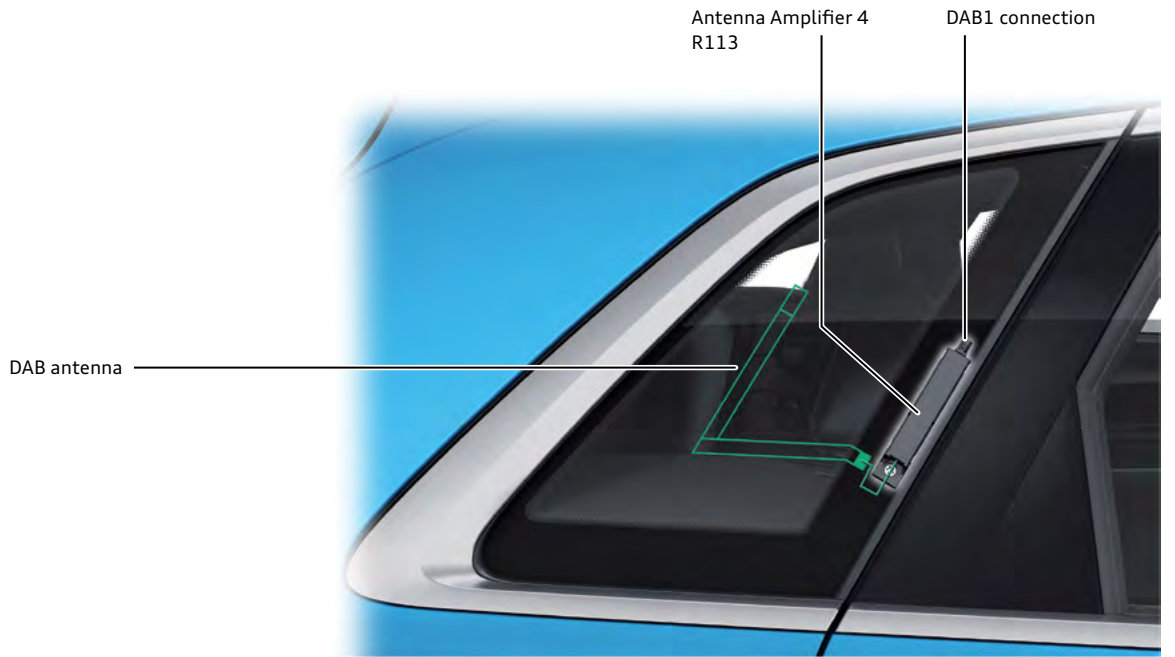
Antennas

In the Audi e-tron, the mobile telephone, GPS and radio antennas 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.

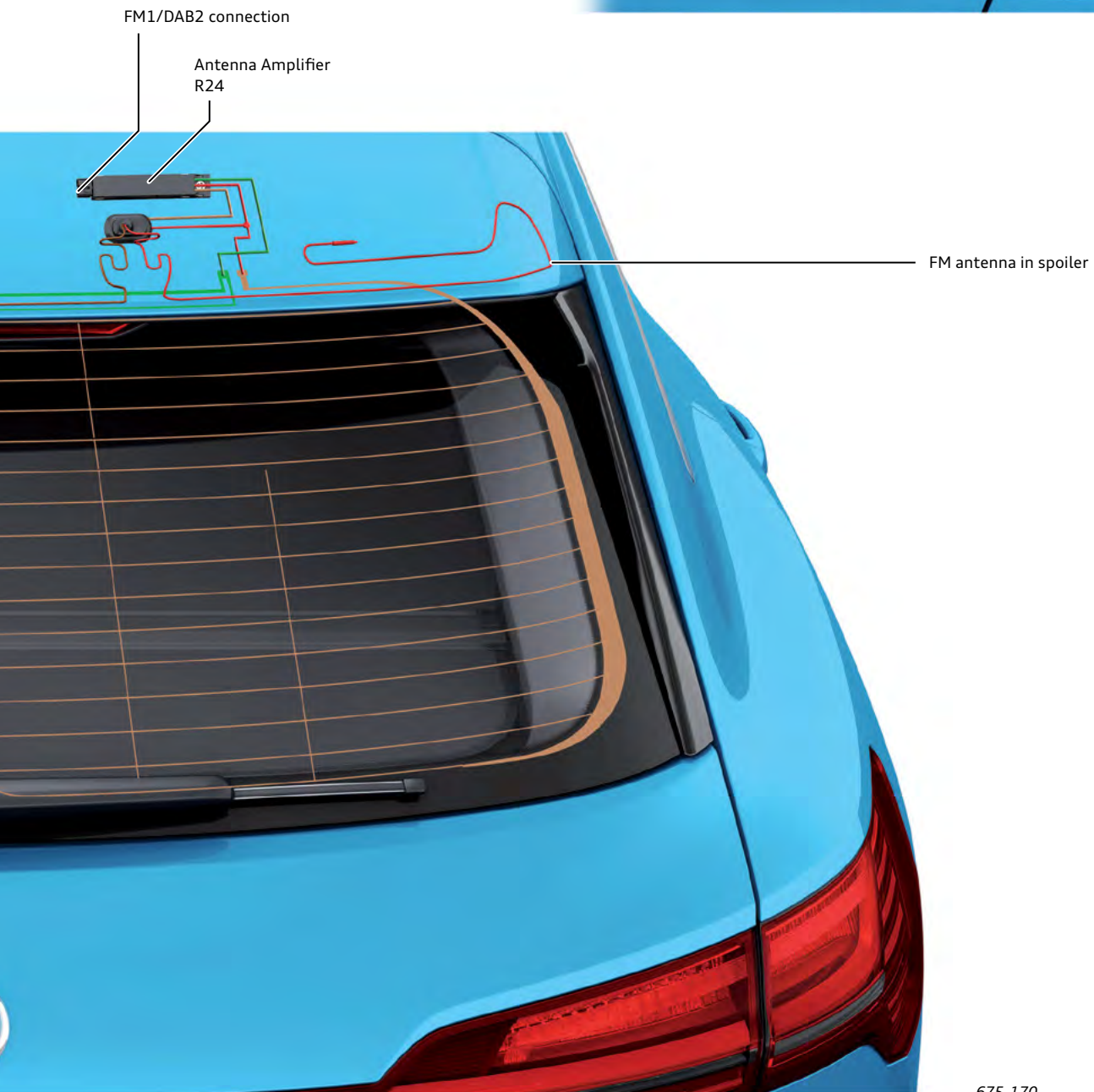
Radio antennas

The antennas for radio are integrated in the rear window, the rear right side window and the rear spoiler.





675_169



675_170

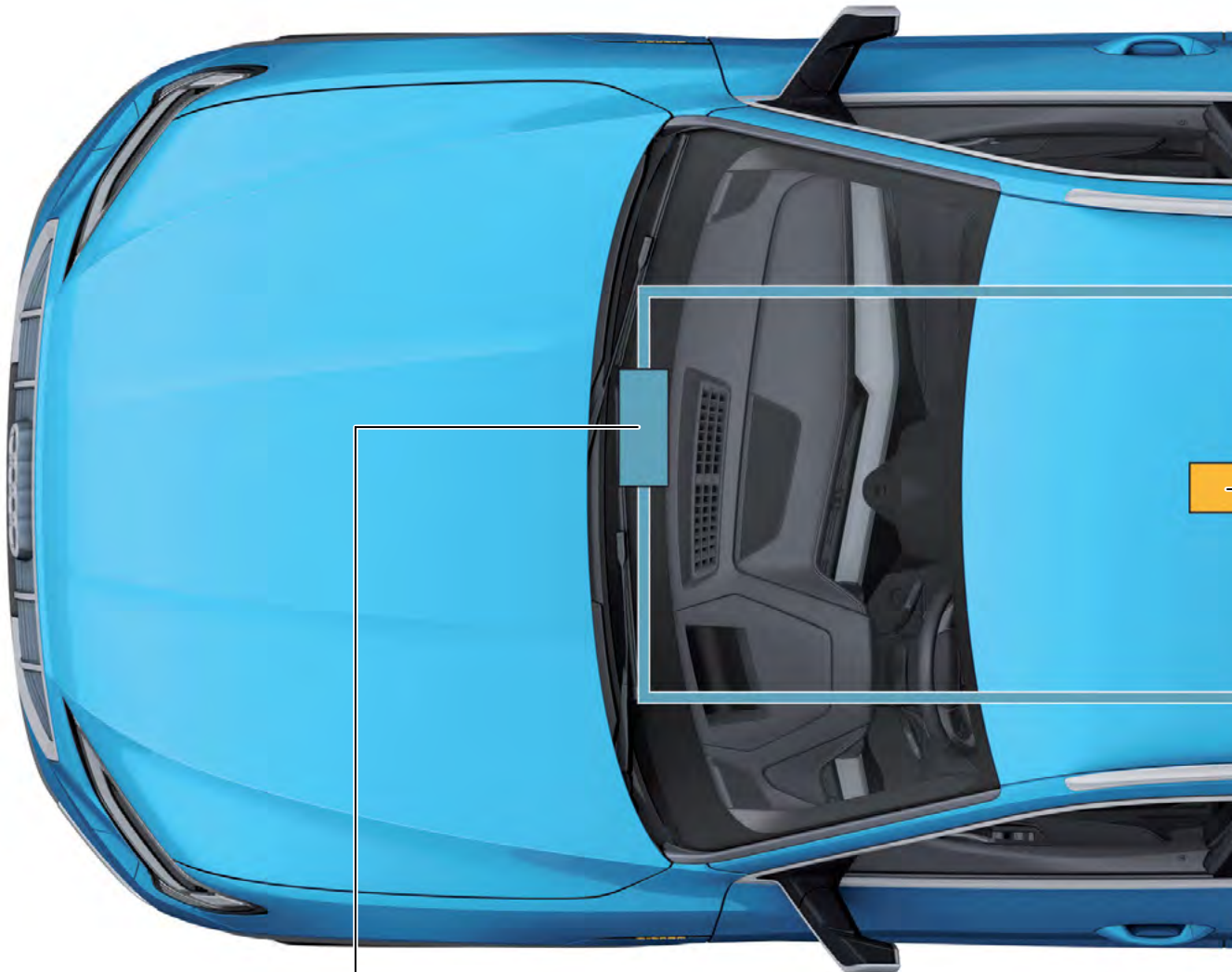
Mobile phone antennas

The Audi e-tron comes with the Audi connect emergency call and Audi connect vehicle-specific services (IW3) as standard. Control Module for Emergency Call Module and Communication Unit J949, which is responsible for these services, is located under the rear seat. It is permanently connected to Emergency Call Module Antenna R263 (main antenna in rear bumper) and Emergency Call Module Antenna 2 R322 in the area of the rear left belt retractor.

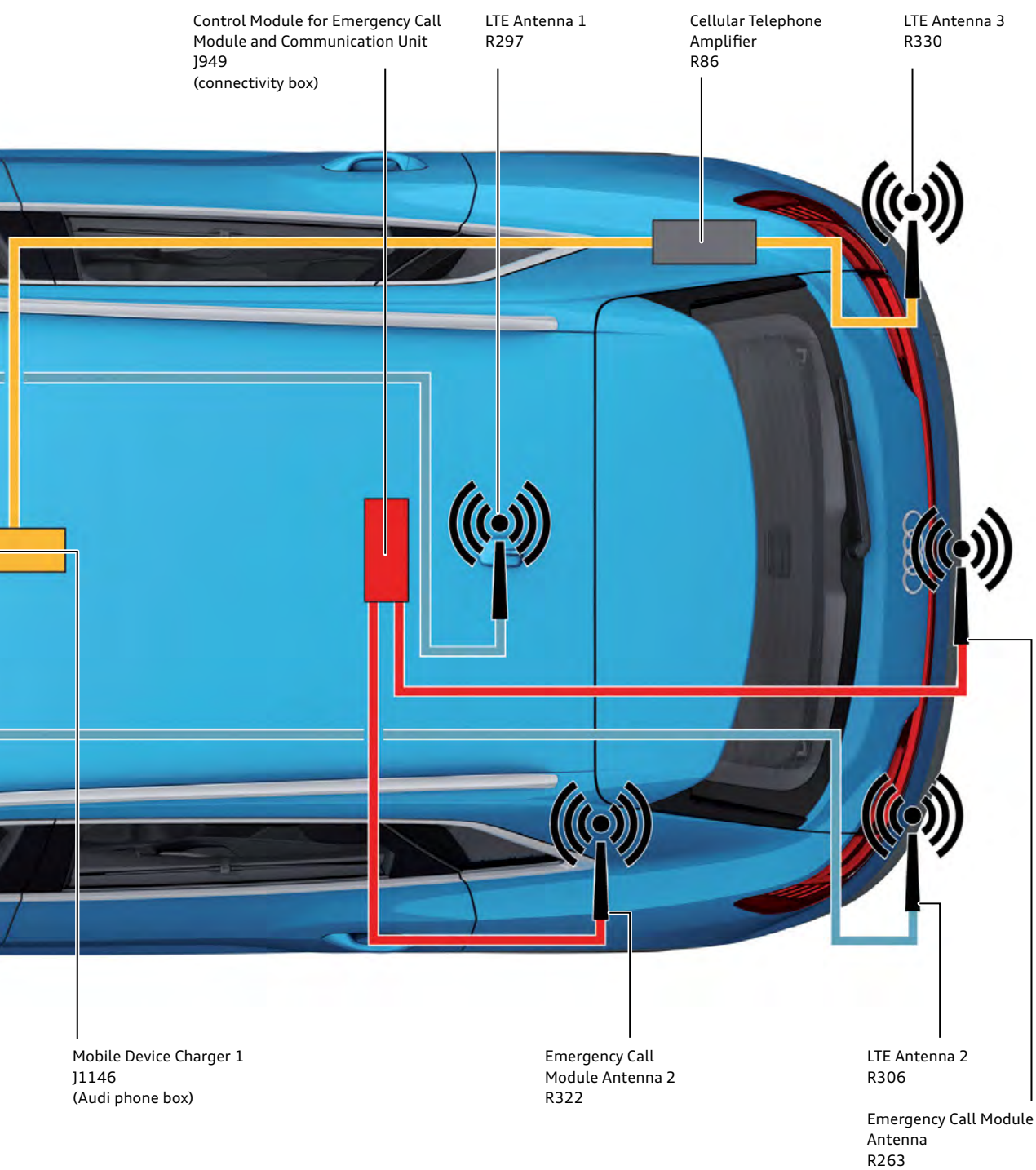
If the vehicle is equipped with the Audi phone box, an LTE-enabled antenna integrated in the rear bumper (right-side) is responsible for communication. Cellular Telephone Amplifier R86 boosts the signal for the telephone. It is located in the luggage compartment (right-side).

The two LTE antennas 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 antennas. The antenna in the bumper is used only to receive signals.

Mobile phone antennas



Information Electronics Control Module
J794



675_195

Inspection and maintenance

Overview

The following service intervals are displayed:

Inspection	TBD
Pollen filter change interval	TBD
Brake fluid change interval	TBD
Air improvement system Flacons in the cabin fragrance system function unit GX43	TBD

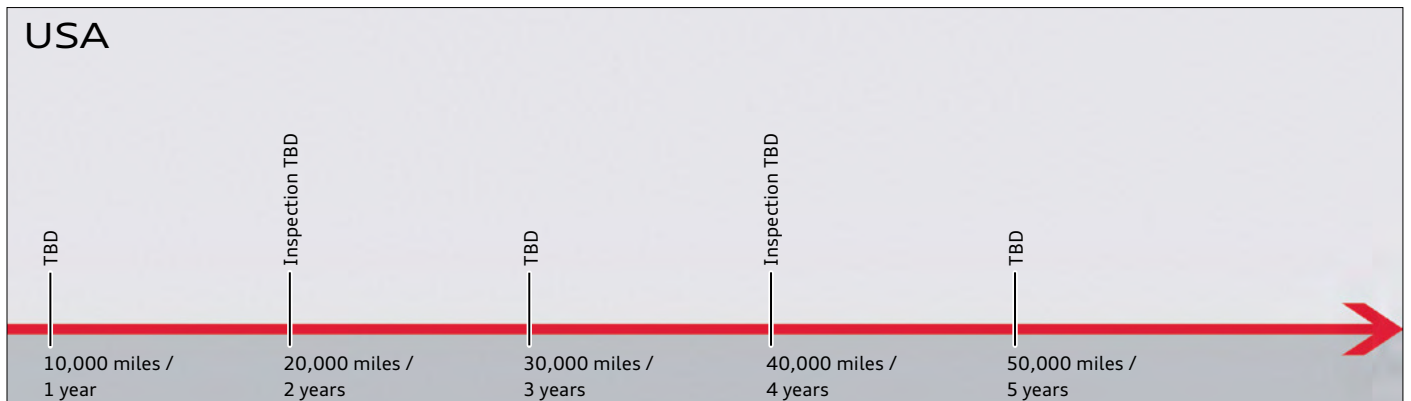


Note

The coolant reservoir of the front electric drive must be emptied approximately every 20,000 (30,000 km) or 2 years during a service. The coolant reservoir of the rear electric drive is replaced at the same intervals.

Overview of service intervals for vehicles in the USA

The e-tron is subject to fixed inspection and maintenance intervals in the USA.



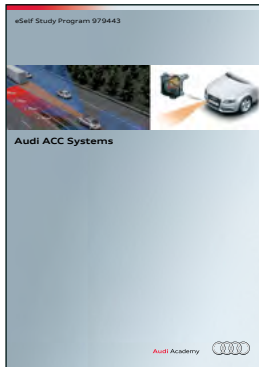
Note

Always refer to the electronic service information for inspection and maintenance procedures.

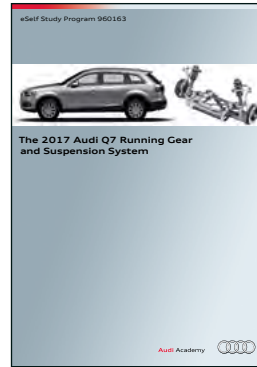
Appendix

eSelf-Study Programs

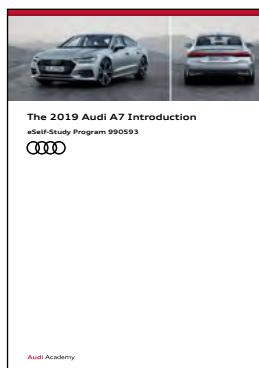
For more information on the technology featured on the Audi e-tron, please refer to the following eSelf-Study Programs.



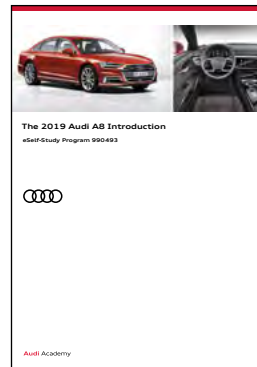
[979443](#)
[Audi ACC Systems](#)



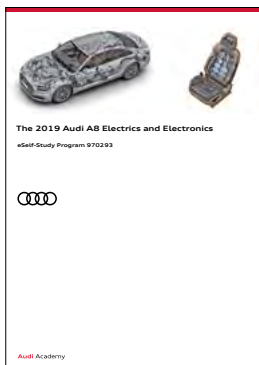
[SSP 960163](#)
[The 2017 Audi Q7 Running Gear and Suspension System](#)



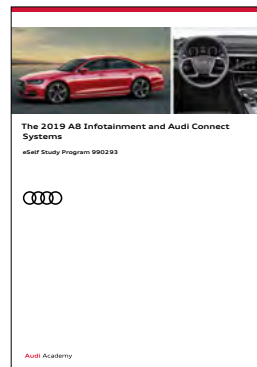
[SSP 990593](#)
[The 2019 Audi A7 Introduction](#)



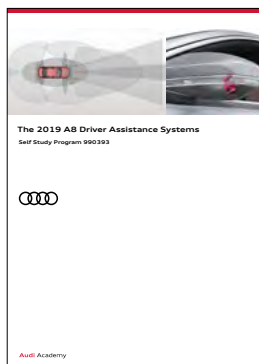
[SSP 990493](#)
[The 2019 Audi A8 Introduction](#)



[SSP 970293](#)
[The 2019 Audi A8 Electrical and Electronics](#)



[SSP 990293](#)
[The 2019 Audi A8 Infotainment and Audi Connect Systems](#)



[SSP 990393](#)
[The 2019 Audi A8 Driver Assistance Systems](#)

Knowledge assessment

An On-Line Knowledge Assessment (exam) is Available for this eSelf-Study Program.

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- > Click on the “App Links”
- > Click on the “Academy site CRC”

Click on the Course Catalog Search and select “990993b - The 2019 Audi e-tron Introduction assessment”

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