Brake servo

Use is made of a tandem vacuum-type brake servo (8+9 inch, basic design as for A4 and A6). In comparison to the A4 and A6, the transmission ratio has been increased to 7:1.
The inlet valve flow characteristics have been optimised and the valve closing distance shortened. This results in far quicker and more precise servo response accompanied by a greatly improved operating feel.
With V8 petrol engines, vacuum is supplied by a suction jet pump driven by the intake manifold vacuum.
An electric vacuum pump is employed for the V6 petrol engine.

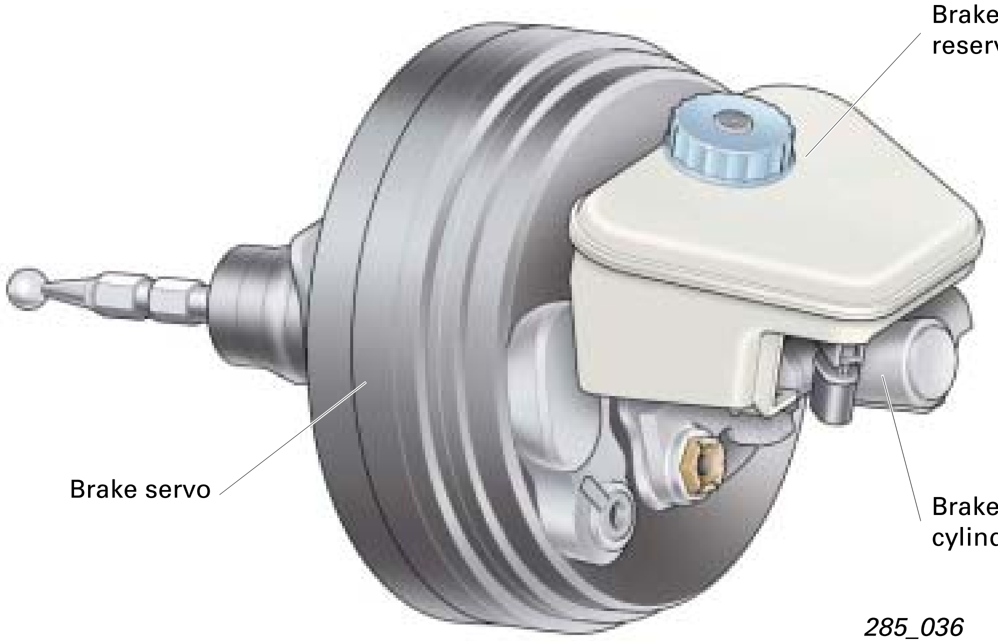
Brake master cylinder

Use is made of a tandem brake master cylinder.
As compared to the A4 and A6, the piston diameter was increased to 26.99 mm with a total stroke of 36 mm (18/18).
The central valves of both brake circuits (diagonal configuration) have been designed for optimum flow. This permits the use of a self-priming ESP unit without a separate charging pump.
These changes and the above-mentioned modifications to the brake servo result in a significant reduction in pedal travel prior to brake response in conjunction with less pedal force. Active safety is thus enhanced by shortening the stopping distance.

Brake fluid reservoir

The brake fluid reservoir is a separate component fitted into the brake master cylinder.

For design reasons, the brake fluid reservoir is never to be completely drained, as this would permit the ingress of air into the pipes on account of the position of the connections. Refer to the current Workshop Manual for procedure for changing brake fluid.

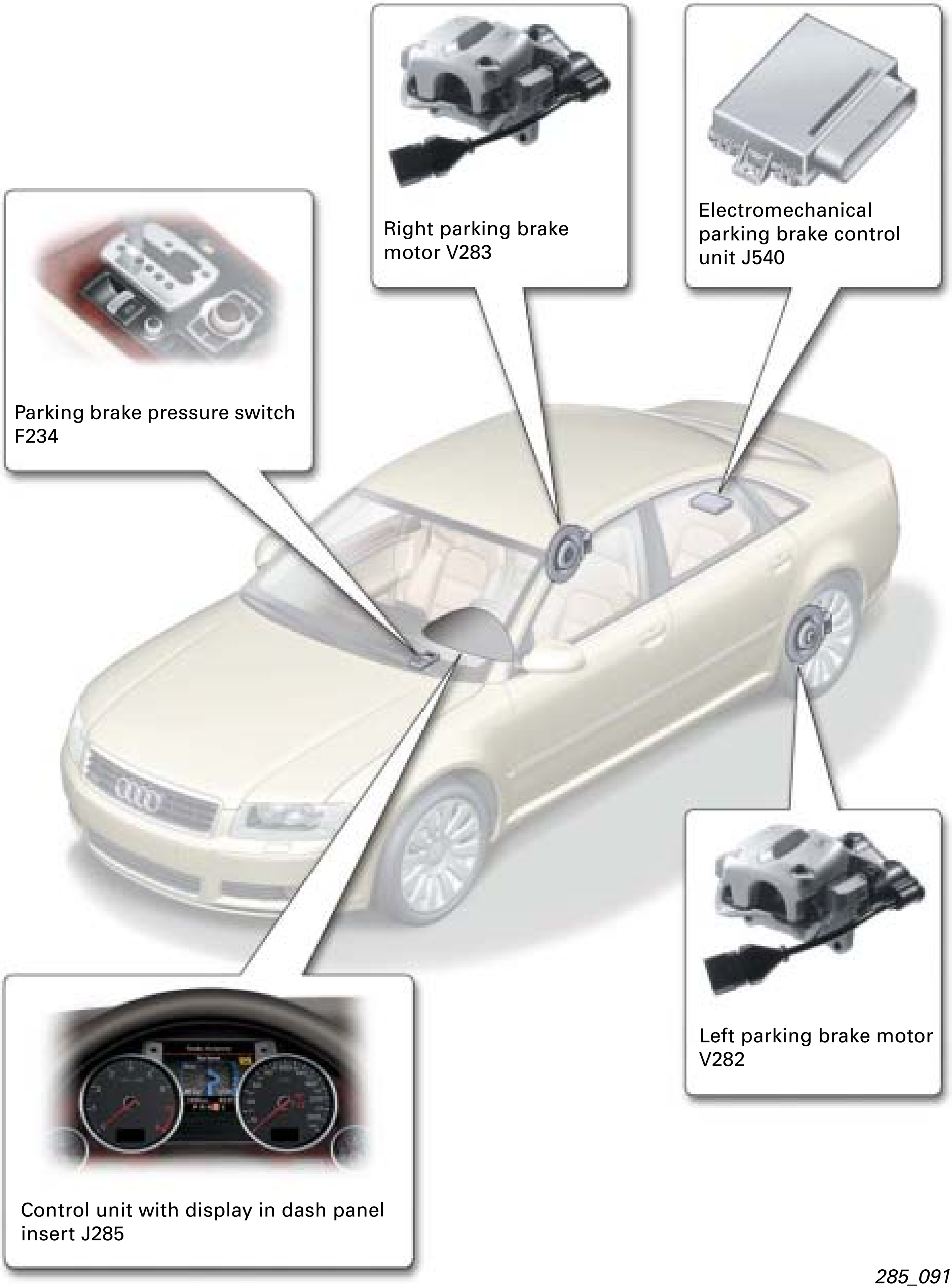


285_036

Notes

Electromech. Parking Brake

Summary



285_091

Operation and display

The parking brake is actuated by the pressure switch F234 in the centre console.
The brake is applied by pulling the switch.
It is released by pressing the switch and at the same time pressing the brake or accelerator pedal.

The electromechanical parking brake can still be applied by pulling the switch even when the ignition is off. The ignition must however be switched on for the brake to be released.

285_041

Application of the parking brake is indicated by the parking brake display in the dash panel insert and a lamp in the switch.

Parking brake display

285_042

Electromech. Parking Brake

System components

Control unit J540

The control unit is fitted beneath the battery on the right side of the luggage compartment.
From the battery, the left and right parking brake motors V282/283 are actuated separately.
There are two processors in the control unit. Release decisions are taken by both processors.
Data transfer is by way of the drive system CAN (refer to "Data transfer").
The control unit contains an integrated micromechanical tilt angle sensor.

285_043

Parking brake motors V282/283

Design:

The brake pads are mechanically tensioned by way of a spindle mechanism. The thread on the shaft is self-locking.
The spindle is driven by a swash plate mechanism.

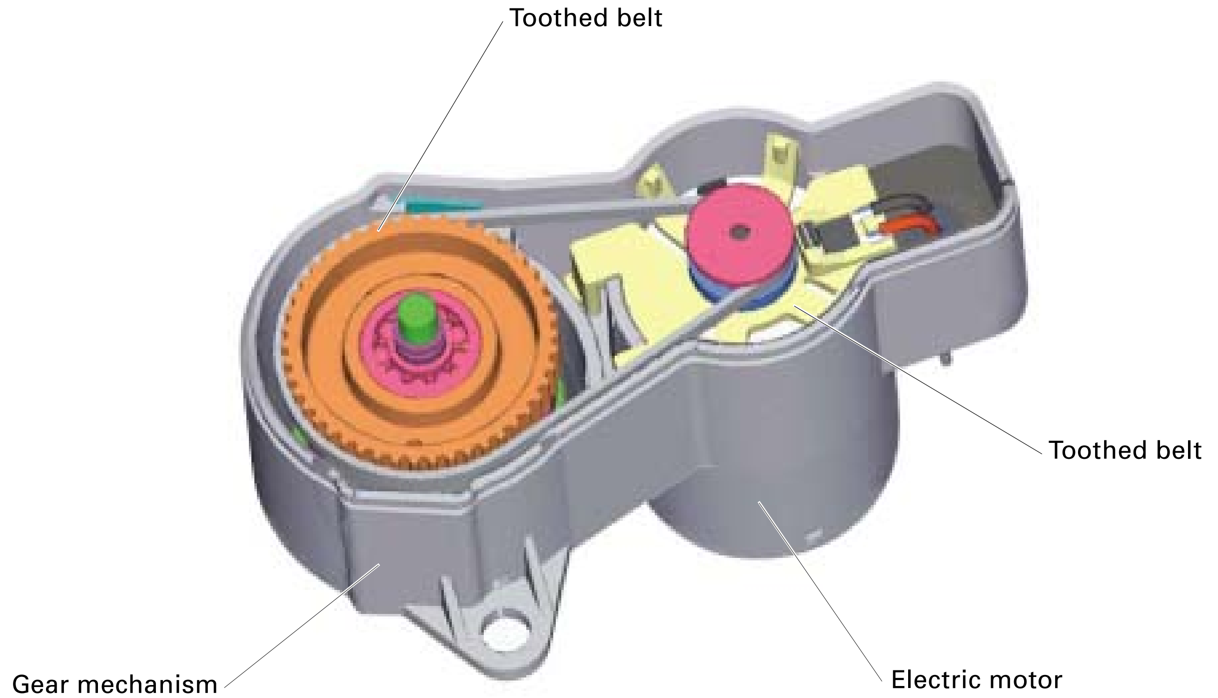
The mechanism is driven by a DC motor.
The mechanism and motor are flanged to the brake caliper.

285_072

Operation:

Implementation of the parking brake function involves translating the rotation of the drive motor into a very short brake piston stroke. This is achieved through the use of a swash plate mechanism in conjunction with the spindle drive.

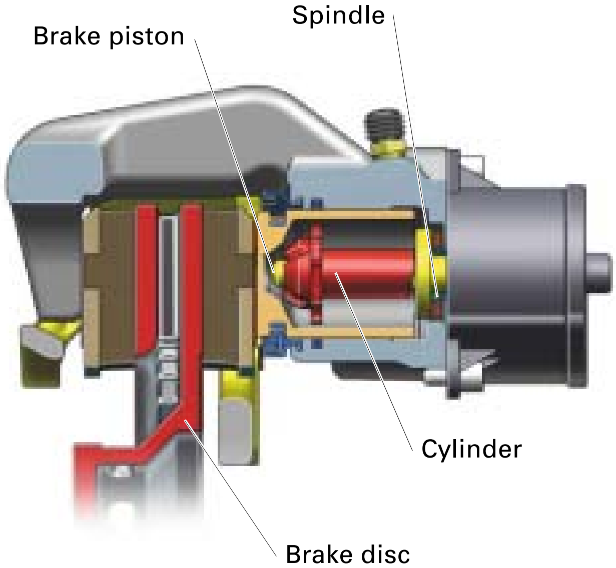
There are three transmission stages. The first reduction stage (1:3) is achieved by the motor/gear mechanism input toothed belt drive. The swash plate mechanism is responsible for the second stage.
A speed reduced by a factor of 147 with respect to the electric motor drive speed is available at the gear mechanism output.



285_044

Electromech. Parking Brake

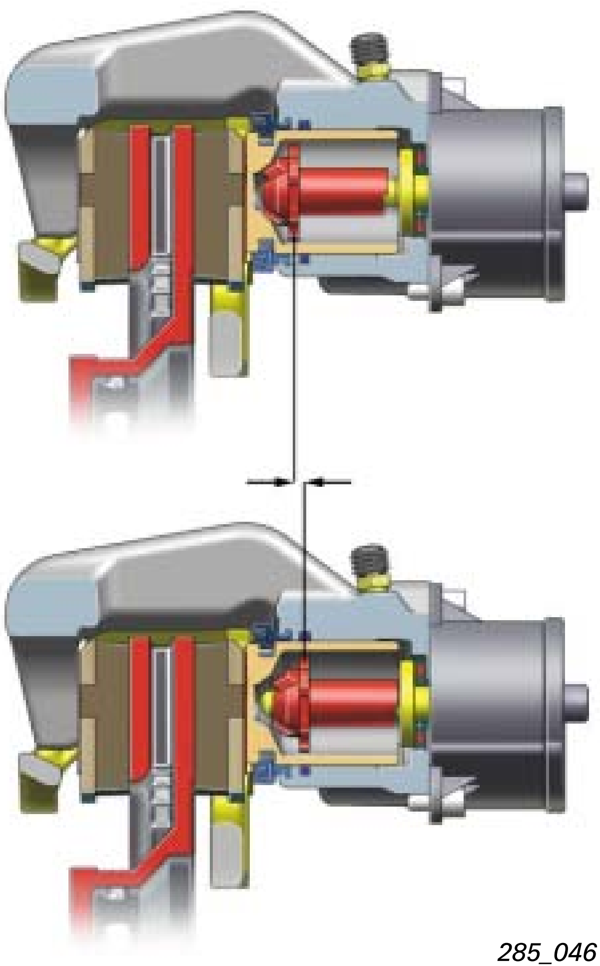
A spindle which drives the brake piston is responsible for converting the rotation into a stroke.
The spindle is driven directly by the swash plate mechanism. A cylinder is mounted such that it can slide axially in the brake piston.
Two plane surfaces stop the cylinder turning.
The flared section at the end of the cylinder is provided with a forcing nut. Rotation of the spindle moves the forcing nut on the spindle thread.
The number of motor revolutions is measured by a Hall sensor.
This enables the piston stroke to be calculated by the control unit.



285_045

Parking brake application:
The nut moves forwards on the spindle. The cylinder makes contact with the piston.
Cylinder and piston are pressed against the brake disc.

Parking brake release:
The nut is screwed back on the spindle, thus relieving the load on the cylinder.
The recovery of the sealing ring moves the piston back and releases the brake disc.

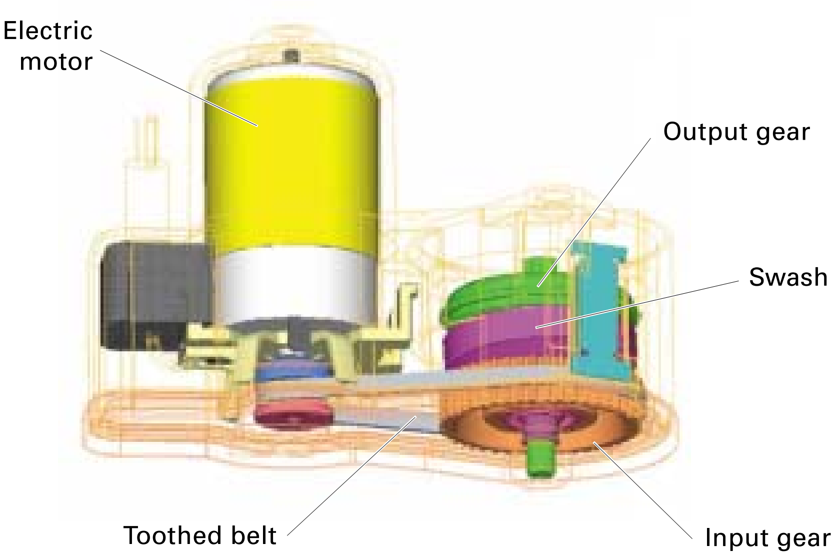


285_046

Mode of operation of swash plate mechanism

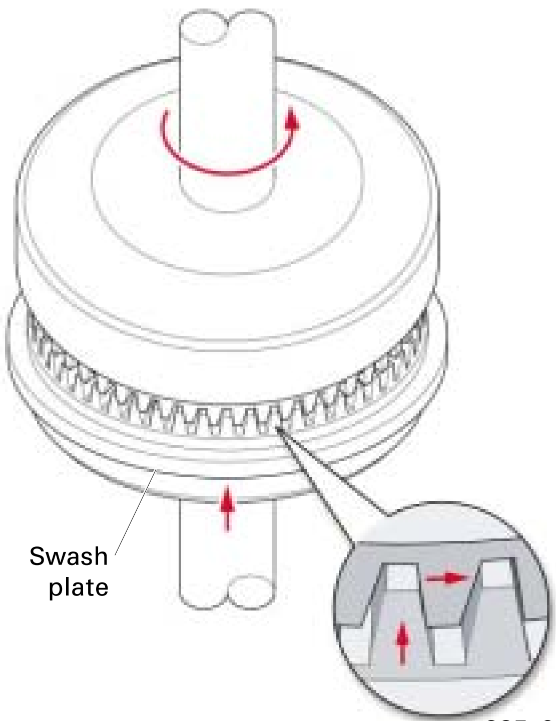
A wheel (swash plate) with bevelled splines is mounted on the input gear. It is mounted obliquely with respect to the input gear shaft.

This causes the plate to wobble as the input gear rotates.
The plate is fixed in position by keyways in the gear housing. It cannot turn freely.



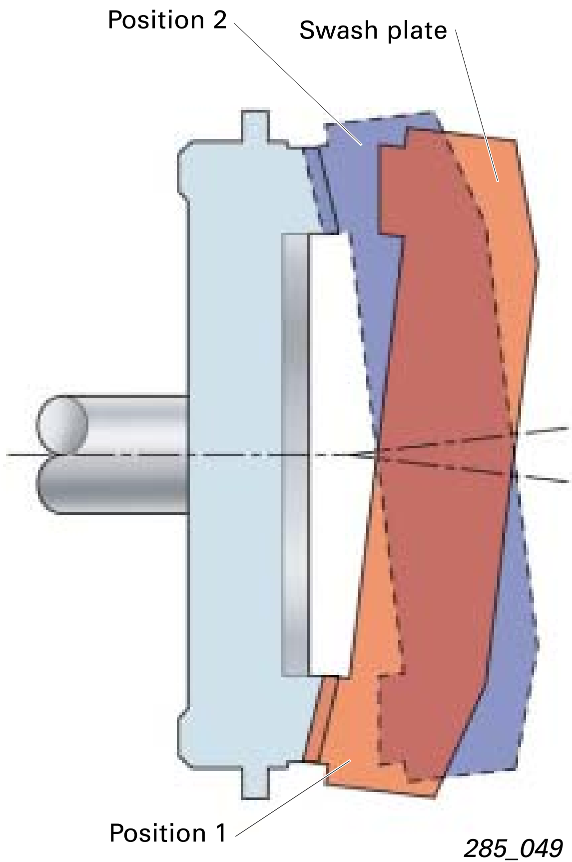
285_047

The swash plate has 51 teeth, the output gear 50 teeth.
As a result of this so-called "pitch error", the swash plate teeth always make contact with the flanks of the output gear and never coincide with the tooth spaces.
Consequently, the output gear is moved on by a small angle of rotation.



285_048

Two output gear teeth are meshed with two swash plate teeth in the course of one revolution of the input gear. The wobble causes the second pair of teeth (position 2) to be meshed after half a revolution of the swash plate. In position 1, the output gear is moved on such that the tooth of the swash plate again makes contact with an output gear flank in position 2. As a result of this sequence, each half revolution moves on the output gear and the spindle connected to it by half a tooth face width.



285_049

Functions

The following functions are provided by the electromechanical parking brake:

- Parking brake function
- Dynamic emergency braking function
- Adaptive starting-off assistant
- Brake pad wear recognition and play correction

Parking brake function

The tensioning force set by the system is sufficient for all driving situations. A text message in the dash panel insert centre display warns the driver in the event of gradients exceeding 30 %.
Activated status is indicated by lamps in the switch and dash panel insert.

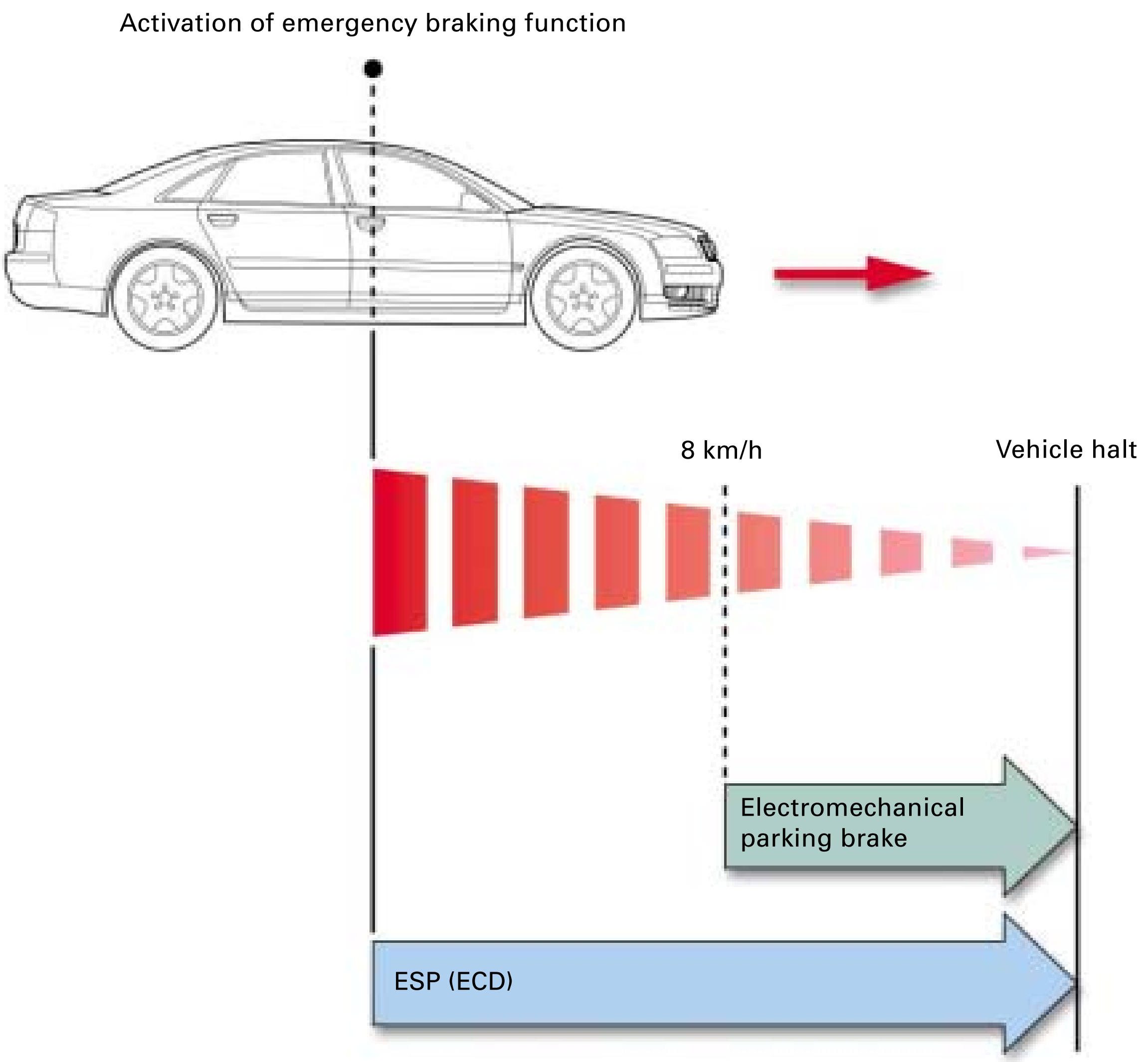
The brake is automatically re-tensioned if the disc cools down after parking the vehicle. For this purpose, the current disc temperature is constantly established by way of a simulation model in the control unit.

Dynamic emergency braking function

Pulling the parking brake pressure switch F234 slows the vehicle at a maximum deceleration rate of 8 m/s^2.
Operation corresponds to that of the handbrake lever. The vehicle is braked as long as the switch is pulled. Braking action is terminated on releasing the switch.

If the vehicle is travelling at a speed of more than 8 km/h, braking is implemented by the ESP. With the accelerator pedal still pressed, engine torque is reduced to idling level and brake pressure is built up by the ESP assembly at all four wheel brakes. The cruise control system is deactivated if in operation.

Actuation of the switch at vehicle speeds below 8 km/h causes the parking brake to be applied.
To prevent possible incorrect operation (triggered for example by the front passenger), active emergency braking function is deactivated as soon as the accelerator is pressed again.



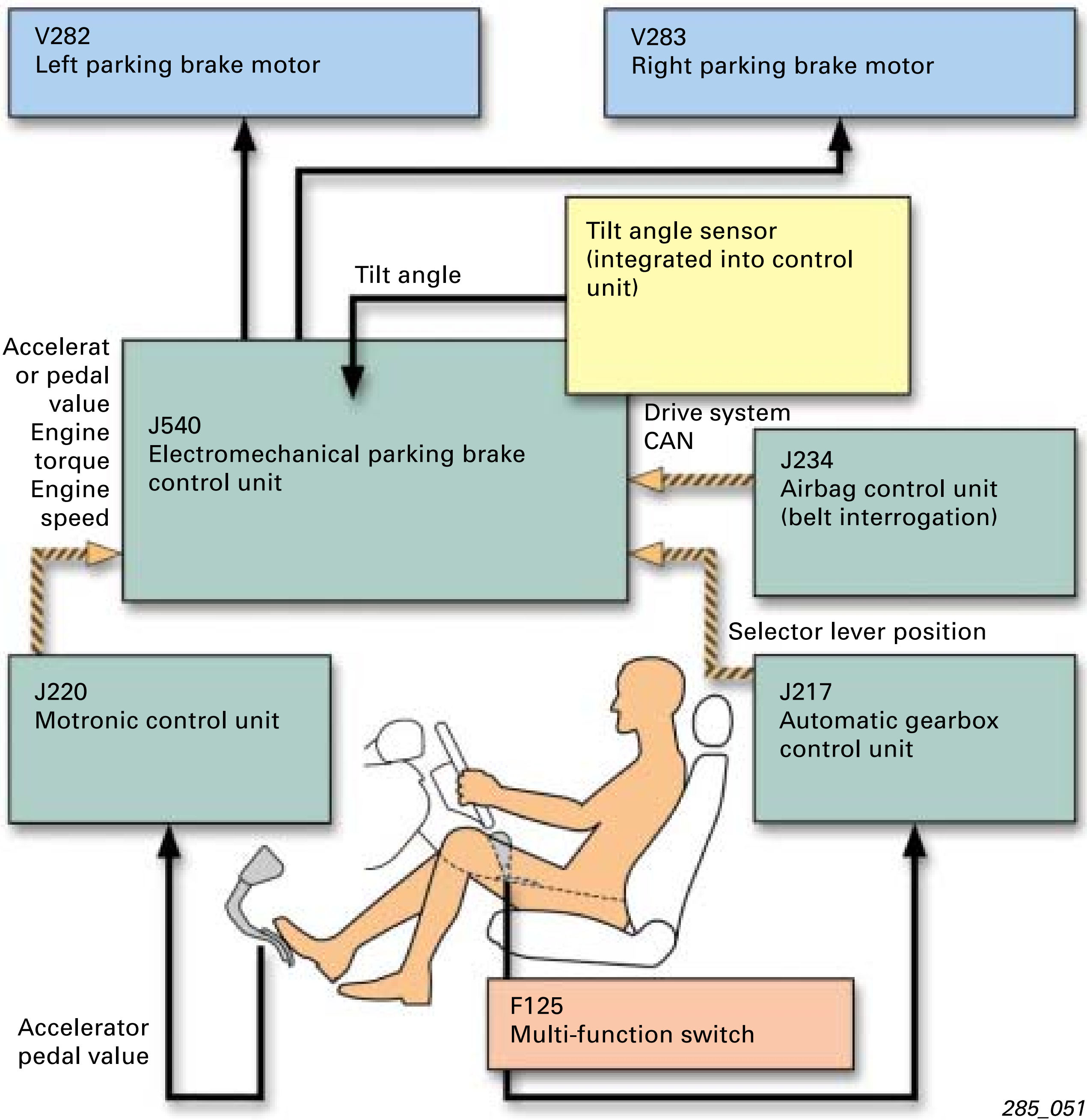
285_050

Electromech. Parking Brake

Adaptive starting-off assistant

This function permits smooth hill starting and stops the vehicle rolling back. The function is only activated if seat belt is fastened.
The tilt angle is measured by a sensor in the control unit. In addition, the control action makes allowance for engine torque, accelerator pedal position and gear selected.
The parameters listed above govern the point at which the parking brake is released when driving off.

Automatic calibration of the tilt angle sensor and starting-off parameters takes place constantly.
Whenever the vehicle is started on the flat, its acceleration behaviour is evaluated and adjusted for control purposes to the parameter set stored in the control unit.
The function can be deactivated at the workshop but not by the driver.



285_051

Brake pad wear recognition and play correction

The pad thickness is automatically determined cyclically (approx. every 500 km) with the vehicle stationary and the parking brake not applied. For this purpose the brake pad is moved out of neutral position (= end position) towards the brake disc. The control unit uses the value measured by the Hall sender to calculate the brake pad travel and thus the pad thickness.

Measurement is performed with the vehicle parked, the ignition lock applied and the parking brake released.

If drivers regularly use the parking brake, the wear measurement may be less precise than if the parking brake is seldom applied.

Special system functions

Pad change mode

Pad change is performed using the diagnosis tester VAS 5051 with the parking brake not applied.
In basic setting function 5, the cylinder is fully retracted by the spindle drive (refer to Releasing parking brake on Page 38). The pad can be replaced after resetting the brake piston with the special tool VAS T10145.

In basic setting function 6, the cylinder is moved back towards the piston (refer to Applying parking brake on Page 38).
The pad thickness is entered in adaption function 6 (for detailed information, refer to current Workshop Manual).

Roadworthiness test mode

Metered braking on a dynamometer is necessary for checking parking brake operation.
Roadworthiness test mode is recognised after 3 seconds if the rear wheels are turning at a constant speed of between 3 and 9 km/h on the dynamometer roller.
Terminal 15 must be on for this purpose.

The parking brake application action is modified by the control unit:
Each time the switch is actuated, the piston is moved by a defined small amount and the brake applied slightly more.

Emergency release

An applied parking brake can be released mechanically if electrical actuation is no longer possible or in the event of mechanical problems with parking brake components. An emergency key is provided for this purpose in the vehicle tool kit.
The vehicle is to be jacked up and the appropriate wheel removed.

The Torx head at one end of the key is used to remove the actuator from the brake caliper. The spindle can then be turned with the opposite end of the emergency key until the brake is released.

285_085

Fault displays

Flashes constantly if parking brake has not been properly applied. Flashing on actuating parking brake pressure switch F234 indicates a wiring fault.

285_086

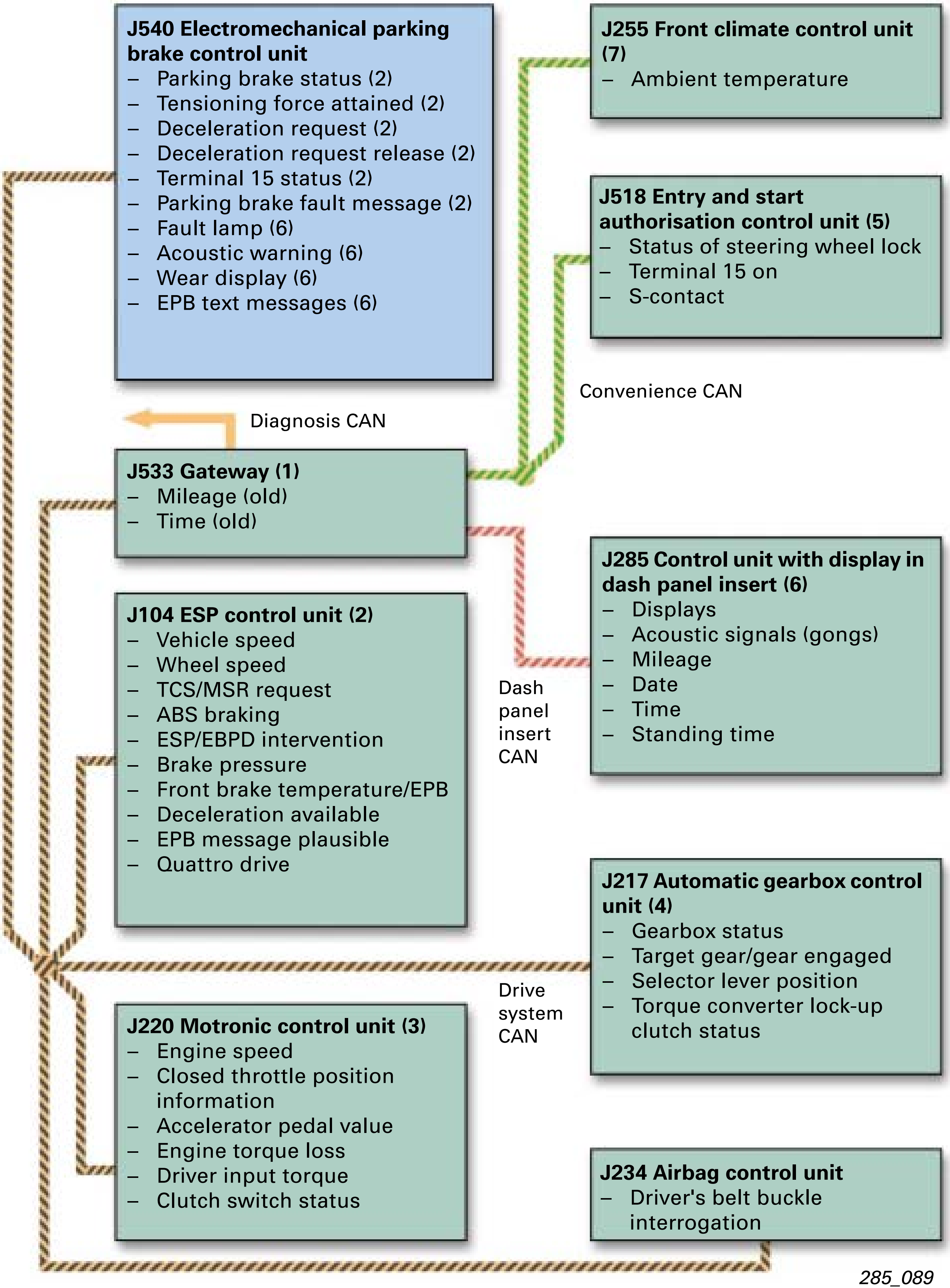
Fault detected by control unit restricting operation.

285_087

System fault; vehicle should no longer be driven for safety reasons.

285_088

Electromechanical parking brake CAN data exchange



285_089

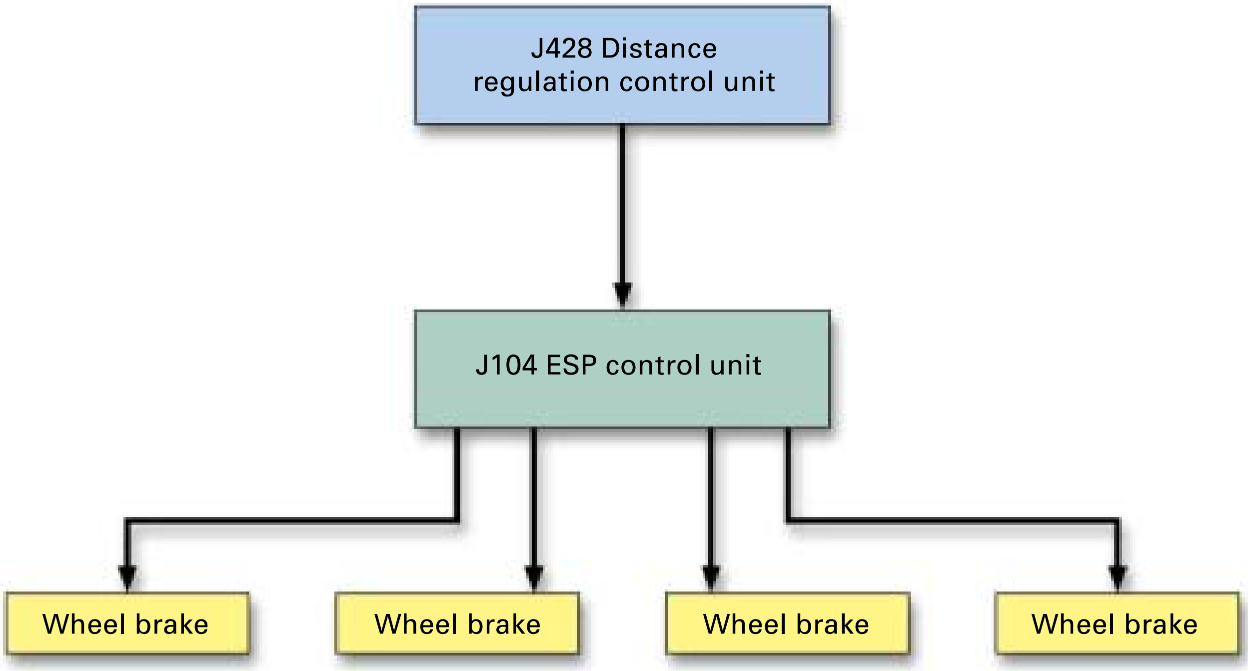
Summary

The Audi A8 `03 is fitted with the ESP 5.7 already used in the Audi A4. In addition to the necessary software adaptation to the new vehicle, the main new features are as follows:

Communication interface ECD
(**el**ectronically **c**ontrolled **d**eceleration)

The interface enables other vehicle systems to actuate the ESP. The ESP control unit J104 can be informed directly of deceleration requests. The ECD request involves deceleration of the vehicle at a maximum rate of 8 m/s^2.

Brake pressure is built up evenly at all four wheels.
The interface in the A8 is used by the electromechanical parking brake and adaptive cruise control functions.



285_052

Active speed sensors

The new sensors detect the corresponding wheel speed directly at the wheel bearing by way of magnetic multipoles.
Direction of rotation and size of air gap are also determined (refer to System components for design and operation).

285_053

New software modules

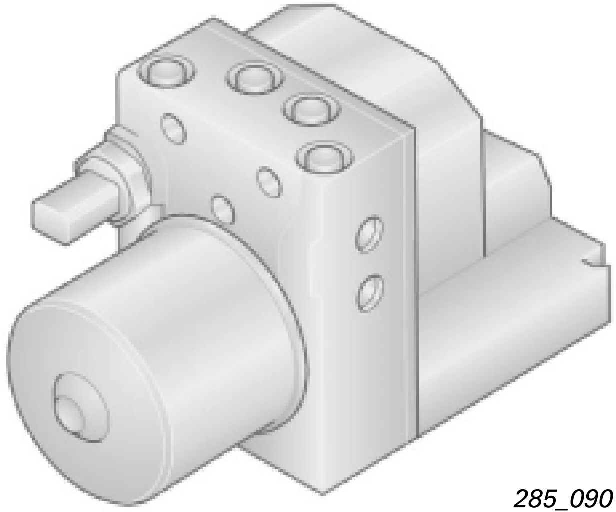
The TCS function has been upgraded to include improved traction on non-compacted surfaces (e.g. deep snow).
Greater wheel slip values are accepted for acceleration when travelling straight ahead or with small steering angle.
Directional stability has priority when cornering. The permissible slip values are reduced.

ESP control action is reduced if a sporty driving style is required. Directional stability is maintained but larger float angles are permitted, leading to higher wheel slip values in transverse vehicle direction.
A sporty driving style is recognised from evaluation of accelerator pedal actuation.

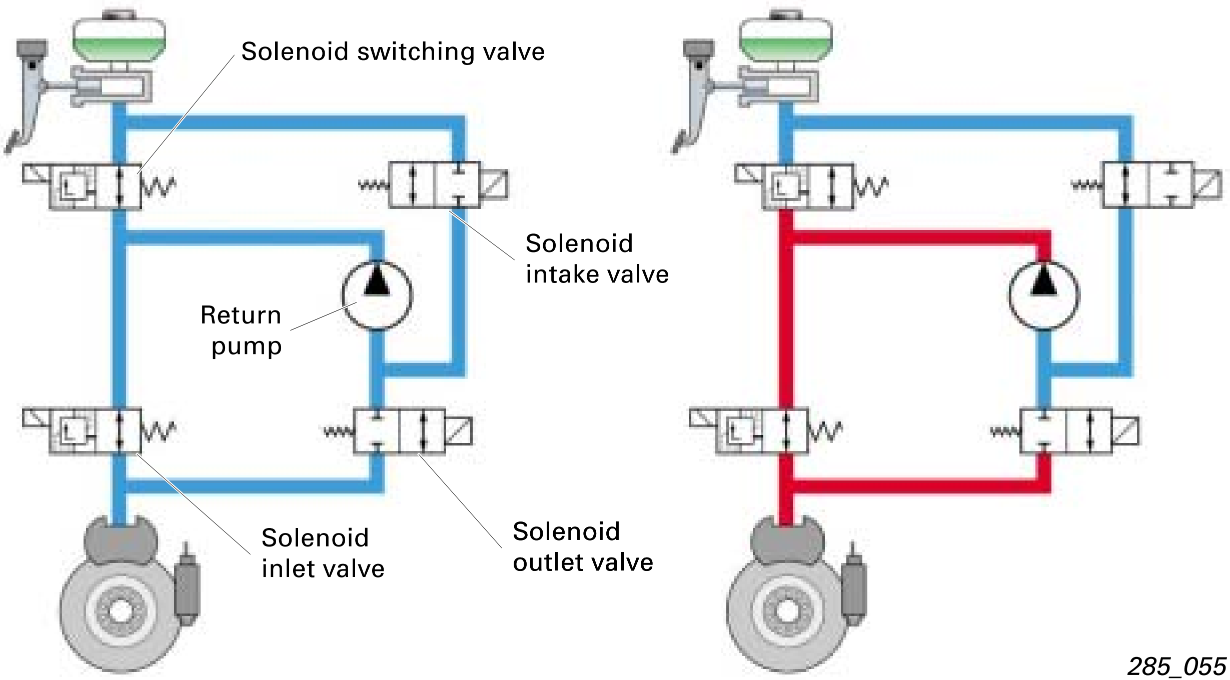
System components

Hydraulic modulator

The basic version of the hydraulic modulator corresponds to that in the Audi A4.
Compliance with noise level requirements with adaptive cruise control action necessitates the use of integrated suction dampers. These take the form of small chambers which dampen brake fluid pulsation by way of rubber diaphragms.
This modified modulator is used exclusively in vehicles fitted with adaptive cruise control.
Attainment of a high level of braking comfort requires the use of the linear solenoid inlet and switching valves developed for the ESP 5.7.



285_090



285_055

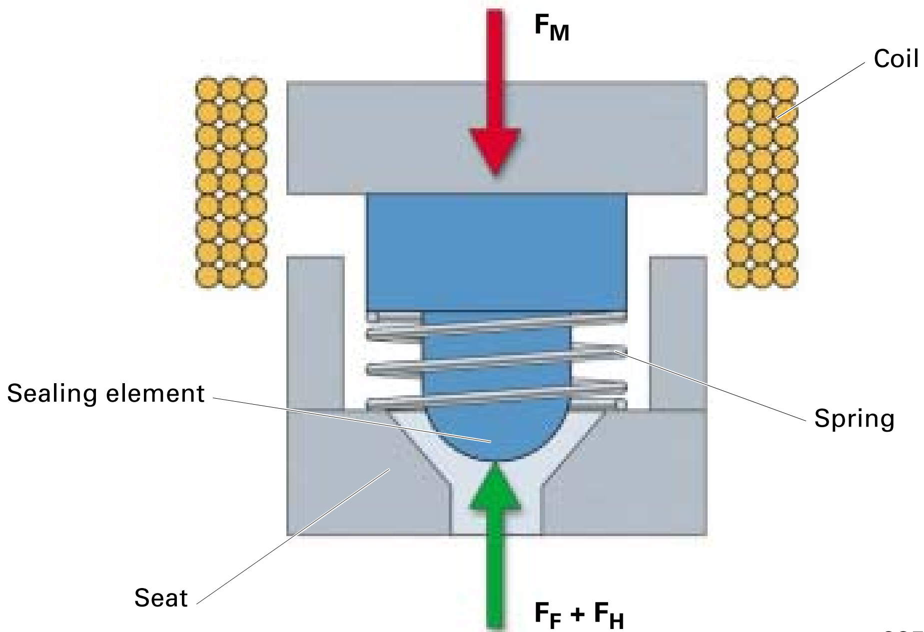
ECD request not active: Valves deenergised
Driver can regulate brake pressure by way of open solenoid switching and inlet valves.

Pressure build-up in response to ECD request:
Solenoid switching and intake valves energised, return pump suction action via open solenoid intake valve and pump regulates brake pressure.

Mode of operation of linear solenoid valves

Application of current to the coil of the solenoid valve causes a magnetic force F_M to act on the sealing element.
The sealing element is pressed onto the seat in the valve housing. The forces exerted by the spring (F_F) and the hydraulic fluid (F_H) act in opposition to the magnetic force.
If F_F+F_H becomes greater than F_M, the sealing element is lifted off the seat and the valve opens. The higher the valve actuation current, the greater the hydraulic fluid pressure must be to open the valve.

Varying the current level makes it possible to set different opening pressures.
In addition, the valve stroke (= valve opening cross-section) can be set in the range between valve closed and valve fully open.
This mode of operation enables the brake pressure to be varied as required.
Such action is a prerequisite for comfortable vehicle deceleration.

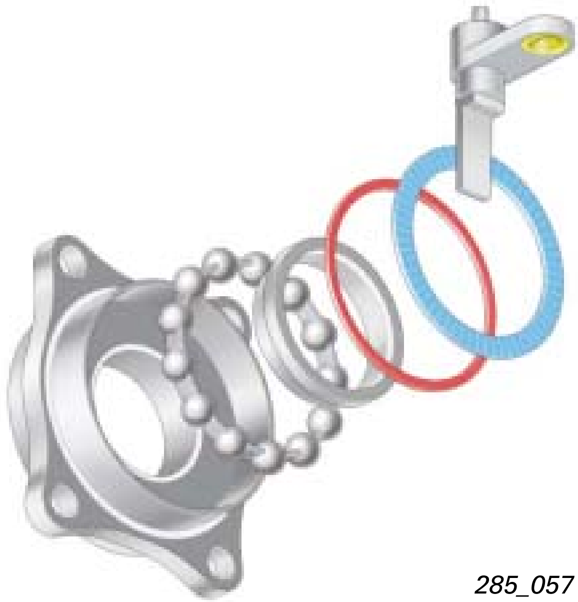


285_056

Speed sensors G44-47

Design:

The measuring element is a Hall sensor consisting of three Hall elements.
The conventional sensor ring is replaced by a magnetised wheel bearing seal carrying 48 pairs of north/south poles (multipole).

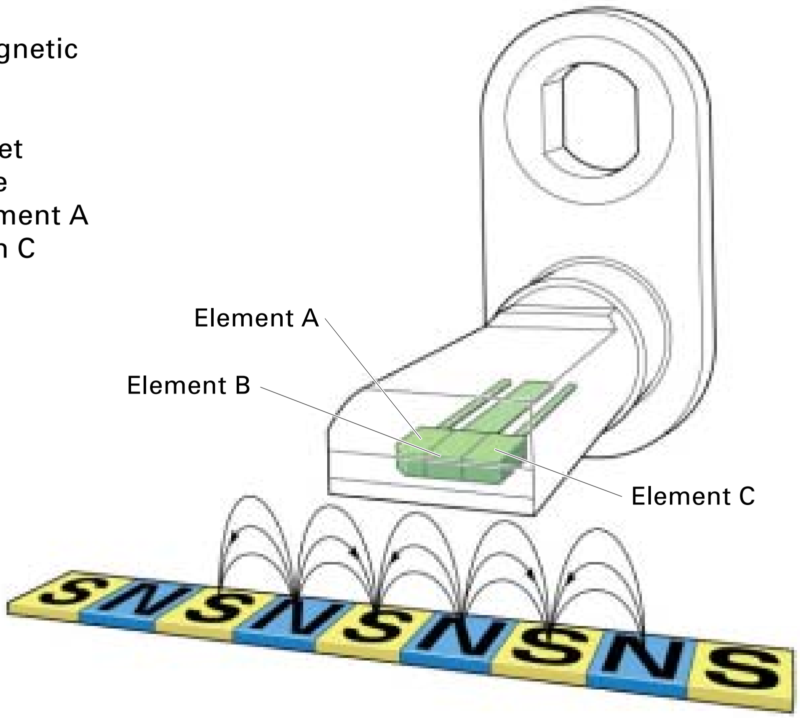


285_057

Operation

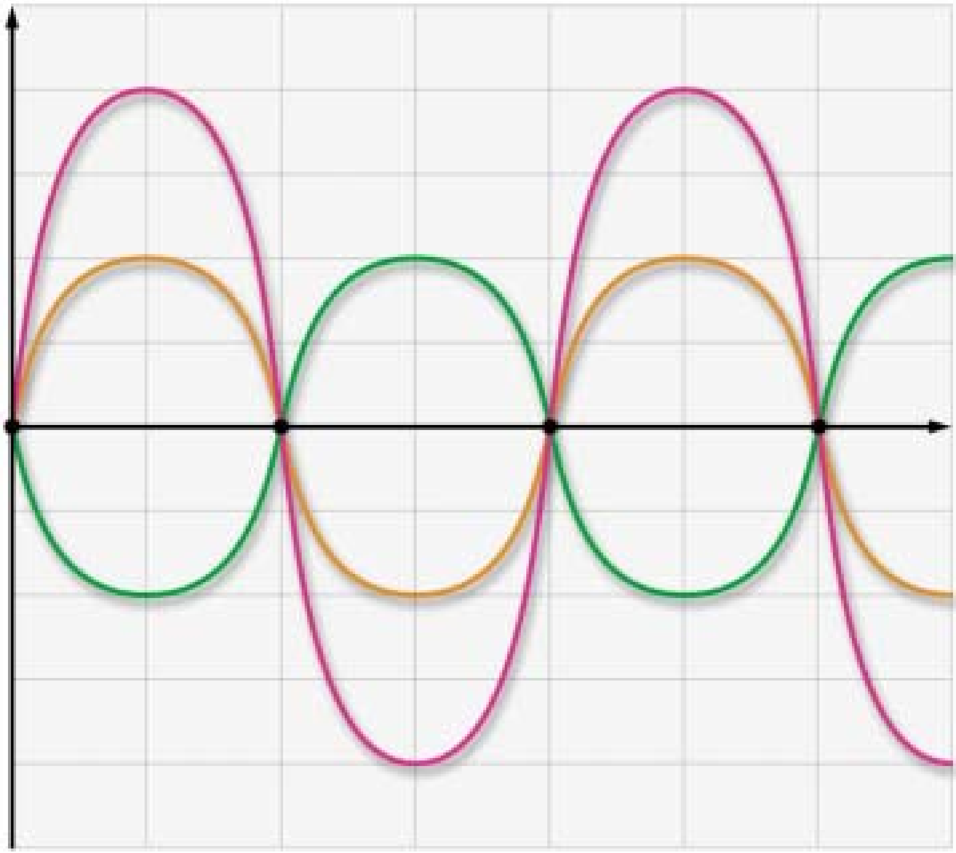
The sensor detects changes in magnetic flux density.

The three Hall elements are in offset arrangement. The gap between the elements is selected such that element A senses a magnetic maximum when C detects a magnetic minimum.



285_058

A difference signal A-C is formed in the sensor.



Signal A

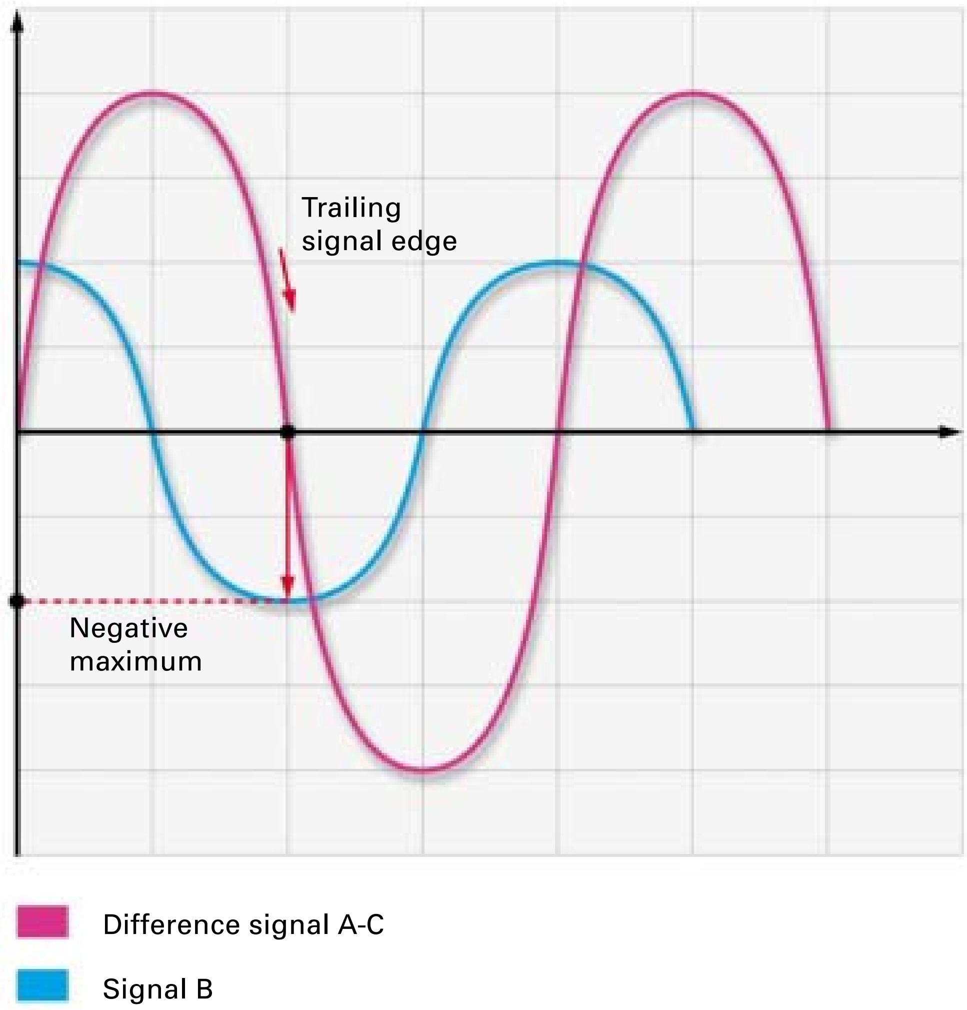
Signal C

Difference signal A-C

285_074

Hall element B is located centrally between A and C. Element B detects a magnetic maximum if signals A and C and thus also the difference signal are at zero.
The point at which signal B reaches its maximum value (positive or negative) is evaluated for detection of direction of rotation.

If, for example, zero crossing of the difference signal A-C is reached by a trailing signal edge and the signal B maximum is then negative, anti-clockwise rotation is recognised.

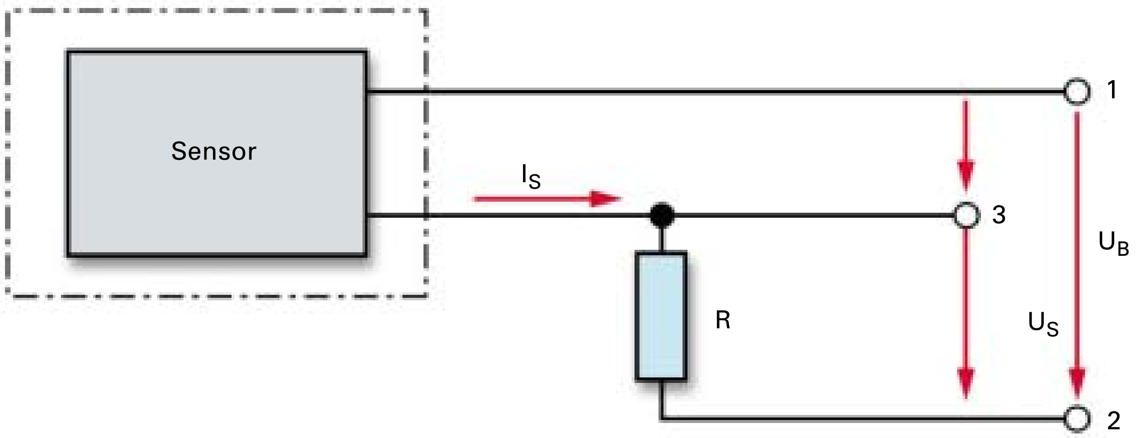


285_075

Electrical configuration

The speed sensor is connected by way of a current interface to the ESP control unit, which is fitted with a low-impedance shunt R.
The speed sensor has two electrical connections and forms a voltage divider together with the shunt.

Battery voltage U_B is applied between connections 1 and 2. The sensor signal produces a drop in voltage U_S at the shunt. This signal voltage is evaluated by the control unit.



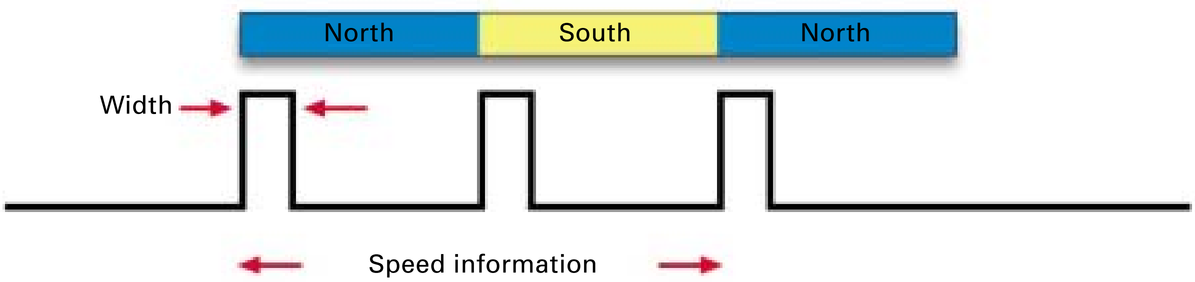
285_061

The output signal of the speed sensor is a PWM signal (PWM = pulse width modulation). The number of pulses in a specific time unit provides the

- speed information.

The following information is encoded by means of the pulse width:
- Direction of rotation
- Size of air gap
- Installation position
- Detection of stop

The correct air gap size is important for system operation and is detected and evaluated for system self-diagnosis.



285_062

Diagnosis

Within the scope of self-diagnosis the system is monitored for mechanical faults, electrical faults and implausible signals.
The most important system data are stored in the measured value blocks and can be read out with the diagnosis tester VAS 5051.

Detailed information can be found in the relevant Workshop Manual.

Summary

The Audi A8`03 is fitted with a new version of the tyre pressure monitoring system, the principal new features of which are described in the following.

Aerials

Use is made of active aerials.
The radio signals transmitted by the tyre pressure sensors are converted by the aerials into digital signals.

There are two aerial versions which differ in terms of the carrier frequency (433/315 MHz) to be processed.

Data transfer

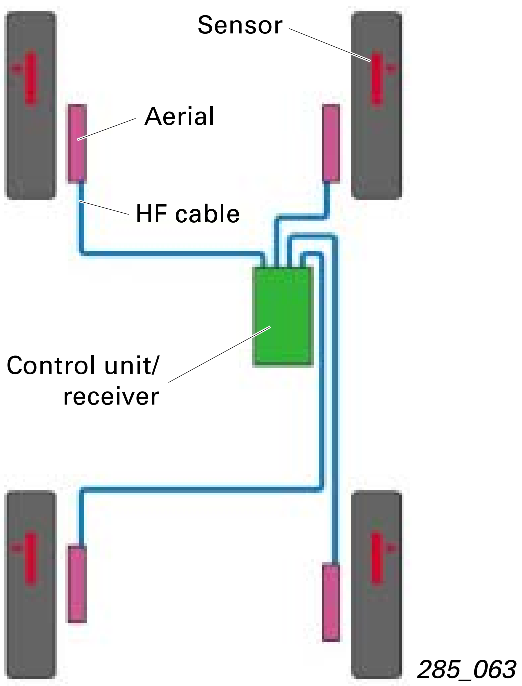
The digital signals are transferred from the aerials to the tyre pressure monitoring control unit via the LIN bus.

The major advantage of this method is the minimal susceptibility to electromagnetic interference.

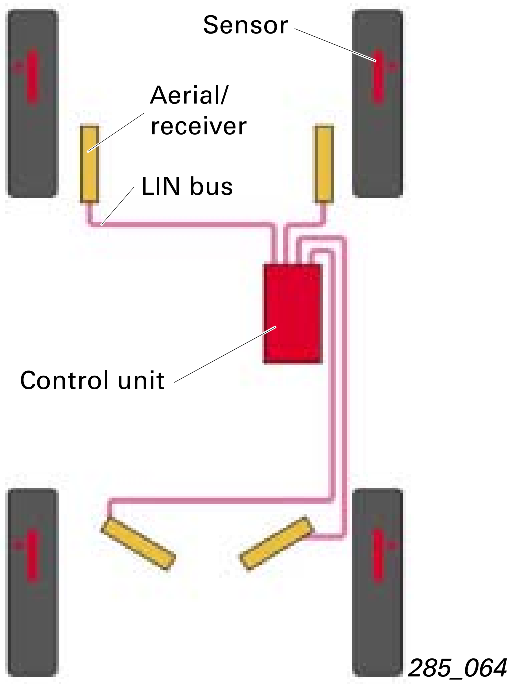
Tyre pressure monitoring control unit

The control unit is located beneath the rear seat bench. There is no sensor signal conditioning in the control unit.

Only one control unit frequency version is required as the signals are already conditioned in the aerials.



1st generation components and networking (Audi A8 up to `03)



2nd generation components and networking (Audi A8 as of `03)

Control concept

System operation forms part of the MMI control concept.
Pressing the CAR button and selecting "Systems"- "Tyre pressure monitoring system" provides a display of the current tyre pressures and temperatures or enables the following settings to be made:

– System activation/deactivation
– Storage of tyre pressures

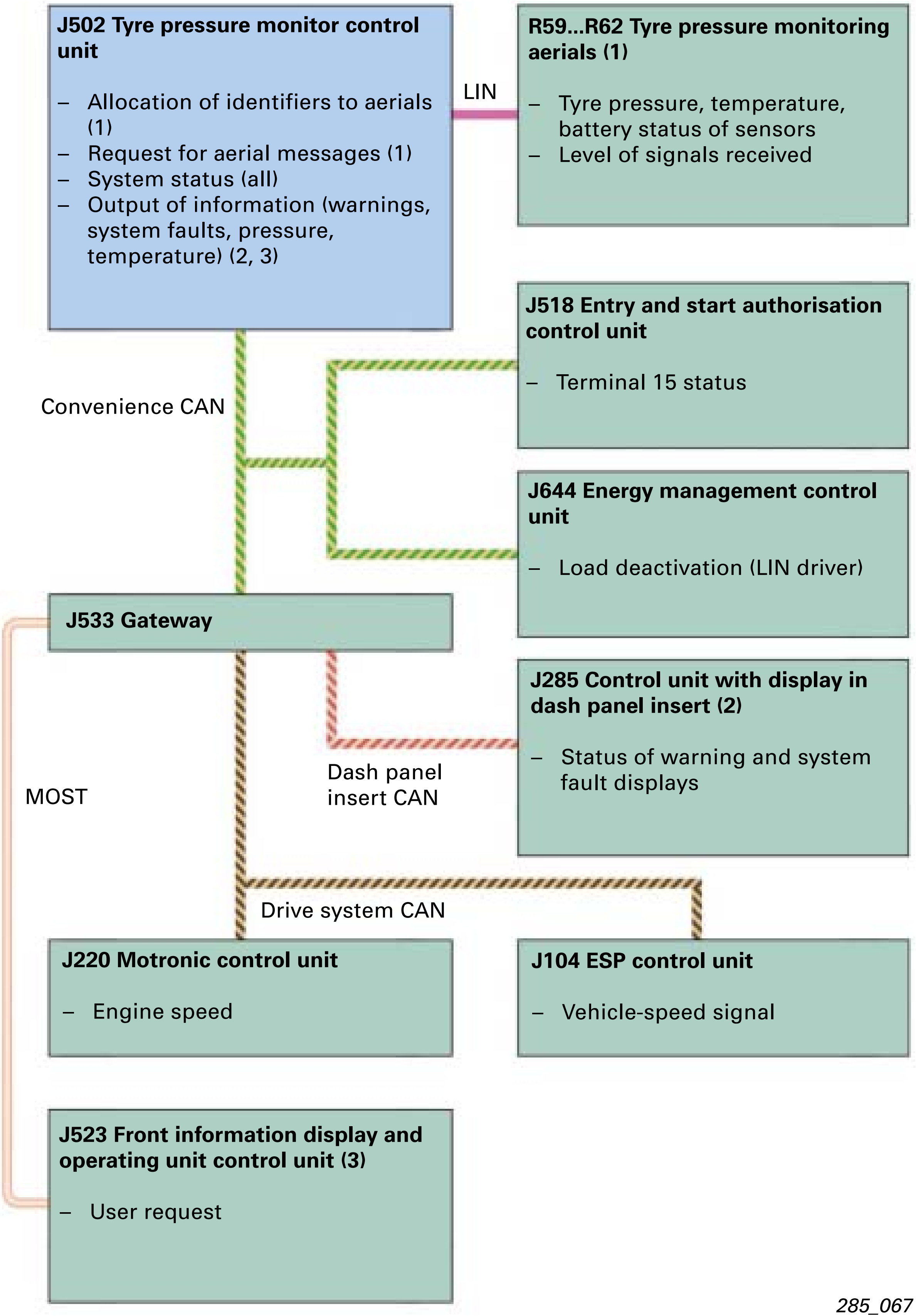
(Refer to operating manual for detailed information)

285_065

Warning displays

Warnings continue to be displayed in the dash panel insert.
The two-stage warning priority system has been retained (refer to operating manual for detailed information).

Tyre pressure monitoring system CAN data exchange



285_067

Service

The range of service diagnosis options has been extended.
Aerial diagnosis is performed constantly and does not have to be started separately.

(For details, refer to current Workshop Manual and assisted fault-finding)

Run Flat System - PAX

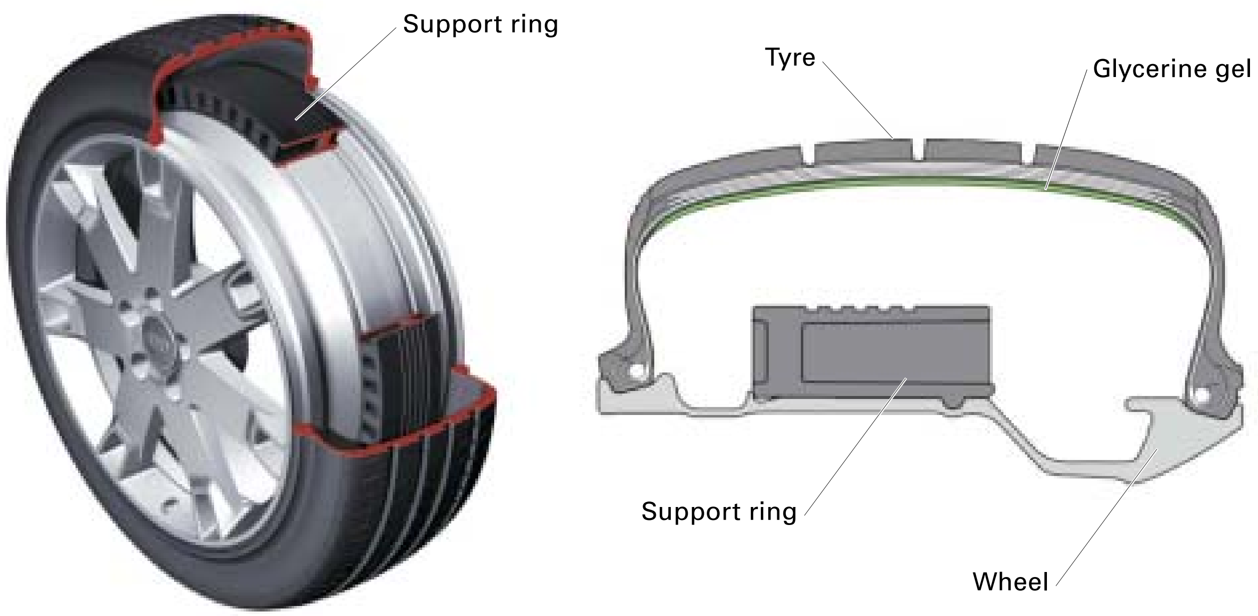
Summary

For the first time in the luxury class, a "run flat" wheel system is available as an option for the Audi A8 `03. As compared to other systems, the PAX run flat system represents an optimum compromise between handling, comfort and durability requirements. Both a summer and a winter version are available.

Design:

The system consists of rim, support ring, tyre and tyre pressure sensor. All components have been newly developed.
The rim is of a completely new geometrical design.
The support ring is fitted onto the centre of the rim and is made of a heavy-duty plastic with honeycomb structure.
The tyre is no longer tensioned behind the rim flange by means of its bead, but rather inserted in the rim seat.

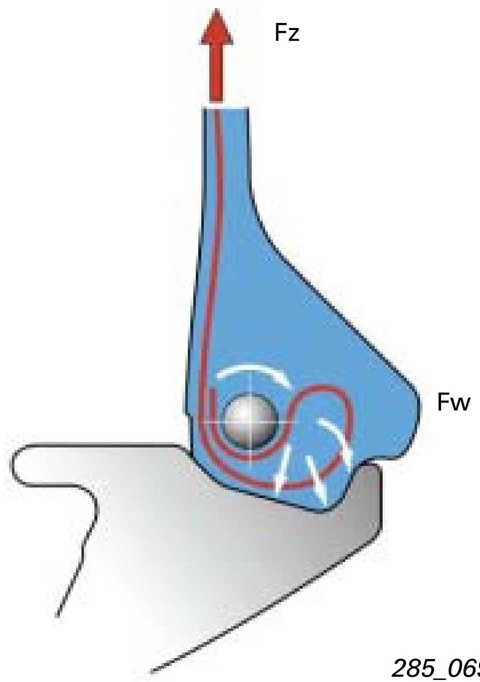
The geometrical and structural design of the PAX tyre differs considerably from conventional tyres, above all in the area of the side wall and bead.
A glycerine gel is applied to the inner surface of the tyre to reduce the friction between support ring and tyre in run flat mode.



285_068

Operation:

In the event of partial or total loss of pressure, the tyre rests on the support ring. The special design of the bead seating on the rim stops a flat tyre coming off. This is particularly critical in situations involving cornering with the tyre side wall subject to tensile load.
The tensile force Fz causes the tyre bead to rotate about the bead core, thus producing a force Fw in the outer bead area which presses the bead more firmly onto its seat.



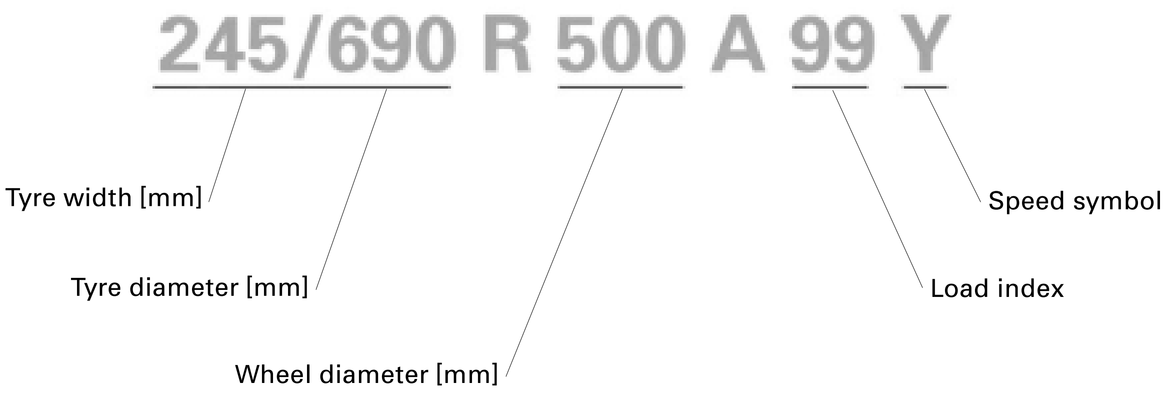
285_069

PAX enables a fully laden vehicle to be driven for a maximum of 200 km at a speed of max. 80 km/h even with a completely flat tyre.
Despite the use of the gel, component temperature and hence wear increase, in particular on account of the friction between tyre and support ring. A high degree of ride comfort is maintained even in run flat situations. A loss of pressure is thus not always immediately apparent. For this reason, PAX always includes the tyre pressure monitoring function.
Run flat mode is indicated on the dash panel insert centre display.

285_070

New tyre designation

PAX tyres have a new designation.
Arithmetically, the wheel used for the A8 corresponds to a wheel size of 18.3".



285_068

Service

Tyre removal/fitting involves completely new procedures.
New tyre fitting machines and PAX attachments for conventional fitting machines are available.

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Department I/VK-35
D-85045 Ingolstadt
Fax 0841/89-36367
000.2811.05.20
Technical status as at 07/02
Printed in Germany