



## Pneumatic suspension system Part 2

### 4-level air suspension in the Audi allroad quattro

#### Design and function

Self-study programme 243

# The 4-level air suspension system in the Audi allroad quattro

The 4-level air suspension system in the allroad quattro is a logical development of the self-levelling system in the Audi A6.

The principles of the suspension/air suspension system and the description of those system components which are identical in the 4-level air suspension system are described in SSP 242. The contents of this self-study program are supplementary to the contents of SSP 242.

## Introduction

Designing a vehicle this perfect for on and off-road use sounds like squaring the circle.

Usually the strengths of an off-road vehicle are decided weaknesses when it comes to road use.

A high ground clearance, crucial for rough terrain, gives the vehicle a correspondingly high centre of gravity.



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243\_002

When it comes to fast cornering, however, this is as disadvantageous as it is for driving stability at higher speeds. In addition, the air resistance is increased, which significantly affects fuel consumption.

In contrast, the shorter spring travel and the firmer running gear matching of an “on-road running gear” offer inadequate driving comfort off-road.

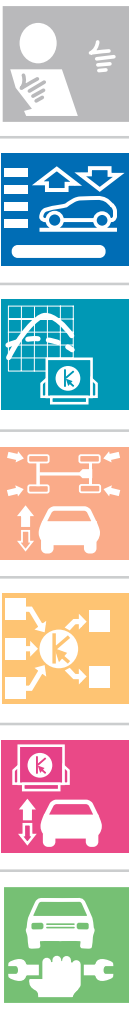
A variable ground clearance is the solution for all road use and it's called **4-level air suspension.**

The air suspension realised in the allroad quattro is based on the familiar self-levelling system of the Audi A6.



243\_003

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The self-study programme will provide you with information on the design and functions of the different assemblies/systems.

**The self-study programme is not intended as a workshop manual.**

For maintenance and repairs please refer to the current technical literature.

**New Note**



**Important: Note**



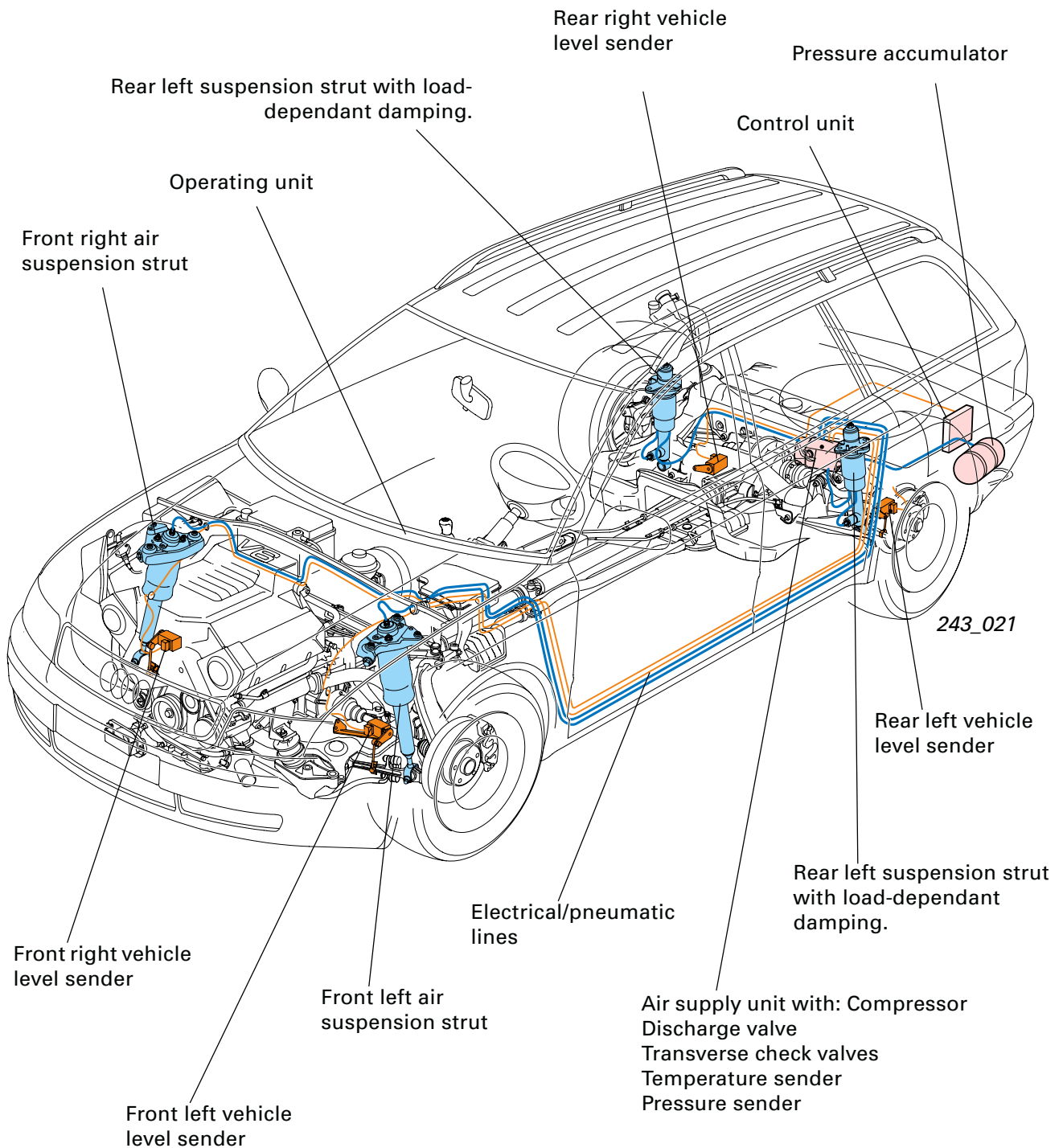
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# Description of the system



The 4-level air suspension system is a fully-supporting level control system with conventional shock absorbers at the front axle and load dependent shock absorbers (PDC dampers) on the rear axle.

The vehicle level is determined separately at each axle side by means of 4 level sensors. Each air suspension strut is allocated a so-called air spring valve (transverse check valve) so that each axle can be controlled individually.





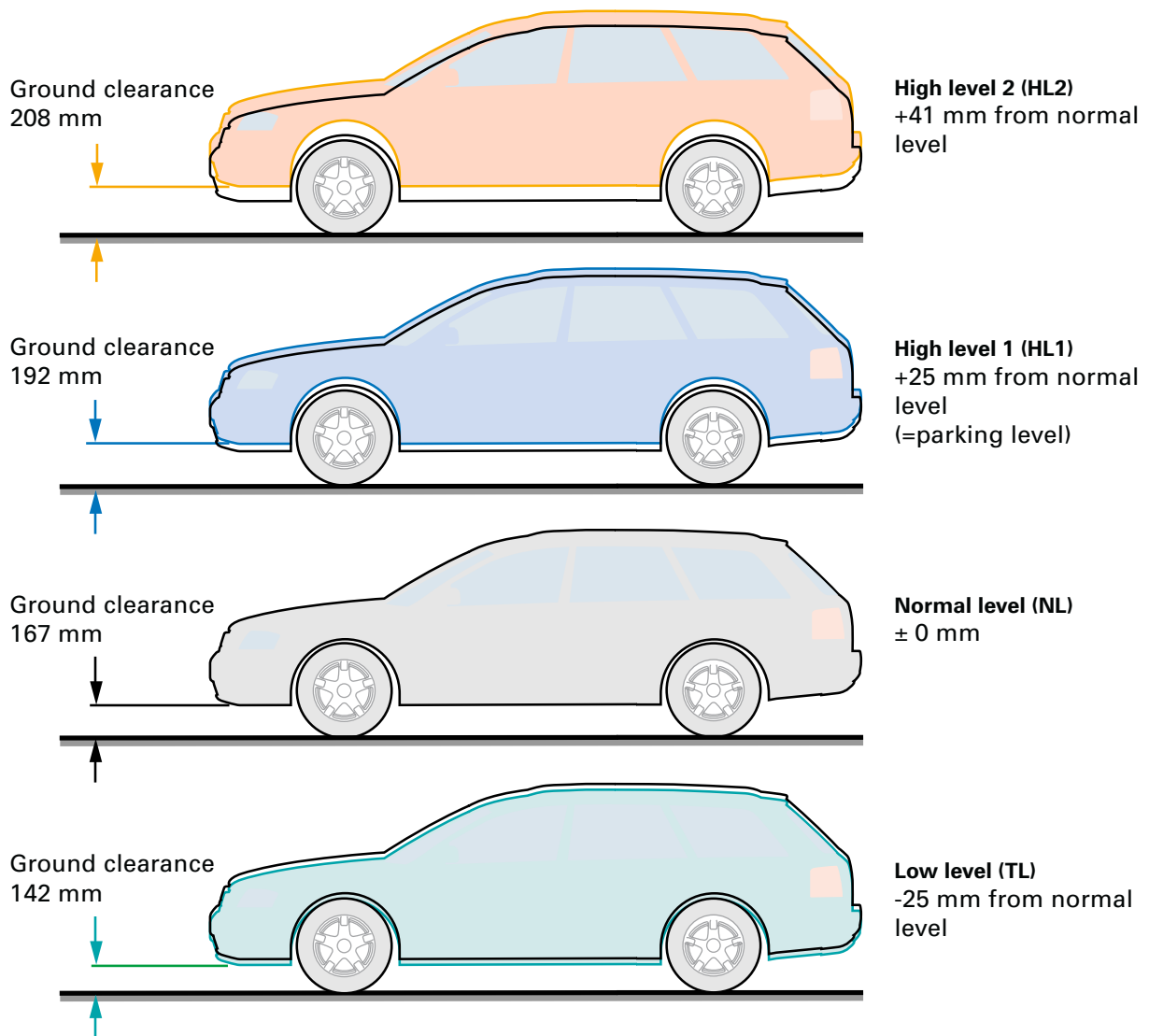
The 4-level air suspension system is designed as what is known as a pressure accumulator system.

The pressure accumulator system increases system availability, reduces noise development and protects the power supply.

One of the special features of the system is the ability to alter the ground clearance by 66 mm in 4 stages. The 4 stages can be controlled manually or automatically (see page 7 onwards).

The levels are designated as follows:

- Level 1 = low level (LL)
- Level 2 = normal level (NL)
- Level 3 = high level 1 (HL1)
- Level 4 = high level 2 (HL2)
- Parking level PL = high level 1



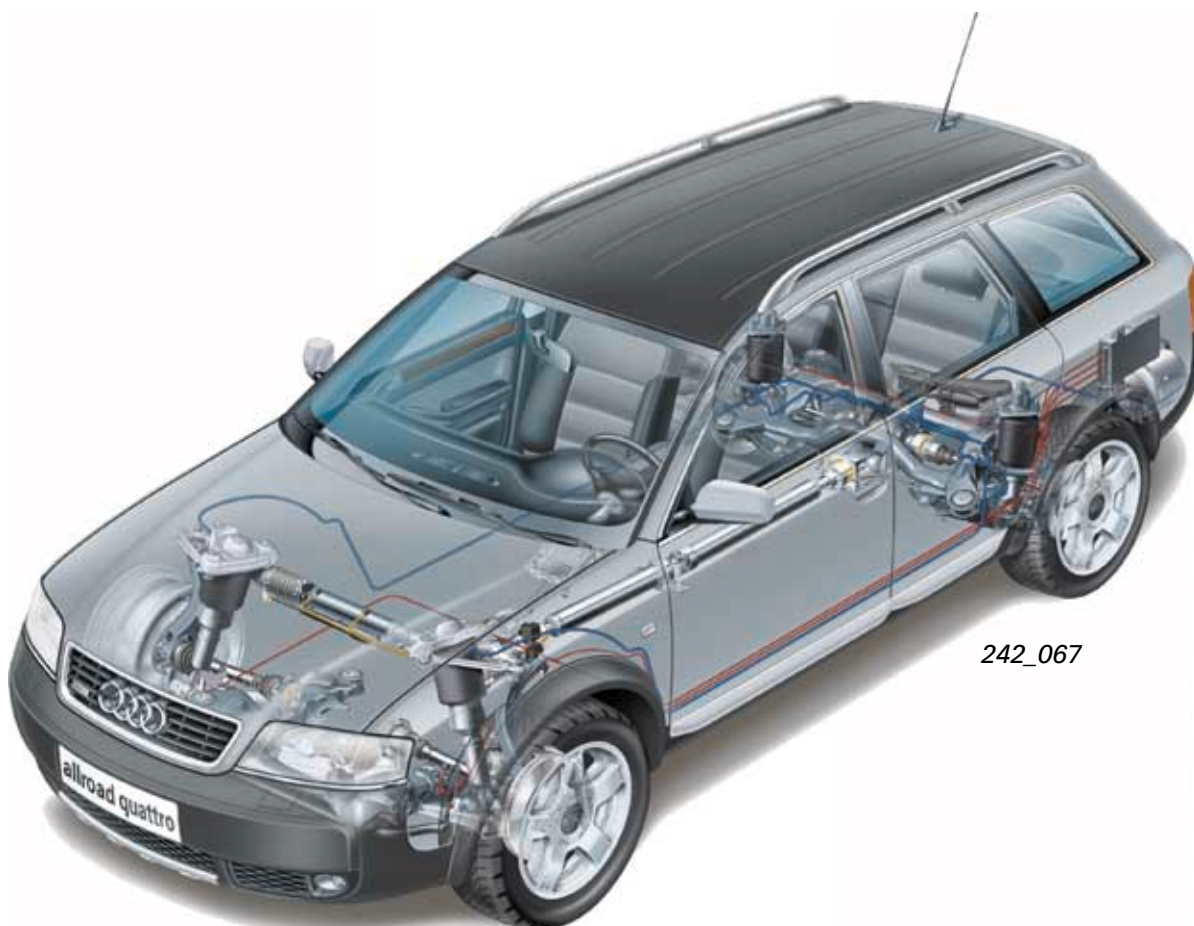
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# Description of the system



The newly developed fully-supporting air suspension system on all four wheels was designed specifically for the allroad quattro. As well as the advantages of air suspension-based self-levelling, as described for the A6 (see SSP 242), this system offers additional benefits.

- ▶ The 4-level air suspension is a sophisticated electronically controlled air suspension system at both axles. The system enables variation of the floor level by 66 mm and offers four defined height levels with between 142 and 208 mm ground clearance.
- ▶ Depending on the driving conditions and requirements you can select greater ground clearance or a low vehicle centre of gravity and a good  $c_w$  value.
- ▶ The 4-level air suspension keeps the pre-set vehicle level constant, regardless of load and weight distribution.
- ▶ The 4 level stages can be controlled manually or automatically within defined limits (see page 8 onwards).
- ▶ Individual automatic functions or the entire system can be switched off via the control system.
- ▶ LEDs in the operating unit indicate the operating status and the control procedures to the driver.
- ▶ Pressure accumulator system for maximum comfort.



242\_067

# Operation and display

## Operation

The self-levelling control unit E281 is used to control the 4-level air suspension and the display/monitor the system status. Certain level changes occur automatically during normal driving (see Control strategy).

Within defined conditions (see Control strategy) the driver can use the "raise" or "lower" buttons to select an appropriate level at any time.

Pressing the "raise" button once selects the next highest level. By pressing the button repeatedly, it is possible to change, e.g. directly from low level to high level 1. High level 2 cannot be selected until high level 1 has already been set.

Changing to a lower level is performed in the same manner as described above using the "lower" button. By pressing several times (x3) it is possible to shift directly from high level 2 to the low level.



Operating unit for self-levelling E281



241\_062



It is possible to switch to a higher level only when the engine is running or when sufficient pressure is present in the pressure accumulator.

It is possible to change to a lower level even when the engine is switched off.

# Operation and display

## Display

The four LEDs which are arranged one on top of the other in the display zone illuminate continuously to indicate the current level status.

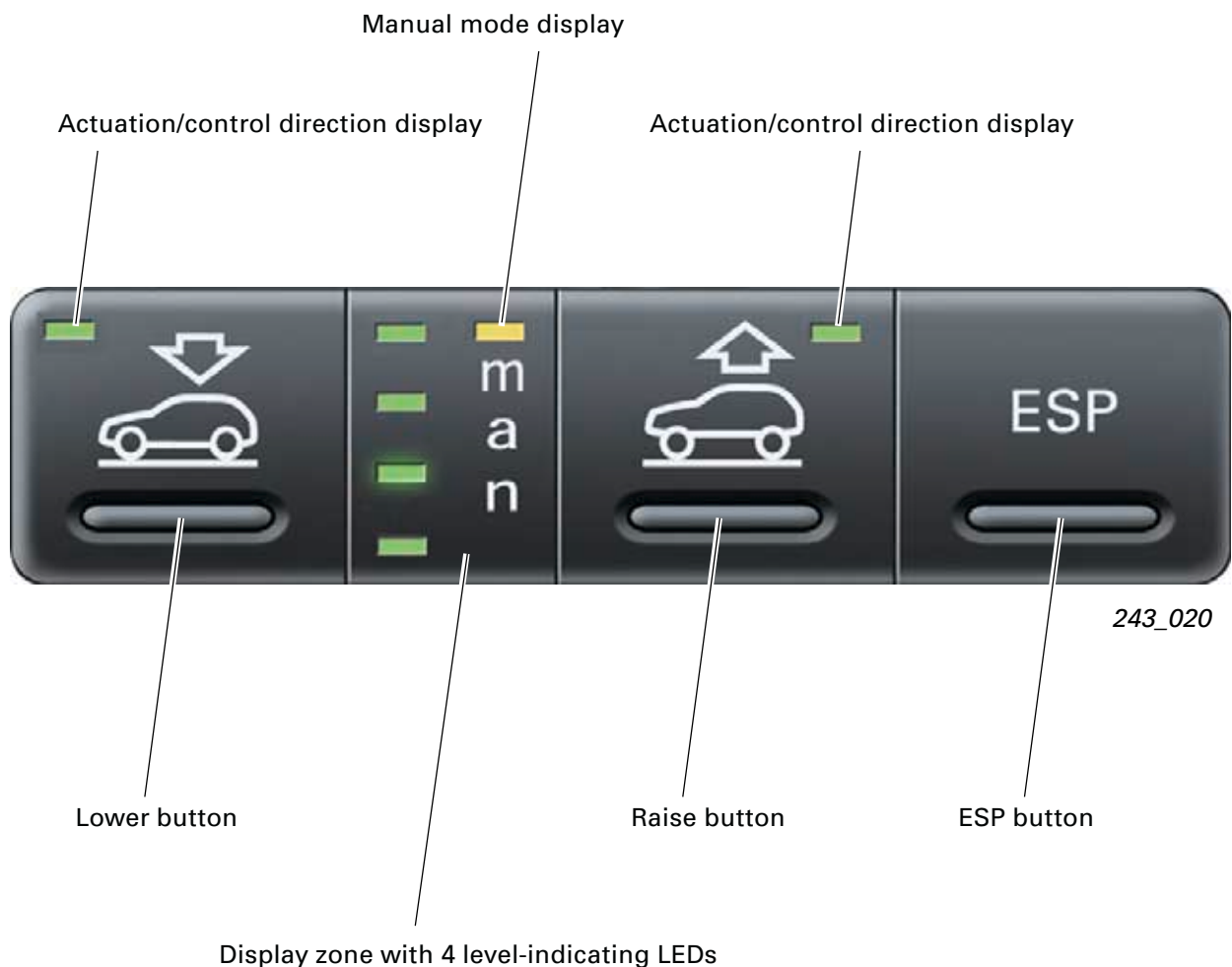
Only the control procedure which has been triggered by a level change (whether automatically or manually) is indicated by one or several flashing LEDs. Once the target level has been reached, the flashing changes to continuous illumination.

The LEDs in the "raise" and "lower" buttons indicate actuation and the control direction. If the LED flashes, a level request has been denied (e.g. if the driving speed is too high)

If the actual level deviates greatly from the reference level, this is indicated to the driver with flashing LEDs (according to a level change).

Significant deviations are:

- at least one axle level is below the next level down.
- both axle levels are above the next level up.





## Other button functions

### Automatic switching

The so-called “manual mode” can be switched on or off by pressing the “raise” or “lower” button for at least 3 sec. The yellow LED marked “man” indicates to the driver that the vehicle is in manual mode.

The automatic “parking level control” and “motorway mode” functions are deactivated in manual mode.

### Switching off control system

The control system is switched on or off by pressing both level buttons for longer than 5 seconds.

When the control system is switched off, the LEDs in the operating unit for manual mode, both level buttons and the warning lamp K134 are illuminated.

The level-indicating LEDs show the level set. The corresponding LED is continuously illuminated.

A control system that has been switched off will be automatically switched back on again when the driving speed exceeds approx. 10 km/h (unless the lifting platform mode is recognised).

The control system can also be switched off using the diagnostic testers (see Workshop Manual).



It is often advisable to switch off the system during repair work (e.g. during axle measurement or if the pressure lines have been detached) in order to prevent the compressor from running unnecessarily.

### Display example: Manual mode and NL



243\_022

### Display example: Raising from LL to HL1



243\_023

### Display example: Raising from HL1 to HL2



243\_024

### Display example: Lowering from NL to LL



243\_025



# Control strategies

There are two control units currently in use, depending on the country.

The control strategies described below relate to the control unit 4Z7 907 **553A**.

The differences in control units with part numbers 4Z7 907 **553B** are described subsequently.

See also page 34, "Self-levelling control unit J197".

If the vehicle is at high level 2, it will lower automatically to high level 1 at a speed of > 35 km/h. The system will respond to a request to shift to high level 2 only up to a speed of < 30 km/h.

At a speed of > 80 km/h in high level 1, the system will automatically lower the vehicle to normal level. The system will respond to a (manual) request to shift to high level 1 only up to a speed of < 75 km/h.

During driving operation, no automatic raising to high level 1 or 2 is performed. It must be selected manually by the driver.

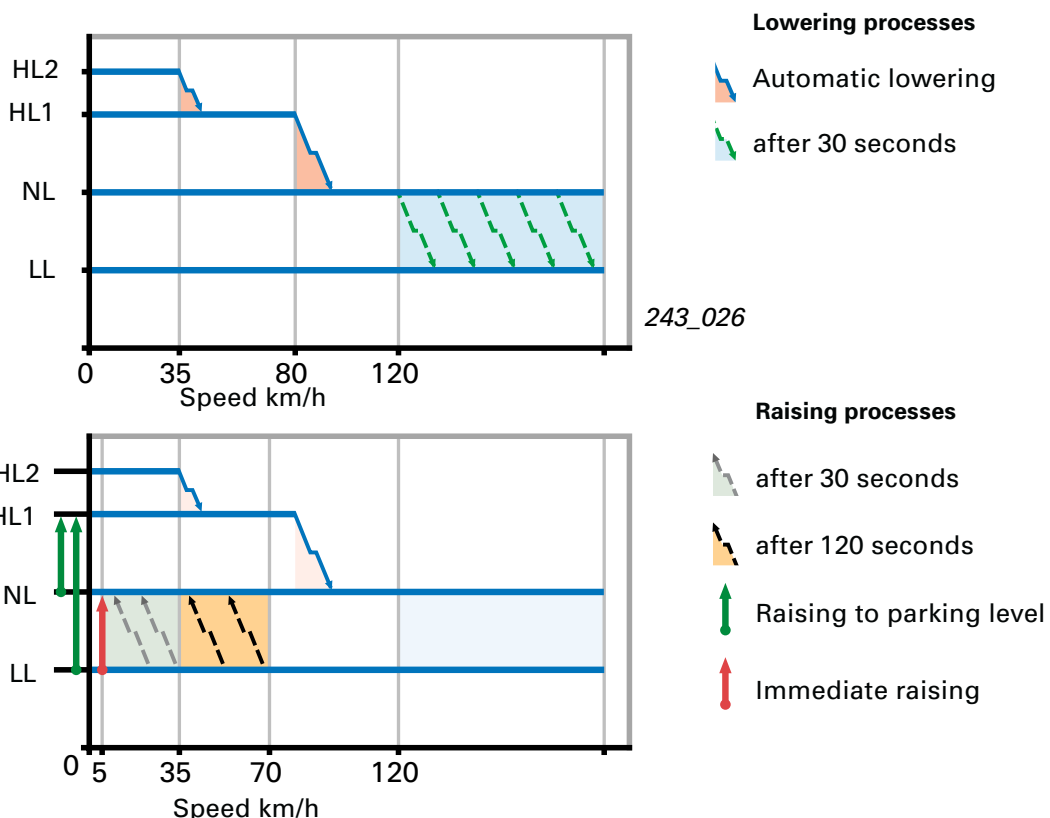
The parking level is an exception. In this mode the vehicle automatically rises to high level 1 once it has been parked and locked (see parking level control).

## Control strategies 4Z7 907 553A

### Automatic lowering

As mentioned previously, the driver can select the appropriate level by actuating the "raise" or "lower" buttons.

The following preconditions relating to driving speed apply for high level 1 and high level 2.



## Motorway mode

If the vehicle travels for longer than 30 seconds at over 120 km/h (vehicle is already at normal level), it will automatically be lowered to low level.

This reduces air resistance (saves fuel) and lowers the vehicle's centre of gravity (improved driving dynamics).

The vehicle rises automatically to normal level at the following speeds and time thresholds:

Vehicle speed	Time
<70 km/h	>120 seconds
<35 km/h	>30 seconds
<5 km/h	immediately



## Parking level control

The parking level ensures that the vehicle is maintained at a suitable level after parking for a long period of time (normal volumetric reduction due to cooling or diffusion). It also facilitates entering and loading the vehicle and optimises the appearance of the stationary vehicle.

The parking level corresponds to high level 1 (HL1).

The vehicle is set to parking level

- when the system is in run-on mode and the vehicle is locked from the outside.
- when sufficient pressure is present in pressure accumulator.
- when the system is not switched to manual mode.



PL (=HL1) is only cancelled when a driving speed of 80 km/h is exceeded (see automatic lowering) or when switching to a lower level manually.

If the vehicle is already in HL2 it is not lowered to parking level.

## Manual mode

The motorway mode and parking level control functions are deactivated in manual mode (see Automatic switching page 9).

# Control strategies

## Control unit strategies 4Z7 907 553B

Variations to the description of control unit 4Z7 907 553A are outlined below:

- ▶ No parking level control
- ▶ Automatic raising to high level 1

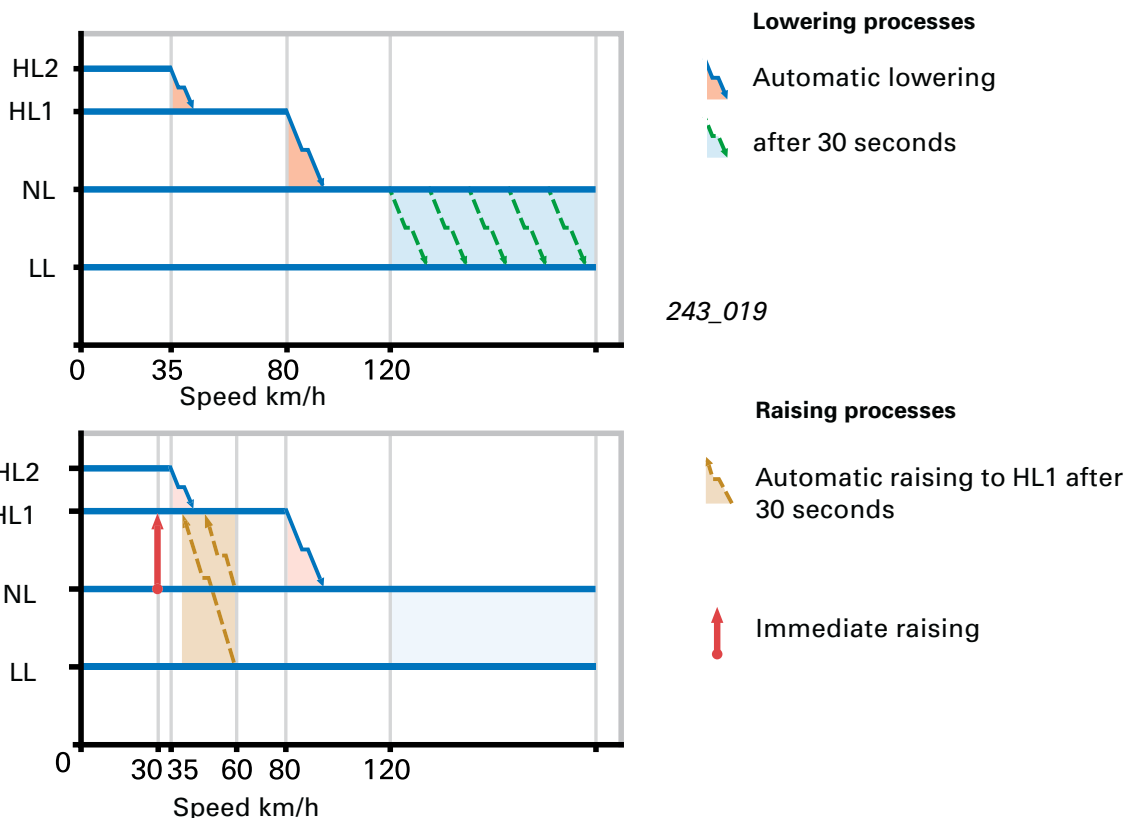
### Preconditions for automatic raising to high level 1:

- ▶ The system must not be switched to manual mode.
- ▶ Between ignition ON and OFF, the driver must select high level 1 or high level 2 once.

The vehicle rises automatically to high level 1 at the following speeds and time thresholds:

Vehicle speed	Time
<60 km/h	>30 seconds
<30 km/h	immediately

If the system has lowered the vehicle to low level (motorway mode), it will automatically raise it to high level 1 when its speed drops below 60 km/h for longer than 30 seconds.



## ESP safety switching

For technical reasons it is not possible to change levels/self-level during cornering. If cornering is recognised, no control functions are performed and control functions already running are interrupted. The target level remains stored and is reset when straight-ahead driving is recognised.

In the Audi allroad quattro it is possible to influence certain ESP functions using the ESP button.

You can find further information about this in SSP 241, from page 67 onwards.

If ESP influences have been activated (via ESP button, ESP warning lamp illuminated), the transverse dynamics control (anti skid function) is passive (not during braking).

If, for example, the vehicle is at high level 2 with active ESP influences and the driver accelerates sharply on a very winding route, speeds of > 35 km can be achieved in high level 2. In order to guarantee maximum safety in such driving conditions, ESP influences are automatically deactivated at a speed of > 70 km/h, despite the high centre of gravity of the vehicle (ESP-safety switching).

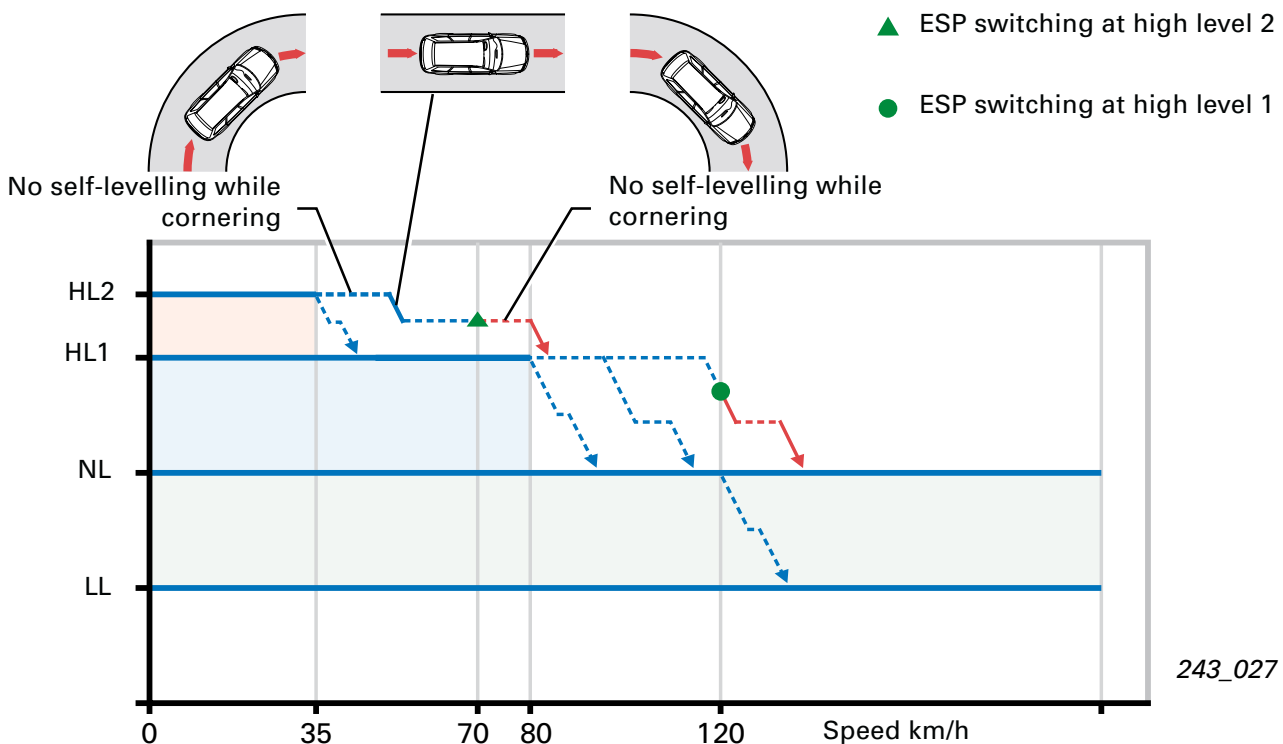
Normal ESP functions are available again and the ESP warning lamp extinguishes.

This ESP safety switching takes place as of 70 km/h at high level 2 and as of 120 km/h at high level 1.

There is no ESP safety switching at normal level or low level.



Cornering is detected by the J197 self-levelling control unit by evaluation of the signals from the four level sensors.



# System components

## The air springs

The front air spring is a new design. As on the rear axle, the air springs are combined coaxially with the dampers as a suspension strut. The rear air springs are identical in design and function to those of the Audi A6 with self-levelling.

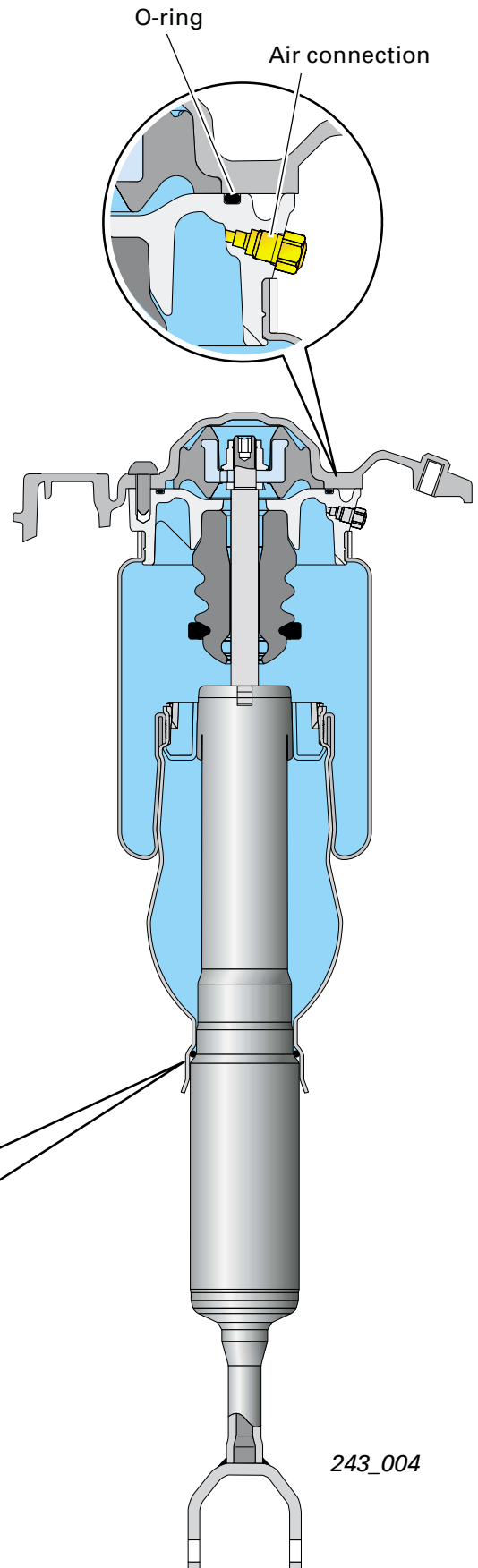
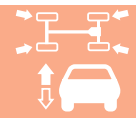
### Design

While in the case of the rear suspension strut, the connection/seal from the air spring (piston) to the damper is made via a double-seal bayonet connection, on the front suspension strut it takes the form of a single-seal N17 connector. The differences in design require a different assembly.

### Front suspension strut

The assembly of the front air spring with the damper is carried out without lubrication. The N17 connector and the O ring must be absolutely dry and free from grease.

Before assembly of the air spring, the O-ring is placed onto the second shoulder of the damper, ensuring an even perimeter. The air spring (piston) is positioned onto the damper and pushed together with adequate force. The O-ring is forced onto shoulder 3 by the movement of the piston, where it supports and seals the air spring.



O-ring

Installation


243\_004

### Rear suspension strut

The bayonet connection must be absolutely clean and is greased with a special lubricant before installation (see Workshop Manual). For installation, the air spring is pushed on and then turned.

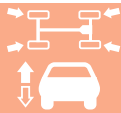
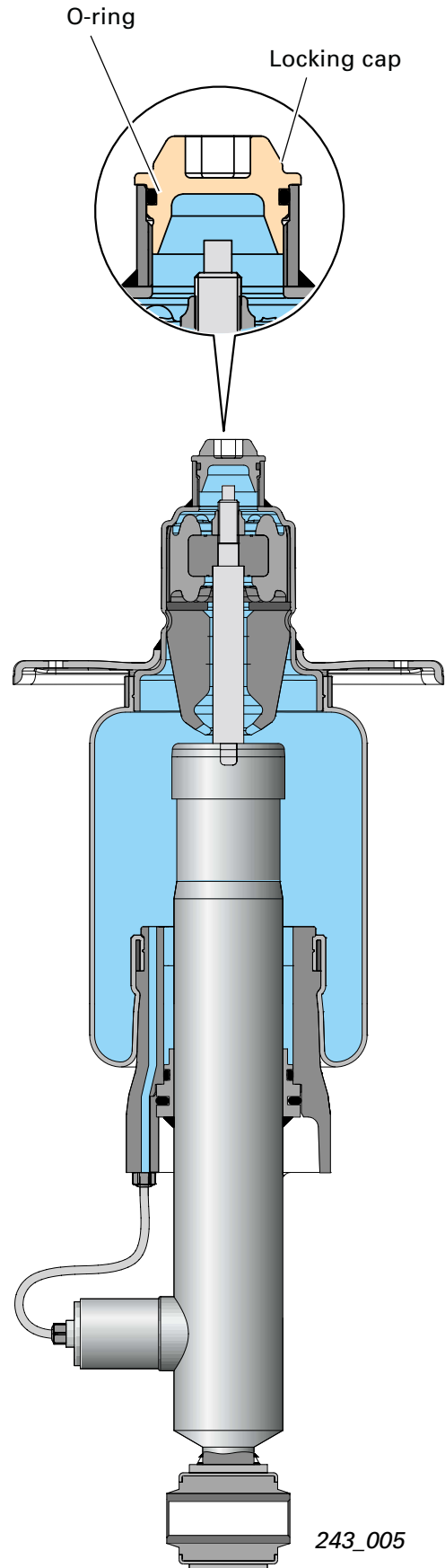
### Operating pressure of the air springs

	front	rear
Minimum operating pressure	6.0 bar	6.1 bar
Nominal operating pressure	6.4 bar	8.5 bar
Maximum operating pressure	9.0 bar	10.9 bar

 Always check for leaks on the O-ring seals at the raised areas. The sealing surfaces must be clean, free from corrosion and pitting (aluminium parts) and greased as required (see Workshop Manual).

Design and function of the rear air springs, see SSP 242, from page 40 onwards.

Full description of the PDC damper, see SSP 242, from page 33 onwards.



# System components



## Warning:

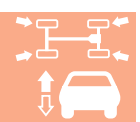
The piston must not be touched during installation or transport of the complete suspension strut assembly as the piston can be easily pushed back when unpressurised.

If the sealing ring is pushed out of position (by the air spring pressure) the air spring will not be sealed correctly.



Air springs must not be moved when pressureless because the air bellows cannot unroll on the piston and would be damaged.

In a vehicle with depressurised air springs, the relevant air springs must be filled with the aid of the diagnostic tester (see Workshop Manual) before raising or lowering the vehicle (e.g. on a vehicle lifting platform or vehicle jack).



## Wrong



## Correct



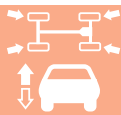
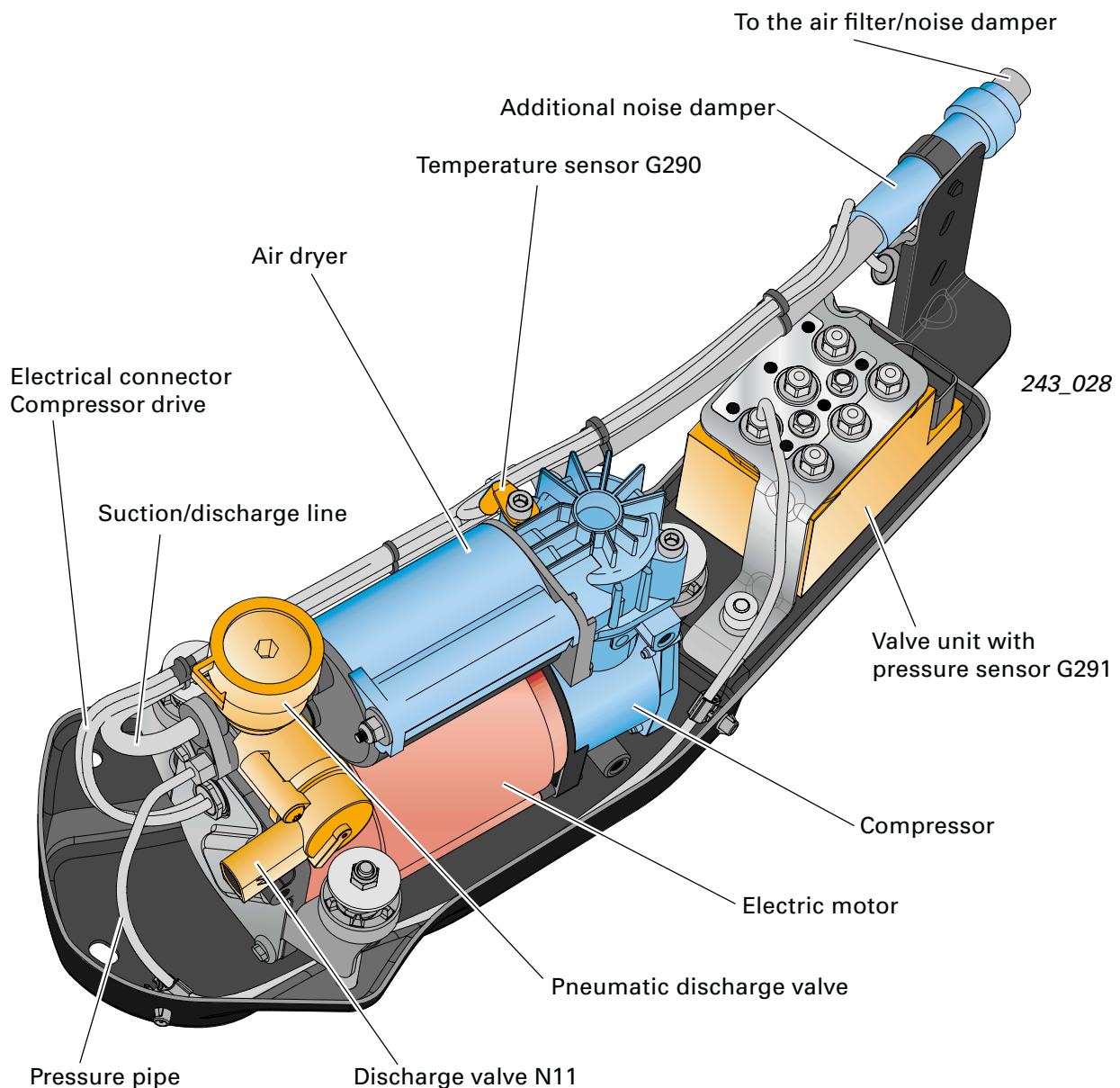


## Air supply

### The compressor

The construction and function of the compressor corresponds largely to the unit described in the self-levelling suspension of the A6. The following is a description only of the differences in the 4-level air suspension system in the Audi allroad quattro

- ▶ The fitting location is outside the vehicle and without noise insulation (in front of spare wheel well).
- ▶ The operating pressure is increased to 16 bar owing to the pressure accumulator system.
- ▶ Lower speed for reduced noise.
- ▶ Suction and discharge of the air is performed from the spare wheel well via an air filter/noise damper (passenger compartment).
- ▶ An additional noise damper in the suction/discharge line ensures minimal through-flow noise, particularly during discharge.
- ▶ Temperature monitoring is performed via a temperature sensor at the cylinder head and a simulation formula in the control unit (temperature model) (more information, see Temperature sensor G290).



# System components



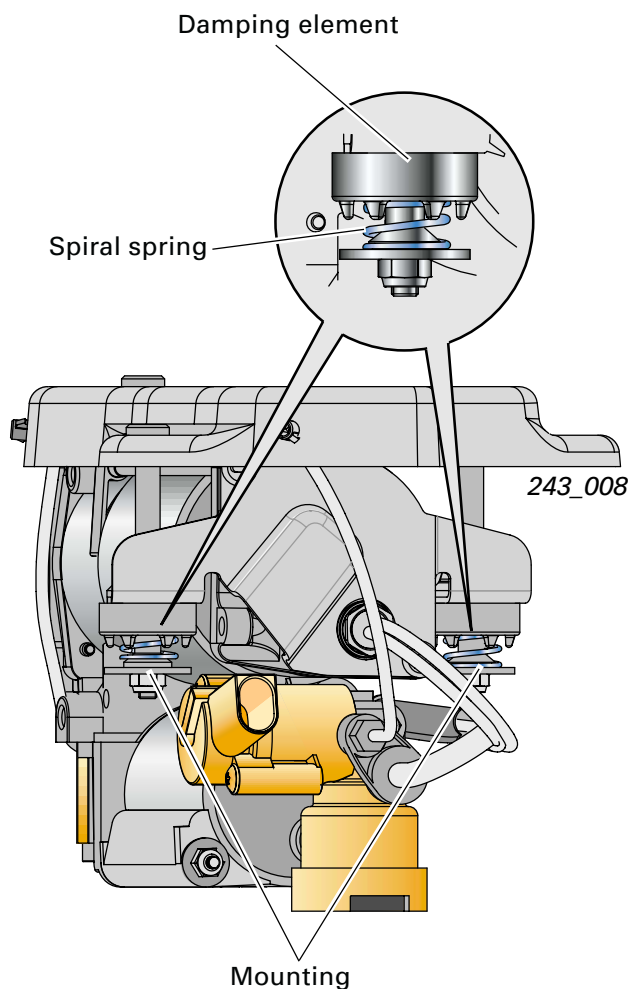
In normal operation the compressor is allowed to run only when the engine is running.

**Exceptions:**

- Final control diagnosis
- Basic system setting
- In pre-run upon recognition of an extremely low level

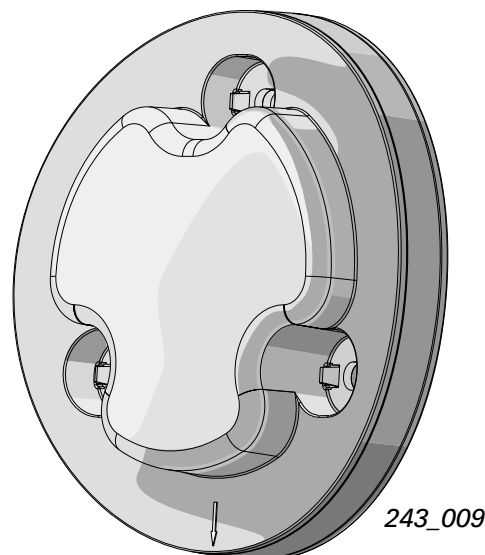
A special mounting consisting of spiral springs and rubber damping elements prevents the transfer of vibrations to the bodywork.

You can find a description of the design and function of the compressor as well as the filling and discharging procedure in SSP 242.



## Air filter/noise damper

Owing to the fitting location of the air filter/ noise damper in the spare wheel well, it requires no maintenance.



## Pressure accumulator

The pressure accumulator allows the vehicle level to be raised more rapidly with minimal noise as the pressure accumulator is only filled while the vehicle is in driving operation and the compressor noise is less noticeable (see air supply strategy).

Provided that there is sufficient pressure in the pressure accumulator, vehicle level raising can be performed without the compressor.

Sufficient pressure means that before the vehicle is raised there must be a pressure difference of at least 3 bar between the pressure accumulator and the air springs.

The pressure accumulator is made of aluminium and has a storage volume of approx. 6.5 l. The maximum operating pressure is approx. 16 bar.

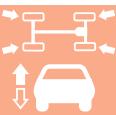
## Air supply strategy

At driving speeds of  $< 36$  km/h air supply is effected primarily by the pressure accumulator (provided sufficient pressure is available).

The pressure accumulator is only filled when driving at speeds of 36 km/h and above.

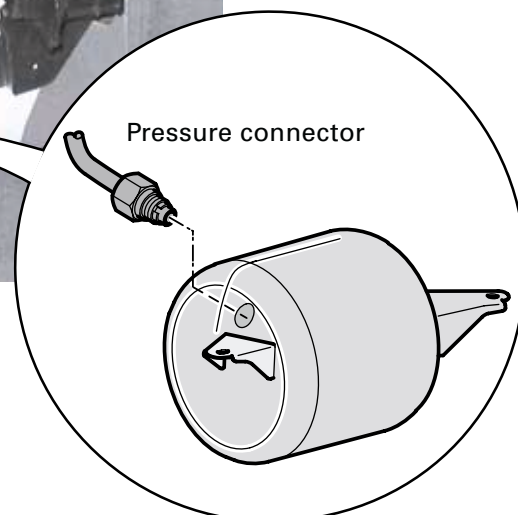
At a driving speed of  $> 36$  km/h the air supply is primarily from the compressor.

This supply strategy ensures virtually noiseless system operation and reduces the current consumption.



243\_029

Pressure accumulator

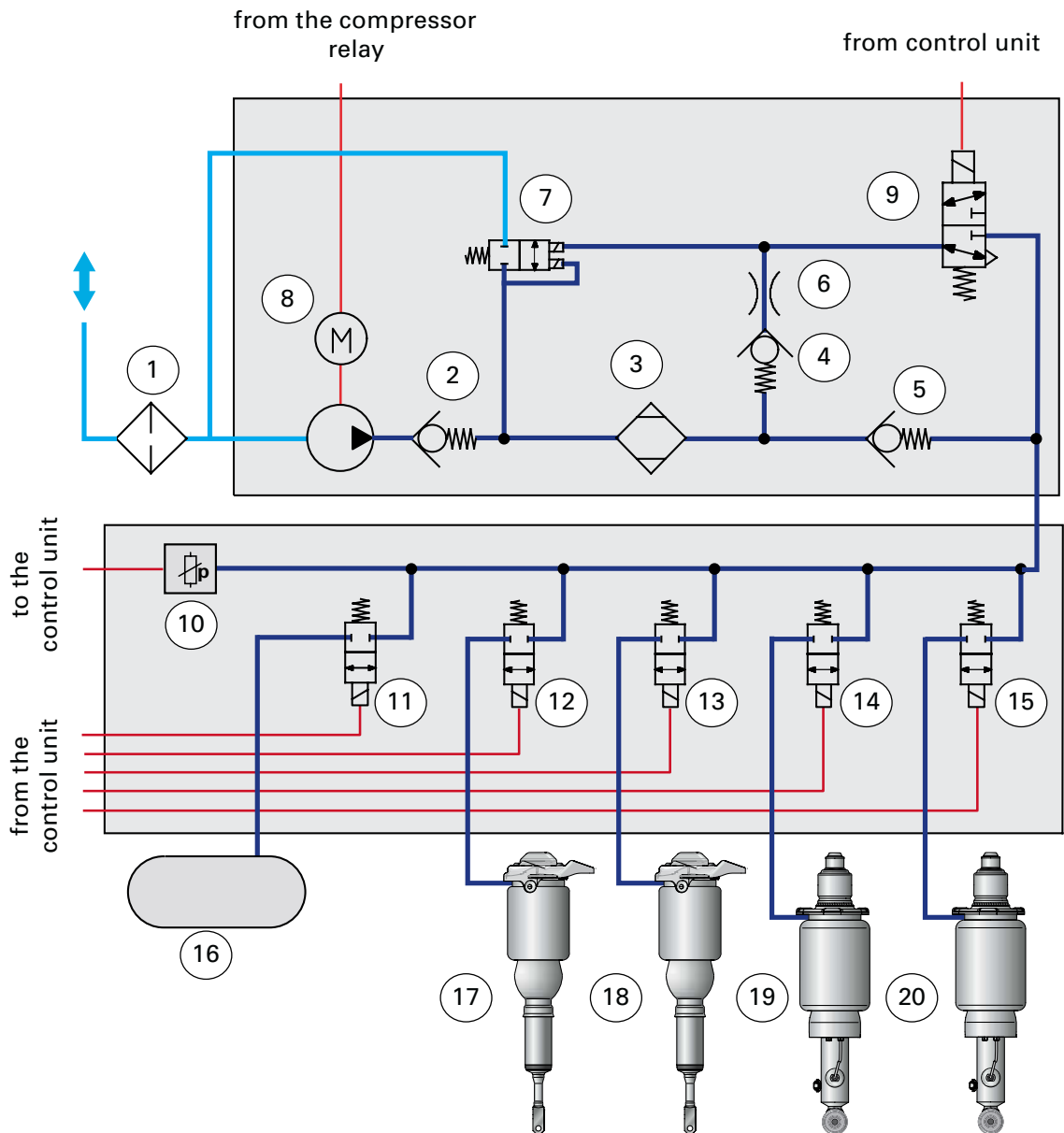
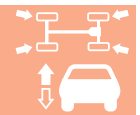


Pressure connector

# System components

## Pneumatic diagram

- |    |                               |    |                                     |
|----|-------------------------------|----|-------------------------------------|
| 1  | Additional noise damper       | 11 | Valve for pressure accumulator N311 |
| 2  | Non-return valve 1            | 12 | Valve for FL suspension strut N148  |
| 3  | Air dryer                     | 13 | Valve for FR suspension strut N149  |
| 4  | Non-return valve 3            | 14 | Valve for RL suspension strut N150  |
| 5  | Non-return valve 2            | 15 | Valve for RR suspension strut N151  |
| 6  | Discharge throttle            | 16 | Pressure accumulator                |
| 7  | Pneumatic discharge valve     | 17 | Front left air spring               |
| 8  | Compressor V66                | 18 | Front right air spring              |
| 9  | Electric discharge valve N111 | 19 | Rear left air spring                |
| 10 | Pressure sensor G291          | 20 | Rear right air spring               |



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## Solenoid valves

The 4-level air suspension has 6 electric solenoid valves.

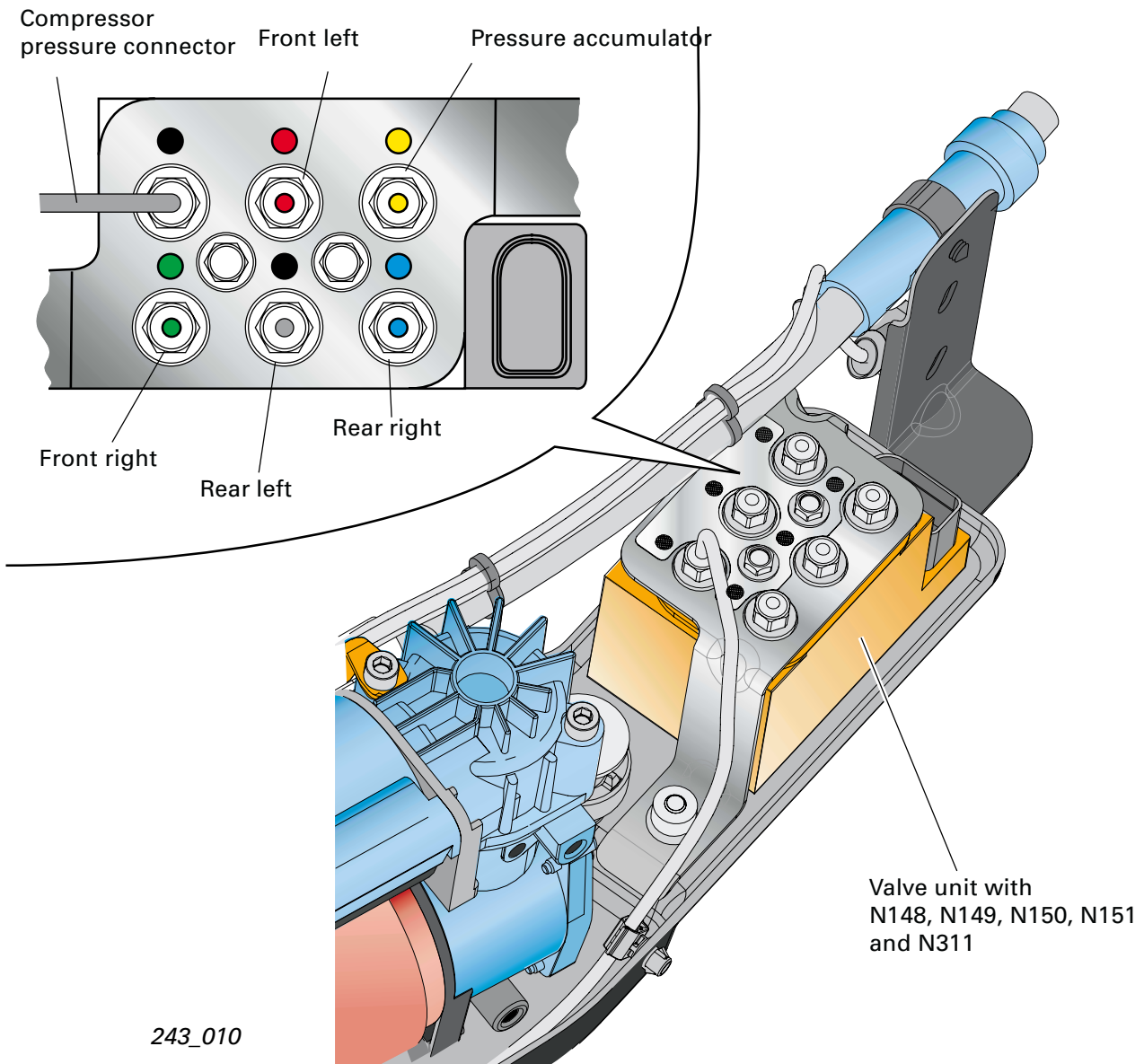
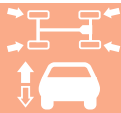
Discharge valve N111 forms a functional unit together with the pneumatic discharge valve and is integrated into the dryer housing (see page 17).

Discharge valve N111 is a 3/2 way valve and is closed without current.

The pneumatic discharge valve acts as a pressure limiter and residual pressure retaining device.

The 4 air spring valves N148, N149, N150, N151 and accumulator valve N311 are combined in one valve unit. They are designed as 2/2 way valves and are closed without current. The pressure on the air spring side/accumulator side acts in the closing direction.

The pressure lines are colour coded to prevent confusion when connecting. The colour allocation on the valve block is echoed by corresponding coloured dots on the connectors.



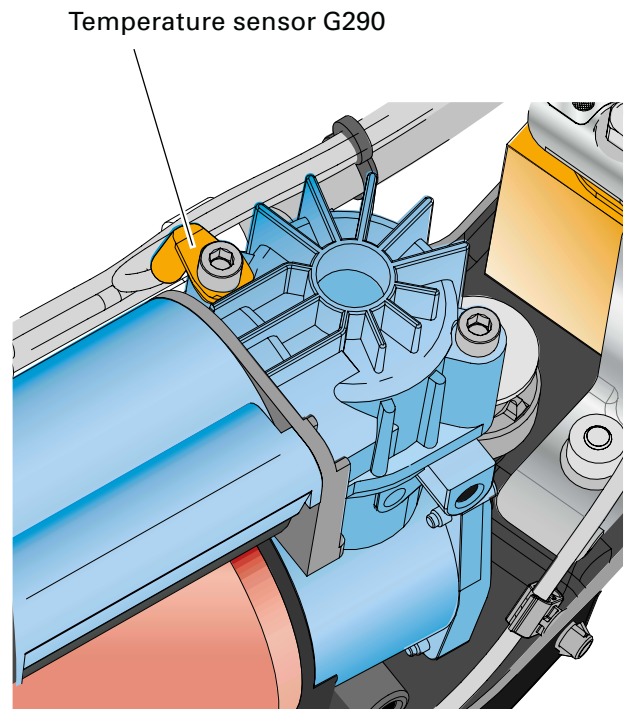
# System components

## Temperature sensor G290 (Overheat protection)

To enhance system availability, temperature sensor G290 is attached to the cylinder head of the compressor.

A temperature model is implemented in control unit J197 which prevents overheating of the compressor while simultaneously utilising the maximum possible raising times.

For this purpose, the control unit calculates a maximum permissible compressor temperature based on the compressor running time and the temperature signal, and deactivates the compressor or prevents activation when defined limit values are exceeded.



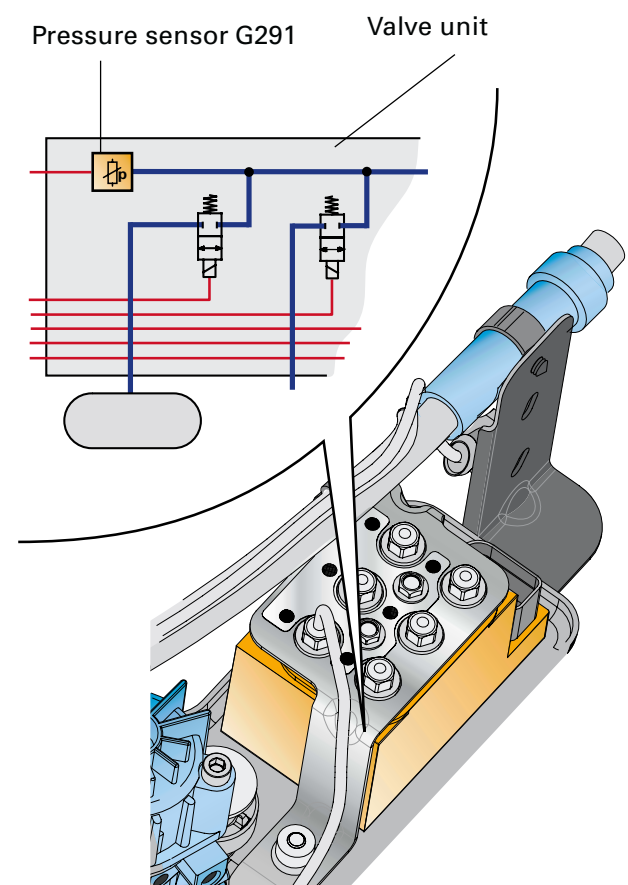
243\_011

## Pressure sensor G291

Pressure sensor G291 is integrated into the valve unit and is used to monitor the pressure in the pressure accumulator and the air springs. The information regarding accumulator pressure is required for checking the plausibility of the raising functions (see Pressure accumulator/control strategies, Page 19) and for self-diagnosis. The individual pressures of the air springs and pressure accumulator can be determined by means of appropriate control of the solenoid valves.

The measurement of individual pressures is performed during discharging or filling of the air springs/pressure accumulator. The pressures determined in this manner are stored and updated by the control unit. The accumulator pressure is additionally determined every 6 minutes (updated) while the vehicle is in driving operation.

The G291 transmits a voltage signal proportional to the pressure.



243\_012

## Vehicle level senders G76, G77, G78, G289 (level sensors)

The level sensors are so-called angle sensors. With the aid of the connecting link kinematics unit, the height changes of the vehicle body are converted into angle changes.

The angle sensor used in the Audi allroad quattro is a contact-free sensor which operates according to the induction principle.

A special feature of the level sensor used is that it produces two different output signals proportional to the angle. This allows it to be used for both 4-level suspension and for headlamp range control (see pin-assignment table).

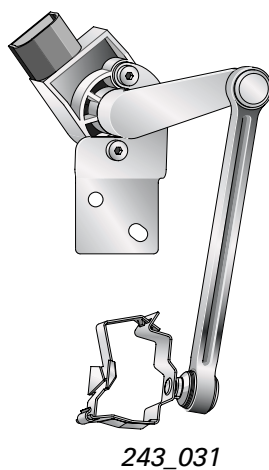
One signal output provides a voltage proportional to the angle (for headlamp range control) and a second signal output provides and PWM signal proportional to the angle (for 4-level air suspension).



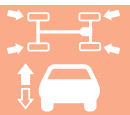
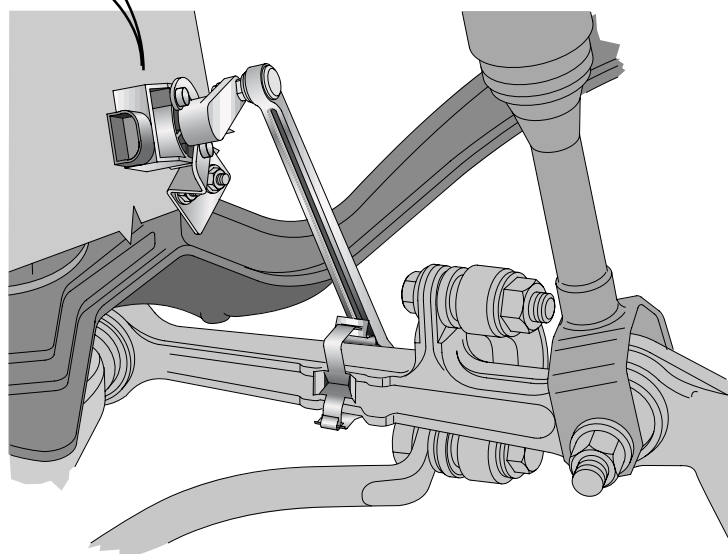
The 4 level sensors are identical in design, only the brackets and connecting link kinematics unit vary according to the side and axle.

The sender arm deflection and thus the output signal are opposite on the right and left sides. For instance, the output during compression increases on one side and decreases on the other.

Level sensor on the front axle



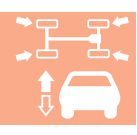
Level sensor installation position



# System components

For technical reasons, the voltage for the left-hand level sensors (front left G78 and rear left G76) is supplied by the headlamp range control unit J431. Power is supplied to the right-hand level sensors (front right G289 and rear right G77) by the 4-level air suspension control unit J197.

This ensures that if control unit J197 fails, the headlamp range control system can continue to operate (see also Self-levelling control unit page 34)

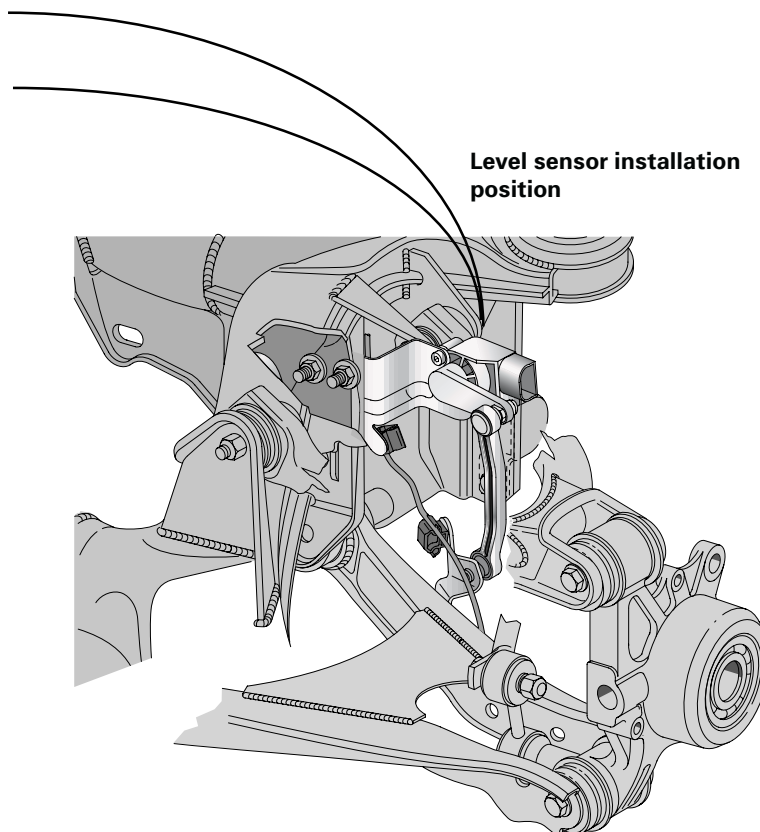


## Pin assignment for the level sensor

Pin	
1	Earth (left from J431, right from J197)
2	Vacant
3	Vacant
4	Analogue signal output, Voltage signal (left only for HRC)
5	5 Volt power supply (left from J431, right from J197)
6	Digital signal output, PWM signal (right and left for J197)

- J431 Control unit for **HeadampRangeControl**
- J197 Self-levelling suspension control unit

Level sensor on rear axle



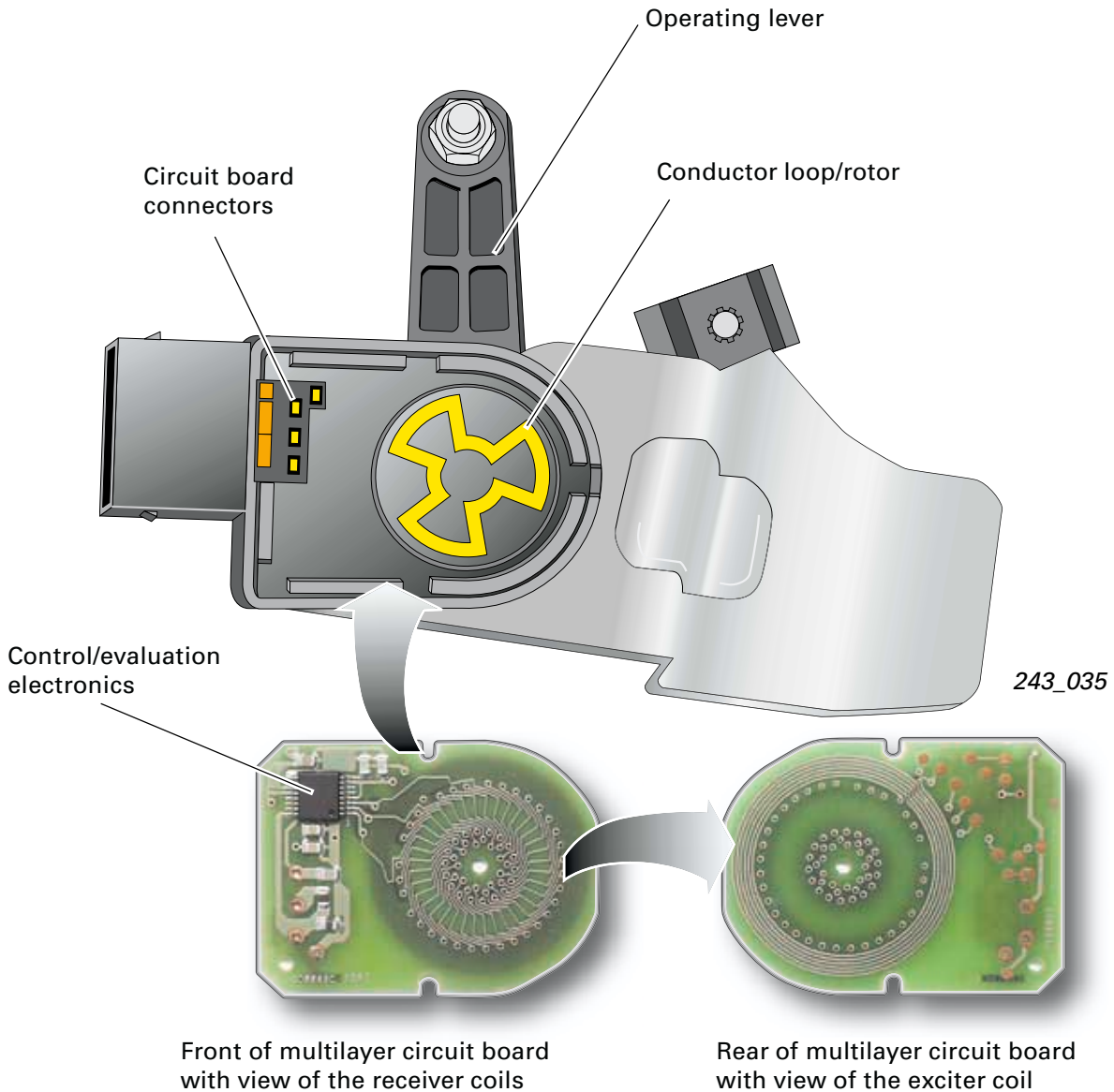
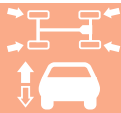


## Construction/design

The angle sensor consists essentially of the stator and the rotor.

The stator consists of a multilayer circuit board comprising the exciter coil, three receiver coils and the control/evaluation electronics. The three receiver coils have an angular geometrical star shape and are arranged out of phase. The exciter coil is mounted on the back of the circuit board.

The rotor consists of a closed conductor loop connected to the sender arm (rotates with the sender arm). The conductor loop has the same geometric shape as the receiver coils.



# System components

## Function

The exciter coil is subjected to an alternating current which produces an electromagnetic alternating field, the induction of which is penetrated by the rotor.

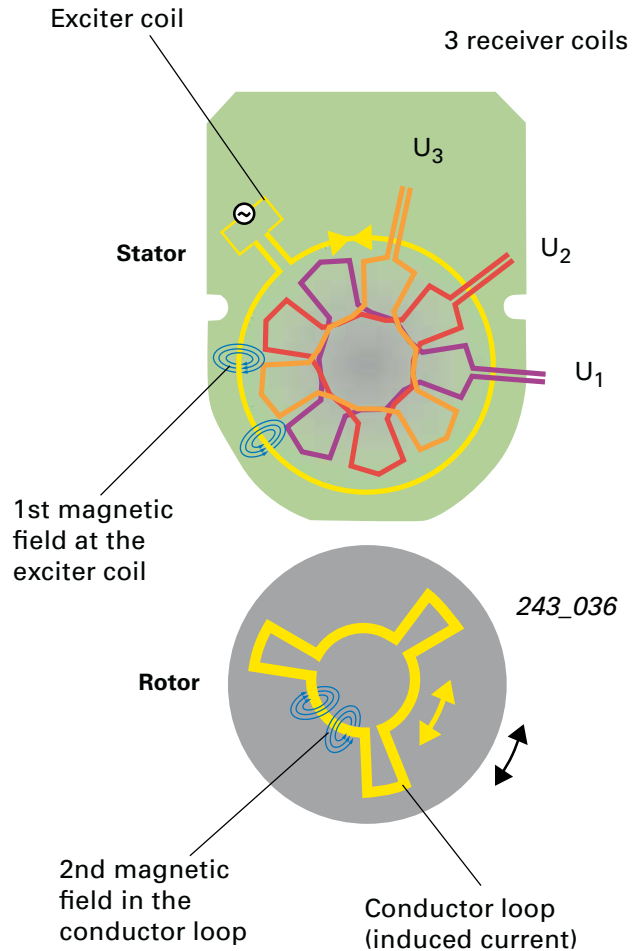
The current induced in the rotor produces a second electromagnetic alternating field around the conductor loop (rotor).

Both alternating fields, from the exciter coil and from the rotor, act on the receiver coils and induce corresponding alternating currents in them.

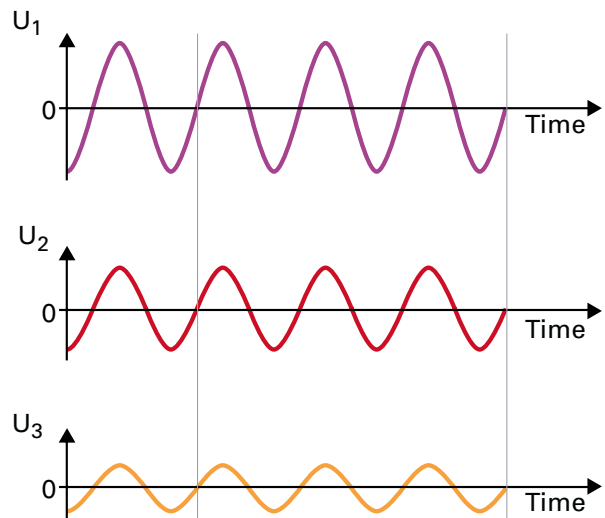
While the induction of the rotor is independent of its angle position, induction of the receiver coils depends on their distance from the rotor and thereby on its angle position.

As the rotor, depending on its angle position, overlaps differently with regard to each receiver coil, their voltage amplitudes vary in accordance with the angle position of the rotor.

The evaluation electronics compensate the alternating currents of the receiver coils, amplify them and produce proportional output voltages for the three receiver coils (proportional measurement). After voltage evaluation, the result is converted into output signals for the level sensors and transmitted to the control units for further processing.



**Voltage amplitudes depending on the position of the rotor with regard to the receiver coil (example of a rotor position)**

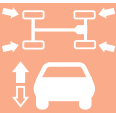


## Level sensors, summary

The advantages of the angle sensor are the proportional measurement process along with their contact-free and therefore wear-free operation.

The generation of ratios (proportional measurement) means that the output signal proportional to the angle is largely independent of mechanical tolerances such as distance changes, axle movement or inclination errors. Magnetic interference is also largely suppressed due to the generation of ratios.

As no magnetic materials are required, temperature and age cause only minimal variances in the measured values. Such variances are caused by a reduction in the strength of the magnetic field of permanent magnets over time or due to temperature changes.



## Warning lamp K134...

... illuminates for one second when terminal 15 is ON (self-test).

... is constantly illuminated in the case of relevant system errors or when the system is switched off.

... is constantly illuminated during basic system setting and when basic system setting has not been performed successfully.

... flashes in the case of extremely low or high levels.

... flashes during final control diagnosis.

Warning lamp K134



242\_050

# System components


## Operating unit for self-leveling E281

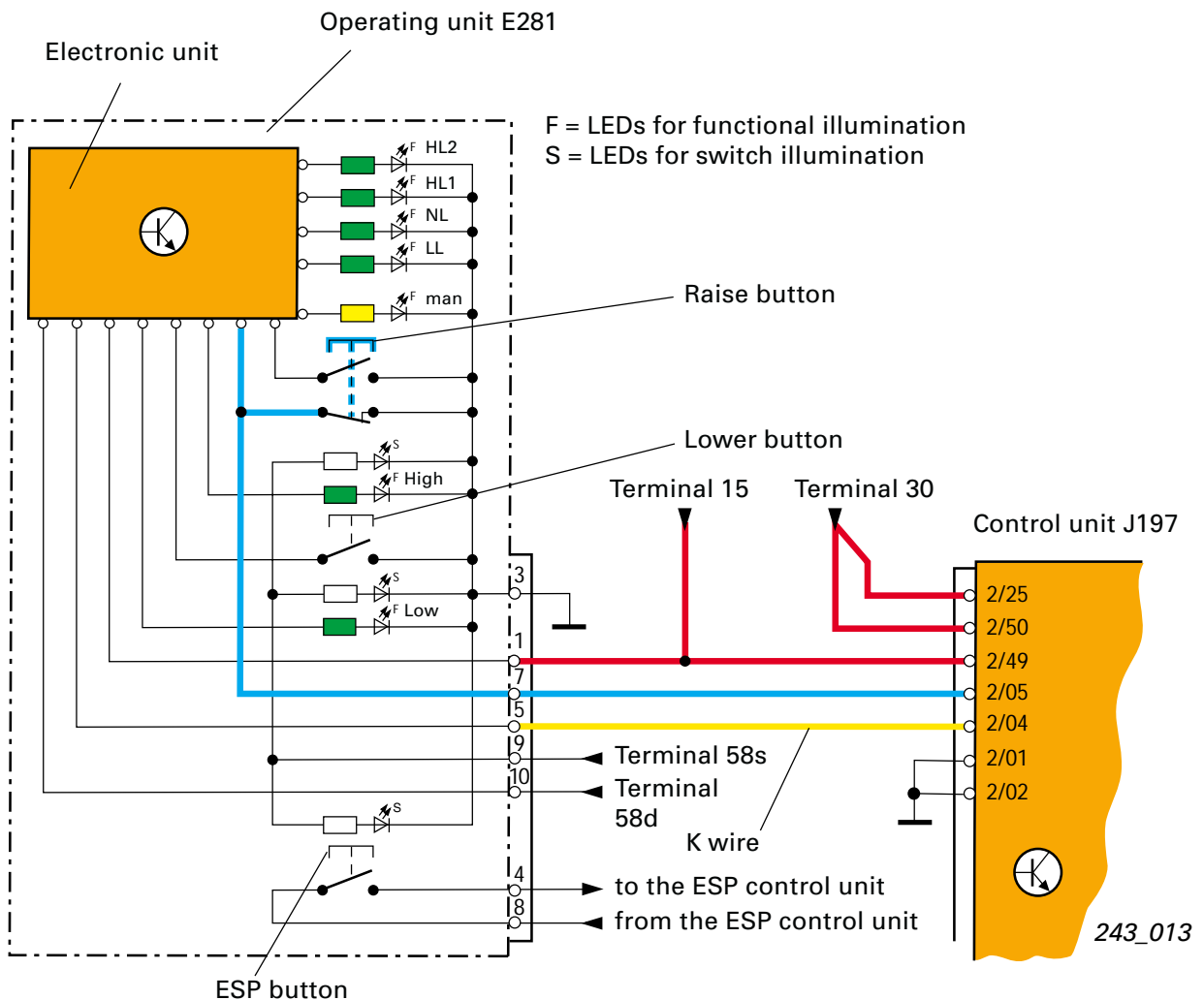
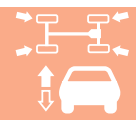
The operation and displays of the operating unit are described on page 7. In this section, the function of the operating unit will be described.

The interface to control unit J197 is performed by means of a data communication wire (K wire)  
An electronic unit integrated into the operating unit evaluates the signals from the level button and transmits these as a corresponding data protocol via the K wire to control unit J197.

Control unit J197 transmits the information concerning the vehicle level and the system status back to the E281 via the K wire, whereupon the electronic unit actuates the relevant LEDs.

For self-diagnosis reasons, the "raise" button is designed as a redundant additional interface.

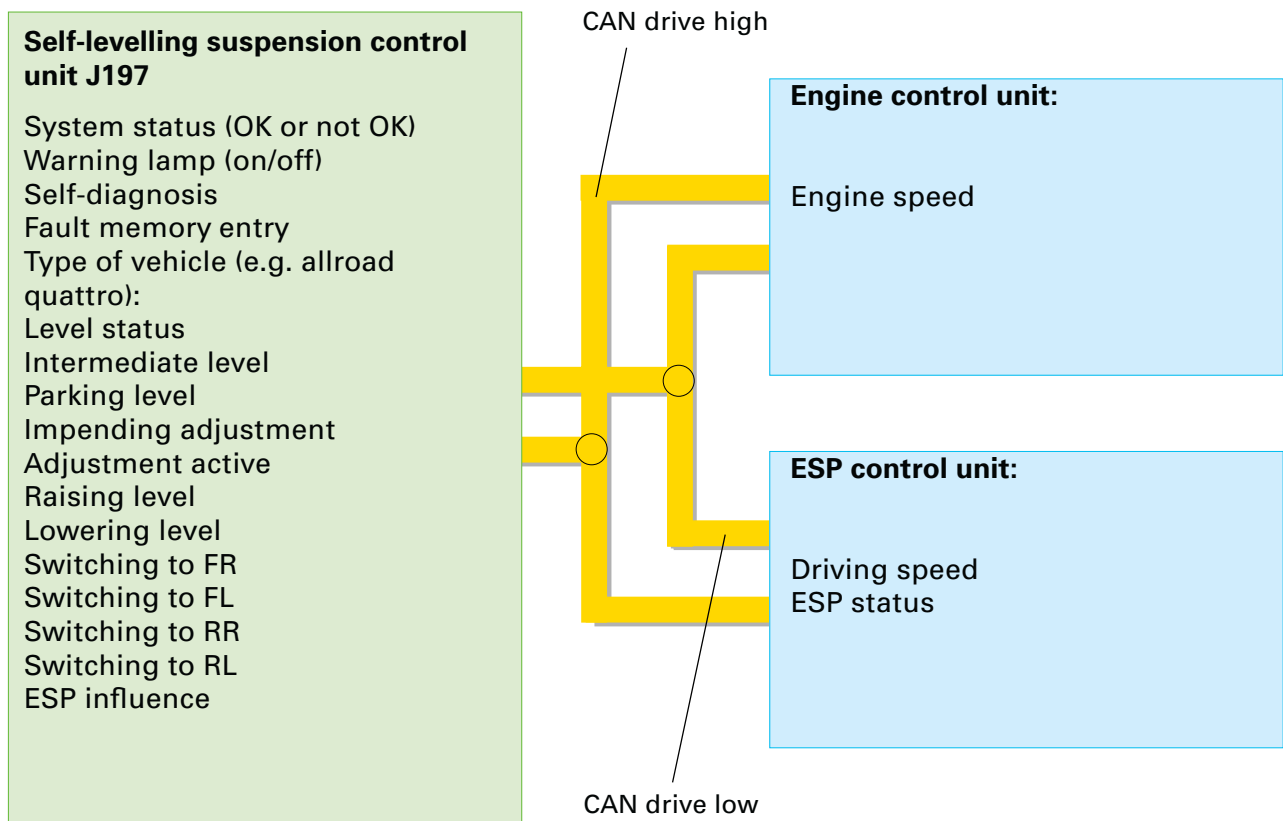
 The K wire between E281 and J197 bears no relation to the self-diagnostic K wire between J197 and the diagnostic testers.



## CAN information exchange

In the case 4-level air suspension, the information exchange between control unit J197 for the self-levelling system and the networked control units is performed via the CAN drive with the exception of a few interfaces.

The system overview shows the information provided by the gearbox control unit via the CAN bus which is received and used by the networked control units.



Information sent by the J197 control unit.

Information received and evaluated by the J197 control unit.



For detailed information on the CAN bus, please refer to SSPs 186 and 213.



# Interfaces

## Additional interfaces

### The door contact signal ...

... is an earth signal from the control unit for central locking. It indicates that the door or boot lid/tailgate is open.

... serves as a "wake-up pulse" for transfer from sleep mode to run-on mode (see "Control concepts").

### Terminal 50 signal...

... signals actuation of the starter and is used to switch off the compressor during start-up.

If a low position is detected following a wake-up pulse, the compressor is activated immediately in order to allow the vehicle to drive off as quickly as possible.

The compressor is switched off during start-up in order to save battery power and ensure starting power.

### The vehicle locking signal ...

... is used as information for parking level control

... is an earth pulse coming from the control unit for central locking J429

... is not detected by the self-diagnosis. Parking level control is not performed if this signal fails.



The vehicle locking signal is not required for vehicles without parking level control (see pages from 10 onwards and 34 onwards).

### The driving speed signal ...

... is a square-wave signal produced by the dash panel, the frequency of which is changed in accordance with the vehicle speed.

... is required in the evaluation of the driving condition (stationary/driving mode) and thereby for selection of the control criteria (see "Control concept").

The interface for the driving speed signal is redundant, as the information regarding speed is also transmitted by the CAN bus.

### K wire

Communication for self-diagnosis between control unit J197 and the diagnostic tester takes place via the familiar K wire by means of conventional data messages.

The self-diagnosis K wire must not be confused with the K wire connecting operating unit E281 to control unit J197.

### Power supply to the headlamp range control system

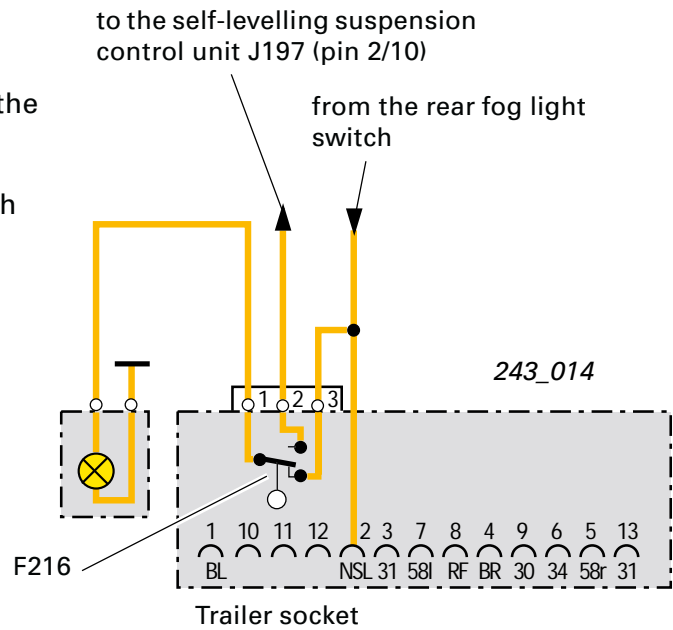
In the case of 4-level air suspension in the allroad quattro, the headlamp range control system voltage is supplied by the air suspension control unit J197. Further information can be found under Control unit J197 on page 34.

### The trailer operation signal ...

..... comes from the F216 contact switch in the trailer socket.

When the plug is connected, contact switch F216 connects control unit J197 to earth.

See also "Trailer operation".



### Headlamp range control signal

As changing vehicle levels is axle-based (i.e. for both sides of an axle at once), this would produce a short-term visibility range reduction when driving at night.

For this reason, the allroad quattro is fitted with an automatic dynamic headlamp control system (also without gas-discharge headlamps). The automatic dynamic headlamp range control system maintains the light beam at a constant angle while the vehicle level changes.

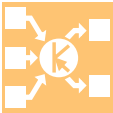
In order to prevent irregularities in the road surface, such as bumps or potholes, from causing the headlamp range to alter unnecessarily, long reaction times are set when the vehicle is travelling at relatively constant speeds (little or no acceleration).

If level change takes place (e.g. motorway mode), the 4-level air suspension control unit J197 transmits a voltage signal to the headlamp range control unit J431. This activates the HRC immediately and controls the bodywork movements.

#### Level change process:

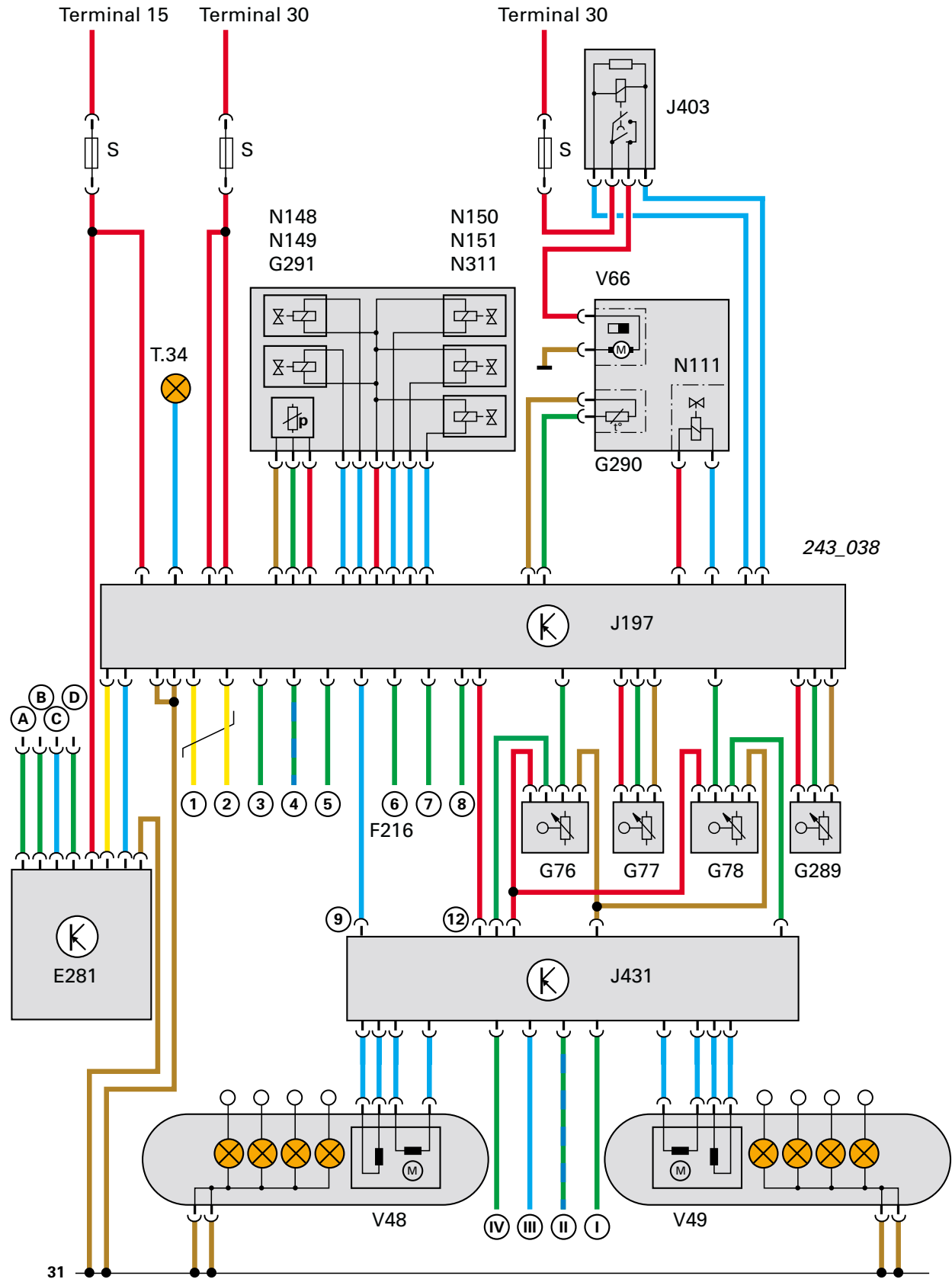
**Raising** - rear axle first, then front axle

**Lowering** - front axle first, then rear axle



# Interfaces







## Functional diagram





## Key to function diagram

E281	Self-levelling suspension operating unit
F216	Contact switch for switchable rear fog light
G76	Self levelling suspension sender, RL
G77	Self levelling suspension sender, RR
G78	Self levelling sender, FL
G289	Self levelling suspension sender, FR
G290	Compressor temperature, self-levelling suspension sender
G291	Self-levelling suspension pressure sender
J197	Self-levelling suspension control unit
J403	Relay for self-levelling suspension compressor
J429	Control unit for central locking
J431	Control unit for headlamp range control
N111	Discharge valve for self-levelling suspension
N148	Valve for FL suspension strut
N149	Valve for FR suspension strut
N150	Valve for RL suspension strut
N151	Valve for RR suspension strut
N311	Valve for self-levelling suspension pressure accumulator
K134	Self-levelling suspension warning lamp
V48	Left headlamp range control motor
V49	Right headlamp range control motor
V66	Self-levelling suspension compressor motor

	= Input signal
	= Output signal
	= Positive
	= Earth
	= Bi-directional
	= CAN bus/signal wire

### Auxiliary signals:

- ① CAN low
  - ② CAN high
  - ③ Door contact signal
  - ④ Diagnostic connector for K wire
  - ⑤ Vehicle locked signal
  - ⑥ Trailer operation signal (F126)
  - ⑦ Terminal 50 signal
  - ⑧ Driving speed signal
  - ⑨ Headlamp range control signal
  - ⑩ Power supply J431
- 
- I Terminal 56
  - II Diagnostic connector for K wire to the instrument cluster
  - III Driving speed signal from ABS control unit, speed sensor output, rear left
- 
- A Terminal 58s
  - B Terminal 58d
  - C ESP button
  - D ESP button



# Control concepts

## Self-levelling suspension control unit J197

The central element of the system is the control unit which, in addition to its control functions, enables the monitoring and diagnosis of the entire system.

The control unit detects the signal from the level sensors and uses it to determine the current vehicle level. This is compared with the reference level and corrected if necessary, depending upon further input variables (interfaces) and its internal control parameters (reaction times and level deviations).

It differentiates between various control situations and controls them via the relevant control concepts (see Control concept).

Comprehensive self-diagnosis facilitates inspection and service of the system (see Workshop Manual).

There are two control units currently in use, depending on the country.

Control units with the part numbers 4Z7 907 553A and 4Z7 907 553B have different control strategies (see page 10 onwards). A common control strategy for all countries (as for Index "B") is planned for the future.

### Power supply to the headlamp range control system

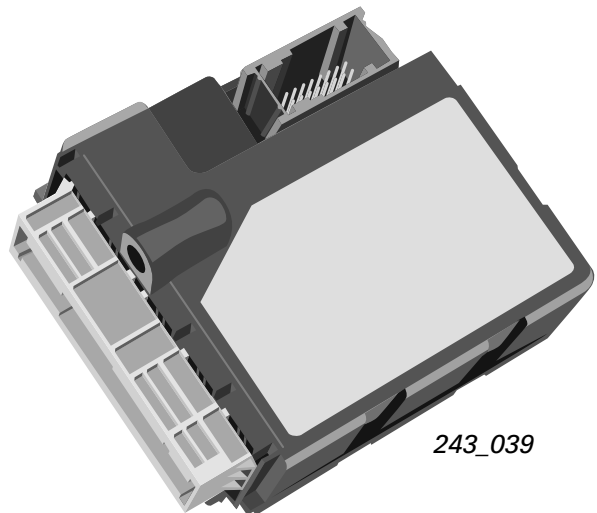
As previously described in the "Level sensors" section, voltage is supplied to the left-hand level sensors by the headlamp range control unit J431)

Headlamp range control requires neither run-up nor run-on times, so the voltage is normally supplied to control unit J431 via terminal 15 (ignition ON) (see function diagram, page 32).



The system can be tested via the self-diagnosis or test adapter 1598/35. For further information, see "Service" chapter.

### Address word 34



243\_039

However, all level sensors (left and right) are required in the air suspension system run-up and run-on mode (ignition OFF).

To allow the left-hand level sensors to deliver measured values in the case of the 4-level air suspension in the allroad quattro, power is supplied to control unit J431 (HRC) from control unit J197).

This ensures that voltage is supplied to all level sensors when control unit J197 is active.

# Modes

## Height mode/driving mode

### Reaction times upon level deviation

Driving speed	Reaction time
<5 km/h Height mode	approx. 5 seconds approx. 1 second at extremely low level
>10 km/h Driving mode	approx. 50 seconds or 15 minutes depending on the level deviation

### Control characteristics during level change

Level change is basically performed axle by axle, whereby level differences between the left and right sides are compensated (e.g. if loaded on one side).

### Run-on mode/run-up mode

The run-on mode enables the compensation of level deviations after the vehicle has been parked (e.g. caused by passengers leaving the vehicle or unloading the vehicle) and before driving off (e.g. caused by intense cooling, leakage or loading).

In this mode, delay times before commencing a journey are kept to a minimum.

### Level change process:

**Raising** - rear axle first, then front axle

**Lowering** - front axle first, then rear axle



# Control concepts

## Sleep mode

To minimise electricity consumption the control unit switches to "system idle" (sleep mode) after 15 minutes.

There is no level adjustment in sleep mode. "Wake-up" is primarily triggered by the door contact signal. If the door contact signal fails, the system is activated when the ignition is switched "ON" or by the driving speed signal.

The system can switch between sleep mode and run-on/run-up mode, triggered via the door contact signal, a maximum of 15 times. For the 15 subsequent wake-up procedures, the system switches to sleep mode after only 1 minute.

The system can then only be activated via terminal 15 and/or the speed signal.



## Lifting platform mode

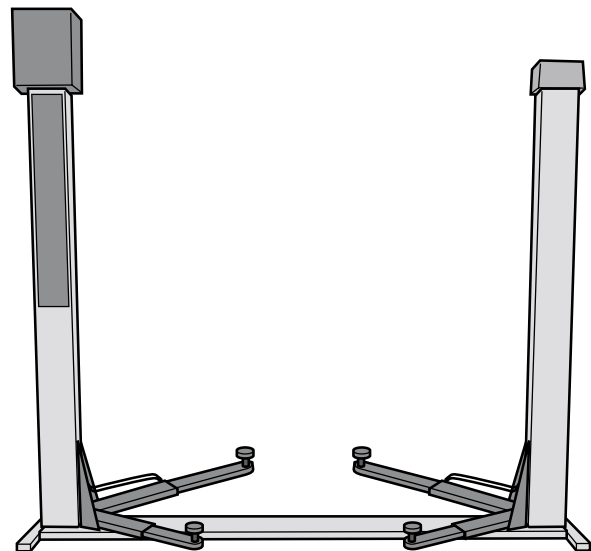
The control unit evaluates the level signals while a stationary vehicle is being lowered and thereby initiates lifting platform operating mode.

The aim of the lifting platform mode is to prevent excessive discharge of the air springs when the vehicle is completely raised.



The vehicle should be raised as quickly as possible in order for the control unit to recognise the lifting-platform mode.

It is often advisable to switch off the system during repair work (e.g. during axle measurement or if the pressure lines have been detached, in order to prevent the compressor running unnecessarily).



242\_010

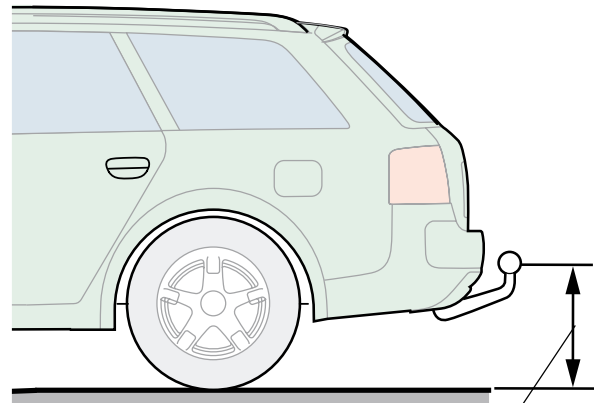
## Trailer operation

The correct position of the tow bar on the trailer attachment during trailer operation is indicated in normal mode.

Contact switch F216 in the 13 pin trailer socket is used to signal that the trailer plug is inserted, i.e. indicates trailer operation (see description "Trailer operation signal").

If trailer operation is recognised, the manual mode is automatically activated (LED "man" lights up) whereby the automatic raising process is stopped.

Normal level is set by the driver via control unit E281.



243\_015

Normal level



In trailer operation, normal mode must always be selected and care must be taken that the system is switched to manual mode (e.g. no automatic switching to manual mode if trailer operation signal fails).

In difficult driving conditions, high level 1 or high level 2 can be selected, however, normal level must be selected before a driving speed of 35 km/h is exceeded.

Driving at low level or in automatic mode is not permitted.



# Service

## Special tools

Adapter cable 1598/35 with test box 1598/14 are used for fault finding and function testing of sensors and signals of the 4-level air suspension system.



Due to the limited number of connections to test box V.A.G. 1598/14, not all interfaces in control unit J197 are wired.

As the pin assignment of the test box is not compatible with the pin assignment of control unit J197, pin template V.A.G 1598/35-1 must be used.

Pin assignment is only possible by means of pin template V.A.G 1598/35-1.

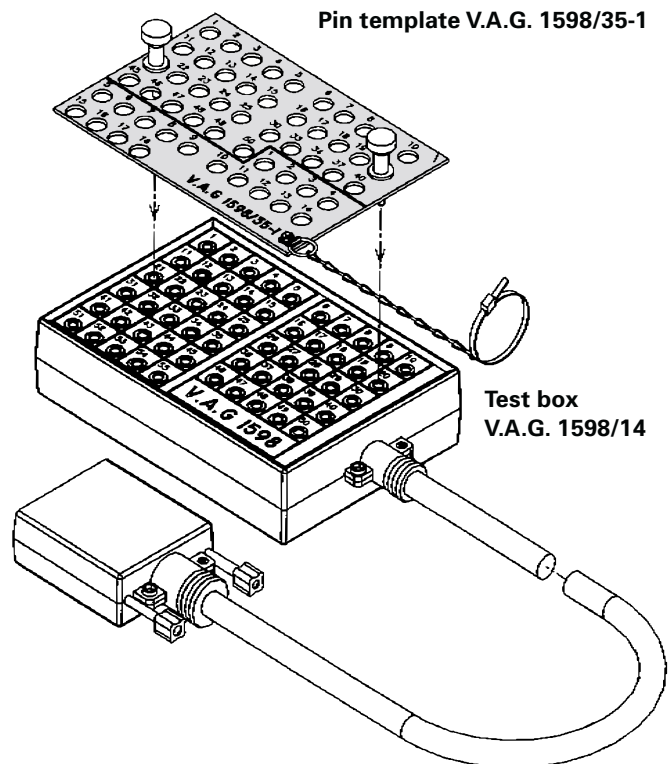


Adapter cable 1V.A.G 598/35



243\_016

Pin template V.A.G. 1598/35-1



Test box  
V.A.G. 1598/14

243\_017

## Basic system setting

The basic system setting of the reference level in the 4-level air suspension system is performed by inputting body-level measured values at normal level.

The measured value, the vertical dimension from the wheel centre to the wheel cut-out, must be input into the control unit using a diagnostic tester in function 10 "Adaption". (Procedure, see Workshop Manual).

The codes serve to define the reference value for normal level (allroad quattro 402 mm). This means that design-specific values of the level sensors are adjusted for this dimension.

Due to the tolerances of the components involved, there is a certain deviation between actual (measured) and reference (defined) values.

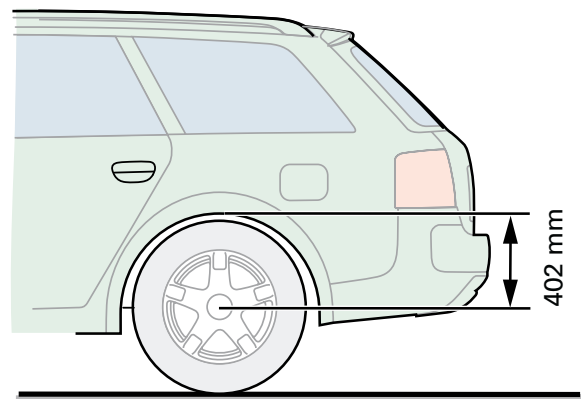
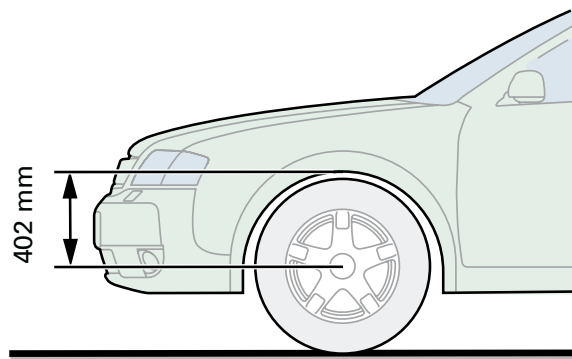
By the inputting of the actual value, control unit J197 recognises a potential difference to the reference value. based on which the design-specific values from the level sensors are adapted.

### Advantages of the measurement method:

- ▶ No influence of the correct basic setting due to ...
  - ... different tread depths and tyre pressures.
  - ... minor unevenness of the road surface.
  - ... different tyre sizes.
  
- ▶ Simple to perform.

### Codes for the allroad quattro 25500

Position	Meaning
X0000	1 = Headlamp control not installed 2 = Headlamp control installed
0X000	5 = Reference height, front axle 402 mm
00X00	5 = Reference height, rear axle 402 mm
000X0	0 = Vacant
0000X	0 = Vacant



243\_018

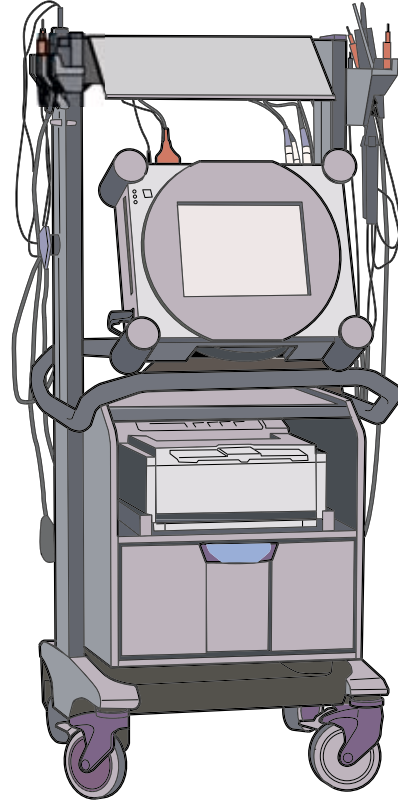


## Self-diagnosis

**Address word: 34 Self levelling suspension**

Both generations of diagnostic tester (V.A.G. 1551/1552 and VAS 5051) are suitable for communication with the 4-level air suspension control unit.

Due to the limited capacity of the tester program cards, there are display text limitations in the case of diagnostic testers V.A.G. 1551 and 1552 (see. e.g. Workshop Manual, Self-diagnosis function 03, Final control diagnosis).



198\_039



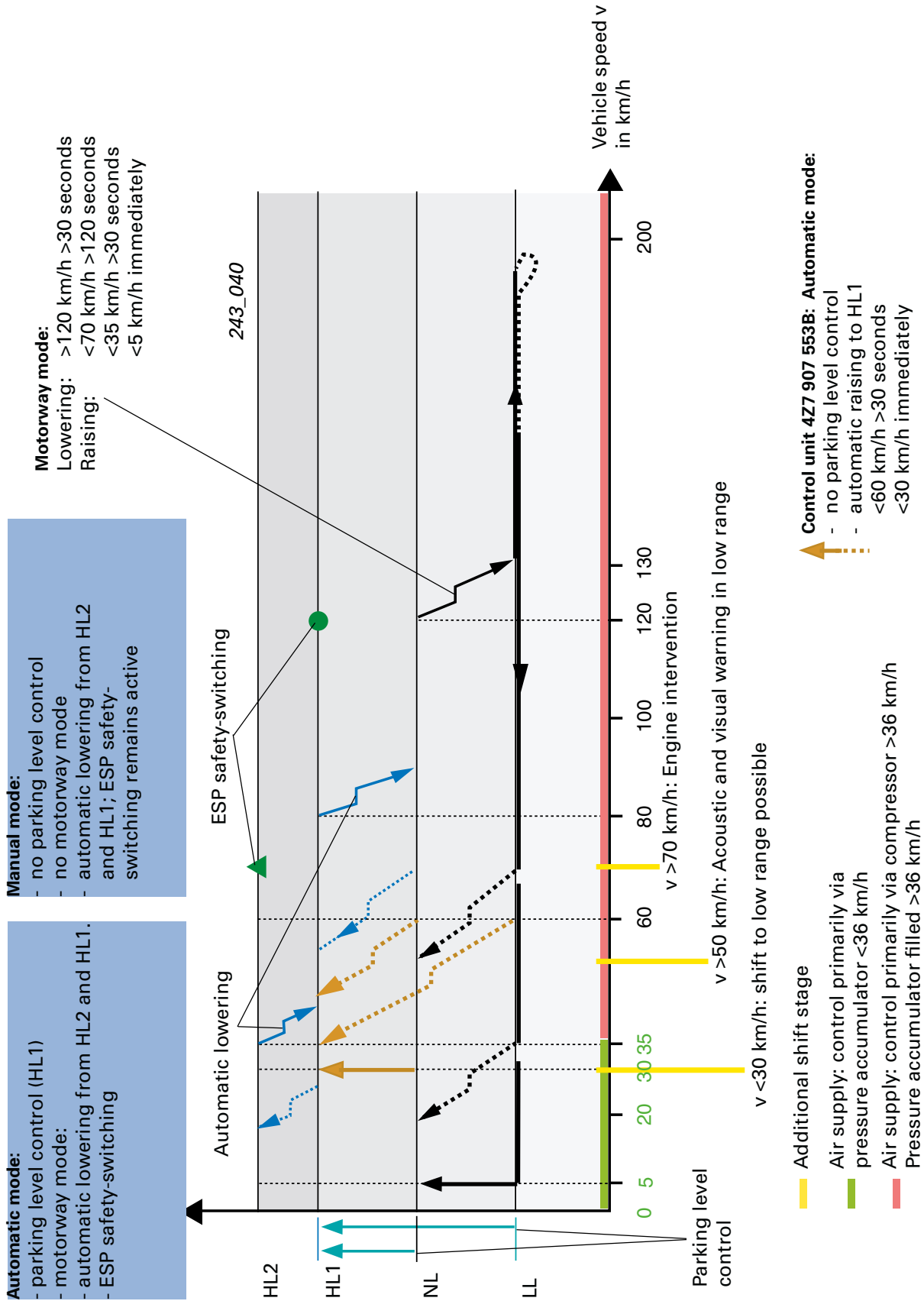


# General overview

Control unit 4Z7 907 553A/B

## Allroad quattro control strategies

4-level air suspension + additional shift stage



	<b>Notes</b>		
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