

Running gear

Power steering

The system pressure required to provide steering assistance is generated by means of a hydraulic pump.

On the traditional, familiar power steering system, the pump is driven directly by the vehicle engine.

Some of the engine power is therefore always required to operate the pump.

When steering assistance is needed the most – i.e. when manoeuvring – the engine speed is at its lowest.

The pump output is designed for these conditions. The faster the steering speed, the higher the pump speed and therefore the volumetric flow rate.

At higher engine speeds, the unwanted pump output is discharged via a bypass system.

In the new steering system, the hydraulics still provide assistance to the steering effort supplied by the driver, but this time the hydraulic pump – a gear pump – is driven by an electric motor and is mechanically independent of the vehicle engine.

A new feature is the steering angle-dependent steering effort assistance. For this, a steering angle sensor is located above the steering-gear housing, see Page 26, Fig. SSP240_059; the sensor transmits the steering angle speed to the electronic control system.

The steering angle information is sent directly to the control unit via a sensor cable.

The road speed is also recorded in the control unit during the evaluation.

This information is sent via the CAN bus.

The adjacent diagram shows the structure of the system.



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Components and fitting locations

Warning lamp for Servotronic K92

The warning lamp is integrated into the dash panel insert (driver information system). Self-diagnosis is done using address word 17 (instrument cluster).

Power steering sensor G250

The sensor is located in the valve dome of the power-assisted steering box. It records the steering angle and calculated the steering angle speed.

If the sensor should fail, the steering function is still guaranteed.

The power steering shifts to a programmed emergency running mode. The steering forces required are greater.

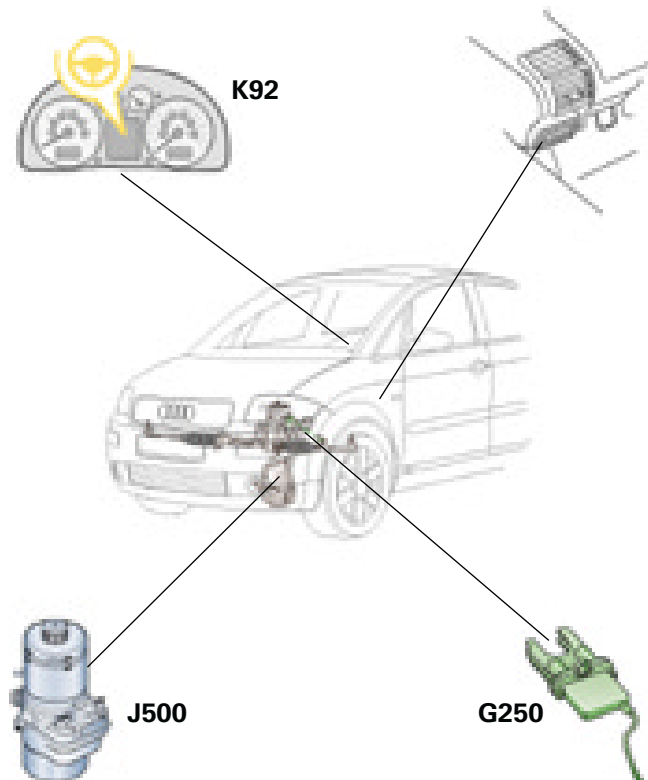
Error functions are stored in the power steering control unit J500.

Power steering control unit J500

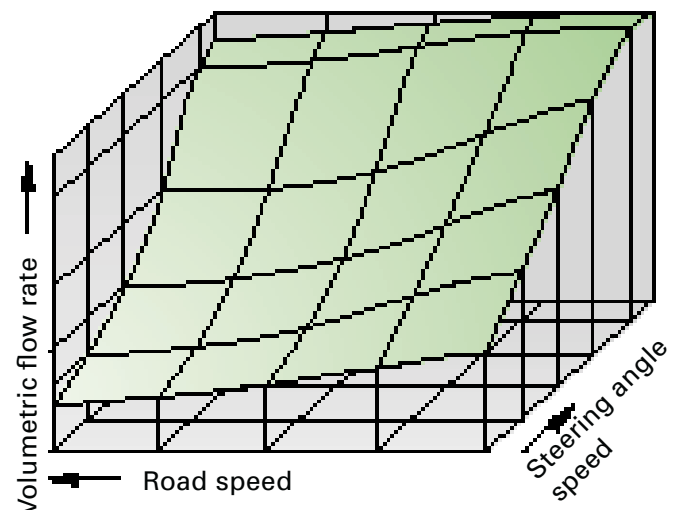
The control unit is integrated into the motor/pump unit.

It converts the signals for driving the gear pump as a function of steering angle speed and road speed. The delivery rate required at any particular moment is read from a map stored in the control unit. It detects and stores faults that occur during operation. An anti-pumping device and a thermal protection facility are integrated into the control unit.

The diagnosis connection is located in the driver's storage compartment.



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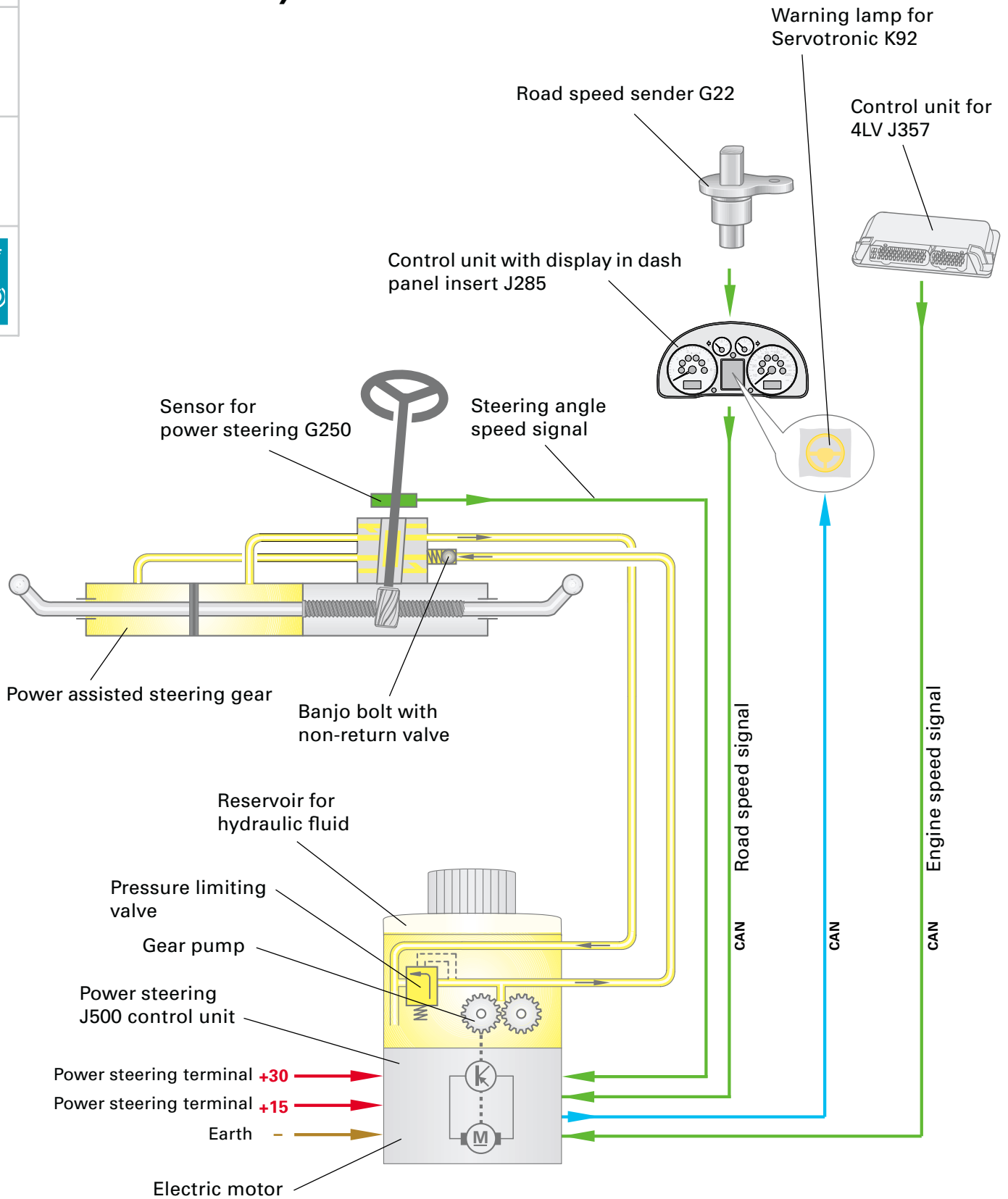


The power steering control unit cannot be replaced separately.



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Overview of system



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Design and function

The EPHS (Electrically Powered Hydraulic Steering) steering system is a power steering system that operates as a function of steering angle speed and road speed.



The pump, V119, for the steering hydraulics comprises a gear pump and an electric motor.

Instead of the vane pump that is traditionally used on conventional power steering systems, this system uses a gear pump that is integrated into the motor/pump unit.

The gear pump is not driven directly by the vehicle's combustion engine; instead it is operated by an electric motor integrated into the motor/pump unit.

The electric motor only operates when the ignition is switched on and the engine is running.

Signals for steering angle speed, road speed and engine speed are sent to the control unit. This control unit regulates the speed of the electric motor and the gear pump, and thereby regulates the delivery rate or the volumetric flow rate of the hydraulic fluid.

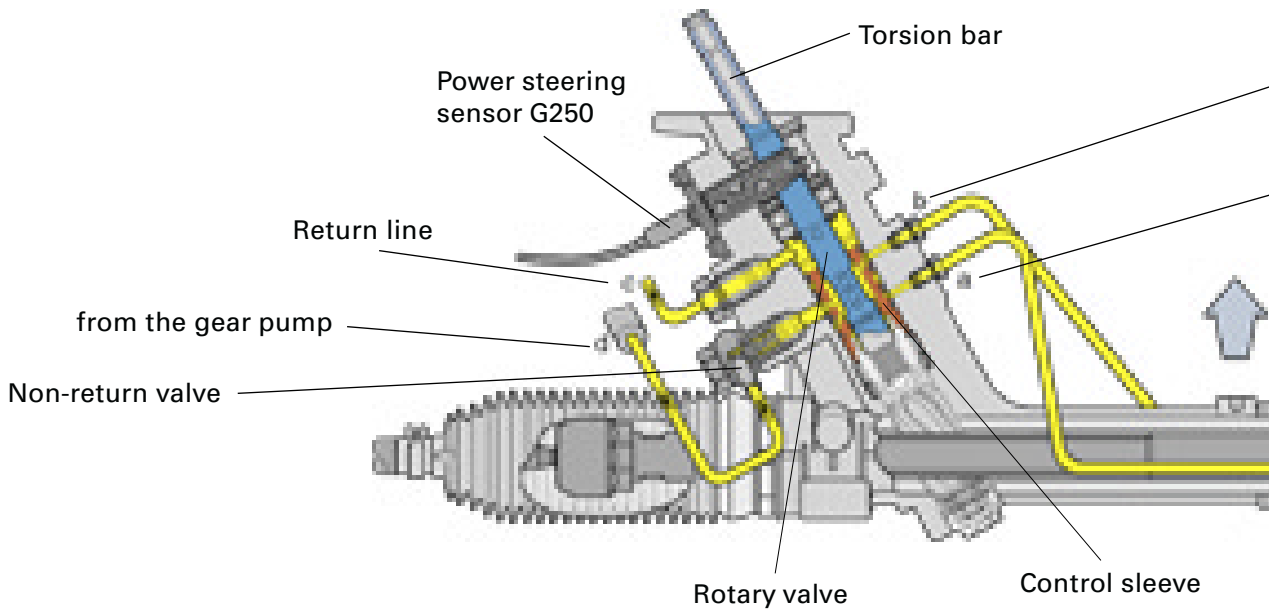
Anti-pumping device

The electrohydraulic power steering has an anti-pumping device that is actuated in the event of faults, a failure or a crash.

The anti-pumping function can be cancelled by switching off the ignition and restarting the engine. If necessary, wait approx. 15 mins to allow the motor/pump unit to cool down after overheating. If, after waiting for this period, the anti-pumping function cannot be cancelled by starting the engine, there is a fault in the vehicle electrical system or the motor/pump unit is faulty. In this case carry out a self-diagnosis and if necessary renew the motor/pump unit.



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As with the familiar power steering, the hydraulic control unit contains a torsion bar that is connected on the one side with a

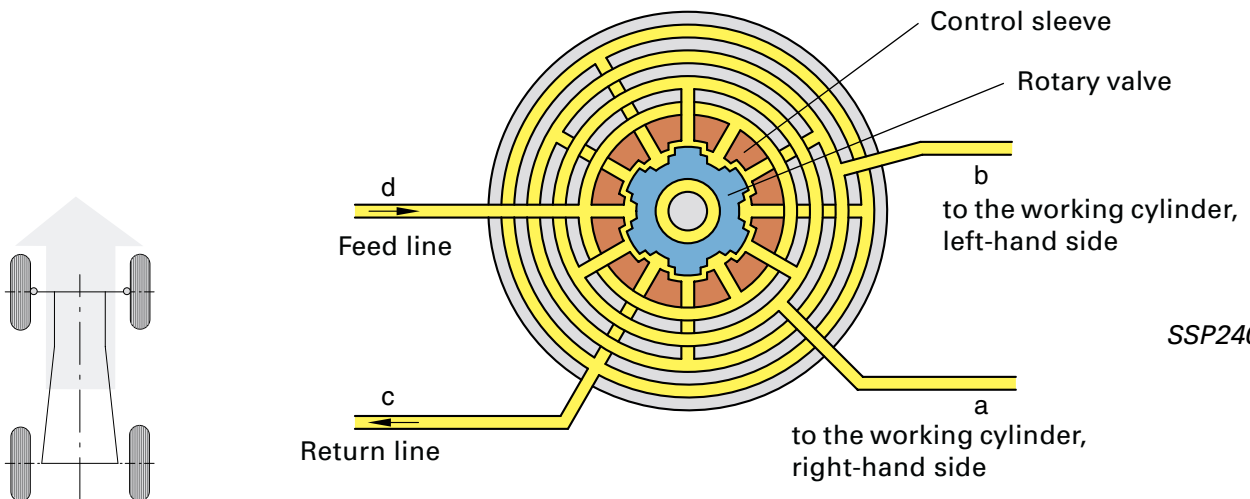
rotary valve and on the other side with the input pinion and the control sleeve.

Straight-ahead driving

In straight-ahead driving situations, the torsion bar holds the rotary valve and the control sleeve in a neutral position. The power steering sensor does not detect any steering angle.

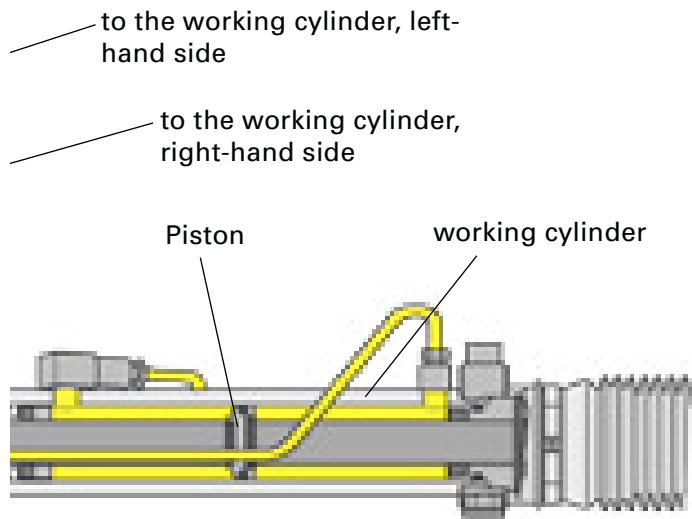
The fluid flows through the hydraulic control unit at virtually no pressure and returns to the reservoir via the return line.

The control grooves on the rotary valve and the control sleeve are in a neutral position with respect to each other so that the oil can enter both sides of the working cylinder and can run off to the reservoir via the return grooves on the control sleeve.



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From a hydraulics point of view, the function positions "right steering lock" and "left steering lock" are similar to the familiar power steering system.

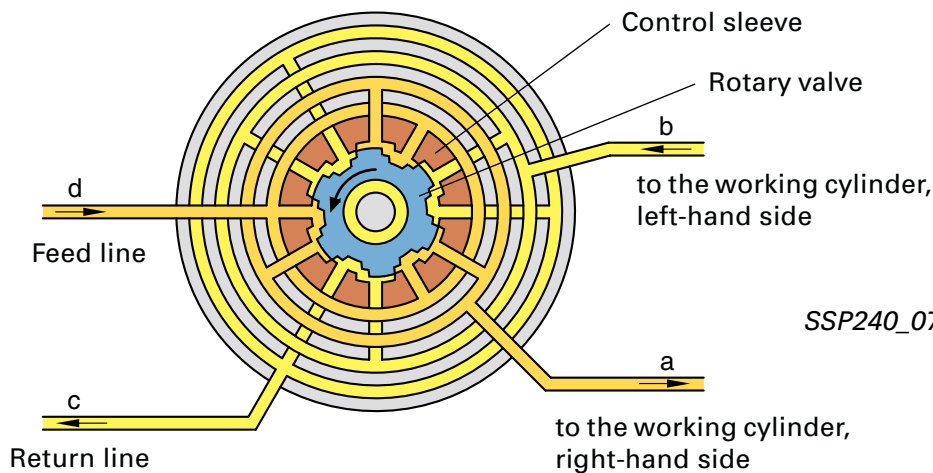
Left steering lock

The deformation of the torsion bar results in the rotary valve being twisted against the control sleeve. The control grooves of the rotary valve release the pressurised fluid feed to the right-hand side of the working cylinder.

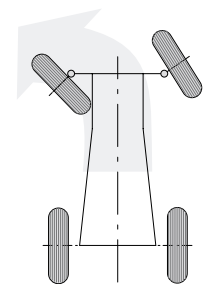
The pressurised fluid flows into the working cylinder and provides assistance for the steering motion. At the same time, the rotary valve closes the feed to the left-hand side and opens the return from the left-hand side of the working cylinder.

The pressure on the right-hand side forces the oil from the left-hand side of the working cylinder into the return line.

When the steering manoeuvre is completed, the torsion bar ensures that the rotary valve and the control sleeve return to the neutral position.



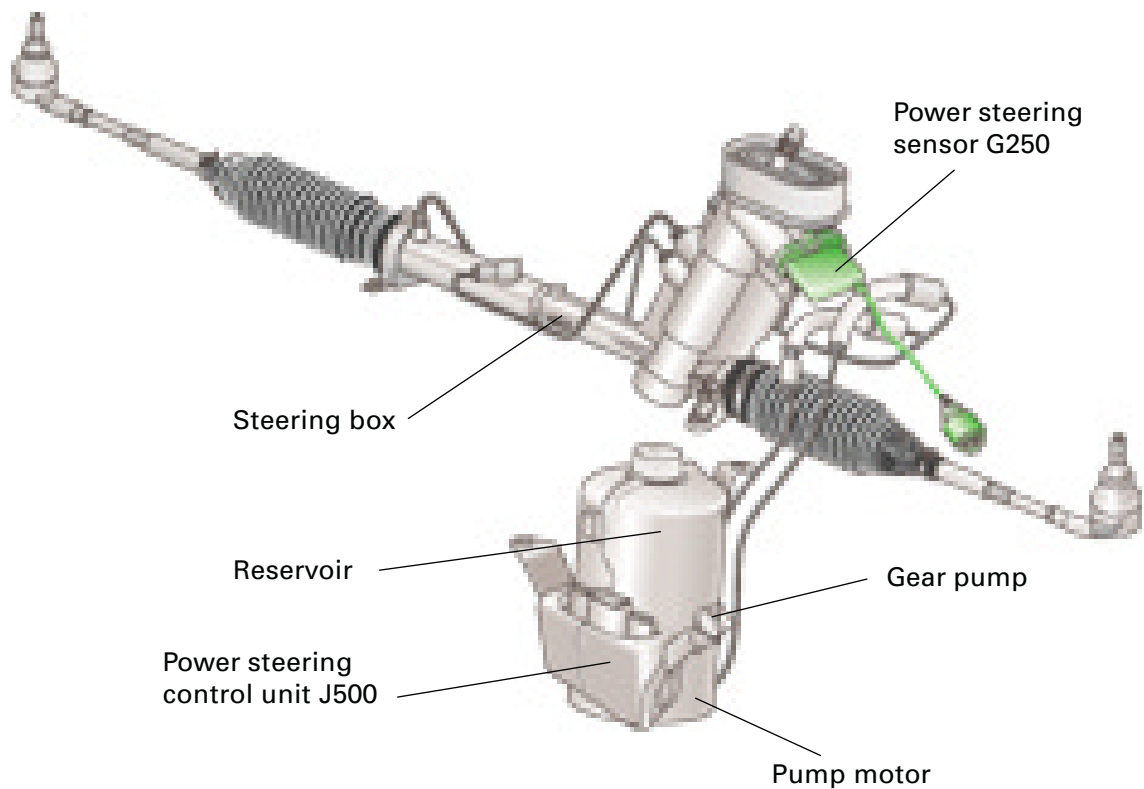
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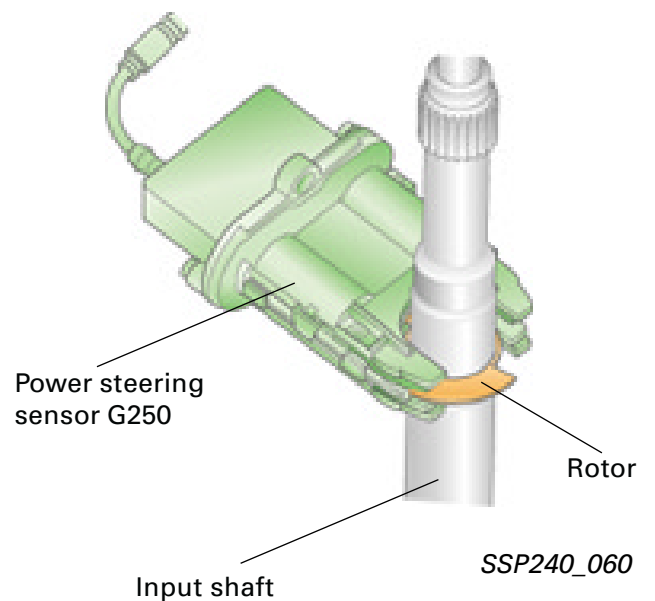
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The hydraulics also provide assistance for the steering effort provided by the driver on the new steering system. The hydraulic gear pump is driven by an electric motor and is therefore independent of the vehicle engine. A new feature is the steering angle-dependent steering assistance.



At a later date on the Audi A2 the signal from the steering angle sender G85 (see Page 33) will be used, thus eliminating the need for the power steering sensor G250.

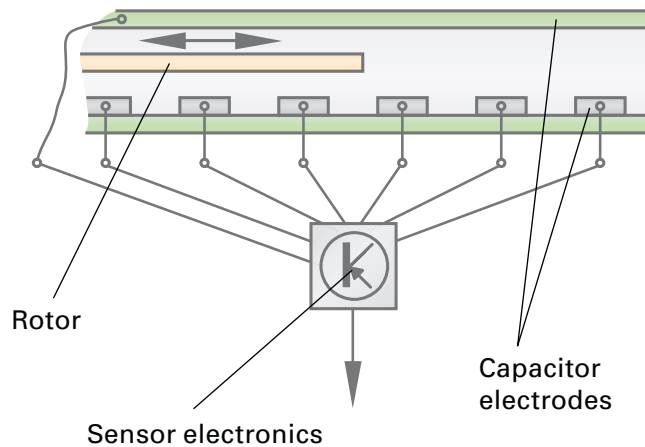
Description of the power steering sensor G250 (capacitive sensor)

A rotor that is attached to the input shaft rotates in between 9 small plate capacitors. This detunes the capacitance of the plate capacitors.

From this change in capacitance, the sensor's electronics calculate signals (steering angle and steering speed) for the power steering control unit.

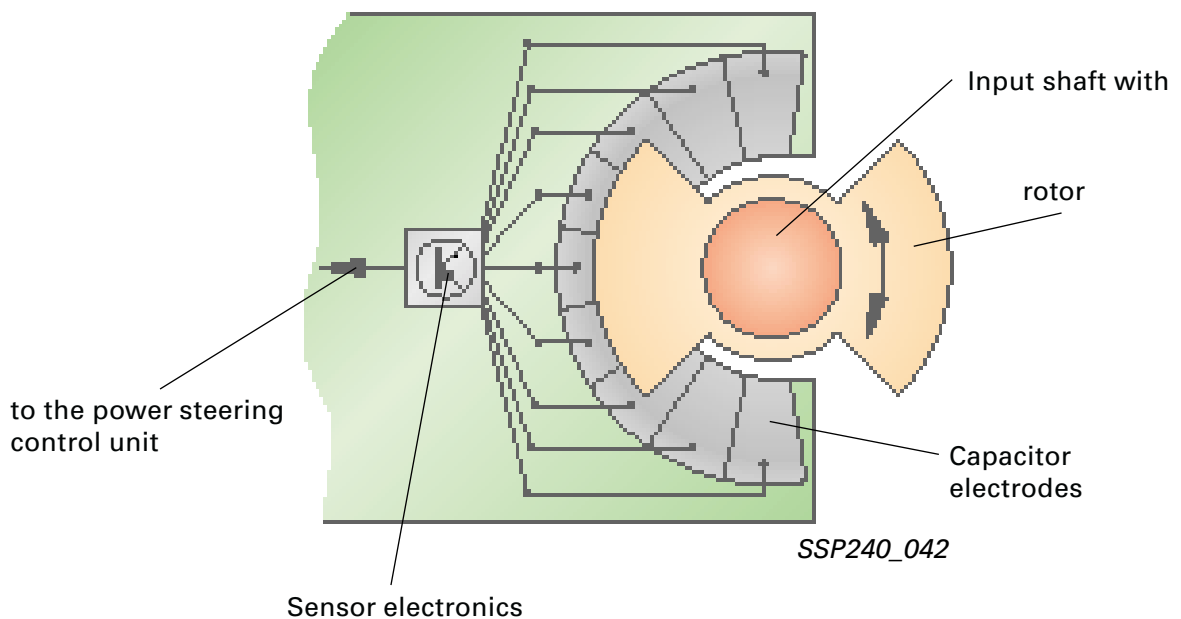


Schematic diagram of capacitor detuning



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Top view



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Running gear

The motor/pump unit consists of:

- the hydraulic unit with gear pump and electric motor
- the reservoir for the hydraulic fluid
- the control electronics for the electrohydraulic steering



The left-hand headlamp must be removed first in order to check/top up the hydraulic fluid.

Under no circumstances must the pressure and return lines for the power steering be detached. Otherwise the plastic inserts in the pipes might be damaged. If the pressure and return lines are lifted clear and tied in place, the bending radius must not be less than the minimum radius of 100 mm.

The power steering control unit J500

converts the incoming

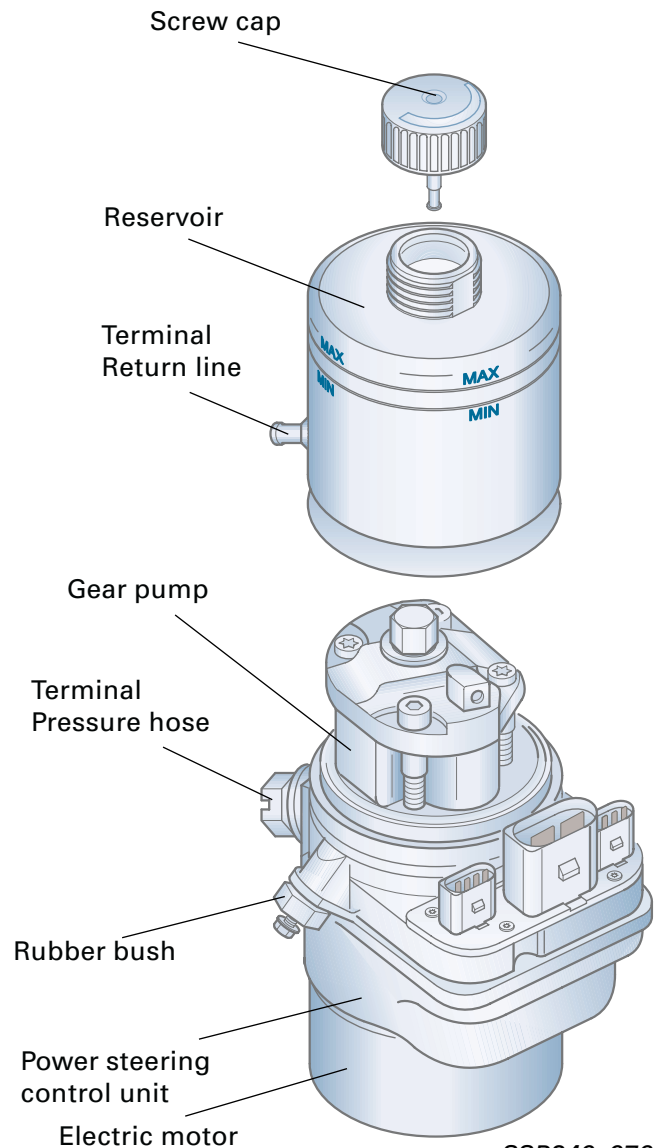
- engine speed (G28)
- road speed (G68)
- and steering speed (G250) signals

to drive the gear pump; this is done as a function of steering angle and road speed.

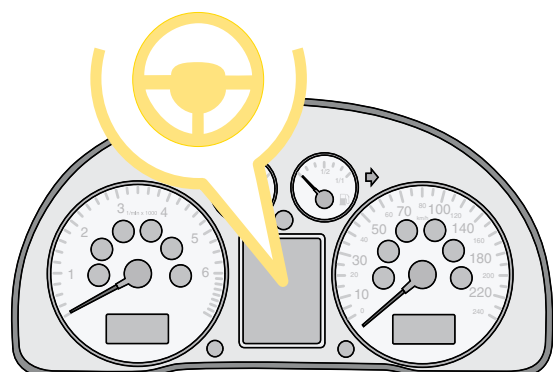


Self-diagnosis is done via the instrument cluster (address word 17). Communication is exclusively via the drive system CAN bus.

Error messages are output via the instrument cluster.



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Pump operation

Ignition	Vehicle engine	Electricpump	Steering assistance
on	running	running	available
off	stationary, road speed = 0 km/h	not running	none

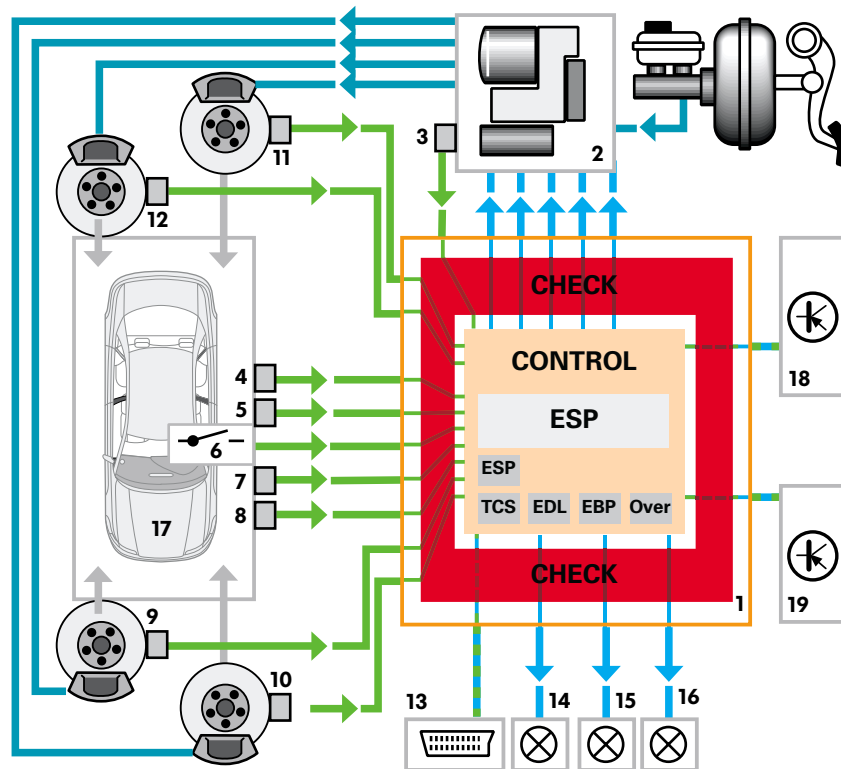


steering assistance

Road speed	Steering angle speed	Delivery rate	Steering assistance
low e.g. parking	high	high	high (light steering)
high e.g. motorway driving	low	low	low (heavy steering)

Running gear

ESP control system



SSP240_062

- | | |
|--|---|
| <ul style="list-style-type: none"> 1 Control unit for ABS with EDL/TCS/ESP J104 2 Hydraulic unit N55 with charging pump V64 3 Brake pressure senders 1 and 2 G201/G214 4 Lateral acceleration sender G200 5 Speed sensor G202 6 Button for TCS/ESP 7 Steering angle sender G85 8 Brake light switch 9 ... 12 active speed sensors G44 ... G47 | <ul style="list-style-type: none"> 13 Diagnosis wiring 14 Warning lamp for braking system K118 15 Warning lamp for ABS K47 16 Warnign lamp for TCS/ESP K155 17 Vehicle and driver behaviour 18 Cut-in to engine management 19 Cut-in to gearbox control system (vehicles with automatic transmission only) |
|--|---|



The rotational speed sensors supply the wheel speed information continually for each individual wheel.

The steering angle sensor is the only sensor that supplies its data directly via the CAN bus to the control unit. The control unit uses both pieces of information to calculate a target steering direction and target vehicle behaviour.

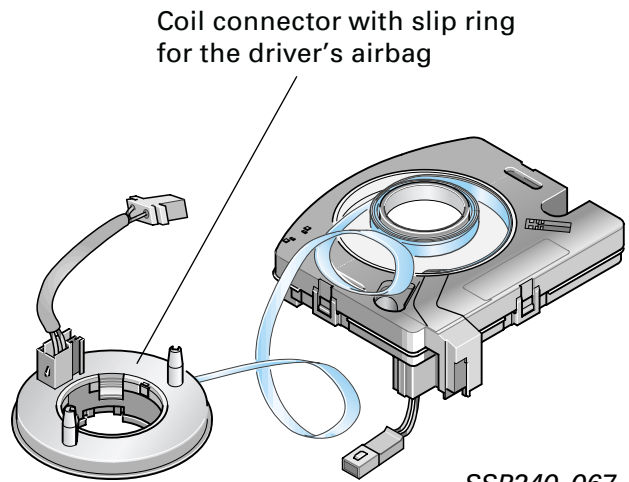
The lateral acceleration sensor reports to the control unit if the vehicle is breaking away to the side, whilst the rate of rotation sensor reports if the vehicle is tending to skid. Using these two pieces of information, the control unit calculates the current condition of the vehicle.

If the target and actual values differ, a control intervention is calculated.

Steering angle sender G85

The coil connector with slip ring forms the electrical connection between airbag control unit and the driver's module in the steering wheel.

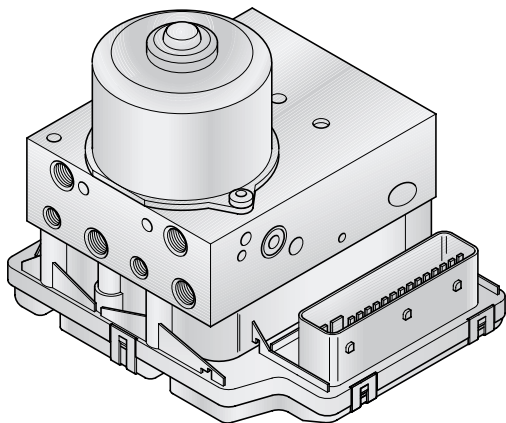
The coil connector housing also accommodates the steering angle sensor (G85) which transmits the steering angle to control unit J104 via the CAN bus (see SSP 204).



After renewing the airbag coil spring/steering angle sensor, a basic setting must be carried out.



Control unit for ABS with EDL/TCS/ESP J104



The control unit for ABS/EDL, J104, is combined with the hydraulic unit to form one module. Both components can be renewed separately. It is not necessary to remove the entire unit when doing this.

Function

- Control of ESP, ABS, EDL, TCS, EBPD and overrun torque limiting functions,
- continuous monitoring of all electrical components and
- diagnosis aid for repair work