

## 6-speed twin-clutch gearbox 02E (S tronic)

Self-Study Programme 386

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## Index

Dear reader, to help you to find information, we have compiled for you an index on the last page.

# Introduction

The S tronic 02E twin-clutch gearbox is also known as the Direct Shift Gearbox (DSG) 02E.

Given that Audi uses the name "-tronic" for its automatic gearboxes (tiptronic, multitronic), the twin-clutch gearbox 02E has been named "S tronic" in keeping with the Audi nomenclature system.



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## Is the S tronic a manual gearbox or an automatic gearbox?

It is both. The S tronic is an automatic sport gearbox with the emphasis on "Sport".

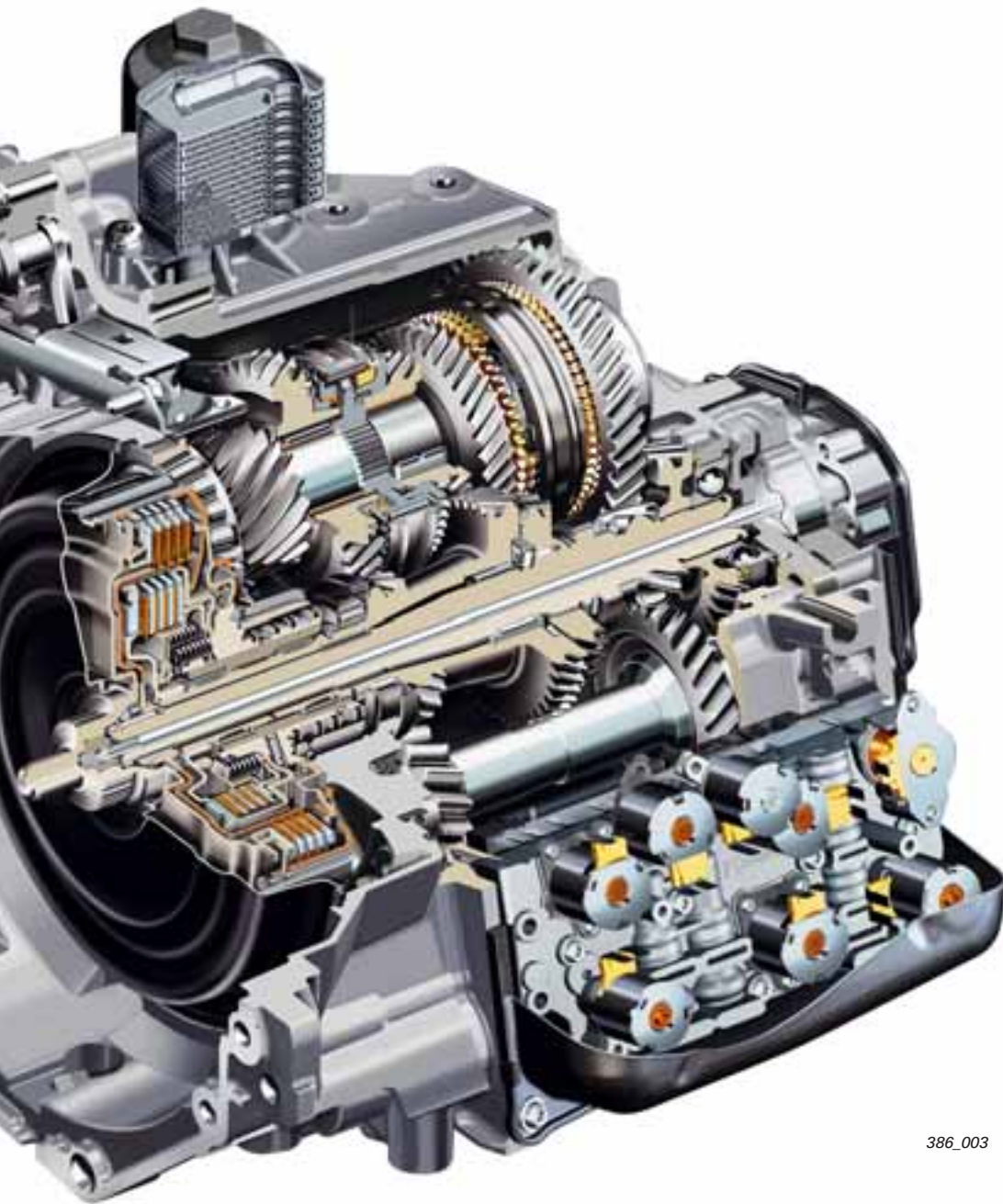
The technical basis of the S tronic is a 6-speed-manual gearbox which, as a special feature, has two clutches (twin clutch).

Clutch control and gearshifts are performed by an electro-hydraulic control.

A twin multi-plate clutch and an intelligent electro-hydraulic control are used allowing two gears to be selected simultaneously.

While driving, one gear is engaged and the matching gear is preselected.

During gearshifts, the clutch engaging the active gear opens while the other clutch of the preselected gear closes. This is done under load and so quickly that power flow is virtually continuous.



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386\_003

### What are the customer benefits of the S tronic gearbox?



The S tronic 6-speed twin-clutch gearbox is more dynamic than a conventional manual gearbox, because it allows fast gear-shifting without any interruption in tractive power while affording the comfort of an automatic gearbox.

In addition to the overtly sporty driving dynamics, the S tronic gearbox is highly efficient. This gives it an advantage over the conventional manual gearbox with regard to fuel economy.

The self-study programme teaches the design and function of new vehicle models, new automotive components or new technologies.

**The Self-Study Programme is not a Repair Manual!**  
The values given are intended as a guideline only and refer to the software version valid at the time of publication of the SSP.

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

Reference	Note
	

# Introduction

## A new generation

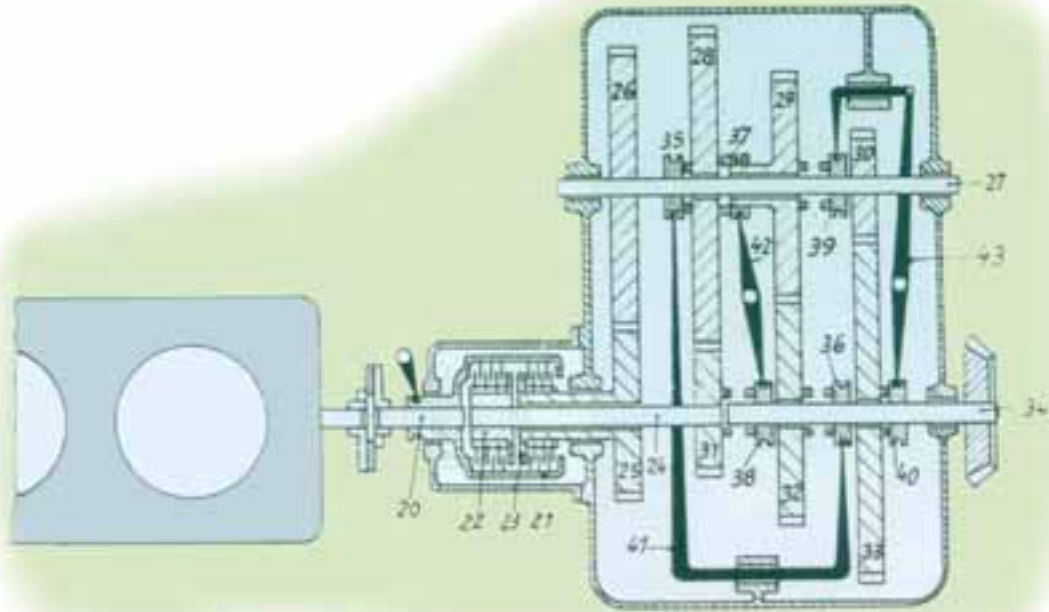
Back in 1940 ...

All efforts at automating clutch and gear shift operations were initially geared towards simplifying the gear-shifting in step-up gearboxes for the benefit of inexperienced drivers.

However, Rudolf Franke did not have this in mind when, in 1940, he applied for a patent on his four speed twin-clutch gearbox.

Franke's objective was to eliminate the interruption in tractive power flow when shifting gear, which was a handicap in commercial vehicles (e.g. off-road vehicles, tractors) in particular.

The concept of "tractive power flow interruption during gear shifts" was, apparently, mentioned for the first time in Franke's patent application. Though his design included nearly all the features of modern designs, it did not get off the drawing board.



386\_004

Drawing from the patent specification of Rudolf Franke dating from 1940

... 30 years later ...

About 30 years after Franke's patent was registered, Porsche readopted the idea and developed the first twin-clutch gearbox for its 962C race car, which was also used by Audi in the short version of its Rallye quattro.

In both cases, the design proved a success. So-called "dry clutches" were used.

All attempts to use this twin-clutch gearbox type in production vehicles failed, because the control system was too difficult to implement and electronics, at the time, were not advanced enough to meet the attendant demands.

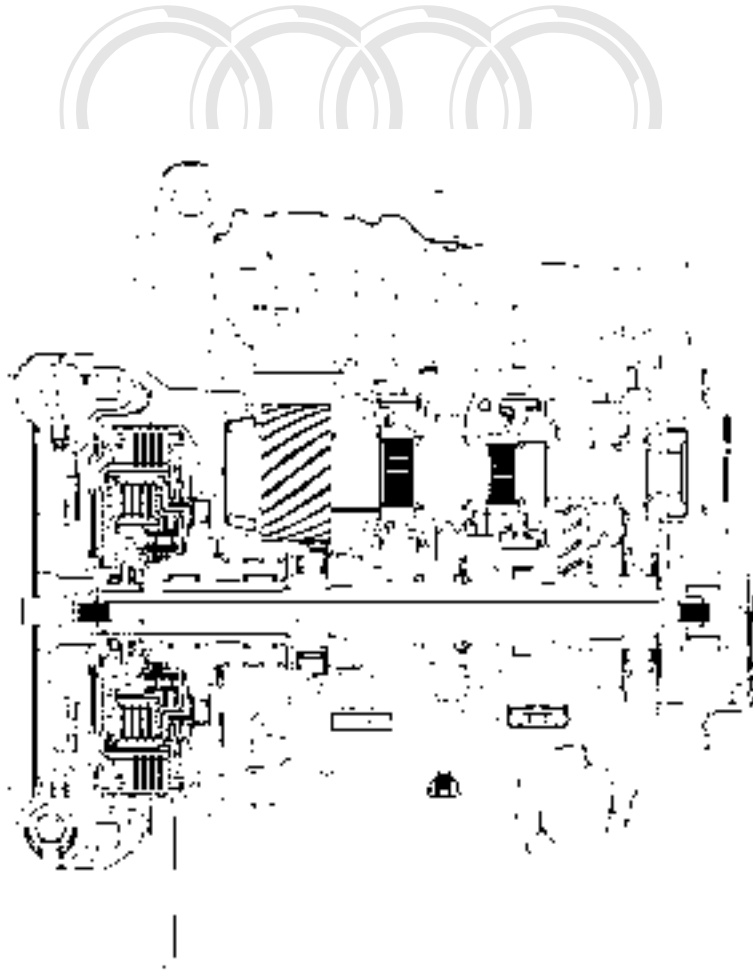
... The year 2003.

However, the twin-clutch gearbox concept was by no means dead and forgotten. The dream of continuous tractive power flow during gear-shifting still lived on.

Today's cutting-edge technology has made it possible to develop and put into production a twin-clutch gearbox which not only meets the original objective and today's requirements, but also sets new standards.

The 02E twin-clutch gearbox was developed by Volkswagen in conjunction with well-known systems suppliers Borg Warner (clutch, hydraulics) and Temic (electronics).

The twin-clutch gearbox combines the key advantages of the manual gearbox with those of a modern automatic gearbox.



**Characteristics of the manual gearbox:**

- + sportiness/driving dynamics
- + efficiency
- comfort
- interruption in tractive power

**Characteristics of the twin-clutch gearbox:**

Superb driving dynamics thanks to lightning-fast and jolt-free gearshifts without any interruption in tractive power

**Characteristics of the automatic gearbox:**

- + high level of comfort
- + no interruption in tractive power
- sportiness/driving dynamics
- efficiency

An excellent balance of comfort, sportiness and efficiency

# Introduction

## Gearbox concept

A twin-clutch gearbox basically consists of two full synchromesh speed change gearboxes connected in parallel (part-gearbox 1 and part-gearbox 2).

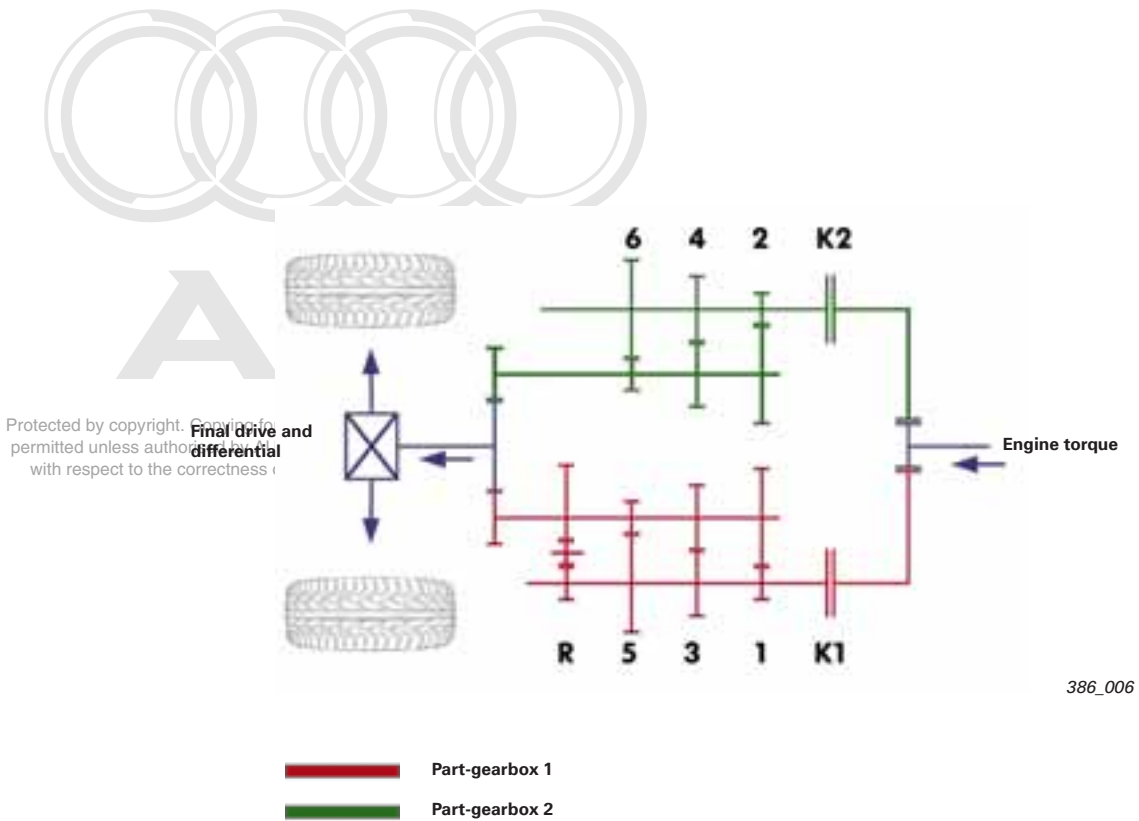
Each part-gearbox has its own clutch:

- Part-gearbox 1 K1
- Part-gearbox 2 K2

Part-gearbox 1 shifts odd gears 1, 3 and 5, as well as reverse.  
Part-gearbox 2 shifts even gears 2, 4 and 6.

While driving, only one part-gearbox is engaged by clutch K1 or K2.

The twin-clutch gearbox has two input shafts and two output shafts.



386\_006

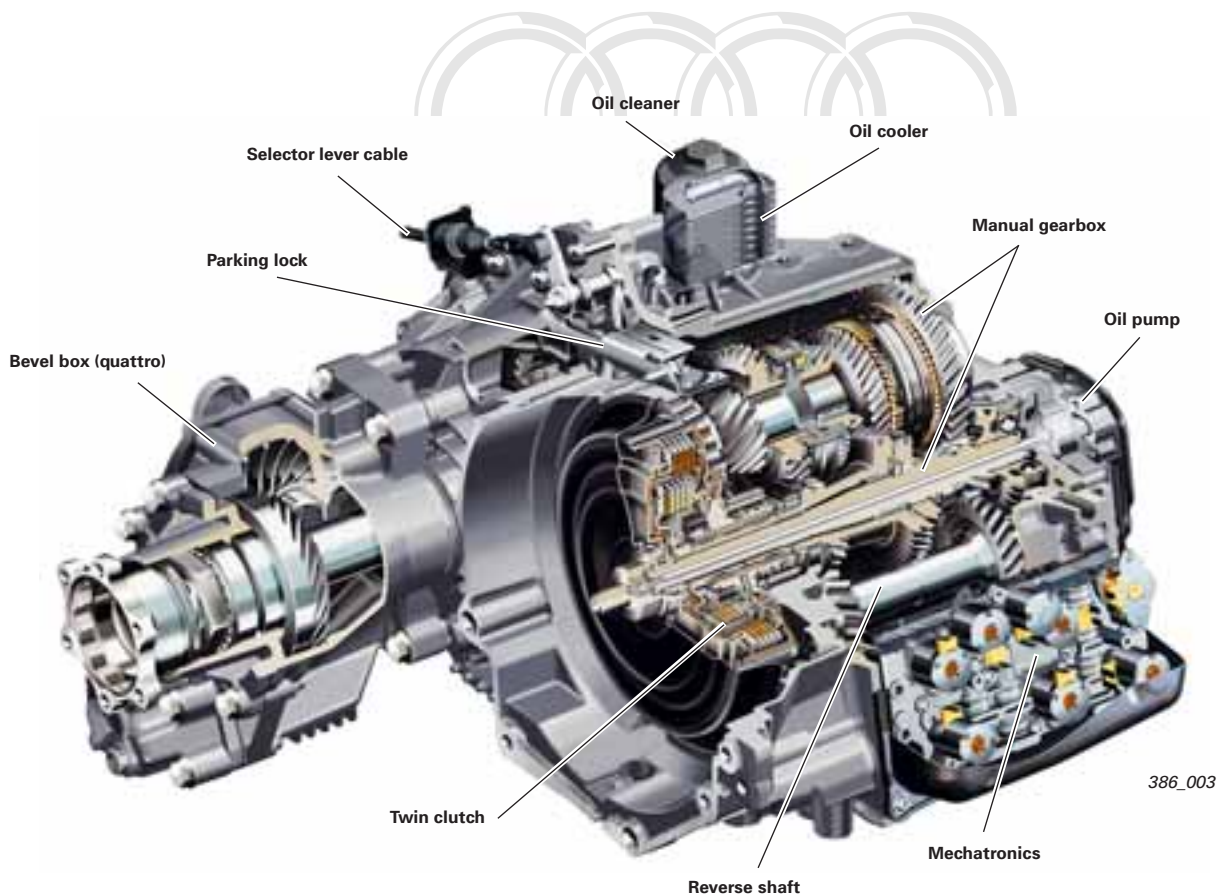
Fig. 386\_006 shows a schematic diagram of a twin-clutch gearbox. It illustrates the functional principle in simple terms.

To make the twin-clutch gearbox 02E as compact and lightweight as possible, the design deviates to a certain extent from this schematic diagram; refer to Fig. 386\_007 on page 16.

# Specifications

## 6-speed twin-clutch gearbox 02E (S tronic)

<b>Designations</b>	Manufacturer: DQ250 6F / DQ250 6Q Service: 02E direct shift gearbox "DSG" 02E S tronic twin-clutch gearbox
<b>Development/manufacturer</b>	Volkswagen AG
<b>Gearbox type</b>	Electro-hydraulically controlled twin-clutch gearbox, full synchromesh 6-speed speed change gearbox
<b>Control</b>	Mechatronics - integrate, as a unit, the hydraulic control unit, the electronic control unit and, to a great extent, the sensors and actuators. Sport program and "tiptronic" shift program for manual gear-shifting (optionally available with tiptronic steering wheel)
<b>Twin clutch</b>	Two electro-hydraulically controlled, oil-cooled multi-plate clutches
<b>Torque capacity</b>	max. 350 Nm (depending on type)
<b>Oil fill quantity, specification and ratios</b>	refer to current service literature
<b>Weight</b>	Front-wheel drive variant, approx. 94 kg quattro variant, approx. 109 kg



# Gearbox periphery

## Gearshift mechanisms

At first glance, vehicles with S tronic gearbox have a similar gearshift mechanism to previous automatic gearboxes.

The fundamental differences are:

- There is no manual selector valve in the hydraulic control unit.
- There is no multi-function switch in or on the gearbox.
- The selector lever cable on the gearbox actuates the parking lock only (mechanical system).

Gearshift mechanism,  
Audi A3 (8P) and Audi TT (8J)



Selector lever sensor system E313

386\_081

### S tronic gearshift mechanism

The S tronic gearshift mechanism incorporates an electronic module – the selector lever sensor system E313. The E313 comprises sensors and a control unit mounted on a board; refer to page 74.

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### The selector lever sensor system E313

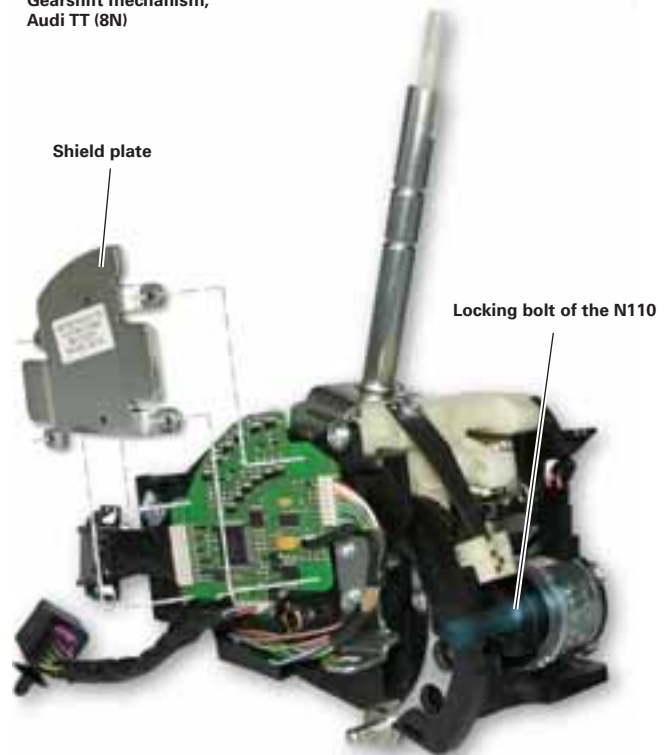
- ... determines all selector lever positions for the gearbox control unit,
- ... controls the LEDs on the selector gate cover or display unit,
- ... controls the shift lock solenoid N110,
- ... communicates all information to the mechatronic control unit J743 by powertrain CAN bus.

There is no mechanical connection between the gearshift mechanism and the mechatronics. This is also known as a "shift by wire" system. As mentioned previously, the selector lever cable on the gearbox serves only to actuate the parking lock.

There are two different shift lock and ignition key withdrawal lock systems:

1. Shift lock and ignition key withdrawal lock conventional by means of locking cable – as used in the Audi TT (8N)
2. Shift lock and ignition key withdrawal lock without locking cable and with electrically actuated ignition key withdrawal lock – as used in the Audi A3 (8P), Audi TT (8J)

Gearshift mechanism,  
Audi TT (8N)



Shield plate

Locking bolt of the N110

View from the left

386\_113

The selector gate covers in the Audi A3 and in the Audi TT come in two versions, depending on model:

Old: Selector gate cover with integrated for selector lever position indicator light

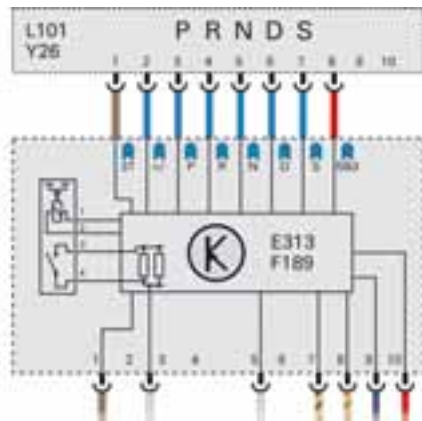
New: Selector sleeve and separate selector lever position indicator unit

The selector lever position indicator LEDs are activated directly by the selector lever sensor system E313; refer to function diagram below.

Audi A3 - old specification



386\_104



386\_122

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Audi A3 - new specification



Selector lever position indicator unit Y26 (also known as L101)

386\_119

386\_103

Shift lock solenoid N110



386\_114

View from the right

The illustrations show the variants of the selector gate covers for the Audi A3.

The selector gate covers for the Audi TT differ in respect of their design, but otherwise they are absolutely identical.

#### Reference



For information on the selector lever position and gear indicator in the dash panel insert, refer to page 84.

# Gearbox periphery

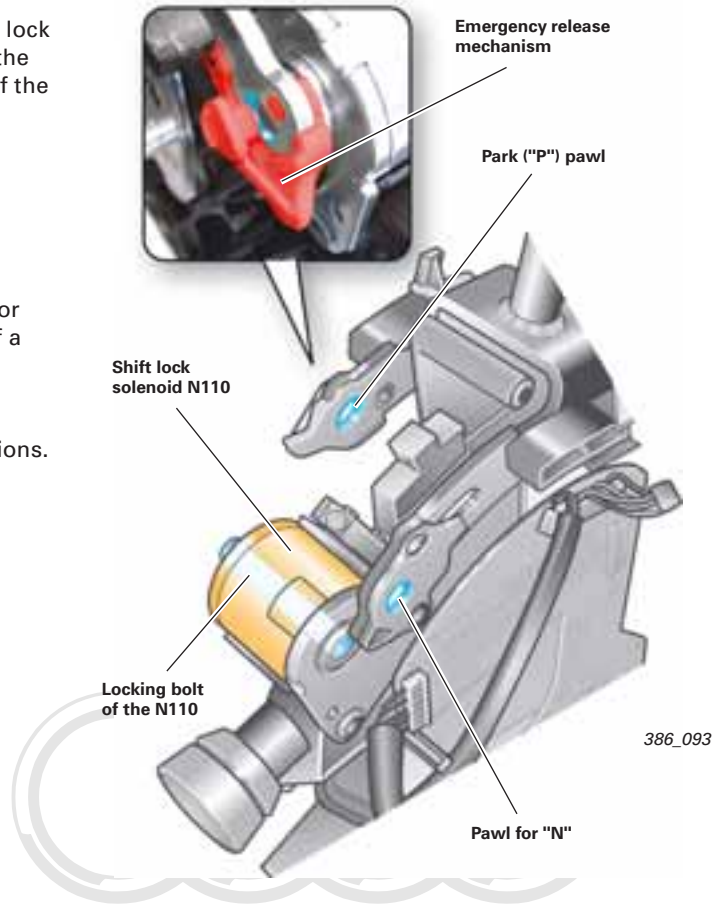
## Shift lock Audi A3 (8P), Audi TT (8J)

Basically, a distinction is made between the P/N lock while driving or at ignition 'on', and locking of the selector lever in the "P" position after removal of the ignition key (P-lock).

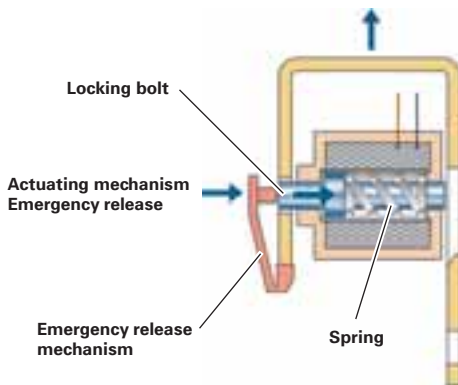
The kinematics of the selector lever and the shift lock solenoid allow locking when N110 is energised (position "P") and deenergised (position "N").

This functional principle is such that the selector lever stays locked in position "P" in the event of a malfunction or power failure (e.g. flat battery); refer to Fig. 386\_094.

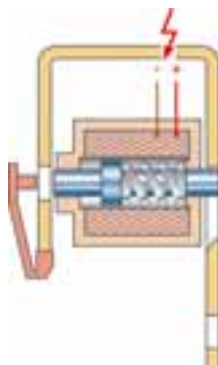
There is an emergency releasemechanism for moving (e.g. towing) the vehicle in these situations.



Selector lever position "P" locked



Selector lever position "P" unlocked



Solenoid N110 is deenergised and the locking bolt engages the park (P) pawl due to the spring pressure. The selector lever is locked.

### Emergency release

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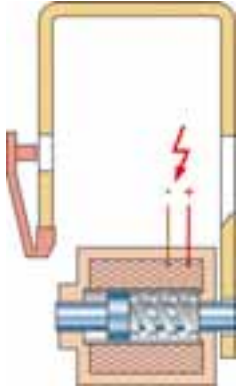
The emergency release mechanism is accessible after removing the gearshift console cover (refer to the operating instructions).

When the emergency release is actuated, the locking bolt of N110 is pushed out of the park pawl against the pressure of the spring. The selector lever can now be moved out of position "P".

Solenoid N110 is energised by the selector lever sensor system E313 and the locking bolt is drawn out of the park pawl against the pressure of the spring.

The shift lock is disengaged.

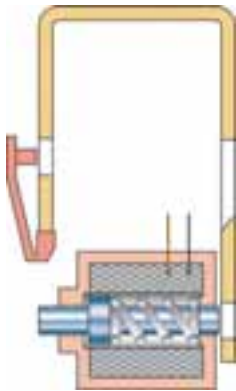
**Selector lever position "N" locked**



If the selector lever is in position "N" for longer than 2 seconds at "ignition ON", then N110 is energised by the selector lever sensor system E313. The locking bolt is moved into the neutral "N" pawl against the pressure of the spring. The N lock is not activated when the vehicle is travelling faster than approx. 5 kph.

386\_088

**Selector lever position "N" unlocked**



N110 is deenergised when the brake is operated or at "ignition OFF". The locking bolt is drawn out of the neutral "N" pawl by the pressure of the spring.

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386\_089

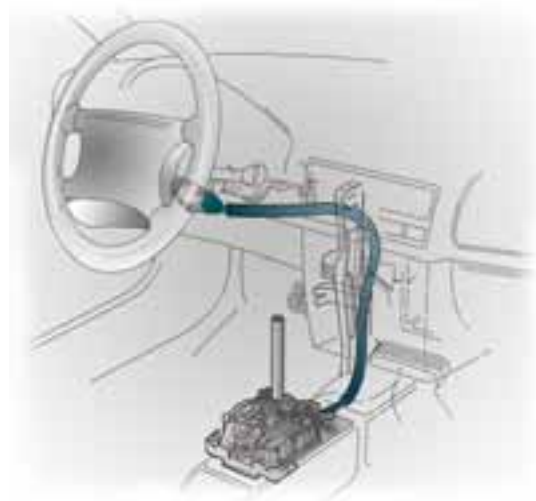
**Shift lock  
Audi TT (8N)**

In the Audi TT (8N) the park "P" lock is actuated by the steering lock by means of a cable pull (locking cable) – refer to Workshop Manual.

The P/N lock is designed in such a way that the shift lock solenoid N110 only engages the selector lever in positions "P" and "N" when it is energised.

**Ignition key withdrawal lock  
Audi TT (8N)**

In the Audi TT (8N) the ignition key withdrawal lock is actuated by the gearshift mechanism by means of a cable pull (locking cable) connected to the steering lock – refer to Workshop Manual.



386\_096

# Gearbox periphery

## Ignition key withdrawal lock Audi A3 (8P), Audi TT (8J)

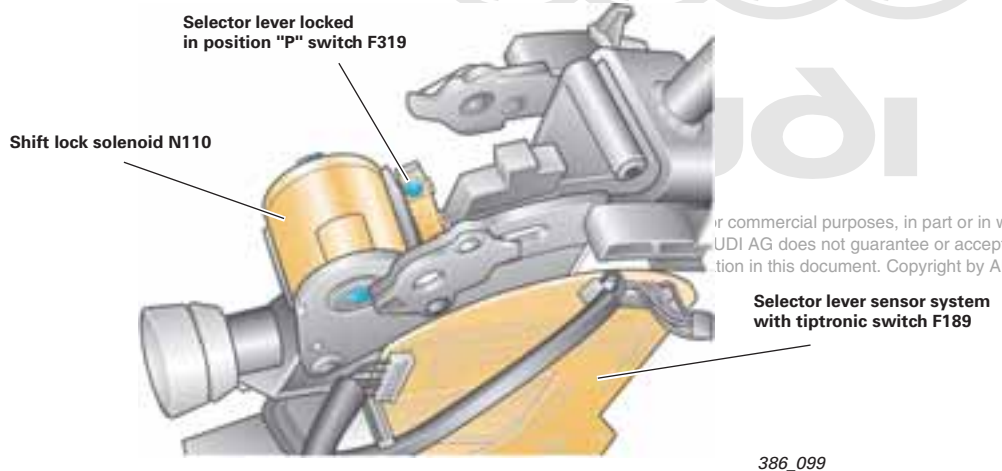
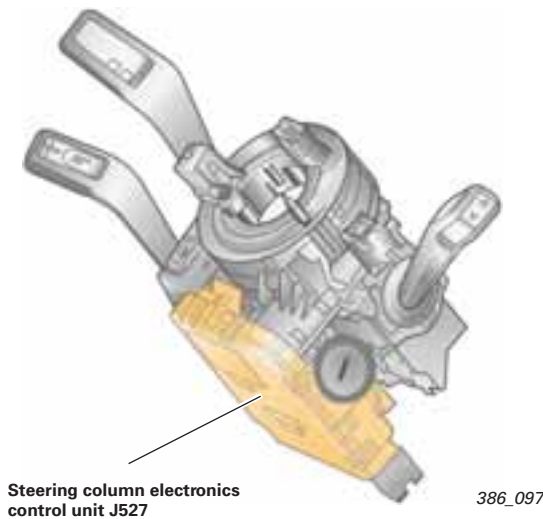
The ignition key withdrawal lock is operated electro-mechanically by means of the ignition key withdrawal lock solenoid N376. It does not allow the ignition key to be turned anticlockwise to the end position (withdrawal position) if the selector lever is not in the "P" position.

N376 is activated by the steering column electronics control unit J527. Before J527 can do this, it must receive the information "selector lever in position P". For safety reasons and for the purpose of diagnostics, this information is transmitted to J527 in two ways.

**Firstly**, by means of microswitch F319. F319 is integrated in the gearshift mechanism. It supplies the information "selector lever locked in P" to the selector lever sensor system E313 and from E313 to J527 via a discrete line (refer to function diagram).

**Secondly**, the selector lever positions are communicated to J527 by CAN information exchange. Information path: E313 (powertrain CAN bus) > J743 (powertrain CAN bus) > J533 (convenience CAN bus) > J527.

The CAN information is used for verifying the plausibility of the signal from F319 and as a substitute signal in case of malfunctioning of F319.

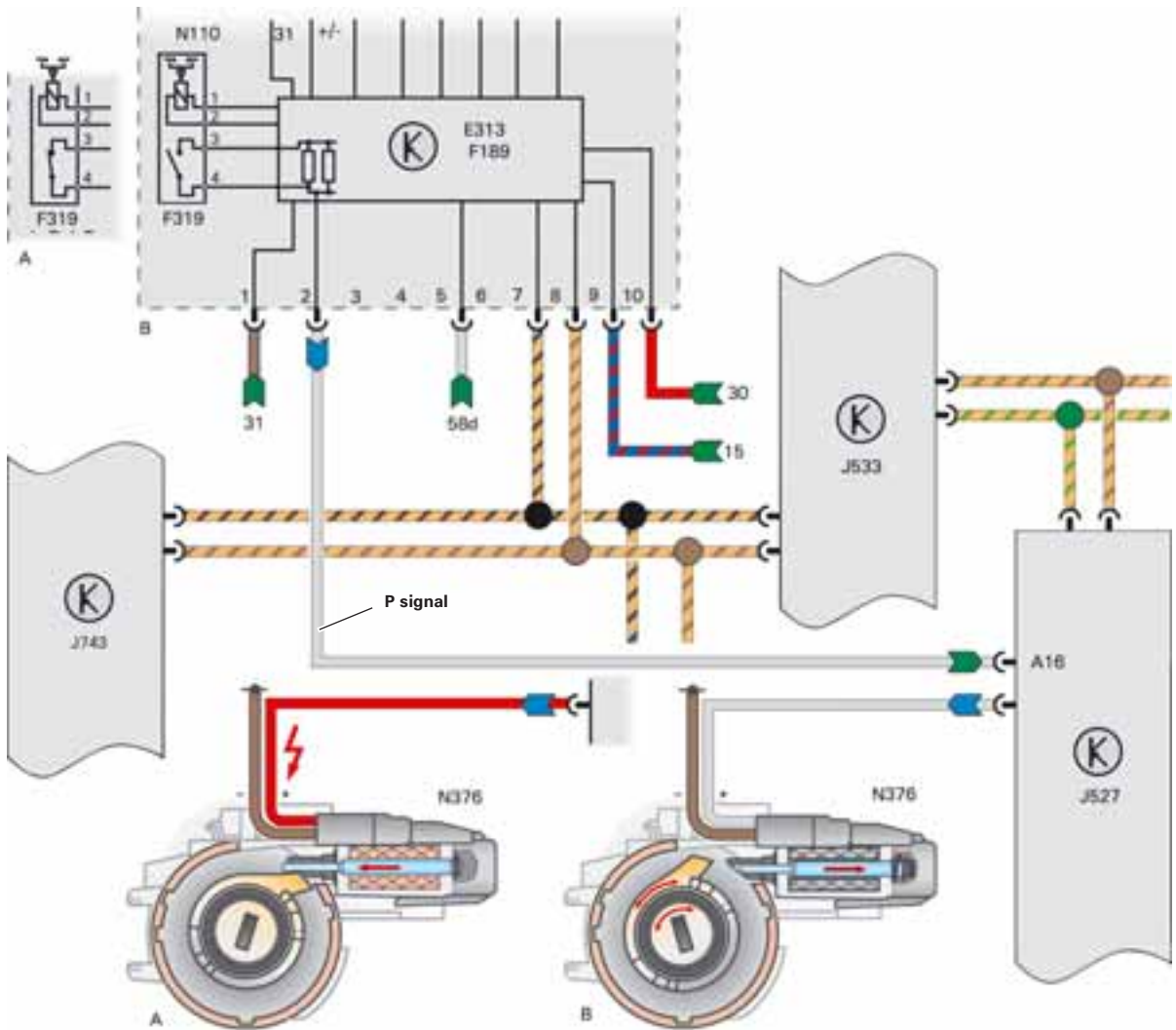


Switch F319 is configured as an NC contact. It is actuated when the gearshift knob lock button is released in selector lever position "P" ("open" circuit state).

Switch F319 is closed in selector lever positions "R", "N", "D", "S" and tiptronic (and in "P" with the lock button pressed).

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## Ignition key withdrawal lock function



386\_100

### A)

When the selector lever is not in the "P" (Park) position, the ignition key withdrawal lock solenoid N376 is energised by J527. The locking bolt of N376 is pressed into the steering lock against the pressure of the spring. The ignition lock cannot be turned to the withdrawal position as long as the N376 is energised (locking bolt retracted). The ignition key cannot be removed.

### B)

The solenoid is not energised when the ignition is OFF and the selector lever is in the "P" position (lock button on selector lever not pressed). The locking bolt is retracted by the spring in the N376. The key can be turned to the withdrawal position and removed.

### Note

The function of the selector lock in position "P" switch F319 can be checked in steering column electronics control unit J527 (address word 16), in data block 005, 1st display value.

### Note

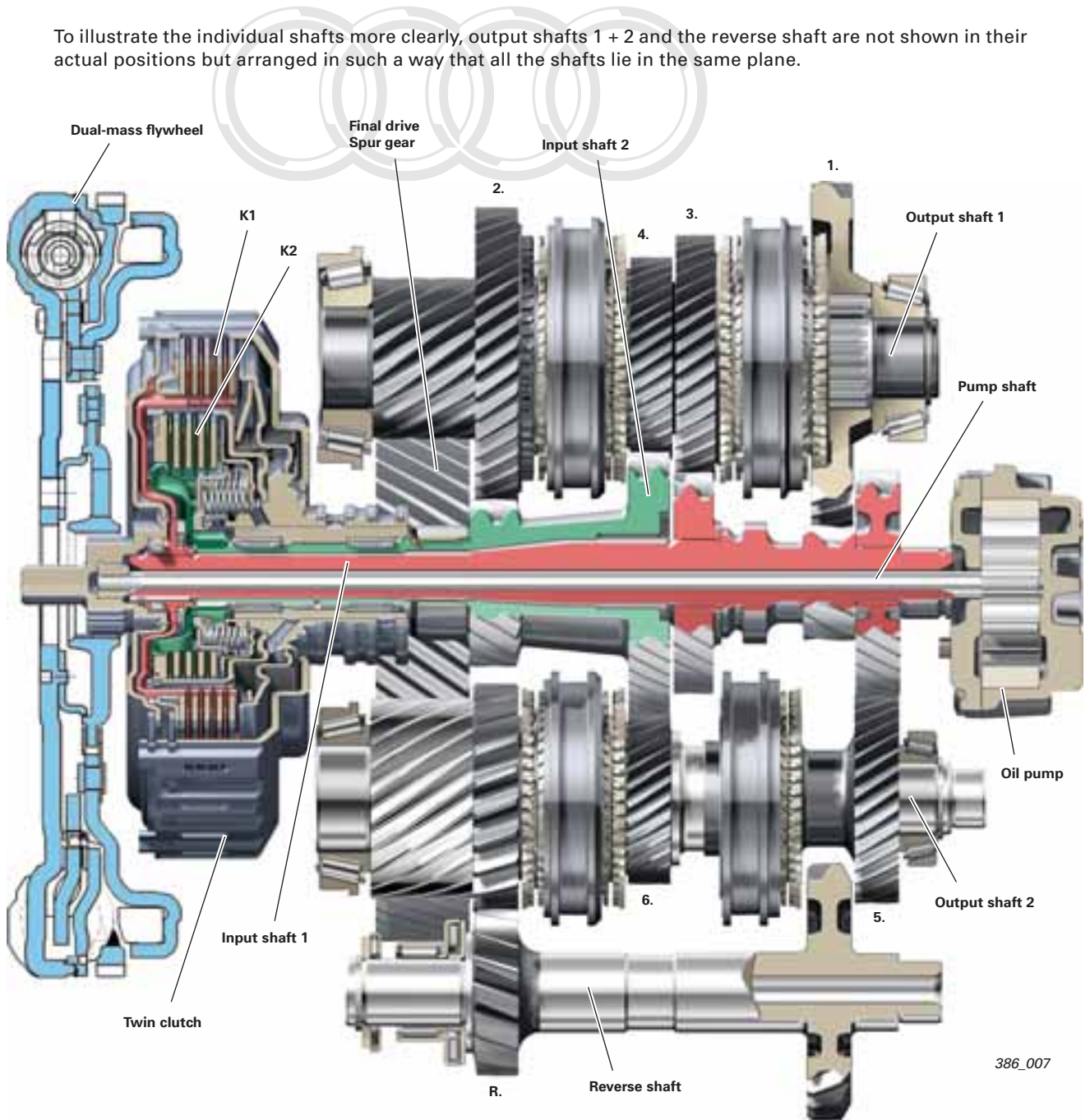
J527 applies an electrical current to solenoid N376 as long as the selector lever is out of the "Park" position after ignition OFF. The battery can become discharged if the vehicle is parked for a lengthy period of time with the selector lever out of the "P" position.

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# Gearbox subassemblies

## Overview - 02E gearbox

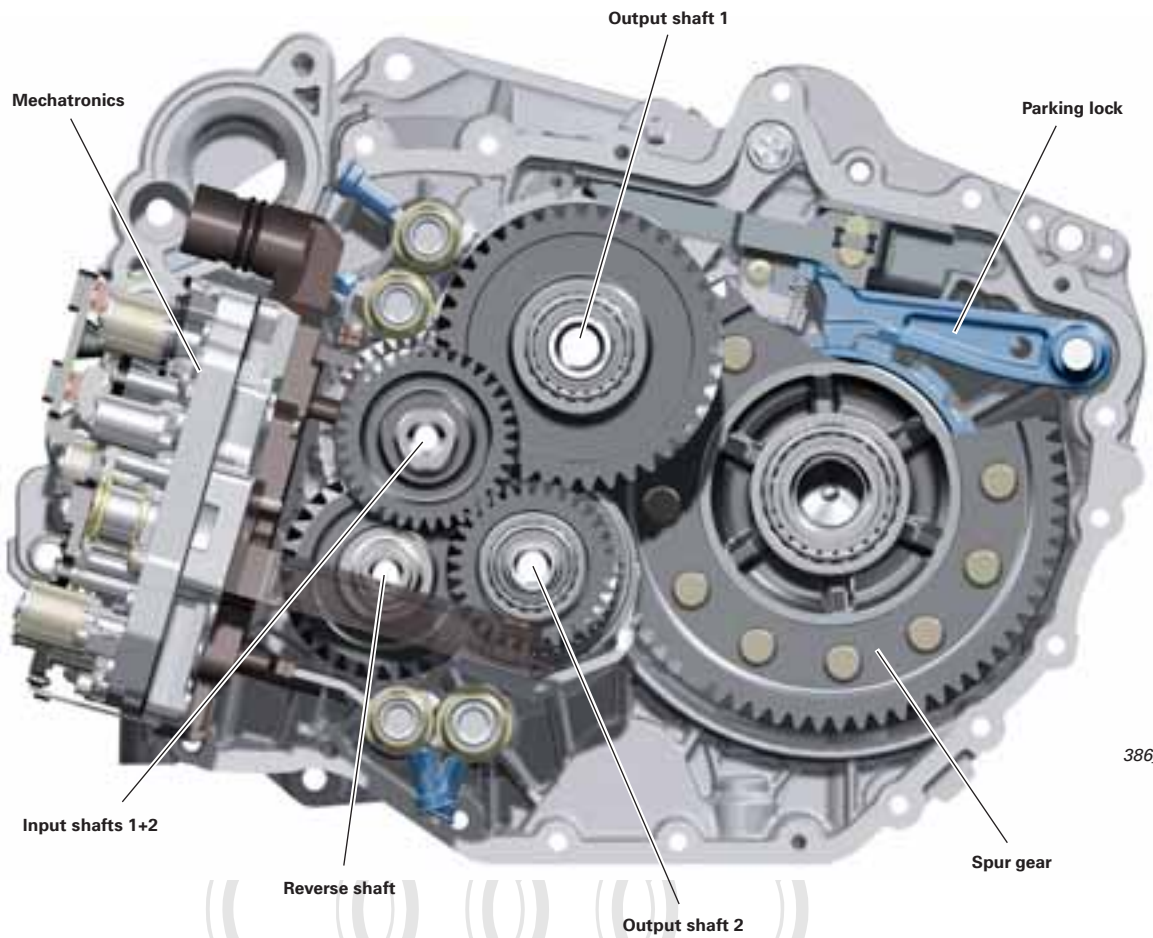
To illustrate the individual shafts more clearly, output shafts 1 + 2 and the reverse shaft are not shown in their actual positions but arranged in such a way that all the shafts lie in the same plane.



Engine torque is transmitted through a dual-mass flywheel to the twin clutch input hub by means of a stub shaft spline. Depending on which gear is engaged, the twin clutch transmits the torque either to input shaft 1 or 2 and from this shaft to output shaft 1 or 2. The coaxial arrangement of the input shafts and the mixed distribution of odd and even gears to the two output shafts allow a very compact design and keep weight to a minimum.

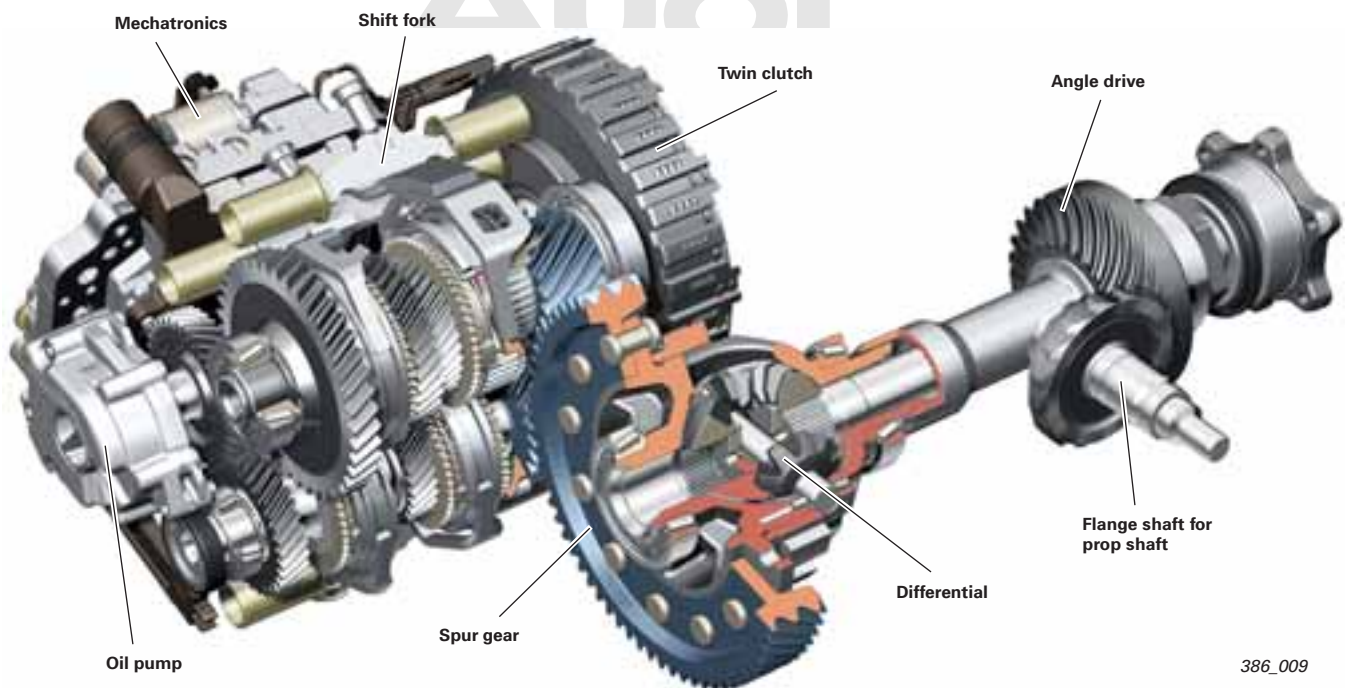
The two output shafts transmit engine torque in different ratios to the final drive spur gear, and from here to the differential and (in models with quattro drive) the bevel box (also refer to Fig. 386\_009).

Position of the shafts in the gearbox - side-on view



386\_008

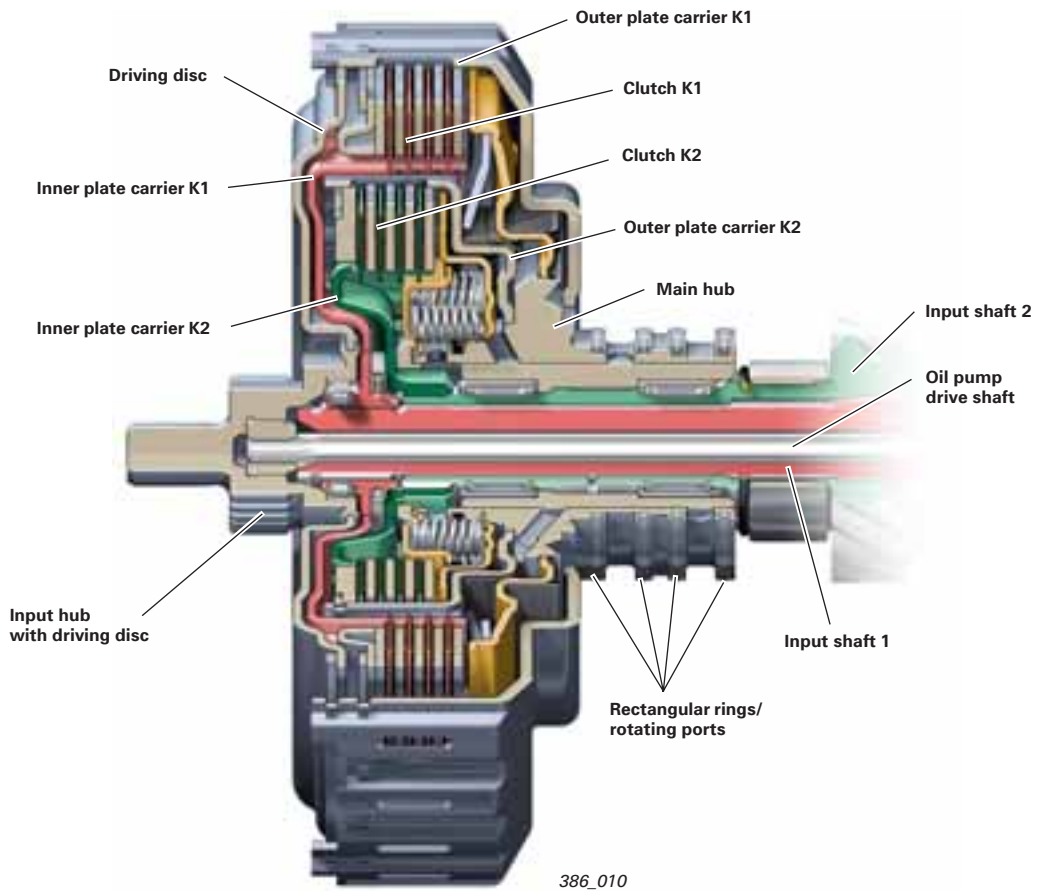
View with final drive and bevel box  
(bevel box for quattro four-wheel drive only)



386\_009

# Gearbox subassemblies

## Twin clutch



### Power flow

Engine torque is transmitted via a stub shaft spline from the dual-mass flywheel to the twin clutch input hub.

The input hub is welded to the driving disc. The driving disc is positively connected to outer plate carrier K1, and transmits engine torque thus to the twin clutch. Outer plate carrier K1 and outer plate carrier K2 are both welded to the main hub, so they are in positive engagement at all times.

Engine torque is transmitted to the two clutches at the respective outer plate carriers and, when clutch is positively engaged, to the appropriate inner plate carriers.

Inner plate carrier K1 is connected to input shaft 1, and inner plate carrier K2 is connected to input shaft 2.

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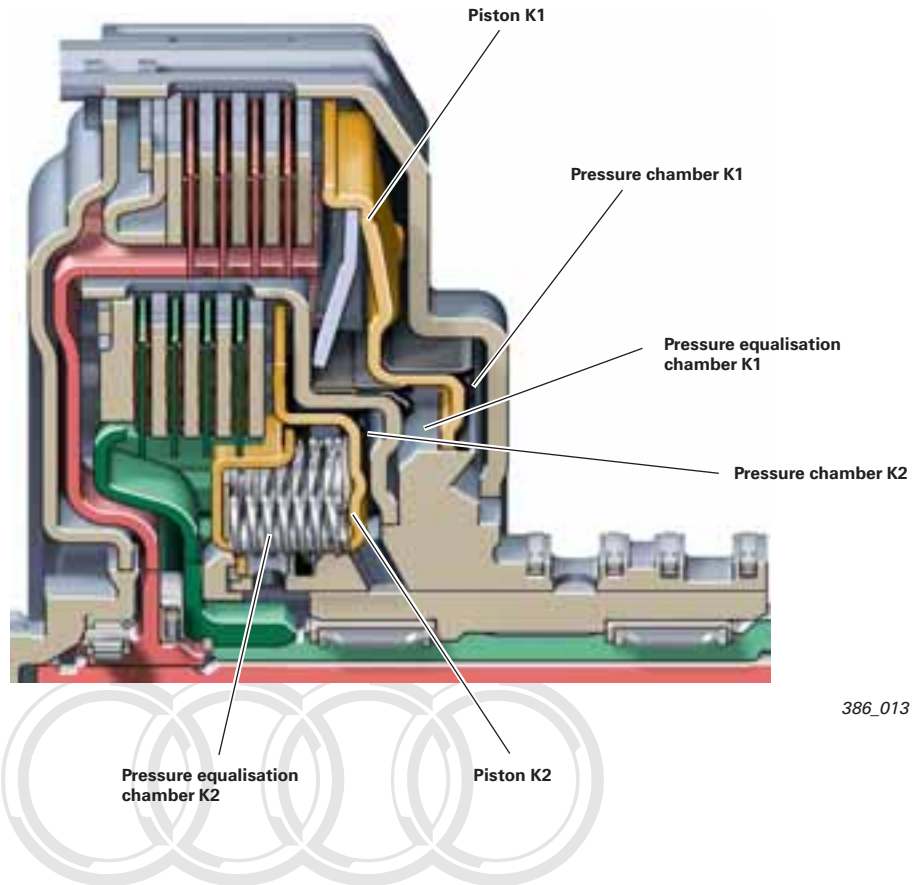
### Note



The twin clutch must not be dismantled. If the driving disc or the retaining clip is removed, the plates of clutches K1 and K2 can drop out of the clutch plate carriers. The steel plates and the lined plates of the clutches are aligned and installed in pairs at the factory. This ensures optimum torque uniformity during clutch engagement and counteracts drive-away shudder.

The installation position of the clutch plates in relation to one another is not marked. The clutch plates cannot be reassembled in their original state after the clutch has been dismantled or fallen apart. Incorrect installation will provoke drive-away shudder.

After replacement of the twin clutch or the mechatronics and after updating the gearbox control unit program, the clutch adaptation values must be reset using the diagnostic tester. For this purpose, the "Basic Setting" procedure must be started under "Guided Functions" and the described adaptation procedure subsequently carried out.



386\_013

## Design features

Since clutch K1 serves as a starting clutch in 1st gear and in reverse (R), it is subjected to greater loads than clutch K2.

The twin clutch has therefore been designed in such a way that clutch K1 is disposed on the outside. As a result, it has the greater diameter and, therefore, is capable of transmitting a greater amount of torque and a higher power output. All the requirements are therefore met.

To keep to a minimum the synchronising masses during gearshifts, the lined plates of both clutches are assigned to the respective inner plate carriers. The heavier steel clutch plates are assigned to the outer plate carriers.

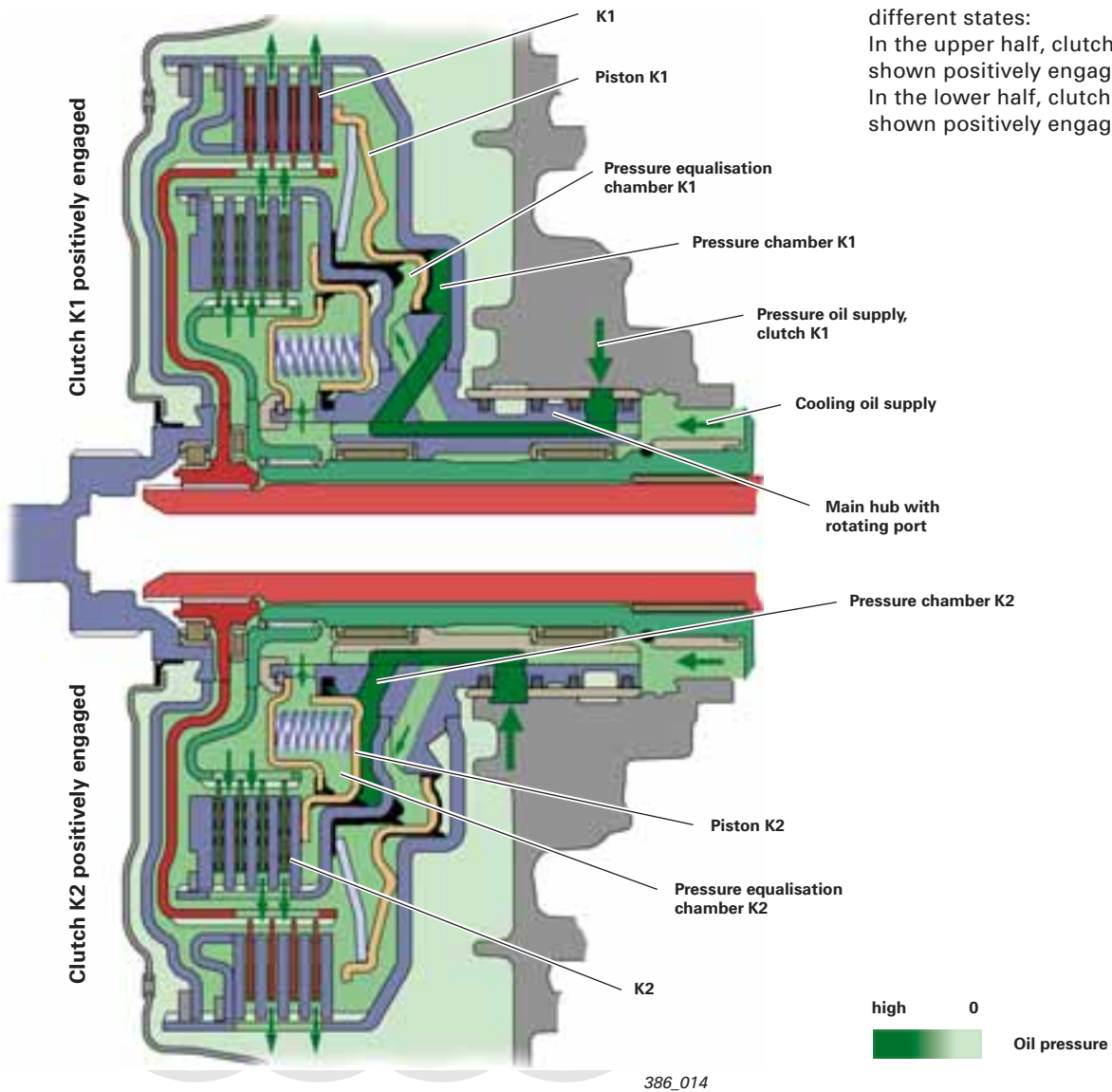
Dynamic pressure build-up in both clutches is equalised, refer to page 21.

Specifications of the twin clutch:

– Max. torque	350 Nm
– Max. surface pressure	10 bar
– Max. friction	70 kW
– Max. cooling oil flow rate	20 l/min

# Gearbox subassemblies

## Oil supply



Pressure oil is supplied to the clutches through the main hub by means of rotating ports.

Rectangular rings provide a tight seal between the housing and the main hub. The oil flows along ducts in the main hub to the respective points.

The clutches are continuously cooled and lubricated by a separate cooling oil system in accordance with demand (refer to "Clutch cooling").

The cooling and lubricating oil is ducted through coaxial bores in the main hub to K2. The oil for the pressure equalisation chamber is likewise extracted from this flow.

If K1 is positively engaged, the cooling oil flows through the open K2 (without heating up) and then to K1, where it does its work (lubricating and cooling) and is recirculated into the gearbox housing.

The clutch plate carriers are perforated, allowing the cooling oil to flow from the inside out to the respective clutches. The shape of the lined plates and the centrifugal force are conducive to through-flow in the clutches. This allows the pressure of the cooling oil flow to be kept relatively low. The quantity of cooling oil is decisive.

## Dynamic pressure equalisation in the clutches

At high engine speeds, due to rotation, the oil is subjected to high centrifugal forces inside the clutch pressure chambers. This causes the pressure inside the clutch pressure chamber to increase towards the largest radius. This is known as "dynamic pressure build-up".

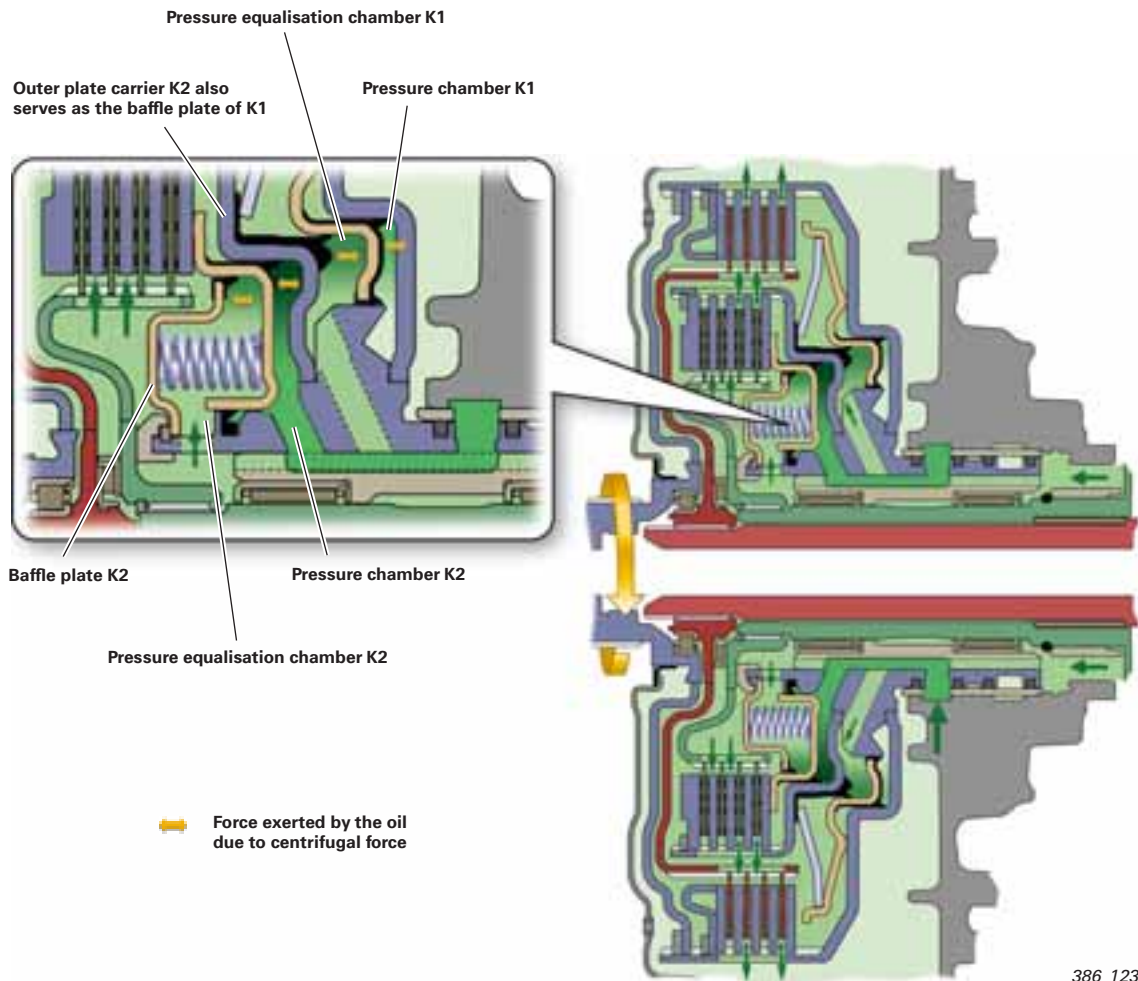
Dynamic pressure build-up is undesirable, because it increases the surface pressure unduly and makes defined pressure increase and reduction inside the pressure chamber more difficult to implement.

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To ensure that clutches K1 and K2 open and closed in a defined fashion, dynamic pressure equalisation takes place in the respective pressure equalisation chambers (when engine speed is increased).

This allows gearshifts to be regulated exactly, which in turn considerably enhances shift comfort.

Leaks in the pressure equalisation chamber will cause damage to the clutch and the synchronizer due to uncontrolled positive engagement of the clutch at high engine speeds.



386\_123

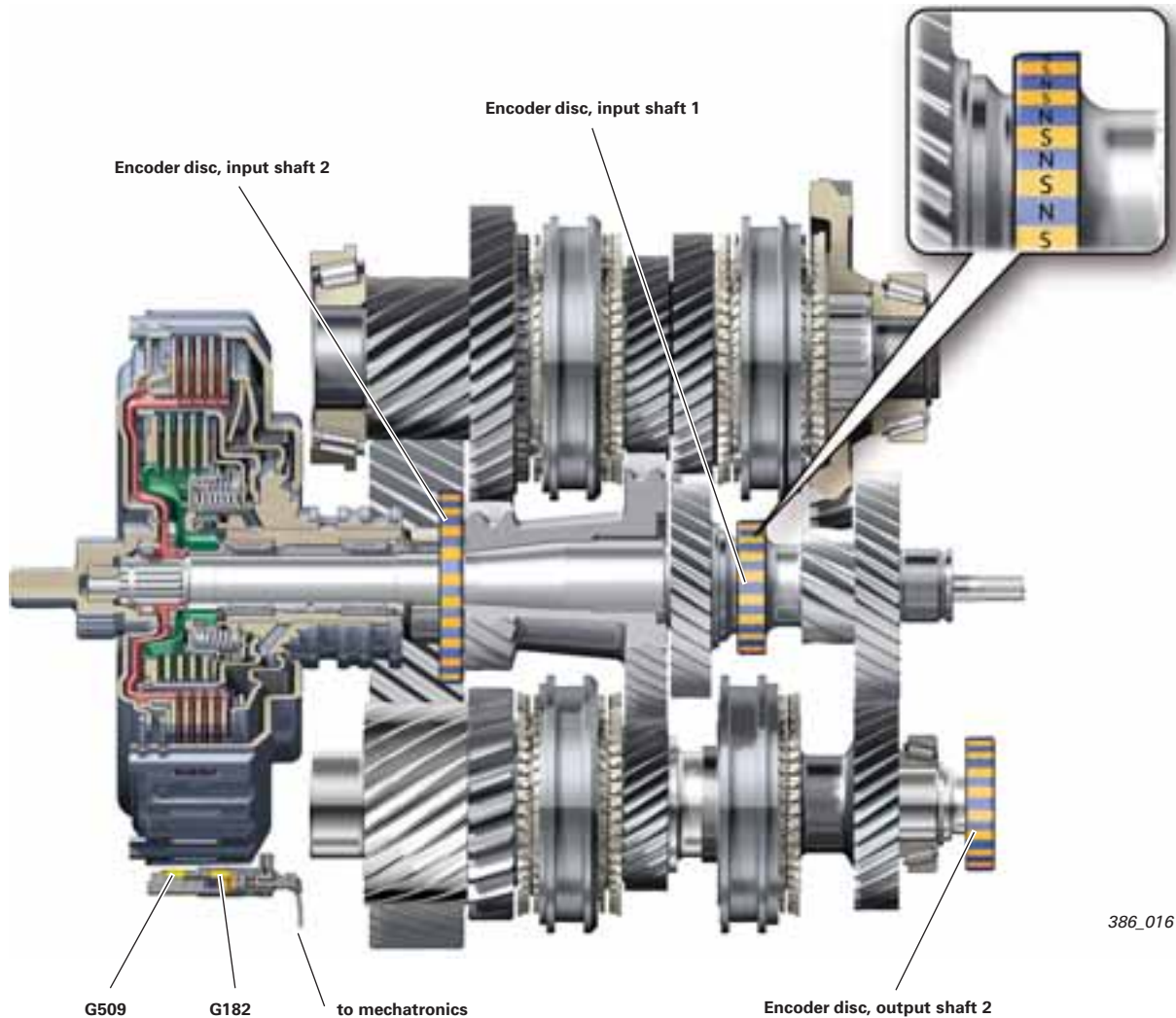
### This is how it works:

The pistons are sprayed by oil on both sides. This is achieved by using additional oil chambers (pressure equalisation chambers) on the sides the pistons opposite the pressure chambers. For this purpose, clutch K2 has a baffle plate which represents the pressure equalisation chamber K2 between clutch K2 and piston K2. In the case of clutch K1, the outer plate carrier of clutch K2 serves, additionally, as the baffle plate.

The pressure equalisation chambers are filled with cooling oil under low pressure. The oil encased in the pressure equalisation chamber is subjected to the same forces (dynamic pressure build-up) as in the pressure chambers. The surface pressures in the pressure chambers are thus equalised.

# Gearbox subassemblies

## Clutch control



To control clutches K1 and K2, the following information is processed:

- Engine speed
- Gearbox input speed from G182 (= clutch input speed)
- Speed of input shaft 1 from G501 (= clutch output speed K1 = gearbox input speed of part-gearbox 1)
- Speed of input shaft 2 from G502 (= clutch output speed K2 = gearbox input speed of part-gearbox 2)
- Engine torque
- Cooling oil outlet temperature from G509 (multi-plate clutch oil temperature sender)
- Brake pressure

The following functions are relevant to the twin clutch:

- Drive-away
- Power flow transition
- Clutch cooling
- Clutch control at standstill (creep control)
- Overload protection
- Safety shutdown
- Microslip control
- Clutch adaptation

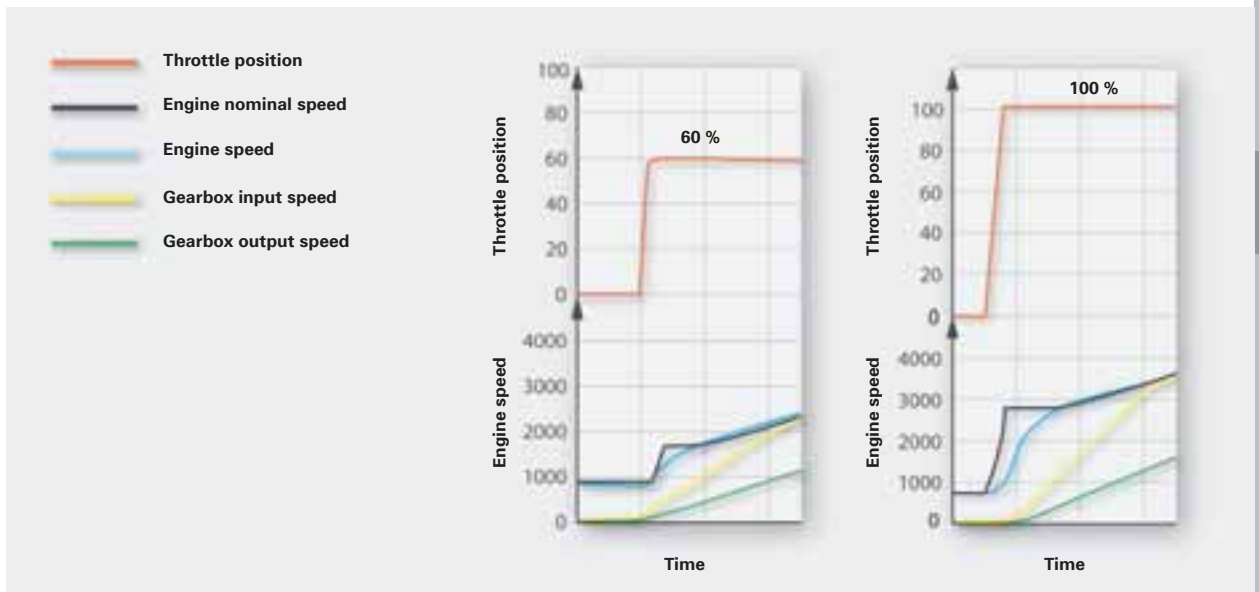
## Drive-away

When starting from a stop, the clutch is controlled according to engine speed. Depending on the drive-away characteristic, the gearbox control unit computes an engine nominal speed which is set via the clutch torque.

The driver input as well as the torque curve of the various engine variants define the drive-away characteristic.

When starting from a stop at a low throttle position (e.g. 60 %), engine speed is increased at a low level up to the next clutch engagement point.

When starting from a stop at a high throttle position (e.g. 100 %), the engine speed is increased at a higher level up to the clutch engagement point.



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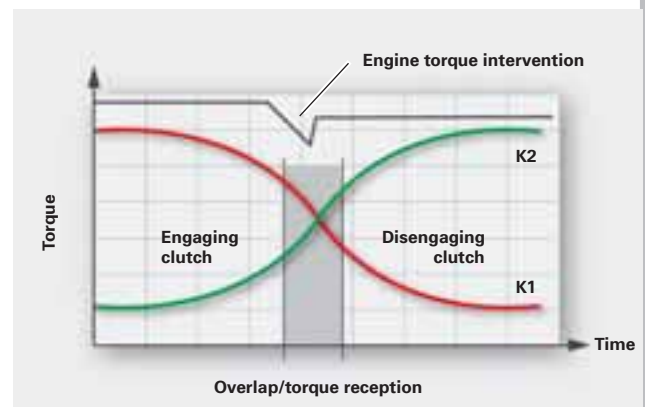
## Power flow transition (overlap)

The gearshift involves two functions:

1. Engagement of gears in part-gearbox 1 and/or part-gearbox 2 by means of hydraulically actuated shift forks.
2. Power flow transition between part-gearbox 1 and part-gearbox 2 by means of clutches K1 and K2

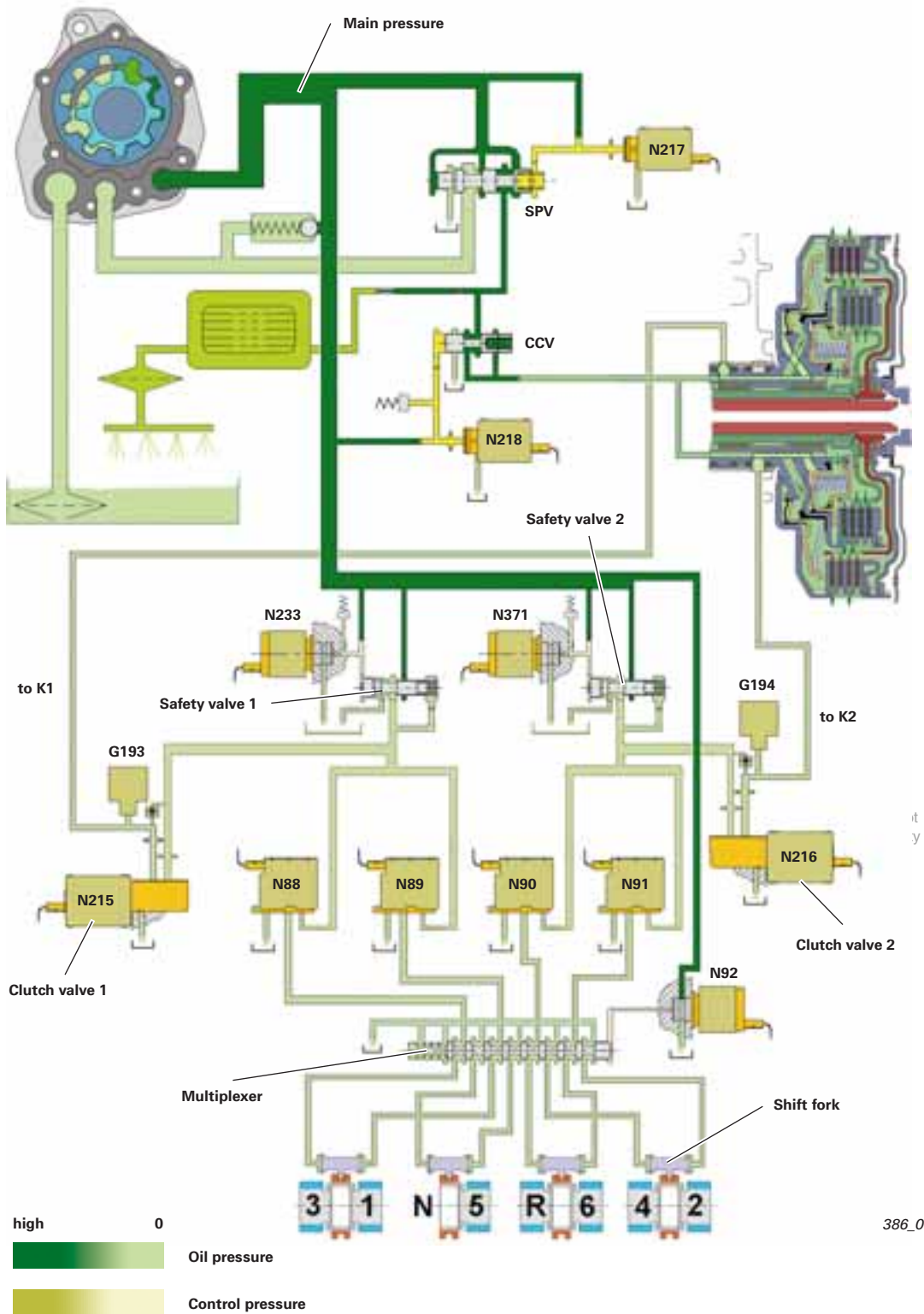
The power flow transition (first to sixth gear) is implemented by means of so-called overlapping shifting between clutches K1 and K2. This means that, during the power flow transition, the power-transmitting clutch (K1 in this example) remains capable of transmitting torque at a reduced pressure until the engine torque is transmitted to the engaging clutch (K2 in this example).

The gearshift is assisted by a temporary reduction in engine torque during upshifts (refer to illustration), or by a temporary increase in engine torque during downshifts.



# Gearbox subassemblies

## Hydraulic clutch control



386\_058

A special feature of the 02E gearbox is the direct activation of clutches K1 and K2 by electromagnetic pressure control valves.



### Note

The hydraulic diagram shows the valve positions when the engine is running and when the gearbox control unit is deenergised.

## Hydraulic control

Mechatronic control unit J743 calculates from the parameters on page 18 the nominal clutch pressure and determines a corresponding control current for pressure control valve N215 or N216.

The clutch pressure, and hence the engine torque transmitted by the clutch, changes nearly proportionally to the control current.

Senders G193 and G194 (hydraulic pressure senders) monitor the clutch pressure (actual pressure) in the hydraulic control unit.

The actual clutch pressure is continuously compared with the nominal clutch pressure calculated by J743.

The actual and nominal pressures are checked continuously for plausibility and a safety shutdown is effected in case of critical deviations; refer to page 28.

## Clutch cooling

To avoid overheating of the clutches, the clutches are cooled by a separate oil flow. The clutch cooling system is activated at the same time as the clutch is controlled. The near-permanent microslip ensures that the clutches are continuously cooled and lubricated. The cooling oil flow is shown overleaf on Fig. 386\_021.

The mechatronic control unit J743 activates N218 depending on clutch state/cooling oil demand by applying a defined electrical current, which in turn produces a proportionate control pressure. This control pressure acts upon the piston of the clutch cooling valve (CCV). Depending on the control pressure, a corresponding oil flow is branched off the system oil pressure and fed to the clutches. The maximum cooling output is approx. 20 l/min at 2.0 bar.

The N218 has a falling current/pressure characteristic. This means that in case of failure of the N218, the maximum cooling oil flow is set at all times and, therefore, the maximum possible cooling output is available. Fig. 386\_058 (adjacent) shows this state.

To keep power losses due to clutch cooling to a minimum, the cooling oil flow is controlled according to the following driving conditions:

Driving condition	State - clutch cooling	Activation of N218
Drive-away	Max. cooling output	0 mA
Creep control	Max. cooling output	0 mA
Gearshift	Max. cooling output	0 mA
Driving with microslip	Reduced cooling output	575 mA*
Driving without microslip	Reduced cooling output	575 mA*
Emergency (limp-home) mode	Max. cooling output	0 mA

\* average current value,  
Ramp-shaped activation curve with 150 - 1000 mA in a second

### Legend of Fig. 386\_058

G193	Automatic gearbox hydraulic pressure sender -1-	N91	Solenoid valve 4
G194	Automatic gearbox hydraulic pressure sender -2-	N92	Solenoid valve 5
K1	Clutch 1	N215	Electrical pressure control valve 1
K2	Clutch 2	N216	Electrical pressure control valve 2
CCV	Clutch cooling valve	N217	Electrical pressure control valve 3
N88	Solenoid valve 1	N218	Electrical pressure control valve 4
N89	Solenoid valve 2	N233	Electrical pressure control valve 5
N90	Solenoid valve 3	N371	Electrical pressure control valve 6
		SPV	System pressure valve (main pressure)

# Gearbox subassemblies

## Clutch functions

### Overload protection

If the cooling oil outlet temperature exceeds a value of approx. 160 °C (determined by G509), this means that the temperatures in the clutch have reached a critical level.

These temperatures can occur, for example, when driving away on very steep gradients (e.g. when towing a trailer) or when the vehicle is held on an incline using the clutch (i.e. without using the brake).

In such a case, as a protective function, the clutch is activated intermittently, this being perceived by the vehicle occupants as heavy shudder (warning shudder).

The selector lever position indicator in the dash panel insert begins to flash at the same time; refer to page 84.

The purpose of this "warning shudder" is to cause the driver to abort drive-away and thus avert further increases in clutch temperature.

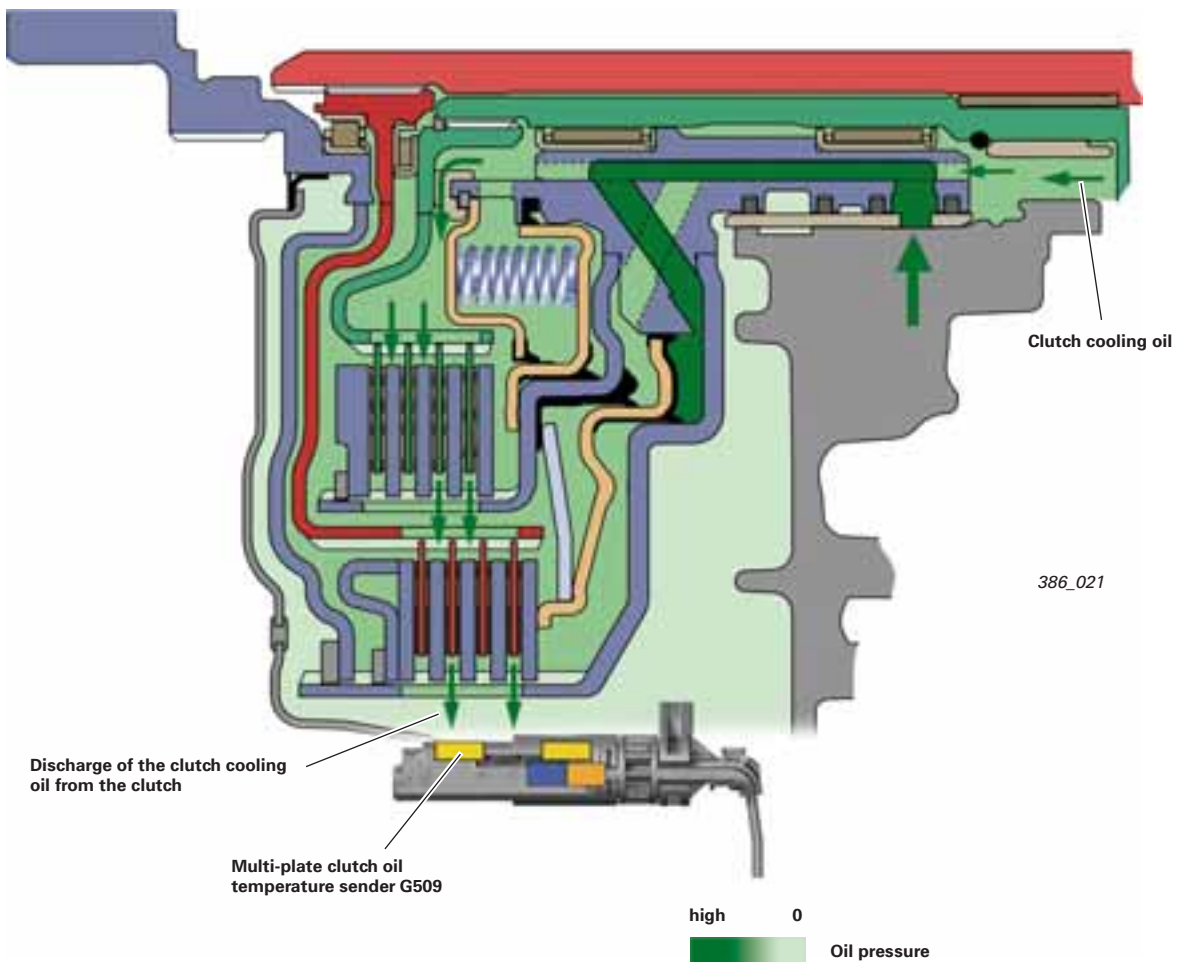
The normal reaction of the driver to the warning shudder is to ease back off the accelerator. If the driver ignores the warning shudder and continues to press down on the accelerator, then, when the cooling oil outlet temperature exceeds approx. 170 °C, clutch and engine torque will be reduced to the extent that the engine runs powerlessly at a high idling speed.

In this way, the driver is forced to ease back off the accelerator.

The clutch cooling system operates at maximum cooling output, and after a short time the clutch cools down again.

At the next attempt to drive away the vehicle, the full engine torque will again be available and the journey can be continued.

Clutch cooling/cooling oil flow



## Creep control

"Creep" refers to the creep behaviour which a conventional automatic gearboxes with a torque converter exhibits when the engine is idling and a gear is selected.

The creep control function works like this: when the engine is idling and a gear is selected, a defined slip torque is set at the clutch (clutch torque) causing the vehicle to "creep". This allows the vehicle to be manoeuvred (e.g. when parking) without using the accelerator pedal, thus enhancing driving comfort.

The vehicle behaves as one would expect an automatic gearbox to. The clutch torque is adjusted to between 1 and 40 Nm, depending on the driving condition and vehicle road speed.

A **special feature of the creep control** is that of reduced clutch torque at vehicle standstill with the brake applied, whereby less torque is required of the engine (the clutch is further open). Clutch torque is reduced to approx. 1 Nm, depending on the brake pressure.

The tendency of the vehicle to creep is reduced accordingly.

This has a positive effect on fuel efficiency and comfort, because the vehicle has better acoustics when at a standstill and considerably less brake pressure is required to hold the vehicle.

If the stationary vehicle begins to roll back on an incline with the brake only lightly applied, clutch torque will be increased **slightly**. The vehicle must be held by increasing the brake pressure or by applying the handbrake. The vehicle behaves as one would expect a normal manual gearbox to.

## Microslip control

The clutches are continuously engaged, with a minimum slip rate of approx. 10 rpm. This is referred to as "microslip" on account of the low slip value.

Microslip improves clutch control response and gearshift quality. Certain clutch adjustments are made under microslip.

The microslip also has the effect of reducing vibration between the engine and gearbox, thereby improving the vehicle's vibrational behaviour.

Clutch K2 is closed completely when the engine reaches a speed at which it is no longer possible to shift down into fifth gear. The special additives in the gearbox oil are protected in this way.

## Clutch control adaptation

Comfortable clutch operation must be maintained in all operating states and throughout the useful life of the clutch.

For this purpose, the relationship between clutch valve control current and clutch torque is subject to **continuous updating**.

This process of updating is necessary since the friction coefficients of the clutches are continuously variable.

The coefficient of friction is dependent on the following continuously variable factors:

- ATF (quality, ageing, wear)
- Oil temperature
- Clutch temperature
- Clutch slip

To compensate for these influences, the relationship between control current and clutch torque is determined in various driving conditions, e.g. under microslip, and stored.

### Note



After replacement of the mechatronics or the twin clutch or after updating of the gearbox control unit programming, the clutch adaptation values must be reset using the diagnostic tester. For this purpose, the "Basic Setting" procedure must be started under "Guided Functions" and the described adaptation procedure carried out.

# Gearbox subassemblies

## Safety shutdown

To counteract uncontrolled closing of a clutch, safety circuits are integrated in the hydraulic circuit. If the actual clutch pressure is clearly in excess of the nominal clutch pressure, this means that a safety-critical malfunction is present. In this case, the part-gearbox in question is depressurised by means of a safety shutdown (refer to "Emergency program", page 85).

Further events which trigger a safety shutdown are all faults to which the gearbox control unit reacts by starting the emergency program.

Part-gearbox 1 enters emergency (limp-home) mode; part-gearbox 2 is shut down (N371 not activated (0 %),

Part-gearbox 2 enters emergency (limp-home) mode; part-gearbox 1 is shut down (N233 not activated (0 %).

Oil feed to the clutch control for clutches K1 and K2 and for shift control is via a separate fail-safe oil supply. This means that clutch K1 or part-gearbox 1 or clutch K2 or part-gearbox 2 can be shut down hydraulically.

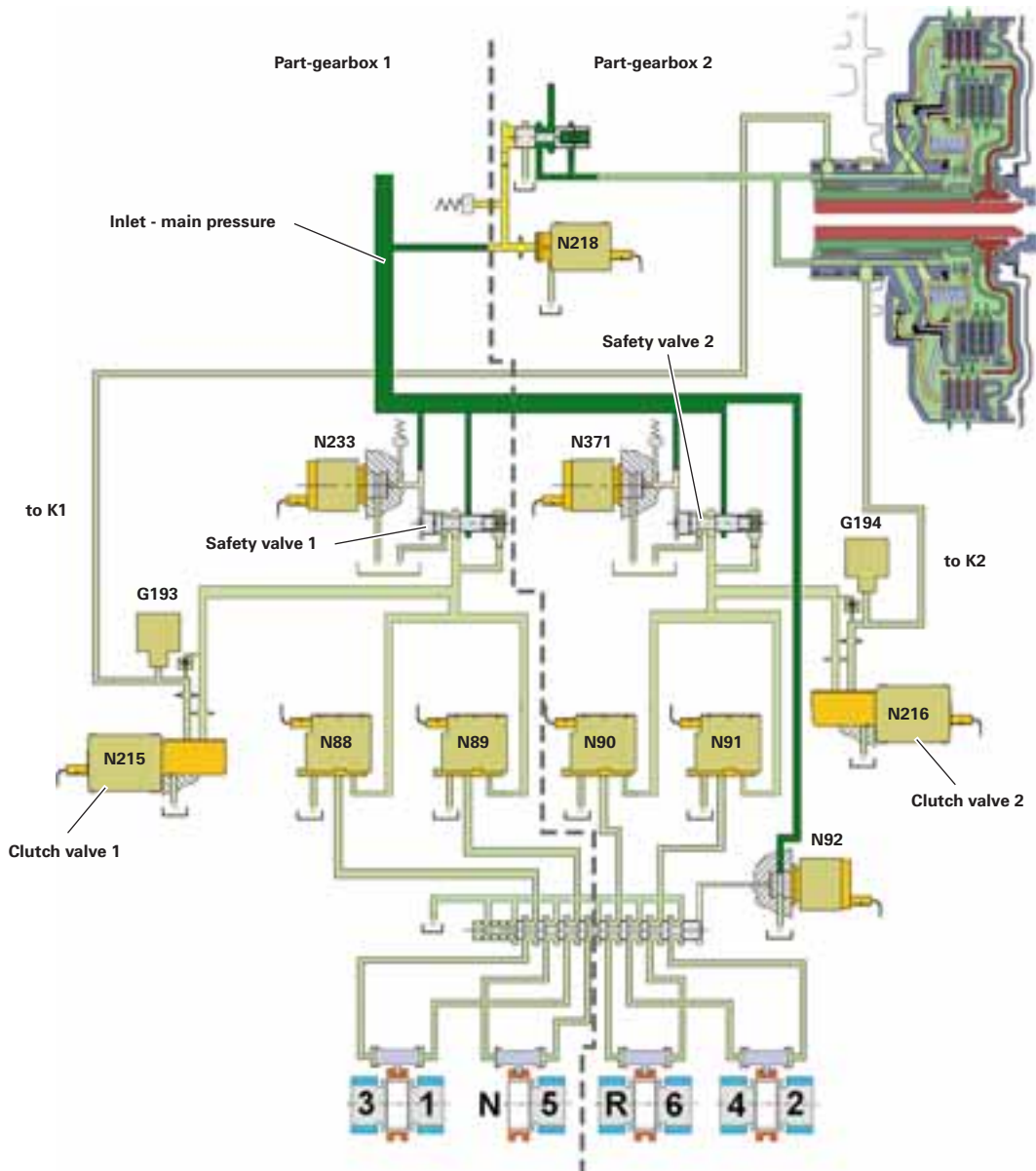
The element responsible for safety shutdown of part-gearbox 1 (2) is the electrical pressure control valve N233 (N371) and the accompanying safety valve 1 (2).



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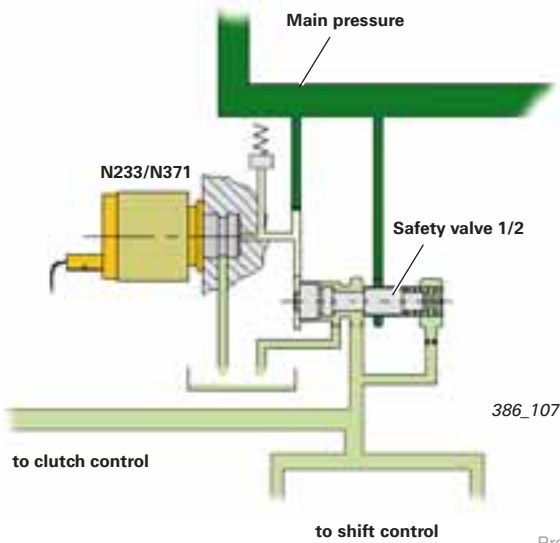
**Note**

The hydraulic diagram shows the pressure in the hydraulic system when electronic pressure control valves N233 and N371 are deenergised.



386\_101

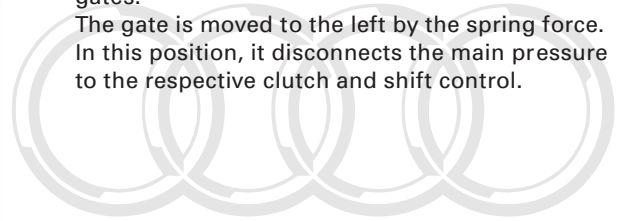
### N233/N371 deenergised



Pressure control valves N233 and N371 have a rising current/pressure characteristic.

This means that if they are not activated, there will be no control pressure acting on the safety valve gates.

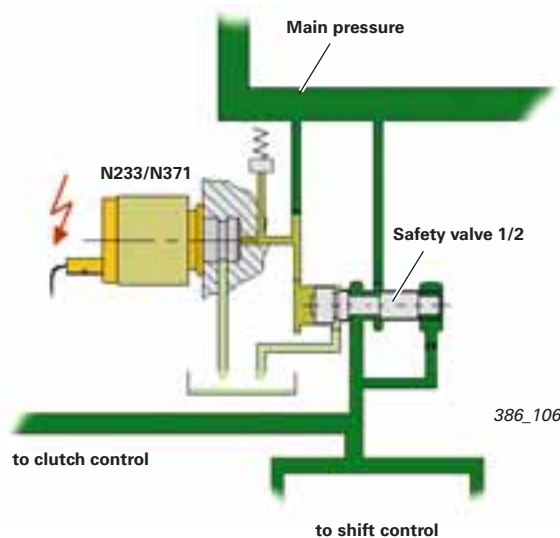
The gate is moved to the left by the spring force. In this position, it disconnects the main pressure to the respective clutch and shift control.



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### N233/N371 energised



When the electromagnetic pressure control valve N233 (N371) is energised, the control pressure acts on the respective safety valve. The gate is moved to the right against the spring force.

In this position it opens the pressure supply to the clutch and shift control systems.

high 0

 Oil pressure  
 Control pressure

#### Reference

For further information on electronic pressure control valves N233 and N371, refer to page 55.



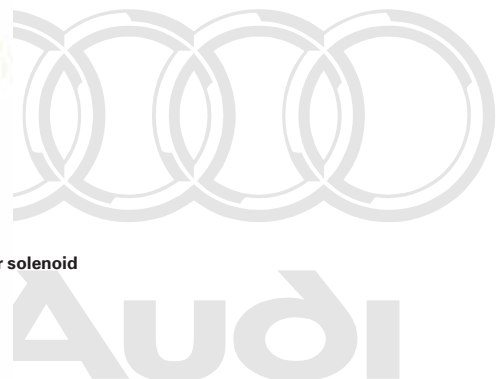
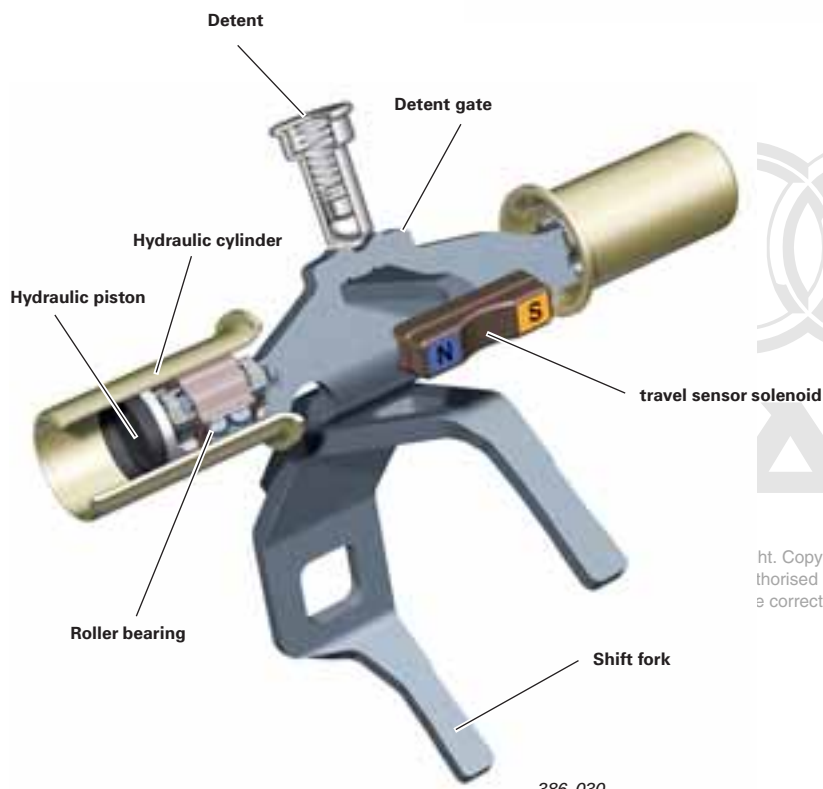
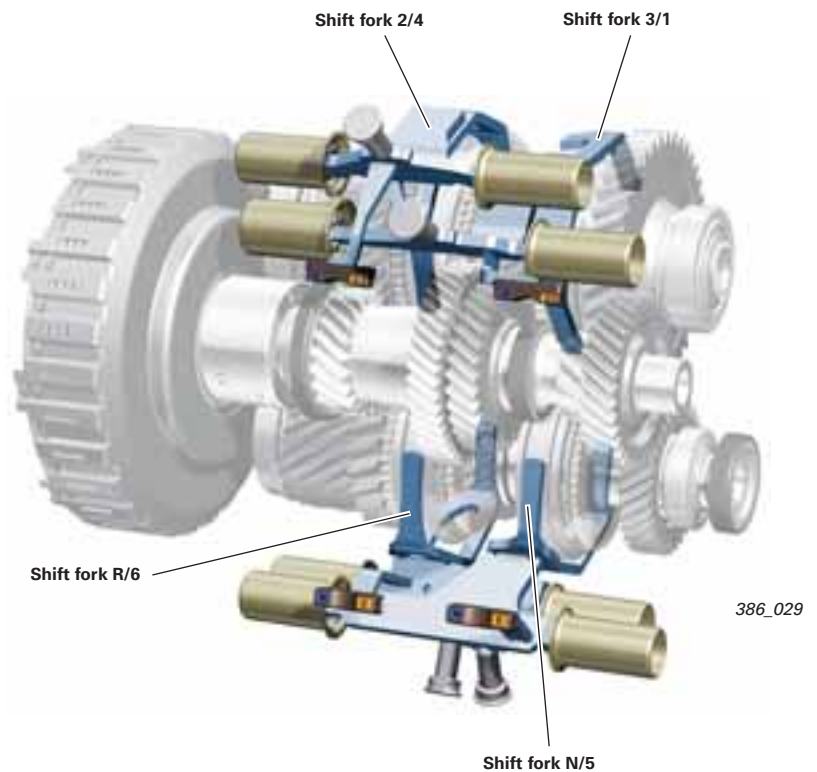
# Gearbox subassemblies

## Manual gearbox

### Selector mechanism

The four gear change sleeves are actuated by hydraulically controlled shift fork. Each shift fork is located in two steel sleeves by means of roller bearings. The steel sleeves are press fitted into the gearbox housing; at the same time, they act as cylinder chambers for the hydraulic pistons through which the shift forks can be moved back and forth.

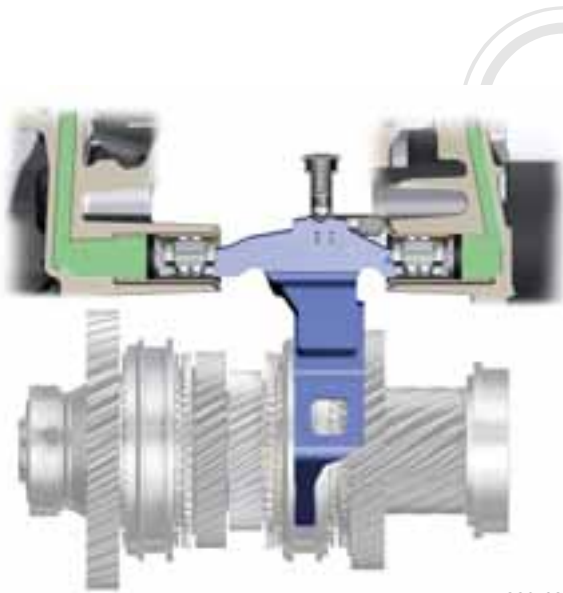
The shift pressure flows through bores in the gearbox housing into the cylinder chambers (hydraulic cylinder) which are open at the rear. A travel sensor is assigned to each shift fork and determines the exact position and travel of the shift fork, refer to page 72.



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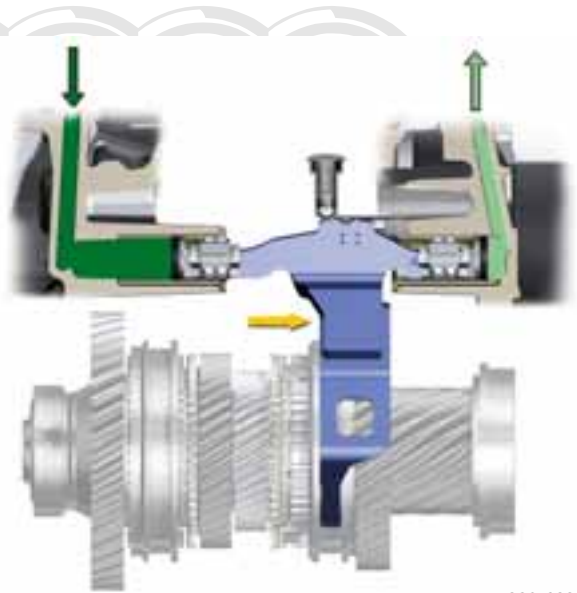
The shift forks are pressurised in such a way that, depending on requirements, they move to the left/right stop (corresponding gear selected) or to the middle position (neutral position).

Once the gear is selected, the corresponding hydraulic cylinder is depressurised. The gear is held in place by the selector teeth and by the shift fork detent. In the neutral position, the shift fork is held in the centre position by the detent. The gear change sleeve has a separate detent for the neutral position.



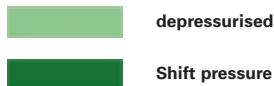
386\_031

Shift fork depressurised in neutral position



386\_032

Shift fork during the gearshift



To maintain a constant shift time, the gearshift pressure is adapted according to gearbox temperature and gearshift duration, and can be up to 20 bar.

In the event of malfunction or if incorrect shift positions are executed, the part-gearbox concerned is shut down hydraulically by means of the safety shutdown function; refer to "Safety shutdown", page 28.

#### Note

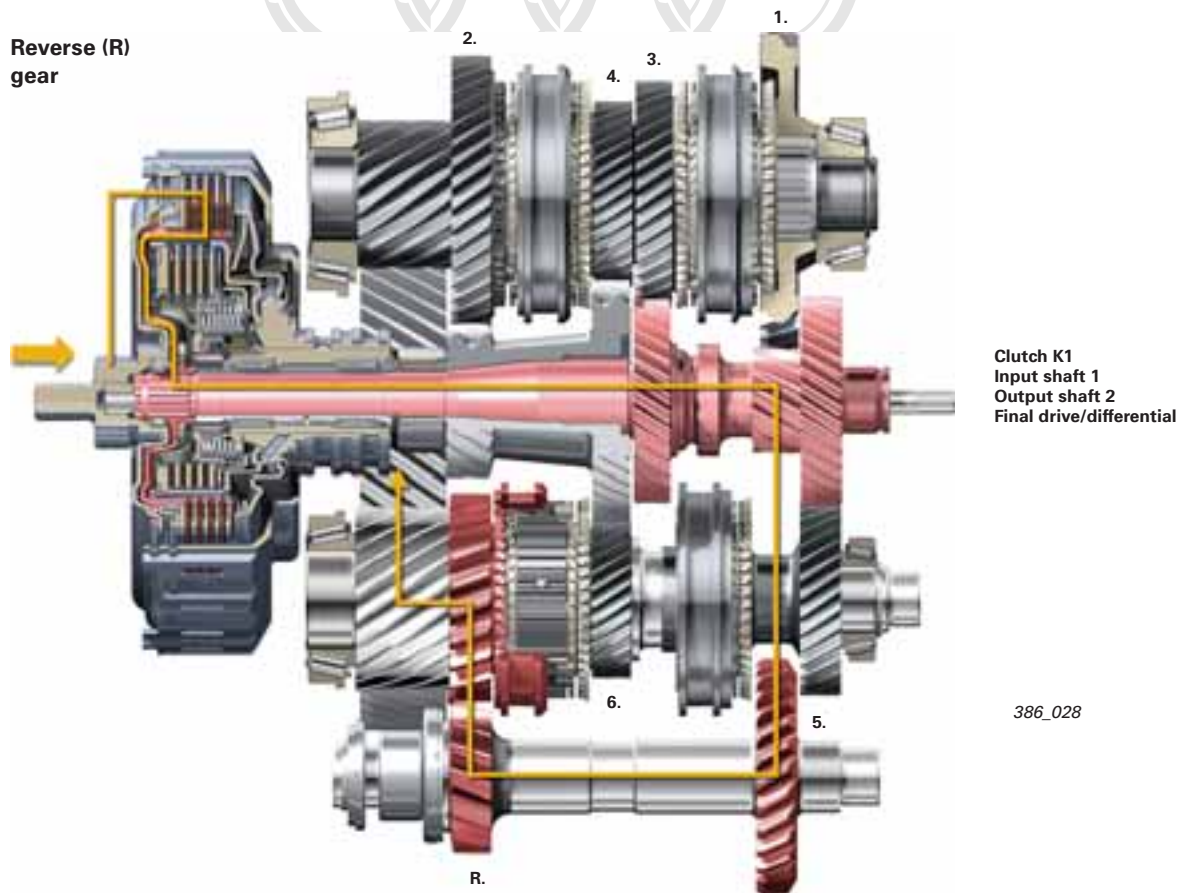


To ensure proper functioning of the gearbox, the exact positions of the shift forks in relation to the gearbox control unit must be known. Travel sensors determine the position of the shift forks; also refer to page 72. Due to manufacturing tolerances, the respective end positions and the synchronisation points of each shift fork (each gear) in the gearbox control unit must be programmed by teach-in (basic setting). After replacement of the mechatronics or entries relating to the selector mechanism are made in the fault memory, the basic setting procedure (basic alignment) must be carried out using the diagnostic tester. For this purpose, the "Basic setting" procedure must be started under "Guided Functions" and the described adaptation procedure then carried out.

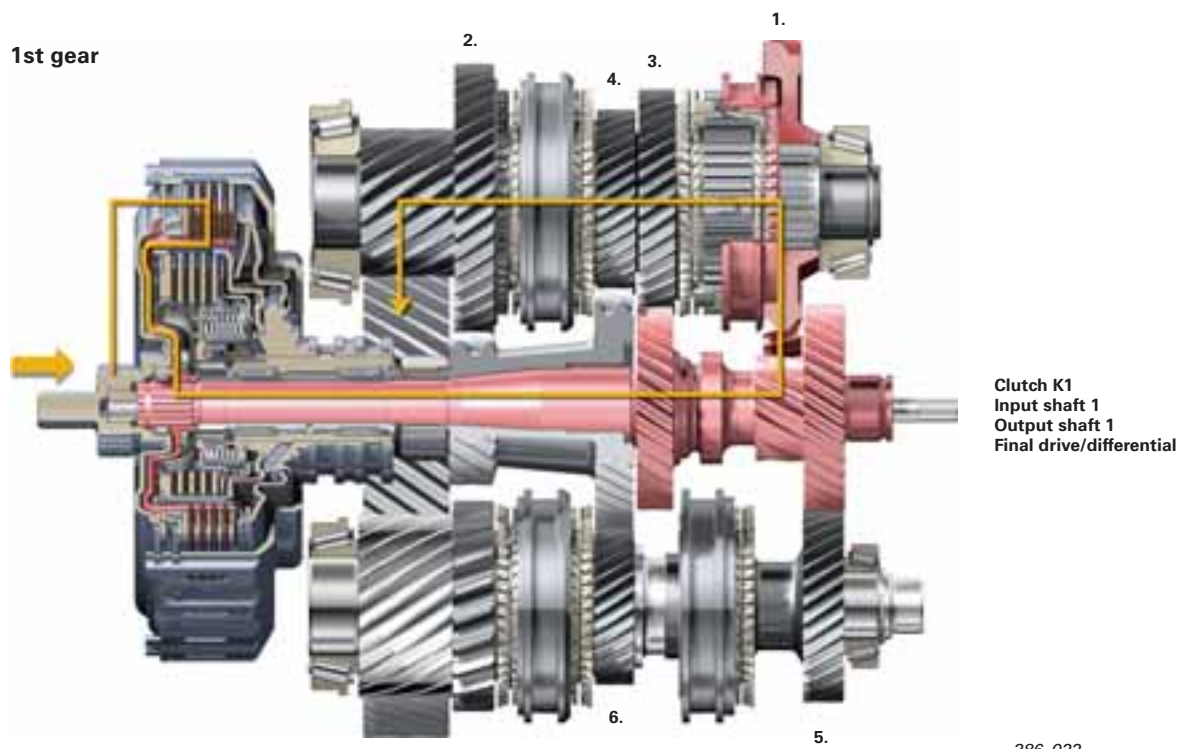
# Gearbox subassemblies

## Power flow

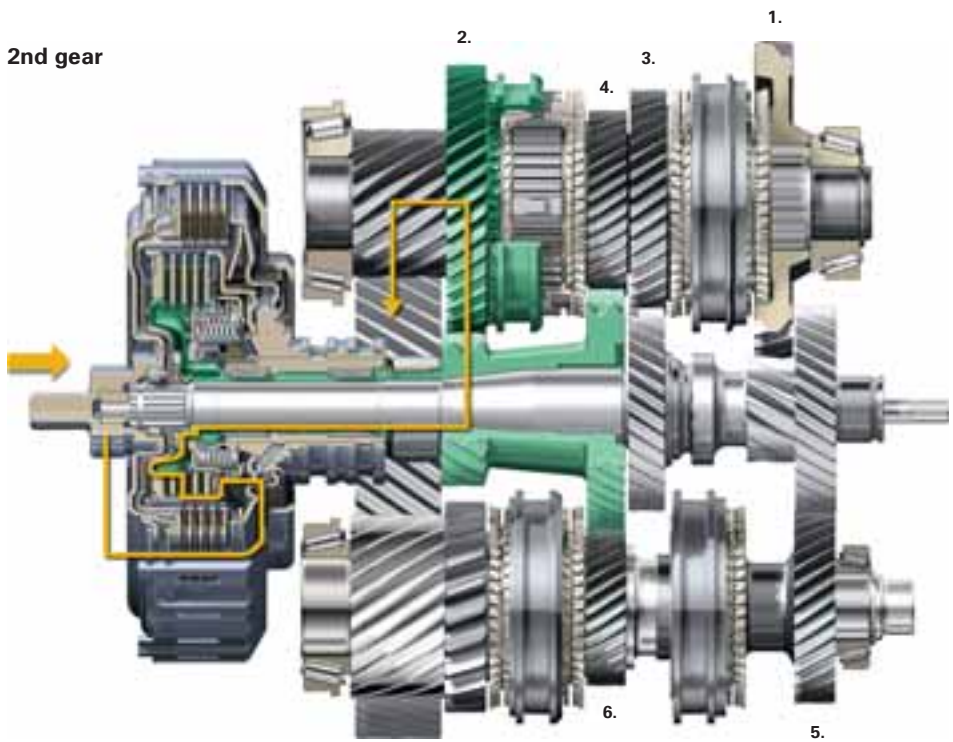
### Reverse (R) gear



### 1st gear



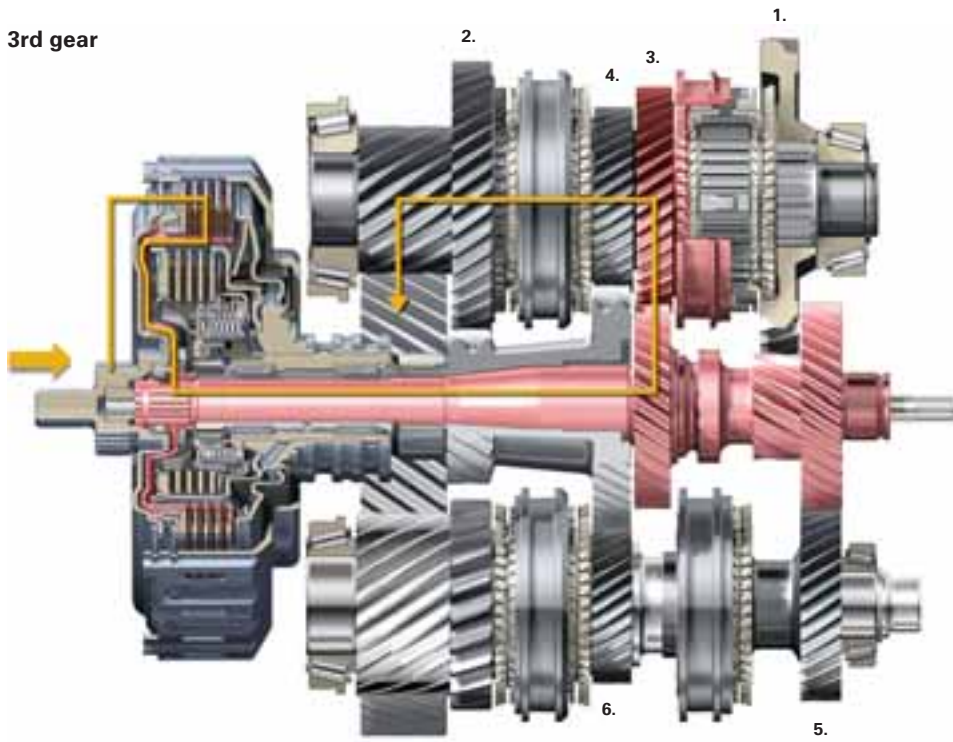
2nd gear



Clutch K2  
Input shaft 2  
Output shaft 1  
Final drive/differential

386\_023

3rd gear



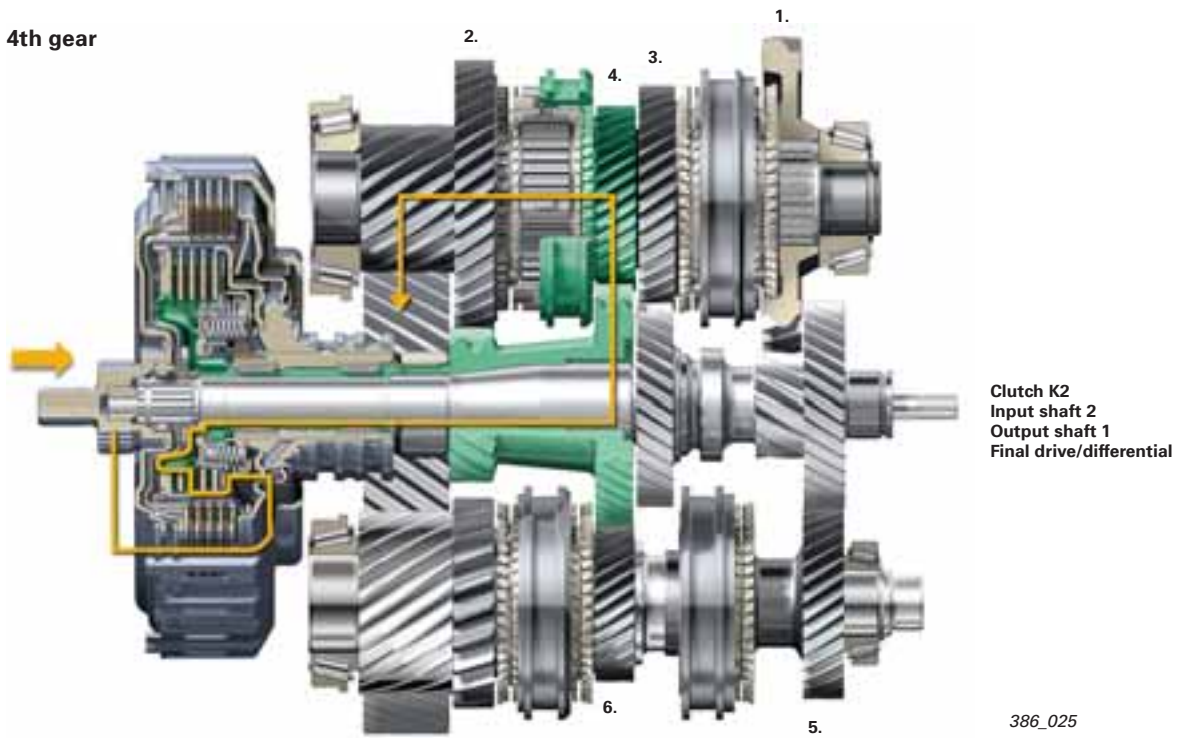
Clutch K1  
Input shaft 1  
Output shaft 1  
Final drive/differential

386\_024

# Gearbox subassemblies

## Power flow

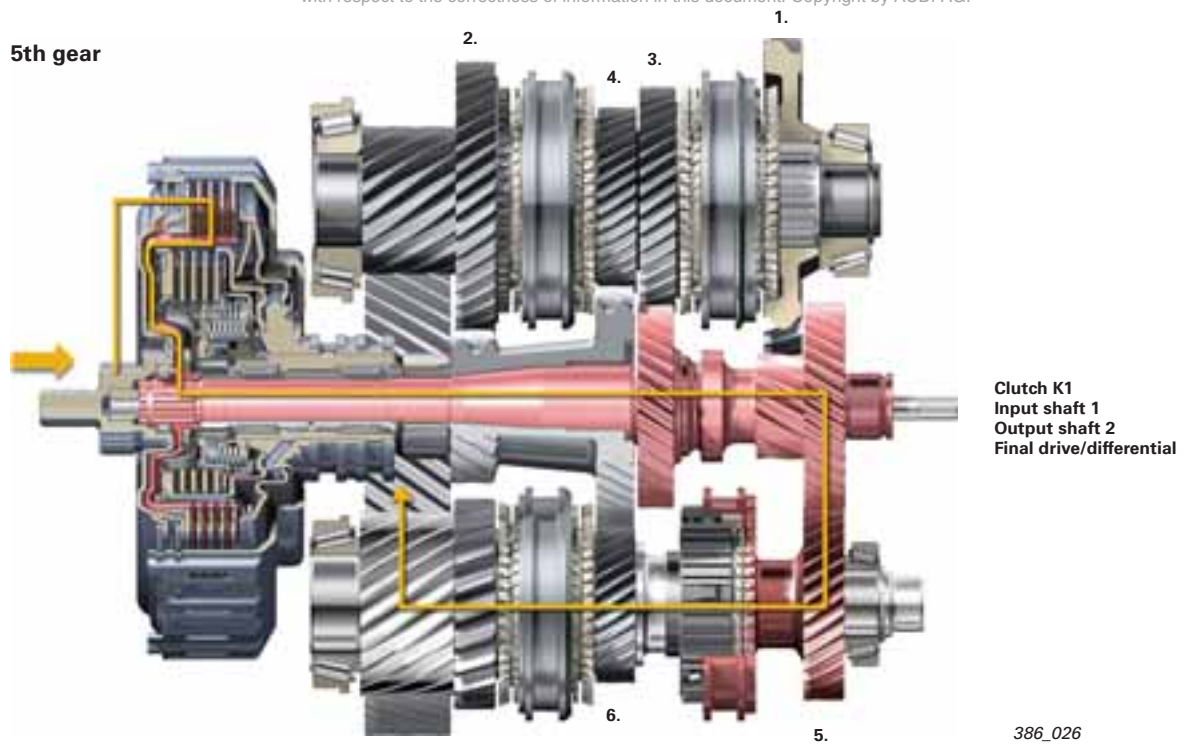
### 4th gear



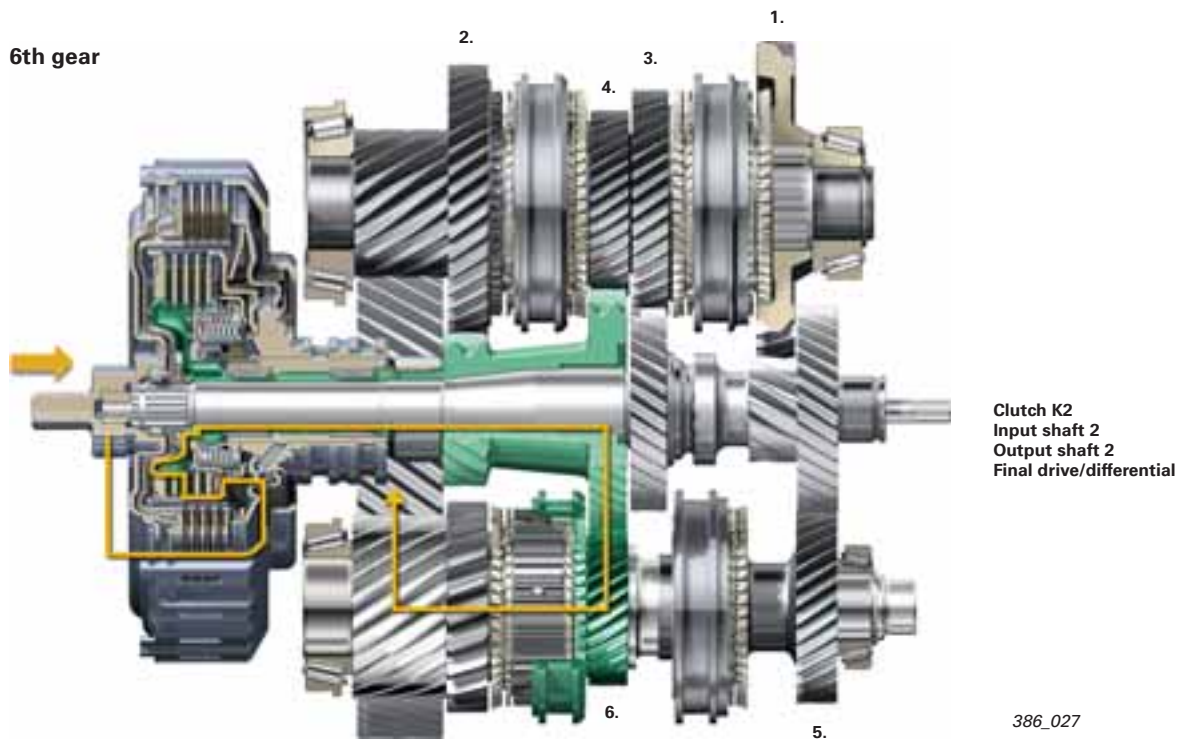
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### 5th gear



6th gear



386\_027

## Synchromesh

### Single cone synchromesh

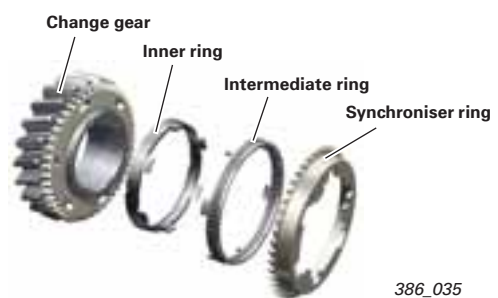
The gearbox has single cone synchromesh on 4th, 5th and 6th gear.



386\_034

### Double cone synchromesh

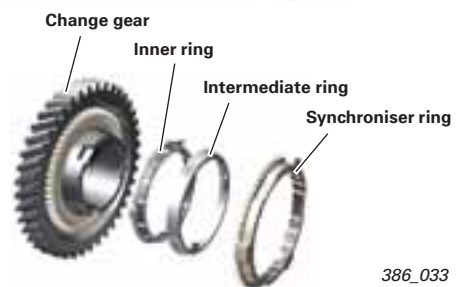
The gearbox has double cone synchromesh on reverse.



386\_035

### Triple cone synchromesh

The gearbox has triple cone synchromesh on 1st, 2nd and 3rd gear.



386\_033

The above-specified assignments of the synchromesh units to the individual gears and the illustrations conform to the gearbox specifications valid to week 45/05. The synchromesh mechanisms of gears 1 to 4 have since been optimised in the course of further development work.

# Gearbox subassemblies

## Hydraulic control

The shift forks are controlled by four solenoid valves (N88 - N91) and a so-called "multiplexer". The multiplexer is controlled by the solenoid valve N92. The multiplexer makes it possible to control the eight hydraulic cylinders (each shift fork has two hydraulic cylinders) using only four solenoid valves.

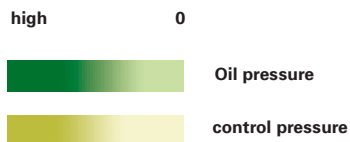
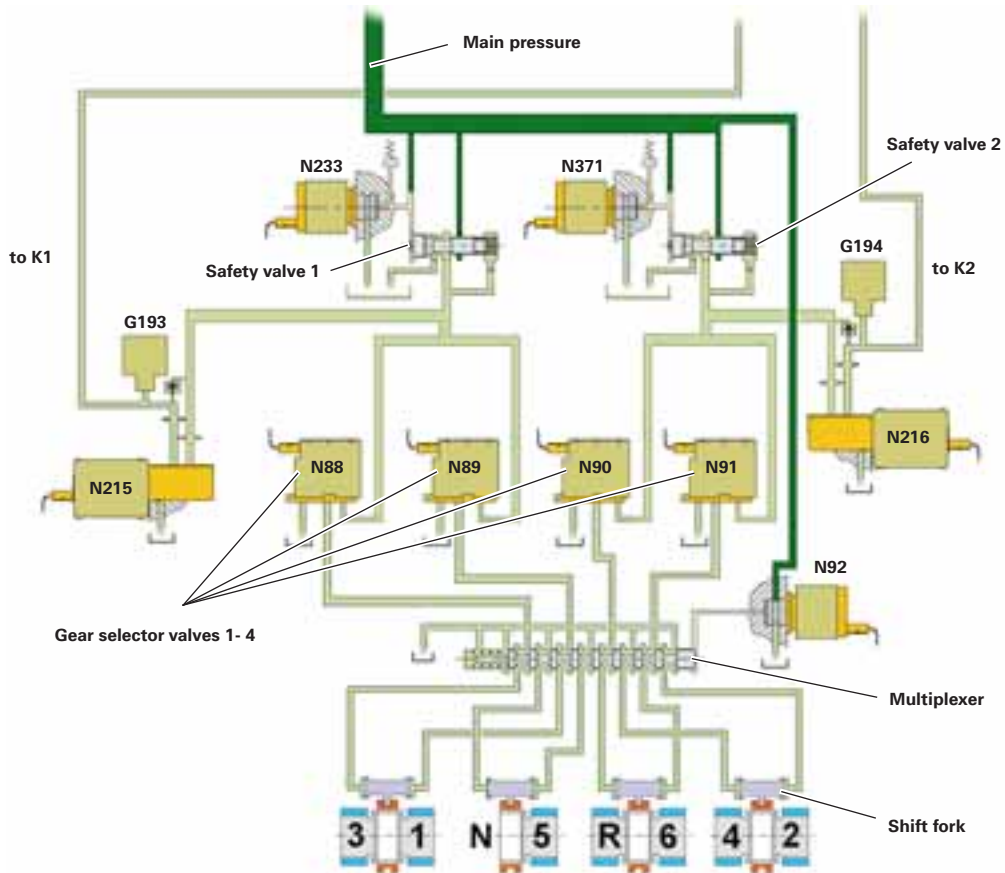
When solenoid valve N92 is deenergised, the multiplexer is in its basic setting. It is pressed against the right-hand stop by the spring pressure. The following shift forks/gears can be activated:

N88 + N89 control shift forks 3-1  
 N90 + N91 control shift forks R-6

When the solenoid valve N92 is energised, the multiplexer is pressed against the left-hand stop by the control pressure. The following shift fork/gears can be activated:

N88 + N89 control shift forks -5  
 N90 + N91 control shift forks 4-2

The shift pressure generally corresponds to the main pressure. To minimise shift noise, the shift pressure is reduced in certain situations by means of electronic pressure control valves N233 and N371. You can find more information on page 57.



386\_036

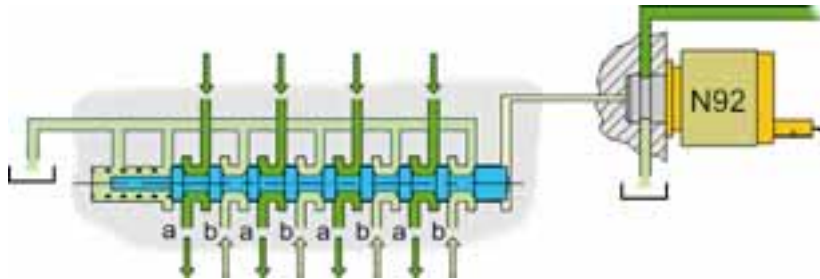
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**Multiplexer function**



386\_037

**Solenoid valve N92 deenergised**

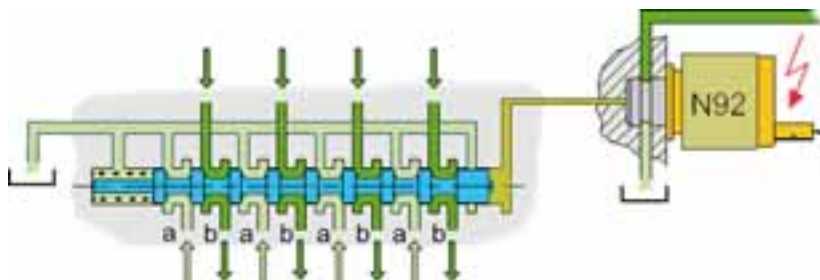


386\_038

If the solenoid valve N92 is deenergised, the multiplexer is in its basic setting. It is pressed against the right-hand stop by the spring pressure.

Connections "a" are connected to the pressure ports. Connections "b" are ventilated.

**Solenoid valve N92 energised**

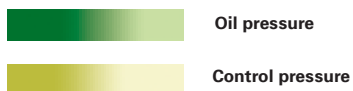


386\_039

When the solenoid valve N92 is energised, the multiplexer is pressed against the left-hand stop by the control pressure.

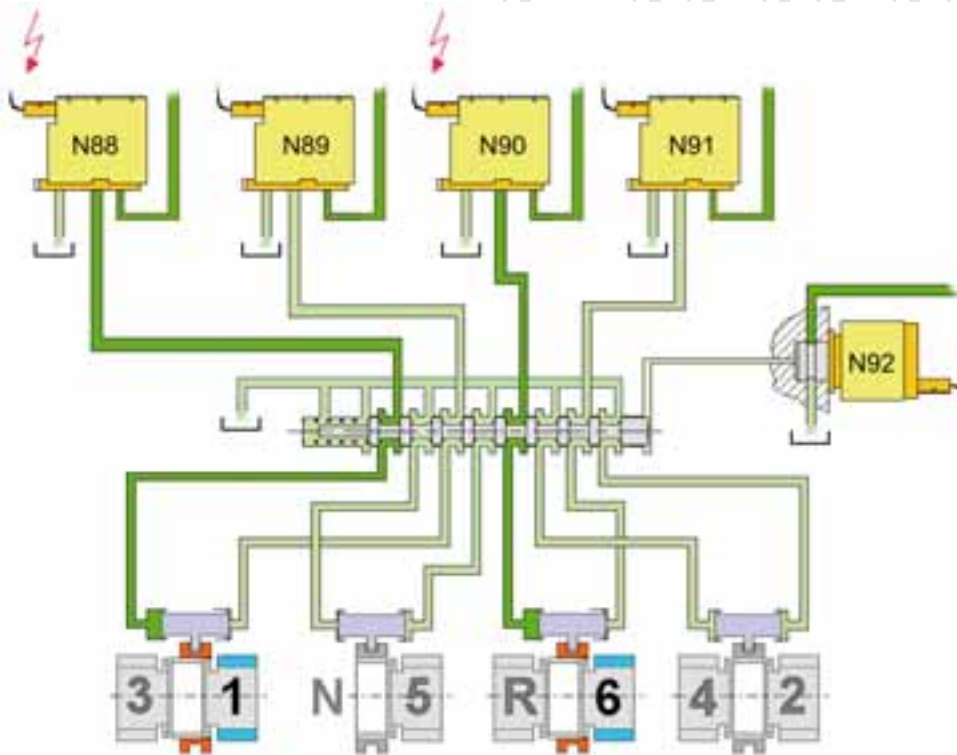
Connections "b" are connected to the pressure ports. Connections "a" are ventilated.

high 0



# Gearbox subassemblies

## Shift control

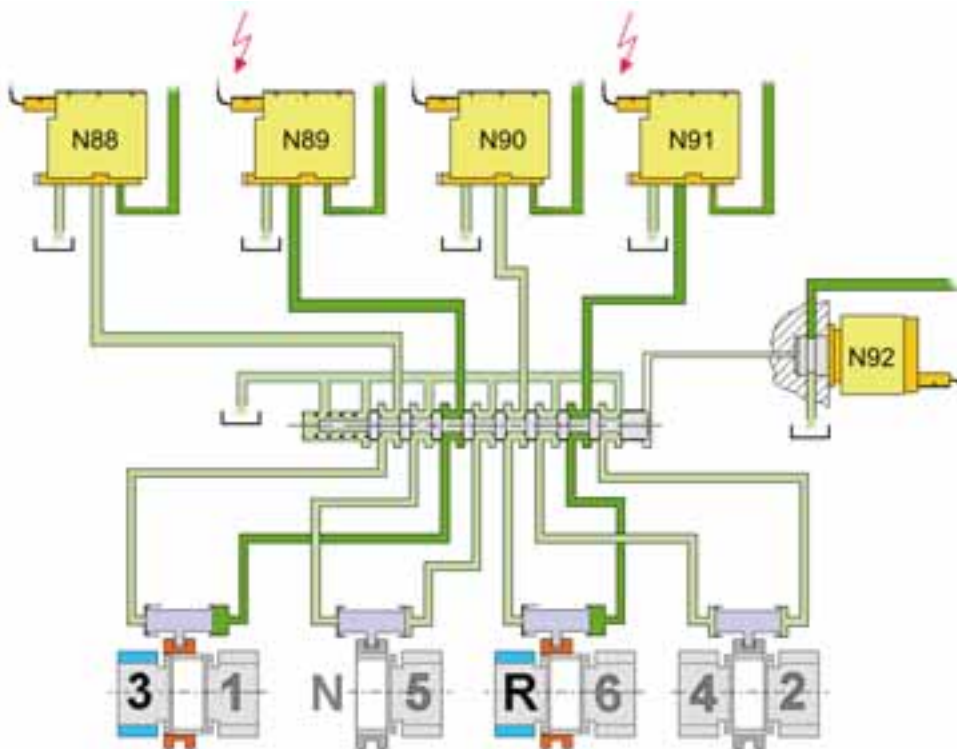


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The following shift forks/gears can be activated when N92 is deenergised:

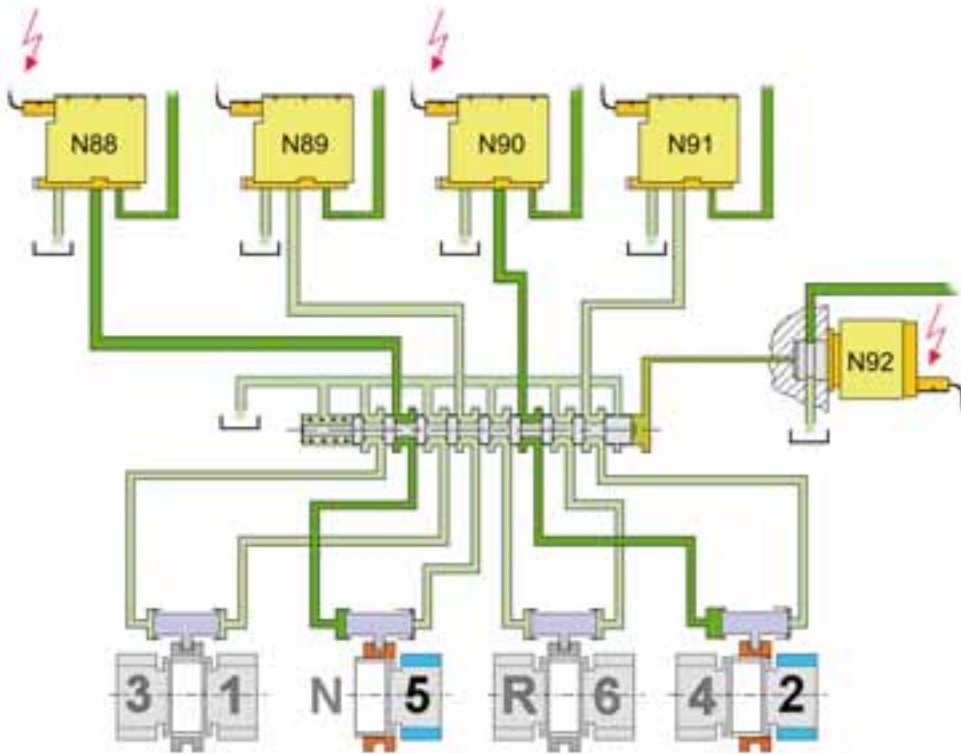
386\_040

- N88 + N89 control shift forks 3-1
- N90 + N91 control shift forks R-6



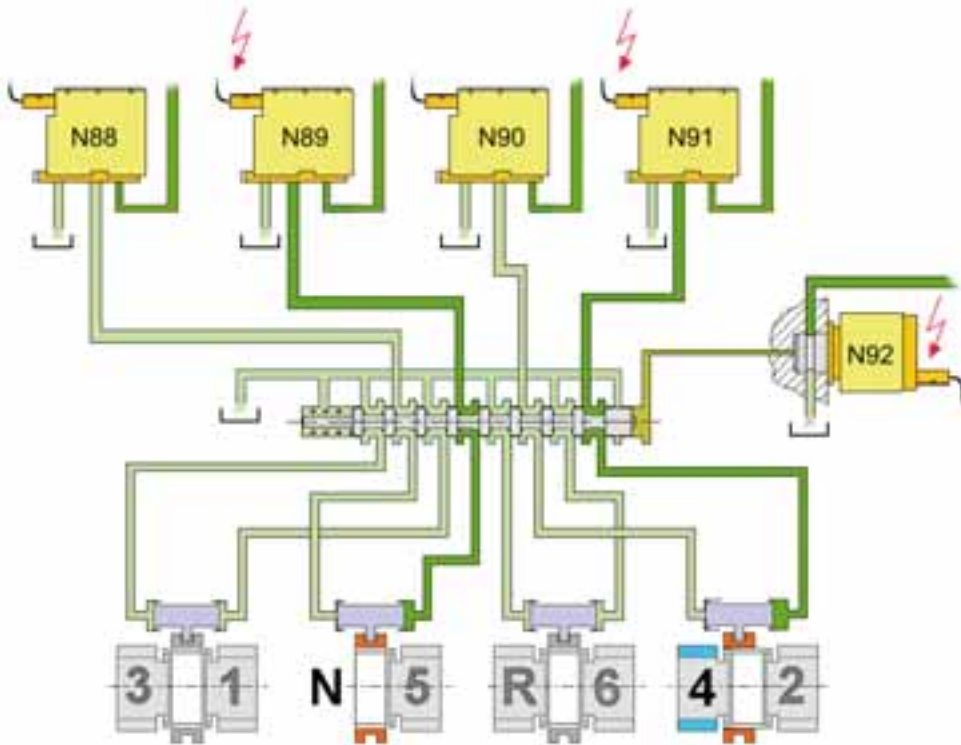
386\_041

No control pressure - solenoid valve N92 deenergised



The following shift forks/gears can be activated when N92 is energised:

- N88 + N89 control shift forks N-5
- N90 + N91 control shift forks 4-2



Maximum control pressure - solenoid valve N92 energised

# Gearbox subassemblies

## Gearshift sequence

### Initial state

Engine idling, selector lever in position "P" or "N". The driver wants to drive away forwards and accelerate, and, therefore, selects selector lever position "D" or "S" and pushes down the accelerator pedal.

### Situation 1

In selector lever position "P" or "N", the driver input – forwards or reverse – is initially unknown to the gearbox. Is "R" or "D" selected?

Since reverse and 1st gear are assigned to part-gearbox 1, both gears cannot be preselected simultaneously.

To reduce the reaction time at drive-away with the selector lever in position "P" or "N", reverse is preselected in part-gearbox 1 and second gear is preselected in part-gearbox 2.

When the selector lever is moved into position "D" or "S", clutch K2 is initially filled and a torque transmitted via 2nd gear.

### Situation 2

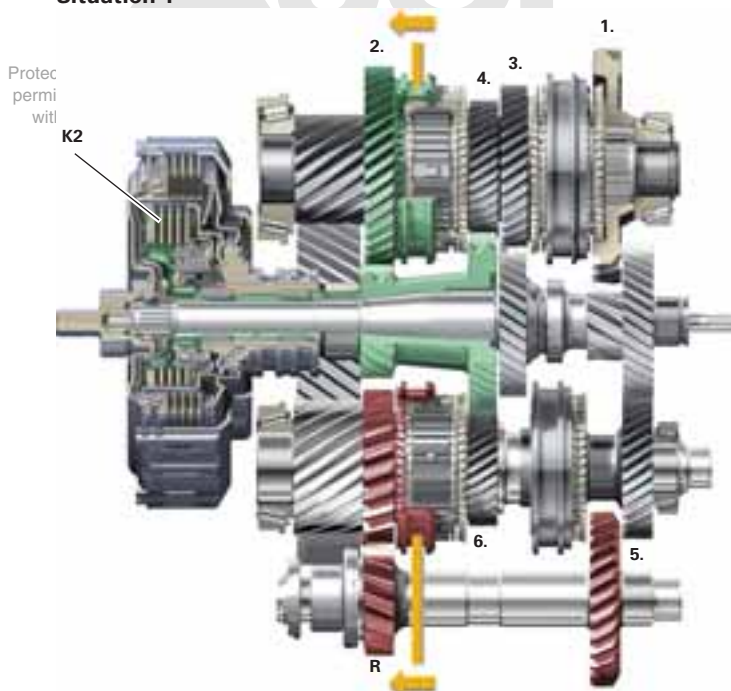
At the same time, part-gearbox 1 (now "available") shifts from reverse to 1st gear and clutch K1 is filled. Clutch K1 receives the full torque, and K2 is completely reopened.

Normally the reaction time of the gearbox is sufficient to complete the shift from reverse to 1st gear by the time the driver depresses the accelerator, and the vehicle moves away in 1st gear. In a driving condition where the driver moves the selector lever from "N" to "D" and simultaneously depresses the accelerator, the reaction time of the gearbox will not be sufficient and, therefore, the vehicle will initially move away in 2nd gear until the aforementioned shift is completed in part-gearbox 1.

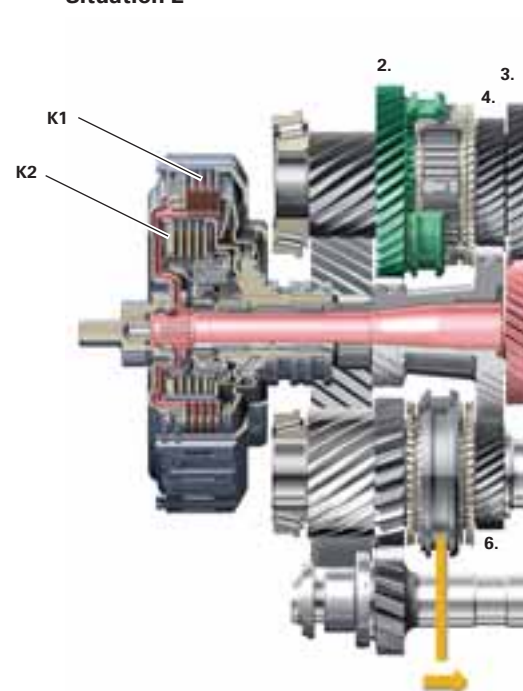


## Audi

### Situation 1



### Situation 2



### Note



A normal gearshift is completed within approx. 200 ms. However, very low temperatures prolong gearshifts due to the higher viscosity of the gearbox oil and the associated increase in the reaction time of the hydraulic control system.

386\_044

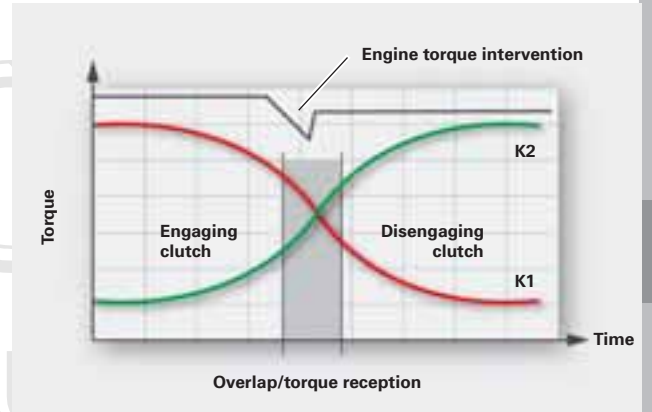
### Initial state

Acceleration in 1st gear.  
Additional acceleration after drive-away.

### Situation 3

When the characteristic for the upshift from 1st to 2nd gear is reached, 2nd gear is selected by overlapping operation of clutches K1 and K2. This means that clutch K1 opens while clutch K2 closes and transmits the engine torque. To enhance shift comfort and conserve the clutches, engine torque is reduced during the clutch overlap phase.

After the upshift from 1st to 2nd is complete, part-gearbox 1 shifts into 3rd gear (the gear is preselected). The aforementioned process is repeated alternately during the subsequent gearshifts from 2-3, 3-4, 4-5 and 5-6, and also during downshifts. In selector lever position "S" and in tiptronic mode, engine torque is increased during the downshift in order to reduce the shift time (synchronisation speed is reached more quickly) and enhance gearshift comfort.

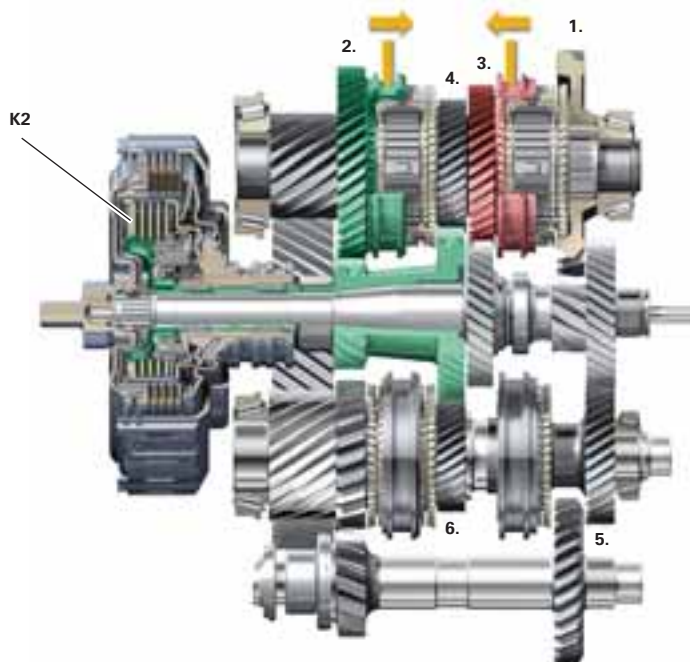


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### Situation 3



386\_045



386\_047

# Gearbox subassemblies

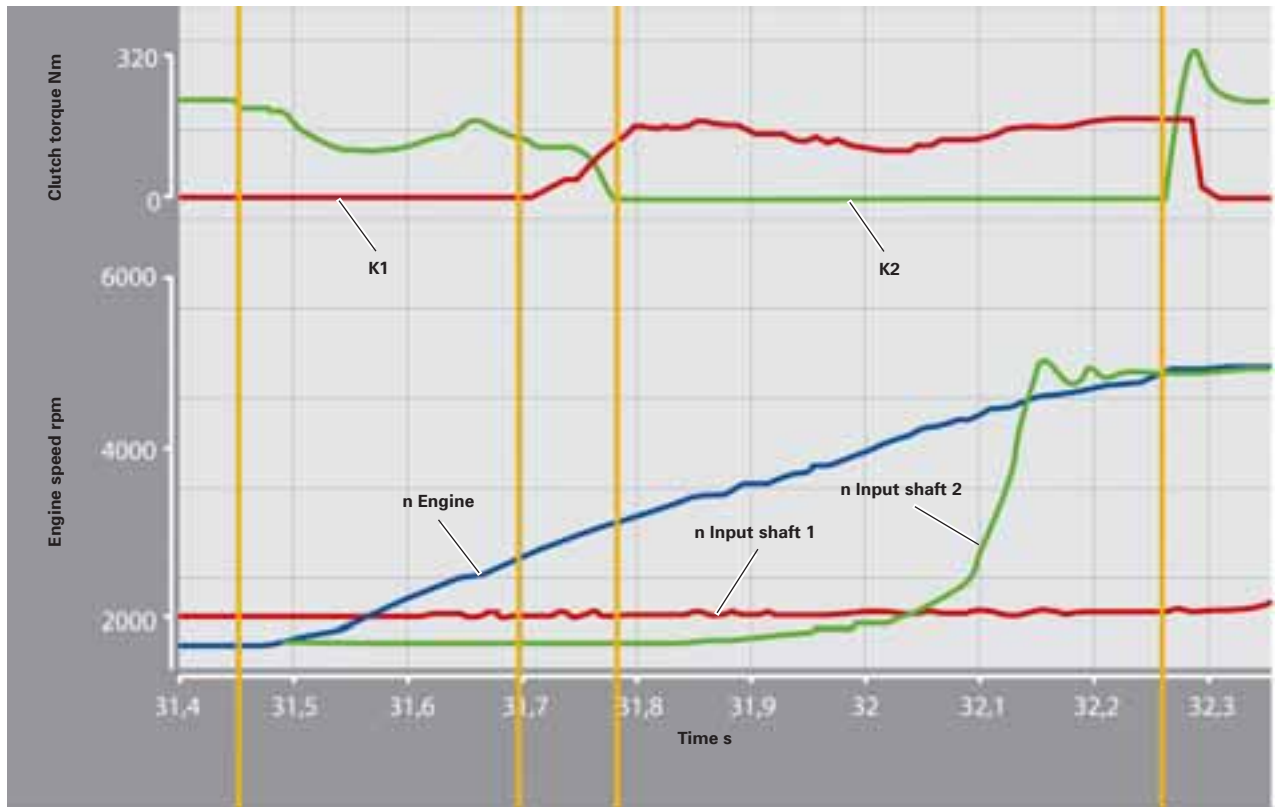
## Gearshift sequence/multi-step downshifts

Power flow is not interrupted, not even during multiple shifts (gears are skipped). Skipping of gears is possible (e.g. 5 → 3). However, one gear is positively engaged at all times. Gearshifts from one part-gearbox to the other (e.g. 6 → 3) are made directly.

During gearshifts within a part-gearbox, power flow is maintained by intermittent shifting to the "available" part-gearbox.

A multi-step downshift, e.g. from 6th gear to 2nd gear, is made via 5th gear (6 → 5 → 2). The driver does not notice this transition, however, because 5th gear is engaged only momentarily (for the duration of the downshift from 6th to 2nd gear), and the increase in engine speed is adapted by regulating clutch K1 accordingly; refer to Fig. 386\_048.

Downshift from 6th to 2nd in less than 0.9 s



386\_048

Start of gearshift  
 ▶ 6th gear active  
 ▶ Engine start-up via clutch K2

▶ Controlled engine start-up via 5th gear (part-gearbox 1, clutch K1)  
 ▶ 2nd gear is engaged in part-gearbox 2.

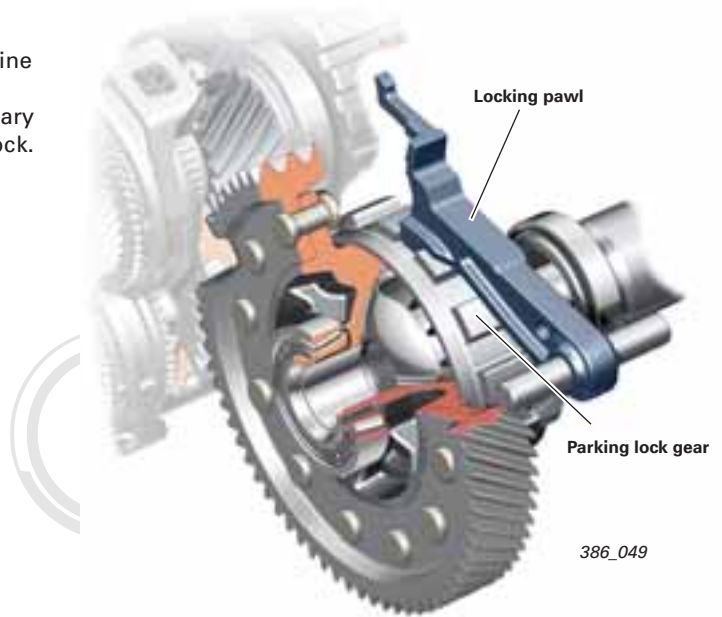
Transmission of engine torque to clutch K1 (5th gear)

Transmission of engine torque to clutch K2

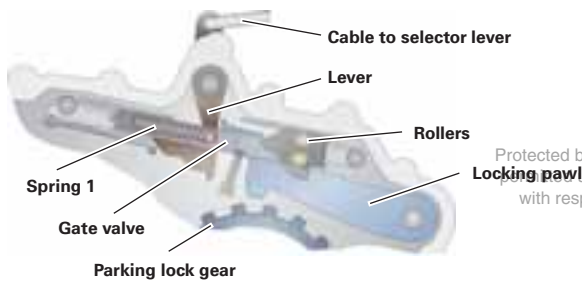
## Parking lock

Generally, no traction is available when the engine is at a standstill (both clutches, K1 and K2, are open). The 02E gearbox, therefore, as is customary with automatic gearboxes, requires a parking lock.

The parking lock gear is coupled to the final drive (spur gear). The locking pawl is actuated mechanically with the selector lever cable. The selector lever cable actuates the parking lock only.

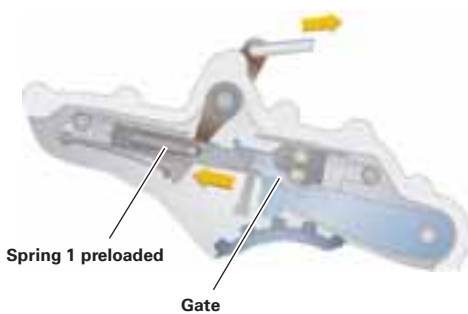


Function:



Selector lever in position R, N, D or S

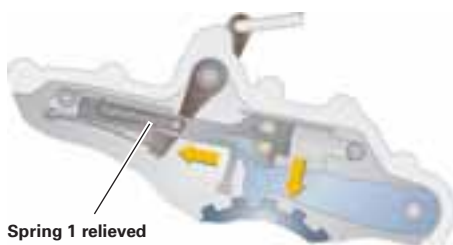
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### Selector lever position "P" (locking pawl not engaged)

In selector lever position "P" the locking pawl is moved by means of the cable pull and lever in such a way that it engages the gearing of the parking lock gear and, consequently, blocks the final drive.

When the selector lever is shifted into position "P", the locking pawl of the parking lock is moved via the cable pull and the lever in such a way that it engages the gearing of the parking lock gear and, consequently, blocks the final drive.



### Selector lever position "P " (locking pawl engaged)

When the vehicle moves (the parking lock gear continues to rotate), the locking pawl is moved automatically into the next tooth space in the parking lock gear by preloaded spring 1 and by the shape of the gate.

For safety reasons, the shape and flank angle of the locking pawl as well as the teeth of the parking lock gear and the pressure force of the locking pawl are such that the locking pawl does not engage when the vehicle is travelling at speeds of higher than approx. 7 kph.

If the parking lock is inadvertently actuated at higher speeds, the locking pawl will ride loudly over the teeth of the parking lock gear.

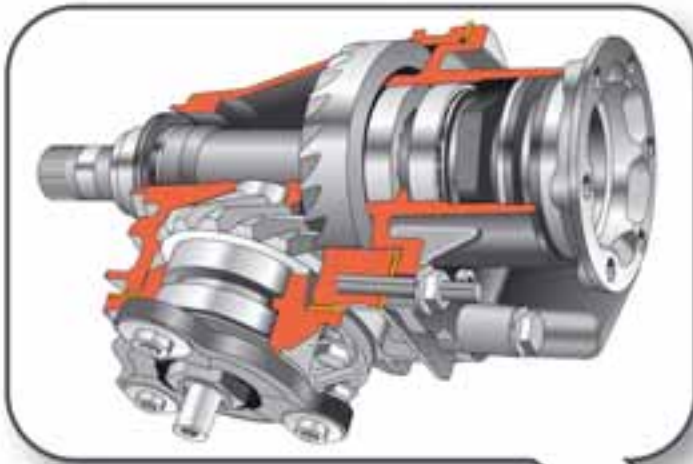
# Gearbox subassemblies

## All-wheel drive - power distribution

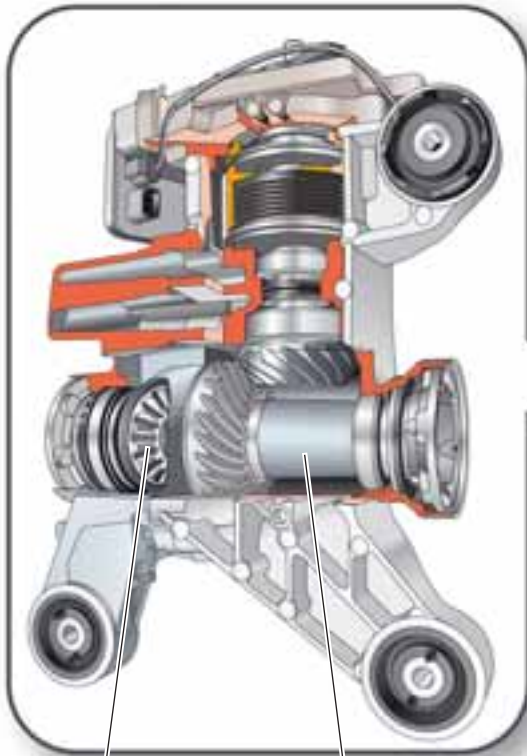
The 02E gearbox is available for the following powertrain types: front-wheel drive and quattro all-wheel drive. The gearbox for quattro all-wheel drive is the all-wheel drive concept with Haldex coupling.

The 02E gearbox for all-wheel drive has a bevel box which transfers the gearbox output torque to the Haldex coupling.

Bevel box 02M (i = 1 : 1.6)

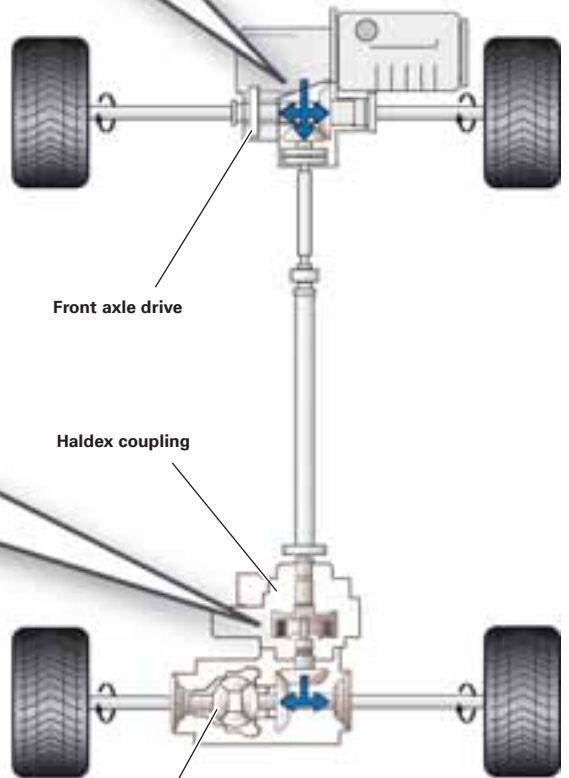


Haldex coupling 02D/0AV



Rear axle differential

Rear axle drive (i = 1.6 : 1)



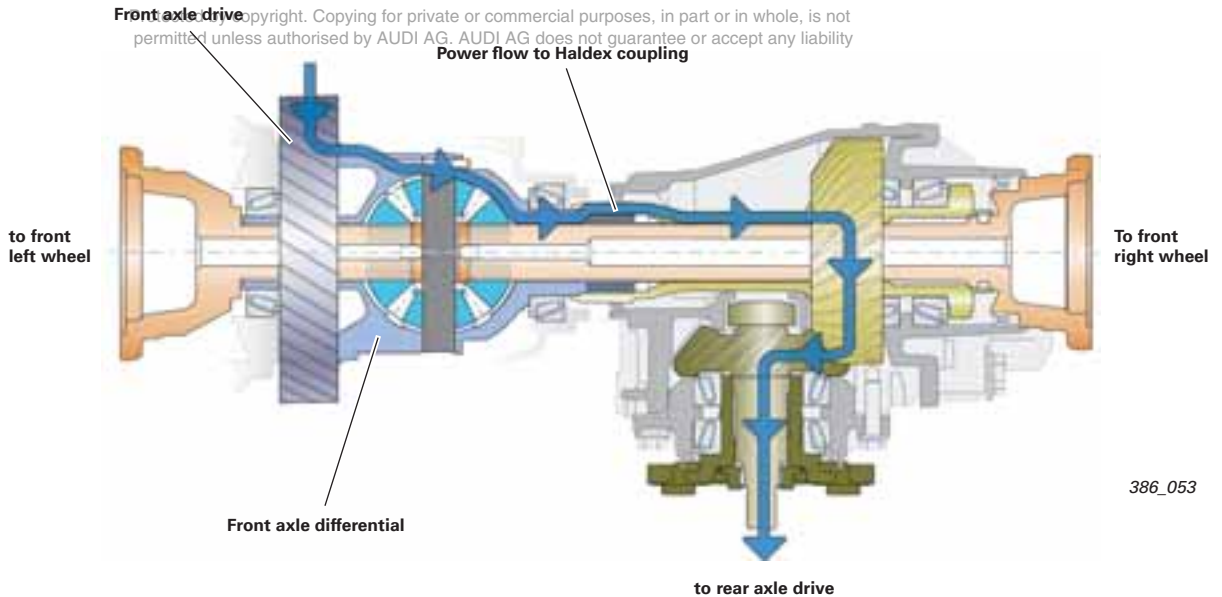
Rear axle differential

386\_051



## Bevel box

# Audi



The speed of the front axle drive is increased by a factor of 1.6 in the bevel box and transmitted to the Haldex coupling by prop shaft. The increase in speed improves the response of the Haldex coupling. Torque is reduced, thereby allowing a smaller prop shaft design to be used. Speed is then reduced by a factor of 1.6 in the rear axle drive.

### Reference

For information on the Haldex coupling, refer to SSPs 206 and 333.



# Gearbox subassemblies

## Oil supply

Power transmission in the 02E gearbox is dependent on the hydraulics and on the electrical system.

**Without oil pressure and electrical current, there is no power transmission!**

The oil supply ensures the availability of oil pressure and oil flow for

- ... the multi-plate clutches,
- ... the clutch cooling system,
- ... the shift hydraulics

as well as the lubrication and cooling of all components.

The gearbox oil has to meet a variety of stringent and, in some cases, conflicting requirements. In response to these special requirements, a special gearbox oil was developed for twin-clutch gearbox 02E.

For this reason, the approved oil type prescribed in the parts catalogue must be used.

The front-wheel drive gearbox has only one oil supply. The all-wheel drive bevel box has its own supply of axle oil.

The oil pump – a high performance vane cell pump – ensures a reliable supply of oil. The oil pump is driven via the pump shaft running at engine speed. The pump shaft is coaxially mounted inside hollow input shaft 1 and is driven by the driving disc by means of a stub shaft spline.

Max. power consumption of the oil pump is 2 kW.

The oil supply system also includes the following components or subassemblies:

The main pressure control adapts the main pressure according to engine torque and gearbox oil temperature. The main pressure is between 3 bar and 20 bar.

The main pressure control system includes the system pressure valve (SPV) and electrical pressure control valve N217 (refer to page 47 Fig. 386\_055 and page 56).

A pressure limiting valve (PLV) opens at approx. 32 bar and protects the components in the oil circulation system against excessively high pressures.

In addition to the suction filter, a separate compressed air filter provides effective cleaning of the gearbox oil and allows increased operational reliability.

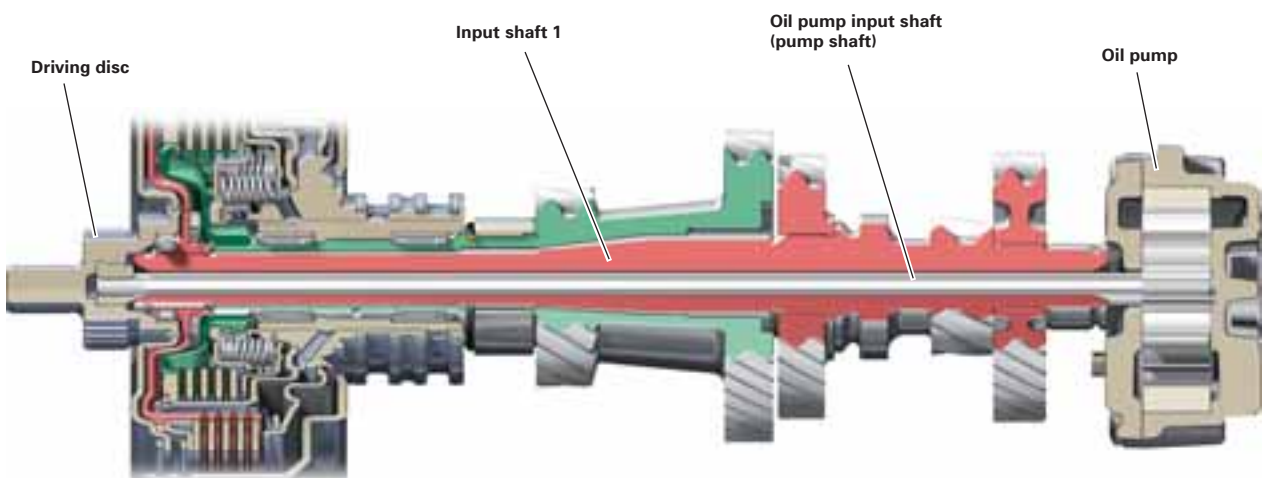
The filter cartridge must be replaced when changing the oil and after repair work.

For magnetic abrasion, there are permanent magnets on the suction filter and in the oil drain screw.

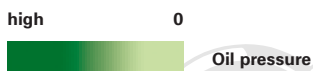
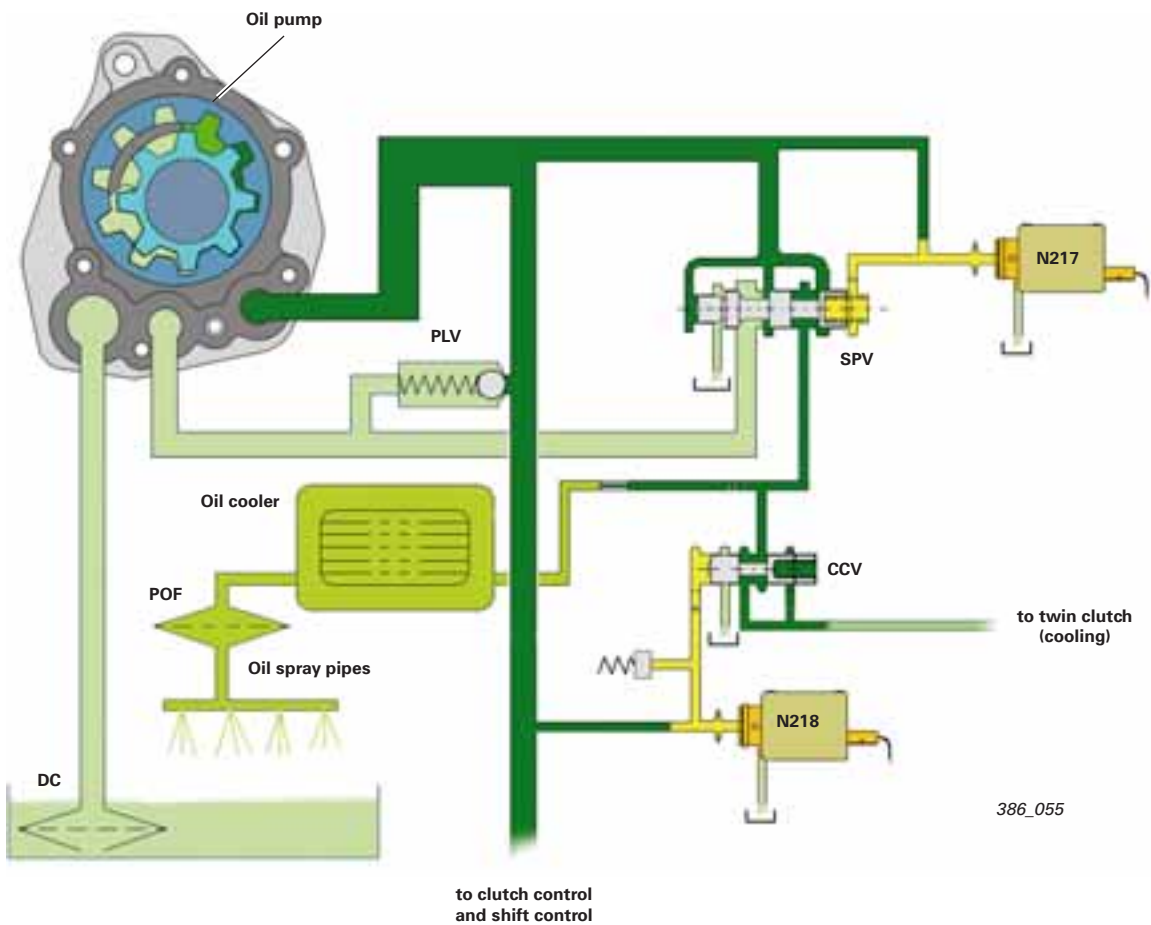
The oil cooler is directly flanged to the gearbox and integrated in the engine cooling system (coolant-oil heat exchanger).

The gears and bearings are lubricated by means of oil spray pipes which form the return lines of the heat exchanger and the pressure oil filter circuit. The oil level can be kept to a minimum through systematic lubrication. This reduces churning losses and improves efficiency.

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386\_056



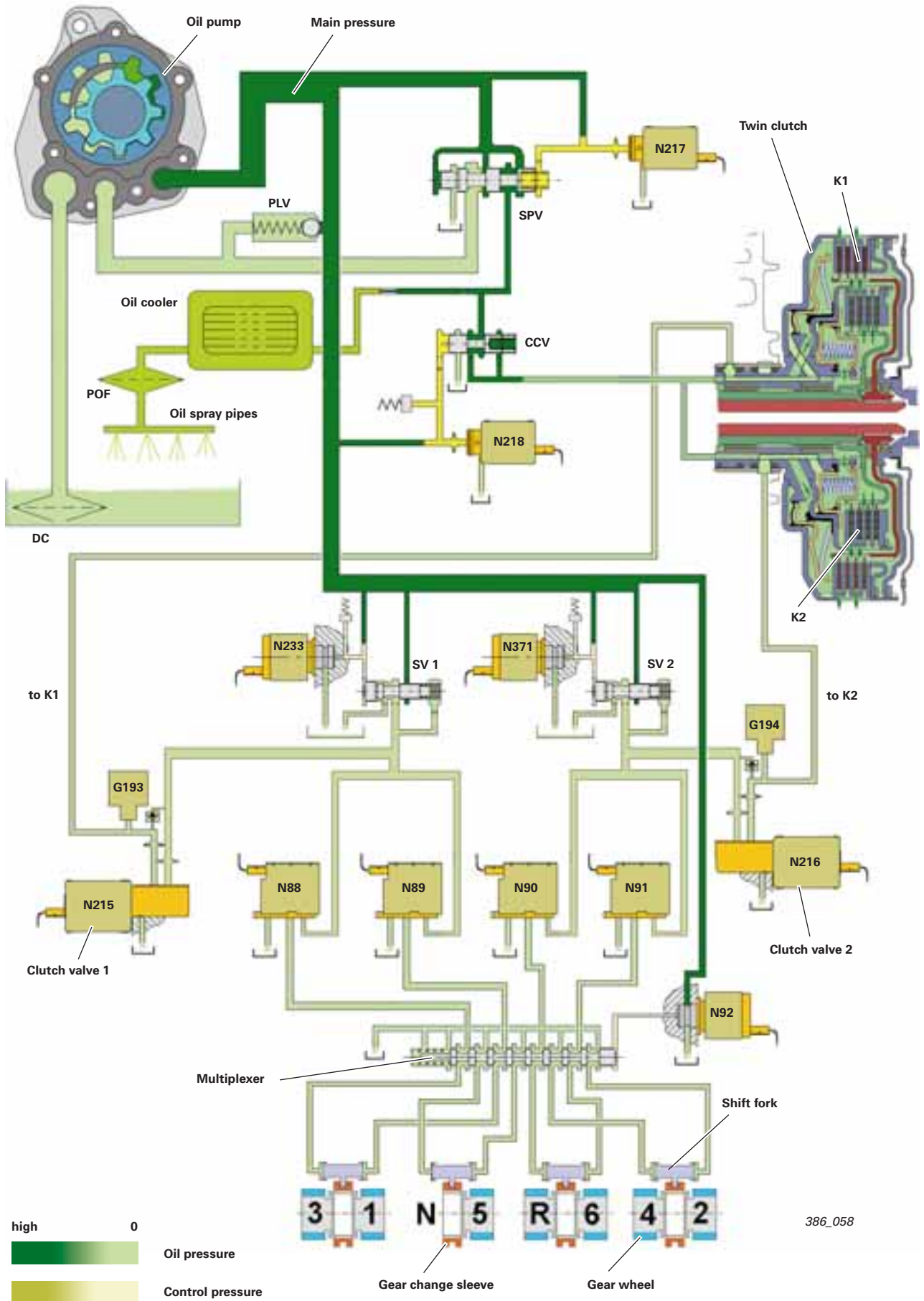
### Legend

- PLV Pressure limiting valve
- POF Pressure oil filter
- CCV Clutch cooling valve
- N217 Electrical pressure control valve 3
- N218 Electrical pressure control valve 4
- SF Suction filter
- SPV System pressure valve (main pressure)

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# Gearbox subassemblies

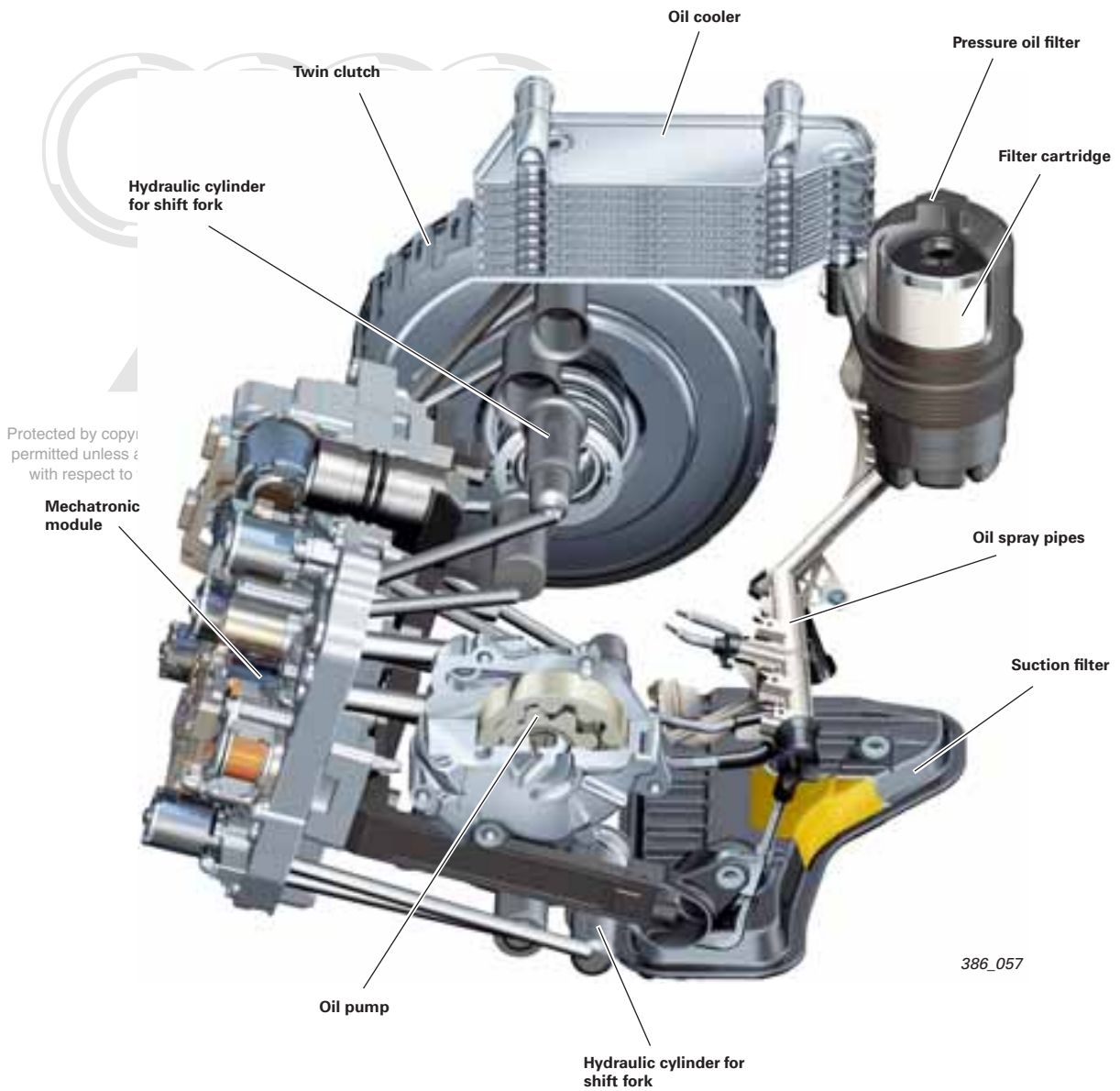
Hydraulic diagram of 02E gearbox



high 0  
 Oil pressure  
 Control pressure

386\_058

## Oil supply/overview



## Legend

PLV	Pressure limiting valve	N215	Electrical pressure control valve 1
POF	Pressure oil filter	N216	Electrical pressure control valve 2
G193	Automatic gearbox hydraulic pressure sender -1-	N217	Electrical pressure control valve 3
G194	Automatic gearbox hydraulic pressure sender -2-	N218	Electrical pressure control valve 4
K1	Clutch 1	N233	Electrical pressure control valve 5
K2	Clutch 2	N371	Electrical pressure control valve 6
CCV	Clutch cooling valve	SF	Suction filter
N88	Solenoid valve 1	SV	Safety valve
N89	Solenoid valve 2	SPV	System pressure valve (main pressure)
N90	Solenoid valve 3		
N91	Solenoid valve 4		
N92	Solenoid valve 5		

# Gearbox control unit

## Gearbox control unit – mechatronic module

The mechatronic module is the nerve centre of the gearbox. It makes up a well balanced unit by combining the electro-hydraulic control unit (actuators), the electronic control unit and most of the sensors (electronic module). The mechatronic module should, therefore, only be replaced as a complete part.

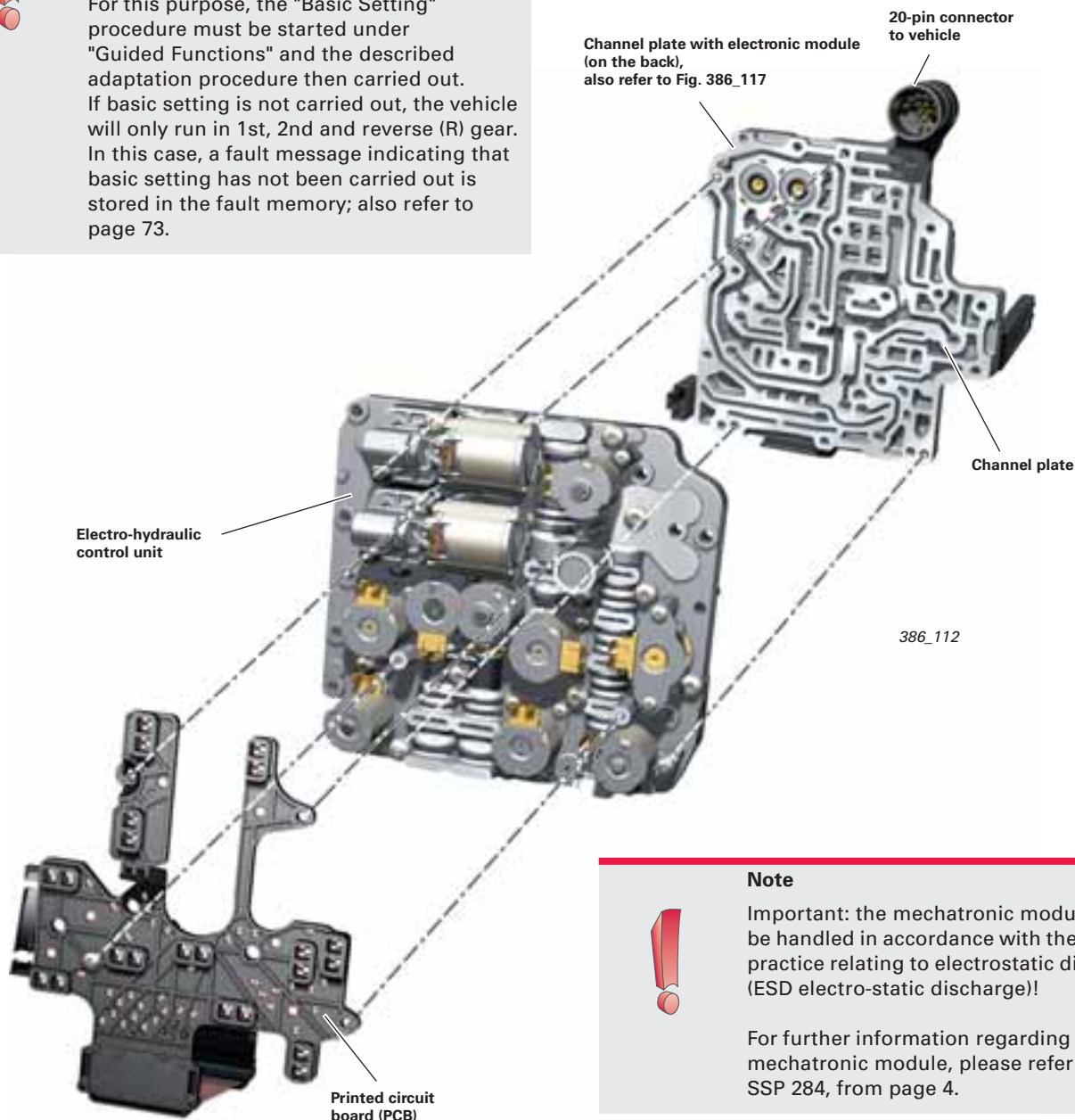
The mechatronic module controls, regulates and executes the following functions:

- Adaptation of the oil pressure in the hydraulic system to the respective requirements and needs
- Twin clutch control
- Clutch cooling control
- Shift point selection
- Gear-shifting
- Communication with other control units
- Emergency program
- Self-diagnosis

### Note



After replacement of the mechatronic module, the gearbox mechanism must be adapted using the diagnostic tester. For this purpose, the "Basic Setting" procedure must be started under "Guided Functions" and the described adaptation procedure then carried out. If basic setting is not carried out, the vehicle will only run in 1st, 2nd and reverse (R) gear. In this case, a fault message indicating that basic setting has not been carried out is stored in the fault memory; also refer to page 73.



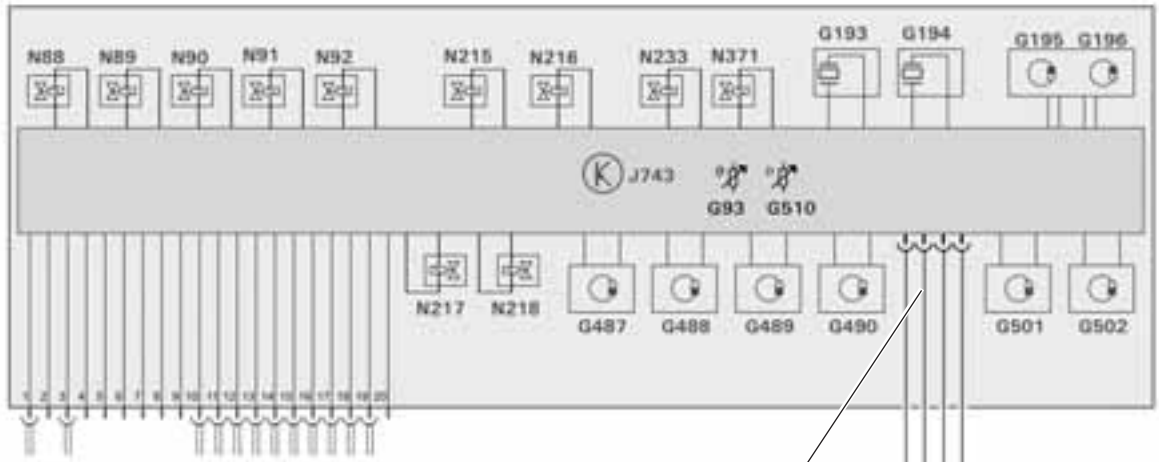
### Note



Important: the mechatronic module must be handled in accordance with the code of practice relating to electrostatic discharge (ESD electro-static discharge)!

For further information regarding the mechatronic module, please refer to SSP 284, from page 4.

## Function diagram of the mechatronic module



20-pin connector to vehicle wiring loom

386\_062

Connector on electronic module of the mechatronic module

Combined sender G509/G182 is a separate component and is integrated in the gearbox (refer to page 67/68)

### Pin assignments of 20-pin connector to mechatronic module

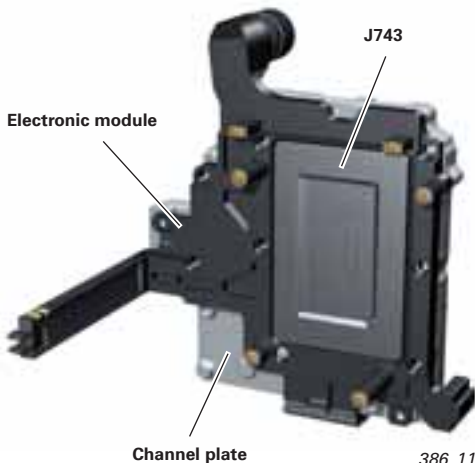
- Pin 1 K-wire (diagnostics)
- Pin 2 not used
- Pin 3\* tiptronic steering wheel Tip-
- Pin 4,5 not used
- Pin 6\* V-signal (speedo/dash panel insert), TT 8N MY 03 only
- Pin 10 Powertrain CAN bus high
- Pin 11 Term. 30
- Pin 12\* R-signal (reversing light control)
- Pin 13 Term. 15
- Pin 14\* tiptronic steering wheel Tip+
- Pin 15 Powertrain CAN bus low
- Pin 16 Term. 31
- Pin 17 P/N signal (starter control)
- Pin 18 Term. 30
- Pin 19 Term. 31
- Pin 20 not used

\* only in the Audi TT (8N)



### Legend

- G93 Gearbox oil (ATF) temperature sender
- G182 Gearbox input speed sender
- G193 Automatic gearbox hydraulic pressure sender -1-
- G194 Automatic gearbox hydraulic pressure sender -2-
- G195 Gearbox output speed sender -1-
- G196 Gearbox output speed sender -2-
- G487 Gear selector travel sensor 1
- G488 Gear selector travel sensor 2
- G489 Gear selector travel sensor 3
- G490 Gear selector travel sensor 4
- G501 Drive shaft 1 speed sender
- G502 Drive shaft 2 speed sender
- G509 Multi-plate clutch oil temperature sender
- G510 Temperature sensor in control unit



386\_117

- J743 Mechatronic control unit
- N88 Solenoid valve 1
- N89 Solenoid valve 2
- N90 Solenoid valve 3
- N91 Solenoid valve 4
- N92 Solenoid valve 5
- N215 Electrical pressure control valve 1
- N216 Electrical pressure control valve 2
- N217 Electrical pressure control valve 3
- N218 Electrical pressure control valve 4
- N233 Electrical pressure control valve 5
- N371 Electrical pressure control valve 6

# Gearbox control unit

## Electro-hydraulic control unit

The electro-hydraulic control unit comprises the following components:

- Valve body
- 5 hydraulically actuated switch valves (gate valves)
- Pressure limiting valve
- 5 electrical solenoid valves
- 6 electronic pressure control valves (EDL)
- Channel plate with 2 pressure sensors
- Printed circuit board (PCB)

### Reference

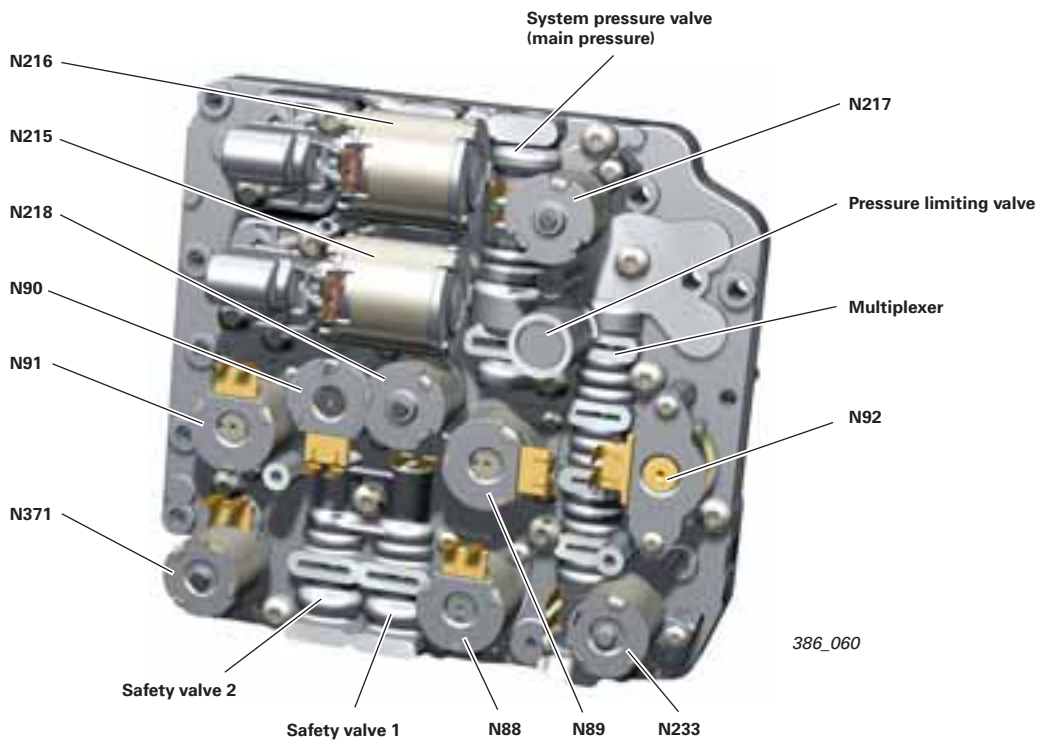
Refer to hydraulic diagram on page 48.  
Refer to description of valves, from page 54.

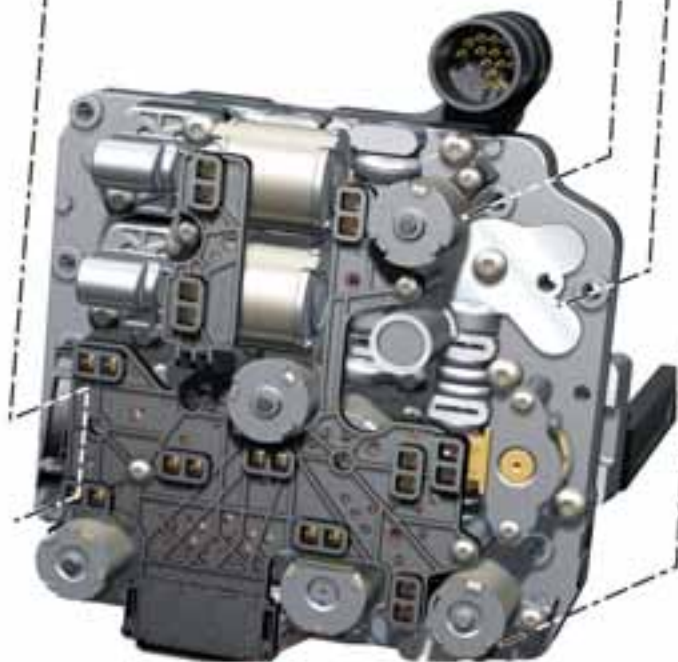
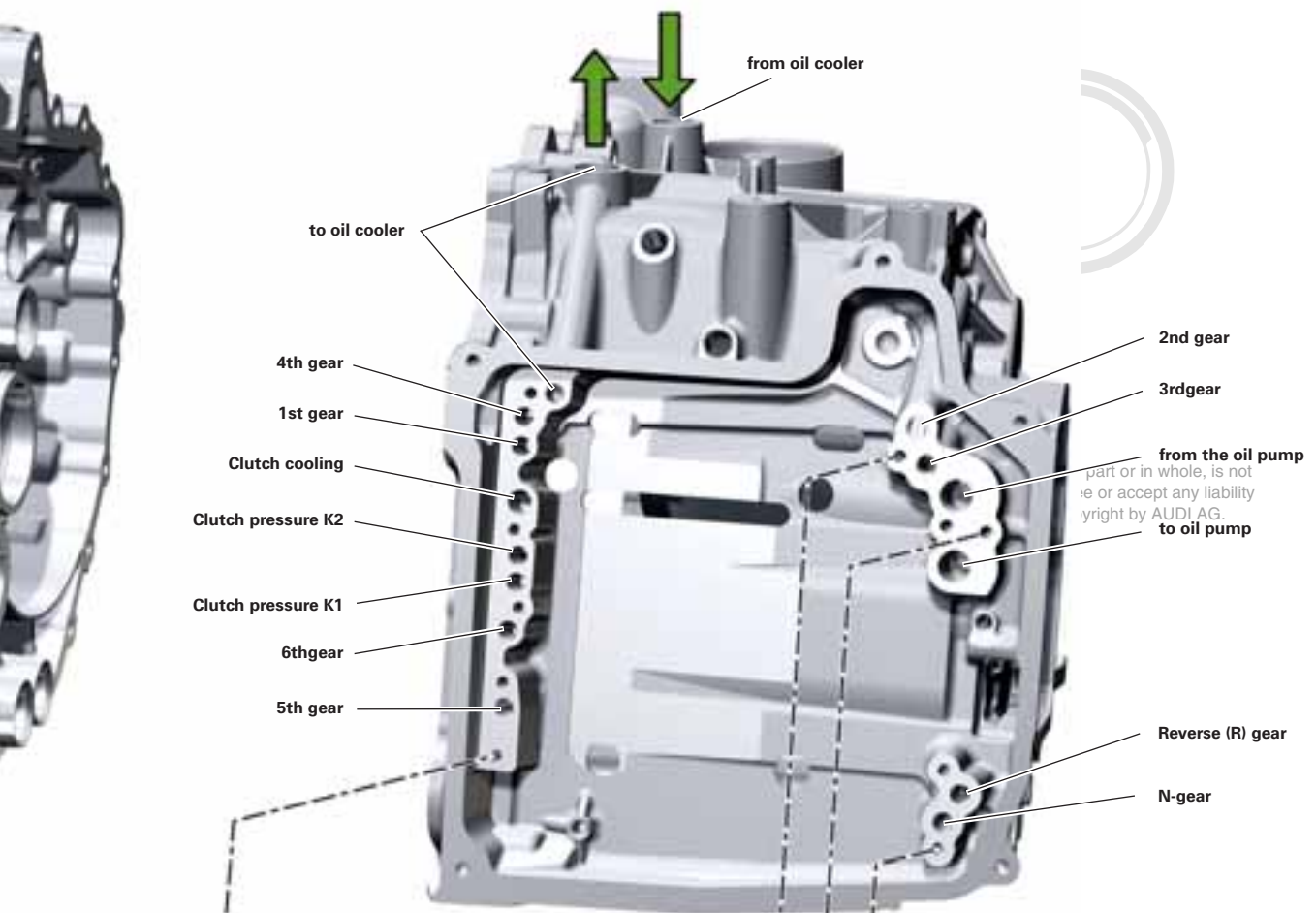


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## Electro-hydraulic control unit





**Electro-hydraulic control unit with channel plate and PCB**

**Legend**

- N88 Solenoid valve 1
- N89 Solenoid valve 2
- N90 Solenoid valve 3
- N91 Solenoid valve 4
- N92 Solenoid valve 5
- N215 Electr. pressure control valve 1
- N216 Electr. pressure control valve 2
- N217 Electr. pressure control valve 3
- N218 Electr. pressure control valve 4
- N233 Electr. pressure control valve 5
- N371 Electr. pressure control valve 6

# Gearbox control unit

## Description of the valves

The **hydraulic switch valves** (gate valves) and their tasks:

The **system pressure valve** (SPV) controls the oil pressure which is required to control the gearbox. It is activated by N217 in dependence on engine torque and gearbox oil temperature.

The **clutch cooling valve** (CCV) controls the twin clutch cooling oil. The CCV is activated by N218; refer to pages 25 and 57.

The two **safety valves** SV 1 and SV 2 allow hydraulic shutdown of the two part-gearboxes. Valves SV 1 and SV 2 are activated by N233 and N371; refer to pages 28 and 57.

The **multiplexer** allows the 8 hydraulic cylinders for the shift forks to be controlled with only 4 electromagnetic valves. The multiplexer is activated by N92; refer to page 37.

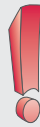
The **pressure limiting valve** (PLV) ensures that the pressure in the system does not exceed approx. 32 bar, and thus protects all components affected, directly and indirectly (refer to page 48).

**Solenoid valves** N88, N89, N90, N91 and N92 are electromagnetic switch valves. They are also known as 3/2 valves, which means 3 connections and 2 switch positions (open/closed or ON/OFF). When no electrical current is present, the pressure connections are closed and the control ports to the oil sump are open. Solenoid valves N88 to N91 control the gear selectors and N92 controls the multiplexer; refer to page 36.

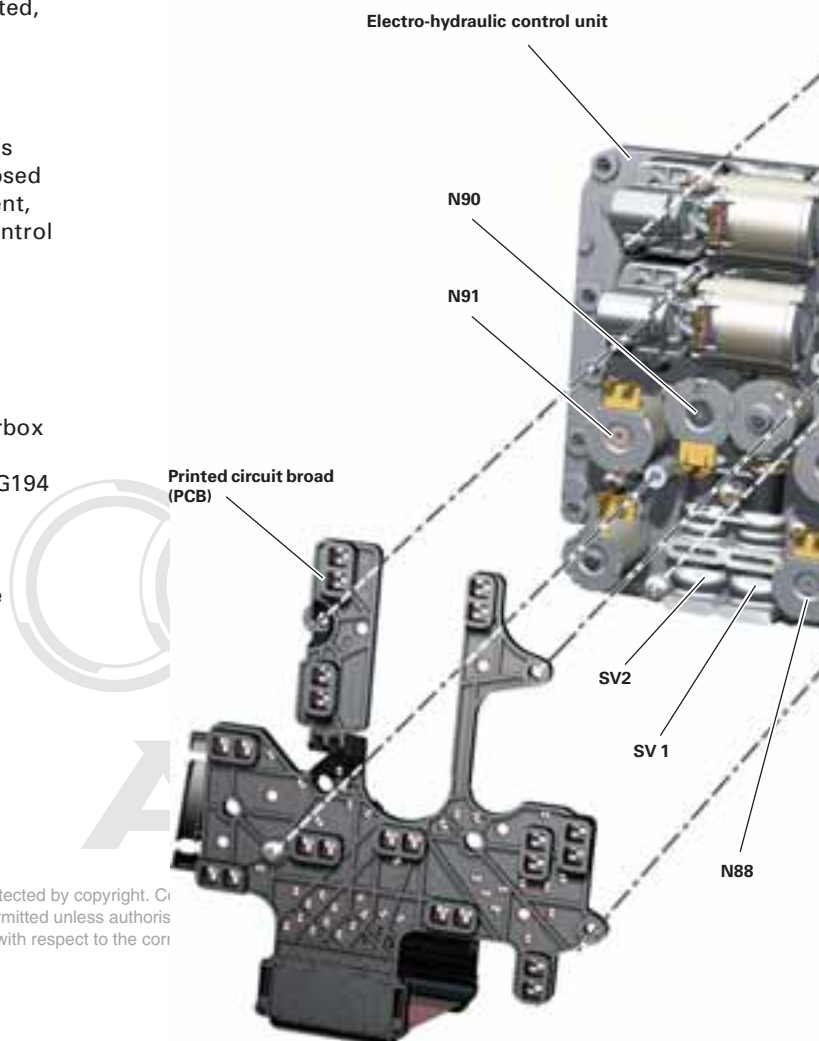
The **channel plate** makes the line connection between the mechatronic module and the gearbox housing. The two hydraulic pressure senders G193 and G194 are integrated in the channel plate.

The **printed circuit board (PCB)** connects the electronic control unit to the solenoids and the electronic pressure control valves.

### Note



Manufacturing tolerances of the electro-hydraulic control unit (e.g. EDL, gate valves, valves etc.) and the power modules of the electronic control unit are determined on a test bench and compensated by basic programming of the electronic control unit. This basic programming is not covered by service, which is why the mechatronic module can only be replaced as a complete unit.



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**Electronic pressure control valves (EDL) N215, N216, N217, N218, N233 and N371**

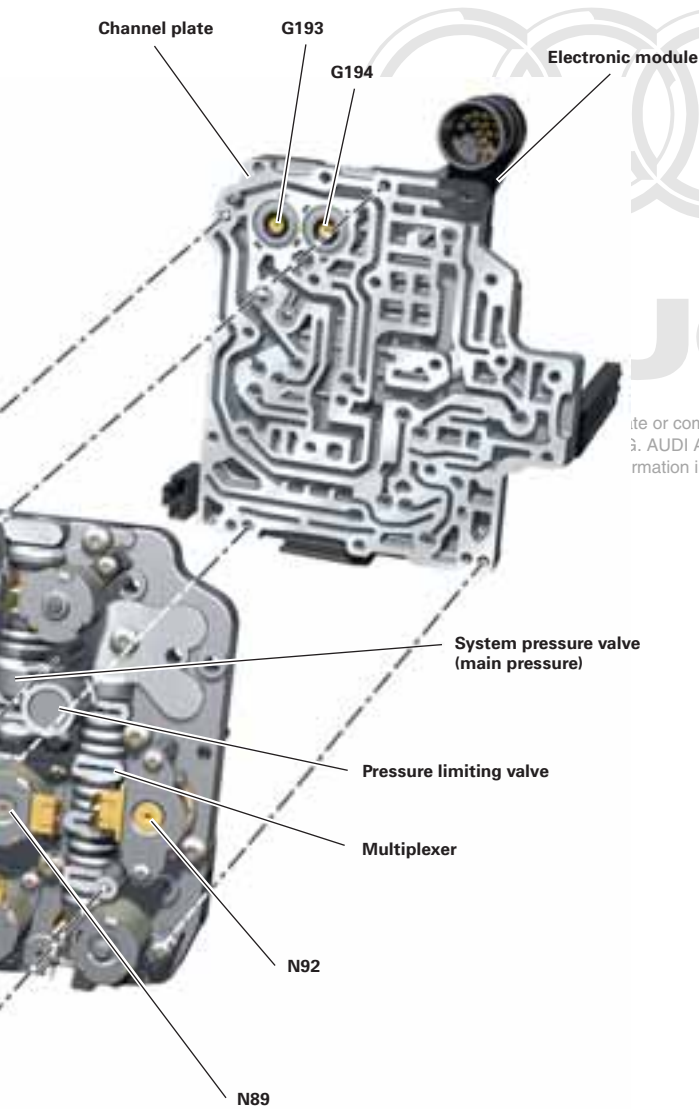
The electronic pressure control valves convert an electrical control current into a near-proportional hydraulic control pressure. There are EDLs with a so-called rising or falling characteristic.

**Electronic pressure control valves with rising characteristic**

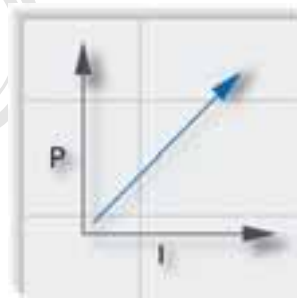
EDLs N215, N216, N233 and N371 have a rising current-pressure characteristic. This means that the control pressure rises with increasing control current.

Valve deenergised = no control pressure (0 mA = 0 bar)

In case of failure of one of these valves, the corresponding gate valve is not activated and the associated functions fail.



Rising characteristic



386\_066

P = pressure  
I = current

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**Electronic pressure control valves with falling characteristic**

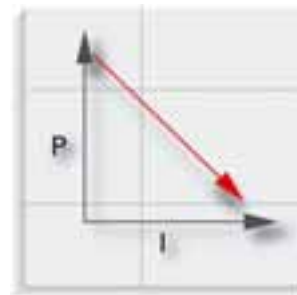
Electronic pressure control valves N217 and N218 have a falling current-pressure characteristic. This means that the control pressure decreases with decreasing control current.

Valve deenergised = maximum control pressure

In case of failure of N217, it is ensured that the maximum main pressure is present.

In case of failure of N218, it is ensured that the maximum cooling oil flow is present.

Falling characteristic



386\_067

P = pressure  
I = current

# Gearbox control unit

## Electronic pressure control valves 1/2 N215 and N216

Electrical pressure control valves N215 and N216 are a special feature. They control the clutch pressure (from 0 to 10 bar) directly, i.e. without the use of a downstream hydraulic gate valve; refer to "Clutch control" on page 24.

N215 controls the clutch pressure of clutch K1.

N216 controls the clutch pressure of clutch K2.

Valves N215 and N216 are activated according to engine speed, gearbox input speed and the speeds of the input shafts.

### Effects of malfunctions

As mentioned previously, both valves have a rising characteristic. If they are not activated, the associated function is not available. The gearbox control unit shuts down part-gearbox in question and the relevant emergency program is activated.

The valves are monitored by means of hydraulic pressure senders G193 and G194; refer to page 71. If the actual pressure deviates too much from the nominal pressure, in this case, too, the part-gearbox in question is shut down and the relevant emergency program is activated.

Fault indication: yes

## Electrical pressure control valve 3 N217

N217 supplies the control pressure for the system pressure valve (SPV) and controls the main pressure in the hydraulic system. The pressure in the system is adapted to the operating conditions, i.e. unnecessarily high pressures are avoided by adjusting the main pressure to the existing engine torque.

This results in a significant increase in gearbox efficiency. Without this adaptation, the high pressure necessary for full-throttle operation would have to be maintained.

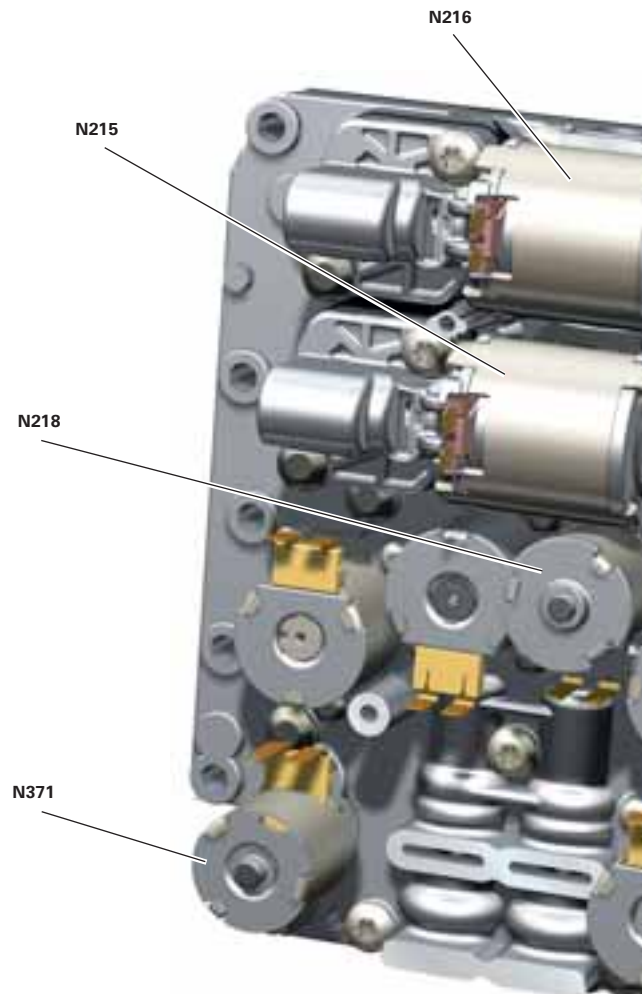
N217 is activated according to engine torque and gearbox oil temperature.

### Effects of malfunction

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If N217 fails, the maximum main pressure is set according to the falling characteristic. This increases fuel consumption and can lead to noisy gearshifts.

Fault indication: yes



### Note



Incorrect engine torque values from the engine control unit will impair clutch and gearbox control, which, in turn, can result in loss of shift comfort or gearbox and clutch damage.

#### Electrical pressure control valve 4 N218

N218 supplies the control pressure for the clutch cooling valve (CCV), and hence controls the cooling oil flow to the twin clutch; refer to page 25.

#### Effects of malfunction

If N218 fails, the maximum cooling oil flow will be set according to the valve characteristic. This will increase fuel consumption and can cause gear-shifting problems at low ambient temperatures.

If the cooling system fails (e.g. due to sticking of the gate valve or valve), the clutch will overheat.

Fault indication: yes

#### Electronic pressure control valves 5/6 N233/N371

Electrical pressure control valve N233 (N371) activates safety valve 1 (2) and thereby allows the part-gearbox in question to be shut down (hydraulic safety shutdown).

Part-gearbox 1 (N233) and part-gearbox 2 (N371); refer to page 28.

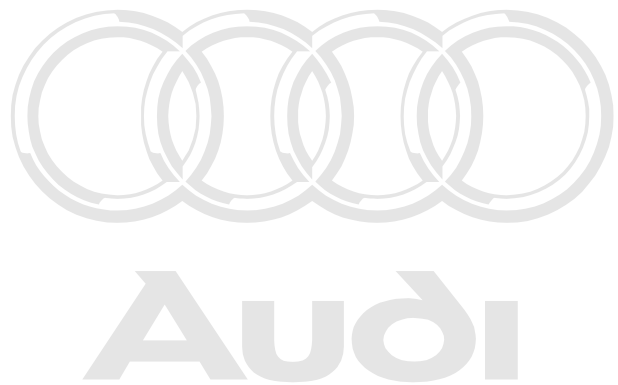
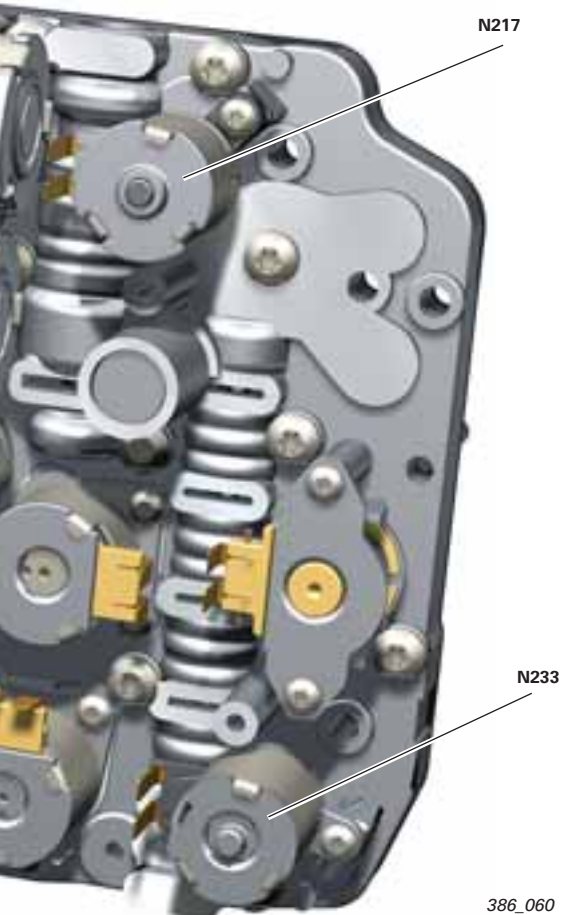
Electronic pressure control valves N233 and N371 are activated at a duty cycle of approx. 62 %. At this value the control pressure is already so high, the safety valves are fully open. The advantage of the low duty cycle is that the valves and oil are heated less and hence conserved.

To minimise gear-shifting noise, the shift pressure is reduced by means of electronic pressure control valves N233 and N371. The valves are activated at a reduced duty cycle (< 62 %).

#### Effects of malfunction

As mentioned previously, both valves have a rising characteristic. If they are not activated, the associated function will not be available. This means that the part-gearbox in question will not be functional (no clutch activation and shift control). The gearbox control unit activates the relevant emergency program; refer to page 80.

Fault indication: yes



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386\_060

# Gearbox control unit

## Electronic module

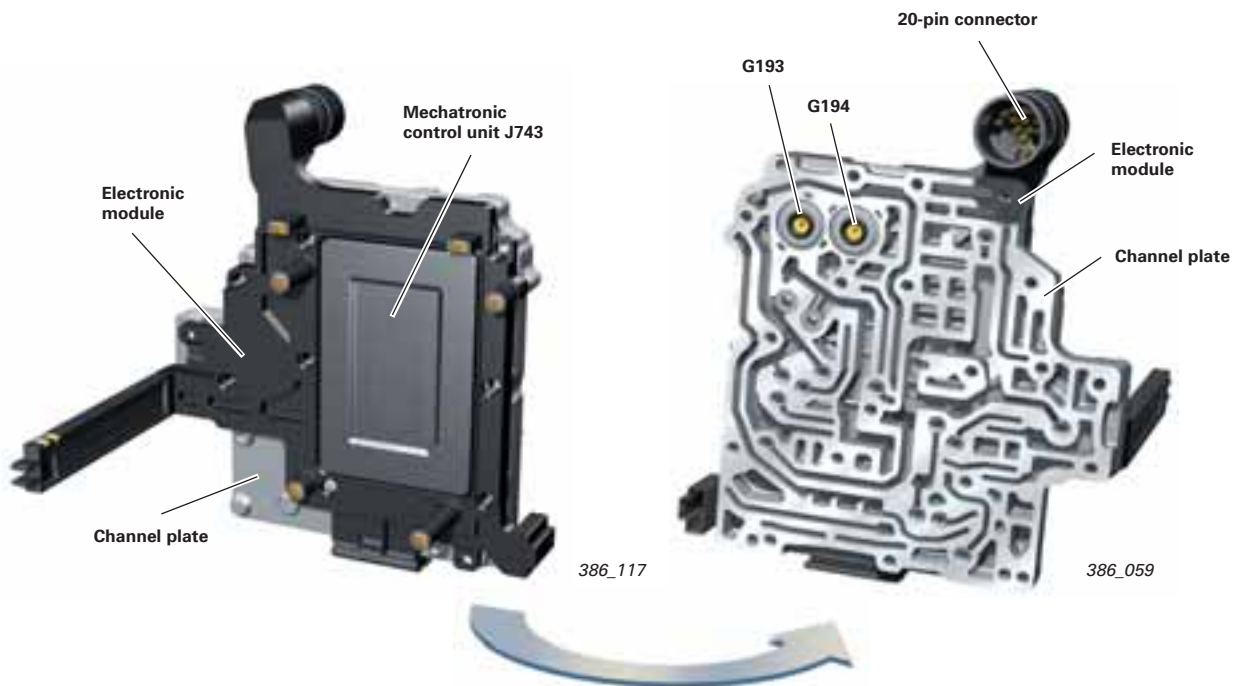
The electronic module is an inseparable unit comprising the electronic control unit and most of the sensors. The electronic module is bolted to the channel plate. The aluminium channel plate serves as the electronic module mounting plate and holds hydraulic pressure senders G193 and G194.

The electronics of the mechatronic control unit J743 are connected directly to the channel plate by means of a heat conductive gel. This gel dissipates to the gearbox oil the heat which is generated by the electronics.

**Note**

The control unit and the channel plate must not be separated!

Neither the control unit nor the sensors of the electronic module can be replaced individually.



## Mechatronic control unit J743 (gearbox control unit)

Control unit J743 is the nerve centre of the mechatronic module. J743 acquires, evaluates and transfers all the information required for operation of the gearbox and peripheral systems. J743 generates the output signals for the actuators inside and outside of the gearbox. Communication with the periphery is implemented mainly by powertrain CAN bus.

On account of the fact that the gearbox control unit is integrated in the gearbox (it is immersed in the gear oil), it is vital to monitor the temperature of the electronic components. High temperatures significantly affect the service life and the functional capability of electronic components.

The gearbox oil temperature is monitored by two temperature sensors (G93/G510) which are integrated in the gearbox control unit. They measure the temperature directly at critical components.

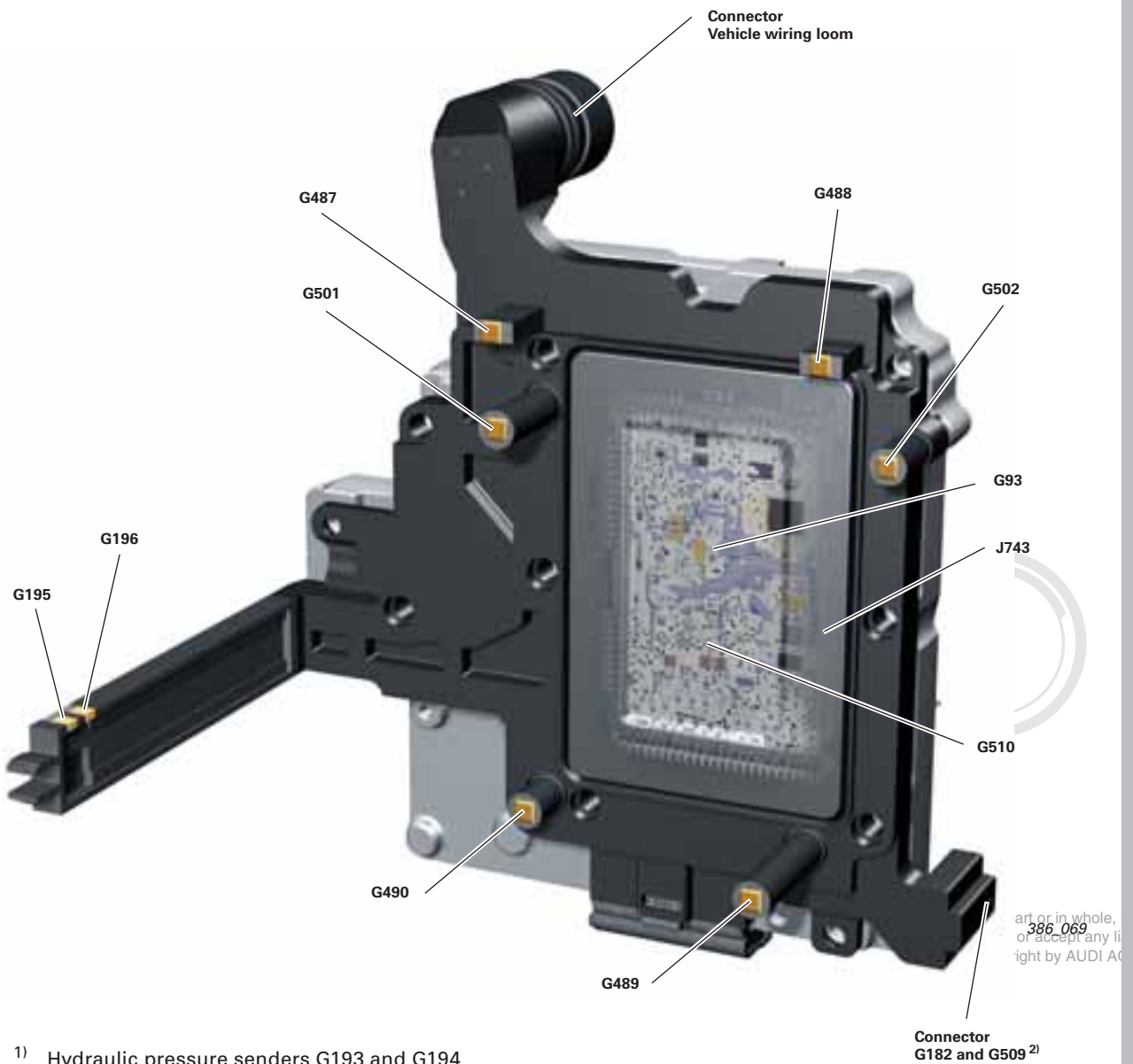
**Note**

The use of microelectronics demands special care with regard to protection against electrostatic discharge. Persons handling the mechatronic module must discharge static by touching a grounded surface (e.g. heating pipe, car lift) or the vehicle's grounding point before working on the vehicle. Do not touch the plug contacts of the electronic module.

Persons handling the mechatronic module must observe the code of practice relating to electrostatic discharge (ESD electro-static discharge)!

**Overview of the sensors in the electronic module and in the gearbox**

- |      |  |      |   |
|------|--|------|---|
| G93  | Gearbox oil (ATF) temperature sender                           | G501 | Drive shaft 1 speed sender                              |
| G182 | Gearbox input speed sender <sup>2)</sup>                       | G502 | Drive shaft 2 speed sender                              |
| G193 | Auto. gearbox hydraulic pressure sender -1- (K1) <sup>1)</sup> | G509 | Multi-plate clutch oil temperature sender <sup>2)</sup> |
| G194 | Auto. gearbox hydraulic pressure sender -2- (K2) <sup>1)</sup> | G510 | Temperature sensor in control unit                      |
| G195 | Gearbox output speed sender -1-                                | J743 | Mechatronic control unit                                |
| G196 | Gearbox output speed sender -2-                                |      |   |
| G487 | Gear selector travel sensor 1 (shift fork 3/1)                 |      |   |
| G487 | Gear selector travel sensor 2 (shift fork 2/4)                 |      |   |
| G487 | Gear selector travel sensor 3 (shift fork -/5)                 |      |   |
| G490 | Gear selector travel sensor 4 (shift fork 6/R)                 |      |   |



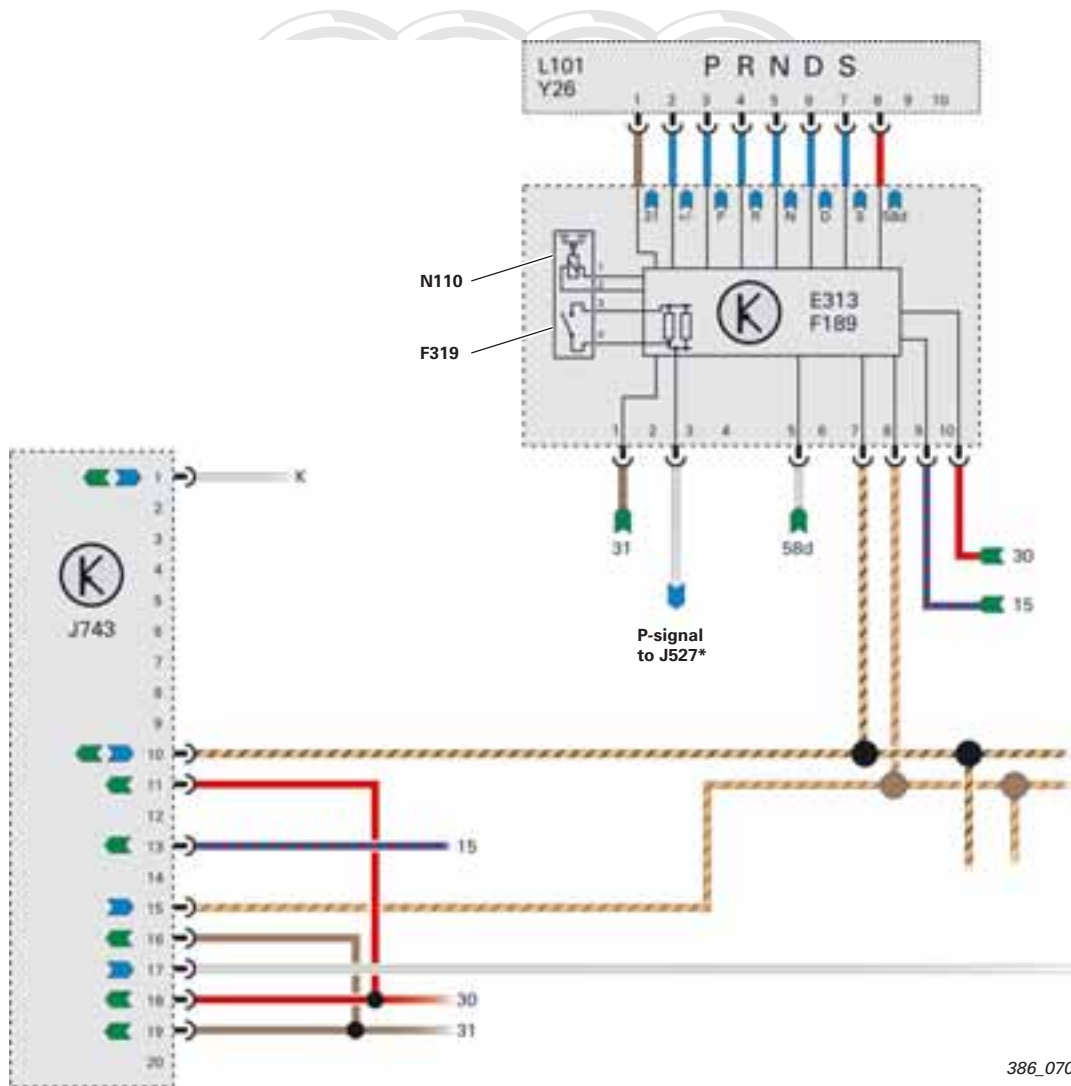
<sup>1)</sup> Hydraulic pressure senders G193 and G194 are component parts of the channel plate.

<sup>2)</sup> Sensors G182 and G509 are combined in a single component; refer to page 67 and 68.

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# Gearbox control unit



Function diagram of the Audi A3 (8P) and Audi TT (8J)



386\_070

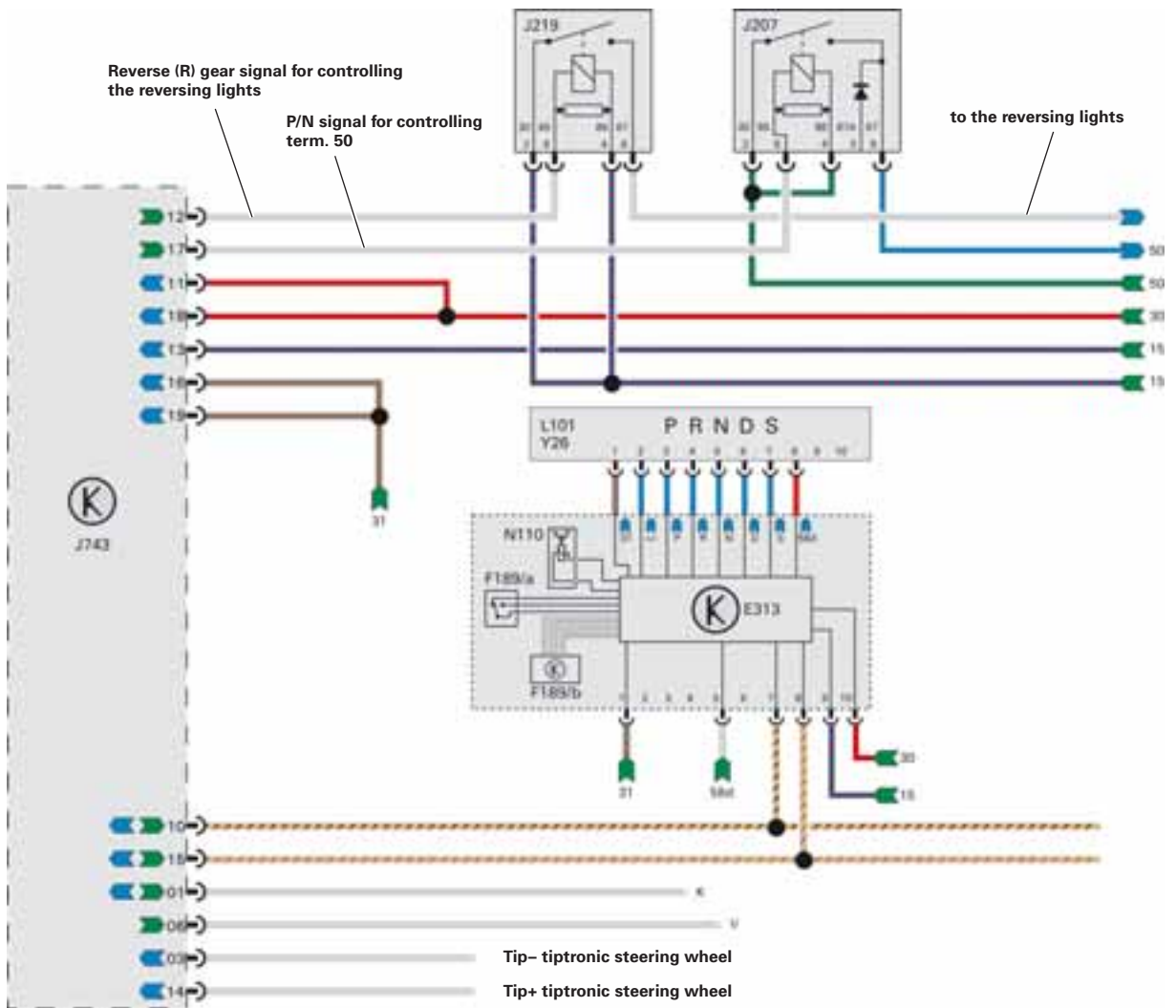
## Legend

- E313 Selector lever sensor system (selector lever)
- F189 tiptronic switch
- F319 Selector lever locked in position P switch
- J527 Steering column electronics control unit
- J743 Mechatronic control unit
- K K-wire (diagnostics)
- L101 Selector lever display illumination
- N110 Selector lever lock solenoid
- Y26 Selector lever position indicator unit

-  Input
-  Output

\* The P-signal serves to enable the ignition key withdrawal lock

# Function diagram of the Audi TT (8N)



386\_071

## Legend

- |        |   |  |        |
|--------|---|--|--------|
| E313   | Selector lever sensor system (selector lever) |  | Input  |
| F189/a | tiptronic switch (tip gate signal)            |  | Output |
| F189/b | tiptronic switch (Tip-/Tip+ signal)           |  |        |
| J207   | Starter inhibitor relay                       |  |        |
| J219   | Reversing light relay                         |  |        |
| J743   | Mechatronic control unit                      |  |        |
| K      | K-wire (diagnostics)                          |  |        |
| L101   | Selector lever display illumination           |  |        |
| N110   | Selector lever lock solenoid                  |  |        |
| V      | Road speed signal (MY 03 only)                |  |        |
| Y26    | Selector lever position indicator unit        |  |        |

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# Gearbox control unit

## CAN information exchange in the Audi A3 (8P) Audi TT (8J) (gearbox-specific)

### Mechatronic control unit J743

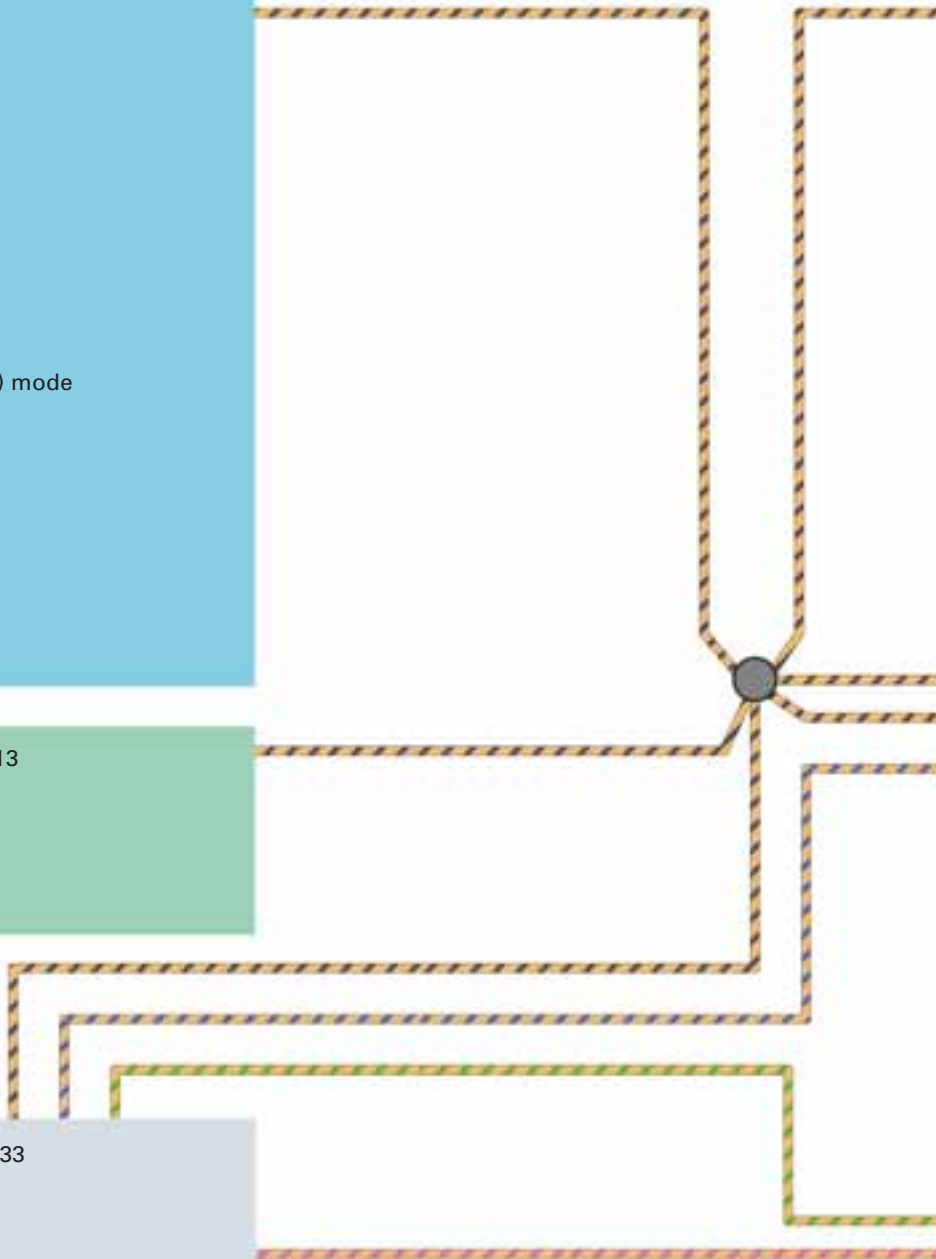
Selector mechanism active  
Engine power reduction  
Air conditioner compressor OFF  
Clutch status  
Idle speed increase  
Gearbox control unit coding  
Engine control unit coding  
Target gear or selected gear  
Nominal engine torque  
Motion resistance (drag)  
Gearbox emergency (limp home) mode  
Nominal cooling output  
OBD status  
Fault memory entry  
Gearbox torque loss  
Desired synchronisation speed  
Shift lock lamp  
Gear signal

### Selector lever sensor system E313

Selector lever position  
tiptronic status  
Shift lock shift command  
Fault conditions

### Data bus diagnostic interface J533

Mileage (km), time, date  
CAN Sleep Acknowledge

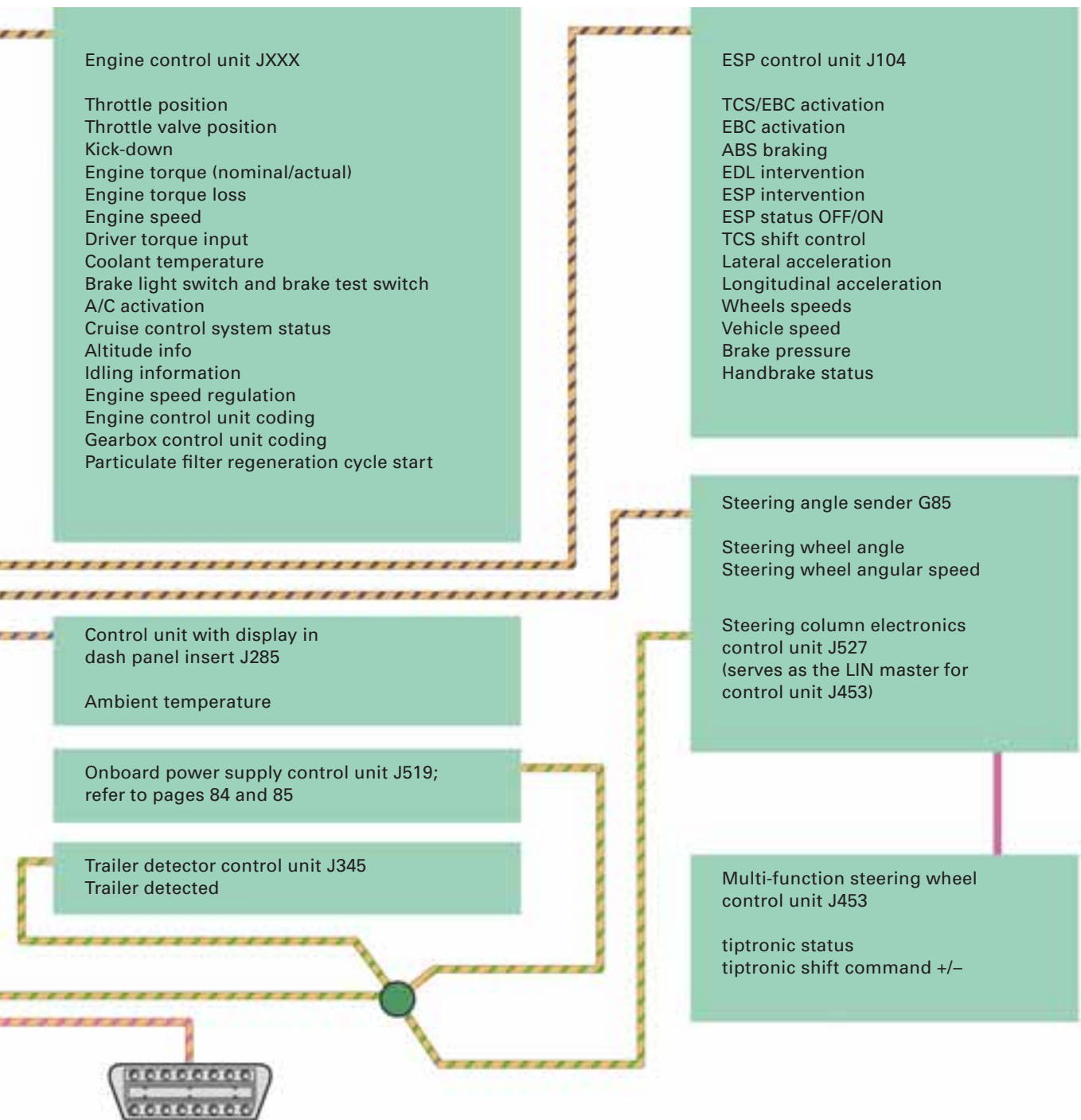


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### Reference

You will find detailed information on the CAN bus in SSPs 186 and 213.





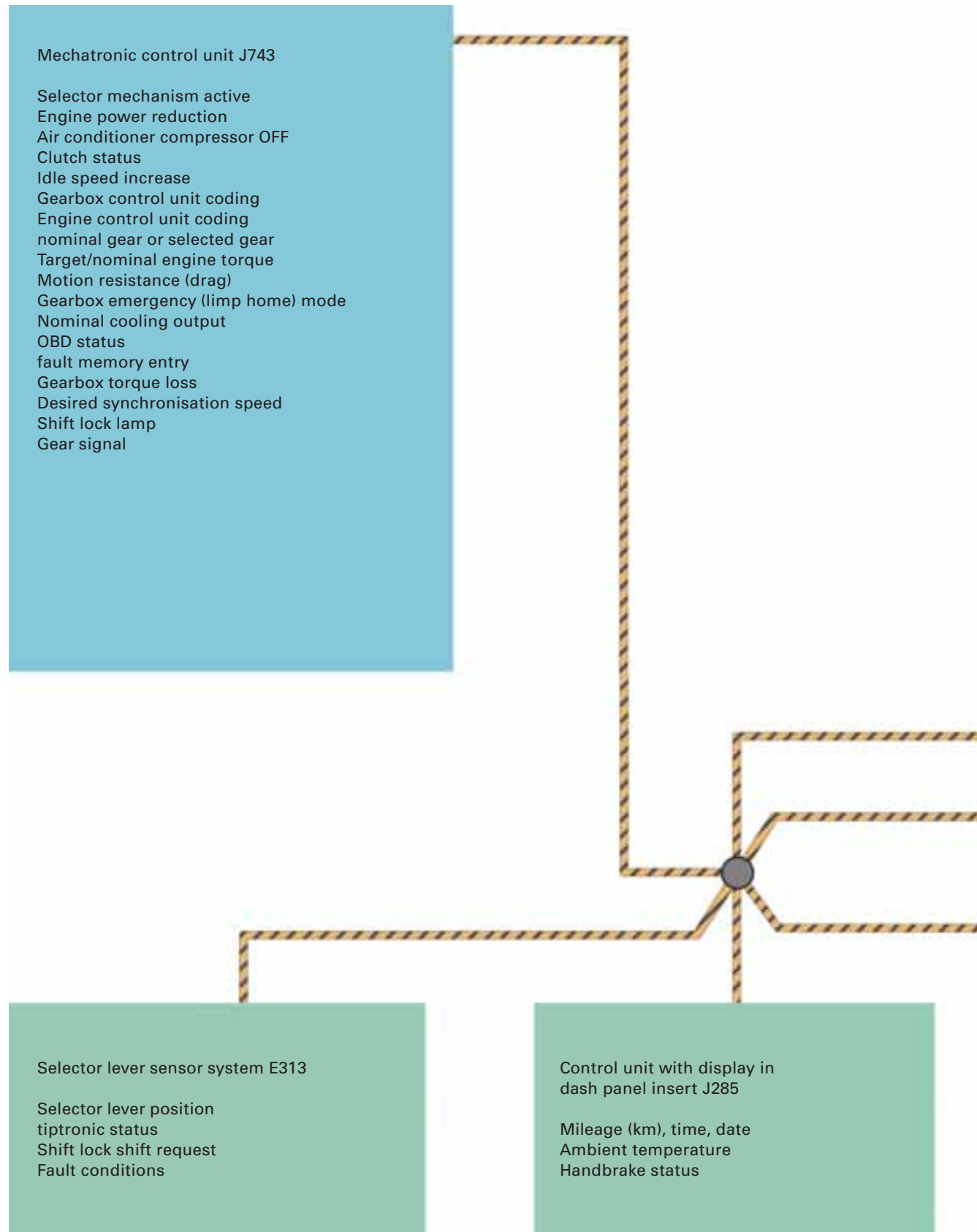
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386\_072

- = information which is sent by the mechatronic control unit
- = information which is received by the mechatronic control unit

# Gearbox control unit

## CAN information exchange in the Audi TT (8N) (gearbox-specific)





Engine control unit J220

Throttle position  
Throttle valve position  
Kick-down  
Nominal/actual engine torque  
Engine torque loss  
Engine speed  
Engine speed  
Driver torque input  
Coolant temperature  
Brake light switch and brake test switch  
A/C activation  
Cruise control system status  
Altitude info  
Idling information  
Engine speed regulation  
Engine control unit coding  
Gearbox control unit coding

ESP control unit J104

TCS/EBC activation  
EBC activation  
ABS braking  
EDL intervention  
ESP intervention  
ESP status OFF/ON  
TCS shift control  
Lateral acceleration  
Longitudinal acceleration  
Wheel speeds  
Vehicle speed  
Brake pressure



Powertrain CAN bus

Steering angle sender G85

Steering wheel angle  
Steering wheel angular speed



= information which is sent by the mechatronic control unit



= information which is received by the mechatronic control unit

# Gearbox control unit

## Sensors

### Gearbox oil (ATF) temperature sender G93 Temperature sensor in control unit G510

On account of the fact that the gearbox control unit is integrated in the gearbox (it is immersed in the gear oil), it is vital to monitor the temperature of the electronic components and, therefore, the gearbox oil temperature.

High temperatures significantly affect the useful life and the functional capability of electronic components.

Due to the stringent safety requirements which apply to temperature monitoring, two sensors (G93/G510) are integrated in the control unit electronics and measure directly the temperature of critical components.

Thus, temperature reducing measures can be initiated at an early stage (refer to "Temperature monitoring/protective function").

The aluminium channel plate serves as a heat exchanger for the electronics.

Since there is a continuous flow of gearbox oil flows through the channel plate, its temperature is approximately the same as that of the gear oil.

G93 supplies exact data and is, as it were, the main electronics and gearbox oil temperature sensor. G510 is principally used for verifying the plausibility of sensor G93.

In addition to safety aspects, the gearbox oil temperature affects the clutch control and hydraulic control systems. Therefore, it is a key factor in the regulation and adaptation functions.

### Signal utilisation

Temperature monitoring/protective function  
Adaptation criterion  
Shift pressure adaptation  
Warm-up program

### Effects of signal failure

Both senders check each other and, in case of failure of one of the senders, the other sender generates a substitute signal. In case of failure of both senders, an emergency signal is generated from the engine temperature.

Fault indication: no, fault memory entry only

### Temperature monitoring/protective function

When the temperature (G93) exceeds 138 °C, the mechatronic control unit J743 reduces the engine torque.

At temperatures up to 145 °C, the engine torque is reduced incrementally until the engine is running at idle speed. The multi-plate clutches are open and the vehicle has no drive.



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386\_069

### Multi-plate clutch oil temperature sender G509

The G509 and the gearbox input speed sender G182 are integrated in a unit.

G509 measures the temperature of the cooling oil discharged from the twin clutch. The highest gearbox oil temperatures occur here.

G509 has a very short reaction time to changes in temperature. It delivers very exact measurement data within a range of temperatures from -55 °C to +180 °C.

#### Signal utilisation

Monitoring of the temperature of the cooling oil discharged from the twin clutch in order that counter-measures can be taken at approx. 160 °C.

#### Effects of signal failure

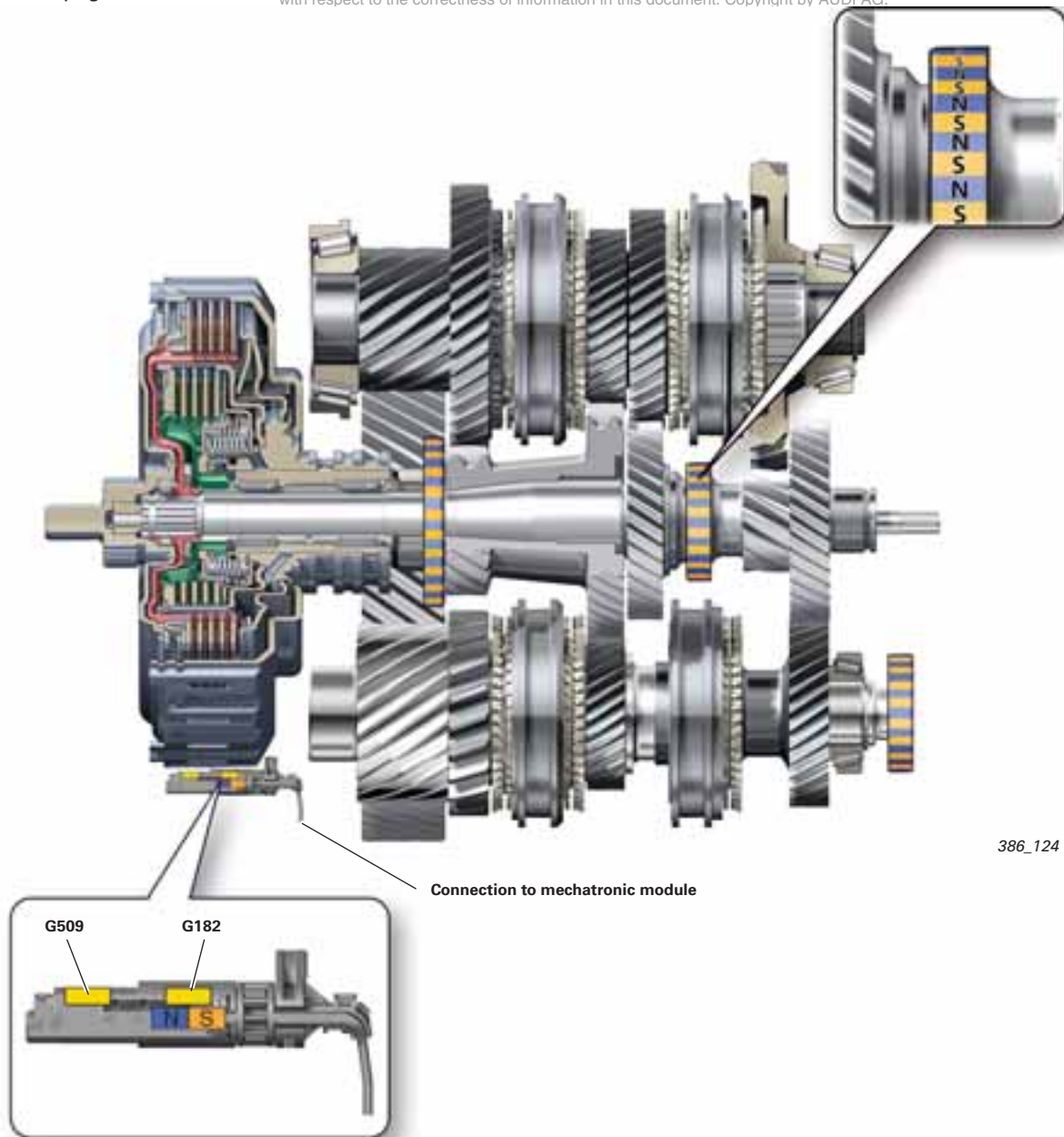
Sporadic losses of signal will result in overly harsh gearshifts or gear drop-out.

In the event of complete loss of signal, the gearbox control unit utilises the signals from senders G93 and G510.

In all fault situations, no corrective action is taken, rather an entry is made in the fault memory only (without fault indication).

Refer to "Clutch functions/overload protection" on page 26.

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386\_124

# Gearbox control unit

## Gearbox input speed sender G182

G182 is a Hall sender. It monitors the input speed of the twin clutch. The encoder function is performed by the outer plate carrier of clutch K1, which in turn is positively connected to the main hub and the outer plate carrier of K2.

### Signal utilisation

The clutch input speed signal ...

... is used for more precise clutch control.

... is used for clutch adaptation, refer to page 27.

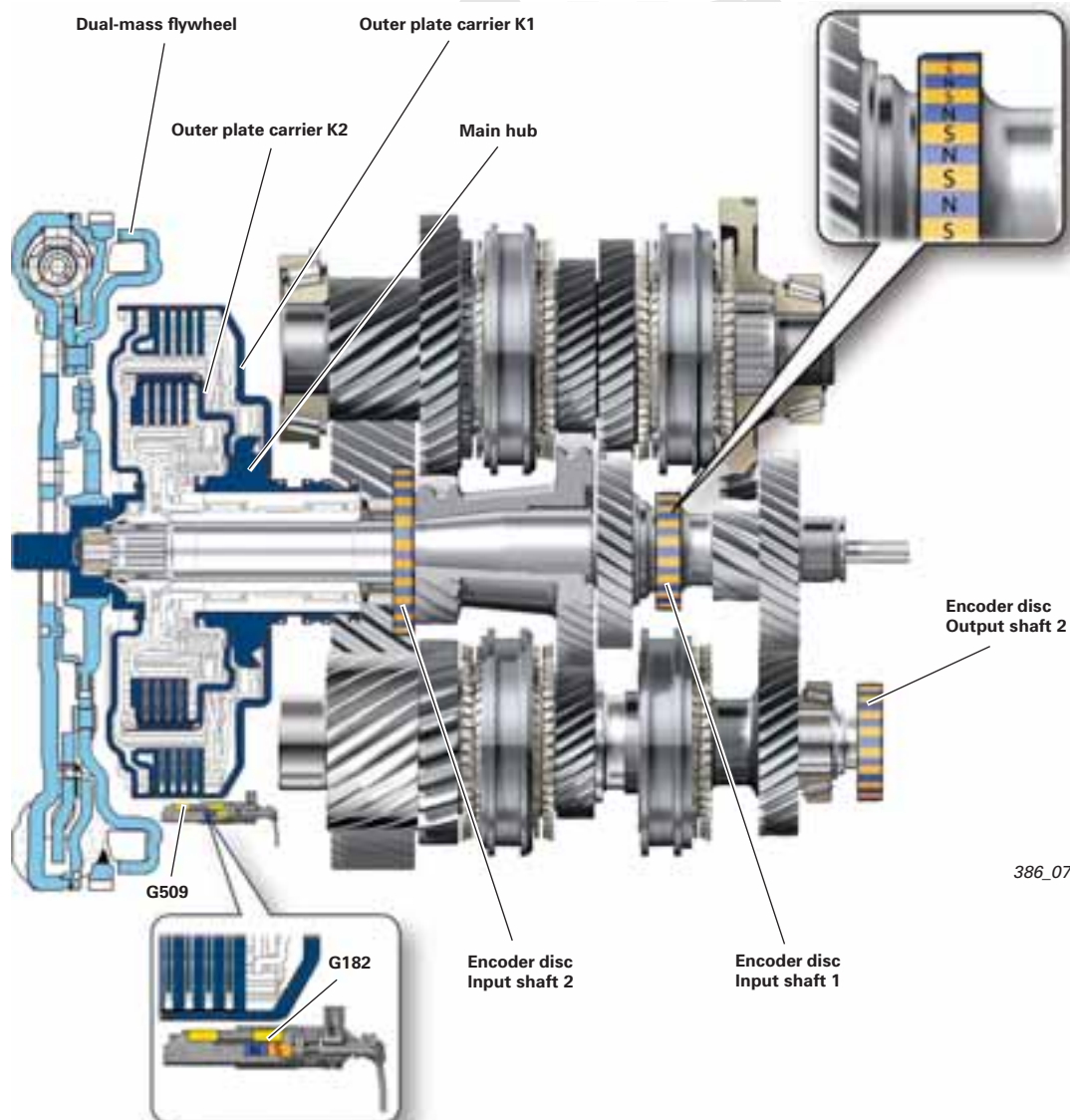
... is used for microslip control; refer to page 27.

### Effects of signal failure

In case of failure of G182, the engine speed is utilised as a substitute signal. Microslip control and certain adaptive adjustments will not be possible. There will be loss of shift quality.

In the event of sporadic losses of signal, fluctuations in engine speed can occur.

In all fault situations, no corrective action is taken, rather an entry is made in the fault memory only (without fault indication).



386\_076

## Gearbox output speed sender 1 (2) G501 (G502)

Both senders are Hall senders and are integrated in the electronic module. The encoder disc is a sheet metal part with a magnetised rubber ferrous metal coating.

### Signal utilisation

- Measurement of the clutch output speed for calculating the slip (microslip) of each clutch (G501 = K1, G502 = K2).
- Utilisation for microslip regulation and clutch adaptation: refer to page 27.
- Determination of the synchronisation speed for gearshifts.

### Effects of signal failure

If either of the senders fails, the part-gearbox in question is shut down.

The gearbox starts the emergency program, refer to page 85.

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Fault indication: yes



386\_117



#### Note

The encoder discs must be kept clear of magnetic fields. Metal chips and swarf can impair the function of the encoder discs.

# Gearbox control unit

## Gearbox output speed sender 1 (2) G195 (G196)

Both senders are Hall senders and are integrated in the electronic module. The encoder disc is a sheet metal part with a magnetised rubber ferrous metal coating. Senders G195 and G196 monitor the speed of output shaft 2 and hence the gearbox output speed.

The signal from G196 is utilised for detecting the direction of rotation of the gearbox, and hence for differentiating between forward and reverse travel. For further information, refer to SSP 228 (from page 68).

One of the principal signals utilised for electronic gearbox control is gearbox output speed. There exists a defined relationship between gearbox output speed and vehicle speed.

### Signal utilisation

- Determining the vehicle speed for shift point selection and determination
- Recognition of travel direction to verify the plausibility of gear selections (e.g. when reversing at > 10 kph, 1st gear cannot be selected)

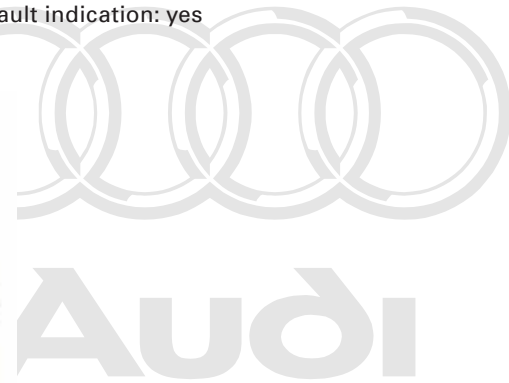
Creep control function

### Effects of signal failure

The vehicle speed and travel direction signals from the powertrain CAN bus (ESP) are utilised as substitute signals.

Fault indication: yes

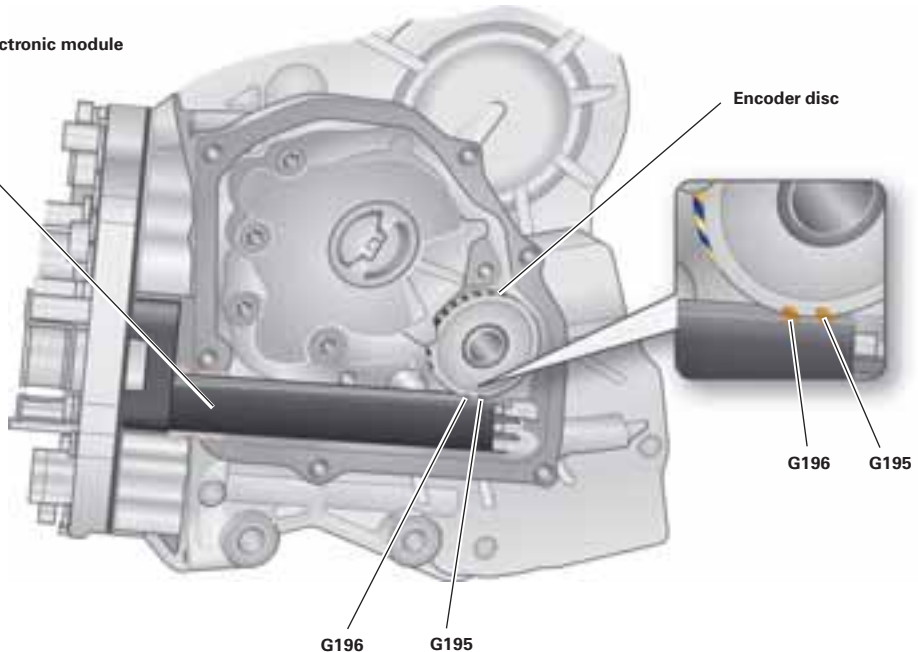
Electronic module



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386\_117

Sender arm of the electronic module



386\_079

## Automatic gearbox hydraulic pressure sender -1- (2) G193 (G194)

Both senders are located in the channel plate of the electronic module.

G193 monitors the clutch pressure of clutch K1 (actual clutch pressure).

G194 monitors the clutch pressure of clutch K2 (actual clutch pressure).

The actual clutch pressure is continuously compared to the nominal clutch pressure computed by the gearbox control unit and checked for plausibility. In case of deviations (malfunctions), a safety shutdown of the part-gearbox is initiated and the relevant emergency program is activated; refer to "Safety shutdown" and "Emergency program".

### Signal utilisation

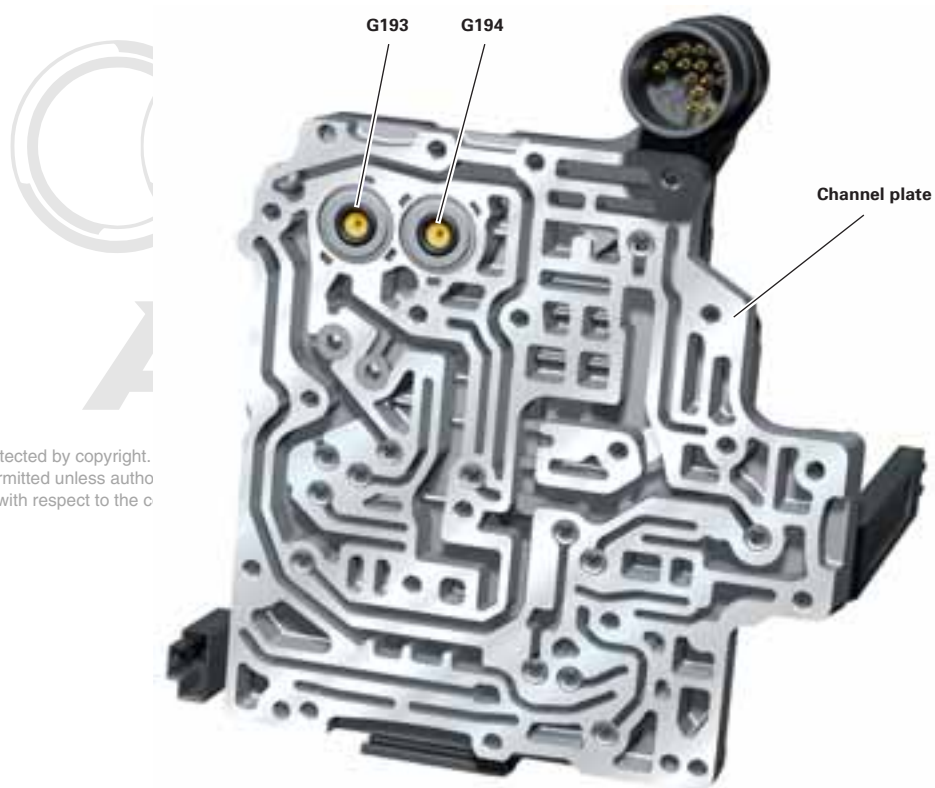
- Monitoring of the clutch pressure of K1 and K2

Adaptation of the main pressure

### Effects of signal failure

In case of signal failure or implausible signals, the part-gearbox in question is shut down and the relevant emergency program is activated.

Fault indication: yes



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386\_059

# Gearbox control unit

## Gear selector travel sensor 1 (2, 3, 4) G487 (G488, G489, G490)

The gear selector travel sensors are Hall senders and are integrated in the electronic module. Gear selectors are hydraulically actuated shift forks; refer to page 30.

In combination with permanent magnets mounted on the shift forks, they generate a signal which provides the control unit with information on the position of each shift fork.

### Signal utilisation

The exact position of the shift fork is important for correct gear selection and selected gear status recognition.

Care must also be taken to ensure that the various shift forks do not adopt incorrect positions and hence that no incorrect gearshifts executed.

### Effects of signal failure

In case of failure of a travel sensor, the part-gearbox concerned is shut down and the relevant emergency program is activated.

Fault indication: yes

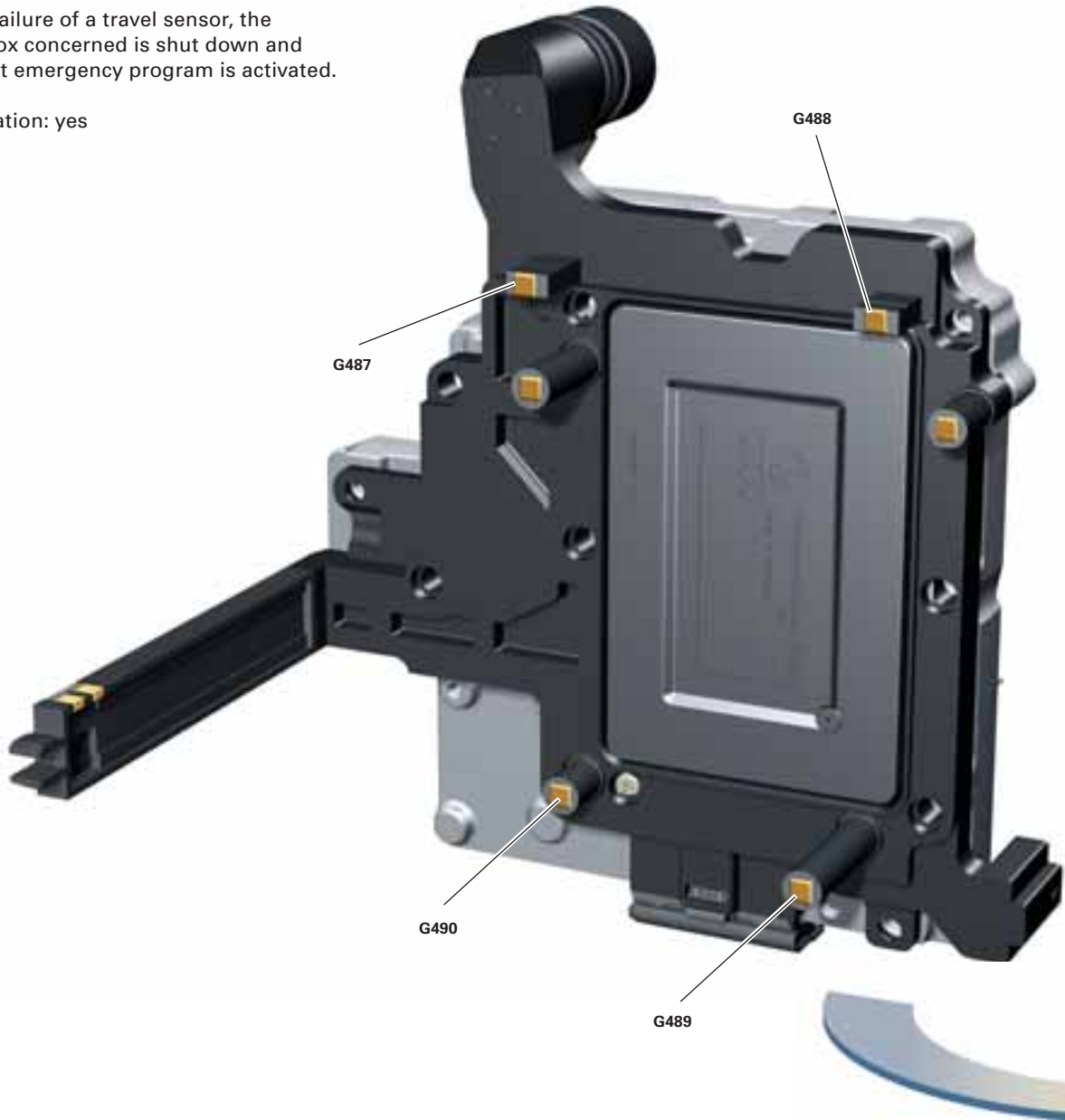
The travel sensors are assigned to the following shift forks:

G487 – gear selector/shift fork 1 (1st/3rd gear)

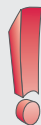
G488 – gear selector/shift fork 2 (2nd/4th gear)

G489 – gear selector/shift fork 3 (6th/reverse)

G490 – gear selector/shift fork 4 (5th gear)

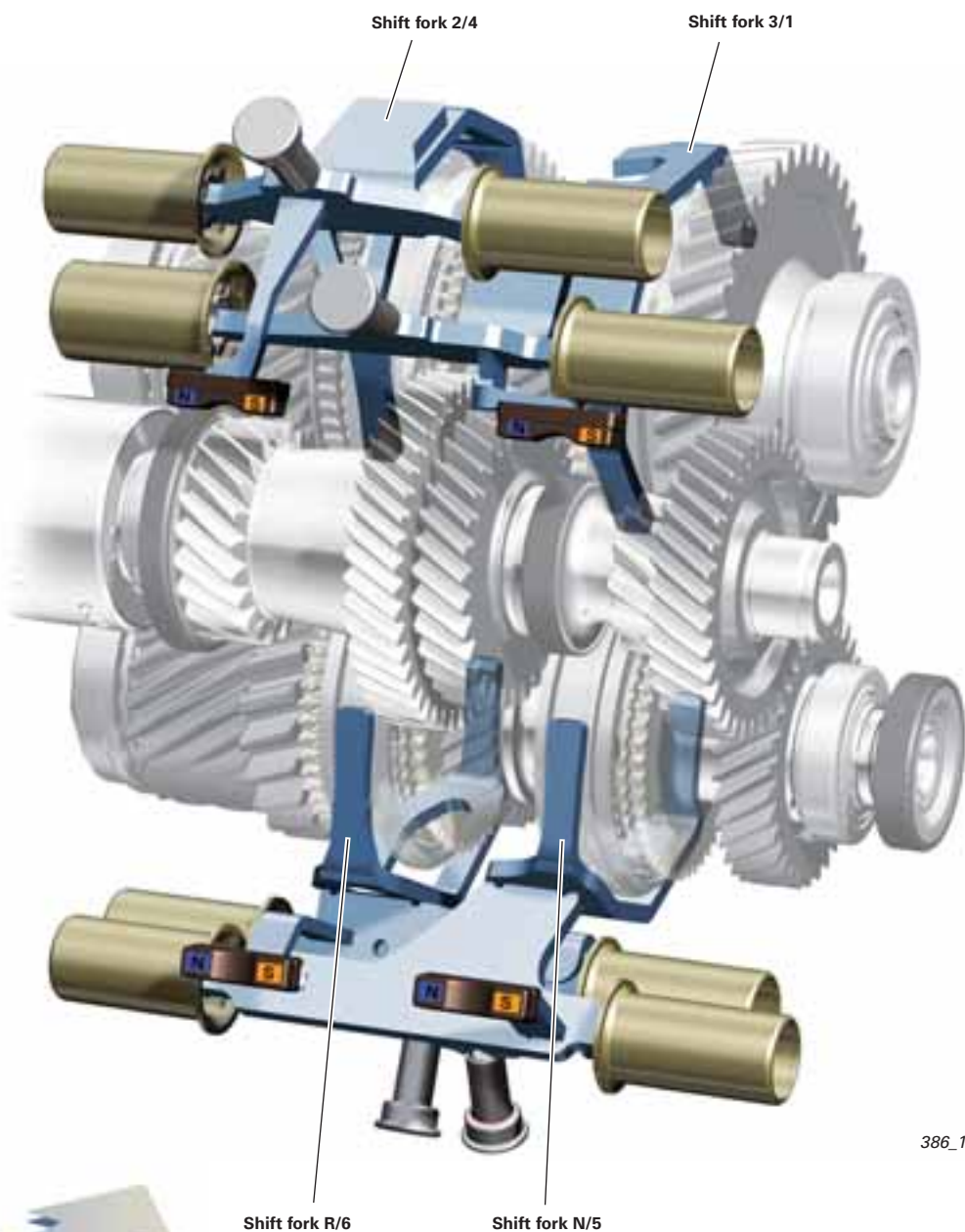


#### Note



To ensure the required positional determination accuracy, the travel sensors and the shift forks must be adapted by performing the basic setting procedure (e.g. after replacement of the mechatronic module).

If basic setting is not performed, the vehicle will only drive in 1st, 2nd and reverse gear. In this case, a fault message indicating that basic setting has not been carried out is stored in the fault memory.



386\_111

# Gearbox control unit

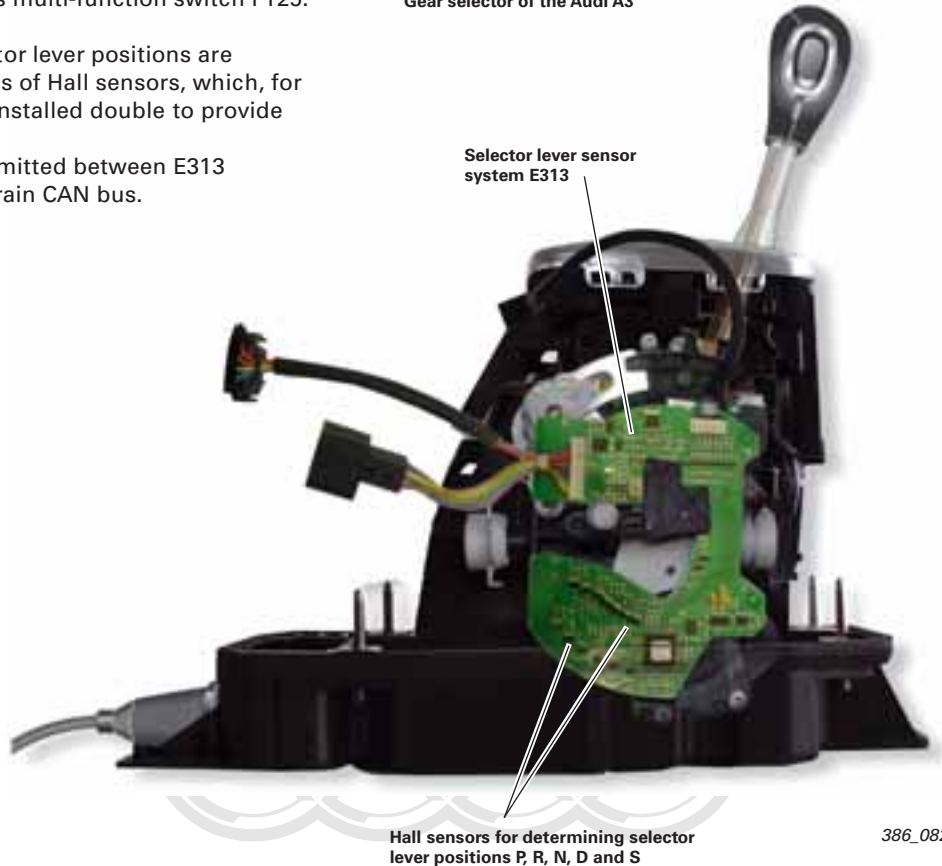
## Selector lever sensor system E313

The mechatronic control unit J743 receives information on the selector lever position from the selector lever sensor system E313. The mechatronic control unit is integrated in the gearshift mechanism.

E313 is an electronic component comprising the sensors and a control unit which communicates by means of the powertrain CAN data bus. The selector lever sensor system E313 performs the tasks of the previous multi-function switch F125.

The individual selector lever positions are recognised by means of Hall sensors, which, for safety reasons, are installed double to provide redundancy. Information is transmitted between E313 and J743 by powertrain CAN bus.

Gear selector of the Audi A3



Selector lever sensor system E313

Hall sensors for determining selector lever positions P, R, N, D and S

386\_082

### Signal utilisation

Information on selector lever position is required to implement the following functions:

- Information on the driver input/driving condition (forwards, reverse, neutral) for activation of the gear selectors and clutches
- Control of the tiptronic function (not Audi TT 8N)
- Information on shift program "D" or "S"
- Starter inhibitor control
- P/N lock (Shift Lock) control
- Control of the reversing lights
- Control of the selector lever position indicator in the dash panel insert

Control of the LEDs according to the selector lever position in the selector gate cover or in the display unit.

### Effects of signal failure

Faults in the E313 manifest themselves in very different ways. If it is not possible to clearly identify the selector lever position, the start enabling signal is generated, but no power transmission is possible.

Fault indication: inverted flashing

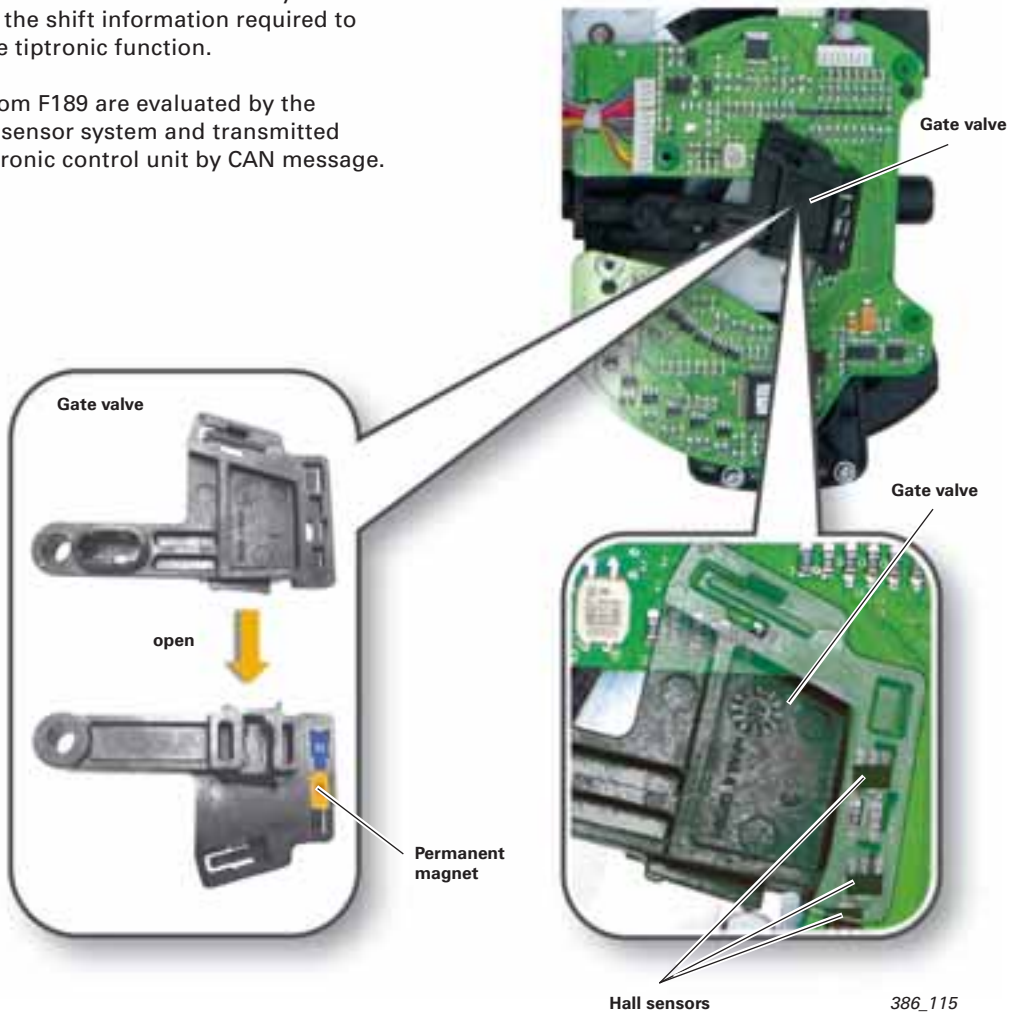
The selector lever sensor system E313 has its own diagnostic address word. Faults are transferred to the mechatronic control unit J743 and can be read out here.

## tiptronic switch F189

Gearshift mechanism  
Audi A3 (8P) and TT (8J)

F189 consists of three Hall sensors. They are integrated in the selector lever sensor system. F189 supplies the shift information required to implement the tiptronic function.

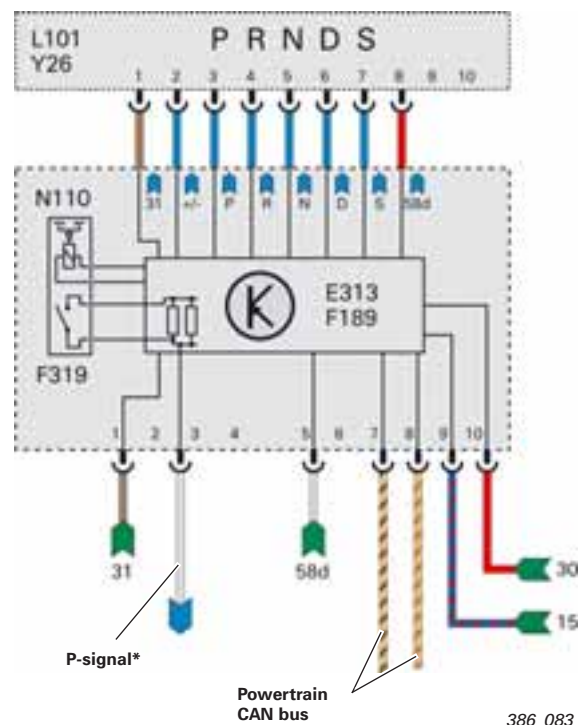
The signals from F189 are evaluated by the selector lever sensor system and transmitted to the mechatronic control unit by CAN message.



386\_115

### Legend

- E313 Selector lever sensor system (selector lever)
- F189 tiptronic switch (integrated in E313)
- F319 Selector lever locked in position P switch
- L101 Selector lever scale
- N110 Selector lever lock solenoid
- Y26 Selector lever position indicator unit



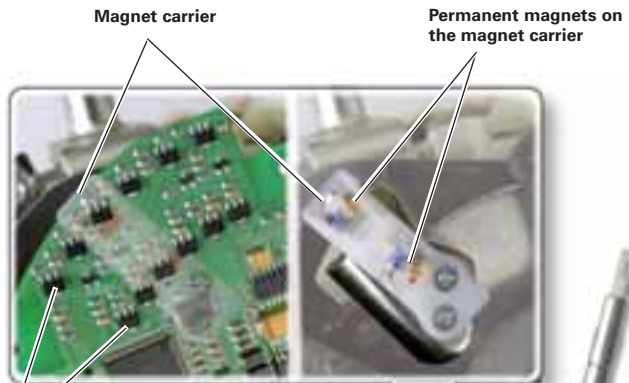
386\_083

\* refer to pages 14 and 60

# Gearbox control unit

## Selector lever sensor system E313 for Audi TT (8N)

The information on signal utilisation and function on page 74 basically applies to the selector lever sensor system E313 in the Audi TT (8N). The design and function of the tiptronic switch F189 are different.



Hall sensors for the determination of selector lever positions P, R, N, D and S

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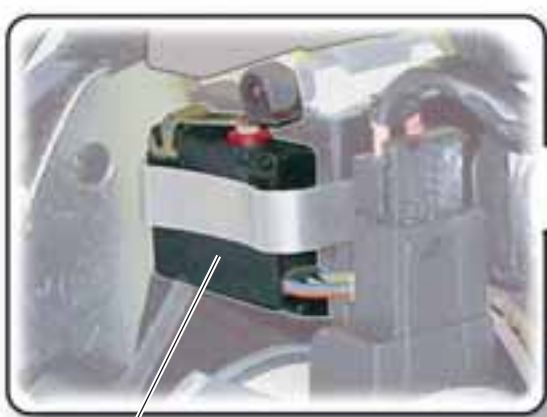
386\_118

## tiptronic switch F189 for Audi TT (8N)

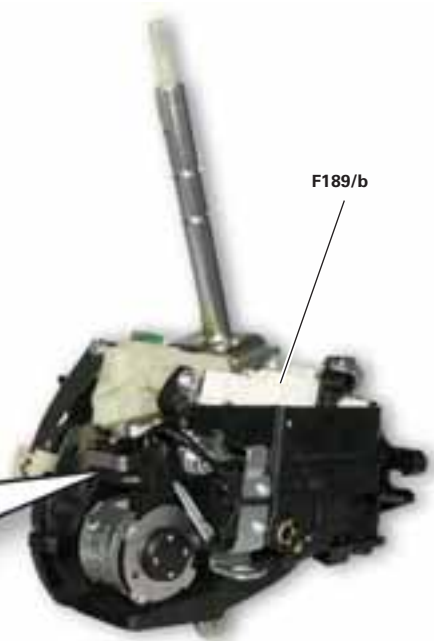
In the Audi TT (8N), the tiptronic switch F189 consists of two components, the F189/a and the F189/b.

### tiptronic switch F189/a

F189/a is a mechanical micro-two-way switch which is used for tiptronic gate detection.



F189/a

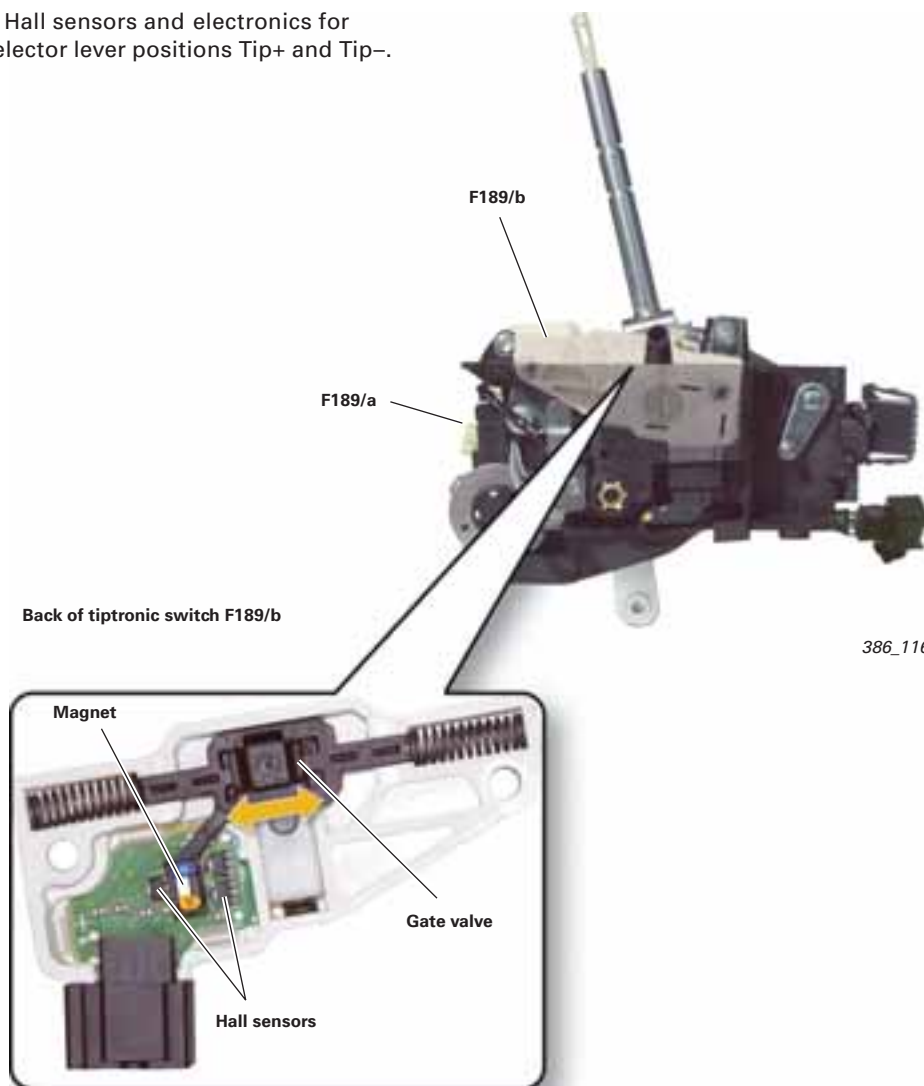


F189/b

386\_125

### tiptronic switch F189/a

F189/b consists of Hall sensors and electronics for the detection of selector lever positions Tip+ and Tip-.



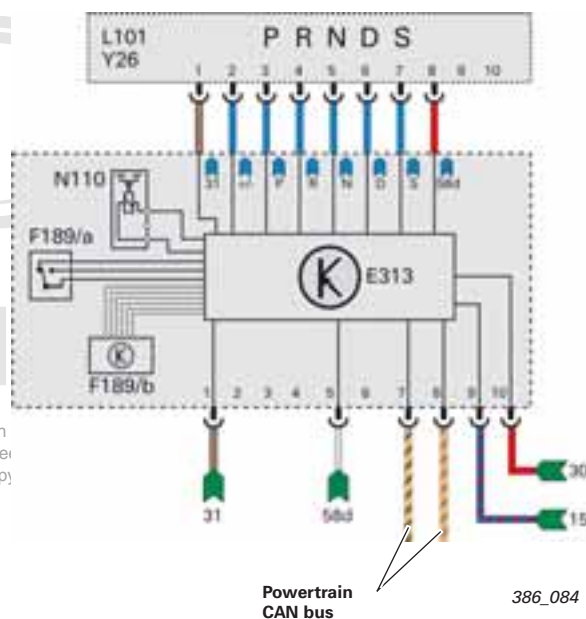
386\_116

Function diagram of the gearshift mechanism Audi TT (8N)

The information from F189/a and F189/b is evaluated by the selector lever sensor system and transmitted to the mechatronic control unit by CAN message.

### Legend

- E313 Selector lever sensor system (selector lever)
- F189/a tiptronic switch (tip gate signal)
- F189/b tiptronic switch (Tip-/Tip+ signal)
- L101 Selector lever display illumination
- N110 Selector lever lock solenoid
- Y26 Selector lever position indicator unit



386\_084

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# Gearbox functions

## tiptronic steering wheel

In combination with the tiptronic steering wheel, the "tiptronic" function is also available in selector lever position "D" or "S".

The transition to tiptronic mode is made by pressing either of the tiptronic shift paddles on the steering wheel (in selector lever position "D" or "S"). The system switches to tiptronic mode for approx. 8 seconds. Gears can be selected within the allowable engine speed ranges. It is possible to skip gears by pressing the tiptronic button several times, e.g. to shift down from 6th to 3rd gear.


The system returns to normal automatic operation approximately 8 seconds after the last tip shift request.

Special feature: The countdown of 8 seconds until return to normal automatic operation is halted as long as it is determined that the vehicle is cornering (transverse acceleration limit exceeded) or is in overrun or is being driven at full throttle.

In vehicles from MY '06 or earlier, however, the system returns from tiptronic mode to automatic mode within 40 seconds at the latest.

In Audi vehicles from model year '07 or later, the countdown is halted until one of the aforementioned driving situations is present.

**Note**

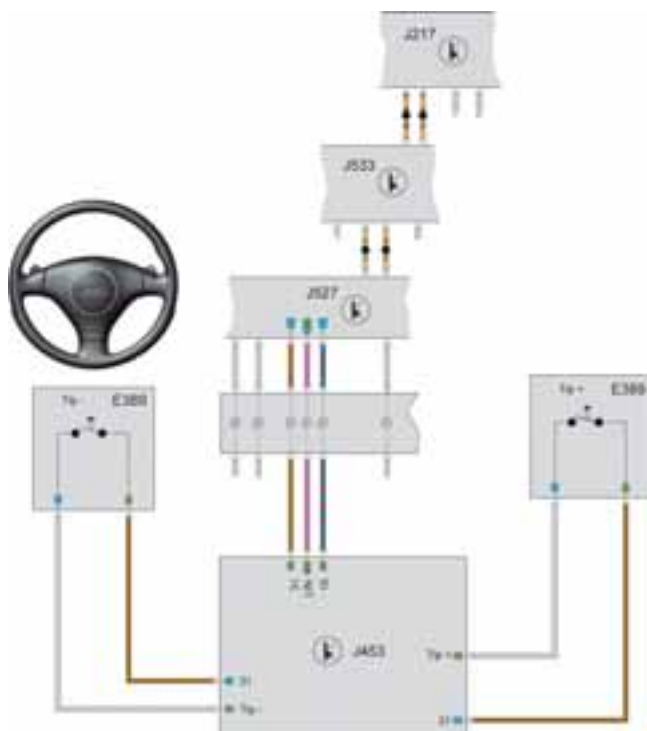


The tiptronic shift paddles may, in certain circumstances, be operated unintentionally. The driver often registers this as undefined gearshifts or notices that for a certain period time no gearshifts are made. In such cases, the gearbox control unit can be encoded in such a way that the tiptronic steering wheel is only active when the selector lever is in the tiptronic gate. Please consult the customer in regard to this matter.

### Function in the Audi A3 (8P):

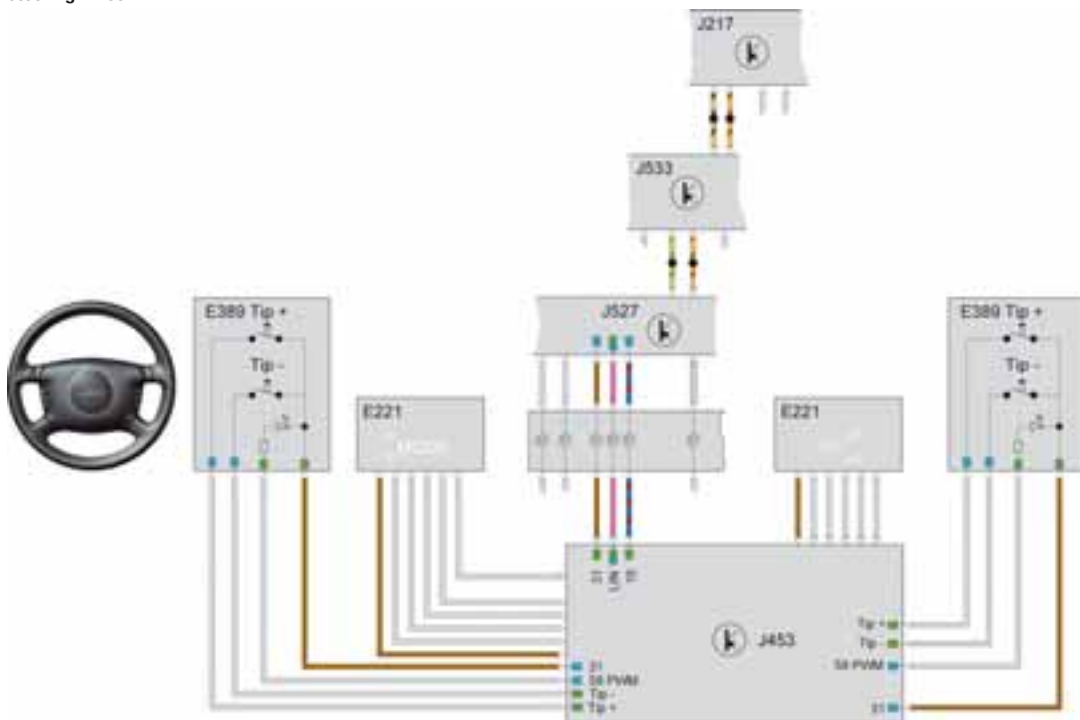
The shift pulse from the tiptronic shift paddles (earth signal) is evaluated by the multi-function steering wheel control unit J453 and sent by LIN data bus to the steering column electronics control unit J527.

J527 sends the information by convenience CAN bus to J533 (gateway). The data is transferred from J533 to the powertrain CAN bus and thus made available to mechatronic control unit J743.



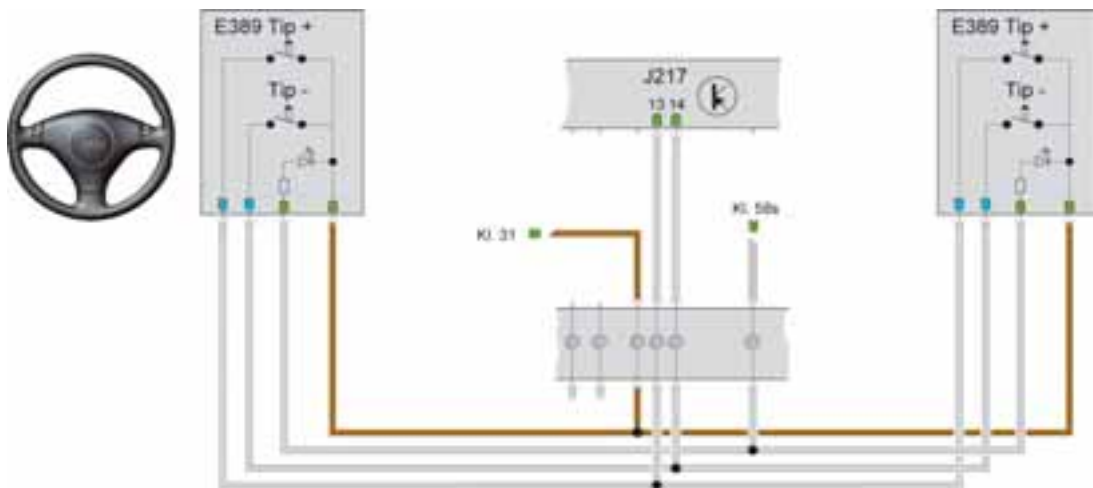
Further variants of the tiptronic steering wheel in the Audi A3 (8P)

Audi A3 (8P) tiptronic steering wheel with multifunction steering wheel



386\_086

Audi TT (8N) tiptronic steering wheel without multifunction steering wheel



386\_087

Legend

- |      |   |       |   |
|------|---|-------|---|
| E221 | Operating unit in steering wheel                | LIN   | LIN single-wire bus system                        |
| E389 | tiptronic switch in steering wheel              | 58PWM | Pulse-width modulated dimming of the switch light |
| E438 | tiptronic switch (shift up) in steering wheel   |       |   |
| E439 | tiptronic switch (shift down) in steering wheel |       |   |
| F138 | Coil spring                                     |       | Output signal                                     |
| J453 | Multi-function steering wheel control unit      |       | Input signal                                      |
| J527 | Steering column electronics control unit        |       |   |
| J533 | Data bus diagnostic interface (Gateway)         |       |   |
| J743 | Mechatronic control unit                        |       |   |

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# Gearbox functions

## "Freeing vehicle by rocking back and forth" and drive-away in 2nd gear

As described previously under "gearshift sequence" on page 40, the vehicle is driven away in 2nd gear under certain conditions.

The driver is not normally conscious of this function, because 1st gear is subsequently selected for acceleration.

If vehicle is stuck fast, it can be dislodged by rocking it back and forth by selecting "D" then "R" in rapid succession. In this situation, drive-away in selector lever position "D" is in 2nd gear. The background to this is the gearshift sequence described on page 40 at drive-away in "D" or "S".

In addition, the vehicle can be deliberately driven away in 2nd gear in order to reduce the driving power at the wheels on road surfaces with a low frictional coefficient, e.g. in wintry road conditions. This makes drive-away easier, because the wheel traction is not exceeded as quickly.

This function can be activated by moving the selector lever back and forth several times between selector lever positions "R" and "D".

The vehicle subsequently drives away in 2nd gear.



## Launch Control Program

The Launch Control Program allows maximum acceleration from a standing start.

For this purpose, engine speed is set to

approx. 3200 rpm\* before the starting clutch is positively engaged.

Engine torque and power transmission by the clutch are balanced fully automatically.

The requirements for use of the "Launch Control Programme" are as follows:

- ▶ Vehicle speed 0 kph
- ▶ Gearbox oil temperature > 30 °C
- ▶ Normal clutch temperature
- ▶ ESP or TCS switched OFF (at the ESP button, ESP warning lamp "on")
- ▶ Selector lever position "S" or tiptronic
- ▶ Apply brake\*\* (with left foot)
- ▶ Apply full throttle (engine runs at approx. 3200 rpm\*)

As soon as the brake is released, the gearbox control unit sets maximum acceleration.

- \* There is almost no load on the engine. Clutch torque is approx. 1 Nm, i.e. the clutch pressure is low. "Launch Control speed" is dependent on engine variant.

3200 rpm for naturally aspirated petrol engines  
2600 rpm for TFSI engines  
2000 rpm for TDI engines

- \*\* A brake pressure of at least 20 bar must be generated.

### Note



If the function is activated inadvertently (e.g. while manoeuvring), the next drive-away will, as described, be executed in 2nd gear. This can prompt the following complaint: "insufficient vehicle acceleration".

### Note



Observe the safety instructions in the relevant operating instructions. Remember to switch on the ESP again.

The "Launch Control Program" is unavailable with US spec vehicles.

In the Audi TT MY '07 (8J), the "Launch Control Program" is also available in the US spec model since TCS can be deactivated separately from ESP in this vehicle.

## S - sport program

A performance oriented shift program is available to the driver in selector lever position "S". When the gearbox control unit receives the information "selector lever position S", the shift characteristics are biased towards higher engine speeds. The result is improved driving dynamics.

## Downshifting with short intermediate throttle application between gearshifts (petrol engines only)

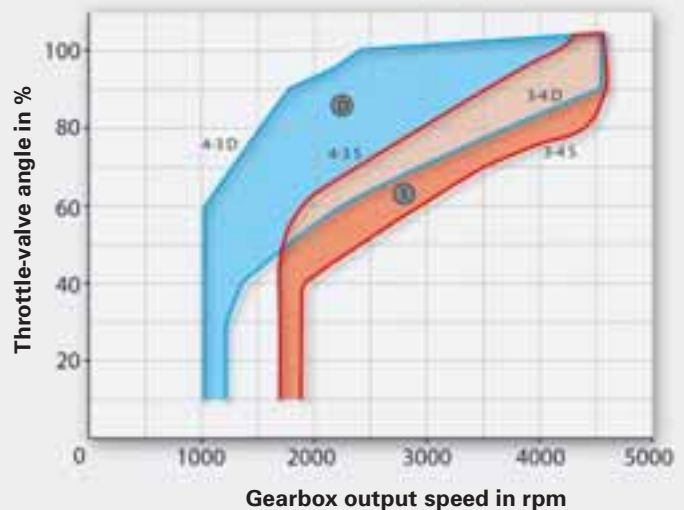
To underscore the sporty character of the Q2E gearbox, overrun downshifts are executed in the **S program** or in the **tiptronic program** with short intermediate throttle application between gearshifts.

The engine speed is actively increased to synchronisation speed through the engine management system. The clutches are opened temporarily.

The result is faster downshifts and a sporty driving feel. Load reversal when downshifting is positively influenced.

### Shift characteristic D/S

- D** Selector lever position = Drive
- S** Selector lever position = sport program



## Software Shift Lock

The Software Shift Lock function is a safety feature. If the shift lock solenoid N110 cannot lock the selector lever in position "P" or "N", this safety function prevents unintentional drive-away by selecting a gear while the engine is running.

The Software Shift Lock may be activated inadvertently by the driver. In this case, the complaint will usually be: "Vehicle sporadically has no drive". When the driver applies the brake again, the function is deactivated and vehicle drive is restored.

### The Software Shift Lock can be activated as follows:

The engine runs at idle. Apply the brake and move the selector lever far enough out of "P" so that the "P" position is still indicated, but the locking bolt can no longer engage after the brake is released. Release the brake and move the selector lever to "R", "D" or "S".

The vehicle has no drive. To restore drive, the brake must be applied and released.

The fault indicator in the dash panel insert flashes while the "Software Shift Lock" function is active; refer to page 84.

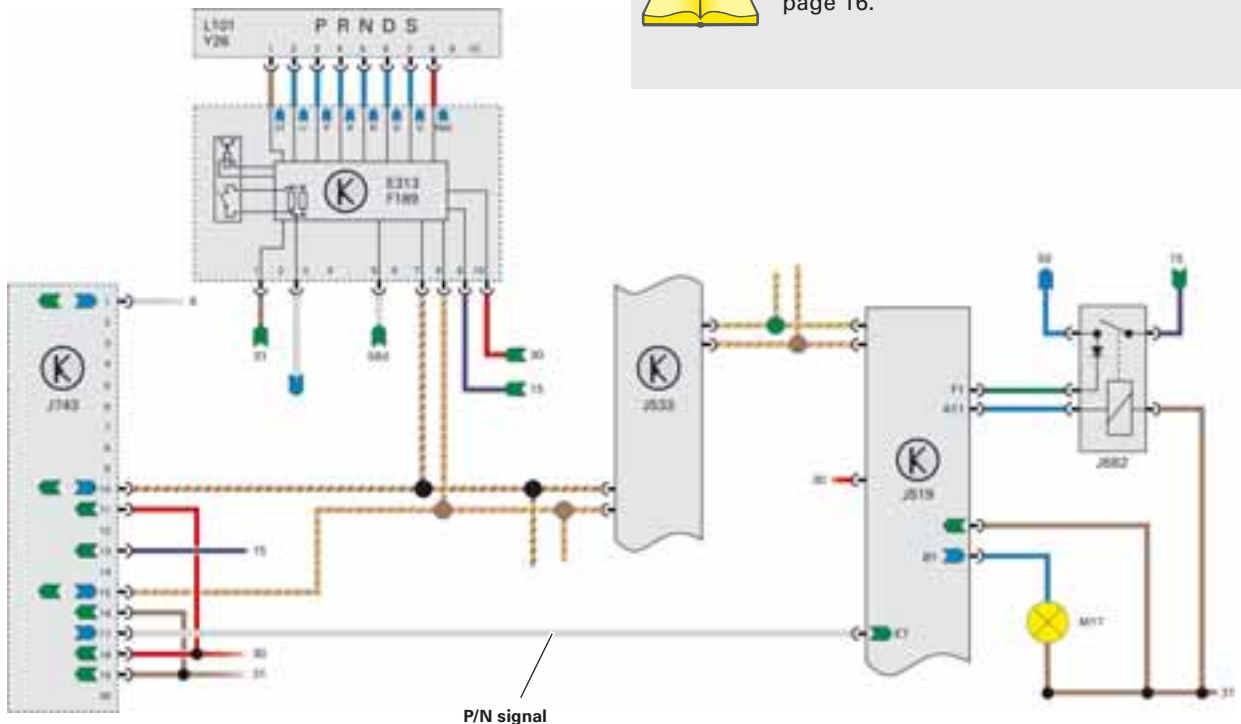
# Gearbox functions

## Starter inhibitor/starter control Audi A3 (8P) and Audi TT (8J)

### Reference



For further information on the terminal control system, refer to SSP 312 from page 16.



386\_091

### Legend

E313	Selector lever sensor system (selector lever)
F189	tiptronic switch
J519	Onboard power supply control unit
J533	Data bus diagnostic interface (Gateway)
J682	Terminal 50 voltage supply relay
J743	Mechatronic control unit

K	K-wire (diagnostics)
L101	Selector lever display illumination
M17	Reversing light bulb, right
Y26	Selector lever position indicator unit

The "starter inhibitor" function allows activation of the starter (terminal 50) only in selector lever position "P" or "N".

Terminal 50 is activated by relay J682 which in turn is activated by onboard power supply control unit J519.

For this purpose, control unit J519 requires, in addition to the signals from the ignition lock and the engine control unit, the information that the selector lever is in position "P" or "N".

The selector lever sensor system E313 determines the selector lever position (also refer to page 74) and sends the information by powertrain CAN bus to the mechatronic control unit J743.

Control unit J743 sends, via a discrete line, a P/N signal (start enabling signal from gearbox, earth) to control unit J519.

Once all signals required for starting have been received by J519, the control unit activates relay J682.

For the purpose of diagnosis of the discrete line for the P/N signal, the selector lever position information is sent concurrently to J519 by CAN data bus.

Information route: E313 (powertrain CAN bus) > J743 (powertrain CAN bus) > J533 (convenience CAN bus) > J519.

In the event of disruption in the power supply to J743/E313, the starting enable signal is not generated at the P/N signal or at the CAN connection.

## Special features of the starter inhibitor

At gearbox oil temperatures below -10 °C the start enabling signal is only generated in selector lever position "P".

Extremely low temperatures produces a high drag torque in the clutches.

This in turn produces unwanted driving torque at the wheels, causing the vehicle to creep as of a certain torque.

To prevent this the engine can only be started in such situations in selector lever position "P". The parking lock holds the vehicle securely in place.

## Starter inhibitor/starter control, activation of the reversing lights in the Audi TT (8N)

In the Audi TT Type 8N the starter is activated via relay J207 and the reversing lights are activated directly by the mechatronic control unit J743 by means of relay J219.

The selector lever sensor system E313 supplies the information on selector lever position, as described previously.

Likewise, at temperatures below -10 °C, the start enabling signal is only generated in selector lever position "P".

Refer to "Special features of the starter inhibitor".

## Activation of the reversing lights

The reversing lights are controlled by control unit J519 (refer to function diagram 386\_091 on page 82). For this purpose, J519 receives the information "selector lever position R" by CAN information exchange.

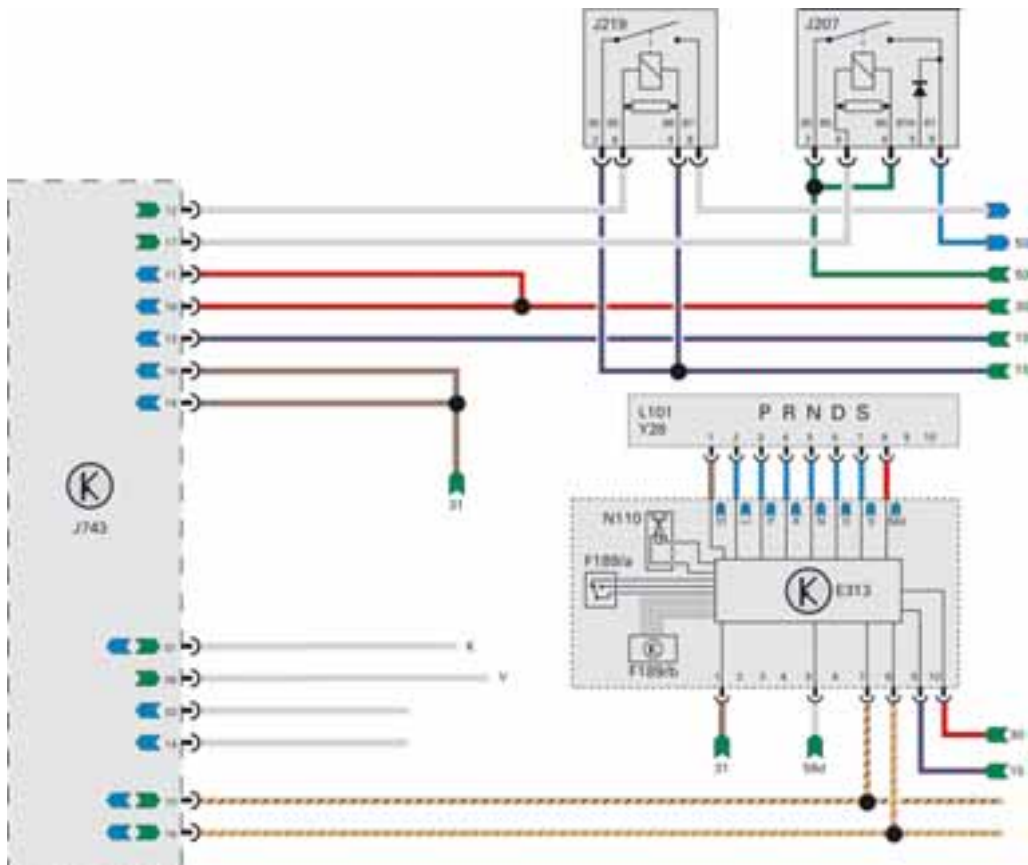
Information route: E313 (powertrain CAN bus) > J743 (powertrain CAN bus) > J533 (convenience CAN bus) > J519.

# Audi

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### Legend

E313	Selector lever sensor system (selector lever)
F189/a	tiptronic switch (tip gate signal)
F189/b	tiptronic switch (Tip-/Tip+ signal)
J207	Starter inhibitor relay
J219	Reversing light relay
J743	Mechatronic control unit
L101	Selector lever display illumination
N110	Selector lever lock solenoid
K	K-wire (diagnostics)
V	Road speed signal
Y26	Selector lever position indicator unit



386\_092

# Gearbox functions

## Selector lever position, gear and fault display in the dash panel insert

In addition to the selector lever position and gear indicator for automatic and tiptronic mode, the display is used for the visualisation of faults and protective functions (e.g. clutch overload protection, page 26).

Depending on the effect on the gearbox and driving safety, faults and protective functions are indicated to the driver by inversion of the selector lever position indicator colours.

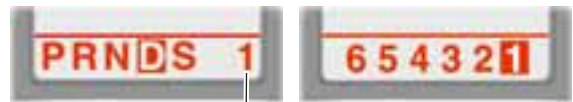


386\_127

Automatic mode

tiptronic mode

Displays in normal operation



Active gear indication  
(8P MY 05 or later and 8J)

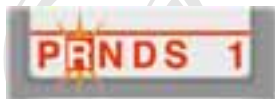
A distinction is made between the following additional displays:

**Fault indication**  
(inverted colours, static)



The self-diagnostics have diagnosed a fault in the system which activates the emergency program or a substitute program, or is only indicated. The driver must bring the vehicle immediately to a service partner workshop in order to have the fault corrected.

**Warning displays**



### Software Shift Lock

Depending on which of the three selector lever positions is engaged when the Software Shift Lock is activated, the corresponding selector lever position is indicated by a flashing light.



### Clutch overload protection

When clutch overload protection is active, the selector lever position indicator alternates between the display modes shown (frequency 1 Hz).

The warning displays signal to the driver to abort and retry the current operation (refer to description of overload protection or Software Shift Lock).

## Emergency program

Faults in the system or safety functions are detected by the self-diagnostics. Depending on what effect the system fault in question has on motoring safety, the appropriate emergency programs are made available.

Faults are indicated by the selector lever position indicator.

In the case of defined system faults, the part-gearbox in question is deactivated by the safety shutdown function (refer to page 28), and the gearbox control unit activates the relevant emergency program.

### 1. Part-gearbox 1 OK, part-gearbox 2 shut down:

Only gears 1 and 3 are selected (with interruption in tractive power).

Reversing is not possible.

### 2. Part-gearbox 2 OK, part-gearbox 1 deactivated:

Only 2nd gear is selected; in this case, it is used for drive-away.

Reversing is not possible.



#### Note

In emergency mode, reversing is not possible for technical reasons.

Emergency operation with part-gearbox 1: Reverse (R) gear belongs mechanically to part-gearbox 1, but is engaged by the hydraulic safety circuit of part-gearbox 2. Reversing is not possible because the latter is deactivated.

Emergency operation with part-gearbox 2: Reverse (R) gear can be selected, but it is gaged positively via clutch K1 (part-gearbox 1). Reversing is not possible because the hydraulic safety circuit of the part-gearbox is deactivated. Refer to the hydraulic diagram on page 28.

The following generally applies to the 02E gearbox:

**Without electrical power and oil pressure, no traction (or emergency operation) is possible.**

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## Towing

In the event that a vehicle with S tronic has to be towed, the following restrictions apply:

- ▶ The selector lever must be in the "N" position.
- ▶ A max. towing speed of 50 kph must not be exceeded.
- ▶ A max. towing distance of 50 km must not be exceeded.

When towing (engine at standstill) the vehicle, the oil pump is not driven and there is no lubrication of rotating parts.

Failure to observe the above restrictions will result in serious gearbox damage.

### Reasons for towing speed limit:

Example:  
A vehicle breaks down in 1st gear.

The clutches are open because the system is pressureless. The wheels drive the input shafts and clutches via the output shafts. If the vehicle is towed too quickly, the shafts and gears will reach engine speeds for which they are not designed. As mentioned previously, there is no lubrication, which is why there is also a limit on towing distance.

A further example illustrates the problem: In selector lever position "P" or "N" reverse (R) gear and 2nd gear are always selected. When a vehicle is towed in this gear configuration, this will result in a high speed differential between the input shafts and the clutches, which can result in terminal gearbox damage if the max. allowable towing speed is exceeded.

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