

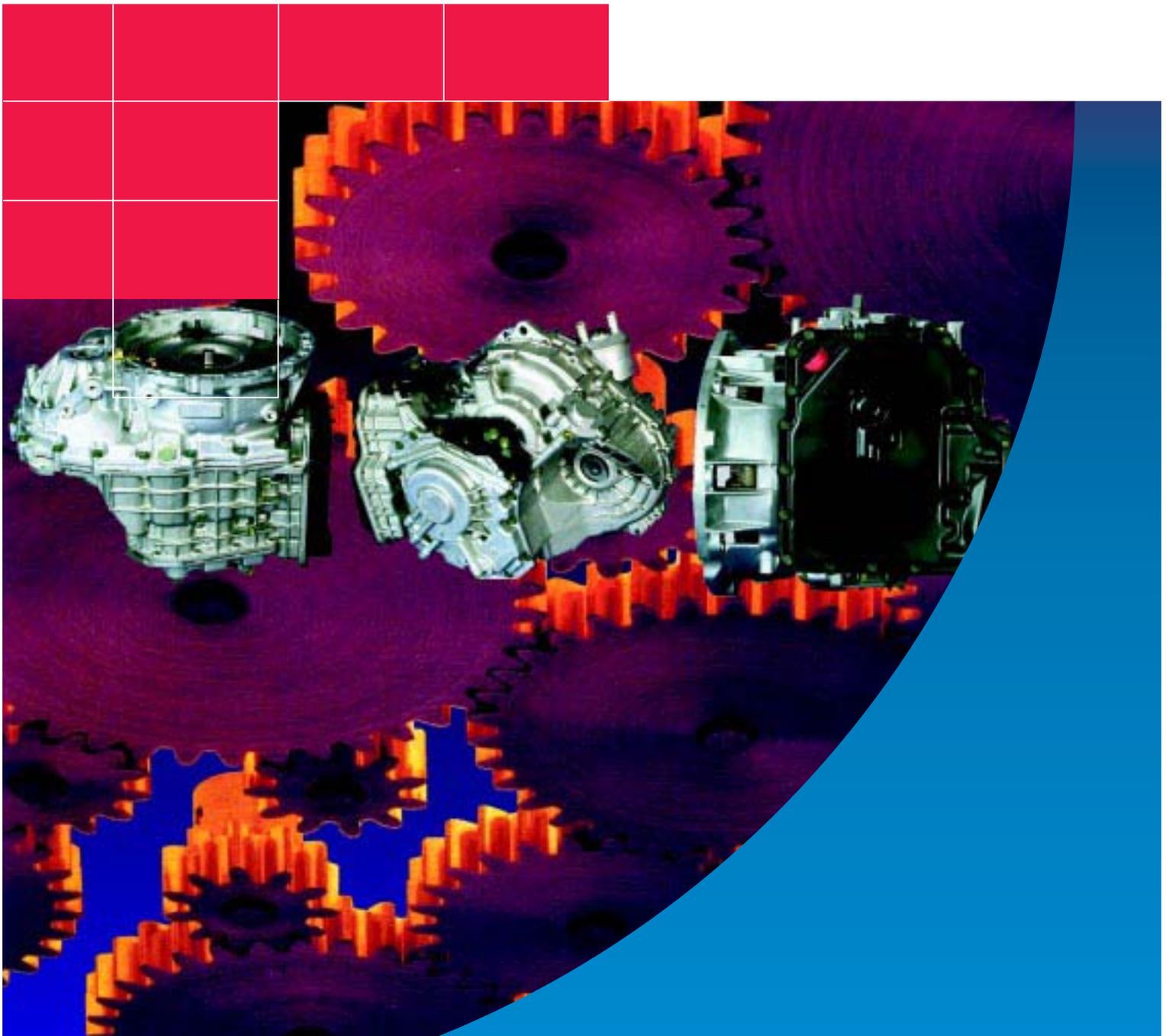
Service.



Self-Study Programme 232

5-speed Automatic Gearbox 09A/09B

Design and Function



The new 5-speed automatic gearbox

The new automatic gearbox is intended for installation in the Volkswagen and Audi platform for transversely mounted engines.



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232_998

NEW



Important Note



The Self-Study Programme describes the design and the function of new developments! The contents are not updated!

Please always refer to the relevant Service Literature for all inspection, adjustment and repair instructions.Literature.

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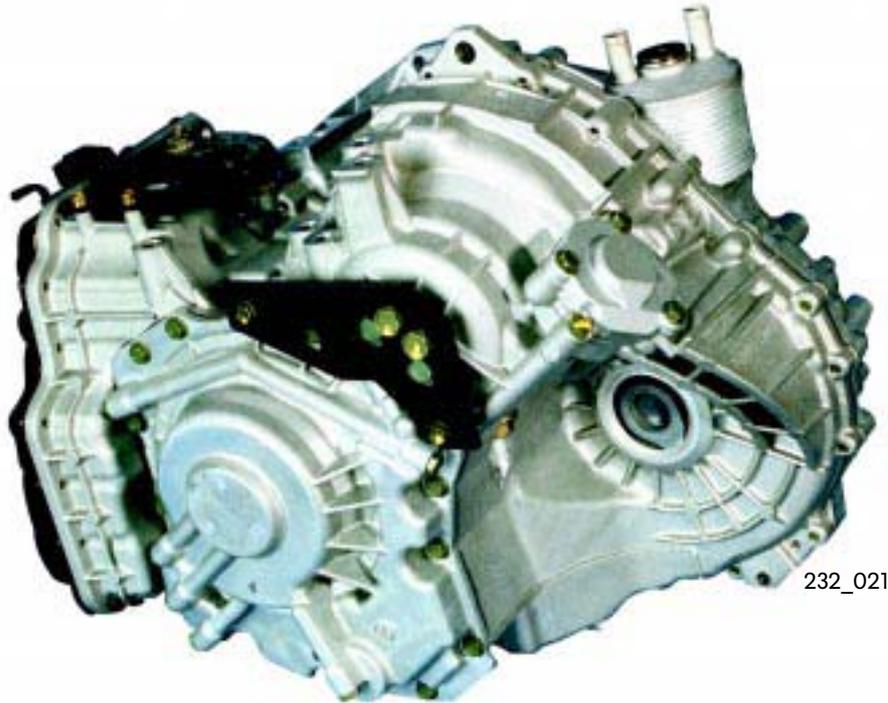
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General information



As with the 4-speed automatic gearbox in the Polo and Lupo, the new 5-speed automatic gearbox is built by Jatco, the well-known automatic gearbox manufacturer. The gearbox was adapted to the vehicle and the control unit software in co-operation with Volkswagen's engineers.



This gearbox is notable for the following components and functions:

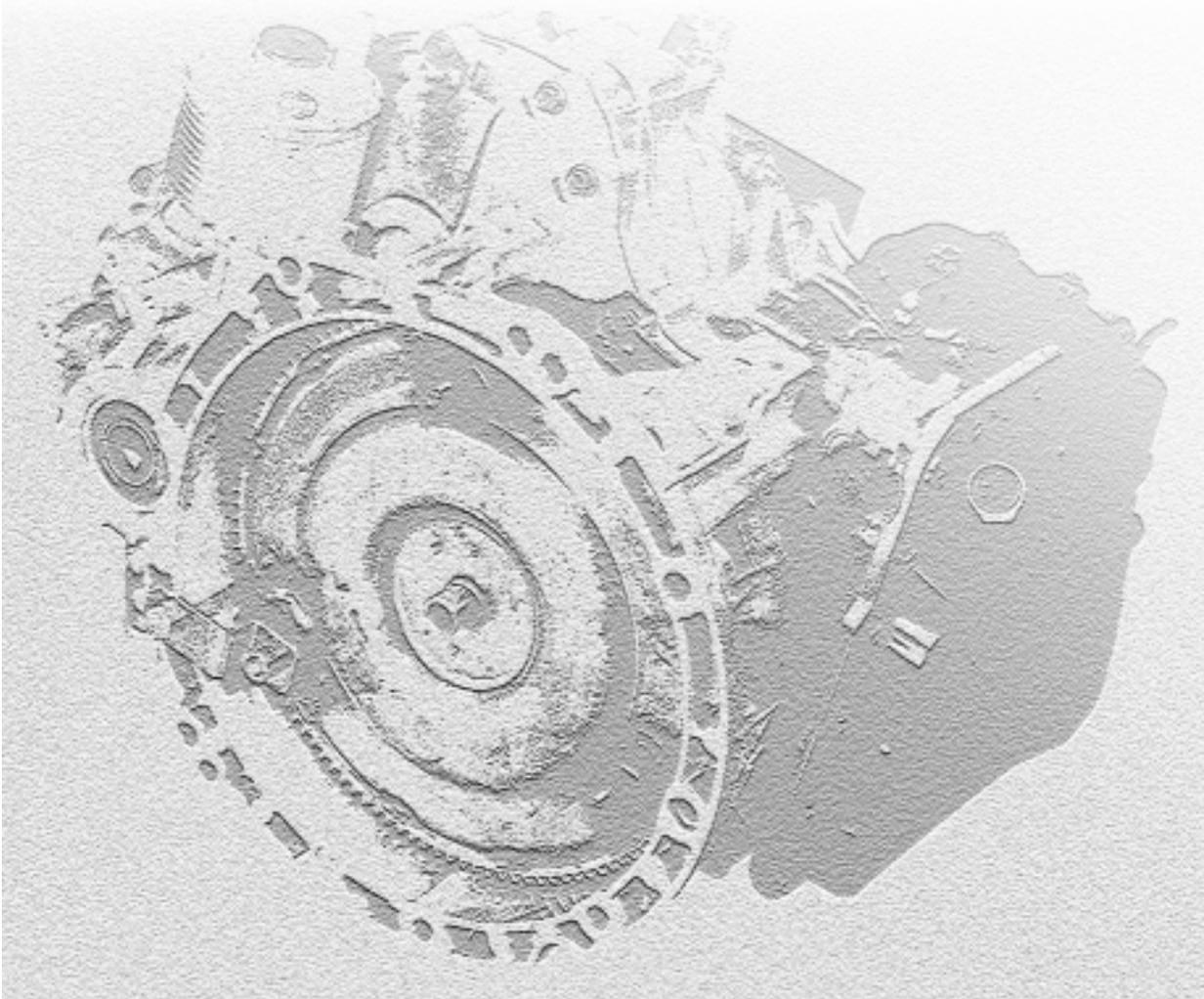
- Automatic shifting of the five gears by driver and situation dependent driving programs (fuzzy logic: see SSP No.172)
- A drag-dependent driving program (recognises traction resistances when driving uphill and downhill, when towing a trailer and when driving into a headwind)
- Tiptronic
- Shift indicator in dash panel insert
- Ignition key removal lock
- Torque converter with torque converter lock-up clutch
- Stationary decoupling
When the vehicle stops and a forward drive position is engaged, the gearbox changes into neutral.
Advantage: the vehicle shows no tendency to creep, which means higher fuel economy and lower emissions.

Specifications



Designation	A-platform 09A/09B Sharan	
Max. torque	350 Nm	
Weight	unladen	89.5 kg
	filled with ATF oil	101.5 kg
ATF oil	G 052 990	
Capacity	9 l	
Oil-change quantity	5 l 7 l when changing the converter	

The ATF oil is designed to last for the service life of the gearbox. It also lubricates the final drive.

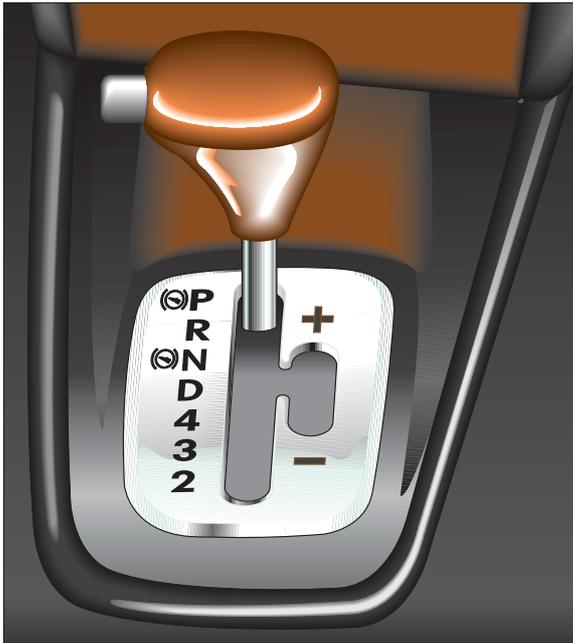


General information



The selector lever

has two selector gates:
one for automatic gearshifts and
one for Tiptronic.



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Automatic selector gate

In »D« position, the gearbox automatically changes gears 1 to 5 depending on load. However, first gear cannot be selected directly by the driver - it is engaged by the control unit depending on vehicle load.

1st gear can only be engaged directly in the Tiptronic selector gate. In this case, 1st gear uses the engine brake.

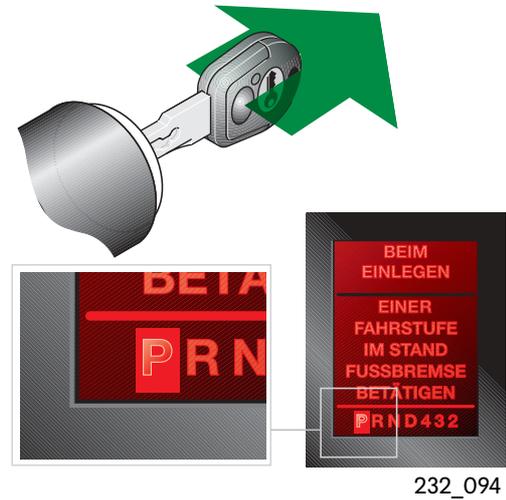
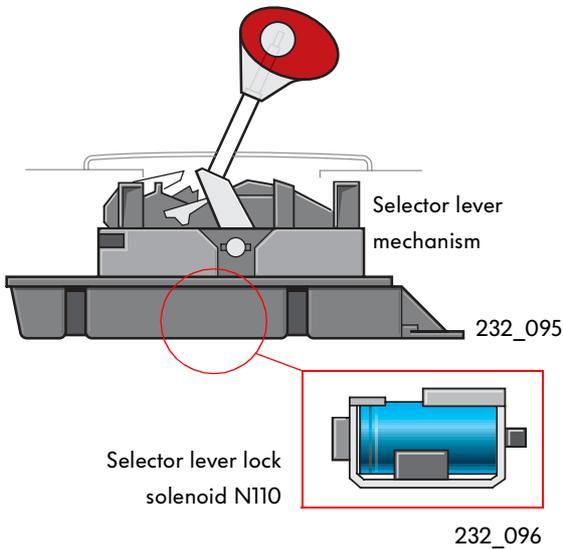


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Tiptronic selector gate

If the selector lever is engaged in the right selector gate, the gearbox is in the Tiptronic program. If the selector lever is moved forward or backward in this program, the gearbox shifts up or down a gear.

Move selector lever towards "+",
to select the next higher gear.
Move selector lever towards "-",
to select the next lower gear.
The gear selected is displayed in the dash
panel insert.



The selector lever lock

is implemented as described previously by means of the selector lever lock solenoid. The selector lever lock prevents accidental selection of a drive position while the engine is running. The solenoid does not cancel the interlock until the brake is operated.

The ignition key removal lock

only allows the ignition key to be withdrawn in selector lever position »P«. This stops the driver exiting the vehicle without applying the parking lock.

Starting the engine

The engine can only be started in »P« or »N« position.

Push-starting and towing

The conditions for push-starting or towing have not changed compared with other Group automatic gearboxes.

For more information, refer to the vehicle Owner's Manual.

Basic configuration of gearbox

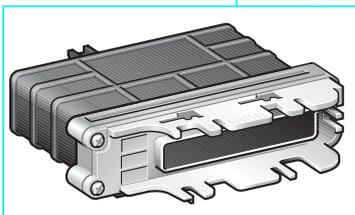
External views



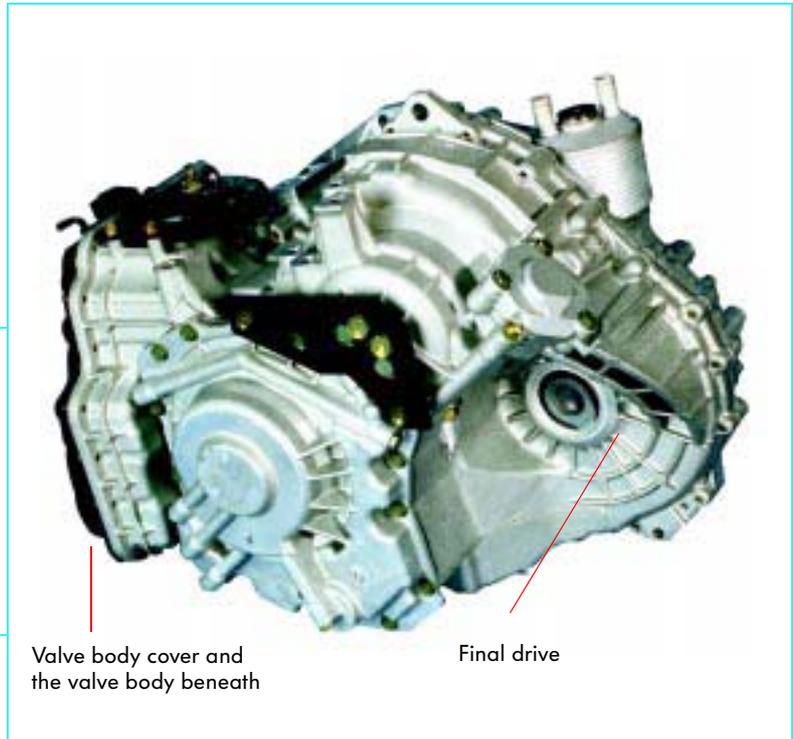
Selector lever

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Automatic gearbox control unit



Valve body cover and the valve body beneath

Final drive

Automatic gearbox

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The automatic gearbox system can be subdivided into the following main components:

The selector lever

- signals to the control unit in the Tiptronic selector range the gear the driver wishes to select and
- positions the manual selector valve in the valve body in the desired selector range in the automatic gearbox.

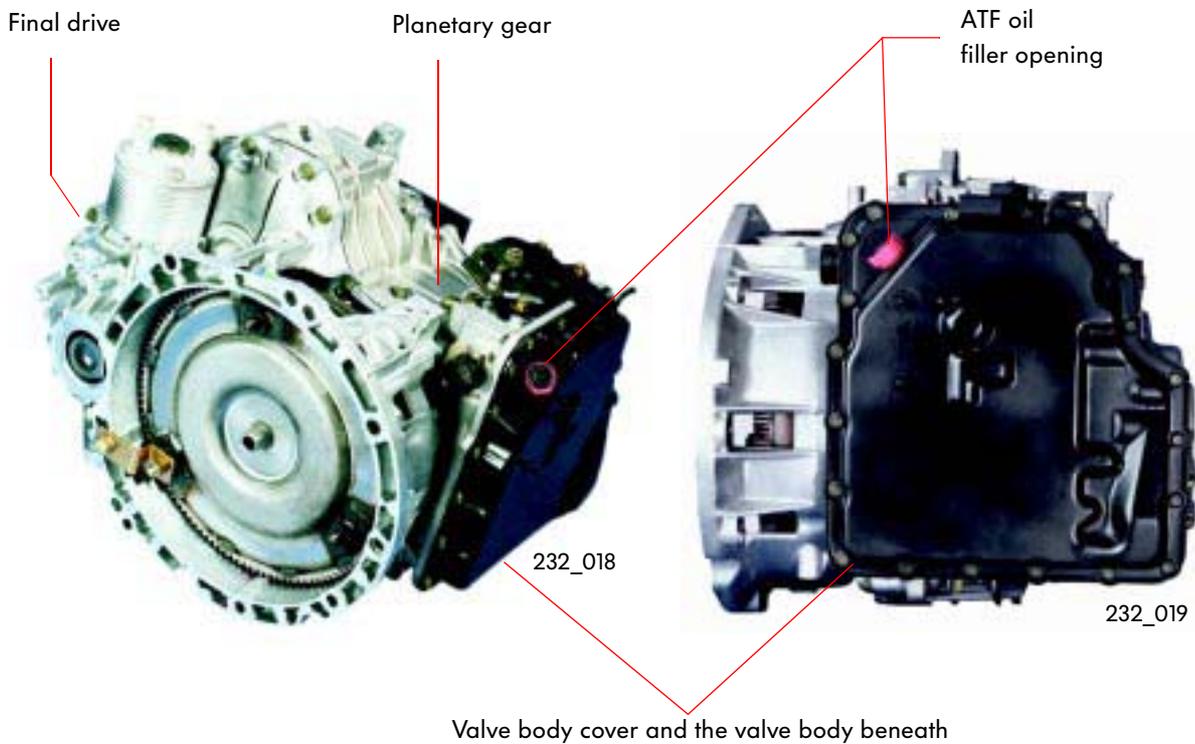
The automatic gearbox

- This translates all hydraulic and electrical control commands into mechanical functions or gears.

The control unit

- is the brain of the automatic gearbox. It controls all electrical and hydraulic functions of the automatic gearbox.

Several components of the automatic gearbox are recognisable from the exterior. In the following we will show you the complex inner workings of the gearbox in the form of a simplified cut-away diagram so that you can see how the individual modules and components are arranged inside the gearbox.



In this SSP we use schematic diagrams to explain the functional principle of the gearbox. These diagrams need not necessarily show the true installation position or dimensions.

Basic configuration of gearbox

The torque curve

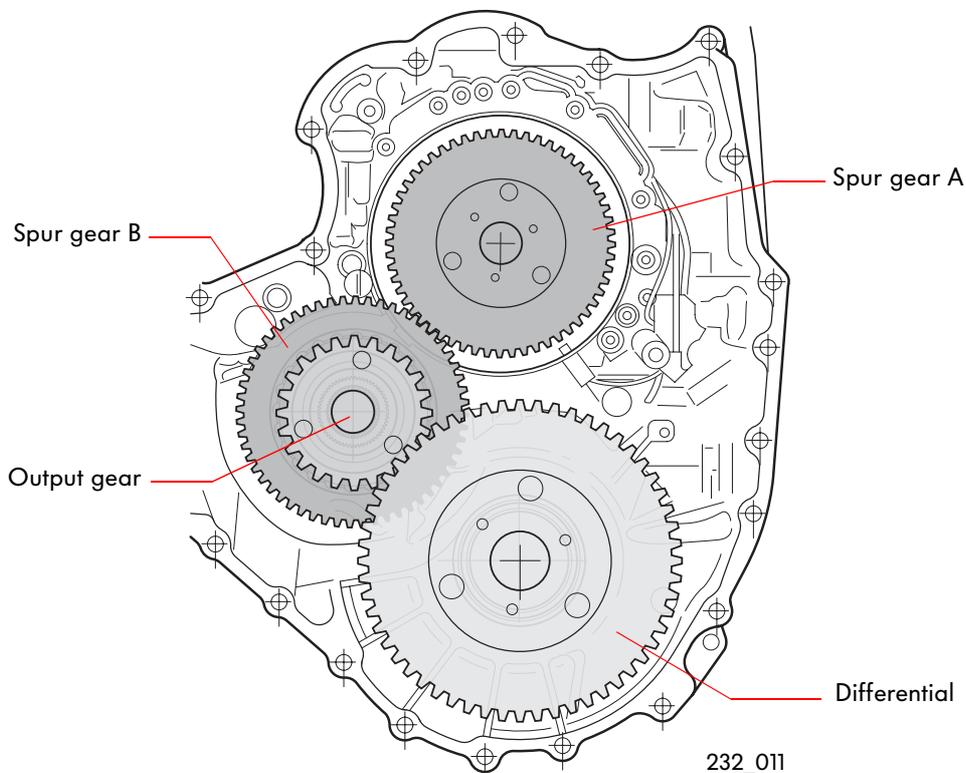
To develop a 5-speed automatic gearbox for vehicles with transversely mounted engines it was necessary to arrange the three planetary gears on two planes due to the confined space.

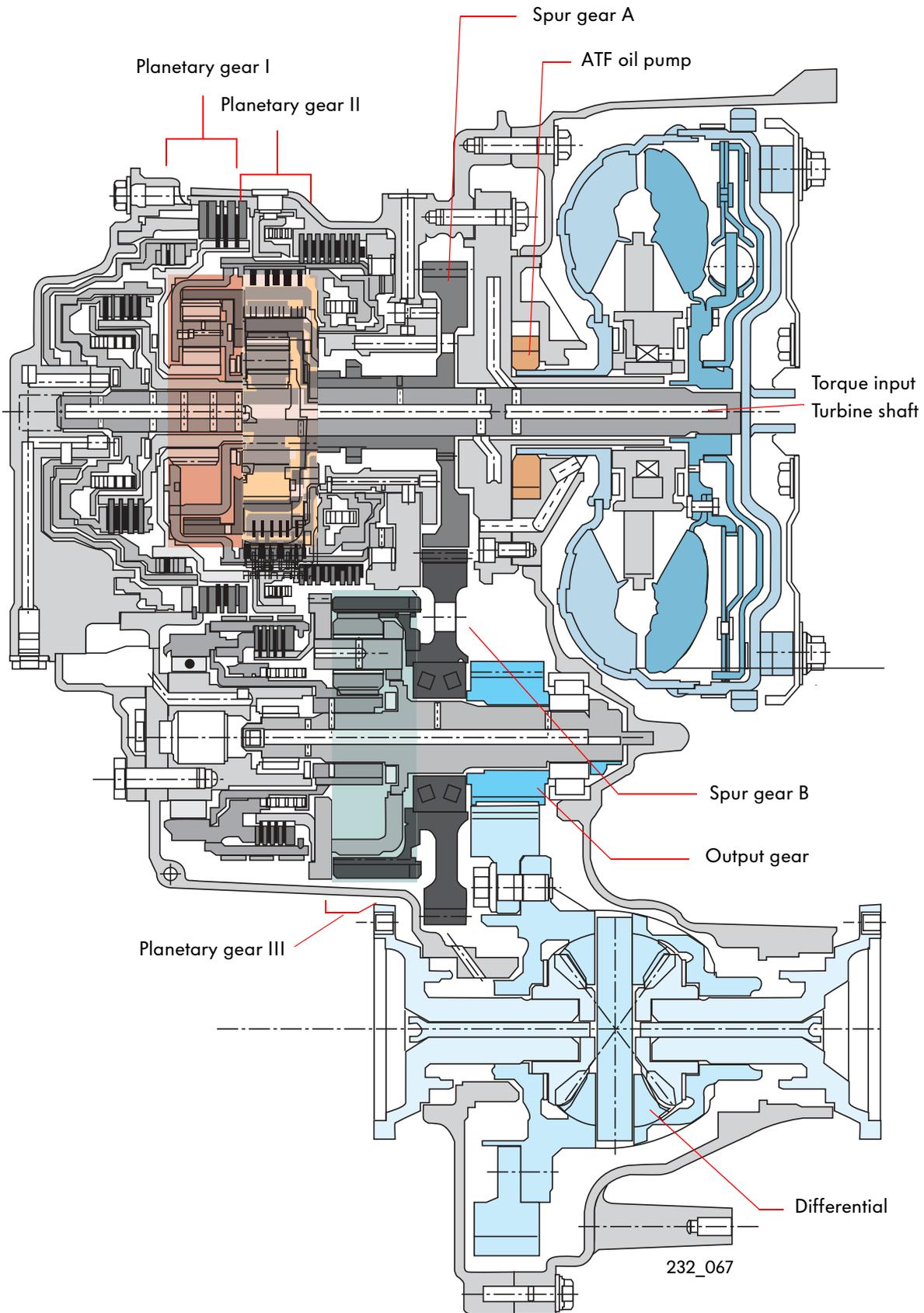
Planetary gears I and II are located directly on the turbine shaft. Planetary gear III is arranged below them on a separate shaft.

Planetary gears I and II are coupled to planetary gear III via spur gears A and B.

Torque is always output via the output gear on the shaft of planetary gear III. The torque is then transmitted from the output gear to the drive shaft via the differential.

The ATF oil pump is driven by the input rotor of the torque converter.

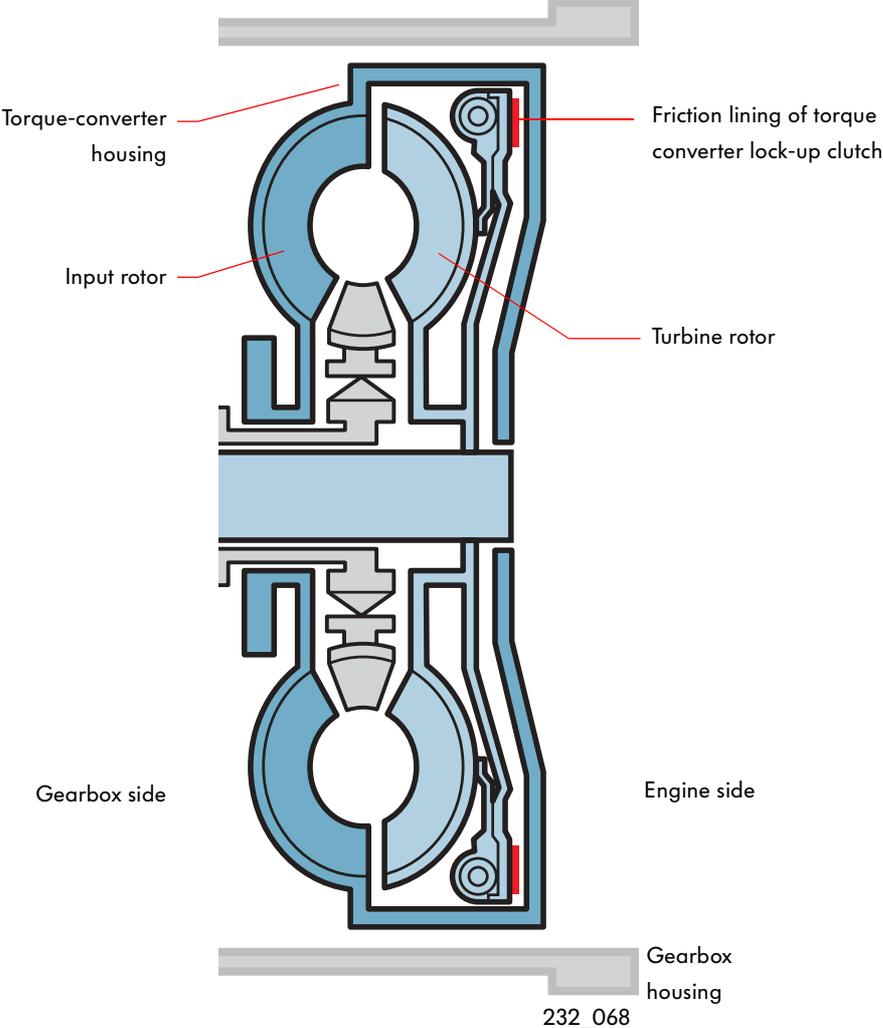




Gearbox design

The torque converter

is equipped with a torque converter lock-up clutch which transmits the engine torque directly to the gearbox input shaft at high engine speeds. The control unit controls the closing movement of the torque converter lock-up clutch.



This is how it works:

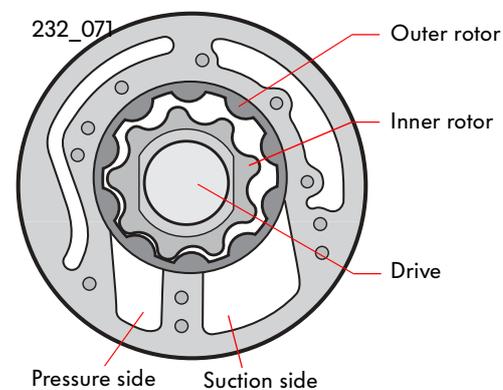
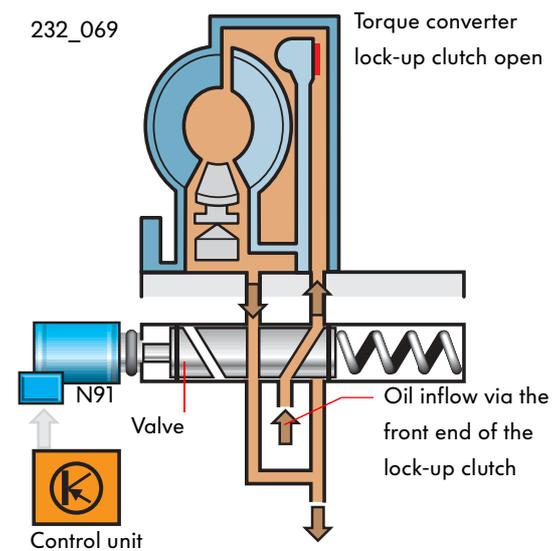
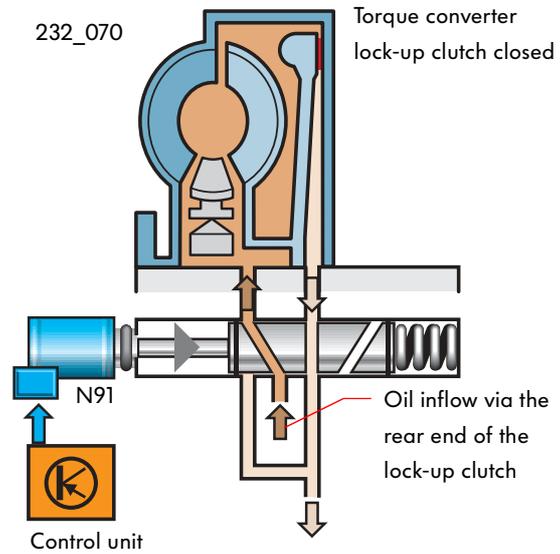
If the gearbox control unit decides, based on engine speed and engine torque, that it would be more economical to close the torque converter lock-up clutch, it activates solenoid valve N91.

The oil chamber upstream of the torque converter lock-up clutch is opened by the solenoid valve to allow oil pressure to drop. This causes the oil pressure downstream of the clutch to increase. The clutch closes.

When solenoid valve N91 shuts off the flow, the oil pressure upstream of the clutch builds up again. The clutch opens.

The ATF oil pump

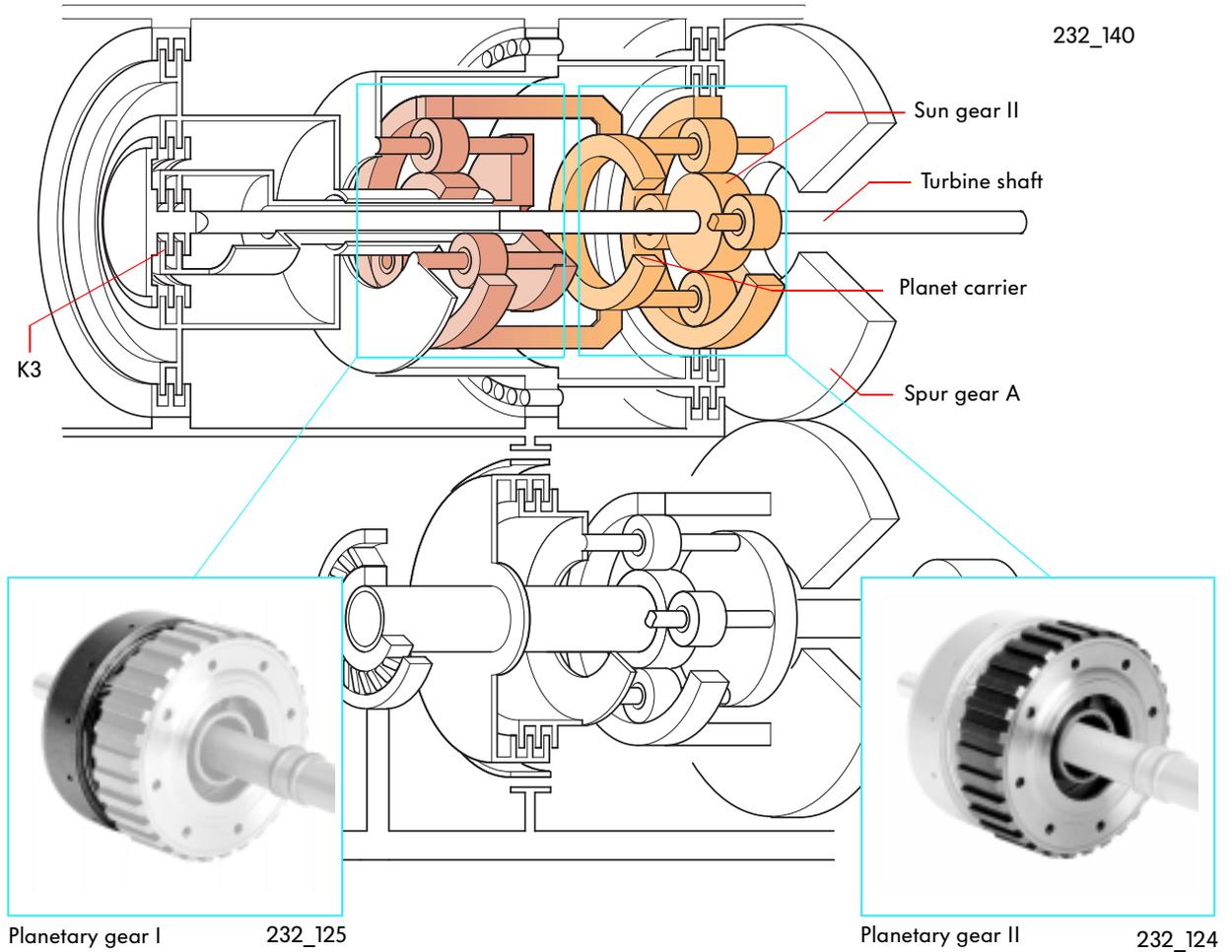
It is driven by the input rotor of the torque converter. Its tasks are to draw ATF oil out of the oil sump, build up oil pressure and transfer oil pressure to the valve body.



Basic configuration of gearbox

The planetary gear

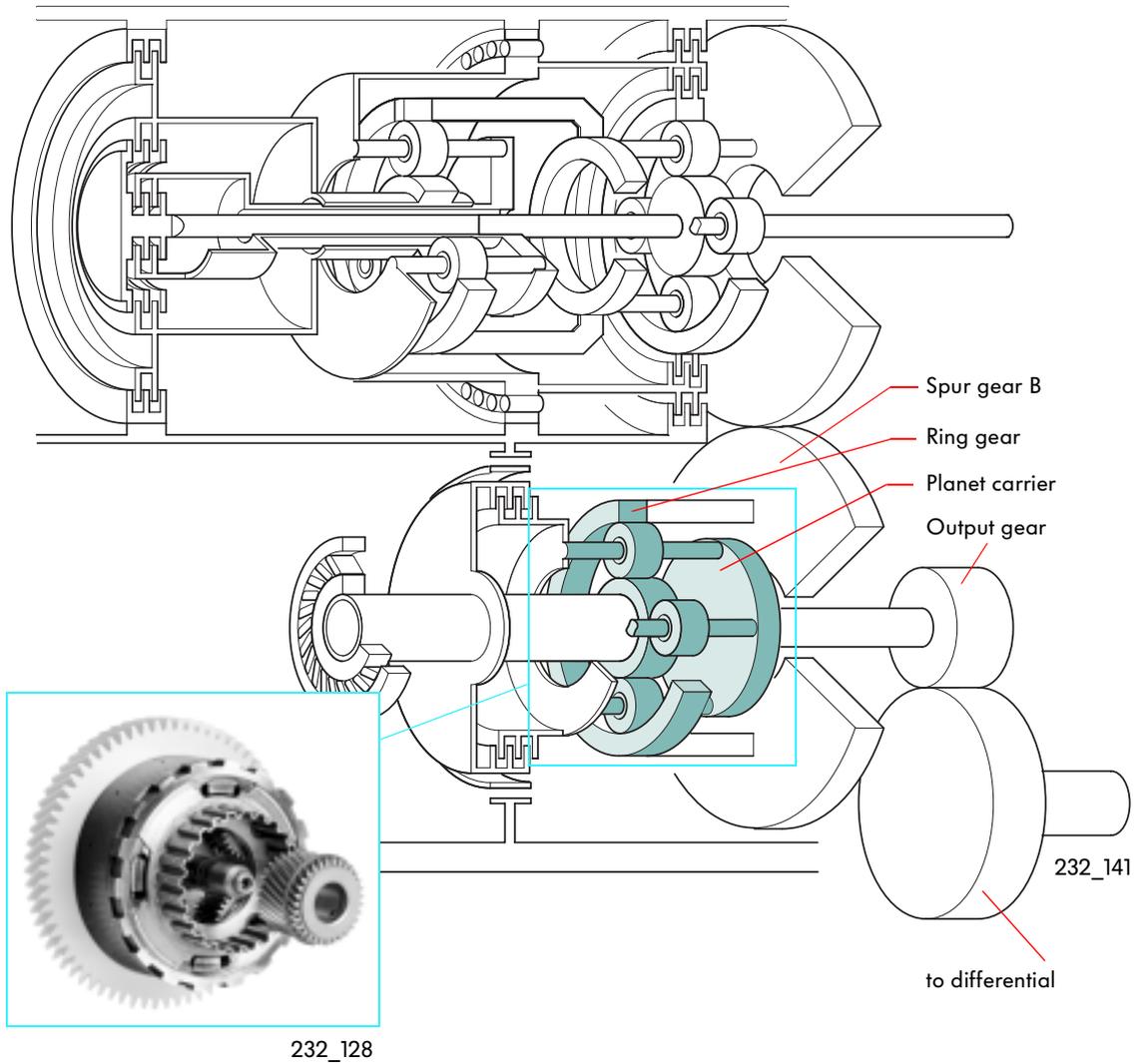
It comprises three individual planetary gears which engage the five forward gears and reverse gear.



Planetary gears I and II

They are connected to the turbine shaft of the torque converter. Torque is applied to planetary gear I via clutch K3 (indirect connection). Torque can only be transmitted to planetary gear I when clutch K3 is closed.

Planetary gear II is positively (directly) connected to the turbine shaft via the sun gear. Torque is always output from the planet carrier of planetary gear II to spur gear A.

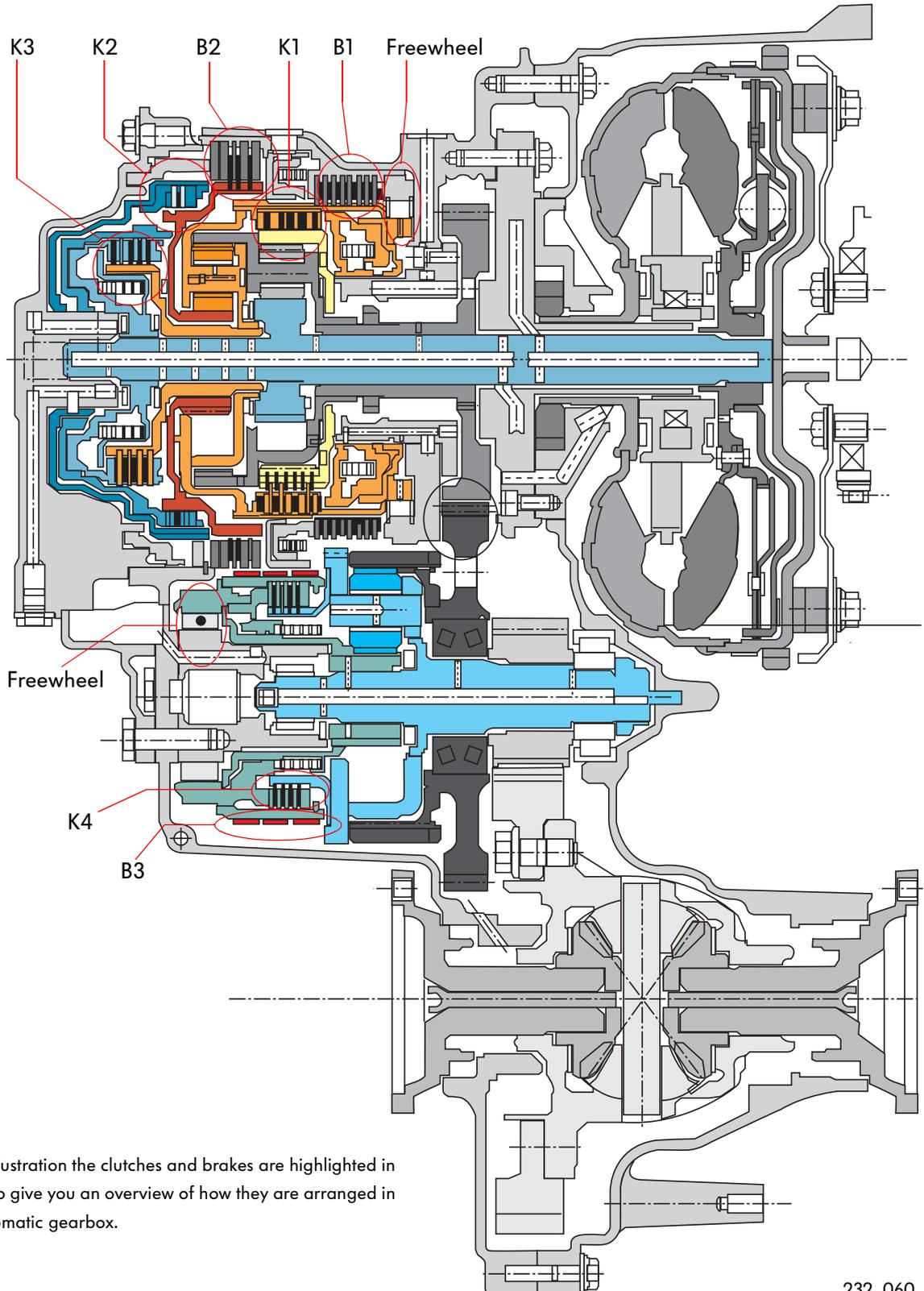


Planetary gear III

It receives torque via spur gears A and B onto the ring. The torque is output via the planet carrier to the differential output gear.

Basic configuration of gearbox

The position of the clutches and brakes



In this illustration the clutches and brakes are highlighted in colour to give you an overview of how they are arranged in the automatic gearbox.

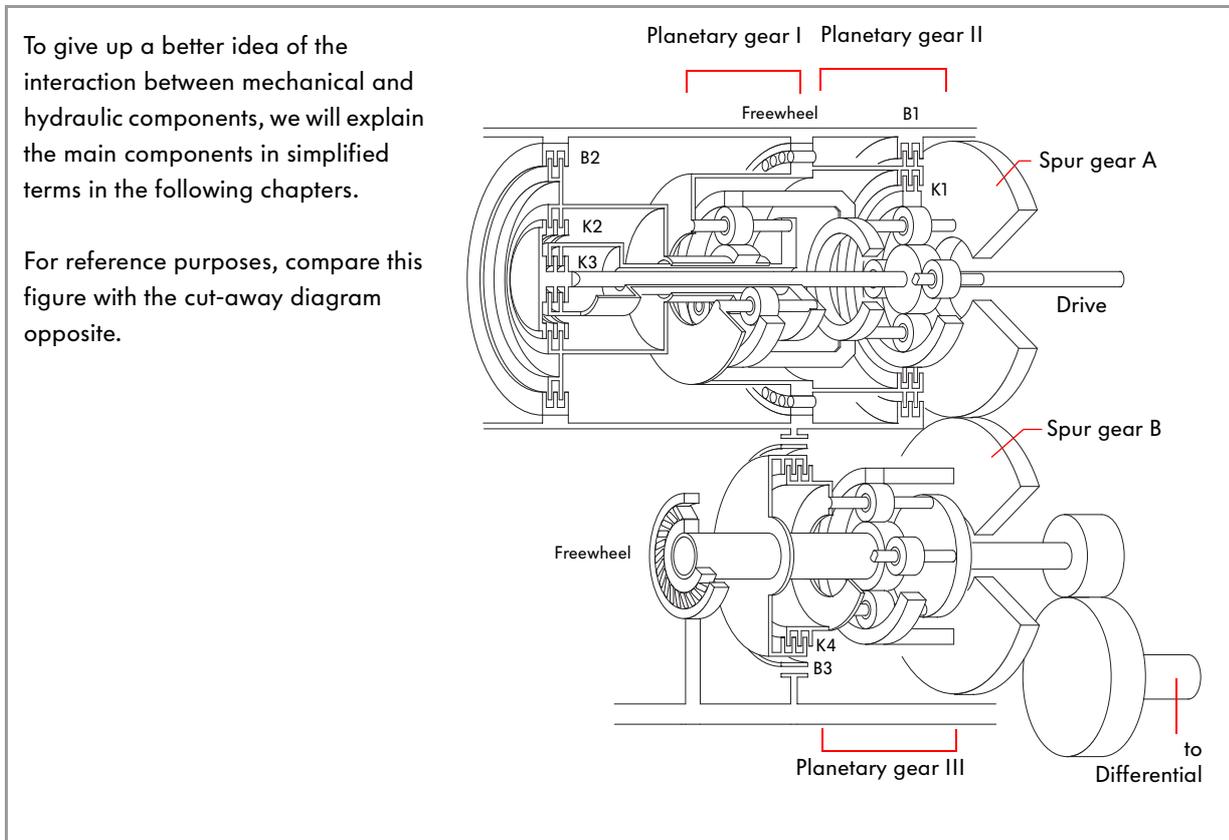
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Gears are engaged by driving or arresting components of the planetary gear by opening and closing the clutches and brakes.

Gears 1-4 and reverse gear are engaged via clutches K1, K2 and K3 and brakes B1 and B2.

Drive-away engine torque is compensated by the freewheels on planetary gears I and III.

5th gear is engaged by clutch K4 on planetary gear III. Brake B3 is closed in all gears, except 5th gear.

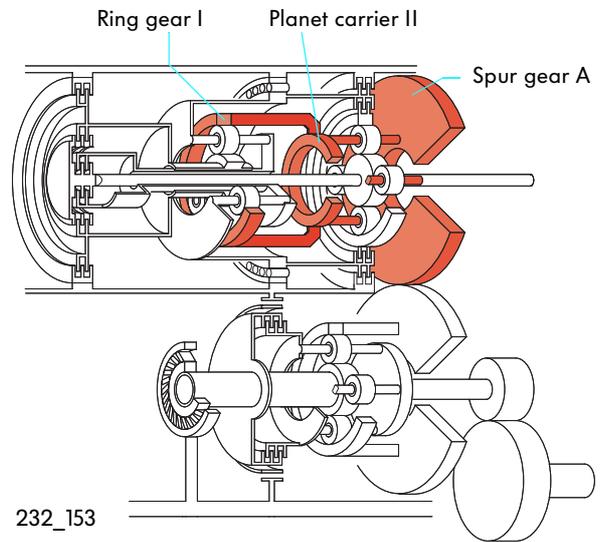


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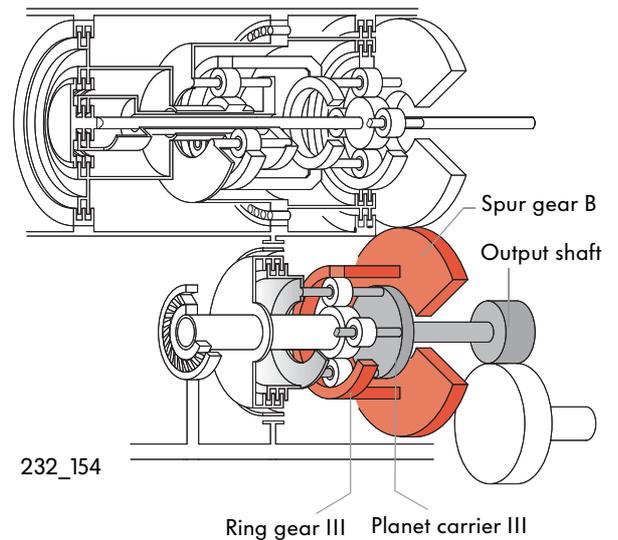
Basic configuration of gearbox

Fixed connections

Planetary gears I and II are mechanically coupled by the ring gear of planetary gear I and the planet carrier of planetary gear II. Torque is also output to spur gear A via planet carrier II.

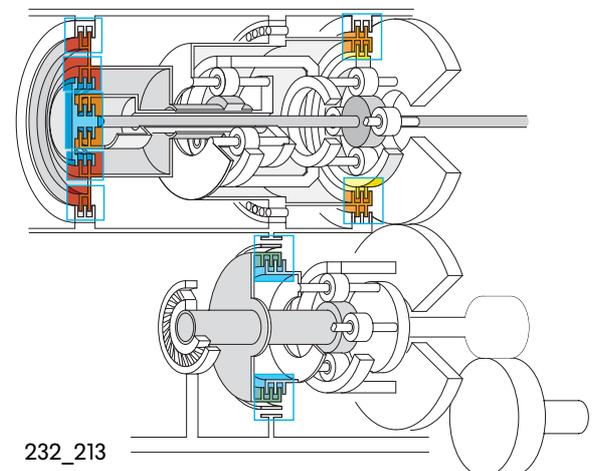


There are also positive mechanical connections in planetary gear III. Spur gear B is positively connected to the ring gear of the planetary gear and the planet carrier, in turn, is connected to the output shaft.



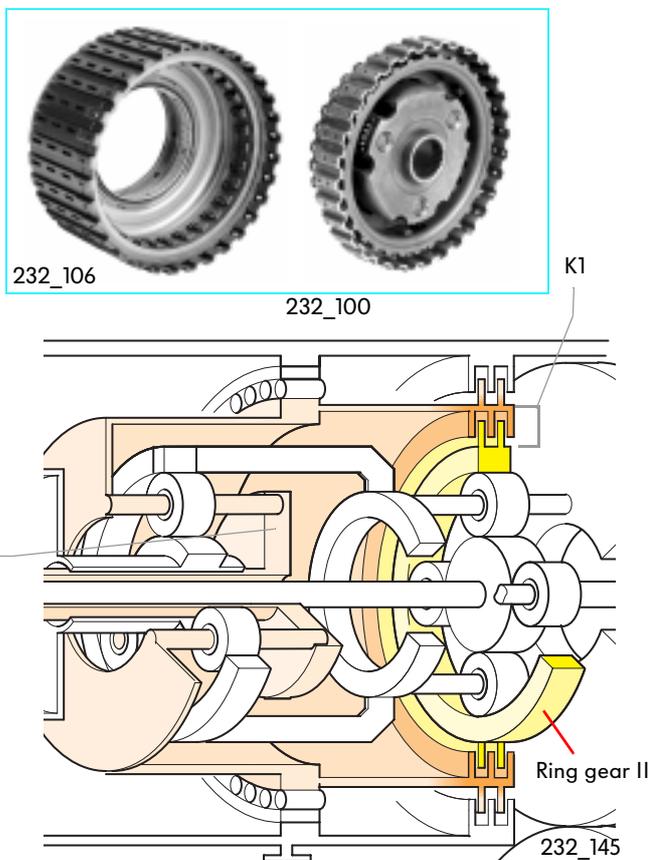
The clutches

They are controlled by the valve body by applying ATF oil pressure. When closed, the clutches drive individual components of the planetary gear and this transfers engine torque to the final drive.



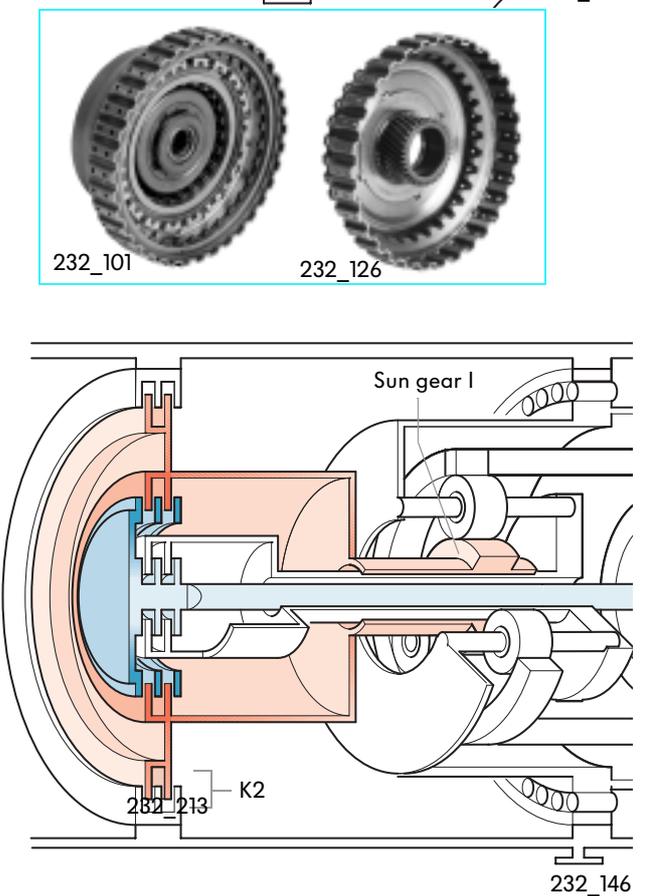
Clutch K1

It drives the ring gear of planetary gear II and the planet carrier of planetary gear I when closed. Clutch K1 is closed in first, second and third gear and has a centrifugal force equaliser (for function see SSP172).



Clutch K2

It drives the sun gear of planetary gear I. It is actuated by a ball valve and is closed in second gear (see SSP172).

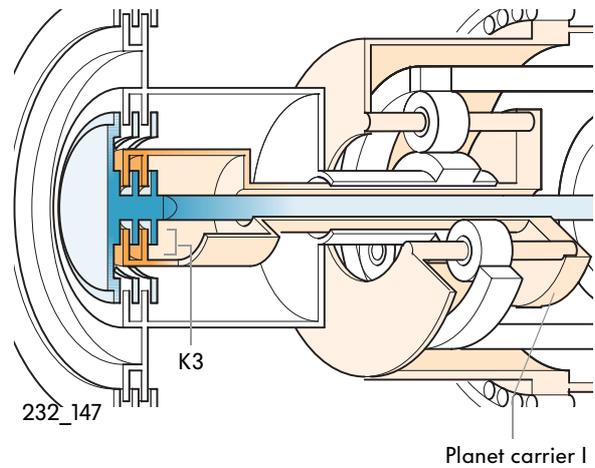
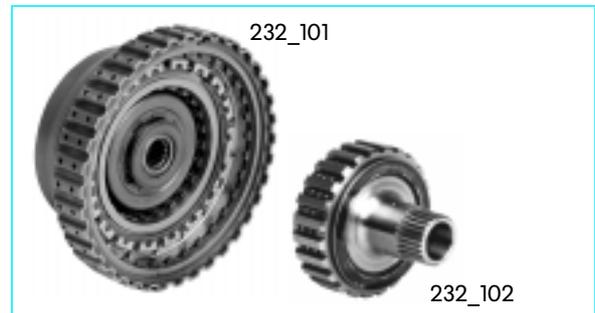


Basic configuration of gearbox



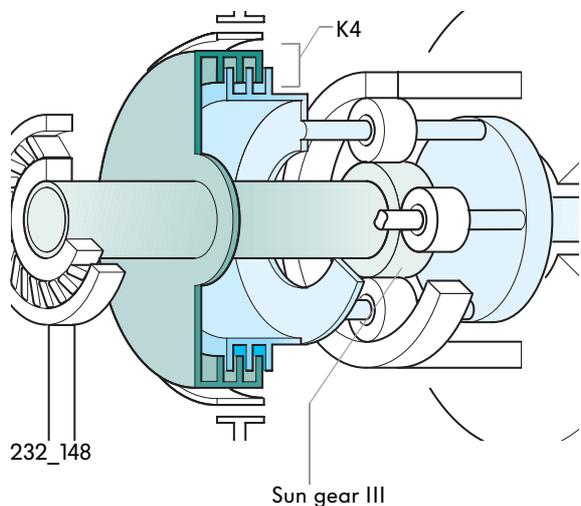
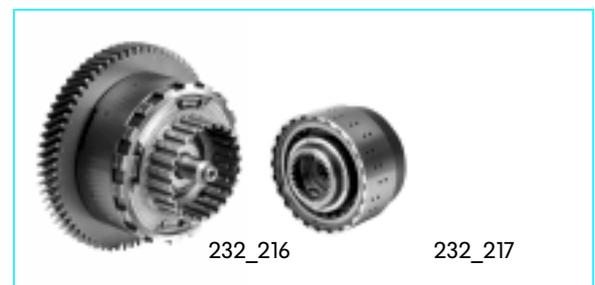
Clutch K3

It drives the planet carrier of planet gear I. Third, fourth and fifth gear are engaged via K3. This clutch also has a centrifugal force equaliser.



Clutch K4

It drives the sun gear of planetary gear III in fifth gear. This clutch is also actuated by a ball valve.

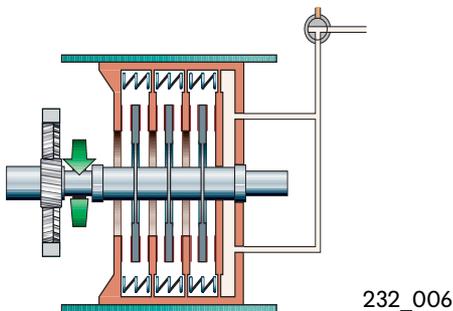




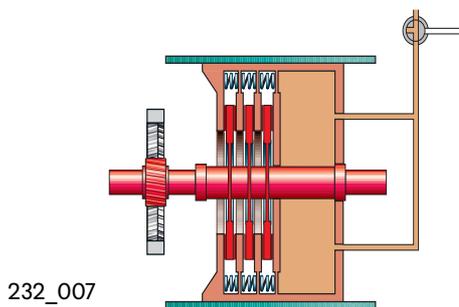
The brakes

The brakes in the automatic gearbox have the task of controlling the gear ratios by arresting individual components of the planetary gear. Different types of brake are used in the 5-speed automatic gearbox:

- Two multi-disc brakes and
- a singleband brake.



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Multi-disc brakes

They function according to the same principle as plate clutches. They also consist of two clutch plate sets which are pressed together hydraulically. Unlike the clutches, which drive the movable components of the planetary gear, the multi-disc brakes arrest these components.

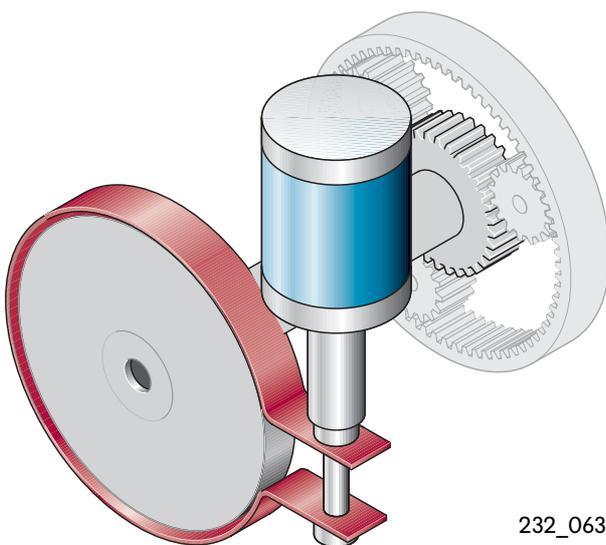
Example of multi-disc brake B1

Brake B1 is a clutch plate set connected to the gearbox housing and the planet carrier of planetary gear I. If the brake is required to arrest the planet carrier, the control unit sweeps the clutch plate set with ATF oil via the valve body.

Band brakes

They have the same function in the automatic gearbox as multi-disc brakes. However, the clutch plate sets are not pressed against each other. Instead, a brake band is tightened by a hydraulic cylinder.

In this illustration you can see that the sun wheel of the planetary gear is arrested when the brake band is applied.



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Basic configuration of gearbox

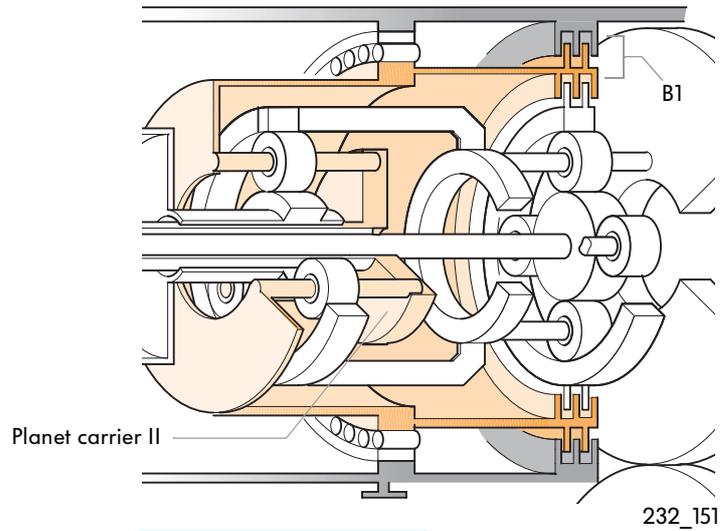


Multi-disc brake B1

It arrests the planet carrier of planetary gear II in reverse gear and the first gear of the Tiptronic by means of the engine brake.



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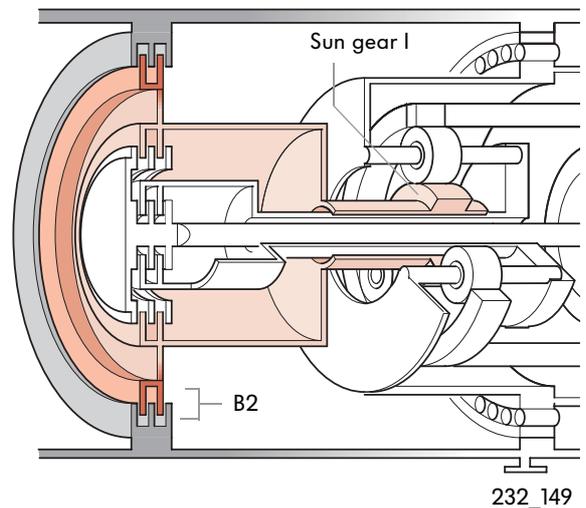


Multi-disc brake B2

It arrests the sun gear of planetary gear I in second, fourth and fifth gear.



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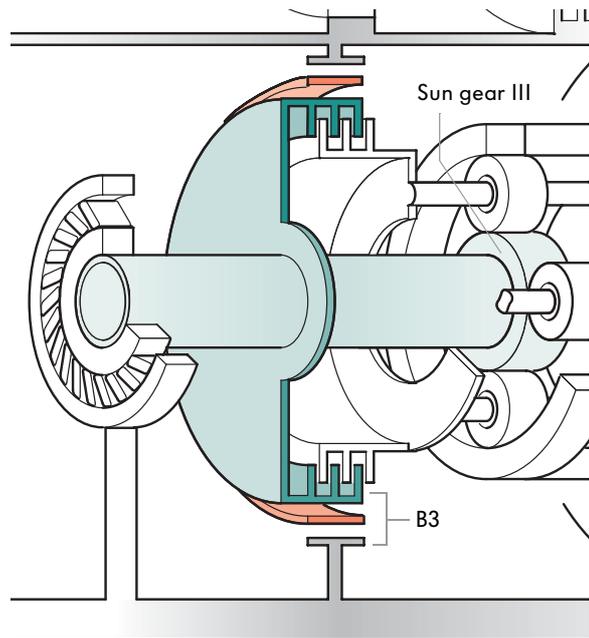


Band brake B3

It arrests the sun gear of planetary gear III.
It is closed in all gears, except in fifth gear.



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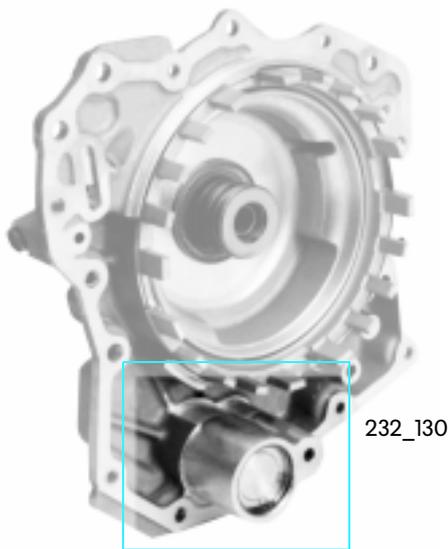


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Basic configuration of gearbox

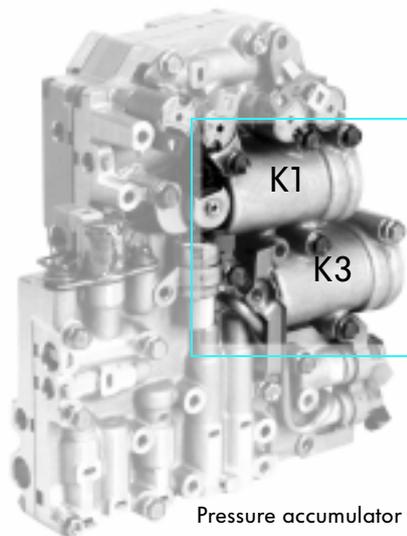
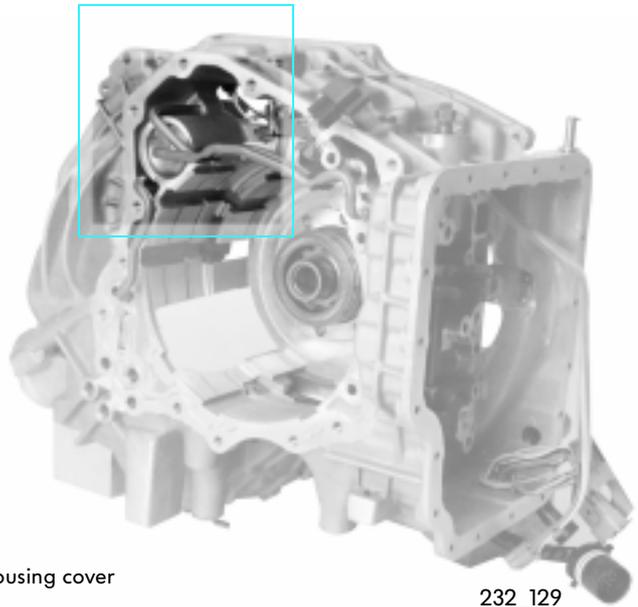
The pressure accumulator

A pressure accumulator is located in the hydraulic circuits of clutches K1, K3 and K4 as well as multi-disc brake B2. Two additional pressure accumulators are located in the valve body and gearbox housing respectively. Their task is to ensure that the clutches and brake mentioned above close softly.



Pressure accumulators in the housing and housing cover for brake B2

Pressure accumulator in the gearbox housing for clutch K4



232_131

Pressure accumulator on the valve body for clutches K1 and K3

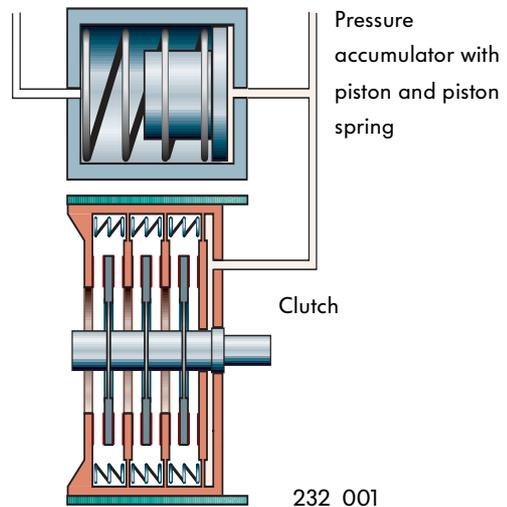
This is how it works.

Example:

First gear, selector lever position "D".

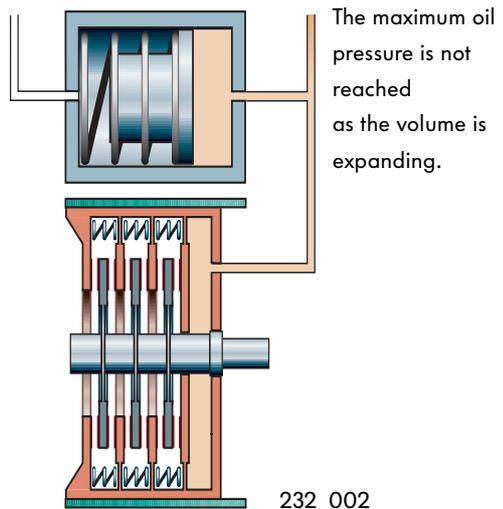
If one of the clutches or brakes mentioned in the introduction to this topic is closed, then pressurised ATF oil flows simultaneously from the valve body to the pressure accumulator and the clutch or brake to be closed.

Controlled oil pressure



In the pressure accumulator, the oil presses against a chamber filled with oil under pressure and a spring-loaded piston. A portion of the oil pressure is used to counteract the spring and oil pressure. Therefore, the full oil pressure is not applied to the clutch. The clutch does not close completely yet.

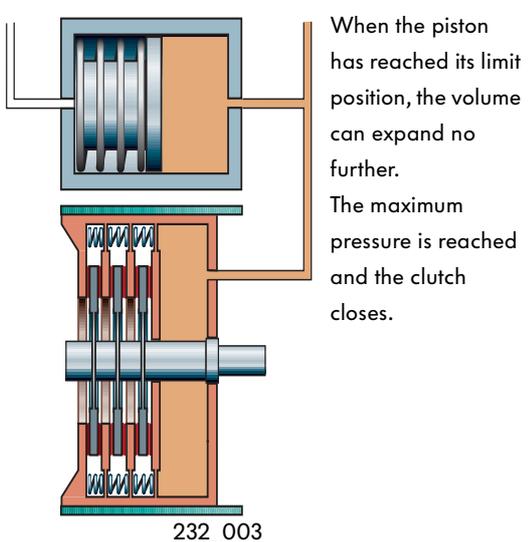
Controlled oil pressure



Only when the piston has reached its limit position does the full pressure act upon the clutch to close it completely.

This process follows exactly the same pattern as clutches K3 and K4 and brake B2, and is repeated during every gearshift.

Controlled oil pressure



Selector mechanism

The hydraulic control unit

has the task of controlling the automatic upshifts and downshifts of the individual gears at the correct point in time.

It comprises the following component parts:

- the valve body with control valve and two pressure accumulators,
- the solenoid valves and
- the hand-operated change-over valve.



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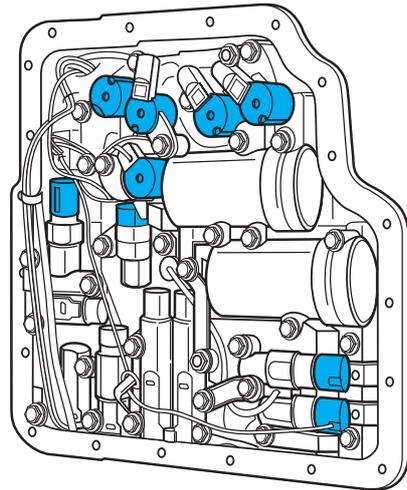
The valve body

It has the task of adapting the oil pressure built up by the ATF pump to the shift pressure and distributing it to all gear shifting elements.

Solenoid valves

N88- N93 and N281-N283 are arranged in the valve body. They are activated by the control unit.

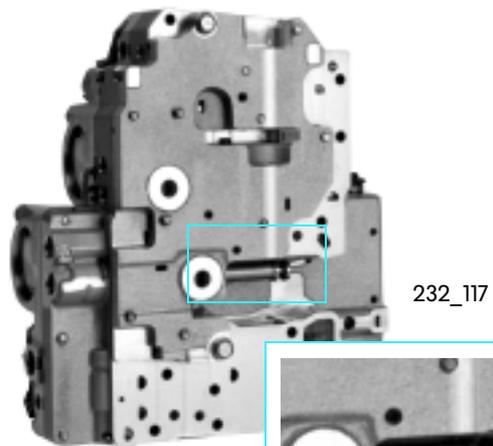
They are responsible for all changes in oil pressure in the oil galleries and supply the clutches and brakes with oil pressure.



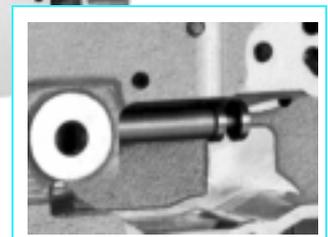
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The hand-operated change-over valve

It is actuated by the selector lever. The driver defines the desired drive position with the selector lever. Fourth gear and reverse gear are engaged directly via this valve without intervention by the control unit.



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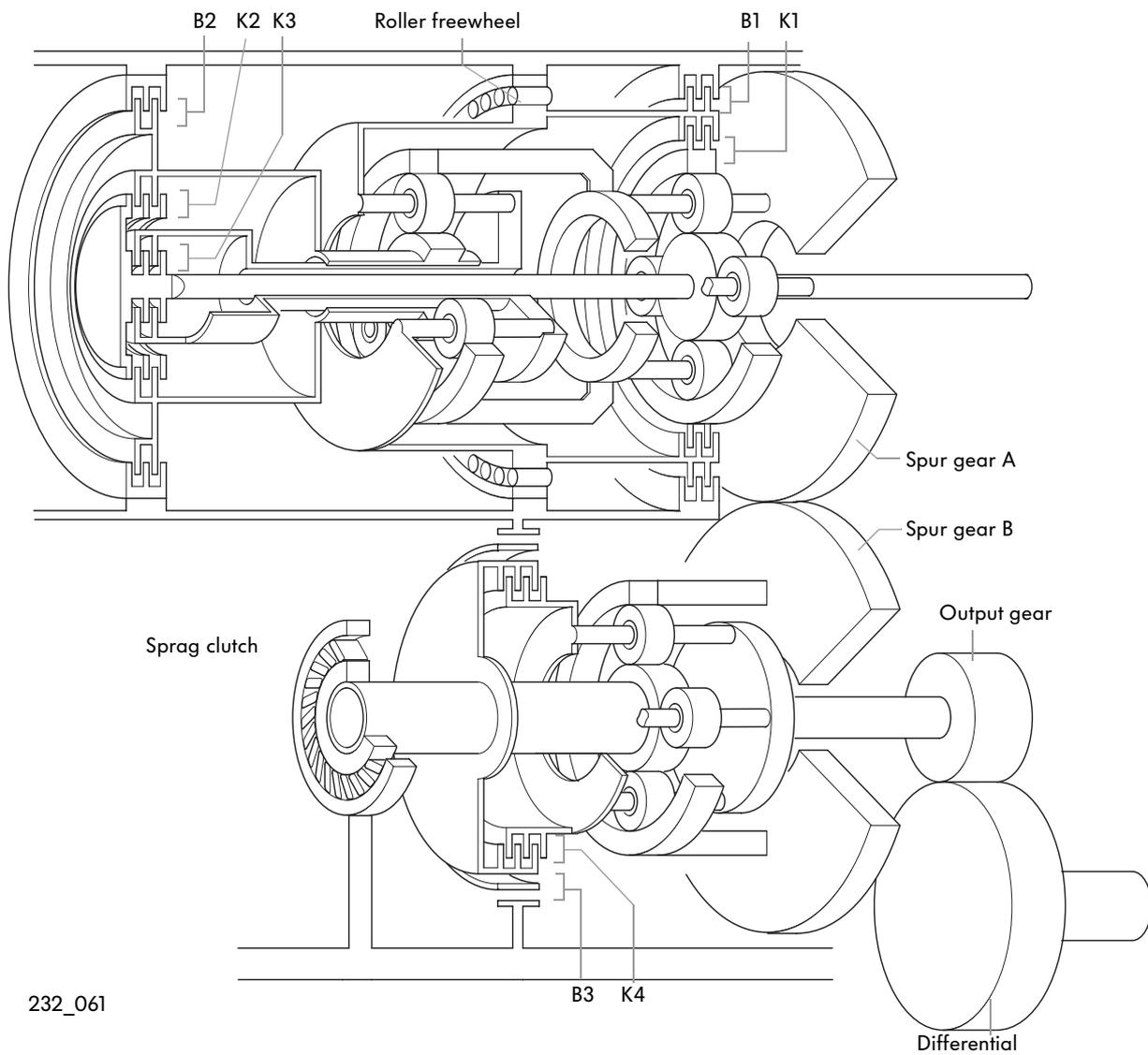


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Selector mechanism

To illustrate more clearly how the clutches and brakes on the planetary gear interact, we will now examine more closely what components are required to change gears.

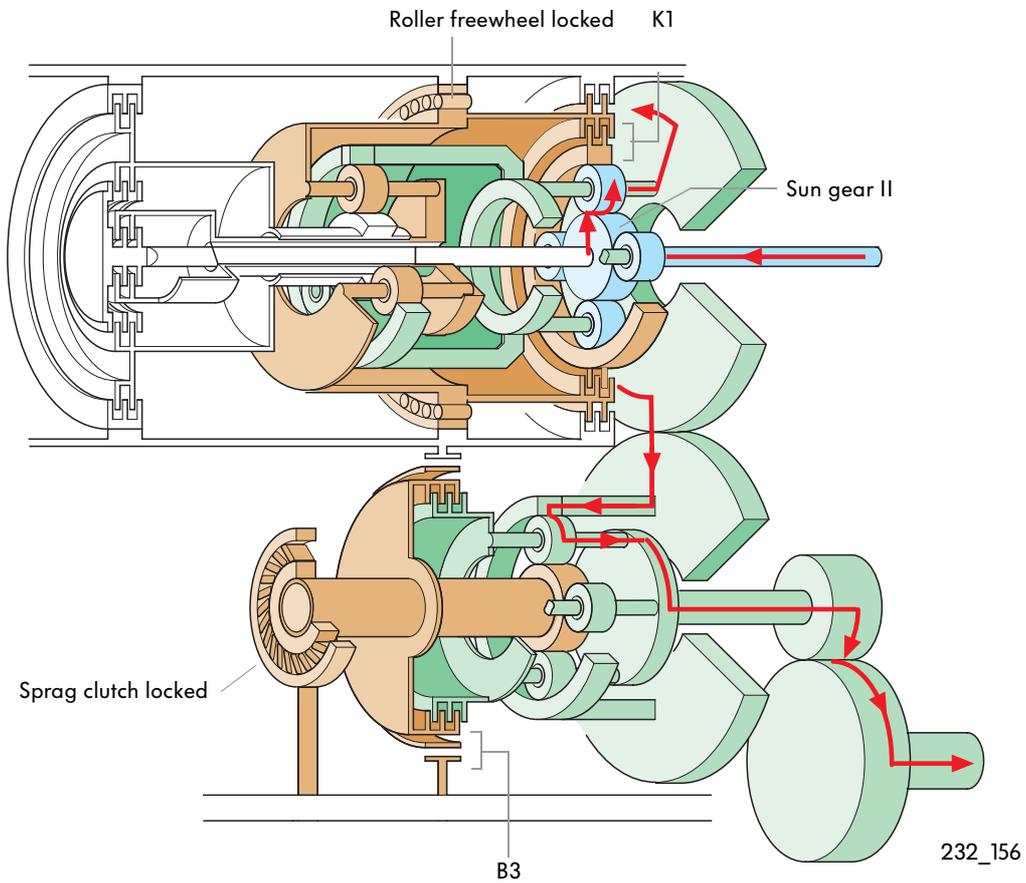
Let's recap on the component parts involved:



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Torque curve

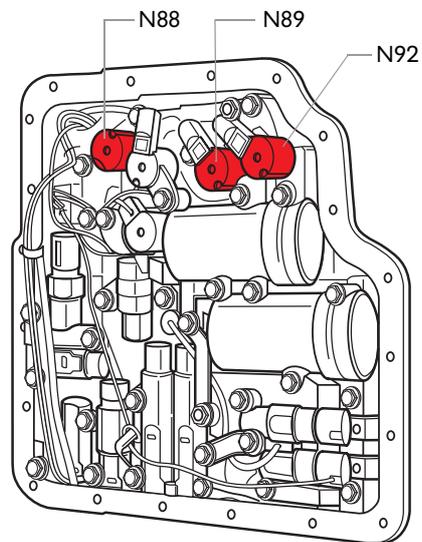
1st gear – selector lever position D



- █ Torque input
- █ Torque curve
- █ Torque output
- █ Arrested components

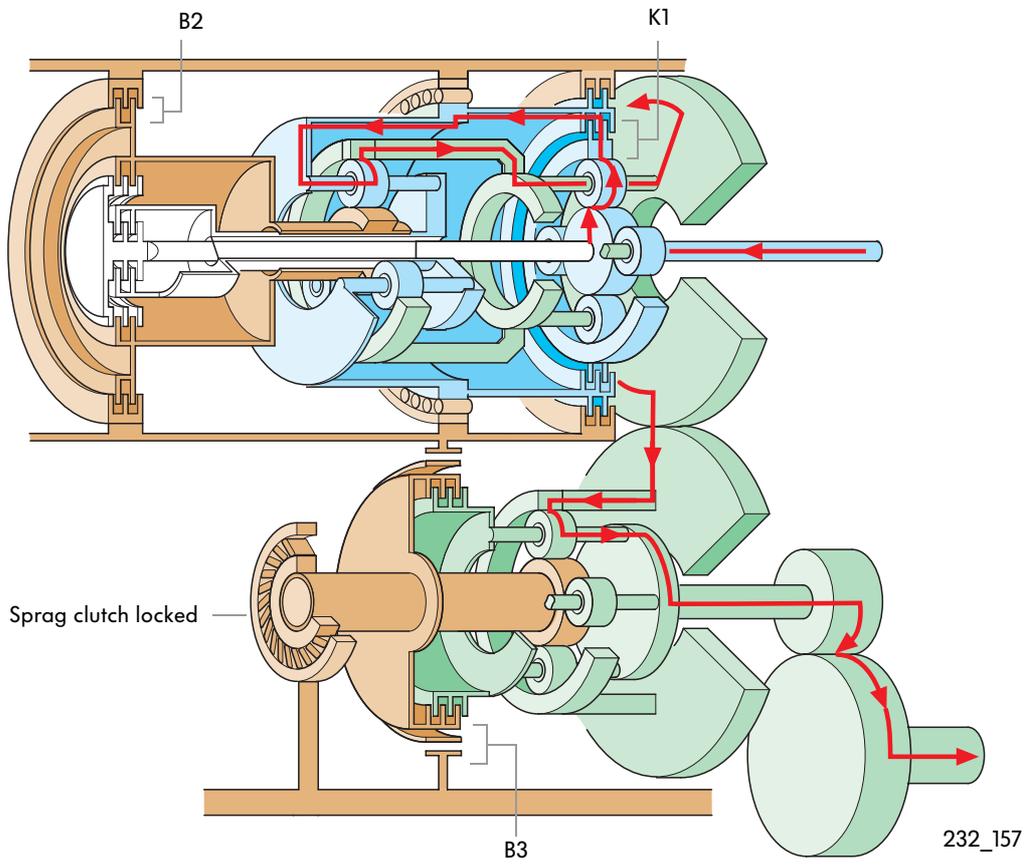
Valve body

- █ Solenoid valves energised



In Tiptronic 1st gear, brake B1 is additionally closed.
So the vehicle can be driven with the engine brake.

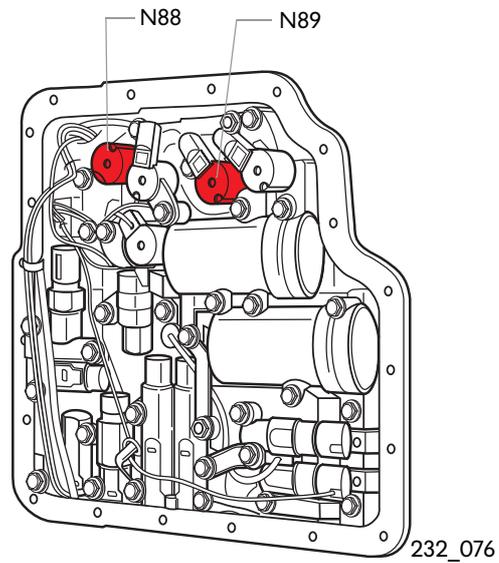
2nd gear



- Torque input
- Torque curve
- Torque output
- Arrested components

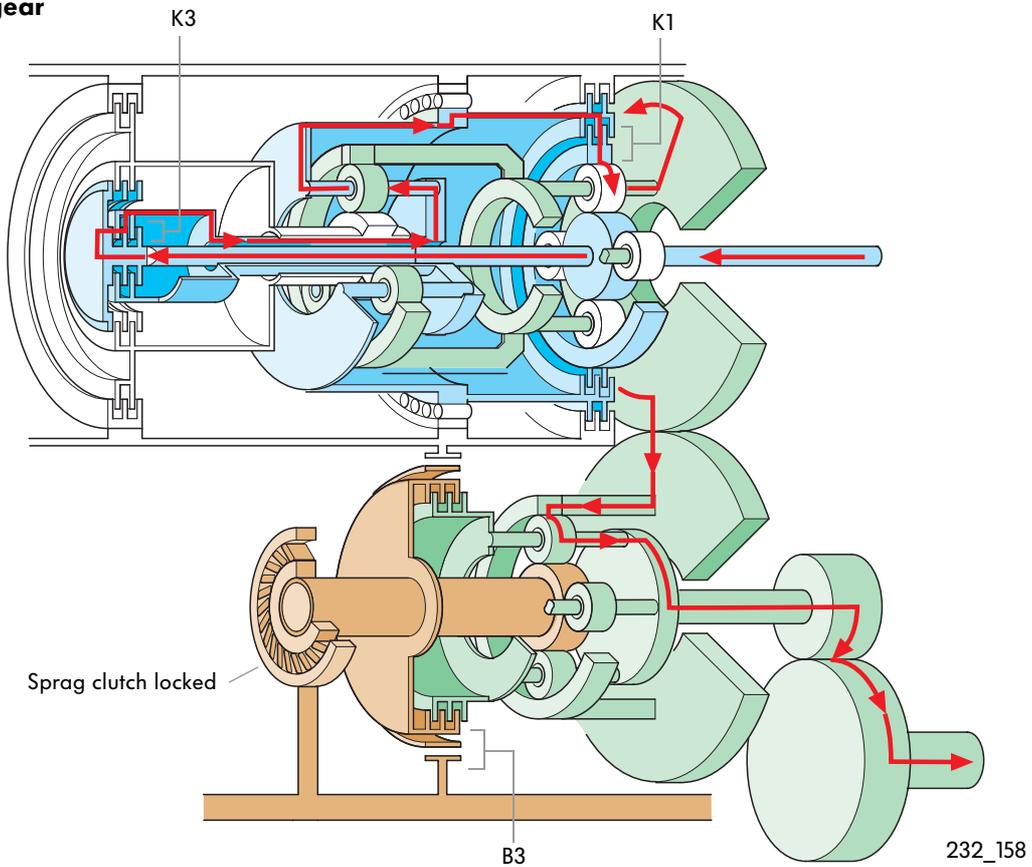
Valve body

- Solenoid valves energised



Torque curve

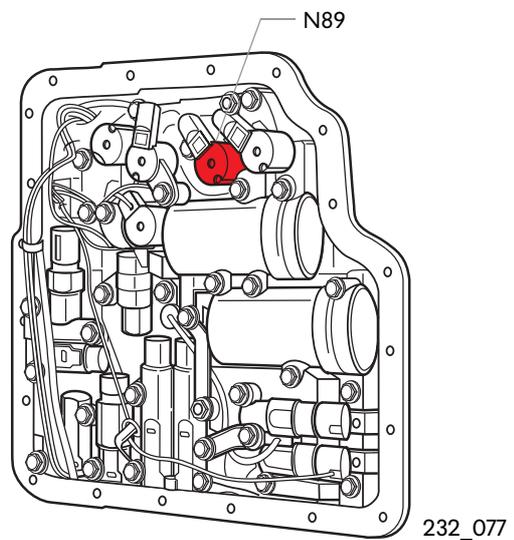
3rd gear



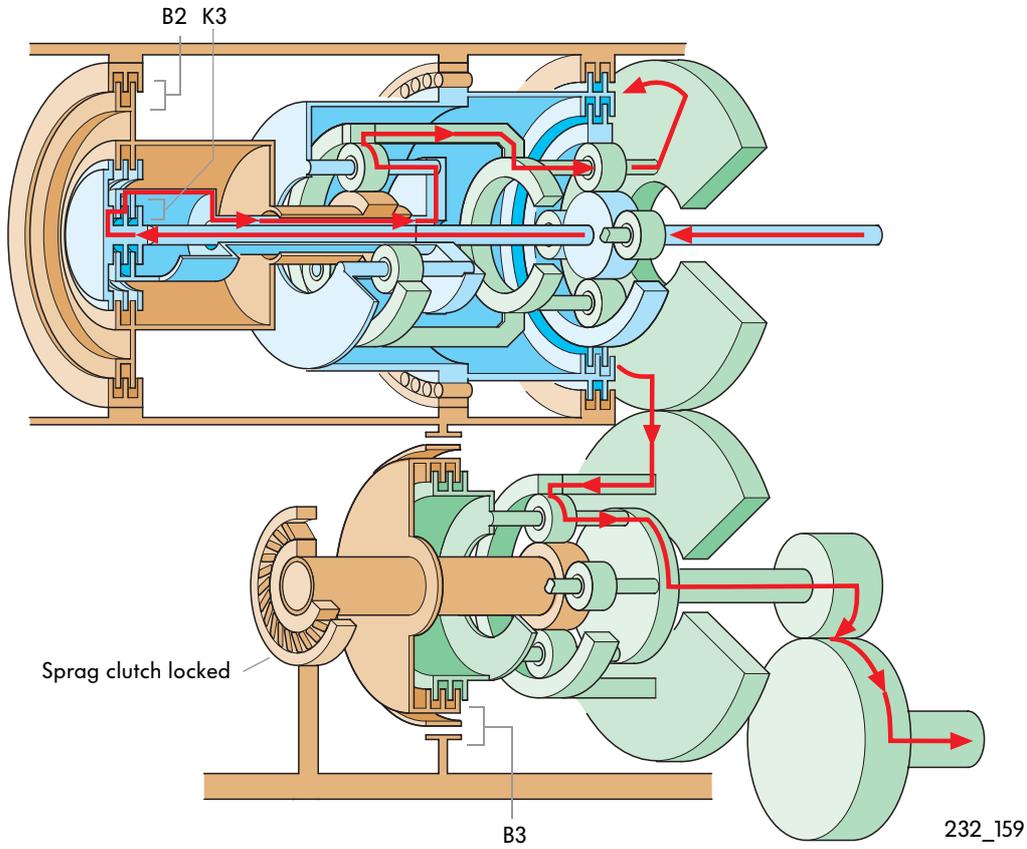
- █ Torque input
- █ Torque curve
- █ Torque output
- █ Arrested components

Valve body

- █ Solenoid valves energised



4th gear



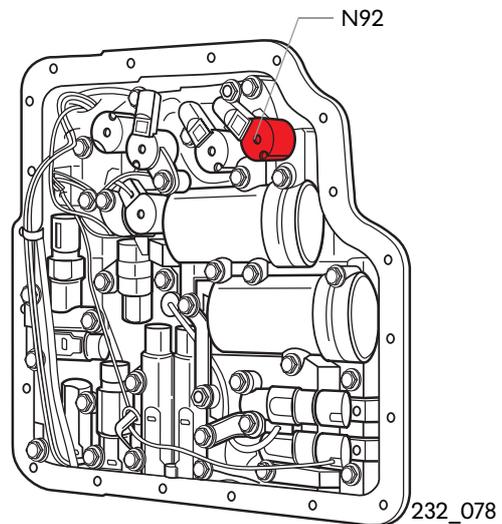
- Torque input
- Torque curve
- Torque output
- Arrested components

Valve body

- Solenoid valves energised

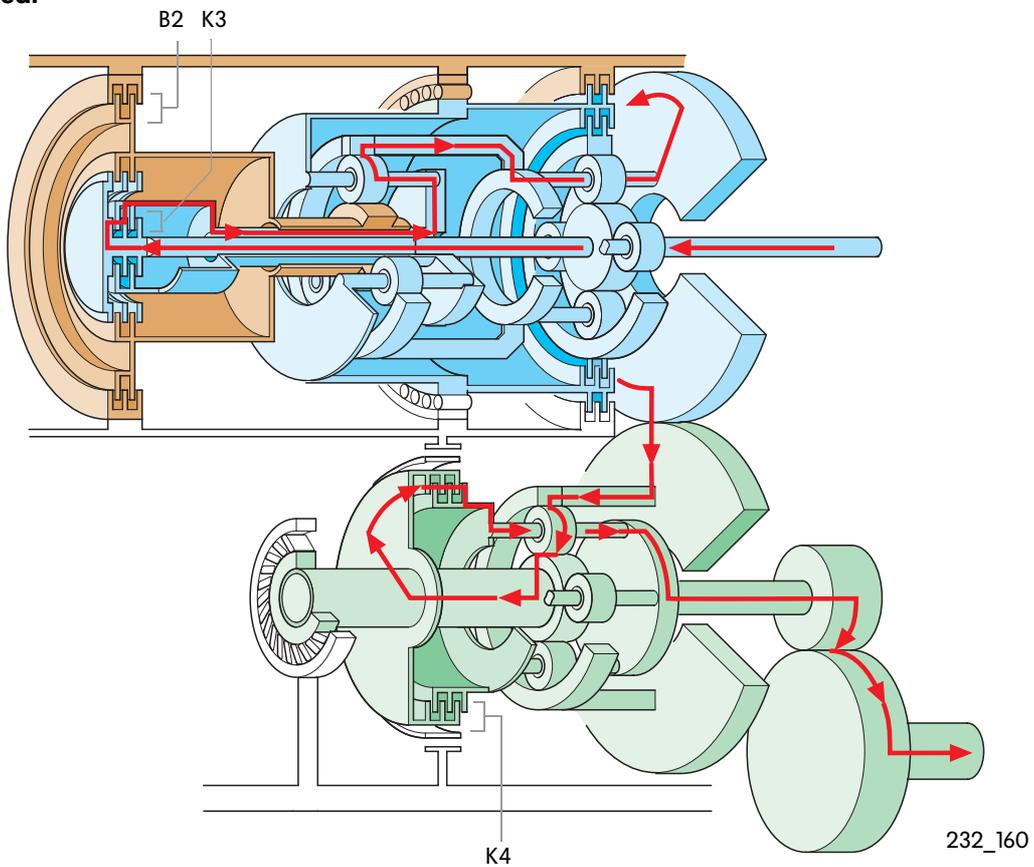


If the solenoid valves cannot be activated (e.g. because the control unit has failed), fourth gear is engaged by the manual selector valve.



Torque curve

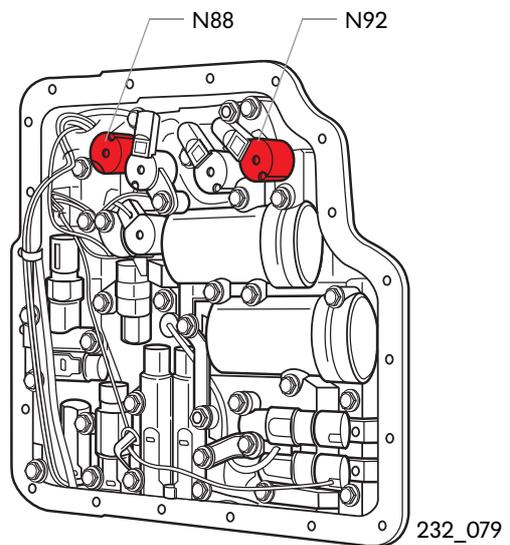
5th gear



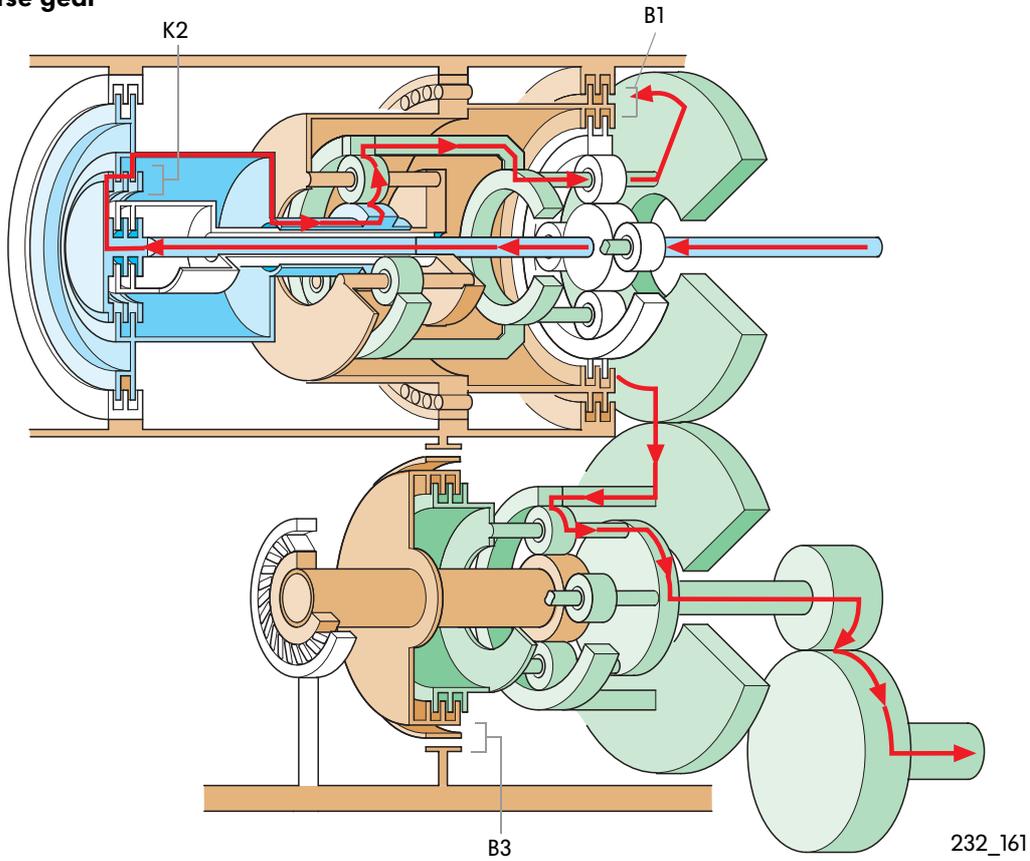
- █ Torque input
- █ Torque curve
- █ Torque output
- █ Arrested components

Valve body

- █ Solenoid valves energised



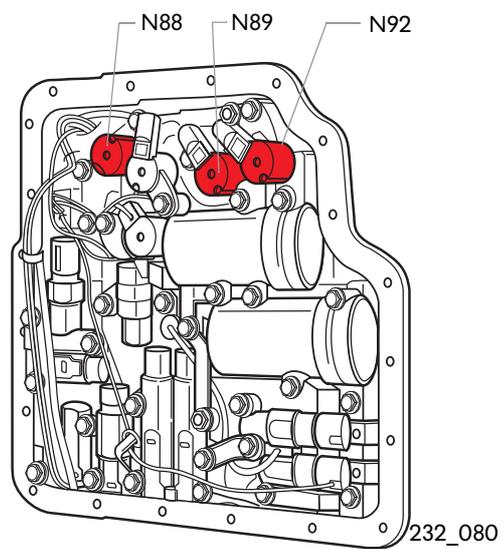
Reverse gear



- Torque input
- Torque curve
- Torque output
- Arrested components

Valve body

- Solenoid valves energised



System overview

Sensors

Automatic gearbox control unit **J217**

Gearbox input speed sender **G182**

Road speed sender **G68**

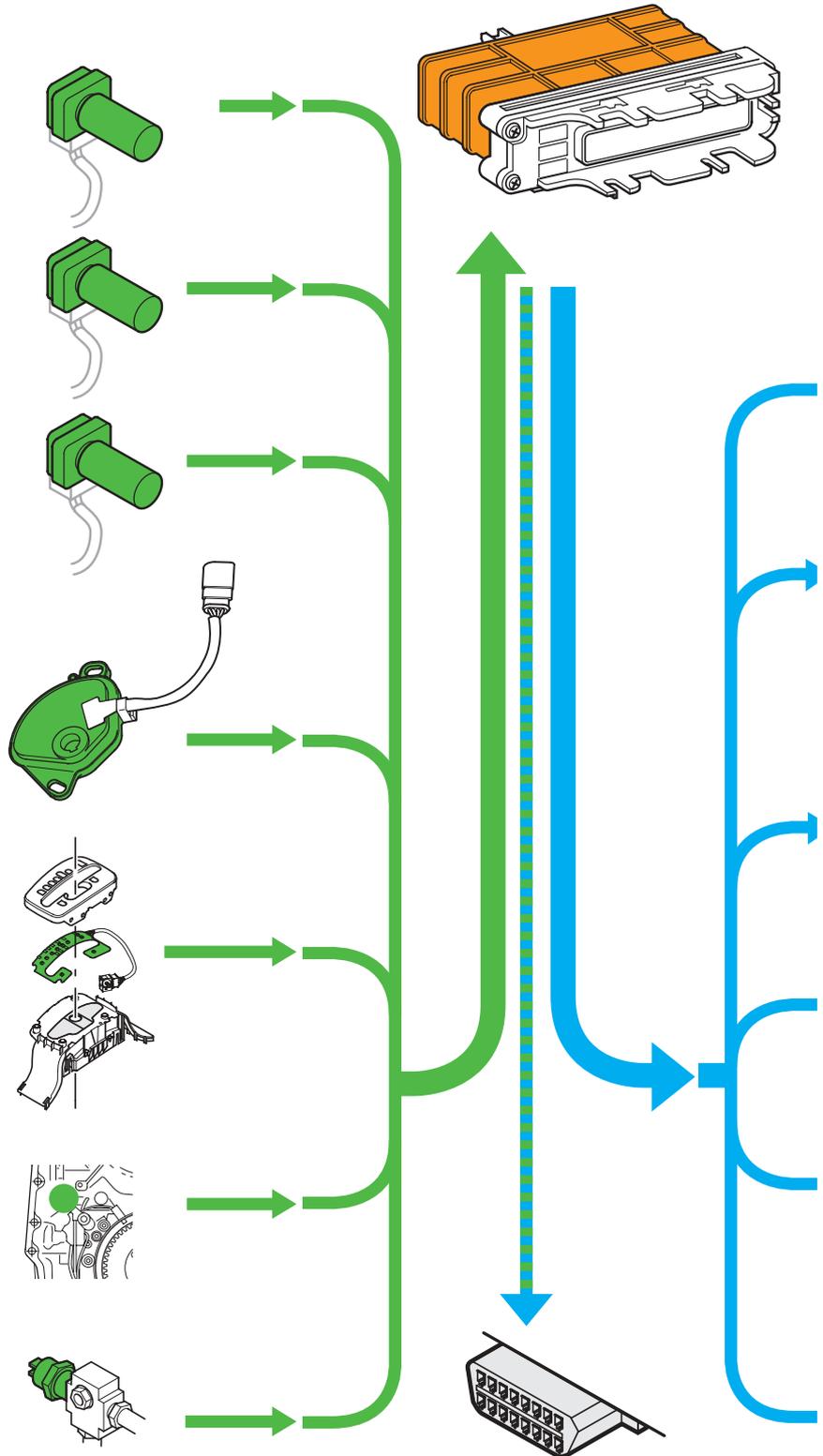
Intermediate shaft speed sender **G265**

Multi-function switch **F125**

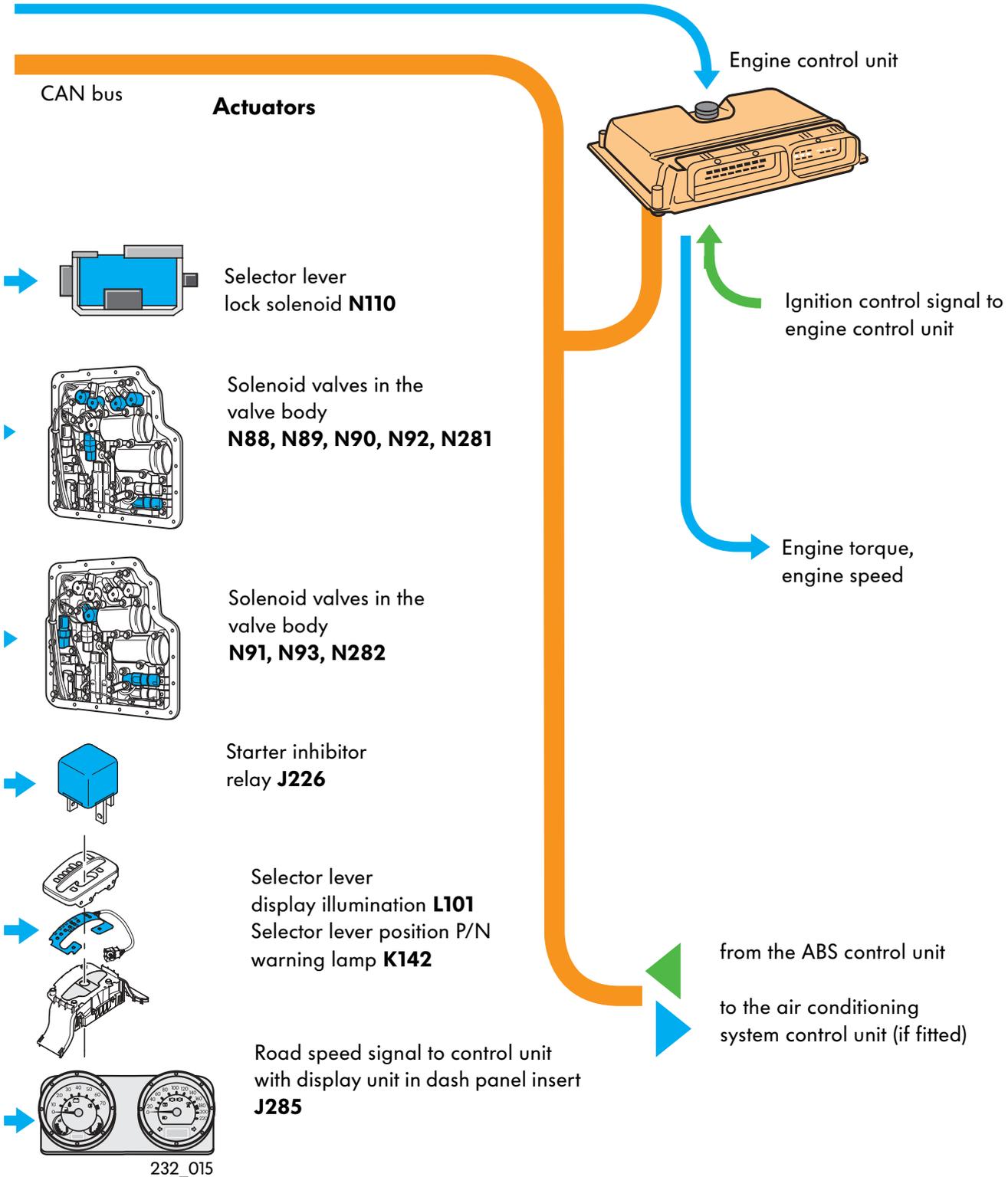
Tiptronic switch **F189**

Gearbox oil (ATF) temperature sender **G93**

Brake pressure switch **F270**



Signal for cruise control system



232_015

Electronic components - The control unit

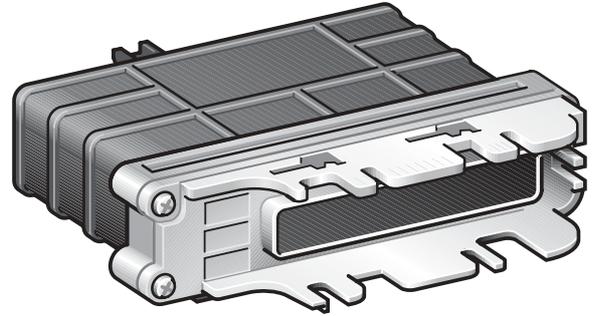
Automatic gearbox control unit J217

This is the brain of the gearbox. It controls the output signals as well as the actuators, based on the information received from the sensors.

The driving programs

The control unit has a driver/situation-dependent driving program based on the information processing fuzzy logic (refer to SSP172).

An additional program recognises and makes allowance for tractive resistance, e.g. when driving uphill or downhill, as well as the influencing factors when driving into headwind or towing a trailer.



232_081

Emergency running mode

If the gearbox control unit fails,

- fourth gear and
- reverse can still be selected.



These gears are mechanically shifted in the valve body by the selector lever via the manual selector valve.



232_162

Torque signal from engine control unit

In all vehicles with an electronic accelerator pedal control (EPC), the main input variable in the gearbox control unit is the torque signal from the engine control unit. The gearbox control unit receives this signal via the CAN bus. It replaces the signal from the throttle valve potentiometer used in previous automatic gearboxes.

Due to the new functional structure the engine control units, where engine torque is used as the central reference variable, the signal from the engine control unit now refers directly to the actual torque.

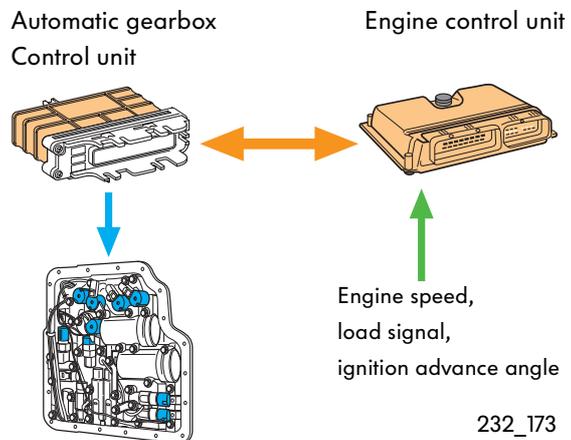
This allows the gearbox control unit to adapt the shift pressures to the actual engine torque with much greater accuracy and to execute gearshifts more precisely and smoothly.

Signal utilisation

On the basis of the torque signal, the gearbox control unit determines what shift pressures are required. The gearshift sequence is structured in such a way that the gearbox control unit first sends a signal to the engine control unit indicating that it wishes to execute a gearshift. The engine control unit then reduces engine torque so as to allow the gearbox control unit to close the clutches at low pressure. This results in soft, jolt-free gearshifts.



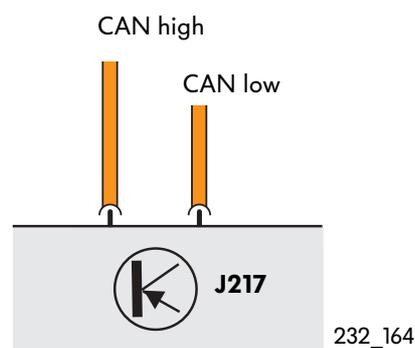
This modification will also be made to the Polo with electronic accelerator pedal control and automatic gearbox.



Effects of signal failure

Gearshifts are harsher as shift pressure cannot be adapted by the gearbox control unit.

Electrical circuit



Electronic components - The sensors

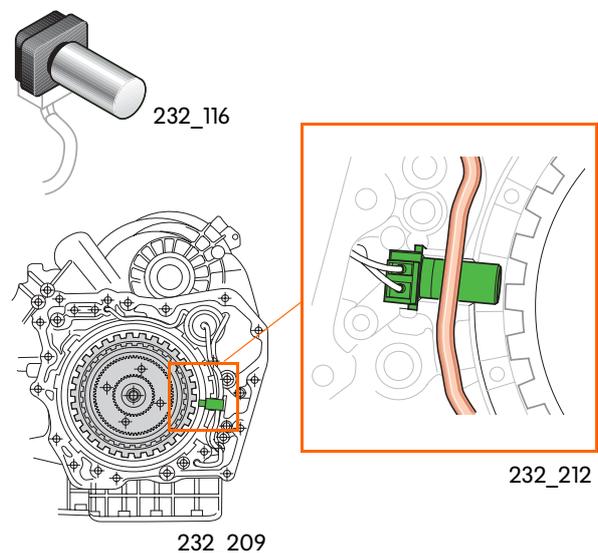
**Data is transferred directly to the control unit
(and not via the CAN bus)**

The engine speed sensor

There are three engine speed sensors in the automatic gearbox. All three sensors are housed in the gearbox and are not accessible from outside. They are all inductive senders and are of identical design.

Gearbox input speed sender G182

detects the speed of the gearbox input shaft by sampling the teeth on the outside of clutch K2.



Signal utilisation

The control unit uses this signal to:

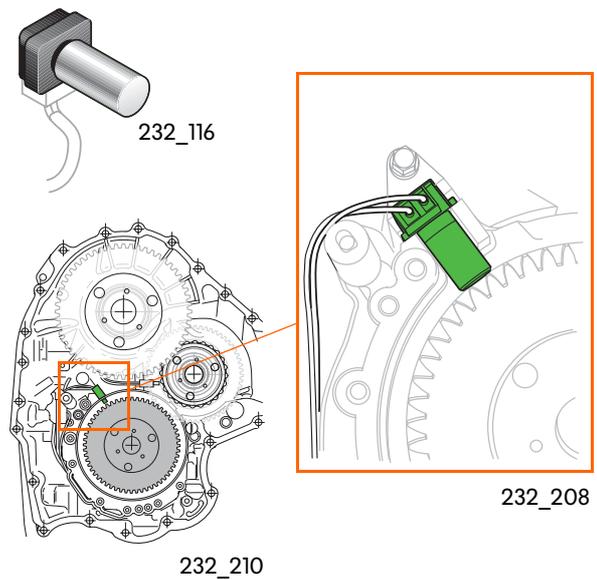
- control the torque converter lock-up clutch and
- calculate the slippage of the torque converter lock-up clutch

Effects of signal failure

The gearshifts are harsher.
The stationary decoupling function is de-activated and the lock-up clutch can no longer be closed.

Intermediate shaft speed sender G265

This sender picks up a signal corresponding to the number of teeth on spur gear A at the torque output of planetary gears I and II.



Signal utilisation

The control unit requires this signal to determine the opening and closing times of the clutches.



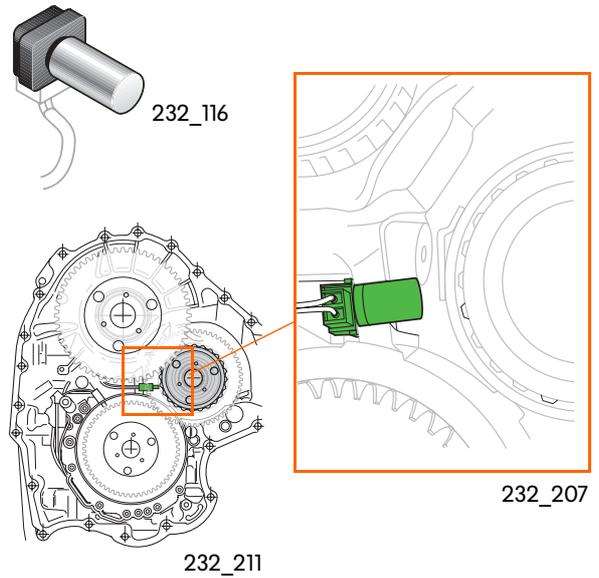
Effects of signal failure

The stationary decoupling function is de-activated.
The gearshifts are harsher.

Electronic components - The sensors

Road speed sender G68

detects the speed of the parking lock gear.



Signal utilisation

The control unit requires this signal:

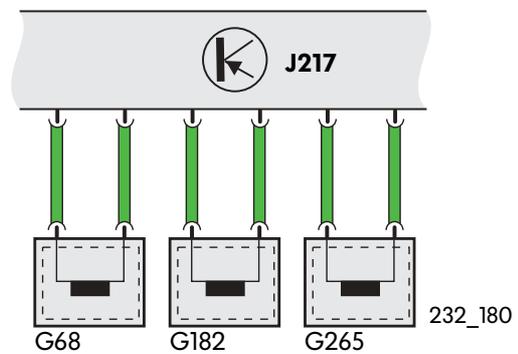
- to calculate vehicle speed,
- to select the gears and
- to control the torque converter lock-up clutch



Effects of signal failure

5th gear is no longer engaged. The gearshifts are harsh, the stationary decoupling function is de-activated and the shift points are displaced.

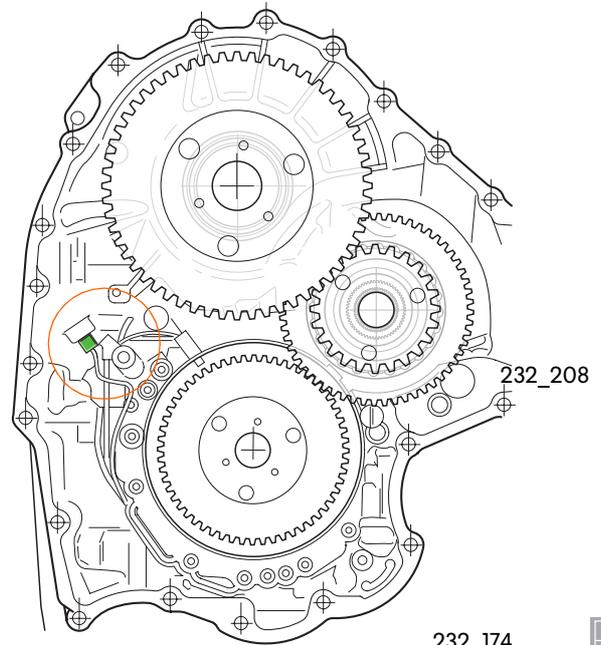
Electrical circuit



The vehicle speed signal is sent to the control unit with a display unit in the dash panel.

Gearbox oil (ATF) temperature sender G93

It is also located inside the gearbox housing. It continuously monitors the temperature of the ATF oil and sends a temperature signal to the gearbox control unit.



Signal utilisation

The gearbox control unit uses the ATF oil temperature to calculate a hot-engine shift program in order to regulate shift pressures as a factor of gear oil temperature. In simplified terms, a high shift pressure is applied at low oil temperature. This pressure is then continuously reduced as a function of rising ATF oil temperature.

To prevent the ATF oil from overheating, the engine is revved for longer in the individual gears and the lock-up clutch is closed more frequently when the oil temperature exceeds 150° Celsius. These measures reduce friction and allow the oil to cool down.

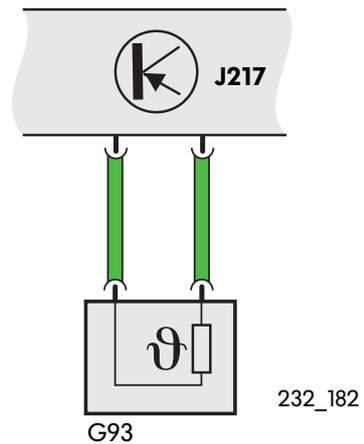


Electronic components - The sensors

Effects of signal failure

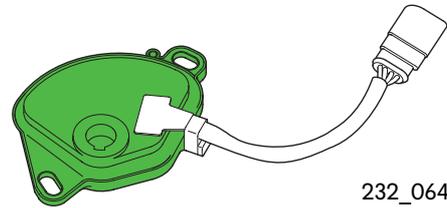
If the signal from sender G93 fails, the hot-engine shift program is no longer received, with the result that the gearbox performs gearshifts at higher pressures. The control unit utilises the signal from the coolant temperature sender up to a temperature of 70° C. It then utilises a fixed value of 110 °C.

Electrical circuit



Multi-function switch F125

This is located on the exterior of the gearbox housing.
It is actuated by the selector lever cable.



In previous automatic gearboxes, mechanical circuits were used in the multi-function switch. The mechanical circuits have now been replaced by Hall senders. The non-contact switches are wear free. For inspection and repair work, please refer to the relevant Workshop Manual.

Signal utilisation

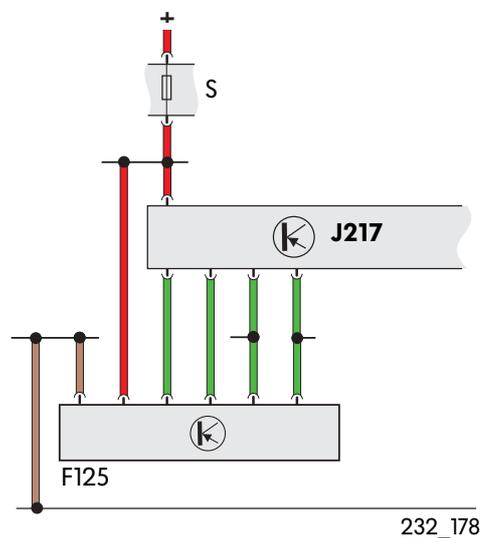
The multi-function switch detects the position of the selector lever and passes this information on to the gearbox control unit.
The control unit initiates the required gearshifts and activates the starter inhibitor relay if the selector lever is in »P« or »N« position.

Effects of signal failure

If the multi-function switch fails, the engine can only be started in selector lever position »P«.
If it fails while travelling, the control unit reverts to automatically to selector lever position »D«.
In both cases the control unit no longer accepts a forward selector lever position request from the driver.
It shifts all forward gears electrically. The driver need only engage reverse gear.



Electrical circuit

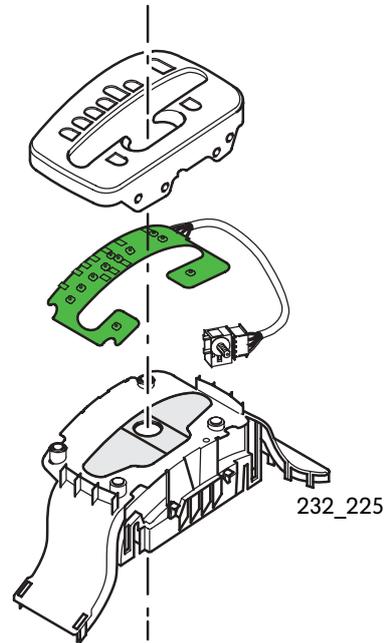


232_178

Electronic components - The sensors

Tiptronic switch F189

is located on the selector lever mechanism. If the driver engages the selector lever in the right selector gate, the Tiptronic switch is actuated and the automatic gearbox enters Tiptronic mode.



Signal utilisation



Based on this signal, gears are selected as follows:

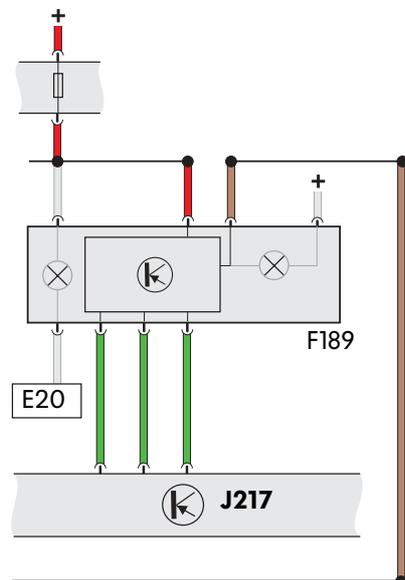
- Move selector lever forward (+) to change up one gear
- Move selector lever backward (-) to change down one gear.

Effects of signal failure

Tiptronic mode cannot be activated.

Electrical circuit

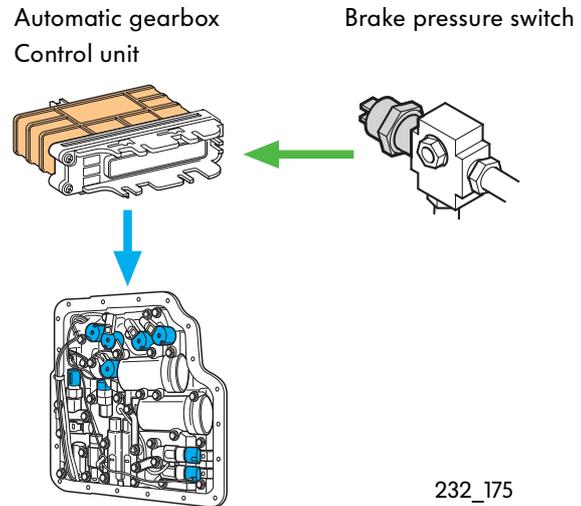
- J217 Automatic gearbox control unit
- F189 Tiptronic switch
- E20 Switches and instruments - lighting control



232_181

Brake pressure switch F270

This is integrated in the brake circuit. It supplies the automatic gearbox control unit with a signal indicating when brake pressure has been built up.



232_175

Signal utilisation

The gearbox control unit utilises the signal from the brake pressure switch to control the stationary decoupling of the gearbox. At present, stationary decoupling is only performed on diesel engine vehicles.

Stationary decoupling suppresses the vehicle's tendency to creep. This improves fuel economy and reduces exhaust emissions. When the vehicle stops (e.g. at traffic lights), the gearbox control unit disengages the gear.



Effects of signal failure

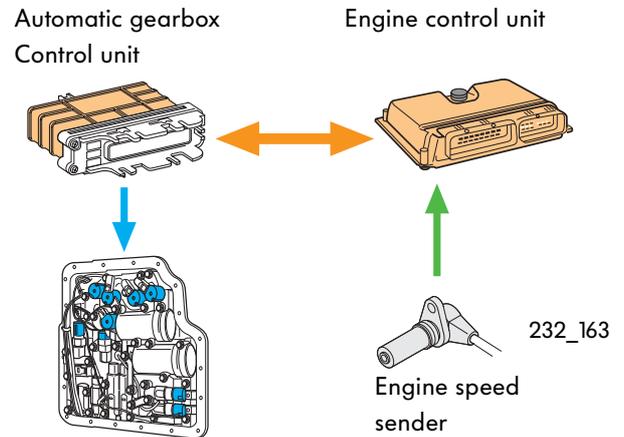
- No stationary decoupling

Electronic components - The sensors

Data transfer via the CAN bus

Engine speed

This is detected by the engine speed sender and transferred to the engine control unit. The engine control unit sends this information to the automatic gearbox control unit via the CAN bus.



Signal utilisation

The gearbox control unit utilises the engine speed to control the torque converter lock-up clutch and stationary decoupling.



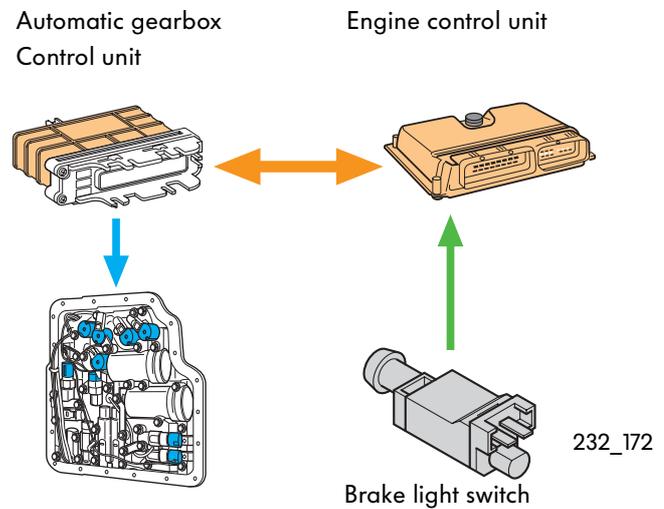
Effects of signal failure

- The lock-up clutch is no longer closed,
- no stationary decoupling.

Brake light switch F

For safety reasons, there are two brake light switches on the brake pedal. Both switches send a »brake operated« signal to the engine control unit.

The engine control unit then sends this signal to the automatic gearbox control unit via the CAN bus.



Signal utilisation

When the vehicle is stationary, the control unit releases the selector lever lock after it receives the corresponding signal from the brake light switch.

If a travelling vehicle is braked while the lock-up clutch is closed, the gearbox control unit opens the torque converter lock-up clutch.



Effects of signal failure

If one of the two signals is received, the functions remain active.

If both signals fail, then the selector lever can be operated without depressing the brake pedal.

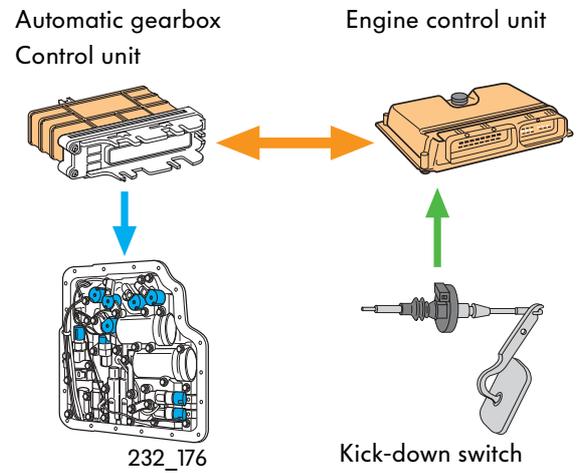


The engine control unit self-diagnostics stores the brake light switch fault.

Electronic components - The sensors

Kick-down switch F8

This switch is only used in vehicles without electronic accelerator. By operating this switch, the driver indicates to the control unit that he wishes to accelerate at full throttle. The relevant data is transferred over the CAN bus.



Signal utilisation



After the »kick-down« command is given, the control unit selects a special shifting characteristic which revs the engine for longer in the individual gears.

To accelerate the vehicle more quickly, a downshift is executed depending on actual engine speed after the kick-down command is given.

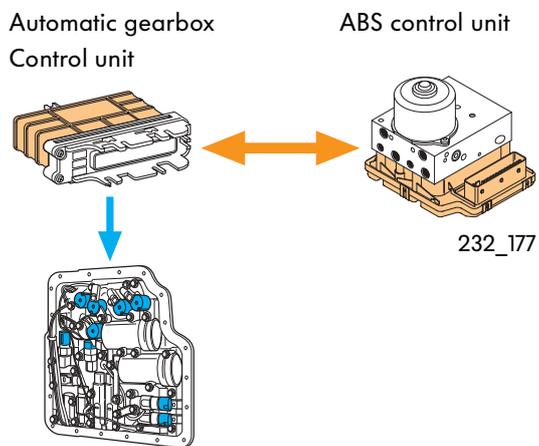
Effects of signal failure

If the signal fails, the engine control unit calculates a substitute signal from the position of the accelerator pedal.

Further CAN signals which are used as input variables for the gearbox control unit include:

the signal from the ABS control unit

If the driving situation requires the ABS control unit to employ the Traction Control System (TCS) or the Electronic Stability Program (ESP), then the ABS control unit passes this information on to the CAN bus.



Signal utilisation

If the gearbox control unit is informed that the TCS or ESP have intervened to compensate for loss of traction or instability, the control unit performs no gearshifts during the intervention period.



Effects of signal failure

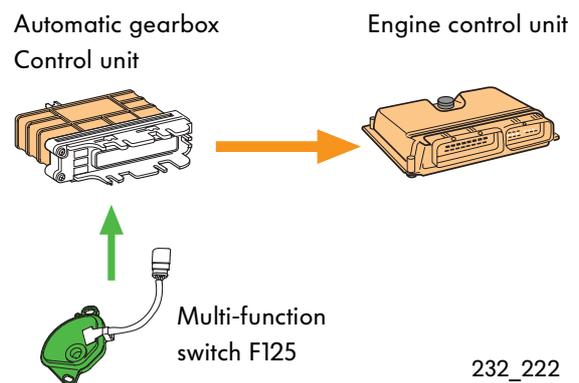
If the automatic control unit does not receive any signals from the ABS control unit, the gearbox continues to perform gearshifts even if TCS or ESP are activated.

Electronic components - The output signals

The gearbox control unit receives data signals from other control units and sends the same information to the other control units.

Signal for selector lever position to engine control unit

The signal for selector lever position is an analogue signal and is supplied to the engine control unit over an electric wire.



Signal utilisation

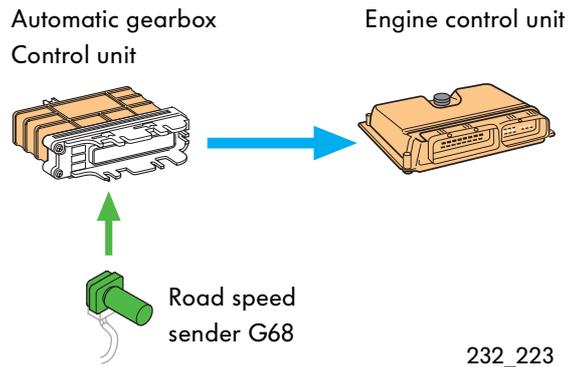
The engine control unit uses the selector lever position signal to deactivate the cruise control system in the »P«, »N« and »R« selector lever positions.

Effects of signal failure

The cruise control system is not functional.

The signal from the road speed sender

The signal is sent to other control units via the CAN bus.



Signal utilisation

The control unit in the dash panel insert uses the signal for the speedometer.



Effects of signal failure

The control unit in the dash panel insert calculates a substitute value from the gearbox speed sender G38 signal.

Electronic components - The actuators

Solenoid valves

Nine solenoid valves are located in the valve body of the automatic gearbox. They are activated for gear changing by the automatic gearbox control unit. There are two types of solenoid valve which have different operating modes:

 yes/no valves and

 modulation valves.

Six of the nine solenoid valves are yes/no valves. They can either fully open or completely close an oil gallery. Intermediate settings are not possible.

The other three solenoid valves are modulation valves. They not only have the circuit states »fully open« and »fully closed« but can also be steplessly adjusted.

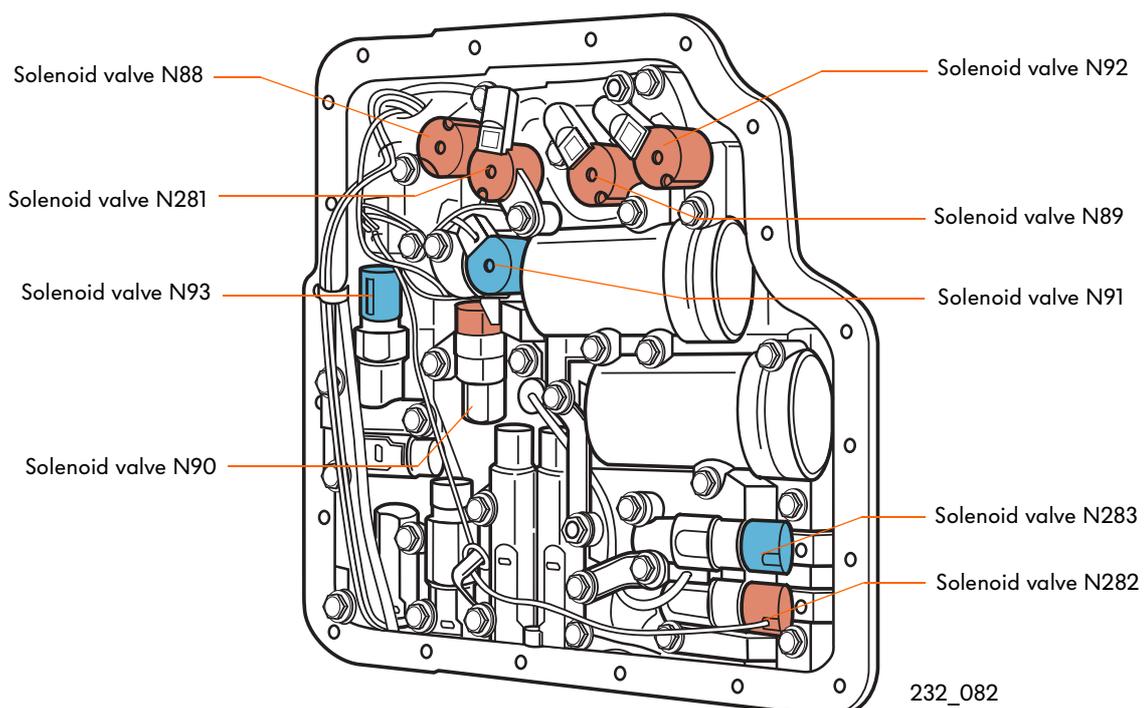
These valves are numbered

These valves are numbered N91, N93 and N283.

N88, N89, N90, N92, N281 and N282.



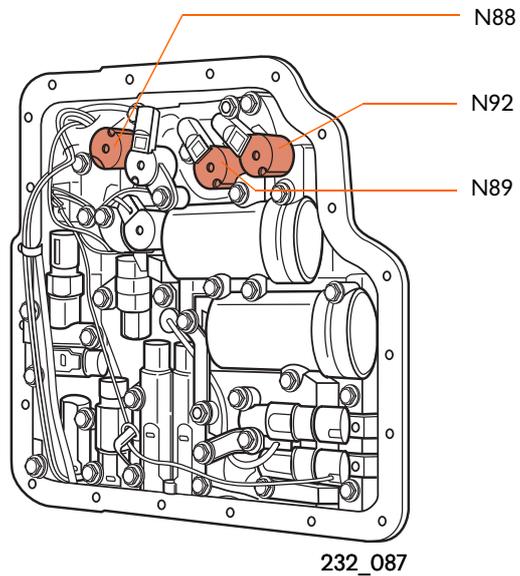
Layout of solenoid valves in the valve body



The yes/no valves

Solenoid valves N88, N89 and N92

They are responsible for gear changing



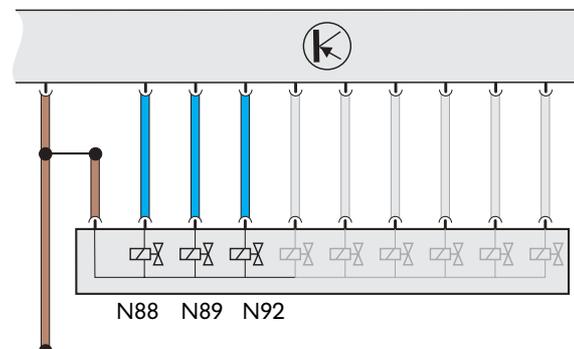
The table shows which of the three solenoid valves is activated in the individual gears by the control unit.

(+) = activated

Gear	Solenoid valve		
	N88	N89	N92
1.	+	+	+
1. Tip		+	+
2.	+	+	
3.		+	
4.			+
5.	+		+
R.	+	+	+



Electrical circuit



Even if a single valve fails, the gearbox control unit reverts to emergency mode.

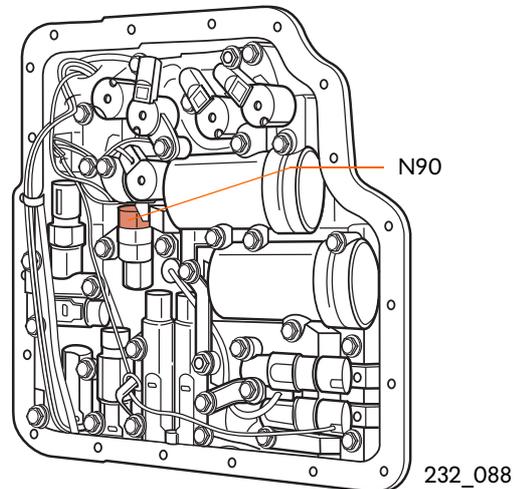
Electronic components - The actuators

Solenoid valve N90

is activated to open and close clutch K1 depending on driving conditions.

Solenoid valve N90 is also activated if the reverse gear is engaged while the vehicle is moving forwards. This prevents clutch K2 for the reverse gear from closing.

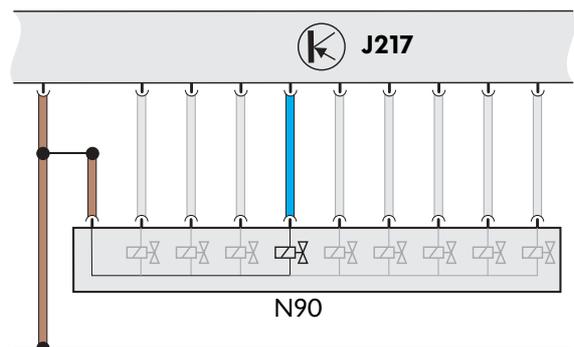
When driving away, the main ATF oil pressure is increased by this solenoid valve.



Effects of signal failure

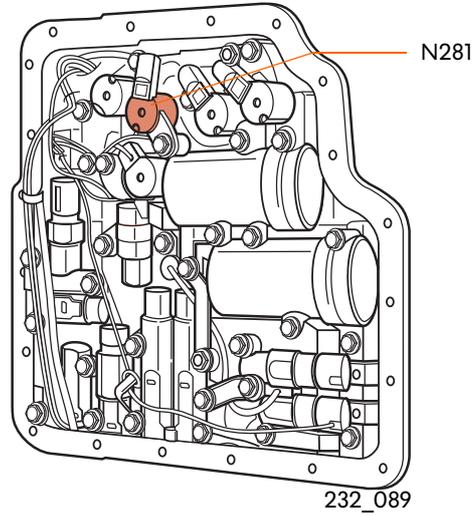
- The control unit does not select 5th gear.
- Stationary decoupling is not carried out.

Electrical circuit



Solenoid valve N281

This maintains the ATF oil pressure on brake B3 in gears 1 to 4 and in reverse while the pressure on the other clutches and brakes is reduced during gear changes.

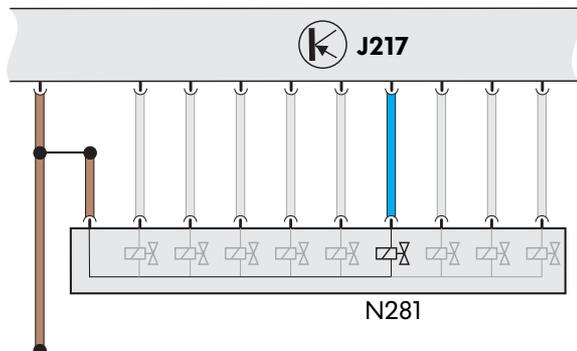


Effects of signal failure

If this solenoid valve fails, brake B3 is kept closed and this results in slightly harsher downshifts.



Electrical circuit

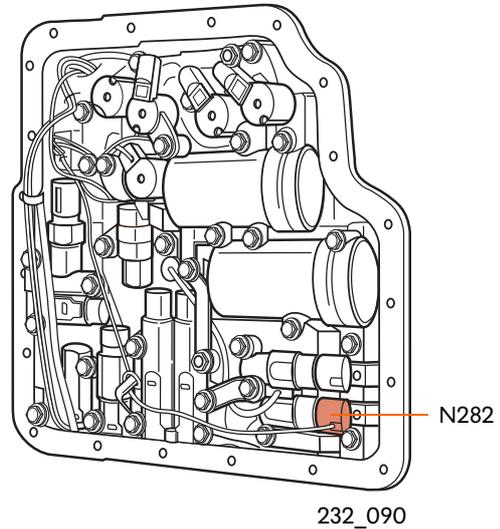


232_192

Electronic components - The actuators

Solenoid valve N282

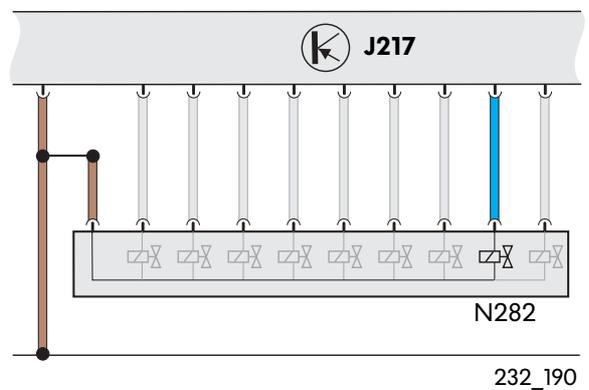
This solenoid valve is activated by the control unit when brake B2 is opened or closed. It is closed in 2nd, 4th and 5th gear. Together with solenoid valve N90, this solenoid valve decouples the gearboxes of diesel-engined vehicles when stationary.



Effects of signal failure

- The vehicle can only be driven in 4th gear and in reverse.
- Stationary decoupling is not carried out.

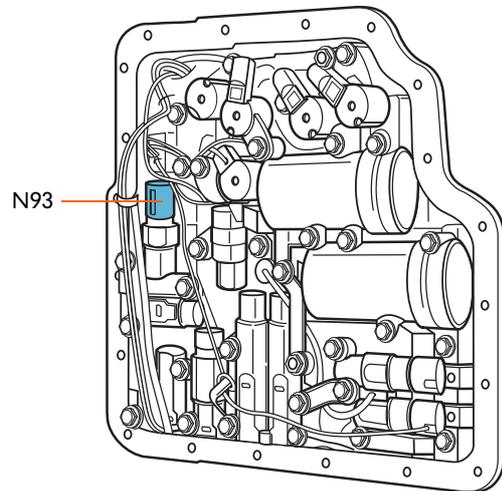
Electrical circuit



The modulation valves

Solenoid valve N93

This regulates the main oil pressure for the entire automatic gearbox depending on driving conditions. It ensures smooth running and jolt-free gear changes.



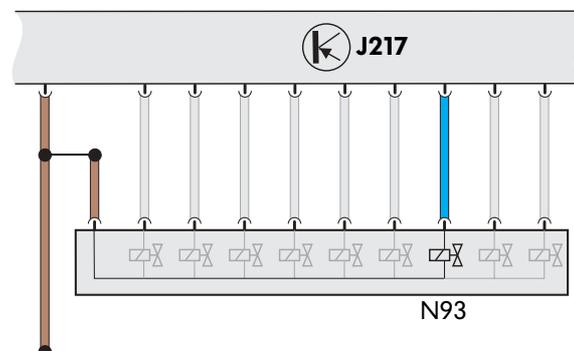
232_091

Effects of signal failure

- The main oil pressure is not regulated, resulting in harsh gearshifts,
- no stationary decoupling.



Electrical circuit

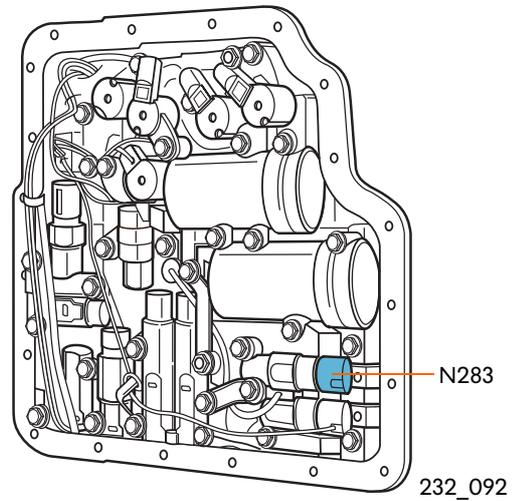


232_191

Electronic components - The actuators

Solenoid valve N283

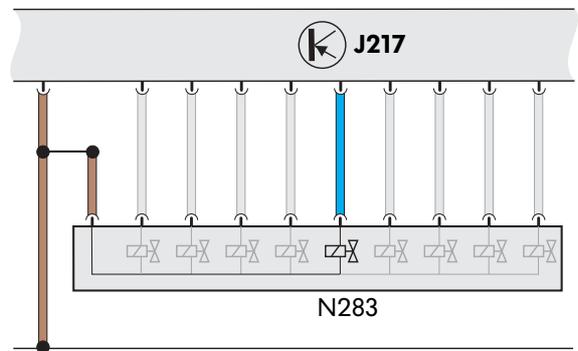
This regulates the ATF oil pressure of brakes B2 and B3. Brake B2 is closed in 2nd, 4th and 5th gear while brake B3 is closed in 1st, 2nd, 3rd, 4th and reverse gear.



Effects of signal failure

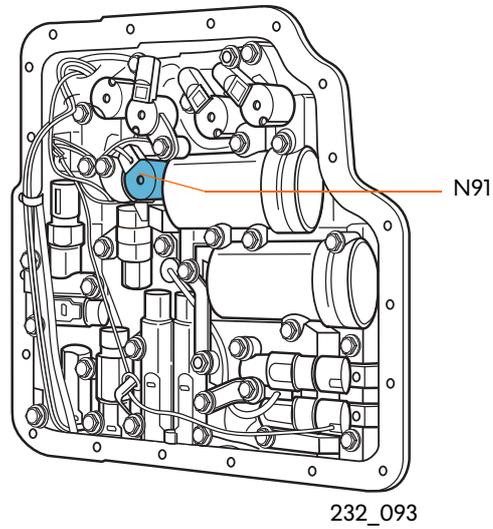
- The maximum main oil pressure is applied to the brakes, resulting in harsh gearshifts
- no stationary decoupling.

Electrical circuit



Solenoid valve N91

This regulates the pressure during the opening and closing movements of the torque converter lock-up clutch.
To close the torque converter lock-up clutch, the solenoid valve is energised by the control unit.

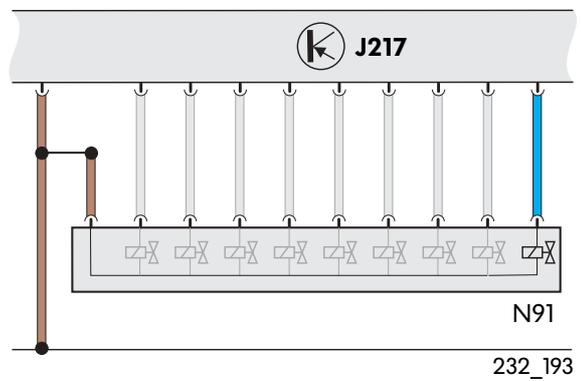


Effects of signal failure

- The torque converter lock-up clutch is no longer closed.



Electrical circuit



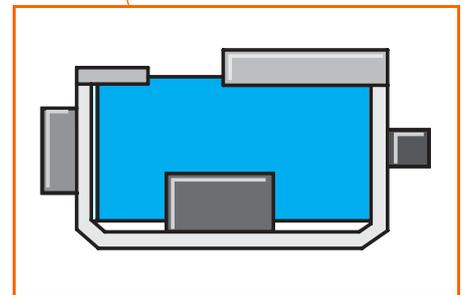
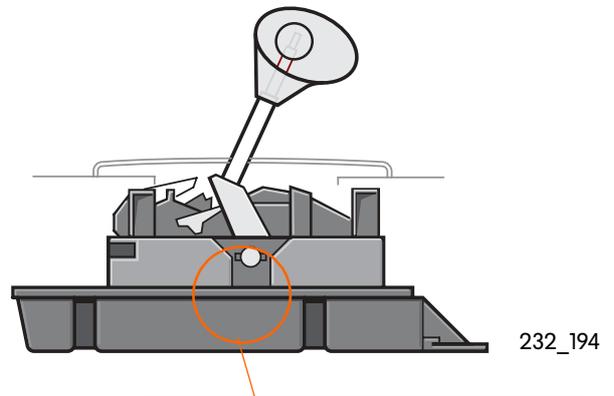
Electronic components - The actuators

Selector lever lock solenoid N110

It is located in the selector lever mechanism.

It prevents the gear lever from being moved from selector lever positions P and N into other positions.

The selector lever lock is cancelled when the brake is operated. The lock is activated when the driver turns on the ignition.



Effects of signal failure

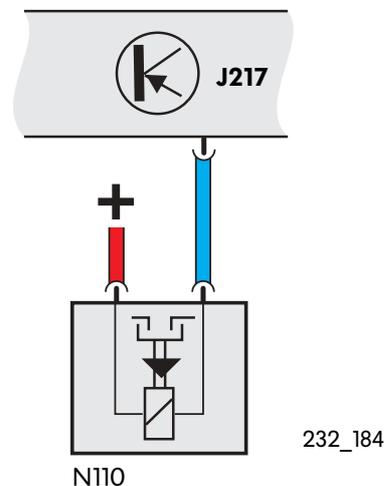
If the solenoid for selector lever lock fails, the selector lever can be engaged in a drive position without the driver having to depress the brake pedal.

If both brake light switches fail, the selector lever can no longer be moved.

If fault in the brake light switch is stored in the self-diagnostics of the engine control unit.

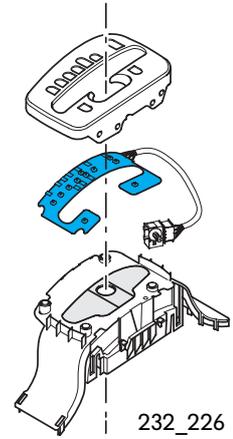
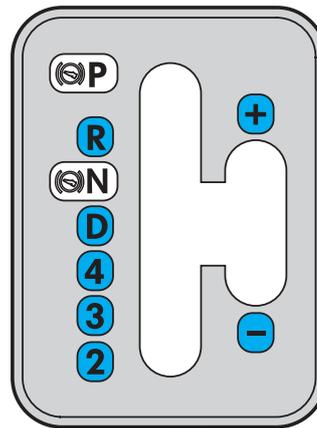


Electrical circuit

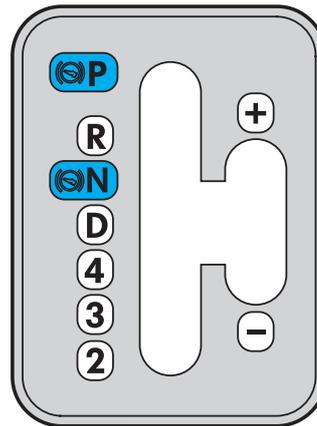


Selector lever display illumination L101 and selector lever position P/N warning lamp K142

are integrated in Tiptronic switch F189. The brightness of the selector lever display illumination can be adjusted by switches and instruments-lighting control E20.

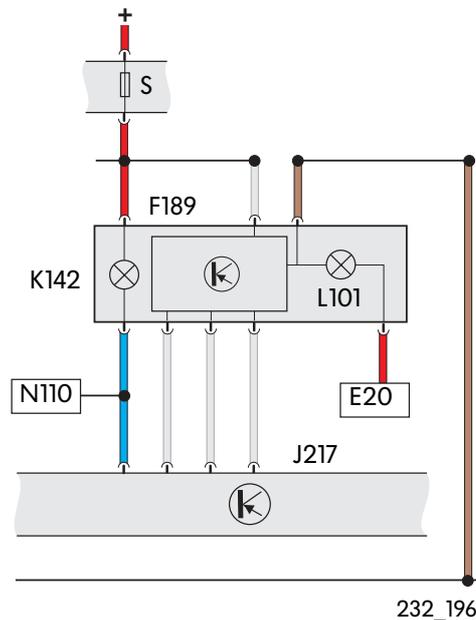


The selector lever position P/N warning lamp indicates when the lever is in these two positions. It serves to remind the driver that the brake pedal has to be depressed in order to move the selector lever out of these positions.



Electrical circuit

- J217 Automatic gearbox control unit
- F189 Tiptronic switch
- E20 Switches and instruments - lighting control
- K142 Selector lever position P/N warning lamp
- L101 Selector lever display illumination



Function diagram

Components

- F125 Multi-function switch
- F189 Tiptronic switch
- F270 Brake pressure switch

- G68 Road speed sender
- G182 Gearbox input speed sender
- G265 Intermediate shaft speed sender

- J217 Automatic gearbox control unit
- J226 Starter inhibitor and reversing light relay

- K142 Selector lever position P/N warning lamp

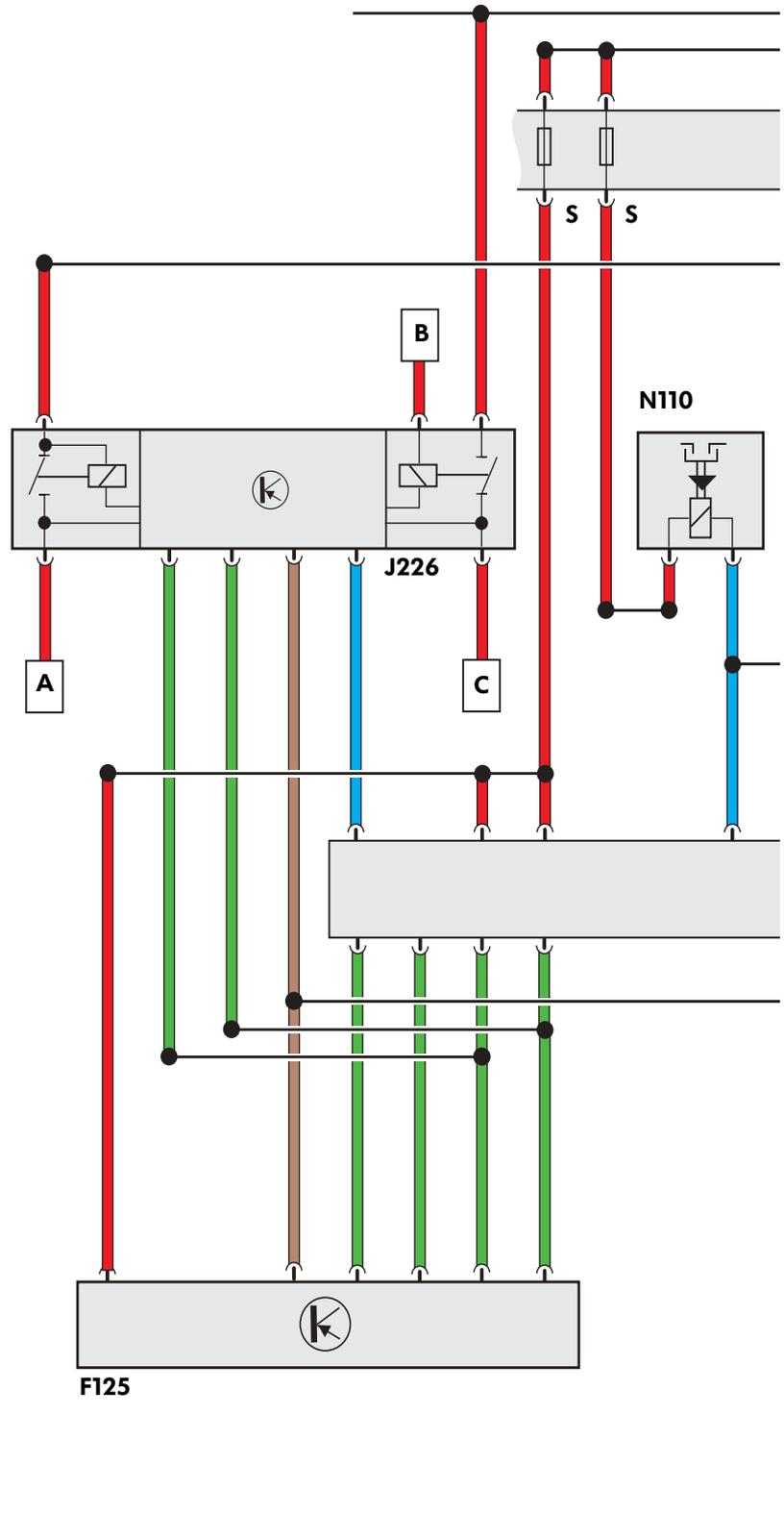
- L101 Selector lever display illumination

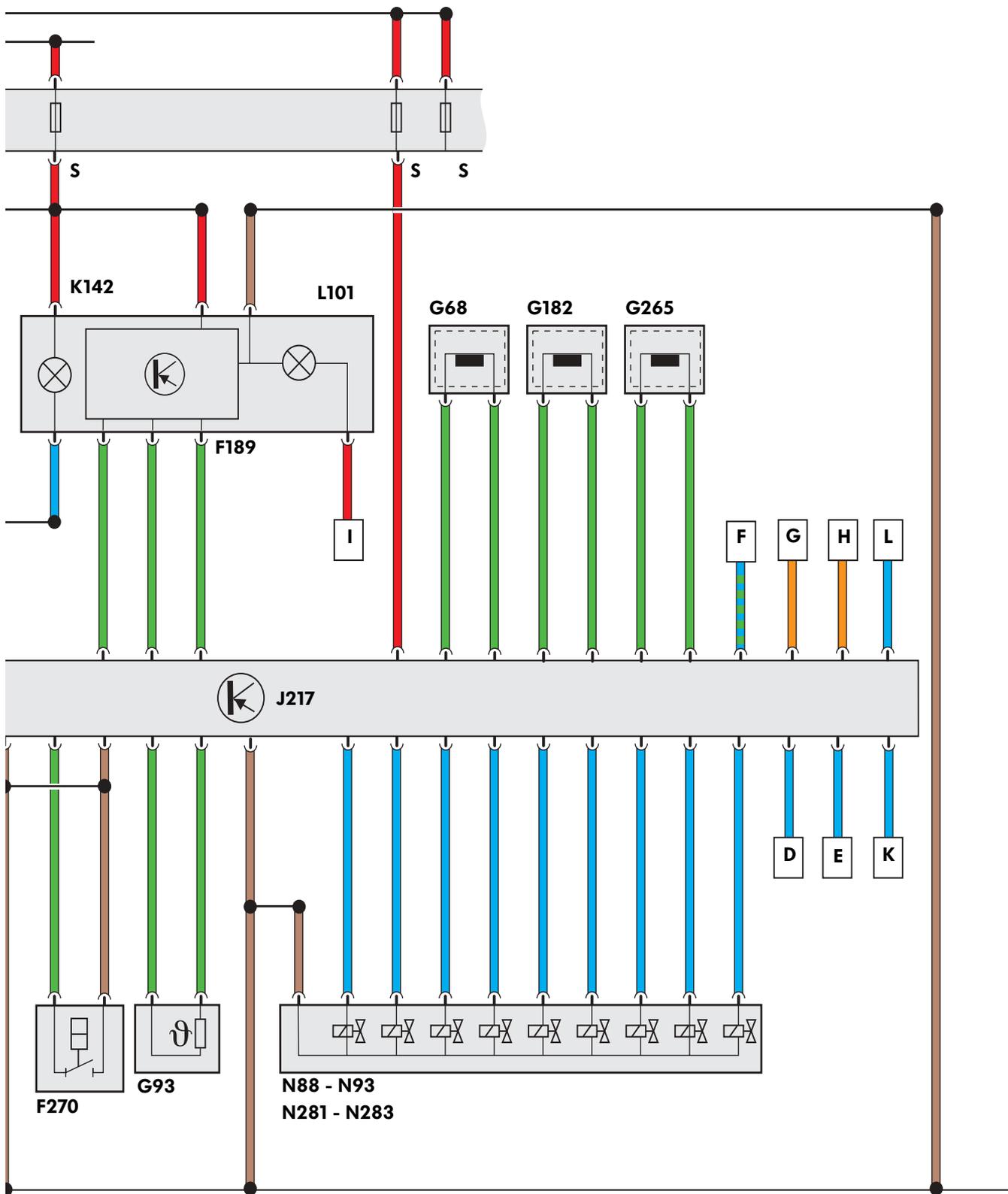
- N88 -
- N93 Solenoid valves
- N110 Selector lever lock solenoid
- N281-
- N283 Solenoid valves

- S Fuse

Auxiliary signals

- A to the reversing lights
- B to the ignition switch
- C to the starter Terminal 50
- D Road speed signal
- E Road speed signal
- F Self-diagnostics
- G CAN - high
- H CAN - low
- I Switches and instruments - lighting control
- K Selector lever position to engine control unit
- L Signal for cruise control system





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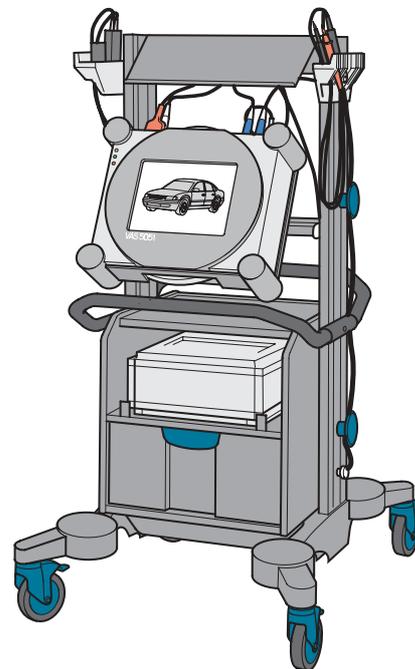
Self-diagnostics

The self-diagnostic function of the automatic gearbox independently monitors the signals from the sensors as well as the actuator activation signals, and checks the control unit.

If faults occur, substitute functions are made available and the fault is stored in the control unit's fault memory. The control unit has a non-volatile fault memory. This means that the contents of the fault memory are kept even if the control unit is temporarily disconnected from the power supply.

The new vehicle diagnostic, testing and information system VAS 5051 is used for fault-finding and reading out the fault memory.

This device includes all the tools required for fault-finding in electronic vehicle systems. The user can run the guided fault finding routine or carry out test procedures using the test instruments.



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The following functions can be invoked in the self-diagnostics under the **address word 02 »Gearbox electronics«**:

- 01 »Interrogate control unit version«,
- 02 »Read out fault memory«,
- 04 »Start basic adjustment«,
- 05 »Clear fault memory«,
- 06 »End of output« and
- 08 »Read data block«.



Function 01

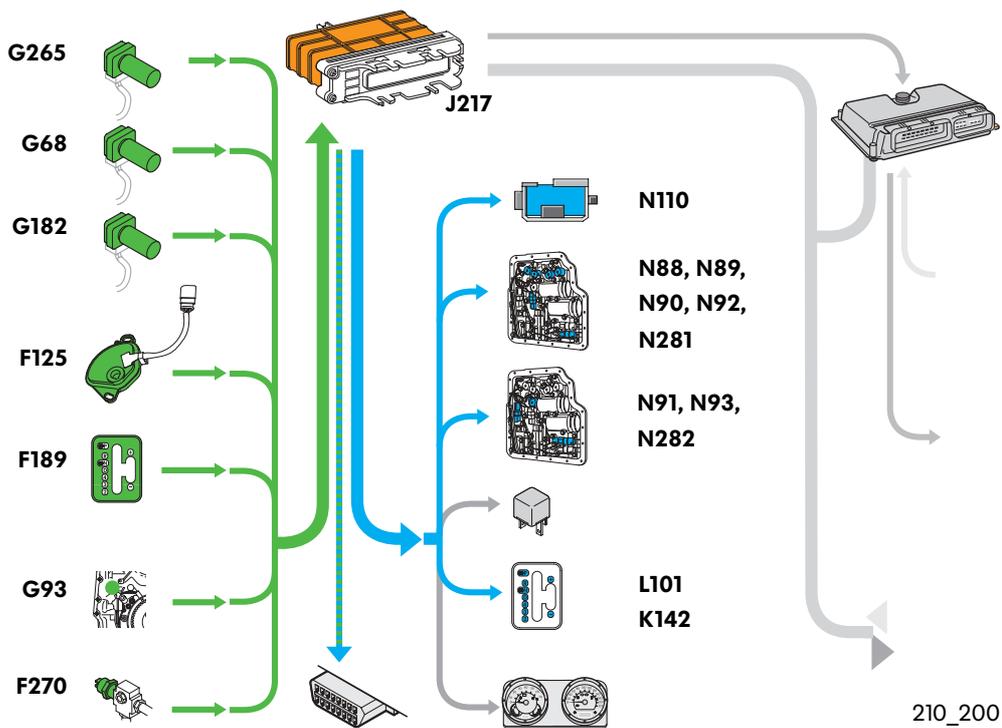
Interrogate control unit version

Spare part No. of control unit	<input type="checkbox"/> Gearbox designation	Program version
09A927750	AG5 gearbox 09A	0004
		WSC 0000
		Workshop code

Function 02

Interrogate fault memory

The colour-coded sensors and actuators are detected by the self-diagnosis function and stored in the fault memory.



Self-diagnostics

Function 04

Basic setting

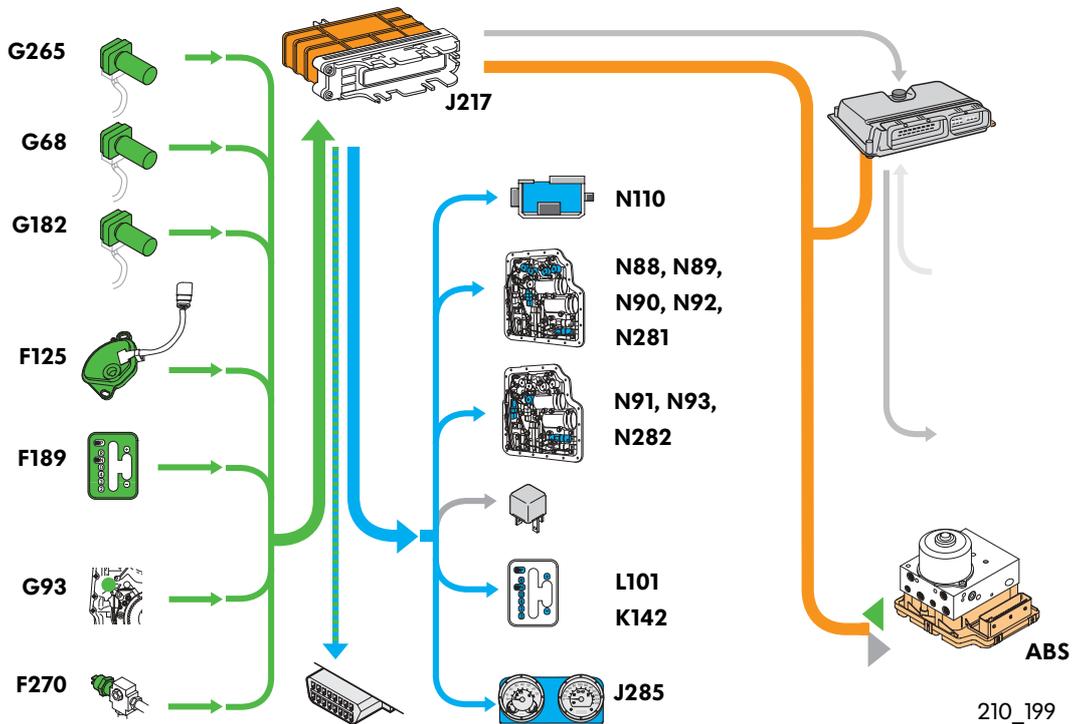
On completion of repair work on the accelerator pedal sender or after replacing the engine control unit, carry out a basic setting procedure.

As with the 4-speed automatic gearbox, you must carry out the basic setting procedure after you replace the control unit.

Function 08

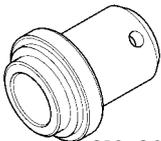
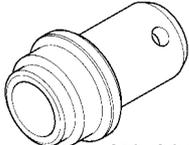
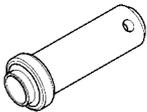
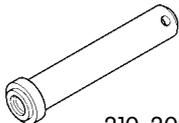
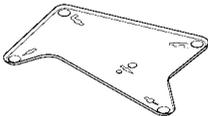
Read data block

Signals from the components highlighted in colour can be tested in the measured value block.



Special tools

In keeping with the care concept for the 5-speed automatic gearbox, the following new special tools are required to carry out repair work.

Pressure piece T 10087	 210_205	for installing the shaft oil seal
Pressure piece T10088	 210_204	for installing the left and right flange shafts
Pressure piece T10089	 210_203	for fitting the oil seal on the torque converter
Pressure piece T10090	 210_202	for fitting the oil seal on the selector shaft
Adjustment plate 3282/32	 210_201	for removing the gearbox from the vehicle
T10091	 210_224	for adjusting the multi-function switch



Test your knowledge

1. In what selector lever position does 1st gear use the engine brake?

- a) 1st gear always uses the engine brake.
- b) in selector lever position "D" only
- c) in the Tiptronic selector gate only

2. How many planetary gears are there in the AG5?

- a) 2 Ravignaux planet gear sets
- b) 3 planetary gears
- c) 4 planetary gears

3. Via which components is torque transmitted to the planetary gears?

- a) via the sun gear of planetary gear II and via clutch K3
- b) via clutch K1 and clutch K2
- c) via clutch K3 only

4. What clutches equalise centrifugal force in the AG5?

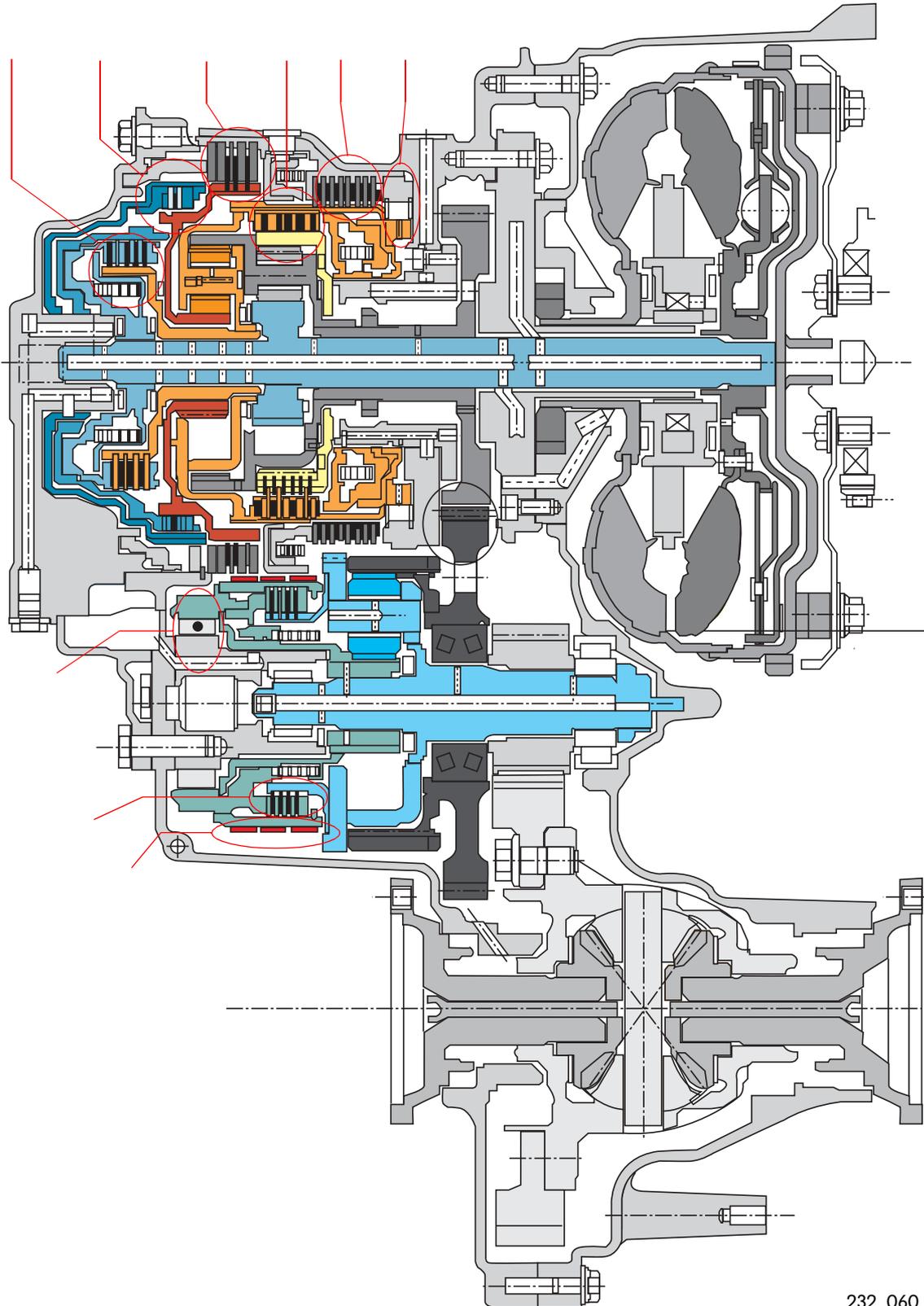
- a) clutch K4 only
- b) clutches K2 and K4
- c) clutches K1 and K3

**5. Are there different types of brake in the AG5?
If yes, name them.**

- a) no
- b) yes 1. _____ 2. _____



6. Identify the components!



7. What is the task of the pressure accumulators?

- a) They regulate the main oil pressure of the automatic gearbox.
- b) They are responsible for ensuring the soft closing of clutches K1, K3 and K4 as well as brake B2 .
- c) B3 is activated by the pressure accumulators.

8. How many solenoid valves are located in the valve body of the automatic gearbox?

- a) 7
- b) 8
- c) 9

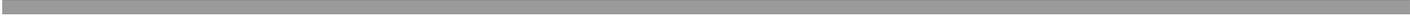
9. Gearshifts are initiated by the different solenoid valve closing combinations. What are the electrical designations of the 3 solenoid valves?

- a) N88, N89 and N92
- b) N91, N93 and N282

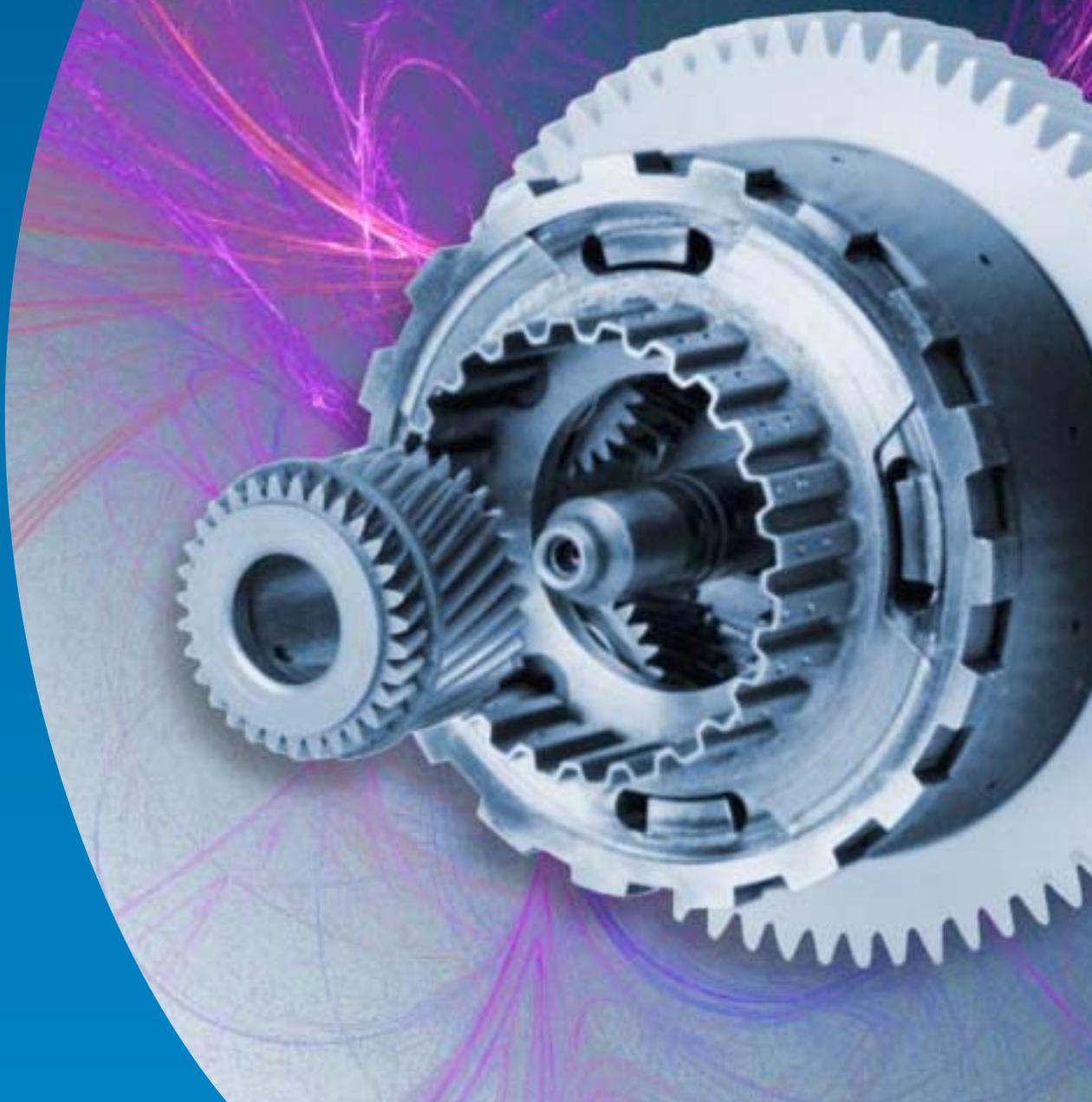
10. Three engine speed sensors with identical design and operating principles are located in the automatic gearbox. According to what electrical operating principle do they work?

- a) their function is based on the Hall principle.
- b) their function is based on the induction principle.





- Solutions**
- 1.) c
 - 2.) b
 - 3.) a
 - 4.) c
 - 5.) b
 - 6.) see page 16
 - 7.) b
 - 8.) c
 - 9.) a
 - 10.) b



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