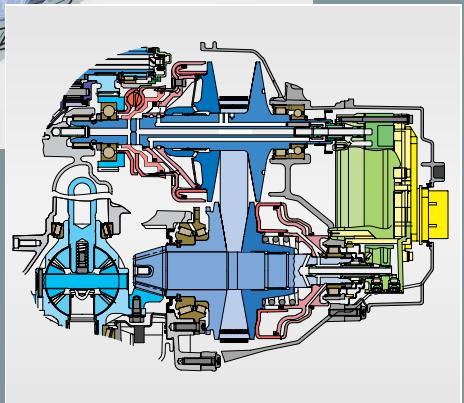
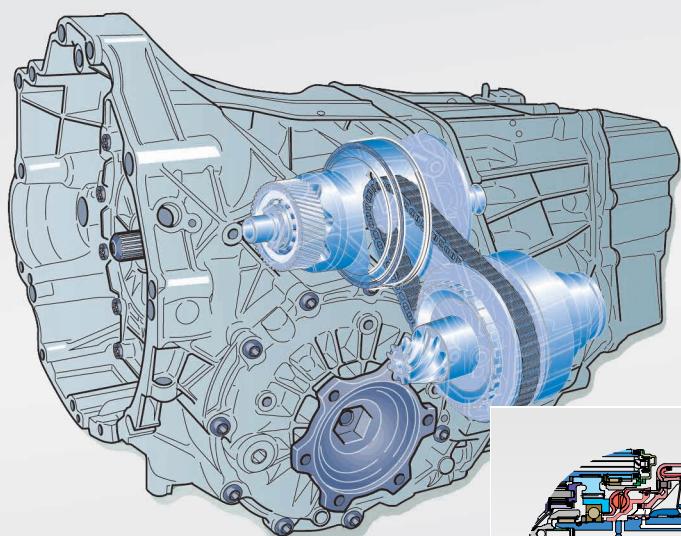


Service.



Variable Automatic Gearbox
multitronic® 01J
Design and Function

Self-Study Programme 228

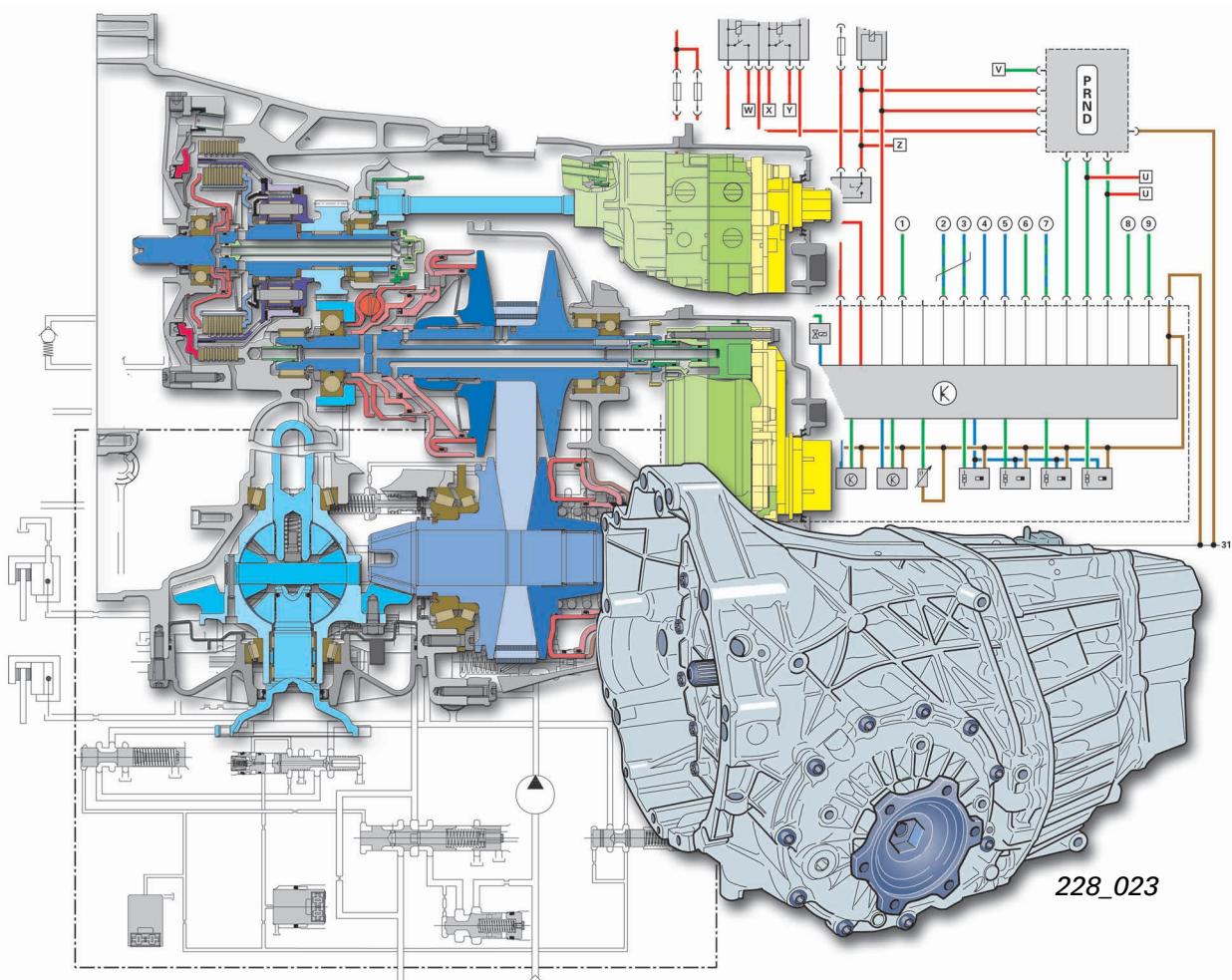
multitronic®

The name multitronic® stands for the new variable automatic gearbox developed by Audi.

The variable automatic gearbox is commonly known as the CVT gearbox.

The CVT concept improved by Audi is based on the long-established principle of the "chain drive transmission". According to this principle, the reduction ratio between the shortest and the longest ratio can be controlled steplessly by means of a so-called "variator".

CVT is the English abbreviation for "Continuously Variable Transmission".



The new Audi multitronic® with Tiptronic function offers a synergy of the best possible dynamics, optimal fuel utilisation and the highest possible level of drive comfort.

Contents

	Page
Introduction	
multitronic®	2
The gearbox concept	9
Specifications	10
Gearbox modules	
The flywheel damper unit	11
Sectional view of gearbox	13
The forward clutch/reverse clutch with planetary gear train	14
The clutch control	20
The clutch cooling system.....	28
The auxiliary reduction gear step	31
The variator	32
The transmission control	35
The torque sensor	38
The splash oil cover	43
The chain	44
The oil supply	47
Electrohydraulic control	52
Selector shaft and parking lock	56
Gearbox housing/ducting and sealing systems	57
Hydraulic chart	60
ATF cooling system	62
Gearbox control	
Control unit for multitronic J217	63
Sensors	66
CAN information interchange, multitronic®	75
Auxiliary signals/interface	76
Function diagram	80
Dynamic control program (DCP)	82
Service	
Towing	91
Update programming (flash programming)	92
Special tools/workshop equipment	96

The Self-Study Programme contains information about designs and functions.

The Self-Study Programme is not a Workshop Manual!

Please refer to the relevant Technical literature for all maintenance and repair instructions.

New!
Note!



Important!
Note!



Introduction



Gearboxes are required in order to match the torque characteristic of the internal combustion engine to the vehicle.

In the main, multi-step reduction gears are used such as manual gearboxes, automated manual gearboxes and multi-step automatic reduction gears.

A multi-step reduction gear always represents a compromise between handling dynamics, fuel economy and driving comfort.

In an internal combustion engine, torque flow is not intermittent, rather it is continuous. A variable ratio is, therefore, ideal with regard to engine power utilisation.

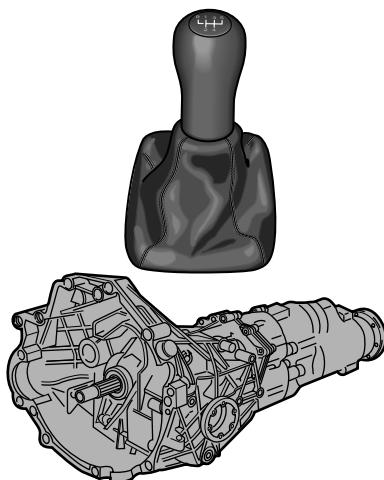
The CVT concepts which have been available on the market until now are also based upon the "chain drive principle". On account of their limited power transmission, however, they are only suitable for subcompact cars and vehicles in the lower mid-range segment with low engine performance. As the results

of independent tests show, these CVT concepts have yet to impress in terms of driving performance.

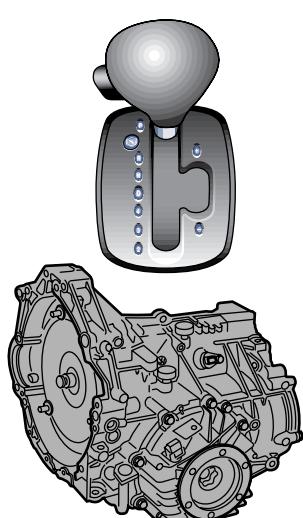
Audi also chose the belt/chain drive principle for the development of its CVT gearbox, since it is the most advanced form of transmission available today.

Audi's objective was to develop a CVT gearbox for high-performance premium segment vehicles that sets new standards in terms of driving performance and fuel economy, as well as in handling dynamics and comfort.

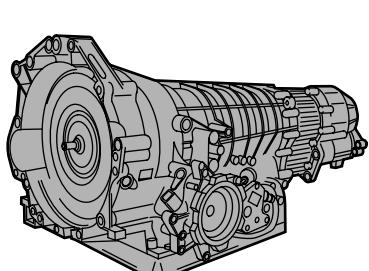
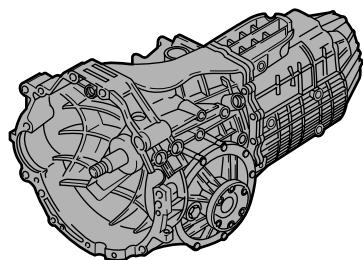
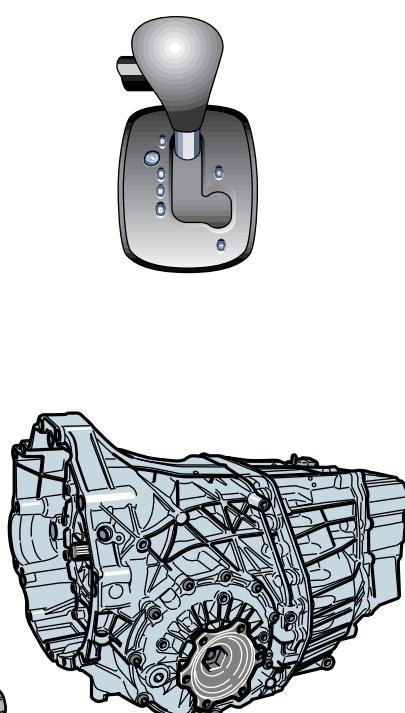
Manual gearbox



CVT stepped mode



multitronic®



228_002



The innovations incorporated by Audi and its development partners in the course of advanced development work will surpass existing gearbox concepts with regard to all the characteristics mentioned above.



Audi is therefore the first car-maker to present a CVT gearbox which can be used in combination with 2.8-ltr. V6 engines for power and torque ratings of 200 bhp and 300 Nm respectively.

Basic principle

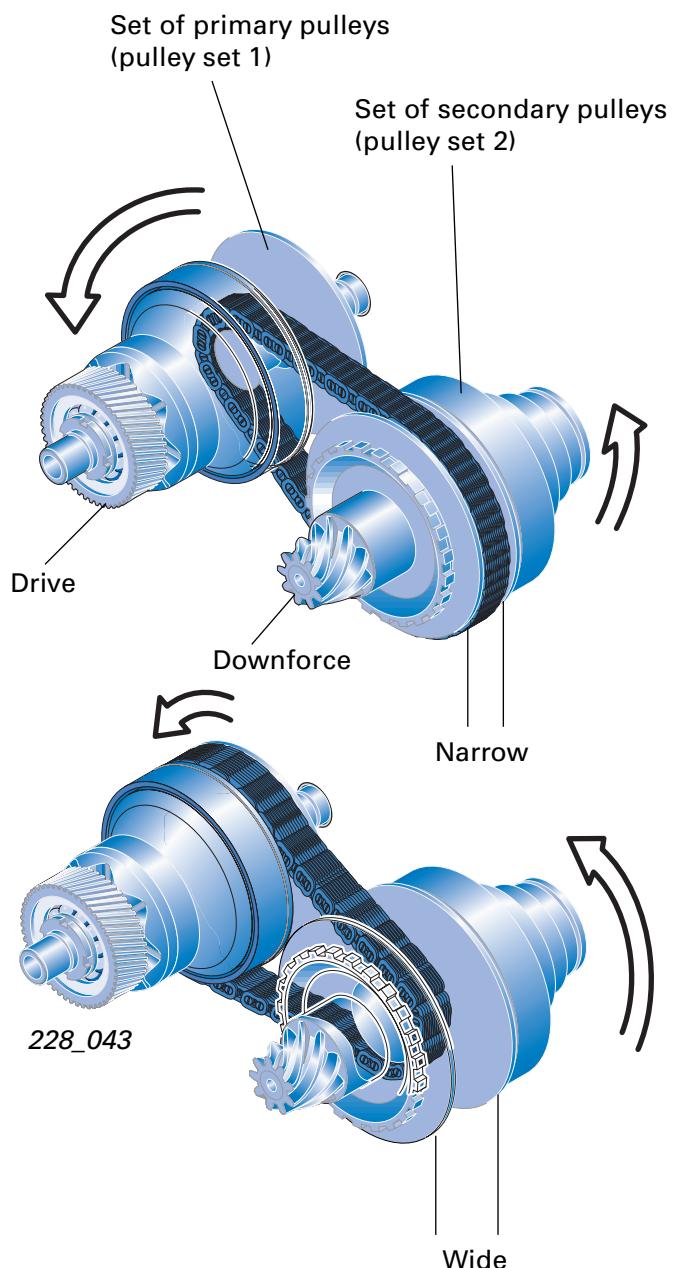
The key component part of the multitronic® is the variator. It allows reduction ratios to be adjusted continuously between the starting torque multiplication ratio and the final torque multiplication ratio.

As a result, a suitable ratio is always available. The engine can always operate within the optimum speed range regardless of whether it is optimised for performance or fuel economy.

The variator comprises two tapered disc pairs - a set of primary pulleys (pulley set 1) and a set of secondary pulleys (pulley set 2) - as well as a special chain which runs in the V-shaped gap between the two tapered pulley pairs. The chain acts as a power transmission element.

Pulley set 1 is driven by the engine by means of an auxiliary reduction gear step. Engine torque is transmitted via the chain to pulley set 2 and from here to the final drive. One of the tapered pulleys in each of the sets of pulleys can be shifted on the shaft for variable adjustment of the chain track diameter and transmission ratio.

The two sets of pulleys must be adjusted simultaneously so that the chain is always taut and the disc contact pressure is sufficient for transmission purposes.



This gearbox is known as a chain drive transmission because of its design.

Introduction

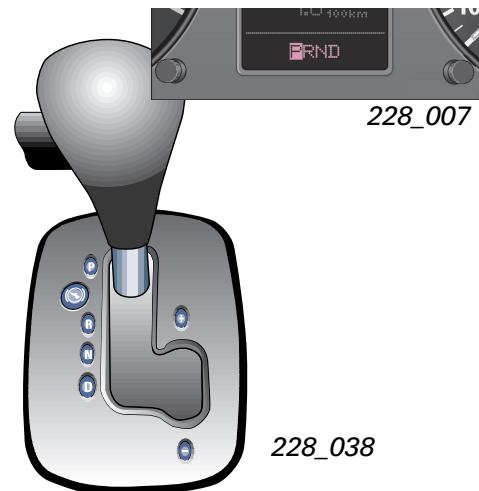


multitronic® for maximum comfort

In automatic mode, any ratio is possible within the bounds of the control map. The factors that determine rpm are driver input (accelerator pedal position and actuation rate) and traction resistance. Transmission ratios are adjusted completely free of jolts and without any interruption in tractive power flow.

In the tiptronic function, there are 6 defined shifting characteristics for manual gear selection. The driver can therefore choose handling dynamics to suit his/her personal preferences. This feature is particularly useful on downhill gradients for example, as the driver can personally determine the engine braking effect by selective down-shifting.

Top speed is achieved in 5th gear. 6th gear is configured as an economy gear or overdrive. The tiptronic can be operated from the steering wheel at option. This makes the tiptronic function very user-friendly indeed.



228_007

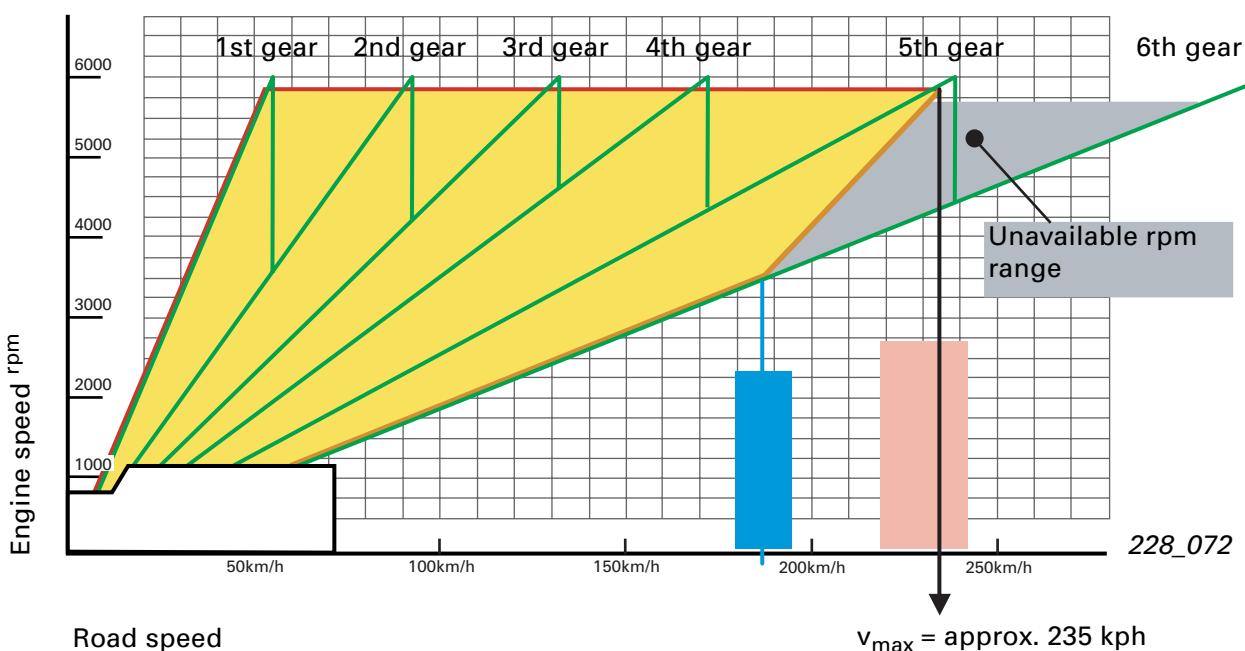
228_038

228_015



228_016

Transmission ratio diagrams of multitronic® 01J in the 2.8-litre Audi A6 V6 developing 142 kW





multitronic® for maximum dynamics

Multi-step reduction gear:

The coloured fields show the ranges within which maximum engine power is not available. The result is a loss of acceleration.

multitronic®:

The gearbox input speed control maintains engine performance at maximum. The vehicle accelerates with no interruption in tractive power flow. The result is an optimum acceleration characteristic.



Control map



Gearbox input speed control is used to vary maximum road speed as a function of tractional resistance.



Depending on tractional resistance, it is necessary to shift down from the longest ratio sooner or later.



Shifting characteristics of tiptronic 01J



Most economical characteristic



Sporty characteristic

Comparison of ratios:

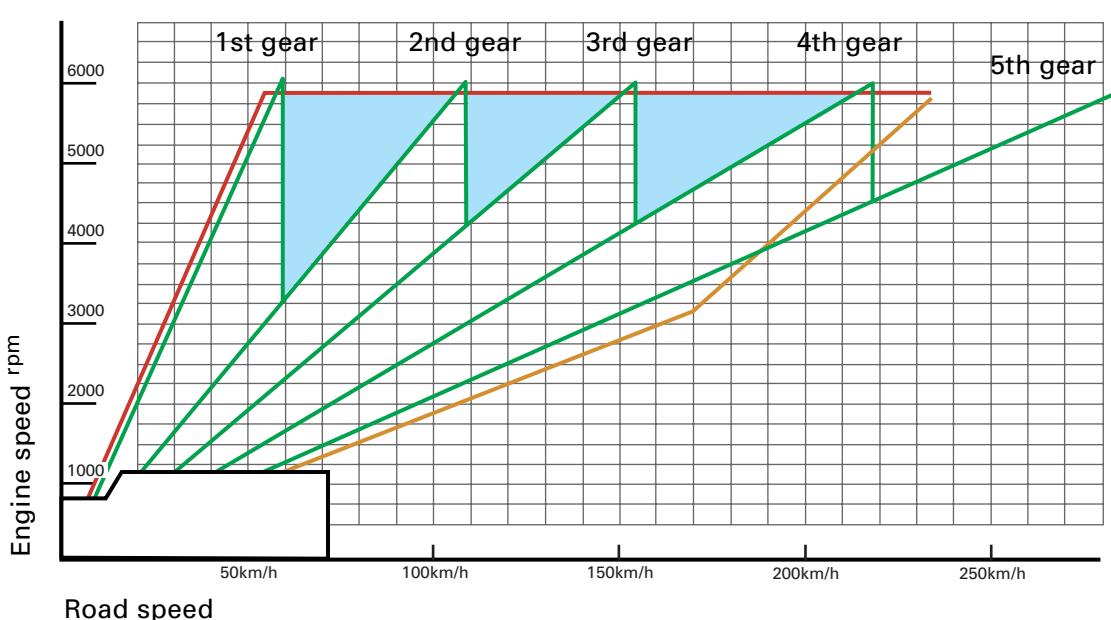
- 5-speed automatic gearbox 01V (gearbox code DEU)
- multitronic® 01J (gearbox code DZN)



rpm range not available for stepped gearboxes



Shifting characteristics of 01V



228_073

Introduction



multitronic® for high fuel economy

As a result of the long ratio, a large reduction in engine speed is possible in the economy driving mode.

In comparison with the 5-speed manual gearbox, engine speed for example is reduced from approx. 3200 rpm to approx. 2450 rpm at a road speed of 130 kph so as to increase fuel economy.

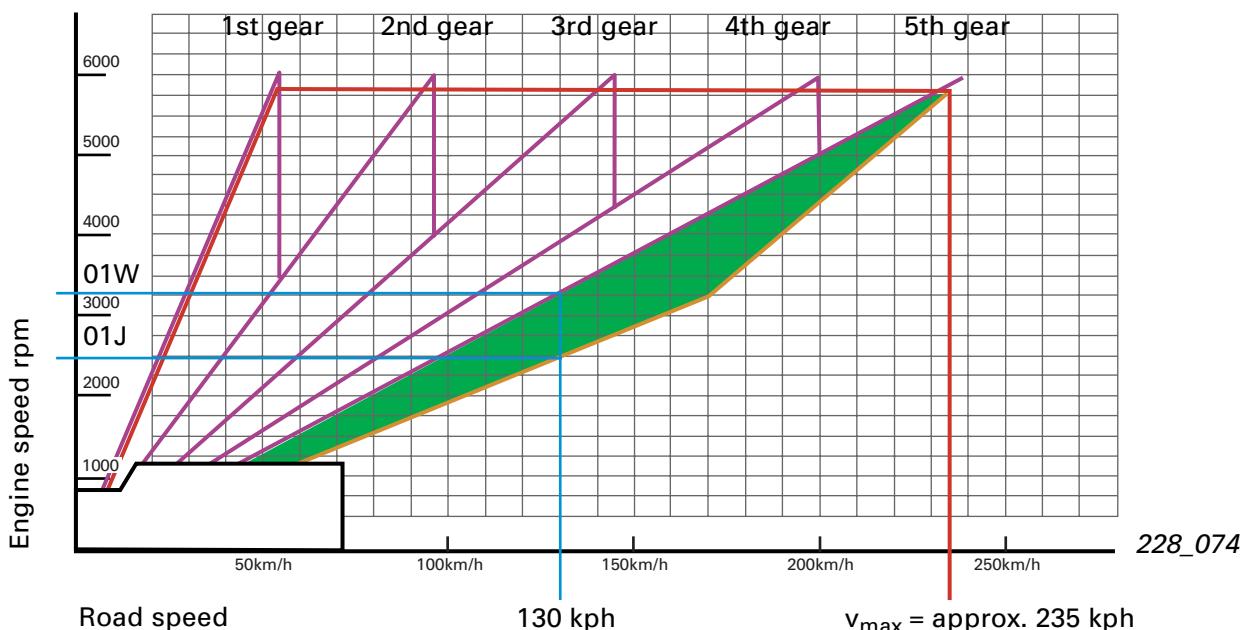
Through continuous transmission ratio adjustment, the engine always runs within the optimum operating mode, regardless whether it is optimised for performance or fuel economy.

The green area shows the engine speed reduction within the "Economy" operating mode.

- Most economical characteristic
- Sporty characteristic
- Transmission ratios on 01W

Comparison of ratios:

- ▶ 5-speed-manual gearbox 01W (gearbox code DHY)
 - ▶ multitronic® 01J (gearbox code DZN)
- Engine speed reduction within "Economy" operating mode
 - Example 130 kph





The gearbox concept

Engine torque is transmitted to the gearbox through either a flywheel damper unit or a two-mass flywheel depending on engine output.

There is one "wet" plate clutch for forward travel and one for reverse travel; both act as starting clutches.

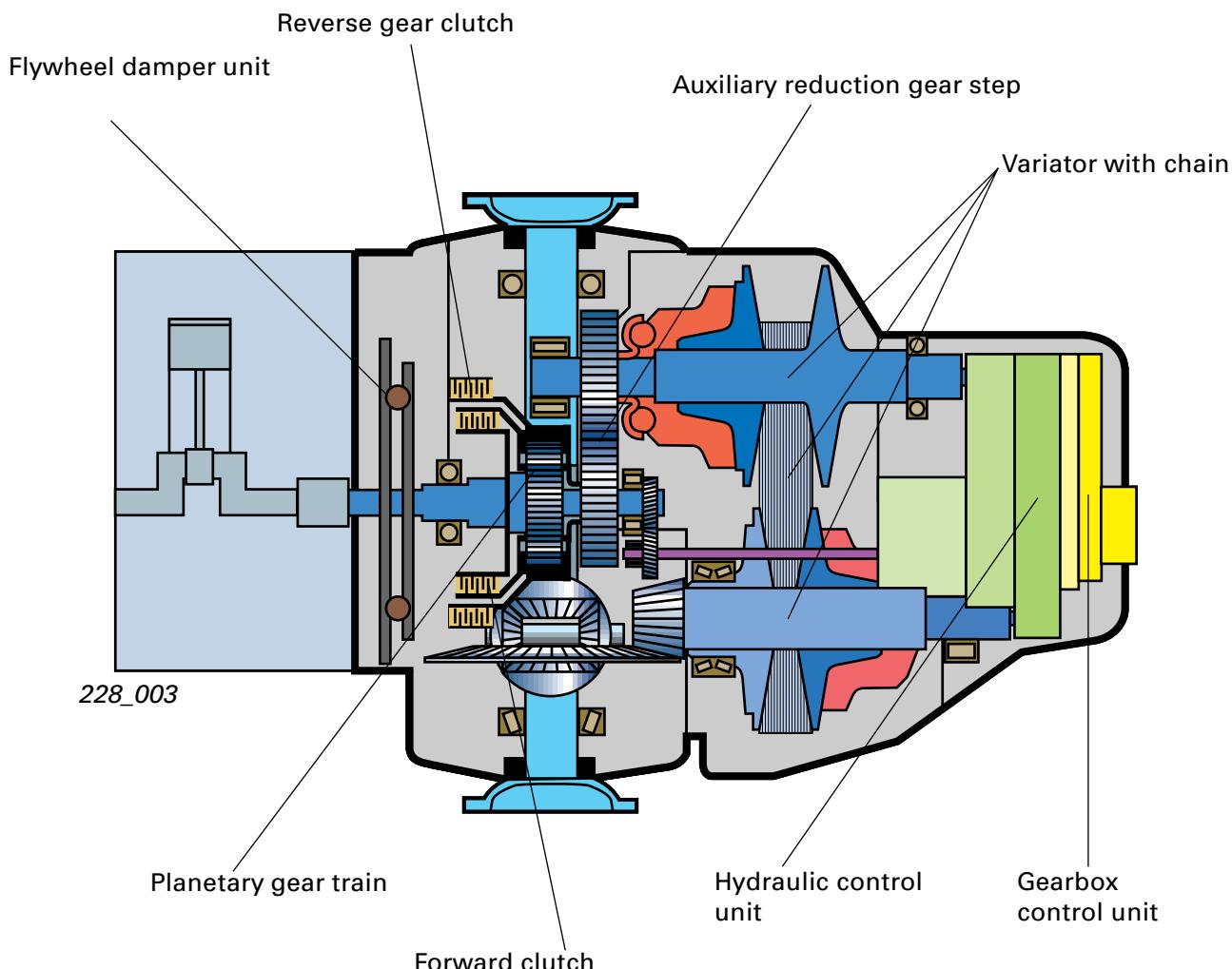
The rotational direction for reverse is changed by means of a planetary gear train.

The engine torque is transmitted to the variator via an auxiliary reduction gear step and transferred from there to the final drive.

It is worth mentioning the innovative concept for torque transfer by means of a pull chain (refer to description of variator and pull chain).

The electro-hydraulic control, together with the gearbox control unit, forms a unit which is accommodated in the gearbox housing.

The Tiptronic function provides 6 "speeds" for manual gear selection.

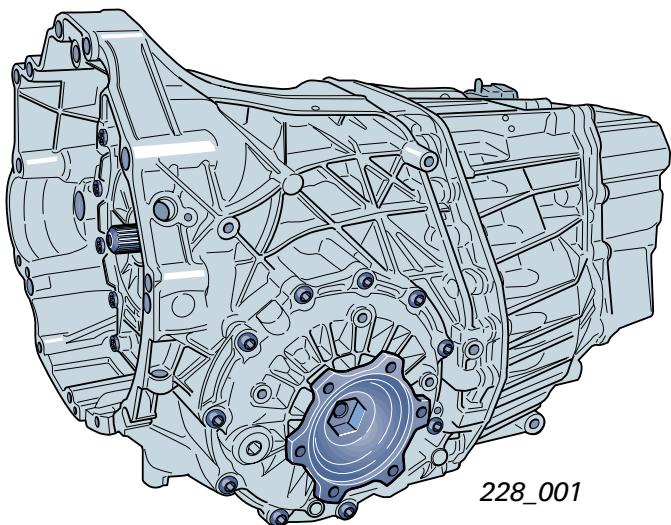


Introduction



Specifications

Designation:	multitronic® 01J
Factory designation:	VL 30
Code:	DZN
Max. transferable torque:	max. 310 Nm
Range of ratios of the variator:	2.40 - 0.40
Spread:	6
Ratio of auxiliary reduction gear step:	$51/46 = 1.109 : 1$
Final drive ratio:	$43/9 = 4.778 : 1$
Operating pressure of oil pump:	max. approx. 60 bar
Delivery rate of oil pump:	10 rpm @ 1000 rpm
  ATF for multitronic®:	G 052 180 A2
Axle oil for multitronic®:	G 052 190 A2
Gear oil quantities: ATF new filling (incl. ATF cooler and ATF filter) ATF change Axle oil	approx. 7.5 litres approx. 4.5 litres approx. 1.3 litres
Gross weight (without flywheel):	approx. 88 kg
Overall length:	approx. 610 mm



All the sizes specified in this Self-Study Programme refer only to the multitronic® with the code DZN.

Gearbox modules

The flywheel damper unit

In reciprocating engines, the unevenness of the combustion sequence induces torsional vibration in the crankshaft.

This torsional vibration is transmitted to the gearbox and results in resonant vibration here, producing noise and overloading components in the gearbox.

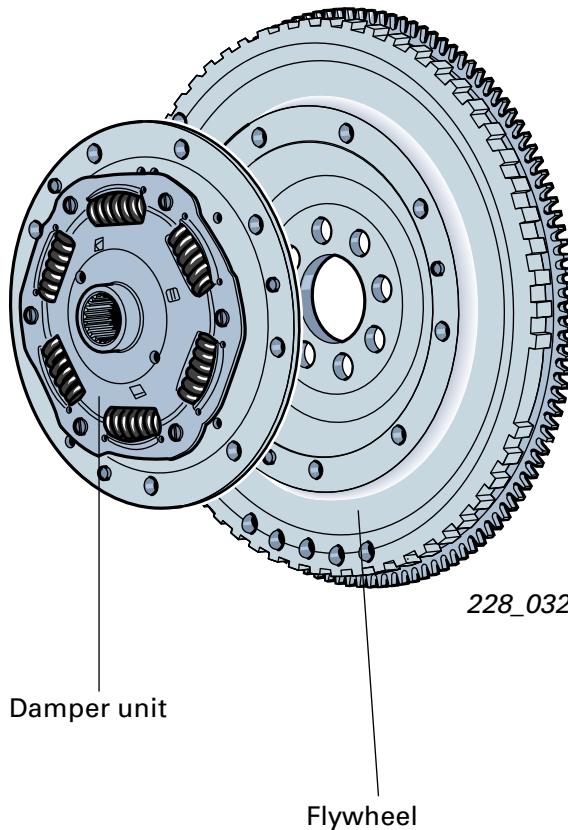
The flywheel damper unit and the two-mass flywheel dampen torsional vibration and ensure the engine runs quietly.

In the 2.8-litre V6 engine, engine torque is transmitted to the gearbox through a flywheel damper unit.

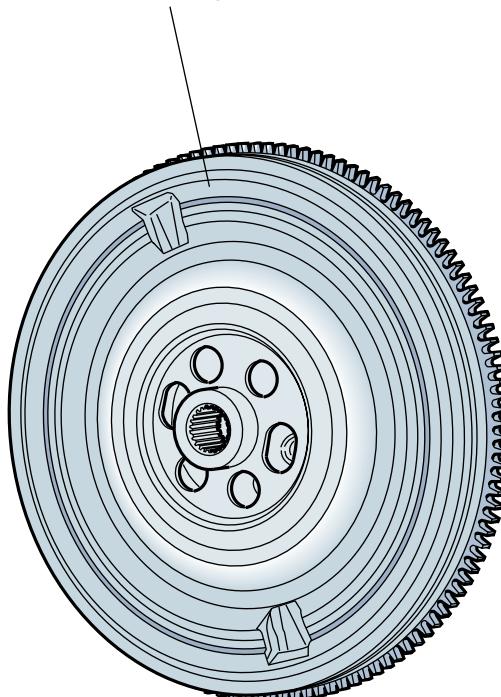
As four-cylinder engines do not run as smoothly as 6-cylinder engines, a two-mass flywheel is used in 4-cylinder engines.



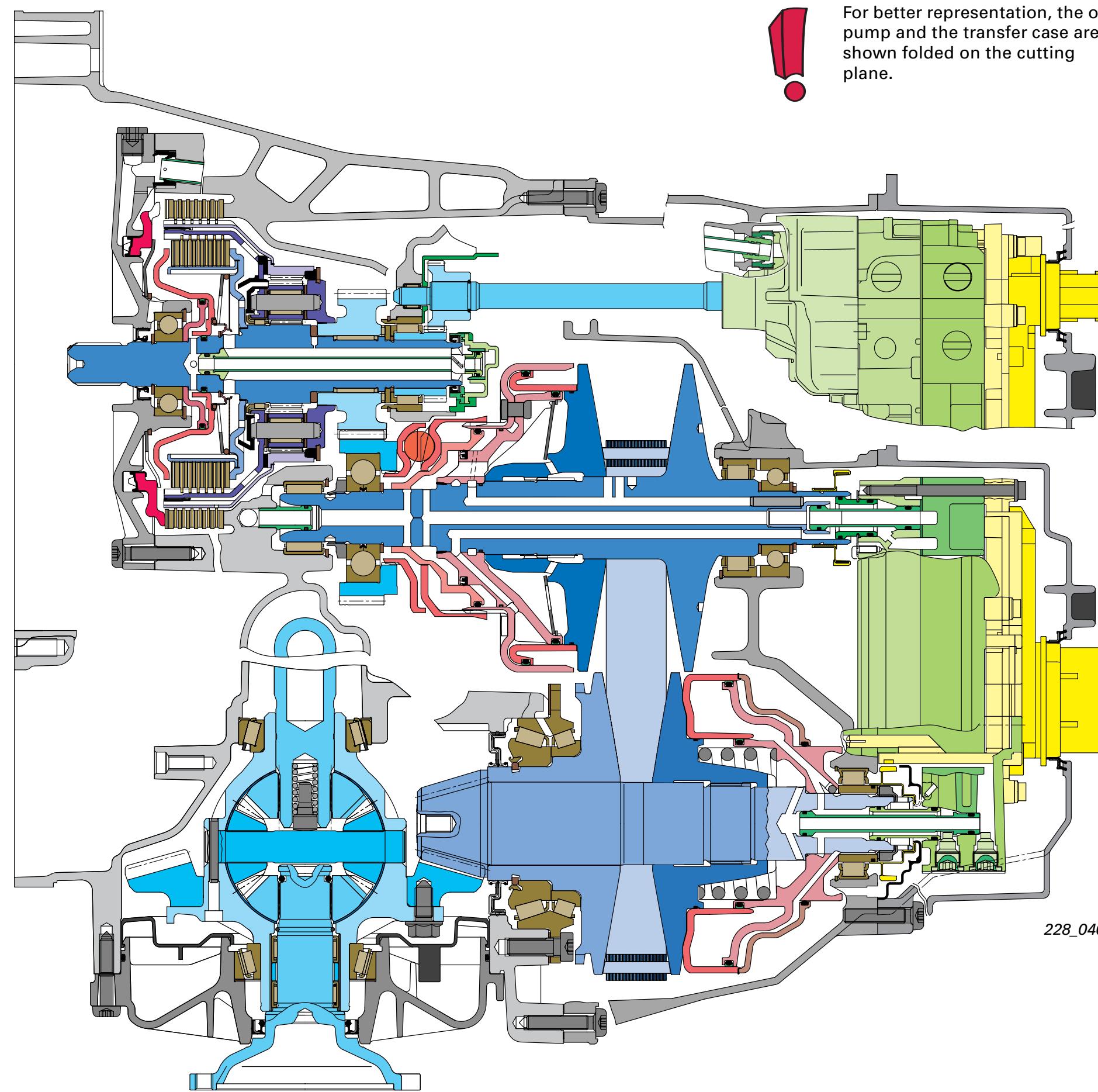
For more detailed information, please refer to Self-Study Programme 142.



Two-mass flywheel



For better representation, the oil pump and the transfer case are shown folded on the cutting plane.



Gearbox modules

Sectional view of gearbox



Colour definitions

- Housing, screws, bolts
- Hydraulic parts/control
- Electronic gearbox control
- Shafts, gears
- Plate clutches
- Pistons, torque sensors
- Bearings, washers, circlips
- Plastics, seals, rubber



Order No.: 507.5318.01.00

This figure can be ordered as a size A0 poster through
Bertelsmann Distribution for a net price of DM 10.00.

Direct ordering through Bertelsmann only applies to
Germany.

Dealers in export markets are requested to contact their
importer.

Gearbox modules

The forward clutch/reverse clutch with planet gear set

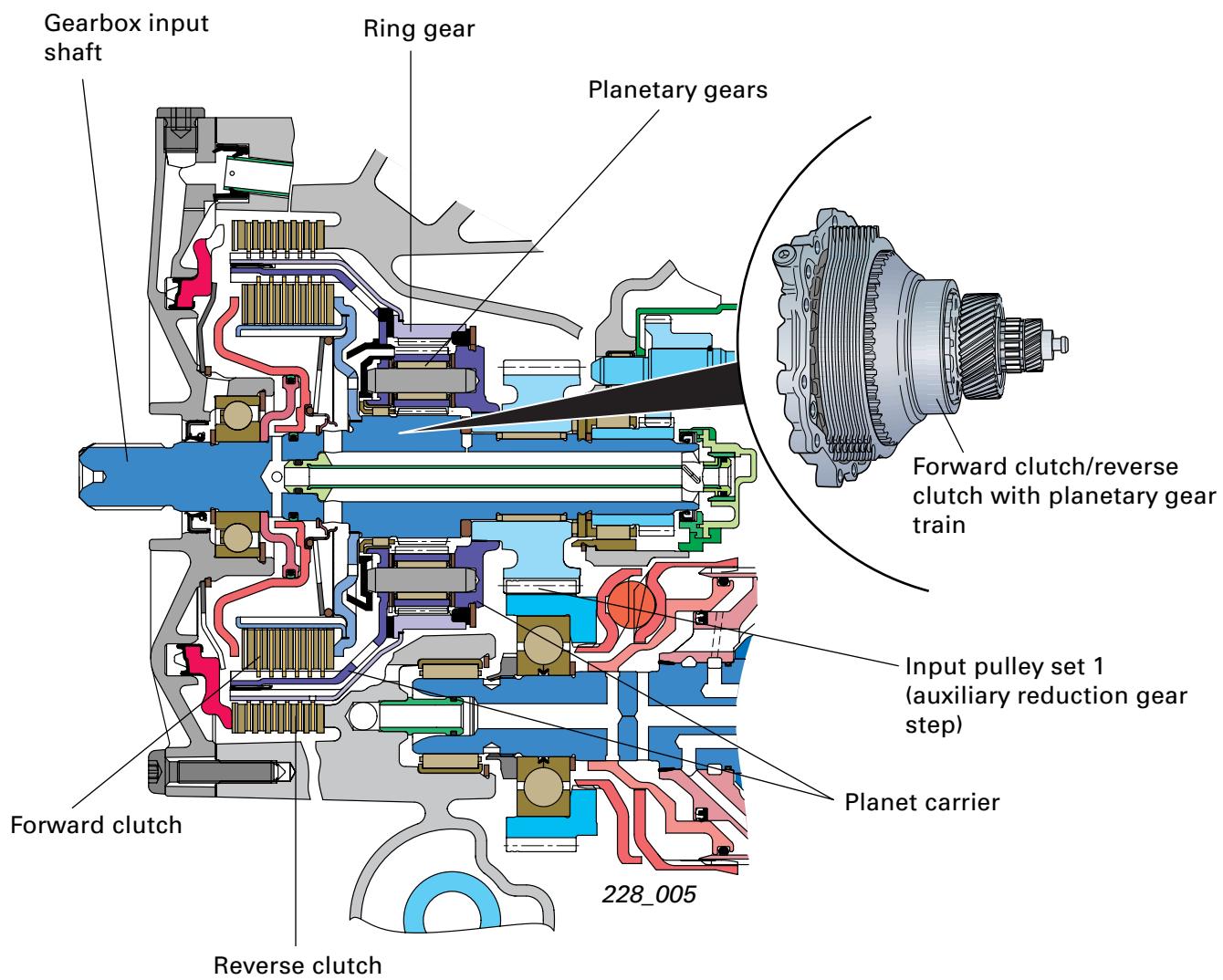
In contrast to multi-step automatic transmissions, which use a torque converter for torque transmission, separate clutches are used for forward and reverse travel in the Audi CVT concept.

These clutches, so-called "wet plate clutches", are also used to execute gearshifts in multi-step automatic transmissions. They are used for driving off and transmitting the torque to the auxiliary reduction gear step.

The drive-off process and torque transmission are monitored electronically and regulated electro-hydraulically.

The electro-hydraulically controlled plate clutch has the following advantages over a torque converter:

- ▶ Low weight
- ▶ Very little installation space is required
- ▶ Adaptation of drive-off characteristic to driving situation
- ▶ Adaptation of creep torque to driving situation
- ▶ Protective function in the event of overloading or misuse



The planetary gear train

The planetary gear train is constructed as a planet reversing gear set and its only function is to change the rotational direction of the gearbox for reversing.

The reduction ratio in the planetary gear train is 1:1 when reversing.

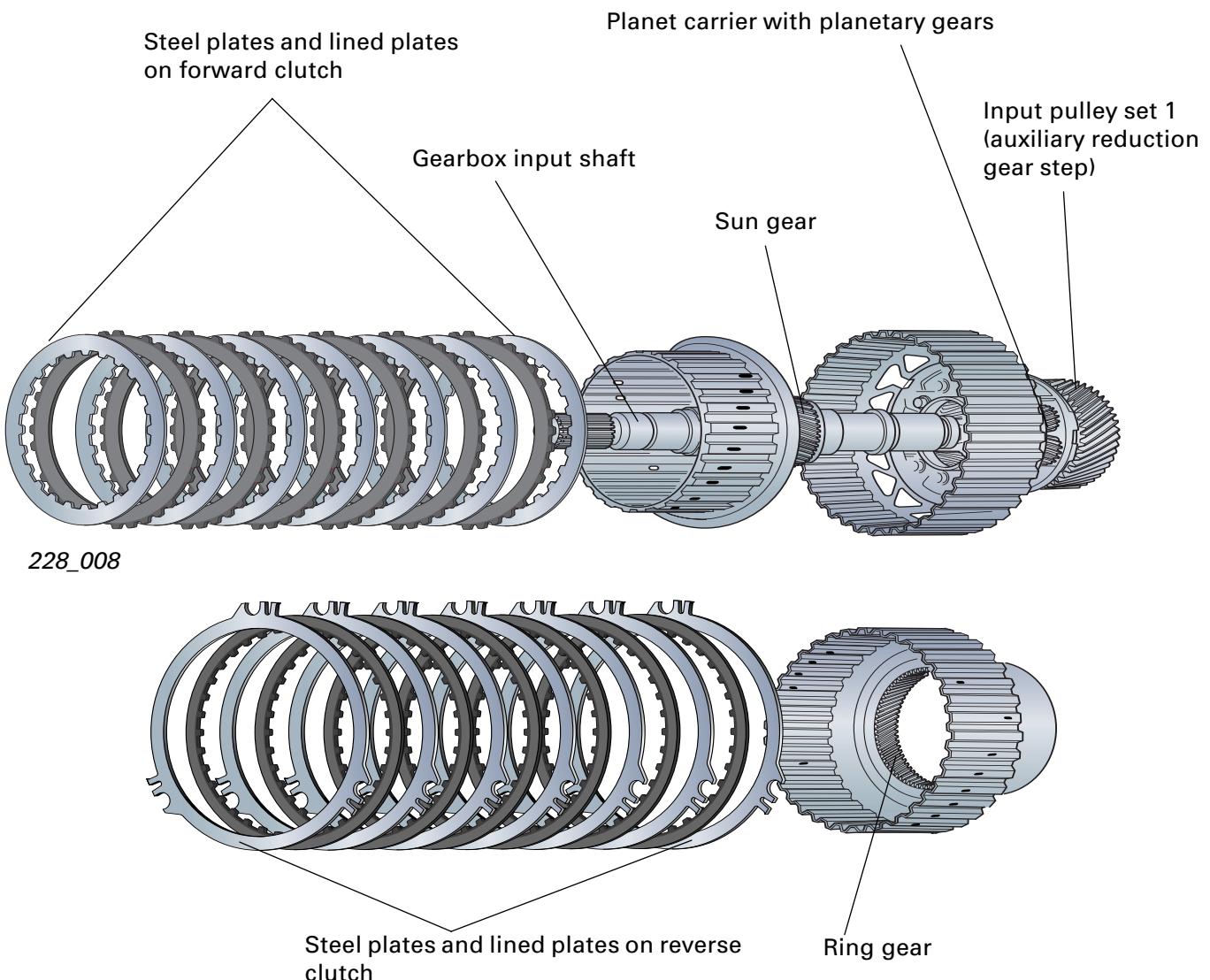
Assignment of components

The **sun gear** (input) is linked to the gearbox input shaft and the steel plates on the forward clutch.



The **planet carrier** (output) is linked to the drive gear the auxiliary reduction gear step and the lined plates on the forward clutch.

The **ring gear** is connected to the planetary gears and the lined plates on the reverse clutch.



Gearbox modules

Force path in the planetary gear train

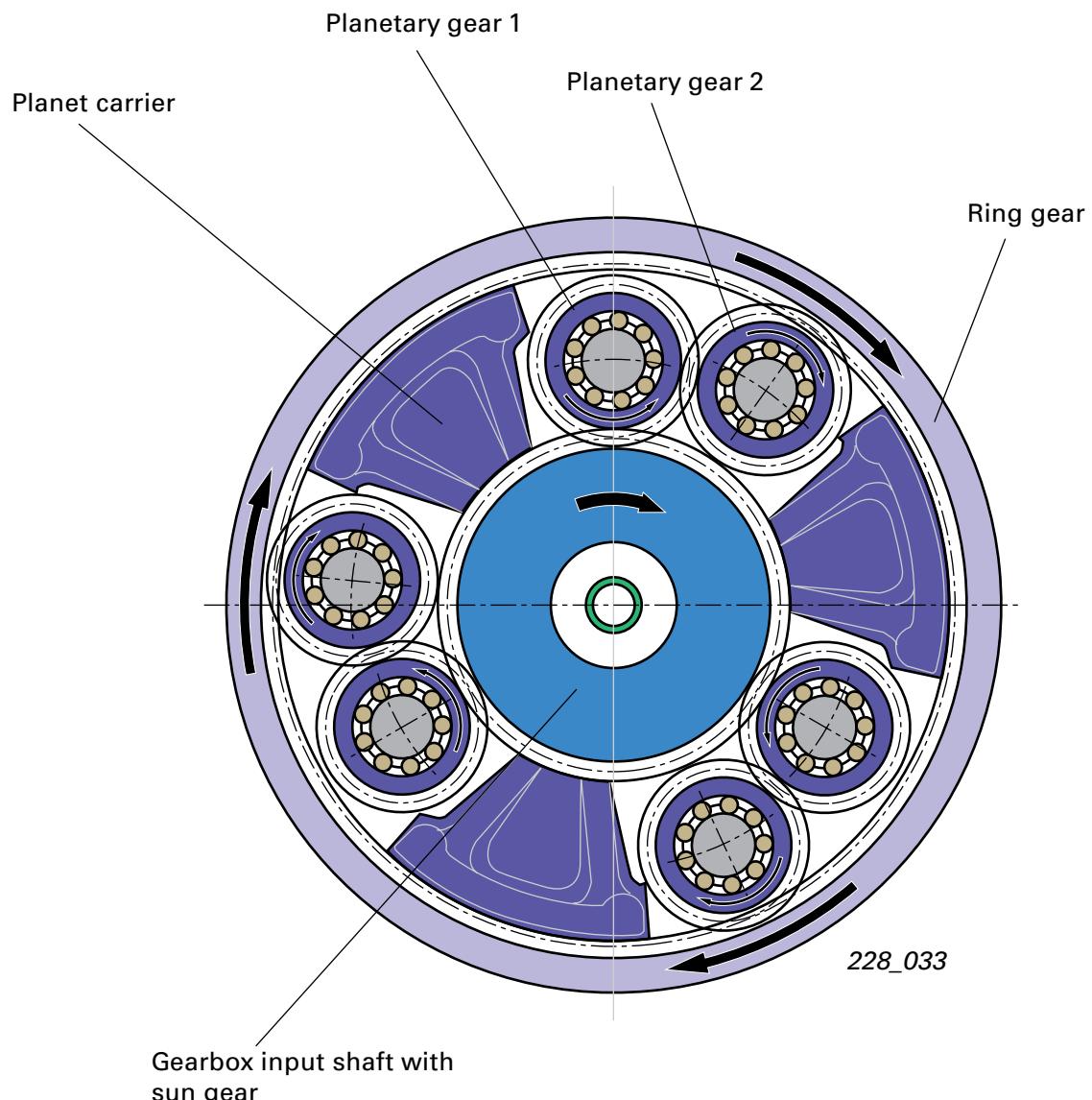


Torque is transferred to the planetary gear train via the sun gear connected to the input shaft and drives the planetary gears 1.

Planetary gears 1 drive planetary gears 2, which are in mesh with the ring gear.

The planet carrier (output planetary gear train) is stationary because it acts as the input for the auxiliary reduction gear step and the vehicle is still not moving.

The ring gear idles and rotates at half engine speed in the direction of engine rotation.



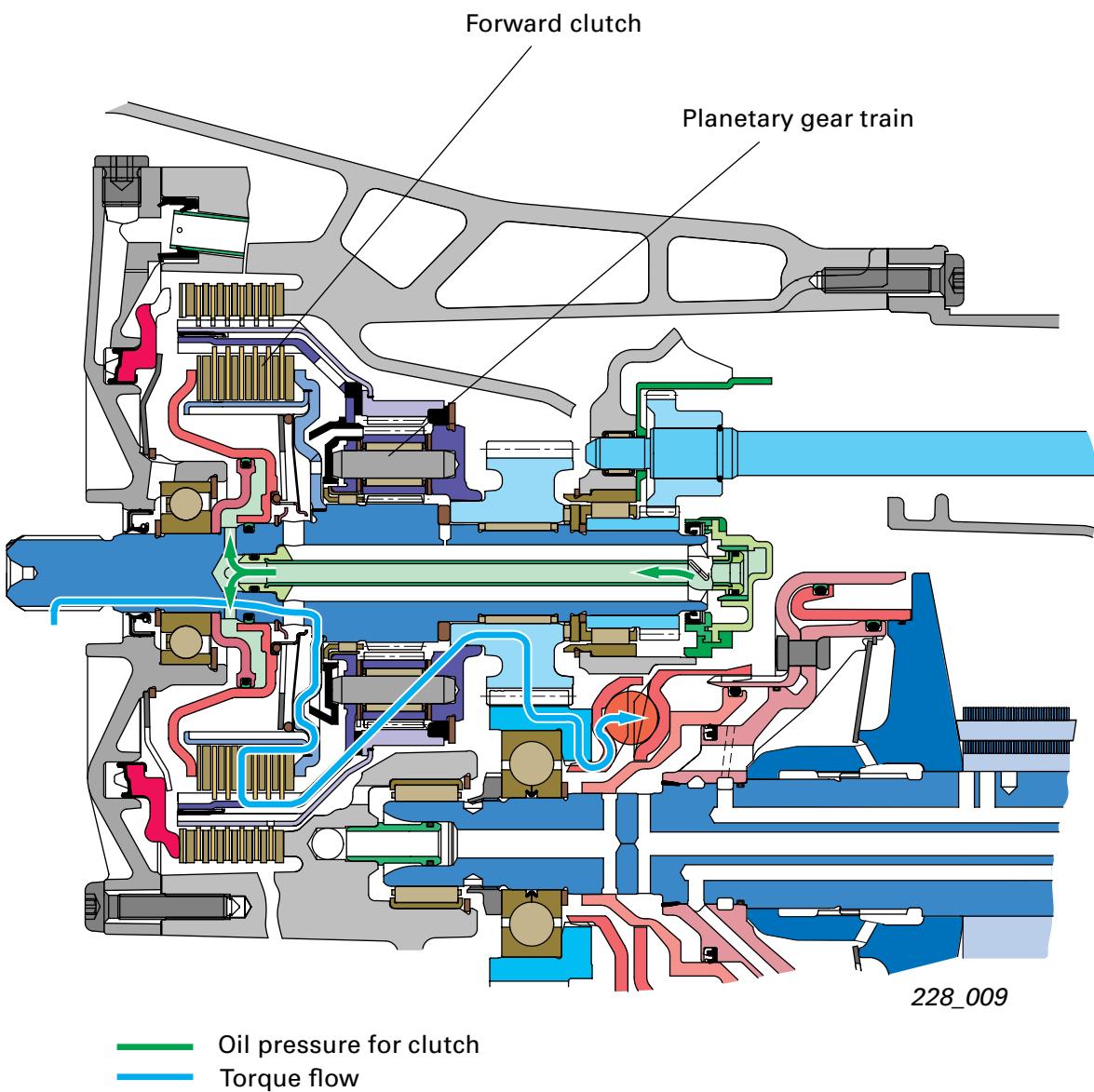
Direction of rotation of components when engine is running and vehicle is stationary

Force path during ahead travel

The steel plates on the forward clutch are linked to the sun gear and the lined plates are linked to the planet carrier.



When the forward clutch is positive (engaged), it connects the gearbox input shaft to the planet carrier (output). The planetary gear train is locked and rotates in the same direction as the engine; the torque transmission ratio is 1:1.



Gearbox modules

Force path when reversing



The lined plates of the reverse clutch are connected to the ring gear and the steel plates are connected to the gearbox housing.

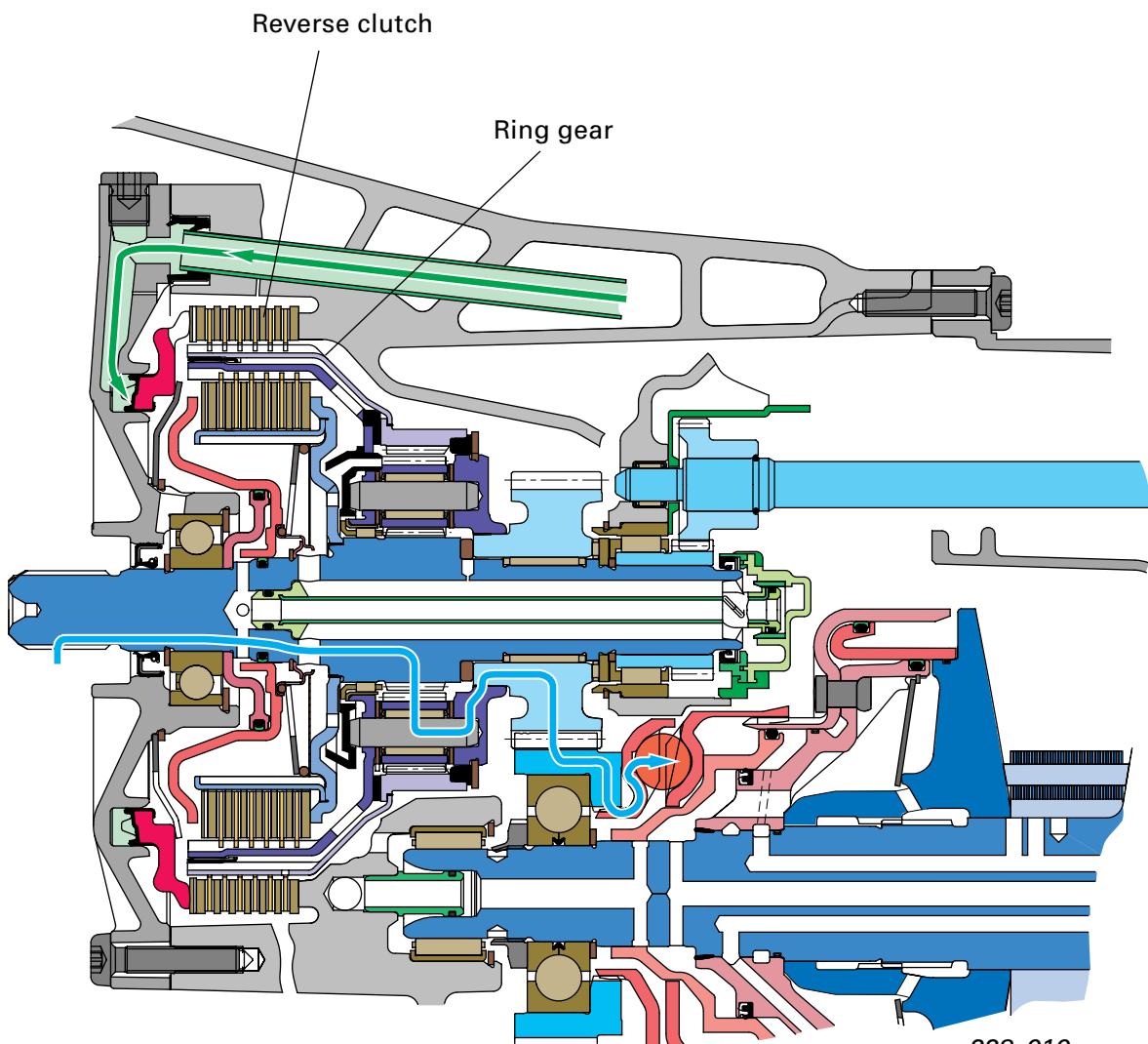
When the reverse clutch becomes positively engaged, it holds the ring gear and thereby prevents the gearbox housing from rotating on starting.

Torque is then transmitted to the planet carrier, which begins to rotate in the opposite direction to the engine. The vehicle reverses.



When reversing, road speed is limited electronically.

The variator remains in the starting torque ratio.



— Oil pressure for clutch
— Torque flow

Notes



Gearbox modules

The clutch control



The drive-off process

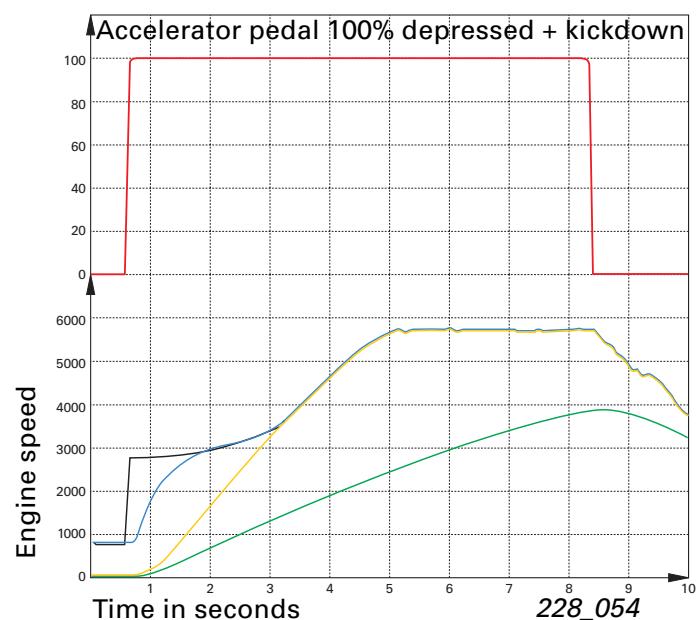
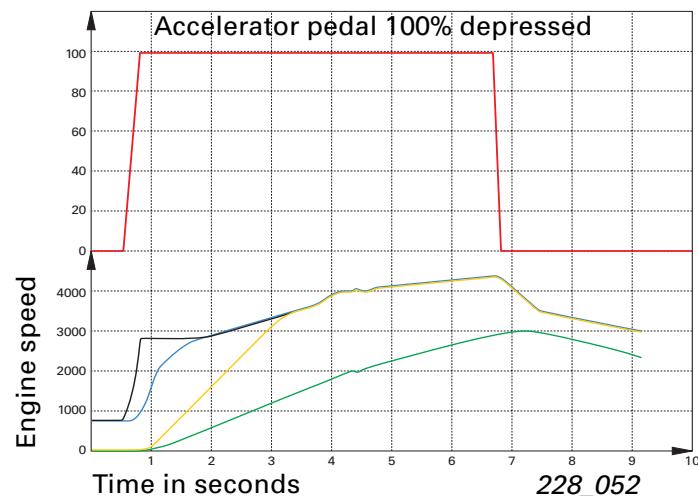
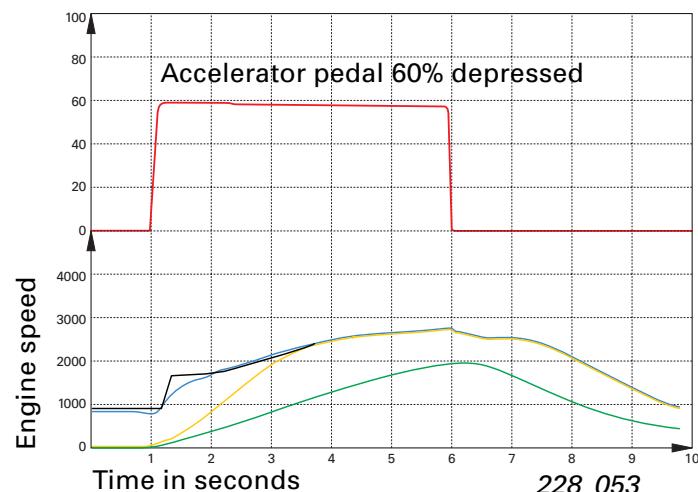
During the drive-off process engine speed is primarily used for clutch control. Depending on the starting characteristic, the gearbox control unit defines a nominal engine speed at which engine speed is regulated as a function of clutch torque.

The driver input and the internal demands in the gearbox control unit are the factors that determine the starting characteristic.

In an economy driving mode, which is characterised - for instance - by a small accelerator pedal angle during the drive-off process, the transition from engine idling speed to drive-off engine speed is performed at low revs. Short clutch slip times and low engine speed allow for higher fuel economy.

For a performance start, the transition from engine idling speed to drive-off engine speed takes place at higher revs. The higher engine torque leads to correspondingly higher vehicle acceleration.

Several engine variants (petrol/diesel, torque and torque curve) also have an effect on the starting characteristic.



- Accelerator pedal angle
- Engine speed
- Nominal engine speed

- Gearbox input speed, pulley set 1
- Gearbox output speed, pulley set 2

Electronic control

The following parameters are used for clutch control:

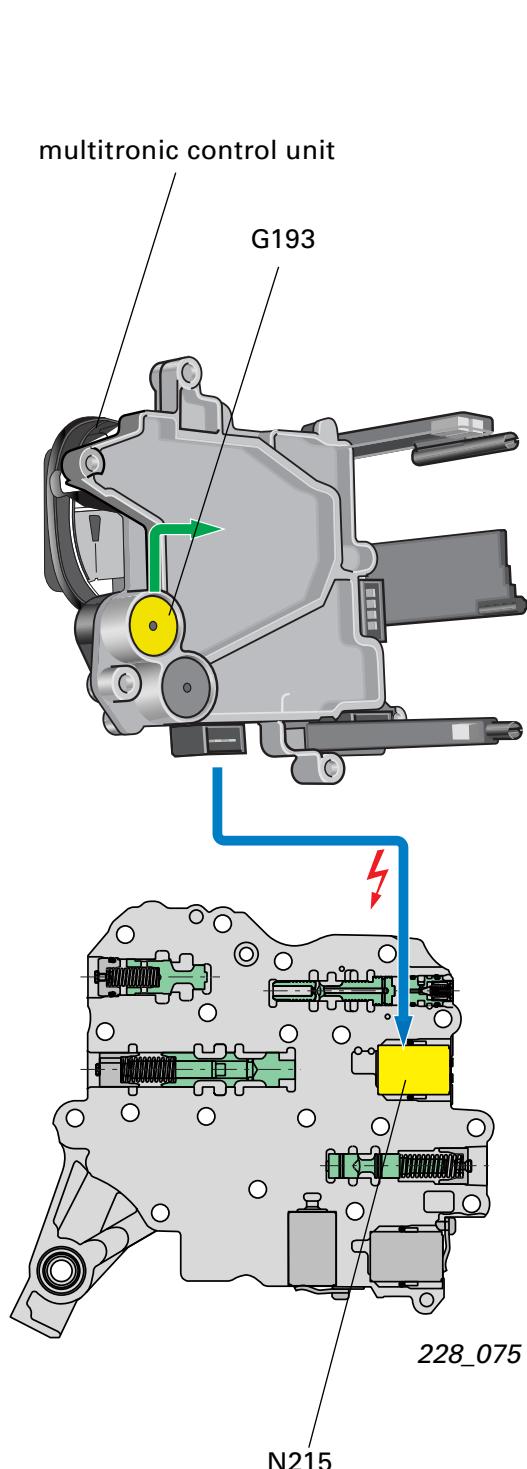
- ▶ Engine speed
- ▶ Gearbox input speed
- ▶ Accelerator pedal position
- ▶ Engine torque
- ▶ Brake pressed
- ▶ Gearbox oil temperature

The gearbox control unit calculates the nominal clutch pressure from these parameters and determines the control current for pressure regulating valve N215. The clutch pressure, and therefore also the engine torque to be transmitted by the clutch, changes almost in proportion to the control current (refer to "Hydraulic control", page 22).

Hydraulic pressure sender 1 G193 registers the clutch pressure (actual clutch pressure) in the hydraulic control. Actual clutch pressure is continuously compared to the nominal clutch pressure calculated by the gearbox control unit.

The actual pressure and specified pressure are checked continuously for plausibility and corrective action is taken if these two values deviate from one another by more than a certain amount (refer to "Safety shut-off", page 23).

To prevent overheating, the clutch is cooled and clutch temperature is monitored by the gearbox control unit (for more detailed information, refer to "Clutch cooling", page 28, and "Overload protection", Page 23).



Gearbox modules

Hydraulic control

Clutch pressure is proportional to engine torque and is not dependent on the system pressure.

A constant pressure of approx. 5 bar is applied by the pilot pressure value (VSTV) by the pressure regulating valve N215. N215 produces a control pressure which controls the position of the clutch control valve (KSV) depending on the control current calculated by the gearbox control unit.

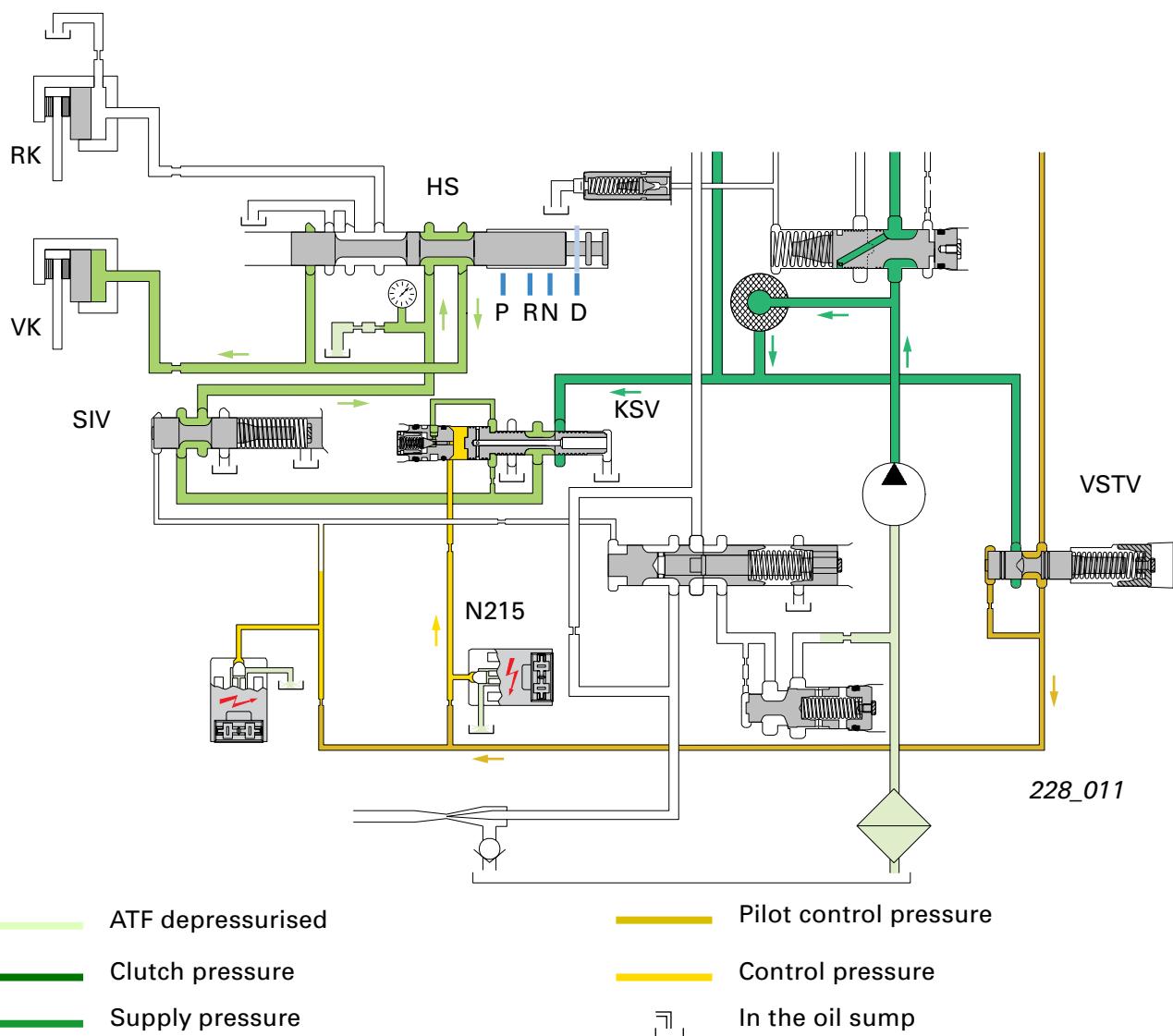
A high control current results in a high control pressure.

The clutch control valve (KSV) controls the clutch pressure and therefore also regulates the engine torque to be transmitted.

The clutch control valve (KSV) is supplied with system pressure and produces clutch pressure in accordance with the activation signal from N215. A **high control pressure result in a high clutch pressure**.

The clutch pressure flows via the safety valve (SIV) to the manual selector valve (HS). The manual selector valve transfers clutch pressure either to the forward clutch (position D) or to the reverse clutch (position R), depending on the selector lever position. The non-pressurised clutch is vented into the oil sump.

In selector lever positions N and P, the supply is shut off via the manual selector valve and both clutches are vented into the oil sump.



Safety shut-off

A safety-critical malfunction has occurred if actual clutch pressure is clearly higher than specified clutch pressure. In this case, the clutch is depressurised regardless of the manual selector valve position and other system states.

A safety shut-off is implemented via the safety valve (SIV) and enables the clutch to open quickly.

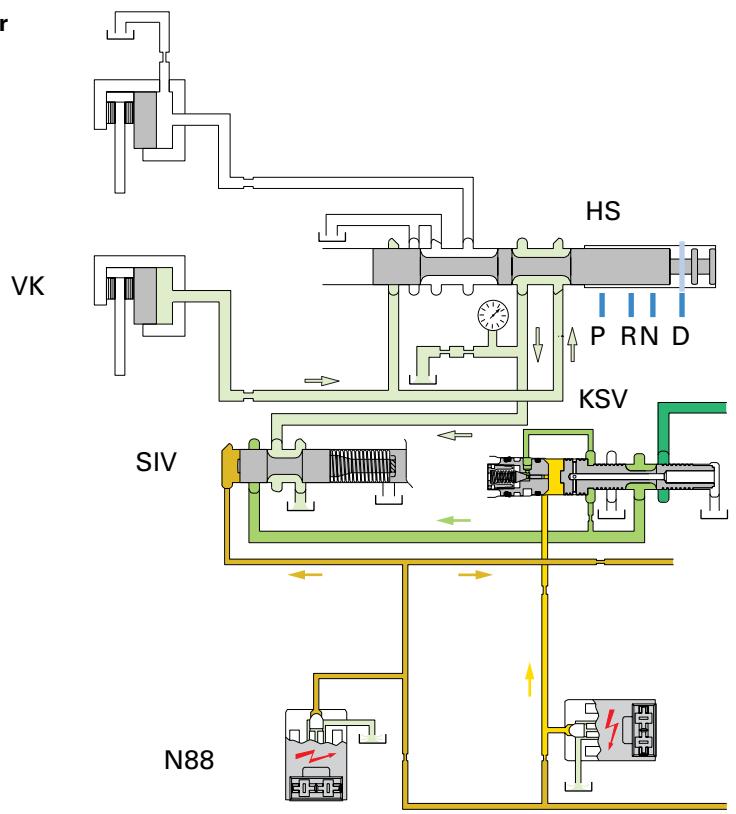
The SIV is activated by solenoid valve 1 N88. At control pressures upwards of approx. 4 bar, the supply to the clutch control valve (KSV) is shut off and the connection to the manual selector valve in the oil sump is vented.

Overload protection

Using a model calculation, the gearbox control unit calculates the clutch temperature from clutch slip, engine torque to be transmitted and gearbox oil temperature. Engine torque is reduced if the measured clutch temperature exceeds a defined threshold because of excess load on the clutch.

Engine torque can be reduced to the upper end of the idling speed range. It is possible that the engine will not respond to the accelerator pedal for a short period of time. The clutch cooling system ensures a short cooling-down time. Maximum engine torque is quickly available again. Overload of the clutch is almost impossible.

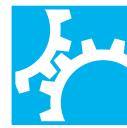
Switched position after safety shut-off



228_082

- Vented into oil sump/depressurised
- Clutch pressure
- Supply pressure

- Pilot control pressure
- Control pressure
- In the oil sump



Gearbox modules



Clutch control when vehicle is stationary (creep control)

The creep control function sets the clutch to a defined slip torque (clutch torque) when the engine is running at idling speed and a drive position is selected.

The vehicle behaves in the same way as an automatic transmission with a torque converter.

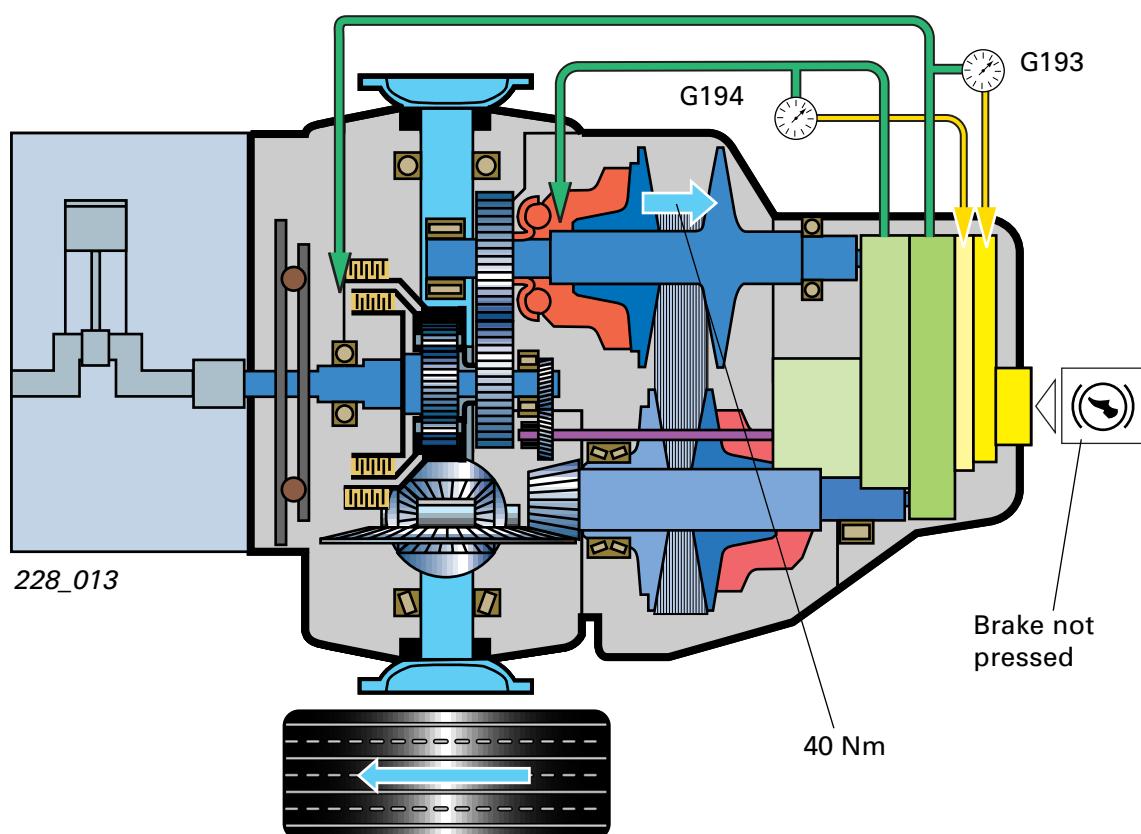
Selective clutch pressure adaptation results in an input torque which causes the vehicle to "creep".

Input torque is varied within defined limits depending on vehicle operating state and vehicle road speed.

The contact pressure applied by the taper pulleys - as determined by G194 - is used for precision clutch torque control.



Creep control allows the vehicle to be manoeuvred (when parking) without pressing the accelerator pedal and therefore enhances driving comfort.



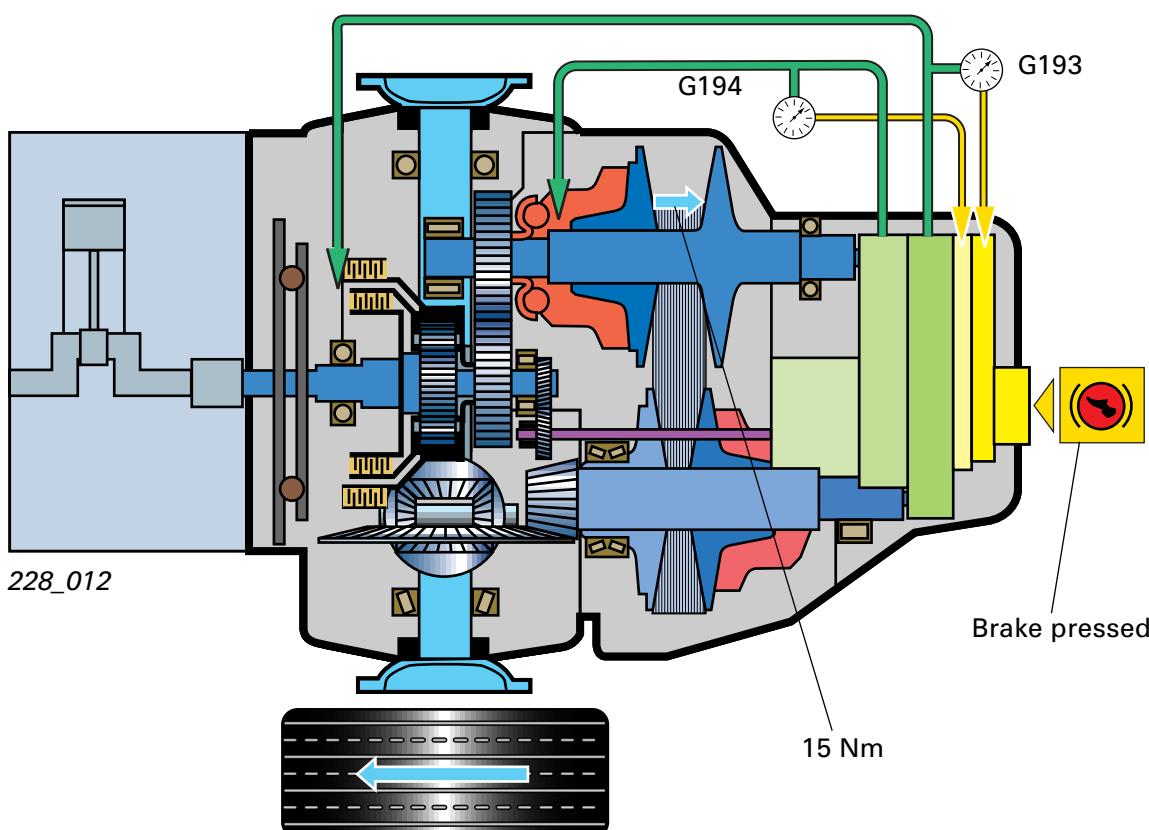
Special feature of the creep control

A special feature of the creep control is the reduction of creep torque when the vehicle is stationary and the brake is actuated; as a result, the engine is not required to develop so much torque (the clutch is also open wider).

This has a positive effect on fuel economy and comfort, as the vehicle's acoustics (humming of the engine running at idling speed when the vehicle is stationary) are improved and much less pressure has to be applied to the brake to stop the vehicle.

If the vehicle rolls back when standing on a slope with only light pressure applied to the brake, the clutch pressure is increased so as to immobilise the vehicle ("Hill-holder" function).

By using two gearbox output speed senders - G195 and G196 - it is possible to distinguish between ahead travel and reverse travel, which makes the hillholder function possible (for further information, please refer to the chapter on "Sensors").



Gearbox modules

The micro-slip control



The micro-slip control serves to adapt the clutch control (see description of adaption process) and dampen the torsional vibration induced by the engine.

In the part-throttle range, the clutch characteristics are adapted up to an engine torque of 160 Nm.

In the rev range up to approx. 1800 rpm and at engine torques up to approx. 220 Nm, the clutch operates in what is known as "micro-slip" mode.

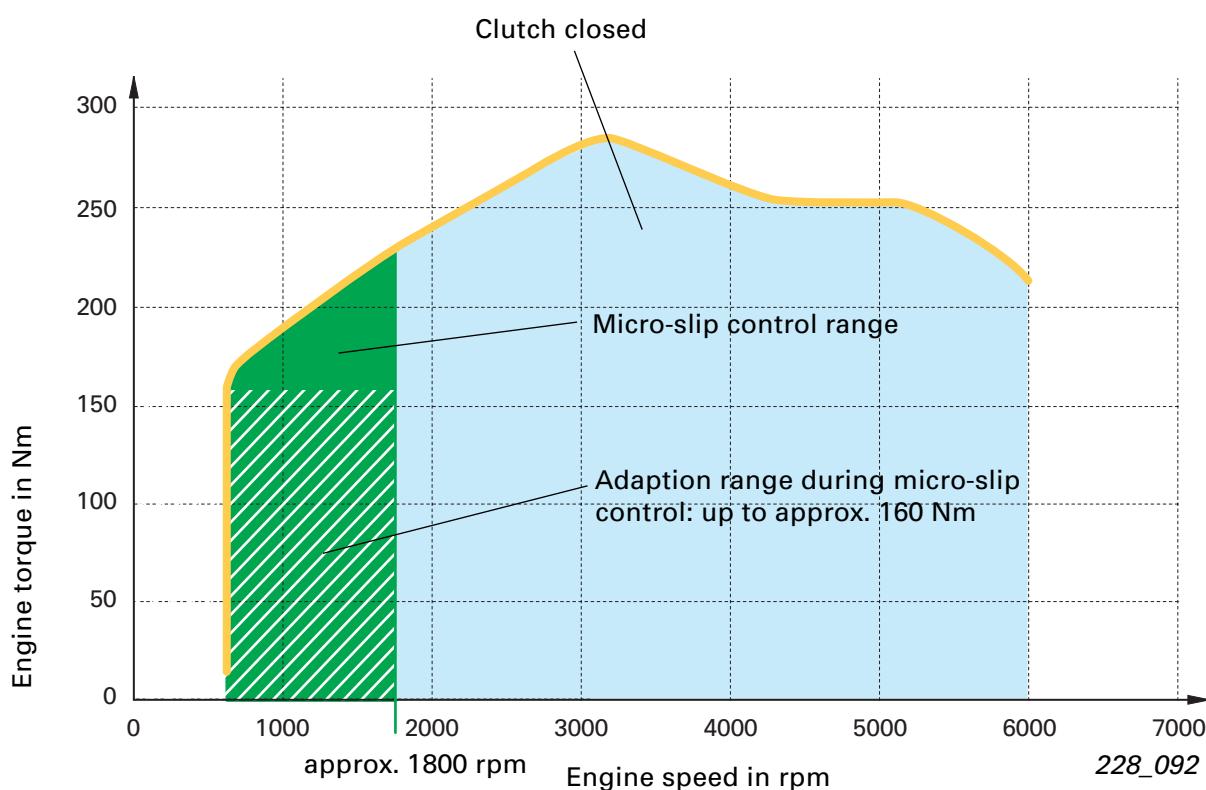
In this operating mode, a slip speed (speed differential) of approx. 5 rpm to 20 rpm is maintained between the gearbox input shaft and pulley set 1.

For this purpose, the gearbox control unit compares the signal generated by gearbox input speed sender G182 with the engine speed (making allowance for the auxiliary reduction gear step).

Sender G182 registers the rpm of pulley set 1.



As the term "micro-slip" suggests, clutch slip is kept at a minimum so no penalties in lining wear and fuel economy are noticeable.



Clutch control adaption

To be able to control the clutch equally as comfortably in any operating state and throughout its service life, the relationship between control current and clutch torque has to be updated continuously.

This is necessary because the coefficients of friction of the clutches are constantly changing.

The coefficient of friction is dependent on the following factors:

- ▶ Gearbox oil (quality, ageing, wear)
- ▶ Gearbox oil temperature
- ▶ Clutch temperature
- ▶ Clutch slip

To compensate for these influences and optimise clutch control, the relationships between control current and clutch torque are adapted in creep control mode and in the part-throttle range.

Adaption in creep control mode (brake pressed):

As mentioned already, a defined clutch torque is set in creep control mode. The gearbox control unit observes the relationship between the control current (from N215) and the data from pressure sender G194 (contact pressure) and stores these data. The actual data are used for calculating new characteristics.



Here, "adaption" means learning new pilot control values.



In the part-throttle range, adaption....

..... is performed in micro-slip control mode. In this operating mode the gearbox control unit compares the engine torque (from the engine control unit) to the control current to N215 and stores these data. The actual data are used for calculating new characteristics (see "Micro-slip control").

Summary:

The adaption function serves to maintain a constant clutch control quality.

The adaption data also have an effect on the calculation of clutch pressure at higher transmission torques (clutch fully positively engaged).

High clutch pressures are not required, which ultimately has a positive effect on efficiency.

Gearbox modules

The clutch cooling system

The clutches are cooled by a separate oil flow in order to protect them from exposure to excessively high temperatures (particularly when driving away in heavy conditions).

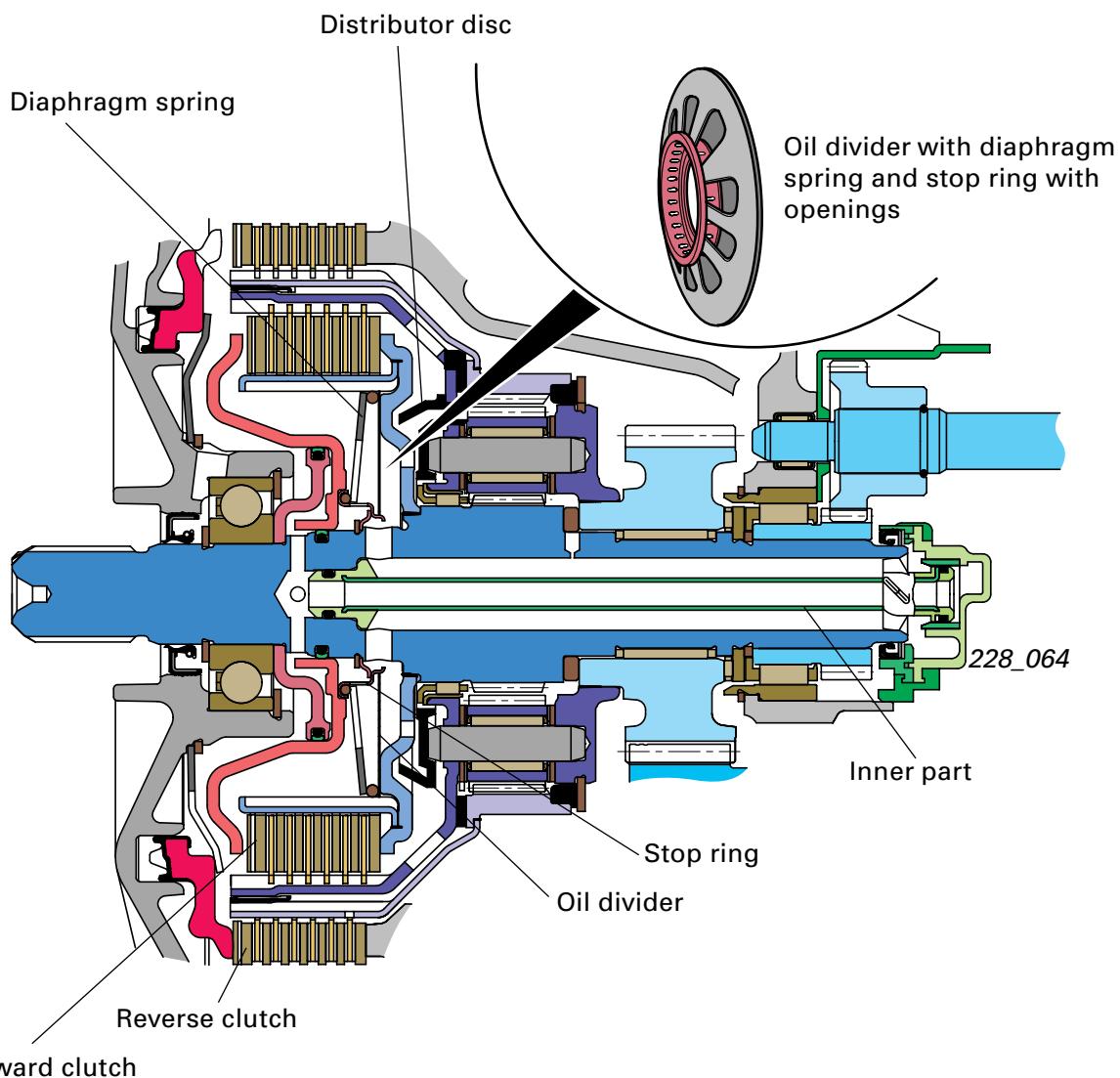
To minimise power losses due to clutch cooling, the cooling oil flow is connected when required via a cooling oil control unit integrated in the valve body.

The cooling oil quantity is also increased via a suction jet pump (entrainment pump) without placing a considerable higher demand on oil pump capacity.

To optimise clutch cooling, the cooling oil flows only to the power-transmitting clutch pulley set.

The cooling oil and the pressurised oil of the forward clutch flow through the hollow gearbox input shaft. The two oil circuits are separated from one another by a steel tube, the so-called "inner part".

An "oil divider" located at the oil outlet bores on the gearbox input shaft guides the cooling oil flow to the forward clutch and the reverse clutch.



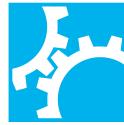
Cooling the forward clutch

If the forward clutch is engaged, the cylinder (thrust plate) of the forward clutch presses the oil divider back.

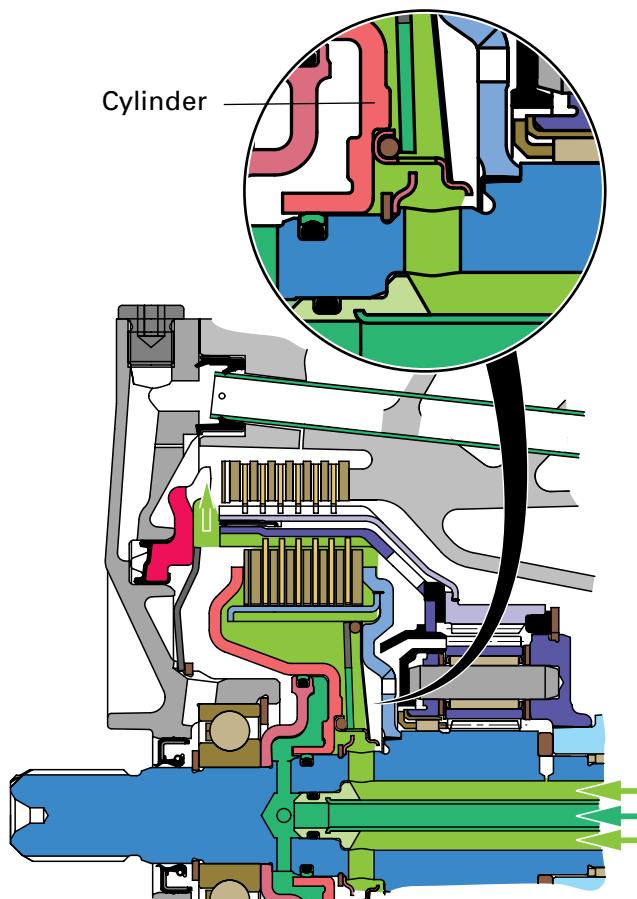
In this position, the cooling oil flows past the front face of the oil divider and through the forward clutch

Cooling the reverse clutch

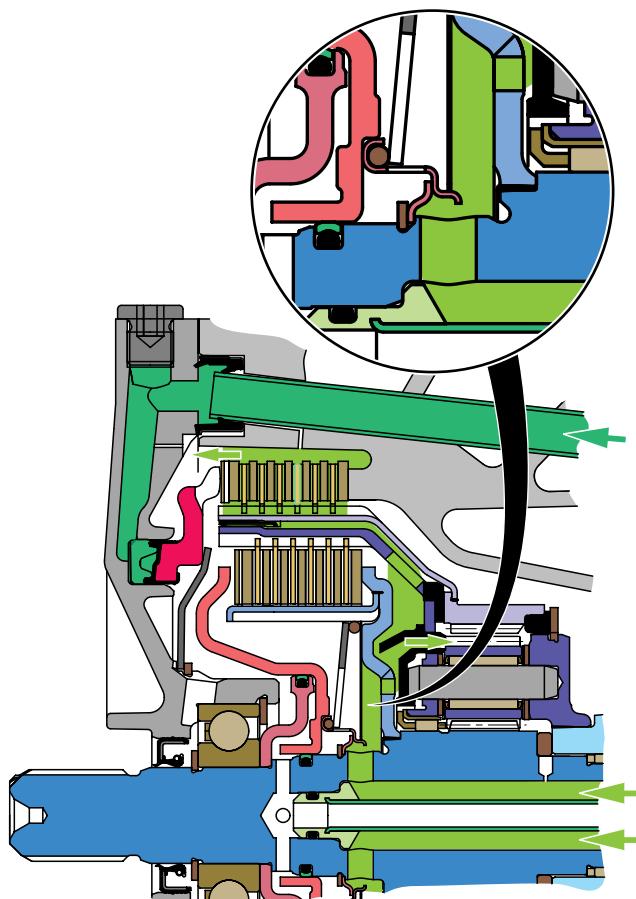
If the forward clutch is not operated (when the engine is running at idling speed or when the reverse clutch is operated), the oil divider is in its basic position.



Forward clutch



Reverse clutch



228_014

— Oil pressure for clutch

— Clutch cooling oil flow

Gearbox modules

Hydraulic clutch cooling control

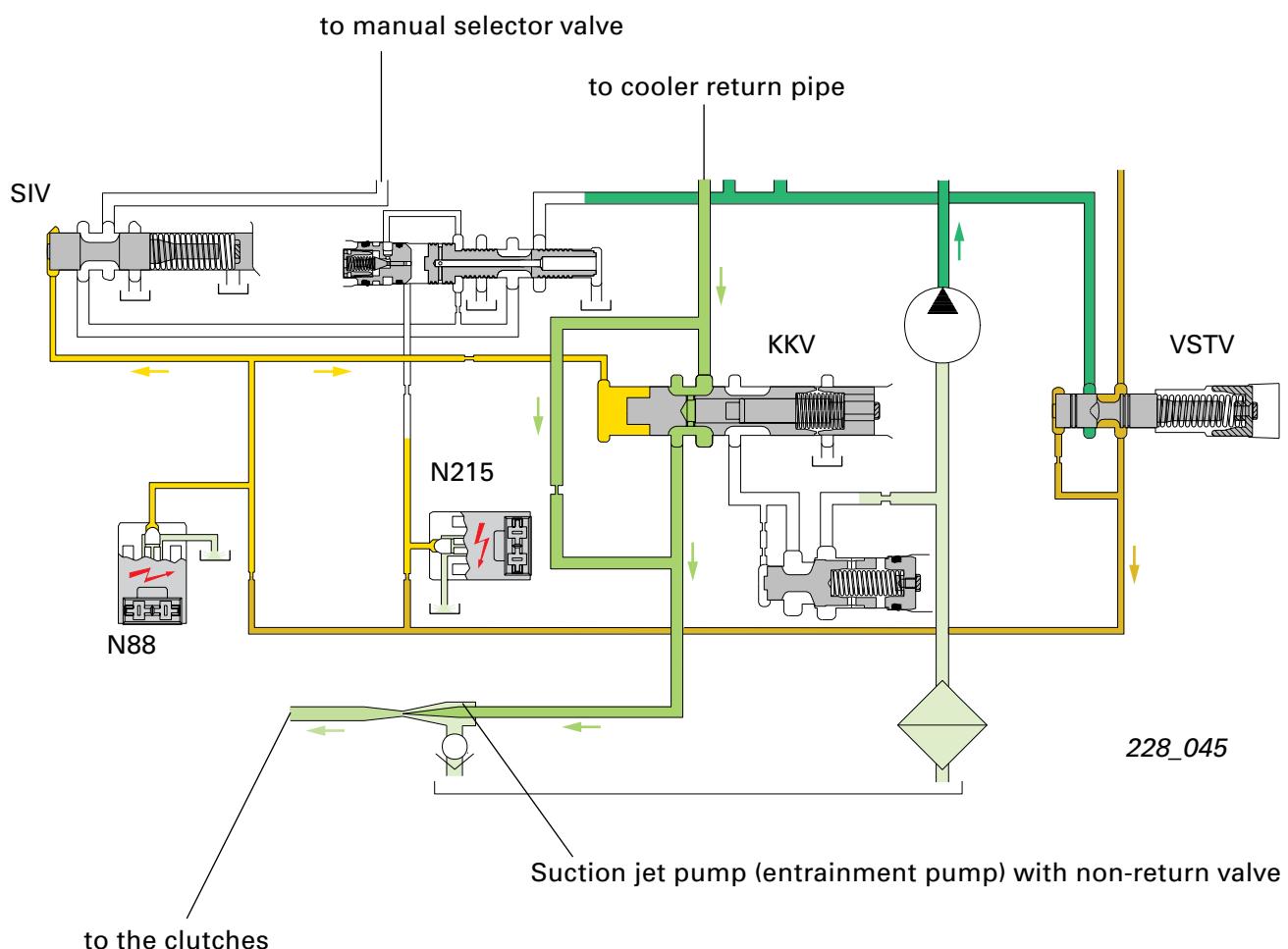


The clutch cooling system cuts in at the same time as the clutch control is activated.

The gearbox control unit applies a defined control current to solenoid valve 1 N88. This produces a control pressure which switches the clutch cooling valve (KKV).

The clutch cooling valve (KKV) transfers pressure from the cooler return pipe to the suction jet pump (entrainment pump).

The pressurised oil is used to operate the suction jet pump (entrainment pump) (for further details, refer to "Oil supply/suction jet pump (entrainment pump)", page 51).



— ATF depressurised
— Cooling oil flow
— Oil from cooler return pipe

— Pilot control pressure
— Control pressure
— In the oil sump

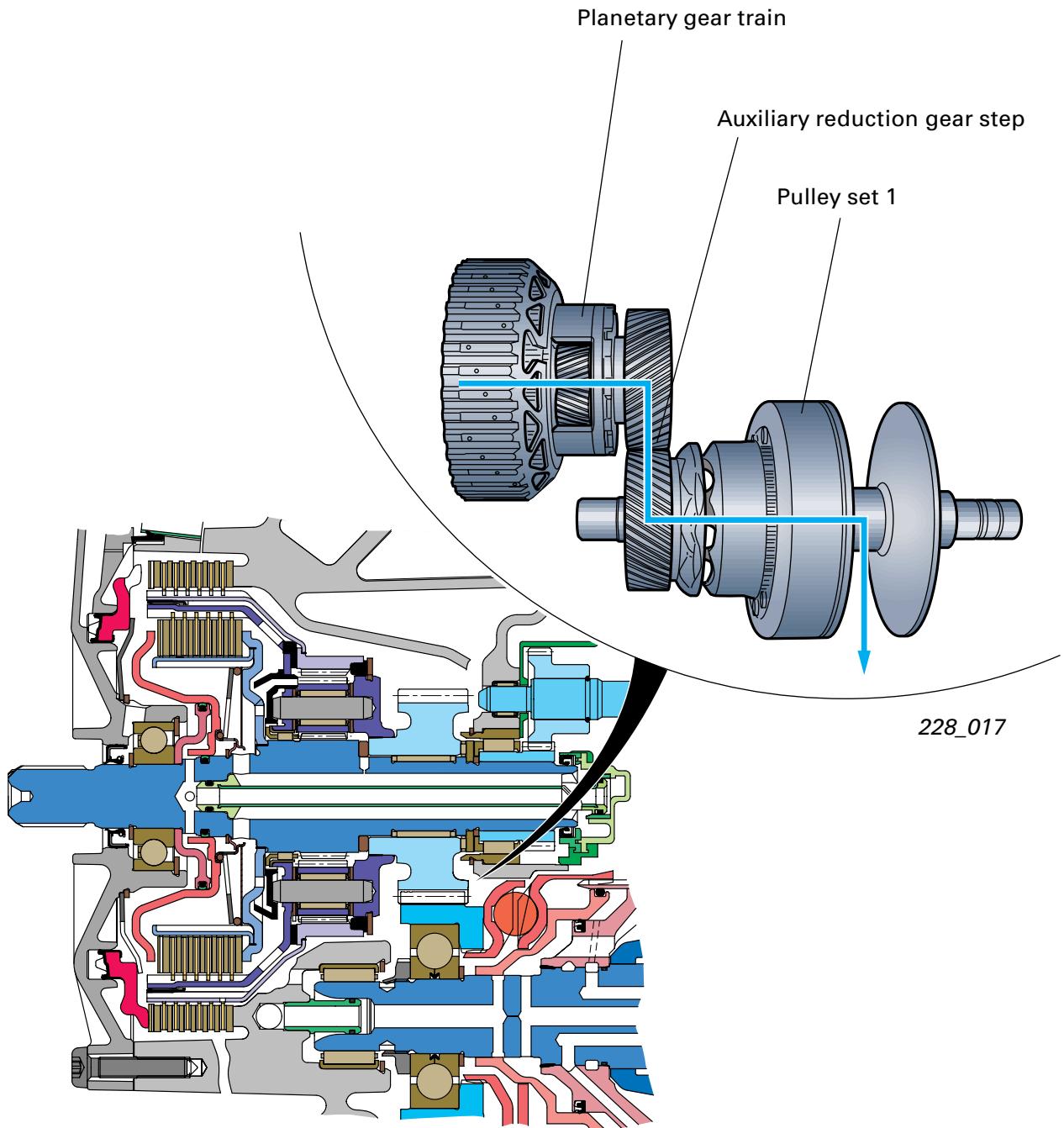
The auxiliary reduction gear step



Due to constraints on space, torque is transmitted to the variator through a auxiliary reduction gear step.

The auxiliary reduction gear step has different ratios for adapting engine variants to the gearbox.

As a result, the variator is operated within its optimum torque range.



Gearbox modules

The variator

The basic principle of the variator has already been explained on page 5. The special features and functions of the multitronic® variator are described on the following pages.

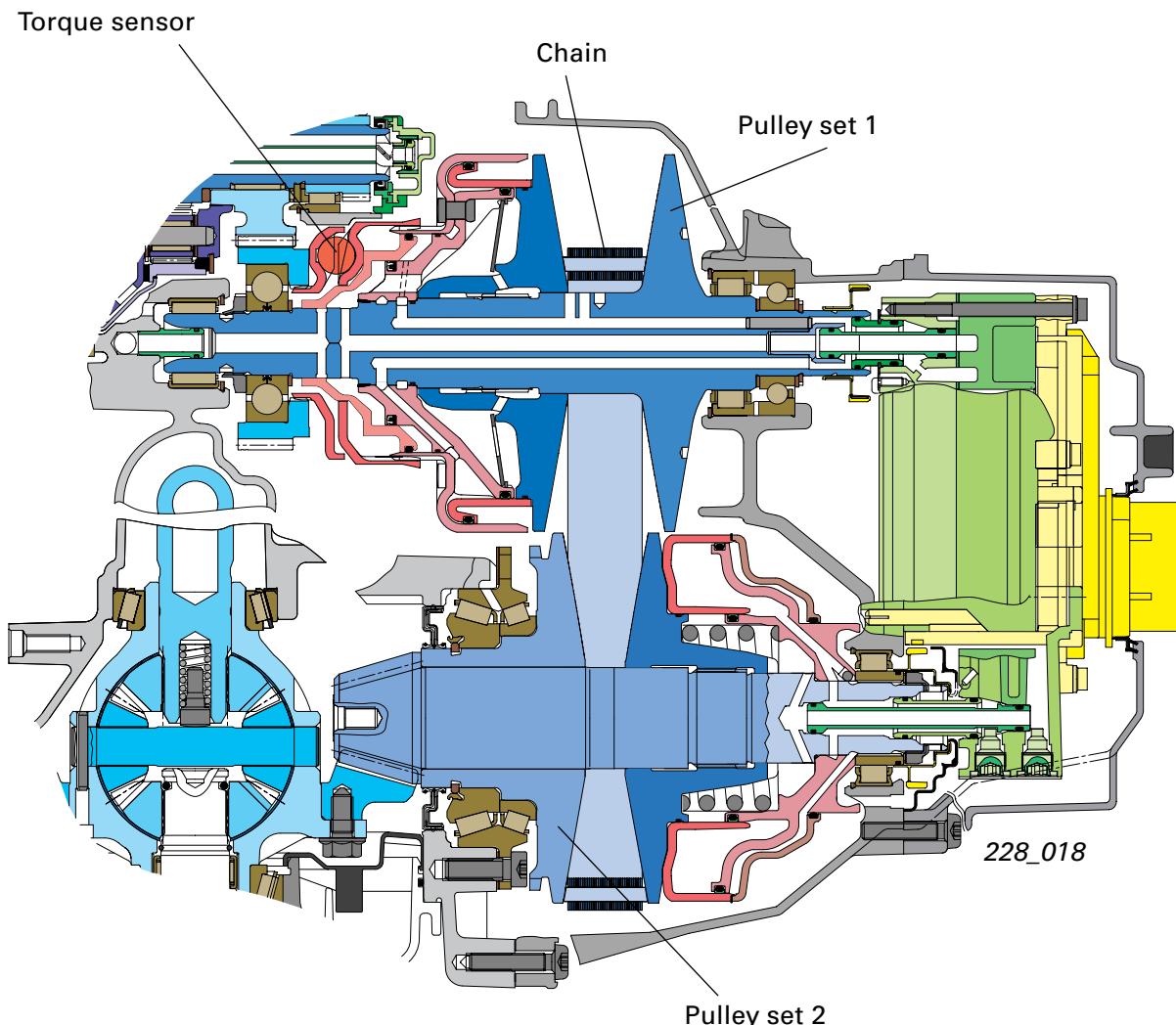
The concept of the variator used in the multitronic®

The mode of operation of the variator is based on what is known as the dual-piston principle. A further special feature of the variator is the torque sensor integrated in pulley set 1 (for more detailed information refer to "The torque sensor", page 38).

Pulley sets 1 and 2 each have a separate cylinder for pressing home the taper pulleys (pressure cylinder) as well as a separate cylinder for transmission ratio adjustment (variable displacement cylinder).

The dual-piston principle makes it possible to change the transmission ratio very quickly by applying a small amount of pressure; this ensures that the taper pulleys maintain sufficient contact pressure at a relatively low pressure level.

Starting torque ratio (underdrive)



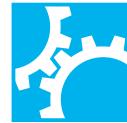
Adjustment

A suitable supply of pressurised oil is required due to the heavy demands on the adjustment dynamics. To minimise the required quantity of oil, the variable displacement cylinders have a smaller surface area than the pressure cylinders. Therefore, the quantity of oil needed for adjustment is relatively small.

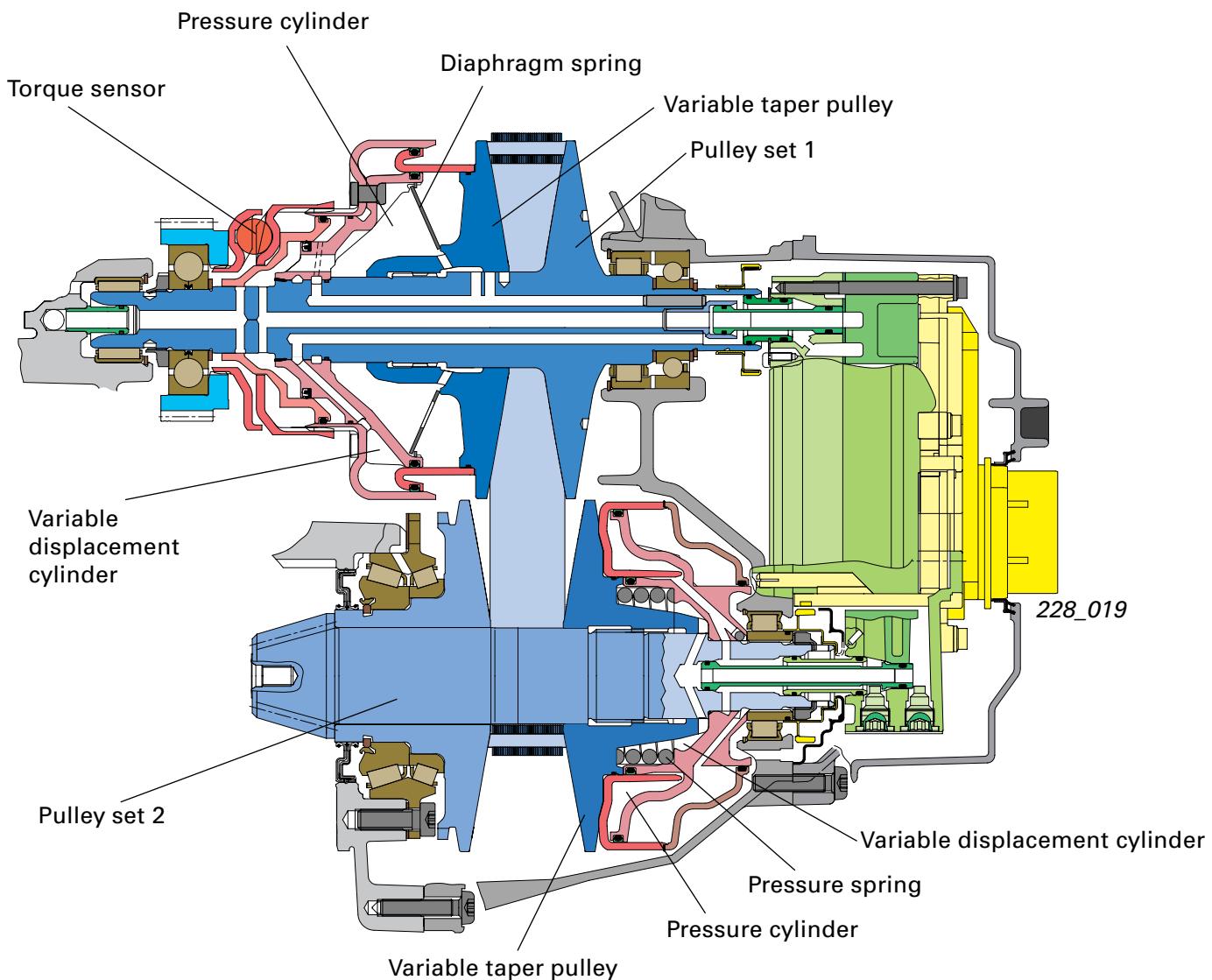
This makes possible high adjustment dynamics and higher efficiency despite the low delivery rate of the oil pump.

The diaphragm springs in pulley set 1 and the coil springs in pulley set 2 create a defined basic chain tension (contact pressure) when the hydraulic system is depressurised.

In the depressurised state, the variator for the starting torque ratio is adjusted by the spring force of the coil springs in pulley set 2.



End torque multiplication ratio (overdrive)



Gearbox modules

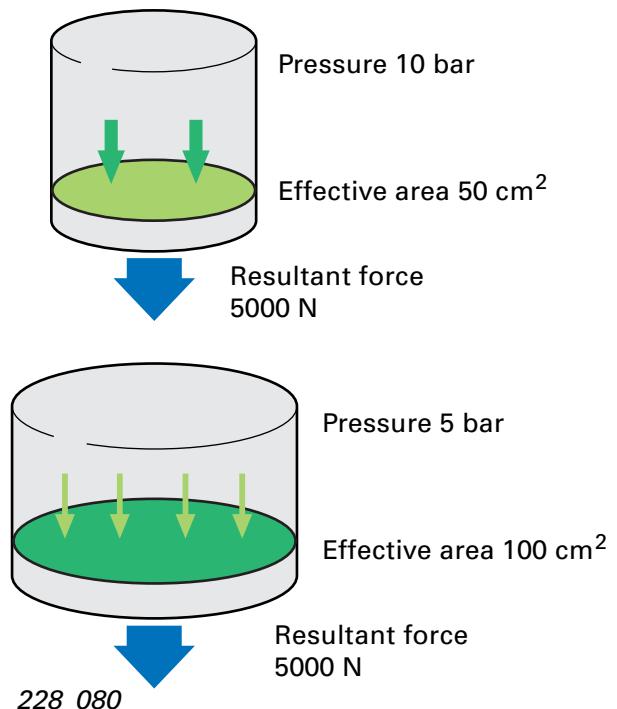
Contact pressure



High contact pressures are required between taper pulley and the chain to transmit the torques which the engine develops. The contact pressure is produced by adjusting the oil pressure in the pressure cylinder as appropriate.

According to the Law of Hydraulics, a resultant force (contact pressure) can be varied as a function of pressure and effective area.

The pressure cylinders have a larger surface area and can therefore apply the required contact pressure with less oil pressure. The relatively low oil pressure also has a positive effect on efficiency.



Towing

When the vehicle is being towed, pulley set 2 drives pulley set 1 and there is a dynamic pressure buildup in the variable displacement cylinder and pressure cylinder of the pulley sets.

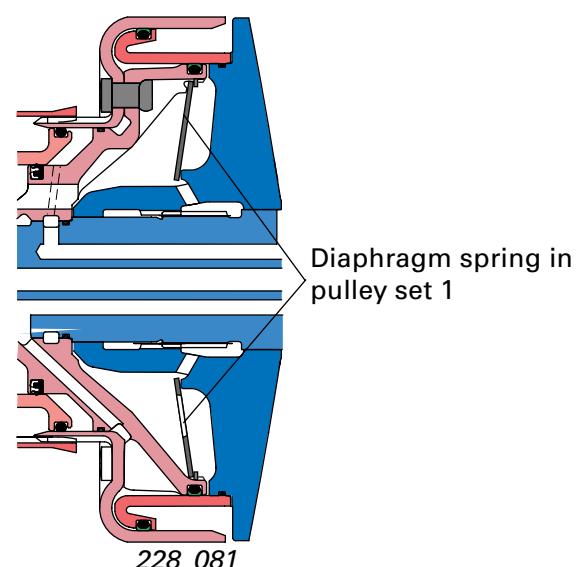
The system is designed in such a way that the reduction ratio is adjusted to approx. 1:1 by the dynamic pressure build-up in the variator. Pulley set 1 and the planetary gear train are thus protected from excessively high engine speeds.

The diaphragm springs in pulley set 1 assist with this process.



For more detailed information regarding dynamic pressure build-up, refer to the chapter on the "Splash oil cover".

Also observe the towing information given in the chapter on "Service".



The transmission control

Electronic control

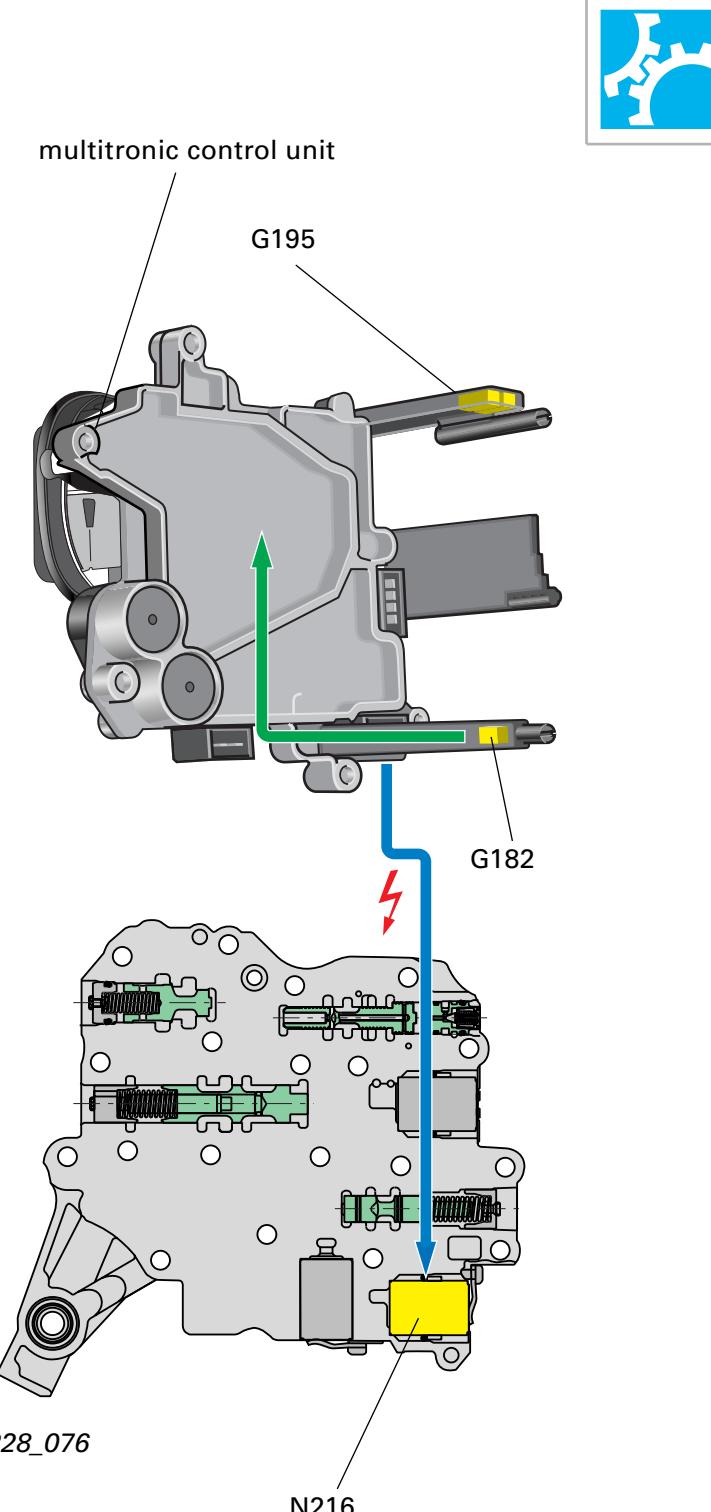
The multitronic[®] control unit has a dynamic control program (DRP) for calculating the nominal gearbox input speed. It is an improved version of the dynamic shift program DSP already being used in multi-step automatic transmissions. The driver input and vehicle operating state are evaluated in order to provide the optimal gear ratio in every driving situation (see description of DSP on page 82).

The dynamic control program calculates a nominal gearbox input speed depending on the boundary conditions.

Sender G182 registers the actual gearbox input speed at pulley set 1.

The gearbox control unit calculates a control current for pressure regulating valve N216 based on an actual-value/setpoint comparison. N216 produces a control pressure for the hydraulic reduction valve which is almost proportional to the control current.

Transmission control is monitored by checking the plausibility of the signals from G182 (gearbox input speed sender) and G195 (gearbox output speed sender) as well as the engine speed.



228_076

N216

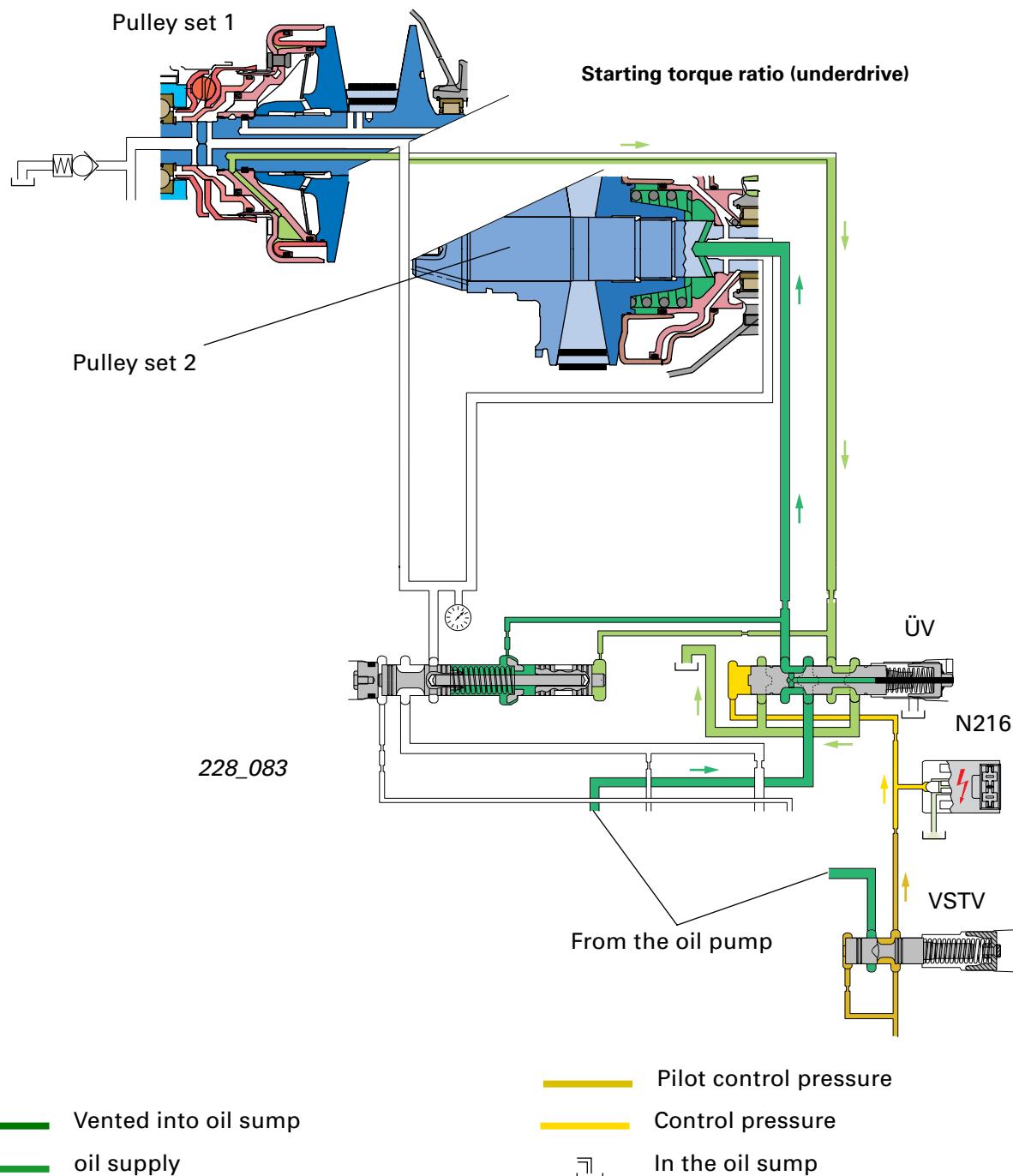
Gearbox module

Hydraulic transmission control



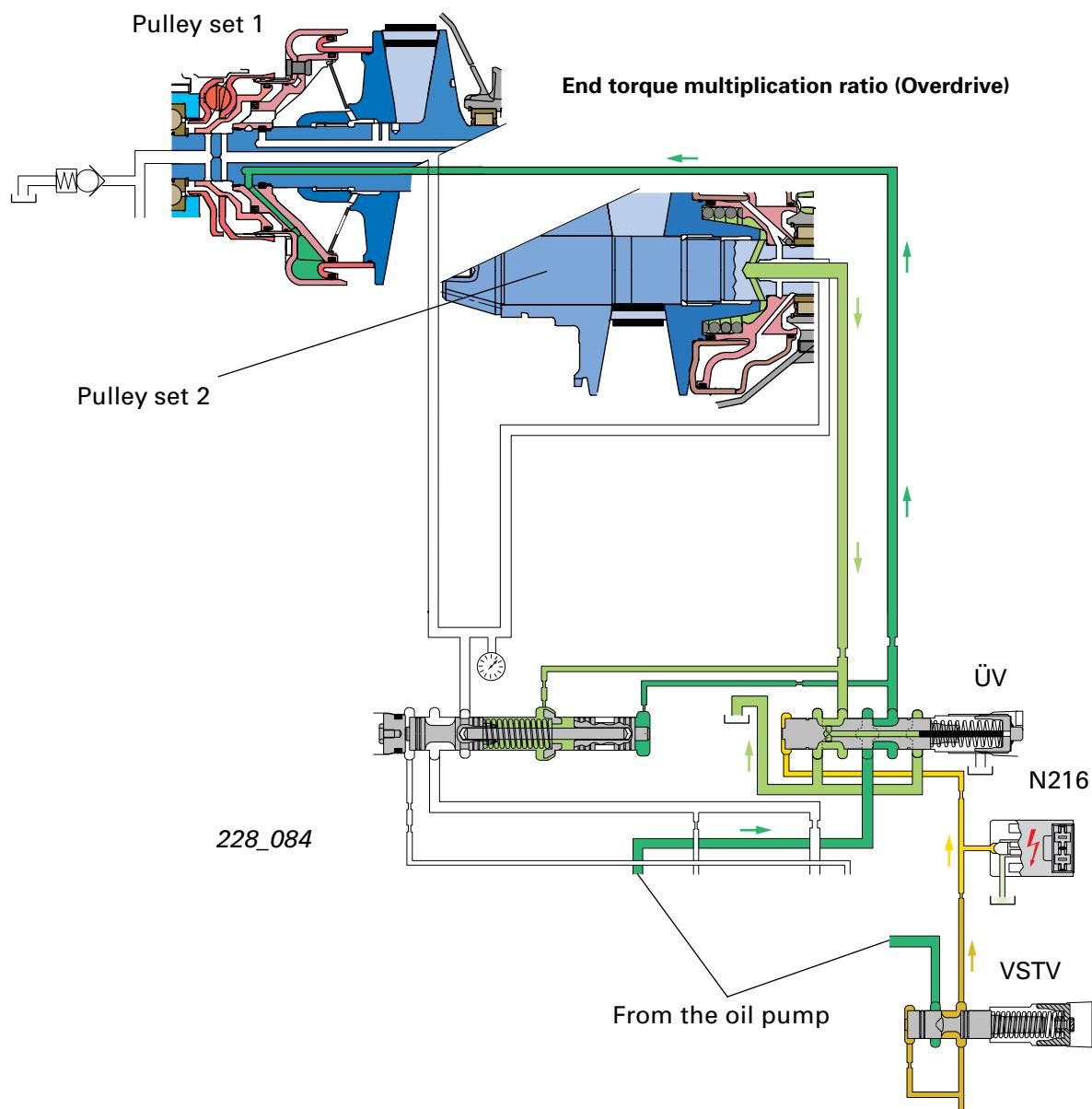
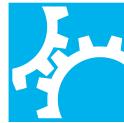
Pressure regulating valve N216 is supplied with a constant pressure of approx. 5 bar by the pilot pressure value (VSTV). N216 produces a control pressure corresponding to the control current calculated by the gearbox control unit, which influences the position of the reduction valve (ÜV).

A high control current leads to a high control pressure.
The reduction valve (ÜV) transfers the adjusting pressure to the variable displacement cylinder of pulley set 1 or 2, depending on the control pressure.



The valve is closed at a control pressure of between approx. 1.8 bar and 2.2 bar. At a control pressure of less than 1.8 bar, the adjusting pressure is transferred to variable displacement cylinder / pulley set 1 and the variable displacement cylinder / pulley set 2 is simultaneously vented into the oil sump. The variator shifts the reduction ratio towards "Overdrive".

If the control pressure is greater than 2.2 bar, the adjusting pressure is transferred to the variable displacement cylinder / pulley set 2 and the variable displacement cylinder / pulley set 1 is simultaneously vented into the oil sump. The variator shifts the reduction ratio towards "Starting torque ratio".



— Vented into oil sump
— Oil supply

— Pilot control pressure
— Control pressure
— In the oil sump

Gearbox modules

The torque sensor

(contact pressure control)

As mentioned before, a suitable oil pressure in the pressure cylinder gives a resultant contact pressure of the taper pulleys. If the contact pressure is too low, slippage of the chain will occur and the chain and pulley sets will be damaged. An excessively high contact pressure, on the other hand, will result in loss of efficiency.

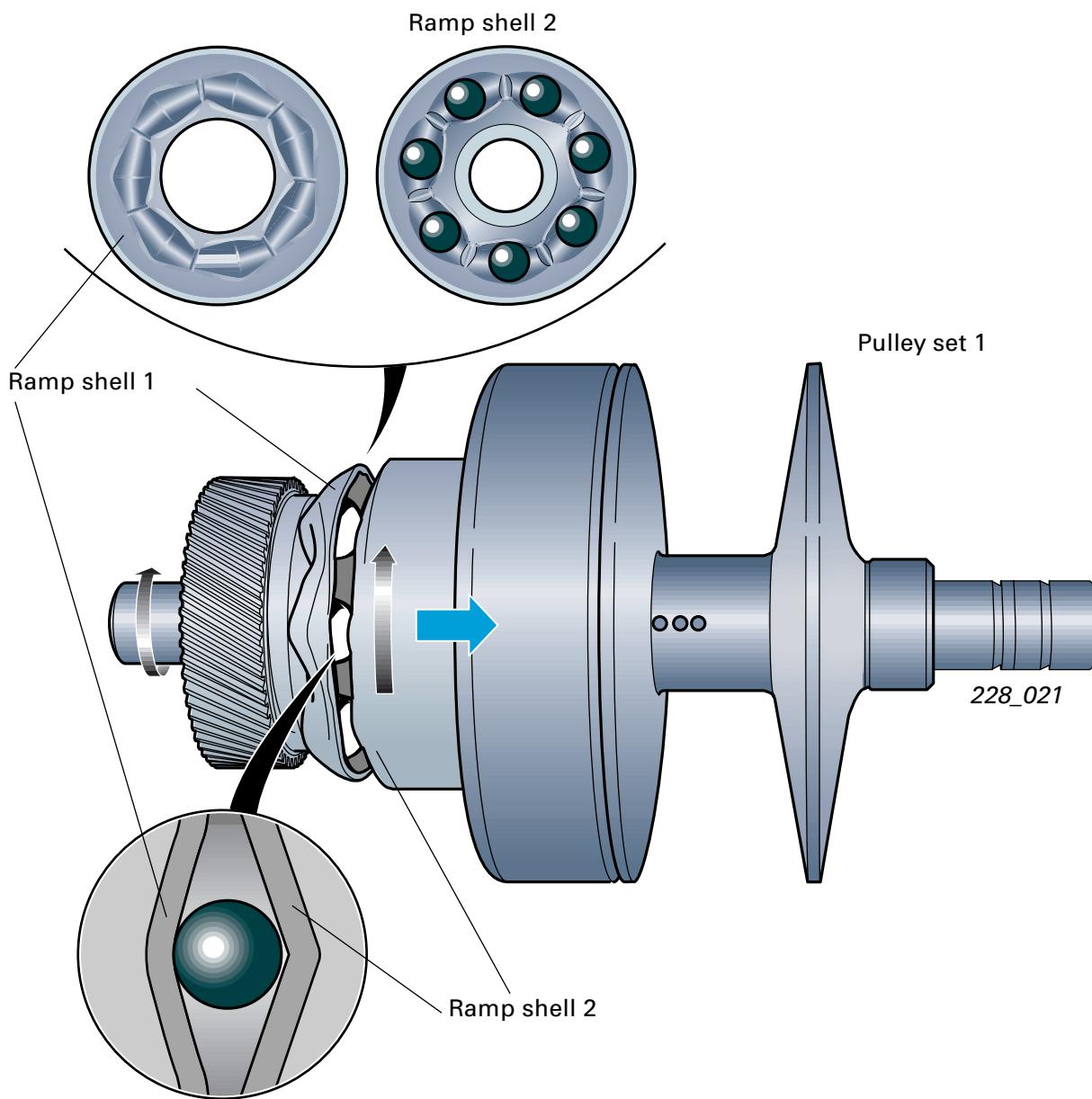
The object, therefore, is to set the contact pressure of the taper pulleys as accurately and safely as possible according to requirements.

A hydromechanical torque sensor integrated in pulley set 1 statically and dynamically registers the actual torque transmitted to a high degree of accuracy and sets the correct oil pressure in the pressure cylinders.



The engine torque is transferred to the variator via the torque sensor only.

The contact pressure is controlled hydromechanically by the torque sensor.



Design and function

The torque sensor essentially comprises two shells with seven ramps between which steel balls are mounted in bearings. Ramp shell 1 is form-fitted to the output gear of pulley set 1 (output gear wheel of auxiliary reduction gear step). Ramp shell 2 is connected to pulley set 1 via a grooved gearing in such a way as to allow axial movement and is supported by the torque sensor piston. The torque sensor piston serves to regulate the contact pressure and houses torque sensor spaces 1 and 2.

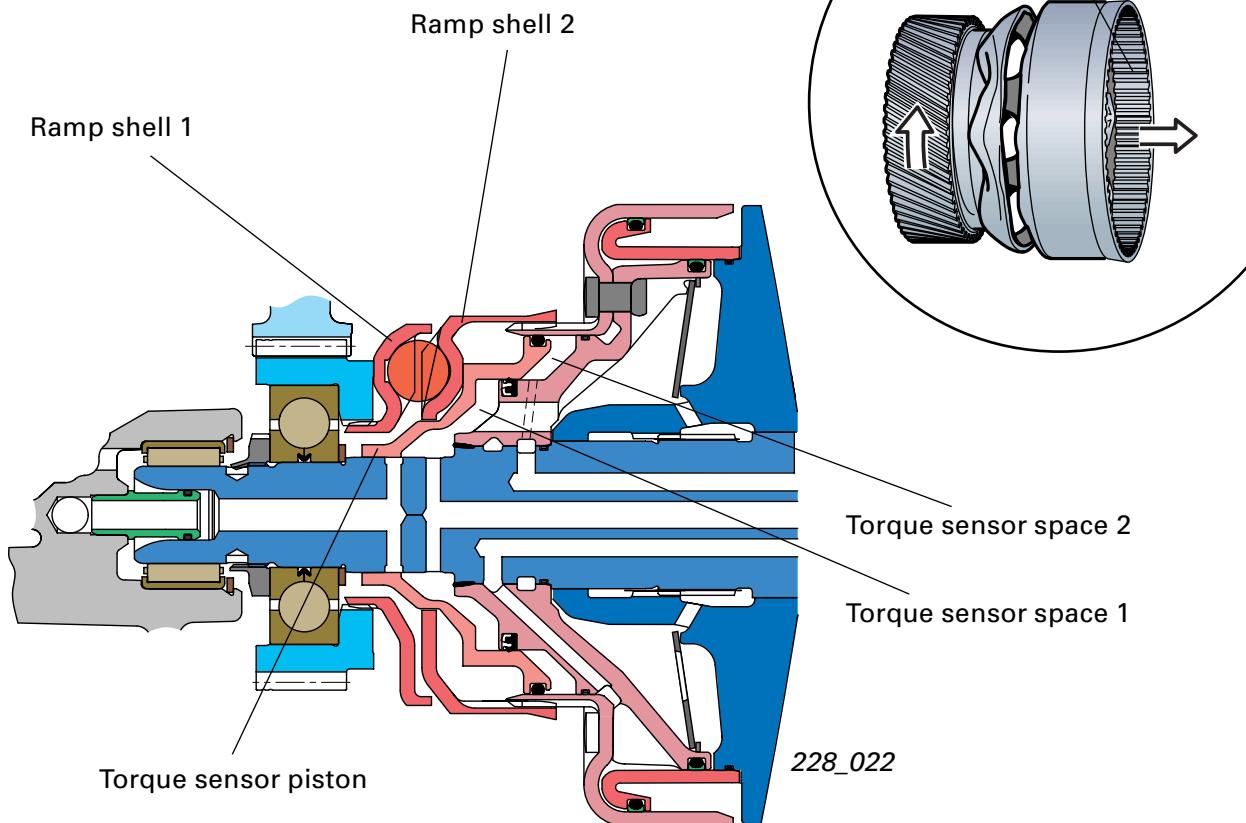
The shells can be rotated radially towards one another, converting the torque to an axial force (due to the ball and ramp geometry). This axial force acts upon ramp shell 2 and moves the torque sensor piston which is in contact with the shell.

The control edge of the torque sensor piston now closes or opens the outlets in torque sensor space 1.



The axial force generated by the torque sensor serves as a control force which is proportional to the engine torque.

The pressure which builds up in the pressure cylinder is proportional to the control force.



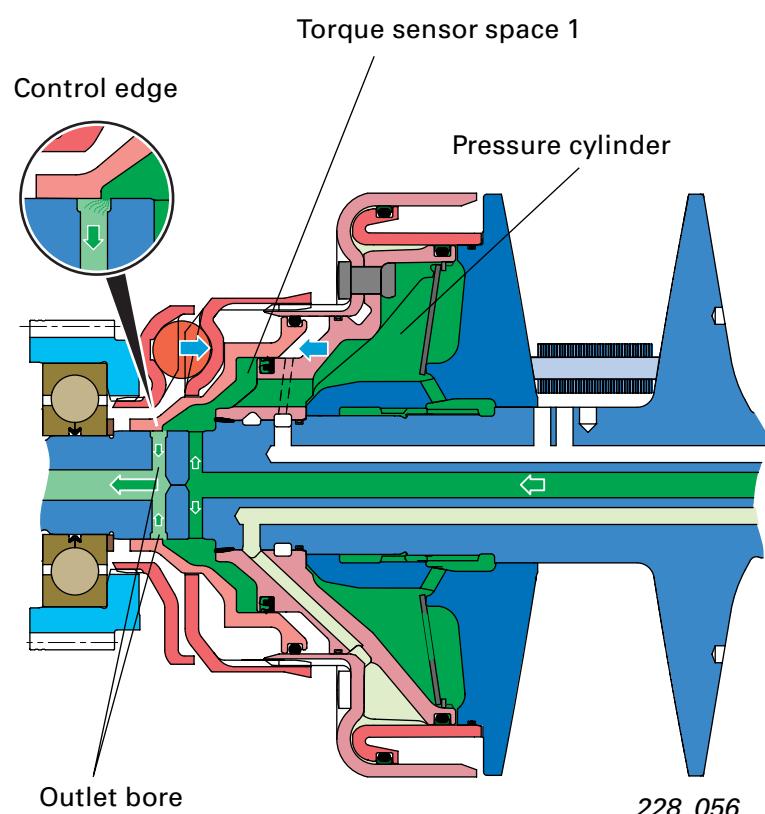
Gearbox modules



Torque sensor space 1 is directly connected to the pressure cylinder.

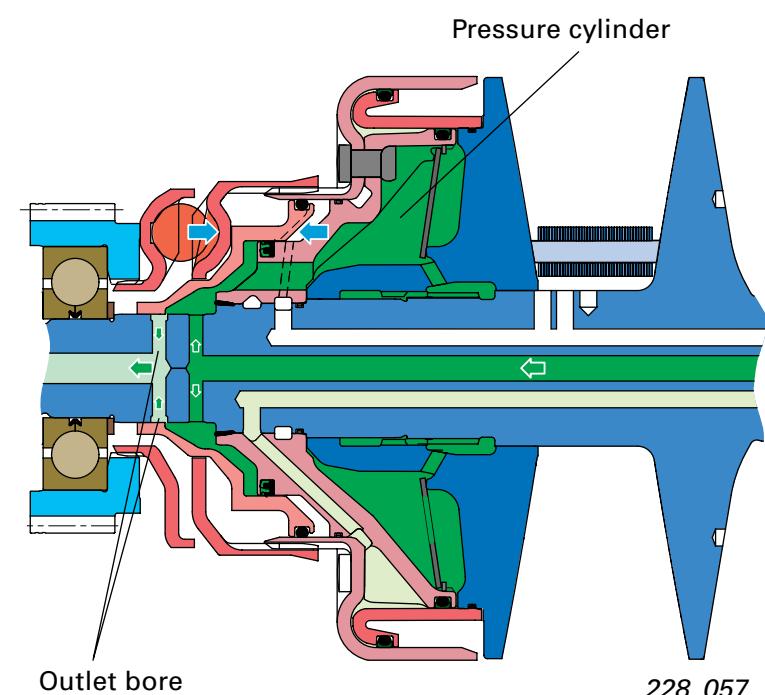
The system is designed such that the axial force generated as a product of engine torque and the pressure in the pressure cylinder form a force equilibrium.

In constant conditions of vehicle operation, the outlet bores are only partially closed. The pressure drop produced by opening the outlet bores (torque sensor) modulates the pressure in the pressure cylinder.



If input torque increases, the outlet bores are initially closed further by the control edge. The pressure in the pressure cylinder rises until a force equilibrium again exists.

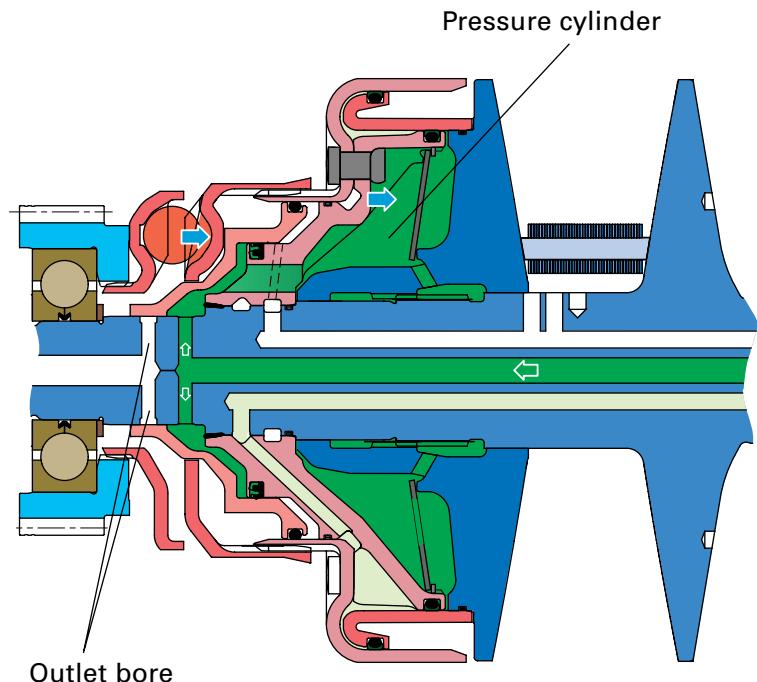
If input torque decreases, the outlet bores are opened further. The pressure in the pressure cylinder decreases until the force equilibrium is restored.



At peak torque levels, the control edge closes off the outlet bores. If the torque sensor moves any further, it acts as an oil pump. The displaced oil volume now causes a rapid rise in the pressure inside the pressure cylinder and thus adapts the contact pressure without delay.



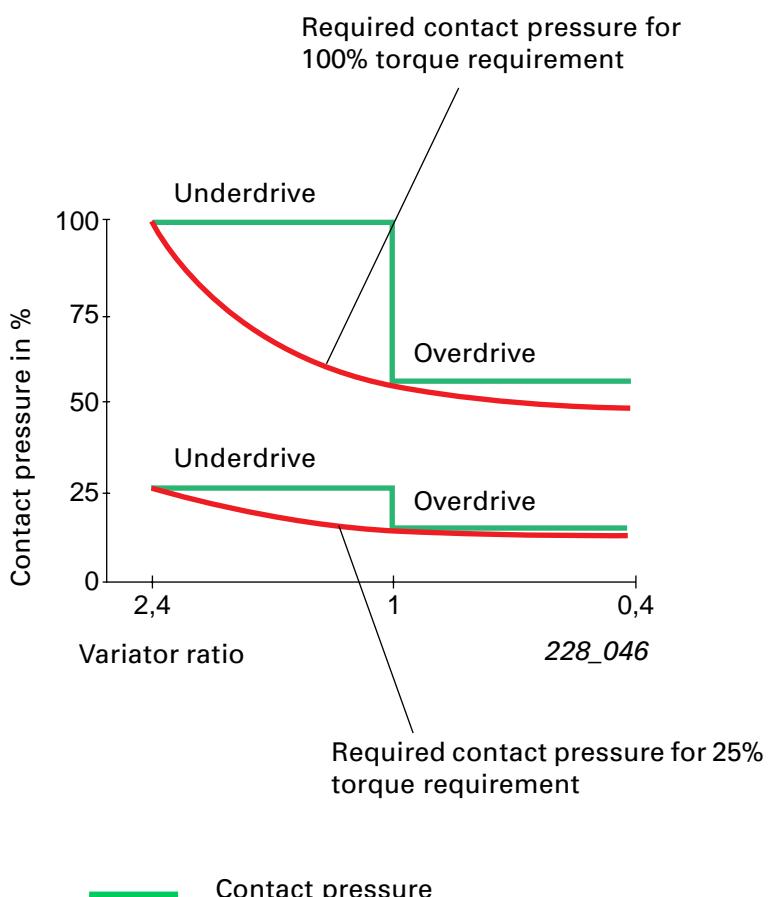
Extremely high peak torques can occur when the vehicle drives over a pot-hole or if the coefficient of friction of the road surface fluctuates considerably (transitions from black ice to tarmac) for example.



Adaptation of contact pressure depending on transmission ratio

The contact pressure exerted by the taper pulleys depends not only on the input torque but also on chain track radius and, therefore, on the actual reduction ratio of the variator.

As the diagram shows, the drive-off ratio requires the greatest contact pressure. The radius of the chain is smallest in pulley set 1. For power transmission, only a small number of cradle type pressure pieces are in mesh despite the high input torque. Therefore, a higher contact pressure is applied by the taper pulleys until a defined reduction ratio (1:1) is exceeded.



Gearbox modules

Function and mode of operation



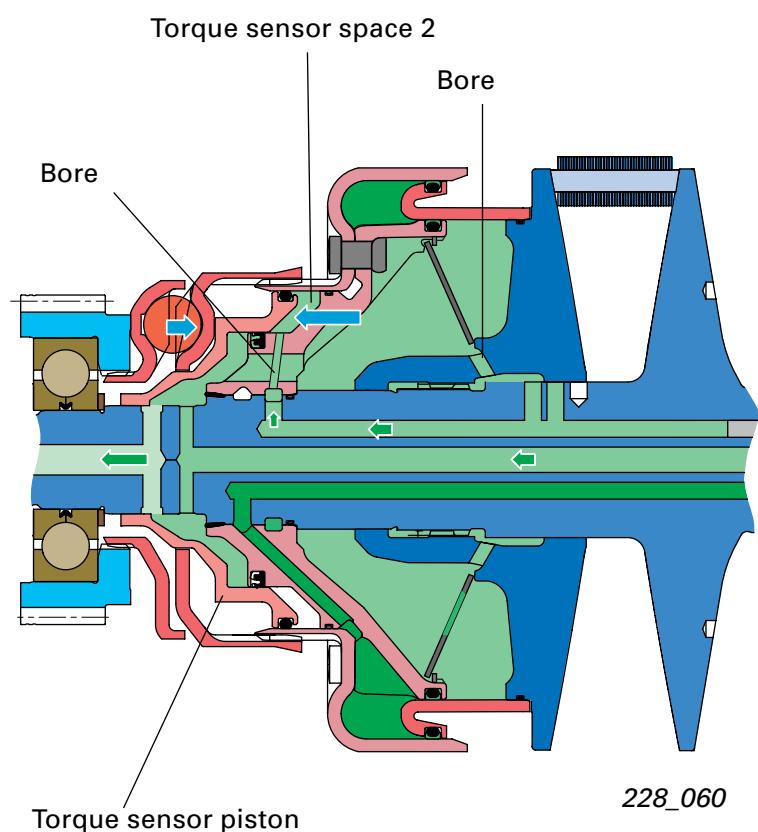
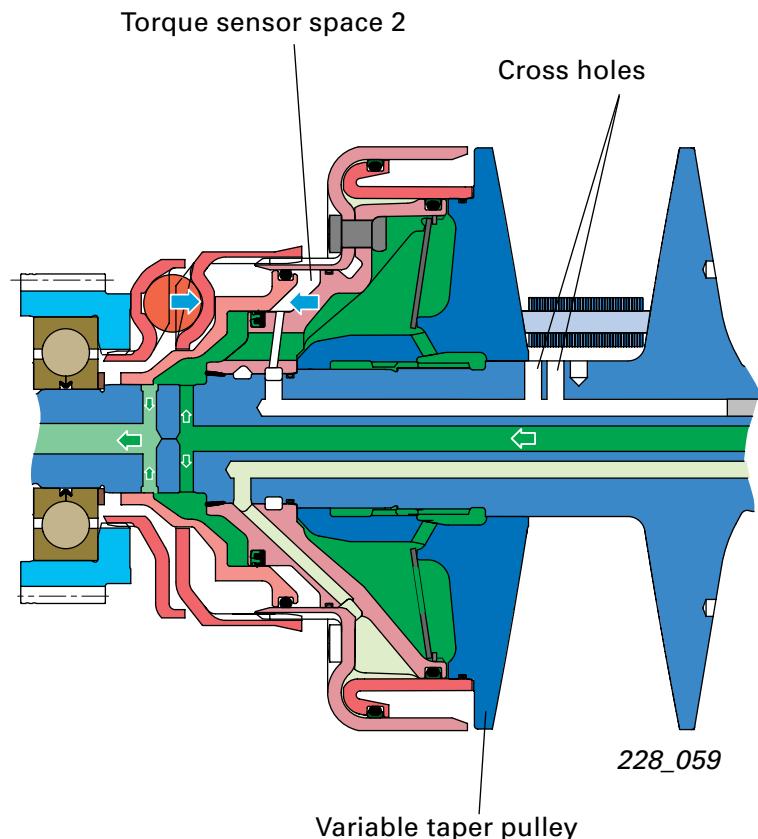
The ratio-dependent contact pressure is adapted in torque sensor space 2. The pressure level the pressure cylinder is varied by increasing or decreasing the pressure in torque sensor space 2. The pressure in torque sensor space 2 is controlled by two transverse holes in the shaft of pulley set 1. These holes are opened or closed through axial displacement of the variable taper pulley.

The transverse holes are open when the variator is in the drive-off torque ratio (torque sensor space 2 is depressurised).

When the variator changes the ratio to "High speed", the transverse holes are shut off initially. As of a defined reduction ratio, the left-hand transverse hole is opened. Now this hole is connected to the pressure cylinder via corresponding holes in the variable taper pulley.

The oil pressure is now transferred from the pressure cylinder into torque sensor space 2. This pressure counteracts the axial force of the torque sensor and moves the torque sensor piston to the left. The control edge opens up the outlet bores further, reducing the oil pressure inside the pressure cylinder.

The main advantage of the two-stage pressure adaption process is that a low contact pressure which increases efficiency can be utilised in the mid-ratio range (refer to Fig. 228_046, previous page).



The splash oil cover

A further special feature of the variator is the "splash oil cover" on pulley set 2 which counteracts the dynamic pressure build-up in the pressure cylinder.

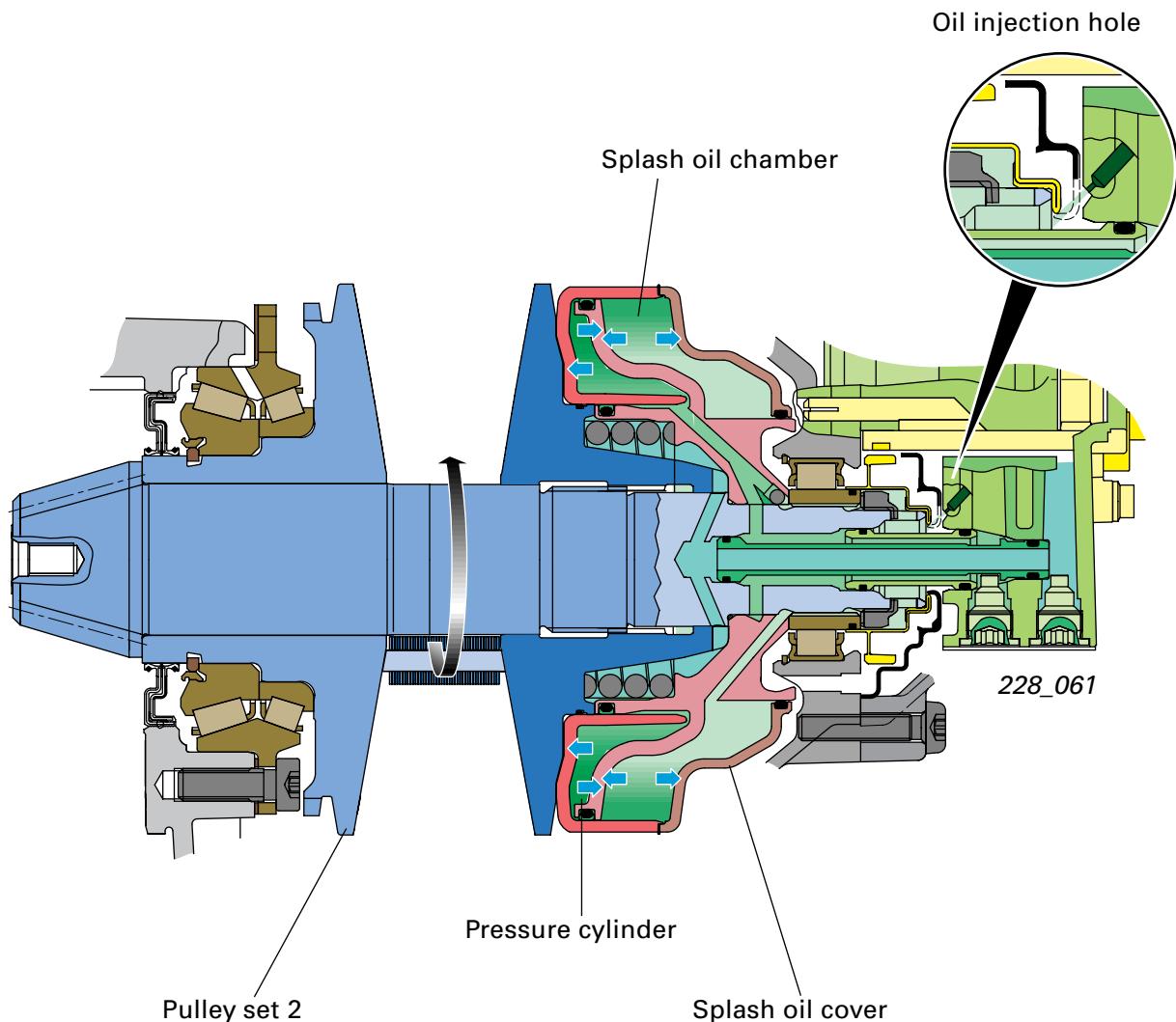
At high engine speeds, the gearbox oil in the pressure cylinder is subjected to high rotation-induced centrifugal forces, which leads to a rise in pressure. This process is known as "dynamic pressure build-up".

A dynamic pressure build-up is undesirable because it unduly increases the contact pressure and has an adverse effect on transmission control.

The oil confined in the splash oil cover is subjected to the same dynamic pressure build-up as in the pressure cylinder. The dynamic pressure build-up in the pressure cylinder is compensated by this.

The splash oil chamber receives its oil supply directly from the hydraulic control unit through an oil injection hole. Oil is continuously injected into the splash oil chamber inlet through this hole.

A reduction in volume inside the splash oil chamber (when varying the transmission ratio) causes the oil to be discharged via the supply inlet.



Gearbox modules

The chain



The chain is a key component part of the variator of the multitronic®.

This is the first time that a chain is for used as a driving means in a CVT gearbox.

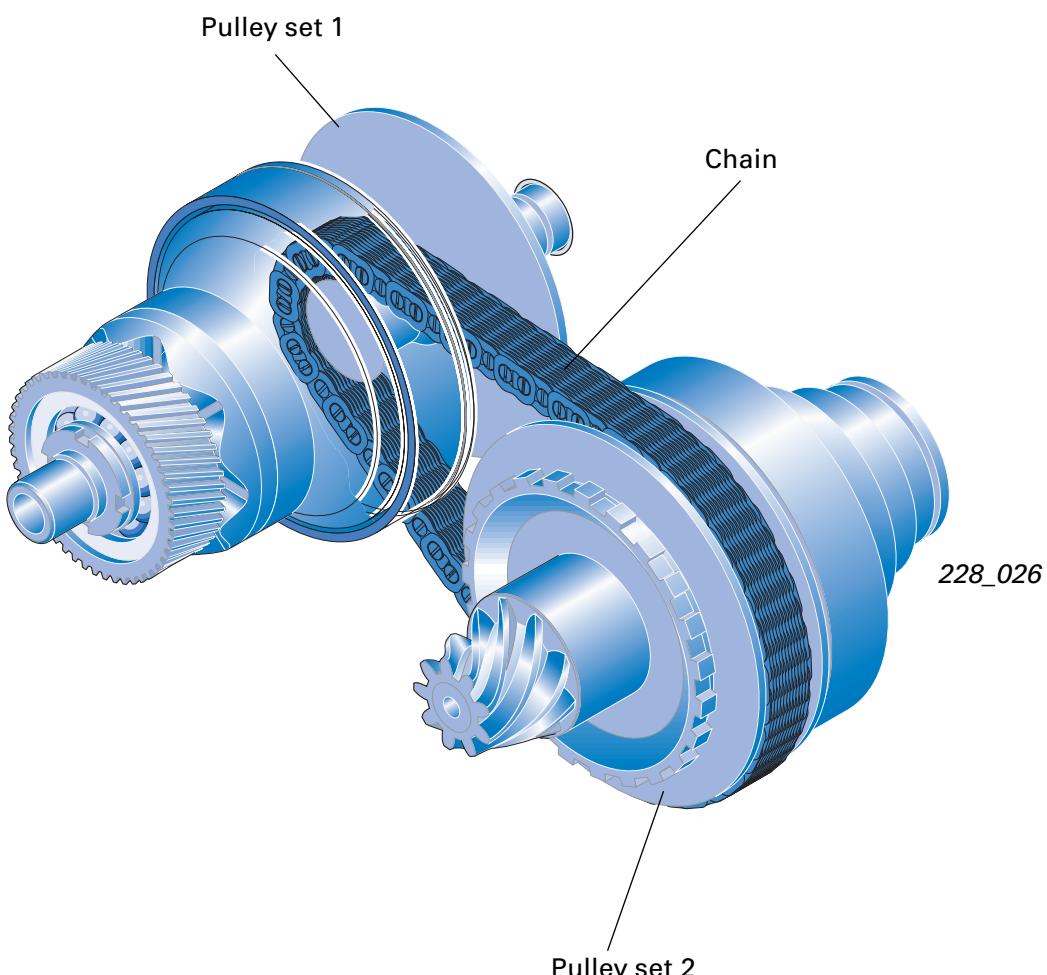
The chain is a new development and has the following advantages over previously conventional driving means such as sliding link belts or V-belts:

- ▶ Very small track radii make possible a large "spread" despite the small size of the variator.
- ▶ High transferable torque
- ▶ High efficiency



The **spread** indicates the range of ratios which a gearbox provides.

The spread is specified as a ratio. The starting torque ratio divided by the spread amounts to the end torque multiplication ratio. In general a large spread is an advantage because both a high starting torque ratio (for good dynamics) and a low end torque multiplication ratio (for low consumption) are available. This applies in particular to the CVT concept, since practically all intermediate steps are available and no ratio steps are out of place.



Design and function

On a conventional chain, the chain link plates are interconnected non-rigidly via the joint pins. For torque transmission, a gear tooth moves into engagement with the pins between the chain link plates.

The CVT chain uses a different technology.

The CVT chain comprises adjacent rows of chain link plates linked continuously by means of cradle type pressure pieces (two per link).

On the CVT chain, the cradle type pressure pieces are "jammed" between the taper pulleys of the variator, i.e. the taper pulleys are pressed against one another.

The torque is transmitted only by the frictional force between the frontal areas of the cradle type pressure pieces and the contact faces of the taper pulleys.

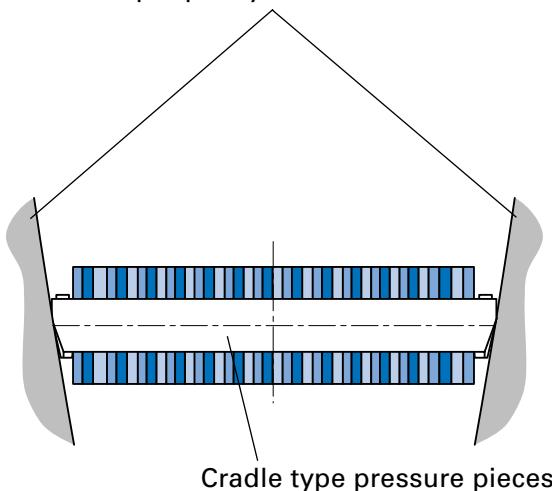
This is how it works:

Each of the cradle type pressure pieces is permanently connected to a row of link plates in such a way that it cannot be twisted. Two cradle type pressure pieces form a so-called cradle type joint.

The cradle type pressure pieces now roll off one another almost frictionlessly as they "drive" the chain within the track radius of the taper pulleys.

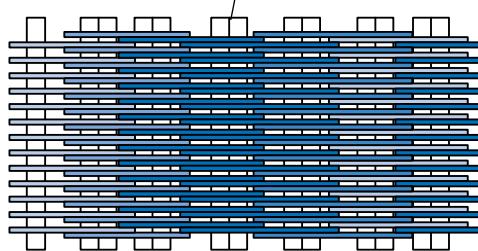
In this way, lost power and wear are minimised despite the high torque and the large angle of bend. The result is long service life and optimal efficiency.

Taper pulley of the variator

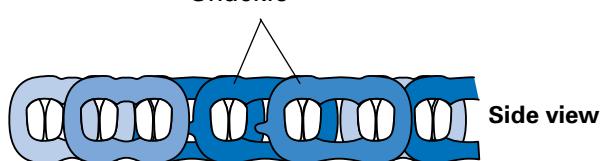


Cradle type pressure pieces

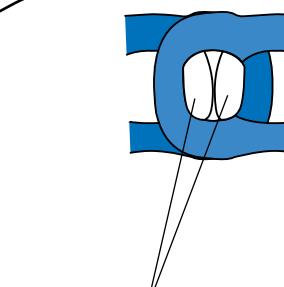
Top view



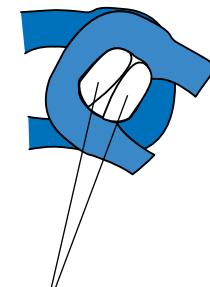
Shackle



Side view



Cradle type pressure pieces



Cradle type joint

228_027



Gearbox modules

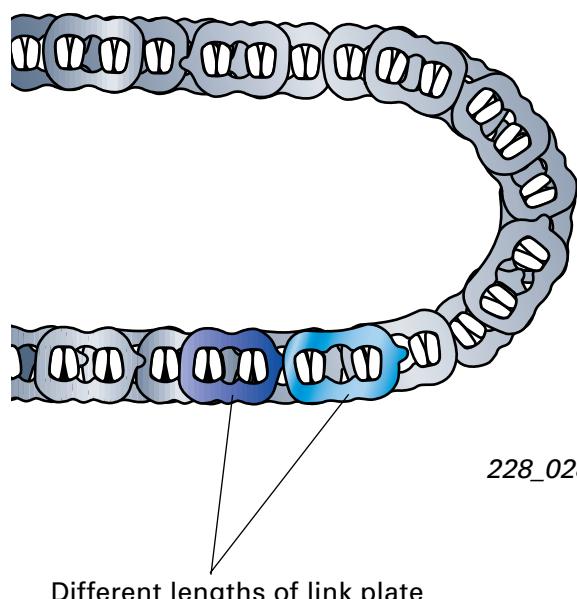
Acoustic measures



Two different lengths of link plate are used in order to ensure that the chain runs as quietly as possible.

When using a constant length of link plate, the cradle type pressure pieces strike the taper pulleys at uniform intervals and induce vibrations which cause a noise nuisance.

Using different lengths of link plate counteracts resonance and minimises running noise.



The oil supply

In the multitronic®, power transmission is dependent on the power supply and also on the hydraulics.

In order to work, an electric current and adequate oil supply are required.

The oil pump is the main power consumer in the gearbox and its capacity is therefore important for overall efficiency.

The systems described above have therefore been designed to run on a minimum of oil, and an innovative oil supply system has been developed.

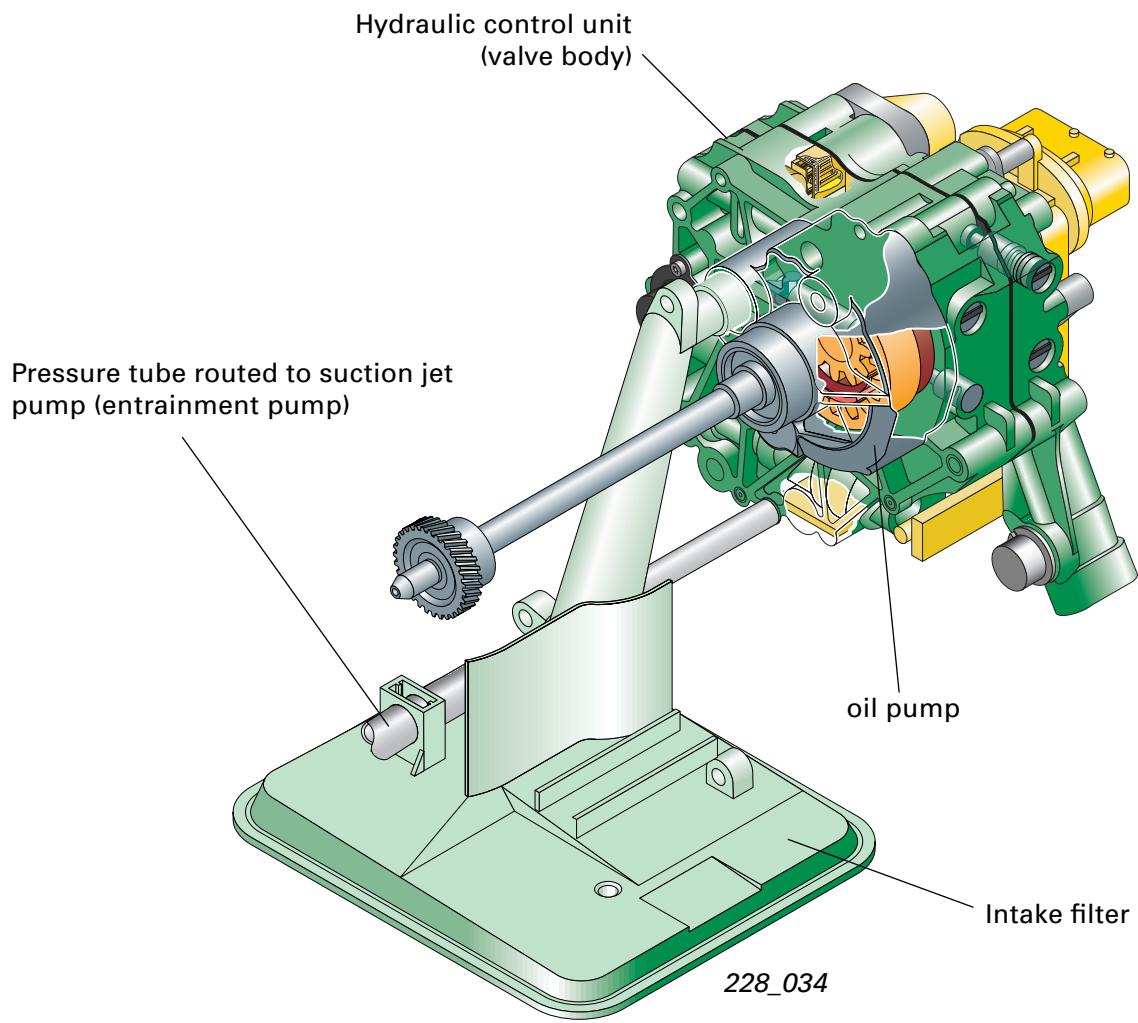
The oil pump

The oil pump is mounted directly on the hydraulic control unit in order to avoid unnecessary interfaces. The oil pump and the control unit form a compact unit, which reduces pressure losses and production costs.

The multitronic® is equipped with an efficiency optimised crescent pump. This pump produces the necessary pressures although it requires only a relatively small quantity of oil.

A suction jet pump (entrainment pump) additionally supplies the oil quantity required for the clutch cooling at low pressure.

The crescent-vane pump, as a compact component, is integrated in the hydraulic control unit and driven directly by the input shaft via a spur gear and pump shaft.



Gearbox modules



As a special feature, the oil pump has axial and radial clearance adjustment.

A pump with good "internal sealing" is required in order to produce high pressures at low engine speeds.

Conventional type oil pumps do not meet these requirements due to component tolerances.

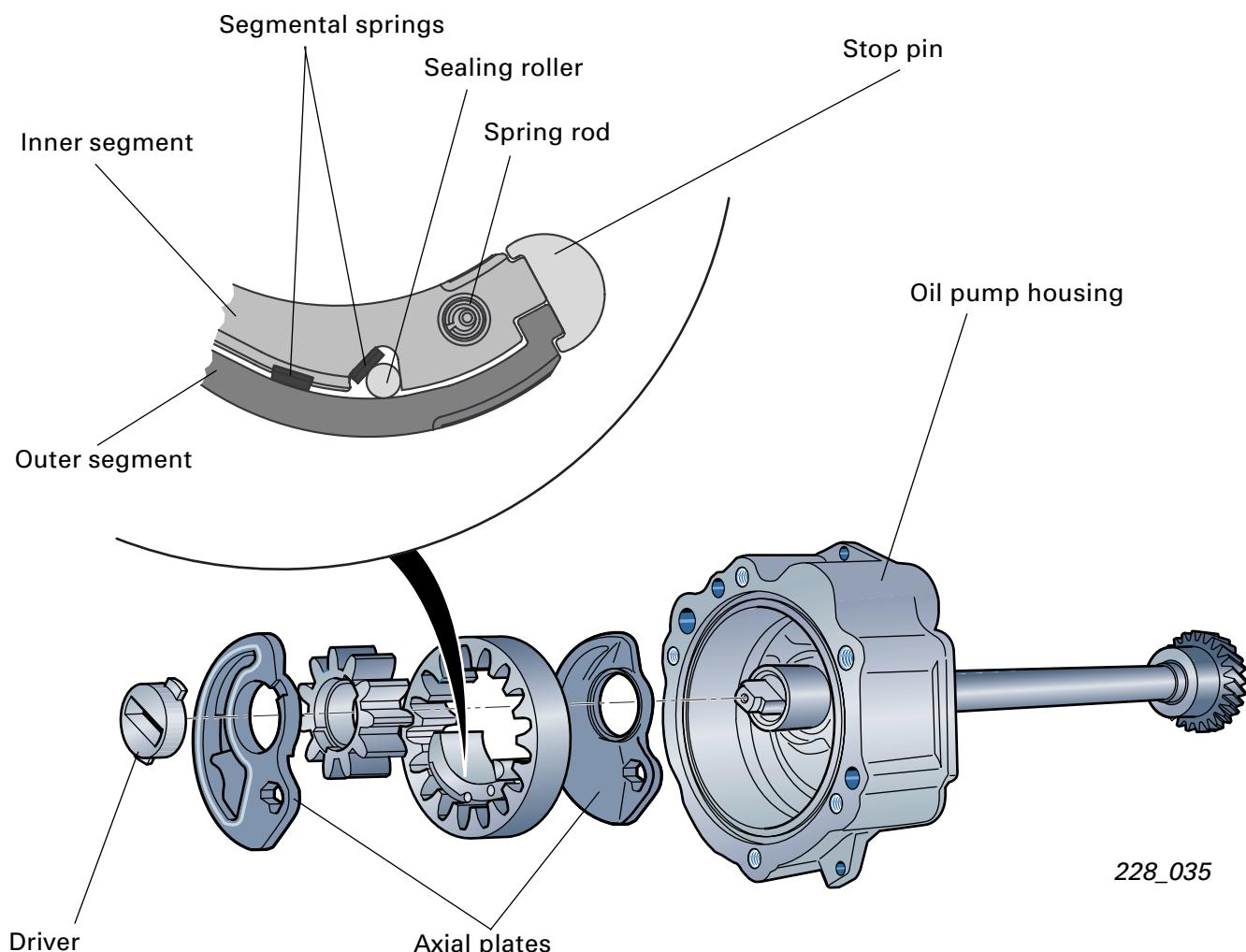


What is meant by "internal sealing" is the inner leakproofing of the pump.

The axial clearance between the gears and the housing, as well as the radial clearance between the gears and the crescent vane vary depending on the tolerance zone position of the component parts.

The pressure generated can thus more or less escape "internally".

The result is a loss of pressure and a drop in efficiency.

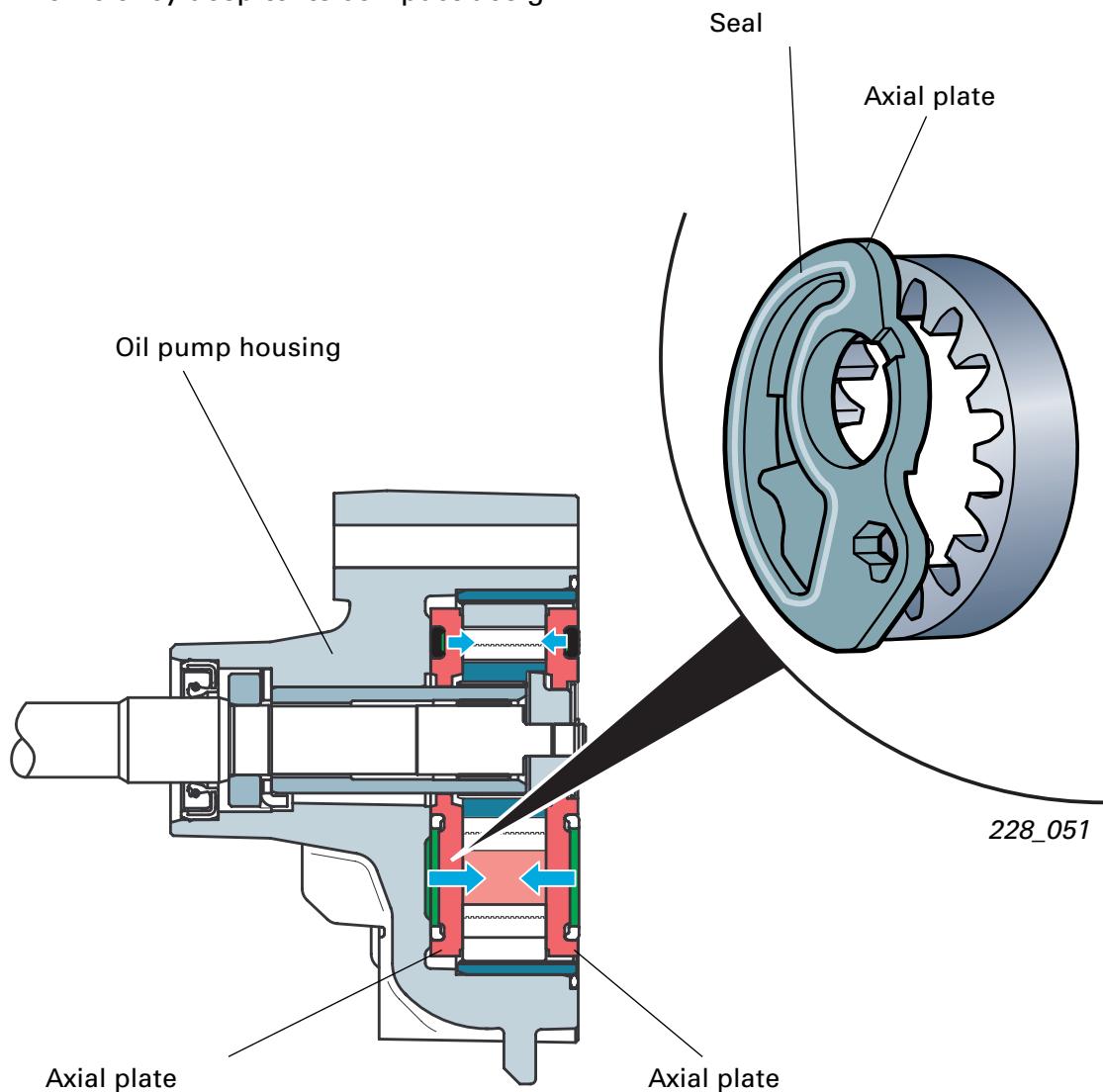


Axial clearance adjustment

Two axial plates cover the pressure range of the pump and form a separate discharge casing inside the pump. They seal the pump pressure chamber laterally (axially). These plates, fitted with a special seal, are supported by the oil pump housing or the pump plate of the hydraulic control unit.

The axial plates are designed so as to allow the pump pressure to act between the axial plates and the housing. The seal prevents pressure from escaping. As pump pressure increases, the axial plates are pressed more firmly against the crescent seal and the pump gears, which compensates for axial clearance.

! Thanks to axial and radial clearance adjustment, the pump is able to generate the required high pressures and simultaneously achieves high efficiency despite its compact design.



Gearbox modules

Radial clearance adjustment



The radial clearance adjustment feature compensates for the radial gap between the crescent seal and the gears (pinion and ring gear).

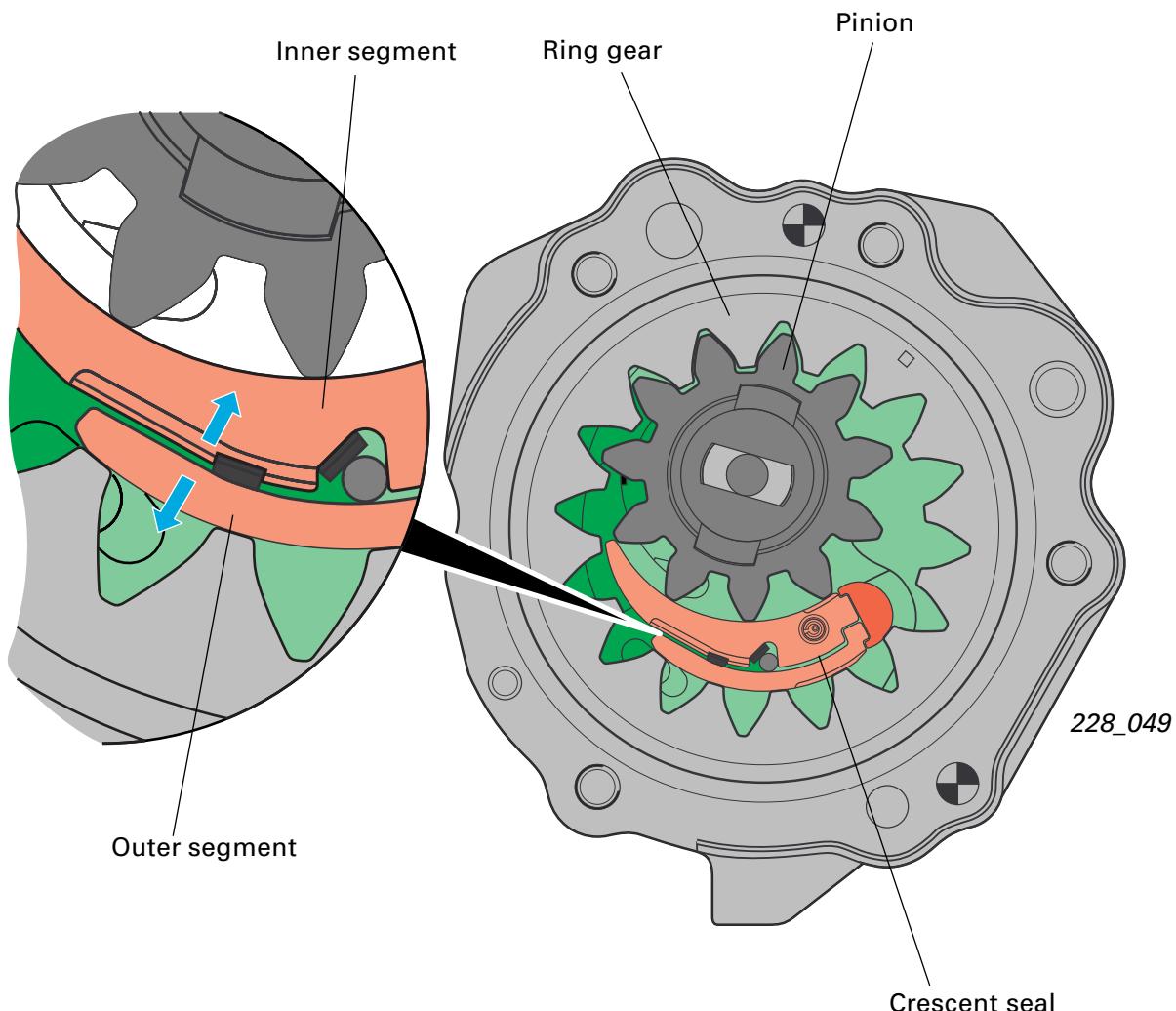
For this purpose, the crescent seal is split in two segments, the **inner segment** and the **outer segment**.

The inner segment seals the pressure chamber off from the pinion. It also holds the outer segment in a radial direction.

The outer segment seals the pressure chamber off from the ring gear.

The pump pressure flows between the two segments. The segments are pressed more firmly against the pinion and ring gear as the pump pressure increases, which compensates for radial clearance.

When the pump is depressurised, the segmental springs provide the basic contact pressure of the segments as well as the sealing roller and improve the suction characteristics of the oil pump. They also ensure that the pump pressure can act between the segments and on the sealing roller.



The suction jet pump (entrainment pump)

A quantity of oil required to ensure sufficient cooling of the two clutches particularly when pulling away (there is high heat buildup due to slip) exceeds the capacity of the internal gear pump.

A suction jet pump (entrainment pump) is integrated in the clutch cooling system in order to supply the quantity of oil required for cooling the clutch.

The suction jet pump (entrainment pump) is of plastic construction and projects deep inside the oil sump.

This is how it works:

The suction jet pump (entrainment pump) operates according to the Venturi principle. When the clutch requires cooling, the cooling

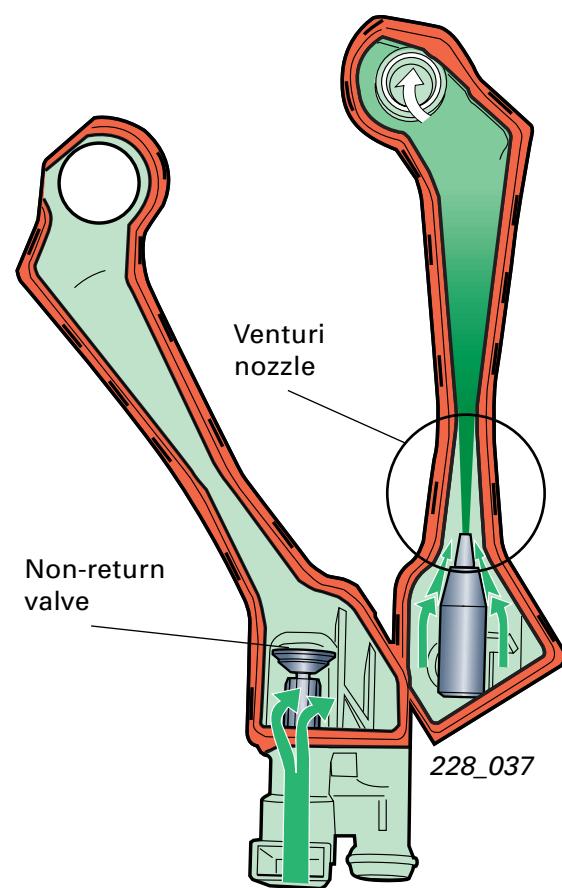
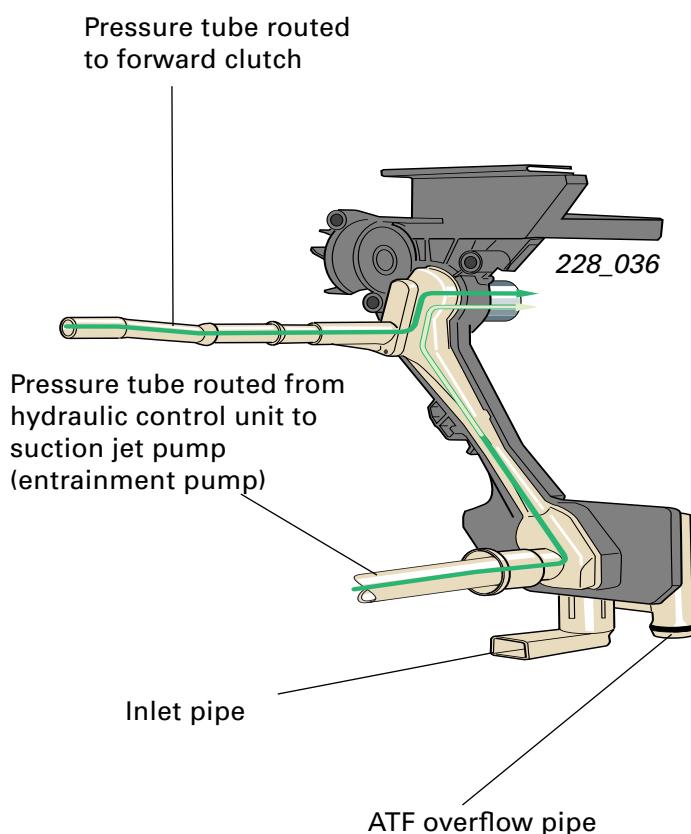
oil (pressurised oil) supplied by the oil pump is ducted through the suction jet pump (entrainment pump) in the form of a powerful jet. The oil flow through the pump vacuum result in a partial vacuum which "sucks" oil out of the oil sump and, together with the powerful jet, results in a large, almost depressurised quantity of oil. The quantity of cooling oil is almost doubled as required without additional pumping capacity.

A non-return valve prevents the suction jet pump (entrainment pump) running dry and facilitates a quick response of the cooling oil feed.



View of suction jet pump (entrainment pump)

Suction jet pump (entrainment pump) shown in profile and folded out



Gearbox modules

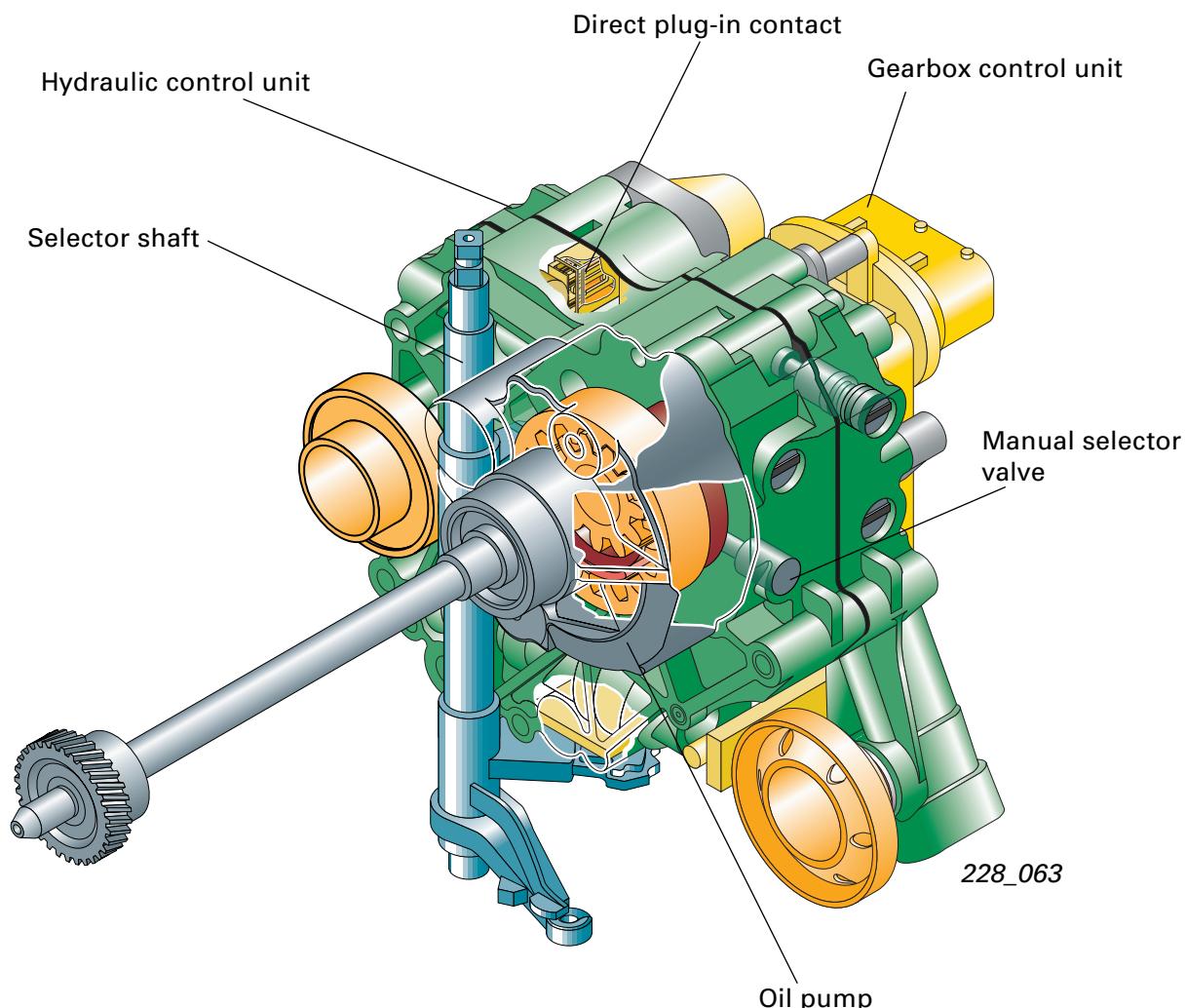
Electrohydraulic control



A new development is that the oil pump, hydraulic control unit (valve body) and gearbox control unit are combined as a compact, fully assembled unit.

The hydraulic control unit comprises the manual selector valve, nine hydraulic valves and three electromagnetic pressure control valves.

The hydraulic control unit and the gearbox control unit are interconnected electrically by direct plug-in contacts.



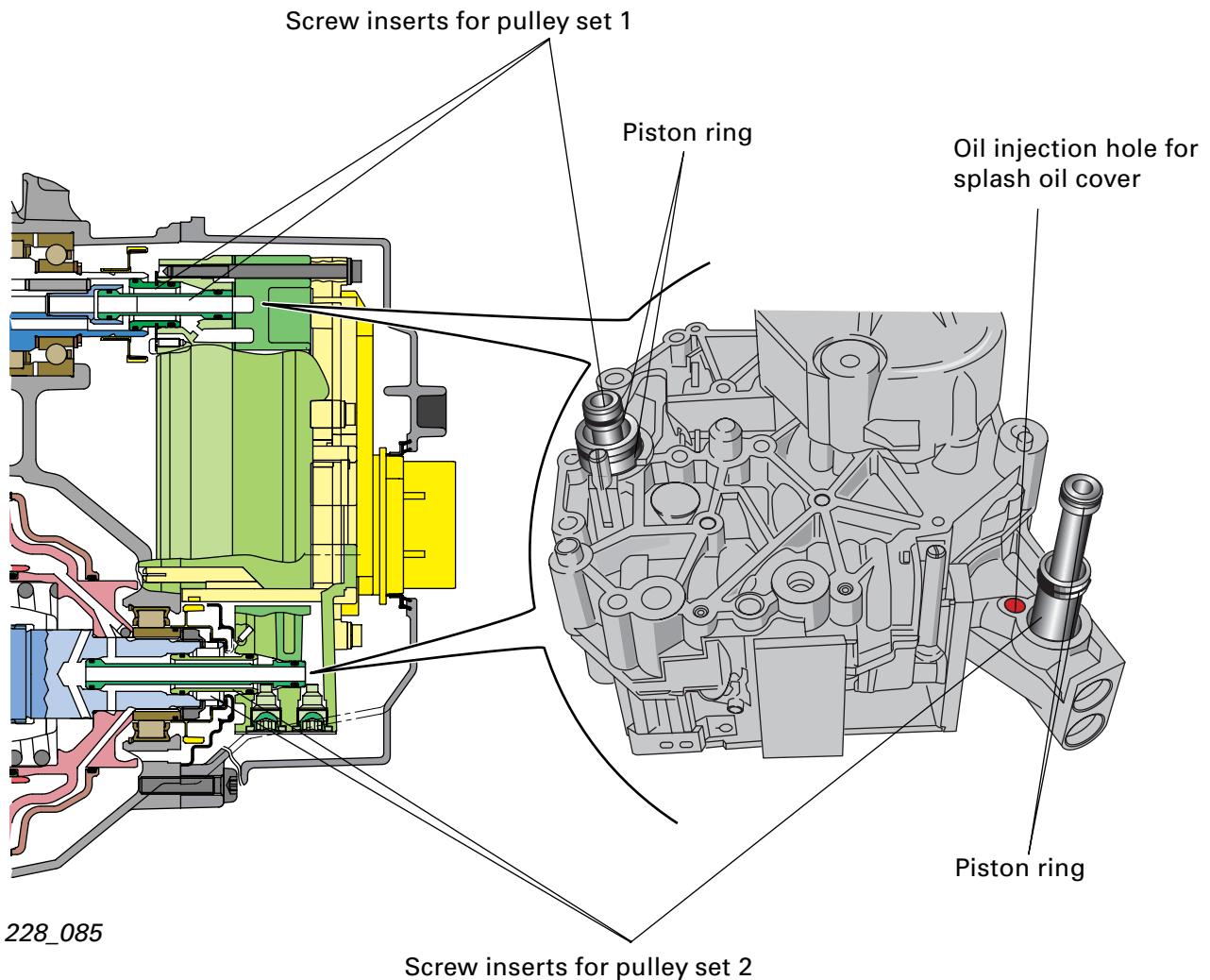
The hydraulic control unit executes the following functions:

- ▶ Forward-reverse clutch control
- ▶ Clutch pressure regulation
- ▶ Clutch cooling
- ▶ Pressurised oil supply to the contact pressure control
- ▶ Transmission control
- ▶ Supplying the splash oil cover



The hydraulic control unit is connected directly to pulley set 1 or pulley set 2 via so-called "screw inserts".

The screw inserts are sealed by means of piston rings.



Gearbox modules



The description of the valves in the following refers to the valves which have still not been included in the module/function descriptions:

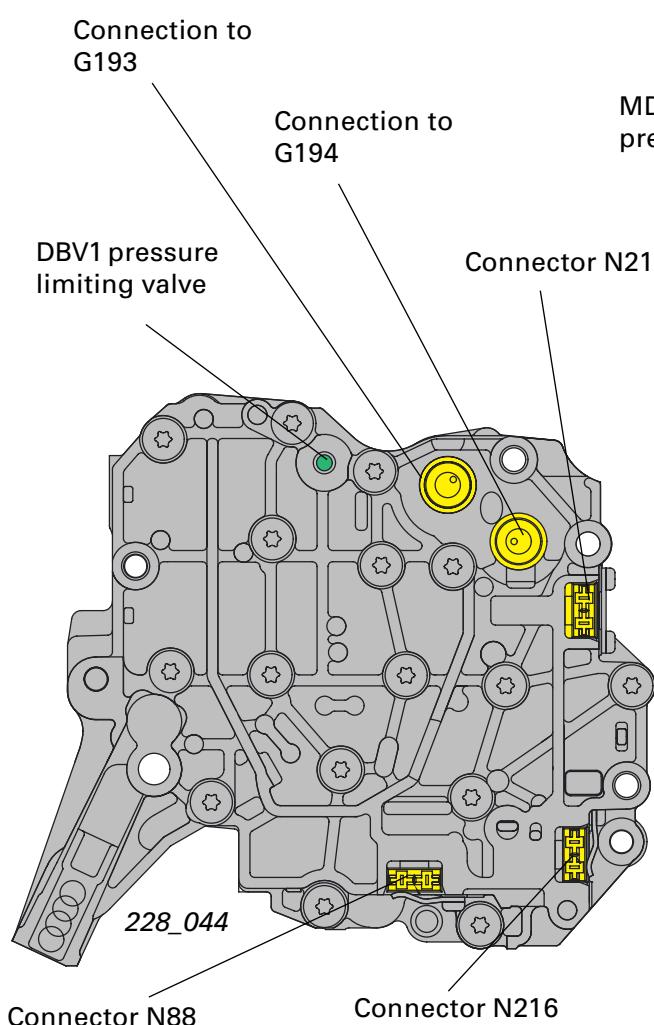
To protect the component parts, **pressure limiting valve DBV1** limits the pump pressure to max. 82 bar.

The pressure control valves are supplied with a constant pilot control pressure of 5 bar via the **VSTV pilot pressure value**.

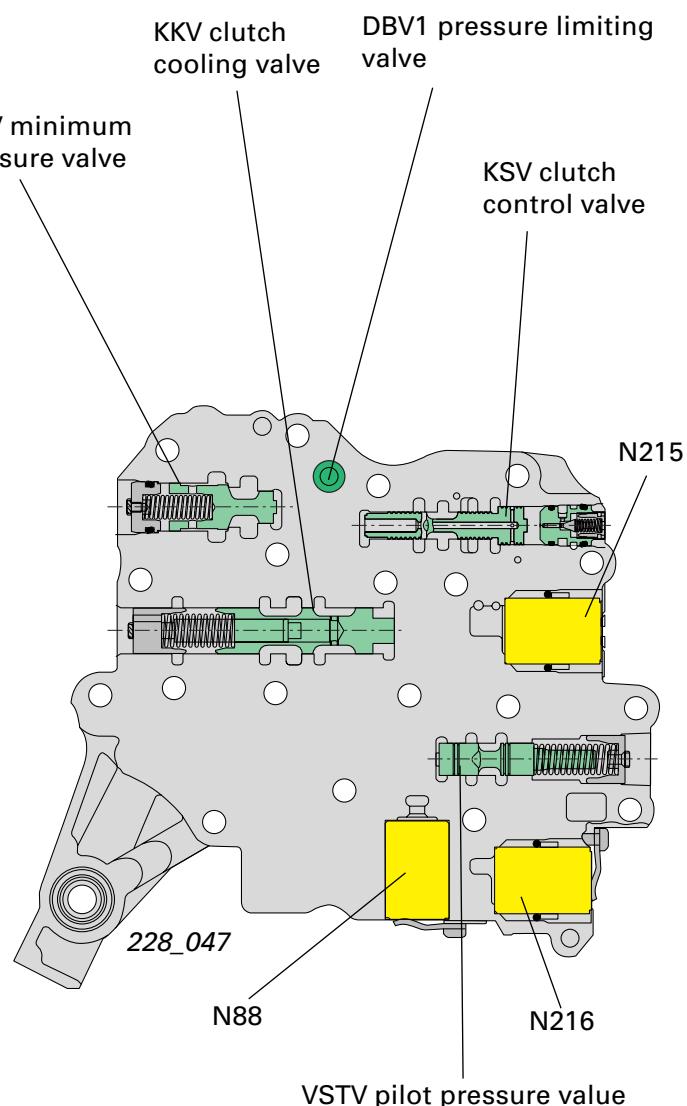
The **MDV minimum pressure valve** prevents the oil pump drawing in engine air when the engine is started.

When pump output is high, the MDV minimum pressure valve opens and allows oil to flow from the oil return pipe to the suction side of the oil pump; this improves efficiency.

**Hydraulic control unit
(gearbox control unit removed)**



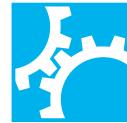
Sectional view of valve plate



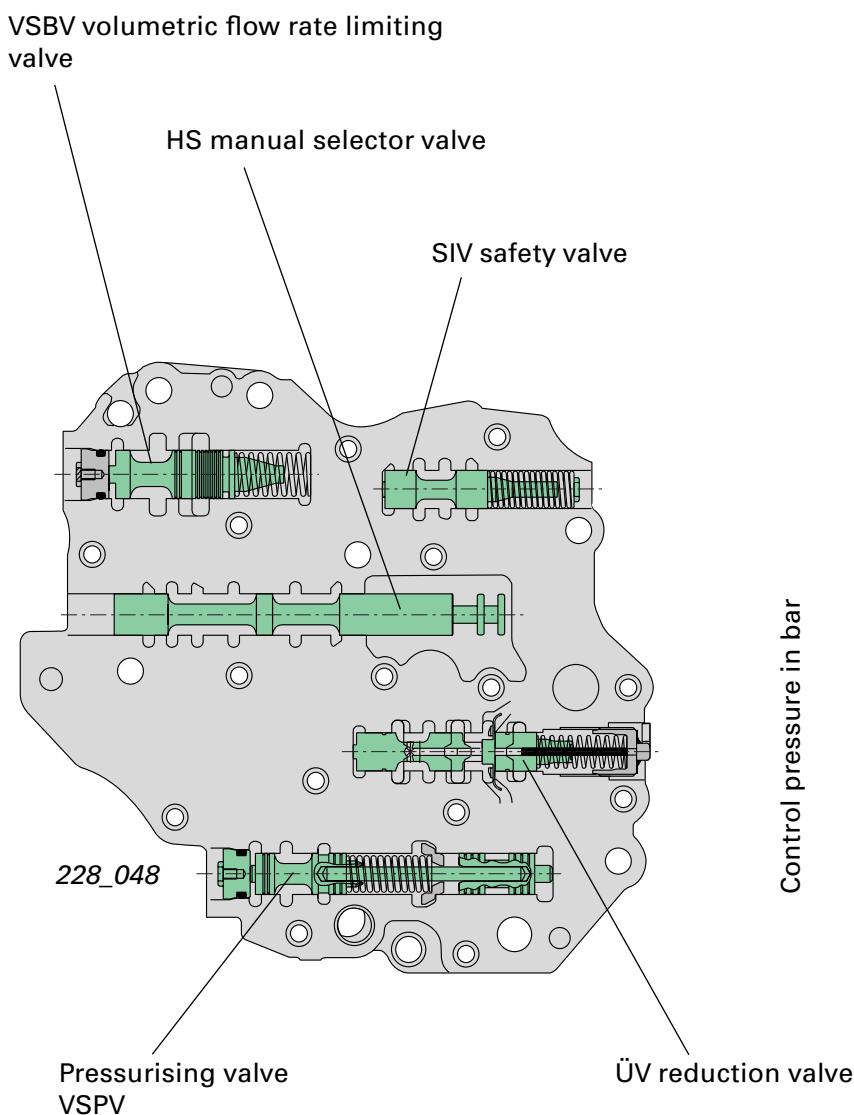
The **VSPV pressurising valve** controls the system pressure so that sufficient oil pressure is always available for a particular function (application of contact pressure or adjustment).

Solenoids **N88**, **N215**, and **N216** are designed as so-called 'pressure control valves'. They convert an electric control current to a proportional, hydraulic control pressure.

The **N88** (solenoid valve 1) serves two functions: First, it controls the clutch cooling valve (KKV) and the safety valve (SIV). Solenoid **N215** (pressure regulating valve 1 for autom. gearbox) actuates the clutch control valve (KSV). Solenoid **N216** (pressure regulating valve 2 for autom. gearbox) actuates the reduction valve (ÜV).



Sectional view of pump plate



Pressure control valve (proportional valve)

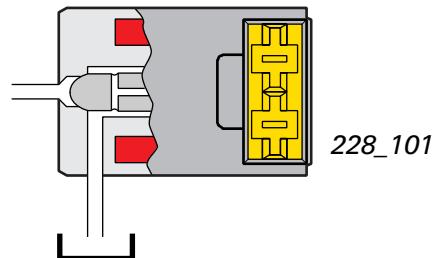
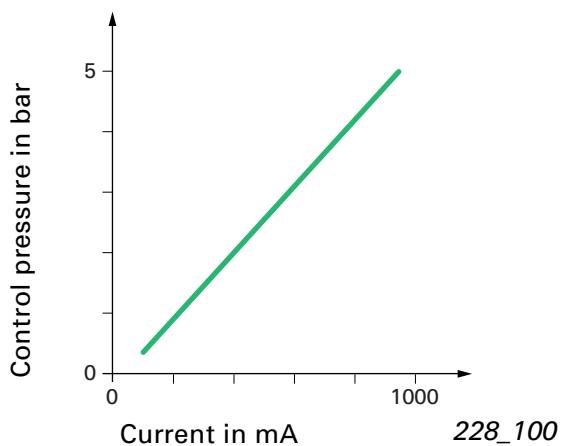


Diagram of pressure control valve



Gearbox modules

Selector shaft and parking lock

A mechanical connection (cable pull) for transmission of selector lever positions P, R, N and D still exists between the gate selector lever and the gearbox.

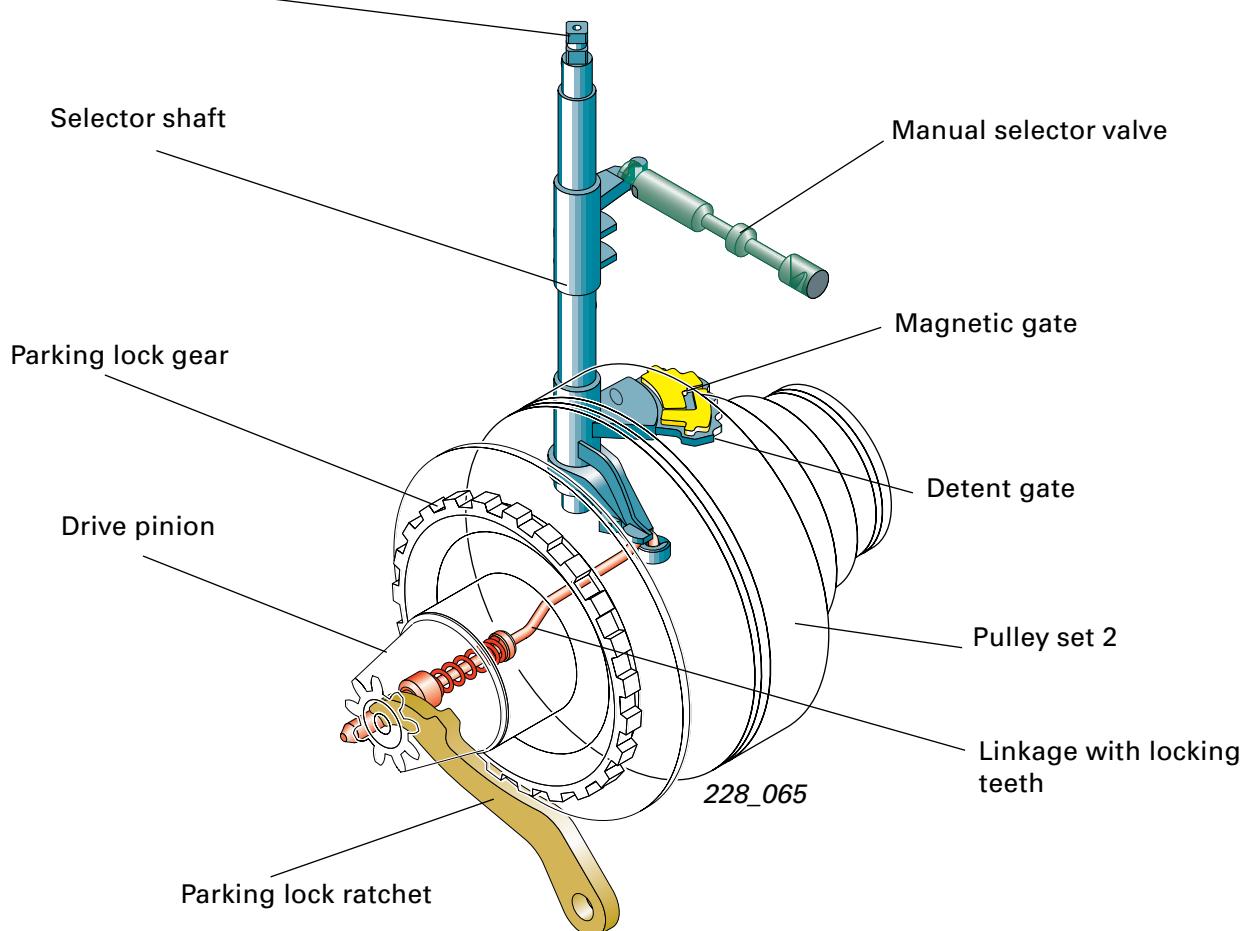
The following functions are executed via selector shaft:

- ▶ Actuation of the manual selector valve in the hydraulic control unit, i.e. hydromechanical control of vehicle operating state (forward/reverse/neutral).

- ▶ Operating the parking lock
- ▶ Actuation of the multi-functional switch for electronic recognition of the selector lever position.

In selector lever position P, the linkage with locking teeth is displaced axially in such a way that the parking lock ratchet is pressed against the parking lock gear and the parking lock is engaged.
The parking lock gear is permanently connected to the drive pinion.

Actuation of the outer selector mechanism



Gearbox housing/ ducting and sealing systems

Sheathed sealing ring system

multitronic® is equipped with a new sheathed sealing ring system.

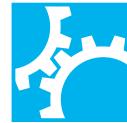
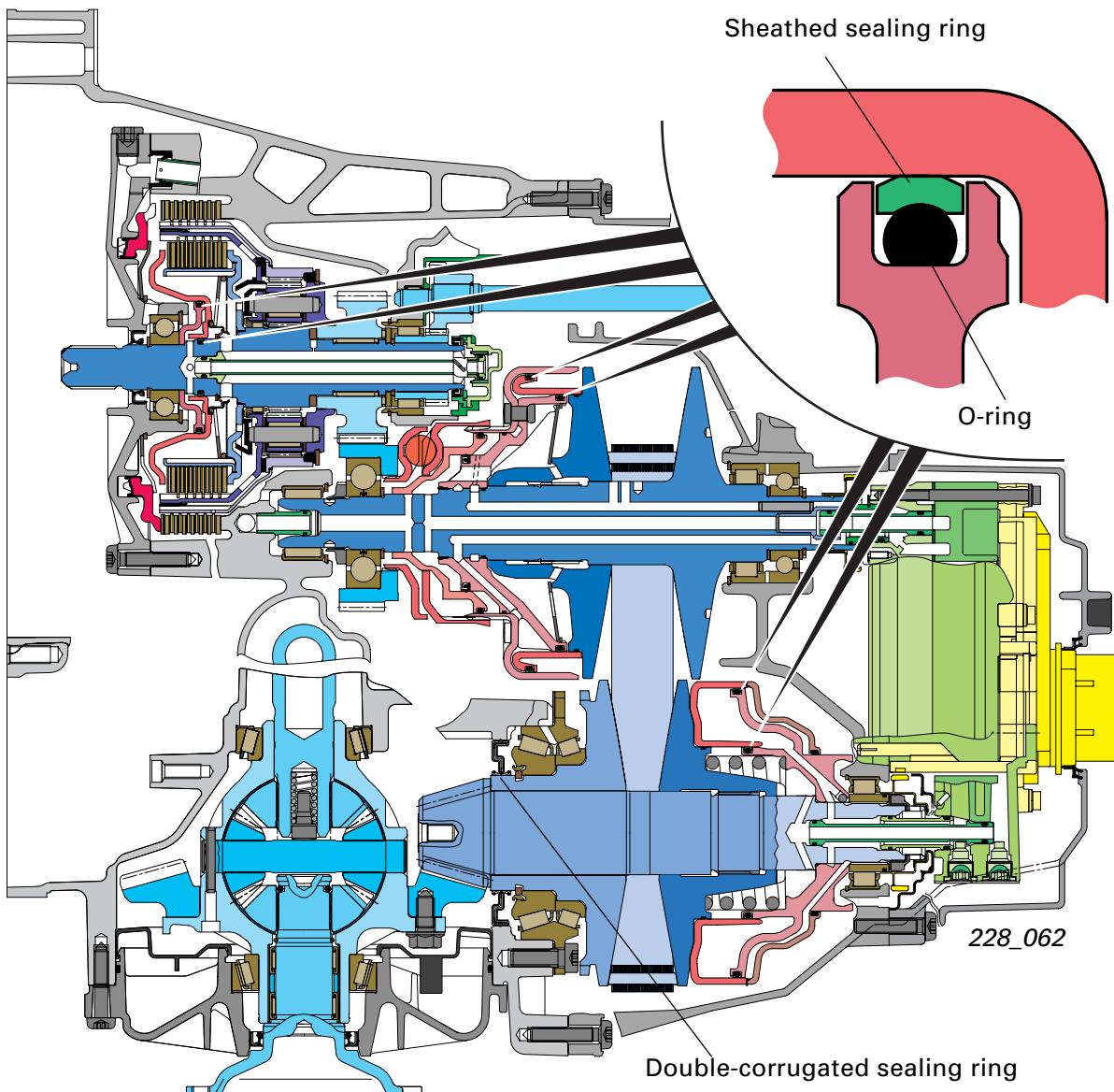
The sheathed sealing rings seal the pressure cylinder and the variable-displacement cylinder of the primary pulley set, the secondary pulley set and the piston for the forward clutch.

The O-ring has two tasks:
To press down and seal the sheathed sealing ring.

The oil pressure present assists the sheathed sealing ring with contact pressure application.

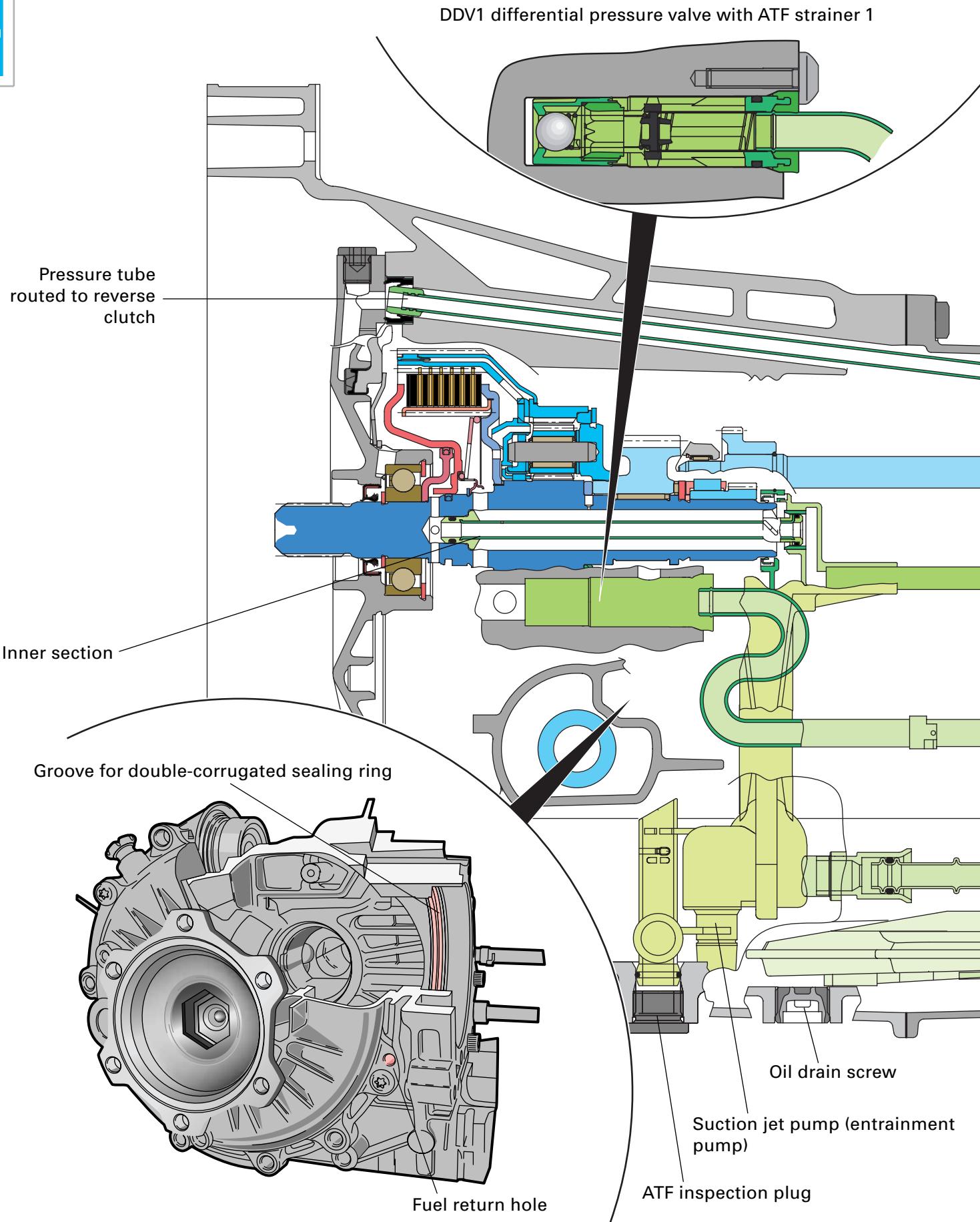
Advantages of the sheathed sealing ring system:

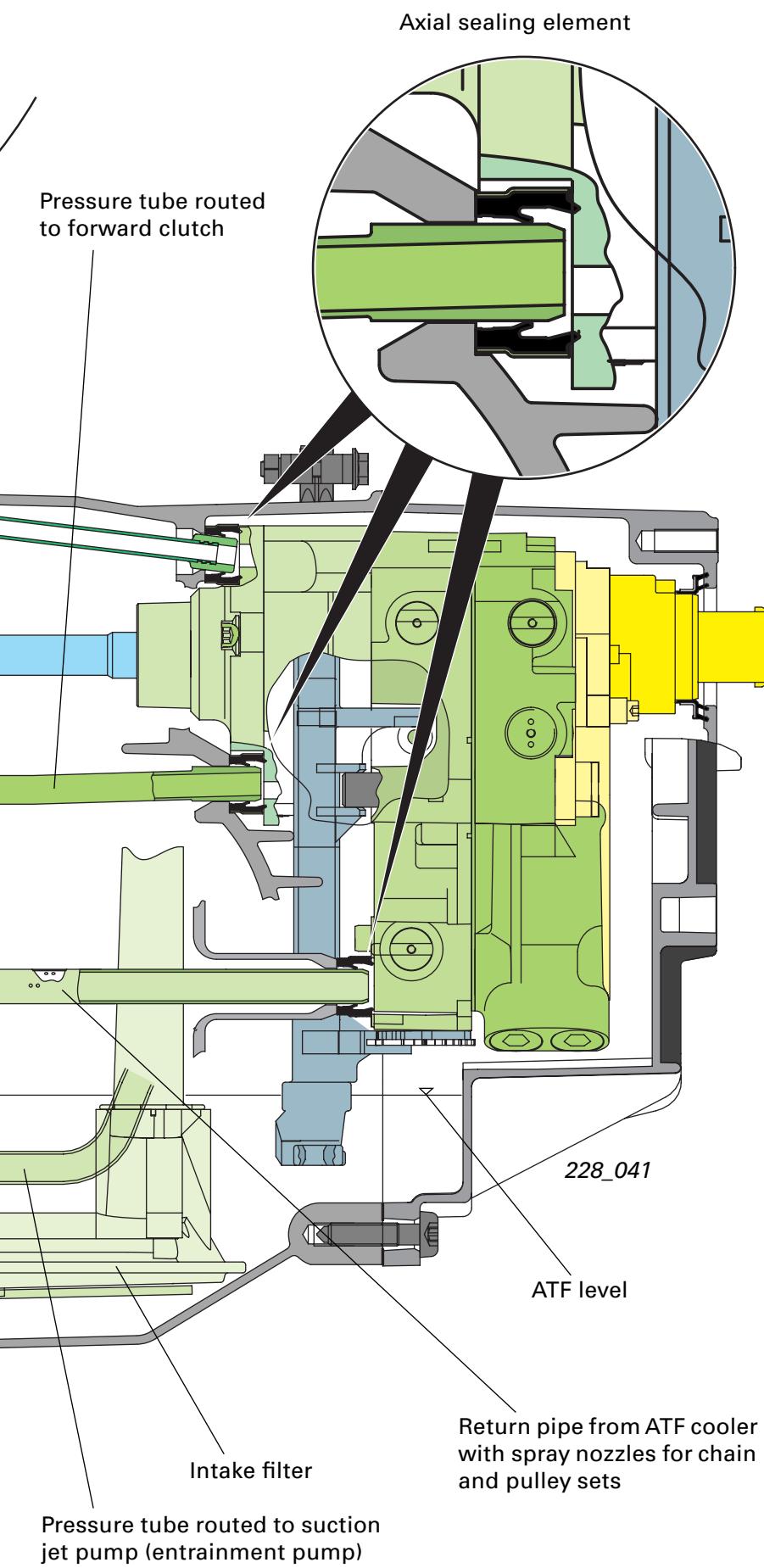
- ▶ Good antifriction properties
- ▶ Low displacement forces
- ▶ Wear
- ▶ Stable at high pressures



Gearbox modules

8





To save weight, the three-piece gearcase is manufactured from the AZ91 HP magnesium alloy.

This alloy is highly corrosion resistant, easy to process and has an 8 kg weight advantage over a conventional aluminium alloy. As a special feature, the ATF pressurised oil is not distributed via housing ducts - as is usual on automatic gearboxes - but almost exclusively via pipes.

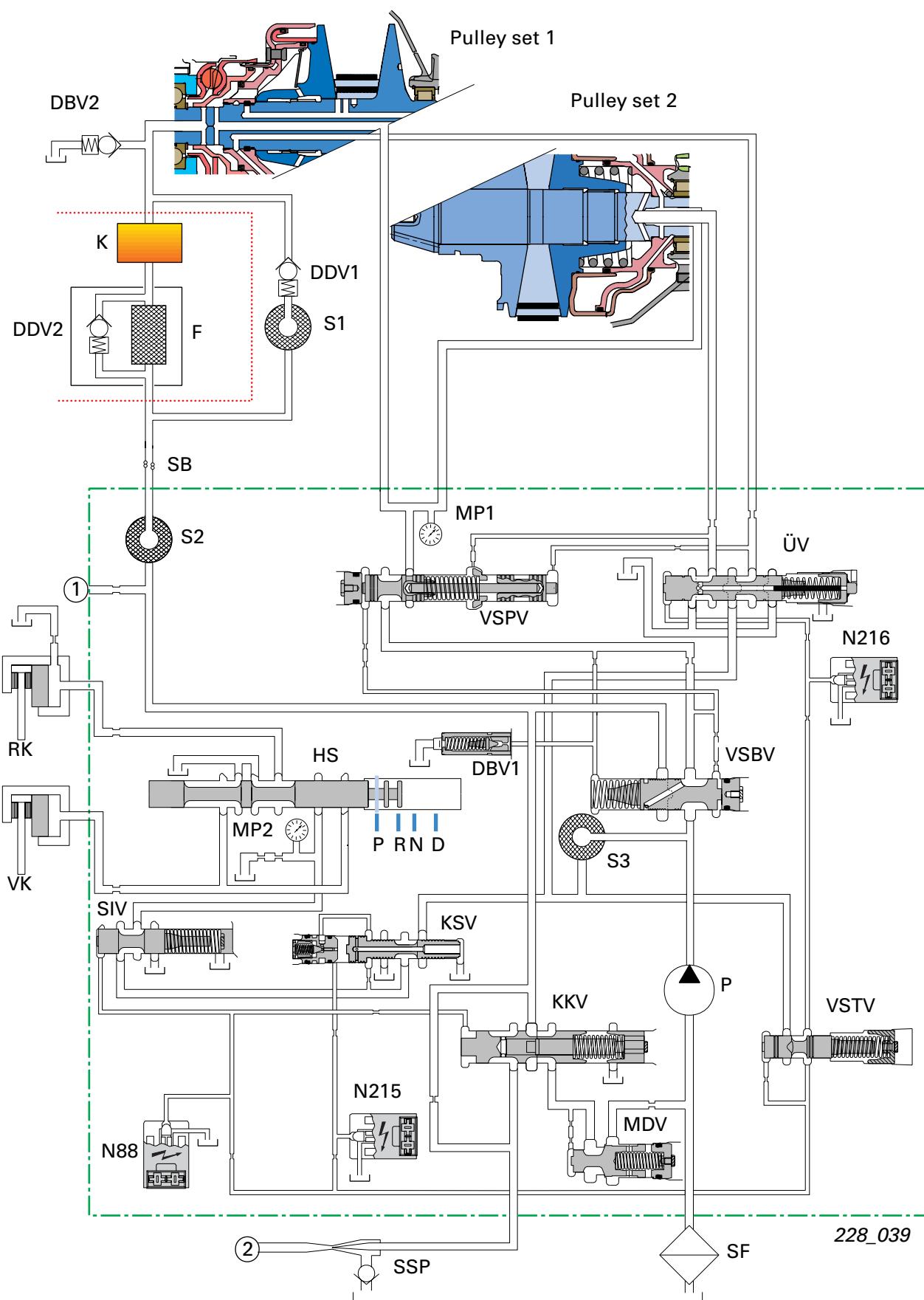
So-called axial sealing elements are used to seal the pipe connections. The axial sealing element of the pressure pipes have two sealing lips which apply a higher contact pressure - as a result of the oil pressure - and therefore seal the pipes reliably. Diagonal pipe connections can also be sealed without difficulty using this technology (e.g. pressure tube connected to reverse clutch). The axial sealing element oil pump intake fitting has sealing beads which seal the fitting by virtue of their contact pressure.

The double-corrugated sealing ring (see page 57) separates the ATF reservoir from the final drive oil reservoir. It prevents the ATF from entering the final drive and oil from the final drive entering the ATF reservoir.

Leaks in the double-corrugated sealing ring become visible at the fuel return hole.

Gearbox modules

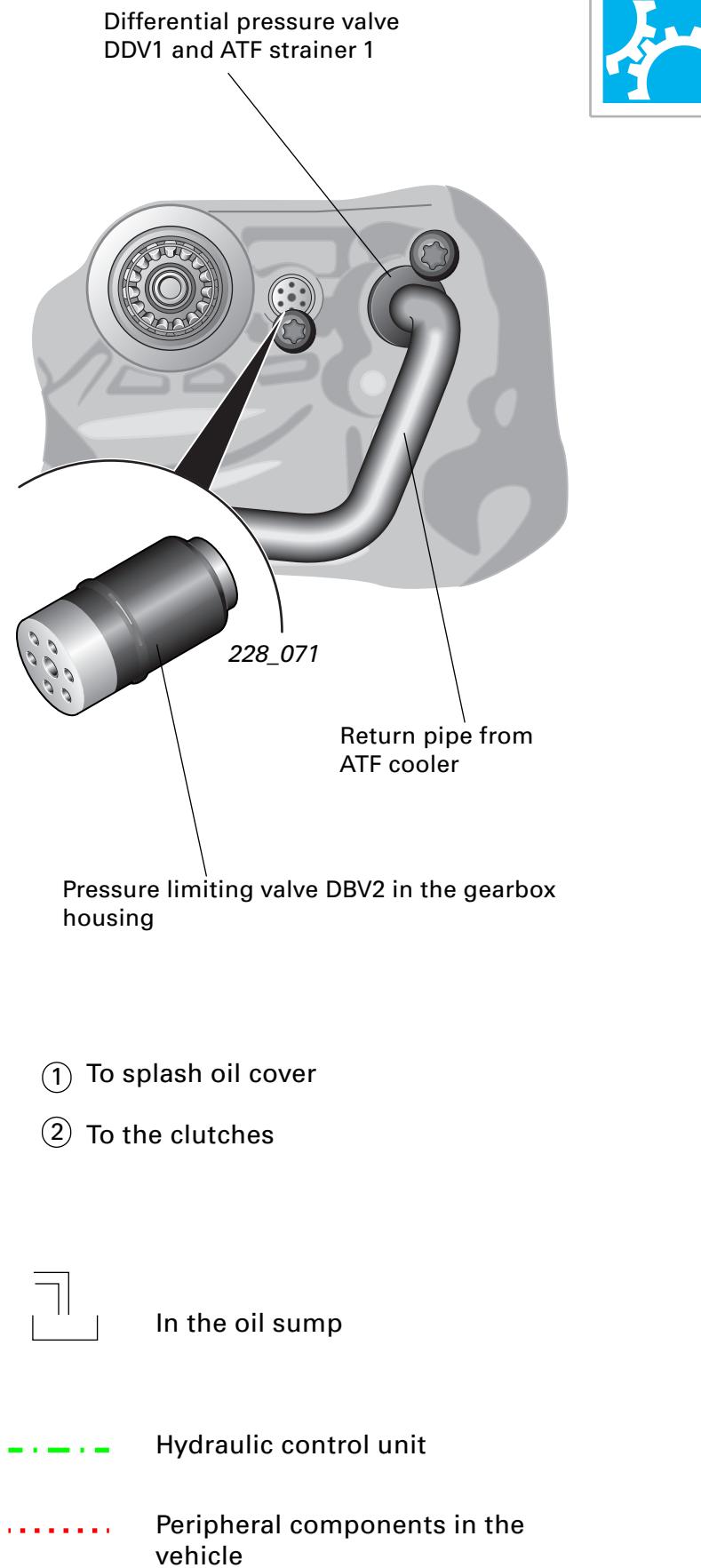
Hydraulic chart



Explanatory notes on the hydraulic chart

(selector lever position P and engine "OFF")

DBV2	Pressure limiting valve 1
DBV2	Pressure limiting valve 2
DDV2	Differential pressure valve 1
DDV2	Differential pressure valve 2
F	ATF filter
HS	Manual selector valve
K	ATF cooler
KKV	Clutch cooling valve
KSV	Clutch control valve
MDV	Minimum pressure valve
MP1	Measuring point for contact pressure (registered via G194)
MP2	Measuring point for clutch pressure (registered via G193)
N88	Solenoid valve 1 (clutch cooling/ safety shut-off)
N215	Automatic gearbox pressure control valve -1- (clutch)
N216	Automatic gearbox pressure control valve -2- (ratio)
P	Oil pump
PRND	Selector lever position
RK	Reverse clutch
S1	ATF strainer 1
S2	ATF strainer 2
S3	ATF strainer 3
SB	4 Spray holes for pulley set lubrication/cooling
SF	ATF intake filter
SIV	Safety valve
SSP	Suction jet pump (entrainment pump)
ÜV	Reduction valve
VK	Forward clutch
VSBV	Volumetric flow rate limiting valve
VSPV	Pressurising valve
VSTV	Pilot pressure value



Gearbox modules

ATF cooling

The ATF coming pulley set 1 initially passes through the ATF cooler. The ATF flows through the ATF filter before it is returned to the hydraulic control unit.

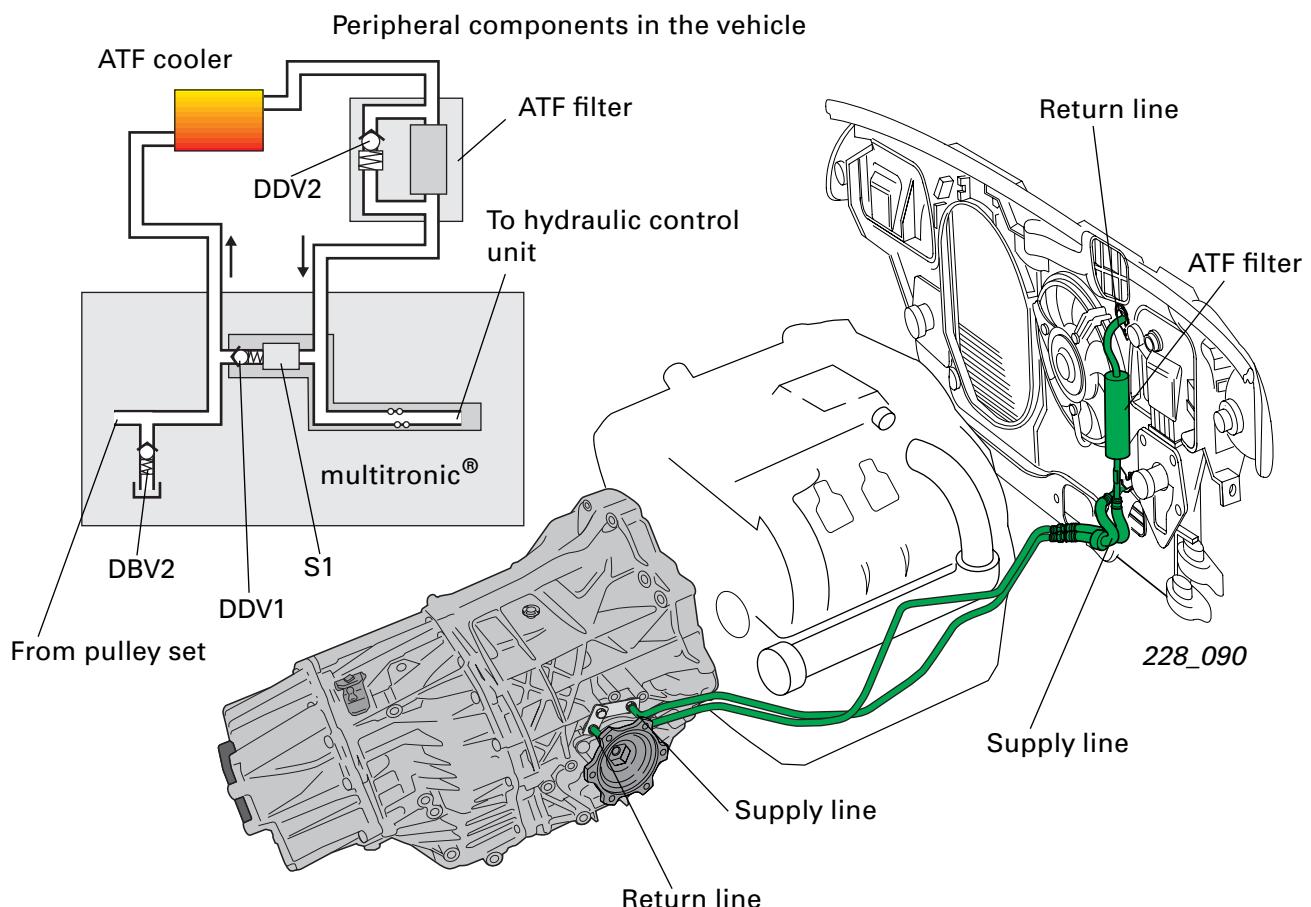
As is the case with the CVT, the ATF cooler is integrated in the "engine cooler". Heat is exchanged with the coolant in the engine cooling circuit (oil-coolant heat exchanger).

The DDV1 differential pressure valve protects the ATF cooler against excessively high pressures (ATF cold). When the ATF is cold, a large pressure difference develops between the supply line and the return line. When a specific pressure differential is reached, the DDV1 opens and the supply line is short-circuited with the return line. This also causes the temperature of the ATF to rise rapidly.

The DDV2 differential pressure valve opens when the flow resistance of the ATF filter is too high (e.g. filter blockage). This prevents the DDV1 from opening and the ATF cooling system from being disabled by the backpressure.



If the ATF cooler is leaky, coolant can enter the ATF. Even small quantities of coolant in the ATF can have an adverse effect on clutch control.



Gearbox control

multitronic control unit J217

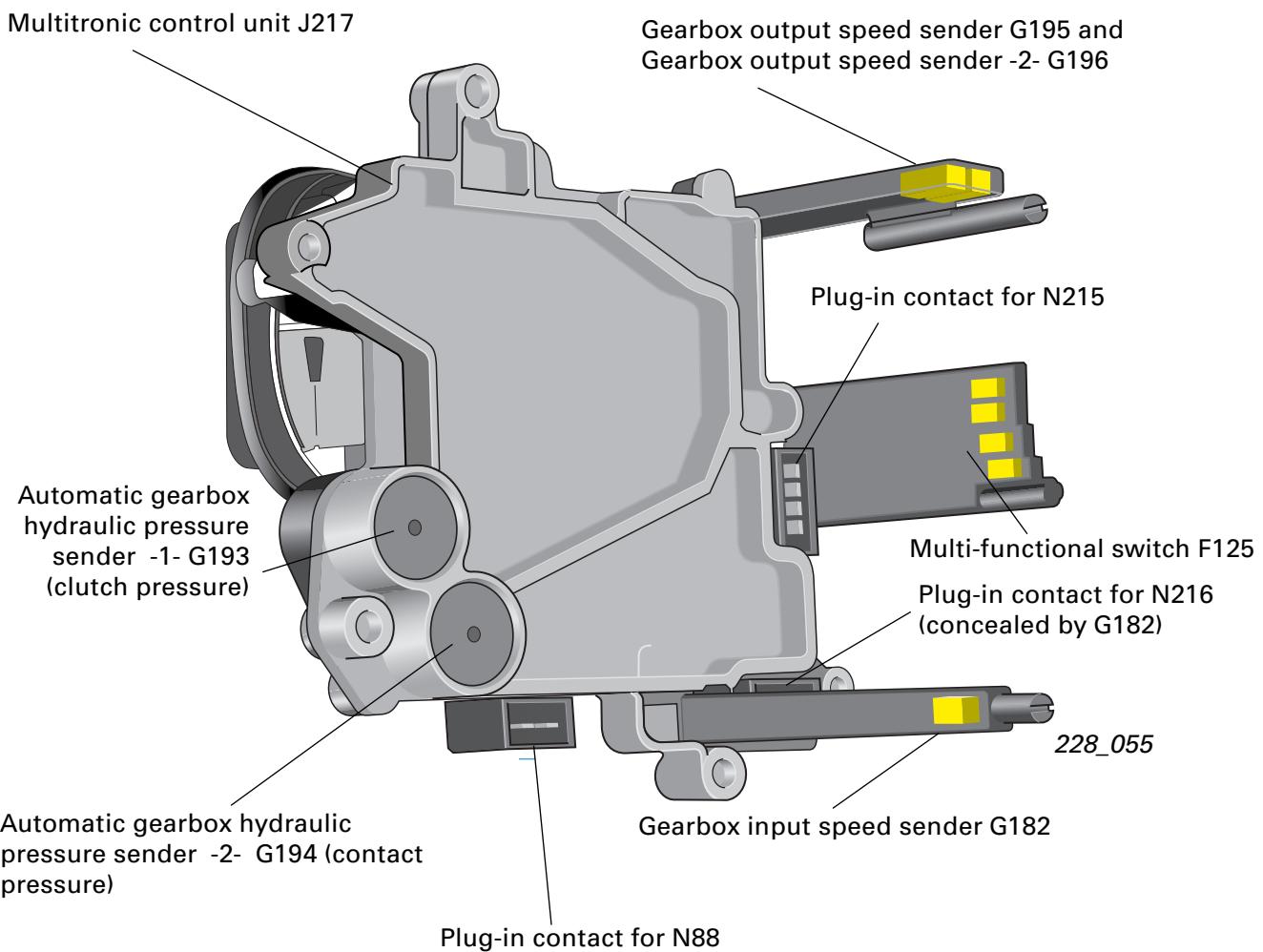
A special feature of multitronic® is the integration of the electronic control unit in the gearbox.

The control unit is attached directly to the hydraulic control with bolts.

The connection to the three pressure regulating valves is made directly from the control unit by means of robust plug-in contacts (gooseneck contacts); there are no wiring connections. A 25-pin compact connector forms the interface to the vehicle.

A further new feature is the integration of sensor technology in the control unit.

- ▶ F125 - Multi-functional switch
- ▶ G182 - Gearbox input speed sender
- ▶ G195 - Gearbox output speed sender
- ▶ G196 - Gearbox output speed sender -2-
- ▶ G93 - Gearbox oil (ATF) temperature sender
- ▶ G193 - Automatic gearbox hydraulic pressure sender -1- (clutch pressure)
- ▶ G194 - Automatic gearbox hydraulic pressure sender -2- (contact pressure)



Gearbox control

A strong aluminium plate acts as the base for the electronics and serves to dissipate heat. The housing is made of plastic and securely riveted to the base. It accommodates all the sensors, so neither wiring nor plug-in contacts are necessary.



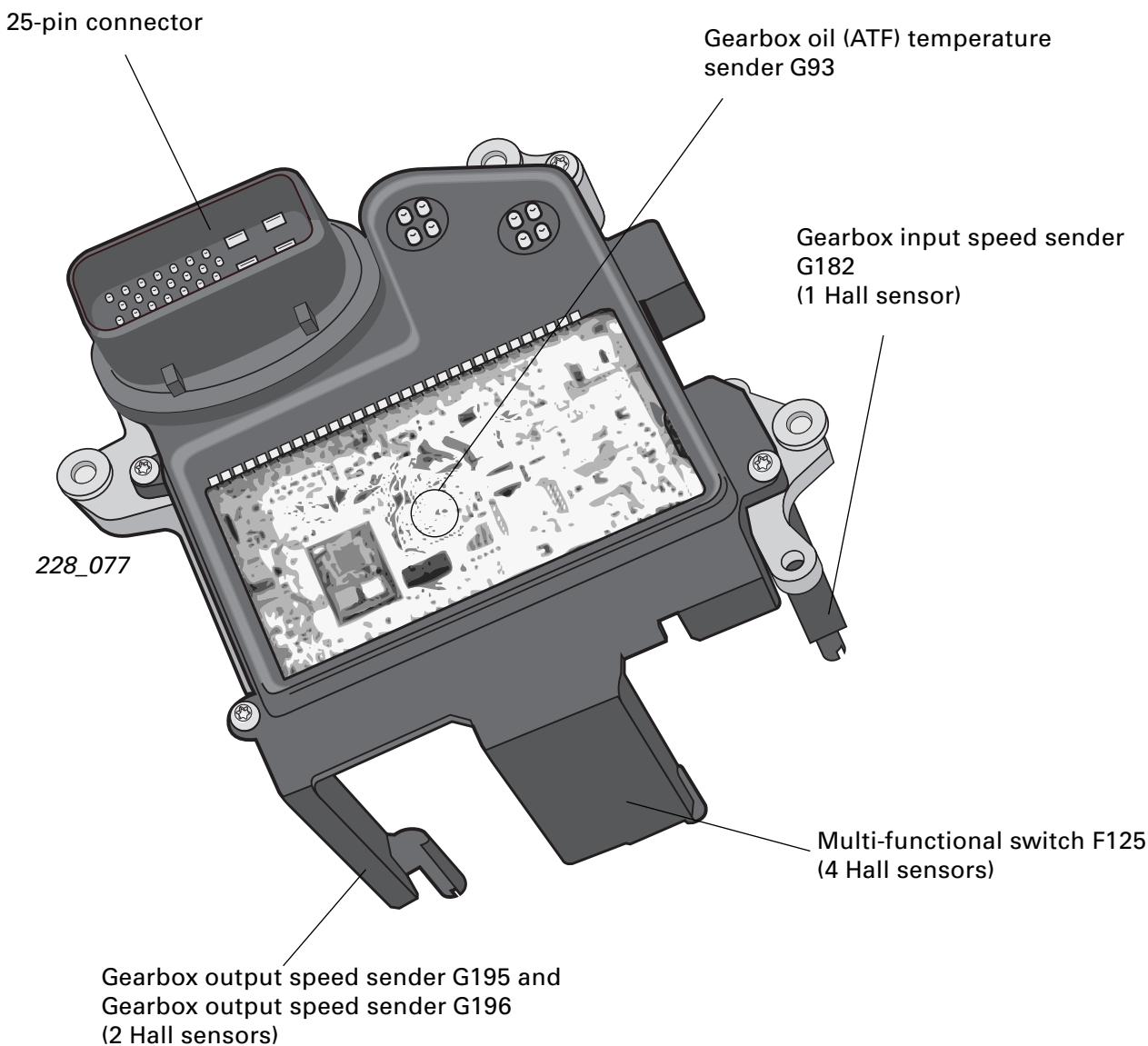
Since the majority of all electrical failures are attributable to faulty wiring and plug-in contacts, this construction offers a very high degree of reliability.

The engine speed sender and the multi-functional switch are designed as Hall sensors.

Hall sensors are free of mechanical wear. Their signal is immune to electromagnetic interference, which improves their reliability still further.



Due to the fact there are only a few interfaces to the gearbox control unit, the multitronic® does without a separate cable set. The wiring is integrated in the engine cable set.



Fault indication

Faults in the multitronic® are to a high degree registered by the extensive self-diagnosis function.

Faults are indicated to the driver via the selector lever position indicator in the dash panel insert depending on their effect on the multitronic® or on driving safety. In this case, the selector lever position indicator also serves as a fault indicator.

As regards faults registered by the multitronic®, a distinction is drawn between 3 states:

1. The fault is stored and a substitute program enables continued operation of the vehicle (with some restrictions). This state is not indicated to the driver, since it is not critical with regard to driving safety or multitronic®. The driver will notice the fault - if at all - by the way the vehicle handles and will automatically seek the assistance of an Audi service partner.
2. As described item 1, the selector lever position indicator also indicates the presence of a fault by inverting the display. The situation is still not critical for driving safety or for the multitronic®. However, the driver should take the vehicle to an Audi service partner as soon as possible in order to have the fault rectified.
3. As described under item 1, the selector lever position indicator also indicates the presence of a fault by a **flashing**. This state is critical with regard to driving safety or multitronic®. Therefore, the driver is advised to take the vehicle to an Audi service partner immediately in order to have the fault rectified.



When the display is flashing, vehicle operation will - in certain circumstances - only be maintained until the next time the vehicle stops. The vehicle can subsequently no longer be driven!

In certain cases, vehicle operation can be resumed by restarting the vehicle.



228_102



228_103



228_104

Gearbox control

Sensors

The signals generated by the sensors can no longer be measured with conventional equipment due to the fact that the control unit is integrated in the gearbox. A check can only be performed with the Diagnostic Testing and Information System by means of the "Read out fault" and "Read out data blocks" functions.

This Self-Study Program does not therefore represent or describe the sensor signals.

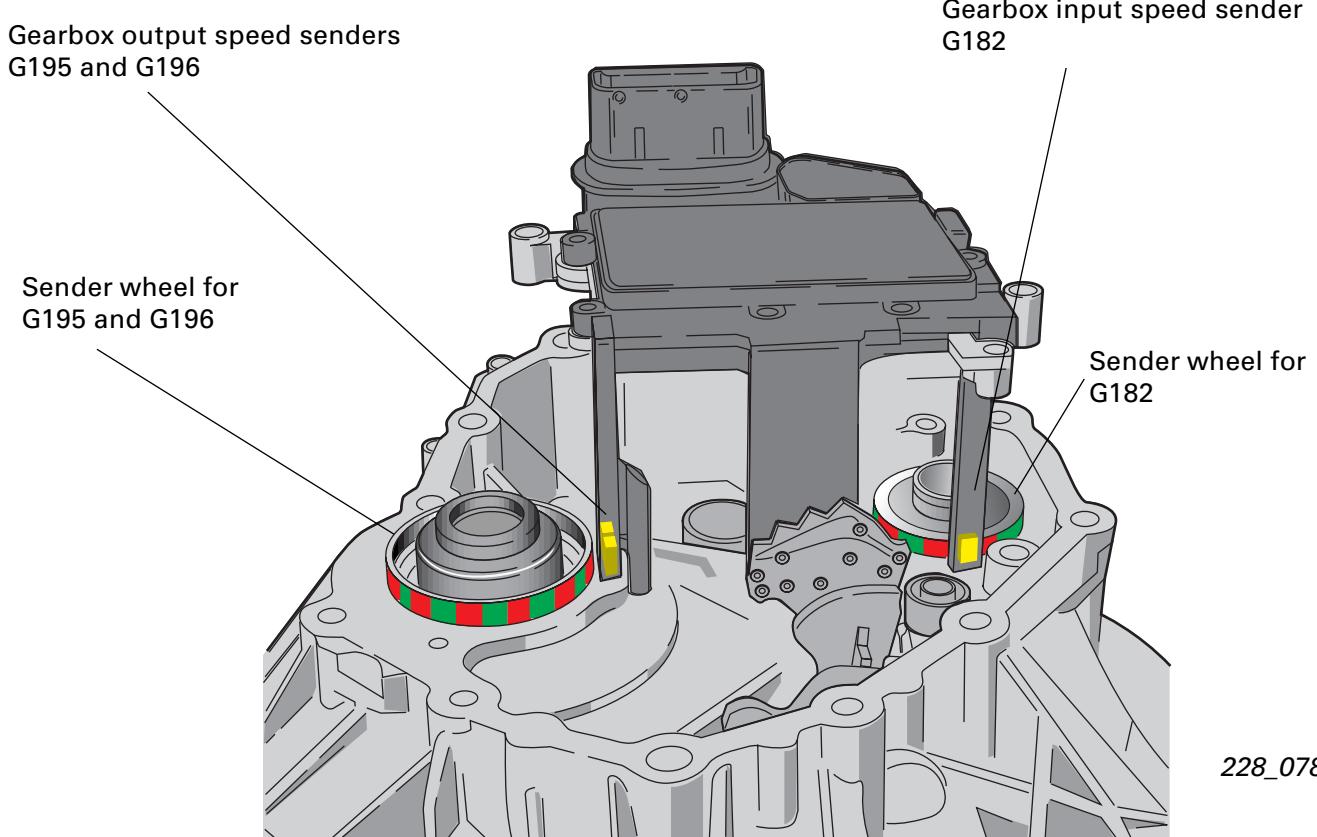
If a sensor fails, the gearbox control unit generates substitute values from the signals from the other sensors as well as the information from the networked control units. Vehicle operation can thus be maintained.

The effects on handling performance are in part so small, the driver will not notice the failure of a sensor immediately. A further fault can, however, have serious effects.



The sensors are an integral part of the gearbox control unit. If a sensor fails, the gearbox control unit must be replaced.

Gearbox input speed sender G182 and gearbox output speed senders G195 and G196



228_078

Sender G182 registers the rotation speed of pulley set 1 and therefore represents the actual gearbox input speed.

Gearbox input speed...

... is used together with engine speed for clutch control (for more detailed information, refer to "Micro-slip control").

... serves as the reference input variable for transmission control (for more detailed information, refer to "Transmission control").

Senders G195 and 196 register the rotation speed of pulley set 2 and with it the gearbox output speed.

The signal from G195 is used for registering rotation speed. The signal from G196 is used for recognition of direction of rotation and therefore also for distinguishing between ahead travel and reverse travel (refer to "Creep control").

"Gearbox output speed" is used.....

... for transmission control,
... for creep control,
... for the hill-holder function,
... for determining the road speed signal for the dash panel insert.

A magnetic ring comprising a row of 40 magnets (for G182) or 32 magnets (for G195 and G196) is located on the end face of the **sender wheel**; the magnets act as N/S poles.

Effects of failure of G182:

- The drive-away process is performed according to a fixed characteristic.
- The micro-slip control and the clutch adaption function are deactivated.

Engine speed is used as a substitute value.

Fault indication: none



If the G195 fails, the gearbox output speed is determined from the signal from G196. The hill-holder function is deactivated also.

If G196 fails, the hill-holder function is deactivated.

If both sensors fail, a substitute value is generated from the information on wheel speeds (across the CAN bus). The hill-holder function is deactivated.

Fault indication: no



Heavy contamination of the magnetic ring (metal swarf caused by wear) can impair the performance of G182, G195 or G196.

Therefore, metal swarf adhering to the magnetic ring should be removed before performing repairs.

Gearbox control

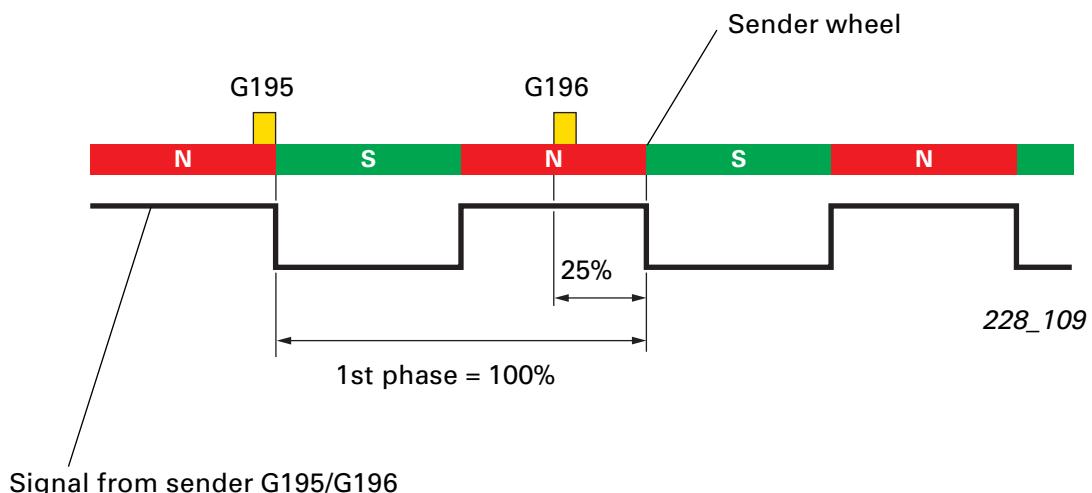
How the direction of rotation is registered:

A magnetic ring comprising row of 32 individual magnets (N/S poles) is located on the end face of the sender wheel for G195 and G196.



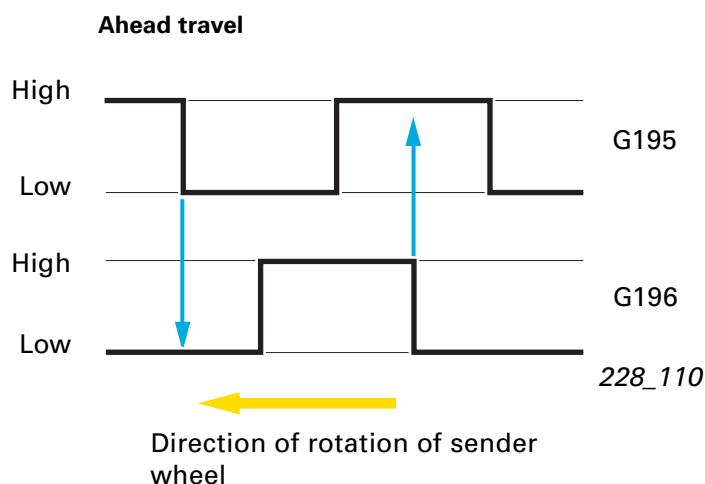
The direction of rotation is essentially registered for the hill-holder function.

The position of sender G195 relative to sender G196 is offset in such a way that the phase angles of the sensor signals are 25% out of phase with one another.

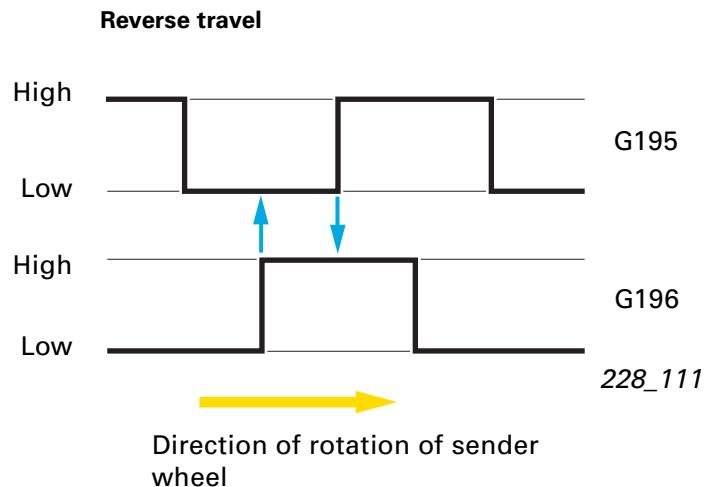


After ignition "ON", the control unit observes the falling edges of the signals from the two sensors and records the level of the other sensors.

As shown in the example, the level of sensor G196 is "Low" at the falling edge of the signal from sensor G195 and the level of G195 is "High" at the falling edge of the signal from sensor G196. The gearbox control unit interprets this "pattern" as ahead travel.



In this example, the level of sensor G196 is "High" at the falling edge of the signal from sensor G195 and the level of G195 is "Low" at the falling edge of the signal from sensor G196. The gearbox control unit interprets this "pattern" as reverse travel.

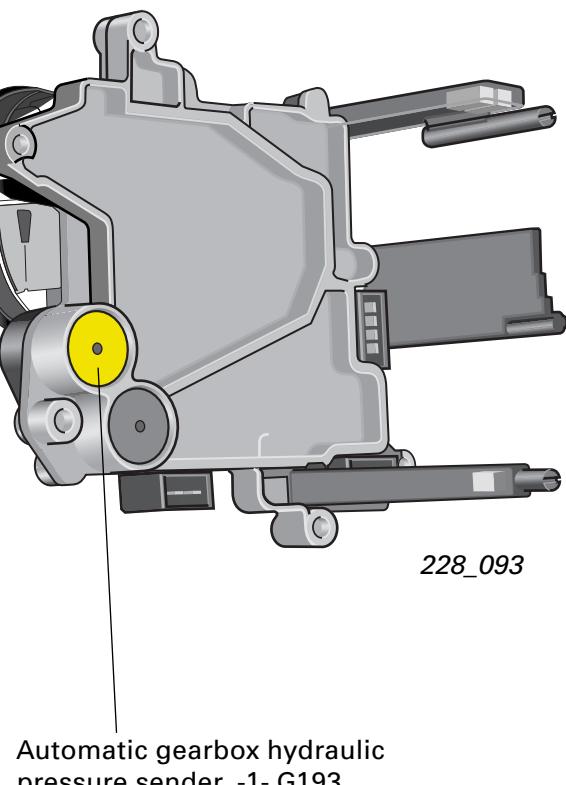


Automatic gearbox hydraulic pressure sender -1- G193

Sensor G193 registers the clutch pressure of the forward- and the reverse-gear clutches and is used for monitoring the clutch function (see "Clutch control").

Clutch pressure monitoring has a high priority, so malfunctioning of G193 will in most cases cause the safety valve to be activated (see "Safety shut-off").

Fault indication: flashing



Gearbox control

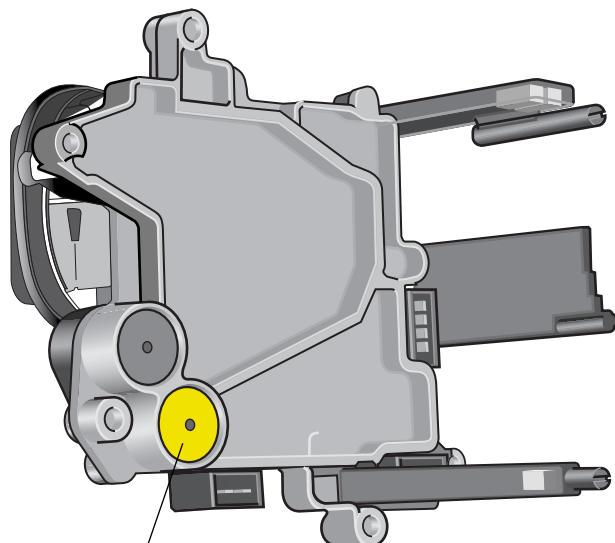
Automatic gearbox hydraulic pressure sender -2- G194

Sensor G194 registers the contact pressure, which is regulated by the torque sensor. As the contact pressure is always proportional to the actual gearbox input torque, the gearbox input torque can be calculated very accurately using G194.

The signal from G194 is used for clutch control (control and adaption of the creep function).

If G194 malfunctions, the creep control adaption function is deactivated. The creep torque is controlled by means of stored values.

Fault indication: none



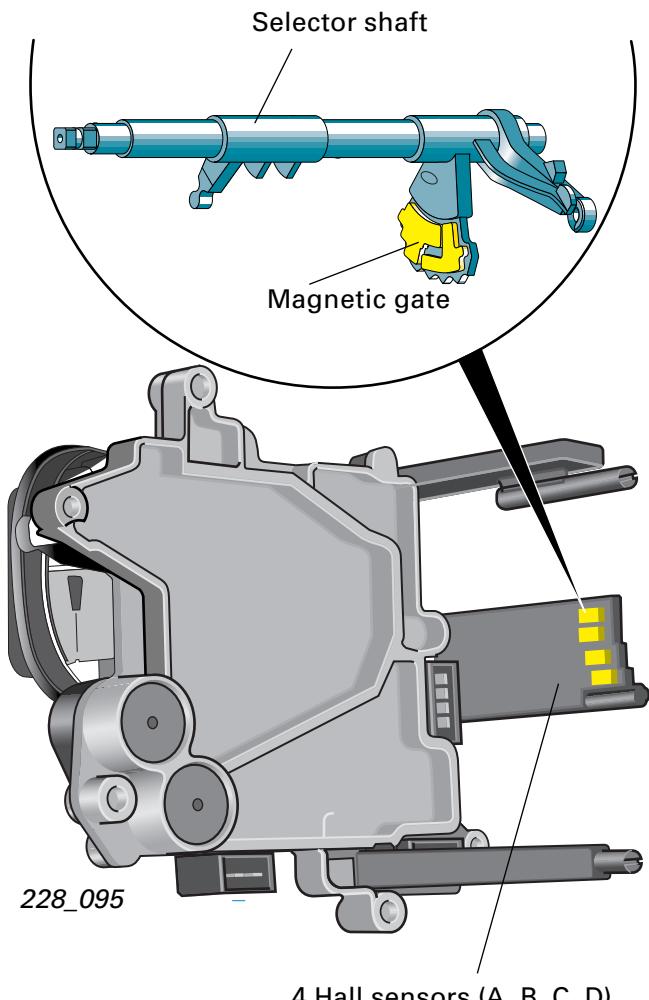
Automatic gearbox hydraulic pressure sender -2- gearbox G194

Multi-functional switch F125

Multi-functional switch F125 comprises 4 Hall sensors which are controlled by the magnetic gate on the selector shaft. The signals from the Hall sensors are interpreted in the same way as the positions of mechanical switches. A High level means: switch is closed (1). A Low level means: switch is open (0).

Therefore, a "switch" (Hall sensor) generates two signals: "1" and "0". 16 different gearshift combinations can be generated with 4 "switches":

- ▶ 4 gearshift combinations for the recognition of selector lever positions P, R, N, D,
- ▶ 2 gearshift combinations which are registered as intermediate positions (P-R, R-N-D),
- ▶ 10 gearshift combinations which are diagnosed as being faulty.



4 Hall sensors (A, B, C, D)

Gearshift combinations

	Hall sensors			
	A	B	C	D
Selector lever position	Gearshift combinations			
P	0	1	0	1
between P-R	0	1	0	0
R	0	1	1	0
between R-N	0	0	1	0
N	0	0	1	1
between N-D	0	0	1	0
D	1	0	1	0
Fault	0	0	0	0
Fault	0	0	0	1
Fault	0	1	1	1
Fault	1	0	0	0
Fault	1	0	0	1
Fault	1	0	1	1
Fault	1	1	0	0
Fault	1	1	1	0
Fault	1	1	1	1

For a table of gearshift combinations, please refer to the Workshop Manual!

Example:

The selector lever is located in selector lever position "N". If Hall sensor "C" for example fails, gearshift combination "0 0 0 1" will be implemented. The gearbox control unit can no longer identify selector lever position "N". It recognises the gearshift combination as being faulty and initiates the appropriate substitute program.

The gearbox control unit requires the information on selector lever position for the following functions:

- ▶ Starter inhibitor control
- ▶ Reversing light control
- ▶ P/N interlock control
- ▶ Information on the vehicle operating state (forward/reverse/neutral) for clutch control
- ▶ Lock ratio when reversing

Faults in F125 manifest themselves very differently. Pulling away may not be permitted in certain circumstances.

If Hall sensor "D" fails, it will no longer be possible to start the ignition.

Fault indication: flashing



Gearbox control

Gearbox oil (ATF) temperature sender G93

Sensor G93 is integrated in the electronics of the gearbox control unit. It records the temperature of the gearbox control unit's aluminium mounting and with it a close approximation of the gearbox oil temperature.



Gearbox oil temperature influences both clutch control and gearbox input speed control. Therefore, it plays an important role in the control and adaption functions.

If G93 fails, the engine temperature is used to calculate a substitute value. Adaption functions and certain control functions are deactivated.

Fault indication: inverted

To protect the component parts of the gearbox, engine performance is reduced if the gearbox oil temperature exceeds approx. 145°C.

If the gearbox oil temperature continues to increase, engine performance is reduced more and more (if necessary, until the engine is running at idling speed).

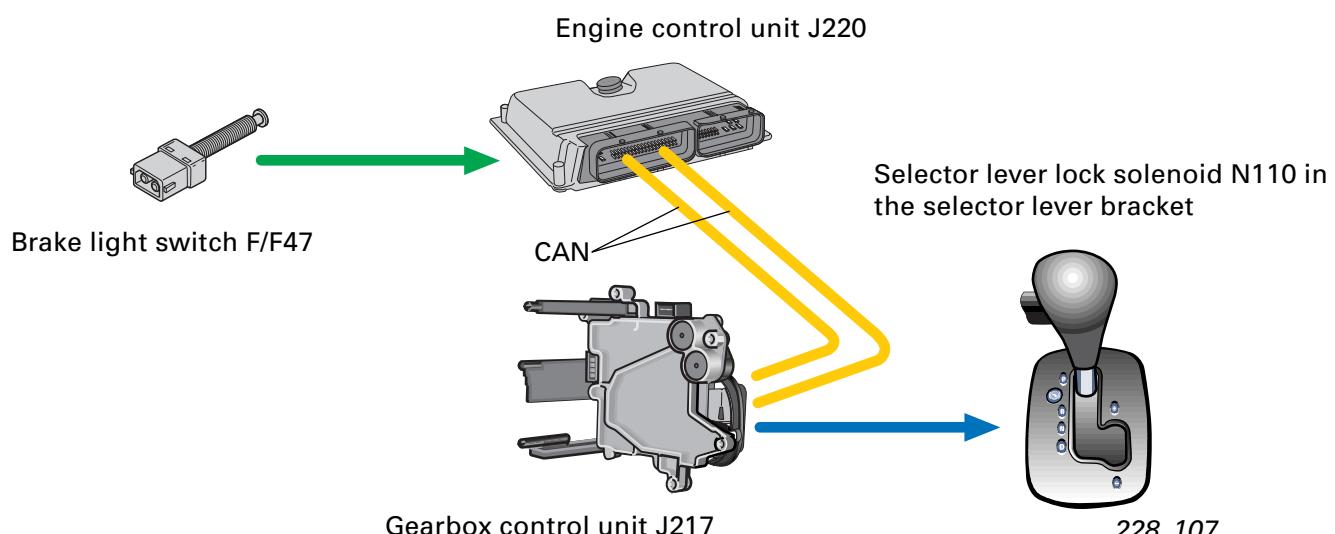
Fault indication: flashing

"Brake actuated" signal

The "Brake actuated" signal is required for the following functions:

- ▶ For the function the selector lever lock
- ▶ For creep control
- ▶ For the dynamic control program (DCP)

There is no direct interface to the brake light switch. The "Brake actuated" signal is provided by the engine control unit across the CAN bus.



Information "Kickdown"

A separate switch is not used for the kickdown information.

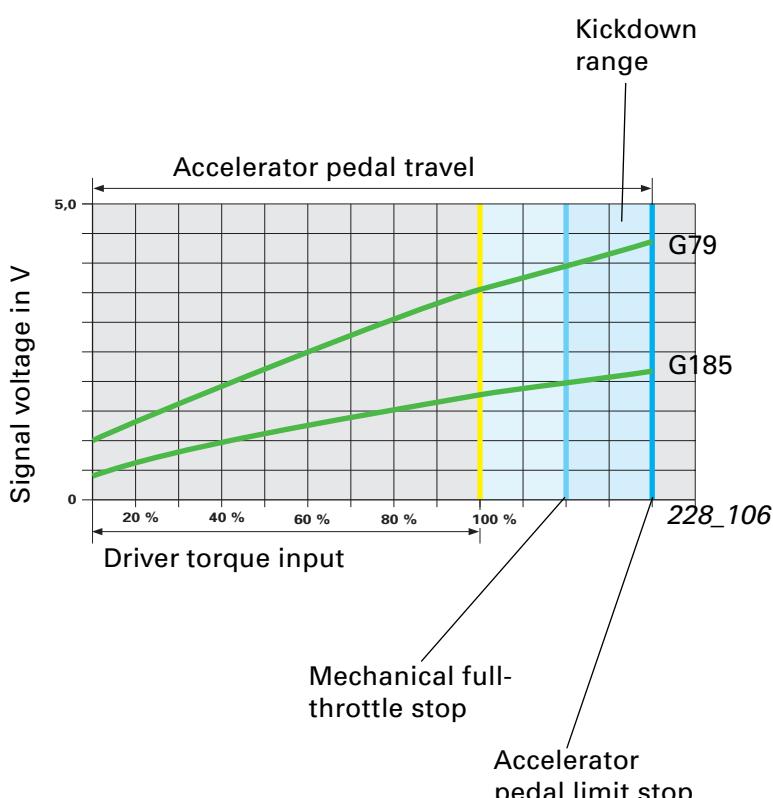
A spring-loaded pressure element located on the accelerator pedal module creates a "point of resistance" conveying a "kickdown feel" to the driver.

When the driver activates the kickdown function, the full-throttle voltage value of senders G79 and G185 (accelerator pedal module) is exceeded. When a defined voltage value corresponding to the kickdown point is exceeded, the engine control unit sends kickdown information to the gearbox control unit across the CAN bus.

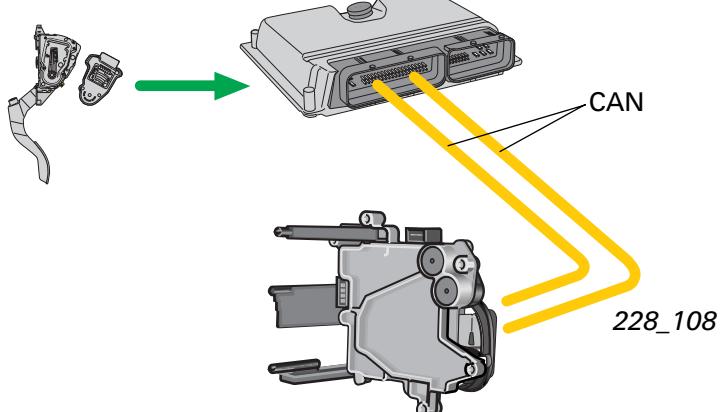
In automatic mode, the most sporty control characteristic for maximum acceleration is selected when the kickdown function is activated.

The kickdown function does not have to be continuously activated. After the kickdown function has been activated once, the accelerator pedal need only be held in the full-throttle position.

If the accelerator pedal module is replaced, the kickdown shift point must be readapted using the diagnostic testing and information system (refer to Workshop Manual).



Accelerator pedal module G79/G185 Engine control unit J220



Gearbox control unit J217

Gearbox control

Tiptronic switch F189

Tiptronic switch F189 is integrated in the pcb of the gear change mechanism. It comprises 3 Hall sensors which are actuated by a magnet located on the shutter.



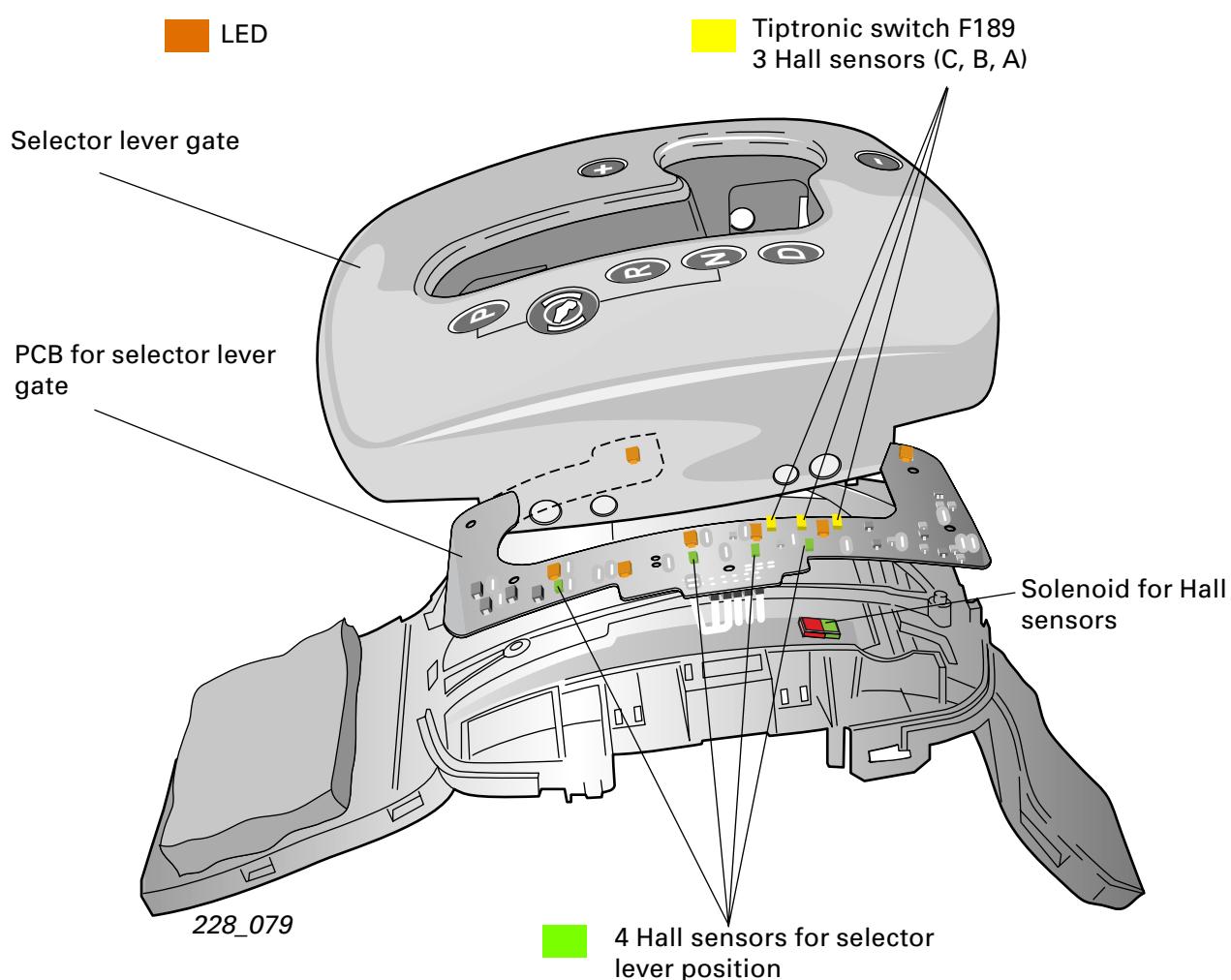
- A - Sensor for downshift
- B - Sensor for tiptronic recognition
- C - Sensor for upshift

7 LEDs are located on the pcb: 1 for each selector lever position, 1 for the "Brake actuated" symbol, and 1 of each for the + and - symbols on the tiptronic gate.

Each selector lever position LED is controlled by a separate Hall sensor.

The switches of F189 apply earth (Low signal) to the gearbox control unit when actuated. If a fault occurs, the tiptronic function is disabled.

Fault indication: inverted



CAN information exchange on multitronic®

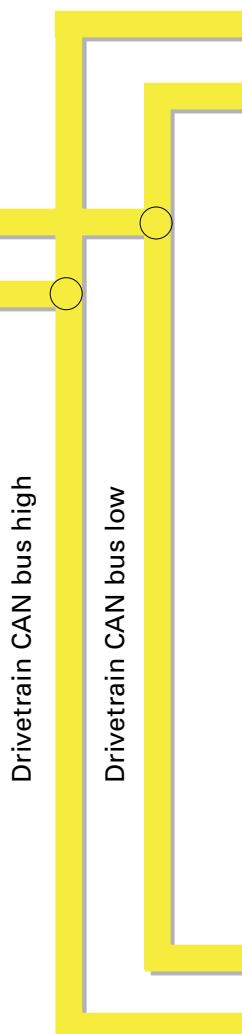
In the multitronic® information is exchanged between the gearbox control unit and the networked control units, apart from only a few interfaces, across the CAN bus (drivetrain CAN bus).

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



Gearbox control unit

- Specified engine torque
- Specified idling speed
- Enable adaption - Idling speed charge regulation
- Overrun shut-off support
- Clutch protection
- Clutch status
- Clutch torque
- Gearshift operation active/inactive
- Compressor switch off
- Selector lever position/drive position
- Vehicle road speed
- Shift indicator
- Currently engaged gear or target gear
- Coding in the engine control unit
- Emergency running program (information on self-diagnosis)
- On-board diagnosis status



Engine control unit

- Engine speed
- Specified idling speed
- Actual engine torque
- Coolant temperature
- Kickdown information
- Accelerator pedal position
- Brake light switch
- Brake pedal switch
- Intake air temperature
- CCS status
- CCS specified road speed
- Altitude information
- Air conditioner compressor status
- Emergency running program (information on self-diagnosis)

ESP control unit

- TCS request
- EBC request
- ABS application
- EDL intervention
- ESP intervention
- Wheel speed, front left
- Wheel speed, front right
- Wheel speed, rear left
- Wheel speed, rear right

Information sent by the gearbox control unit.

Information received and evaluated by the gearbox control unit.

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

Gearbox control

Auxiliary signals/interface

The multitronic® provides in addition the following interfaces for information exchange by CAN bus:



- Pin 15 Signal for engine speed
- Pin 6 Signal for shift indicator
- Pin 5 Signal for road speed
- Pin 2 Diagnosis and programming interface
- Pin 13 Signal for tiptronic (recognition)
- Pin 12 Signal for tiptronic (downshift)
- Pin 14 Signal for tiptronic (upshift)

Signal for engine speed

Engine speed is a key parameter for the multitronic®. To increase the reliability of the multitronic®, the information on engine speed is transmitted to the gearbox control unit via a separate interface and in addition (redundantly) across the CAN bus (see Function diagram).



For more detailed information regarding the engine speed signal, please refer to SSP 198.

In the event of faults or if the separate "engine speed signal" interface fails, the information on engine speed is adopted by the CAN bus as a substitute value.

In the event of faults at the "engine speed signal" interface, the micro-slip control function is deactivated.

Signal for shift indicator

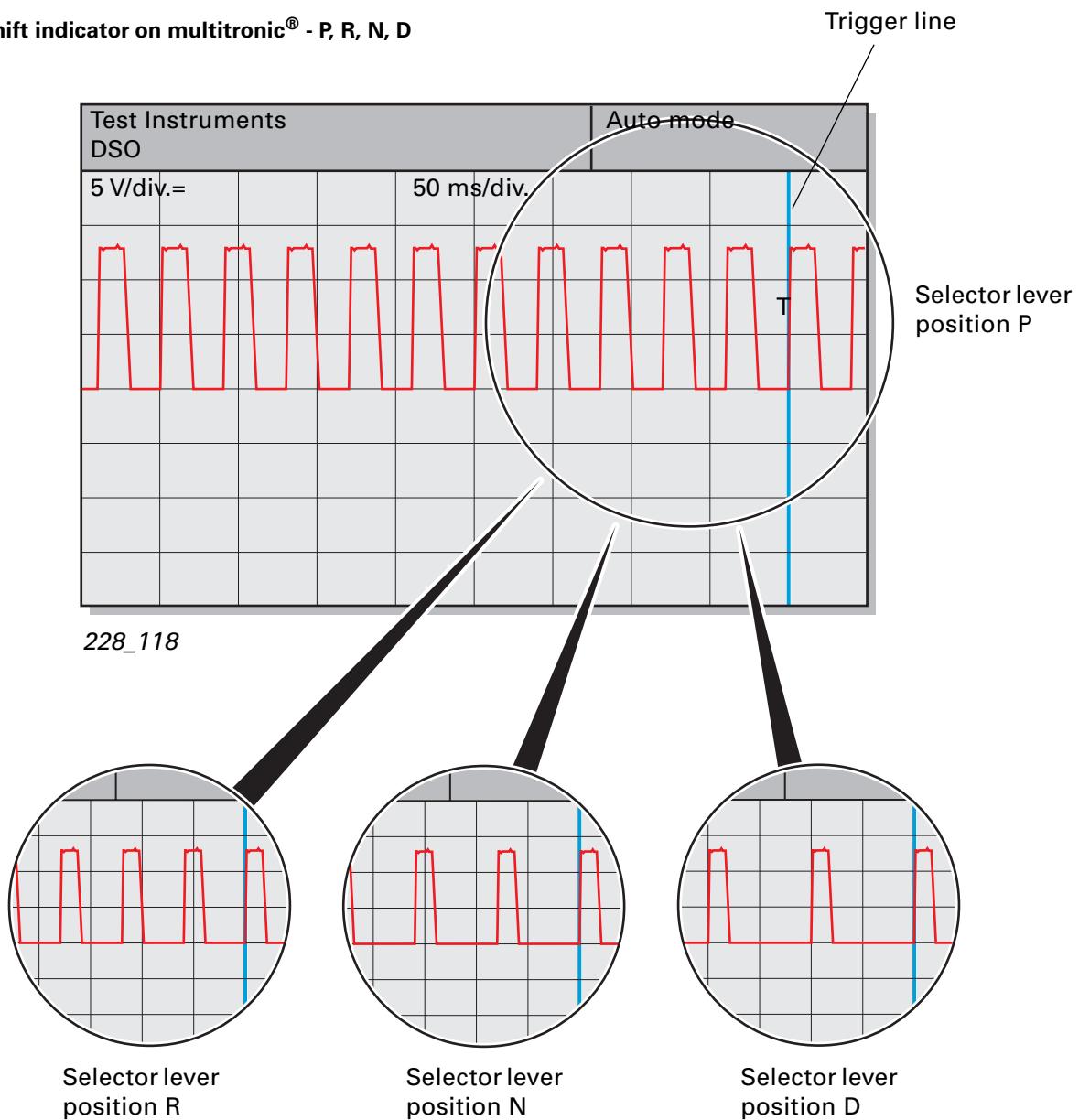
The signal for shift indicator is a square-wave signal generated by the gearbox control unit with a constant high level (20 ms) and variable low level.

Each selector lever position or each "gear" (in the tiptronic function) is assigned to a defined low level.

The selector lever position indicator or the shift indicator in the dash panel insert recognises by the low-level duration what selector lever position or what gear is selected and indicates this accordingly.



Signal for shift indicator on multitronic® - P, R, N, D



Gearbox control

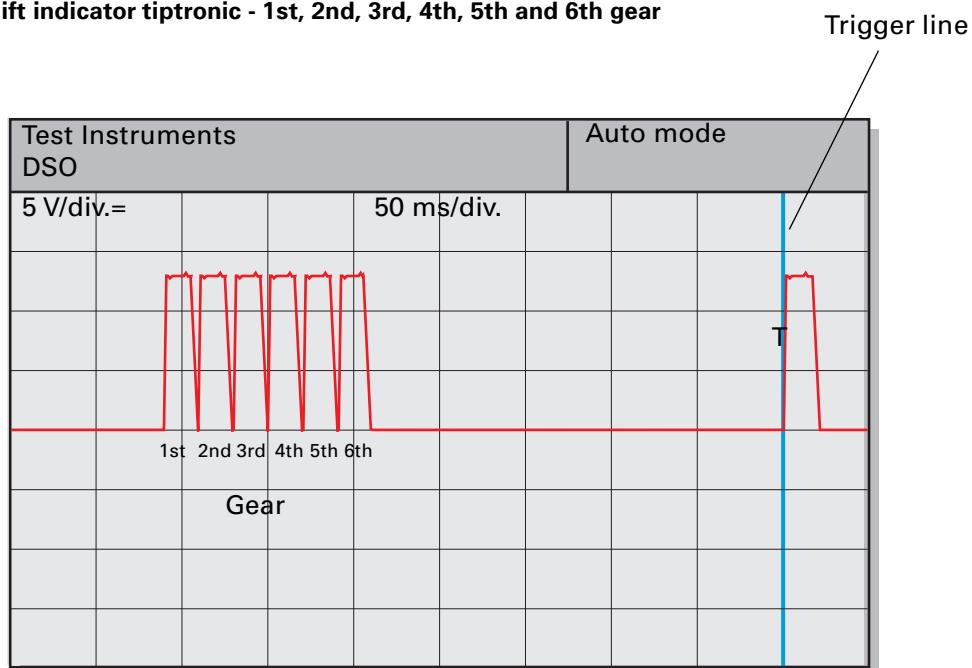


When the CAN bus is introduced into the dash panel insert (it is expected to be introduced into the Audi A6 in mid-2000), the "shift indicator" and "road speed" interfaces will no longer be necessary as their information will be transmitted across the CAN bus.



To simplify the representation, the signals from **all** six gears for the tiptronic function are shown combined in a **single** diagram.

Signal for shift indicator tiptronic - 1st, 2nd, 3rd, 4th, 5th and 6th gear



228_117

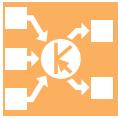
Signal for road speed

The signal for road speed is a square-wave signal generated by the gearbox control unit. The duty cycle is approx. 50% and the frequency changes synchronous to road speed.

8 signals are generated per wheel revolution and relayed to the dash panel insert through a separate interface.

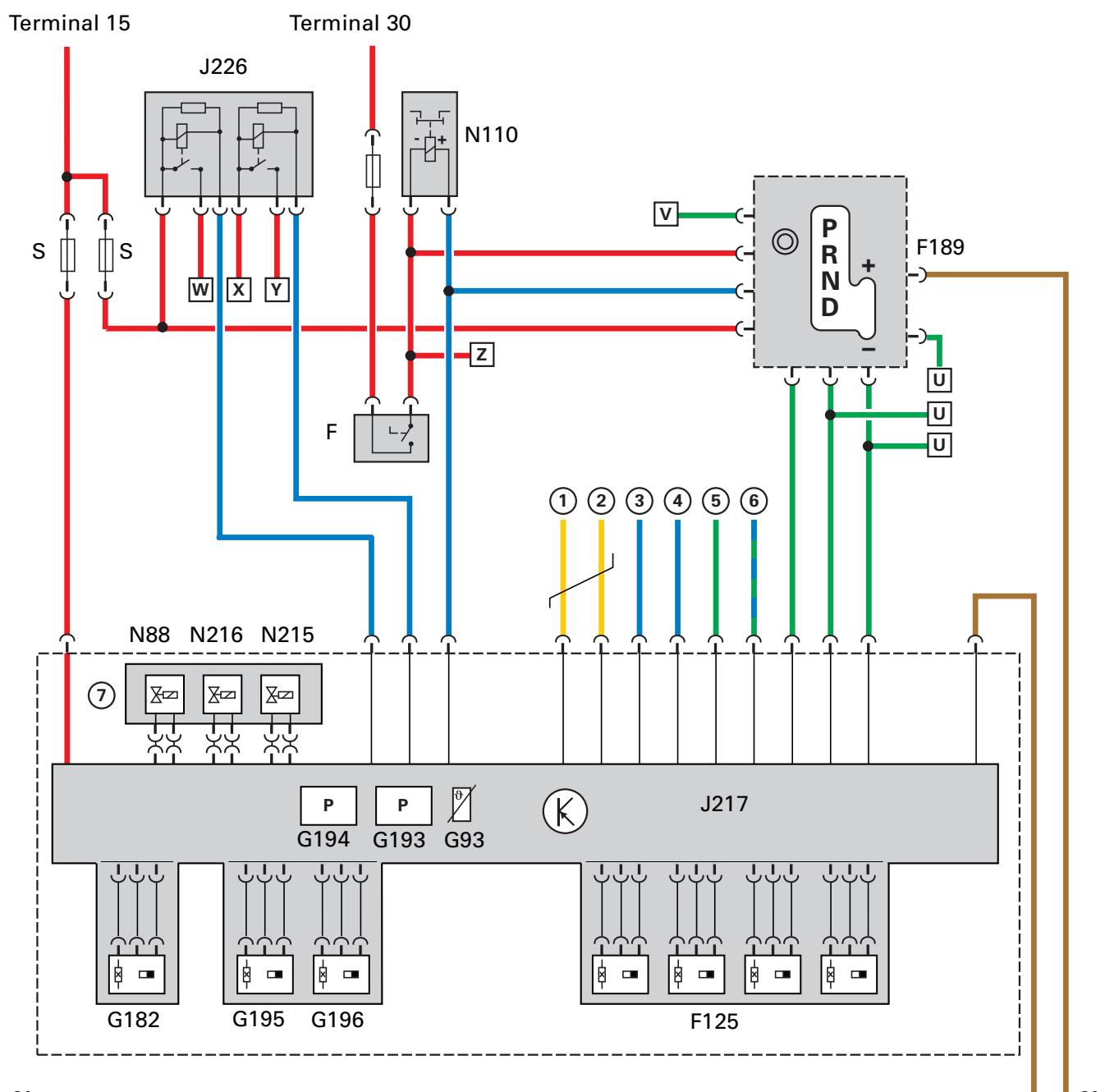
The signal is used here for speedometer operation and is passed on to the networked control units/systems (e.g. engine, air conditioning system, audio system, etc.) by the dash panel insert.

Notes



Gearbox control

Function diagram



228_030

Components

F	Brake light switch
F125	Multi-functional switch
F189	Tiptronic switch
G93	Gearbox oil temperature sender
G182	Gearbox input speed sender
G193	Automatic gearbox hydraulic pressure sender -1- (clutch pressure)
G194	Automatic gearbox hydraulic pressure sender -2- (contact pressure)
G195	Gearbox output speed sender
G196	Gearbox output speed sender -2-
N88	Solenoid valve 1 (clutch cooling/safety shut-off)
N110	Selector lever lock solenoid
N215	Automatic gearbox pressure control valve -1- (clutch control)
N216	Automatic gearbox pressure control valve -2- (transmission control)
J217	Control unit for multitronic
J226	Starter inhibitor and reversing light relay
S	Fuses

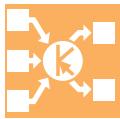
Connections and auxiliary signals

U	To tiptronic steering wheel (option)
V	From terminal 58d
W	To the reversing lights
X	From ignition switch terminal 50
Y	To starter terminal 50
Z	To the brake lights
1	Drivetrain CAN bus Low
2	Drivetrain CAN bus High
3	Signal for shift indicator
4	Signal for road speed
5	Signal for engine speed
6	K-diagnostic connection

Colour codes

 = Input signal

 = Output signal



 = Positive

 = Earth

 = Bidirectional

 = Drivetrain CAN bus

- - - - - multitronic®

⑦ Fitted in the hydraulic control unit



Due to the fact there are only a few interfaces to the gearbox control unit, the multitronic® does without a separate cable set. The wiring is integrated in the engine cable set.

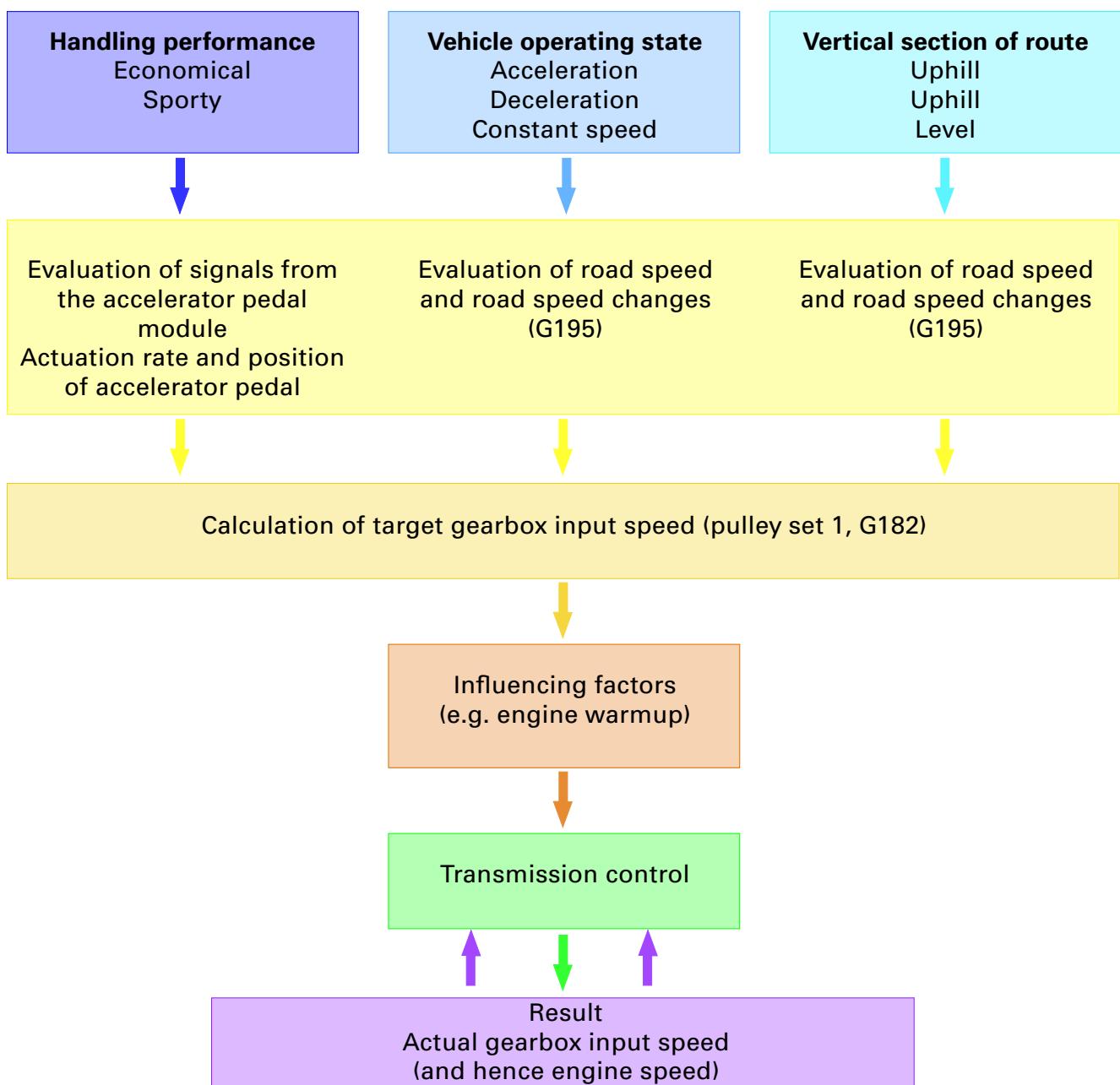
Gearbox control

Dynamic control program (DRP)

The multitronic® control unit has a dynamic control program (DRP) for calculating the target gearbox input speed.

It is a further development of the dynamic shift program DSP already being used in the CVT.

The object of the DRP is to set the gear ratio such that handling performance matches the driver input as closely as possible. The driving feel should be like driving in manual mode.



For this purpose the system determines the driver's behaviour, the vehicle operating state and the vertical section of the route so it can provide the optimum gear ratio in any driving situation.

The gearbox control unit evaluates the actuation rate and angular position of the accelerator pedal (driver evaluation), as well as the road speed and vehicle acceleration (vehicle operating state, vertical section of route).

Using this information and logical combinations thereof the target gearbox input speed level is set to between the most economical characteristic and the most sporty characteristic within the defined RPM limits by varying the transmission ratio so as to account for the vertical section of the route and so that the match between handling performance and driver input is as close as possible.

The logical combinations and calculations (control strategy/control philosophy) are defined by the software and cannot account for every eventuality. Therefore, there are still situations in which manual intervention using the tiptronic function is expedient.

Handling performance
Economical
Sporty

Vehicle operating state
Acceleration
Deceleration
Constant speed

Vertical section of route
Uphill
Downhill
Level



 The control strategy can vary by model, displacement and control unit variant.

Gearbox control

DRP control strategy

The control strategy during typical driving situations is shown by means of the following examples.



Fig. 228_119 shows the speed characteristics when accelerating at full throttle with the kickdown activated.

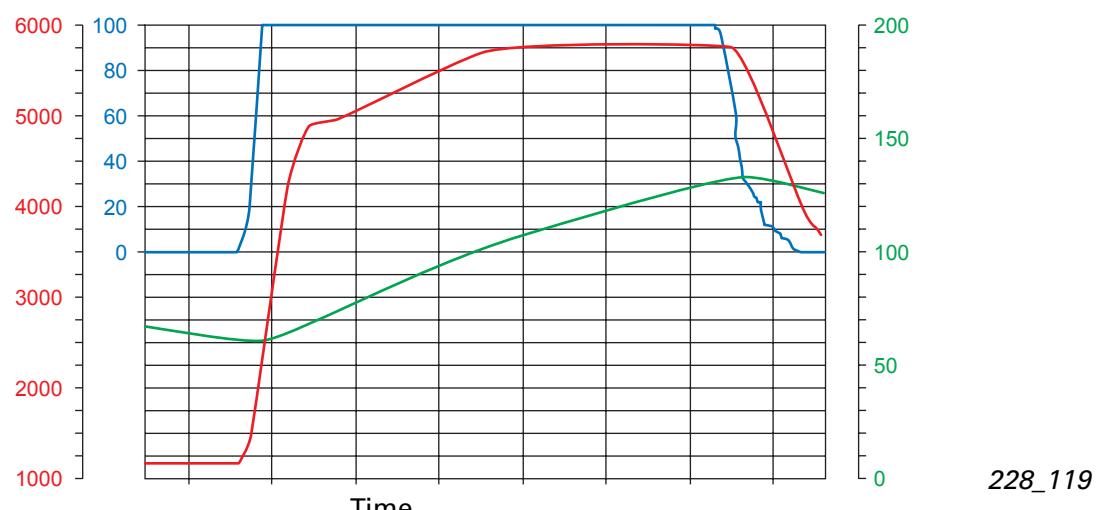
By activating the kickdown, the driver signals to the gearbox control unit that maximum acceleration is required.

To achieve this, the engine's maximum power output must be provided quickly. For this purpose engine speed is adjusted for maximum performance and maintained until the accelerator pedal angle is reduced.

Although the driver will be required to adjust to this unusual behaviour, it makes it possible for the vehicle to accelerate with the maximum possible dynamism. In addition the vehicle's top speed as a function of tractional resistance is kept at the maximum possible value.

The fact that the engine speed increases quickly but the engine does not accelerate to the same extent results in what is known as the "rubber band effect" or what feels like a "slipping clutch". This effect is alleviated by "intercepting" the increase in engine speed shortly before maximum engine speed is attained.

Kickdown acceleration



— Engine speed RPM

— Accelerator pedal position in%

— Road speed in kph

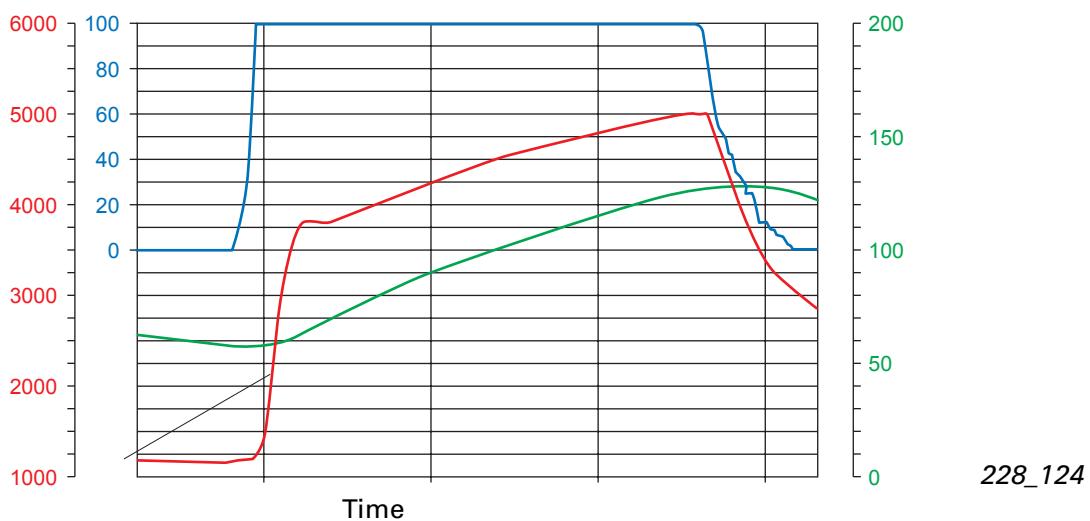
To contain this effect, “normal” acceleration at full throttle (without kickdown), as well as acceleration with lesser accelerator pedal angles, are characterised by the speed characteristics shown in Fig. 228_124 and Fig. 228_122.

The “engine speed tracking” function is used for this purpose. Engine speed and RPM level are regulated depending on the position or actuation rate of the accelerator pedal in such a way that engine speed increases directly proportional to road speed. This control strategy simulates the handling performance of multi-step gearboxes and

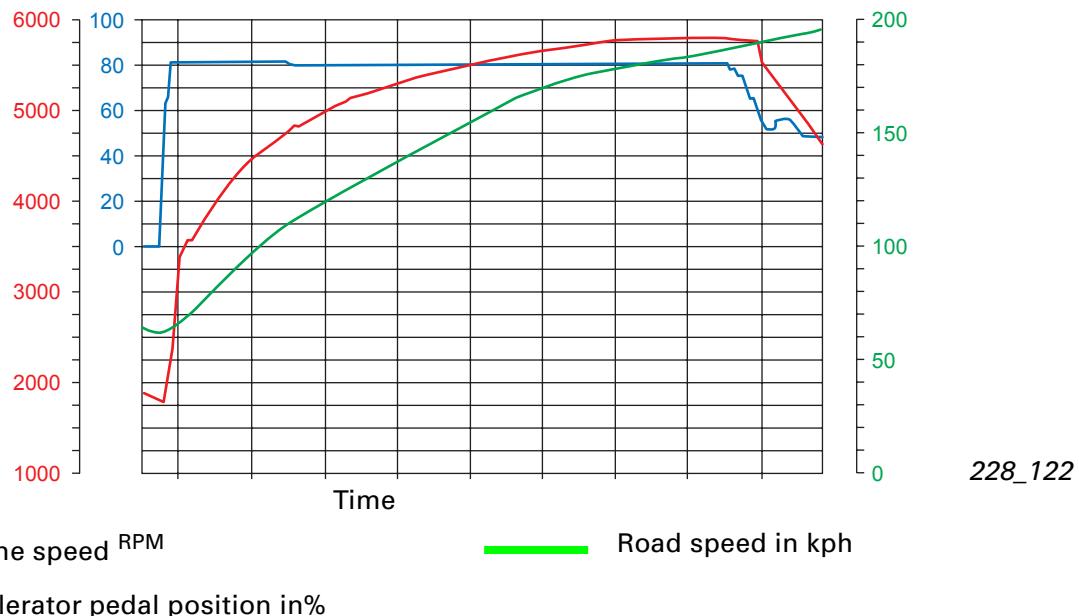
closely matches the driving feel which the driver is accustomed to. In keeping with driving style, the rpm level is high (sporty) at large accelerator pedal angles and low (economical) at small accelerator pedal angles.



Full throttle acceleration



Part throttle acceleration, throttle 80% open



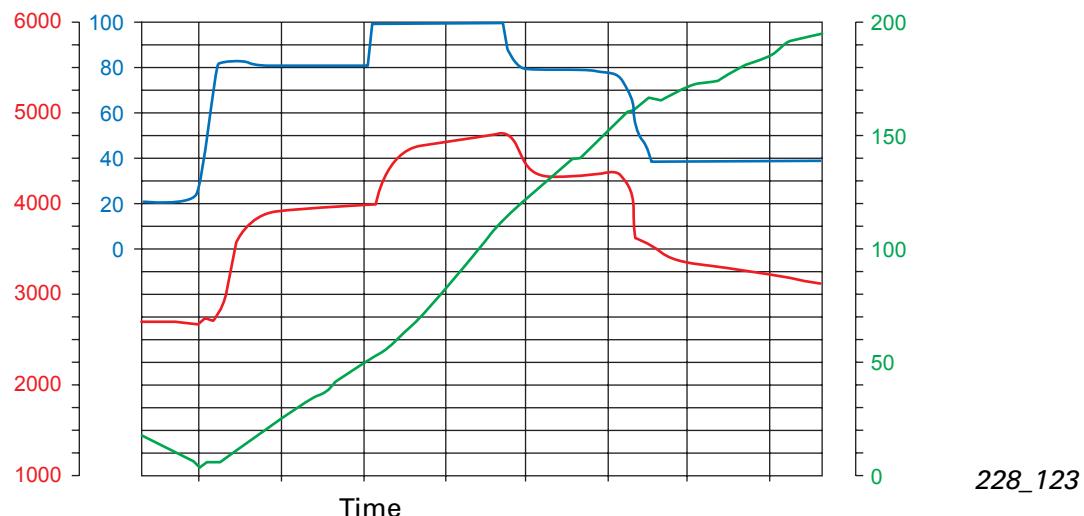
Gearbox control

As shown in Fig. 228_123, quick changes in accelerator pedal position are converted to instantaneous changes in speed in order to meet the driver's demands on performance or acceleration.



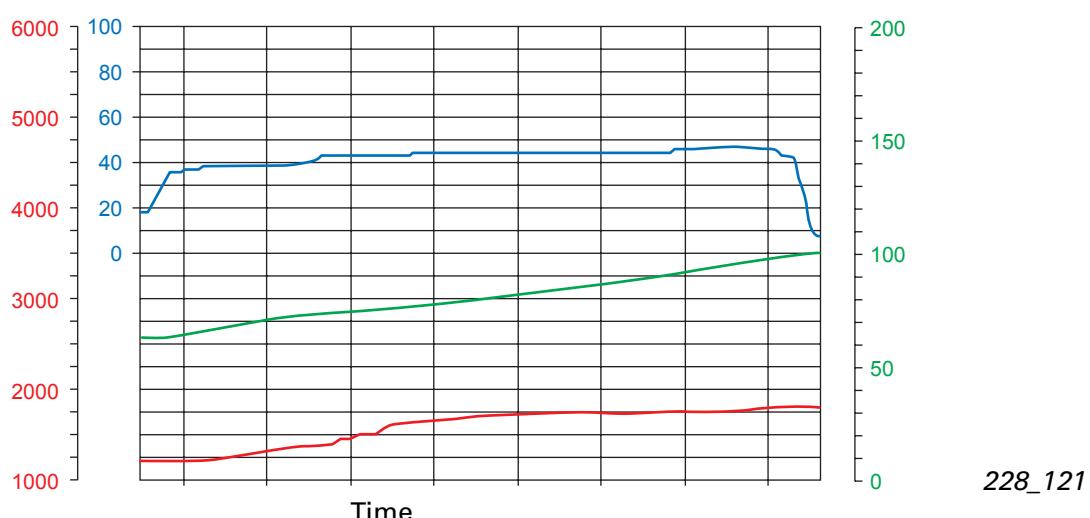
If the driver adopts an economical driving mode, as characterised by small accelerator pedal angles and a slow rate of opening of the throttle, then road speed is increased on the lowest rpm level (see Fig. 228_121).

Engine speed response to quick changes in accelerator pedal angle



228_123

Acceleration in an economical driving mode



228_121

— Engine speed RPM

— Accelerator pedal position in%

— Road speed in kph

In general the system responds to a reduction in the accelerator pedal angle by reducing the rpm level as shown in Fig. 228_120 and Fig. 228_123.

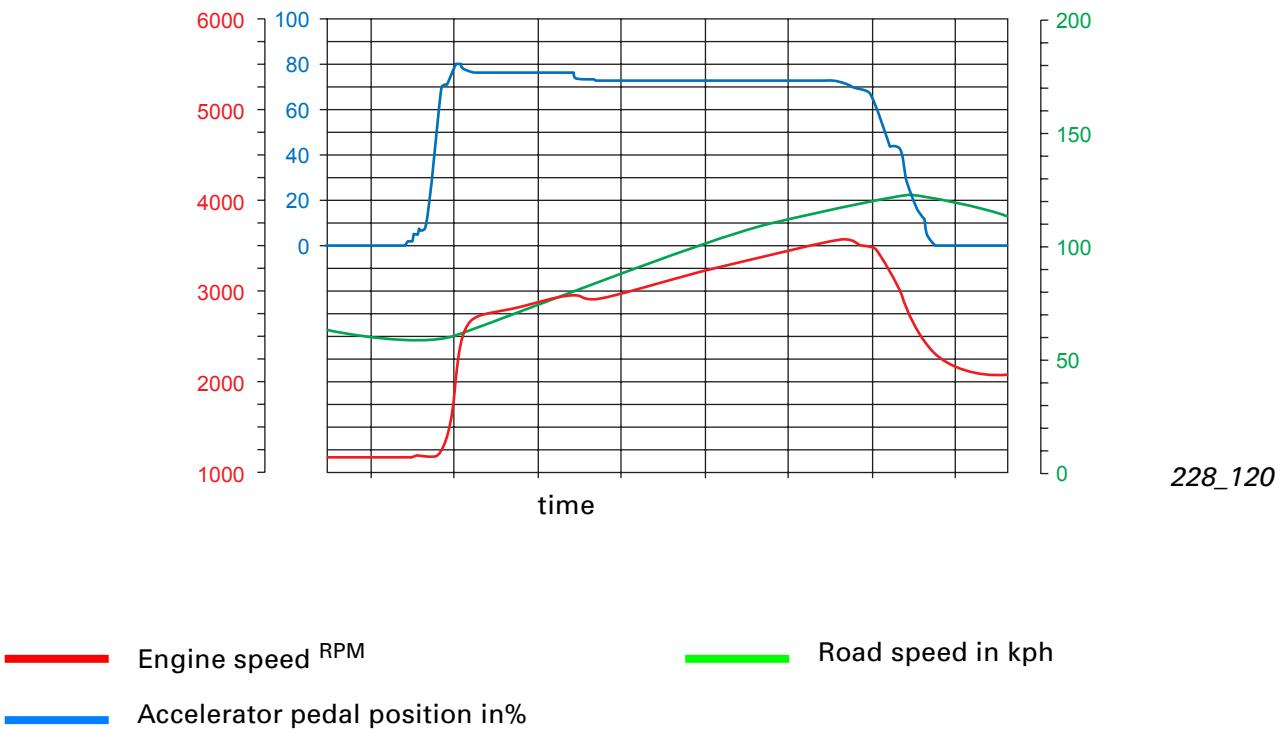
If the accelerator is suddenly released, particularly in a sporty driving mode, the engine speed is "held" at a higher level for longer.

By increasing the braking effect of the engine (high overrun speed), this control strategy helps to brake the vehicle and increases engine dynamism for instant accelerator response.

In addition, unnecessary transmission ratio adjustments are suppressed.



Acceleration with reduced accelerator pedal angle



Gearbox control

Motion resistance

"Power in relation to load" is calculated in order to detect motion resistance (uphill gradient, downhill gradient, vehicle operation with trailer in tow).



It indicates whether power demand is higher or lower compared to the tractional resistance during vehicle operation on a level surface (unladen).

$P_{\text{Engine load}}$	= Power in relation to load
P_{mot}	= Actual engine output
P_a	= Acceleration work
P_{FW}	= Power in relation to motion resistance

$$P_{\text{Engine load}} = P_{\text{mot}} - P_a - P_{\text{FW}}$$

Uphill gradient

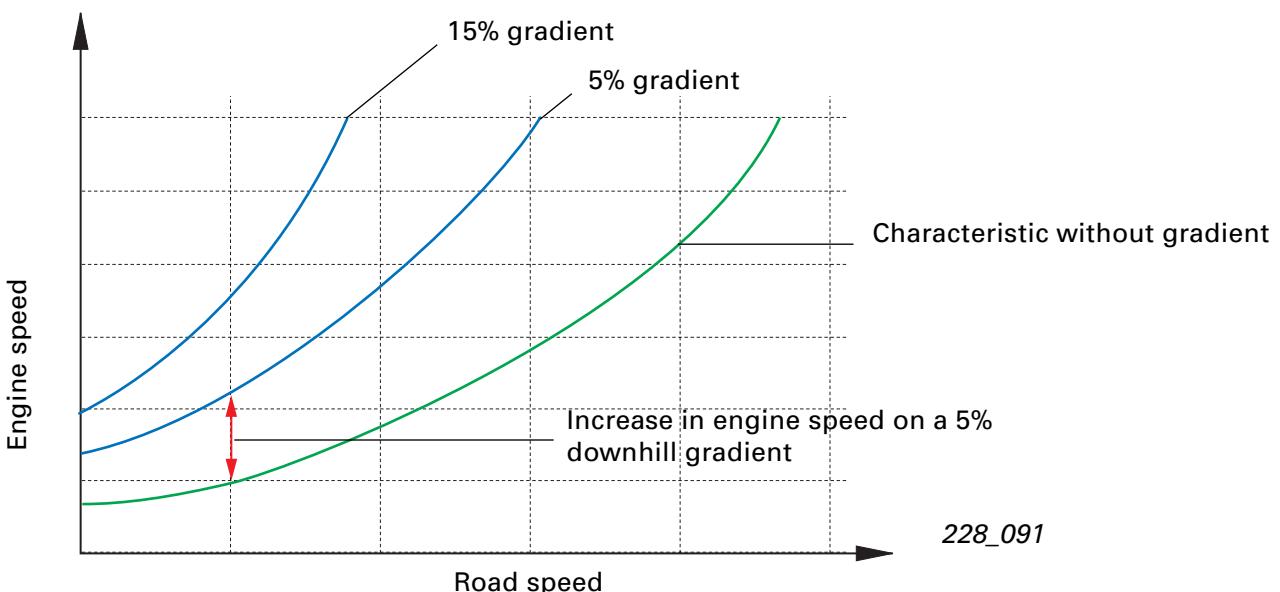
Higher power demand may be due to an uphill gradient or a trailer.

In this case, the engine speed and output level must be increased through a shorter ratio without the driver constantly having to open the throttle more as shown in Fig. 228_091.

In practice the driver will perceive this control

strategy, known as "load compensation", as a comfort increase.

Increase in engine speed on a downhill gradient



Driving downhill

On a downhill gradient the situation is slightly different. If the driver wants to be assisted by engine brake effect when driving downhill, he must indicate this by pressing the brake pedal (signal from switch F/F47).

If the engine is in the overrun phase and road speed increases even though the brake pedal is pressed, the transmission ratio is adjusted towards Underdrive and with it the engine braking moment is increased.

By pressing the brake pedal several times (without reduction in road speed), the gearbox control unit gradually adjusts the transmission ratio towards Underdrive (see Fig. 228_097). Thus the driver has a great deal of control over the intensity of the engine brake effect.

If the downhill gradient decreases, the transmission ratio is again adjusted towards Overdrive and the vehicle's road speed increases slightly.

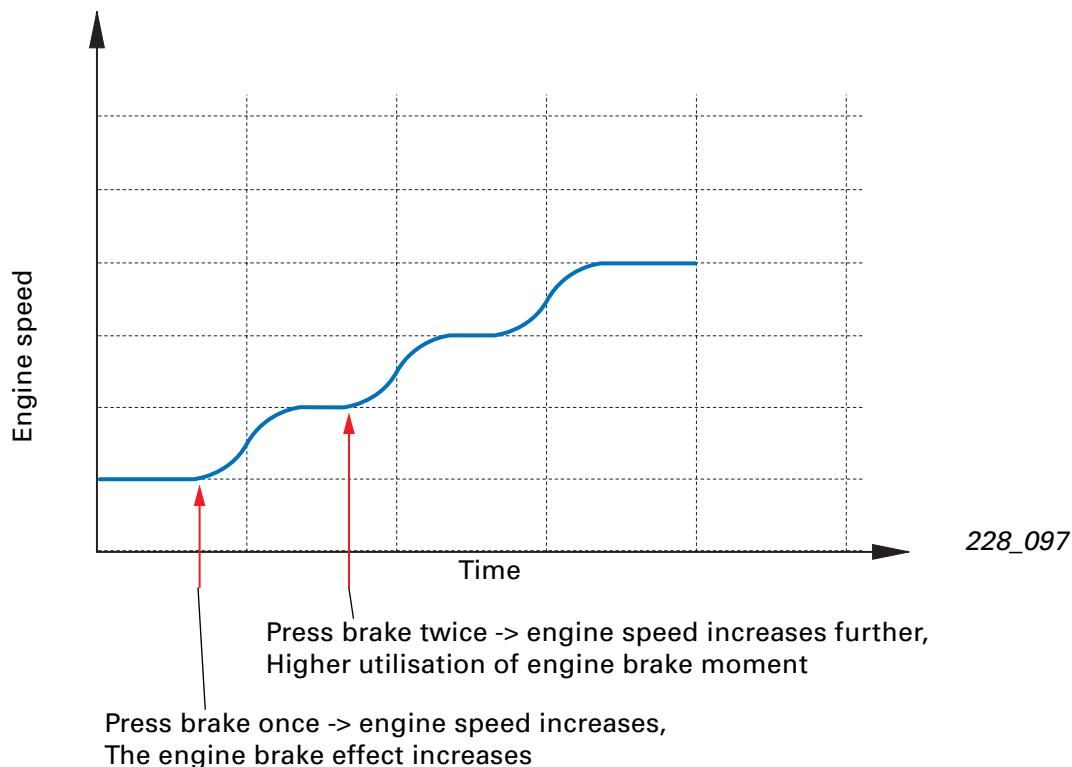


If the driver enters a downhill gradient pressing the brake pedal (and holds the brake pedal down), the "downhill function" as described will not be active initially. If the road speed is kept almost kept constant in this case by applying the brake, the multitronic® will be unable to recognise the driver's intentions and therefore cannot assist the driver by increasing the engine brake effect. However, if the vehicle exceeds a defined rate of acceleration, the "downhill function" will be activated automatically.

Engine braking moment can be controlled individually by using the tiptronic function.



Increase in engine speed when driving downhill



Gearbox control

Driving with CCS

In overrun mode, the engine brake effect is insufficient when driving downhill with the cruise control system (CCS) switched on because the transmission ratio is often low. In this case, the engine brake effect is increased by raising the target gearbox input speed (transmission control is adjusted towards Underdrive).

The set road speed is always slightly higher than the set road speed. This is due to the control tolerance of the CCS and the safety requirement which stipulates that the engine must be in overrun mode.



A maximum overrun speed which serves as a limit value for gearbox input speed control is stored in the gearbox control unit. When the maximum overrun speed is reached, the transmission ratio is not adjusted further towards Underdrive and therefore is limited.

If the engine brake effect is insufficient at maximum overrun speed, the vehicle's road speed increases and the driver has to apply the brakes.

The tiptronic function

As mentioned previously, 6 "gears" can be selected manually in tiptronic mode. In this mode, defined transmission ratios are set and "gears" are simulated (see also Page 6).

The handling performance and shift strategies are identical to the multi-step gearbox with tiptronic (mandatory upshift or mandatory downshift).

If the tiptronic function is selected while driving, the momentary transmission ratio is initially put on hold. The defined transmission ratios are set step by step by shifting up or down.

Reason:

As the transmission ratio may possibly be between two "gears" at the point of change-over to tiptronic mode, an immediate change into a defined ratio would lead to a greater or lesser change in road speed depending on the differential to the next gear.

Towing

To make towing possible, design measures have been implemented in the variator (see "The variator" for details).

When towing a vehicle with multitronic[®], the following conditions must be fulfilled:

- ▶ The selector lever must be in the "N" position.
- ▶ **The vehicle's road speed must not exceed 50 kph.**
- ▶ Trailers must not be towed further than 50 km.

When towing the vehicle, the oil pump is not driven and rotating parts are not lubricated.

Care should therefore be taken in meeting the above-specified conditions since gearbox may otherwise be damaged severely.

It is **not** possible to jump-start the vehicle by towing (e.g. battery too weak).



Update programming (flash programming)

Integrating the gearbox control unit in the gearbox (local electronics) made it possible for the first time to update the software without having to replace the control unit.

The control unit requires programs, characteristics and data (software) for the output signal calculations. These calculations are permanently stored in a so-called EEPROM (electronically programmable memory) and are available to the control unit at all times.

The EEPROM previously could not be programmed in the as-installed condition.

In the event of complaints which could be rectified by making modifications to the software, the control unit had to be replaced.

The multitronic® control unit has a so-called "flash EEPROM".

A flash EEPROM can be reprogrammed in the as-installed condition. This procedure is known as "flash programming" or "update programming".

A prerequisite for flash programming is the Diagnostic Testing and Information System VAS 5051 with the new software version (Update CD 12) and an up-to-date flash CD.

Programming is performed through the diagnostic interface (K-wire).



The introduction of flash programming in the multitronic® will see the advent of further systems with programmable control units.

Flash programming is only necessary when complaints can be rectified by software modification.

Explanatory notes

"in a flash" means "immediately".

In a programming context, "flash" stands for "quick programming".

The word "flash" is also used in many terms which are related to flash programming (e.g. flash CD).

"Update" means "to bring into line with latest status".

Sequence of operations - flash programming

After inserting the current flash CD and subsequently accessing the diagnosis mode of the multitronic® (Address word 02 - Gearbox electronics), the VAS 5051 identifies whether the control unit is programmable by the control unit ID.

Using the data on the flash CD, VAS 5051 determines whether a new software version exists for the part No. of the gearbox control unit.

If this is the case, "Update programming" appears in the selection of diagnostic functions. After selecting the diagnostic function "Update Programming", the programming procedure is started.

Vehicle self-diagnosis	02 - Gearbox electronics 01J927156J V30 01J 2.8I 5V RoW 1000 Encoding 00001 Dealership No. 12345
Select diagnostic function	
02 - Interrogate fault memory 03 - Actuator diagnosis 04 - Basic setting 05 - Erase fault memory 06 - End output 07 - Code control unit 08 - Read data block 09 - Read individual measured value 10 - Adaption 11 - Login procedure <u>Update programming</u>	
<input type="button" value="◀"/> <input type="button" value="Test Instruments"/> <input type="button" value="Jump"/> <input type="button" value="Print"/> <input type="button" value="Help"/>	

228_086



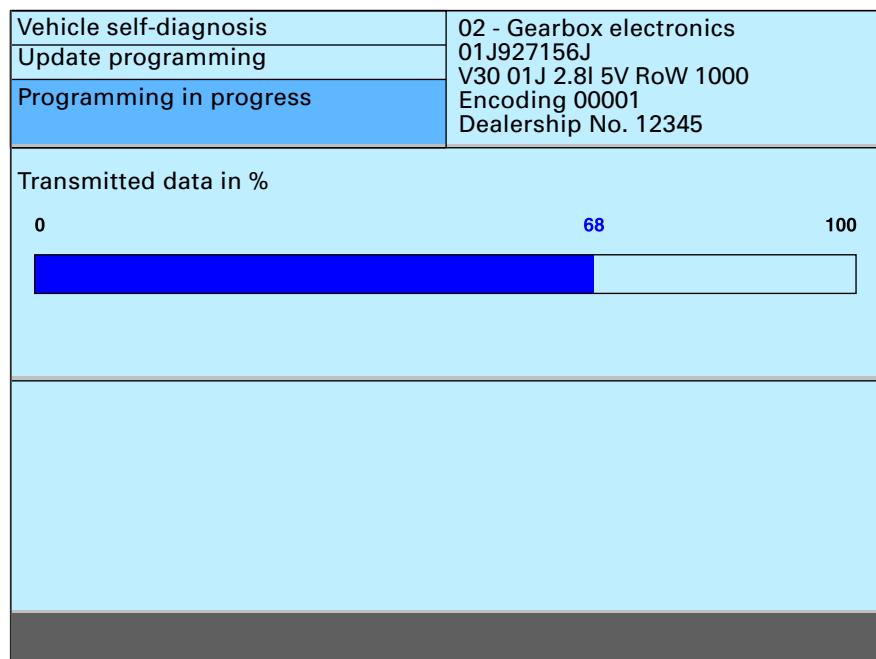
Vehicle self-diagnosis	02 - Gearbox electronics 01J927156J V30 01J 2.8I 5V RoW 1000 Encoding 00001 Dealership No. 12345
Update programming	
Programming can be carried out	
Important! The program version stored in the control unit is deleted. The new version (Version 1100) is programmed. Duration of erasure and programming procedures: approx. 8 minutes.	
The part No. in the control unit ID is subject to change. The vehicle-specific data (coding, adaption, etc.) may be lost and in this case will have to be updated on completion of programming.	
After pressing the 'Continue' key, the procedure can no longer be cancelled.	
Switch off the ignition or disconnect the diagnosis plug during the programming procedure can cause the control units to be switched!	
<input type="button" value="◀"/> <input type="button" value="Test Instruments"/> <input type="button" value="Jump"/> <input type="button" value="Print"/> <input type="button" value="Help"/> <input type="button" value="▶"/>	

228_087

Service

The programming procedure is controlled by the flash CD and runs automatically.

The programming sequence can be tracked on the display, which shows information on the steps in progress and prompts. The programming procedure takes approx. 5 - 10 minutes.



228_088

Once the programming procedure has been completed, a programming log is displayed.

Vehicle self-diagnosis	02 - Gearbox electronics 01J927156J V30 01J 2.8I 5V RoW 1000 Encoding 00001 Dealership No. 12345		
Update programming			
Programming log			
Extended identification old	Extended identification new		
01J927156J	01J927156J		
V30 01j 2.8I 5V RoW <u>1000</u>	V30 01j 2.8I 5V RoW <u>1100</u>		
Encoding 00001	Encoding 00001		
Dealership No. 12345	Dealership No. 12345		
Device number 128	Device number 128		
Importer No. 111	Importer No. 111		
Programming status			
Status	no fault		
Programming attempts counter	1		
Successful attempts counter	1		
Programming preconditions	met		

228_089

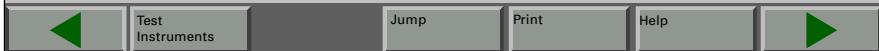


CAN data exchange is interrupted during the programming procedure, which leads to erroneous entries in the fault memories of CAN-networked control units.

On completion of programming, the fault memories of **all** control units must be erased.

Only new software versions can be programmed.
"Reverse-programming" is not possible.

Vehicle self-diagnosis	02 - Gearbox electronics
Update programming	01J927156J
Erase fault memory	V30 01J 2.8I 5V Row 1000 Encoding 00001 Dealership No. 12345
Programming leads to erroneous entries in non-participating control units. The fault memories of all on-board control units have to be erased.	
Press the 'Continue' key, and the fault memories will be erased automatically.	
Press the 'Back' key, and the fault memories will not be erased.	



228_087



The flash CD

The flash CD contains the data and programs for the programming procedure and the "update versions" of new software.

An update of the flash CD is released at certain intervals. The flash CD also contains update data for other programmable control units (future systems). This means, there will only be **one** flash CD for **all** systems (engine, gearbox, brake, air conditioning system, etc.) in future.

Flash CDs are only supplied when new software versions are available.



228_096

Service

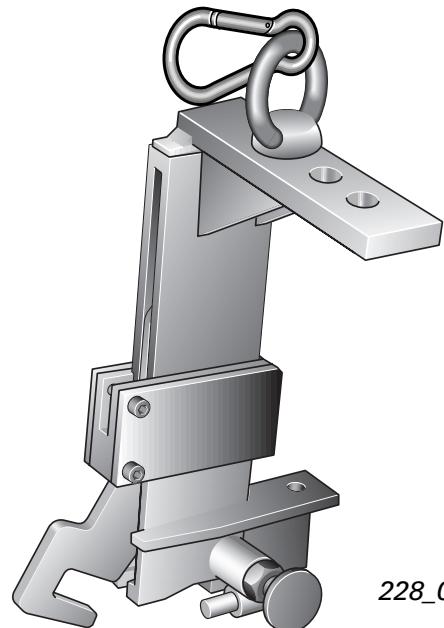
Special tools/workshop equipment

The following special tools/workshop facilities will initially be required by the Service Department.



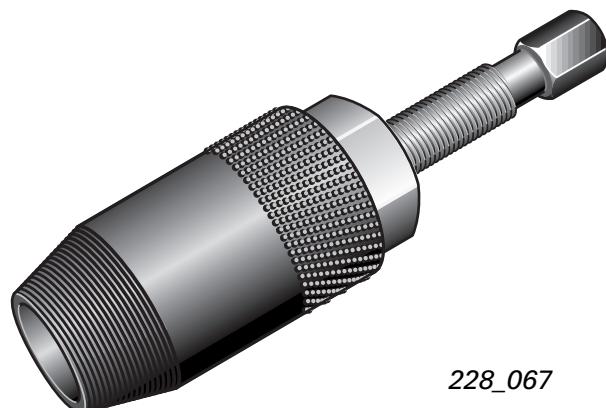
Gearbox towbar

T40013



Oil seal extractor

T40014



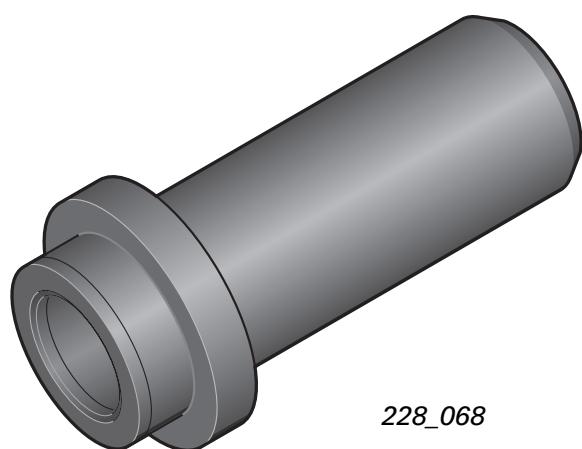
Test box

V.A.G 1598/21



Pressure piece

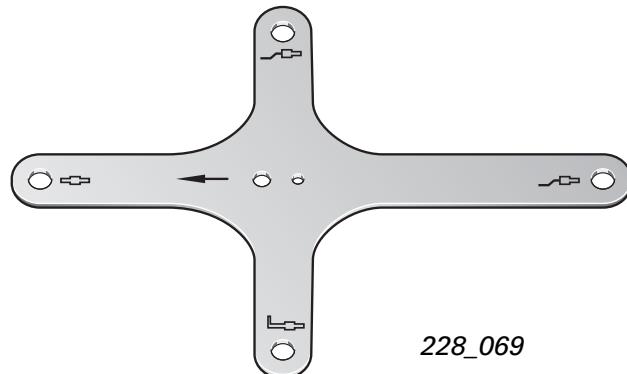
T40015



228_068

Adjustment plate

3282/30



228_069

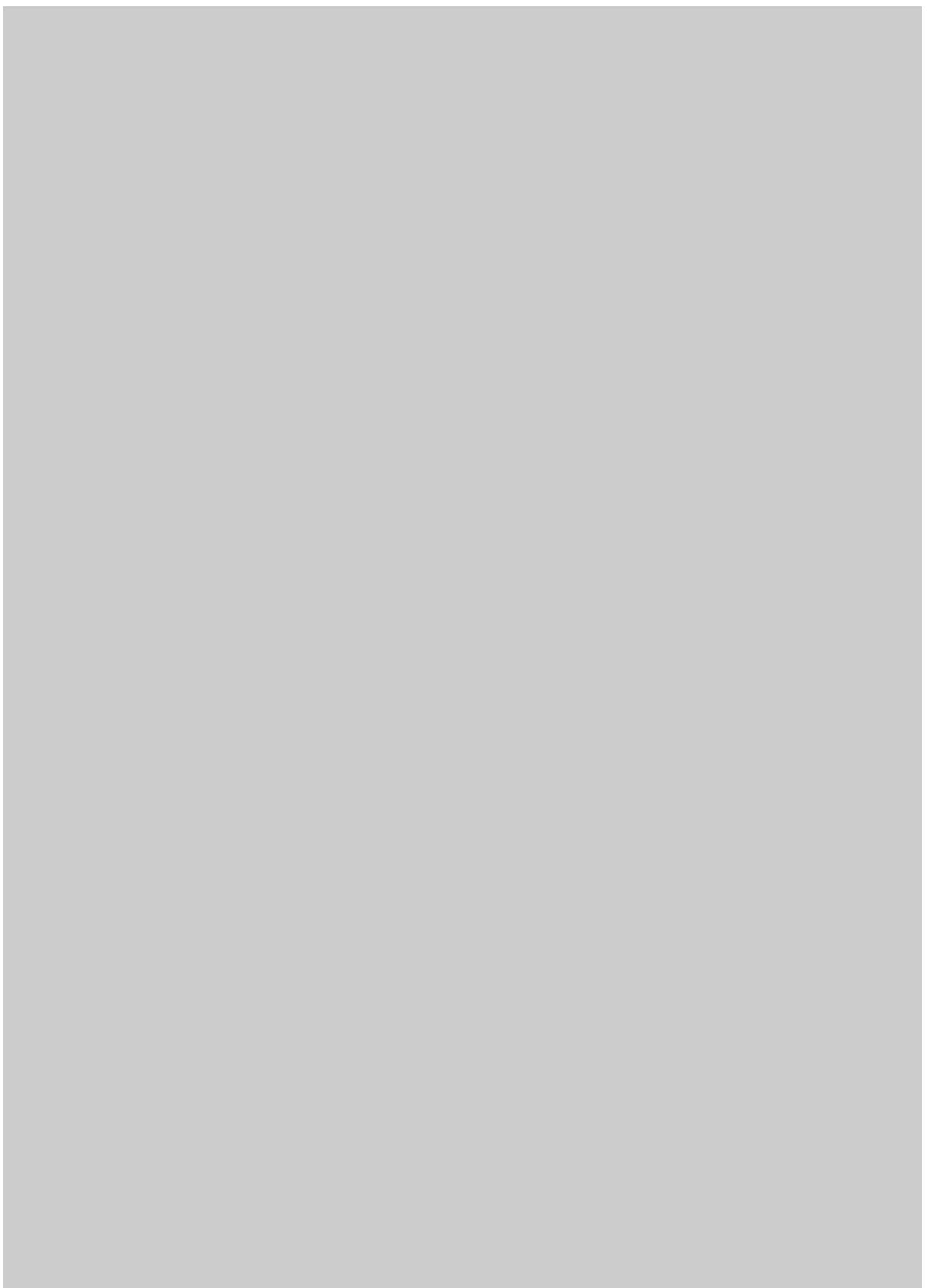
ATF filler system

VAS 5162



228_070

Notes



All rights reserved. Technical
specifications subject to
change without notice.
AUDI AG
Dept. I/VK-5
D-85045 Ingolstadt
Fax +49 (0)841/89-36367
940.2810.47.20
Technical status: 09/99
Printed in Germany