Self-Study Program 950123

Audi R8 Power Transmission

Audi Academy

Audi of America, LLC
Service Training
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Course Number 950123

Always check Technical Bulletins and the latest electronic service repair literature for information that may supersede any information included in this booklet.

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The Self-Study Program provides introductory information regarding the design and function of new models, automotive components, or technologies.

The Self-Study Program is not a Repair Manual!
All values given are intended as a guideline only.

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

Reference

Note

Notes

Introduction

The R8 is the first high-performance sports car based on a mid-engine design concept from Audi. Mid-engine design concepts create different demands on driving dynamics. The quattro full-time all-wheel-drive system in the R8 is different from previous quattro drive systems.

In the Audi R8, drive power is transmitted dynamically to the front axle through a viscous coupling. Power to the rear axle is transmitted through a limited slip differential which improves rear axle traction under high transverse acceleration.

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Two transmission choices are available to the customer: a 6-speed manual transmission featuring a double dry-plate clutch or the fully automatic R tronic transmission.

An innovative selector mechanism in the R tronic version allows the driver to choose between fully automatic operation or manual gear selection. With the R tronic, the driver can also opt for Sport mode.

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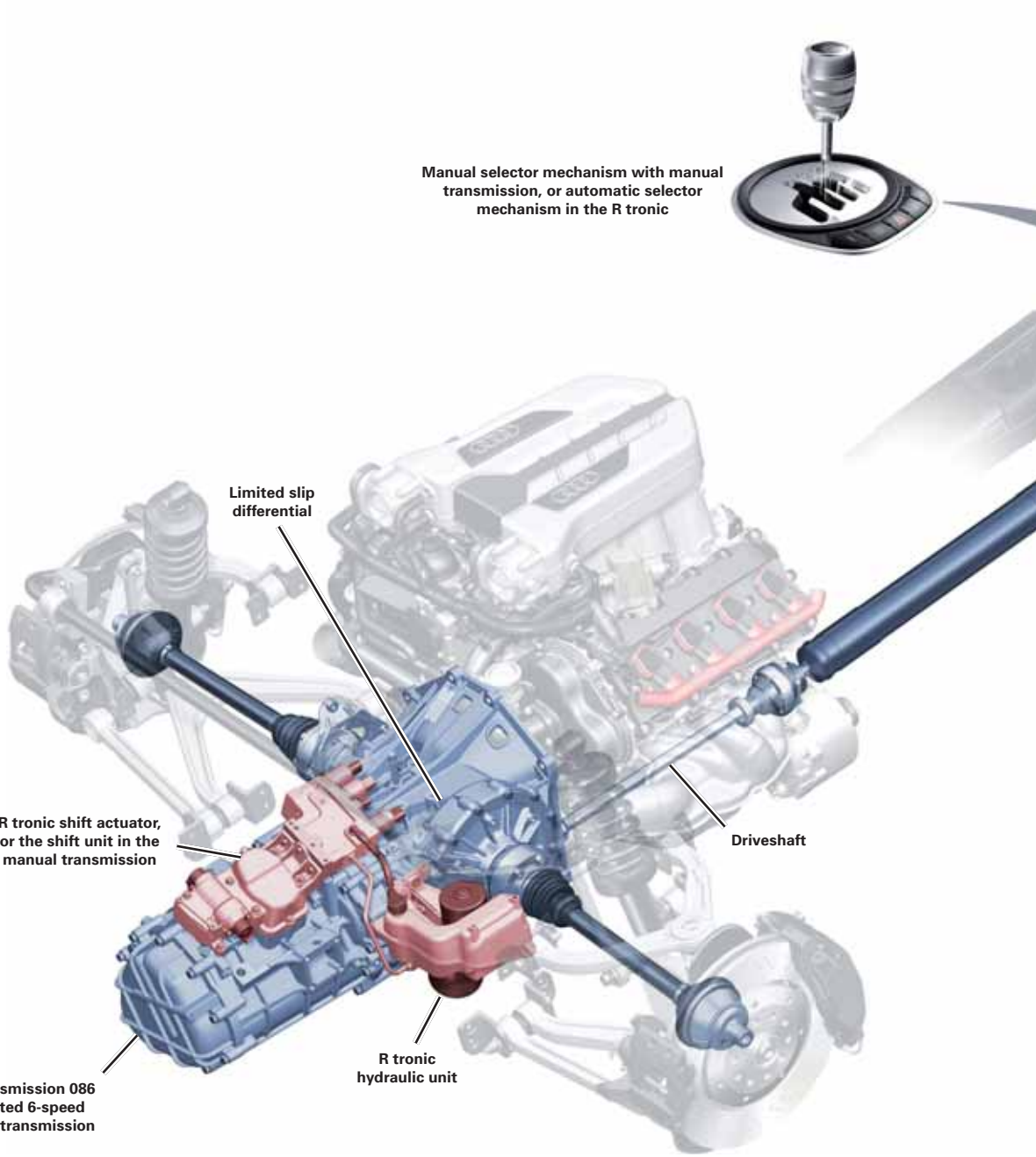
The quattro all-wheel drive system is based on a 44:56 weight distribution favoring the rear axle. If needed, up to 310 lb ft (420 Nm) of torque can be transmitted to the front wheels through the viscous coupling.



The manual transmission 086 and the automated R tronic 086 share an almost identical housing.

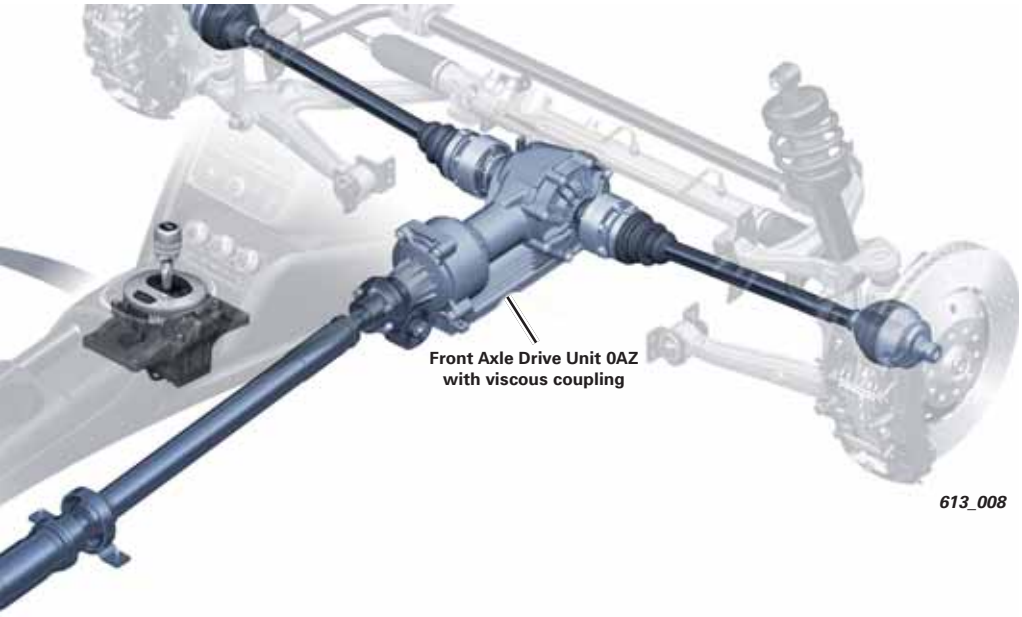
The manual version features high capacity synchronization and short shift lever throws to enable quick gear shifts.

A double-plate clutch transmits engine power to the transmission.

An electro-hydraulic shift unit enables rolling start and automatic gear changes on the R tronic transmission version.

Some modifications were necessary to the transmission housing to accommodate the electro-hydraulic shift unit.

Both the 086 manual and R tronic versions use the same gear ratios. However, gear ratios are adapted to the particular engine installed in the R8.



Front Axle Drive Unit 0AZ
with viscous coupling

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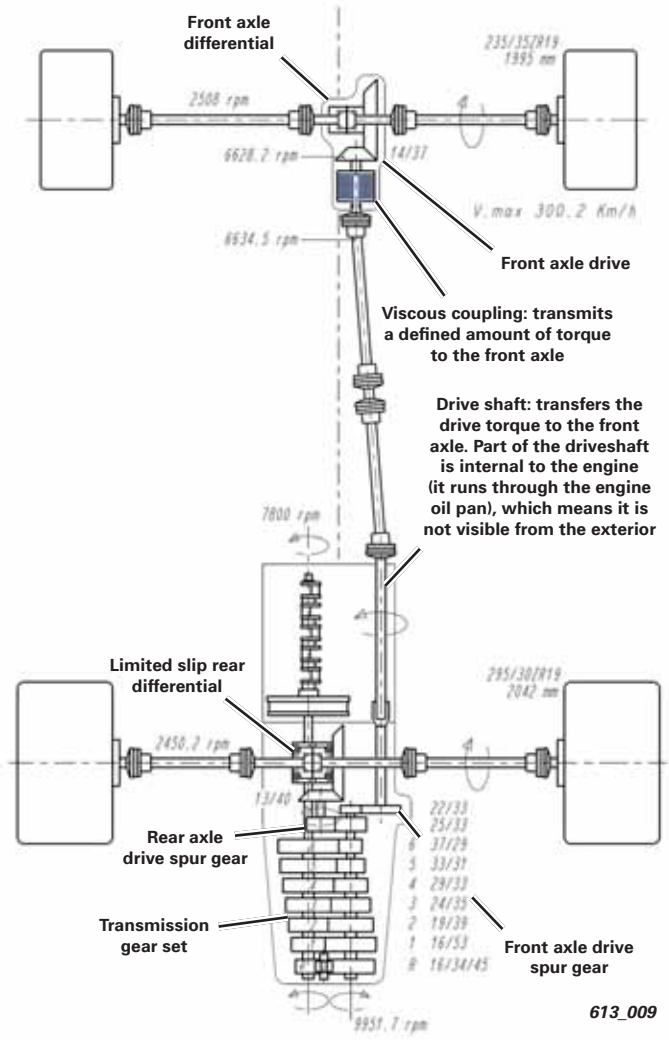
Schematic diagram of power flow



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Drive Design

The quattro design in the Audi R8 is a slip-controlled all-wheel drive system. The rear axle is the main drive axle. Engine torque is transferred through a spur gear to the limited slip rear differential, which ensures a continuous flow of drive torque even under high transverse acceleration. Engine torque is transmitted to the viscous coupling through a second spur gear in the front axle drive. There is no center differential.

Depending on the speed differential between the front and rear axles, the viscous coupling transfers a defined amount of torque to the front axle drive. From there, an open differential distributes torque equally to both sides.

The EDL function of the ABS Control Module is specifically adapted to the R8 drive concept and assists torque distribution in the usual way.

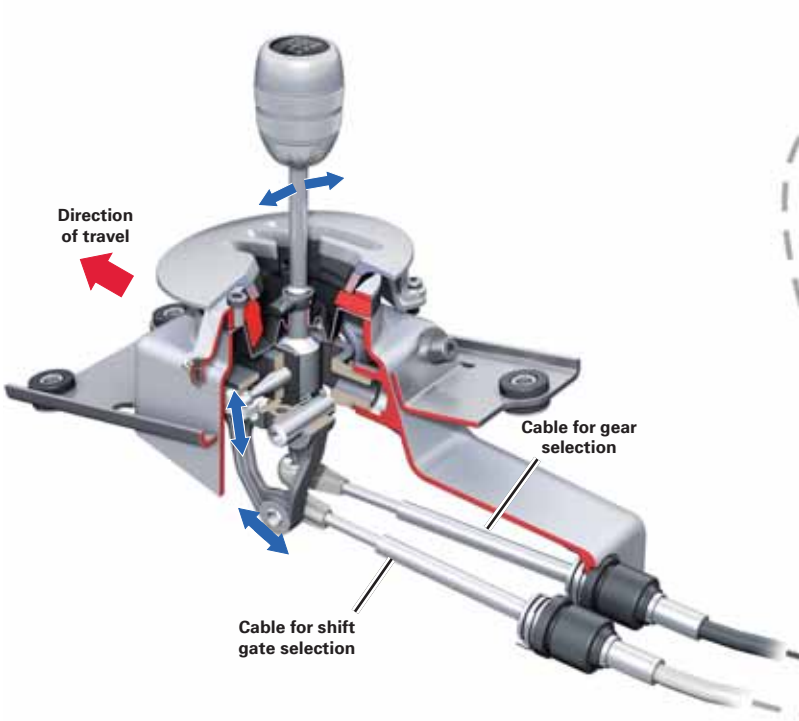
Gear Selector Mechanism

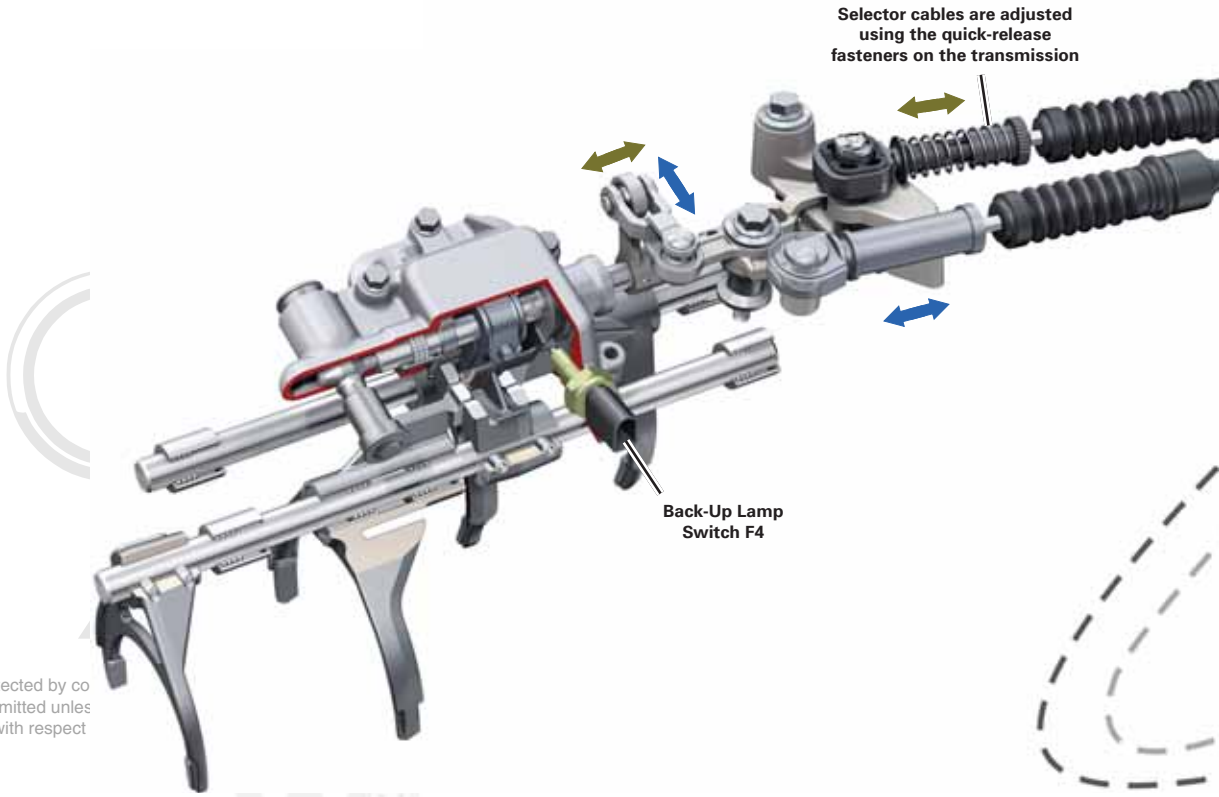
Manual Transmission

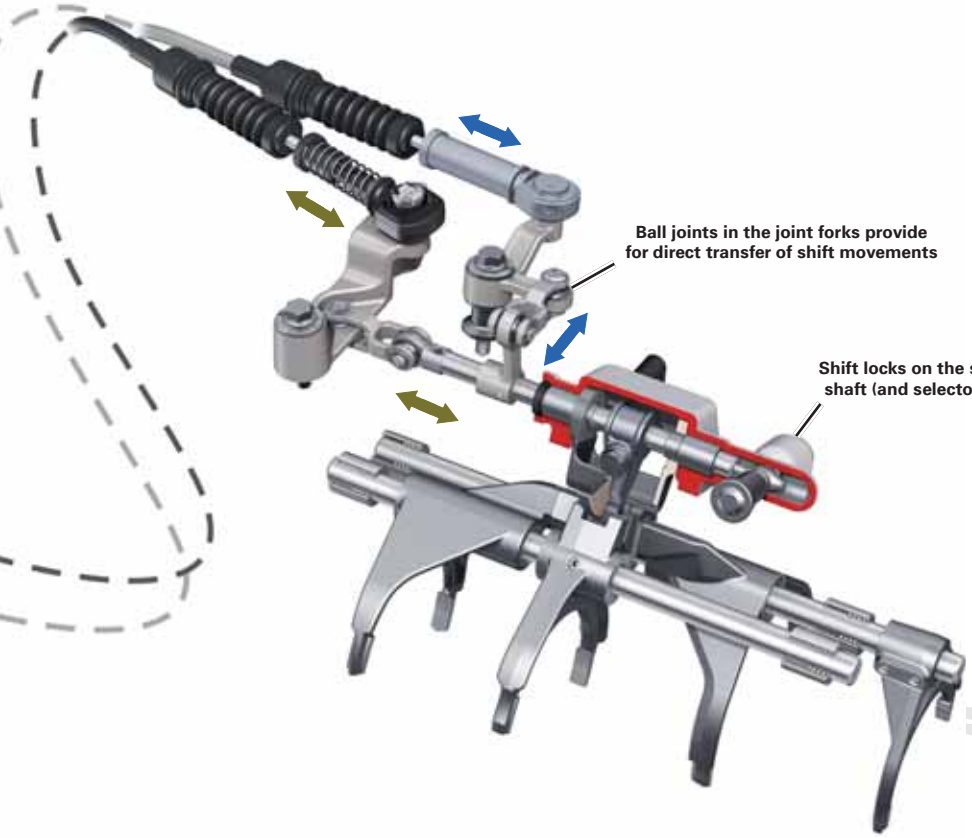
The 6-speed manual transmission is equipped with a gate shift system which enables short and smooth gear changes, providing precise feedback on the gear engaged.

To start the engine on 6-speed manual transmission equipped vehicles, the clutch pedal must be fully depressed. Clutch Pedal Switch F36 on the clutch slave cylinder provides a signal to the engine control module (ECM) about the engaged/not engaged status of the clutch.

Shift movements are transmitted from the shift lever to the transmission through two Bowden cables. The robust housing, and high-quality bearings and ball joints, ensure a direct transfer of shift movement.







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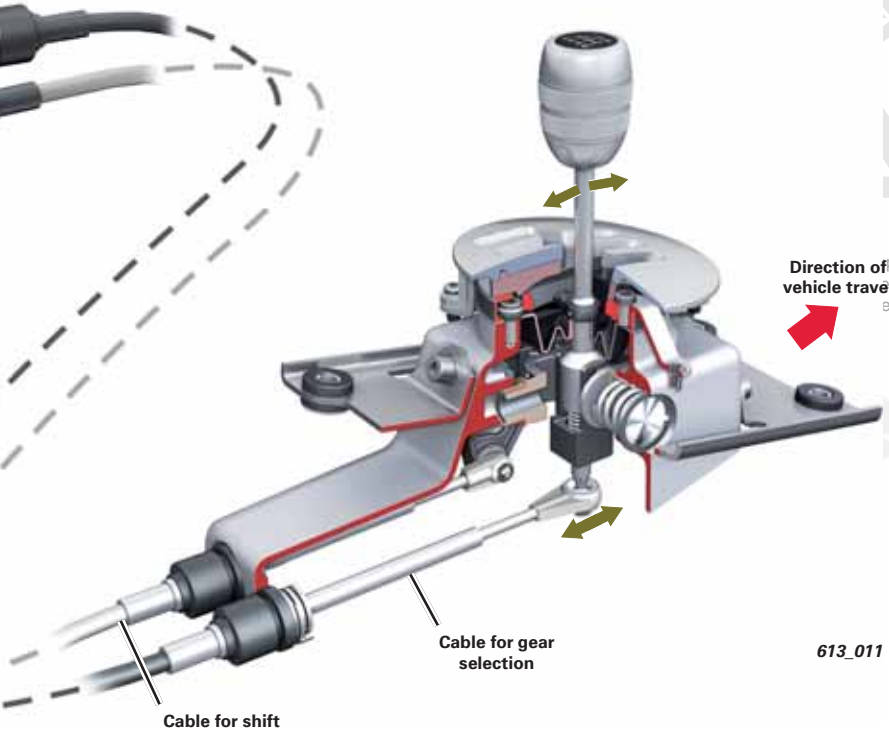

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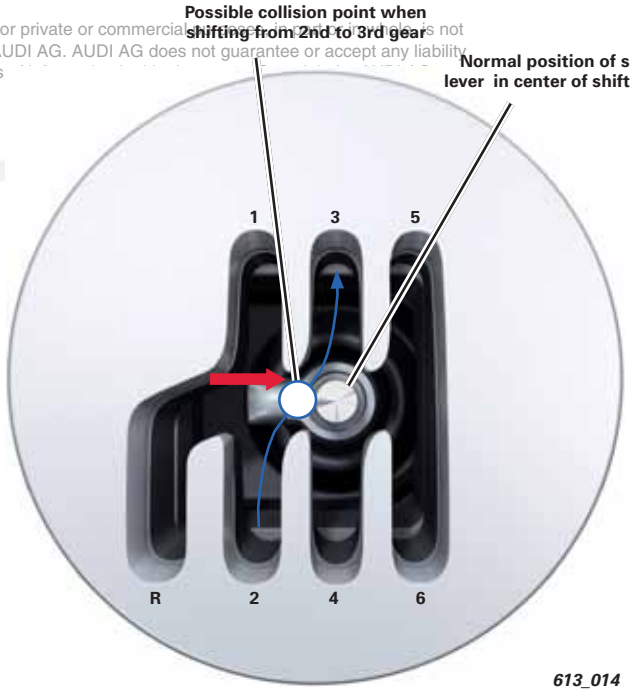
Shifter Operation

The shift gate provides a sporty look to the gear selector system. However, the shift lever can collide with the aluminum fingers of the gate during shifting. This creates an audible clicking sound and cannot be eliminated with damper elements.

Therefore, it is important that the shift mechanism is kept properly adjusted and that gearshifts are made precisely.

Launch Control Program

Audi R8s with the V10 engine feature a Launch Control Program to provide maximum power delivery from a standing start. The Launch Control Program process is described in the Owner's Manual.



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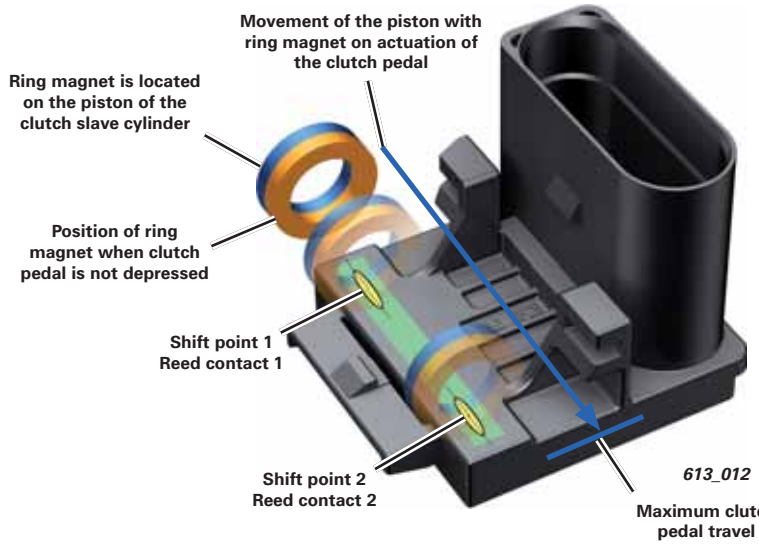
Clutch Pedal Switch F36

To start the engine on models with the manual transmission, the clutch pedal must be fully depressed. This is indicated by Clutch Pedal Switch F36, and safeguards against unintentional lurching when the vehicle is started.



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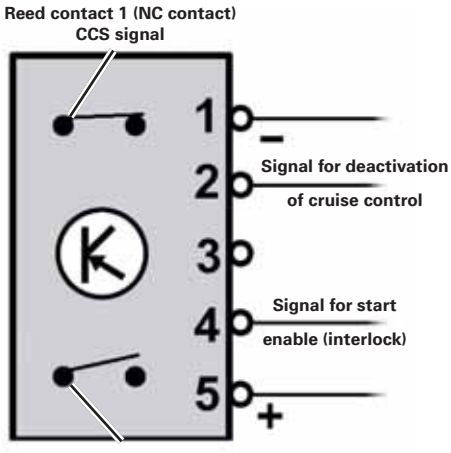
Circuit diagram



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Back-Up Lamp Switch F4

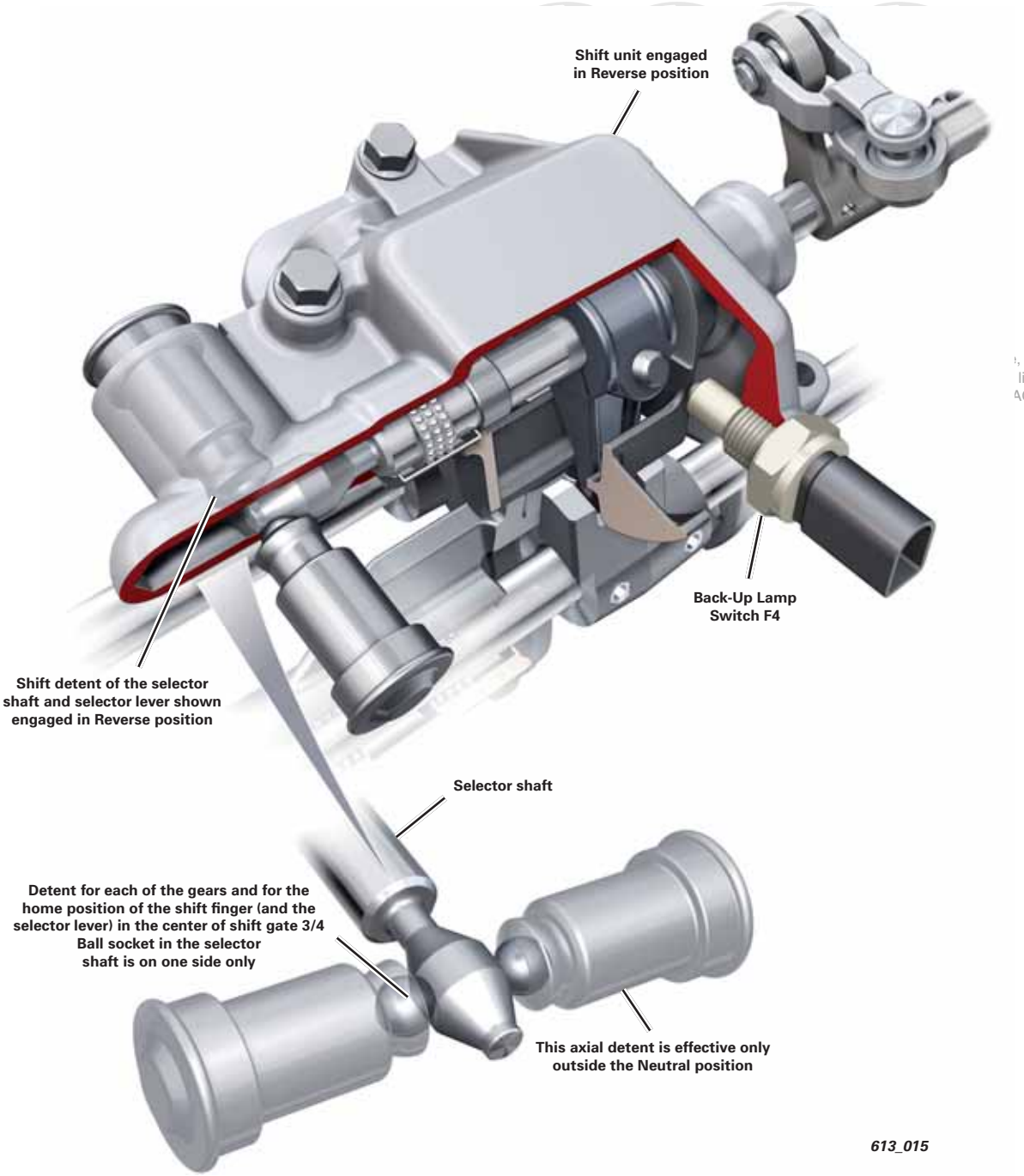
F4 is supplied power from “terminal 15” via a fuse. When the selector lever is shifted into the Reverse gate, F4 is connected directly to Vehicle Electrical System Control Module J519.

J519 actuates the back-up lights and relays the information to Data Bus On Board Diagnostic Interface J533, which signals other control modules of the back-up light status via their respective bus systems.

The information supplied by F4 is required for the following functions:

- Activation of the back-up lights
- Automatic anti-glare rear-view mirror/door mirror
- Activation of the front passenger door mirror tilt-down function
- Activation of the parking aid or rear view camera
- Audi hold assist (ESP)

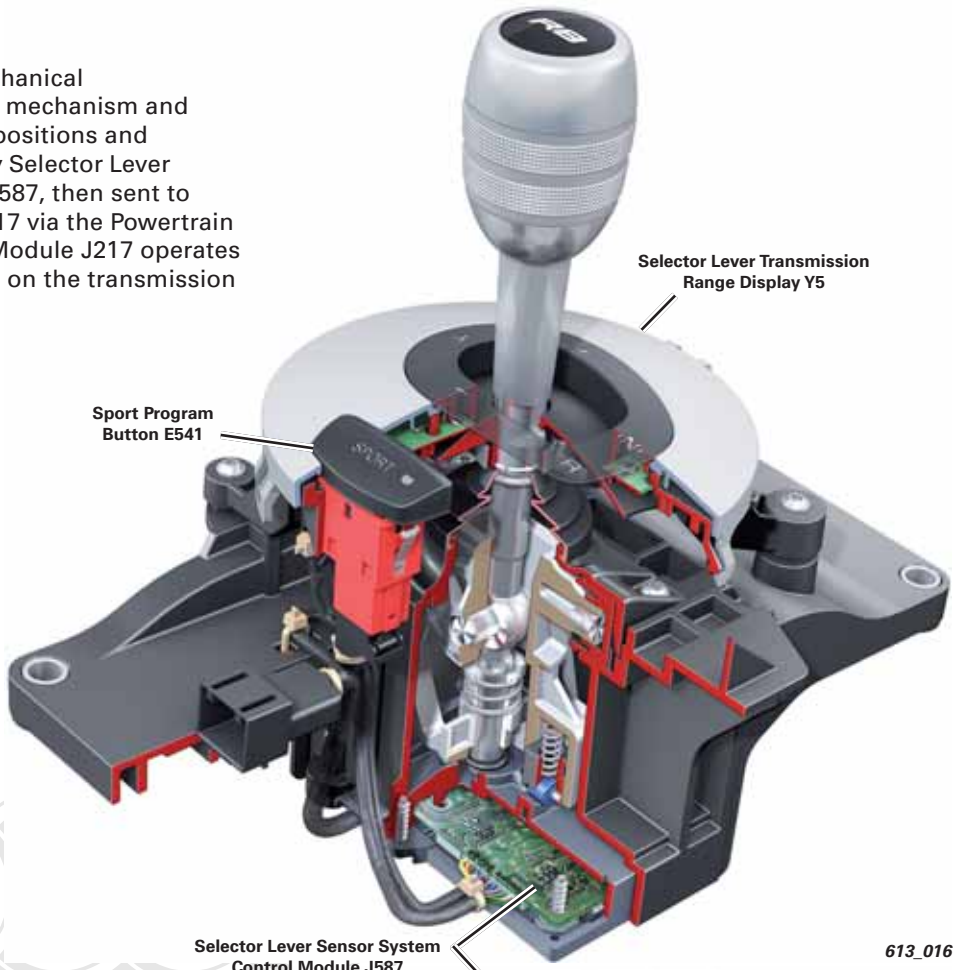
Shift detent of the 6-speed manual transmission



This illustration shows the shift detent in the Neutral/home position of shift gate 3/4

R Tronic

With the R tronic there is no mechanical connection between the selector mechanism and the transmission. Selector lever positions and shift commands are identified by Selector Lever Sensor System Control Module J587, then sent to Transmission Control Module J217 via the Powertrain CAN-bus. Transmission Control Module J217 operates the electro-hydraulic control unit on the transmission based on this information.



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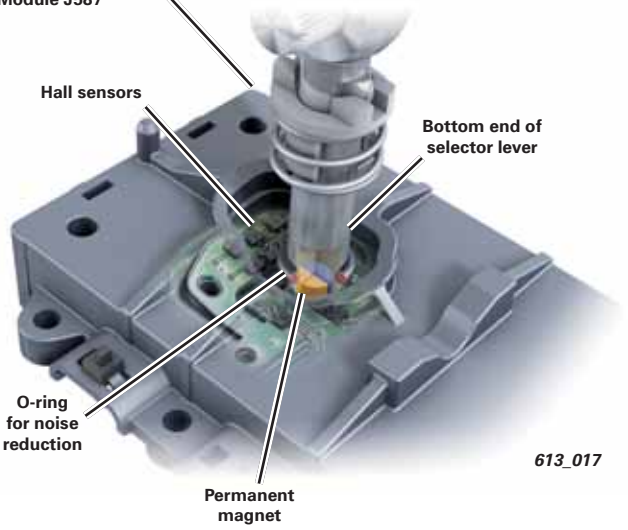

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Selector Lever Sensor Control Module J587

- Determines selector lever positions for the TCM
- Controls the LEDs in Selector Lever Transmission Range Display Y5
- Transmits all information to TCM J217 via the Powertrain CAN
- Is the interface to Sport Program Button E541

The selector lever positions are monitored by multiple Hall sensors. At the bottom end of the selector lever there is a permanent magnet which controls the corresponding sensors according to selector lever position. The selector lever sensors of J587 evaluate the signals and transmit the selector lever positions to the TCM.

The TCM utilizes this information to identify the driver's input and controls the valves of the hydraulic control unit to engage corresponding gear and clutch functions.

The R tronic selector mechanism differs not only visually from the selector mechanisms of other automatic transmissions but has been specially adapted to suit the design of the automated manual transmission.

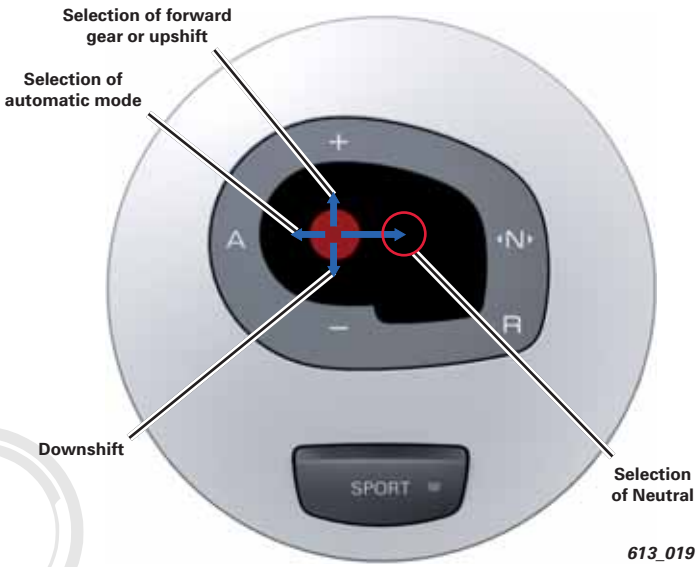
The selector lever has two lockable normal positions (left and right positions) from which the corresponding functions can be selected.

Operation

Selector Lever in Left Normal Position

From the locked left normal position, the driver can select Automatic mode by moving the selector to position A. Manual shifting is done by moving the selector lever to the + or – position. Neutral can also be selected.

Depending on prior selection, when the vehicle is in the locked left position the transmission may be either in Neutral or a forward gear. When the vehicle is at a standstill with the engine running, the brake pedal must be depressed to select Automatic mode or a gear.



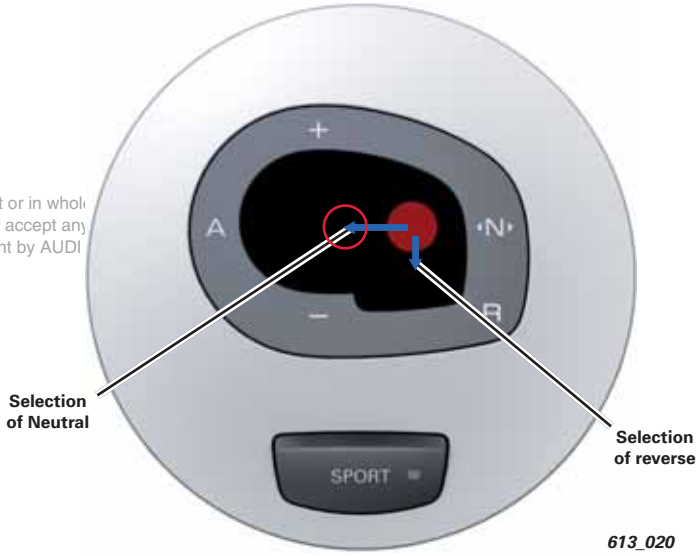
Selector lever in left normal position

Selector Lever in Right Normal Position

From the locked right position, either Neutral or Reverse can be selected.

To select Reverse gear, the vehicle must be stationary, the brake pedal depressed, and the engine idling.

Depending on prior selection, when the vehicle is in the locked right position the transmission may be either in Neutral or a forward gear.



Selector lever in right normal position

Neutral Position

When changing from one locked position to another, the transmission goes into Neutral (no gear selected). The brake pedal must be depressed to shift to Neutral (ignition ON) even when the engine is not running. This prevents the vehicle from rolling away unintentionally.

System Malfunctions

The display shown at right appears in the Driver Information System if the following actions occur:

- Malfunction in Selector Lever Sensor System Control Module J587
- Interruption in the power supply to the selector mechanism
- Interruption in the data bus connection to the selector mechanism

If the transmission was in Manual mode when the malfunction occurred, it switches over to Automatic mode. Gears can still be shifted manually using the selector paddles on the steering wheel. Reverse gear can no longer be selected. First gear can be selected from the Neutral position using the + selector paddle.

R Tronic Operating Characteristics

The engine can only be started when the brake pedal is depressed. R tronic always shifts into Neutral when the engine is started. This prevents the vehicle from driving away unintentionally when the accelerator pedal is pressed.

If the transmission is in Neutral, a gear must be selected manually. A selected gear remains engaged after switching the engine OFF.

There is no Park position or parking lock on the R tronic transmission. The vehicle can be secured against rolling away by selecting either 1st gear or Reverse before switching the engine OFF. However, the handbrake should also be applied, as with a manual transmission equipped vehicle.

Drivers can select 1st gear, Reverse, or Neutral with the ignition switched ON and the engine not running, after first depressing the brake pedal. Gear selection noise and noise from the hydraulic pump can be heard.

If the transmission is in Neutral when the ignition is switched OFF, a gear can be selected for approximately 30 seconds (or while the shift lever position display is lit) with the brake applied. The Audi R8 with R tronic does not have an ignition interlock function.

Neutral Gear Selection

If neither the accelerator nor the brake pedal is depressed when the vehicle is stationary and the engine is running, Neutral is engaged automatically after 10 seconds.

Standing Start Characteristics

Automatic transmissions usually produce a certain amount of drive torque when the engine is idling and a gear selected. This is known as creep torque. The vehicle begins to move away if it is not held with the brake.

R tronic does not generate creep torque when the engine is idling and a gear is selected.

R tronic automatically opens the clutch wide and interrupts power flow when the vehicle is stationary, the engine idling, and a gear is selected. This state is similar to that which occurs with a manual transmission when the clutch is depressed. No noticeable feedback is provided as to whether a gear has been selected or not.

For safety, Neutral is engaged after approximately 10 seconds when the engine is idling and a is gear selected, unless the throttle or brake is applied during this time.

Starting on Grades

Because the R tronic does not produce creep torque, the vehicle will roll back from a stationary start on even the slightest of grades when the brake is not applied. The vehicle must be held with the handbrake or the footbrake.

“Holding” the vehicle on a grade by balancing the clutch and accelerator pedal will result in heavier clutch wear and cause the clutch to overheat.

Audi hill hold assist is optional. If a grade is detected and the footbrake is applied when the vehicle is stationary, the built-up brake pressure is held for a short time after releasing the brake. This eliminates rollback.

Driving in Manual Mode (tiptronic)

Manual mode can be selected by operating the shift paddle on the steering wheel or by moving the selector lever into the + or – position, which keeps Manual mode permanently activated. To change over to Automatic mode, the selector lever must be moved toward “A”.

Transmission Control Module J217 can be adapted so the transmission will automatically switch back to Automatic mode after a pre-determined amount of time when the Tip command is initiated through the steering wheel shift paddles.

Driving in Sport Mode

During normal operation in Automatic mode, shift times are longer to place an emphasis on driving comfort.

Sport Mode is selected by pushing Sport Mode Button E541. It is effective during both automatic and manual shift modes. In Automatic mode, the shift points are adjusted to higher engine speeds, and shift times are reduced.

In both Automatic and Manual Sport modes, the emphasis is on performance. Gear shifts are very short and crisp. A kick-down function is available while in manual Sport mode.

The higher the engine speed and load, the faster the gear shifts. Customers may encounter abrupt gear changes at times, but this characteristic is integral to the high-performance design of this sports car.

When Sport mode is selected, the ECM changes to a more spontaneous accelerator pedal characteristic. The exhaust flaps are also opened earlier.

Blip of Throttle During Downshifts

In the Audi R8, the throttle is always automatically blipped (rpm raised) before a downshift is executed.

The lower the engine speed, the lower the intensity of the throttle blip.

In Sport and Manual modes, throttle blip is noticeably pronounced at high engine speeds. When downshifts are executed at engine speeds of approximately 2500 rpm, throttle blip is relatively light and not as noticeable.

Launch Control Program

A Launch Control Program is available in the Audi R8 V10 with R tronic. The Launch Control Program provides maximum power delivery when accelerating from a standing start. Refer to the Owner's Manual for details on requirements, operating instructions, and other information.

Operating Noises of R Tronic

Essentially, R tronic is an automated manual transmission. As with manual transmissions, a clicking sound can be heard when engaging or shifting gears.

Idler gear rattle typical of manual transmissions may also be audible on the R tronic transmission. This is caused by an unevenness in the rotational motion of the internal combustion engine. Rotary oscillations are transmitted to the transmission gear set, where traction and thrust flanks or gear teeth may collide with one another in a rhythmic manner.

This noise is usually more noticeable when the engine is idling or coasting at low speed and low engine load. The noise is more prominent when the transmission is at operating temperature.

Idler gear rattle is also enhanced by sound reflection. For example, when driving along narrow lanes between buildings with the window open.

The hydraulic control unit of the R tronic is supplied with oil pressure by an electrically driven pump. This is why it is possible to execute gear shifts even when the engine is not running.

The R tronic hydraulic system operates at a system pressure of 580 to 725 psi (40 to 50 bar). The oil pump produces this pressure and meters the oil to the pressure accumulator.

When a shut-off pressure of approximately 725 psi (50 bar) is reached, the pump is deactivated. System pressure is then supplied from the accumulator. The pump re-activates when pressure drops below 580 psi (40 bar).

If the ignition is not switched ON for a prolonged period of time (for example, when the vehicle is parked), hydraulic pressure slowly decreases due to internal leakage.

To ensure that the hydraulic shift system is always primed for immediate operation by the driver, the pump is automatically activated when the driver's door is opened. However, this only occurs if the pressure is less than 580 psi (40 bar). The driver may hear the pump run.

The auxiliary water pump can also be a source of audible operating noise when the engine is not running. If the engine is hot when shut OFF, the auxiliary water pump can run on for up to seven minutes.

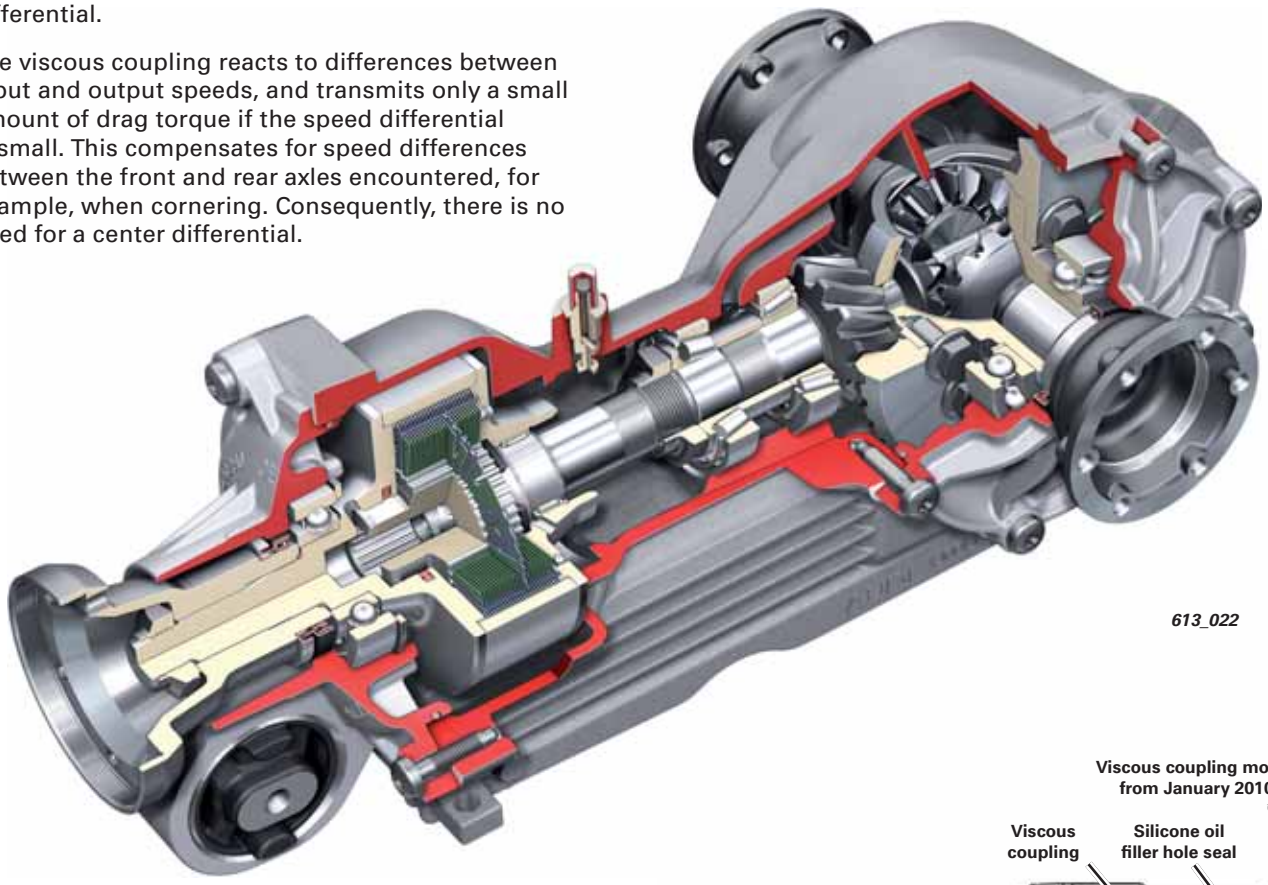
Gear shifts are performed at a higher pressure during the first 62 mi (100 km) of vehicle operation. The higher pressure creates higher shift forces which may be needed because the components are not broken in. This may also be true if a transmission has been replaced.

Front Axle Drive 0AZ

The front axle drive is driven directly by a shaft from the transmission. There is no center differential as found on other quattro models.

A viscous coupling is integrated into the front axle drive unit. When needed, it can transmit up to 118 lb ft (160 Nm) of torque to the differential pinion shaft. This input torque is increased by a factor of 2.6 to approximately 310 lb ft (420 Nm) by the final drive ratio and distributed equally to the wheels by the front differential.

The viscous coupling reacts to differences between input and output speeds, and transmits only a small amount of drag torque if the speed differential is small. This compensates for speed differences between the front and rear axles encountered, for example, when cornering. Consequently, there is no need for a center differential.



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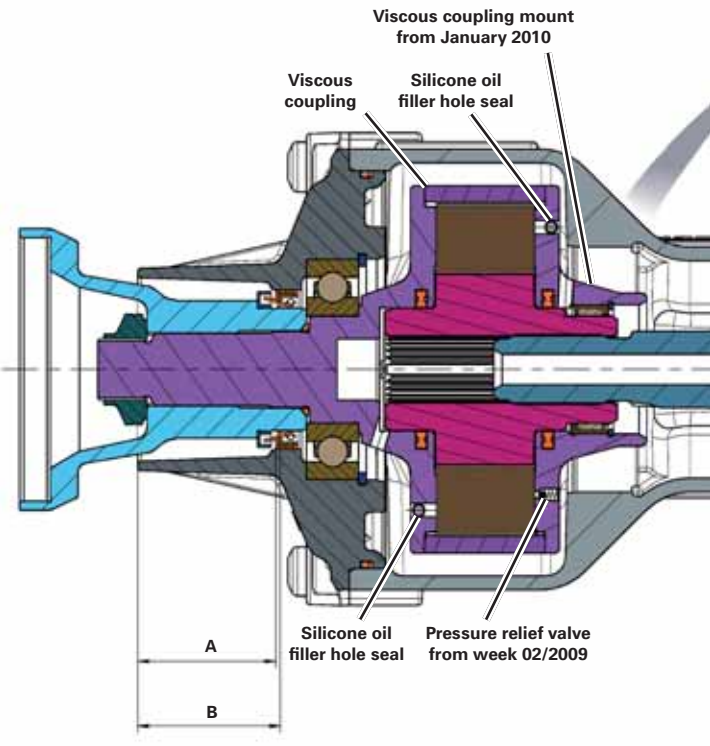
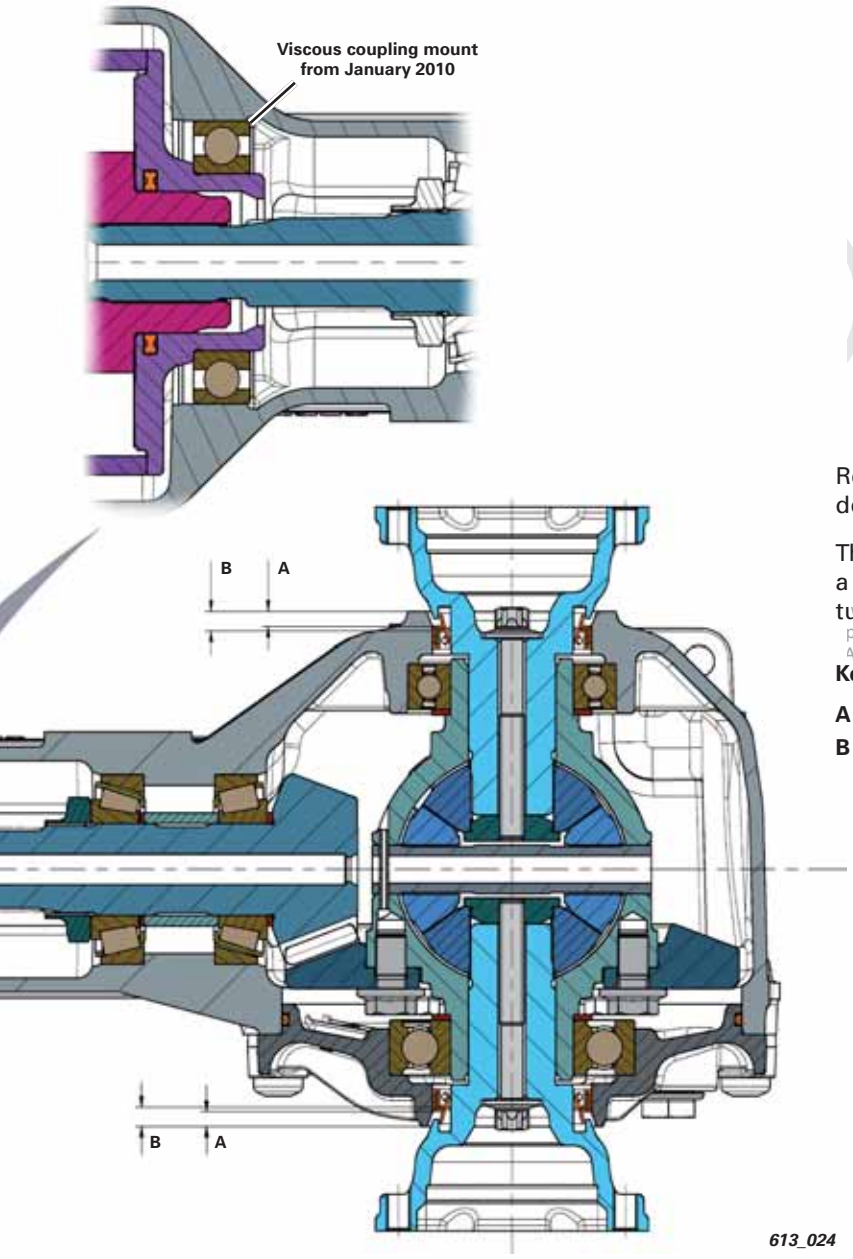


Specifications

Designation	Front axle drive 0AZ
Manufacturer	GETRAG
Torque capacity	332 lb ft (450 Nm)
Viscous coupling	118 lb ft (160 Nm) @ 100 rpm of slip
Final drive ratio	37/14 (2.643 : 1)
Oil supply	▶ Axle oil in final drive — there is no change interval, as there is a lifetime fill ▶ Special silicone oil in the viscous coupling (hermetically sealed housing)
Weight	47.3 lb (21.5 kg) including oil



Replacement axle flange oil seals are pressed to a deeper depth than when installed during production.

This allows the sensitive lip of the oil seal to run on a new surface. It is subjected to less stress, which in turn improves durability and resistance to leaking.

Key:

A Production seal insertion depth

B Replacement seal insertion depth

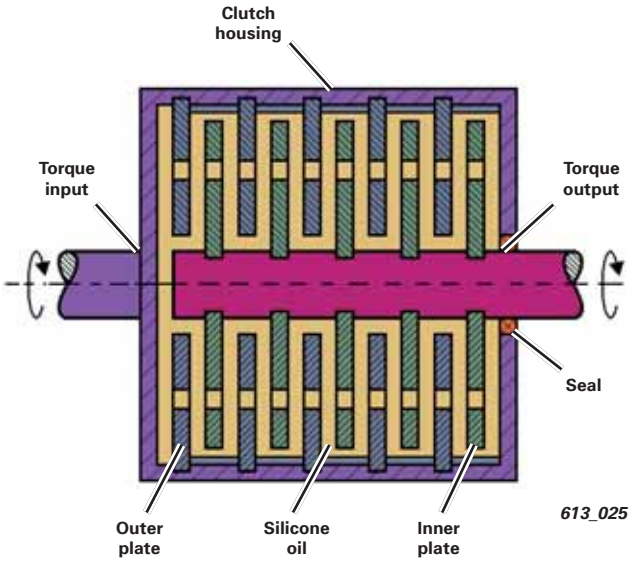
Viscous Coupling

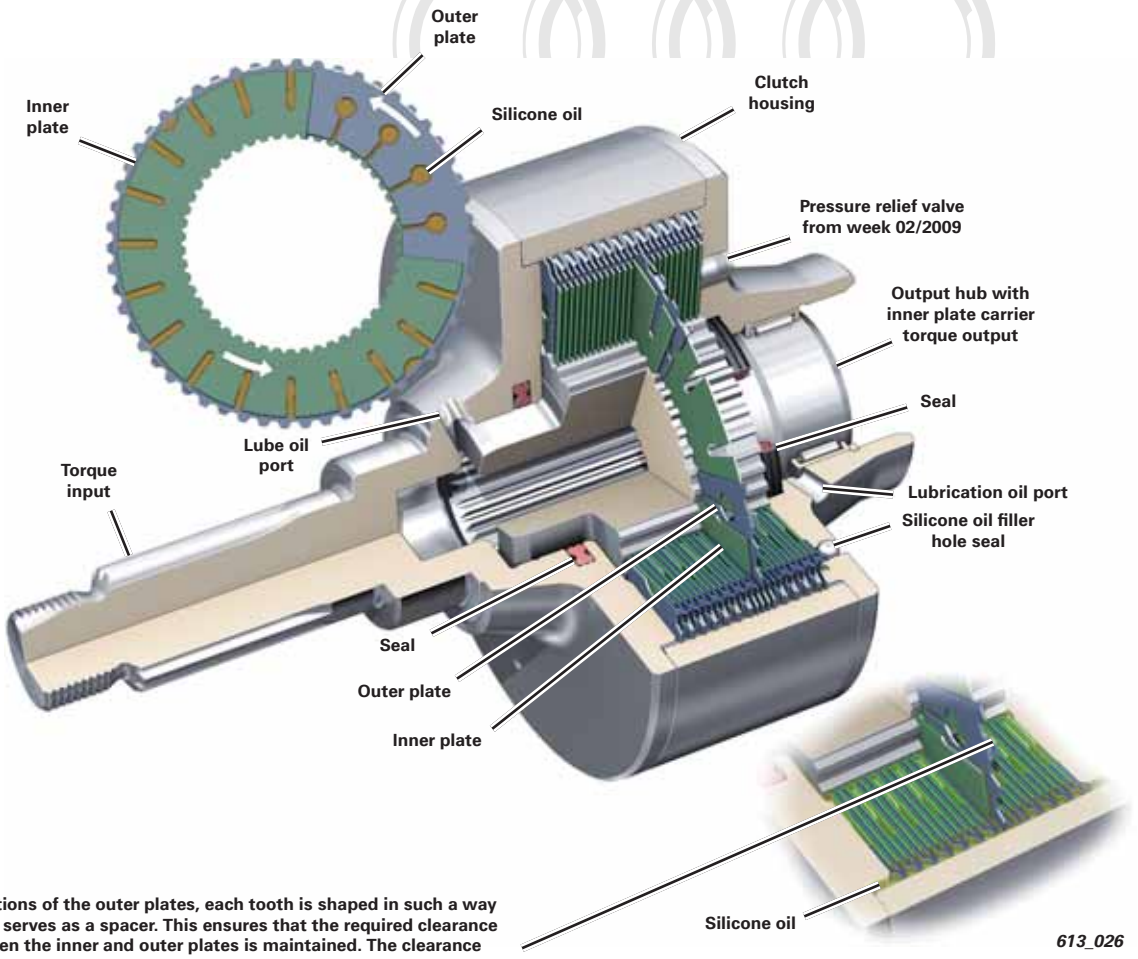
The viscous coupling is a fluid clutch. It consists of a hermetically sealed clutch housing and corresponding inner and outer plates. The outer plates mesh with the clutch housing (torque input), while the inner plates mesh with the output hub (torque output).

The clutch housing is filled with a special grade silicone oil, which has relatively low viscosity at normal temperature and becomes increasingly thicker when heated.

The inner and outer plates have circular and slotted recesses around their entire circumference, with the space between the plates filled with silicone oil. The plates do not come into contact with one another in normal operating range. Due to the silicone oil between the plates, only a small amount of drag torque is transmitted at low slip. This compensates for the differences in speed between the front and rear axles, encountered for example, when cornering.

When the speed differential between the outer plates and the inner plates increases, silicone oil is sheared off at the recesses in the plates. This generates heat, which makes the silicone oil thicker. The result is transmission of variable power between the inner and outer plates of the viscous coupling.





In sections of the outer plates, each tooth is shaped in such a way that it serves as a spacer. This ensures that the required clearance between the inner and outer plates is maintained. The clearance space is filled with silicone oil. The plates do not come into contact with one another, with power transmitted through the silicone oil.

As with any viscous coupling, the greater the slip, the greater the amount of torque transmitted. This can lead to 100% transmission of power for a short period of time.

This characteristic of viscous coupling is known as the "hump effect", which is caused by a sharp increase in temperature and an accompanying rise in pressure inside the clutch housing. This reaction causes mechanical friction between the inner and outer plates, resulting in a sharp increase in the amount of torque transmitted, and a marked decrease in speed difference between the outer and inner plates.

As a result, the silicone oil incurs less friction and cools down, which in turn reduces the amount of power transmitted. This process repeats itself if the load on the clutch is maintained.

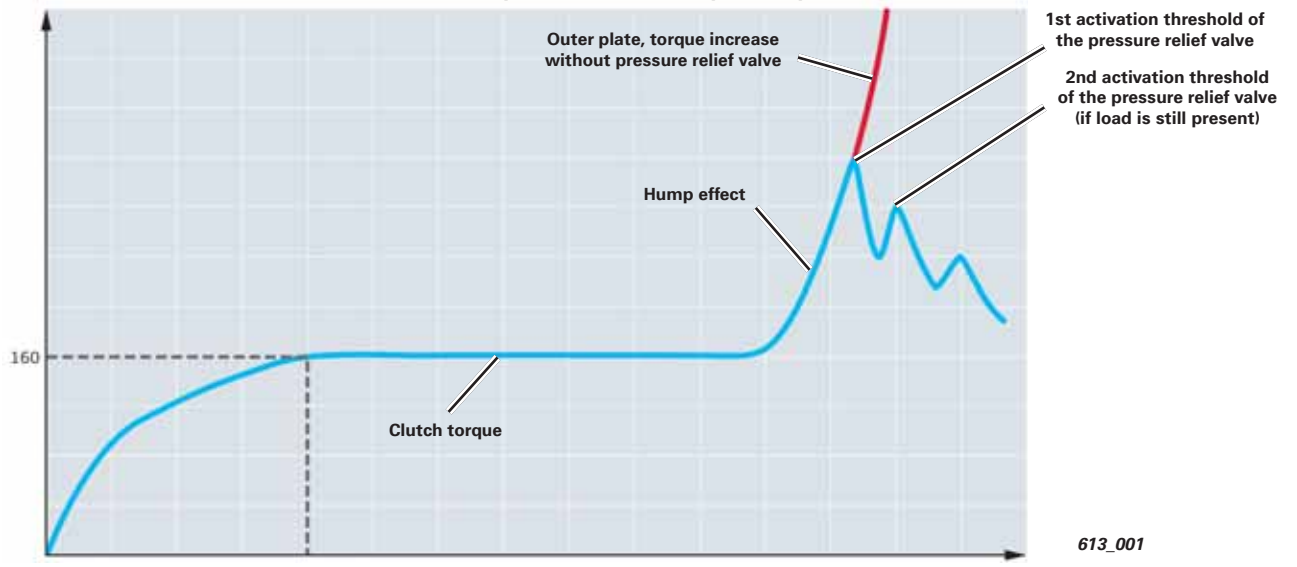
The torque and power transmission characteristics of a viscous coupling is mainly dependent on the following parameters:

- Inner and outer diameters of the plates
- Number of plates
- Viscosity of the silicone oil
- Filling level of the silicone oil

The viscous coupling in the Audi R8 is rated to transmit approximately 118 lb ft (160 Nm) of torque at a speed differential of 100 rpm. The viscous coupling should not incur a hump effect even under heavy load. A rapid increase in torque is not desirable, as it would adversely affect driving dynamics.

To prevent the hump effect from occurring, a pressure relief valve is built into the clutch housing (from February 2009). If too much load is placed on the viscous coupling, temperature and pressure in the clutch housing will rise sharply. If the pressure exceeds approximately 290 psi (20 bar), a pressure relief valve opens reducing pressure, which in turn reduces the amount of torque transmitted, preventing the hump effect from occurring.

Characteristic curve of clutch slip as a function of slip and slip duration



As the speed differential increases, the clutch torque initially rises rapidly to a defined value of 118 lb ft (160 Nm) and then levels off. If the speed differential remains unchanged, a hump effect will occur after a certain period of time.

The time at which the hump effect occurs is essentially dependent on the speed differential, duration of slip, and operating temperature.

If the viscous coupling is placed under extreme load, the pressure relief valve opens and silicone oil is discharged from the clutch housing. The amount of torque which is transmitted by the viscous coupling is permanently reduced after the pressure relief valve has been activated.

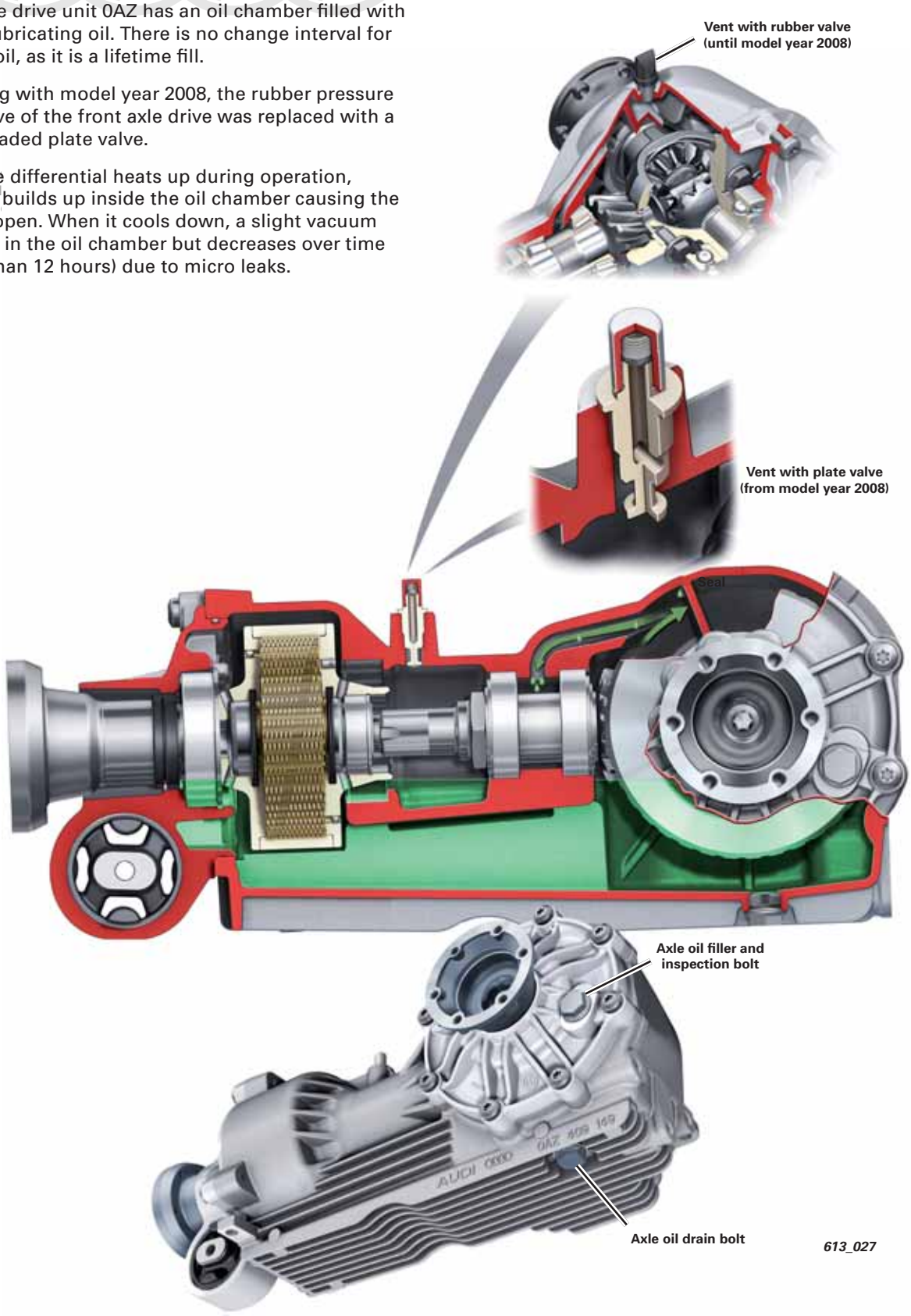
The silicone oil cannot be checked or refilled. If there are issues concerning power transmission, the viscous coupling must be replaced. The silicone oil does not mix with the axle oil and deposits in the oil pan, and performance of the final drive and differential is not affected.

Lubrication Oil Supply

Front axle drive unit 0AZ has an oil chamber filled with hypoid lubricating oil. There is no change interval for the axle oil, as it is a lifetime fill.

Beginning with model year 2008, the rubber pressure relief valve of the front axle drive was replaced with a spring loaded plate valve.

When the differential heats up during operation, pressure builds up inside the oil chamber causing the valve to open. When it cools down, a slight vacuum develops in the oil chamber but decreases over time (longer than 12 hours) due to micro leaks.



Special Operating Notes

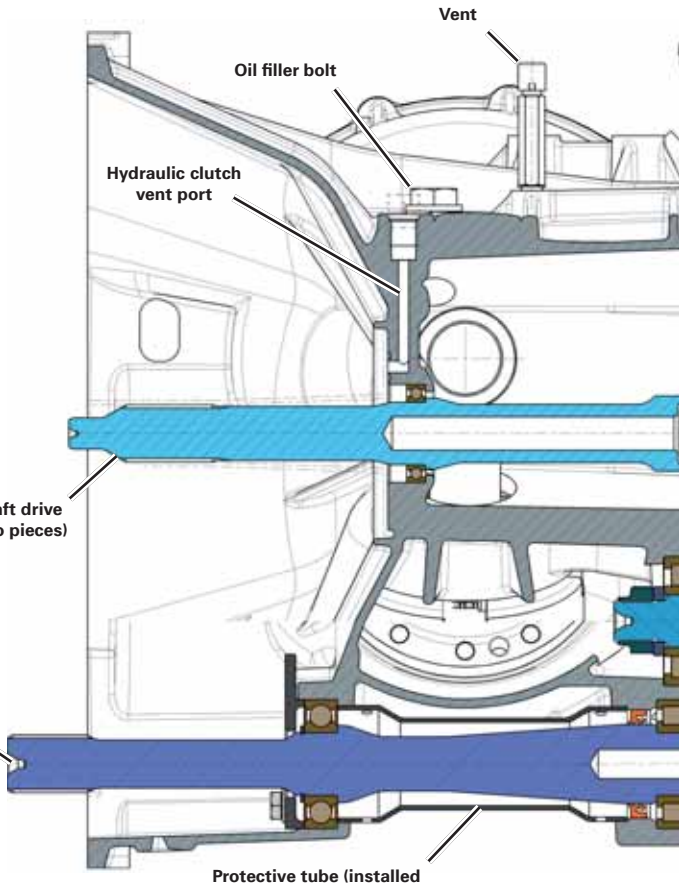
- For performance testing and road simulation, the Audi R8 can only be run on a permanently coupled four-roller dynamometer. This means that the front and rear axle rollers of the dynamometer must be interconnected so that the wheels can be driven at the same speed.
- Continuous balancing of high speed differentials between the front and rear axles will damage the viscous coupling and the front axle drive.
- If the front propeller shaft has been removed, the Audi R8 can be driven as a rear-wheel drive model.
- A brake test can be safely conducted on a low speed dynamometer. A speed differential of less than 6.2 mph (10 km/h) is not problematic and is acceptable for a period of less than five minutes.
- The Audi R8 must never be towed with the front or rear axle elevated off the ground. Towing with the front or rear wheels off the ground will damage the viscous coupling.
- At large steering angles, stresses occur in the front axle due to toe-in when cornering. This causes the tires to scrub and produce a droning or rubbing noise. This effect is intensified by low aspect tires, low ambient temperatures, and certain road surface conditions.

  This characteristic occasionally will lead the driver to wrongly believe there is an issue with the front axle.
- The viscous coupling is a maintenance-free part. The silicone oil cannot be checked or refilled. If the viscous coupling is faulty or ineffective, it must be replaced.

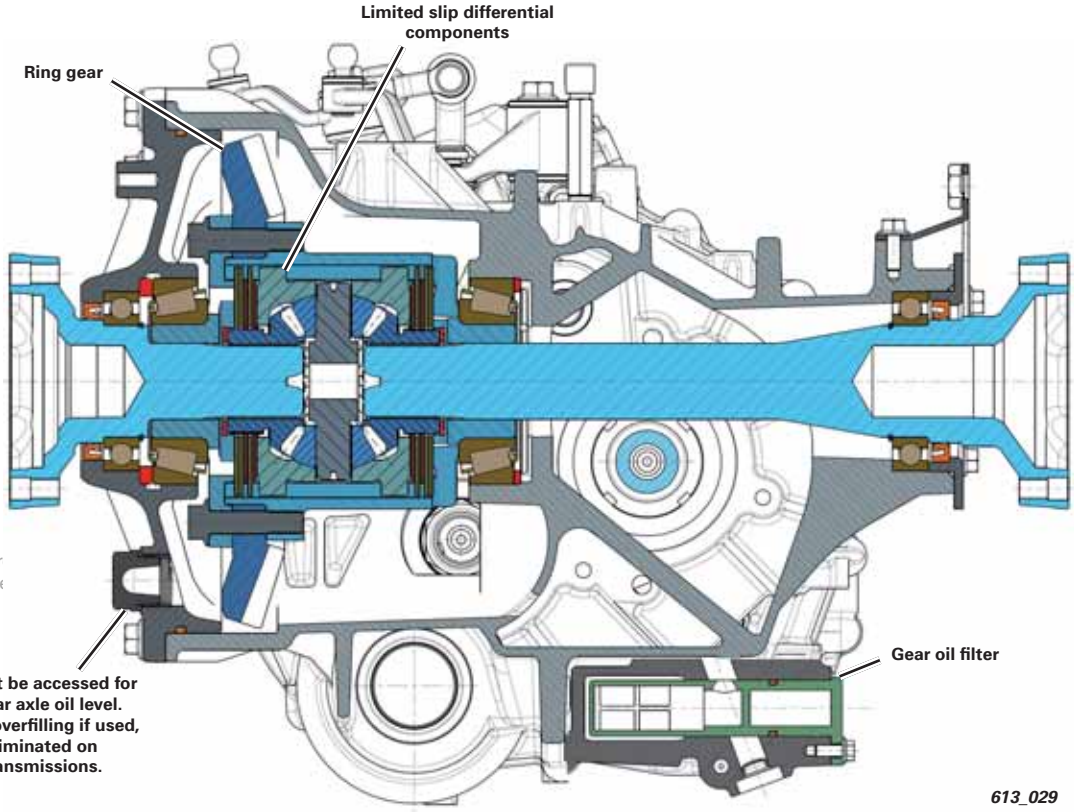
Sectional View of the Base 086 Transmission

The manual transmission and automated R tronic version use an almost identical housing.

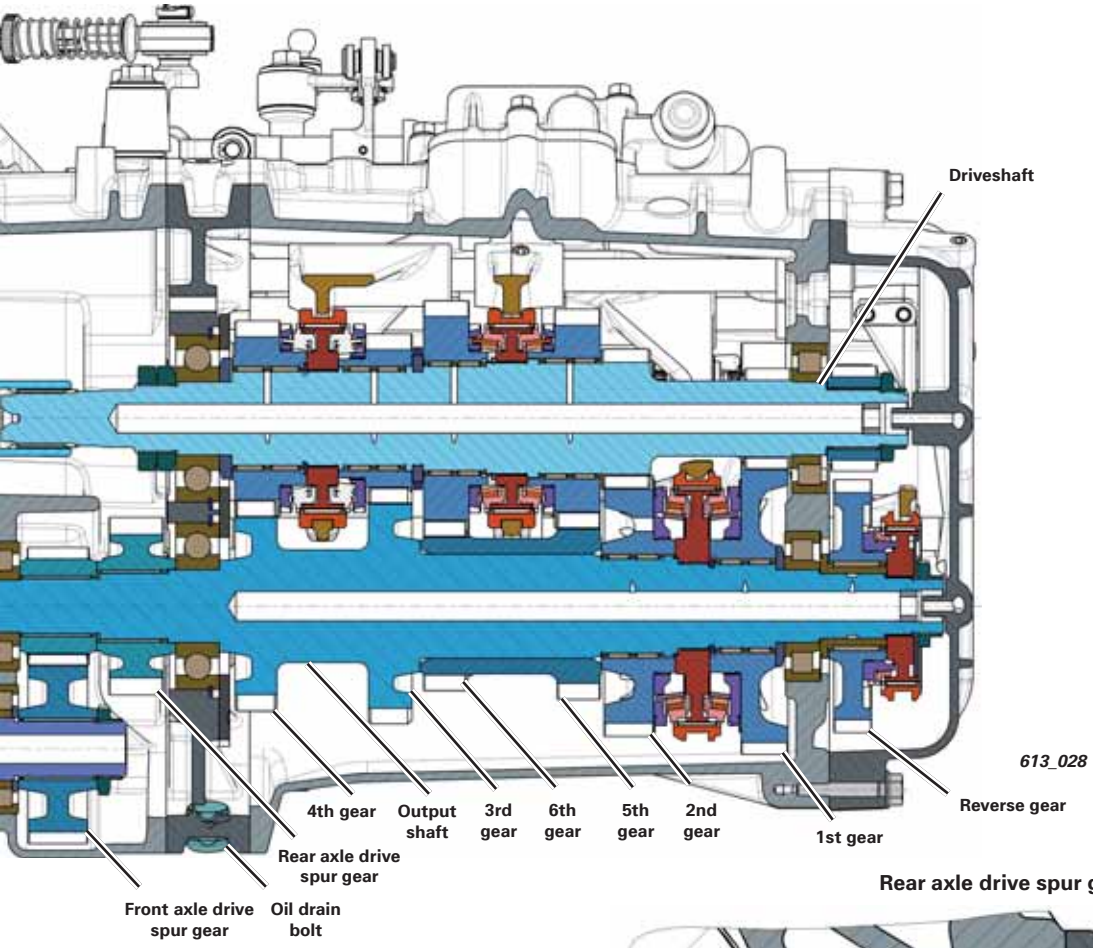
In the R tronic version, an electro-hydraulic shift unit actuates the clutch and performs the gear shifts. This functional design makes this an automated manual transmission.



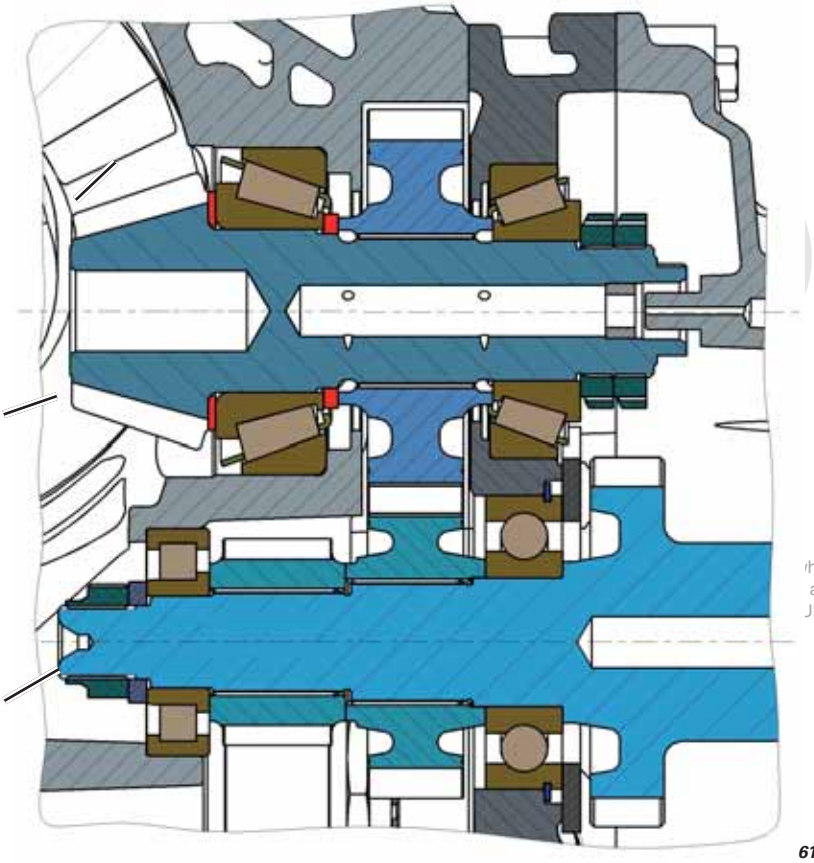
Rear axle with limited slip rear differential



6-speed manual transmission



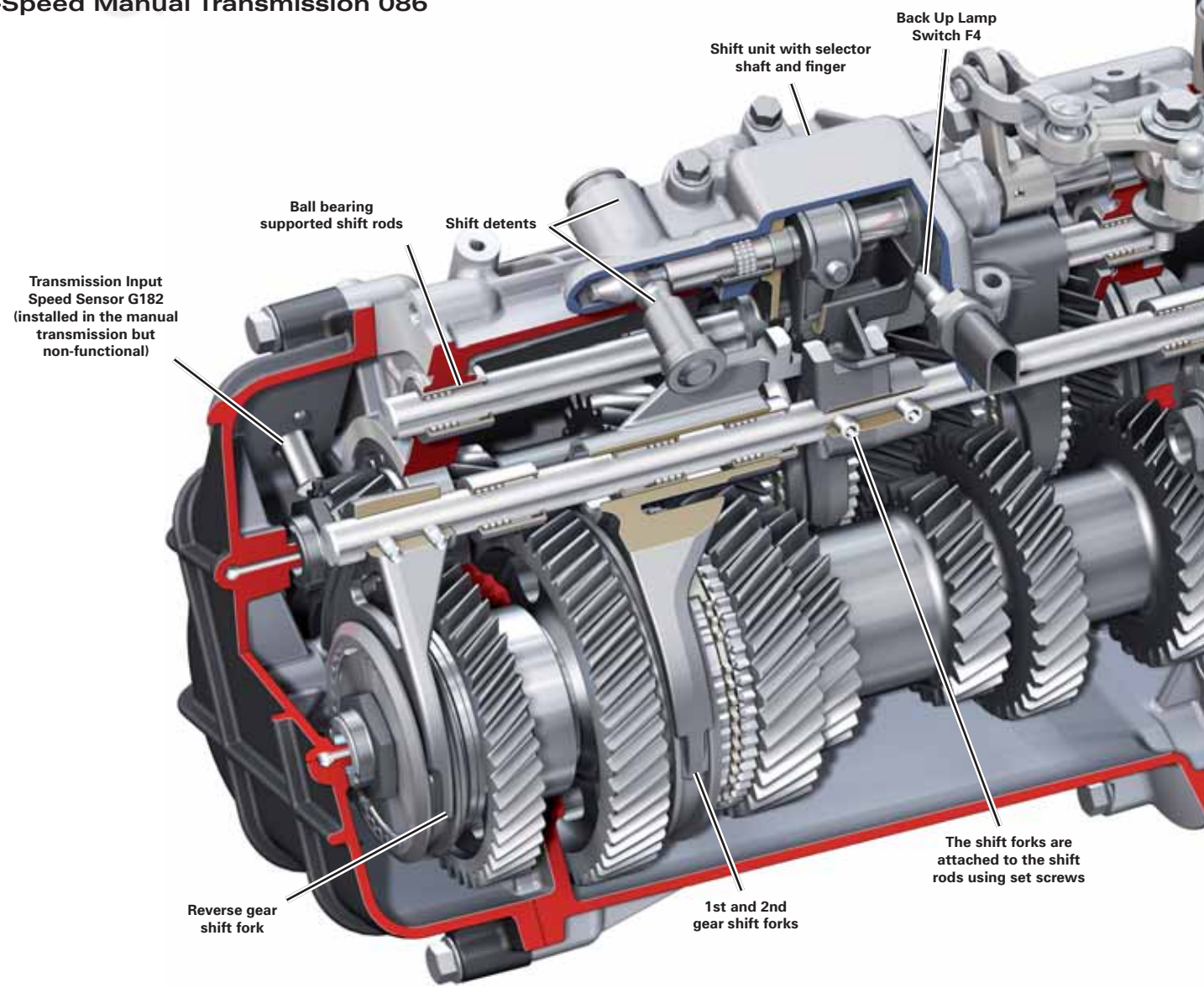
Rear axle drive spur gear

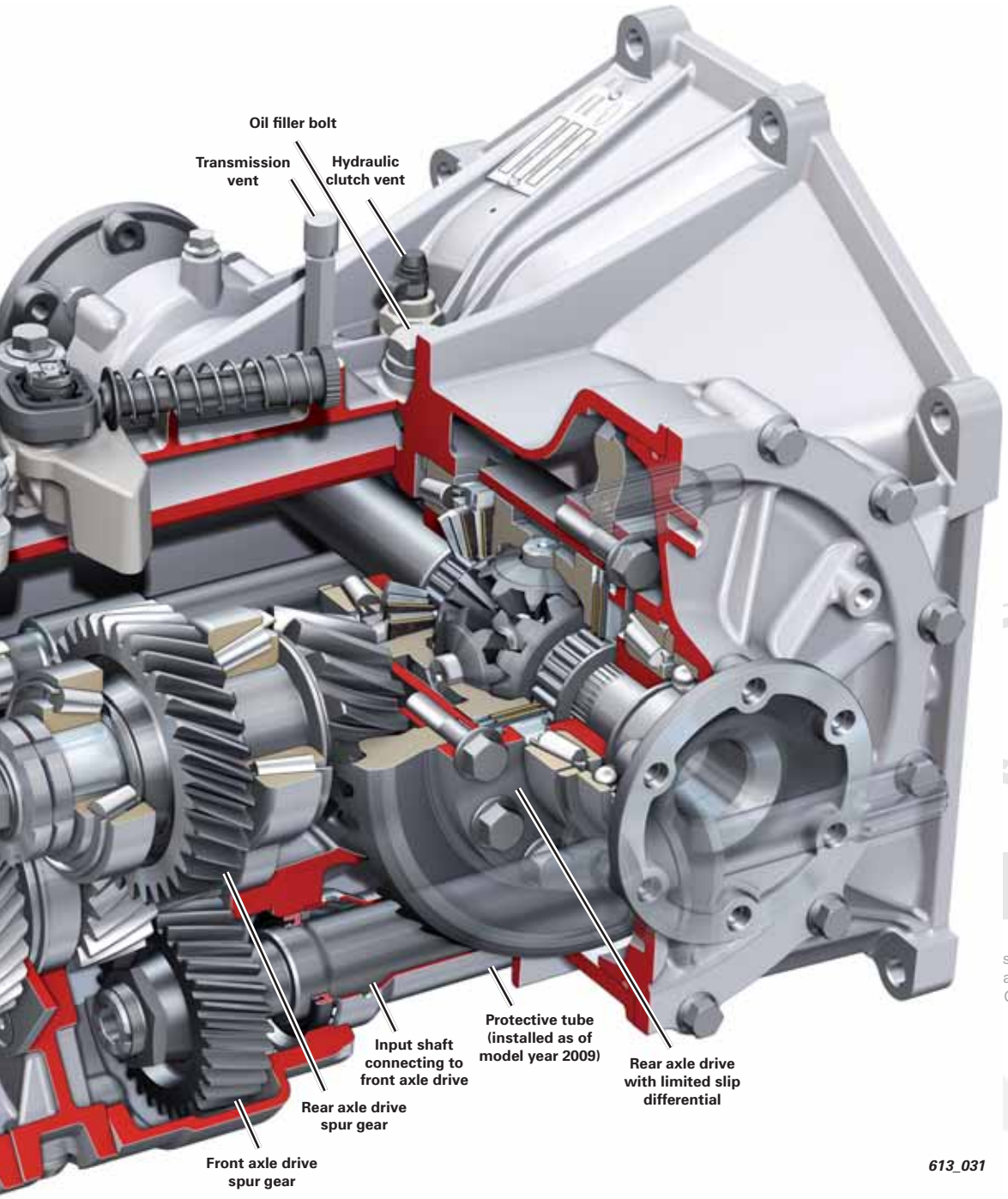


Specifications

Service designation	6-speed manual transmission 086	Automated 6-speed manual R tronic transmission 086
Factory designation	ML600-6A	SL600-6A
Manufacturer	Oerlikon/Graziano	Oerlikon/Graziano
Electro-hydraulic control module manufacturer	—	Magneti Marelli
Torque capacity	443 lb ft (600 Nm)	443 lb ft (600 Nm)
Oil supply	▶ Oil is supplied via an integrated oil pump ▶ Thermostat-controlled gear oil cooling is by an air-oil heat exchanger ▶ There is no oil change interval, as there is a lifetime fill	
Weight	210 lb (95 kg) including oil	231 lb (105 kg) including oil

6-Speed Manual Transmission 086



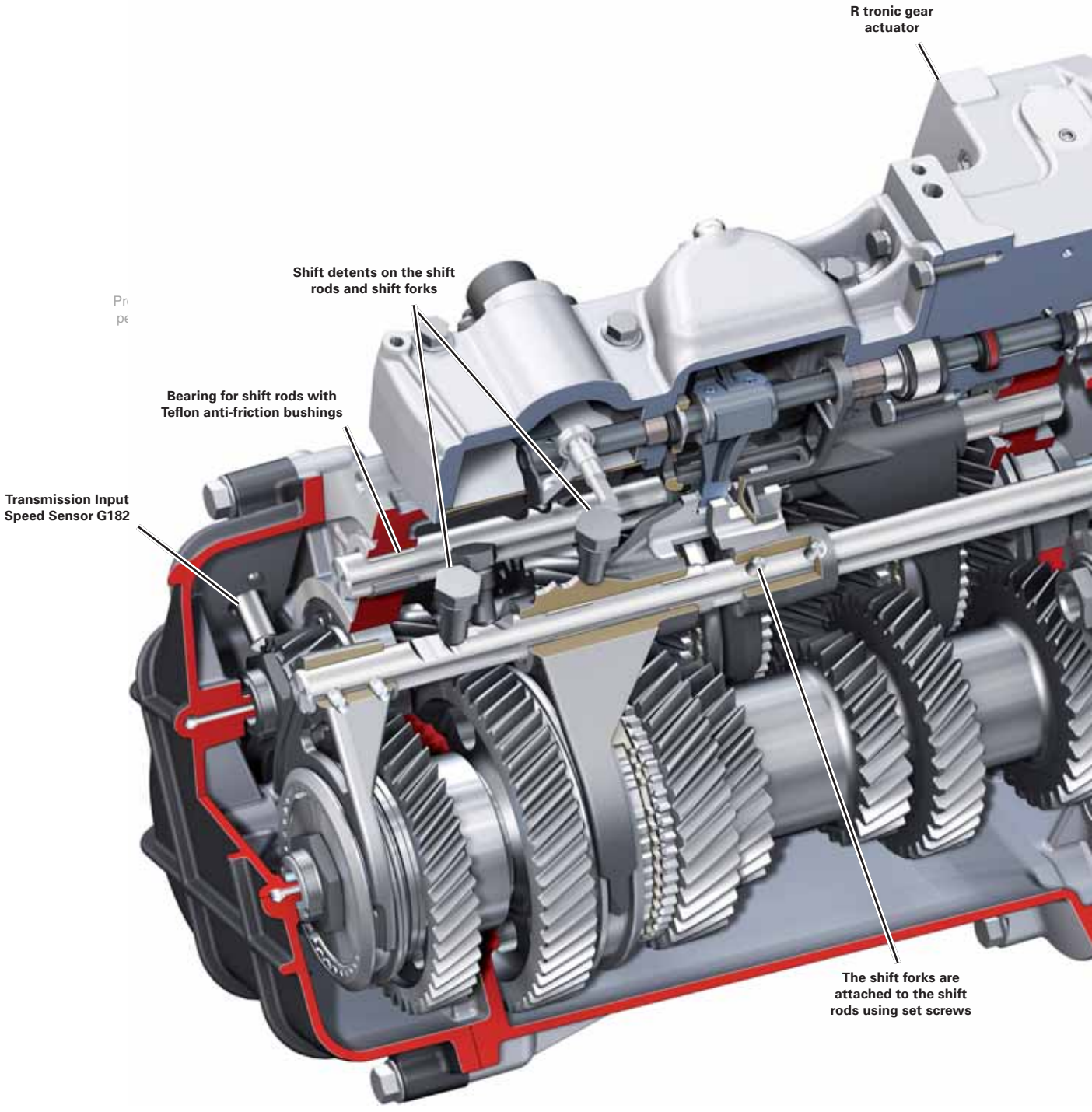


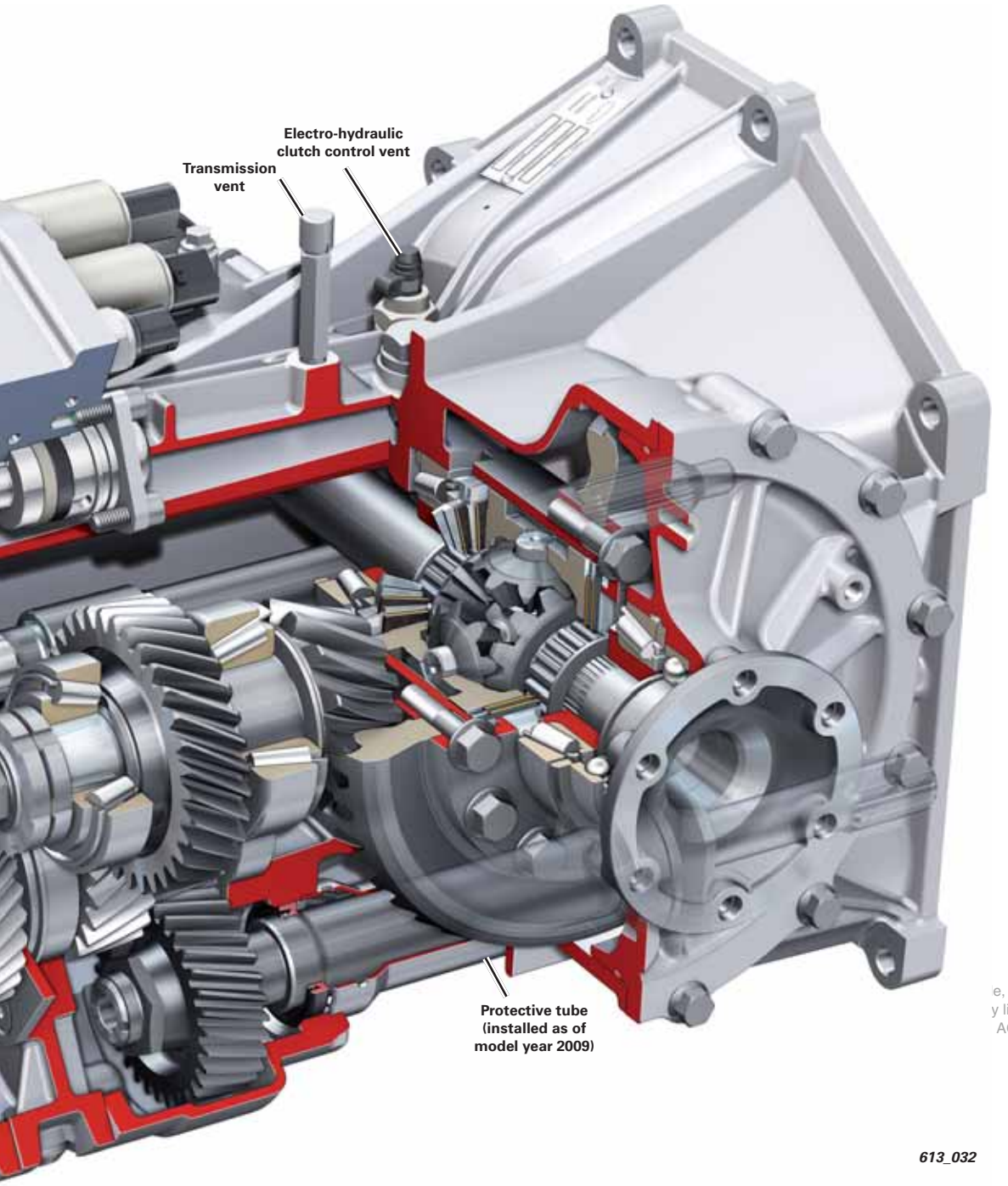
613_031

Automated 6-Speed Manual R Tronic Transmission 086

The R tronic was selected as the automated manual transmission in the R8 because of its low weight, quick gear shifts and minimal loss of tractive power transmission during shifts.

Two shift programs are available with the R tronic. The emphasis is on performance rather than comfort, with shifting oriented toward a short and quick profile.





613_032

Gear Set, Internal Shift Mechanism, and Synchromesh

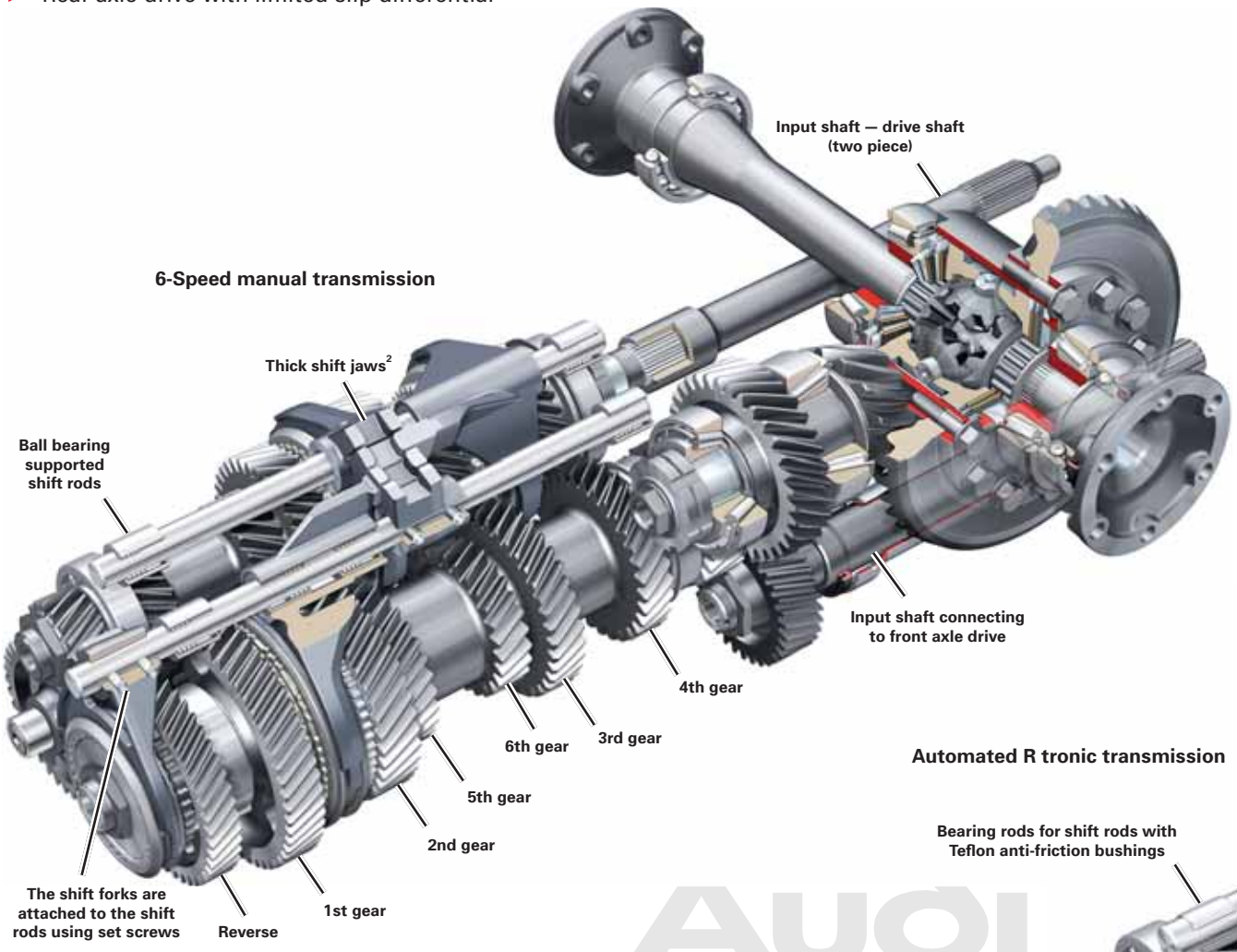
Differences Between the Manual Transmission and R tronic

Common features:[1]

- Input shaft — driveshaft (two piece)
- Bearings and synchromesh
- Output shaft
- Output shaft connecting to front axle drive
- Rear axle drive with limited slip differential

Differences:

- Shift jaws of the shift forks
- Shift rod mounts
- Attachment of the shift forks to the shift rods
- Shift locks



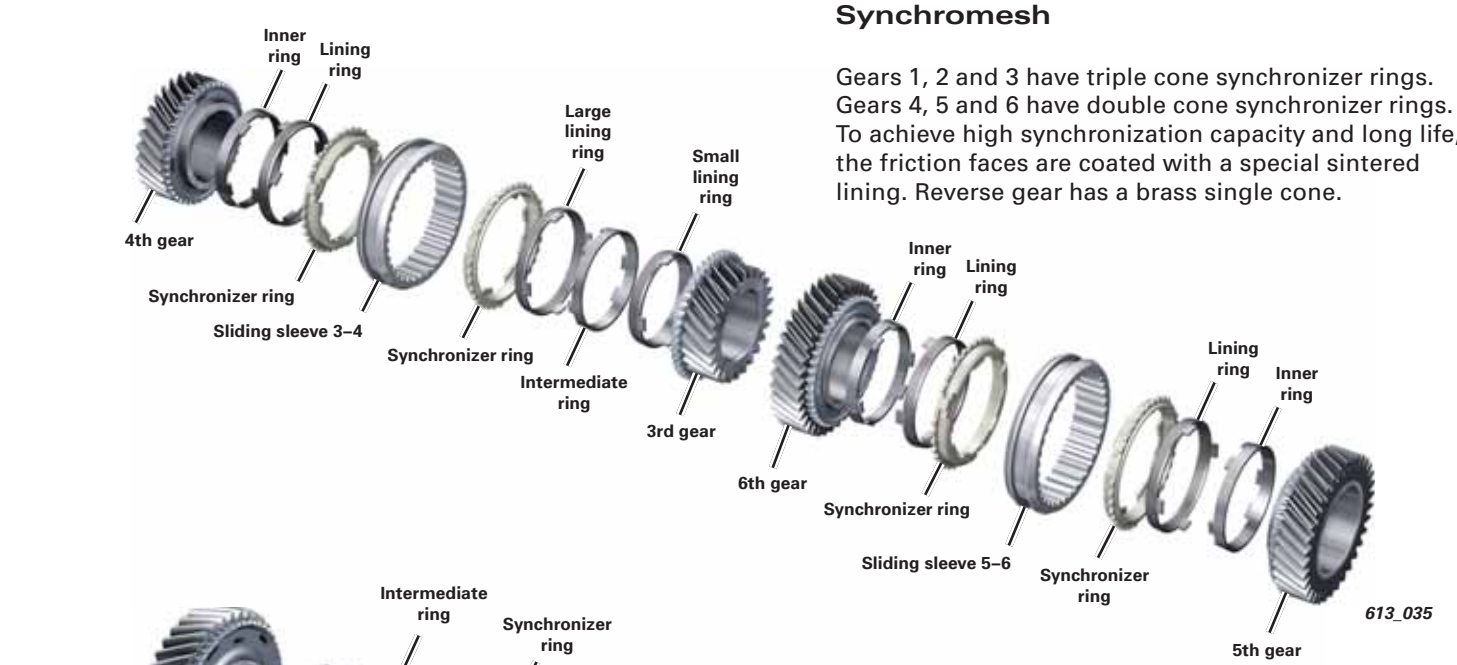
Automated R tronic transmission

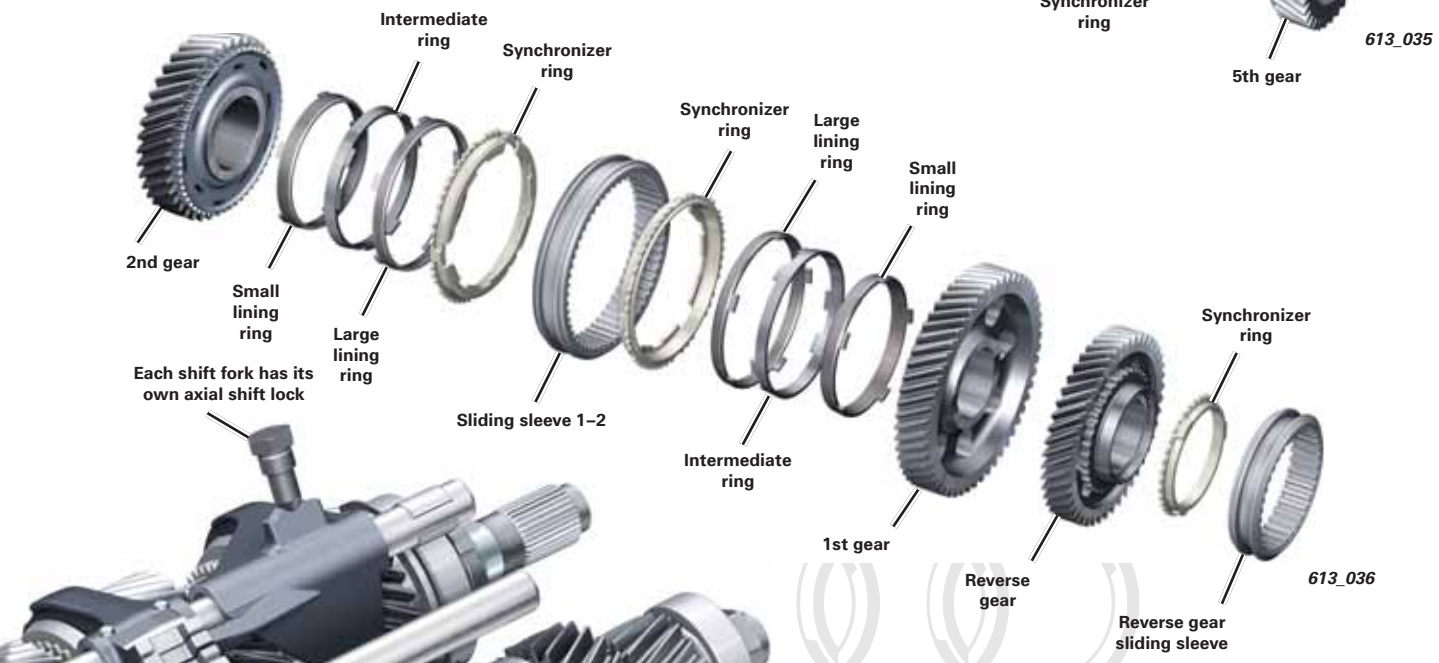
[1]The gear ratios of the individual gears and the final drive will vary according to engine type.

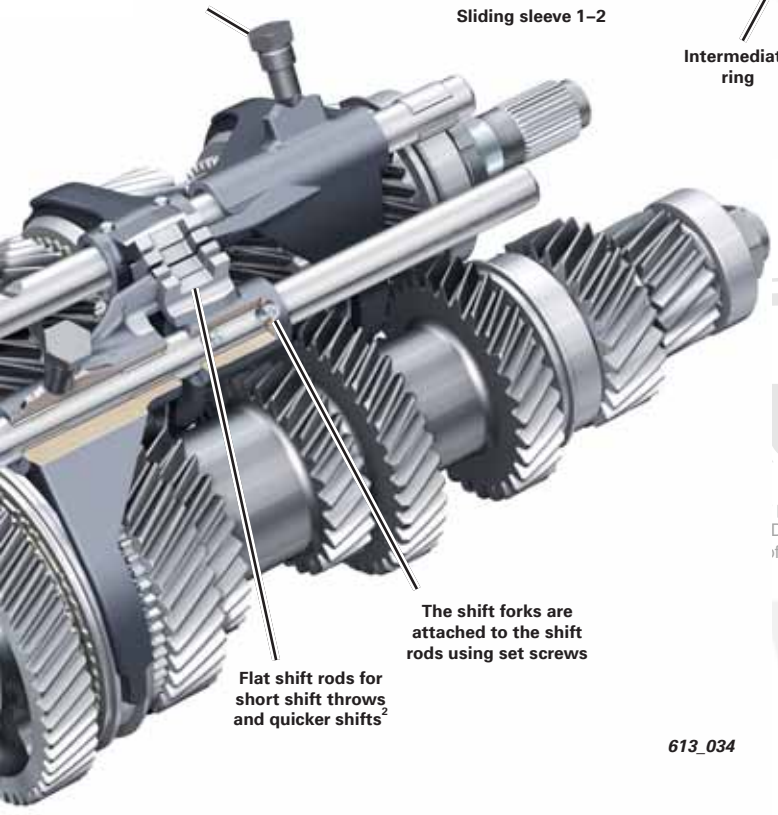
[2]R tronic has flatter shift jaws, which reduces the rotation angle of the selector shaft from approximately 15° (manual transmission) to approximately 7° when changing shift gates. This shortens the shift throws, which in turn cuts the reaction time of the gear actuator, enabling quicker shifts.

Synchromesh

Gears 1, 2 and 3 have triple cone synchronizer rings. Gears 4, 5 and 6 have double cone synchronizer rings. To achieve high synchronization capacity and long life, the friction faces are coated with a special sintered lining. Reverse gear has a brass single cone.







The shift positions and limit stops of the gears in the R tronic transmission must be learned by the Transmission Control Module. This is done via Guided Fault Finding on the VAS Scan Tool.

Limited Slip Rear Axle Differential

Both the manual and R tronic transmissions use a limited slip rear axle differential. This ensures that torque flow is continuous, especially during high transverse acceleration.

Background

The classic open differential always distributes drive torque evenly, with the left and right wheels transmitting the same amount of force (50 : 50). Due to the dynamic distribution of wheel load, the wheel on the inside of the corner defines how much torque the wheels are able to transmit to the road when cornering, because it is the one which begins to spin first.

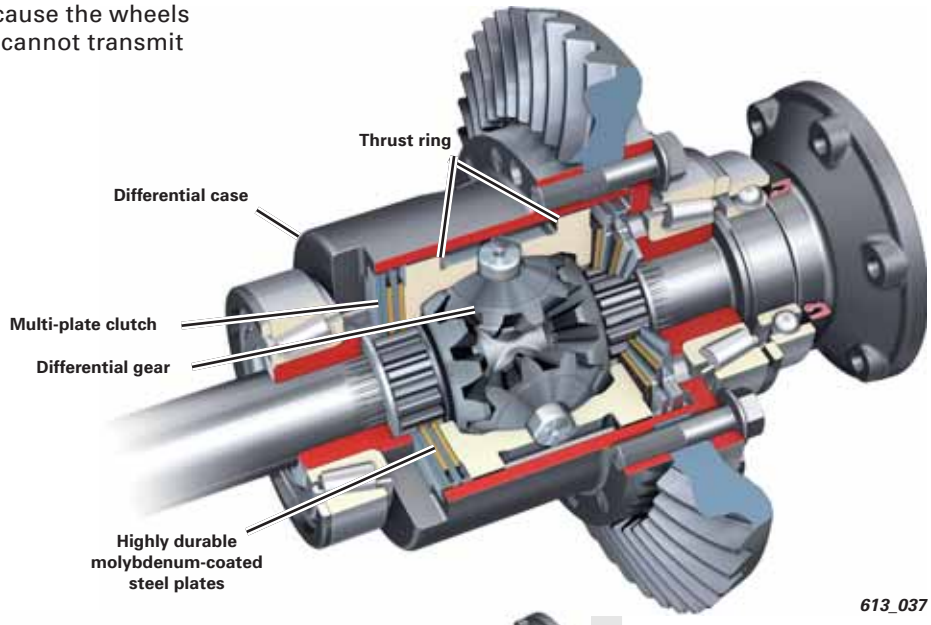
In this case, the inner wheel cannot transmit any torque, and neither can the wheel on the outside of the corner, which results in a loss of traction. The same dynamic applies when one wheel is, for example, driving on ice. The rear axle, again, cannot transmit any torque to the road because the wheels on the opposite side of the vehicle cannot transmit any torque to the road.

However, a differential always has a certain amount of inner friction. This friction produces a small amount of "locking torque," which acts as "assisting torque" on the other side of the vehicle.

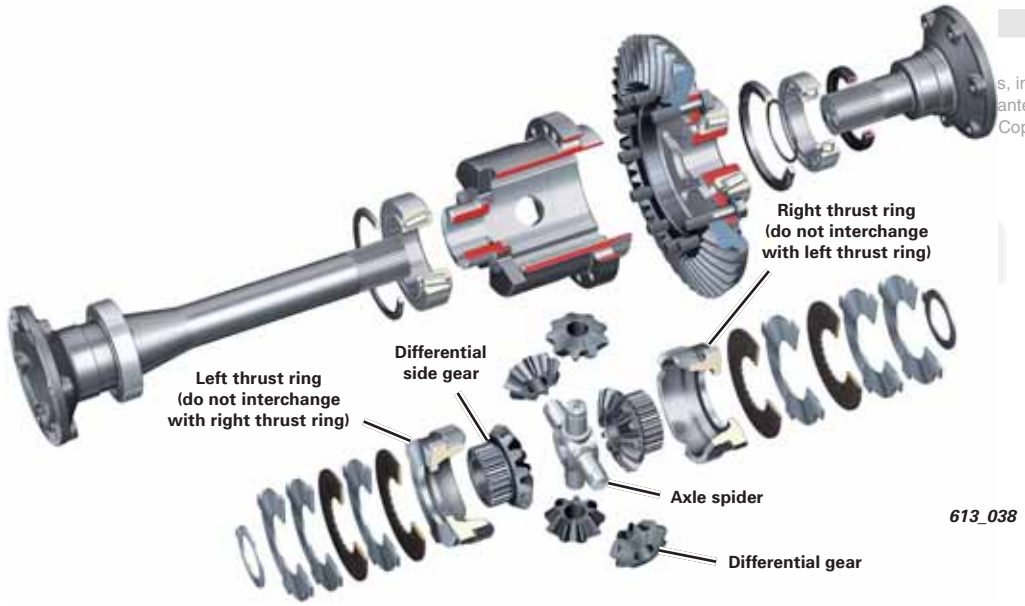
In the case of a limited slip differential, a specified amount of torque is transmitted from the faster-turning wheel to the slower turning wheel (on the inside of the corner) depending on the limited slip value.

This results in steering effects which counteract steering direction during normal cornering. The vehicle initially has a tendency to understeer.

This behavior changes when cornering at high speed. The wheel on the inside of the corner is relieved of load and has a tendency to spin. The limited slip differential transfers torque to the wheel on the outside of the curve, enabling the axle to continue transmitting torque to the road.



613_037



613_038

Design and Function

The drive torque transmitted from the drive pinion to the ring gear is transmitted from the differential case to both thrust rings. Each of the thrust rings has four wedge-shaped recesses in which the axle spider is mounted in bearings.

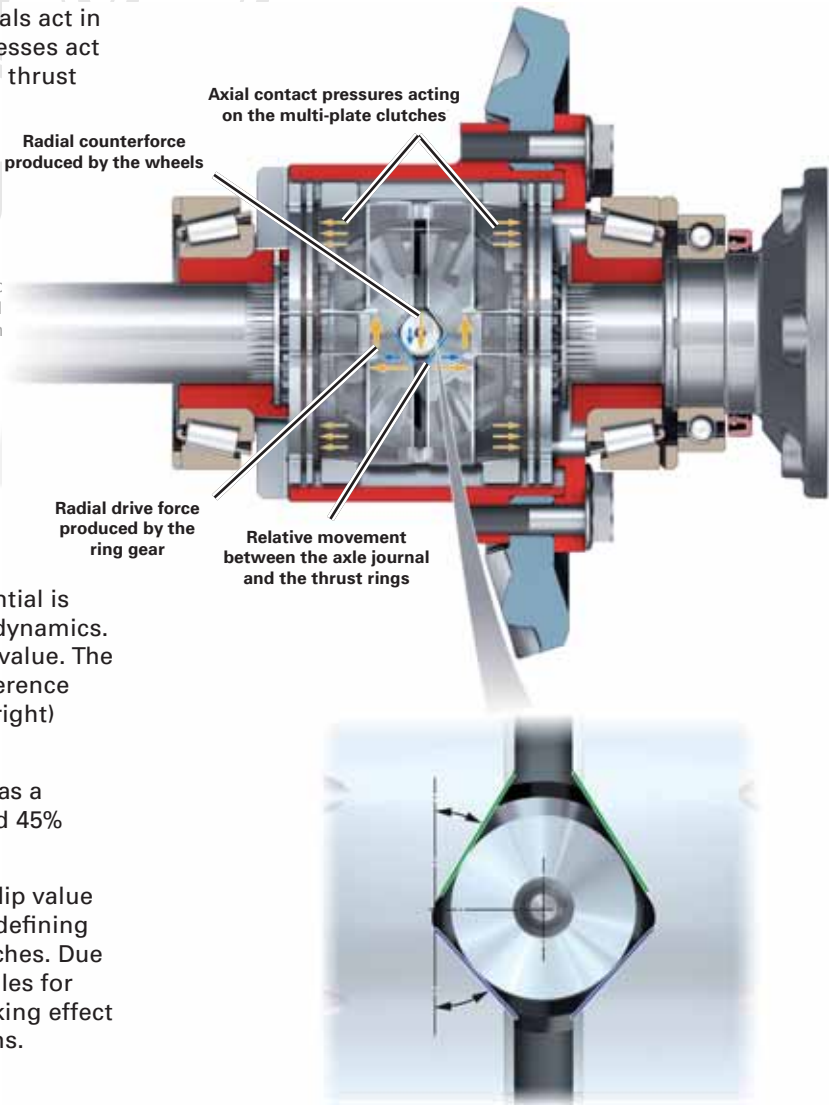
The axle spider forms the axle journal for the four differential gears. The axle journals flatten at the same angle as the recesses in the thrust rings. This ensures full surface contact between the swivel pins and thrust rings.

As soon as drive torque is input, the radial forces produced by the thrust rings and axle journals act in opposite directions. The wedge-shaped recesses act like ramps, and the axle journals spread the thrust rings apart axially like a wedge.

The axial contact pressures resulting from the wedge effect act on both the left and right multi-plate clutches and produce a load-dependent clutch torque.

This clutch torque produces the locking effect. The outer plates (steel plates) interlock with the differential case and the inner plates engage the differential side gears. As a result, a portion of the drive torque is transferred directly from the differential case to the gears.

Forces in the limited slip differential (when driving forward)



613_039

Locking Effect and Slip Value

The locking effect of the limited slip differential is adapted to the vehicle and desired driving dynamics. The lock-up effect is defined by the lock-up value. The slip value defines the maximum torque difference at both outputs of the differential (left and right) resulting from the locking effect.

The limited slip differential in the Audi R8 has a nominal slip value of 25% under throttle and 45% when coasting.

One of the adjustment parameters for the slip value is the ramp angle, since this is a key factor defining the pressure applied to the multi-plate clutches. Due to the fact that there are different ramp angles for driving under throttle and coasting, the locking effect is adapted to both of these driving situations.

Operating Characteristics

The limited slip differential has an all-mechanical action, is self-locking and becomes effective with input drive torque. This can place strain on the rear wheels when negotiating tight corners at high drive torque. When this occurs, the wheels have a tendency to rub which may be felt as a vibration in the driveline.

Lubrication

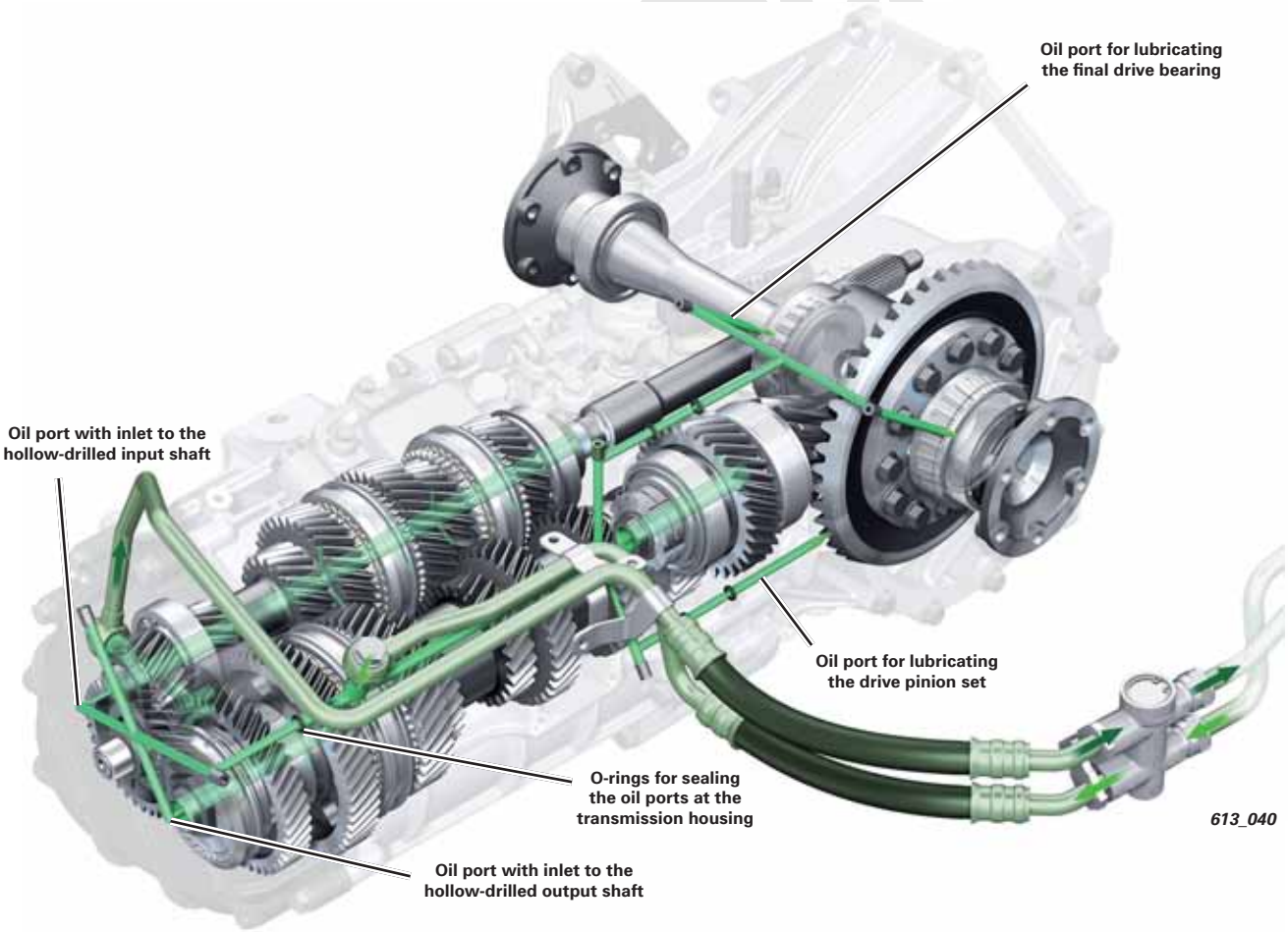
Both the manual and R tronic transmissions are lubricated with gear oil from a common supply.

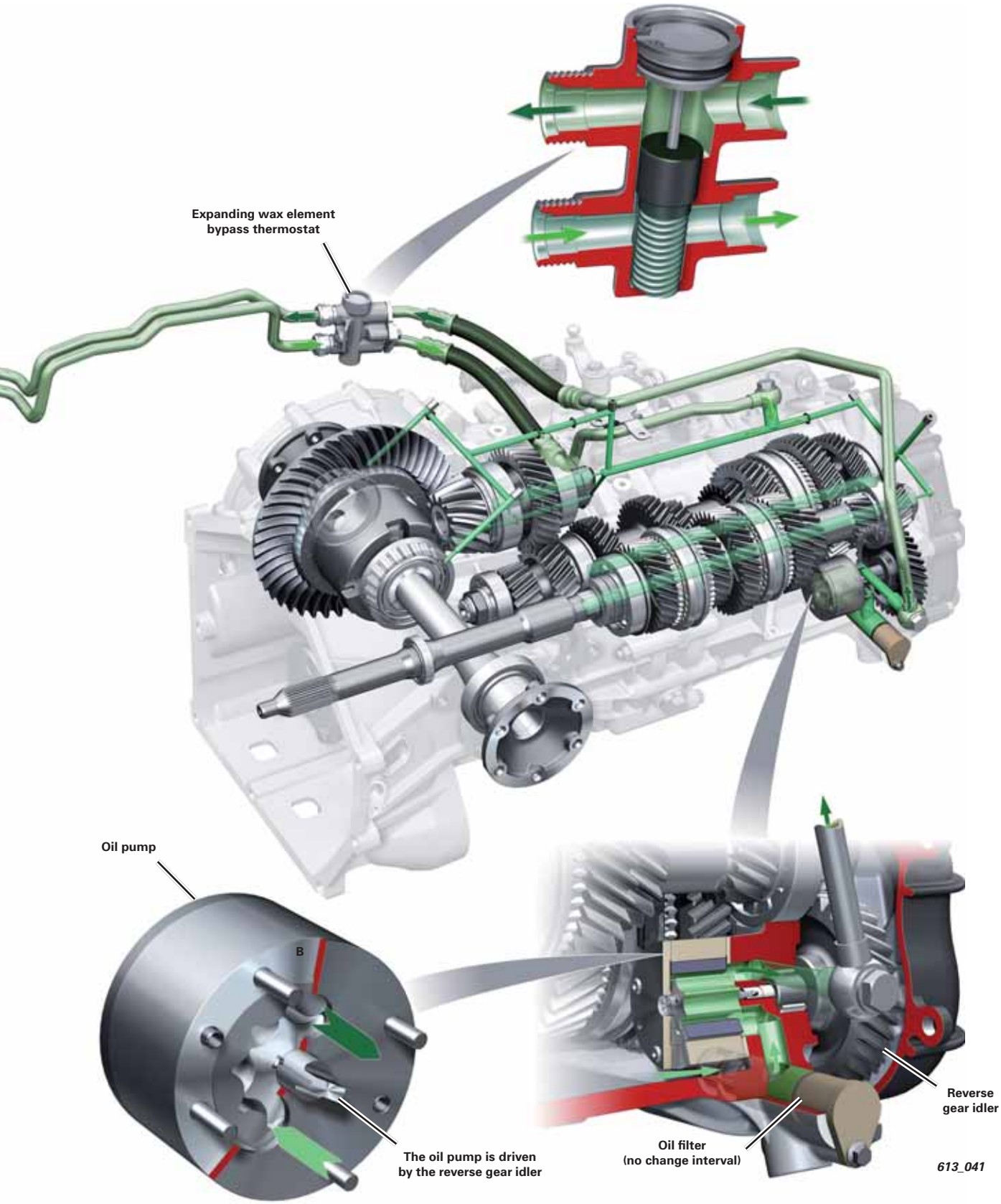
Gear oil is circulated by a pump located at the rear of the transmission. This controlled lubrication allows a lower oil quantity to be used which reduces churning losses and improves efficiency. The use of a pump also ensures adequate lubrication under high transverse and longitudinal acceleration.

An air-to-oil cooler is used to reduce the thermal load on the gear oil and transmission components.

The oil flows first to the thermostat, then, depending on oil temperature, it is either channeled through the oil cooler or directly to the transmission. Oil galleries in the transmission case distribute oil to the lubrication points.

The input and output shaft pinion bearings are lubricated through hollow-drilled shafts. Cross-drilled holes in the shafts channel the oil to bearing points.

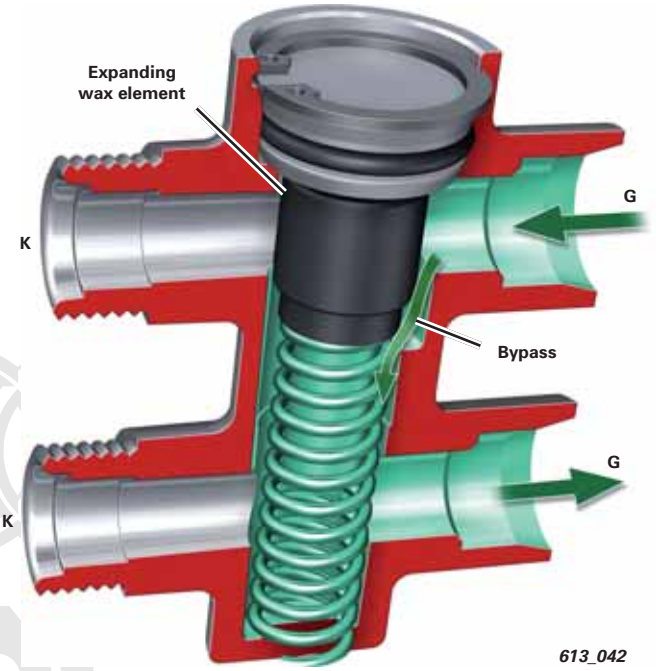



Expanding wax element
bypass thermostat
Oil pump
B
The oil pump is driven
by the reverse gear idler
Oil filter
(no change interval)
Reverse
gear idler
613_041

Function of the Bypass Thermostat

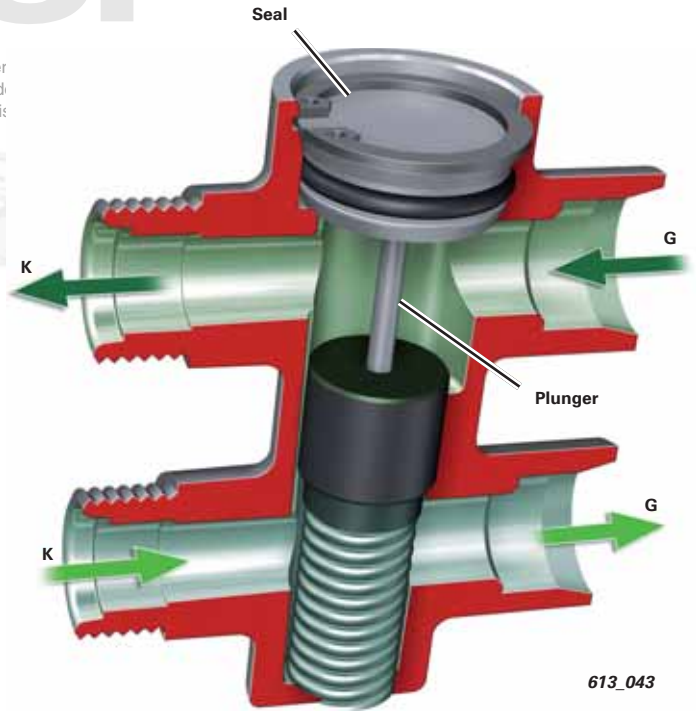
Thermostat Closed

The expanding wax element also regulates inflow into the radiator. In a closed state, a small quantity of gear oil flows through the bypass and back to the transmission. The gear oil flows along the expanding wax element and heats it up.



Thermostat Open

From approximately 167°F (75°C) the plunger begins to push the expanding wax element down against the force of the spring. This opens the inlet to the radiator. The thermostat is fully open at approximately 194°F (90°C).



Key:

G From or to transmission

K From or to cooler

Note

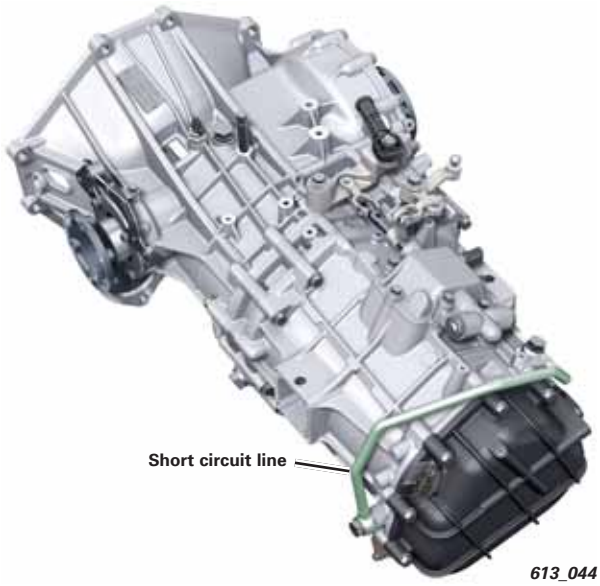
Impurities in the transmission oil (for example, wear-chips and emulsion) are also distributed throughout the lubrication cooling system and can be deposited in the oil cooler or thermostat.

It is therefore important to carefully flush the system and individual components after any repairs to or replacement of the transmission. To do this, the lines to the cooler and thermostat must be disconnected. If there is doubt that the impurities can be removed, the component must be replaced.

Impurities can clog the thermostat bypass, which can impair or disable its function. If the lubrication cooling system is opened during repairs, the replacement oil must be heated higher than the opening temperature of the thermostat so that it is distributed throughout the system. This ensures that it is filled to the proper level.

Oil Circulation — R8 GT

Due to the lightweight design of the R8 GT, a transmission oil cooler is not installed. To maintain oil circulation in the transmission, a “short circuit line” is installed.



613_044

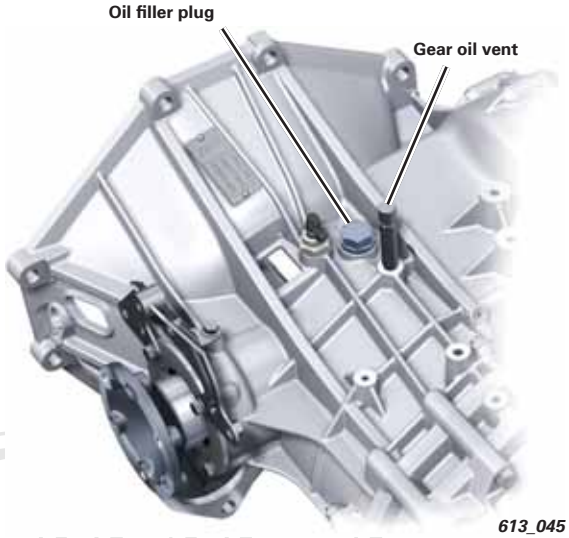
Checking Gear Oil Level

All transmission versions have an oil filler plug and oil drain plug.

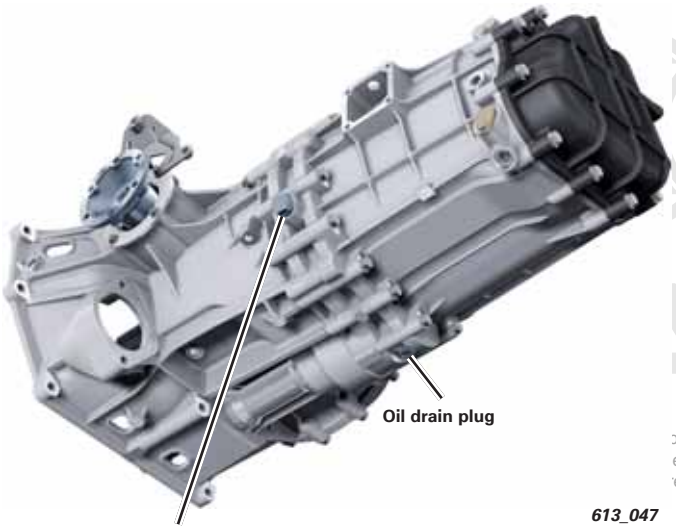
Early production transmissions do not have an inspection plug to check oil level. In these versions, the oil must be completely drained and then refilled with the correct quantity.

What appears to be an inspection plug on the final drive (illustration 613_046 below right) must NOT be used for checking oil level. This will result in a false reading.

Later production transmissions have an oil inspection plug which can be used to set oil level correctly.



613_045



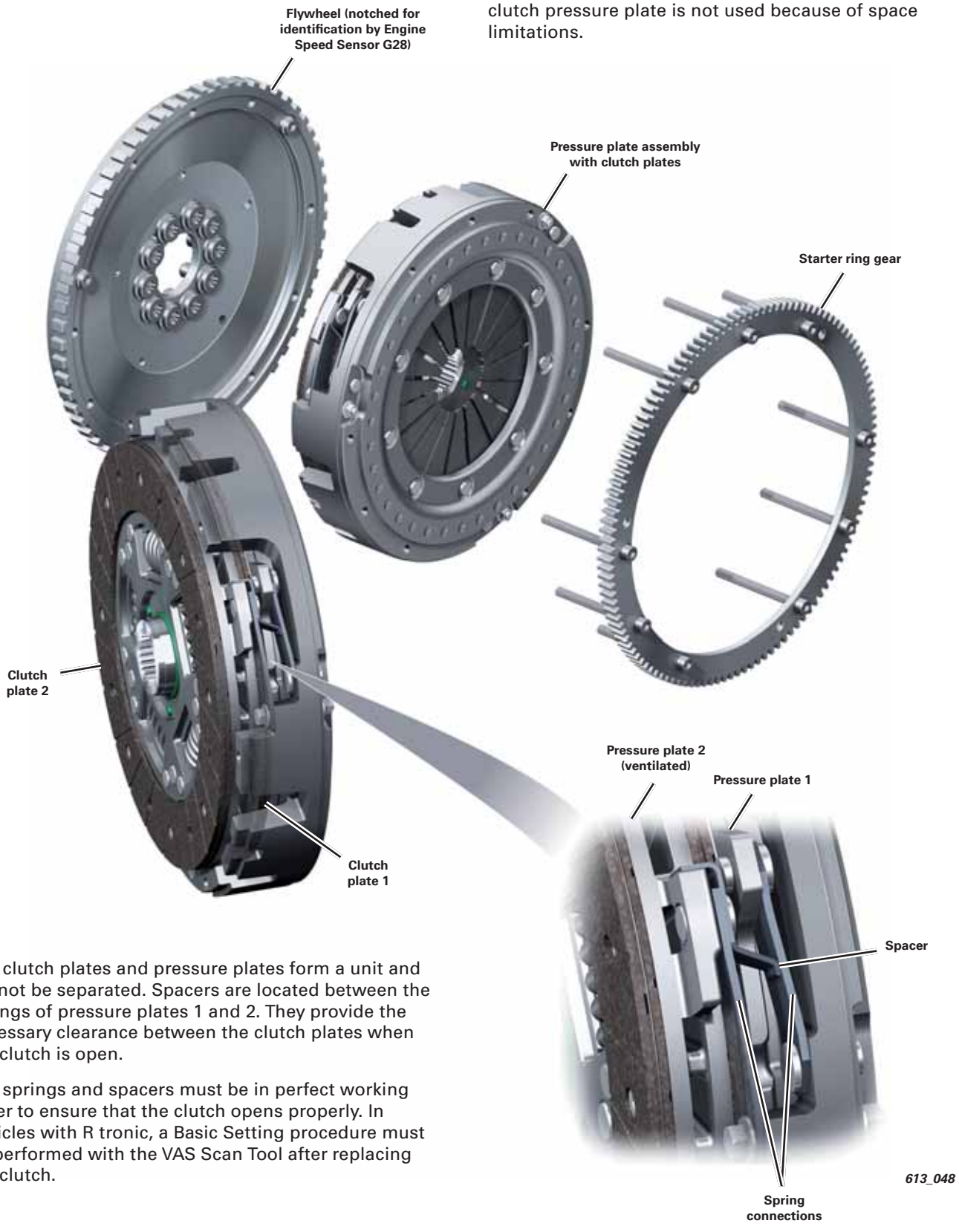
613_047

613_046

Early production transmissions have an oil inspection plug here. This must not be used for checking the oil level.

Double Plate Clutch

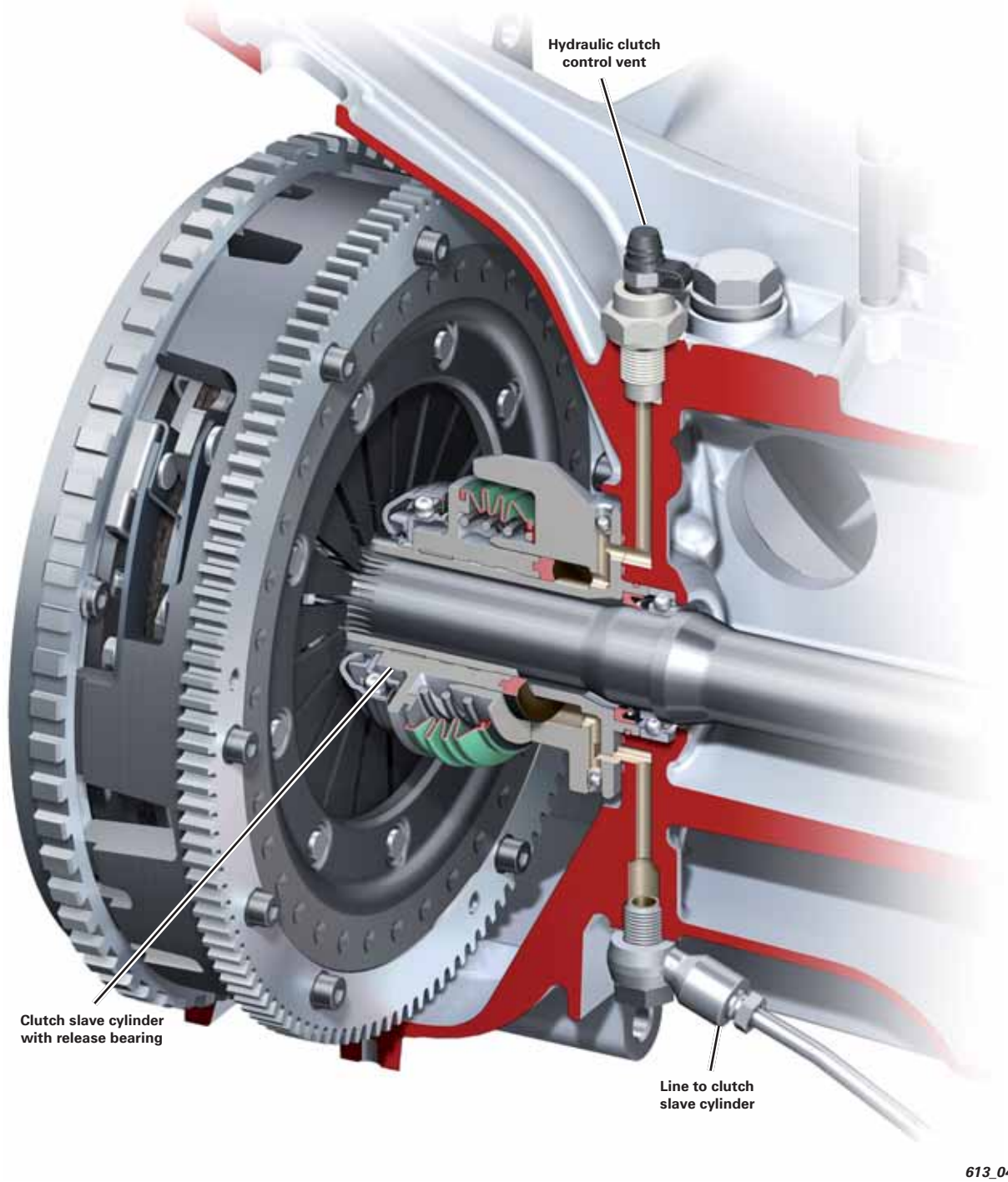
Engine torque is transmitted to the transmission by a double plate clutch. The advantage of the double plate clutch is its high torque transfer capability and relatively small diameter. A self-adjusting clutch pressure plate is not used because of space limitations.



The clutch plates and pressure plates form a unit and cannot be separated. Spacers are located between the springs of pressure plates 1 and 2. They provide the necessary clearance between the clutch plates when the clutch is open.

The springs and spacers must be in perfect working order to ensure that the clutch opens properly. In vehicles with R tronic, a Basic Setting procedure must be performed with the VAS Scan Tool after replacing the clutch.

Clutch Control — Manual Transmission 086



Clutch disengagement is done by a hydraulically actuated release bearing in both the manual transmission and the R tronic. It is installed concentrically relative to the transmission input shaft and clutch.

There are no levers or bearing points which could cause frictional losses over time in use. Hydraulic operation provides a central and more even application force for clutch disengagement.

The manual transmission uses brake fluid for release bearing operation. The R tronic uses hydraulic fluid.

Since the components are identical in design, they can be mistakenly interchanged. Components which are rated specifically for the fluid in use (for example, seals and O-rings) must not come into contact with the other type of fluid. It is important that only the correct parts are installed.

R Tronic — Clutch and Shift Control

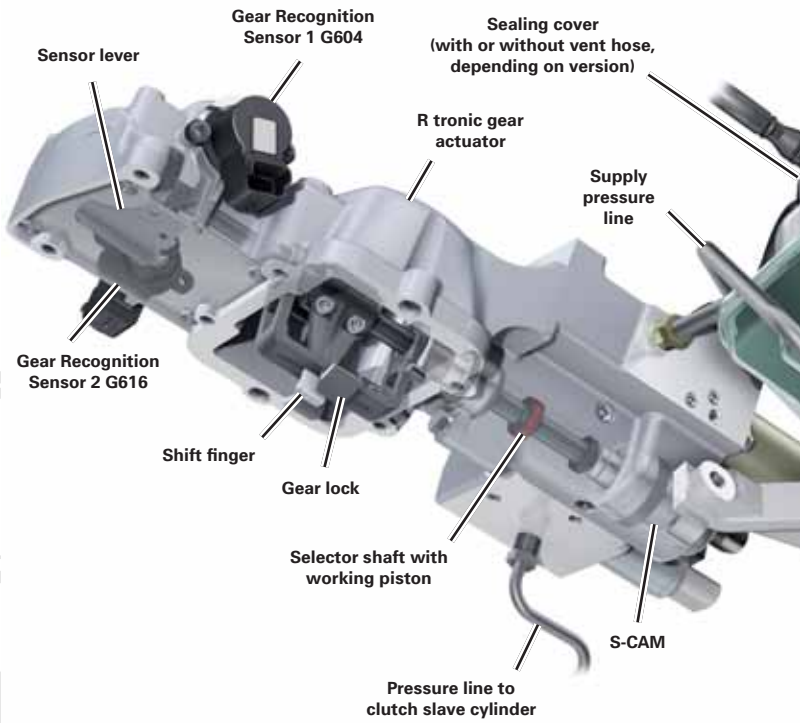
System Overview

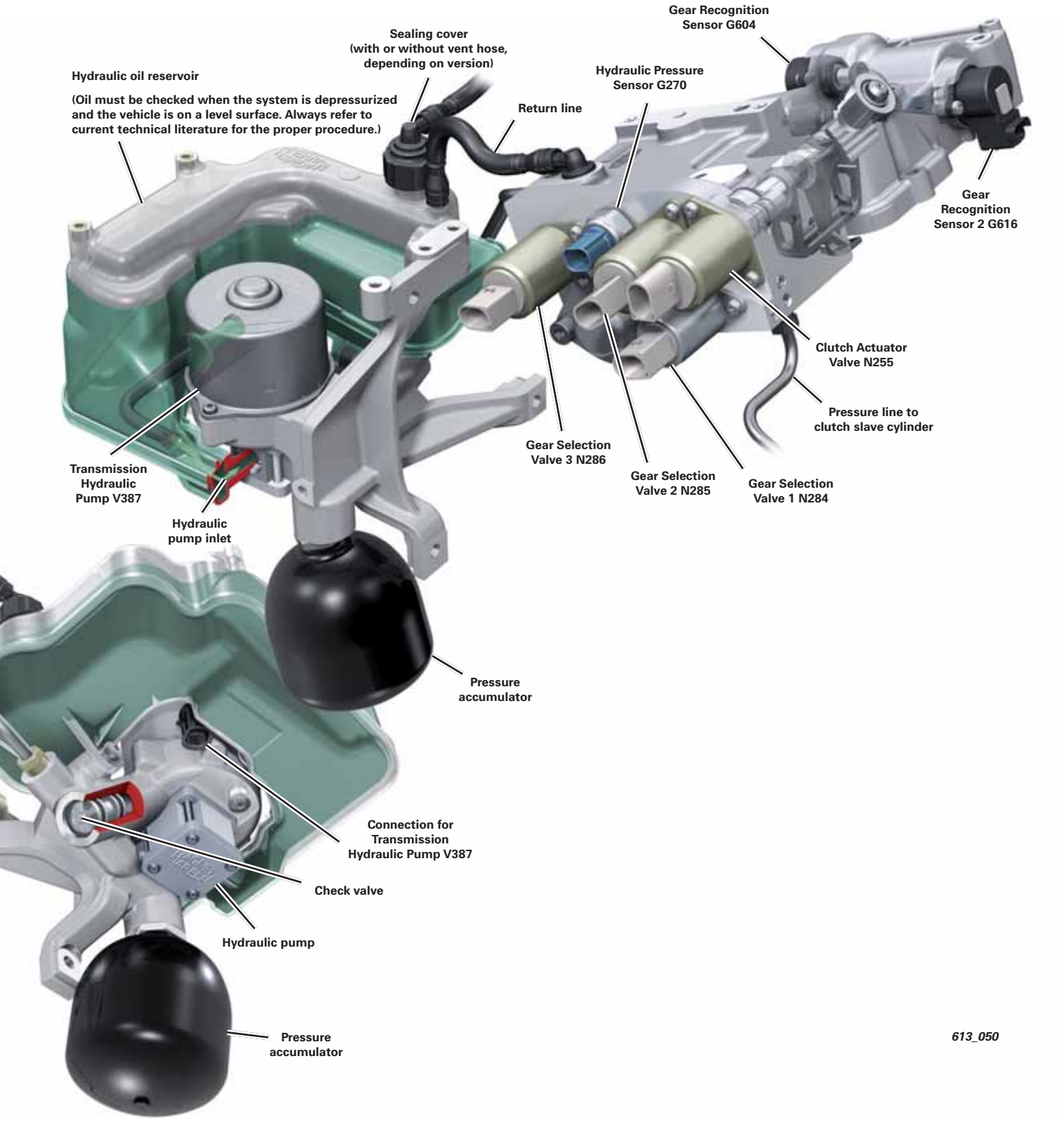
In the R tronic transmission, clutch operation and gear selection are performed hydraulically. The system is composed of two main components: the hydraulic unit and gear actuator.

The hydraulic unit supplies the gear actuator with required oil pressure, approximately 580–725 psi (40–50 bar).

The gear actuator is activated by the TCM. It changes gears and controls the hydraulic pressure applied to the clutch. The key components of the gear actuator are:

- Gear Selection Valves 1–3 (N284, N285, N286)
- Clutch Actuator Valve N255
- Hydraulic Pressure Sensor G270
- Gear Recognition Sensors 1 and 2 (G604, G616)
- Selector shaft with shift finger, gear lock, working piston, and sensor lever
- S-CAM
- Reservoir
- Transmission Hydraulic Pump V387
- Pressure accumulator

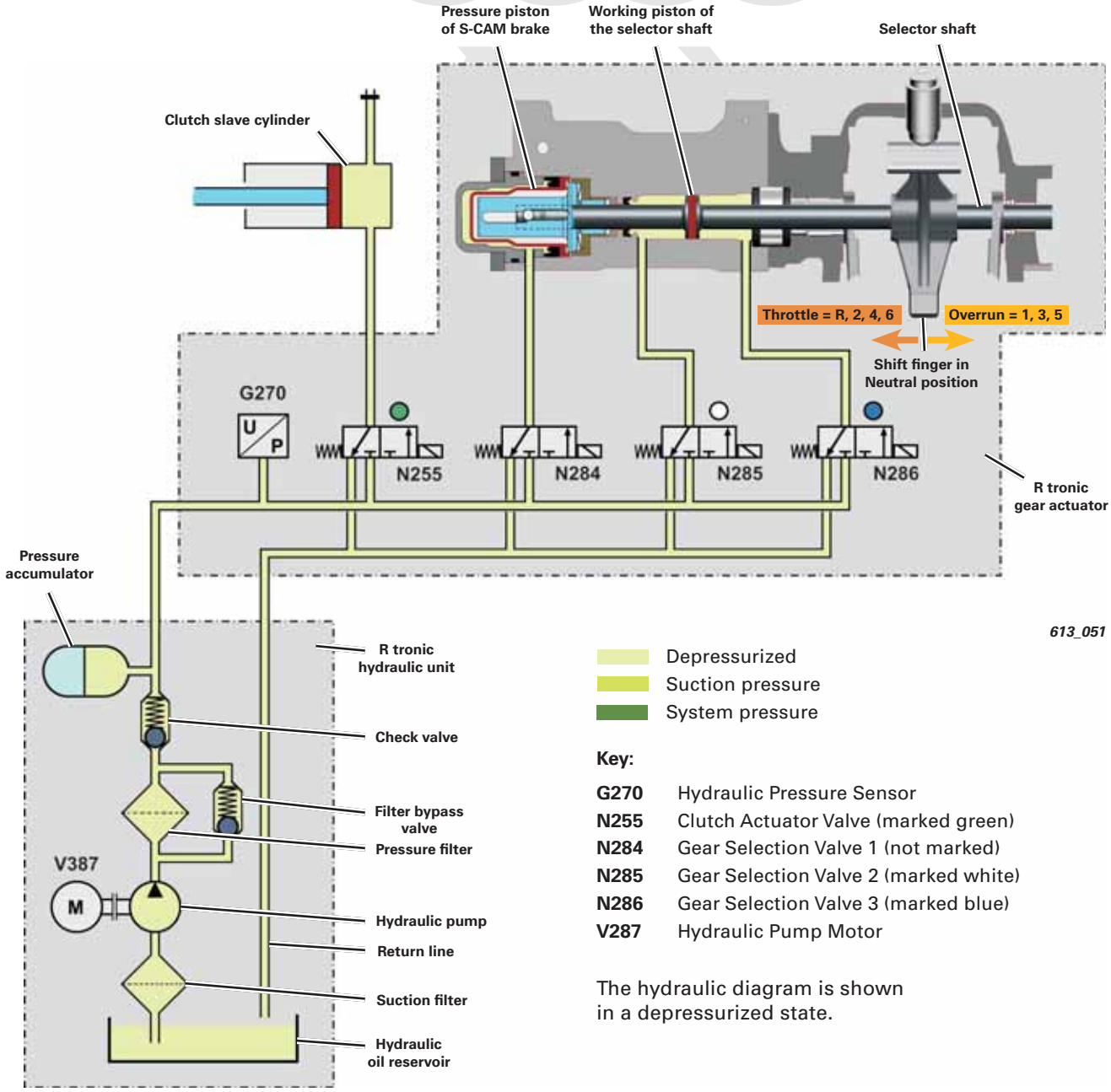




Caution!

The hydraulic control unit operates under high pressures even when the engine is not running and the ignition is switched OFF. Always depressurize the system using the VAS Scan Tool before doing any repair work.

Hydraulic Diagram



Key:

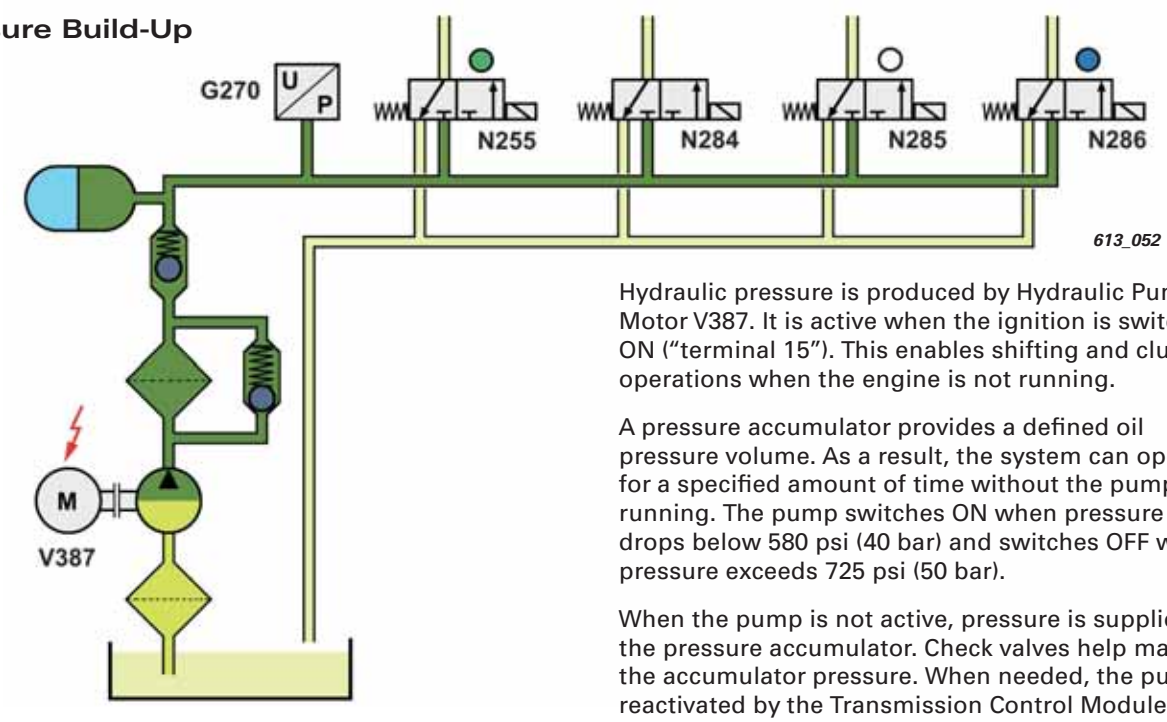
G270	Hydraulic Pressure Sensor
N255	Clutch Actuator Valve (marked green)
N284	Gear Selection Valve 1 (not marked)
N285	Gear Selection Valve 2 (marked white)
N286	Gear Selection Valve 3 (marked blue)
V287	Hydraulic Pump Motor

The hydraulic diagram is shown in a depressurized state.

The connectors on the solenoid valves are identical in design and not coded. The connectors on the wiring harness to the solenoid valves are color-coded. To ensure the wiring harness connectors are installed on the correct valves, always mark them before removal.

Special feature of N284: A pressure limiting valve is integrated into N284. It opens at approximately 1160–1305 psi (80–90 bar) and protects the hydraulic system against excess pressure. This pressure limiting function is not shown to simplify the hydraulic diagram.

Pressure Build-Up



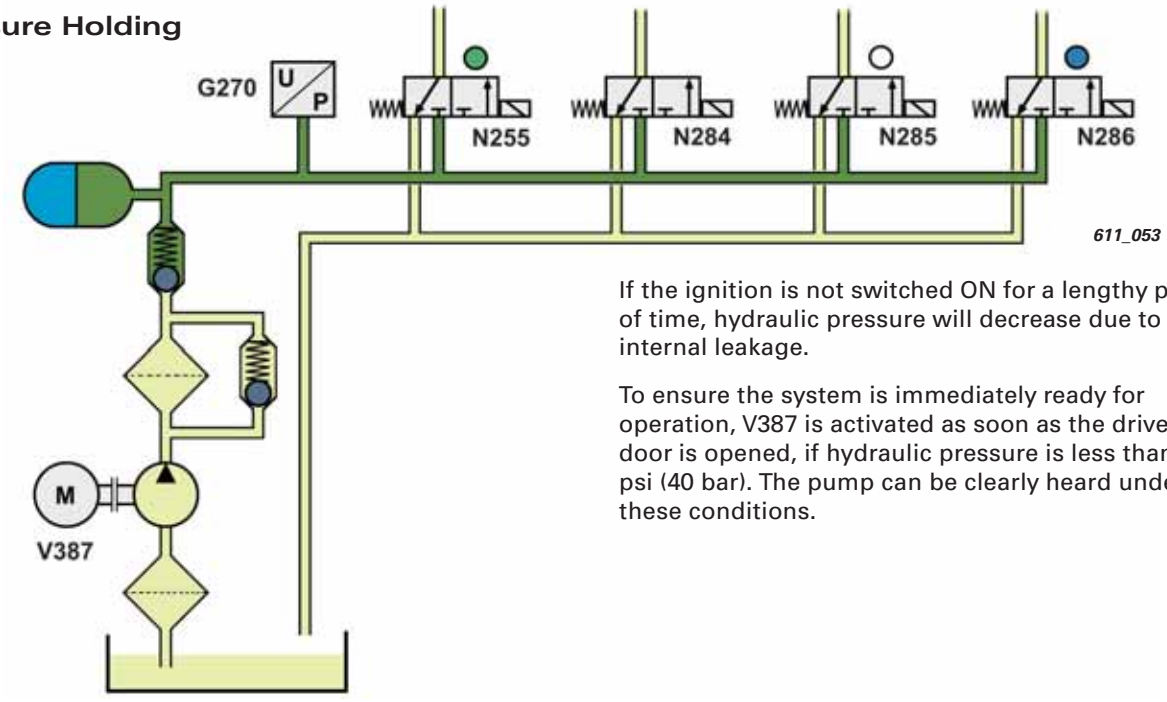
Hydraulic pressure is produced by Hydraulic Pump Motor V387. It is active when the ignition is switched ON ("terminal 15"). This enables shifting and clutch operations when the engine is not running.

A pressure accumulator provides a defined oil pressure volume. As a result, the system can operate for a specified amount of time without the pump running. The pump switches ON when pressure drops below 580 psi (40 bar) and switches OFF when pressure exceeds 725 psi (50 bar).

When the pump is not active, pressure is supplied by the pressure accumulator. Check valves help maintain the accumulator pressure. When needed, the pump is reactivated by the Transmission Control Module via a relay.

The hydraulic pump is not audible when the engine is running but can be heard if active when the engine is not running.

Pressure Holding



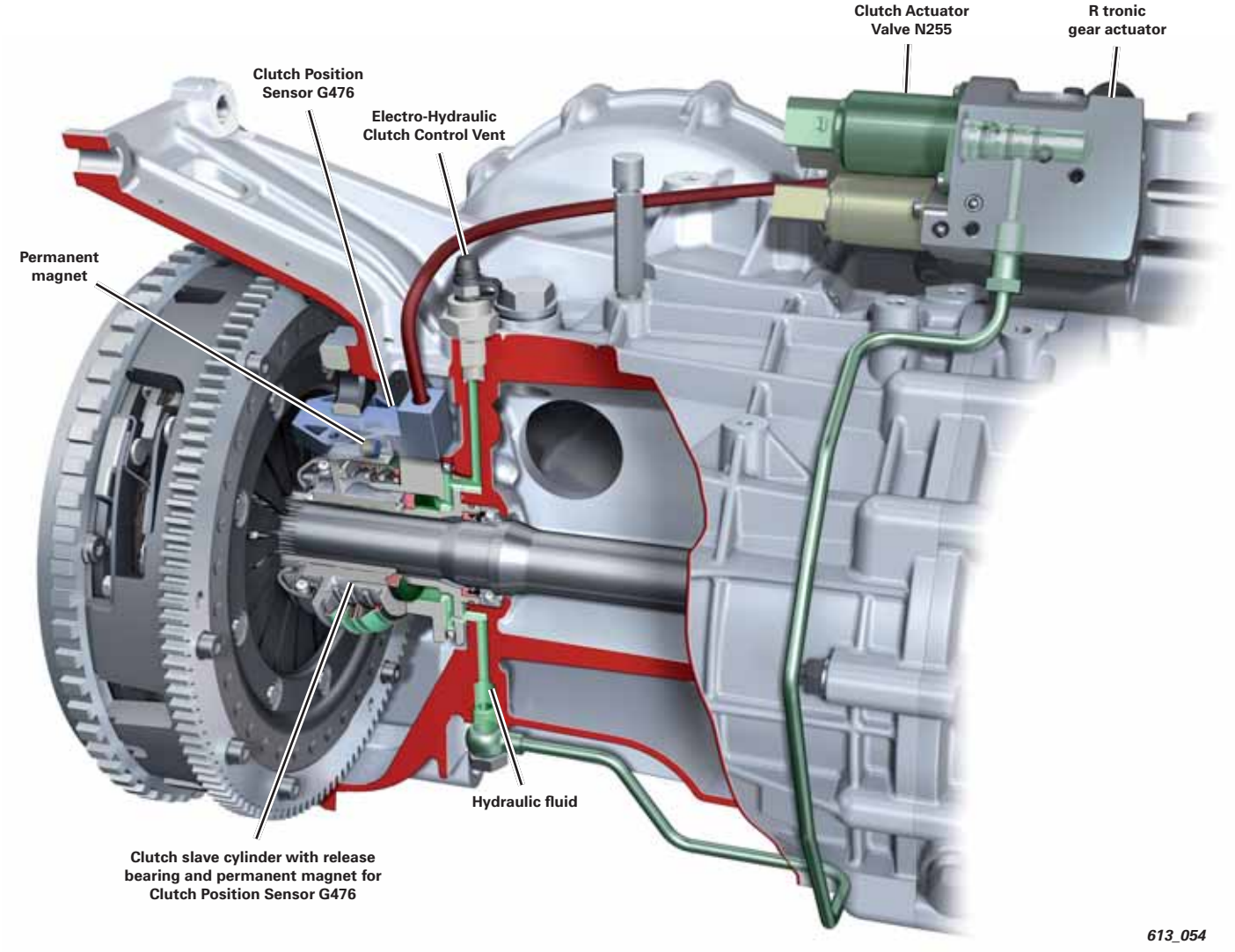
If the ignition is not switched ON for a lengthy period of time, hydraulic pressure will decrease due to internal leakage.

To ensure the system is immediately ready for operation, V387 is activated as soon as the driver's door is opened, if hydraulic pressure is less than 580 psi (40 bar). The pump can be clearly heard under these conditions.

Warning!

Before performing work on the hydraulic system, it must be ensured that the system is depressurized and that the hydraulic pump cannot be started. Refer to current technical literature and the VAS Scan Tool.

Selector Mechanism — R Tronic



The R tronic clutch is disengaged hydraulically. It is controlled electro-hydraulically by Transmission Control Module J217 and actuated by clutch Actuator Valve N255.

The amount of torque present at any defined clutch disengagement or engagement position is programmed in the TCM by a basic setting and continuous adaptation.

A permanent magnet located on the clutch slave cylinder acts upon Clutch Position Sensor G476 to determine the state of the clutch.

As stated earlier, the manual transmission uses brake fluid for release bearing operation. The R tronic uses hydraulic fluid.

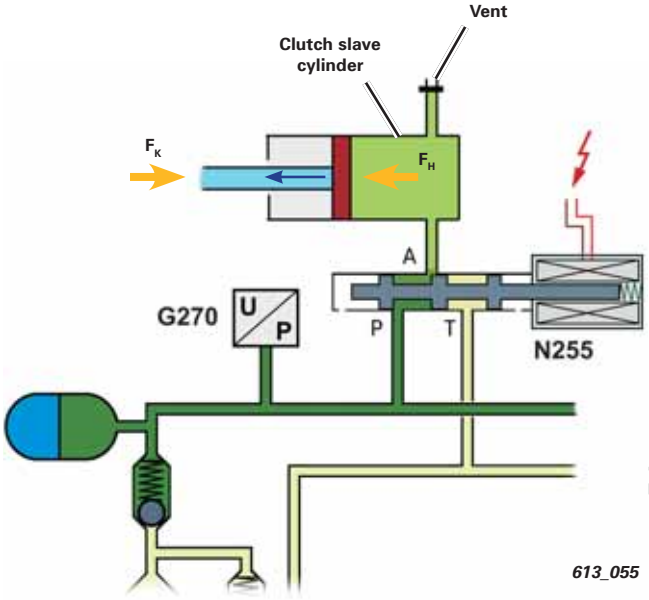
Since the components are identical in design, they can be mistakenly interchanged. Components which are rated specifically for the fluid in use (for example, seals and O-rings) must not come into contact with the other type of fluid. It is important that only the correct parts are installed.

Two basic requirements must be met to ensure proper functioning of the R tronic shifting components.

First, the clutch must be vented. This can be tested using the VAS Scan Tool.

Secondly, if the basic settings for the clutch and gear actuator are not correct, erratic operation may occur. These two basic setting adaptations can be performed using the VAS Scan Tool.

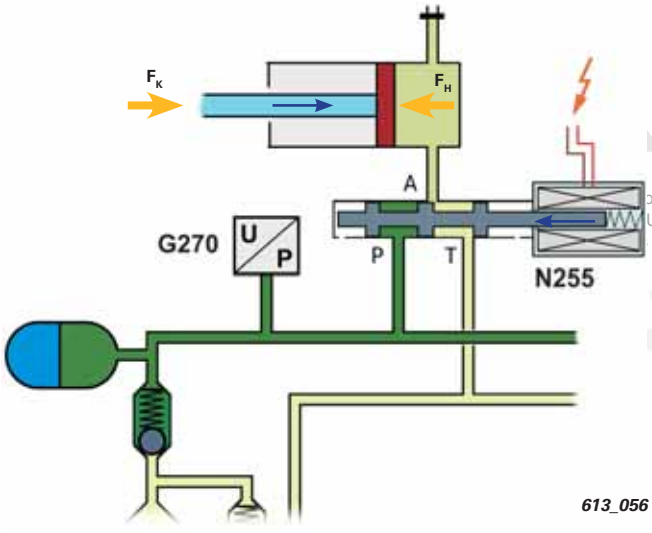
Before the engine can be started, the transmission must be shifted into Neutral and the brake pedal applied. When the engine is running and the vehicle is stationary, the clutch is always disengaged.



Clutch Disengagement

Clutch Actuator Valve N255 is initially in the center position (connection “A” closed) and is energized by application of a medium drive current. The drive current is increased to disengage the clutch.

As a result, connection “A” is opened toward connection “P”. Depending on drive current, controlled system pressure is applied to the clutch slave cylinder. The clutch disengages. If the clutch is disengaged the drive current is reduced until connection “A” is again closed. This is continuously adjusted due to slight leakage at the valve.



Clutch Engagement

The drive current is reduced to engage the clutch. As a result, connection “A” is opened toward connection “T”. The pressure (the volume) of oil from the clutch slave cylinder is admitted to the oil reservoir. The force of clutch spring F acts as a resetting force.

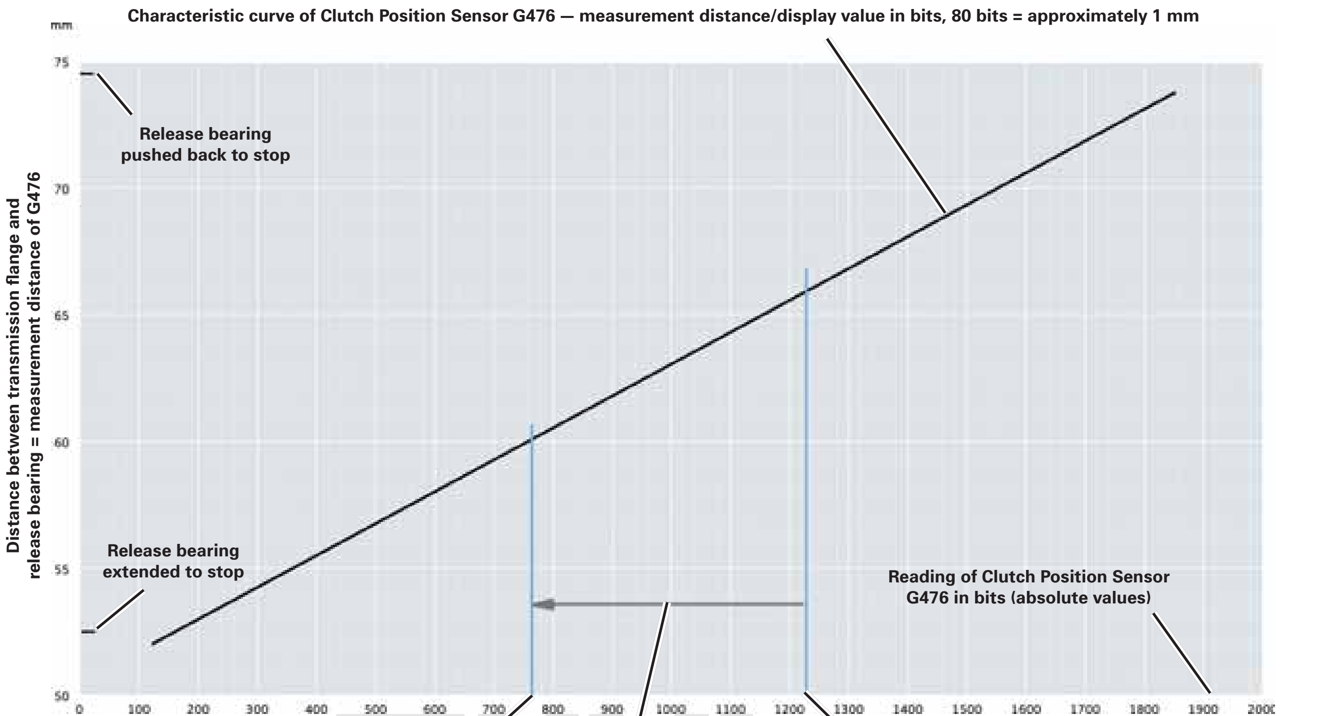
When N255 is de-energized (for example, when the ignition is OFF), the valve piston is moved to the left by the force of the spring. The clutch slave cylinder is then open toward the oil tank and the clutch is engaged.

Depressurized
Modulated clutch pressure (pilot pressure)
System pressure
F_K Spring force of the clutch diaphragm spring
F_H Hydraulic force

Clutch Control, Clutch Adaptation, and Measured Value Blocks

The clutch must be adapted to provide consistently comfortable use in every operating state and during its life cycle. To achieve this, clutch position to clutch torque ratio must be adapted continuously.

This is the only way in which the control current can be calculated correctly for Clutch Actuator Valve N255. The main clutch adaptations are explained on the basis of the corresponding MVBs.



613_057

c) 764 bit — previously adapted clutch kiss point. This value is not displayed, but can be determined from the difference between a) and b). It is defined as a zero reference point and used for further calculation by the TCM, see Fig. 613_005 next page.

b) 468 bit — previously adapted, calculated position of the clutch kiss point, differential between value a) and value c). This value is represented in MVB 10/2.

a) 1232 bit — previously adapted engaged clutch position (measured value 10/4).

The kiss point is the position at which the clutch begins to transmit torque.

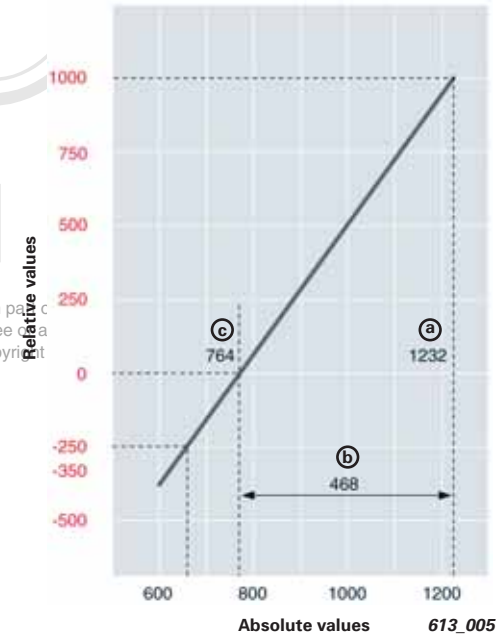
Note

All specified display values and calculated values are provided only for better understanding. The nominal values and instructions given in Guided Fault Finding generally apply.

To calculate nominal clutch position, the TCM converts the two adaptation values of G476 (absolute values) to substitute values (relative values).

A matrix is generated, whereby the clutch position of the previously adapted kiss point (764) is assigned to a value of 0 and the adaptation value for the engaged clutch (1232) assigned to a value of 1000.

Negative values are generated based on a value of 0 if the clutch is to be disengaged. A safely disengaged clutch is assigned a value of between –250 bits and –350 bits depending on whether a gear is engaged (see MVBs 11/1 and 11/3).



Explanation of MVBs

In illustration 613_058 on page 42, measured value 10/1 is an adaptation value which provides information on the clutch characteristic curve and relationship between clutch torque and release travel. This characteristic curve shows the power transmission capacity of a clutch. High index values indicate a steep curve gradient.

A clutch with a steep curve gradient engages powerfully and has a high coefficient of friction. To ensure comfortable clutch operation, the clutch must engage more softly (more slowly). Low index values are indicative of a shallow clutch curve gradient. This clutch must be engaged more quickly so that it does not slip for too long.

MVB 10/1 is adapted continuously throughout the life cycle of the clutch. Programming steps are reduced with increasing mileage. The clutch index must be reset to a default characteristic curve (default value) through the “clutch basic setting” function using the VAS Scan Tool after replacing the clutch or the TCM.

The clutch index must not be reset without good reason. The default characteristic curve (default value) registered when the clutch index is reset can deviate considerably from the characteristic curve of a clutch in a vehicle with mileage.

If the clutch index is reset without good reason, it can have detrimental effects on the clutch and shift quality. The effects on MVBs 10/3 and 31/1–3 must be taken into consideration (see next page).

The clutch index is adapted whenever the vehicle drives away from a standing start if the following conditions are met:

- Drive-away with an accelerator angle of up to 30%
- Clutch lining temperatures between 158–230°F (70–110°C)

Guided Fault Finding	Audi V19.38.02
Function test	Audi R8 2007>
J127 Read data block	2010 (A)
	Spyder
	BUJ 5.2 FSI / 386 kW

Read out measured values			Read
ID	Measured value	Result	Setpoint
010/1	Clutch wear index	3106	–2000 – 12000
010/2	Clutch kiss point position, 0 Nm ...	468	380 – 600
010/3	Clutch fully closed position (g ...	1214	1050 – 2000
010/4	Clutch fully closed position (a ...	1232	1050 – 2000
011/1	Clutch position –G476 (actual value)	–254	–350 – 1000
011/3	Clutch position (nominal value)	–250	–350 – 1000
011/4	Clutch temperature (calculated)	46.0°C	–40 – 250°C

613_058

Measured value 10/2 is the differential value of the adapted clutch position when the clutch is closed (engaged) relative to the position of the adapted clutch kiss point (absolute value). The kiss point is the clutch position at which the clutch begins to transmit torque. For the TCM, this value is a very important basic value for calculating the control current for N255. This value is not the ideal clutch position at the kiss point, rather it indicates the difference to the adaptation value for the closed clutch (10/4) — see Fig. 613_057, description of a), b) and c).

Kiss point adaptation begins if the engine has been running at idle speed a defined period of time (approximately four seconds) at a coolant temperature below 158°F (79°C) and the transmission is in Neutral. The clutch is closed slowly until the transmission input shaft starts to rotate and a transmission input speed is detected.

Kiss point adaptation can be initiated using the “clutch basic setting” function using the VAS Scan Tool.

Measured value 10/3 shows the adaptation value for clutch position when the clutch is closed (absolute value) at the time of initial clutch adaptation (in as-new condition). The value is cleared and reprogrammed when the clutch index is reset.

This is the reason why the clutch index should only be reset after replacing the clutch. Refer to the description of measured value 10/1.

If it can be assumed that MVB 10/3 has not been reset, clutch lining wear will be measurable. For this purpose, the value of measured value 10/3 is subtracted from measured value 10/4.

Example with explanatory notes:

10/4 = 1232 bit

10/3 = 1214 bit

= 0018 bit (80 bit = approximately 1 mm, see Fig. 613_057)

Clutch lining wear can be determined indirectly from the travel of the release bearing: 18 bit = 1/80 mm x 18 = approximately 0.225 mm. To determine actual lining wear, the leverage ratio of the diaphragm springs must still be taken into account.

Measured value 10/4 shows the last position adaptation value programmed for the clutch when closed (absolute value). This value increases with progressive lining wear over time. An important value, it serves as a basic value for clutch control.

The adaptation is made if the ignition has been ON for a specified period of time (“terminal 15” ON), the engine is at a standstill, and Clutch Actuator Valve N255 is not energized.

Converted as a relative value, MVB 11/1 shows current clutch position (actual value). See description adjacent to Fig. 613_005, page 41.

- Clutch closed — approximately 1000
- Clutch open — approximately –250 to –350

MVB 11/2 is identical to MVB 10/2.

Converted as a relative value, MVB 11/3 shows nominal clutch position (reference value).

- Clutch closed — approximately 1000
- Clutch open — approximately –250 to –350

MVB 11/2 shows current clutch temperature (in °C) calculated by the TCM.

- Clutch closed = clutch plates engaged
- Clutch open = clutch plates not engaged

Warning — Clutch Too Hot

The R tronic does not have an active clutch protection function capable of preventing the clutch from overheating. The TCM calculates the clutch lining temperature continuously.

At a clutch temperature of approximately 320°F (150°C), drive-away speed is reduced to minimize heat transfer to the clutch. At a clutch temperature of approximately 518°F (279°C), a warning is displayed in the DIS, and a warning tone (gong) sounds.

This tone warns the driver not to place any further load on the clutch and, if possible, to allow the clutch to cool down. A corresponding DTC entry is made in the TCM.

When the warning “Clutch hot!” is displayed, the driver should take the following steps:

- Driving situation permitting, the driver should immediately accelerate to a speed that closes the clutch, which will remove the “Clutch hot!” display warning
- Driving situation permitting, stop and allow the engine to idle for several minutes. The clutch is disengaged in this case and cools down relatively quickly

Note

At temperatures exceeding approximately 572°F (300°C) the clutch lining incurs permanent damage. At this temperature the binding resin begins to evaporate and the lining material loses strength, resulting in increased wear.

At temperatures exceeding approximately 662°F (350°C) the coefficient of friction drops sharply and the clutch no longer transmits the full amount of torque. As temperatures continue to rise, the lining degrades totally.

Various items of information about temperature load on the clutch are displayed in MVB 31.

- 31/1 Number of warnings
- 31/2 Maximum time (in seconds) when the warning is activated
- 31/3 The maximum clutch lining temperature attained

Caution! These values are deleted when the clutch index is reset. This is why the clutch index should only be deleted if the clutch is replaced.

Electro-Hydraulic Shift Mechanism

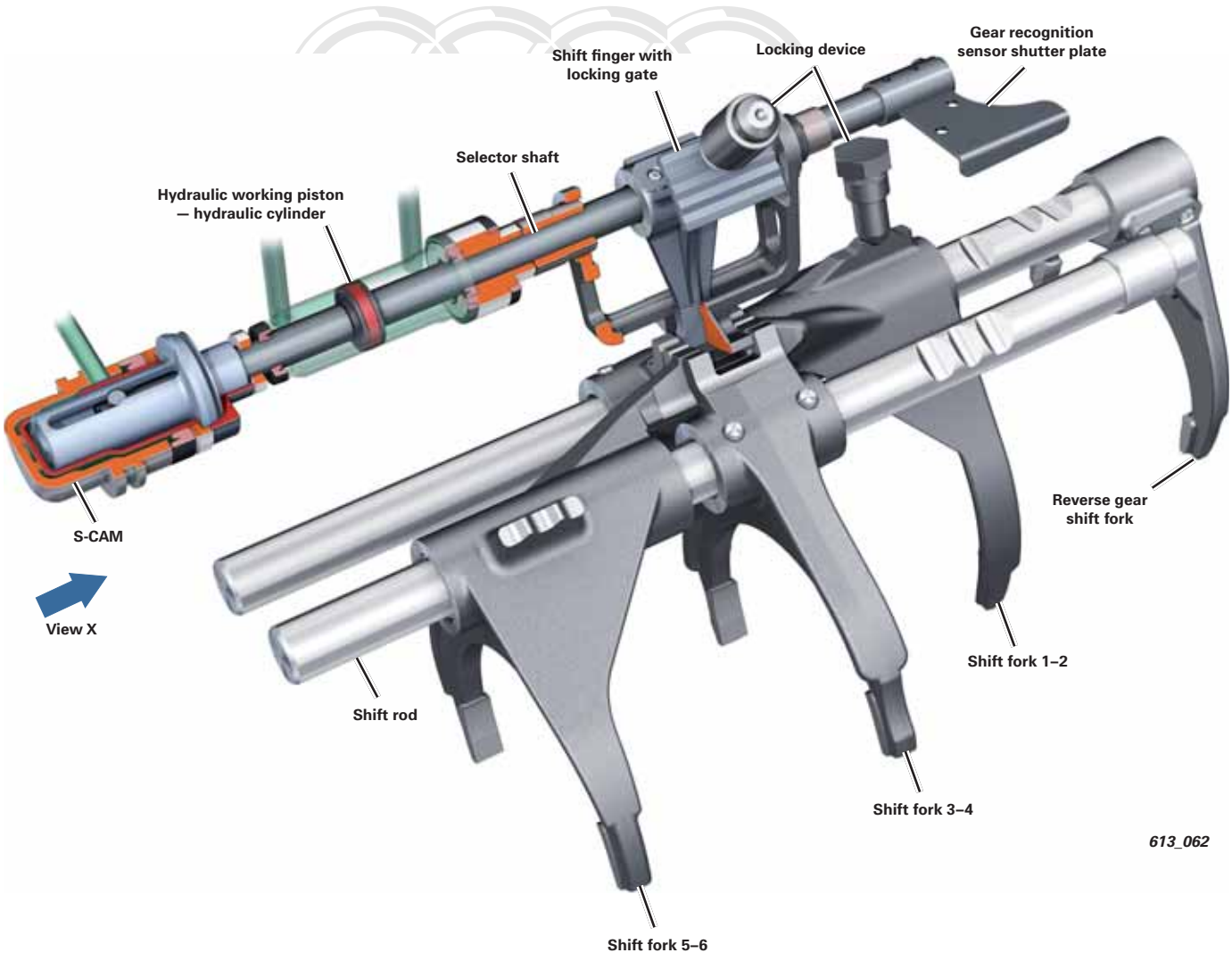
R Tronic Gear Actuator/Internal Selector Mechanism

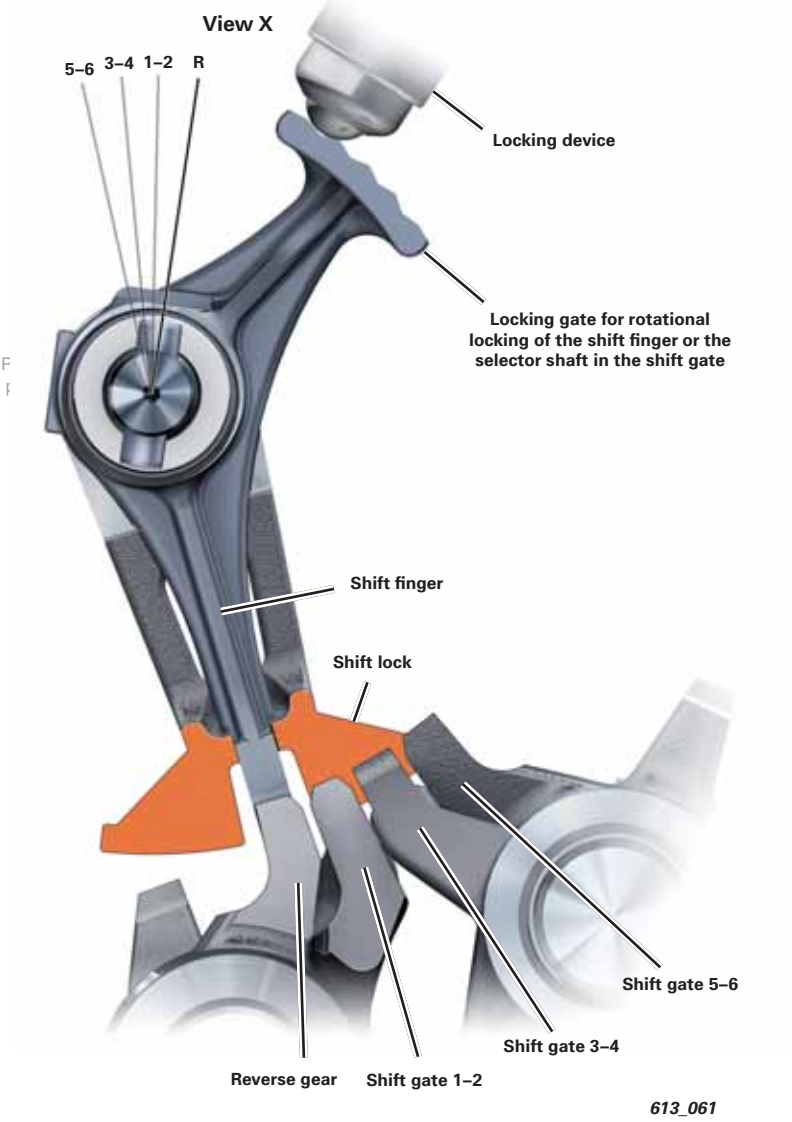
Retaining the shift kinematics of the manual transmission for the R tronic transmission requires a gear actuator that moves four shift rods/shift forks in the same way, turning a selector shaft around its longitudinal axis, as well as in an axial direction. The electro-hydraulic shift mechanism moves a shift finger in the same way as in the manual transmission.

The axial movement necessary for gear selection (within a shift gate) is produced by a double-acting hydraulic cylinder. The piston of the hydraulic cylinder is seated directly on the selector shaft. While the shift finger is attached to one side of the selector shaft, the S-CAM is located on the other side. The S-CAM helps to produce the rotational movement of the selector shaft required to switch between shift gates.

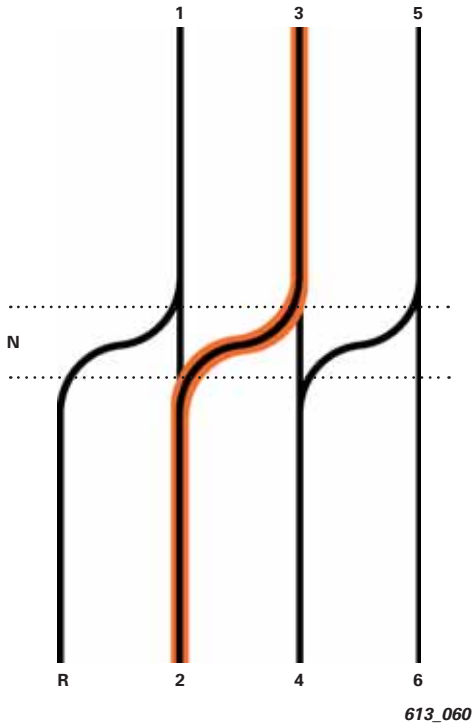
The selector shaft is a continuous shaft running from the gear recognition sensor shutter plate to the S-CAM. The following parts are permanently connected to the selector shaft:

- Gear recognition sensor shutter plate
- Shift finger with locking gate for rotational locking
- Hydraulic working piston (hydraulic cylinder)
- Gate block (pin)





Shift diagram



To keep reaction times of the gear actuator as short as possible, the shift jaws are made of a much thinner material than those of the manual transmission. This has made it possible to reduce the torsion angle of the selector shaft to 7° from approximately 15°. As a result, the gear actuator has less distance to travel when changing shift gates, which in turn allows faster shift times to be achieved.

Shift speed is controlled (as a function of distance and time) up to an accelerator pedal actuation of approximately 35%. From an accelerator pedal actuation of approximately 35%, Gear Selection Valve 2 N285 and Gear Selection Valve 3 N286 are pressure-controlled as a function of control current. The greater the accelerator pedal angle, the higher the control current and pressure in the hydraulic cylinder.

S-CAM

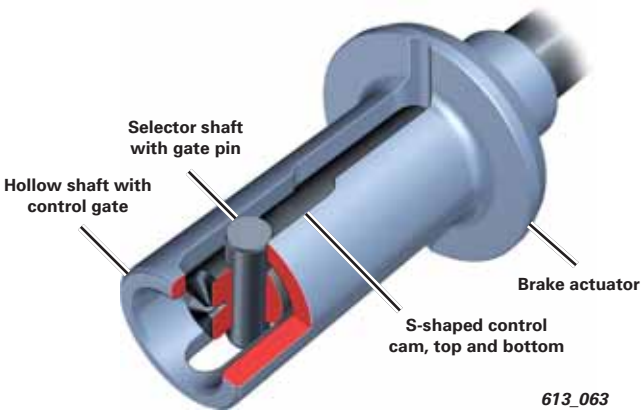
The name S-CAM refers to the shape and functional principle of the shift actuator mechanism. “S” stands for the S-shaped control cam in the hollow shaft of the selector shaft. The control cam is referred to as a control gate or gate. The control gate produces a slight rotational movement through which the shift finger changes the shift gate.

S-CAM Function

The offset (S shape) of the upper and lower control cams is opposed. If the selector shaft is moved back and forth axially by the hydraulic cylinder, the gate pin slides along the gates of the hollow shaft. When the gate pin travels through the offset (S shape), it produces a slight rotational movement.

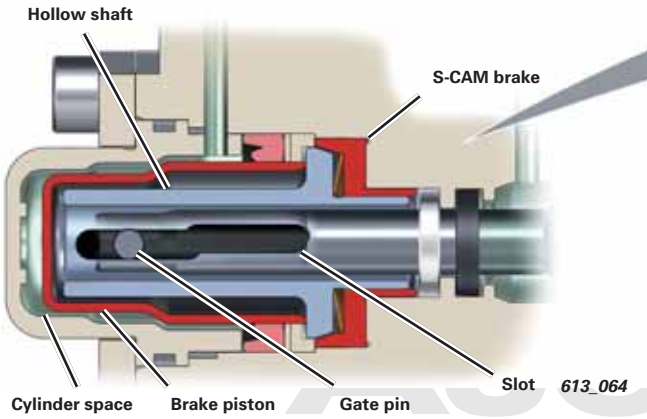
This rotational movement is initially performed by the hollow shaft because the selector shaft is held in both directions of rotation by the detent.

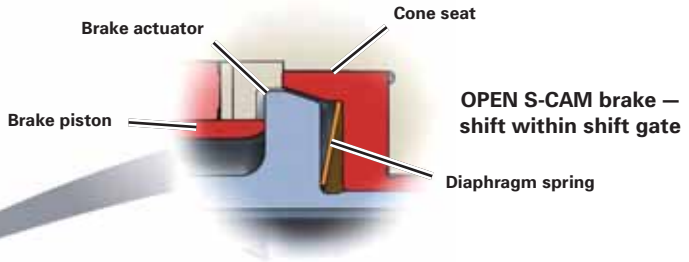
Depending on the axial direction of rotation of the selector shaft (when changing gears within a shift gate, for example, when changing from 1st to 2nd gear), the hollow shaft rotates slightly to the left and to the right.



To change shift gates, for example, when shifting from 2nd to 3rd gear, the selector shaft must also perform a slight rotational movement in order to move the shift finger into the desired shift gate. The hollow shaft must be held in place (braked) so that the selector shaft can perform this rotational movement. This task is performed by the S-CAM brake.

Design and function of the S-CAM brake

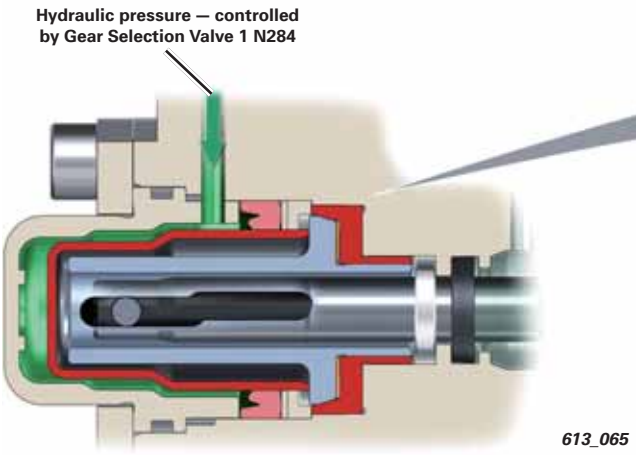




OPEN S-CAM brake — shift within shift gate

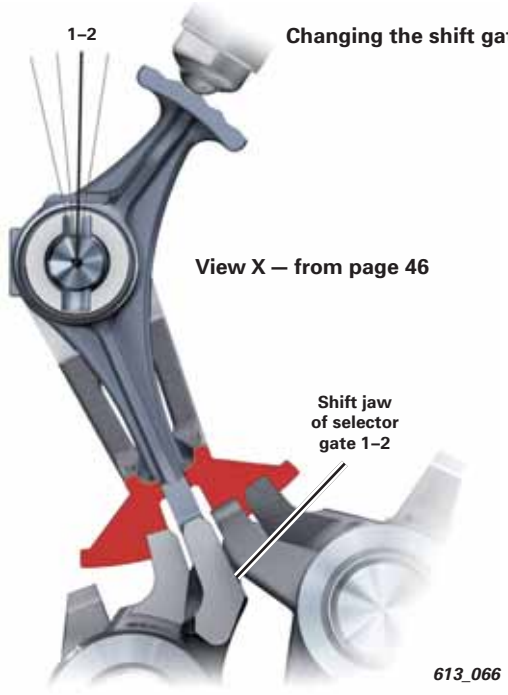
The hollow shaft has a collar with a conical end face which serves as a brake cone. The tubular brake piston which rests on the collar of the brake cone is located over the hollow shaft.

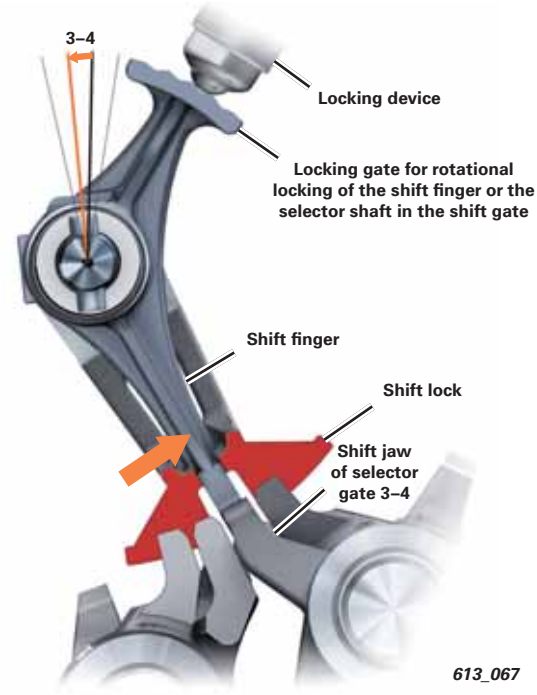
The housing of the S-CAM forms a cylindrical space for the brake piston. The diaphragm spring maintains a clearance between the brake cone and cone seat. When no pressure is applied, the hollow shafts rotates about the offset in the gate when the gate pin runs along the gate during gear-shifting.



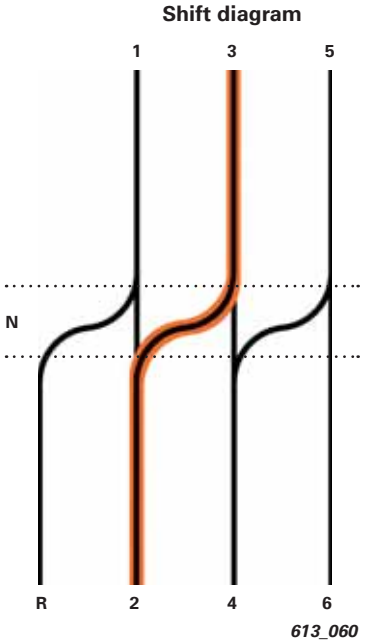
CLOSE S-CAM brake — change shift gate

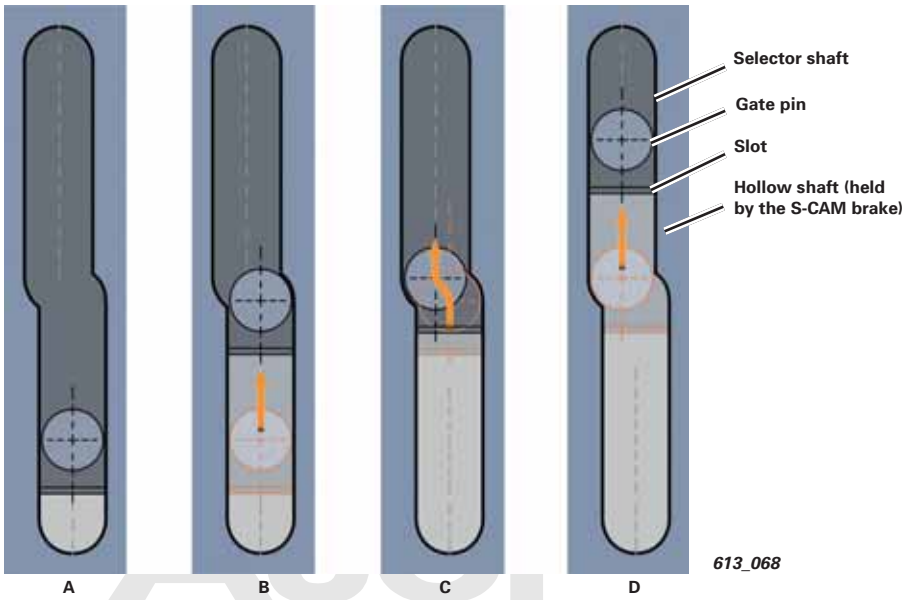
If pressure is applied to the cylindrical space, the brake piston pushes the brake cone against the cone seat. As a result, the hollow shaft locks up and is no longer able to rotate. If the selector shaft is moved axially during gear shifting (for example, 2→3), the gate pin produces a slight rotational movement of the selector shaft when travelling through the S offset of the gate. This is the position in which the selector gate is changed (see Fig. 613_068 C).





Change of shift gate — shown using the 2→3 gearshift as an example





The figures above, which are subdivided into four phases, show the changing of the shift date using a gearshift from 2→3 as an example

A — starting position, 2nd gear is engaged.
The shift finger is in the 1–2 shift gate.

B — start of gearshift.
The selector shaft is moved axially toward the odd-numbered gears until the shift finger is in the center position of the shift gate (Neutral position). The S-CAM brake is closed at the same time.

C — gate pin passes the S-offset of the gate.
When the gate pin travels through the gate offset, the selector shaft is rotated slightly and the shift finger is moved into the 3–4 shift gate.

D — shift into 3rd gear.
The selector shaft moves until 3rd gear is engaged.

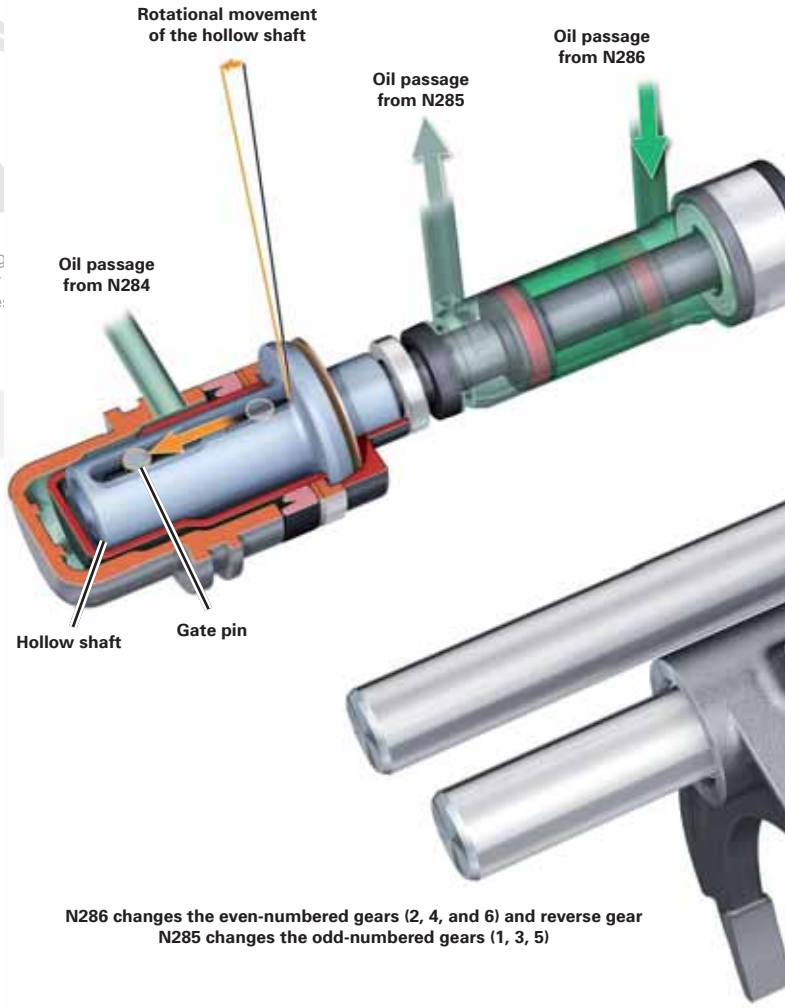
Shift Sequence — Gear-Changing

1. Gear change without change of shift gate (shown using the gearshift from 1st to 2nd gear as an example)
2. Gear change with change of shift gate (shown using the gearshift from 2nd to 3rd gear as an example)

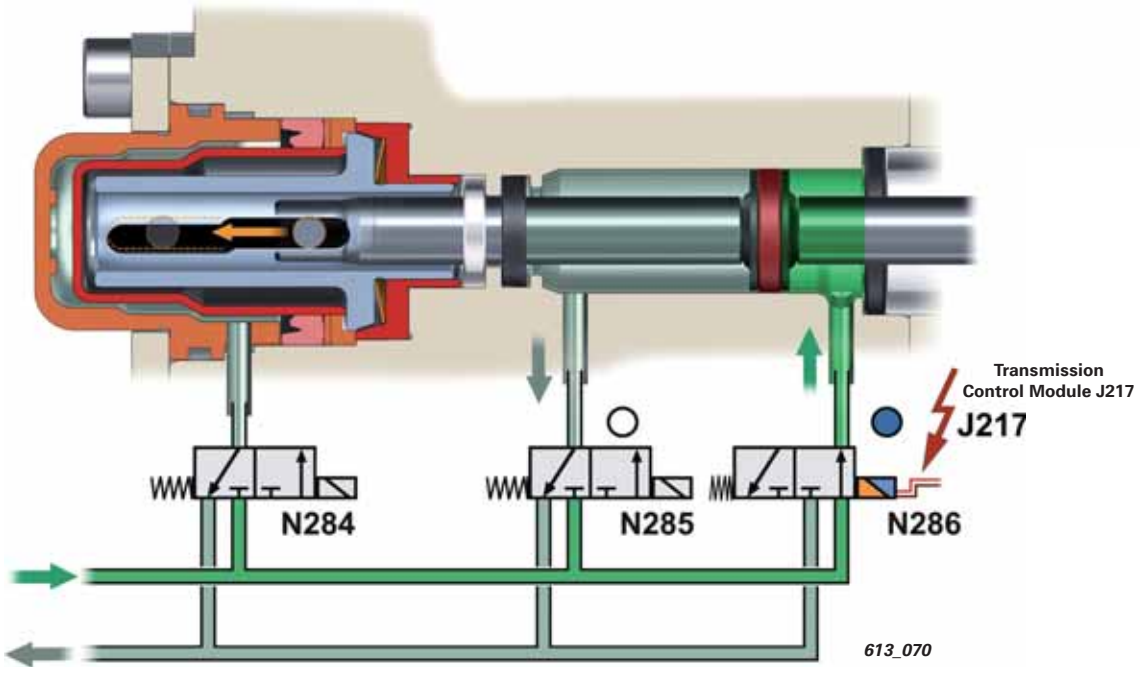
1. Gear-Changing Without Change of Shift Gate (1→2)

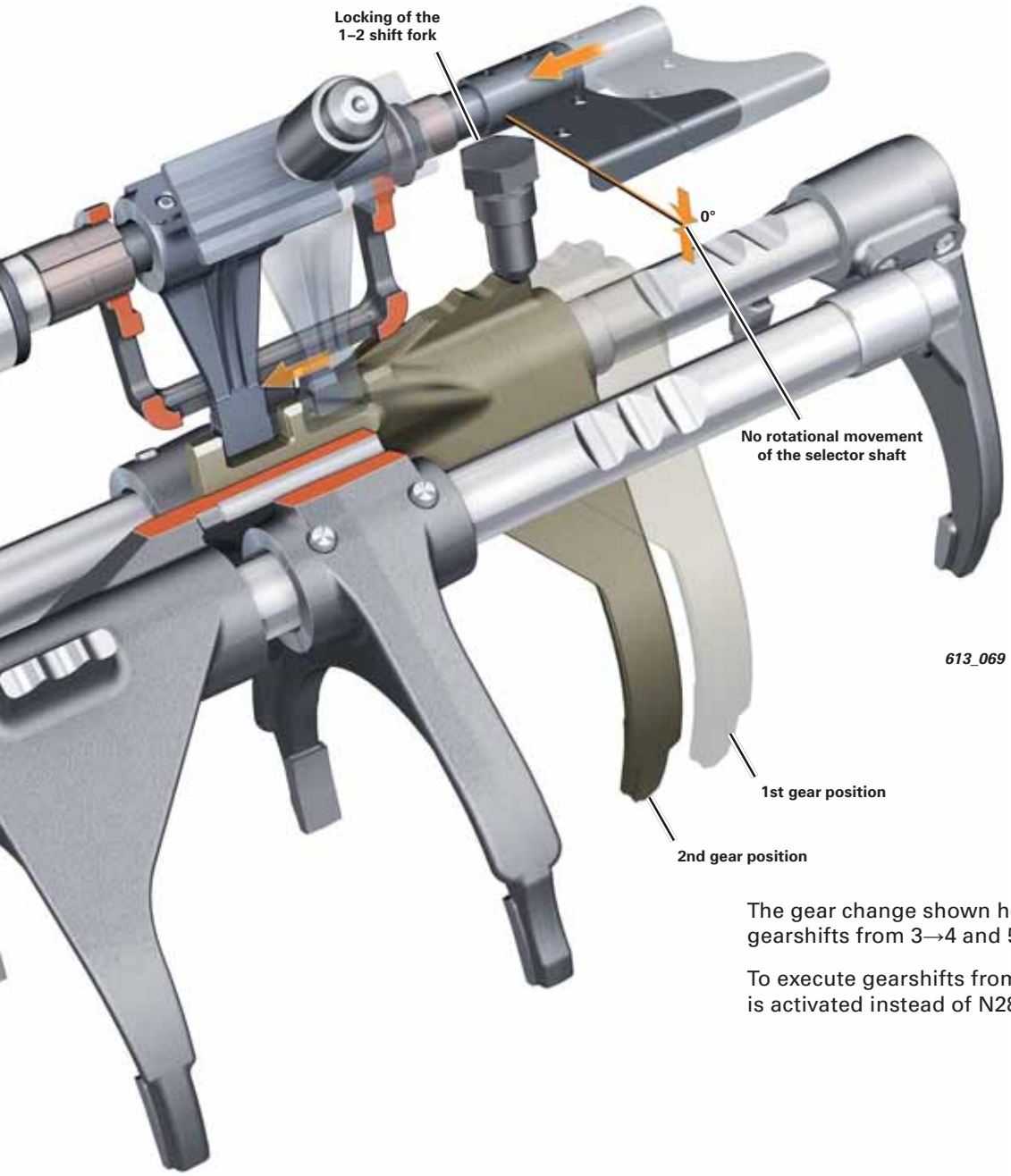
1st gear is initially engaged. To shift into 2nd gear, Gear Selection Valve 3 N286 is energized and pressure admitted to the right cylinder space of the double acting hydraulic cylinder. The left cylinder space is vented through Gear Selection Valve 2 N285, which is de-energized. The piston moves the selector shaft together with the shift finger to the left toward 2nd gear.

The S-CAM brake is also vented through the de-energized Gear Selection Valve 1 N284 and the brake is open. If the gate pin travels through the gate offset, the hollow shaft deflects by performing a slight rotational movement, because the selector shaft is prevented from rotating by the lock with a defined amount of force (see illustration 613_072 B).



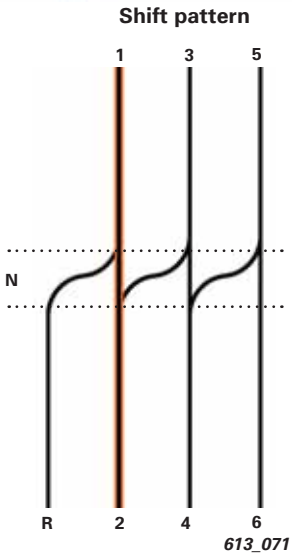
N286 changes the even-numbered gears (2, 4, and 6) and reverse gear
N285 changes the odd-numbered gears (1, 3, 5)

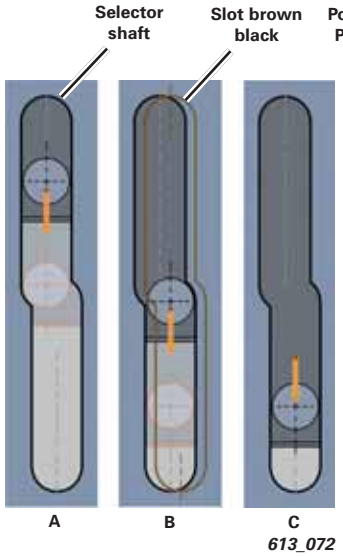




The gear change shown here applies equally to the gearshifts from 3→4 and 5→6.

To execute gearshifts from 6→5, 4→3, and 2→1, N285 is activated instead of N286



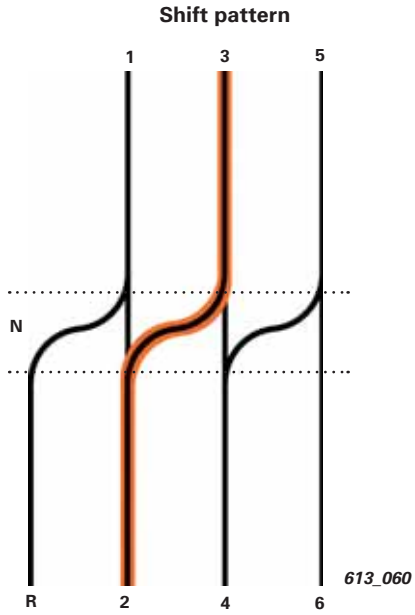


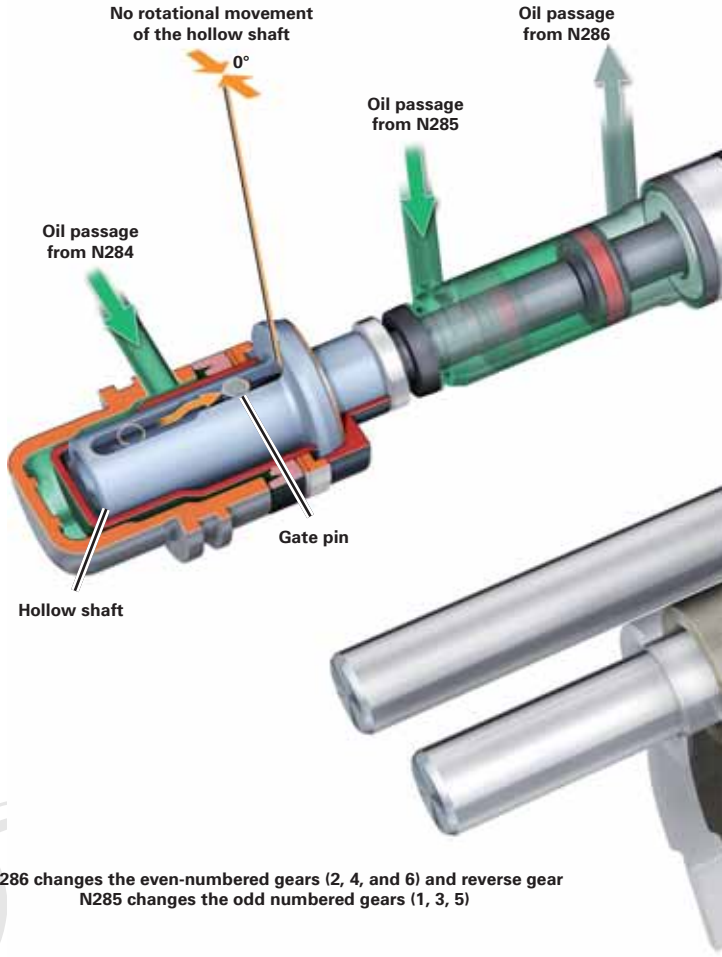
A — starting position, 1st gear is engaged, start of gearshift.
The shift finger moves axially toward the even-numbered gears.

B — the gate pin passes the gate offset.
When the gate pin travels through the gate offset, the hollow shaft is rotated slightly. Since the S-CAM brake is open, the hollow shaft deflects because the selector shaft is locked.

C — shift into 2nd gear.
The selector shaft travels on until 2nd gear is engaged.

2. Gear-Changing With Change of Shift Gate (2→3)

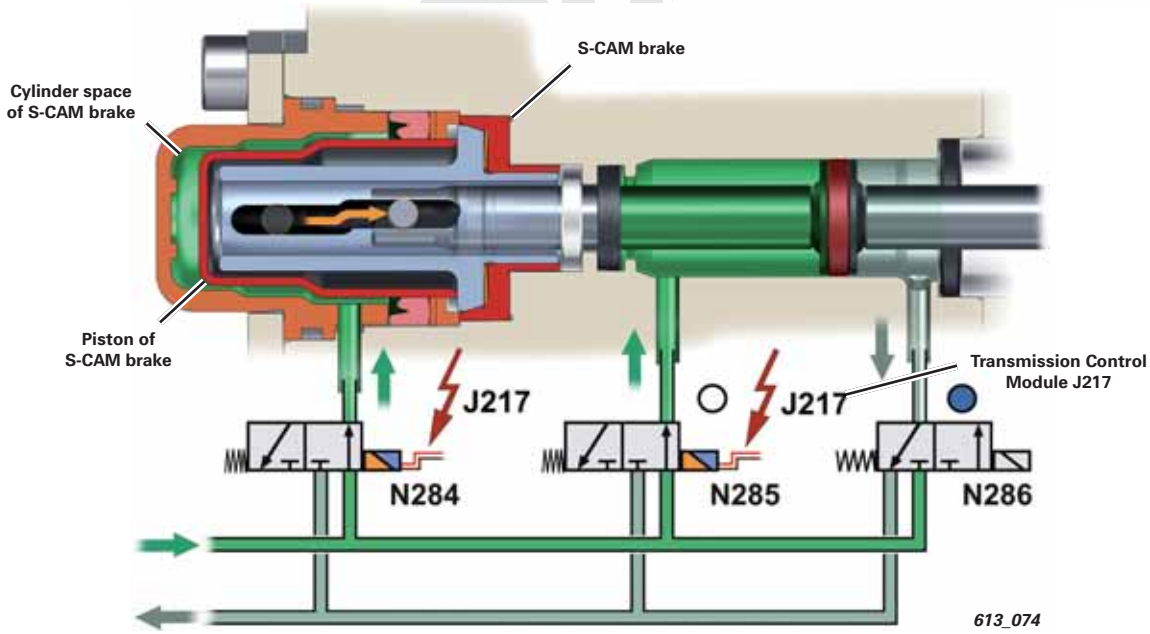


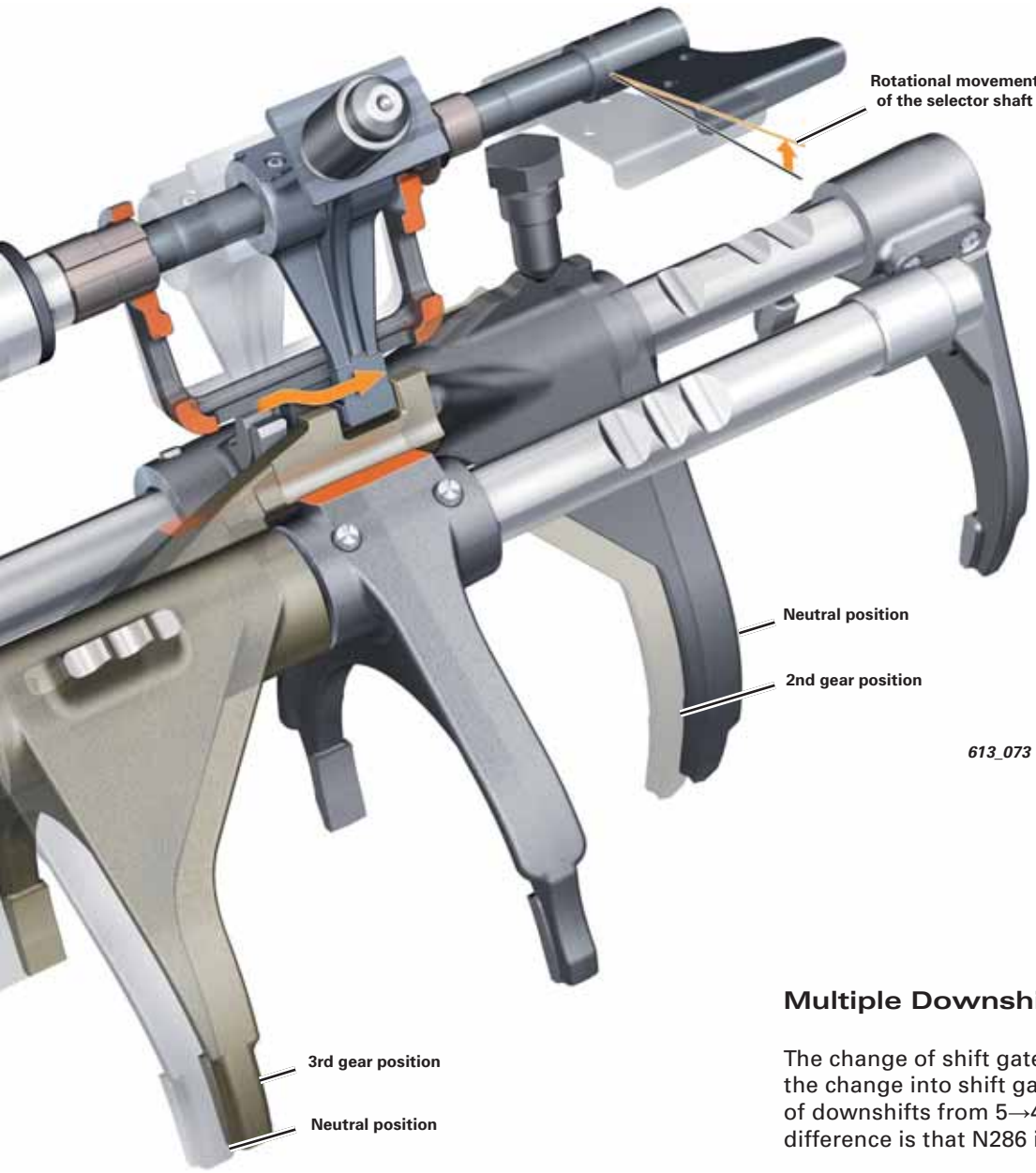


N286 changes the even-numbered gears (2, 4, and 6) and reverse gear
N285 changes the odd numbered gears (1, 3, 5)

To shift from 2nd to 3rd gear, the shift gate must be changed. During this, the S-CAM brake engages. Gear Selection Valves N285 and N284 are energized. N285 admits the pressure into the left cylinder space. The right cylinder space is vented through the de-energized open valve N286. N284 admits the pressure into the cylinder space of the S-CAM brake, thereby locking the hollow shift.

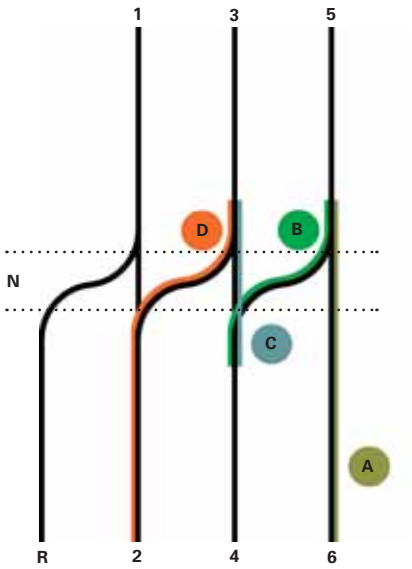
When the gate pin travels through the gate offset, the selector shaft is forced to execute a rotational movement. The gate offset corresponds exactly to the rotational movement which is necessary to guide the shift finger into the next shift gate.





613_073

Shift pattern



613_075

Multiple Downshifts

The change of shift gate shown applies equally to the change into shift gate 5–6 or N–R. In the case of downshifts from 5→4, 3→2 and 1→R, the only difference is that N286 is activated instead of N285.

Gears can only be changed one shift gate at a time. Multiple downshifts, for example, a downshift from 6→2 (across two shift gates) is performed in four steps. In the process, the gears are not fully selected, rather the selector shaft is only moved to the extend that the gate pin travels the S offset in order change from one shift gate to another.

A — gearshift from 6th gear toward 5th gear, just slightly past the Neutral position. Activation of N285, S-CAM brake open.

B — change from shift gate 5–6 to shift gate 3–4. Activation of N286 and N284, S-CAM brake closed.

C — gearshifts toward 3rd gear, just slightly past the Neutral position. Activation of N285, S-CAM brake open.

D — change from shift gate 3–4 to shift gate 1–2 and shift into 2nd gear. Activation of N286 and N284, S-CAM brake closed.

Basic Setting, Shift Adaptation, Self-Diagnostics, Measured Data

Gearshifts must be controlled precisely. The transmission control module always needs to know the exact position and movement of the selector shaft. Gear Recognition Sensors G604 and G616 supply this information. The TCM also needs to know the limit positions of all gears.

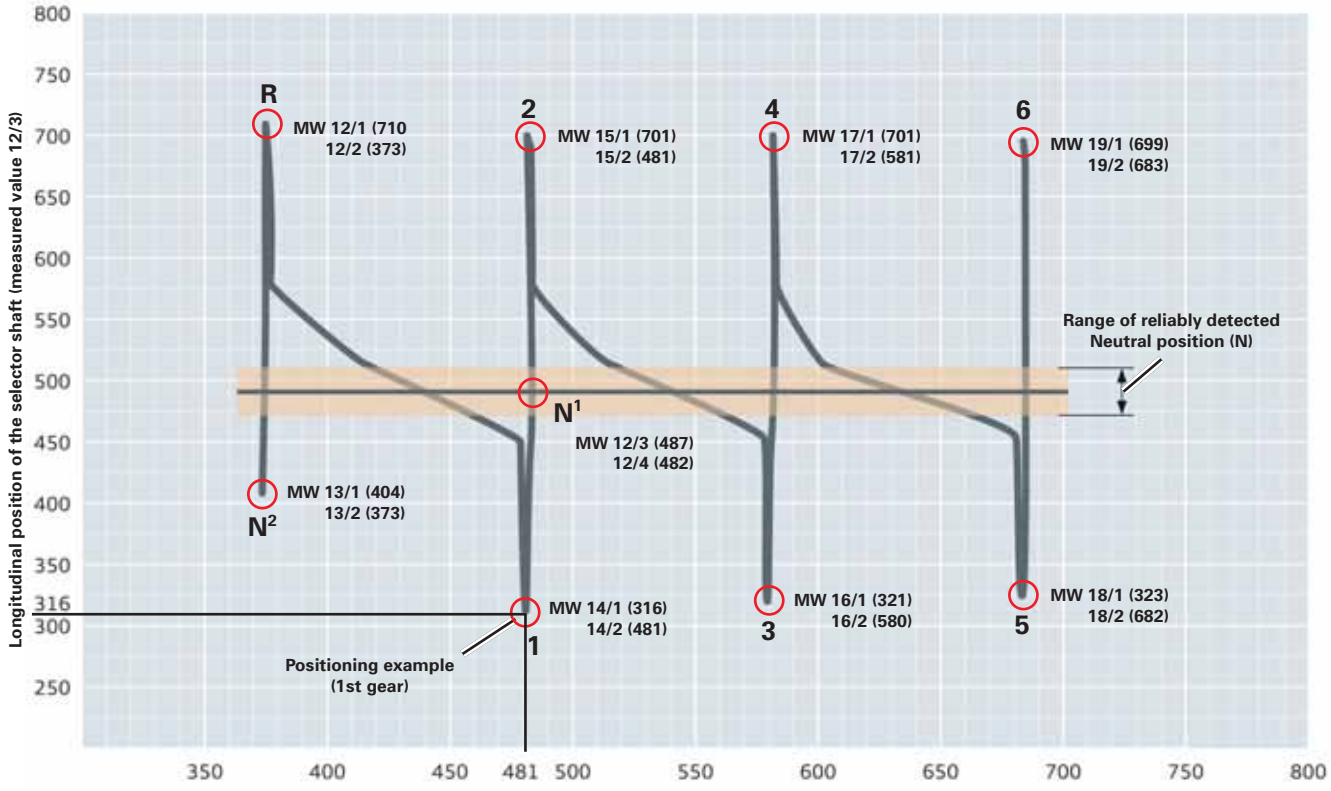
To ensure the TCM has correct information, a “gear actuator basic setting” Test Plan must be done using the VAS Scan Tool. The basic setting Test Plan does the following: it measures and stores the limit positions of the gears when they are actuated and not actuated. In addition, basic adaptations are made for the electro-hydraulic control unit. This includes adapting the characteristic curves of all electromagnetic valves.

If this basic setting procedure is not performed, the R tronic transmission will not work properly.

It is possible that the adaptation limits will not be maintained during this basic setting procedure. If this happens, the procedure is cancelled. This could happen, for example, if the procedure is performed on a new transmission which shifts more sluggishly than a transmission that has been in service.

An unfavorable gear position can also lead to the cancellation of the Test Plan. In these cases it is important to make multiple attempts to complete the basic setting procedure.

Shift matrix



613_004

How the Shift Matrix Works

The shift matrix shows a plot of the gear actuator positions during basic setting of the gear actuator. Compare the measured values to those on the page at left. The grid corresponds to the bit values which are displayed in measured values 12 to 19, as well as 65 and 66.

N^1 Is the gear actuator position when Neutral is selected during normal vehicle operation, for example, from 1st G–N or from R–N.

N^2 Is the stable Neutral position. It is the reference position for starting the basic setting procedure. The position N^2 can be activated using the “Basic settings” function of the self diagnostics by selecting channel 4.

MW Measured value

Shift Adaptation, Shift Matrix

All parts of the selector mechanism are subject to wear during the break-in process and normal use. To ensure the transmission operates reliably throughout its life, various gear actuator positions are continuously monitored.

Measured Values

Measured values 12/3 and 12/4 show the current gear actuator position (actual value).

The other measured values show adaptation values.

Self Diagnostics, Shift Matrix

To detect malfunctions, the limit positions and the various settings of the gear actuator are monitored continuously.

The longitudinal positions of the even and odd numbered gears should not differ significantly from one another. The rotary positions and positions of the individual gears should lie within defined values.

In the event of deviations from the nominal values, a DTC is generated and a corresponding emergency running mode is activated.

In many cases, the deviation is usually found in the transmission mechanism, for example, heavy wear of a shift fork.

Select measured values			Read
ID	Measured value	Result	Setpoint
012/1	Adapted long. pos. for reversing ...	710	645 – 755
012/2	Adapted rotat. pos for reverse ...	373	320 – 415
012/3	Long. pos. of sel. shaft (actual value ...	487	275 – 750
012/4	Rotat. position of sel. shaft (actual ...	482	320 – 735
013/1	Adapted long. pos. for Neutral ...	404	355 – 465
013/2	Adapted rotat. pos. for Neutral ...	373	320 – 415
014/1	Adapted long. pos. for 1st gear	316	270 – 380
014/2	Adapted rotat. pos. for 1st gear	481	425 – 525
015/1	Adapted long. pos. for 2nd gear	701	640 – 750
015/2	Adapted rotat. pos. for 2nd gear	481	425 – 525

Select measured values			Read
ID	Measured value	Result	Setpoint
016/1	Adapted long. pos. for 3rd gear	321	275 – 385
016/2	Adapted rotat. pos for 3rd gear	580	530 – 630
017/1	Adapted long. pos. for 3rd gear	701	635 – 750
017/2	Adapted rotat. pos. for 4th gear	581	530 – 630
018/1	Adapted long. pos. for 5th gear	323	275 – 385
018/2	Adapted rotat. pos. for 5th gear	682	635 – 735
019/1	Adapted long. pos. for 6th gear	699	635 – 745
019/2	Adapted rotat. pos. for 6th gear	683	635 – 735

613_111

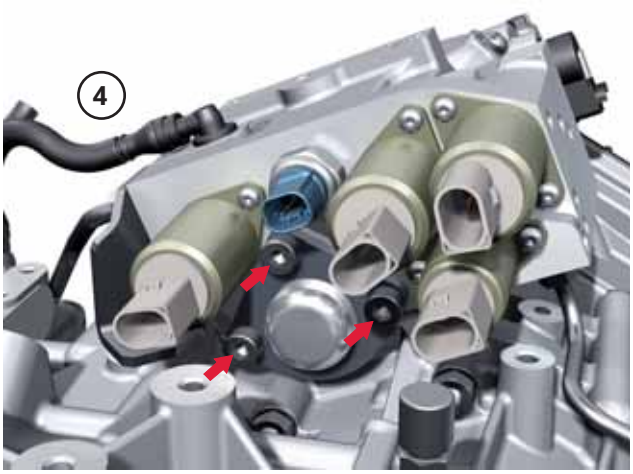
Select measured values			Read
ID	Measured value	Result	Setpoint
065/1	Reverse, adapted limited stop ...	715	655 – 765
065/2	Neutral, adapted limit stop ...	394	345 – 455
065/3	1st gear, adapted limited stop ...	308	260 – 370
065/4	2nd gear, adapted limited stop ...	706	650 – 760
066/1	3rd gear, adapted limited stop ...	313	265 – 375
066/2	4th gear, adapted limited stop ...	710	645 – 755
066/3	5th gear, adapted limited stop ...	313	265 – 375
066/4	6th gear, adapted limited stop ...	708	645 – 755

Neutral Selection After Malfunctions

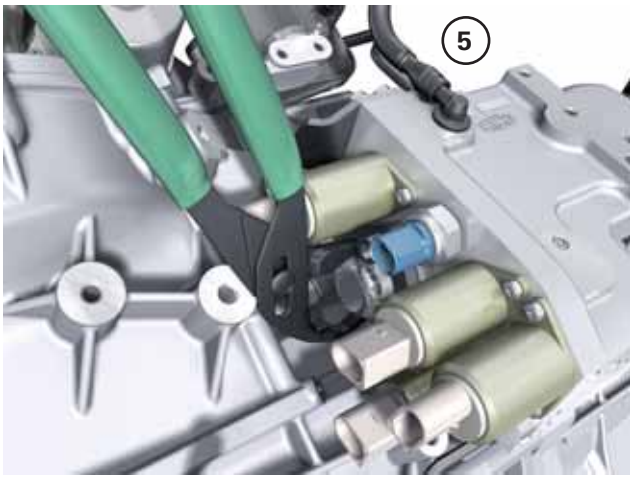
Certain faults in the hydraulic control unit may prevent the clutch from being disengaged. This means an engaged gear can no longer be disengaged. In this case, the vehicle cannot be pushed nor can the engine be started.

Because there is no emergency release mechanism for shifting into Neutral, vehicle recovery is a very complex process. The following section explains the easiest method for placing the transmission into Neutral.

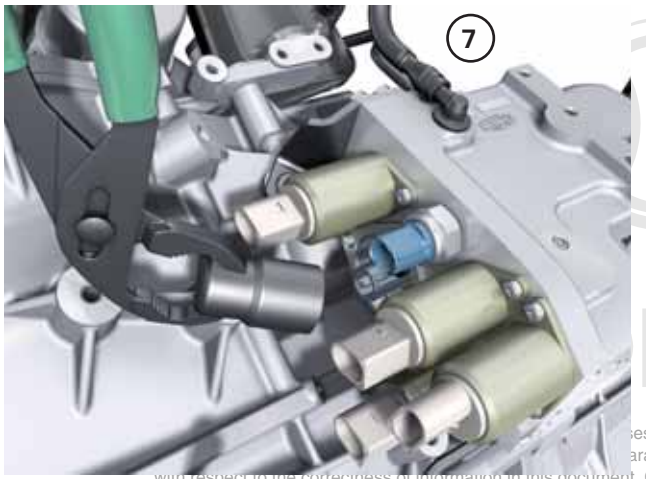
1. Remove ignition key.
2. Remove either Transmission Hydraulic Pump Relay J510, the fuse for the pump, or the electrical connector at the pump to prevent the pump from operating.
3. Label the connectors from the front shift actuator and remove them.
4. Loosen the three hexagon socket bolts of the retaining flange for the S-CAM brake cover, but do not remove them completely. Hydraulic pressure may still be present. Let the hydraulic pressure (if present) bleed off slowly.
5. Slowly remove the cover completely. Protect yourself and the immediate area from a possible sudden discharge of hydraulic oil.
6. Unbolt the hexagon socket bolts completely, and remove the retaining flange and cover.
7. Carefully extract the S-CAM brake piston.



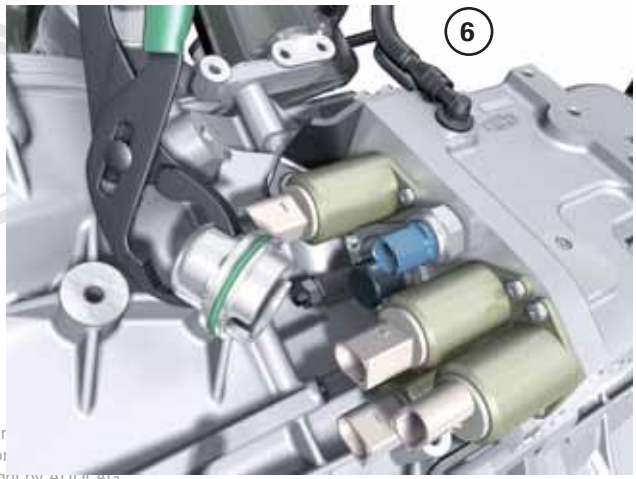
613_076



613_077



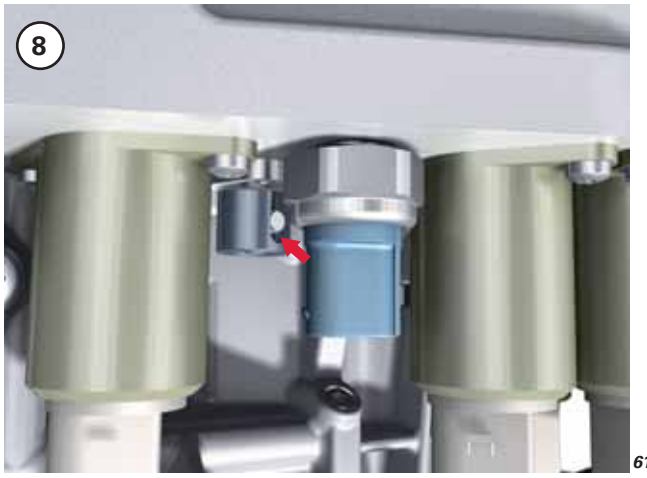
613_079



613_078

Note

Always refer to current technical literature when performing this procedure. Always wear eye protection and protective clothing.



613_080

8. Depending on which gear is selected, the selector shaft must be pushed in or pulled out slightly to place the transmission into Neutral.

613_081

If the selector shaft is positioned in such a way that the gate pin is visible, as shown above in Figs. 613_080 and 081, the selector shaft must be pushed in slightly.

613_082

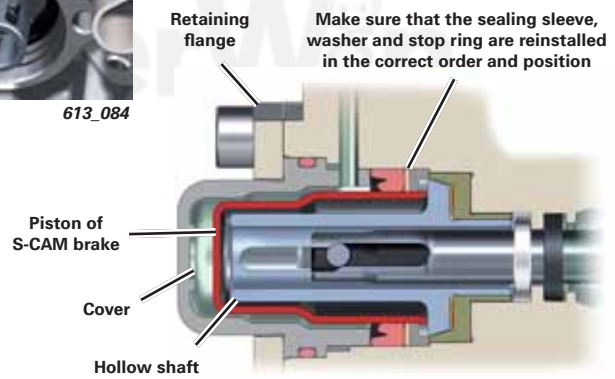
If the selector shaft is positioned in such a way that the gate pin is barely visible, as shown above in Fig. 613_082, the selector shaft must be pulled out slightly.

613_083

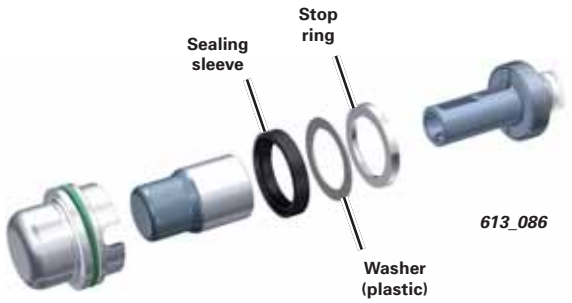
Because the selector shaft is located inside the hollow shaft, pull out the selector shaft using the hollow shaft as a support. In the process, the sealing sleeve, a washer and a stop ring are pressed out.

613_084

9. If the selector shaft is positioned in such a way that the gate pin is at the center, as shown in Fig. 613_084 (the hollow shaft must be against the stop in the housing), then the transmission is in Neutral. The vehicle can be moved.



613_085



613_086

Transmission Control Module J217

J217 records, evaluates and relays all information required for operation of the transmission.

613_087

Installation location — behind the right seat, under the cover

Functions and tasks of J217:

- Issue the start enable signal
- Carry out basic settings and adaptations
- Provision for emergency running mode
- Protective functions
- Warnings and driving instructions
- Extensive self diagnostics

The R tronic will not work without electrical power or a sufficient supply of oil and pressure. In the event of a system malfunction where it is not possible to shift into Neutral or the clutch cannot be disengaged, the engine is not allowed to start. The vehicle cannot be pushed either.

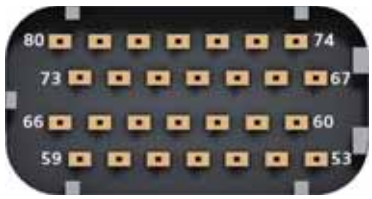
A — 52 pin connector, pins 1–52

J217 plug connections

B — 28 pin connector, pins 53–80

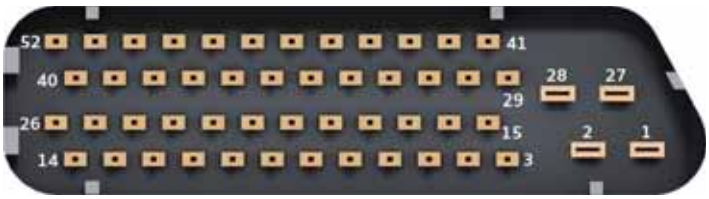
613_088

Connector B — front view of the plug-in contacts



613_089

Connector A — front view of the plug-in contacts



613_090

Note

Basic setting procedures for the gear actuator and clutch must be performed if Transmission Control Module J217 is replaced. The new TCM is programmed to perform shifts at a higher pressure during the first 62 miles (100 km). During this time, louder shift noise may be noticeable.

Basic Settings, Adaptations

To ensure acceptable drive-away and shift comfort, two basic settings must be performed using the diagnostic tester.

1. Basic setting of gear actuators

The following adaptation values are determined in this basic setting procedure:

- Zero calibration of Clutch Actuator Valve N255
- Position of the closed clutch
- Limit positions of the gear actuator in each of the gears

2. Basic setting of clutch

The following adaptation values are determined in this basic setting procedure:

- Adaptation of the clutch kiss point
- Resetting the clutch wear index (only after replacing the clutch or the control module)

These values are continuously adapted during vehicle operation, while the adaptations can only be performed in very specific operating conditions and driving situations. If there are concerns about drive-away starts or shift comfort, perform basic setting of the gear actuator and clutch before performing major work.

Refer to current technical literature and Guided Fault Finding for further information on when and how this basic setting must be performed.

TCM Encoding

Two different versions of the Tip-in function can be set by encoding the transmission control module.

Encoding version 1 (factory default coding)

Coding 00001

The driver can change from Automatic mode to Manual mode by selecting "+" or "–" with the selector lever or the steering wheel shift paddles. The transmission will then remain in Manual mode.

Encoding version 2

Coding 00003

By selecting "+" or "–" with the selector lever, the driver can permanently change from Automatic mode to Manual mode (as is the case with version 1).

By selecting "+" or "–" with the steering wheel shift paddles, the driver can temporarily change from Automatic mode to Manual mode. If no further shift command is given, the transmission returns to Automatic mode after approximately 10 seconds.

If another shift command is issued within 10 seconds, the countdown is reset to 10 seconds.

Encoding has been available since model year 2009. More detailed information can be found in Guided Fault Finding.

Functions, Displays/Warnings

Emergency running modes are provided, depending on the malfunction and their effect on driving safety.

The TCM then changes over to emergency running mode or activates a protective function. System malfunctions or protective functions of the transmission are indicated in the instrument cluster.

Warn Level 1

The TCM has diagnosed a malfunction, which initiates an emergency running mode program or only a warning.

This has little or no effect on the operating range of the transmission. The purpose of the warning is to alert the driver to take the vehicle to an authorized dealer at the next opportunity.

Vehicles prior to model year 2008:

Transmission malfunctions are indicated by static representation of the gear indicator of the Driver Information System display.

613_091

Vehicles from model year 2008:

Transmission malfunctions are indicated by an icon and by a text on the Driver Information System display.

Transmission malfunction: you can continue driving.

613_093

Warn Level 2

A system malfunction has occurred and can lead to the following function restrictions:

- Certain gears can no longer be selected
- The clutch can no longer be disengaged. The engine stalls when braking to a stop.
- Once the engine has been shut off, it can no longer be started.
- Vehicle operation can be very limited (for example, no drive-away, no R gear, etc.).

Vehicles prior to model year 2008:

Transmission malfunctions are indicated by a flashing inverted representation of the gear indicator on the Driver Information System display.

613_091

Vehicles from model year 2008:

Transmission malfunctions are indicated by an icon and text on the Driver Information System display.

Transmission malfunction: you can continue driving (limited functionality).

613_093

Other Displays

All versions have the following displays, but these vary in appearance depending on model year.

613_021

613_059

Ignition Key Removal Lock Functions

The Audi R8 with R tronic transmission does not have an ignition key interlock.

Starter Control Functions

The R8 with an R tronic transmission does not have a parking lock. The engine is switched off with a gear and the clutch engaged. Before starting the engine, the clutch must be disengaged and the transmission shifted to neutral. To do this, the footbrake must be applied.

Function sequence:

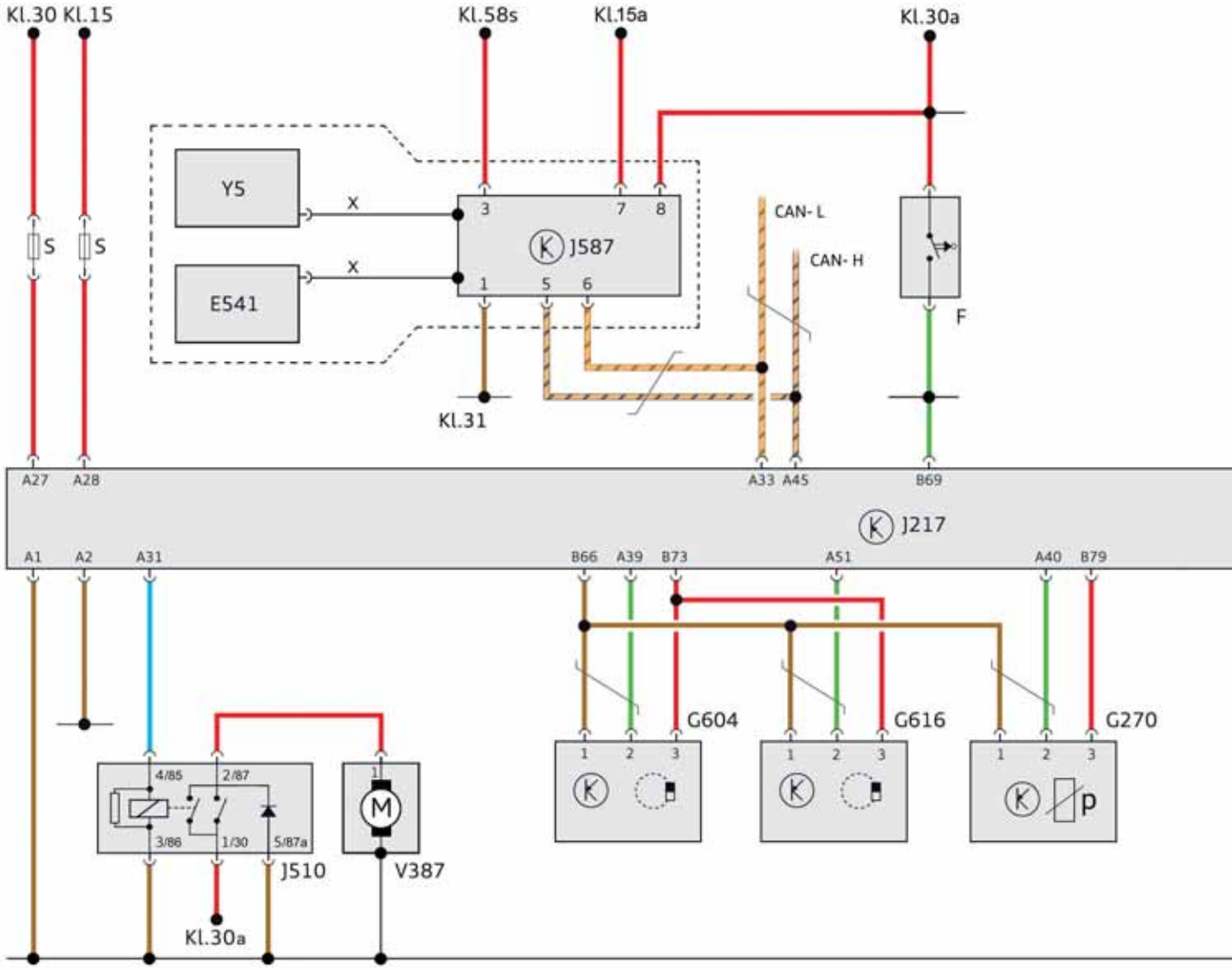
When a start request is initiated, Steering Column Electronics Control Module J527 switches pin 76 of Transmission Control Module J217 from ground to 12 volts.

The TCM first checks whether the footbrake is applied. If applied, the clutch is disengaged and the transmission put into Neutral. After this has happened, the TCM sends a “start enable” signal to the Engine Control Module at pin 42. The voltage at pin 42 changes from approximately 10 volts to 0 volts.

Only then does the ECM begin the start cycle.

In the event of a system malfunction where it is no longer possible to shift into Neutral, or the clutch cannot be disengaged, the engine is not allowed to start. The vehicle cannot be pushed either.

Functional Diagram



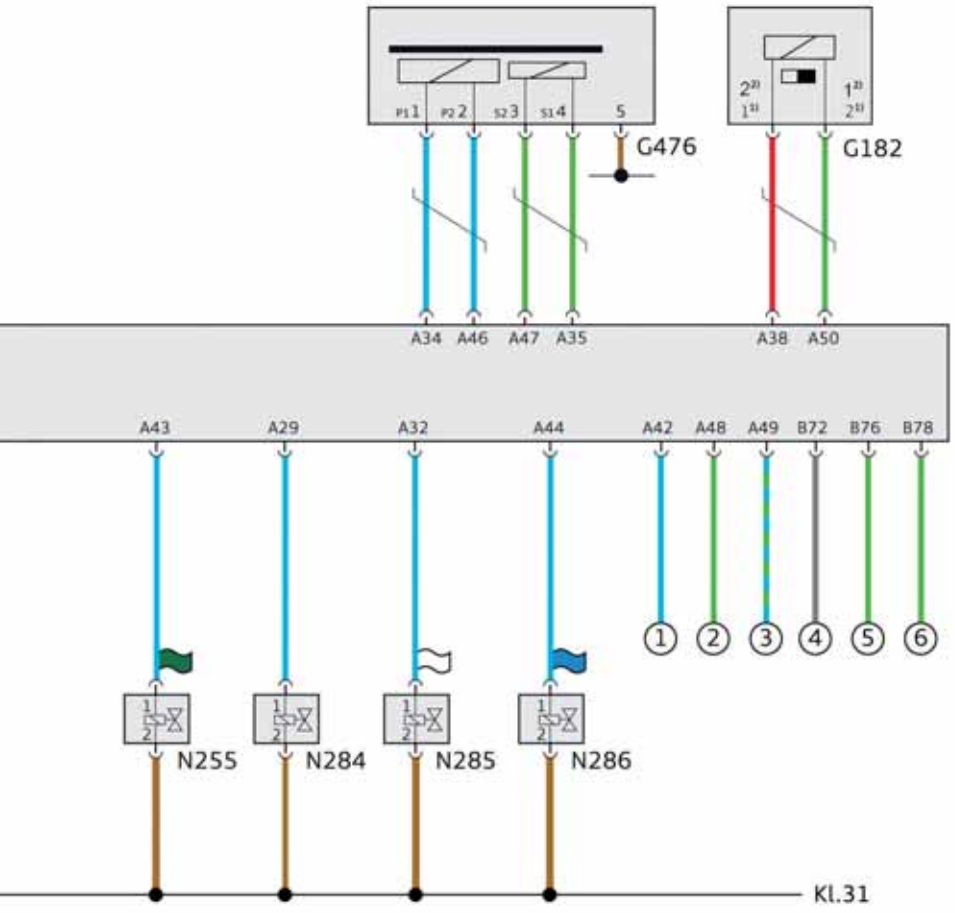
Key:

E541	Sport Program Button
F	Brake Light Switch
G182	Transmission Input Speed Sensor
G270	Hydraulic Pressure Sensor
G476	Clutch Position Sensor
G604	Gear Recognition Sensor
G616	Gear Recognition Sensor 2
J217	Transmission Control Module
J510	Transmission Hydraulic Pump Relay
J587	Selector Lever Sensor System Control Module
N255	Clutch Actuator Valve
N284	Gear Selection Valve 1
N285	Gear Selection Valve 2
N286	Gear Selection Valve 3
S	Fuse
V387	Transmission Hydraulic Pump
Y5	Selector Lever Transmission Range Display

Color code:

Shielded line

The connectors for valves N255 to N286 are identical in design but not coded. To ensure that the connectors are connected correctly, the wiring harness connecting to the electromagnetic valves is color-coded. The valves are not usually color-coded. To ensure that the connectors are reconnected to the matching valves, they must be unmistakably marked before disconnecting.



613_002

Data bus interface:

CAN-L	Powertrain CAN low
CAN-H	Powertrain CAN high

Plug connections on Transmission Control Module J217:

A	52 pin connector, pins 1–52
B	28 pin connector, pins 53–80

Auxiliary signals — separate signal lines

(1) Pin 42 — signal — start enable
If the conditions for engine starting have been met, TCM 217 sends the start enable signal to the engine control module. The voltage level at pin 42 changes from approximately 10 to 0 volts.

(2) Pin 48 — signal — engine speed (TD signal from the ECM).

(3) Pin 49 — signal — vehicle diagnostics (K line)

(4) Pin 72 — a line is assigned to this connection, but the connection is not functional.

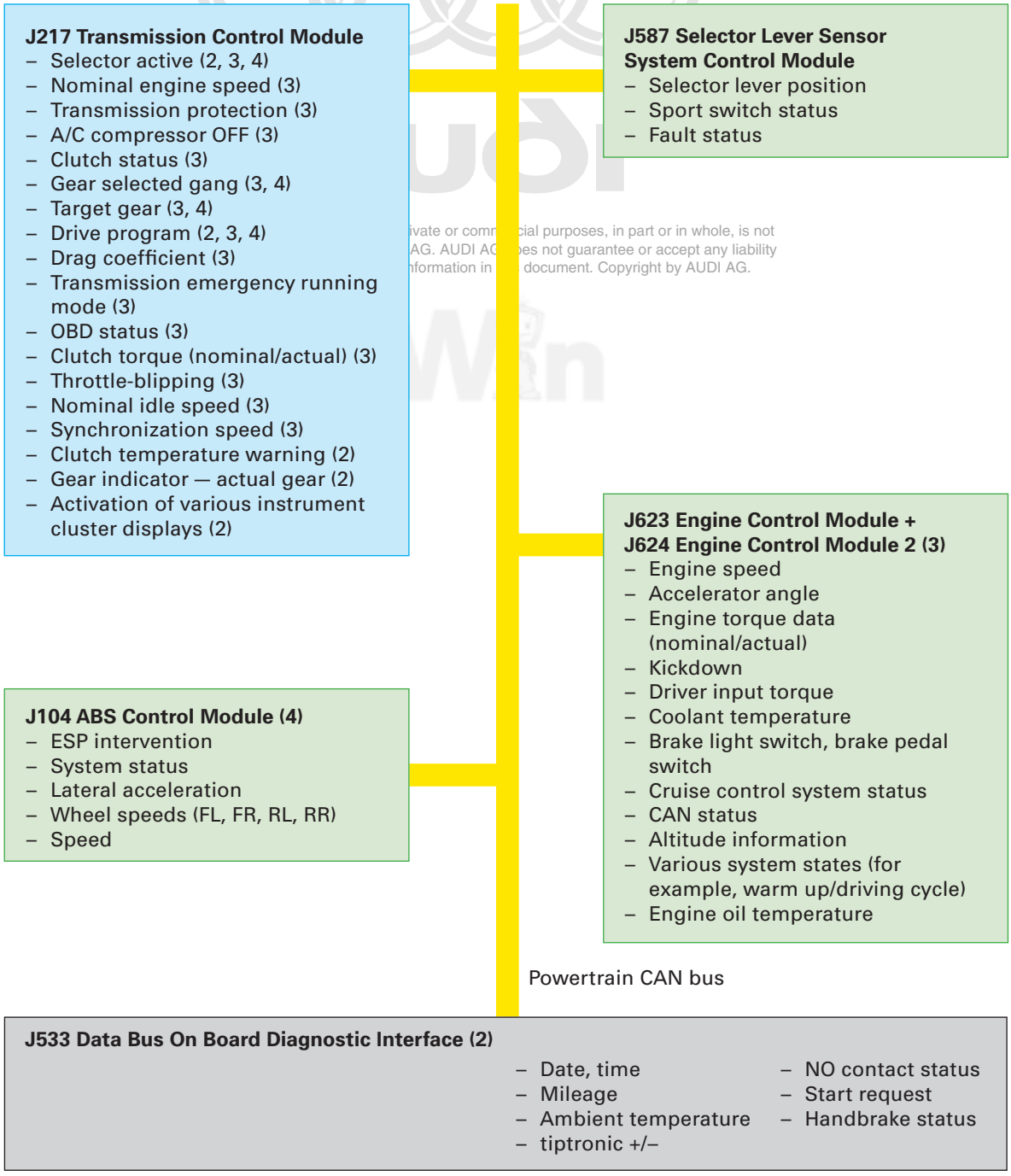
(5) Pin 76 — signal — start request[3]
Information on a start request (ignition key position — engine start) from Steering Column Electronics Control Module J527. Pin 76 is switched from ground to 12 volts. The signal is simultaneously sent to the ECM. The start request signal is also referred to as "status term. 50" or "terminal 50 ON".

(6) Pin 78 — signal — driver door open
When the driver's door is opened, Vehicle Electrical System Control Module J519 activates Control Relay J789 for a defined period of time. J789 briefly activates Transmission Hydraulic Pump V387 to build up pressure in the hydraulic system.

To prevent the hydraulic pump from operating every time the driver's door is opened, the pump is only activated once within a 30 minute time period.

[1]4.2L V8 engine
[2]5.2L V10 engine
[3]The start request signal is also referred to as "status term. 50" or "term. 50 ON"

CAN Information Exchange



Information sent by TCM J217. The number in brackets indicates the bus user to which the information is sent.

Information received and evaluated by TCM J217.

In the CAN information exchange process shown here, only the main items of information are given.

Sensors

Gear Recognition Sensor G604, Gear Recognition Sensor 2 G616

To enable the desired gears to be selected, the TCM must know the exact position and movement of the shift finger, which can be determined from the angular and axial positions of the selector shaft.

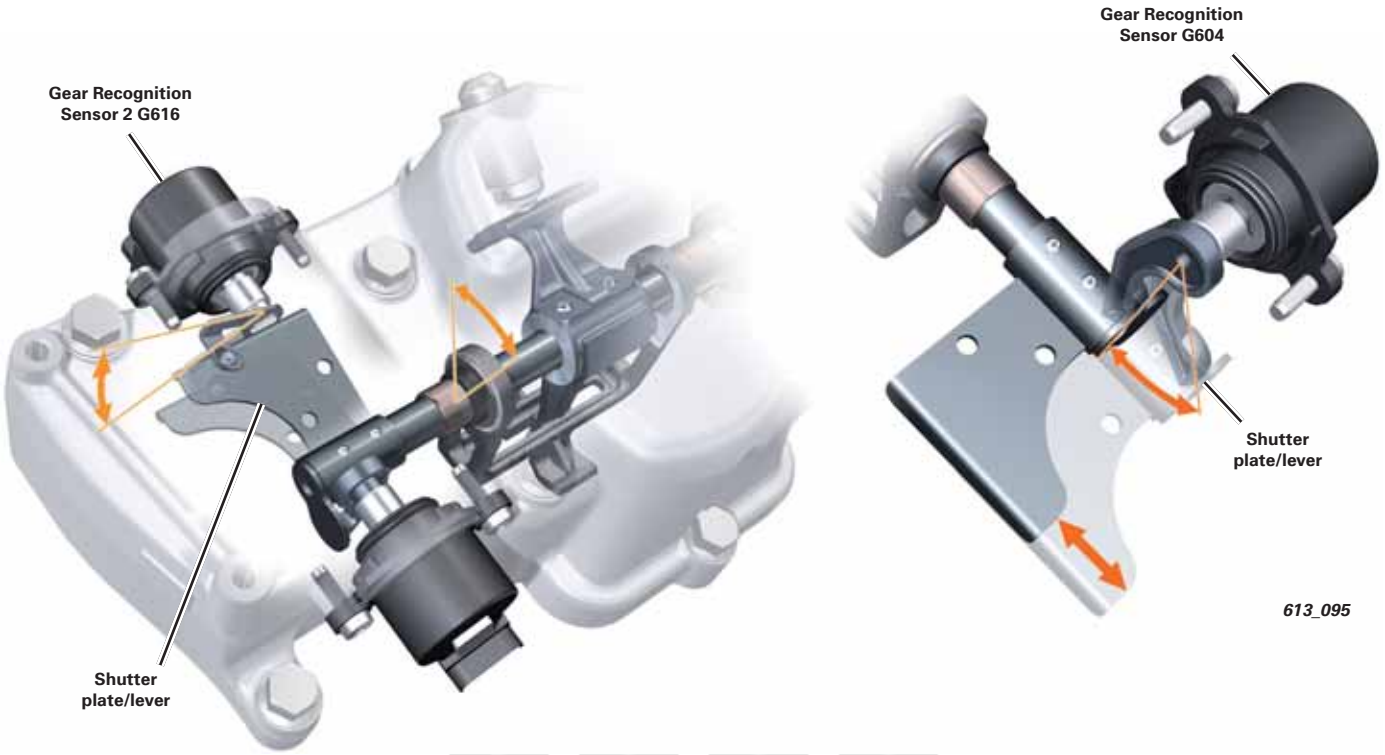
The currently engaged gear can be detected by the signals from G604 and G616. G604 determines the **axial** movements and positions of the selector shaft. G616 determines the **rotational movement** and **angular** positions of the selector shaft for the recognition of the current shift gate.

Sensors G604 and G616 are identical and record a rotational movement. The levers and shutter plates indicate the movements of the selector shaft to the sensors.

The sensors are aided by a Hall sensor. A voltage signal dependent on rotational angle is generated as a sensor signal. G604 and G616, as well as the respective limit positions of the gears, must be adapted to the TCM using the VAS Scan Tool.

Effects of Signal Failure

Depending on the driving situation and fault type, different emergency running mode programs are started. The transmission cannot change gears without signals from G604 and G616 (particularly if G604 fails). If possible, vehicle operation is continued by maintaining the currently engaged gear, or if stationary, by shifting into Neutral.



Note

Older sensors have tin-plated terminal pins, while more recent sensors have gold-plated pins. The advantage of gold-plated terminals is that they are more resistant to corrosion. As a result, the terminal retains a constant contact resistance for a long period of time. However, this only applies if the terminal pairing are made of the same material. A gold-plated pin must not be mated with a tin-plated contact, as this will promote contact corrosion.

If new sensors are installed in a vehicle that had the old type sensors (for example, in company with the replacement of a transmission), the vehicle wiring harness connecting to the sensors must be converted to gold contacts. A pre-fabricated harness must be modified using wiring harness repair kit VAS 1978.

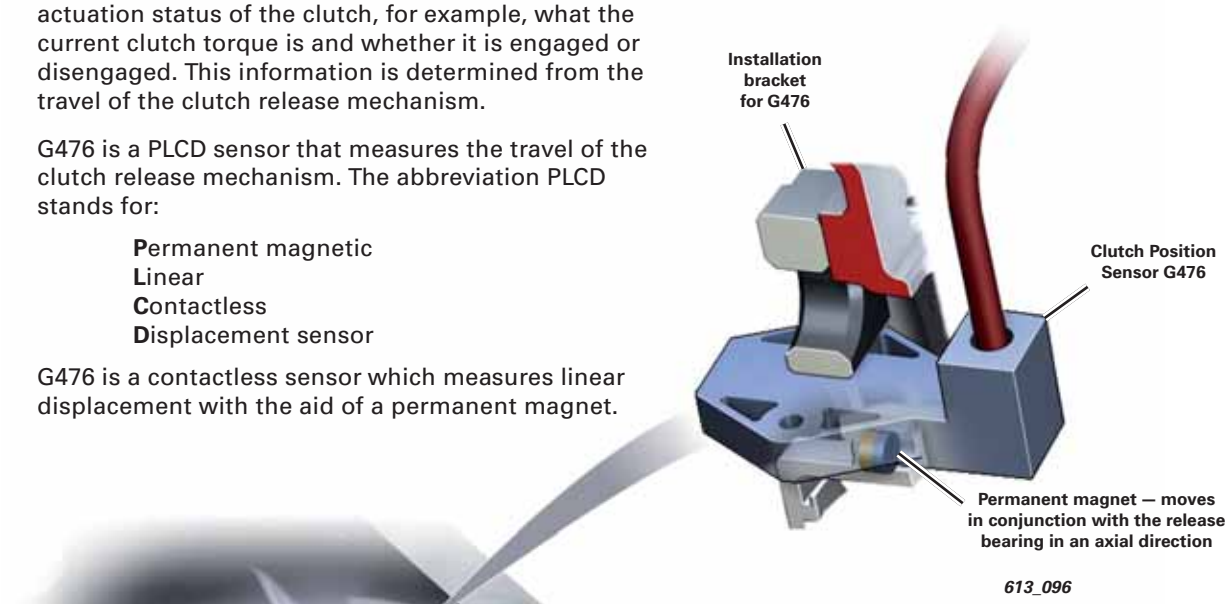
Clutch Position Sensor G476

To control the clutch during drive-away starts and gear shifts, the TCM needs feedback about the actuation status of the clutch, for example, what the current clutch torque is and whether it is engaged or disengaged. This information is determined from the travel of the clutch release mechanism.

G476 is a PLCD sensor that measures the travel of the clutch release mechanism. The abbreviation PLCD stands for:

Permanent magnetic
Linear
Contactless
Displacement sensor

G476 is a contactless sensor which measures linear displacement with the aid of a permanent magnet.



The information provided by G476 is needed for the following functions:

- Recognition of clutch operating states (disengaged, engaged, current clutch torque) for controlling the electro-hydraulic clutch control
- Feedback for shifting gears and for engine start enabling (the clutch must be disengaged during the gearshift and when starting the engine)
- Determination and adaptation of the clutch kiss point for calculating the clutch torque
- Determination and adaptation of clutch status (clutch index)
- Determination of clutch temperature (calculated)

To ensure acceptable drive-away start and shift comfort, a basic setting procedure for the clutch must be performed using the VAS Scan Tool.

Effects of Signal Failure

Depending on the driving situation when a fault occurs with G476, vehicle operation, where possible, is allowed by maintaining the currently engaged gear. During operation, when an idle speed is reached, the clutch is disengaged and Neutral is selected.

If G476 fails, the “clutch disengaged” state is not detected. This means the start enable signal is not sent to the ECM and the engine will not start. A warning level 2 fault indication is displayed in the Driver Information System display.

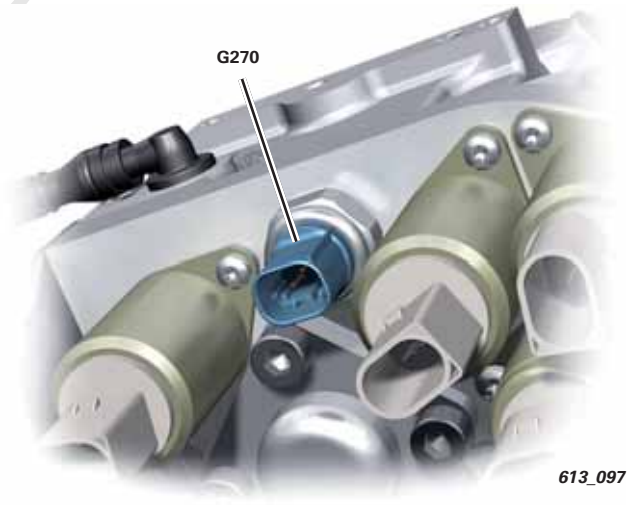
Hydraulic Pressure Sensor G270

G270 is an electronic pressure sensor. It supplies a pressure dependent voltage signal and is used for determining system pressure. The transmission control module uses G270 to determine the cut-in and cut-out pressures of the hydraulic pump. Pressure is set between 580 to 725 psi (40 to 50 bar). The signal generated by G270 is also used for calculating shift force.

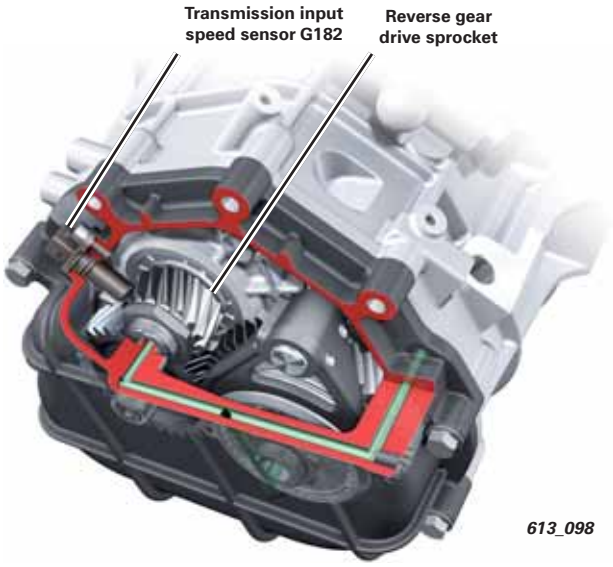
Effects of Signal Failure

In the event of failure of the sensor, the hydraulic pump is activated in a time-dependent manner. The system pressure is considerably higher, as it is defined by the pressure limiting valve. As a result, gearshifts may seem louder.

Measurement range:	0–1160 psi (0–80 bar)
Signal voltage:	0 psi (0 bar) = 0.5 volts
	1160 psi (80 bar) = 4.5 volts



613_097



613_098

Transmission Input Speed Sensor G182

G182 is an inductive sensor that records the speed of the transmission drive shaft past the clutch. The signal is also output as the clutch speed and clutch output speed value. The reverse gear sprocket serves as a sensor wheel.

The signal generated by G182 is:

- Used in conjunction with engine speed (TD signal) to calculate clutch slip for controlling the clutch
- Used for determining synchronous speed for gearshifts
- Required for clutch adaptation

Signal Failure Consequences

The transmission automatically placed into Neutral when the vehicle is at a standstill. An emergency running mode program maintains limited vehicle operation in Manual mode up to 3rd gear. A corresponding fault message is displayed in the Driver Information System display.

Note

G182 is also installed in the manual transmission but is not functional. It serves only to seal the opening in the end cover.

Engine Speed Signal, Time Division (TD) Signal

The TD signal is a square-wave engine speed signal. It is processed by the engine control module and is synchronous in frequency to engine speed. The pulse width ratio is approximately 50% and a defined number of square-wave pulses are output per revolution of the engine.

The TD signal is redundant and checks for plausibility with information received from the Powertrain CAN. It is also used as a substitute signal for CAN information.

Engine speed is key information for the TCM. It represents clutch input speed.

Engine speed is:

- Used in conjunction with the signal from G182 for exact control of the clutch (determination of clutch slip)
- Used for controlling the selector mechanism and for the determination of synchronous speeds
- Required to make various adaptations

Signal Failure Consequences

There is no negative effect as long as engine speed is provided by the CAN data bus.

Actuators

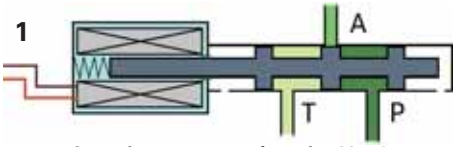
Electromagnetic Valves

Electromagnetic valves convert the electric control current to a hydraulic control current, which in turn is used to actuate the control elements.

613_099

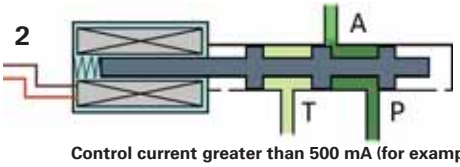
Key:

A Output — control line to clutch slave cylinder
T Tank — return line to oil tank (reservoir)
P Pressure control line — from system pressure (pressure accumulator)



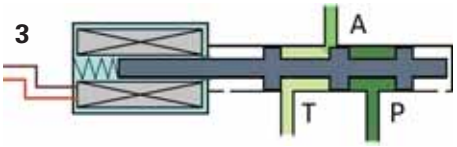
613_100

Control current approximately 500 mA



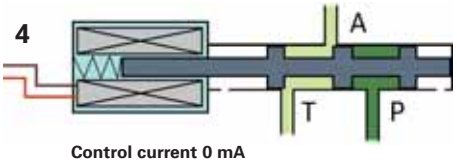
613_101

Control current greater than 500 mA (for example, 600 mA)



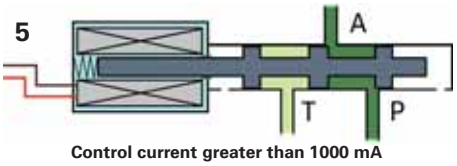
613_102

Control current less than 500 mA (for example, 400 mA)



613_103

Control current 0 mA



613_104

Control current greater than 1000 mA

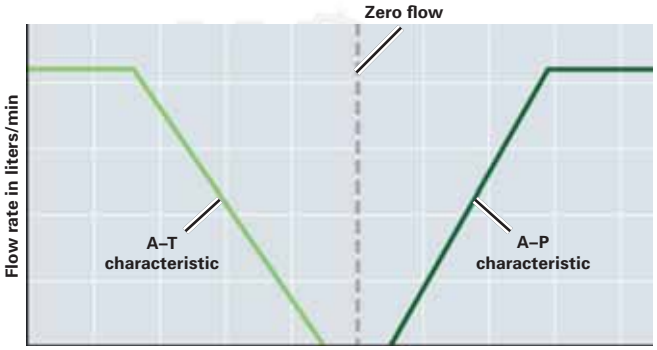
Clutch Actuator Valve N255

N255 is a proportional flow control valve. It sets a hydraulic volumetric flow proportional to the control current. N255 actuates the clutch via a clutch slave cylinder.

Pay attention to the installation assignment and position of the O-ring seals when installing the valve.

Actuator Failure Consequences

- Transmission emergency running mode: warning level 2
- Drive-away start and gear shifting are not possible while driving, as the transmission is placed into Neutral when the vehicle is stationary; the engine can be started



613_105

1. N255 is operated starting from the center position. The valve is in its center position at a control current of approximately 500 mA. Control line A is closed. This position is referred to as the zero-flow position, see Fig. 613_105.
2. If the control current is increased, control line A is opened toward control line P. A pressure is built up in the clutch slave cylinder. See characteristic curve A–P in Fig. 613_105.
3. If the control current is decreased, control line A is opened toward control line T. The pressure in the clutch slave cylinder is reduced, see characteristic curve A–T in Fig. 613_105.

Zero Flow Adaptation

Exact current value for zero flow is very important for the TCM, because it is the basis for determining the drive current. Because the valves are subject to a specific manufacturing tolerance, the value for zero flow must be adapted.

This adaptation is made for the “gear actuator basic setting” function, or during operation if the vehicle is stationary for a defined period of time with the engine idling and the transmission in Neutral or 1st gear.

Gear Selection Valve 1 N284

N284 is an electrically actuated solenoid valve. It controls hydraulic pressure and has two switching positions (open,close and ON/OFF).

N284 controls the S-CAM brake and is used in conjunction with N285 and N286 to switch between shift gates.

When installing the valve, ensure that the O-ring seals are correctly assigned and installed.

Special Feature of N284

A pressure limiting valve is integrated into N284. It opens at approximately 1160–1305 psi (80–90 bar) and protects the hydraulic system from excess pressure.

Valve Failure Consequences

- Transmission emergency running mode: warning level 2
- The transmission is put into Neutral when the vehicle is stationary: the engine can be started

613_106

Gear Selection Valve 2 N285
Gear Selection Valve 3 N286

N285 and N286 are identical electromagnetic proportional pressure control valves. They set a hydraulic control pressure which is proportional to the control current.

N285 is used for shifting odd-numbered gears. N286 is used for shifting even-numbered gears and reverse gear.

When installing the valve, ensure that the O-ring seals are correctly assigned and installed.

The connectors for the valves are identical in design and are not coded. To ensure that the connectors are reconnected to the matching valves, they must be marked before disconnecting.

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N286 Failure Consequences

- Transmission emergency running mode: warning level 2
- It is no longer possible to shift toward the even-numbered gears. If 1st, 3rd, or 5th gear is selected, the transmission cannot be placed into Neutral: the engine cannot be started
- If an even-numbered gear or reverse gear is selected, the transmission can be placed into Neutral with the aid of N285: the engine can be started

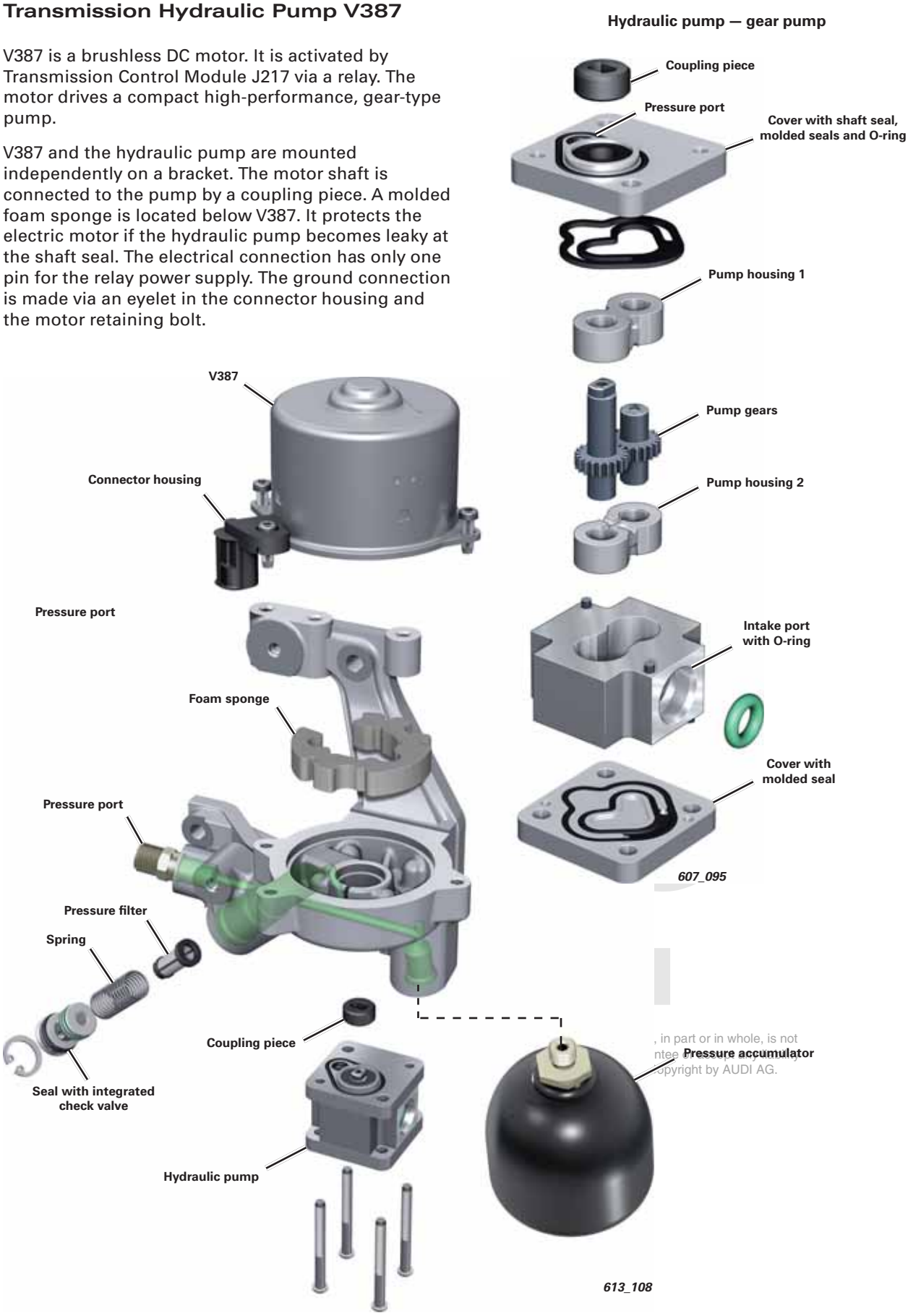
N285 Failure Consequences

- Transmission emergency running mode: warning level 2
- It is no longer possible to shift toward the odd-numbered gears. If 2nd, 4th, or 6th gear is selected, the transmission cannot be placed into Neutral: the engine cannot be started
- If an odd-numbered gear is selected, the transmission can be placed into Neutral with the aid of N285: the engine can be started

Transmission Hydraulic Pump V387

V387 is a brushless DC motor. It is activated by Transmission Control Module J217 via a relay. The motor drives a compact high-performance, gear-type pump.

V387 and the hydraulic pump are mounted independently on a bracket. The motor shaft is connected to the pump by a coupling piece. A molded foam sponge is located below V387. It protects the electric motor if the hydraulic pump becomes leaky at the shaft seal. The electrical connection has only one pin for the relay power supply. The ground connection is made via an eyelet in the connector housing and the motor retaining bolt.



Towing

Towing Vehicles with an R Tronic Transmission

If it is necessary to tow an Audi R8 with R tronic, the following conditions and restrictions must be observed:

- Place the transmission into Neutral. If this is not possible using the selector mechanism, follow the procedure described on page 54
- A maximum towing speed of 31 mph (50 km/h) must not be exceeded
- A maximum towing distance of 31 miles (50 km) must not be exceeded

The gear oil pump is not driven while the vehicle is being towed. This means that sufficient lubrication cannot be guaranteed if the vehicle is towed at excessively high speeds and/or excessively long distances.

The vehicle must not be towed with the front or rear axle elevated.

Failure to observe these points will result in severe damage to the front axle drive, the viscous coupling, and the transmission.

Towing Vehicles with a Manual Transmission

The same conditions, restrictions and instructions as described under “Towing Vehicles with an R Tronic Transmission” apply.

Knowledge Assessment

An on-line Knowledge Assessment (exam) is available for this Self-Study Program.

The Knowledge Assessment is required for Certification.

You can find this Knowledge Assessment at:

www.accessaudi.com

From the accessaudi.com Homepage:

- Click on the “ACADEMY” tab
- Click on the “Academy Site” link
- Click on Course Catalog Search and select “950123B — Audi R8 Power Transmission”

Please submit any questions or inquiries via the Academy CRC Online Support Form which is located under the “Support” tab or the “Contact Us” tab of the Academy CRC.

Thank you for reading this Self-Study Program and taking the assessment.

Audi
Truth in Engineering

950123

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Cautions & Warnings

Please read these WARNINGS and CAUTIONS before proceeding with maintenance and repair work. You must answer that you have read and you understand these WARNINGS and CAUTIONS before you will be allowed to view this information.

- If you lack the skills, tools and equipment, or a suitable workshop for any procedure described in this manual, we suggest you leave such repairs to an authorized Audi retailer or other qualified shop. We especially urge you to consult an authorized Audi retailer before beginning repairs on any vehicle that may still be covered wholly or in part by any of the extensive warranties issued by Audi.

- Disconnect the battery negative terminal (ground strap)whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.

- Audi is constantly improving its vehicles and sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, part numbers listed in this manual are for reference only. Always check with your authorized Audi retailer parts department for the latest information.

- Any time the battery has been disconnected on an automatic transmission vehicle, it will be necessary to reestablish Transmission Control Module (TCM) basic settings using the VAG 1551 Scan Tool (ST).

- Never work under a lifted vehicle unless it is solidly supported on stands designed for the purpose. Do not support a vehicle on cinder blocks, hollow tiles or other props that may crumble under continuous load. Never work under a vehicle that is supported solely by a jack. Never work under the vehicle while the engine is running.

- For vehicles equipped with an anti-theft radio, be sure of the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered when the power is restored, the radio may lock up and become inoperable, even if the correct code is used in a later attempt.

- If you are going to work under a vehicle on the ground, make sure that the ground is level. Block the wheels to keep the vehicle from rolling. Disconnect the battery negative terminal (ground strap) to prevent others from starting the vehicle while you are under it.

- Do not attempt to work on your vehicle if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medicine or any other substances that may impair you or keep you from being fully alert.

- Never run the engine unless the work area is well ventilated. Carbon monoxide (CO) kills.

- Always observe good workshop practices. Wear goggles when you operate machine tools or work with acid. Wear goggles, gloves and other protective clothing whenever the job requires working with harmful substances.

- Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.

next

Cautions & Warnings

- Do not re-use any fasteners that are worn or deformed in normal use. Some fasteners are designed to be used only once and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual - replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.

- Illuminate the work area adequately but safely. Use a portable safety light for working inside or under the vehicle. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

- Friction materials such as brake pads and clutch discs may contain asbestos fibers. Do not create dust by grinding, sanding, or by cleaning with compressed air. Avoid breathing asbestos fibers and asbestos dust. Breathing asbestos can cause serious diseases such as asbestosis or cancer, and may result in death.

- Finger rings should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.

- Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly, do not attempt shortcuts. Use tools that are appropriate to the work and use only replacement parts meeting Audi specifications. Makeshift tools, parts and procedures will not make good repairs.

- Catch draining fuel, oil or brake fluid in suitable containers. Do not use empty food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.

- Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque listed.

- Keep sparks, lighted matches, and open flame away from the top of the battery. If escaping hydrogen gas is ignited, it will ignite gas trapped in the cells and cause the battery to explode.

- Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond, or lake. Consult local ordinances that govern the disposal of wastes.

- The air-conditioning (A/C) system is filled with a chemical refrigerant that is hazardous. The A/C system should be serviced only by trained automotive service technicians using approved refrigerant recovery/recycling equipment, trained in related safety precautions, and familiar with regulations governing the discharging and disposal of automotive chemical refrigerants.

- Before doing any electrical welding on vehicles equipped with anti-lock brakes (ABS), disconnect the battery negative terminal (ground strap) and the ABS control module connector.

- Do not expose any part of the A/C system to high temperatures such as open flame. Excessive heat will increase system pressure and may cause the system to burst.

Cautions & Warnings

- When boost-charging the battery, first remove the fuses for the Engine Control Module (ECM), the Transmission Control Module (TCM), the ABS control module, and the trip computer. In cases where one or more of these components is not separately fused, disconnect the control module connector(s).

- Some of the vehicles covered by this manual are equipped with a supplemental restraint system (SRS), that automatically deploys an airbag in the event of a frontal impact. The airbag is operated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious personal injury. To guard against personal injury or airbag system failure, only trained Audi Service technicians should test, disassemble or service the airbag system.

- Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.

- Never use a test light to conduct electrical tests of the airbag system. The system must only be tested by trained Audi Service technicians using the VAG 1551 Scan Tool (ST) or an approved equivalent. The airbag unit must never be electrically tested while it is not installed in the vehicle.

- Some aerosol tire inflators are highly flammable. Be extremely cautious when repairing a tire that may have been inflated using an aerosol tire inflator. Keep sparks, open flame or other sources of ignition away from the tire repair area. Inflate and deflate the tire at least four times before breaking the bead from the rim. Completely remove the tire from the rim before attempting any repair.

- When driving or riding in an airbag-equipped vehicle, never hold test equipment in your hands or lap while the vehicle is in motion. Objects between you and the airbag can increase the risk of injury in an accident.

I have read and I understand these Cautions and Warnings.

back OK