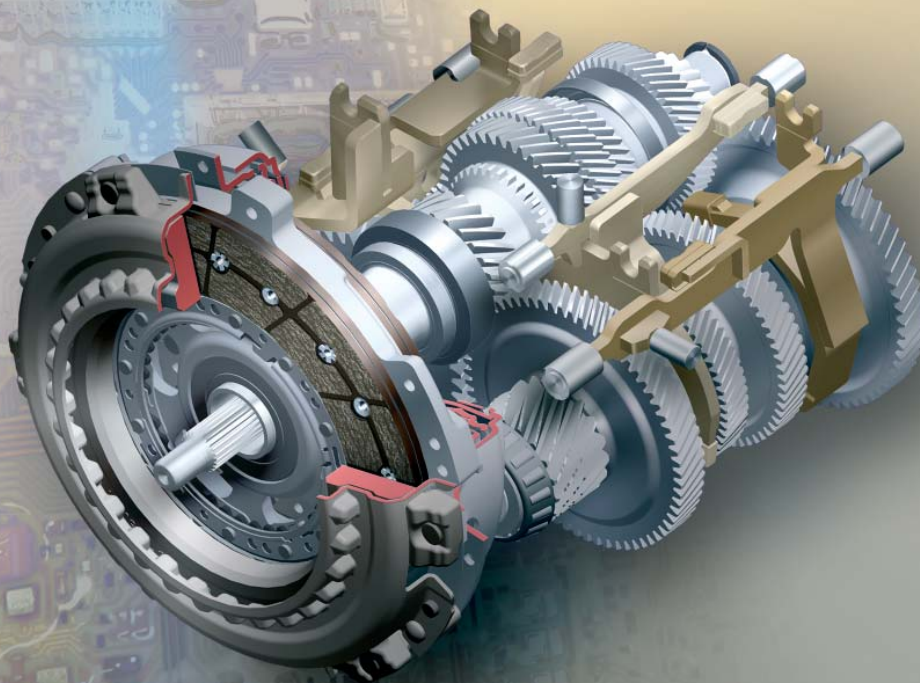




## Self Study Program 850123

# The 7-speed Double-Clutch Transmission 0AM Design and Function



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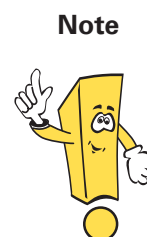
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This Self-Study Program provides information regarding the design and function of new models.  
This Self-Study Program is not a Repair Manual.

**This information will not be updated.**  
For maintenance and repair procedures, always refer to the latest electronic service information.



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## The New 7-Speed Double-Clutch Transmission from Volkswagen

The 7-speed double-clutch transmission 0AM is based on the 02E DSG transmission. It offers the same comfort and shifting characteristics of the 02E DSG. It has been designed for engines with a torque of up to 184 lb/ft (250 Nm) of torque.

The DSG transmission economy is on a par with manual transmission vehicles. The DSG transmission has succeeded in reducing fuel consumption below that of manual transmissions using technical innovations. This reduction in fuel consumption makes a significant contribution towards lowering emissions.

In this SSP, you will learn how the new 0AM double-clutch transmission functions and the technical highlights that help to reduce fuel consumption.

We hope you enjoy reading it.

## Application in the Jetta Hybrid

Although Volkswagen has used this transmission in vehicles for many years, the first application for the North American market is the 2013 Jetta Hybrid. Some aspects of this SSP are different for hybrid applications, and this SSP does not cover those differences.

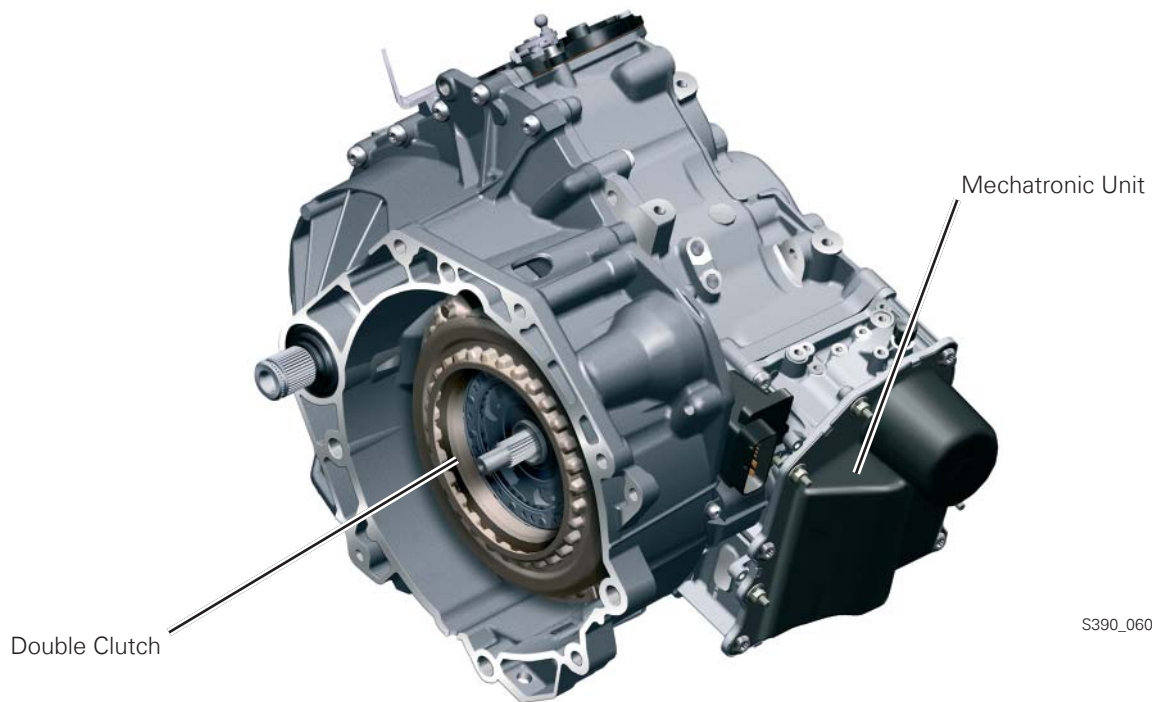
Please refer to ElsaWeb for the specific changes for use in the Jetta Hybrid.

# Introduction

---

The new 0AM DSG is the:

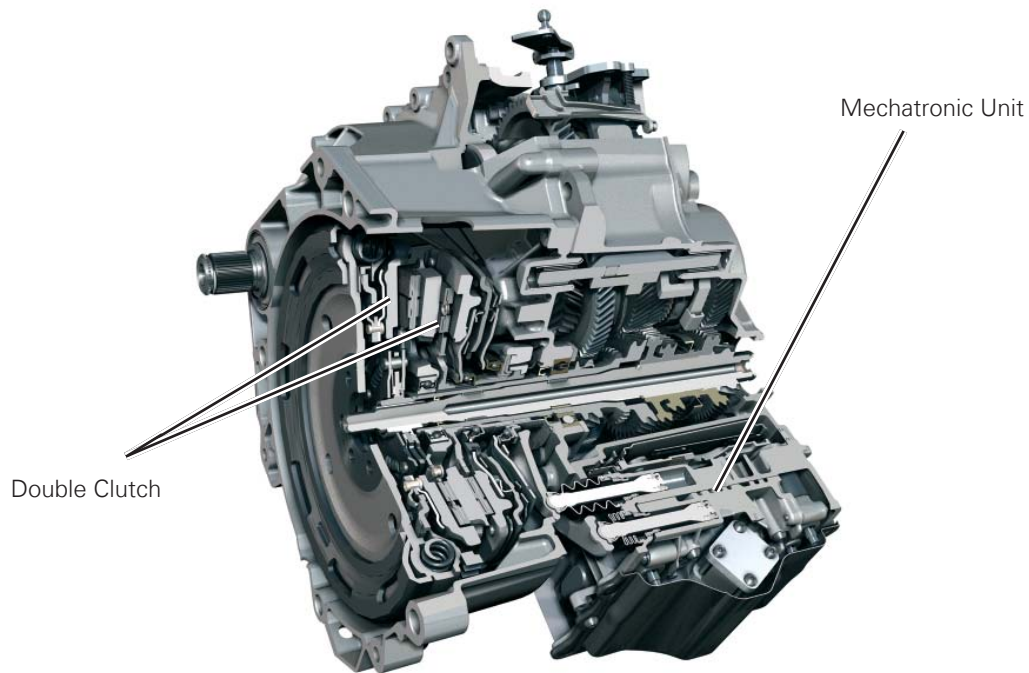
- First transverse 7-speed transmission
- First double-clutch transmission with dry double clutch



The dry double clutch has an extensive impact on the entire transmission concept. In comparison with the direct-shift transmission 02E, efficiency has been considerably improved. This improved efficiency makes a significant contribution towards lowering consumption and emissions.

## Design Features

- Modular design of the transmission: The clutch, mechatronic unit and transmission each form one unit
- Dry double clutch
- Separate oil circuit, mechatronic unit and mechanical transmission, with lifetime fillings
- Seven speeds on four shafts
- No oil/water heat exchanger



S390\_003

## Technical Data

Designation	0AM
Weight	Approx. 154 lb (70 kg) including clutch
Torque	184 ft lbs (250 Nm)
Gears	Seven Forward Speeds, One Reverse =Ggear
Spread	8.1
Operating Mode	Automatic and Tiptronic Modes
Transmission Fluid Volume	1.7L - G 052 171
Mechatronic Unit Fluid Volume	1.0L Central Hydraulic/Power Steering Box Fluid G 004 000

# Selector Lever

## Actuation

The selector lever is the same as in normal automatic transmission vehicles. The double-clutch transmission also offers the option of shifting using Tiptronic.

As with automatic transmission vehicles, the selector lever has with a selector lever lock and an ignition key withdrawal lock.

The selector lever positions are:

### P - Park

To move the selector lever from this position, the ignition must be ON and the foot brake must be depressed. The release button on the selector lever must also be pressed.

### R - Reverse Gear

The release button must be pressed to engage this gear.

### N - Neutral Position

In this position, the transmission is in neutral. If the selector lever is set to this position for a long time, the foot brake must be depressed again to move it from this position.

### D - Drive Position

In this drive position, the forward gears are shifted automatically.

### S - Sport

Automatic gear selection is carried out according to a "sporty" characteristic curve, which is stored in the control module.

Release Button



S390\_005



# Selector Lever

## Design of the Selector Lever

### E313 Selector Lever

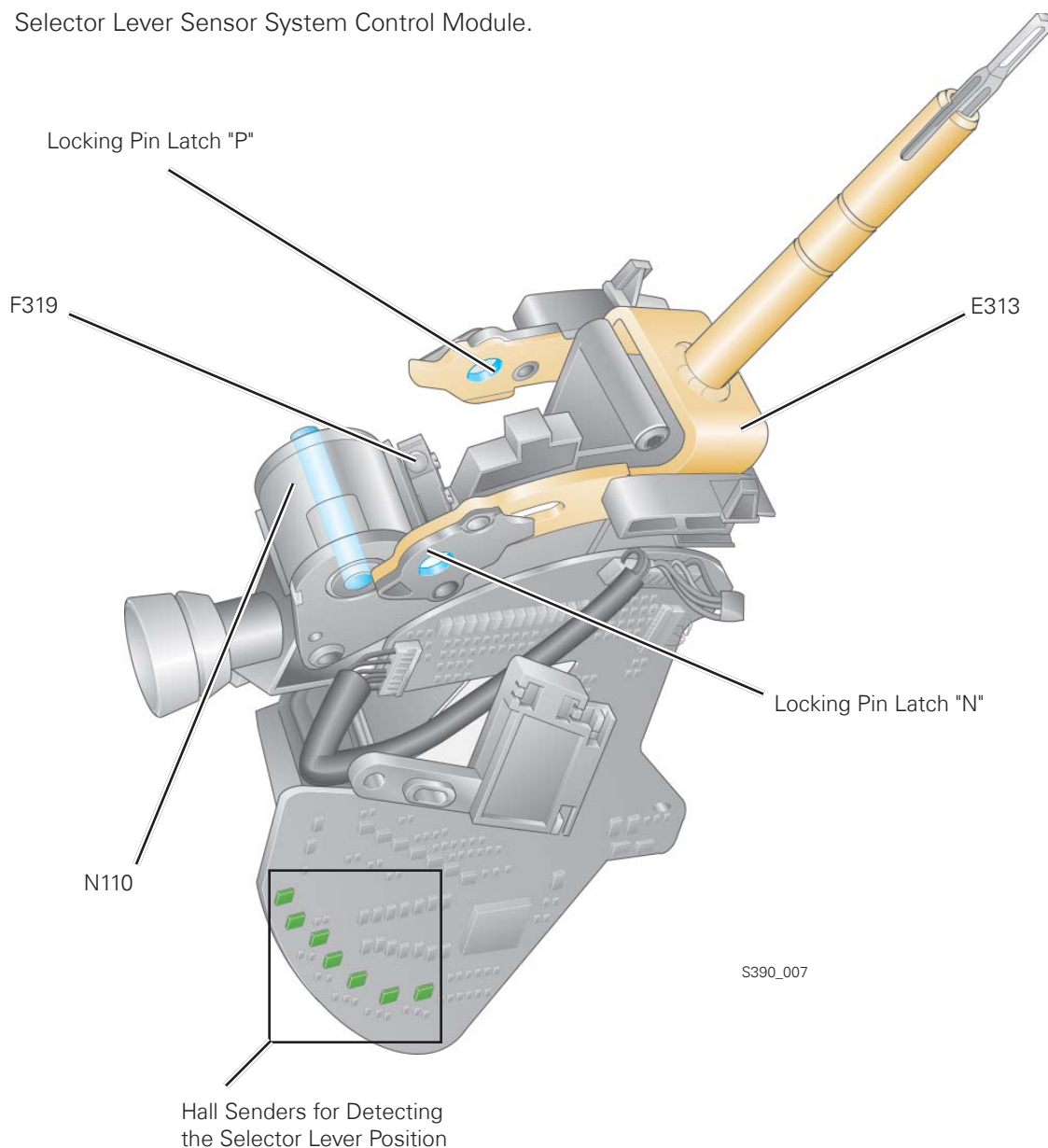
Hall sensors in the selector lever register the selector lever position and make this information available to the mechatronic unit via the CAN bus.

### N110 Shift Lock Solenoid

The solenoid locks the selector lever in the "P" and "N" positions. The solenoid is controlled by the J587 Selector Lever Sensor System Control Module.

### F319 Selector Lever Park Position Lock Switch

If the selector lever is in the "P" position, the signal is sent to the J527 Steering Column Electronics Control Module. The control module requires this signal to control the ignition key withdrawal lock.



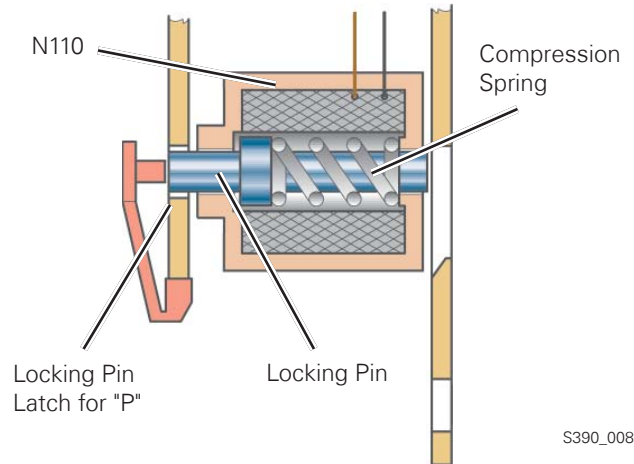
# Selector Lever

## N110 Shift Lock Solenoid

### How It Works:

#### Selector Lever Locked in "P" Position

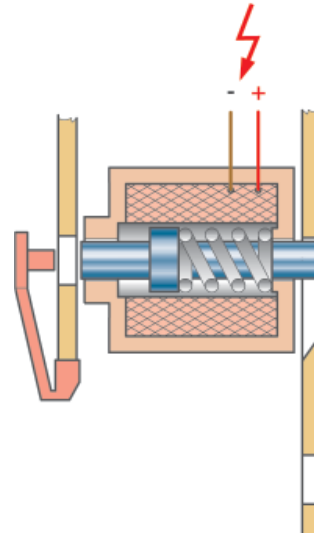
If the selector lever is set to "P", the locking pin is located in locking pin latch "P". This prevents the locking lever from being moved unintentionally.



#### Selector Lever Released:

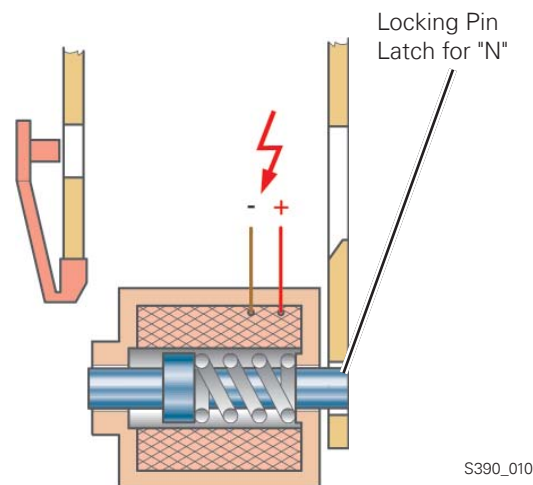
After switching on the ignition and actuating the foot brake, the J587 Selector Lever Sensor System Control Module supply the N110 Shift Lock Solenoid with current. As a result of this, the locking pin is withdrawn from the locking pin latch "P".

The selector lever can now be moved to the drive position.



#### Selector Lever Locked in "N" Position

If the selector lever is set to the "N" position for longer than 2 sec., the control unit supplies the solenoid with current. As a result of this, the locking pin is pressed into locking pin latch "N". The selector lever can no longer be unintentionally moved into a gear. The locking pin is released when the brake is actuated.



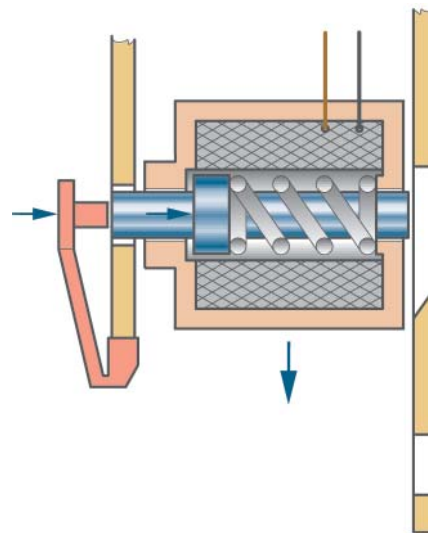
# Selector Lever

## Emergency Release

If the voltage supply to the N110 Shift Lock Solenoid fails, the selector lever cannot be moved because selector lever lock "P" remains activated in the event of a power failure.

By mechanically "pressing in" the locking pin with a narrow object, the lock can be released and the selector lever can be "emergency released" to the "N" position.

The vehicle can be moved again.



S390\_011

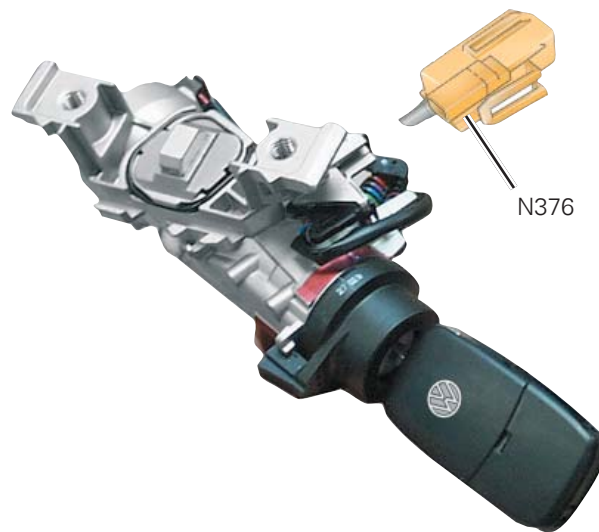
# Selector Lever

## Ignition Switch Key Lock Solenoid

The ignition key withdrawal lock prevents the ignition key from being turned back to the removal position if the parking lock is not engaged.

It functions electromechanically and is controlled by the J527 Steering Column Electronics Control Module.

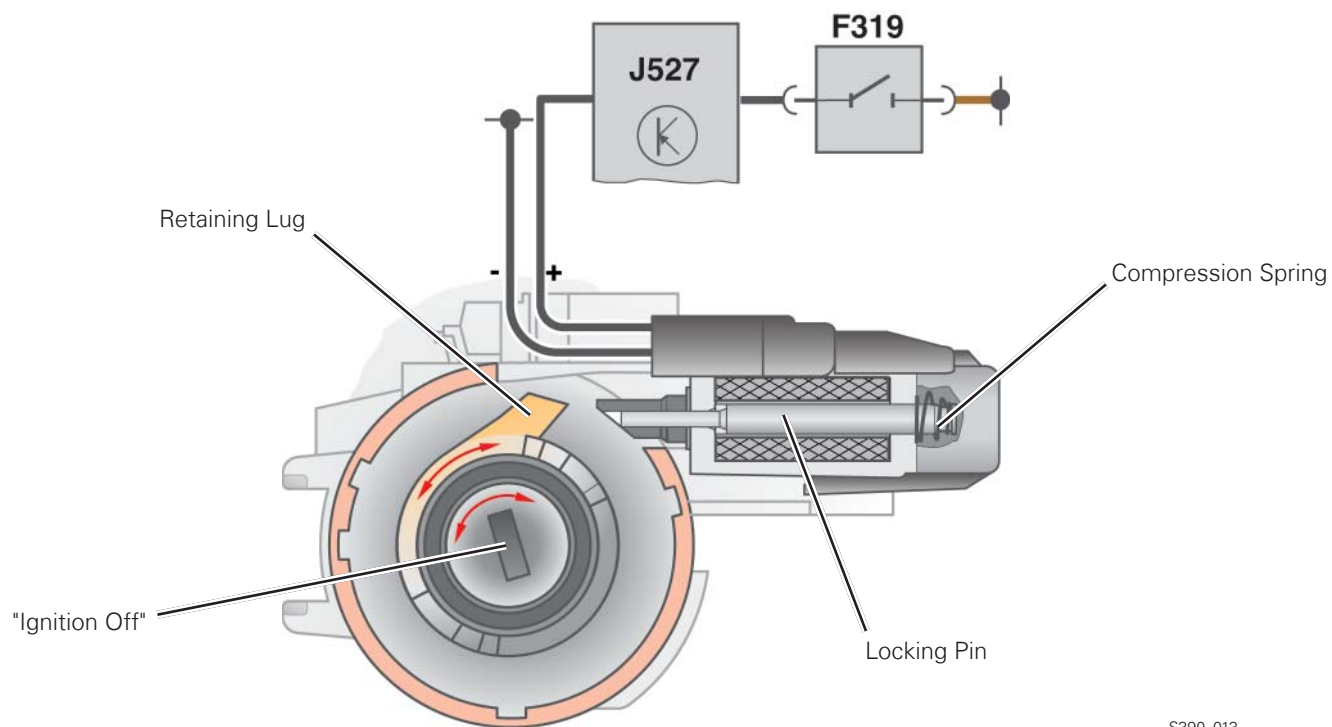
The J527 detects the open switch. The N376 Ignition Switch Key Lock Solenoid is not supplied with current. The compression spring in the solenoid pushes the locking pin into the release position.



S390\_012

## How It Works:

With the selector lever in park position the ignition is switched off. If the selector lever is set to the park position, the F319 Selector Lever Park Position Lock Switch is opened.



S390\_013

# Selector Lever

## How It Works:

Selector lever in drive position the ignition is switched on.

If the selector lever is set to the drive position, the F319 Selector Lever Park Position Lock Switch is closed.

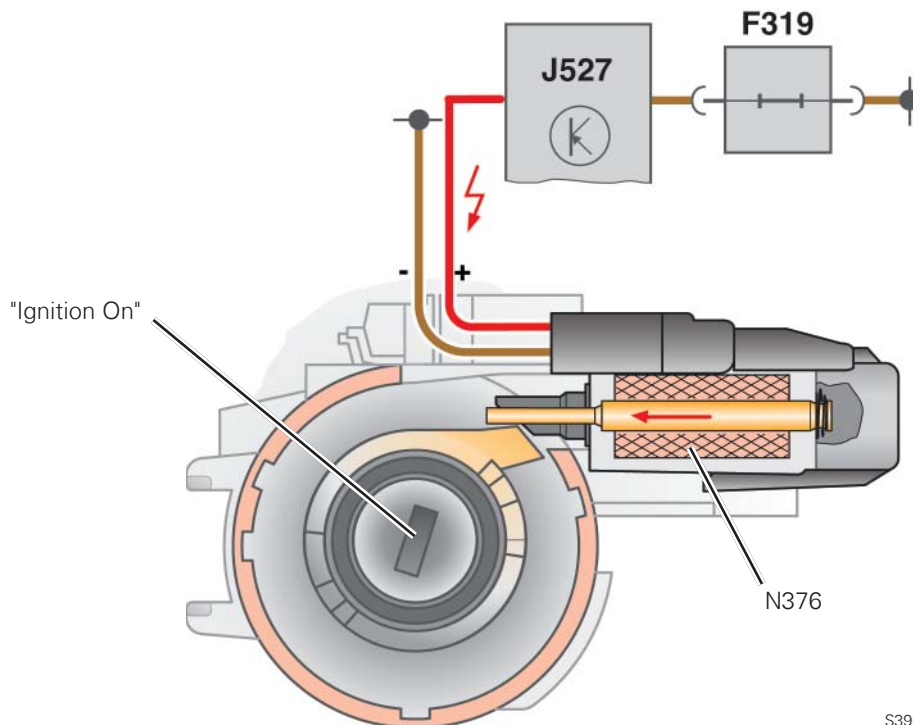
The steering column electronics control unit then supplies the N376 Ignition Switch Key Lock Solenoid with current.

The locking pin is pushed into the locked position because the solenoid overcomes the force of the compression spring.

In the locked position, the locking pin prevents the ignition key from being turned back and withdrawn.

Only when the selector lever is pushed into the park position does the selector lever locked in position "P" switch open and the control unit switches off the current supply to the solenoid.

The locking pin is then pressed back by the compression spring. The ignition key can be turned further and can be removed.



S390\_014

# Transmission Design

## Basic Principle

In principle, the double-clutch transmission consists of two independent halves.

In terms of function, each half is designed as a manual transmission. A clutch is assigned to each half.

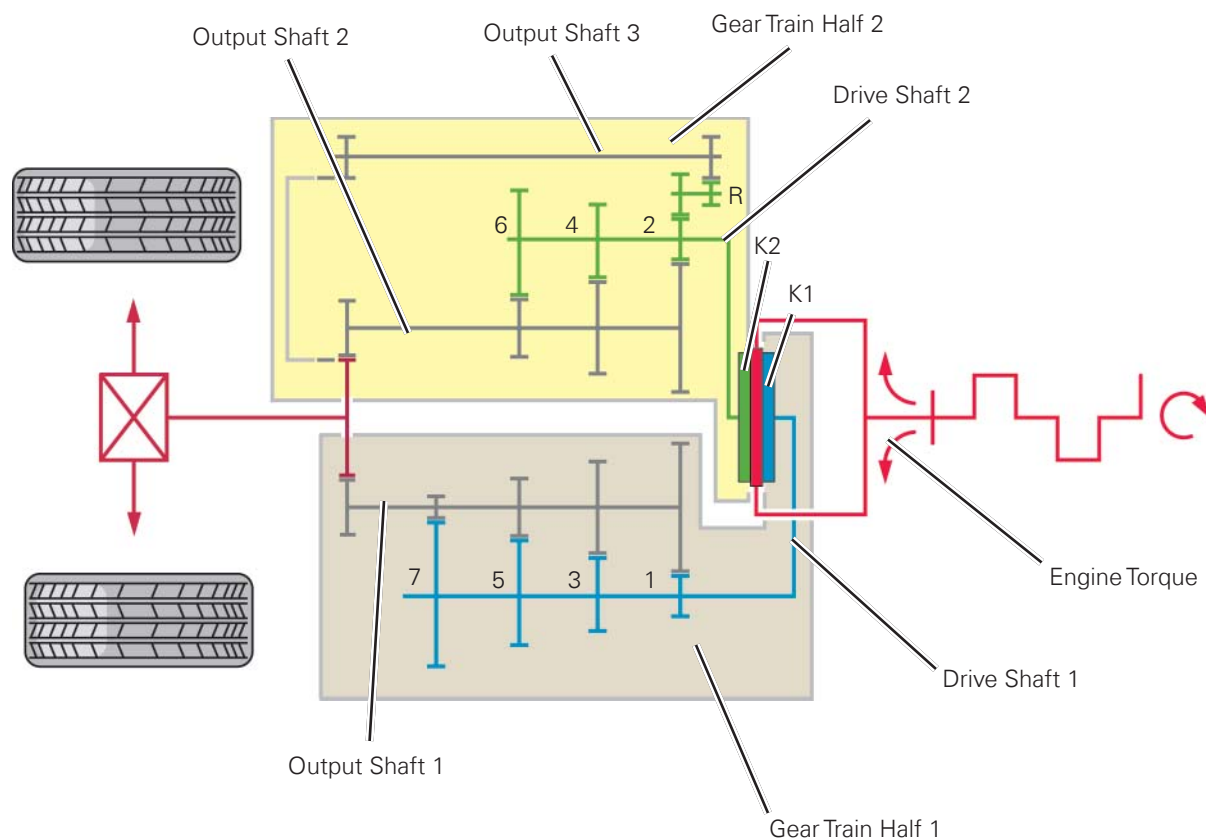
The two clutches are dry clutches. They are opened and closed and controlled by the mechatronic unit depending on the gear to be shifted.

Gears 1, 3, 5 and 7 are shifted via clutch K1 via gear train half 1 and output shaft 1. Gears 2, 4, 6 and reverse gear are actuated via clutch K2 and gear train half 2 and output shafts 2 and 3.

One gear train half is always connected. The next gear can already be shifted in the other gear train half, because the clutch for this gear is still open.

A conventional, manual transmission synchronizer and shift unit is assigned to each gear.

## Basic Schematic

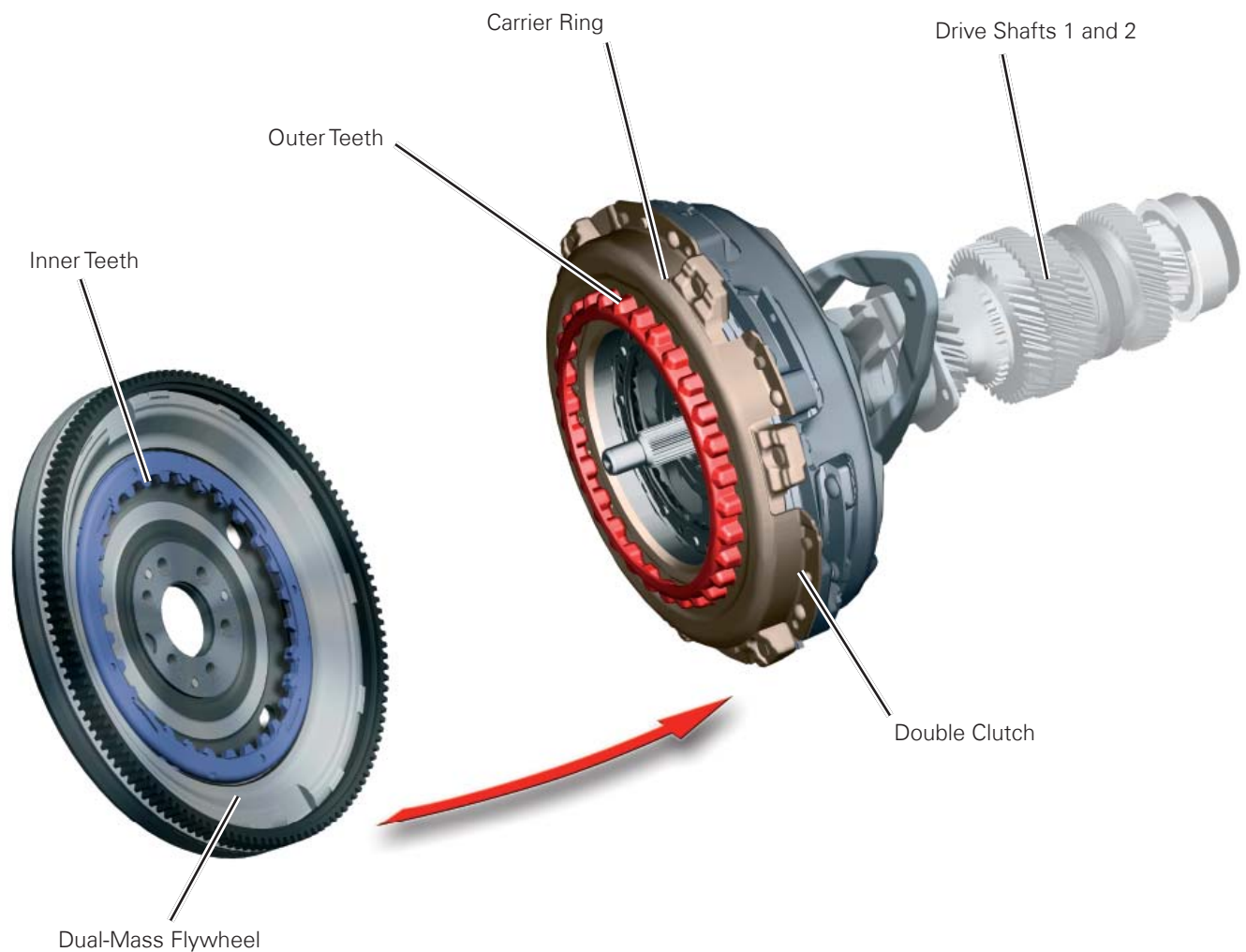


S290\_015

# Transmission Design

## Torque Input

Torque is transferred from the dual-mass flywheel, which is secured to the crankshaft, to the double clutch. The dual-mass flywheel is equipped with inner teeth that engage in the outer teeth on the double clutch carrier ring. From there, the torque is transmitted to the double clutch.



S390\_064



# Transmission Design

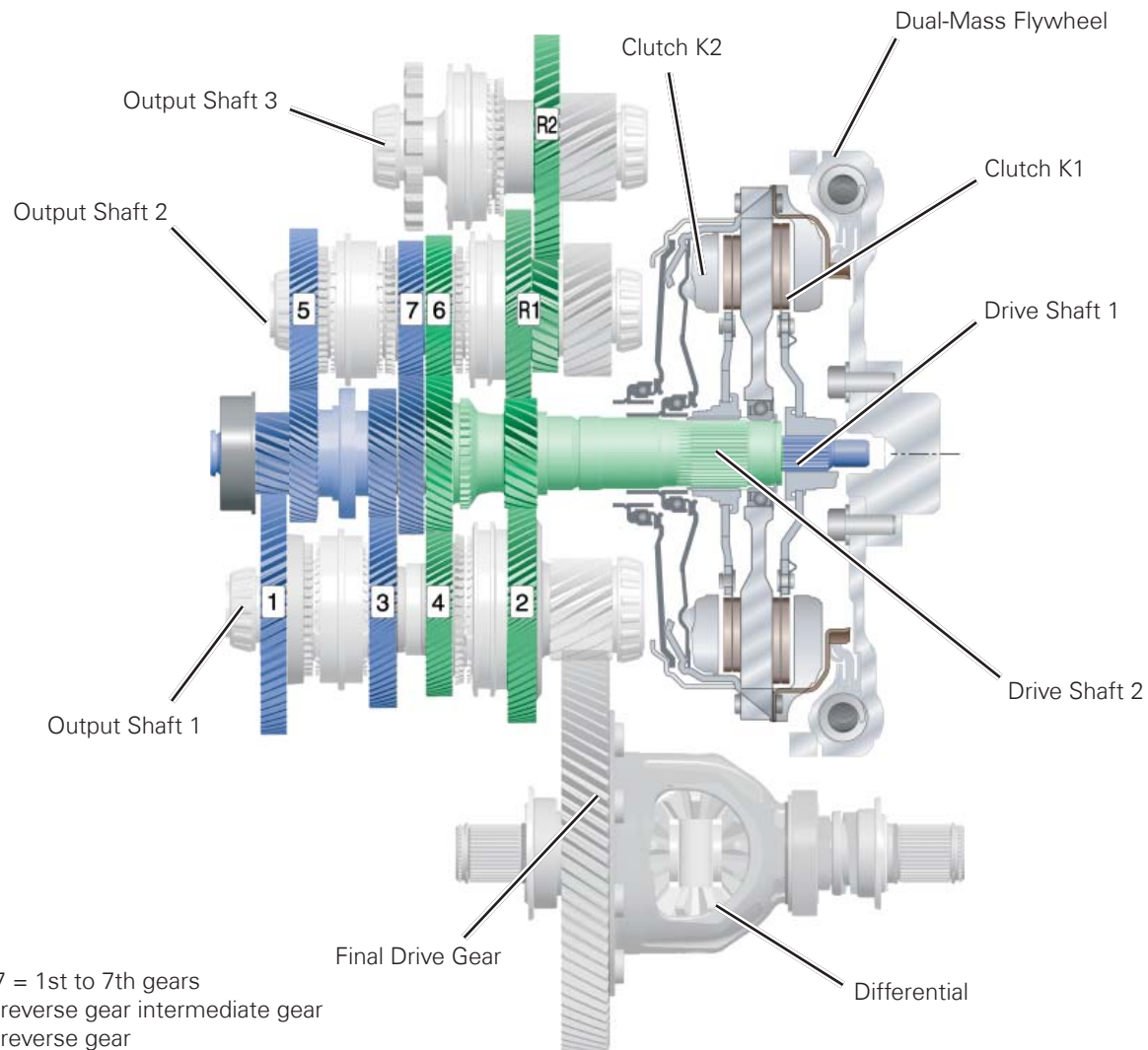
## Double Clutch and Torque Curve

The double clutch is located in the bell housing. It consists of two conventional clutches, which combined form a double clutch. During the remainder of this SSP, the clutches are referred to as K1 and K2.

Clutch K1 transfers the torque to drive shaft 1 via splines. From drive shaft 1, the torque for gears 1 and 3 is transferred to output shaft 1, and the torque for gears 5 and 7 is transferred to output shaft 2.

Clutch K2 transfers the torque to drive shaft 2 via splines. It transfers the torque for gears 2 and 4 to output shaft 1 and the torque for 6th gear and reverse gear to output shaft 2. Using the reverse gear intermediate gear R1, the torque is then passed on to reverse gear R2 on output shaft 3.

All three output shafts are connected to the differential final drive gear.



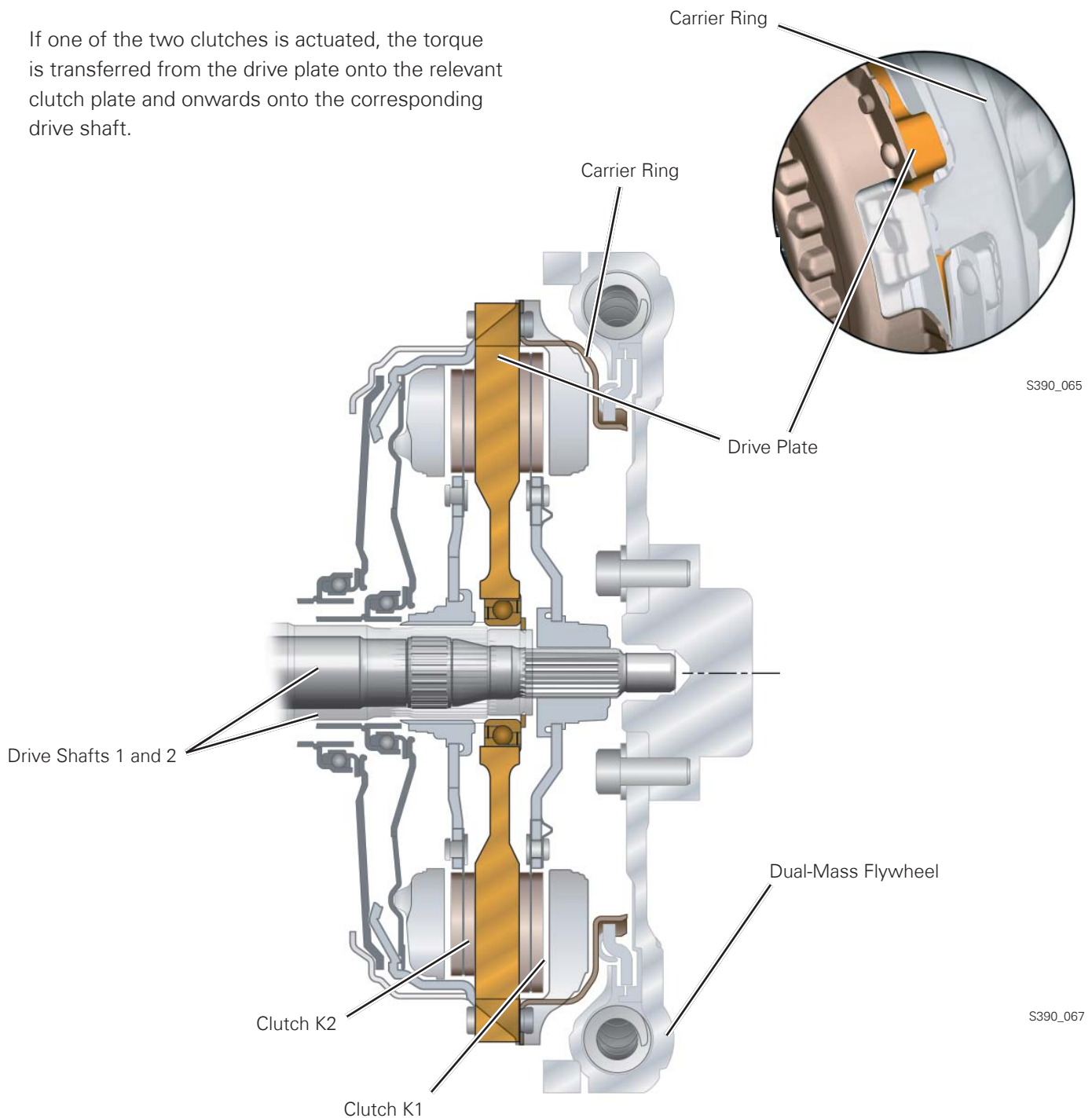


## Double Clutch Drive Plate

From the carrier ring, the torque is transferred to the drive plate in the double clutch. For this to take place, the carrier ring and drive plate are joined firmly together. The drive plate is mounted on drive shaft 2 as an idler gear.

### How It Works:

If one of the two clutches is actuated, the torque is transferred from the drive plate onto the relevant clutch plate and onwards onto the corresponding drive shaft.



# Transmission Design

## Clutches

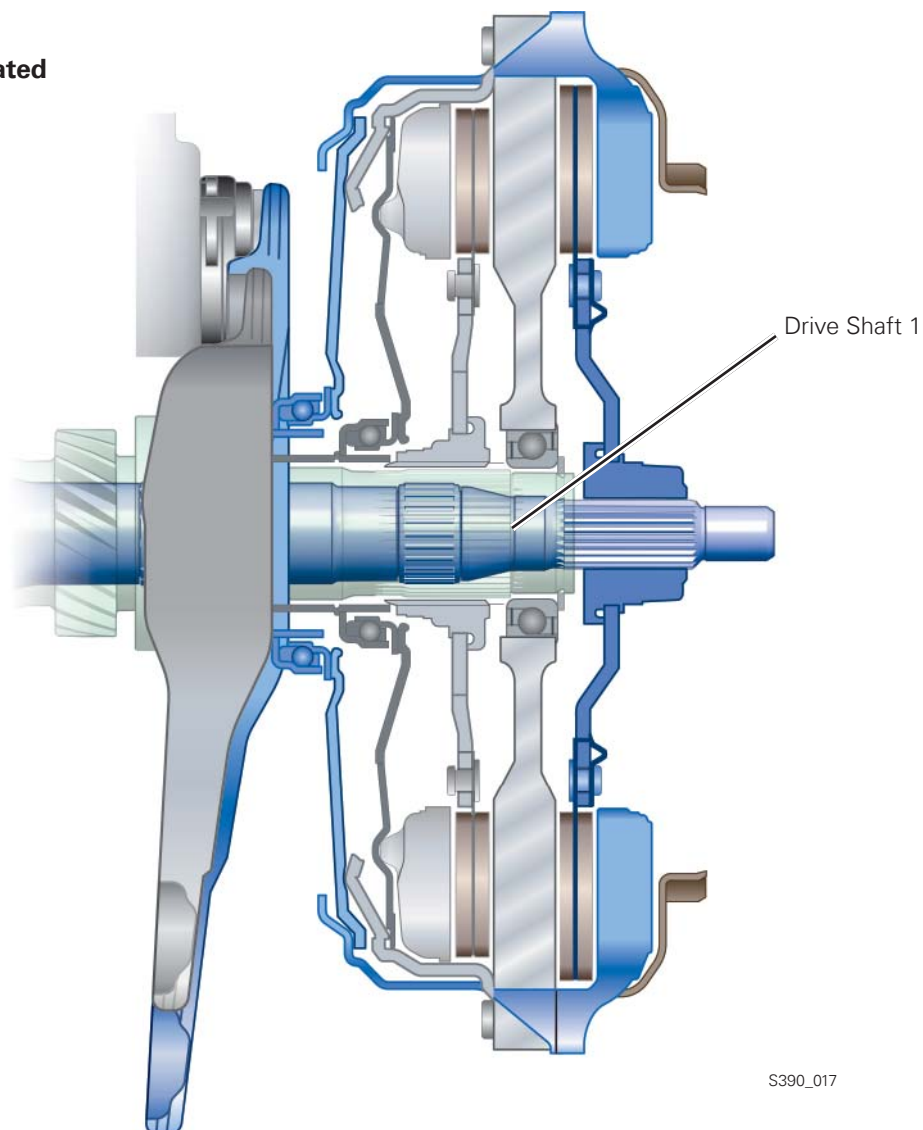
Two independent, dry clutches operate in the double clutch. They each transfer the torque to one gear train half. Two clutch positions are possible:

- When the vehicle is stopped and idling, both clutches are open.
- During vehicle operation, only one of the two clutches is ever closed.

### Clutch K1

Clutch K1 conducts the torque for gears 1, 3, 5 and 7 to drive shaft 1.

### Clutch K1 Not Actuated



S390\_017

# Transmission Design

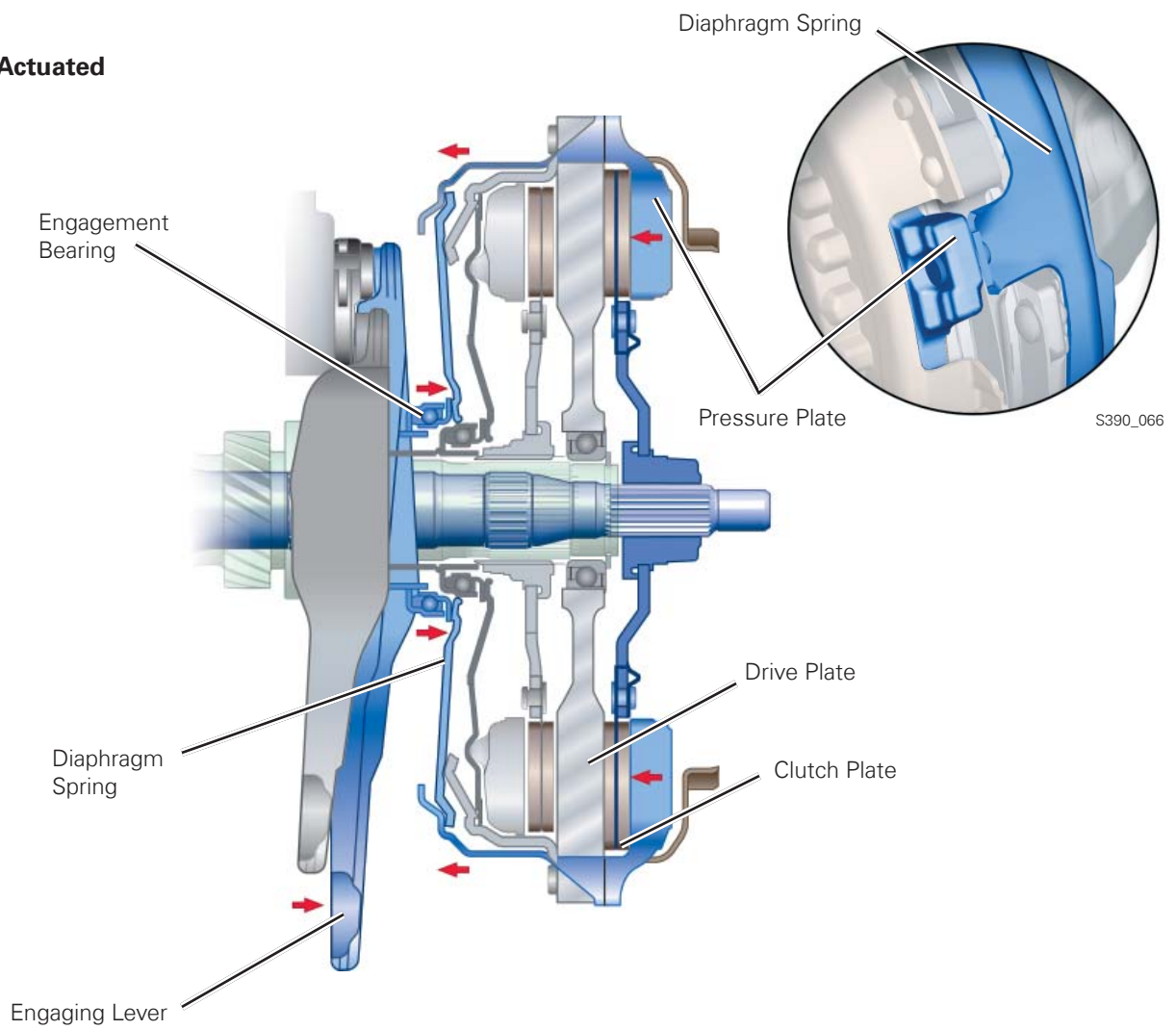
## How It Works:

To actuate the clutch, the engaging lever presses the engagement bearing onto the diaphragm spring. At several contact points, this compression movement is transformed into a tension movement.

As a result, the pressure plate is pulled onto the clutch plate and the drive plate. The torque is then transferred to the drive shaft.

The engaging lever is actuated via N435 Sub-Transmission 1 Valve 3 by the hydraulic clutch actuator for K1.

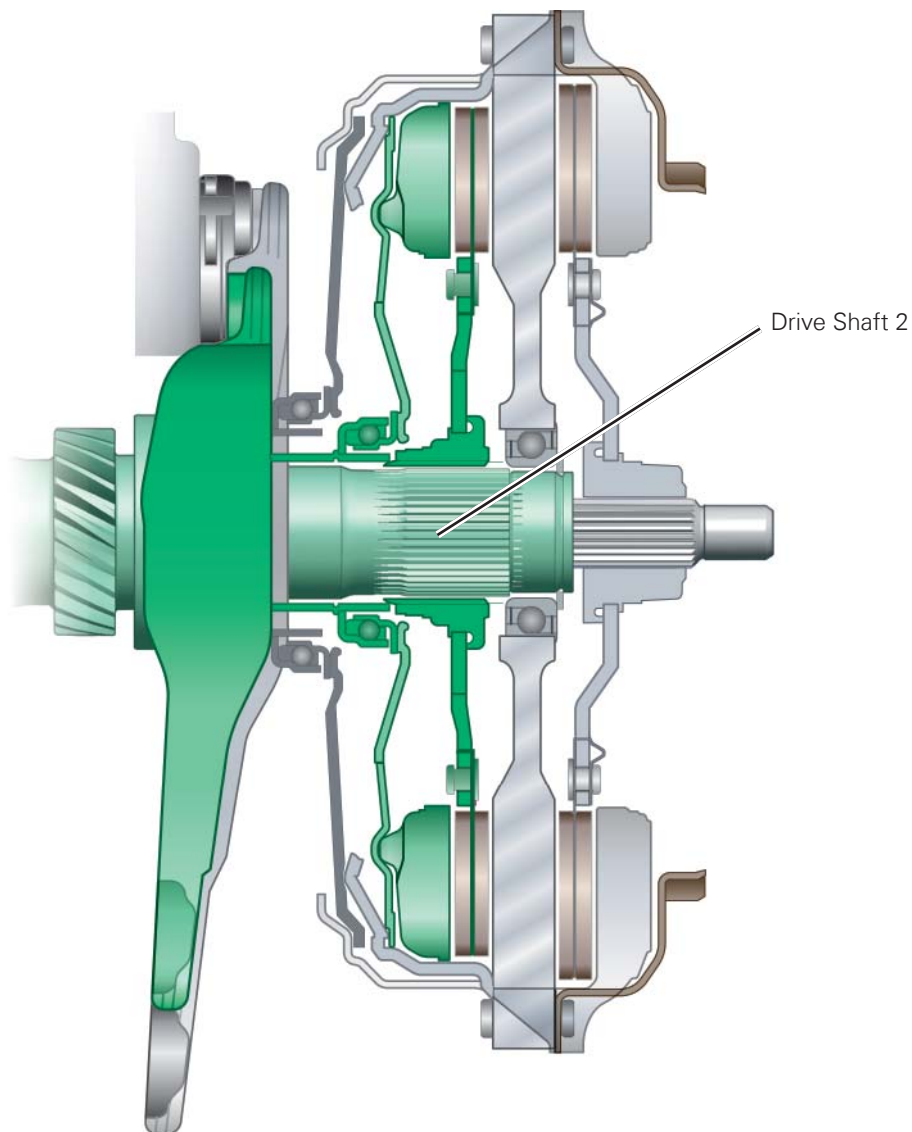
## Clutch K1 Actuated



# Transmission Design

## Clutch K2

Clutch K2 transfers the torque for gears 2, 4, 6 and R to drive shaft 2.



S390\_018

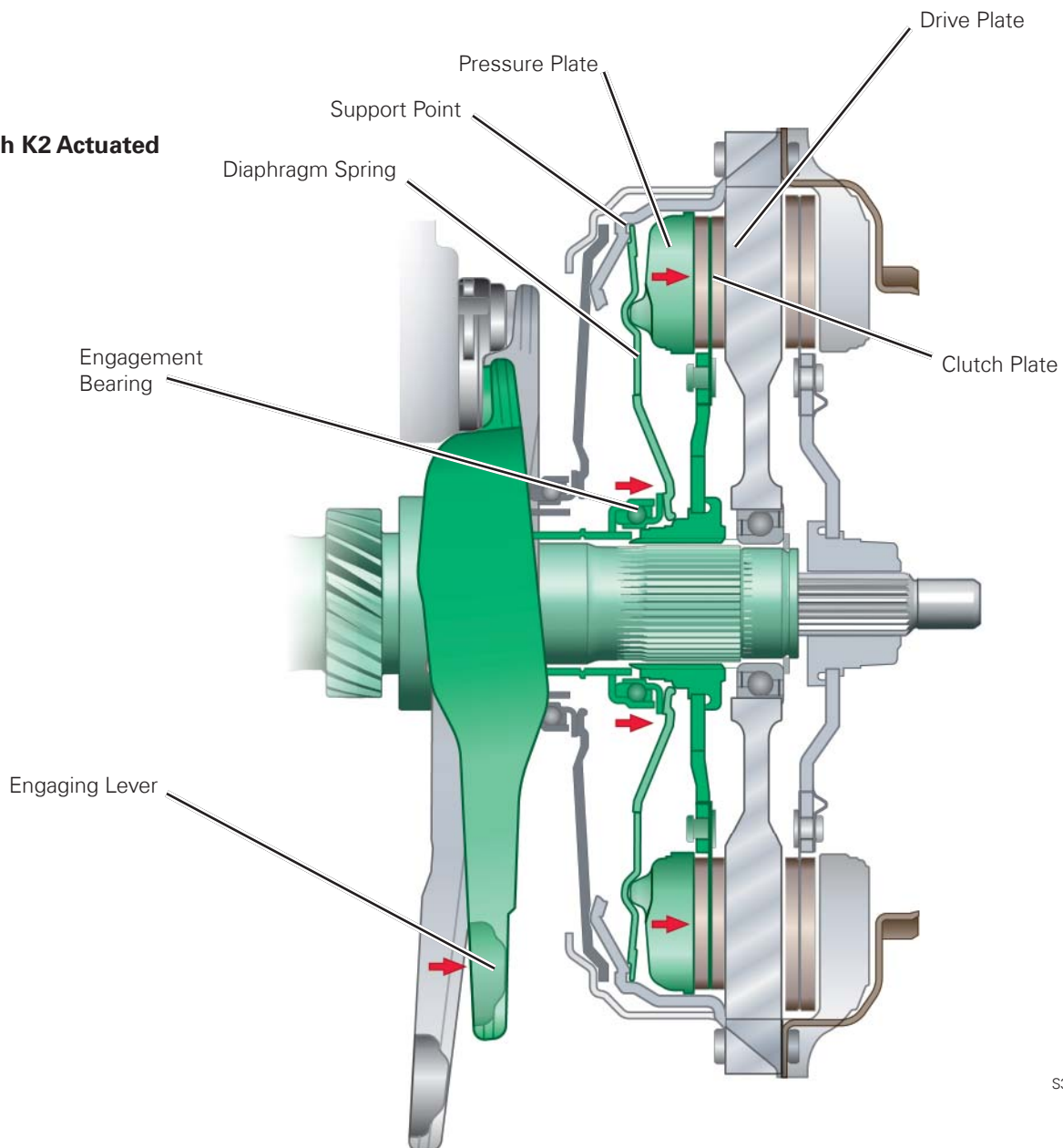
# Transmission Design

## How It Works:

### Clutch K2

If the engaging lever is actuated, the engagement bearing presses against the pressure plate diaphragm spring. Because the diaphragm spring is supported by the clutch housing, the pressure plate is pressed against the drive plate and the torque is transferred onto drive shaft 2. The engaging lever is actuated via N439 Sub-Transmission 2 Valve 3 by the hydraulic clutch actuator for K2.

### Clutch K2 Actuated



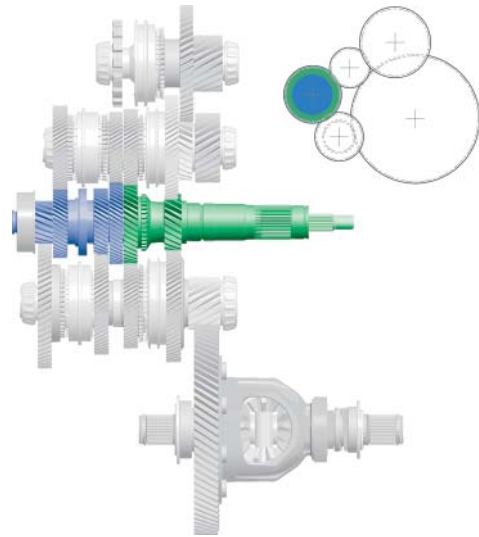
S390\_088

# Transmission Design

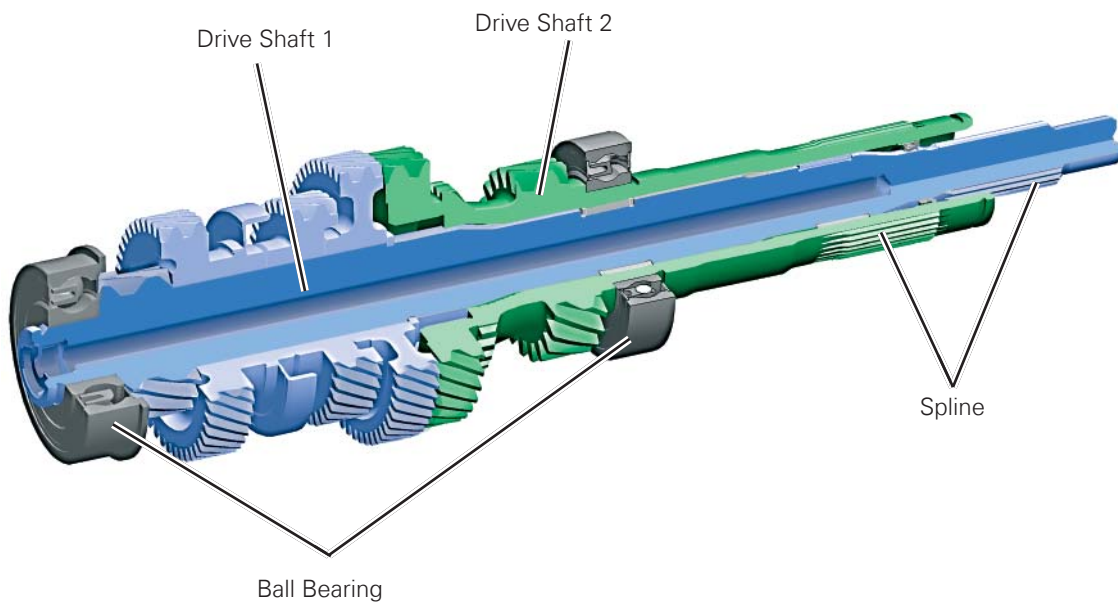
## Drive Shafts

The drive shafts are located in the transmission housing. Each drive shaft is connected to a clutch via splines. These transfer the engine torque onto the output shafts according to the gear which is engaged.

Drive shaft 2 is hollow. Drive shaft 1 runs through hollow drive shaft 2. Ball bearings are mounted in the transmission case.



S390\_046



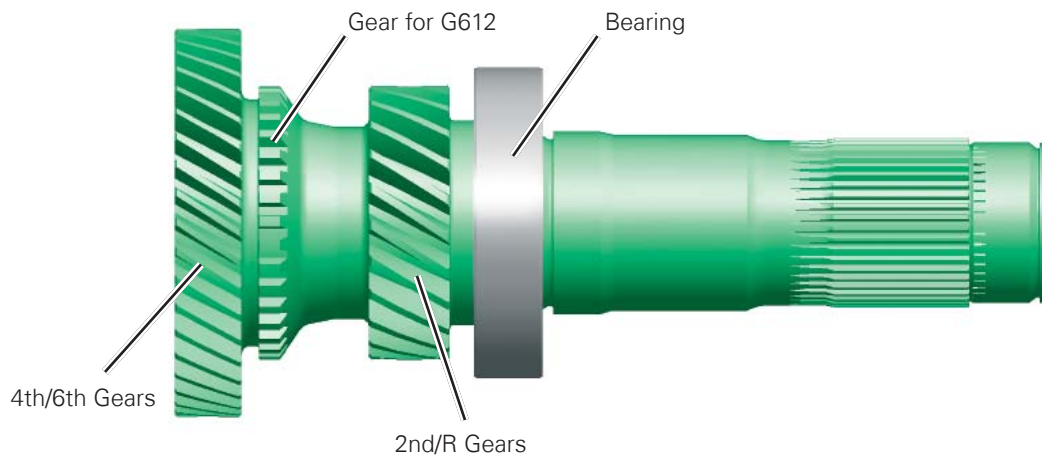
S390\_019



# Transmission Design

## Drive Shaft 2

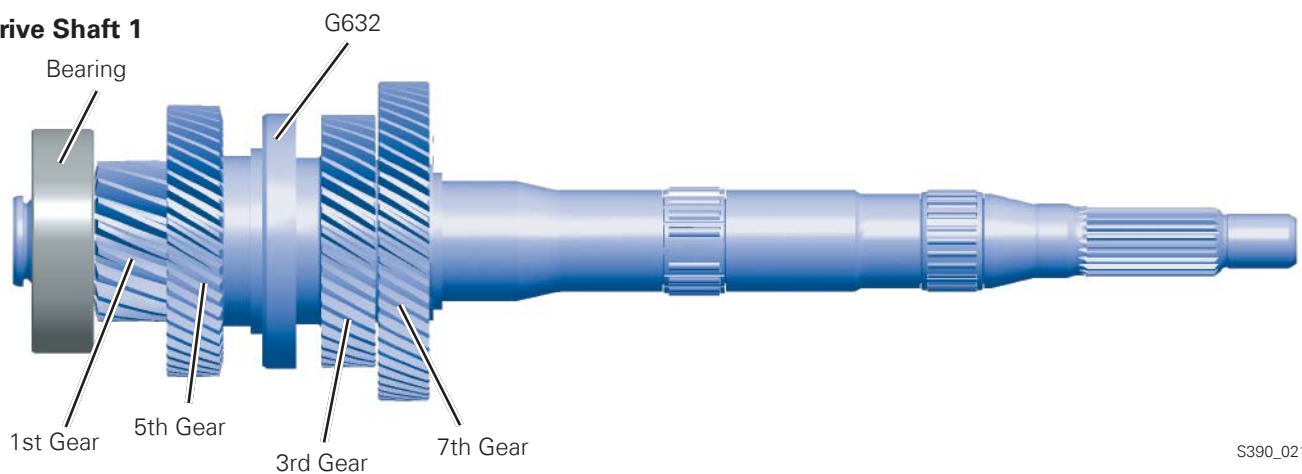
Due to its installation position, we will cover drive shaft 2 before drive shaft 1.



S390\_020

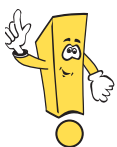
Drive shaft 2 is a hollow shaft. It is connected to K2 via splines. Drive shaft 2 is used to shift gears 2, 4, 6 and R. To record the transmission input speed, this shaft has the gear for G612 Transmission Input Speed Sensor 2.

## Drive Shaft 1



S390\_021

Drive shaft 1 is connected to clutch K1 via splines. It is used to shift gears 1, 3, 5 and 7. To record the transmission input speed, this shaft has the impulse wheel for G632 Transmission Input Speed Sensor 1.



Please note that a strong magnet may destroy the impulse wheel for drive shaft 1.

# Transmission Design

## Output Shafts

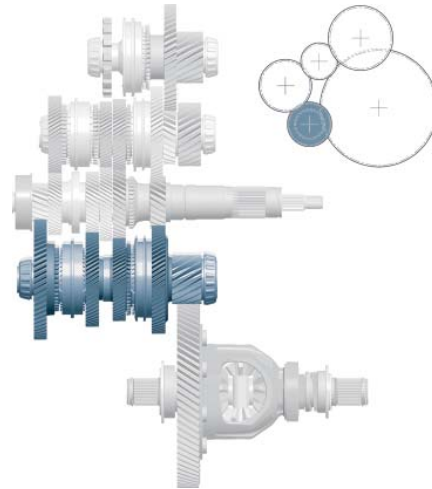
The transmission has three output shafts.

Depending on the gear which is engaged, the engine torque is transferred from the drive shafts to the output shafts.

An output gear is located on each output shaft.

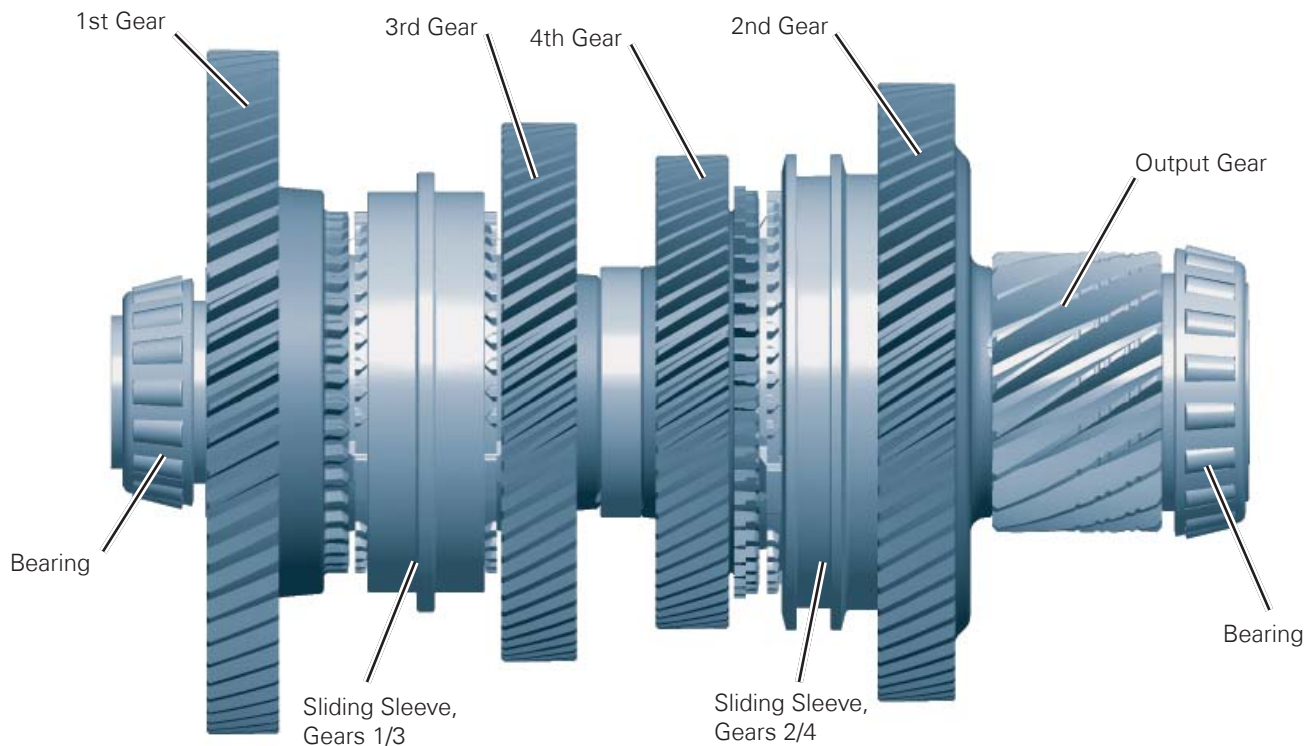
### Installation Position in the Transmission

(View from the left – shown elongated)



S390\_023

### Output Shaft 1



S390\_022

The following are located on output shaft 1:

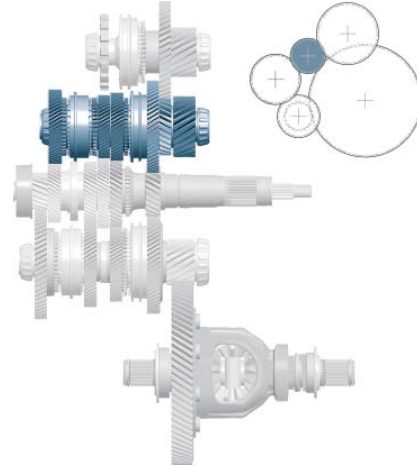
- The selector gears for gears 1, 2 and 3; the 3 gears are 3x's synchromeshed.
- The selector gear for 4th gear; the 4th gear is 2x's synchromeshed.



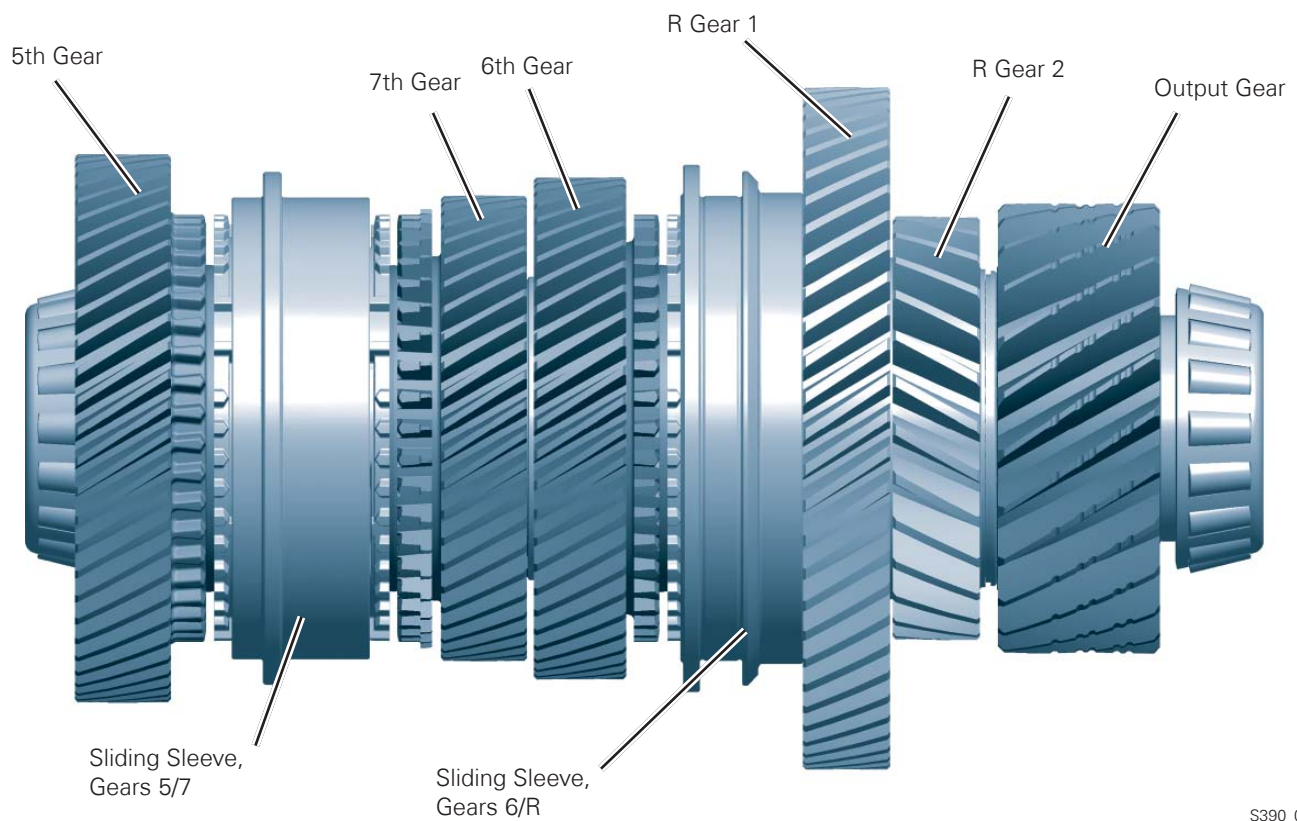
# Transmission Design

## Installation Position in the Transmission

(View from the left – shown elongated)



## Output Shaft 2



The following are located on output shaft 2:

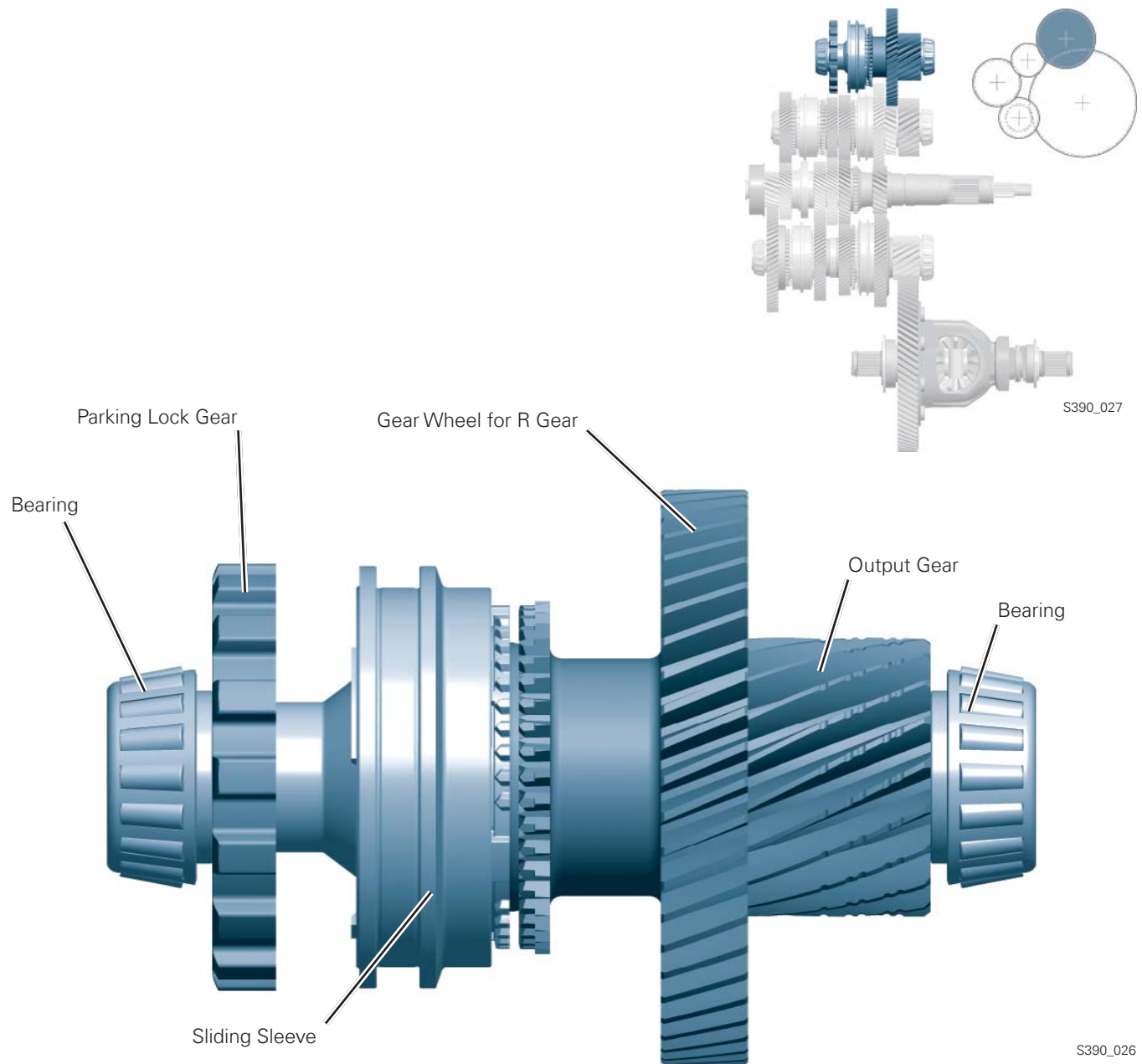
- The 2-fold synchromeshed selector gears for gears 5, 6 and 7, and
- The intermediate gears R gear 1 and R gear 2 for reverse gear.

# Transmission Design

## Output Shaft 3

### Installation Position in the Transmission

(View from the left – shown elongated)



The following are located on output shaft 3:

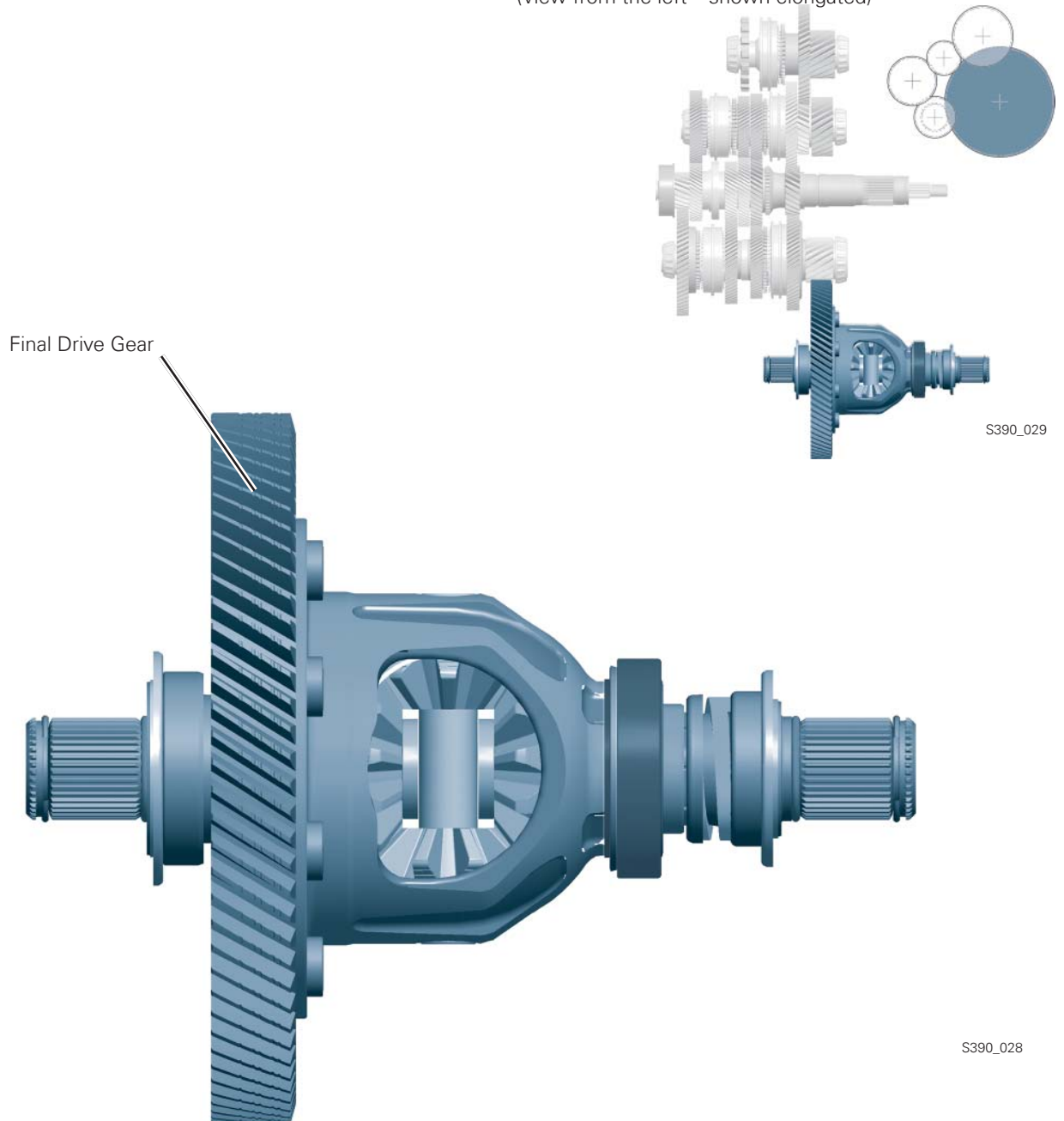
- The 1-fold synchromeshed selector gear for R gear
- The parking lock gear

# Transmission Design

## Differential

### Installation Position in the Transmission

(View from the left – shown elongated)



The differential transfers the torque onwards to the vehicle wheels via the drive shafts.

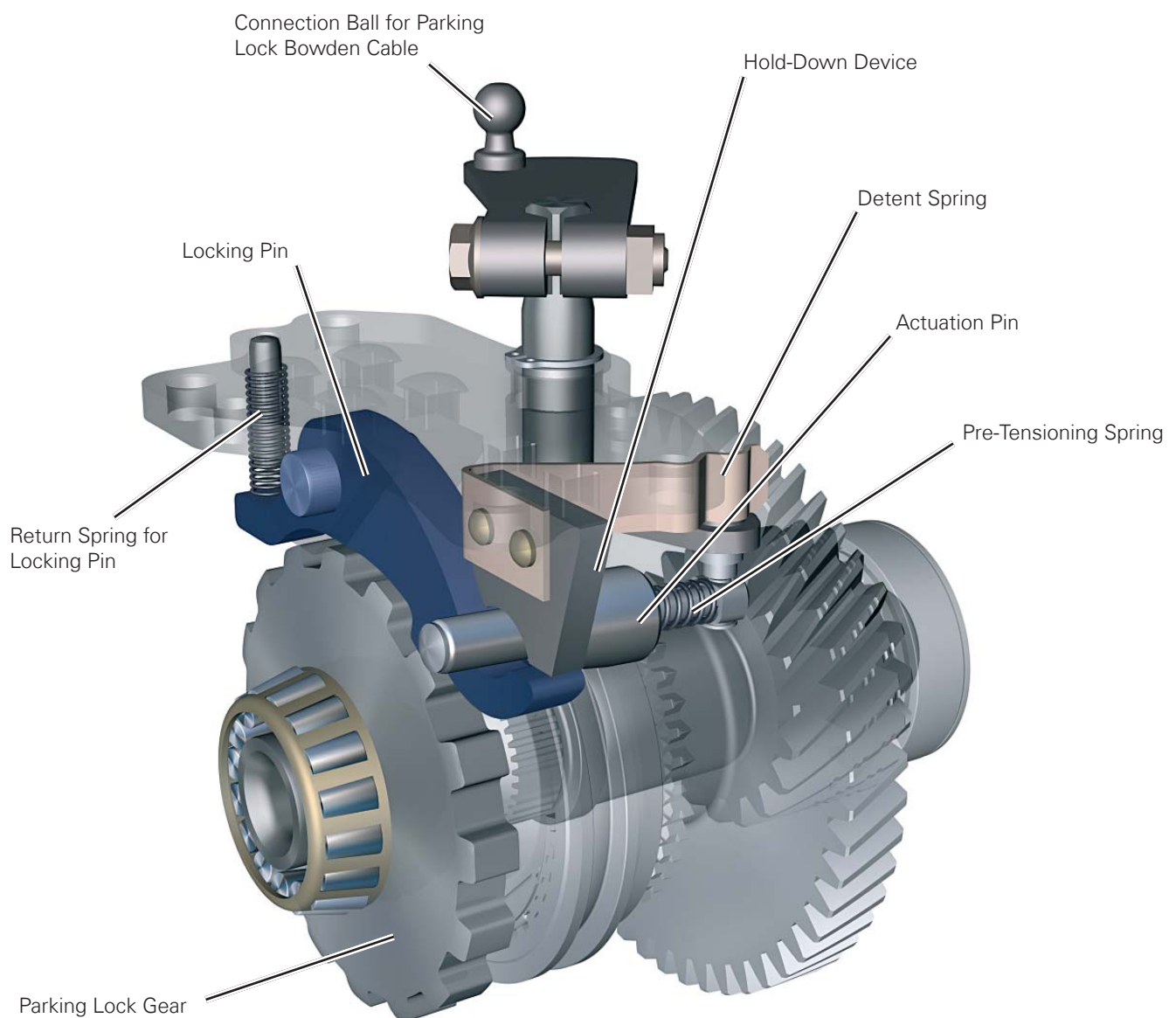
# Transmission Design

## Parking Lock

A parking lock is integrated into the DSG to ensure that a parked vehicle does not roll away.

The locking pin is engaged purely mechanically via a Bowden cable between the selector lever and the parking lock lever on the transmission.

The Bowden cable is used exclusively to actuate the parking lock.



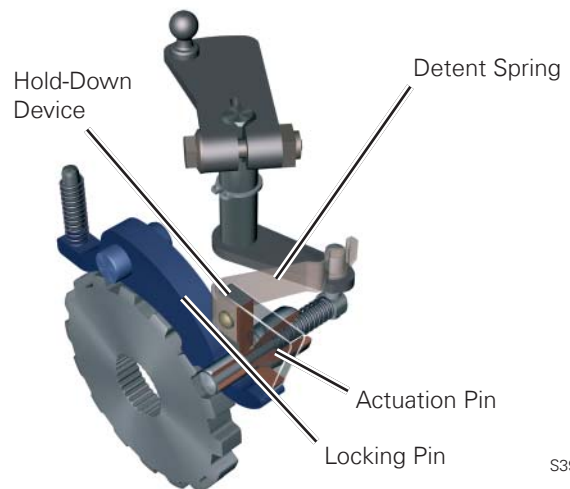
S390\_030

## Function

### **Parking Lock Not Actuated, (Selector Lever Position R, N, D, S)**

When the parking lock is not actuated, the cone of the actuation pin lies on the holding-down device and the locking pin.

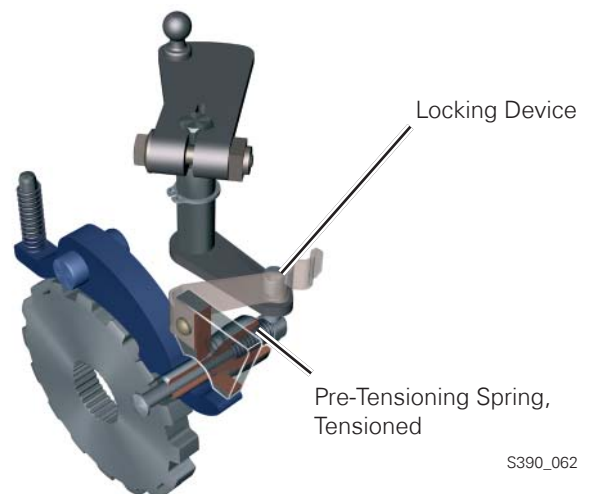
The parking lock is held in the non-actuated position by a locking device.



### **Parking Lock Actuated, Locking Pin Not Engaged (Selector Lever Position P)**

By actuating the parking lock, the cone of the actuation pin is pressed against the hold-down device and the locking pin. As the hold-down device is stationary, the locking pin moves down. If it encounters a tooth on the parking lock gear, the pre-tensioning spring is tensioned.

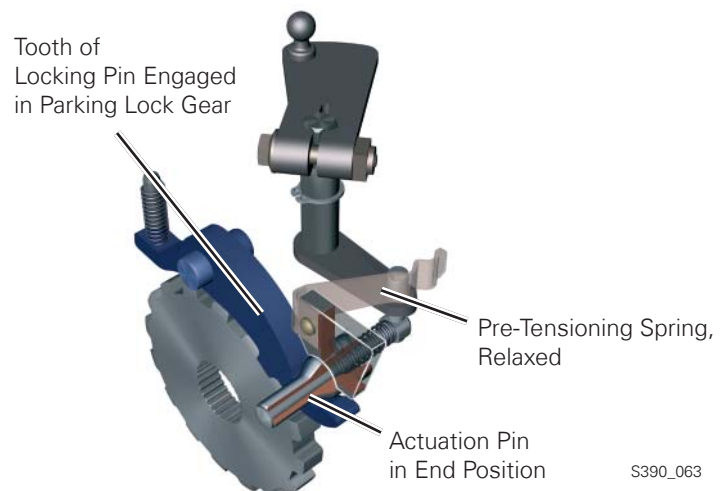
The actuation pin is held in this position by the locking device.



### **Parking Lock Actuated, Locking Pin Engaged (Selector Lever Position P) (Locking Pin Engaged)**

If the vehicle continues to move, the parking lock gear also rotates.

As the actuation pin is pre-tensioned, it automatically pushes the locking pin into the next tooth space on the parking lock gear.





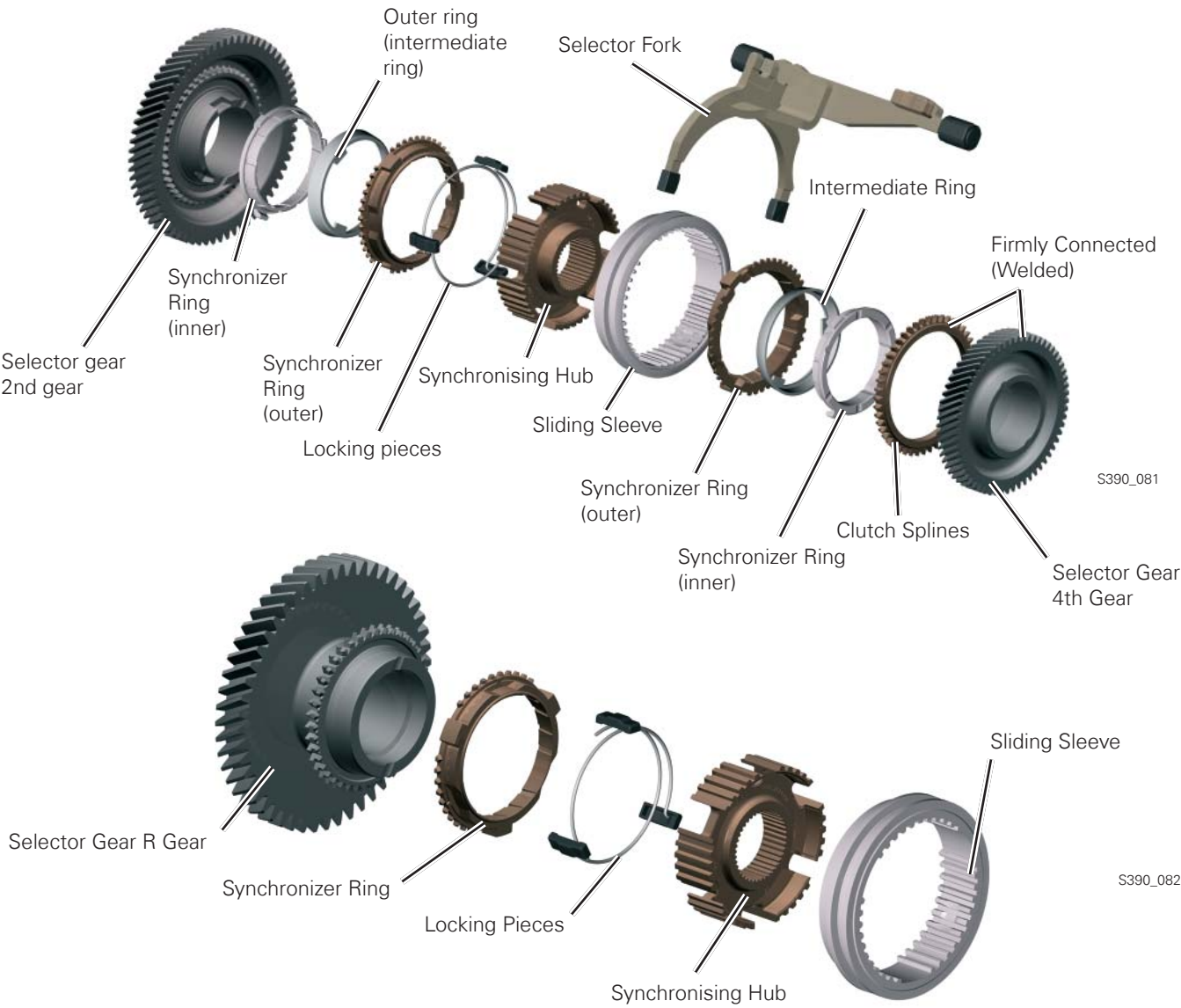
# Transmission Design

## Gear Synchronization

A synchromesh with locking pieces is used for all gears to synchronize the different speeds when changing gears. Depending on the shifting load, the gears are synchronized between one and three times.

Gear	Synchromesh	Synchronizer Ring Material
1st to 3rd	Three synchronizers	Brass with molybdenum coating
4th	Two synchronizers	Brass with molybdenum coating
5th to 7th	One synchronizer	Brass with molybdenum coating
R	One synchronizer	Brass with molybdenum coating

The figure shows the synchromesh design for 2nd, 4th and R gears.

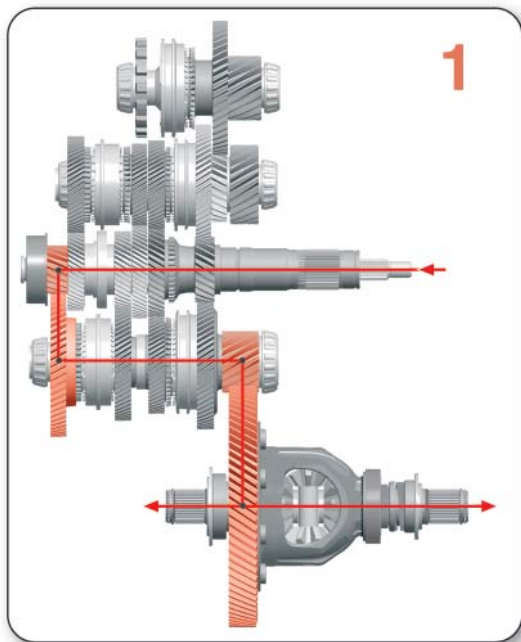


## Power Transmission in the Gears

Torque is transmitted into the transmission by either clutch K1 or K2. Each clutch drives a drive shaft. Drive shaft 1 is driven by clutch K1 and drive shaft 2 is driven by clutch K2.

Power is transmitted to the differential via:

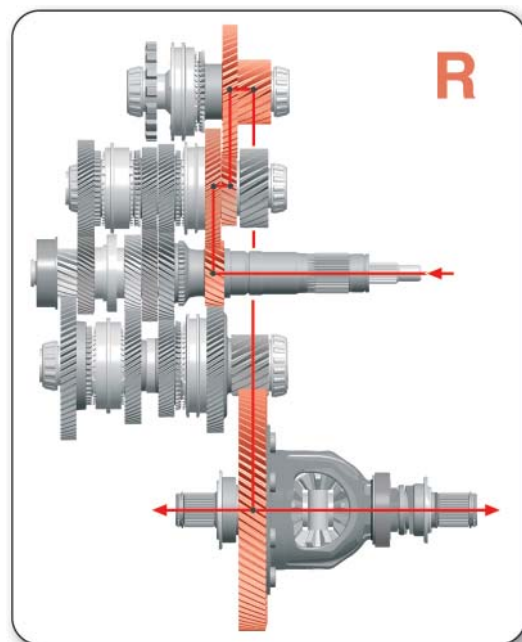
- output shaft 1 for gears 1, 2, 3, and 4,
- output shaft 2 for gears 5, 6 and 7, and
- output shaft 3 for reverse gear and the parking lock.



S390\_033

### 1st Gear

Clutch K1  
Drive Shaft 1  
Output Shaft 1  
Differential



S390\_034

### R Gear

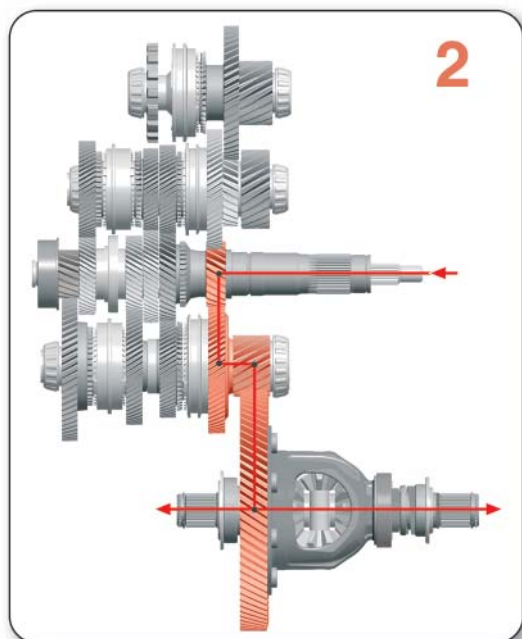
Clutch K2  
Drive Shaft 2  
Output Shaft 3  
Differential

The change in rotational direction for reverse gear is carried out by output shaft 3.



For greater clarity, power transmission is shown schematically in "elongated" form.

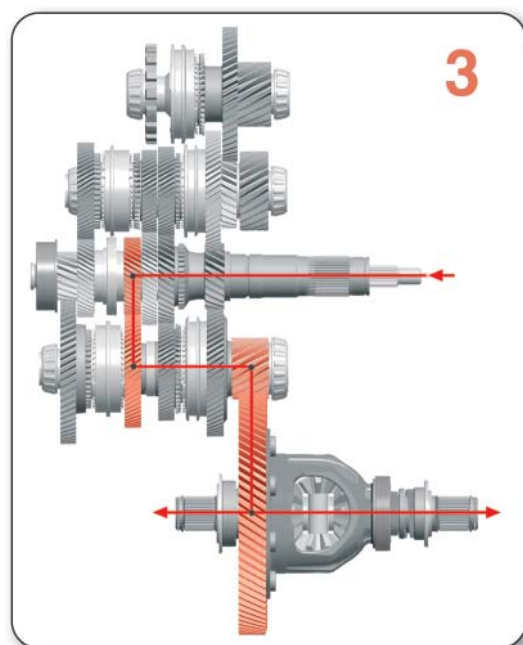
# Transmission Design



## 2nd Gear

Clutch K2  
Drive Shaft 2  
Output Shaft 1  
Differential

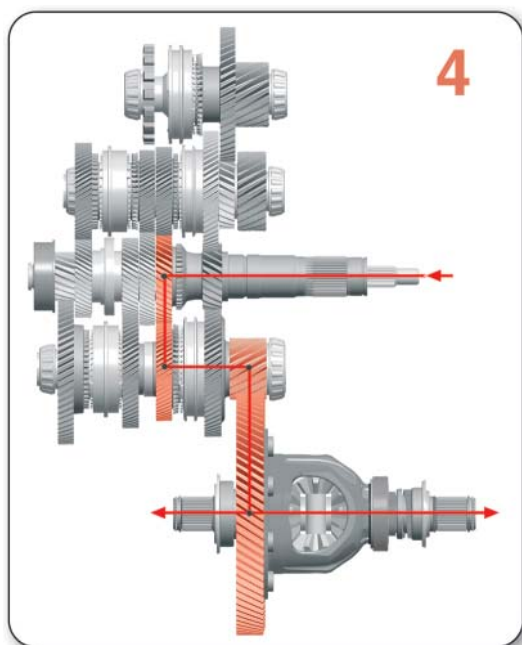
S390\_035



## 3rd Gear

Clutch K1  
Drive Shaft 1  
Output Shaft 1  
Differential

S390\_036



## 4th Gear

Clutch K2  
Drive Shaft 2  
Output Shaft 1  
Differential

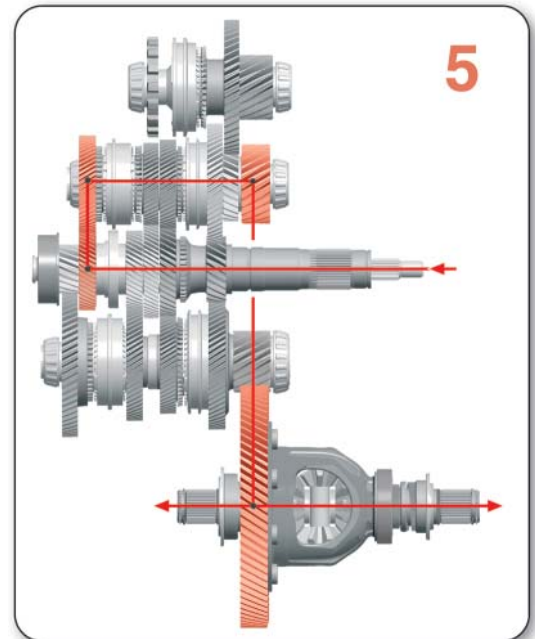
S390\_037



# Transmission Design

## 5th Gear

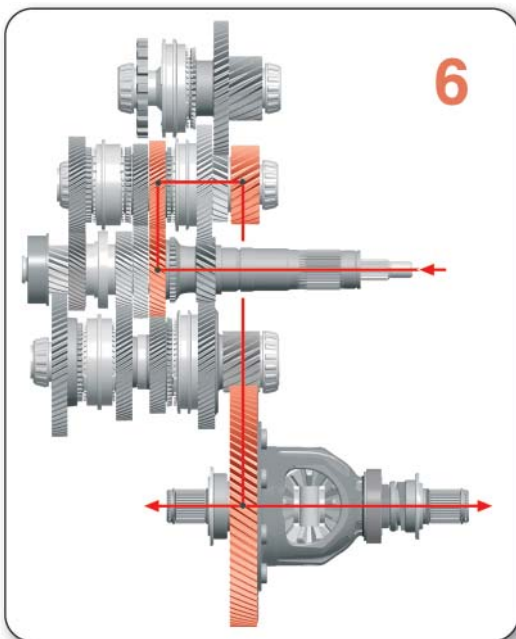
Clutch K1  
Drive Shaft 1  
Output Shaft 2  
Differential



S390\_038

## 6th Gear

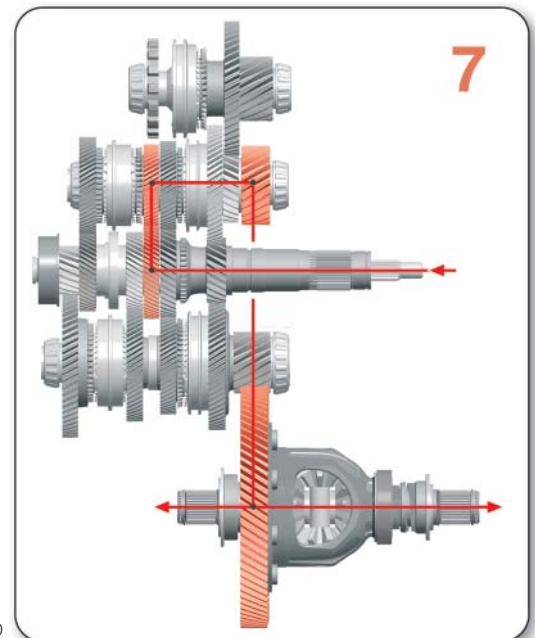
Clutch K2  
Drive Shaft 2  
Output Shaft 2  
Differential



S390\_039

## 7th Gear

Clutch K1  
Drive Shaft 1  
Output Shaft 2  
Differential



S390\_040

# Mechatronic Module

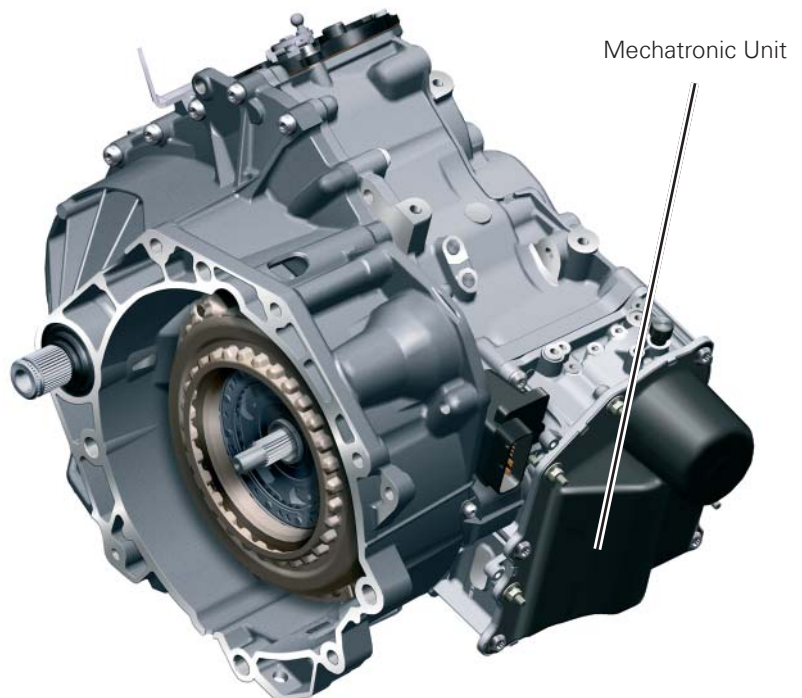
## J743 DSG Transmission Mechatronic

The mechatronic unit controls all transmission functions. It combines the electronic control unit and the electrohydraulic control unit into a single component.

The mechatronic unit is an autonomous unit. It has a separate oil circuit, which is independent of the oil circuit for the mechanical transmission.

The advantages of this autonomous, compact unit are:

- All sensors (except one) and actuators are contained in the mechatronic unit.
- The hydraulic fluid is specifically adapted to the requirements of the mechatronic unit.
- Due to the separate oil circuit, no foreign material from the mechanical transmission enters into the mechatronic unit.
- Good low-temperature behavior, as no compromise has to be made with the requirements of the transmission in terms of viscosity behavior.

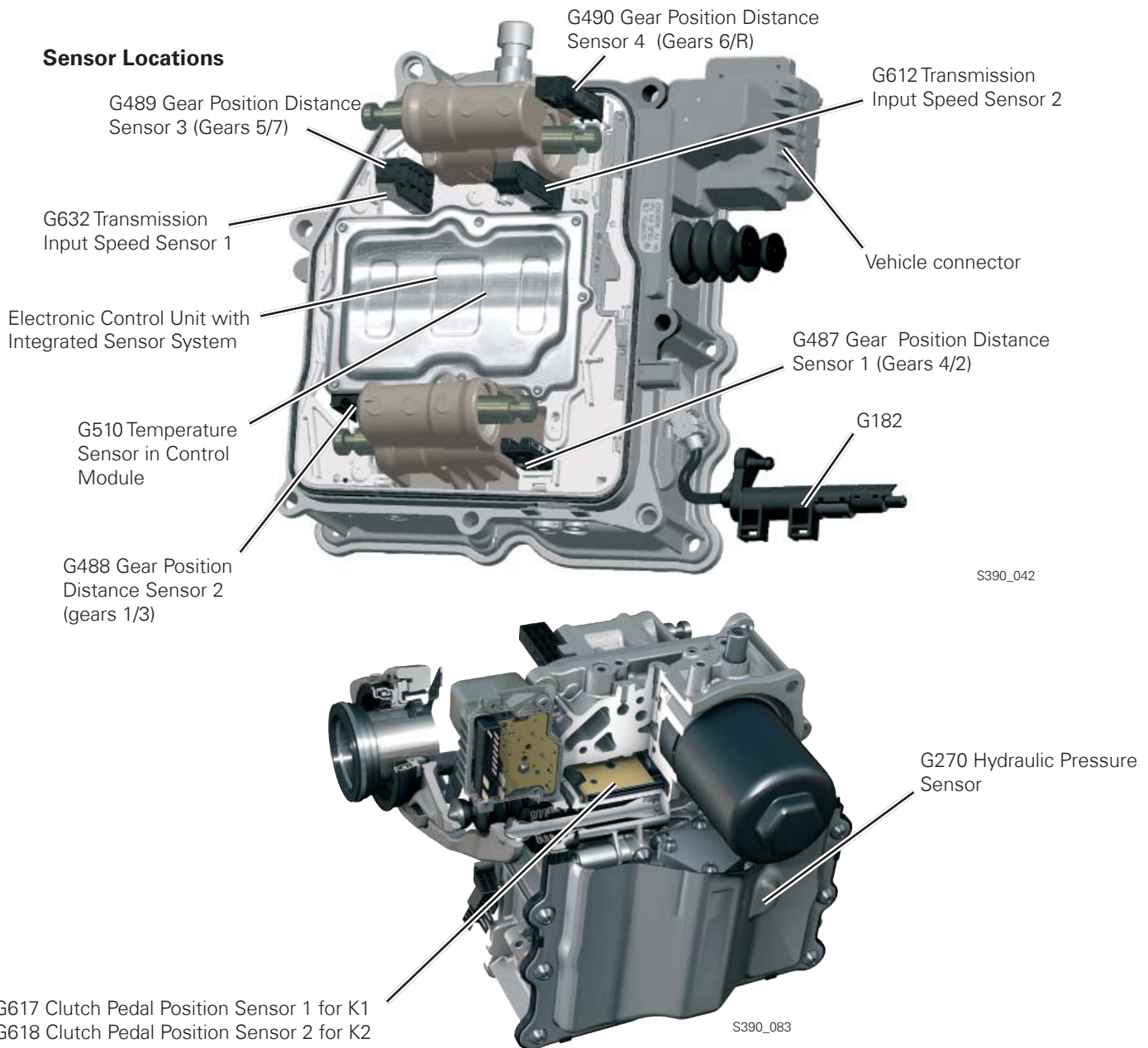


# Mechatronic Module

The electronic control unit is the central transmission control unit. All sensor signals and all signals from other control units come together here, and all actions are performed and monitored by it. Eleven sensors are integrated into the electronic control unit; only the G182 Transmission Input Speed Sensor is located outside of the control unit. The electronic control unit hydraulically controls and regulates eight solenoid valves for shifting the seven gears and for actuating the clutch.

The electronic control unit learns (adapts) the positions of the clutches and the positions of the gear selectors when a gear is engaged and takes what has been learned into consideration for operation of these components.

## Sensor Locations



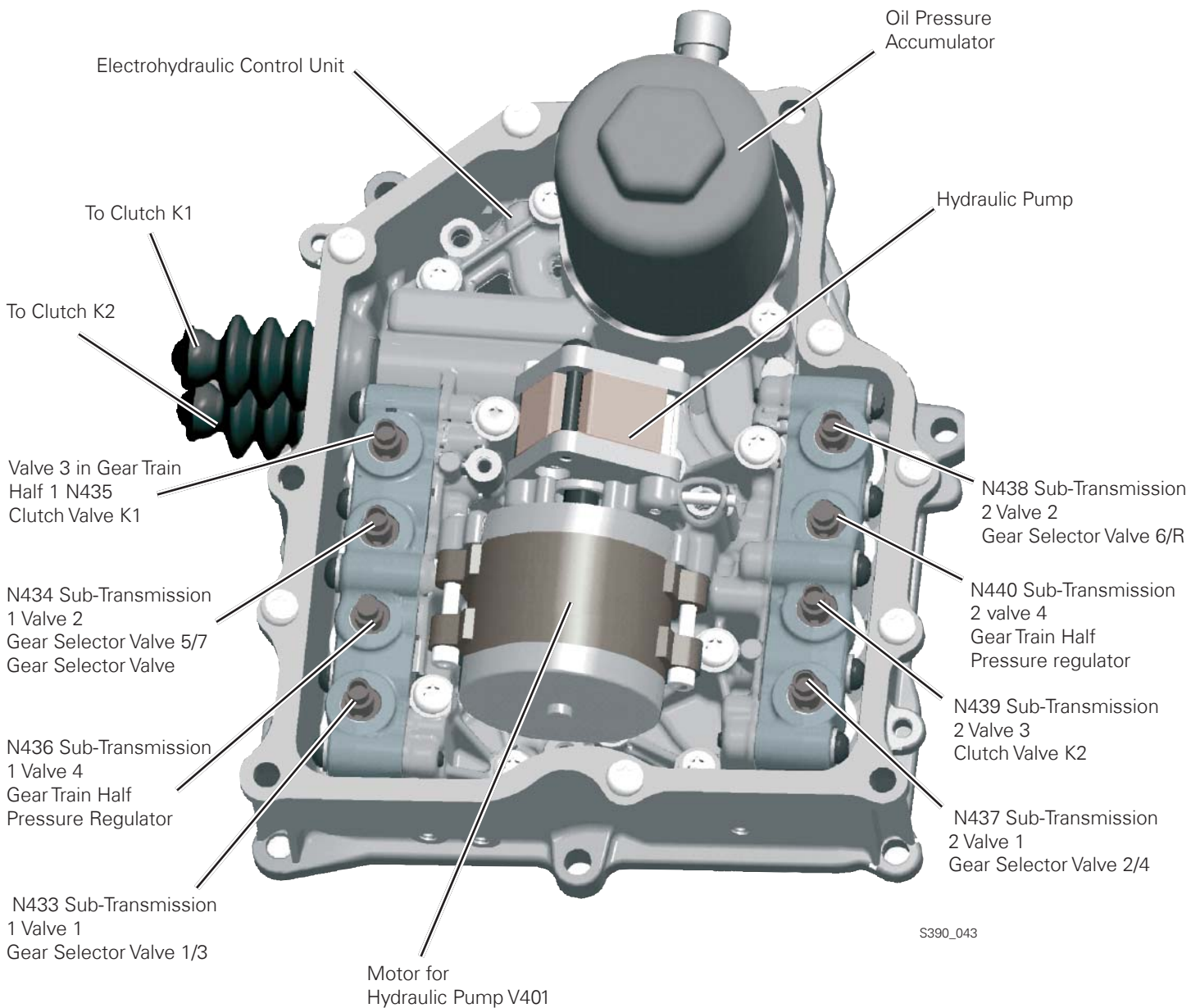
# Electrohydraulic Control Unit

## Electrohydraulic Control Unit

The electrohydraulic control unit is integrated into the mechatronic module. It generates the oil pressure which is required to shift the gears and to actuate the clutches.

### Oil Pressure Generation and Control

The oil pressure is generated by the hydraulic pump motor. An oil pressure accumulator ensures that sufficient oil pressure is always present at the solenoid valves.



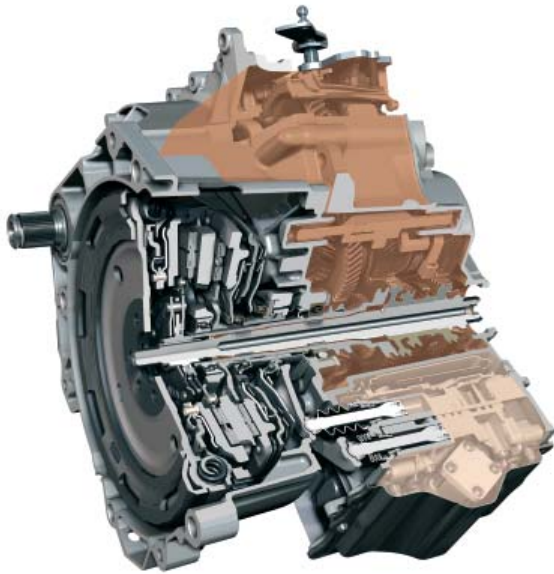
# Oil Circuit - Hydraulic System

## Oil Circuit



The double clutch transmission operates with two independent oil circuits using two different oils:

- Oil circuit for mechanical transmission
- Oil circuit for mechatronic module

Each oil circuit contains a specific oil.



S390\_080

-  Mechatronic Module
-  Oil Circuit for Mechanical Transmission

### Oil Circuit - Mechanical Transmission

The oil supply to the shafts and gears of the mechanical transmission is the same as in a normal manual transmission.

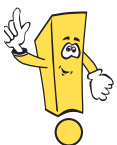
The oil volume in the mechanical transmission is 1.7 L.

### Oil Circuit - Mechatronic Module

The oil supply for the mechatronic unit is separate from the oil circuit for the mechanical transmission.

An oil pump delivers pressurized oil so that the hydraulic mechatronic unit components can function.

The oil volume in the mechatronic unit is 1.1 L.



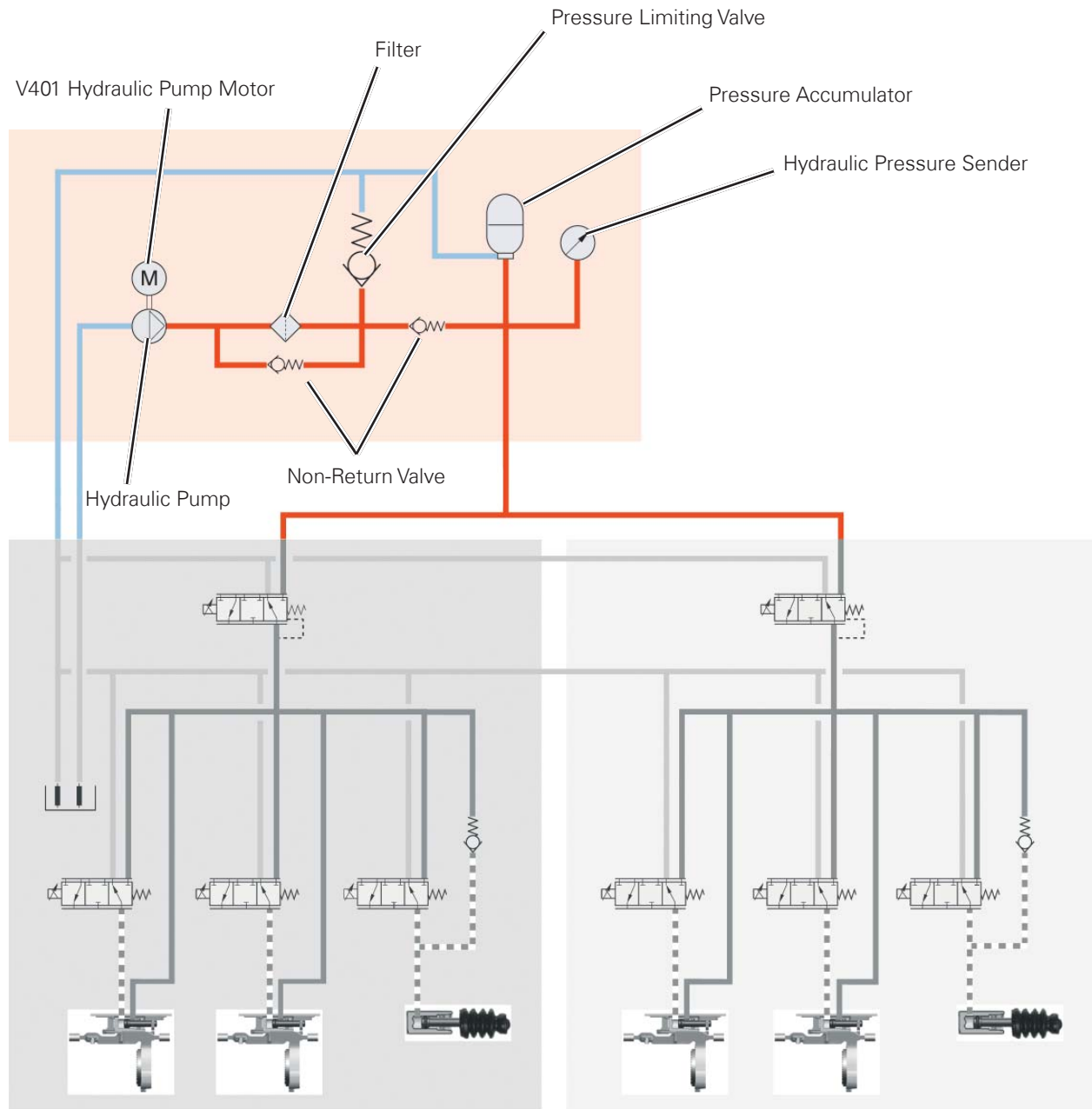
For the volumes and capacities, always refer to the service information



# Oil Circuit - Hydraulic System

## Oil Circuit Flow Chart

### Basic Oil Circuit



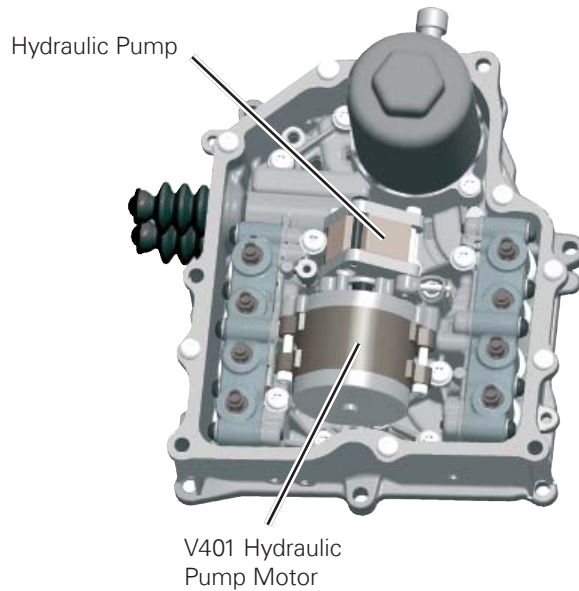
S390\_098

# Oil Circuit - Hydraulic System

## Hydraulic Pump

The hydraulic pump unit is located in the mechatronic module. It consists of a hydraulic pump and an electric motor.

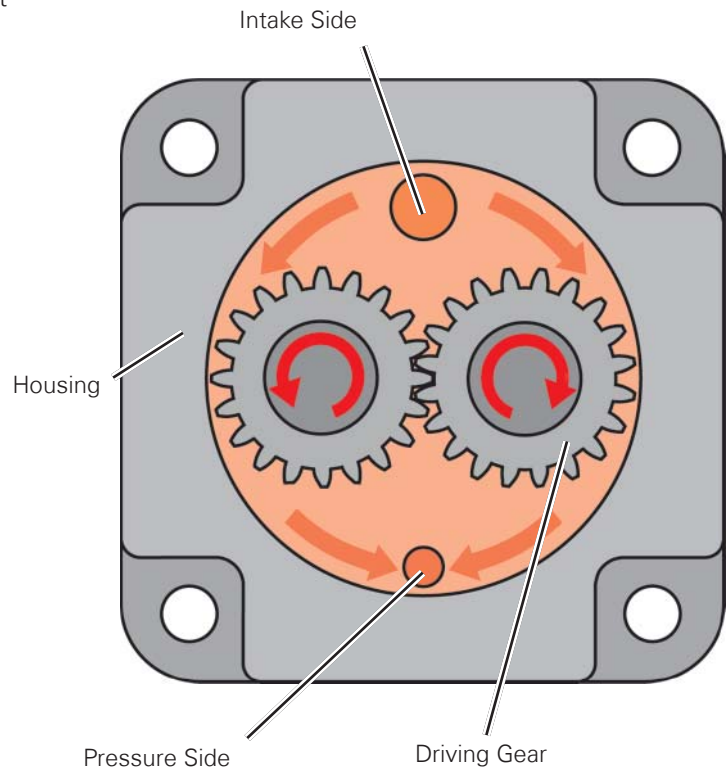
The motor for the hydraulic pump is a brushless DC motor. It is actuated by the mechatronic unit's electronic control unit depending on pressure requirements. It drives the hydraulic pump through a coupling.



S390\_043

The hydraulic pump operates just like a gear pump. It pulls in hydraulic oil and pumps it into the oil circuit at a pressure of approximately 70 bar.

The hydraulic oil is pumped from the intake side to the pressure side between the walls of the pump housing and the tooth gaps.



S390\_071

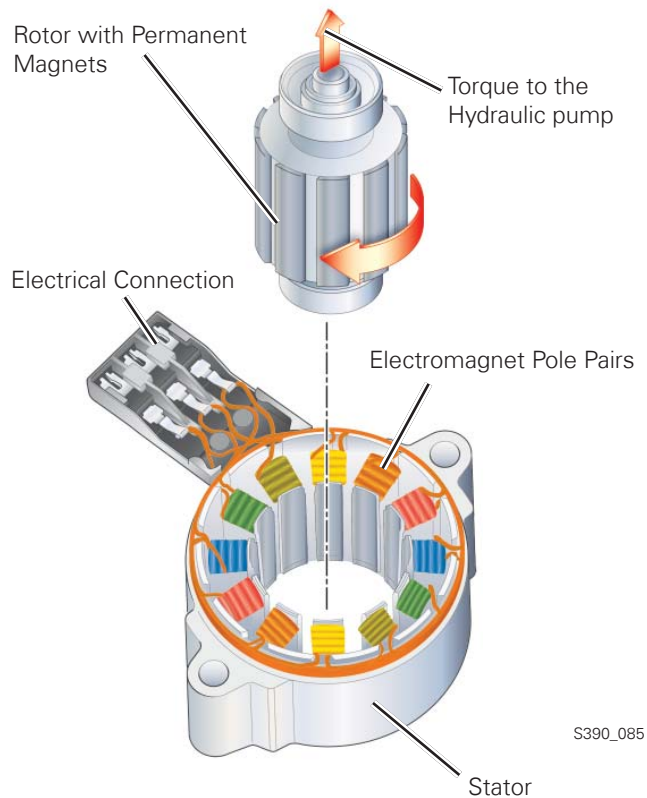
# Oil Circuit - Hydraulic System

## V401 Hydraulic Pump Motor

### Design

Like conventional, smaller DC electric motors, the brushless DC motor has a stator and a rotor. While the stator consists of permanent magnets and the rotor of electromagnets in the conventional, smaller electric motor, the opposite is true in the case of the brushless DC motor.

The rotor consists of six permanent magnet pairs. The stator has six electromagnet pairs.



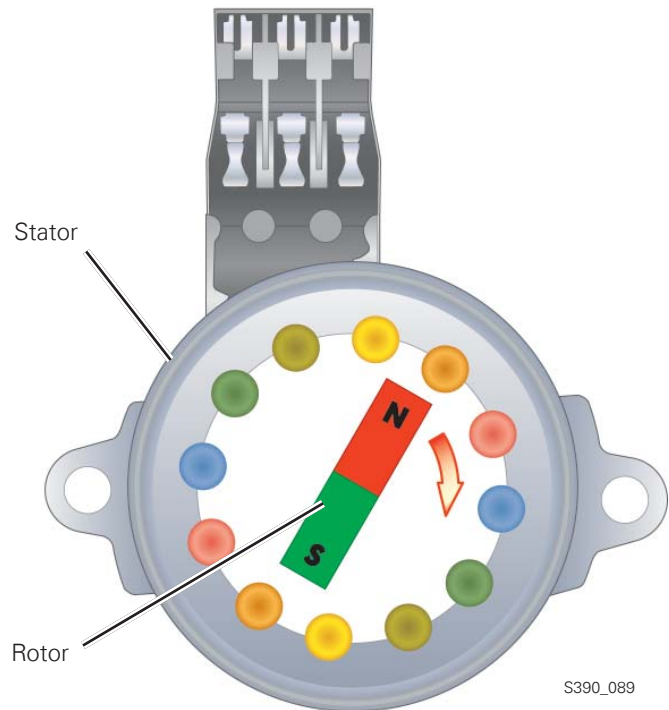
### How It Works

In the conventional DC motor, commutation (current direction change-over) takes place via ring contacts.

Commutation in the brushless DC motor is carried out by the mechatronic unit's electronic control unit and is contact-free.

The stator coils are actuated so that a rotating magnetic field occurs in the stator coils. The rotor follows this magnetic field and is rotated.

Thanks to contact-free commutation, the DC motor runs entirely wear-free, with the exception of bearing wear.



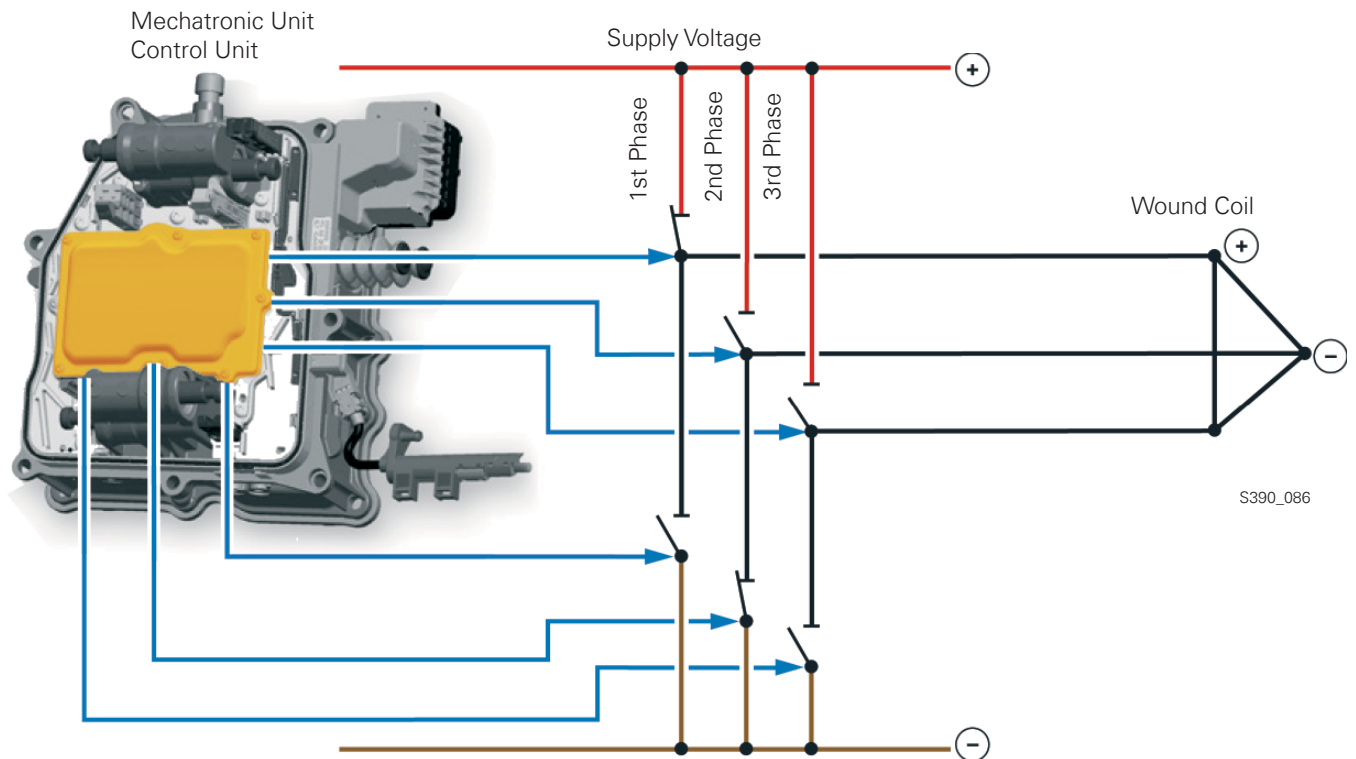


# Oil Circuit - Hydraulic System

## Electrical Actuation

The mechatronic unit controls switching between the individual poles to ensure smooth rotational movement. This changes the magnetic field. As a result, the rotor is rotated.

The schematic shows the design of the circuit using the example of a wound coil.



### Legend

1st phase – positively switched

2nd phase – negatively switched

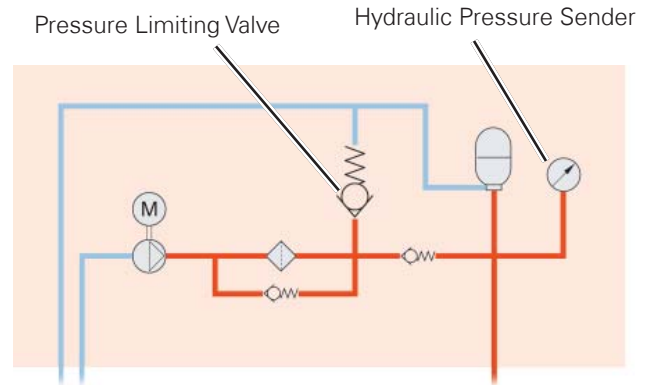
3rd phase - open

# Oil Circuit - Hydraulic System

## G270 Hydraulic Pressure Sensor and Pressure Limiting Valve

The hydraulic pump pumps the hydraulic oil through the filter towards the pressure limiting valve, the pressure accumulator and the hydraulic pressure sender.

When the hydraulic oil pressure at the pressure limiting valve and the hydraulic pressure sender reaches approximately 70 bar, the control unit turns the electric motor and hydraulic pump off. The bypass ensures that the system functions if the filter channel is clogged.



S390\_100

### Pressure Accumulator

The pressure accumulator is designed as a gas pressure accumulator.

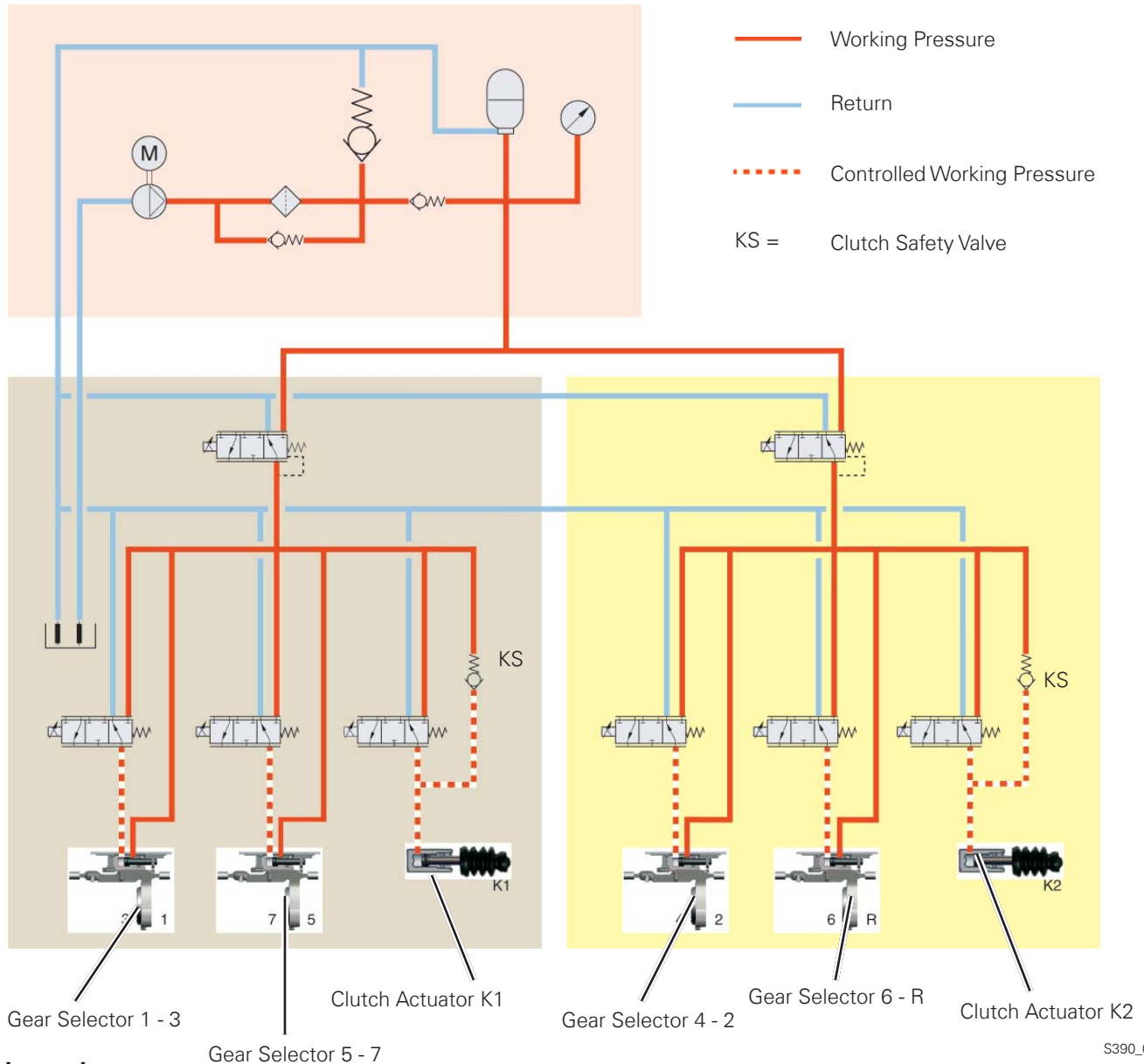
It provides the hydraulic system with oil pressure when the hydraulic pump is turned off. Its storage volume is 0.2 litres.



S390\_096

# Oil Circuit - Hydraulic System

## Oil Circuit Flow Chart



### Legend

N433 Valve 1 in Gear Train Half 1  
 N434 Valve 2 in Gear Train Half 1  
 N435 Valve 3 in Gear Train Half 1  
 N436 Valve 4 in Gear Train Half 1

N437 Valve 1 in Gear Train Half 2  
 N438 Valve 2 in Gear Train Half 2  
 N439 Valve 3 in Gear Train Half 2  
 N440 Valve 4 in Gear Train Half 2

S390\_048

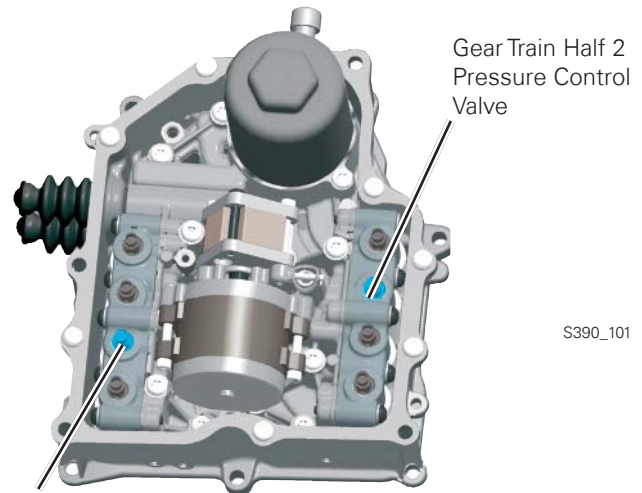
The clutch safety valves enable the clutches to be drained and therefore opened in the event of a fault.

# Oil Circuit - Hydraulic System

## Solenoid Valves

### Gear Train Half Pressure Control Solenoid Valves

The gear train half pressure control solenoid valves control the oil pressure for gear train halves 1 and 2. If a fault is detected in a gear train half, the pressure control solenoid valve can shut off the corresponding gear train half.

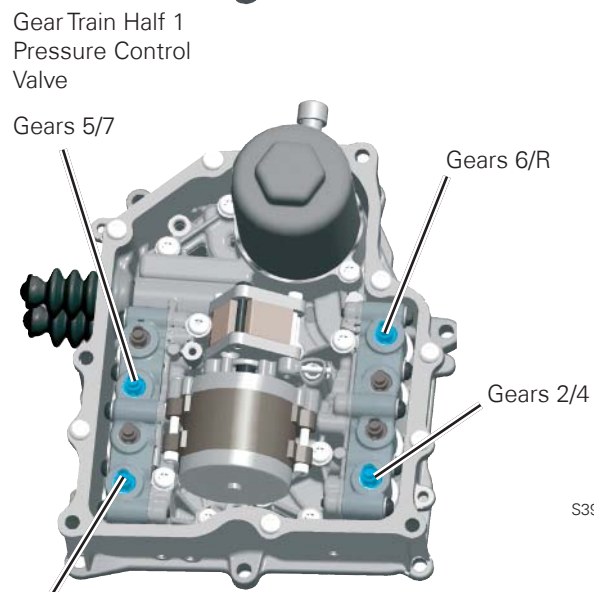


S390\_101

### Gear Selector Solenoid Valves

The gear selector solenoid valves control the volume of oil to the gear selectors. Each gear selector shifts two gears. If no gear is engaged, the gear selectors are held in the neutral position via oil pressure.

In selector lever position "P" and when the ignition is switched off, 1st gear and reverse gear are engaged.

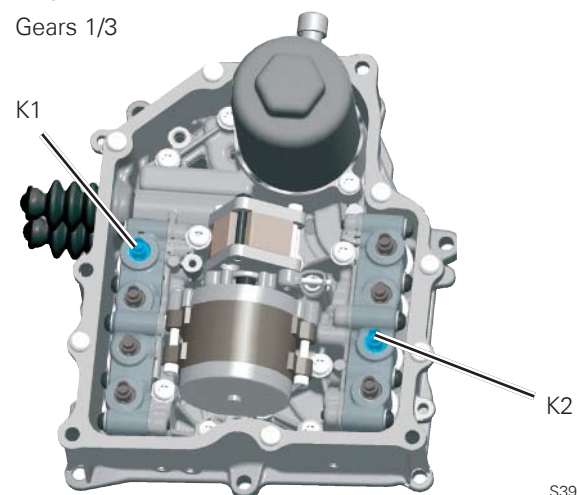


S390\_102

### Clutch Actuator Solenoid Valves

The clutch actuator solenoid valves control the volume of oil to the clutch actuators. The clutch actuators actuate clutches K1 and K2.

When not supplied with current, the solenoid valves and the clutches are open.



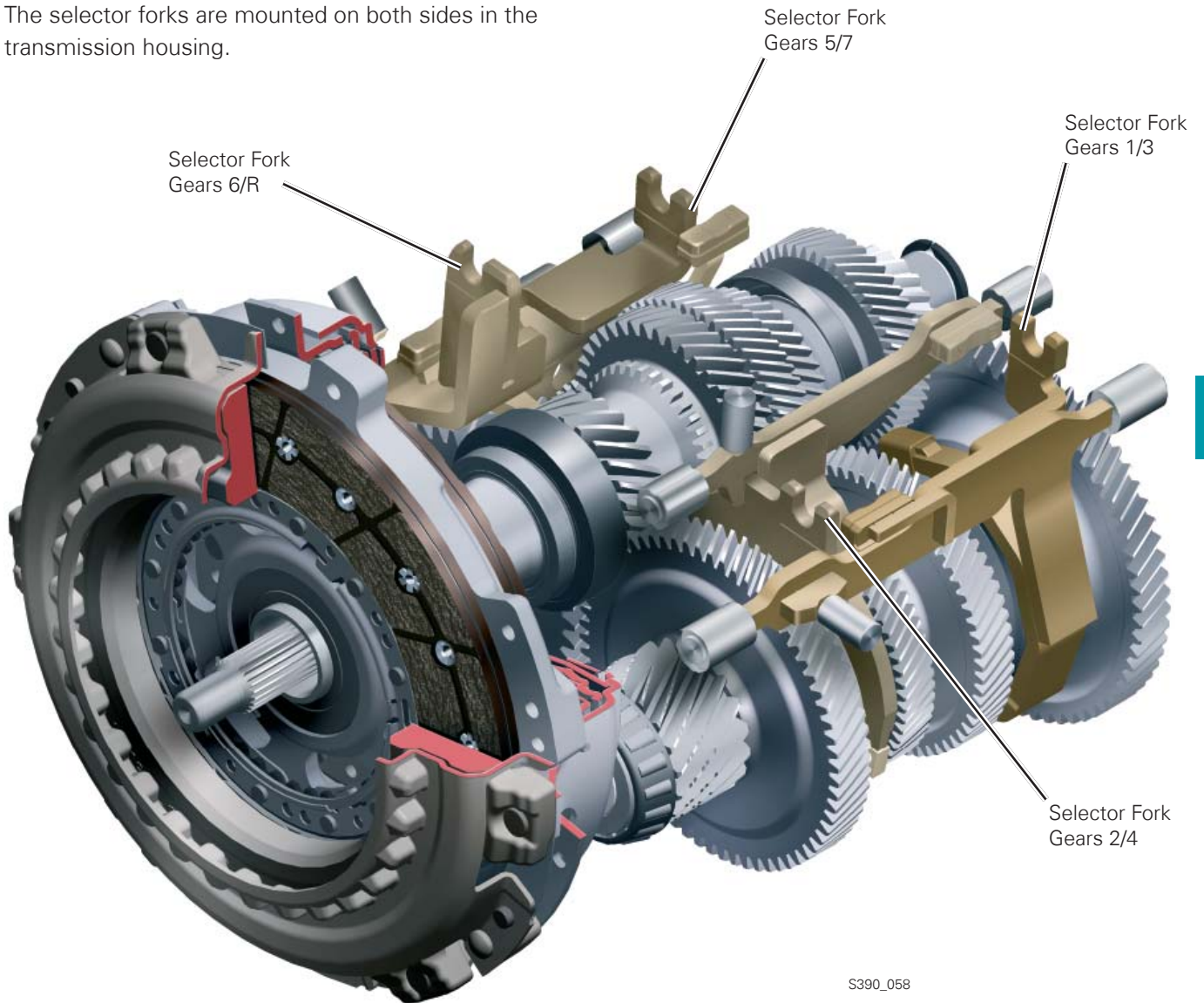
S390\_103

# Oil Circuit - Hydraulic System

## Shifting the Gears

As with conventional manual transmissions, the gears are shifted using selector forks. Each selector fork shifts two gears.

The selector forks are mounted on both sides in the transmission housing.





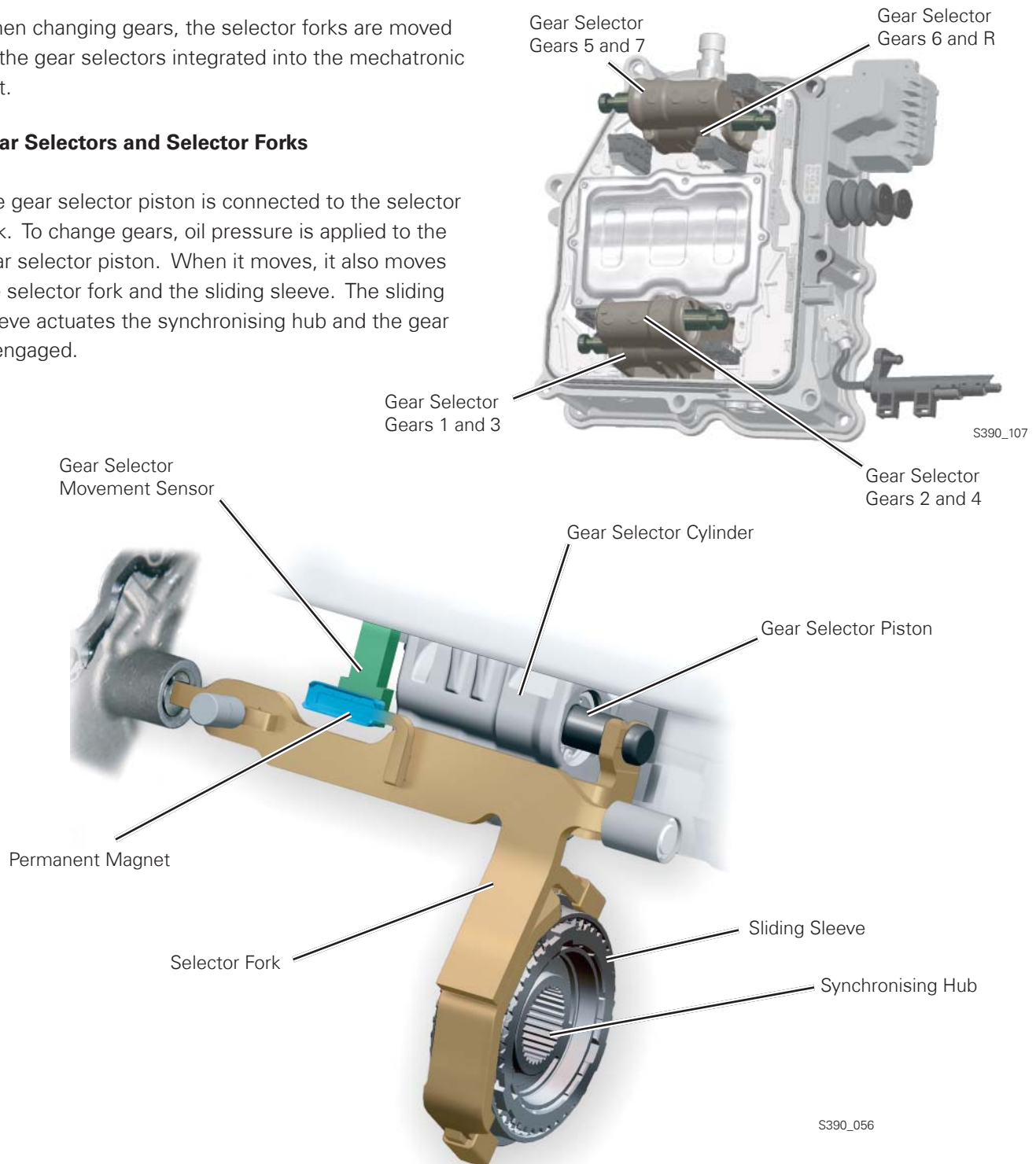
# Oil Circuit - Hydraulic System

## Shifting the Gears

When changing gears, the selector forks are moved by the gear selectors integrated into the mechatronic unit.

### Gear Selectors and Selector Forks

The gear selector piston is connected to the selector fork. To change gears, oil pressure is applied to the gear selector piston. When it moves, it also moves the selector fork and the sliding sleeve. The sliding sleeve actuates the synchronising hub and the gear is engaged.



The mechatronic unit detects the new position of the selector fork via the permanent magnet and the gear selector movement sensor.



# Oil Circuit - Hydraulic System

## Gear Changes

Just like the 02E DSG, the selector forks are actuated hydraulically. To change the gears, the mechatronic unit actuates the correct gear selector solenoid valve.

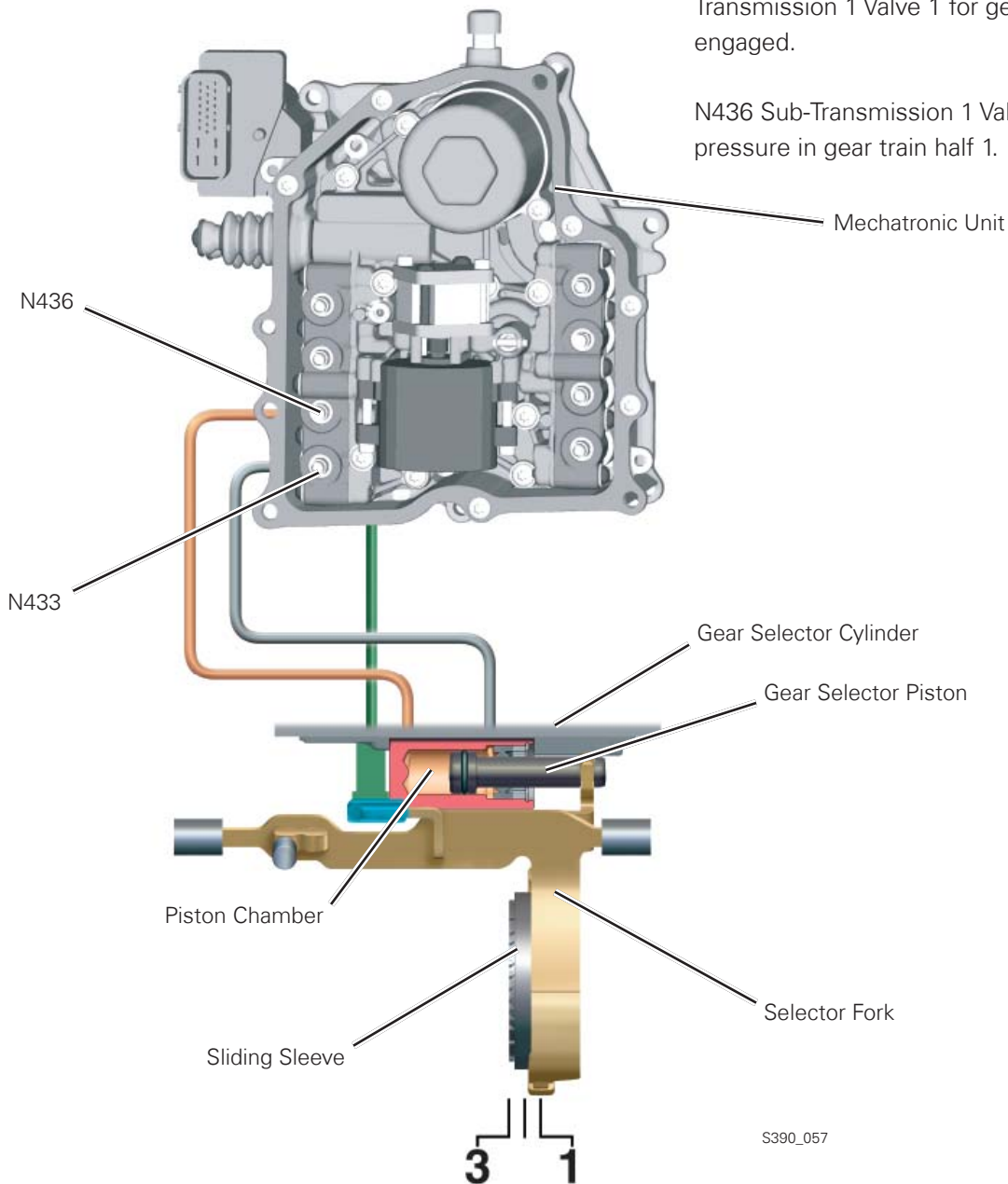
### How It Works

This is an example of changing into 1st gear:

### Initial Position

The gear selector piston is held in neutral position "N" via the oil pressure controlled by N433 Sub-Transmission 1 Valve 1 for gears 1 and 3. No gear is engaged.

N436 Sub-Transmission 1 Valve 4 controls the oil pressure in gear train half 1.

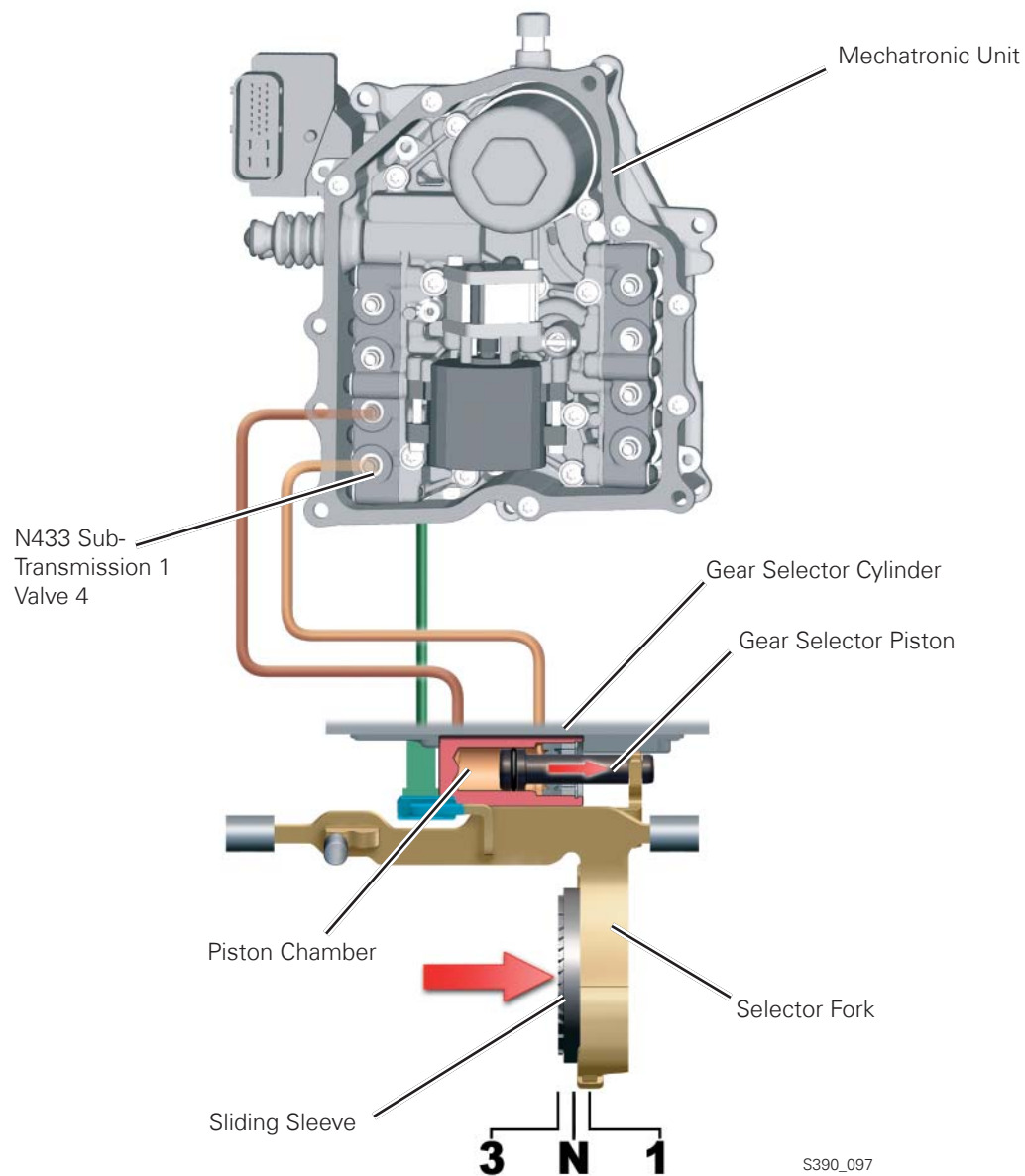


# Oil Circuit - Hydraulic System

## Changing to 1st Gear

To change to 1st gear, the gear selector valve increases the oil pressure in the left piston chamber and pushes the gear selector piston to the right. As the selector fork and the sliding sleeve are connected to the gear selector piston, they also move to the right.

Because of the movement of the sliding sleeve, 1st gear is engaged.



S390\_097

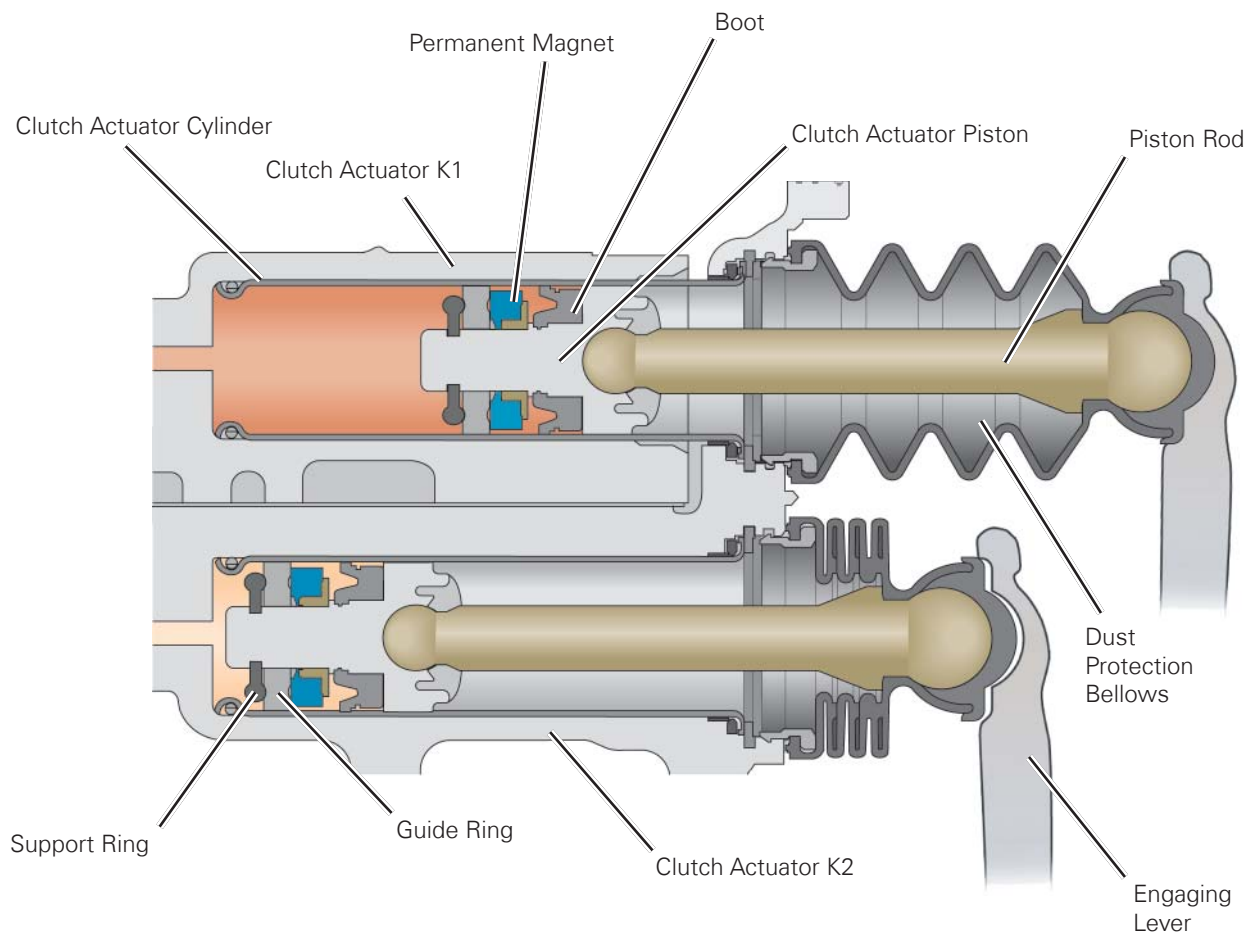
# Oil Circuit - Hydraulic System

## Clutch Actuators

Clutches K1 and K2 are actuated hydraulically. To achieve this, the mechatronic unit contains a clutch actuator for each clutch.

A clutch actuator consists of a clutch actuator cylinder and a clutch actuator piston. The clutch actuator piston actuates the clutch engaging lever. The clutch actuator piston is equipped with a permanent magnet, which is required by the clutch travel sender to detect the piston position.

To prevent detection of the piston position from being impaired, the actuator cylinder and the actuator piston are not magnetic.



S390\_092

# Oil Circuit - Hydraulic System

## Clutch Operation

To actuate the clutches, the mechatronic electronic control unit actuates the solenoid valve

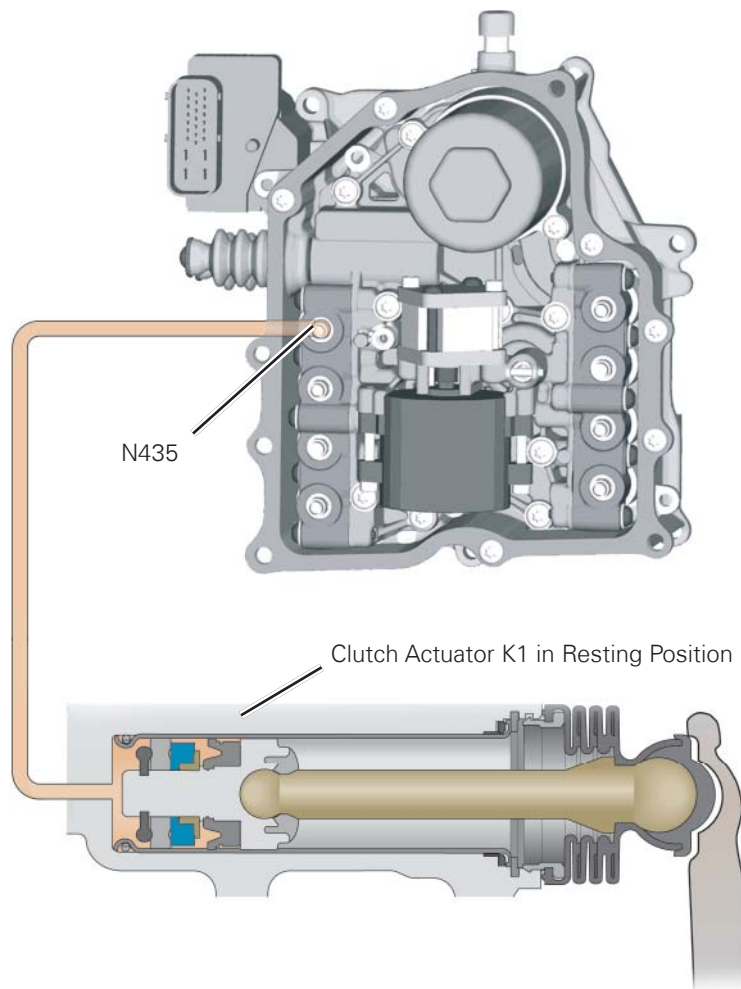
- N435 Sub-Transmission 1 Valve 3 for clutch K1 and
- N439 Sub-Transmission 2 Valve 3 for clutch K2.

### How It Works

Actuation of K1 is shown here as an example.

### Clutch Not Actuated

The clutch actuator piston is in the resting position. The N435 is open in the return flow direction. The oil pressure from the N436 Sub-Transmission 1 Valve 4 flows into the mechatronic unit oil reservoir.



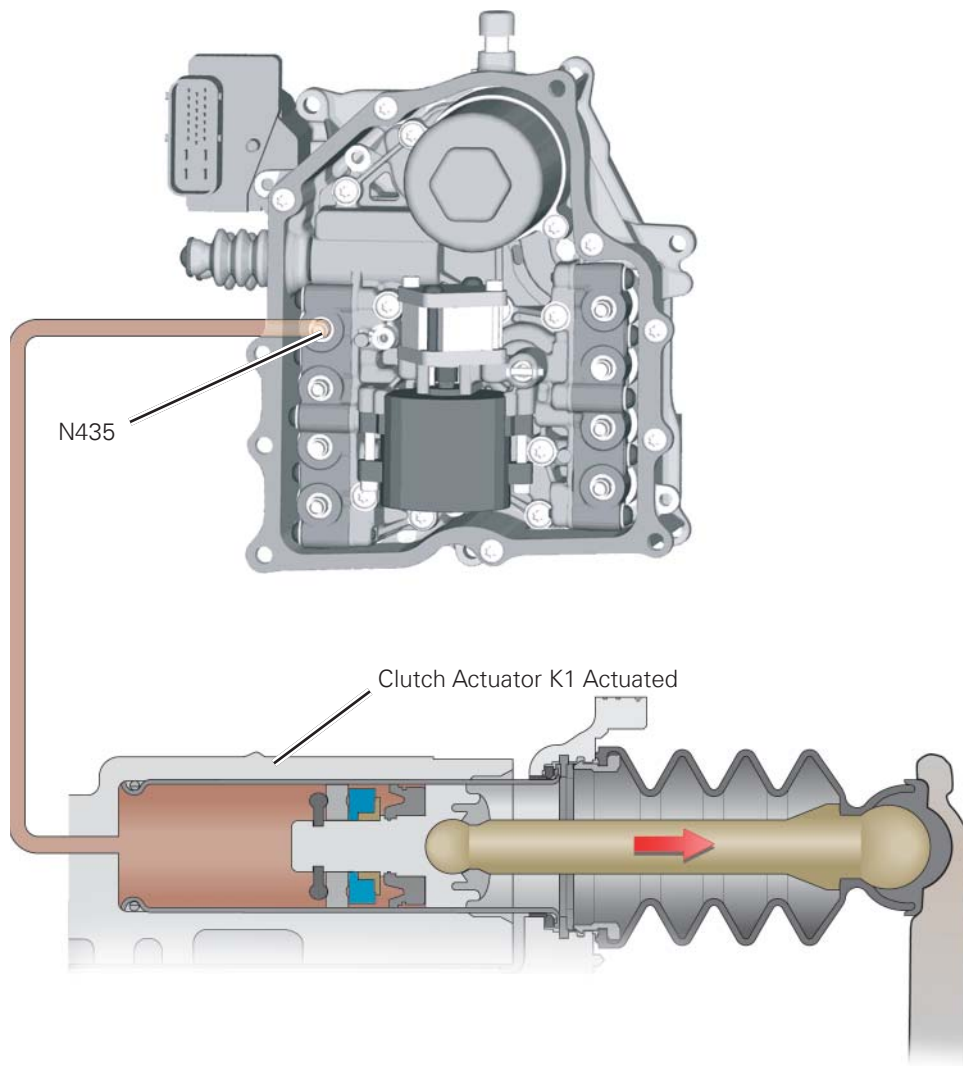
S390\_093

# Oil Circuit - Hydraulic System

## Clutch Actuated

If clutch K1 is to be actuated, the N435 Sub-Transmission 1 Valve 3 is actuated by the electronic control unit. When actuated, it opens the oil channel to the clutch actuator, and oil pressure is built up at the rear of the clutch actuator piston. The clutch actuator piston moves and actuates the K1 clutch engaging lever. Clutch K1 is closed. The control unit receives a signal regarding the precise position of the clutch via G167 Rear Infrared Sensor.

The speed difference between the transmission input speed and drive shaft speed (clutch slip), is controlled by N435 by controlling the oil pressure between the clutch actuator and the return flow.

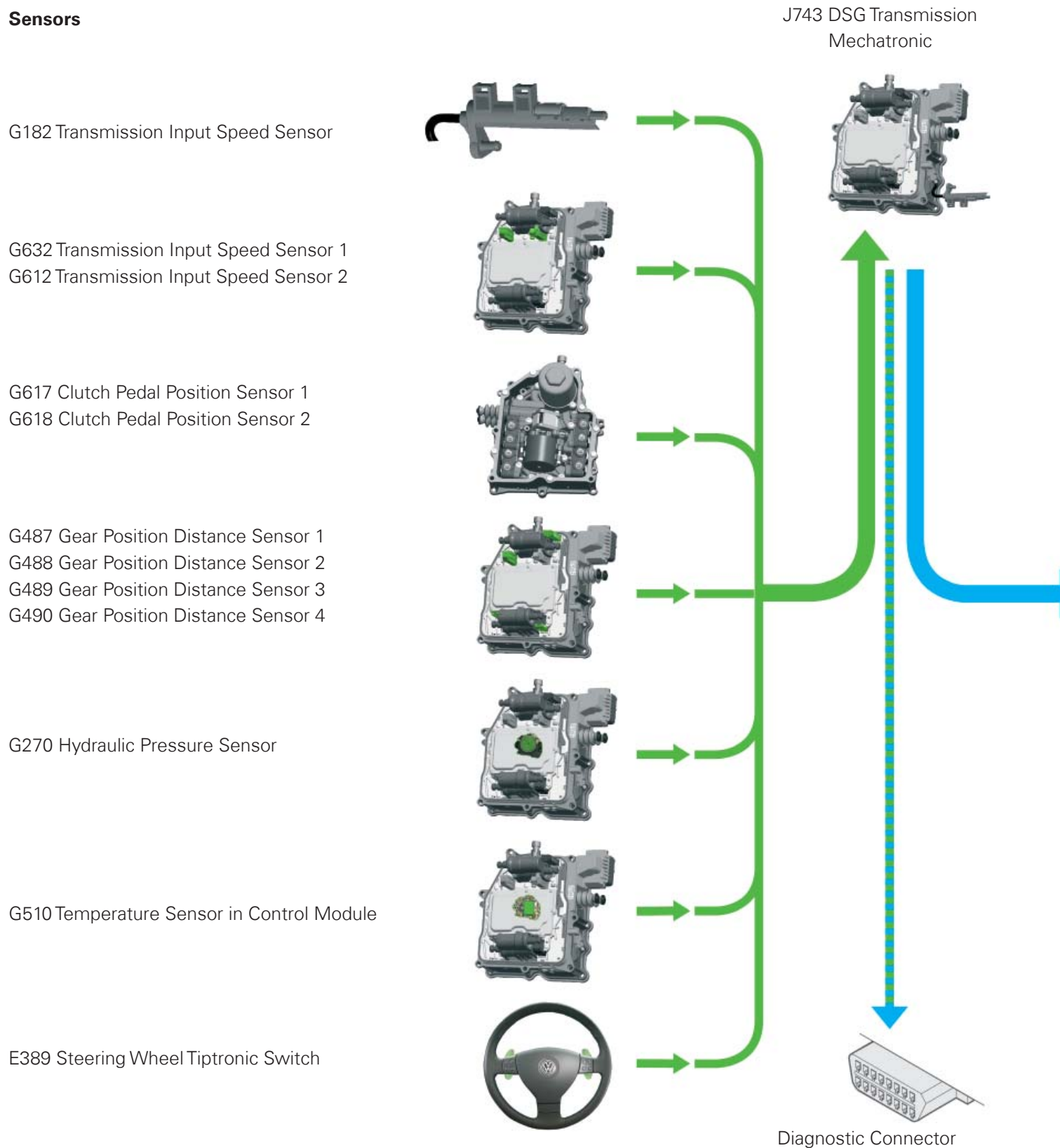


S390\_094

# Transmission Management System

## Overview of the System

### Sensors

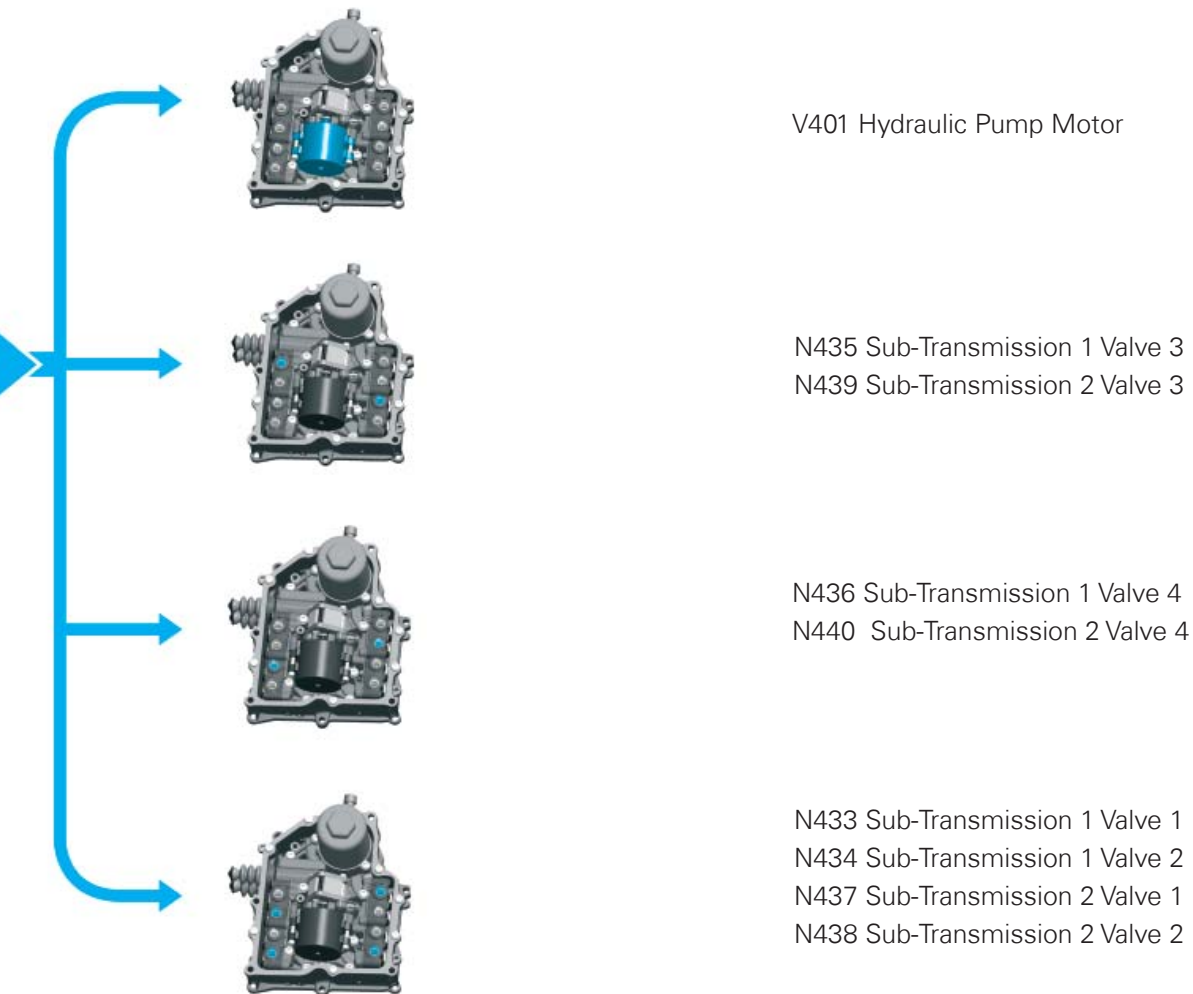




# Transmission Management System



## Actuators



S390\_053

# Transmission Management System

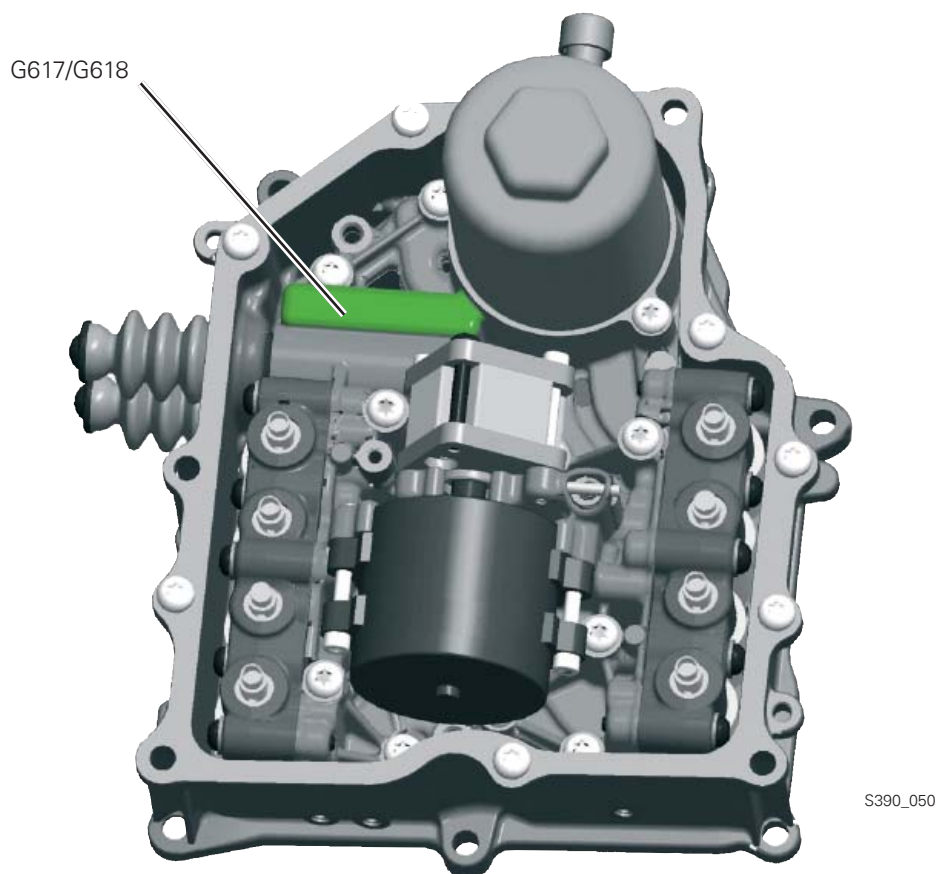
## Sensors

### **G617 Clutch Pedal Position Sensor 1, G618 Clutch Pedal Position Sensor 2**

The clutch pedal position sensors are located in the mechatronic unit above the clutch actuators.

The double clutch control system requires reliable and precise recording of the current clutch actuation status.

For this reason, contact-free sensor technology is used to record clutch travel. Contact-free position recording increases the reliability of the sensor functions. Measured value falsification caused by wear and vibrations is avoided.



### **Signal Use**

The control unit requires these signals to control the clutch actuators.

### **Effects of Signal Failure**

If G617 fails, transmission path 1 is shut off. Gears 1, 3, 5 and 7 can no longer be engaged.

If G618 fails, gears 2, 4, 6 and R can no longer be engaged.

# Transmission Management System

## Clutch Pedal Position Sensors

### Design

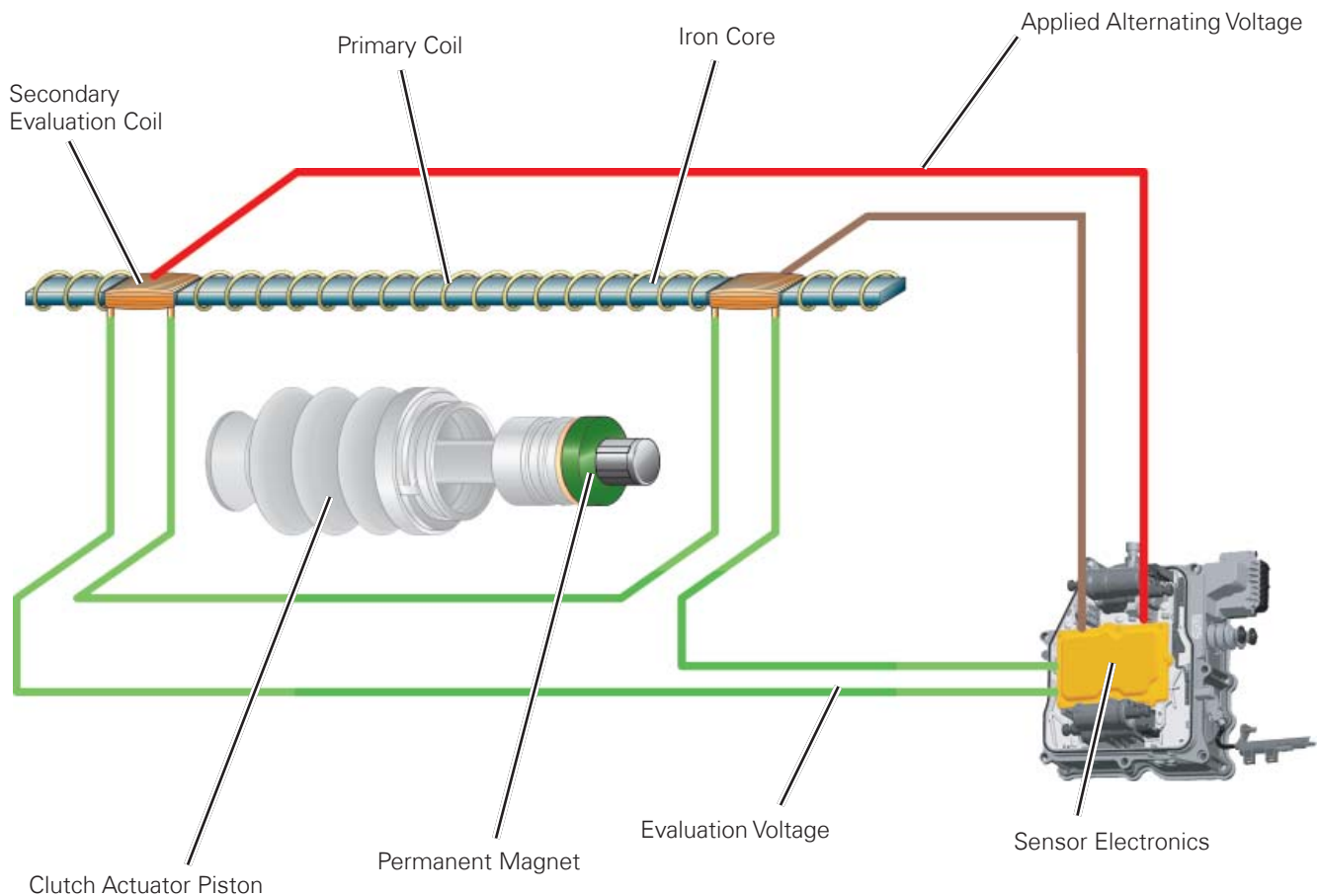
A clutch pedal position sensor consists of:

- The primary coil is wound around an iron core
- Two secondary evaluation coils
- A permanent magnet, located on the clutch actuator piston, and
- The sensor electronics

### How It Works

An alternating voltage is applied to the primary coil and a magnetic field is built up around the iron core. If the clutch is actuated, the clutch actuator piston moves through the magnetic field with the permanent magnet. Voltage is induced in the secondary evaluation coils.

The level of the voltage induced in the left and right evaluation coils depends on the position of the permanent magnet. The sensor electronics detect the position of the permanent magnet and the position of the clutch actuator piston by the level of the voltage in the left and right evaluation coils.

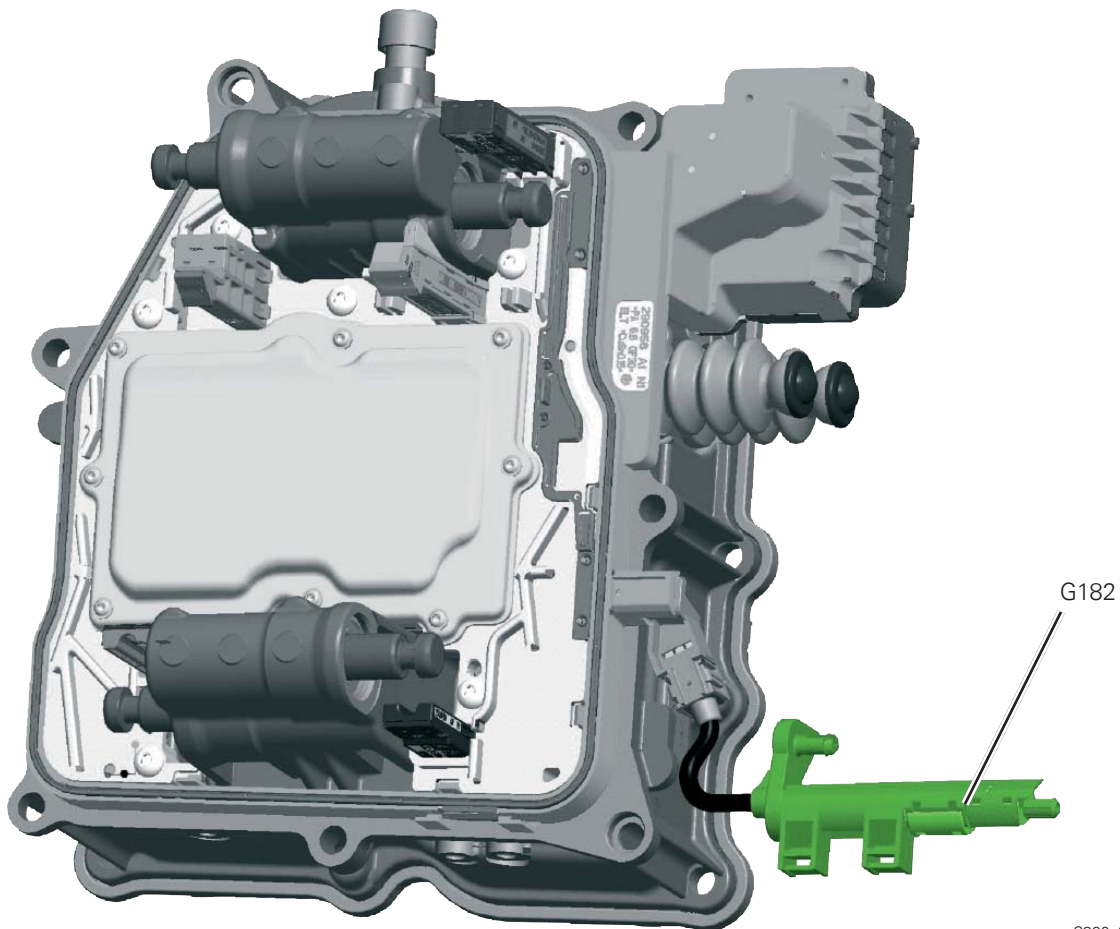


S390\_091

# Transmission Management System

## G182 Transmission Input Speed Sensor

The transmission input speed sensor is a Hall sensor that is inserted into the transmission housing. It is the only sensor located outside of the mechatronic unit. It electronically scans the starter ring gear and records the transmission input speed. The transmission input speed is identical to the engine speed.



S390\_073

### Signal Use

The control unit requires the transmission input speed signal to control the clutches and to calculate slip. It compares the signals from the G182 before the clutches with the signals from G612 and G632 Transmission Input Speed Sensor 1 and 2, which transmit speed signals from the drive shafts.

### Effects of Signal Failure

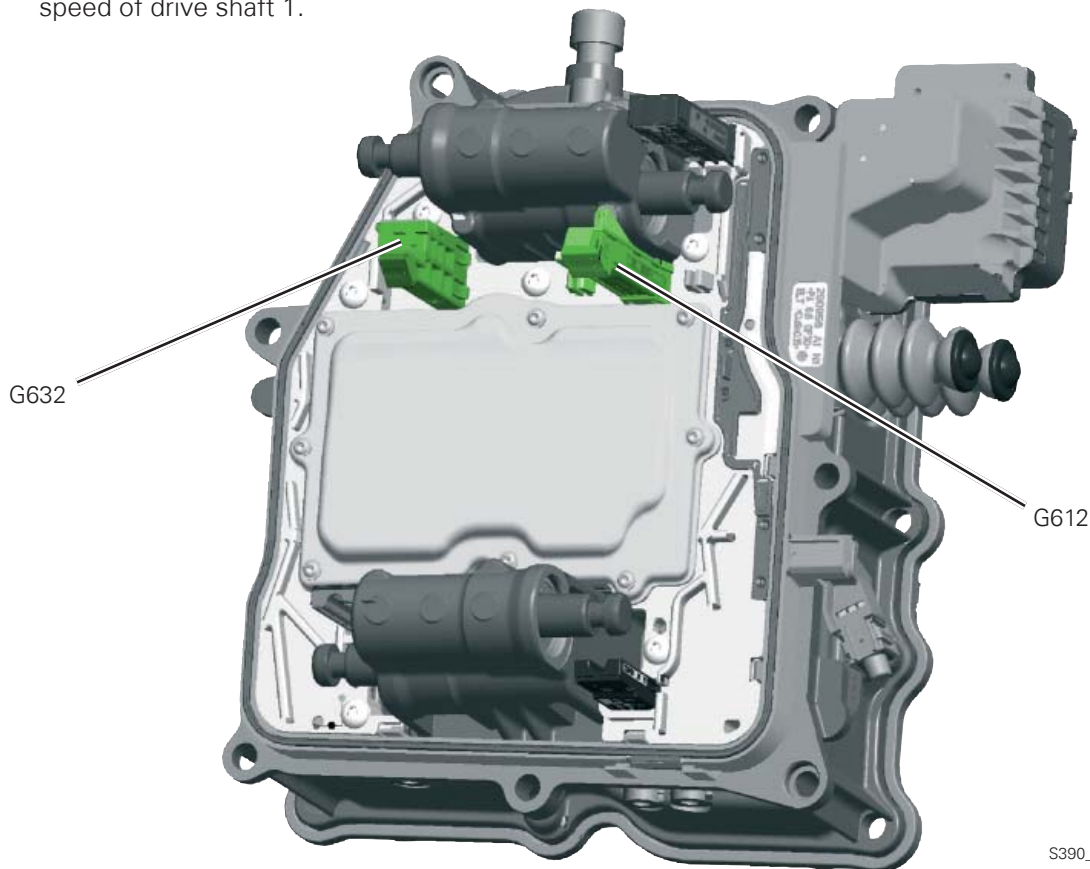
The control unit uses the engine speed signal as a substitute signal. It obtains this signal from the engine control unit over the CAN bus.

# Transmission Management System

## G632 Transmission Input Speed Sensor 1 G612 Transmission Input Speed Sensor 2

Both input speed sensors are Hall sensors that are located in the mechatronic unit.

- G632 scans an impulse wheel located on drive shaft 1. From this signal, the control unit calculates the speed of drive shaft 1.
- G612 scans a gear on drive shaft 2. From this signal, the control unit calculates the speed of drive shaft 2.



### Signal Use

The speed signals from drive shafts 1 and 2 are used by the control unit to control the clutch and to calculate clutch slip.

### Effects of Signal Failure

If G632 fails, gear train half 1 is shut off. The vehicle can then only be driven in gears 2, 4, 6 and R.

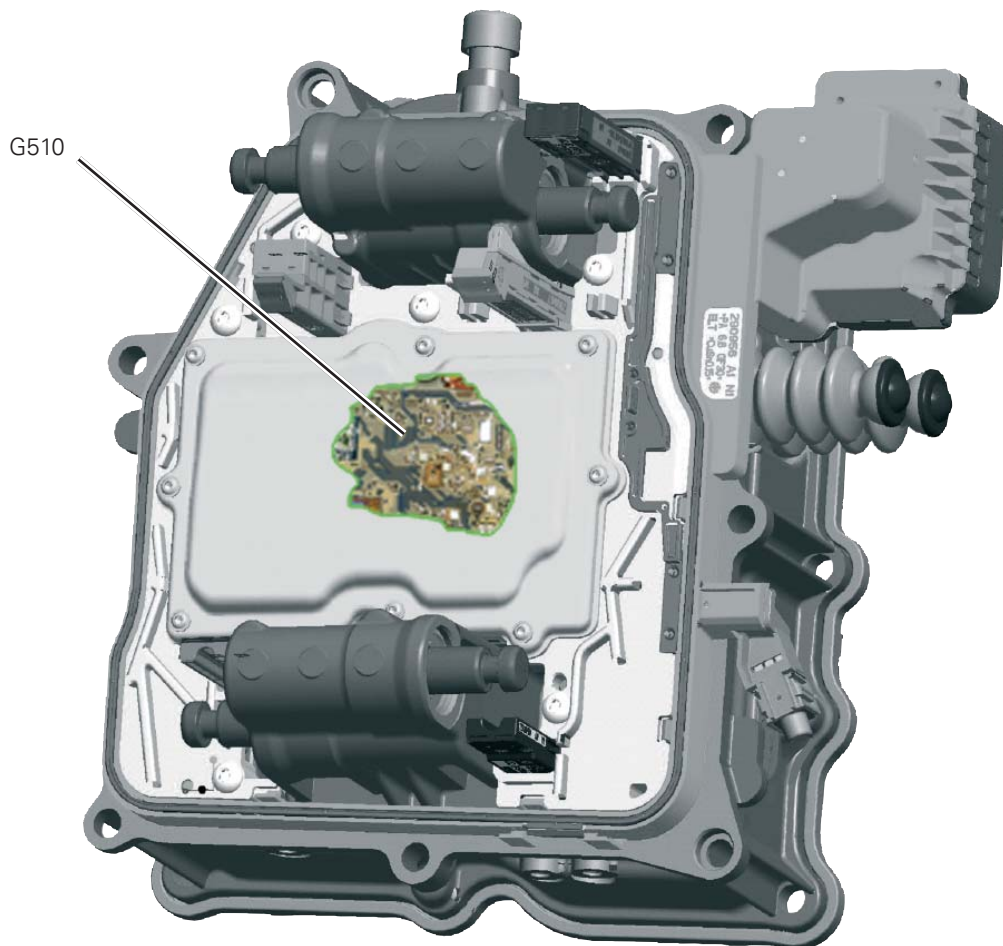
If G612 fails, gear train half 2 is shut off. The vehicle can then only be driven in gears 1, 3, 5 and 7.

# Transmission Management System

## G510 Temperature Sensor in Control Module

The temperature sensor is located directly in the mechatronic unit's electronic control unit.

Hot hydraulic oil constantly flows around the control unit, heating it. Severe heating may impair the functions of the electronics.



S390\_074

### Signal Use

The temperature sensor's signal is used to check the mechatronic unit's temperature.

At a temperature of 139 °C, engine torque will be reduced.

### Effects of Signal Failure

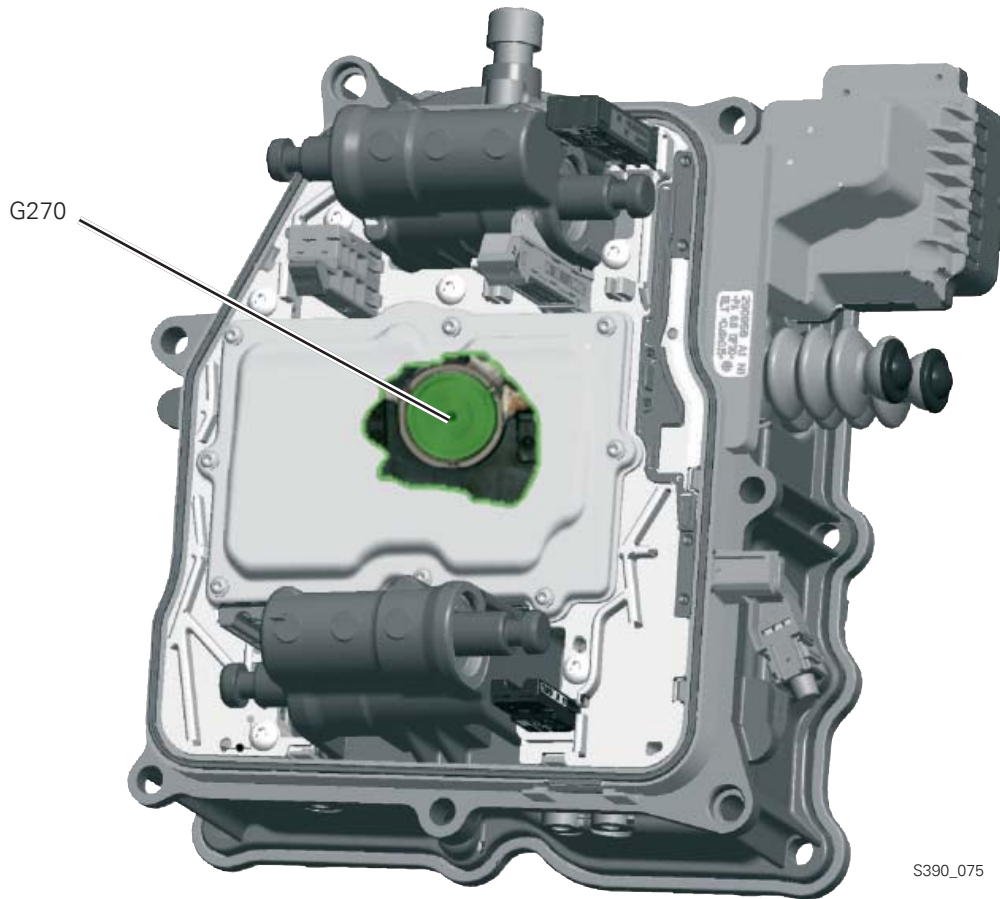
In case of signal failure, the control unit uses an internally available substitute value.



# Transmission Management System

## G270 Hydraulic Pressure Sensor

The hydraulic pressure sensor is integrated into the mechatronic unit hydraulic oil circuit. It is a diaphragm pressure sender.



### Signal Use

The control unit uses the signal to control the motor for the V401 Hydraulic Pump Motor.

At a hydraulic oil pressure of approximately 60 bar, the motor is shut off according to the pressure sensor signal, and is switched on again at approximately 40 bar.

### Effects of Signal Failure

If the signal fails, the motor for hydraulic pump runs continuously.

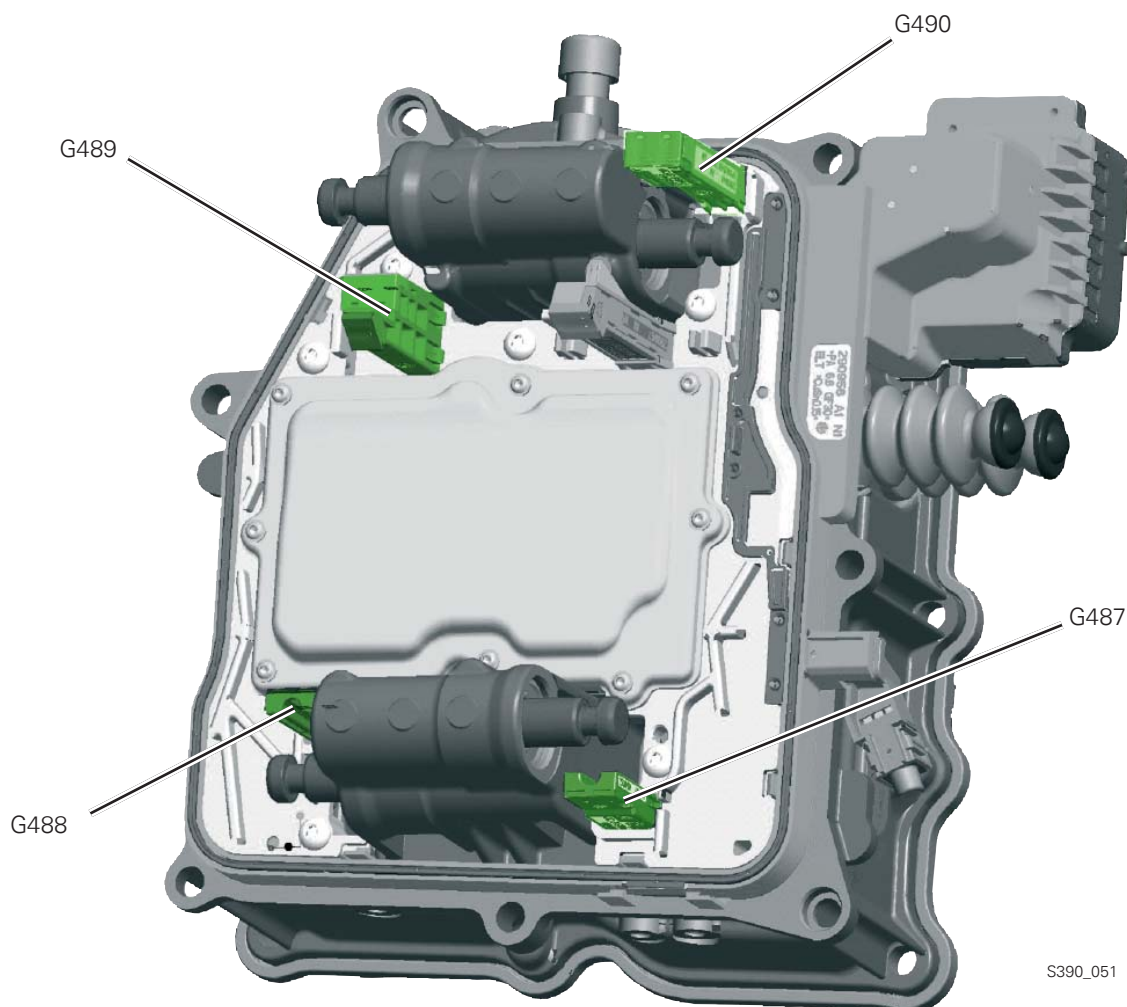
The hydraulic pressure is determined by the pressure control valve.

# Transmission Management System

## G487 to G490 Gear Position Distance Sensor 1 - 4

The gear selector movement sensors are located in the mechatronic unit.

In combination with the solenoids on the selector forks, the sensors generate a signal that the control module uses to determine the precise position of the gear selectors.



### Signal Use

The control unit requires the precise position of the gear selectors to control the gear selectors for changing gears.

### Effects of Signal Failure

If a movement sensor fails, the control module cannot detect the position of the corresponding gear selector. As a result, the control unit is unable to recognise whether or not a gear has been changed using the gear selector and the selector fork. To prevent damage to the transmission, half of the transmission with this failure will be disabled.

# Transmission Management System

## E313 Selector Lever

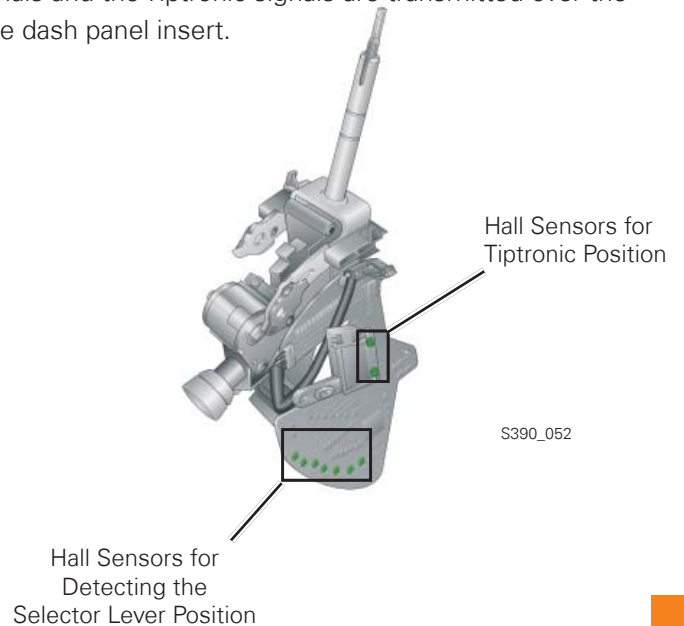
The selector lever sensor system and the control system for the selector lever lock solenoid are integrated into the selector lever. The selector lever positions are detected by Hall sensors, which are integrated into the selector lever sensor system. The selector lever position signals and the Tiptronic signals are transmitted over the CAN bus to the mechatronic unit and to the control unit in the dash panel insert.

### Signal Use

Based on the signals, the control unit detects the selector lever positions. It uses the signals to implement the driver D-R-S or Tiptronic command and to control starter release.

### Effects of Signal Failure

If the control unit detects no selector lever position, both clutches are opened.



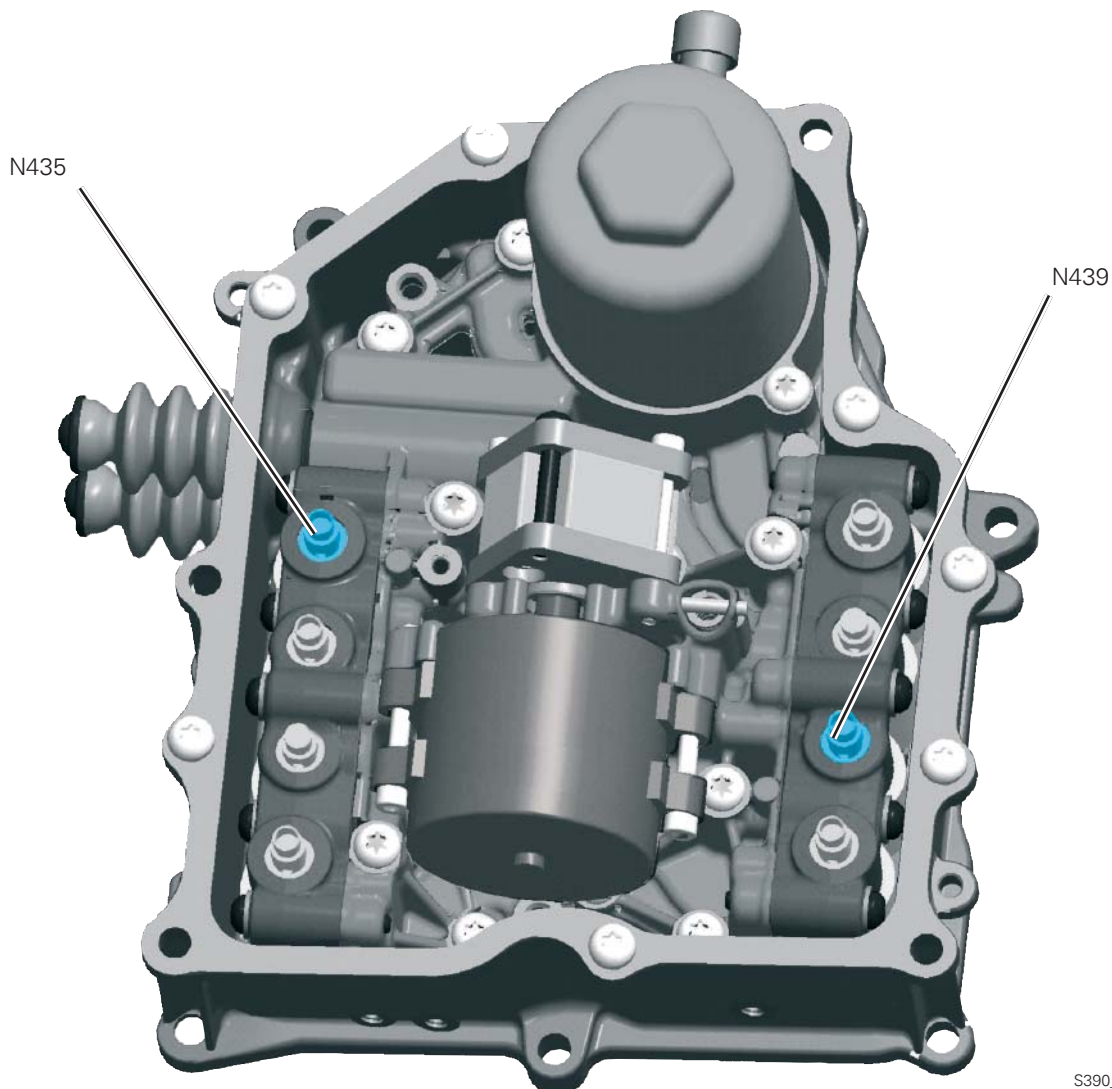
# Transmission Management System

## Actuators

### Clutch Actuator Solenoid Valves N435 Sub-Transmission 1 Valve 3, N439 Sub-Transmission 2 Valve 3

The clutch actuator solenoid valves are located in the mechatronic unit's hydraulic module. They are actuated by the electronic transmission control unit. They are used to control the oil volume for actuating the clutches.

- N435 controls the oil volume for clutch K1
- N439 controls the oil volume for clutch K2



S390\_076

### Effects of Signal Failure

If a solenoid valve fails, that half of the transmission will be disabled.

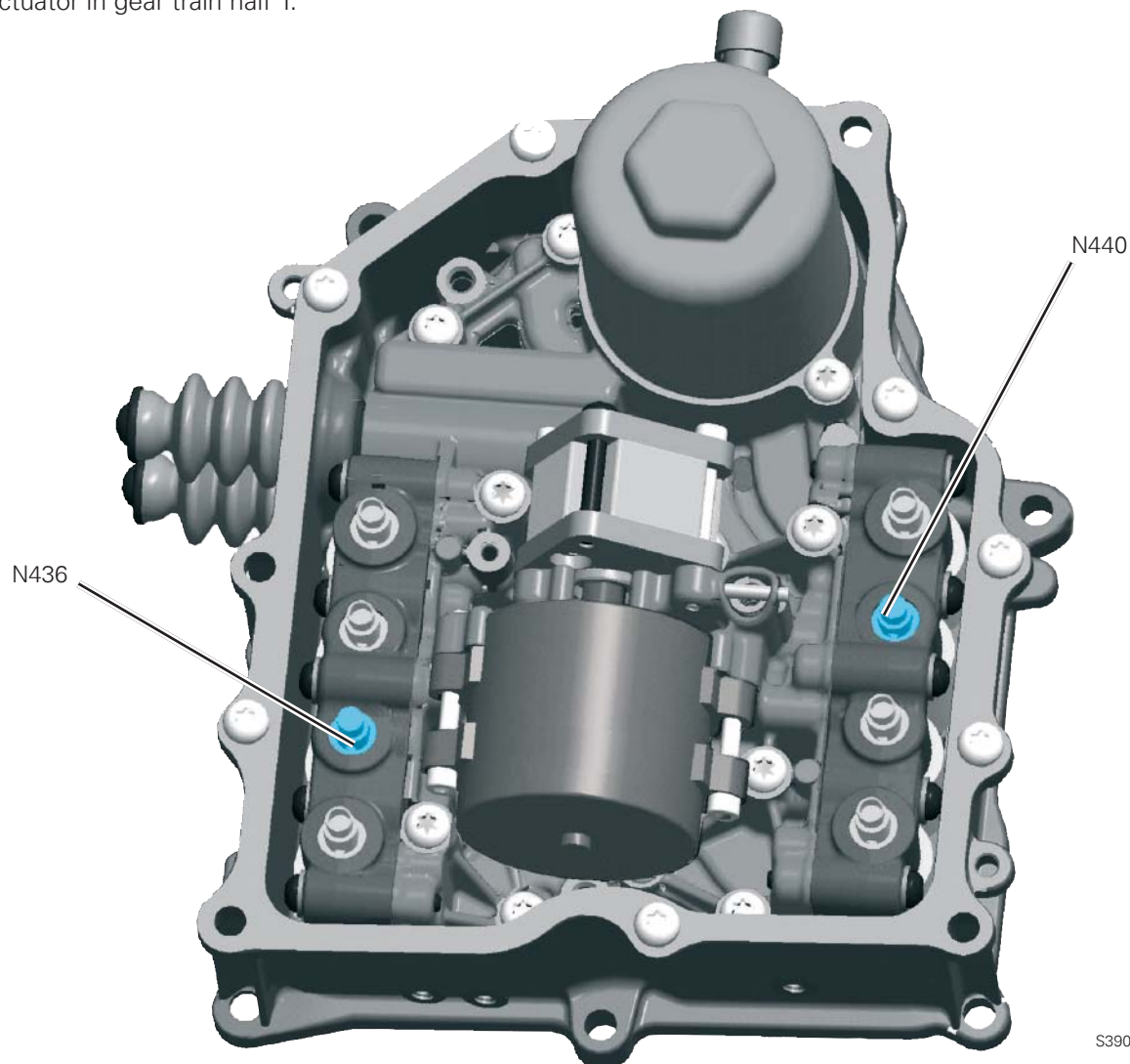
# Transmission Management System

## Gear Train Half Pressure Control Valves N436 Sub-Transmission 1 Valve 4, N440 Sub-Transmission 2 Valve 4

Both sub-transmission valves are solenoid valves, and are located in the mechatronic unit hydraulic module.

Valve 4 in gear train half 1 controls the hydraulic oil pressure to the gear selectors and to the clutch actuator in gear train half 1.

Gear train half 1 is used to shift gears 1, 3, 5 and 7. Valve 4 in gear train half 2 controls the hydraulic oil pressure to the gear selectors and to the clutch actuator in gear train half 2.



## Effects of Signal Failure

If one solenoid valve fails, that half of the transmission will be disabled, and only the gears assigned to the other transmission half can be engaged.



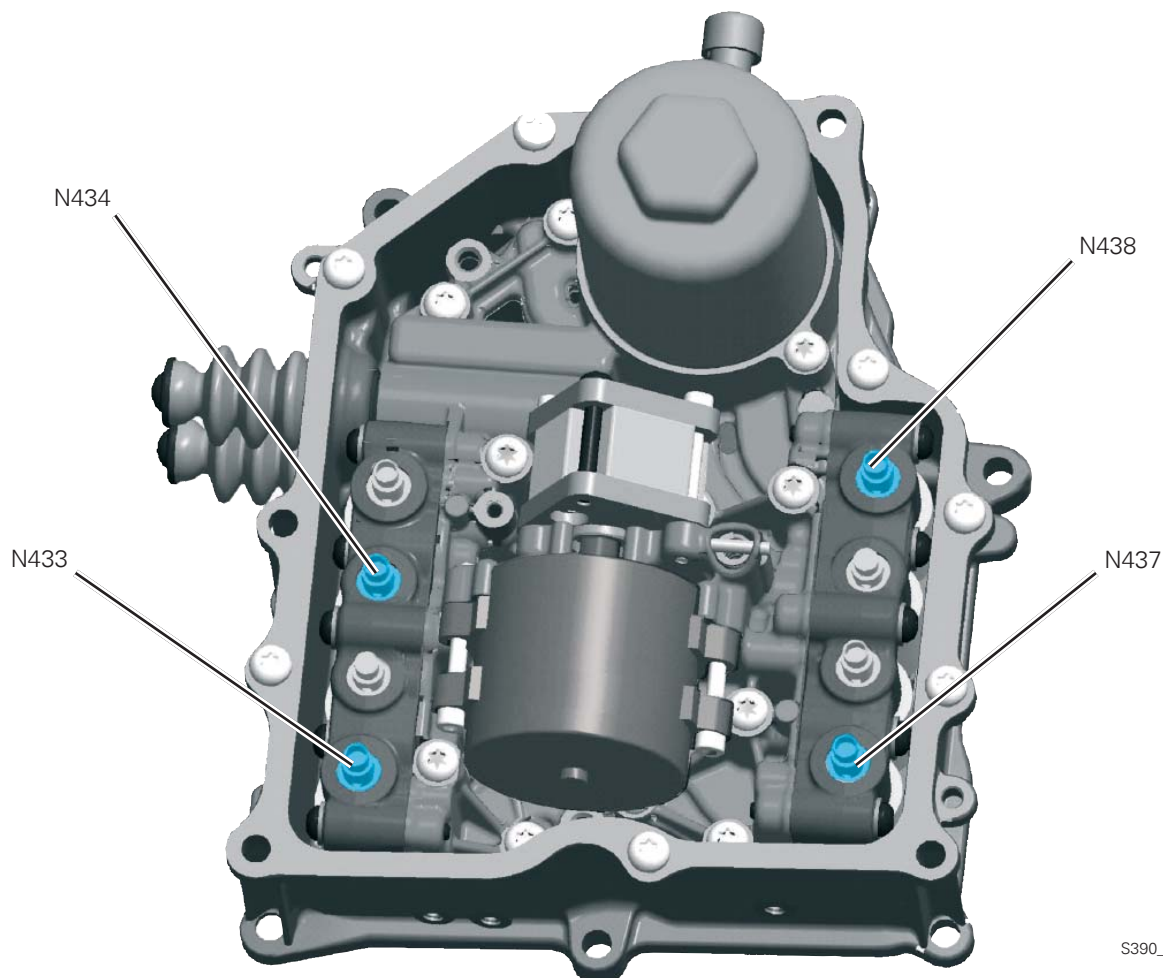
# Transmission Management System

## Gear Selector Solenoid Valves

**N433 Sub-Transmission 1 Valve 1,  
N434 Sub-Transmission 1 Valve 2,  
N437 Sub-Transmission 2 Valve 1,  
N438 Sub-Transmission 2 Valve 2**

The gear selector solenoid valves are located in the mechatronic unit's hydraulic module. They are used by the transmission control unit to control the oil volume to the gear selectors and for changing gears.

- N433 Sub-Transmission 1 Valve 1
- N434 Sub-Transmission 1 Valve 2
- N437 Sub-Transmission 2 Valve 1
- N438 Sub-Transmission 2 Valve 2



S390\_078

### Effects of Signal Failure

If a solenoid valve fails, that half of the transmission will be disabled.

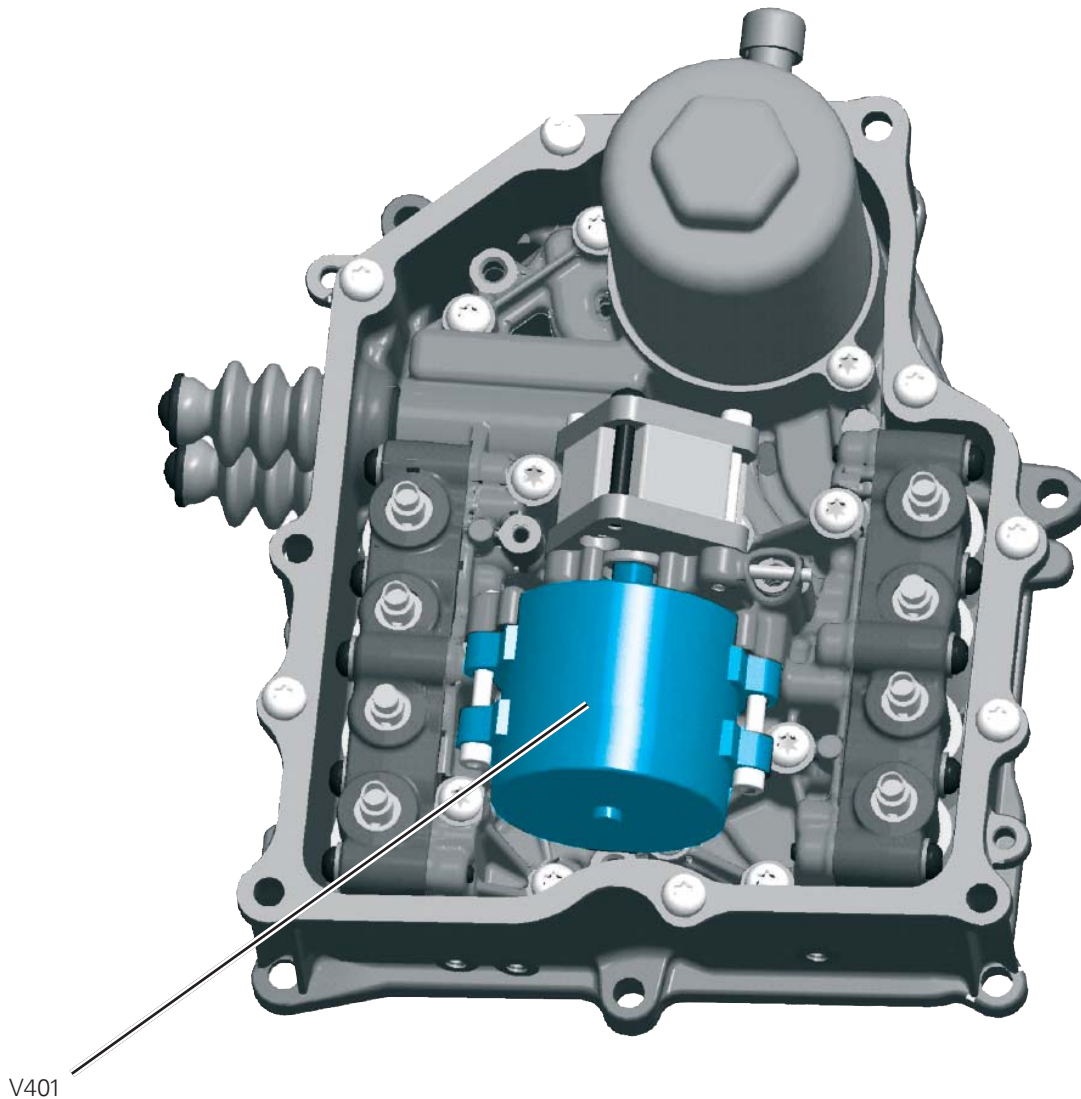


# Transmission Management System

## V401 Hydraulic Pump Motor

The motor for the hydraulic pump is integrated into the mechatronic unit hydraulic module. It is actuated by the transmission control unit.

The control unit shuts off the motor when the hydraulic pressure in the system has reached 60 bar, and turns it on again when the pressure drops to 40 bar.



V401

S390\_079

### Effects of Signal Failure

If the motor cannot be actuated, the hydraulic pressure drops and the clutches open independently due to the spring force of the pressure plates.

# Transmission Management System

## Functional Diagram

E313 Selector Lever

E438 Tiptronic Upshift Button on Steering Wheel

E439 Tiptronic Downshift Button on Steering Wheel

F319 Selector Lever Park Position Lock Switch

G182 Transmission Input Speed Sensor

G270 Hydraulic Pressure Sensor

G487 Gear Position Distance Sensor 1

G488 Gear Position Distance Sensor 2

G489 Gear Position Distance Sensor 3

G490 Gear Position Distance Sensor 4

G510 Temperature Sensor in Control Module

G612 Transmission Input Speed Sensor 2

G617 Clutch Pedal Position Sensor 1

G618 Clutch Pedal Position Sensor 2

G632 Transmission Input Speed Sensor 1

J119 Multifunction Indicator

J285 Instrument Cluster Control Module

J453 Multifunction Steering Wheel Control Module

J519 Vehicle Electrical System Control Module

J527 Steering Column Electronics Control Module

J533 Data Bus on Board Diagnostic Interface

J681 Terminal 15 Power Supply Relay 2

J743 DSG Transmission Mechatronic

N110 Shift Lock Solenoid

N433 Sub-Transmission 1 valve 1

N434 Sub-Transmission 1 valve 2

N435 Sub-Transmission 1 valve 3

N436 Sub-Transmission 1 valve 4

N437 Sub-Transmission 2 valve 1

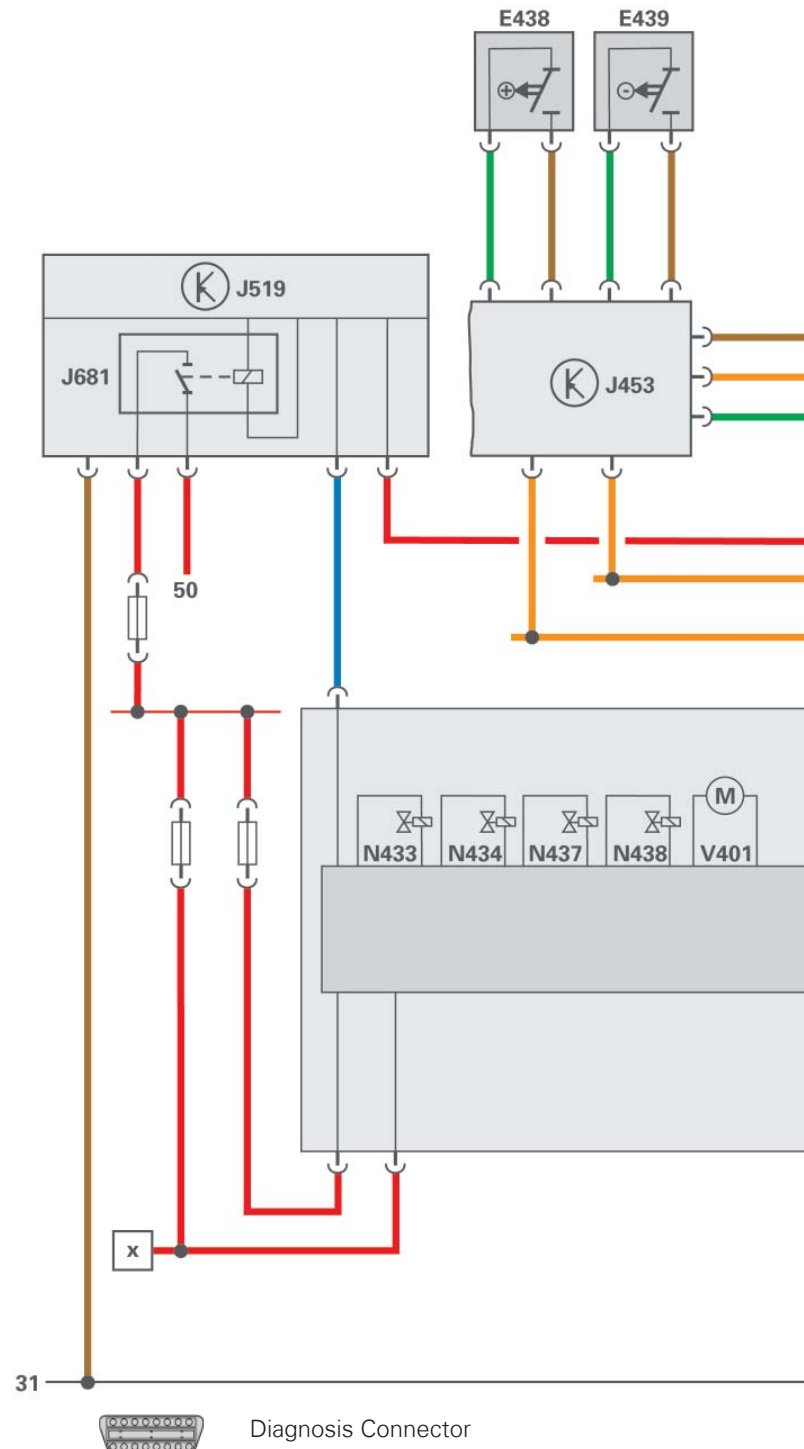
N438 Sub-Transmission 2 valve 2

N439 Sub-Transmission 2 valve 3

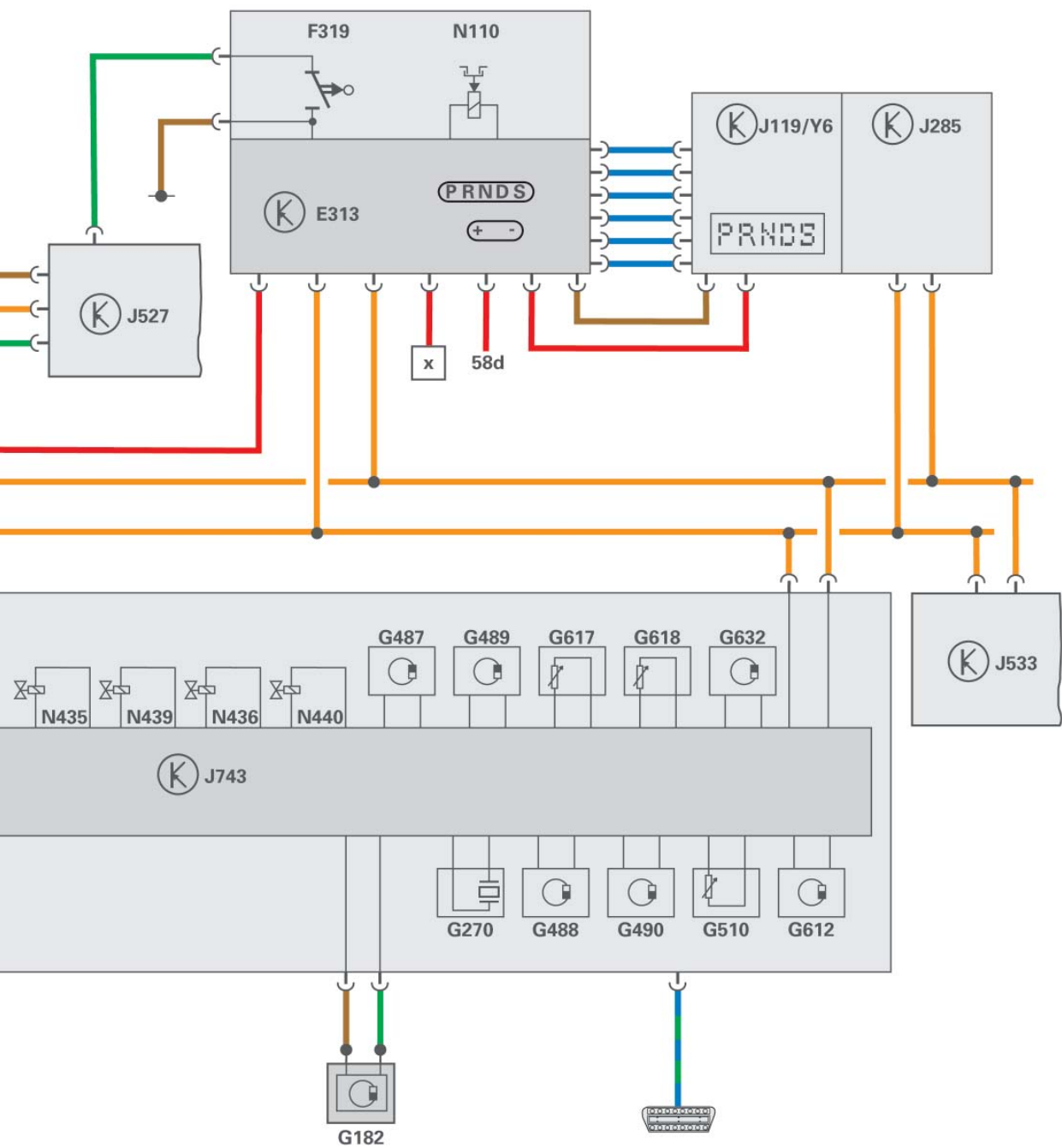
N440 Sub-Transmission 2 valve 4

V401 Hydraulic Pump Motor

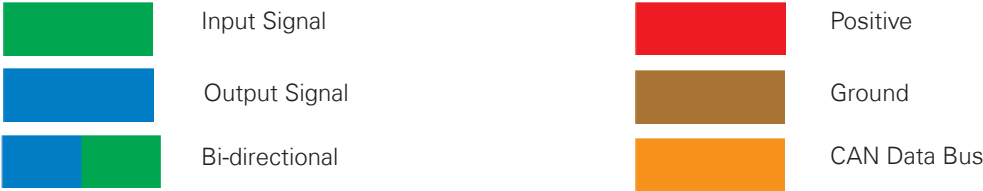
Y6 Selector Lever Position Display



# Transmission Management System



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# Transmission Management System

## CAN Data-bus Connection

The schematic shown below symbolically shows the integration of the mechatronic unit for direct shift transmission into the vehicle CAN data bus structure.

J104 ABS Control Module

J248 Diesel Direct Fuel Injection Engine Control module

J285 Instrument Cluster Control ModuleJ

J519 Vehicle Electrical System Control Module

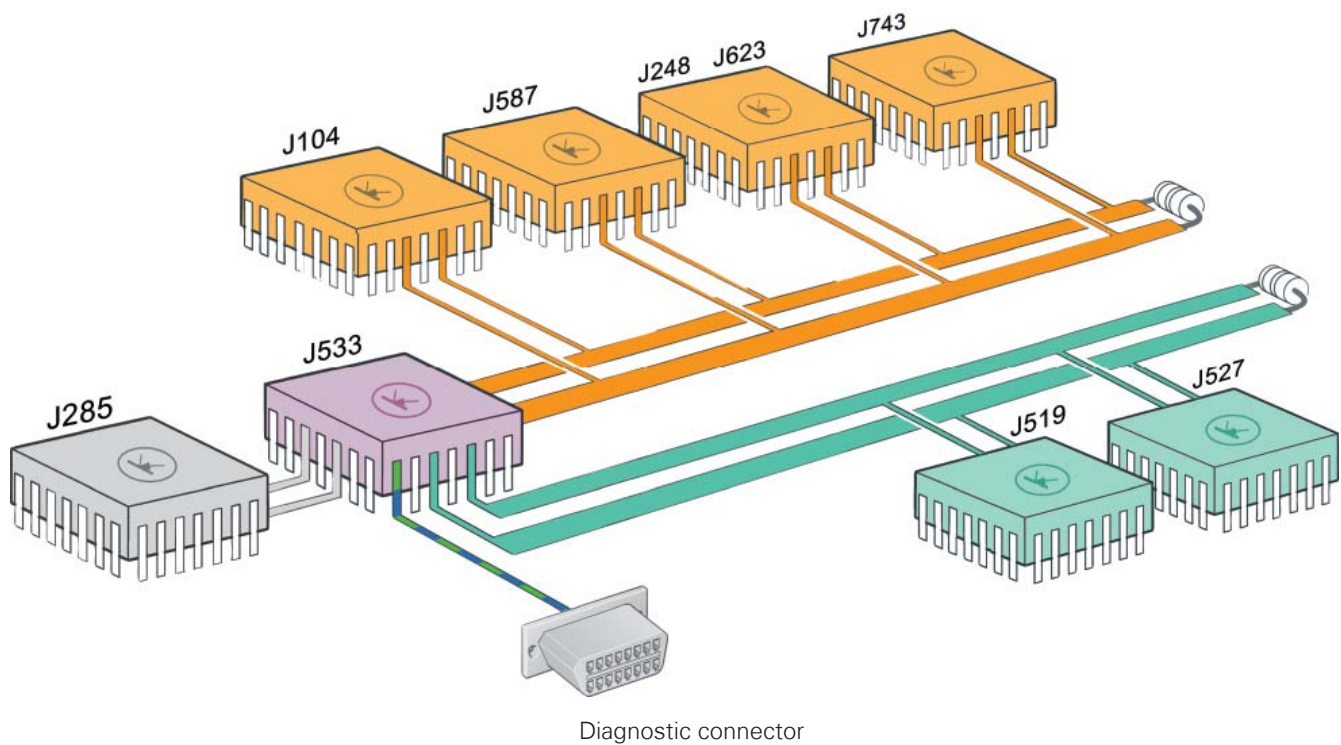
J527 Steering Column Electronics Control Module

J533 Data Bus on Board Diagnostic Interface

J587 Selector Lever Sensor System Control Module

J623 Engine Control Module

J743 DSG Transmission Mechatronic



"Powertrain" CAN data bus



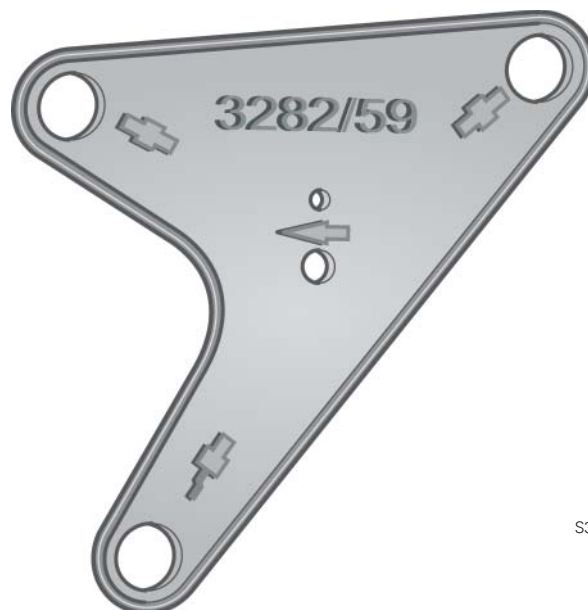
CAN "convenience" data bus

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## Special Tools

When removing the transmission, a new special tool is available for aligning transmission support 3282 of engine and transmission jack V.A.G 1383 A.

Adjustment plate 3282/59



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# Knowledge Assessment

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

The Knowledge Assessment may or may not be required for Certification.

You can find this Knowledge Assessment at:

**[www.vwwebservice.com](http://www.vwwebservice.com)**

For Assistance, please call:

**Volkswagen Academy**

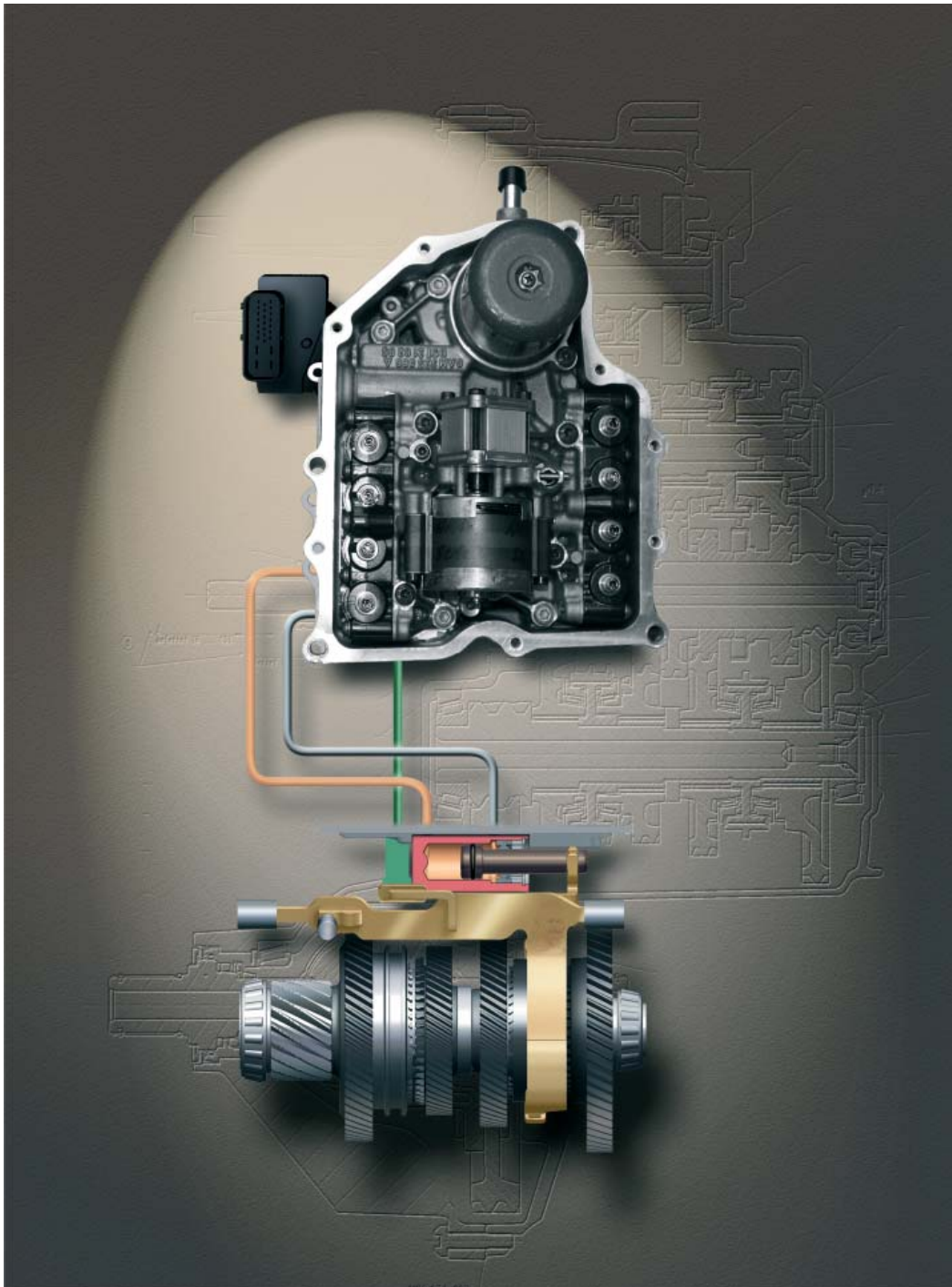
**Certification Program Headquarters**

**1-877-791-4838**

**(8:00 a.m. to 8:00 p.m. EST)**

Or, E-mail:

**[concierge@volkswagenacademy.com](mailto:concierge@volkswagenacademy.com)**



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