

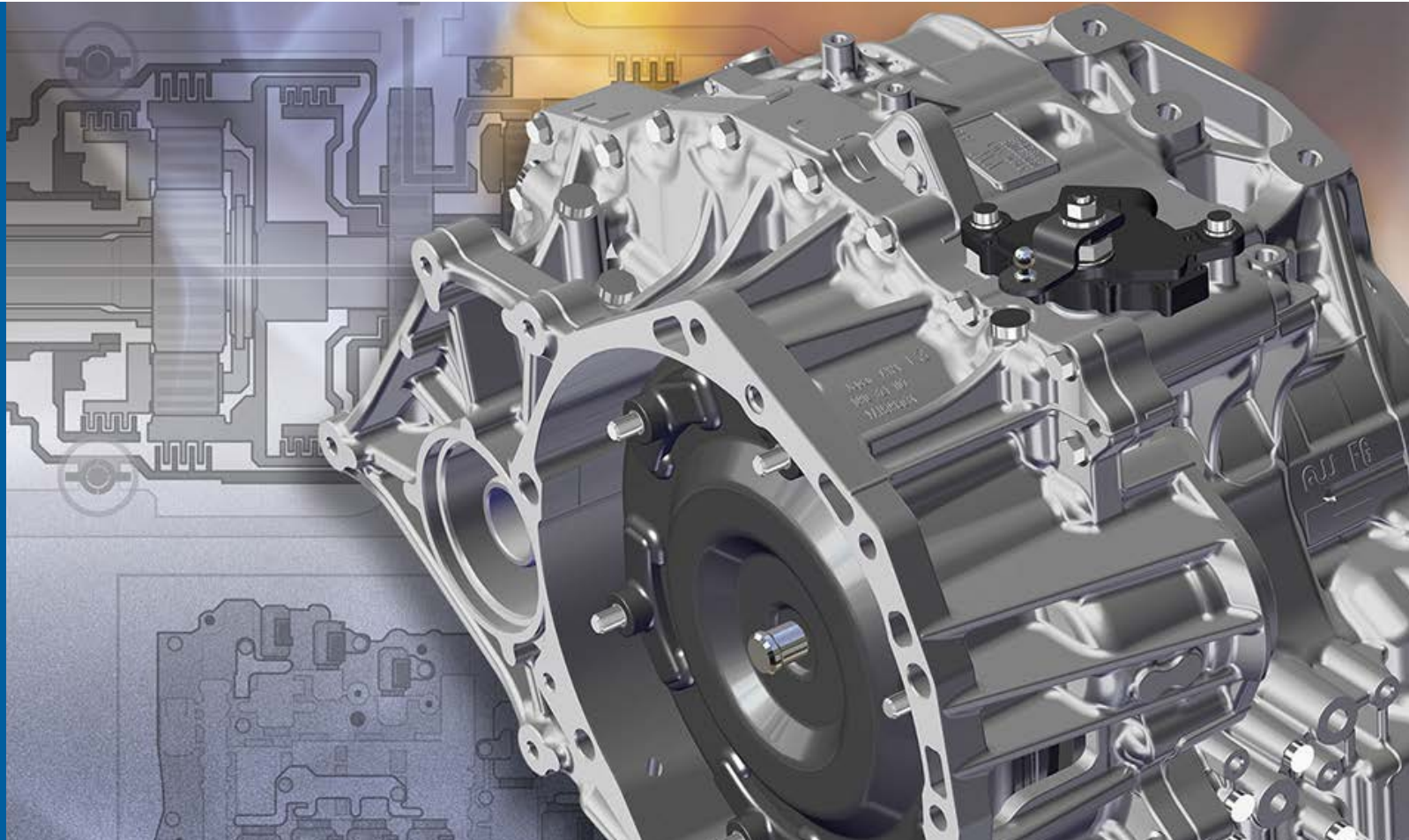
Self Study Program 850193

The 8-speed Automatic Transmission 09P

Design and Function - Tablet Format



Volkswagen



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Table of Contents

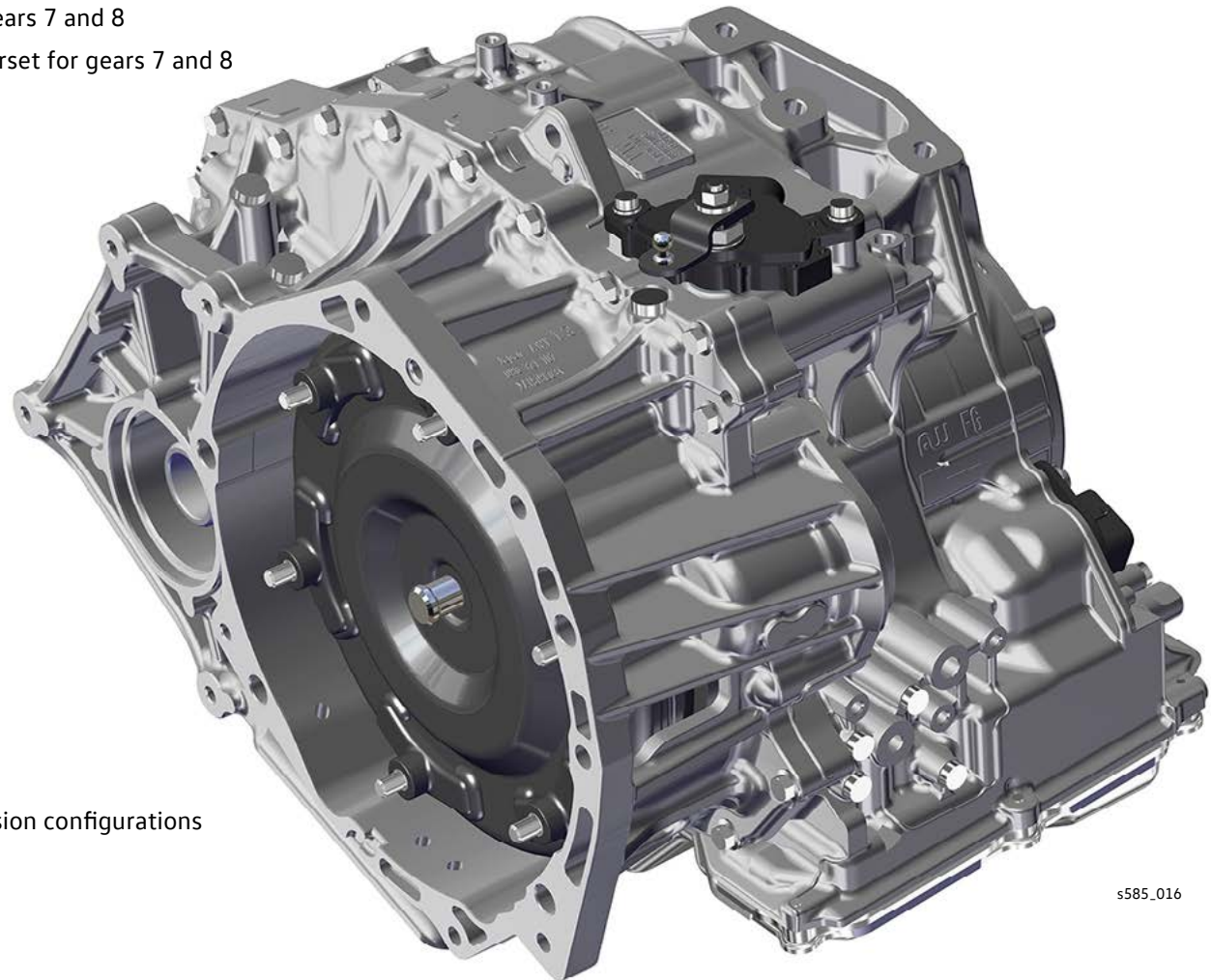
Introduction	2
Selector Lever	4
Transmission Design	8
Valve Body	15
Oil Supply	20
Transmission Management	22
Service	33

Introduction

The Features of the 8-speed Automatic Transmission 09P

The new 8-speed automatic transmission 09P from Aisin has the following technical features when compared to the 09G/09M:

- Transmission Fluid Auxiliary Hydraulic Pump 1 V475 for providing the oil supply in start/stop operation
- Torque converter with starter ring gear
- Two additional electric pressure control valves for gears 7 and 8
- An additional clutch on the Lepelletier planetary gearset for gears 7 and 8
- One of the two brakes is a band brake



There are variances in the 09P transmission configurations depending on vehicle models.

Introduction

The Technical Data for the 8-speed Automatic Transmission

Manufacturer	AISIN AW CO., LTD. Japan
Transmission code	AQ 450
Transmission features	8-speed automatic transmission with single Lepelletier planetary gear set
Maximum torque	450 Nm (332 lb/ft)
ATF specification for transmission fluid	G 055 540 A2 - always check service information for the correct fluid
Filling quantity gear oil	7.65 liters (8.0 qt) at a change interval of 200,000 km (125,000 miles) - always check maintenance information for the correct volume and replacement interval
Filling quantity bevel box	0.86 (0.9 qt) liters lifetime filling

The 09P Applications

The 09P automatic transmission has multiple configurations, depending on application. It is available as a front-wheel drive or a four-wheel drive configuration.

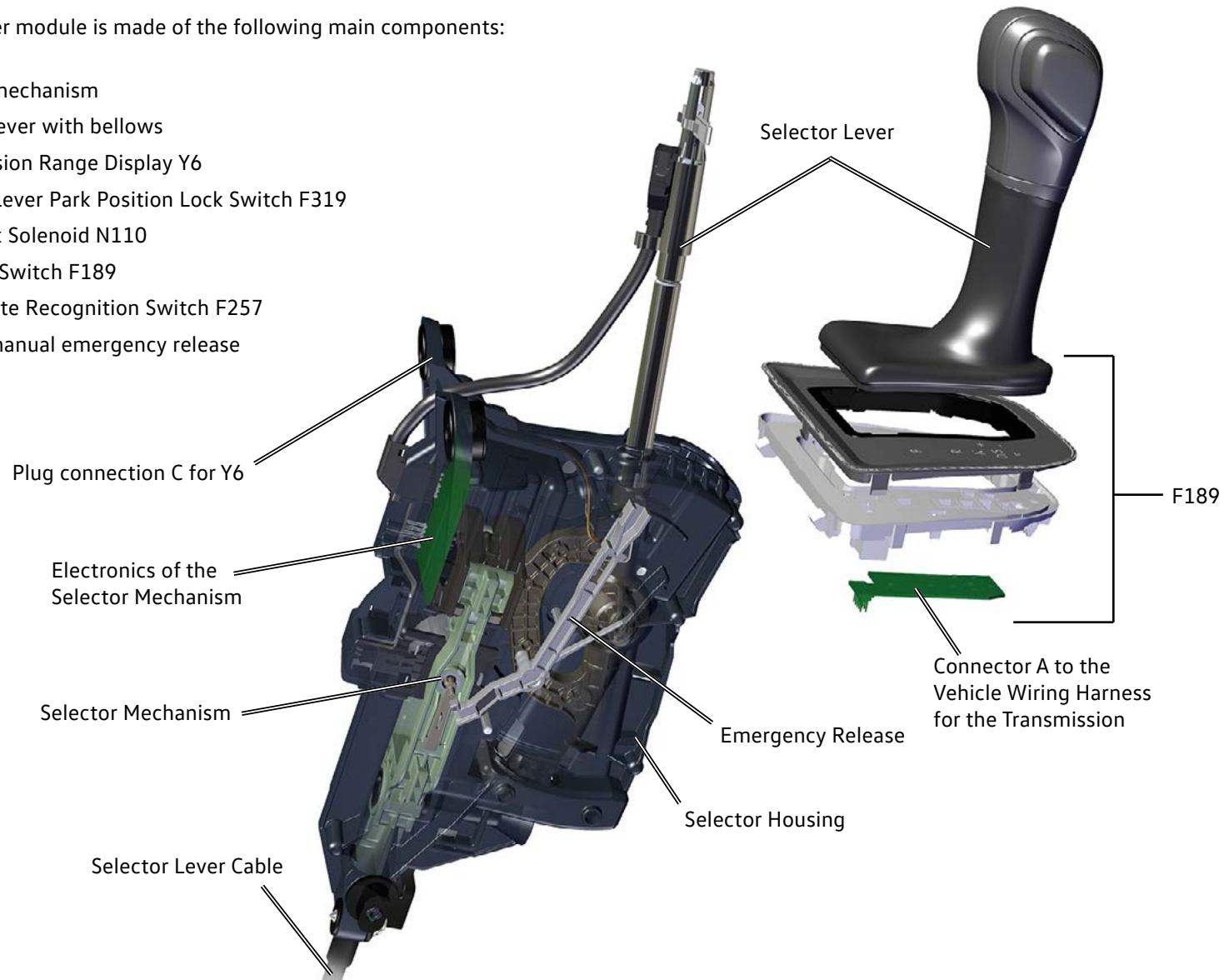
Selector Lever

The selector lever pictured is for the Crafter van (not for the North American Region). The basic layout of the selector lever module varies per application.

Design of the Selector Lever Module

The selector lever module is made of the following main components:

- The selector mechanism
- The selector lever with bellows
- The Transmission Range Display Y6
- The Selector Lever Park Position Lock Switch F319
- The Shift Lock Solenoid N110
- The Tiptronic Switch F189
- Shift Lever Gate Recognition Switch F257
- Mechanical, manual emergency release



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Selector Lever

How the Selector Lever Module Works

The selector lever operates the selector slide in the valve body and the multifunction switch via the selector lever cable and a relay lever. The selector lever module has both mechanical and electrical functions.

Mechanical functions

- Actuation of the parking lock
- Actuation of the selector slide of the hydraulic control module
- Actuation of the multifunction switch in the transmission

Electrical functions

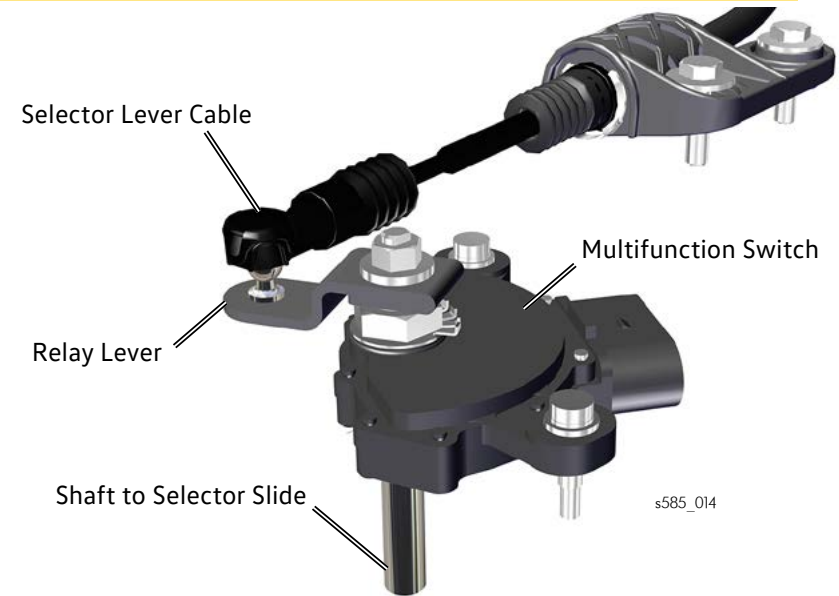
- Ignition key lock
- Control of the display unit for selector lever position
- Tiptronic function
- Selector lever lock (P/N lock)

Additional Electrical Elements of the Switching Operation

Multifunction Switch

The multifunction switch is connected to the selector mechanism with a cable.

In the multifunction switch, the mechanical movement of the cable is converted into electrical signals by the selector lever position and transmitted to the Transmission Control Module (TCM).



Selector Lever Park Position Lock Switch F319

The switch is operated by the selector lever in the "P" position. It then sends a signal "selector lever in position P" to the control module for steering column electronics. The module needs this signal to control the ignition key lock.

Shift Lever Gate Recognition Switch F257

The switch recognizes the position of the selector lever and driver demand. The signal is compared with the multifunction switch and checked for plausibility.

Tiptronic Switch F189

The switch detects the Tiptronic gate as well as "Tip +" and "Tip -." An analog signal is sent to the TCM.

Selector Lever

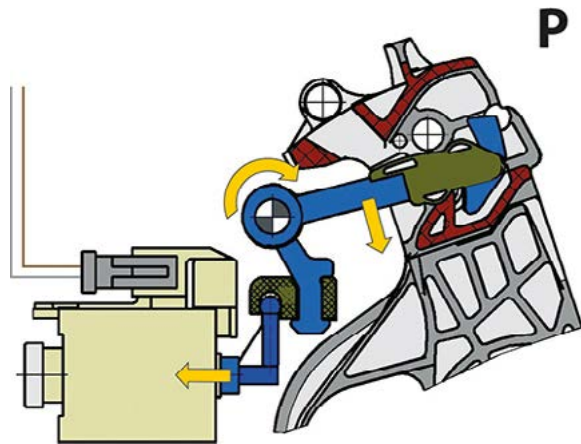
Selector Lever Lock

The selector lever lock is engaged when the ignition is switched on and in the P and N positions during vehicle operation. When the ignition key is removed, the lock is engaged in the P position. The locking mechanism enables the selector lever to be locked both when the Shift Lock Solenoid N110 is de-energized (position P) and when the solenoid is energized (position N).

Lock in selector lever position P

If N110 is de-energized, the locking lever automatically engages in the P latch in the selector mechanism as soon as the selector lever is brought into position P. This movement of the locking lever is supported by an internal spring.

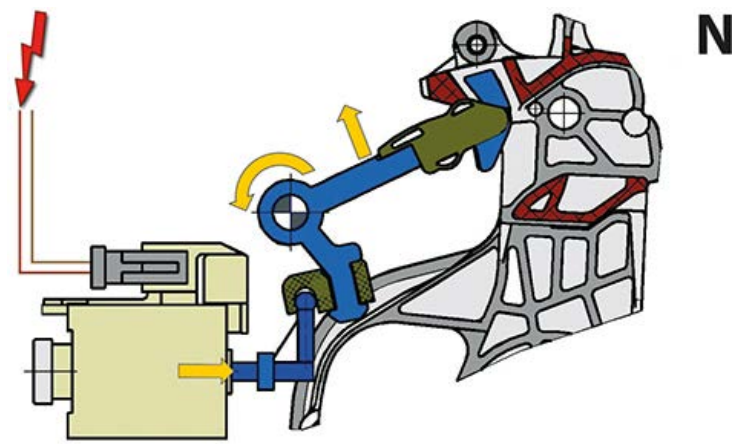
For unlocking, N110 is energized, which means the solenoid pulls the locking lever out of the P latch.



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Lock in selector lever position N

N110 is activated if the selector lever is in Neutral. The solenoid then pushes the locking lever with its upper hook into the N latch and the selector lever locks. N110 is switched off to release. The weight of the locking lever causes it to drop down and release the selector lever again.

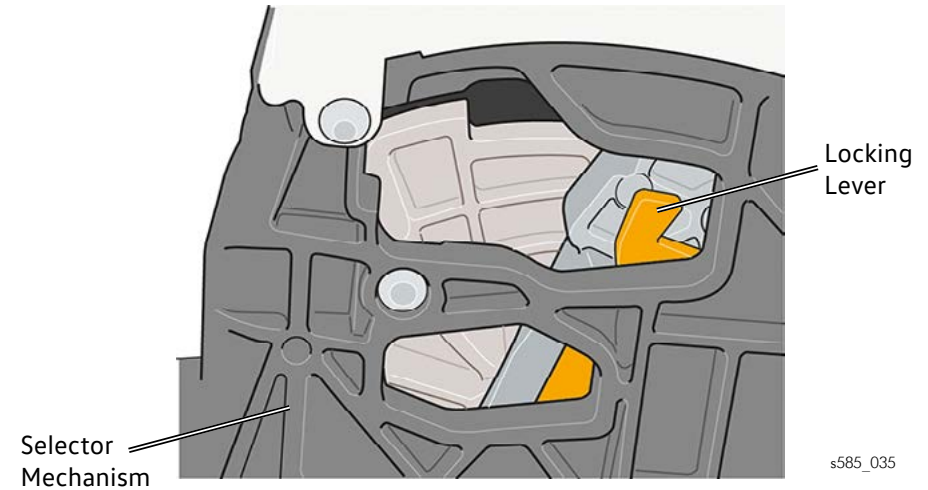


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Selector Lever

The Mechanical, Manual Emergency Release of the P Latch

The locking lever for the emergency release is located to the right of the selector mechanism. To unlock the selector lever lock, pull the locking lever backwards and press the selector lever lock button at the same time.



The Ignition Key Lock

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

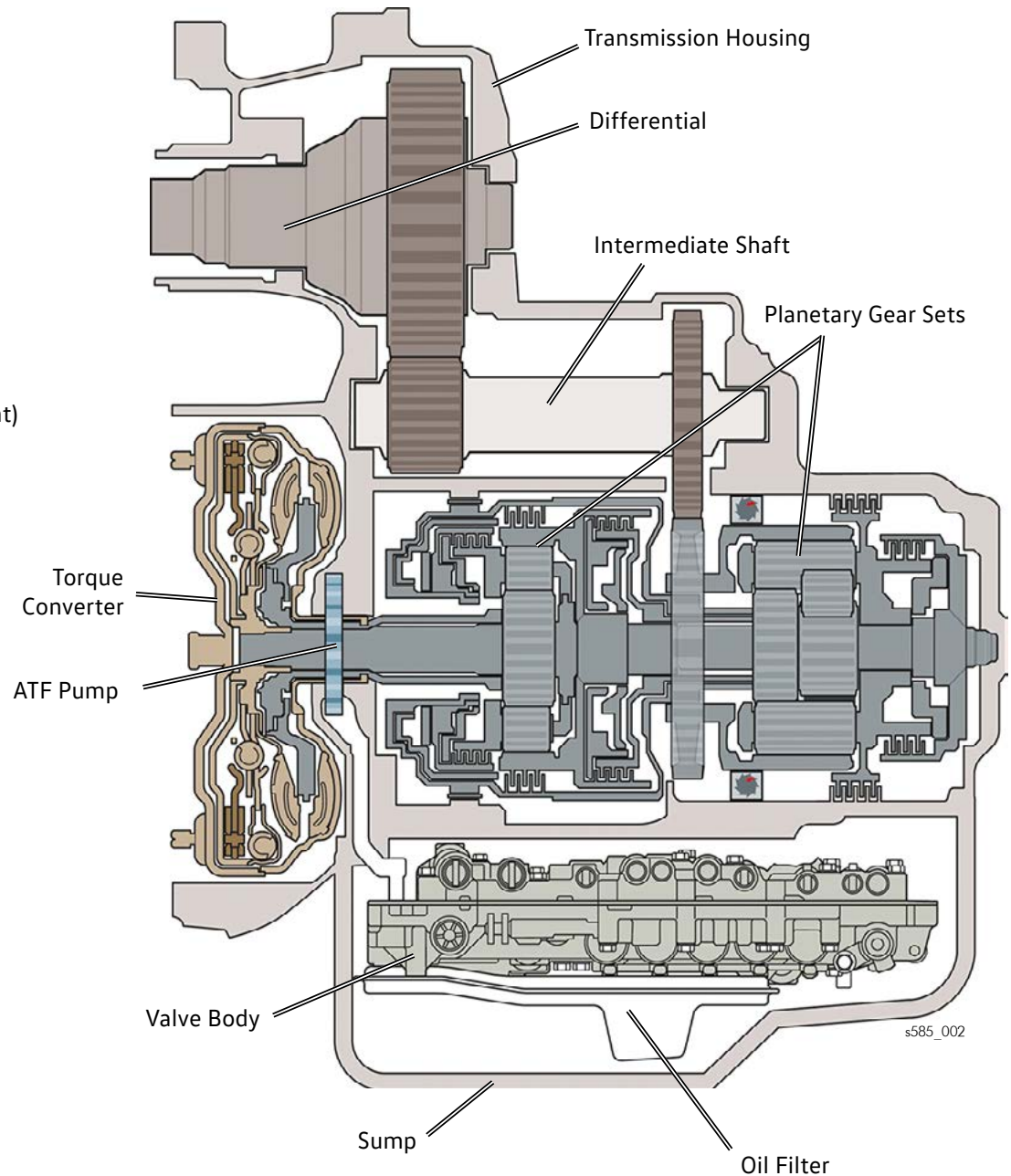
It functions electromechanically and is controlled by the Steering Column Electronics Control Module J527. If the switch is open, the selector lever is in "P", the Ignition Switch Key Lock Solenoid N376 is not energized. The ignition key can be removed.

Transmission Design

The Transmission at a Glance

The transmission is divided into the following main assemblies:

- The torque converter with torque converter lock-up clutch
 - for front-wheel drive without centrifugal pendulum
 - for four-wheel drive with centrifugal pendulum
- The ATF oil pump
- The planetary gear sets
- The valve body
- The transfer case (only for four-wheel drive)
- The Transmission Control Module (in the engine compartment)



Transmission Design

Torque Converter

The torque converter is a fluid coupling. Its primary purpose is to provide a fluid connection between the engine and the transmission. In addition, it magnifies torque.

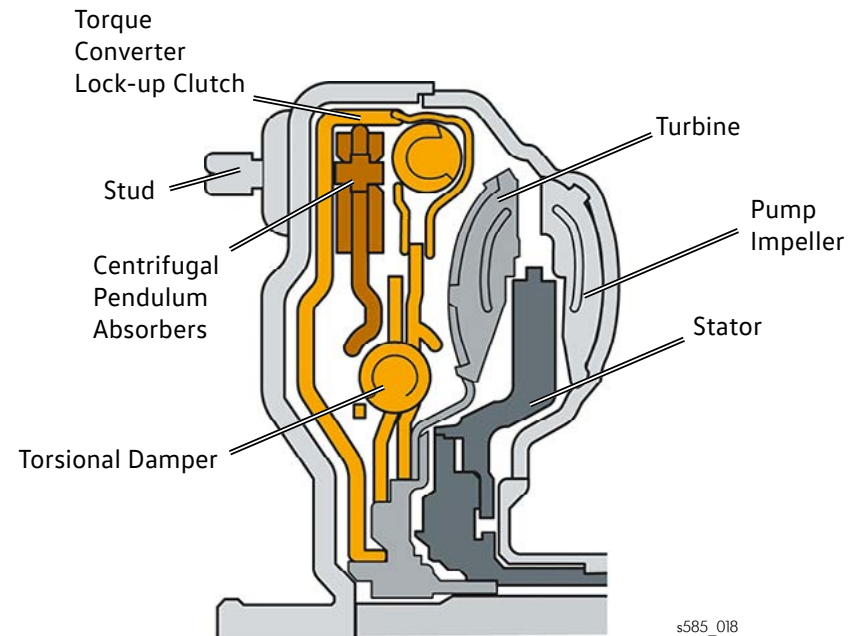
The torque converter has a turbine wheel, pump wheel and stator and a torque converter lock-up clutch. The torque converter of the four-wheel drive versions have centrifugal pendulums to compensate for torsional engine vibrations more efficiently.

During operation, the pendulum inertia causes them to oscillate in the opposite direction to the engine oscillations, largely compensating for them.

The torque converter is connected to different engines using a plate with six studs, which are permanently connected to the torque converter.



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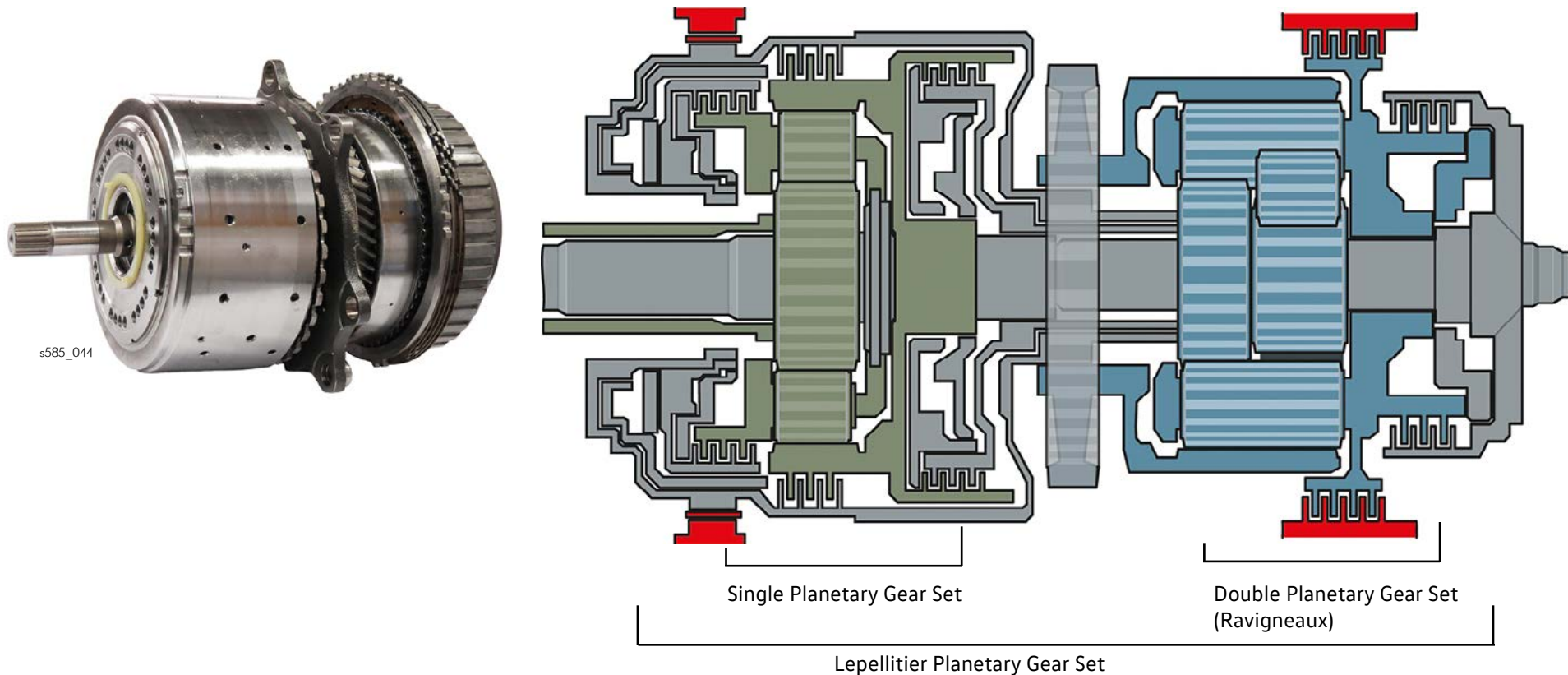
Transmission Design

The Planetary Gear Set

Like its predecessors, this automatic transmission also has two planetary gear sets arranged one behind the other. The first planetary gear set is a single planetary gear set. The second planetary gear set is a double planetary gear (Ravigneaux design).

This special arrangement of the single + Ravigneaux gear sets together is called a Lepelletier planetary gear set. The first planetary gear set makes it possible to drive the second planetary gear set at two different speeds.

Due to this special design, nine gears are possible. This means that transmissions with this design have an extremely wide range of applications between 5-speeds and 8-speeds. They differ only in the number of clutches and brakes required to implement the respective number of gears.



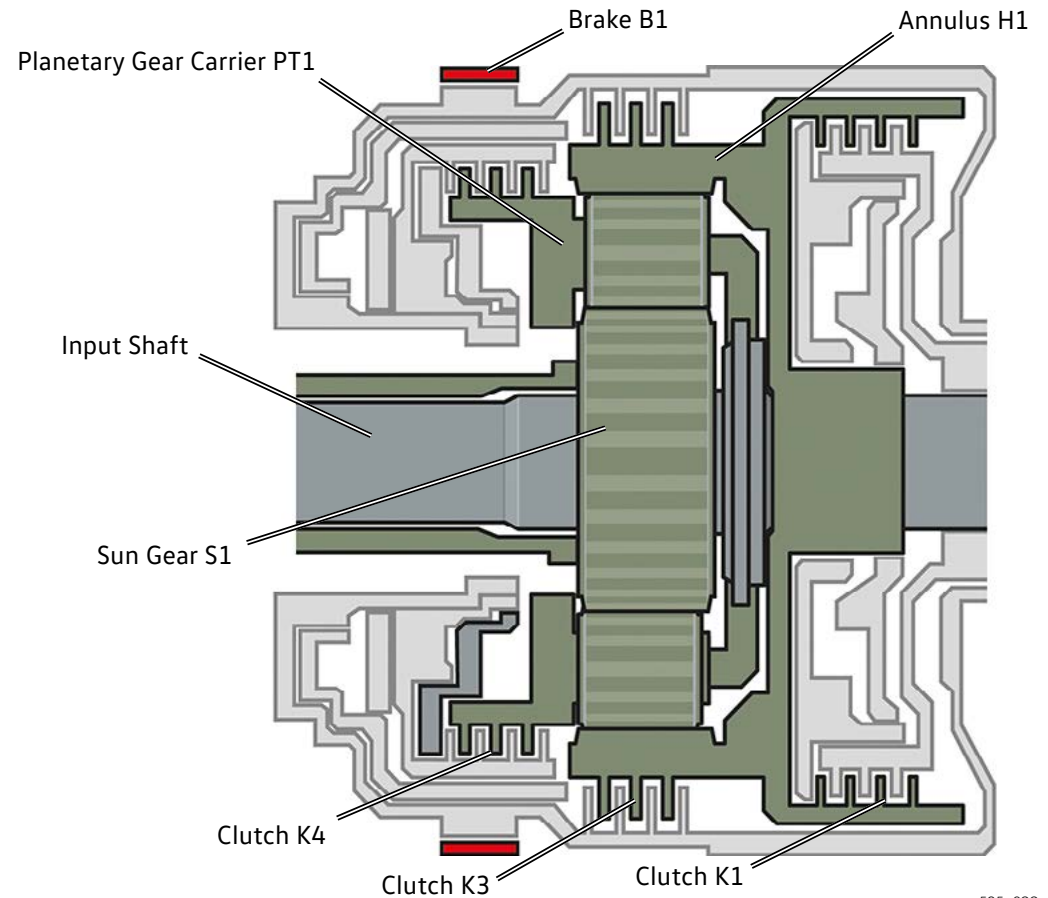
Transmission Design

The Single Planetary Gear Set

Engine torque passes from the torque converter to the transmission input shaft. From there it passes to the planetary gear carrier PT1. The sun gear S1 is permanently connected to the ATF oil pump. This means it cannot rotate freely. The planetary gear set PT1 has five planetary gears for transmission to the annulus H1. The single planetary gear set is integrated into the transmission using the clutches K1, K3 and K4 as well as the brake B1.



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Transmission Design

The Double Planetary Gear Set (Ravigneaux)

The clutches K1, K3 and K4 on the single planetary gear set and the clutch K2 on the Ravigneaux planetary gear set transmit the engine torque to this double planetary gear set. This happens either:

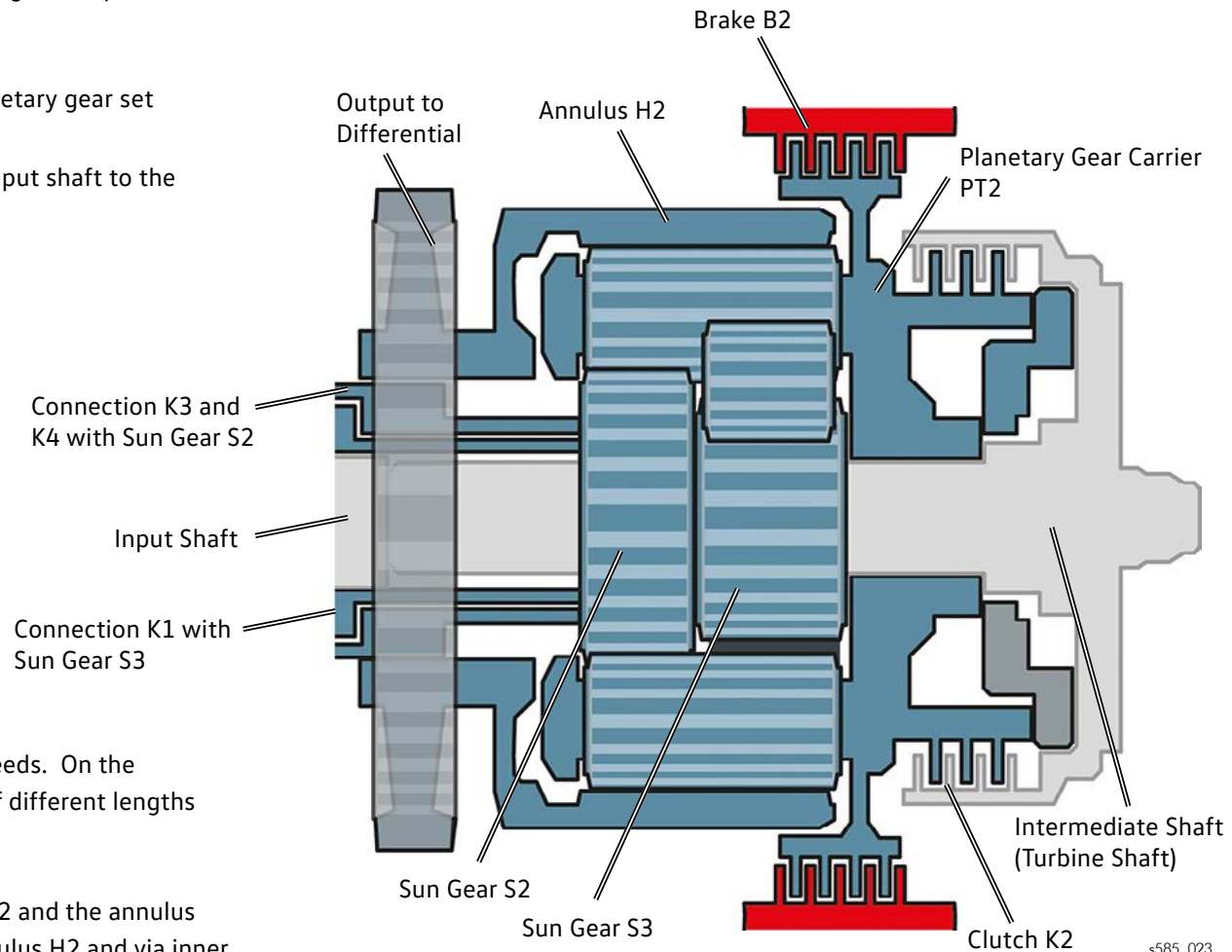
- From the transmission input shaft via the single planetary gear set described above to the sun gears S2 or S3
- Or via the clutch K2 directly from the transmission input shaft to the planetary gear carrier PT2.



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The two sun gears S2 and S3 can rotate at different speeds. On the planetary gear carrier there are three planetary gears of different lengths P2a and P3a.

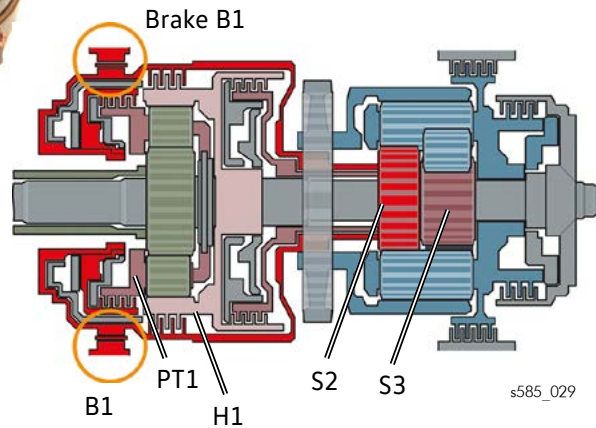
The short planetary gears P2a engage in the sun gear S2 and the annulus H2 and the long planetary gears P3a engage in the annulus H2 and via inner planetary gears P3b on the sun gear S3. The double planetary gear set is integrated using the K2 clutch, the B2 brake and the freewheel.



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Transmission Design

The Brakes



Brake B2

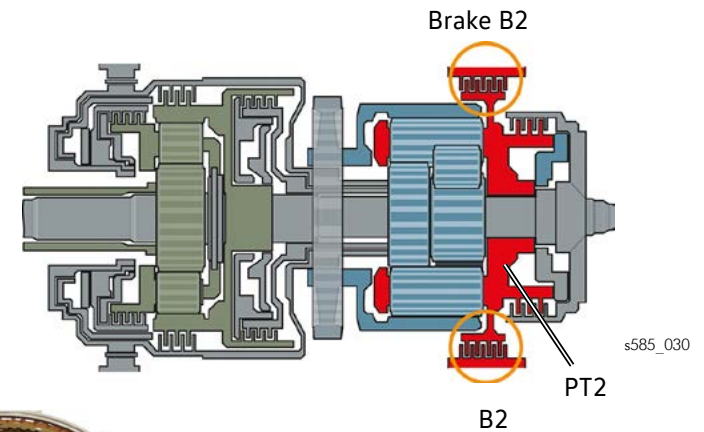
Brake B2 is designed as a multi-disc brake that is connected to the transmission housing.

When the Solenoid Valve 1 N88 is energized, the hydraulic oil pressure compresses the brake disks.

The planetary gear carrier PT2 is held.

Brake B1

Brake B1 is a band brake. It is connected to the transmission housing and is operated hydraulically using a control piston in the valve body. Brake B1 is controlled using the Automatic Transmission Pressure Regulating Valve 2 N216. The return movement is performed using a spring.



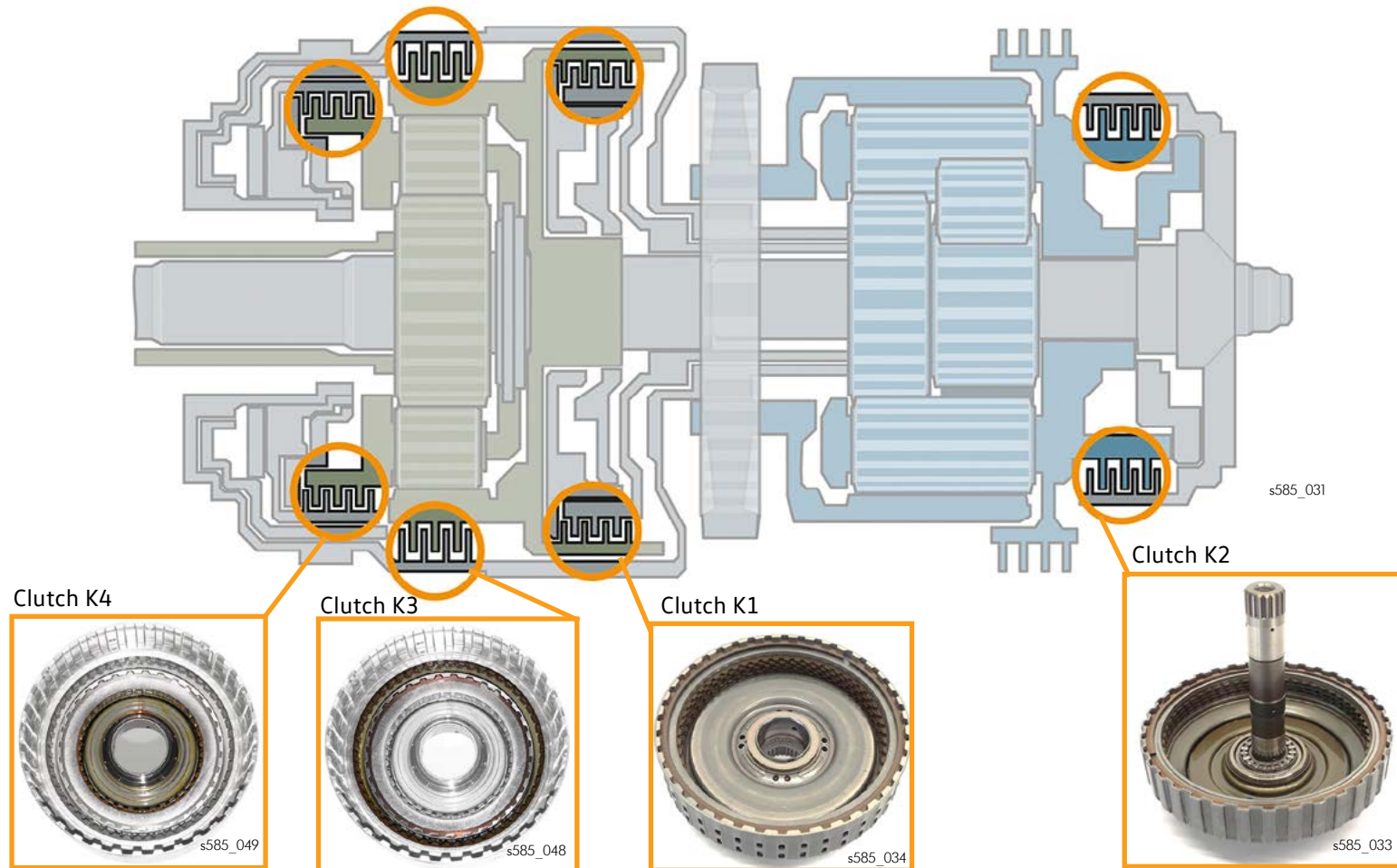
Transmission Design

The Clutches

The clutches K1, K2, K3 and K4

The electric solenoid valves inside the valve body route fluid to open or close the clutches. The clutches perform the following functions when closed:

- Clutch K1 connects the annulus H1 with the sun gear S3.
- Clutch K2 connects turbine shaft to the planetary gear carrier PT2.
- Clutch K3 connects the annulus H1 with the sun gear S2.
- Clutch K4 connects the planetary gear carrier PT1 to the sun gear S2.



Transmission Design

Parking Lock

In order to protect the parking lock against unnecessary mechanical wear, a new design is used to prevent misuse of the parking lock.

The parking lock serves exclusively to secure the vehicle against rolling away and is only allowed to be engaged when the vehicle is stationary.

However, if the driver attempts to engage the parking lock when the vehicle is rolling in order to bring the vehicle to a standstill, a warning will appear in the instrument cluster. There are two warning levels.

Warning Level 1

An acoustic warning tone of priority **level 2** sounds. The display of the dash panel insert shows a warning message for six seconds.

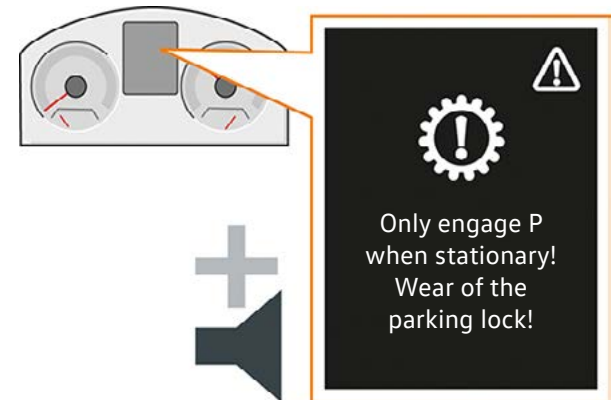
Warning Level 2

An acoustic warning tone of priority **level 1** sounds. The display of the dash panel insert shows the adjacent warning message for six seconds. In addition, the central warning lamp lights up red. The display of this warning level repeats itself with each engine start.

Warning level 2 cannot be reset. The transmission must be replaced.



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Valve Body

The Valve Body at a Glance

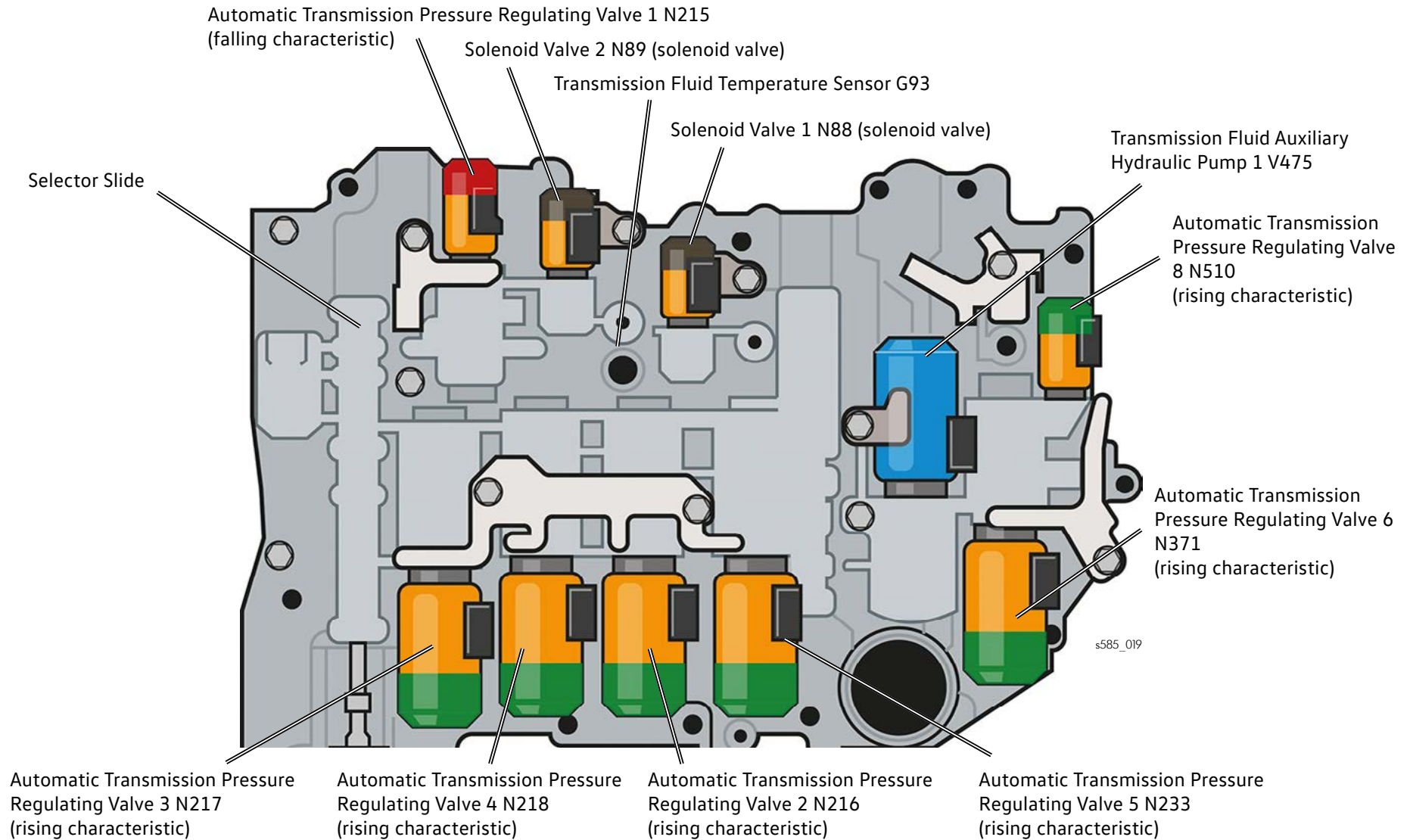
The valve body is attached to bottom of the transmission. The clutches and brakes of the transmission are actuated by means of hydraulic valves, called shift valves, inside the valve body. The shift valves are controlled by electrically operated solenoid valves, which in turn are controlled by the Transmission Control Module J217. In addition to the shift valves, the valve body controls the various pressures in the transmission, such as main pressures, control pressures, torque converter clutch pressure and lubricating pressure.

To provide the required oil pressure during start-stop operation, Transmission Fluid Auxiliary Hydraulic Pump 1 V475 is installed in the valve body.

The valve body contains the following components:

- The mechanically operated selector slide valve
- Two electrically controlled solenoid valves (3/2-way valves)
- Six electric pressure regulating valves with increasing characteristic curve (pressure increases with increasing control current)
- One electric pressure regulating valve with decreasing characteristic (pressure decreases with increasing control current)
- The Transmission Fluid Temperature Sensor G93
- The electric Transmission Fluid Auxiliary Hydraulic Pump 1 V475

Valve Body



Valve Body

Solenoid Application

Gears	P	R	N	1	2	3	4	5	6	7	8
Solenoid Valves											
Solenoid Valve 1 N88	-	-	-	X	-	-	-	-	-	-	-
Solenoid Valve 2 N89	-	-	-	-	X	X	-	-	-	-	-
Automatic Transmission Pressure Regulating Valve 1 N215	The pressure regulating valve 1 modulates the main oil pressure of the transmission depending on of the accelerator pedal value.										
Automatic Transmission Pressure Regulating Valve 2 N216	-	-	-	-	X	-	-	-	-	-	X
Automatic Transmission Pressure Regulating Valve 3 N217	-	-	-	X	X	X	X	X	-	-	-
Automatic Transmission Pressure Regulating Valve 4 N218	-	-	-	-	-	-	-	X	X	X	X
Automatic Transmission Pressure Regulating Valve 5 N233	-	X	-	-	-	X	-	-	-	X	-
Automatic Transmission Pressure Regulating Valve 6 N371	-	-	-	-	-	-	X	-	X	-	-
Automatic Transmission Pressure Regulating Valve 8 N510	The pressure regulating valve 8 modulates the oil pressure for the torque converter lock-up clutch depending on the shift strategy.										

- = Valve switched off, clutch open, brake not applied

X = Valve switch on, clutch closed, brake applied

X* = Only closed in Tiptronic mode in 1st in certain driving situations to use the engine braking effect

Valve Body

Clutch/Brake Application

Gears	P	R	N	1	2	3	4	5	6	7	8
Clutches											
Clutch K1	-	-	-	X	X	X	X	X	-	-	-
Clutch K2	-	-	-	-	-	-	-	X	X	X	X
Clutch K3	-	X	-	-	-	X	-	-	-	X	-
Clutch K4	-	-	-	-	-	-	X	-	X	-	-
Brakes/freewheel											
Brake B1	-	-	-	-	X	-	-	-	-	-	X
Brake B2	-	X	-	X*	-	-	-	-	-	-	-
Gliding	-	-	-	X	-	-	-	-	-	-	-

- = Valve switched off, clutch open, brake not applied

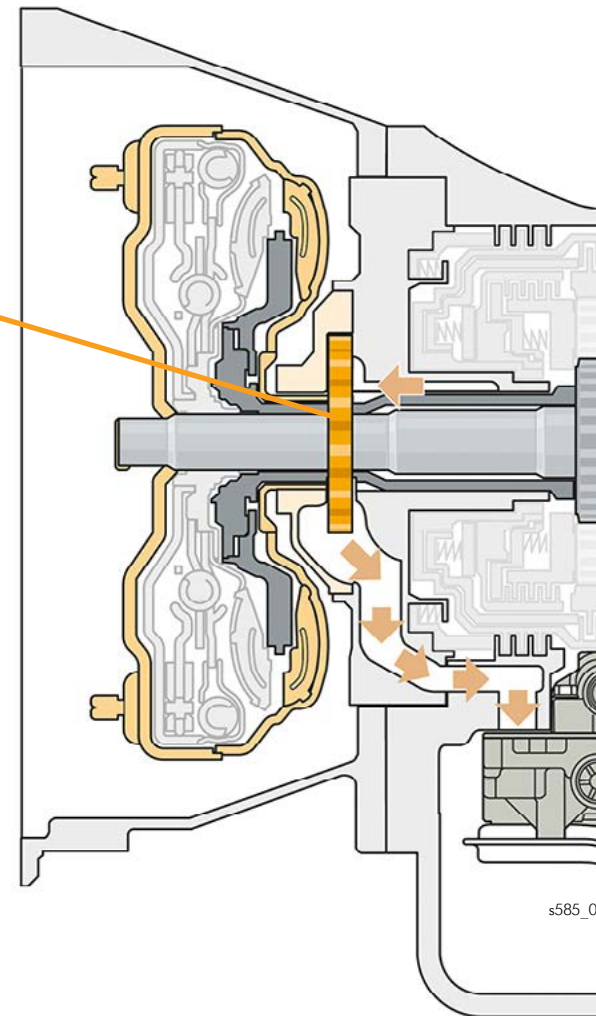
X = Valve switch on, clutch closed, brake applied

X* = Only closed in Tiptronic mode in 1st in certain driving situations to use the engine braking effect

Oil Supply

The ATF Oil Pump

For vehicles with internal combustion engines, the mechanical ATF (Automatic Transmission Fluid) pump is responsible for the supply of hydraulic oil to the transmission during normal driving. It draws the ATF oil from the oil sump, builds up the oil pressure and supplies the valve body with the hydraulic fluid required for the gear changes.

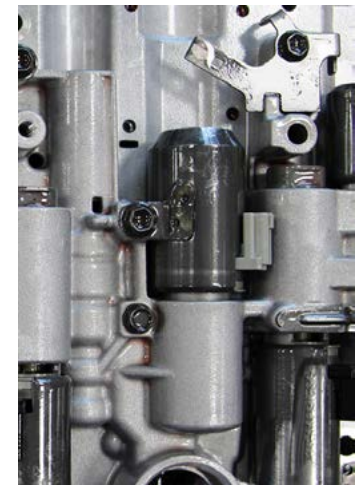
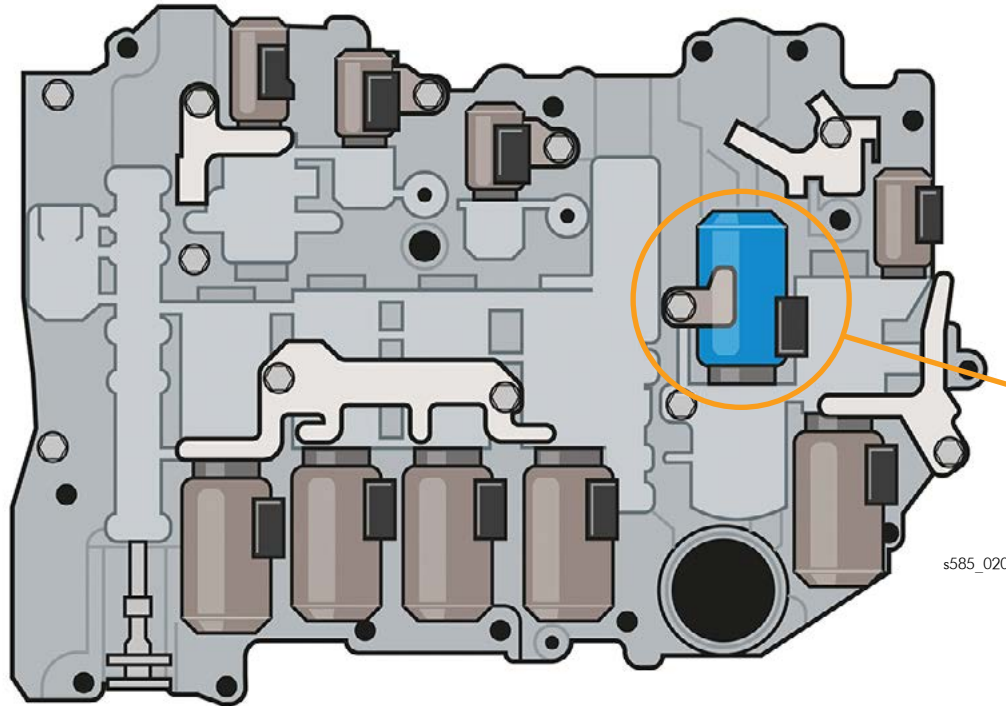


The ATF oil pump is an internal geared wheel pump (duocentric oil pump). It is driven directly by the engine through the converter housing by the converter hub. Here, the drive lugs of the pinion of the ATF oil pump engage in two grooves on the converter hub.

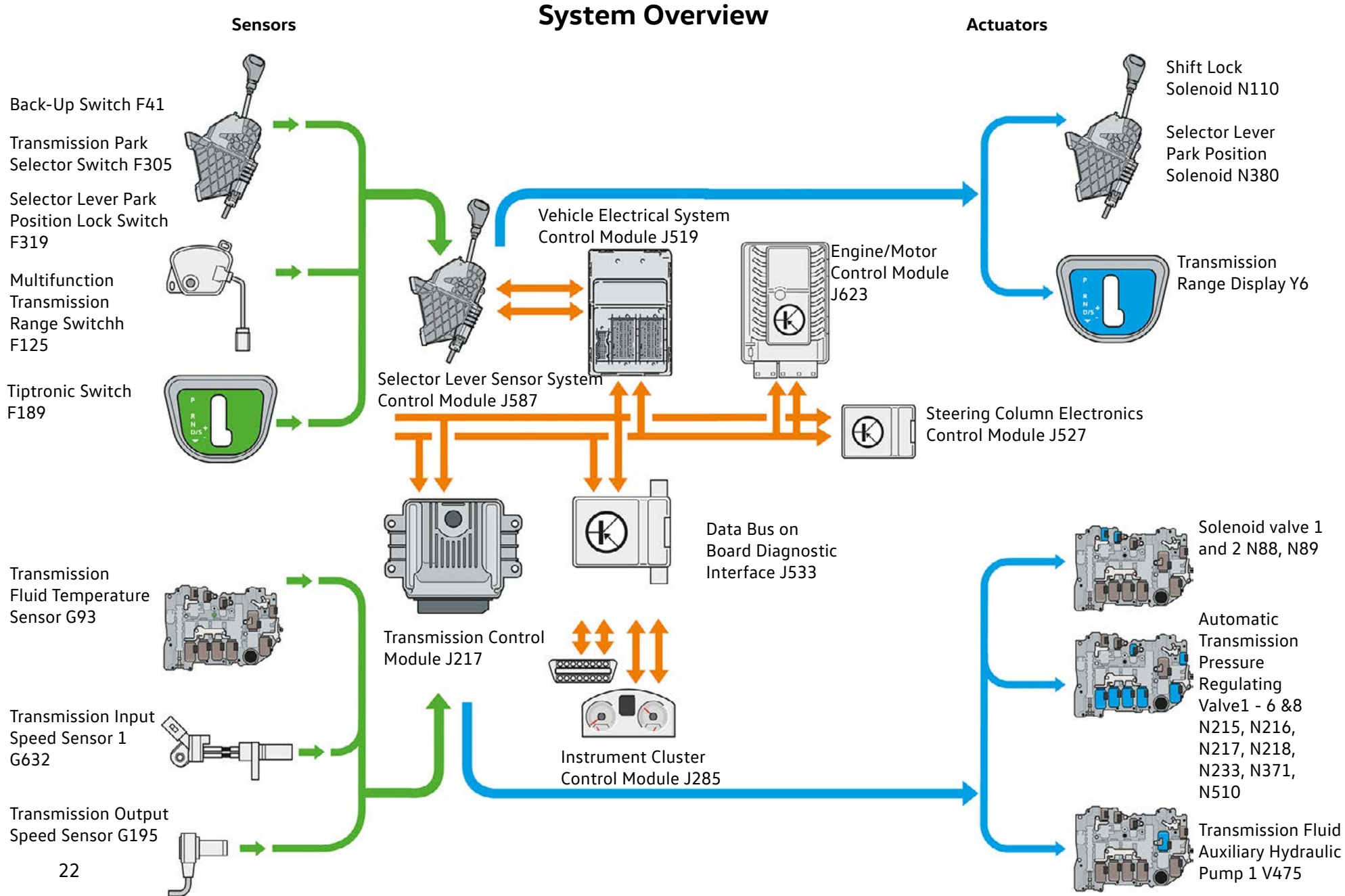
Oil Supply

Transmission Fluid Auxiliary Hydraulic Pump 1 V475

The electric oil pump is required for vehicles with start-stop system. It maintains the oil pressure in the transmission when the engine is stopped. The transmission can use pressure to apply clutches, allowing the vehicle to move immediately. After the engine has started again and the mechanical oil pump has built up the required oil pressure, the Transmission Fluid Auxiliary Hydraulic Pump 1 V475 is turned off.



Transmission Management



Transmission Management

The Transmission Control Module J217

The J217 is located in the front left of the engine compartment.

It is connected to J533 Diagnostic Interface for the CAN Data-Bus through the powertrain CAN-bus. The J217 directly controls the solenoid valves in the valve body using signals from the transmission sensors. A 52-pin plug connects the control module to the on-board electrical system and the transmission.

The VAS adapter cable 1598/48 is available for static and dynamic measurements on the system. The manufacturer of the control module is also AISIN AW Japan. Update programming is possible using the VAS Scan Tool.

The Dynamic Shift Program DSP is integrated in the control module. This shift program evaluates the driving resistance (such as driving on hilly terrain), the route profile (such as windy roads) and the driving style, along with other factors, to determine the transmission shift points.



Transmission Management

Powerflow

The powerflow of the individual gears are shown in the following pages using a highly simplified cross-section of the transmission. The illustration of the valve body shows which solenoid valves are activated for the respective gear.

Clutch K1 and Freewheel F

The transmission input shaft transmits the engine torque to the planetary gear carrier PT1 of the single planetary gear set. The planetary gears P1 roll around supported on the fixed sun gear S1 and drive the annulus H1.

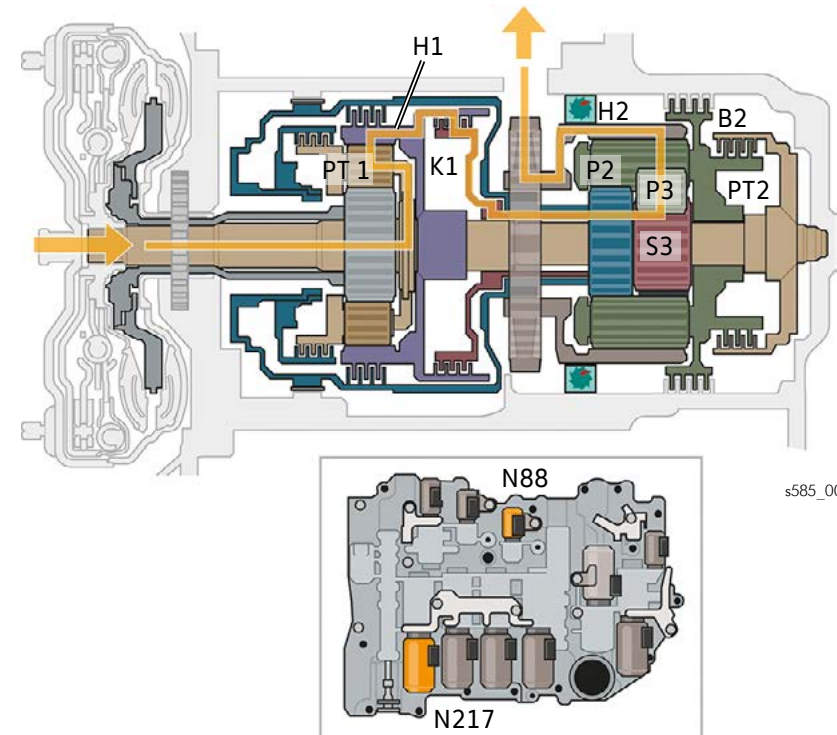
Clutch K1 connects the planetary gear carrier H1 to the sun gear S3, transferring the torque to the double planetary gear set. The freewheel locks the planetary gear carrier PT2.

From the sun gear S3, the torque is transferred to the planetary gears P3. Supported by the planetary gear carrier PT2, the torque is transferred to the annulus H2.

Annulus H2 is connected to the transmission output shaft.

In certain driving situations, engine braking can be used by selecting 1st gear in Tiptronic mode. Using engine braking in 1st gear is made possible by closing the brake B2. Brake B2 locks the planetary gear carrier PT2 to the freewheel. Unlike the freewheel F, however, the brake B2 holds the planetary gear carrier PT2 in both directions of rotation.

1st Gear



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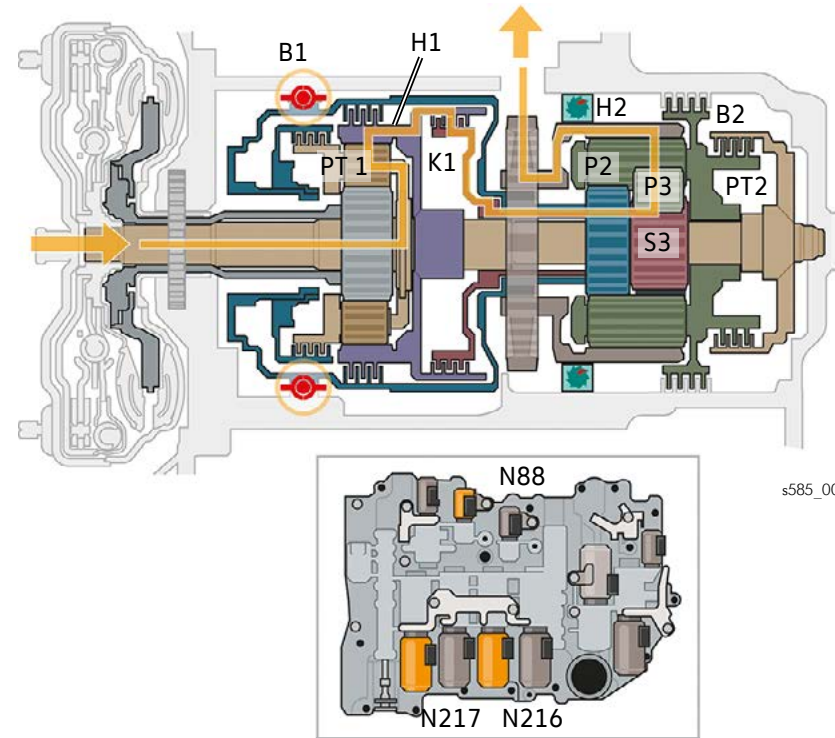
Transmission Management

Clutch K1 and Brake B1

As with the first gear, the engine torque is introduced into the double planetary gear set by the annulus H1 of the single planetary gear set. Clutch K1 connects the annulus H1 to the sun gear S3 for this purpose.

Brake B1 locks the sun gear S2. From the sun gear S3, the torque is transferred to the planetary gears P3. Planetary gears P2 roll around the sun gear S2 and, together with the planetary gears P3, drive annulus H2.

2nd Gear



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Transmission Management

Clutches K1 and K3

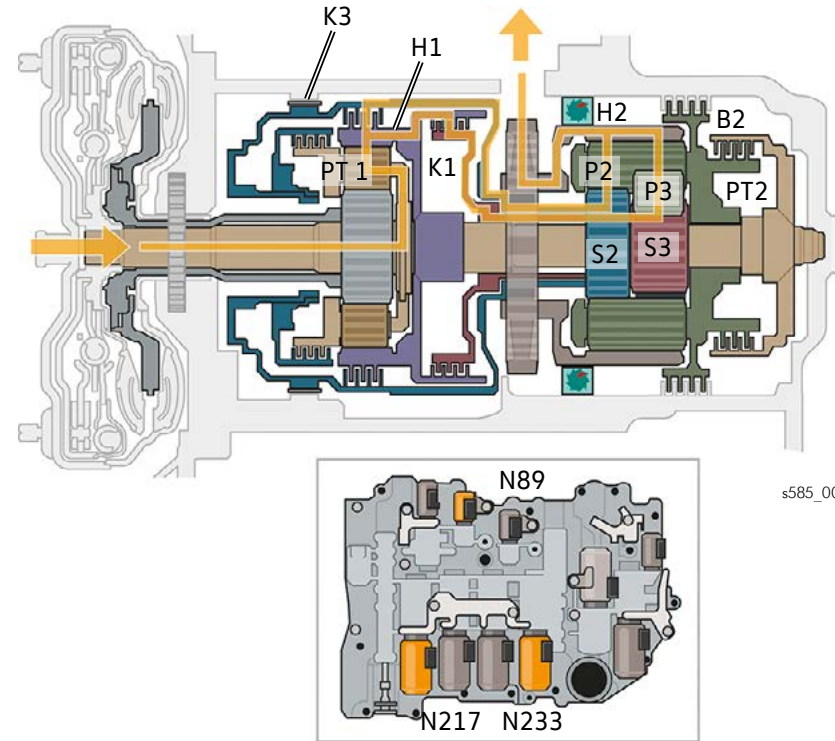
As before, the clutch K1 connects the annulus H1 to the sun gear S3.

Clutch K3 additionally connects the annulus H2 to the large sun gear S2.

Planetary gears P2 and P3 are locked by K1 and K3. Planetary gear carrier PT2 now rotates together with the sun gears S2 and S3.

The torque is transmitted through the planetary gear carrier PT2 to the annulus H2.

3rd Gear



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Transmission Management

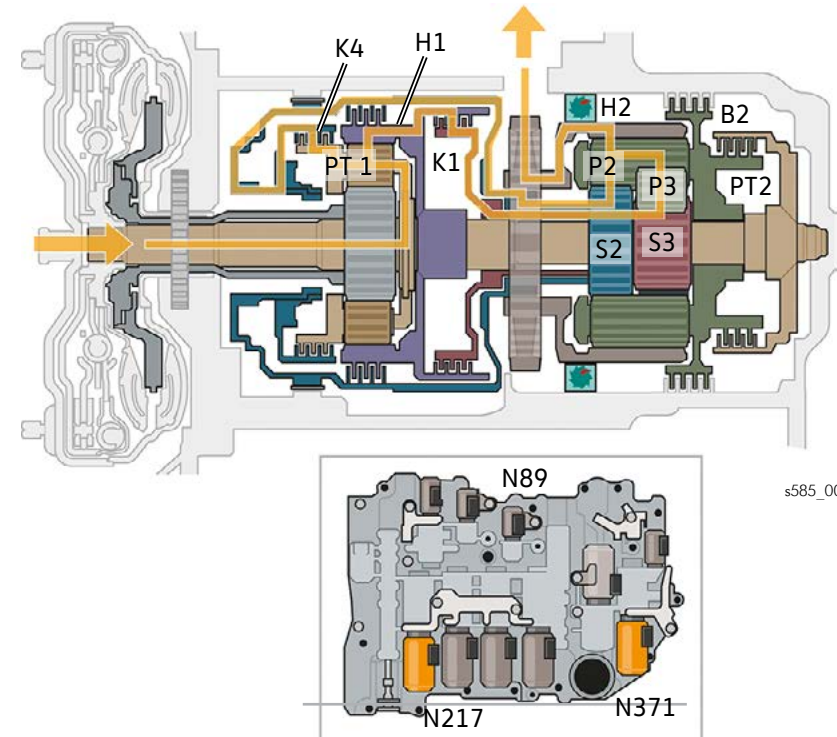
Clutches K1 and K4

Once again, the clutch K3 connects the annulus H1 to the sun gear S3 and transfers the torque to the double planetary gear set.

Clutch K4 connects the planetary gear carrier PT1 to the sun gear S2 and also transfers the torque to the double planetary gear set, although with different input speeds.

Sun gear S3 is driven more slowly than the sun gear S2. Planetary gears P2/P3 roll around the faster-rotating sun gear S2 and drive the annulus H2.

4th Gear



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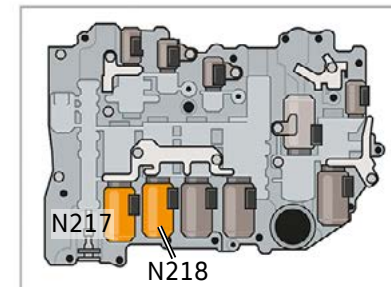
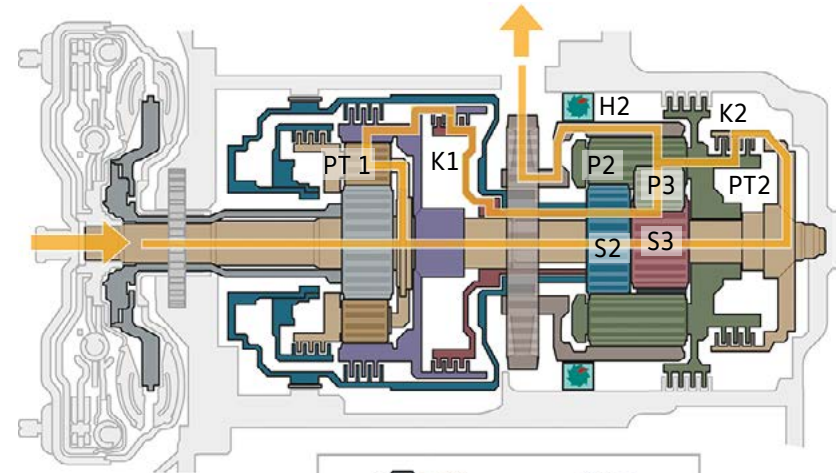
Transmission Management

Clutches K1 and K2

Clutch K1 connects the annulus H1 to the sun gear S3 and transfers the torque to the double planetary gear set. The clutch K2 connects the turbine shaft to the planetary gear carrier PT2 and transfers the torque to the double planetary gear set.

Together with the planetary gear carrier PT2, planetary gears P2 and P3 drive the annulus H2.

5th Gear



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Transmission Management

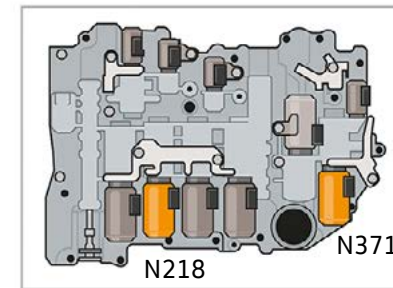
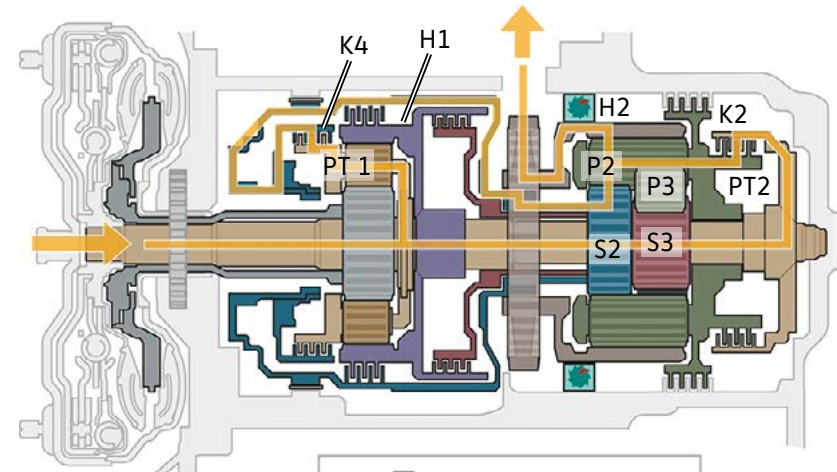
Clutches K2 and K4

The turbine shaft drives the planetary gear carrier PT1 of the single planetary gear set and the outer disc carrier of the clutch K2. The clutch K4 connects the planetary gear carrier PT1 to the sun gear S2, transferring the torque to the double planetary gear set.

The clutch K2 connects the turbine shaft to the planetary gear carrier PT2 and transfers the torque to the double planetary gear set.

Sun gear S2 transfers the torque to the planetary gears P2. The torque is transferred to the planetary gears P3 through the planetary gear carrier PT2. Together with the planetary gears P2, the planetary gear gears P3 drive the annulus H2.

6th Gear



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Transmission Management

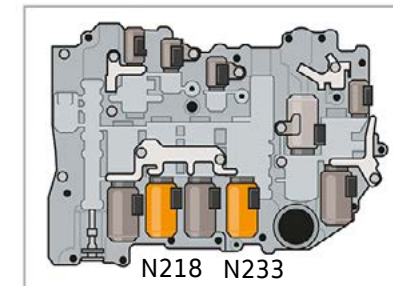
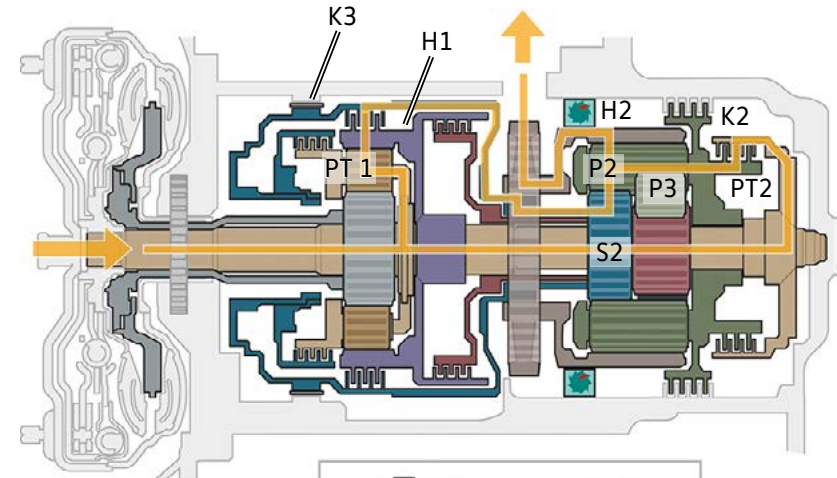
Clutches K2 and K3

The turbine shaft drives the planetary gear carrier PT1 of the single planetary gear set and the outer disc carrier of the clutch K2. Planetary gear carrier PT1 drives the planetary gears P1, which roll around the fixed sun gear S1 and drive the annulus H1.

Clutch K3 connects the annulus H1 to the sun gear S2, transferring the torque to the double planetary gear set.

The clutch K2 connects the turbine shaft to the planetary gear carrier PT2, transferring the torque to the double planetary gear set. The planetary gears P2, which are jointly driven by sun gear S2 and planetary gear carrier PT2, drive the annulus H2 along with the permanently connected outer planetary gears P3.

7th Gear



s585_009

Transmission Management

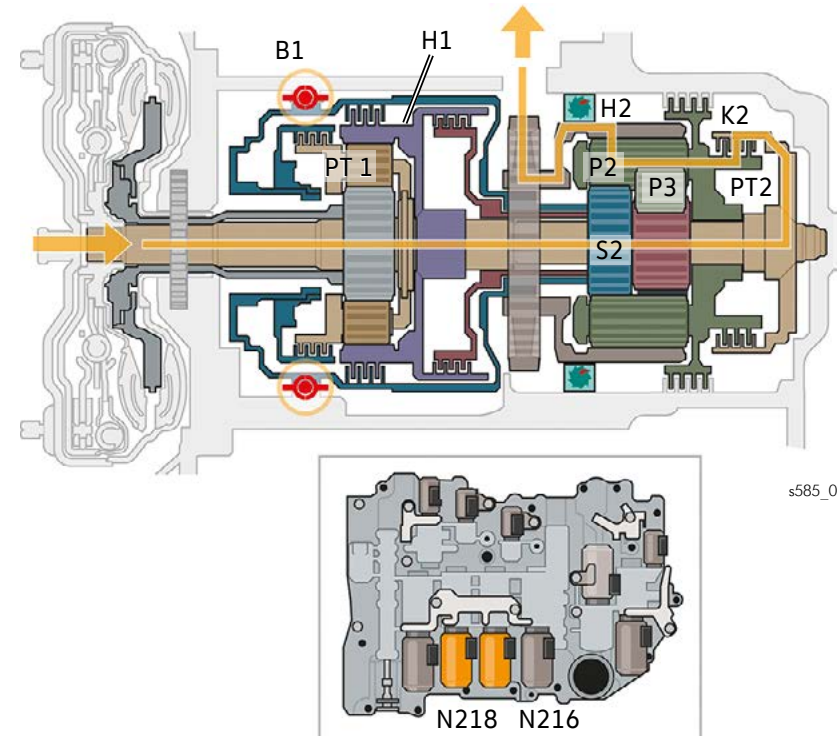
Clutches K2 and Brake B1

Brake B1 locks the sun gear S2. Clutch K2 connects the turbine shaft to the planetary gear carrier PT2 of the double planetary gear set, transferring the torque to the double planetary gear set.

The long planetary gears P3 roll around the stationary sun gear S2 and, together with the planetary gears P2, drive the annulus H2. The clutches K1 and K3 are open.

The single planetary gear set is not part of the power flow.

8th Gear



s585_010

Transmission Management

Clutches K3 and Brake B2

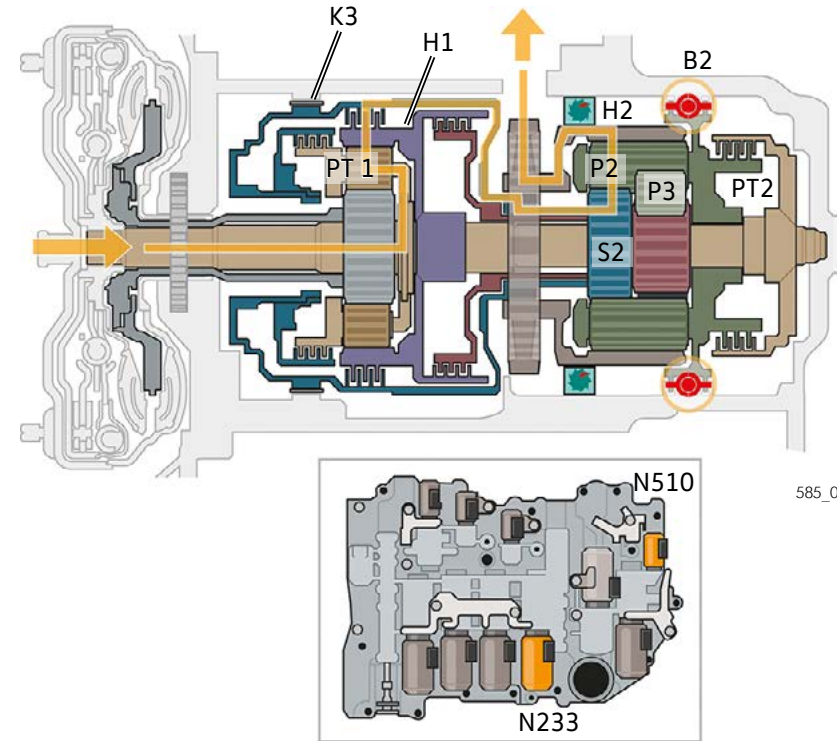
The turbine shaft drives the planetary gear carrier PT1 of the single planetary gear set. The planetary gear carrier PT1 drives the planetary gears P1, which roll around the fixed sun gear S1. The annulus H1 is driven.

Clutch K3 connects the annulus H1 to the sun gear S2, transferring the torque to the double planetary gear set.

In the double planetary gear set, brake B2 locks the planetary gear carrier PT2. From the sun gear S2, the torque is transferred to the planetary gears P2 and P3.

Supported by the planetary gear carrier PT2, the torque is transferred to the annulus H2, which is connected to the output shaft. Annulus H2 is driven against the direction of engine rotation.

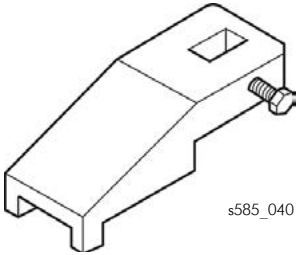
Reverse Gear



585_011

Service

Special Tools

Designation	Tool	Use
T10173 Setting gauge	 <p>s585_040</p>	To set the multifunction switch

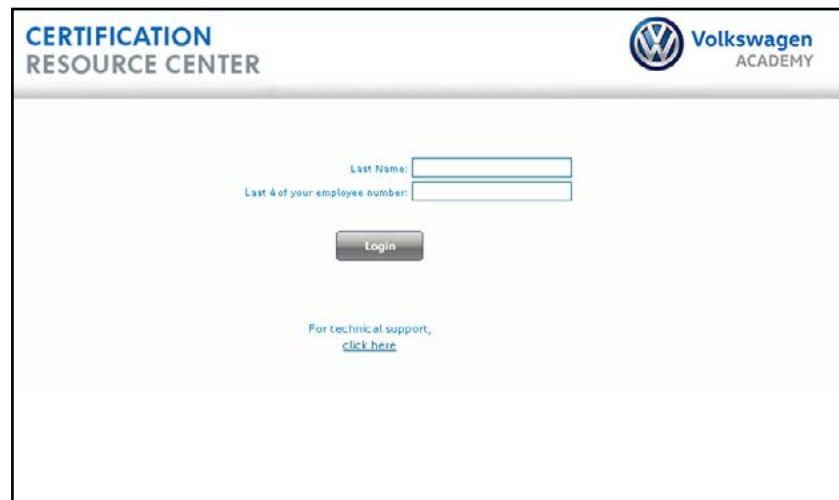
Knowledge Assessment

An on-line Knowledge Assessment (exam) is available for this Self-Study Program. The Knowledge Assessment may or may not be required for Certification.

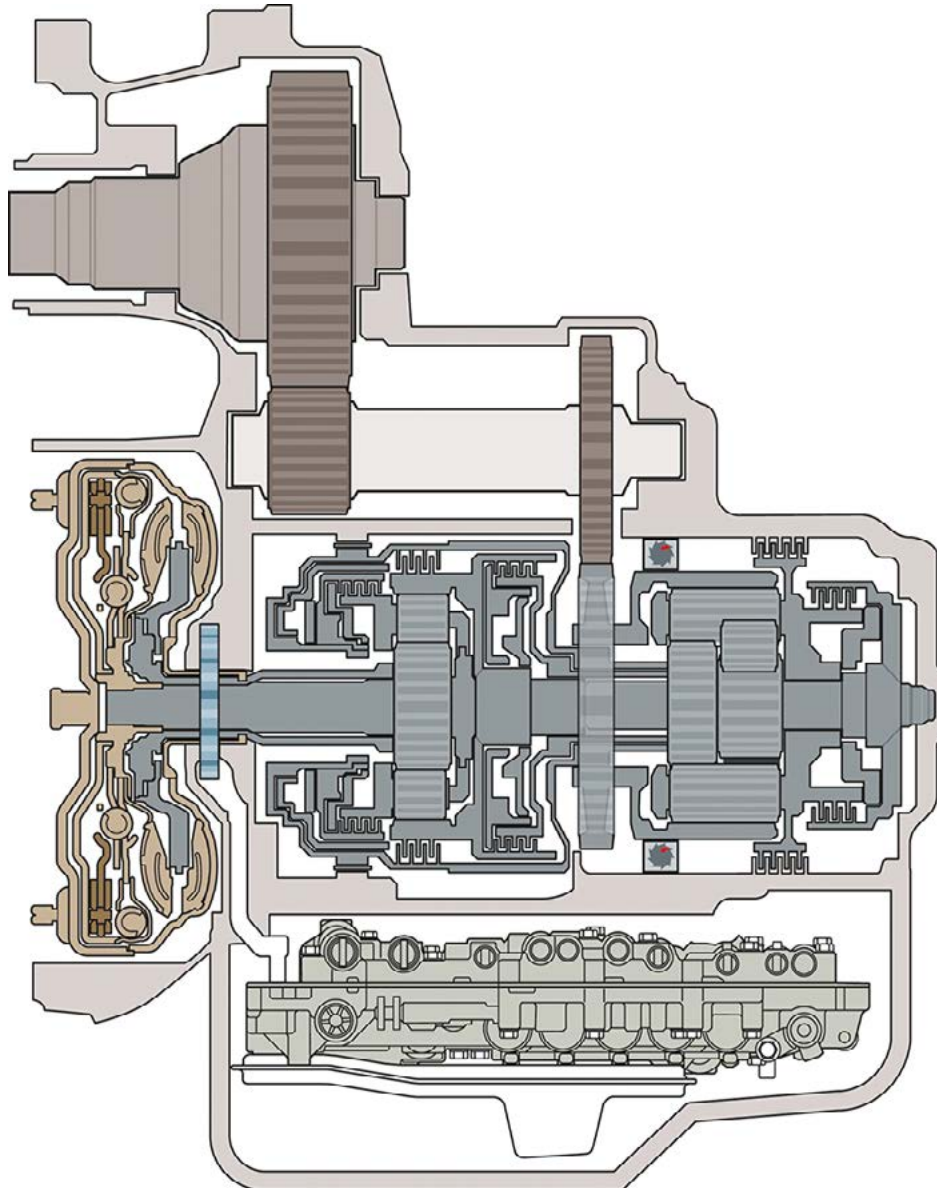
You can find this Knowledge Assessment at: **www.vwwebservice.com**

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**



The screenshot shows the login interface for the Volkswagen Academy Certification Resource Center. At the top left, the text "CERTIFICATION RESOURCE CENTER" is displayed. At the top right, the Volkswagen logo and "Volkswagen ACADEMY" are shown. The main area contains two input fields: "Last Name:" and "Last 4 of your employee number:". Below these fields is a "Login" button. At the bottom, there is a link for technical support: "For technical support, [click here](#)".



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2019

