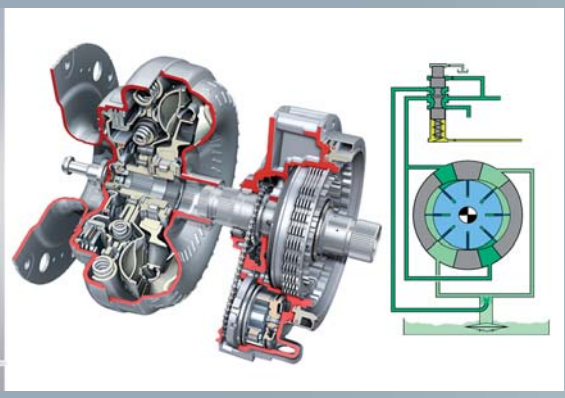
Self-Study Program 950103



The 2011 Audi A8 Power Transmission

Audi Academy

Audi of America, LLC
Service Training
Printed in U.S.A.
Printed 4/2010
Course Number 950103

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

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Table of Contents

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

The Self-Study Program is not a Repair Manual!
All values given are intended as a guideline only.
Refer to the software version valid at the time of publication of the SSP.

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

Reference

Note

2011 Audi A8 Power Transmissions at a Glance

quattro Drive

The Audi quattro permanent all-wheel drive system continues to give the Audi A8 a significant edge on the competition. It provides reliable traction, stability, and dynamic handling in all weather conditions.

The quattro mechanical center differential is at the heart of the drivetrain, distributing robust power to both axles depending upon the situation. With asymmetrical/dynamic standard distribution, 60% power flows to the rear differential and 40% to the front differential, delivering a sports car characteristic to the entire Audi A8 driving experience.

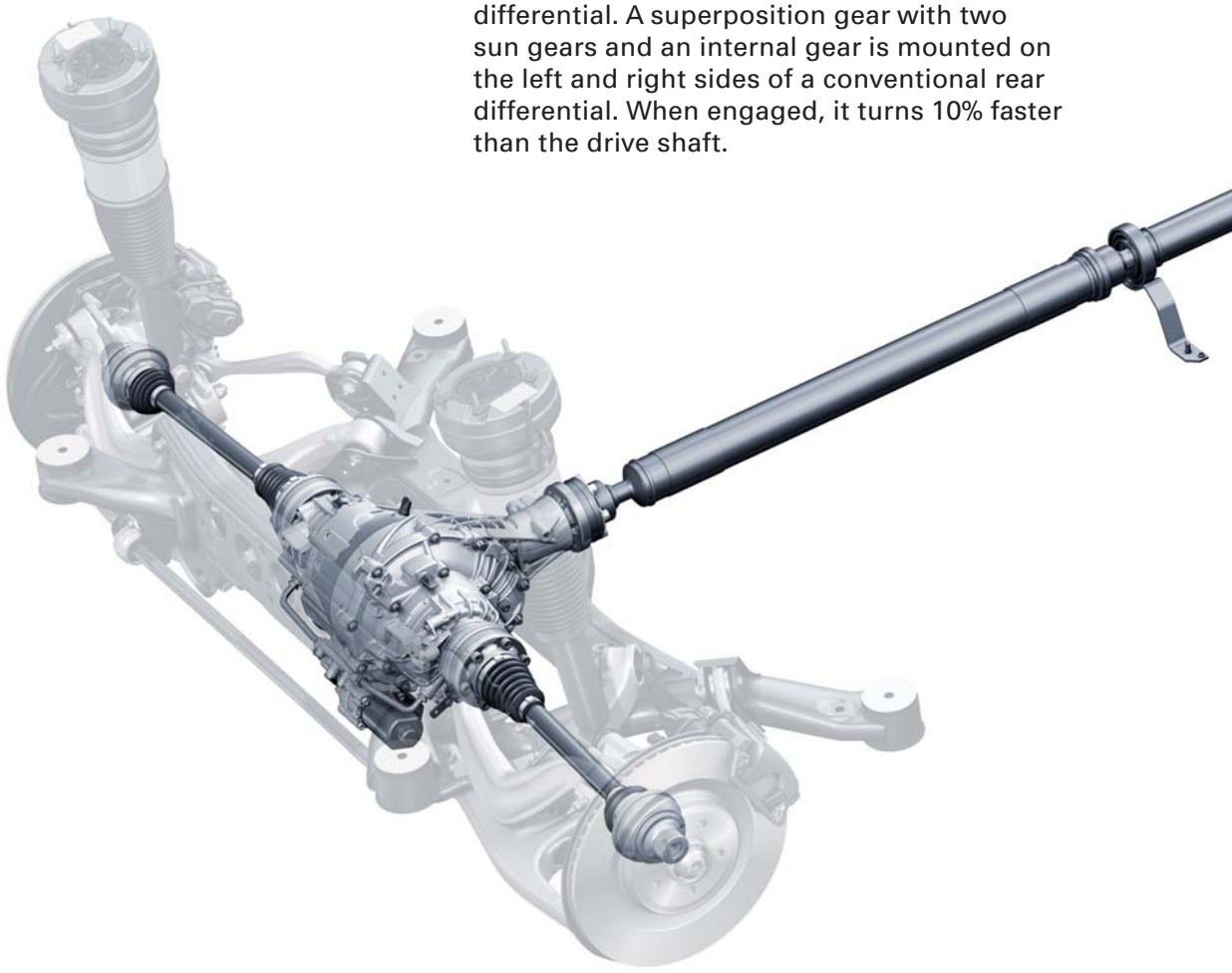
The mechanical center differential senses torque. Then it instantly and automatically transfers most of the engine power to the axle with the better traction. Up to 80% power can be directed to the rear wheels, and up to 60% to the front wheels.

The drive shaft is connected to the center differential by a lighter weight universal joint (also called a Cardan joint or U-joint). A clamped connection instead of a conventional flanged joint, this provides a weight savings of 2.87 lb (1.3 kilograms), while also delivering smoother torque and higher rigidity.

An auxiliary drive shaft runs from the front end of the center differential and along the right side of the eight-speed Tiptronic to the front differential. It is inclined slightly and features a very sophisticated system of teeth.

Rear Axle Drive

Two conventional rear differentials are offered on the 2011 Audi A8. The optional OBF sport differential is a high-performance rear differential. A superposition gear with two sun gears and an internal gear is mounted on the left and right sides of a conventional rear differential. When engaged, it turns 10% faster than the drive shaft.



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Eight-Speed Tiptronic Transmission

This eight-speed, torque converter-equipped transmission is a design based on the earlier six-speed transmissions designed by ZF. Its key strength lies in the high overall spread of 7.0:1 between the shortest and longest gear ratio. The Audi A8 has great acceleration from a standing stop, and because of its efficiency, has great fuel economy in the two highest gears.

Because the 2011 Audi A8 will initially be offered with only the 4.2L V8 FSI engine, the only transmission used will be the eight-speed OBK version. Another version, known as the OBL will become available as other engine options are made available in North America.

This Self-Study Program will only cover the design of the OBK transmission.

The OBK transmission features a new “shift by wire” control system which eliminates direct linkages to the transmission case.

The eight-speed transmission reduces fuel consumption by approximately 6% compared to the six-speed Tiptronic. Eight speeds keep the engine rpm surges between gears low, enabling the engine to always run at optimum efficiency. Gear changes are almost imperceptible to the driver. They are precise, fast, and very responsive.

The gears and shifting components of the eight-speed Tiptronic feature a new design. There are fewer parts, so the eight-speed Tiptronic is smaller than the six-speed version, requiring less installation space.

As in other recent Audi models, the front differential is installed in front of the torque converter. This moves the front axle far forward, enabling a longer wheelbase and better weight distribution.

Eight-Speed Automatic Transmission OBK

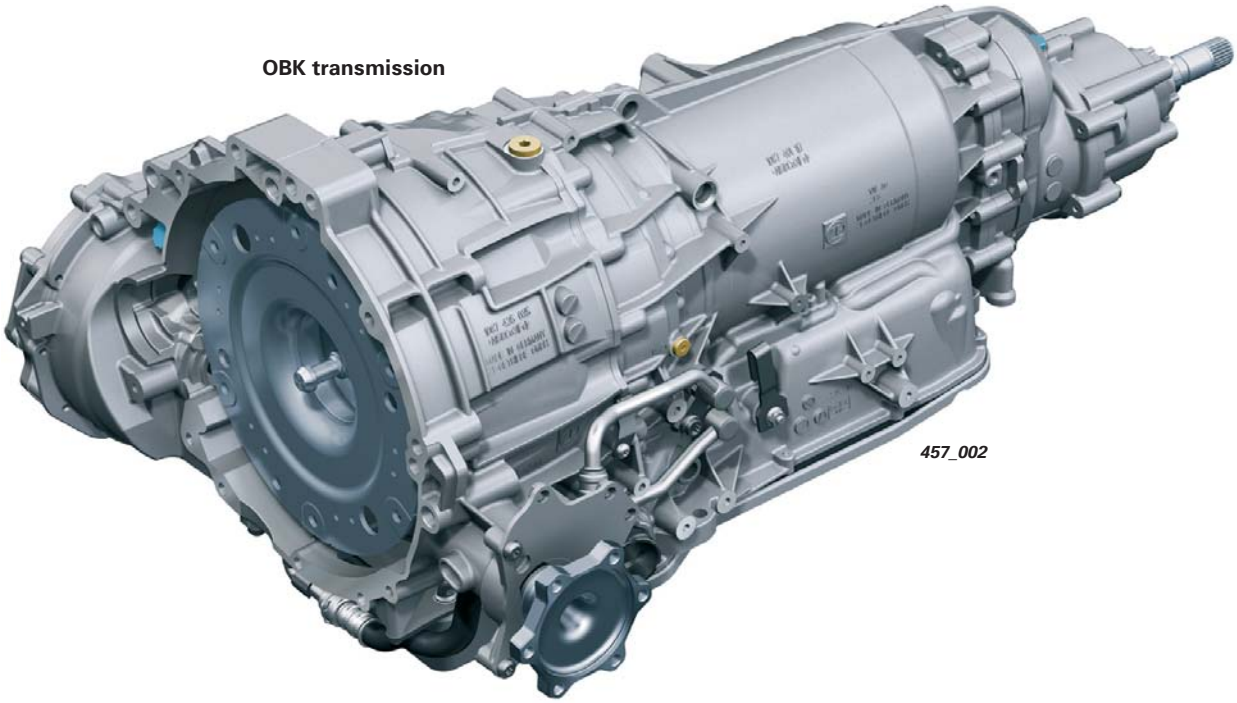
Overview

The OBK is Audi's first eight-speed multi-step automatic transmissions.

It features:

- Differential in front of the torque converter
- Eight forward gears and reverse are implemented using four planetary gearsets and five shift elements
- Minimized drag losses because three shift elements are closed in every gear
- Mechatronics "shift-by-wire" system with electro-hydraulic parking lock
- Eight gears with a ratio spread of 7.0:1, which enables short gear shifts, a powerful acceleration ratio, and high speed at low engine rpm
- ATF supply via a chain driven vane pump
- Lubrication of the transfer case by its own oil pump
- The transmission shifts into Neutral when the vehicle is stationary and the engine is idling (Neutral Idle Control [NIC])

OBK transmission



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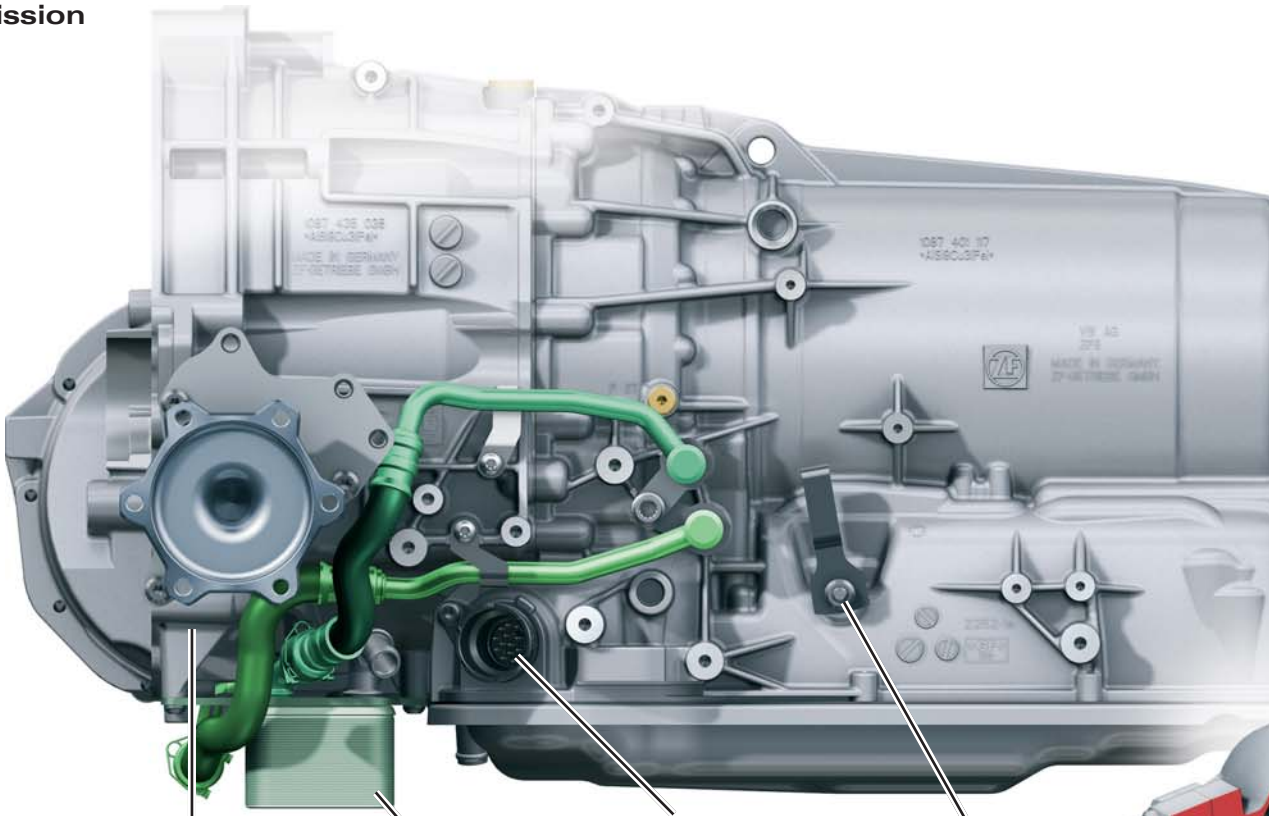
Specifications

	OBK Transmission
Service designation	OBK
ZF designation	8HP-55AF
Audi designation	AL551-8Q
Transmission type	Electro-hydraulically controlled 8-speed planetary transmission with a hydrodynamic torque converter and slip-controlled converter lockup clutch
Control	– Mechatronics (integration of the hydraulic control module and the electronic control system module) – Dynamic shift program with separate S tronic "Sport" program and "Tiptronic" shift program for manual gear shifting – Shift-by-wire shift control system with electro-hydraulic parking lock function
Transmission positioning	– Longitudinally-mounted transmission and all-wheel drive – Final drive/front axle in front of torque converter
Power distribution	Self-locking center differential with asymmetrical/dynamic torque split
Weight including oil	310.8 lb – 321.8 lb (141 kg – 146 kg)
Gear ratio	1st gear: 4.71, 2nd gear: 3.14, 3rd gear: 2.11, 4th gear: 1.67, 5th gear: 1.29, 6th gear: 1.00, 7th gear: 0.84, 8th gear: 0.67, Reverse: 3.32
Ratio spread	7.0:1
Maximum torque	516.2 lb ft (700 Nm)

Special Features

OBK Transmission

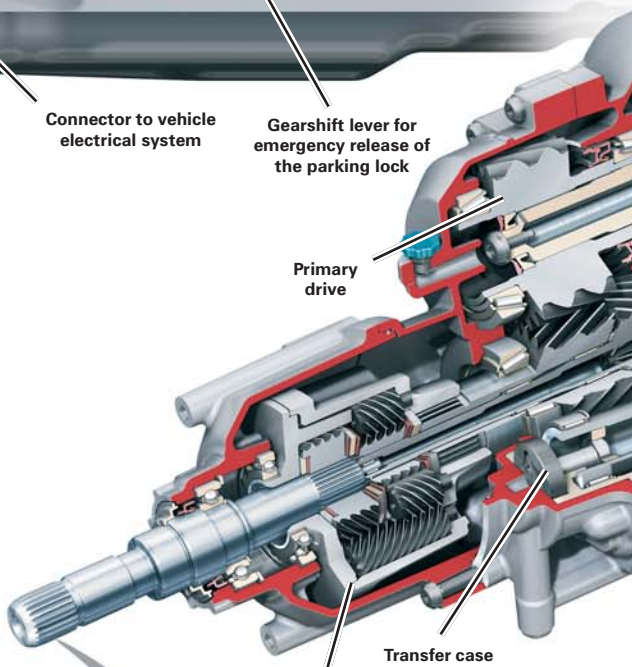


ATF cooler (heat exchanger) mounted on transmission

Connector to vehicle electrical system

Gearshift lever for emergency release of the parking lock

The rating plate is located below the flange shaft (visible from below)



Primary drive

Transfer case oil pump

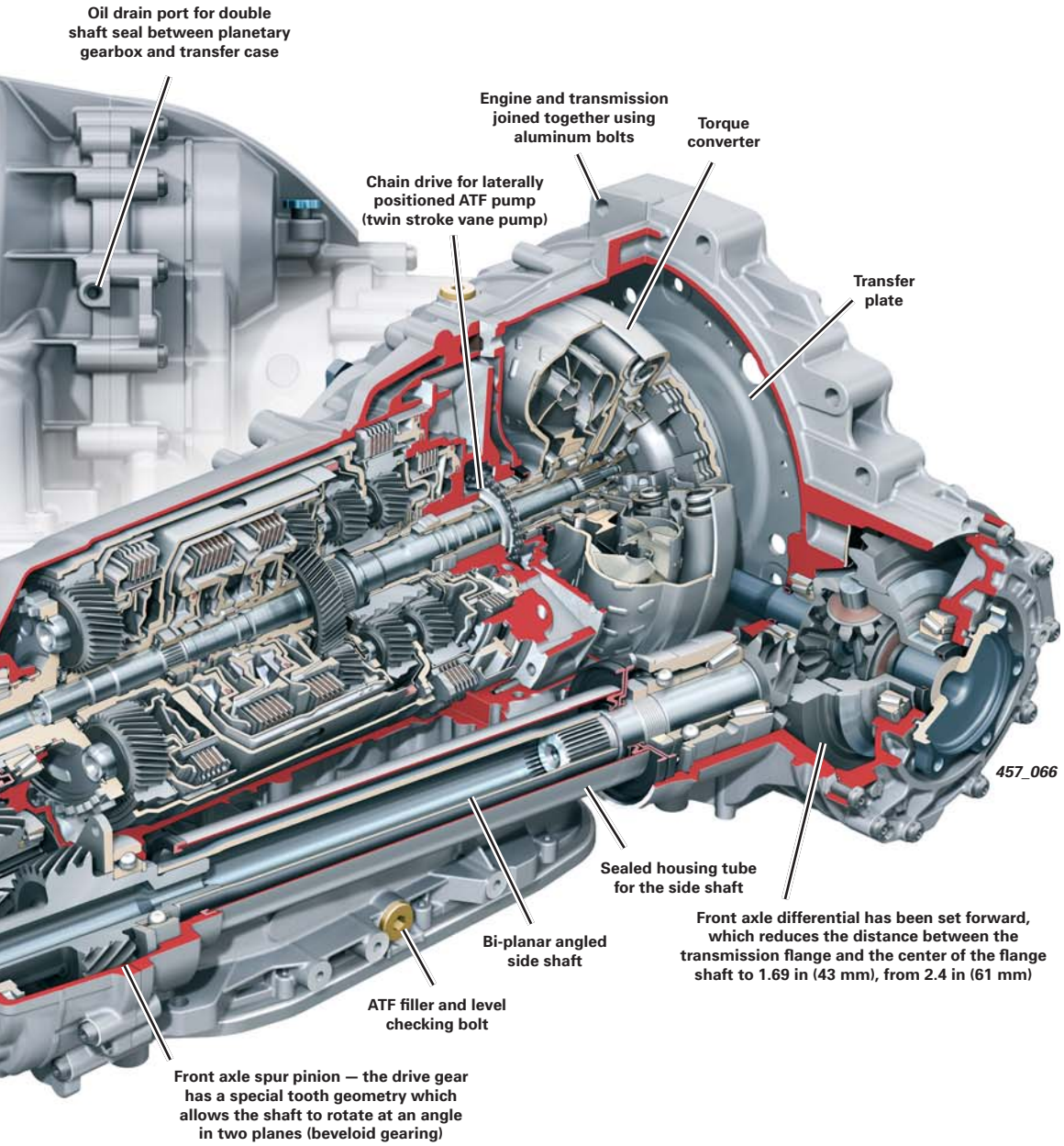
Center differential

Spring sleeve

Splined propeller shaft

Clamp

The joint is an integral part of the propeller shaft and cannot be replaced separately. The rubber sleeve can be replaced using a special tool.



Splined Propeller Shaft

An innovative new propeller shaft coupling is used. A splined propeller shaft is mated to the transmission output shaft and locked into the slot by a spring sleeve. The connection is axially secured by a clamp. The new connection system provides a weight savings of 1.3 lb (0.6 kg). This system will be phased in for all Audi transmissions in the future.

Center Differential

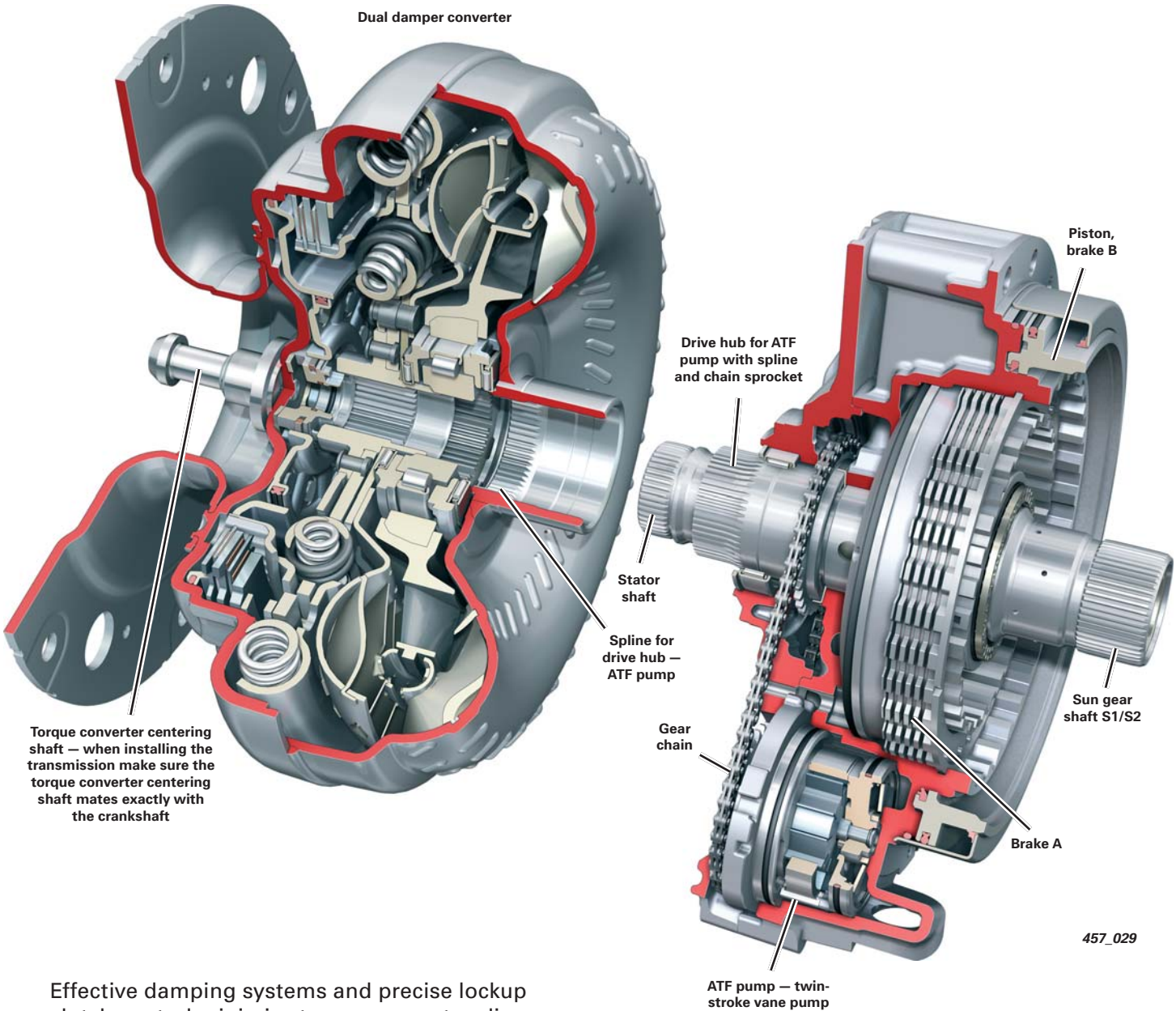
The self-locking center differential with asymmetrical/dynamic torque split is used in the OBK transmission. It is similar in design and function to the center differential in the OB2 and OB5 transmissions. A new innovation is the intelligent torque distribution design.

Torque Converter

The parameters (dimensions and torque conversion factor) of the torque converter and the lockup clutch are adapted for each engine. To effectively dampen the torsional vibration of the engine, various torsion damper systems are used depending on engine version.

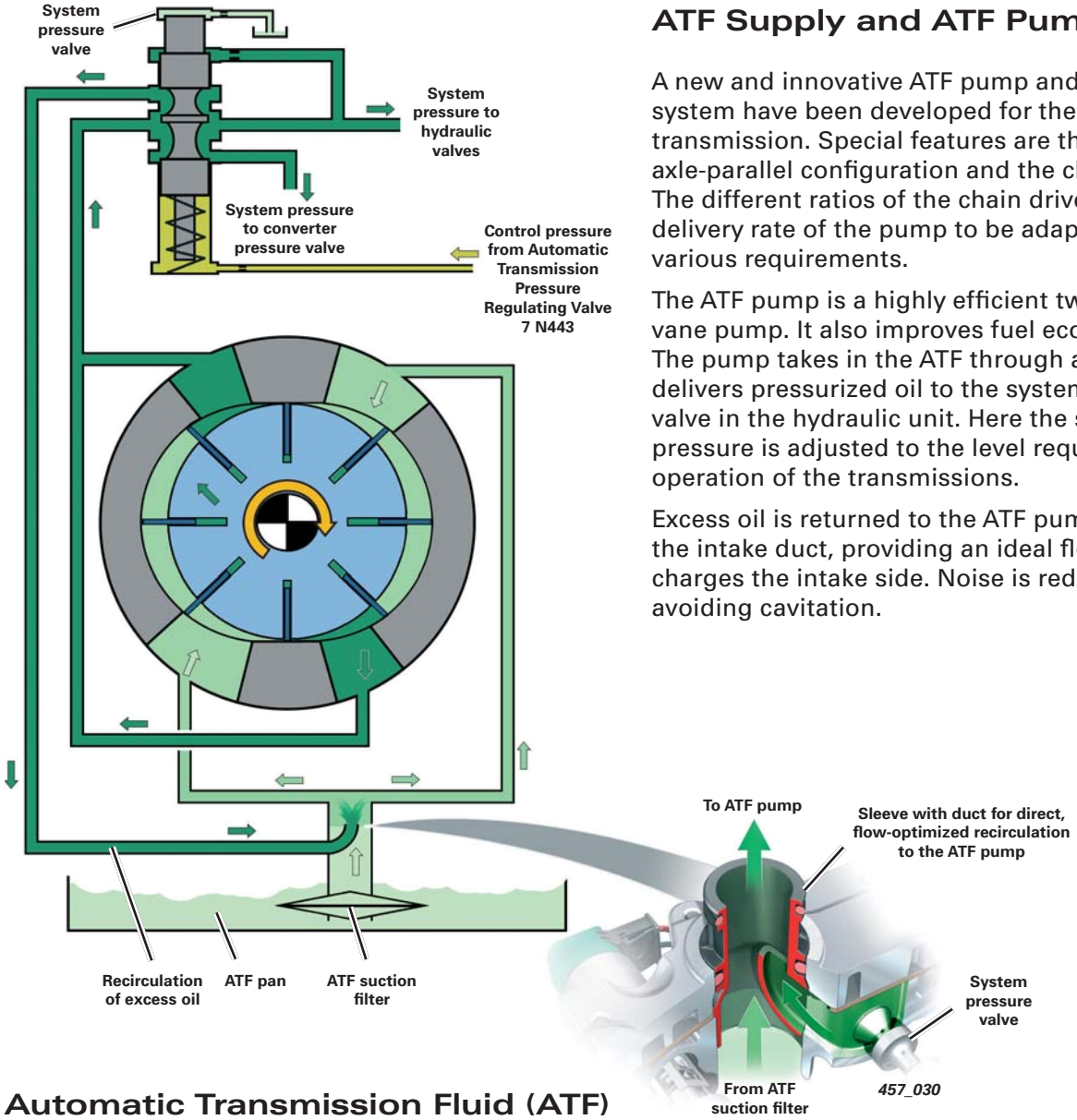
The torque converter of the transmission is configured as a “three line converter”, offering more control over the lockup clutch. The turbine chamber is supplied by two lines and the lockup clutch is activated by a separate third line. The lockup clutch closes and opens independently of and separately from the turbine chamber.

The pressure of the lockup clutch is controlled by Automatic Transmission Pressure Regulating Valve 6 and related hydraulic valves.



Effective damping systems and precise lockup clutch control minimize torque converter slip from first gear upward. A direct and dynamic feel is achieved without adverse acoustic effects.

The neutral idle control also minimizes converter torque loss when the engine is idling and the vehicle is stationary.



ATF Supply and ATF Pump

A new and innovative ATF pump and ATF supply system have been developed for the eight-speed transmission. Special features are the lateral, axle-parallel configuration and the chain drive. The different ratios of the chain drive allow the delivery rate of the pump to be adapted to meet various requirements.

The ATF pump is a highly efficient twin-stroke vane pump. It also improves fuel economy. The pump takes in the ATF through a filter and delivers pressurized oil to the system pressure valve in the hydraulic unit. Here the system pressure is adjusted to the level required for operation of the transmissions.

Excess oil is returned to the ATF pump through the intake duct, providing an ideal flow that also charges the intake side. Noise is reduced by avoiding cavitation.

Automatic Transmission Fluid (ATF)

The availability of a new ATF has made the innovations of this transmission possible. Always make sure that the correct ATF is used.

The ATF pump is installed in the transmission as an “oil supply” assembly, which includes the following components:

- Pump housing
- ATF pump drive hub
- ATF pump chain drive
- ATF pump
- Housing of brake A
- Brake A
- Piston and piston chambers of brake B
- Stator shaft (fixed)

A new feature of this transmission is that power is transmitted from the torque converter housing to the ATF pump drive hub through a spline. Care must be taken to ensure that the converter and drive hub are correctly mated when installing the converter.

Note

When installing the converter, it is important to pay attention to installation dimensions and tolerances.

Planetary Gearbox

The eight forward gears and reverse gear are generated by a combination of four simple single-carrier planetary gearsets. The front two gearsets share a common sun gear. Power output is through the planetary carrier of the fourth gearset.

Shift Elements

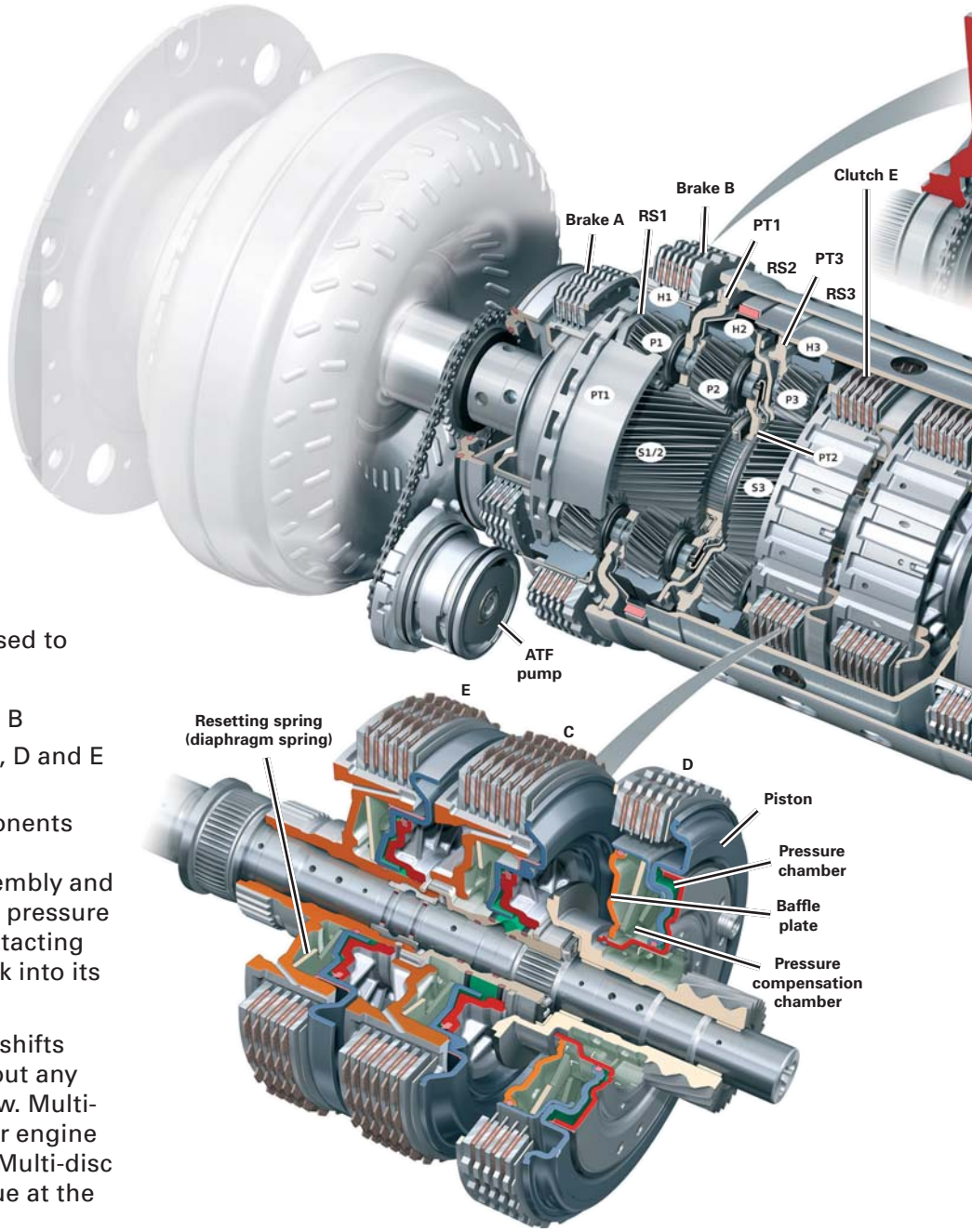
Only five shift components are used to shift eight gears:

– Two multi-disc brakes — A and B
– Three multi-plate clutches — C, D and E

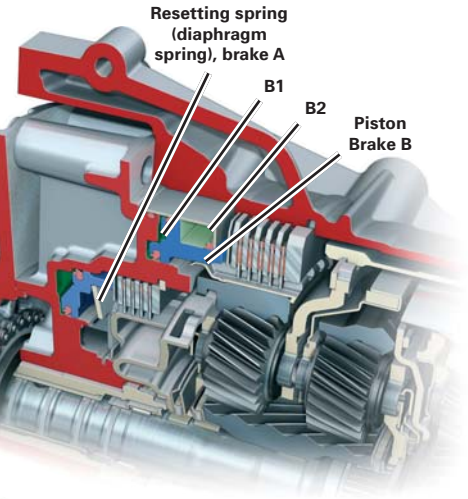
The clutch and brake shift components close hydraulically. Oil pressure compresses the clutch plate assembly and engages the clutch. When the oil pressure drops, the diaphragm spring contacting the piston pushes the piston back into its original position.

The shift components allow gearshifts to be made under load and without any interruption in tractive power flow. Multi-plate clutches C, D, and E transfer engine power to the planetary gearbox. Multi-disc brakes A and B multiply the torque at the gear case.

When each individual gear is engaged, three shift components are closed and two shift elements are open. This has a very positive effect on transmission efficiency, since each open shift component produces drag torque when operating.



To illustrate the shift elements and the planetary gearsets more clearly, several parts are not shown (for example, the outer plate carriers of the shift elements)



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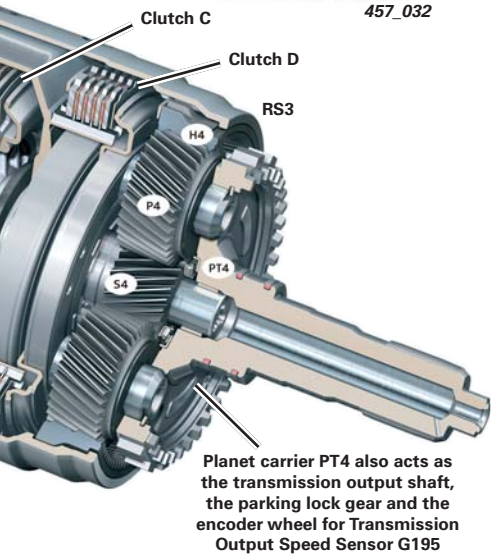


Brakes

Brake B has a special design. The piston of brake B does not have a resetting spring. This task is performed by a second piston chamber, piston chamber B2. Brake B has a piston chamber (cylinder) on both sides, piston chamber B1 and piston chamber B2.

Piston chamber B1 is for closing the brake and piston chamber B2 functions as a resetting spring (opening the brake). When brake B is vented, a certain amount of oil pressure is retained inside piston chamber B2, to push the piston back into its rest position.

Brake B is operated via a slip in neutral idle operating mode, and is specially rated for continuous duty in this mode. It is also cooled in a controlled fashion when activated by the hydraulic unit.

A resetting spring is installed on Brake A.

Planetary Gearbox Legend	
RS1 (2, 3, 4)	Planetary gearset 1 (2, 3, 4)
PT1 (2, 3, 4)	Planet carrier 1 (2, 3, 4)
S1 (2, 3, 4)	Sun gear of planetary gearset 1 (2, 3, 4)
P1 (2, 3, 4)	Planetary gears of planetary gearset 1 (2, 3, 4)
H1 (2, 3, 4)	Ring gear of planetary gearset 1 (2, 3, 4)

Clutches

Clutches E, C, and D are dynamically pressure-equalized. This means that the clutch piston is swept by oil on both sides to avoid any speed-related increase in clutch pressure. This pressure-equalizing effect is achieved by using a second piston chamber, a pressure equalization chamber.

For clutch D, the pressure equalization chamber is created by a baffle plate. For clutches C and E, the clutch plate carrier acts as a barrier. Non-pressurized oil is supplied to the pressure equalization chamber through lubrication ducts.

Advantages of dynamic pressure equalization are:

- Reliable opening and closing of the clutch at all engine speeds
- Greater ease of shifting

Shift Schematic and Shift Matrix

All gearshifts from one to eight and from eight to one are “overlap shifts”. This means that during a gearshift, one clutch must remain capable of transmitting torque at reduced main pressure until the other clutch is ready to accept the torque.

In gearshifts which are not (or cannot be) performed directly (for example, seven to three), the longer gear shifts (direct shifts) always take priority over the individual downshifts (see examples below).

Shift Schematic (possible direct shifts)

Notes on the examples:

The shift schematic shows the technically possible shifts.

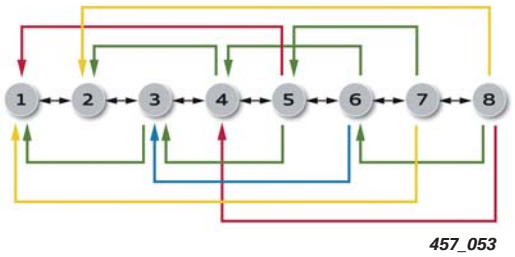
Yellow — 6 gear change (direct shift)

Red — 4 gear change (direct shift)

Blue — 3 gear change (direct shift)

Green — 2 gear change (direct shift)

In examples 1 and 2, the variations currently not in use are highlighted in gray.



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Example 1: gear shift from 8 > 2:
- 8-7-6-5-4-3-2
- 8-6-5-4-3-2
- 8-4-3-2
- 8-4-2
- 8-2

Example 2: gear shift from 7 > 3:
- 7-6-5-4-3
- 7-5-4-3
- 7-6-3
- 7-5-3

Example 3: gear shift from 6 > 3:
- 6-5-4-3
- 6-4-3
- 6-3

Shift Matrix

	Shift Elements/Pressure Regulating Valves/Solenoid Valves							
	A EPC-A N215	B EPC-B N216	C EPC-C N217	D EPC-D N218	E EPC-E N233	SV-Pos N510	EPC-Sys N433	EPC-LC N371
Parking lock	1	1	1	0	0	0	X	0
Neutral	1	1	1	0	0	1	X	0
Reverse gear	1	1	1	1	0	1	X	0
1st gear	1	1[1)]	0	0	0	1	X	X
2nd gear	1	1	1	0	1	1	X	X
3rd gear	0	1	0	0	1	1	X	X
4th gear	0	1	1	1	1	1	X	X
5th gear	0	1	0	1	0	1	X	X
6th gear	0	0	0	1	1	1	X	X
7th gear	1	0	0	1	0	1	X	X
8th gear	1	0	1	1	1	1	X	X

457_054

Clutch closed

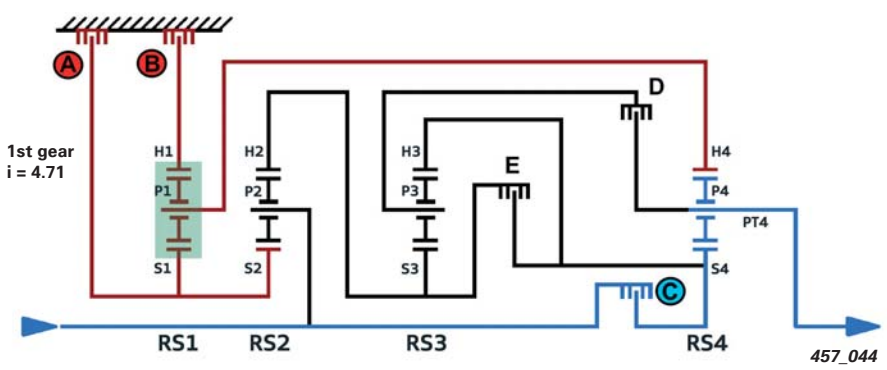
Brake closed

Pressure Regulating Valves/ Solenoid Valve

1	Active
0	Not active (a low basic control current is always present)
X	Active — control current is dependent on operating state
EPC	Electric pressure control valve (pressure regulating valve)
SV	Solenoid valve

Planetary Gearbox Legend	
RS1 (2, 3, 4)	Planetary gearset 1 (2, 3, 4)
PT1 (2, 3, 4)	Planet carrier 1 (2, 3, 4)
S1 (2, 3, 4)	Sun gear of planetary gearset 1 (2, 3, 4)
P1 (2, 3, 4)	Planetary gears of planetary gearset 1 (2, 3, 4)
H1 (2, 3, 4)	Ring gear of planetary gearset 1 (2, 3, 4)

Description of Power Flow — Torque Characteristic Schematics



Torque characteristic/ power flow

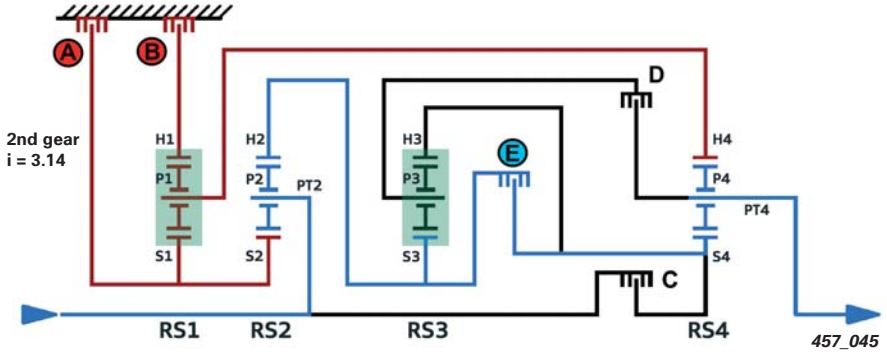
Stationary parts (blocked by foot brake)

Co-rotating parts not contributing to power flow

Planetary gearset in blocking mode or blocked

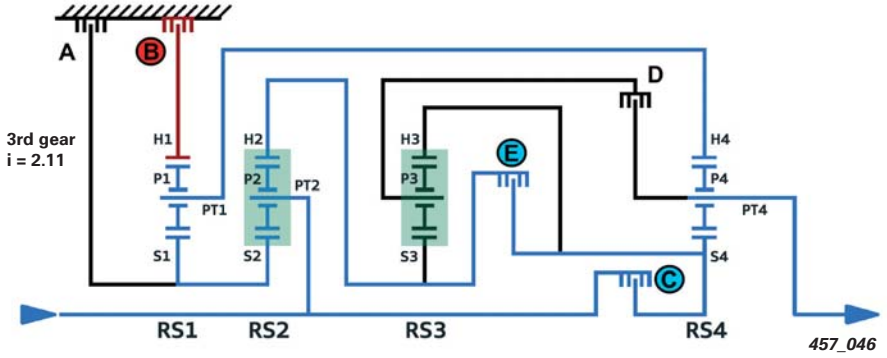
Power Flow in 1st Gear — Activated Shift Elements: A, B, C

Turbine shaft > clutch C > S4 > P4 > PT4 (> output shaft > transfer case ...)



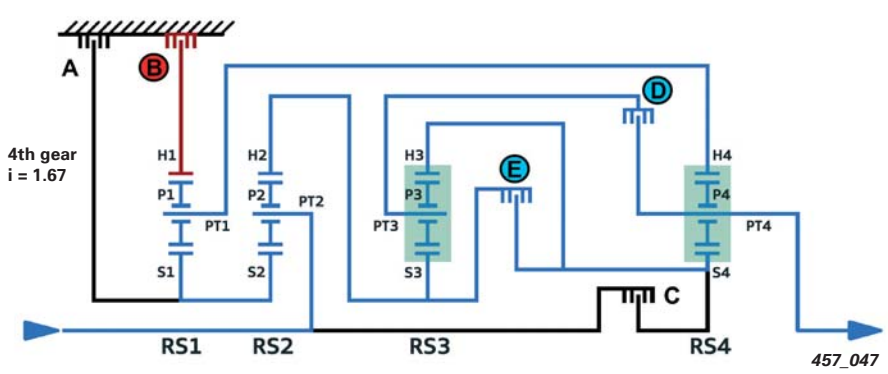
Power Flow in 2nd Gear — Activated Shift Elements: A, B, E

Turbine shaft > PT2 > P2 > H2 > clutch E > S4 > P4 > PT4 (> output shaft > transfer case ...)



Power Flow in 3rd Gear — Activated Shift Elements: B, E, C

1. Turbine shaft > clutch C > S4 > P4 > PT4 (> output shaft > transfer case ...)
2. Clutch C > clutch E > H2 > P2 (RS2 blocks power transmission, because H2 and PT2 are connected through clutches C and E)
3. Turbine shaft > PT2 > S2 (PT2 in blocking mode) > S1 > P1 > PT1 > H4 The connection between PT1 and H4 produces a corresponding ratio in RS4 (compare to power flow in first gear)



Torque characteristic/ power flow

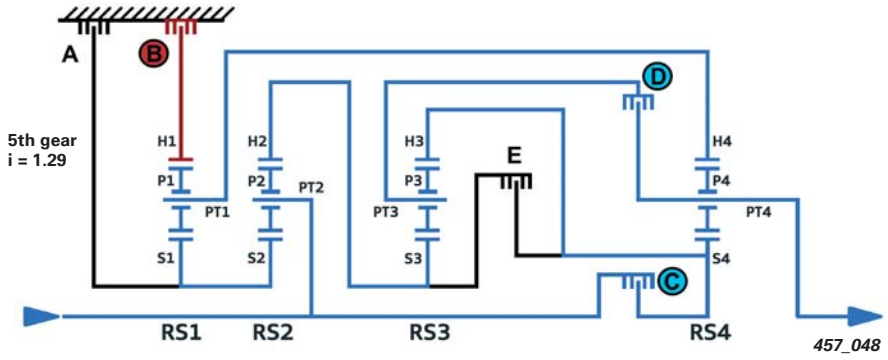
Stationary parts (blocked by foot brake)

Co-rotating parts not contributing to power flow

Planetary gearset in blocking mode or blocked

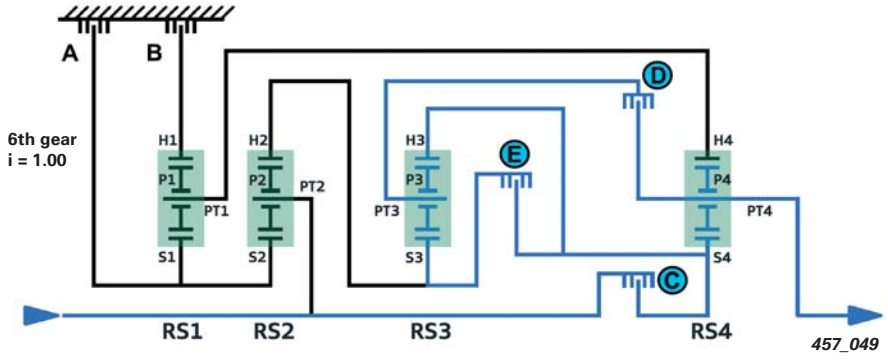
Power Flow in 4th Gear — Activated Shift Elements: B, E, D

1. Clutch E blocks power transmission in RS3, and clutch D and the blocking mode of RS3 block power transmission in RS4 (gearsets 3 and 4 rotate at the same speed = output speed)
2. Turbine shaft > PT2 > P2 > S2/S1 > P1 > PT1 > H4 > P4 > PT4 (= output shaft > transfer case ...)



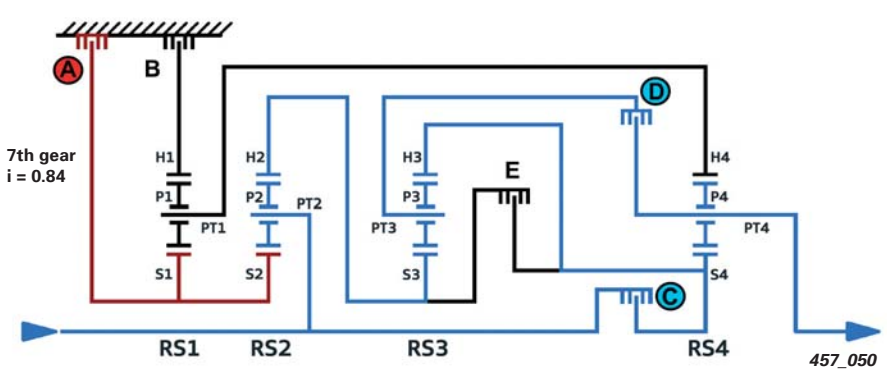
Power Flow in 5th Gear — Activated Shift Elements: B, C, D

1. Turbine shaft > clutch C > S4 + H3 (PT2, H2 and S4 = turbine speed)
2. Clutch D connects PT3 to PT4 (= output shaft)
3. Turbine shaft > PT2 > P2 > S2/S1 > P1 > PT1 > H4 > results in a speed ratio between S4 (=turbine speed) and H4 with corresponding speed at PT4 (= output shaft > transfer case ...)



Power Flow in 6th Gear — Activated Shift Elements: C, D, E

Clutches E and D block power transmission in RS3 and RS4.
Torque is transmitted to the planetary gearbox through clutch C.
The complete planetary gearbox rotates at turbine speed (blocking mode).



Torque characteristic/ power flow

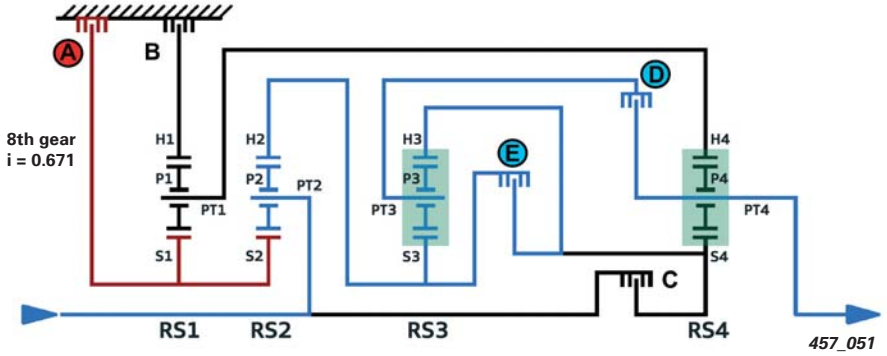
Stationary parts (blocked by foot brake)

Co-rotating parts not contributing to power flow

Planetary gearset in blocking mode or blocked

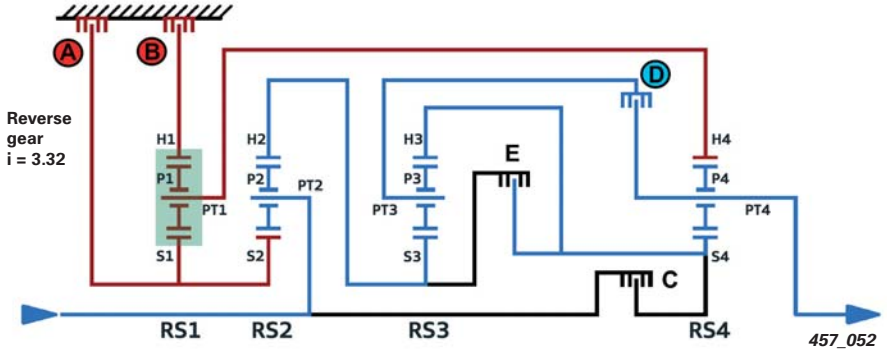
Power Flow in 7th Gear — Activated Shift Elements: A, C, D

1. Turbine shaft > clutch C > S4 + H3 (= turbine speed)
2. Turbine shaft > PT2 > P2 > H2 > S3 > P3 > PT3 > clutch D > PT4 (= output shaft > transfer case ...}
   Clutch D connects PT3 to PT4 (= output shaft))



Power Flow in 8th Gear — Activated Shift Elements: A, E, D

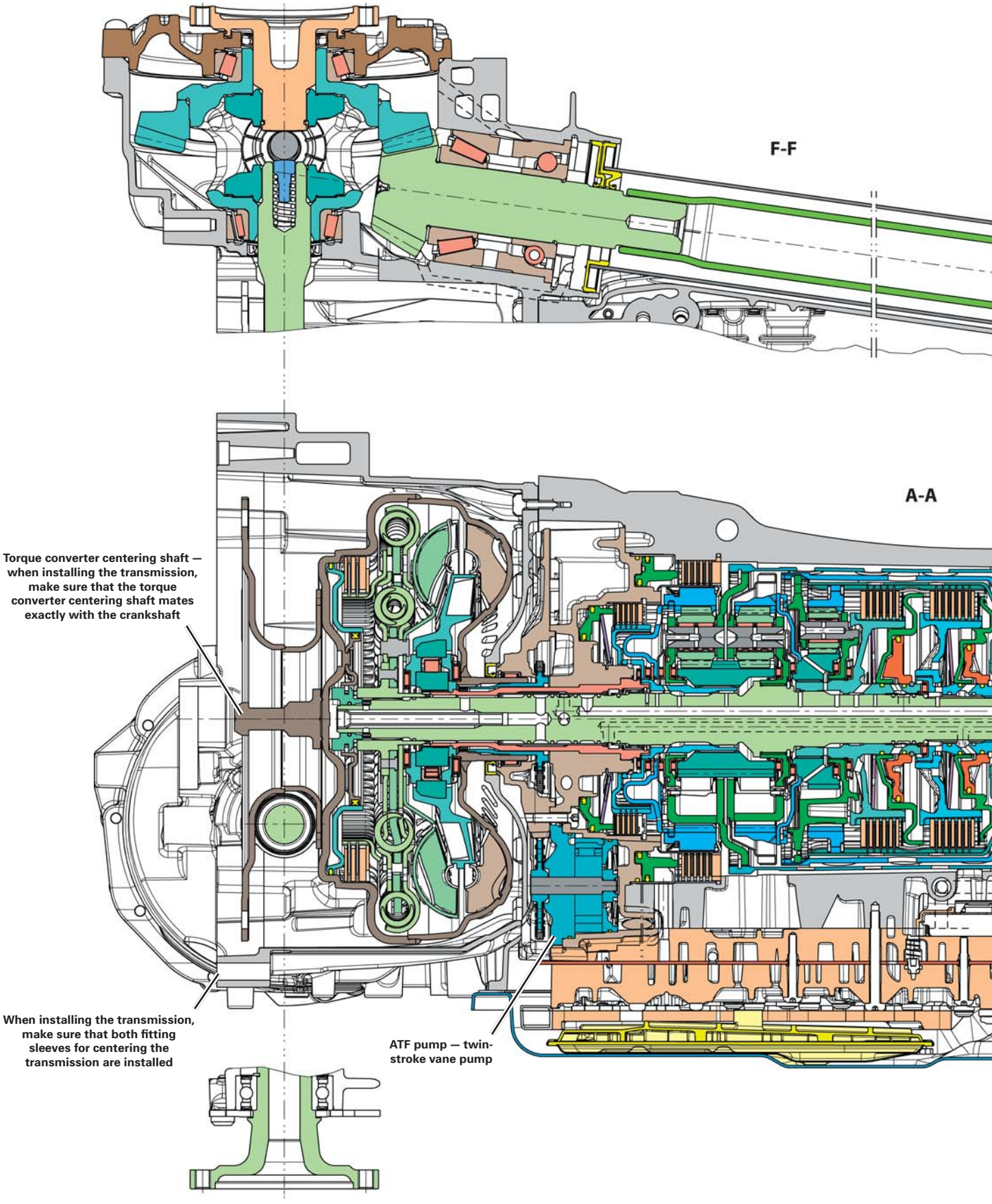
1. Clutch E blocks power transmission in RS3
2. Turbine shaft > PT2 > P2 > H2 > RS3 (blocking mode) > clutch D > PT4 (= output shaft > transfer case ...)
   Clutch D connects PT3 to PT4 (= output shaft)

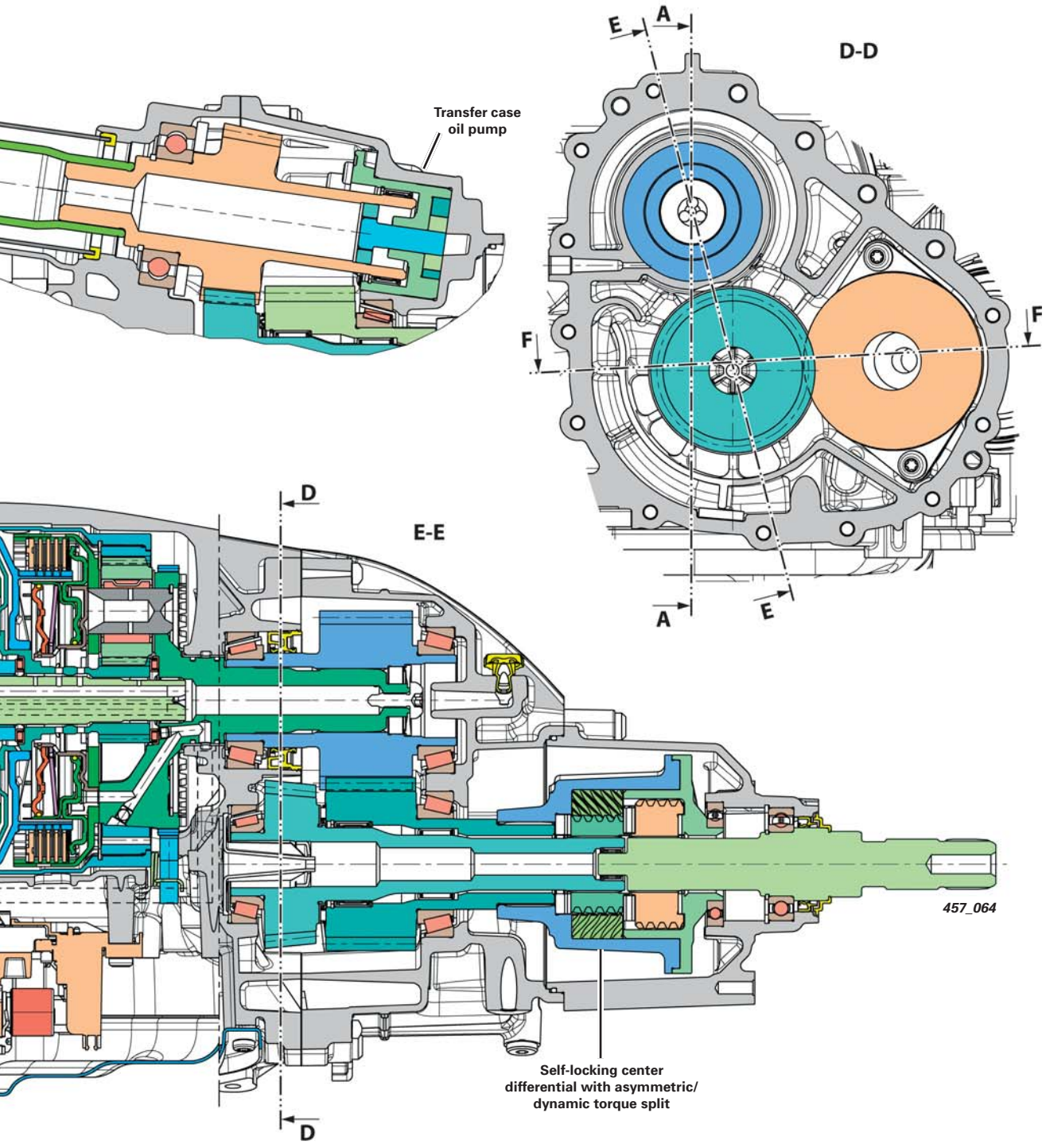


Power Flow in Reverse Gear — Activated Shift Elements: A, B, D

1. Clutch D connects PT3 to PT4 (= output shaft)
2. Turbine shaft > PT2 > P2 > H2 > S3 > P3 > PT3 > clutch D > PT4 (= output shaft > transfer case ...)
   H3 is permanently connected to S4. S4 drives P4 in the opposite direction of rotation to that of the engine. Gears P4 roll against fixed gear H4 and rotate PT4 in the opposite direction of rotation to that of the engine and at the specified ratio.

Sectional View of OBK Transmission




Transfer case
oil pump
D-D
E
A
F
F
A
E
E-E
D
D
457_064
Self-locking center
differential with asymmetric/
dynamic torque split

Oil Systems, Lubrication, and Sealing of the OBK Transmission

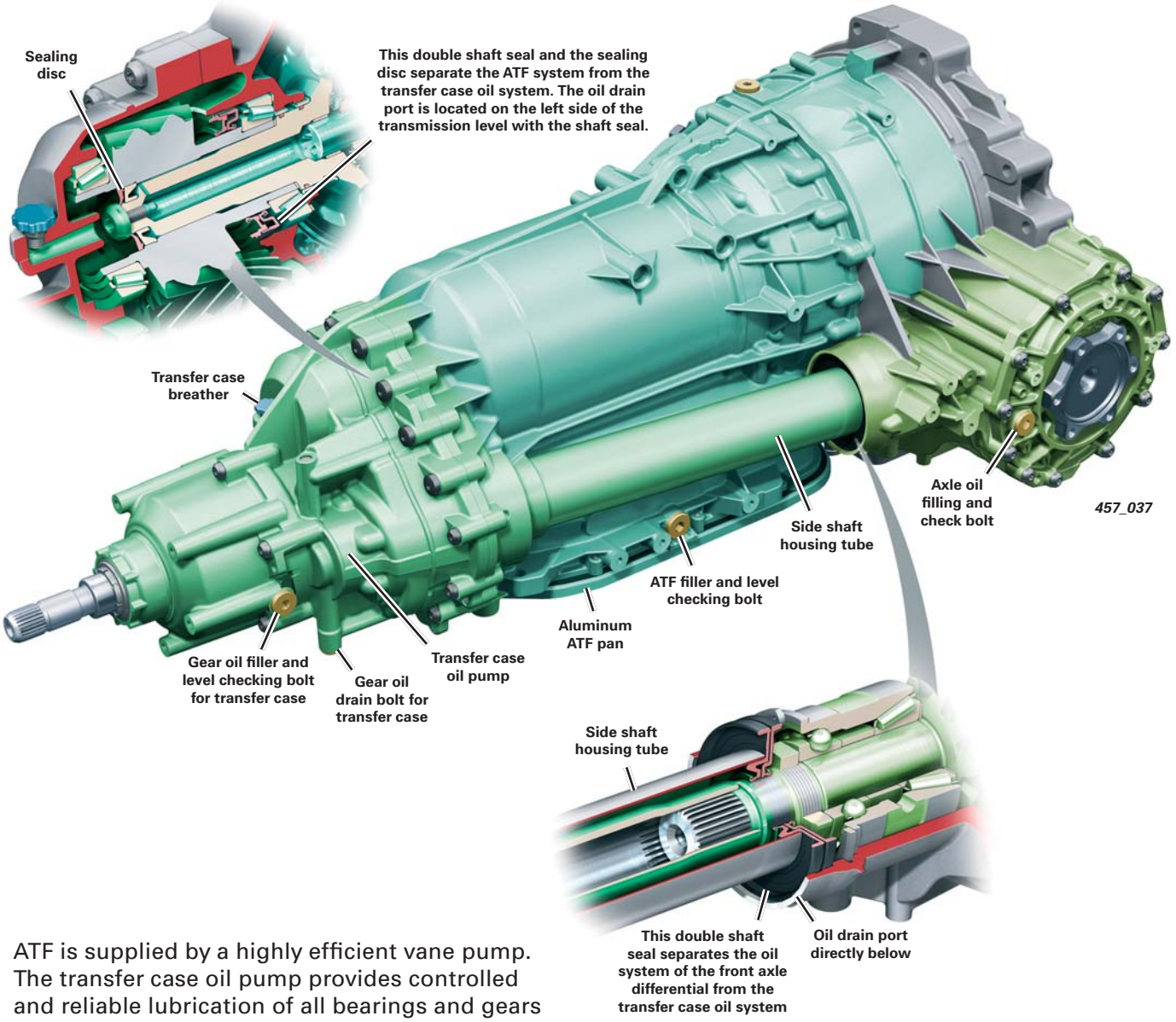
The OBK transmission has three separate oil chambers filled with three different oil types. The planetary gearbox is filled with ATF, the transfer case is filled with gear oil with Sturaco, and the front axle drive is filled with non-Sturaco gear oil. The transfer case oil chamber, and the front differential chamber are separate and not connected.

Sturaco is a thick oil additive which reduces excessive stresses in the center differential, which in turn enhances ride comfort. Always check with the Parts Department for the proper lubricants when doing repairs.

ATF oil system for the planetary gearbox, the hydraulic control module, and the torque converter

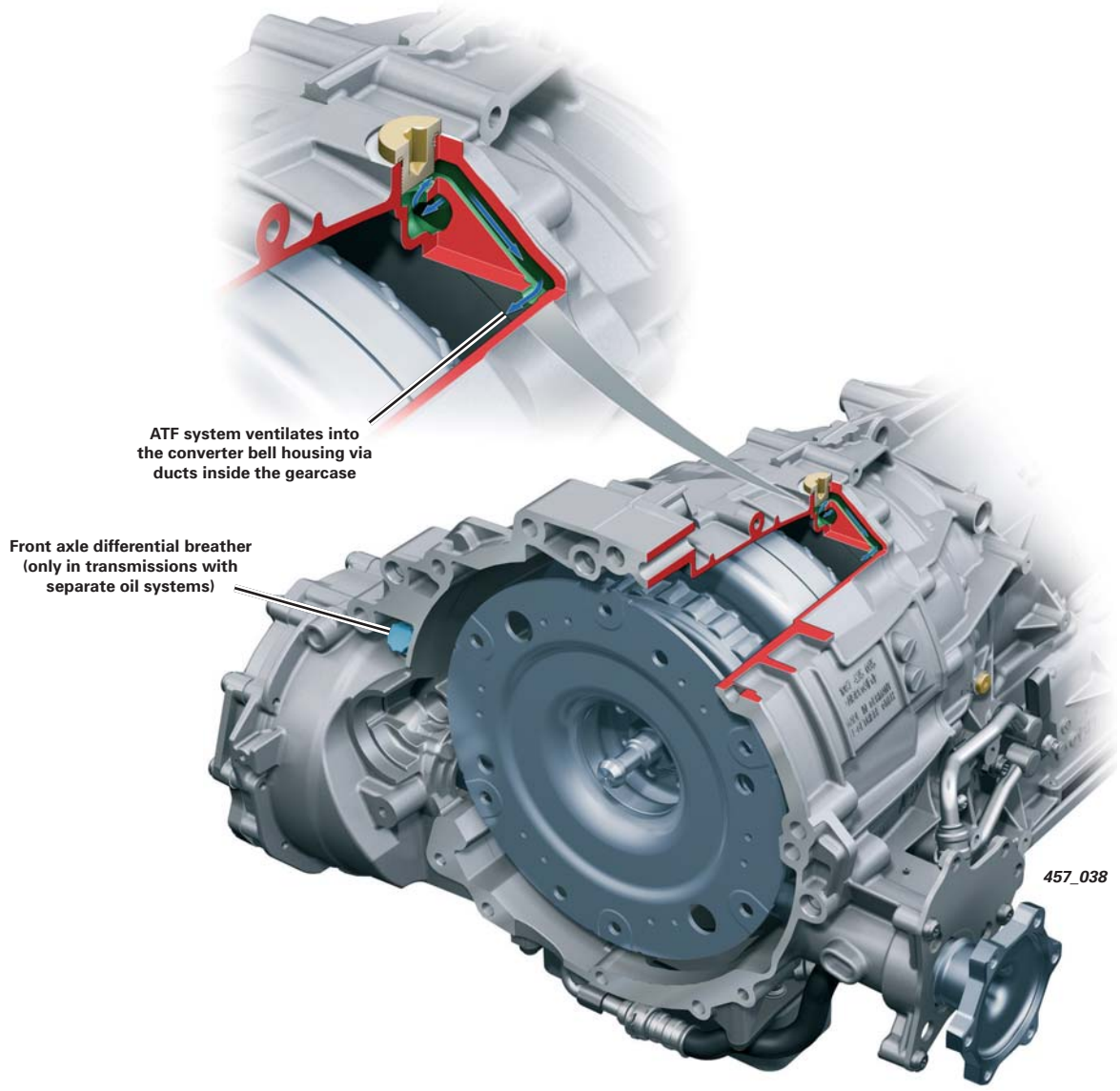
Oil system for the transfer case (gear oil with Sturaco)

Oil system for the front axle drive (gear oil without Sturaco)



ATF is supplied by a highly efficient vane pump. The transfer case oil pump provides controlled and reliable lubrication of all bearings and gears in the transfer case. This design provides highly efficient lubrication with a minimal oil level. Churning losses are also significantly reduced and foaming of the oil is minimized.

This oil system differs only slightly from the system first introduced in the O9E transmission.


ATF system ventilates into the converter bell housing via ducts inside the gearcase
Front axle differential breather (only in transmissions with separate oil systems)
457_038

Innovative Thermal Management (ITM)

The gearbox cooling system is part of the Innovative Thermal Management System (ITM). This system improves fuel economy by shortening the warm-up phase of the engine and transmission.

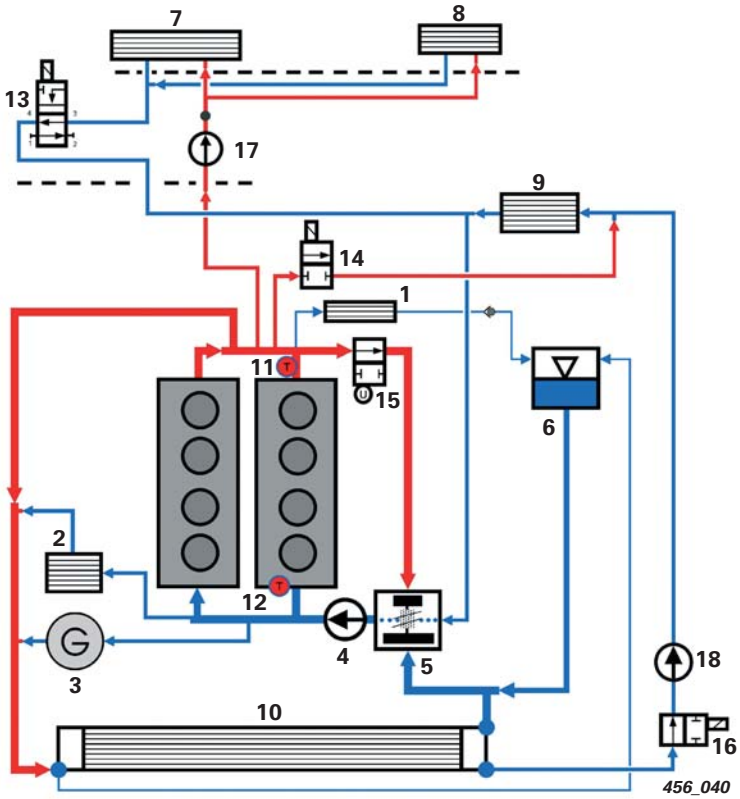
"Heat Management", a newly developed software module in the engine control module (ECM), provides optimal distribution of heat generated by the engine within the engine cooling circuits (engine heating) to the air conditioning system (interior heating) and to the transmission (transmission heating).

The air conditioner and transmission control modules indicate their heating requirements to the ECM via the CAN bus. This information, together with engine heating requirements, is then evaluated, prioritized, and used to generate activation signals for the ITM components (valves and controls).

The function and design of the transmission heating and cooling system are discussed here in combination with the 4.2L V8 FSI engine. Other engine combinations differ from one another.

Transmission Heating and Cooling – V8 FSI Engine

Function diagram — coolant system of Audi A8 with 4.2L V8 FSI engine and OBK transmission



Legend:

1 Crankcase breather heater
2 Heat exchanger for engine oil cooling
3 Alternator
4 Coolant pump
5 Map Controlled Engine Cooling Thermostat F265
6 Coolant expansion tank
7 Heater heat exchanger
8 Heater heat exchanger, rear
9 ATF heat exchanger
10 Radiator
11 (T) Engine Coolant Temperature Sensor G62
12 (T) Engine Temperature Control Temperature Sensor G694
13 Coolant Shut-off Valve N82
14 Transmission Coolant Valve N488
15 (U) Cylinder Head Coolant Valve N489 (vacuum operated)
16 Transmission Fluid Cooling Valve N509
17 Coolant Recirculation Pump V50
18 After-Run Coolant Pump V51 (runs during ATF cooling and after-cooling phases)

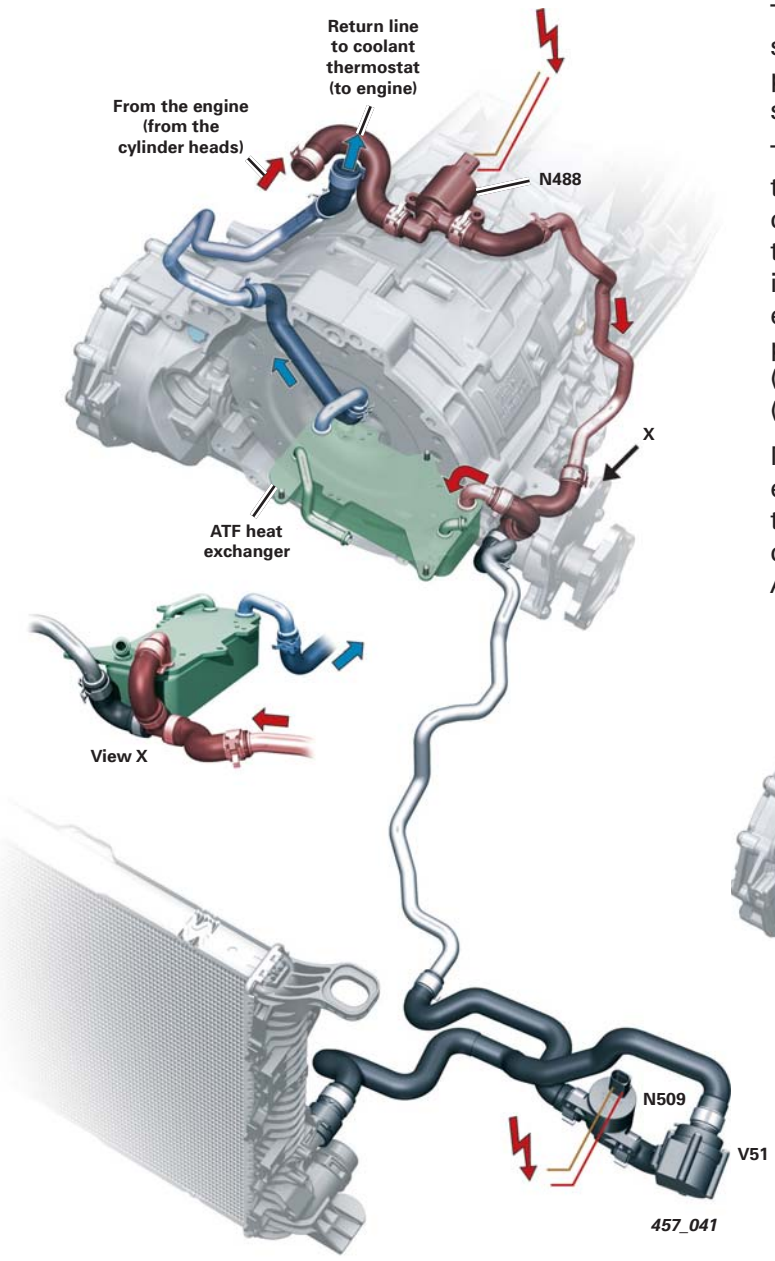
Reference
For further information on the ITM system, refer to Self-Study Program 990103, *The 2011 Audi A8 Vehicle Introduction.*

Transmission Heating

The heating requirements of the air conditioning system (interior heating) have the highest priority. Engine and transmission heating are secondary.

The illustration at left shows the engine and transmission in a cold state. The transmission control module signals its heating requirements to the engine control module. The objective is to heat the ATF as quickly as possible. The engine first tries to heat up as quickly as possible. Transmission Fluid Cooling Valve N509 (energized) and Transmission Coolant Valve N488 (de-energized) are closed.

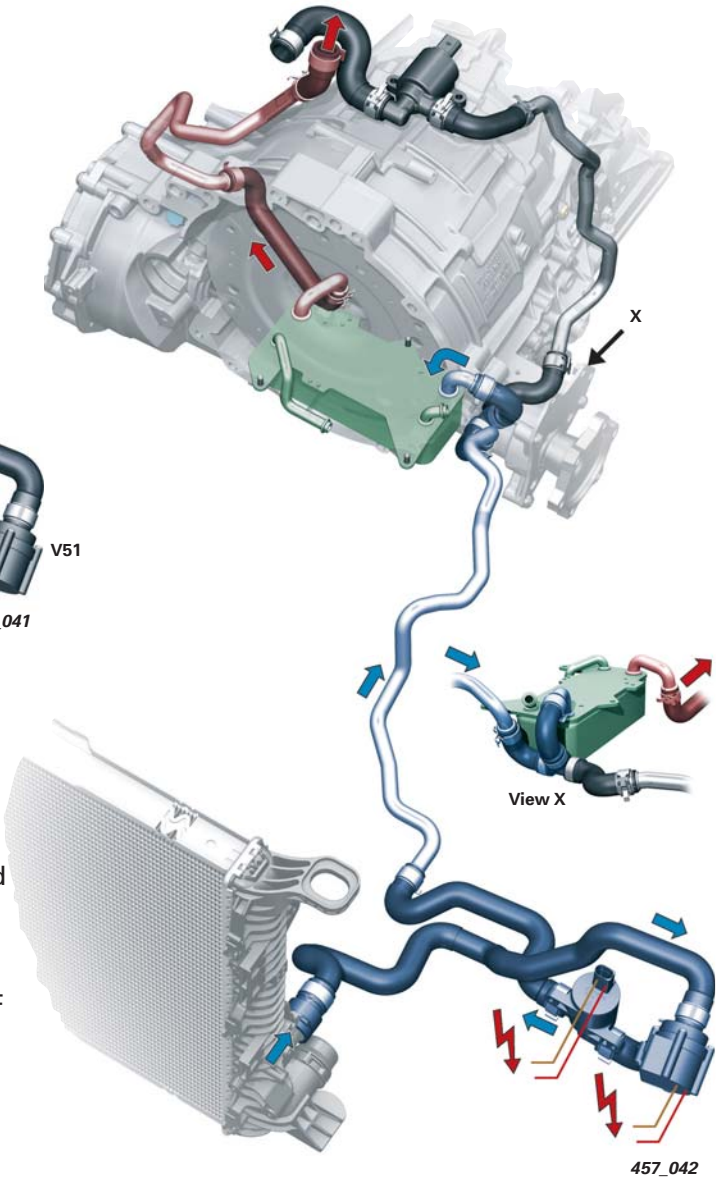
N488 is not opened (energized) until the engine has reached a predetermined target temperature. Then warm coolant flows from the cylinder heads to the ATF heat exchanger. The ATF is heated.



Transmission Cooling

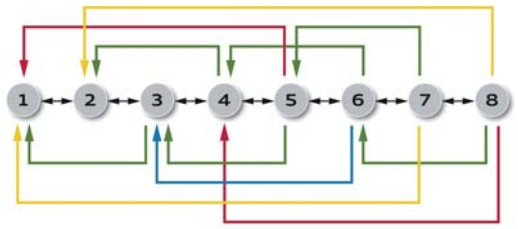
The illustration at right shows the engine and transmission at operating temperature. The transmission heating phase ends when a defined ATF temperature is exceeded and N488 is closed (switched OFF). If the ATF temperature continues to increase, N509 is opened (de-energized) and cooled coolant flows from the radiator to the ATF heat exchanger.

If the ATF temperature rises to 204.8°F (96°C), After-Run Coolant Pump V51 is activated to increase cooling capacity.



Mechatronic Electro-Hydraulic Control System

An increased number of gears has increased the complexity of the clutch control mechanism. This means that an 8–2 downshift can be achieved in various ways. The shift schematic below shows the variety of possible shift sequences.



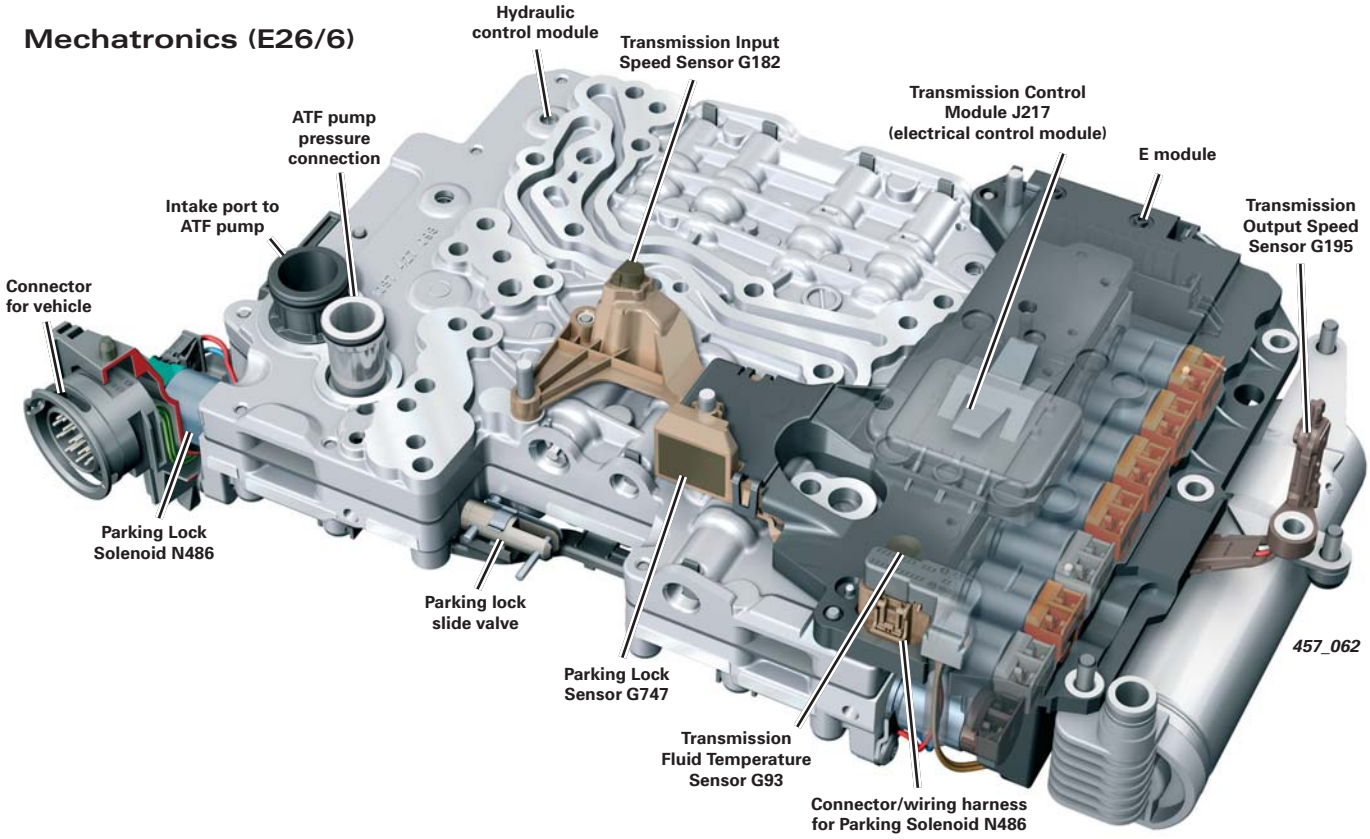
457_053

The shift program selects a suitable shift sequence based on the driver's reaction, driving situation, and driving program. The goal is to execute as direct a shift as possible.

Neutral idle control, which minimizes torque converter loss when the vehicle is stationary (for example, when waiting at a traffic light), was introduced in the OB6 transmission. Next generation hardware and software has enabled the neutral idle control system in the OBK transmission to set new standards in comfort and fuel economy.

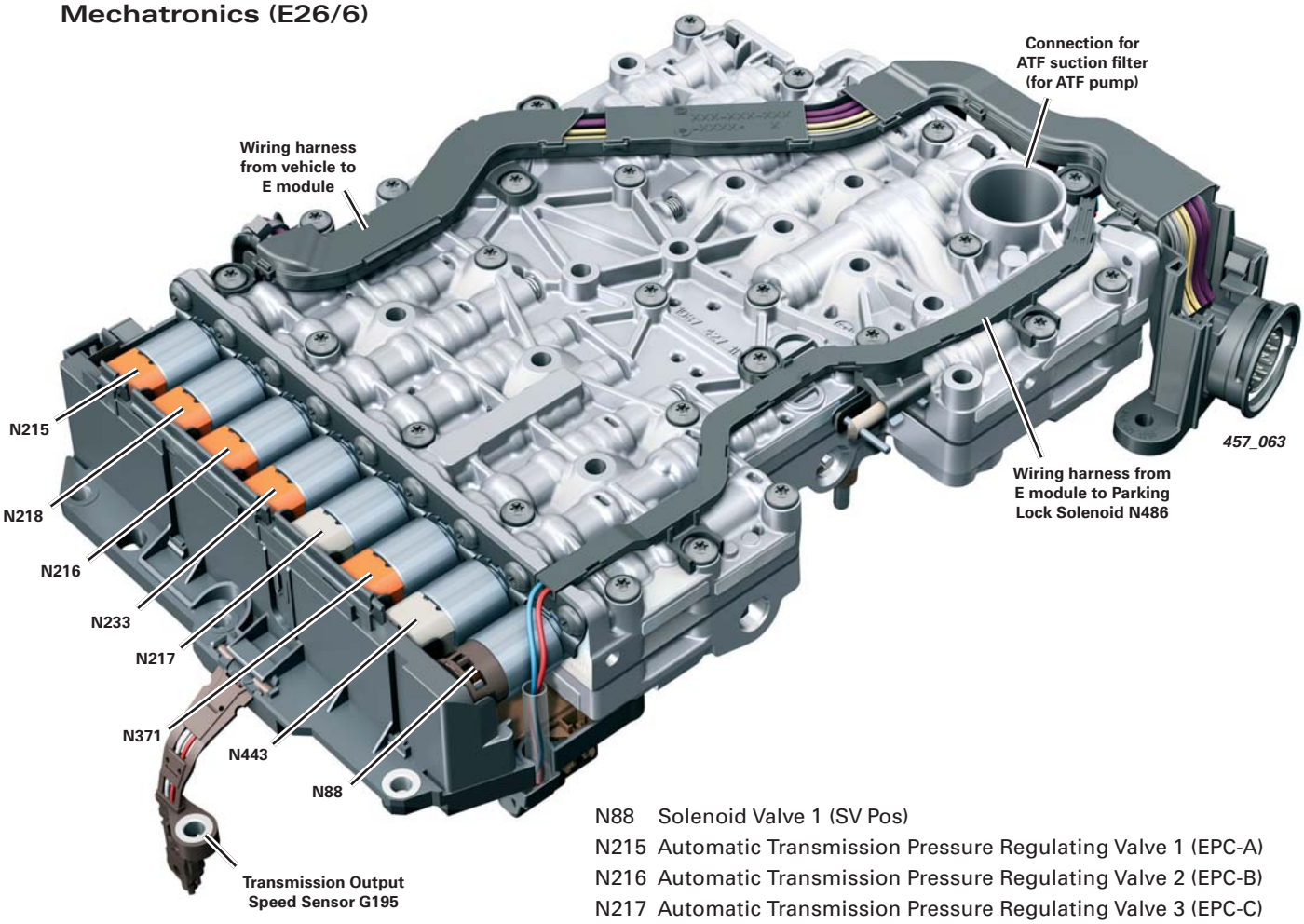
The transmission control module (TCM) has been redesigned. Communication between the hydraulic control module and the transmission mechanism has been enhanced, with shift dynamics and control quality improved.

Mechatronics (E26/6)



457_062

Mechatronics (E26/6)



N88 Solenoid Valve 1 (SV Pos)
N215 Automatic Transmission Pressure Regulating Valve 1 (EPC-A)
N216 Automatic Transmission Pressure Regulating Valve 2 (EPC-B)
N217 Automatic Transmission Pressure Regulating Valve 3 (EPC-C)
N218 Automatic Transmission Pressure Regulating Valve 4 (EPC-D)
N233 Automatic Transmission Pressure Regulating Valve 5 (EPC-E)
N371 Automatic Transmission Pressure Regulating Valve 6 (EPC-LC)
N443 Automatic Transmission Pressure Regulating Valve 8 (EPC-Sys)
N486 Parking Lock Solenoid

Transmission Control Module J217

The Mechatronics are integrated into the immobilizer system, so there is no hydro-mechanical limp-home function. Due to special demands and the complexity of the self-diagnostics, the OBK transmission has adopted the diagnostic data description (to ASAM/ODX standard) which Audi used for the first time in the OB6 transmission.

Replacing Mechatronic Control Module

Care must be taken to ensure that the control module and electronic components are not damaged by electrostatic discharges when replacing the Mechatronics. After a transmission software update or after replacing the Mechatronics, the following must be performed:

- Control module coding
- Adaptation of the gear indicator
- Adaptation of the shift elements

Warning
Special care must be taken to ensure that the electronics are protected against electrostatic discharge. Please follow the guidelines and instructions in current service repair information.

Mechatronic Actuators

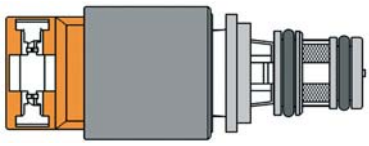
Pressure regulating valves, also referred to as EPCs (electric pressure control valves), convert a control current to hydraulic control pressure. They are activated by the transmission control module and control hydraulic valves (slide valves) connected to the shift elements.

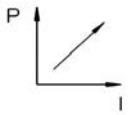
Two types of electronic pressure regulating valve are used:

- EPC with rising characteristic, de-energized, no control pressure (0 mA = 0 bar)
- EPC with falling characteristic, de-energized, maximum control pressure (0 mA = approximately 5 bar)

Pressure Regulating Valves and Solenoid Valves

Automatic Transmission Pressure Regulating Valve 1, 2, 4, 5, 6 (orange)



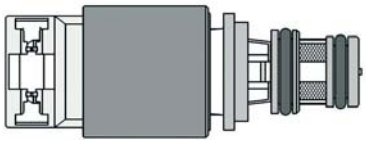


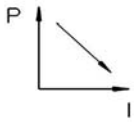
457_067

Pressure range	0 to 4.7 bar
Operating voltage	12 V
Resistance at 20°C	5.05 ohms
Characteristic	Rising

1 N215 Automatic Transmission Pressure Regulating Valve 1 — Brake A
2 N216 Automatic Transmission Pressure Regulating Valve 2 — Brake B
4 N218 Automatic Transmission Pressure Regulating Valve 4 — Clutch D
5 N233 Automatic Transmission Pressure Regulating Valve 5 — Clutch E
6 N371 Automatic Transmission Pressure Regulating Valve 6 — Lockup clutch

Automatic Transmission Pressure Regulating Valves 3, 7 (white)



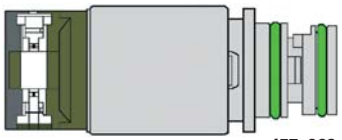


457_068

Pressure range	4.7 to 0 bar
Operating voltage	12 V
Resistance at 20°C	5.05 ohms
Characteristic	Falling

3 N217 Automatic Transmission Pressure Regulating Valve 3 — Clutch C
7 N443 Automatic Transmission Pressure Regulating Valve 7 — System pressure

Solenoid Valve 1 — N88 (black/brown)



457_069

Operating voltage	< 16 V
Pick-up voltage	> 6 V
Dropout voltage	< 5 V
Resistance at 20°C	11 ohms +/- 2 ohms

N88 is an electrically operated solenoid valve. It is a 3/2 valve, with three terminals and two switching positions (open/close or ON/OFF).

N88 is activated by the TCM and controls both the position valve and the parking lock valve. The position valve replaces the previous gear selector valve for selector lever cable operated shift controls. The position valve regulates the system pressure for the various clutches and brake control operations.

The parking lock valve controls system pressure for the parking lock slide valve, which operates the parking lock. This latter task was taken over from the selector lever cable. The parking lock slide valve disengages the parking lock.

Shift Matrix

	Shift Elements, Pressure Regulating Valves, Solenoid Valves							
	A EPC-A N215	B EPC-B N216	C EPC-C N217	D EPC-D N218	E EPC-E N233	SV-Pos N510	EPC-Sys N443	
Parking lock	1	1	1	0	0	0	X	0
Neutral	1	1	1	0	0	1	X	0
Reverse gear	1	1	1	1	0	1	X	0
1st gear	1	1[1)]	0	0	0	1	X	X
2nd gear	1	1	1	0	1	1	X	X
3rd gear	0	1	0	0	1	1	X	X
4th gear	0	1	1	1	1	1	X	X
5th gear	0	1	0	1	0	1	X	X
6th gear	0	0	0	1	1	1	X	X
7th gear	1	0	0	1	0	1	X	X
8th gear	1	0	1	1	1	1	X	X

457_070

Clutch closed

Brake closed

Pressure Regulating Valves/ Solenoid Valve

1	Active
0	Not active (a low basic control current is always present)
X	Active (control current depends on operating condition)
EPC	Electric pressure control valve (pressure regulating valve)
SV	Solenoid valve

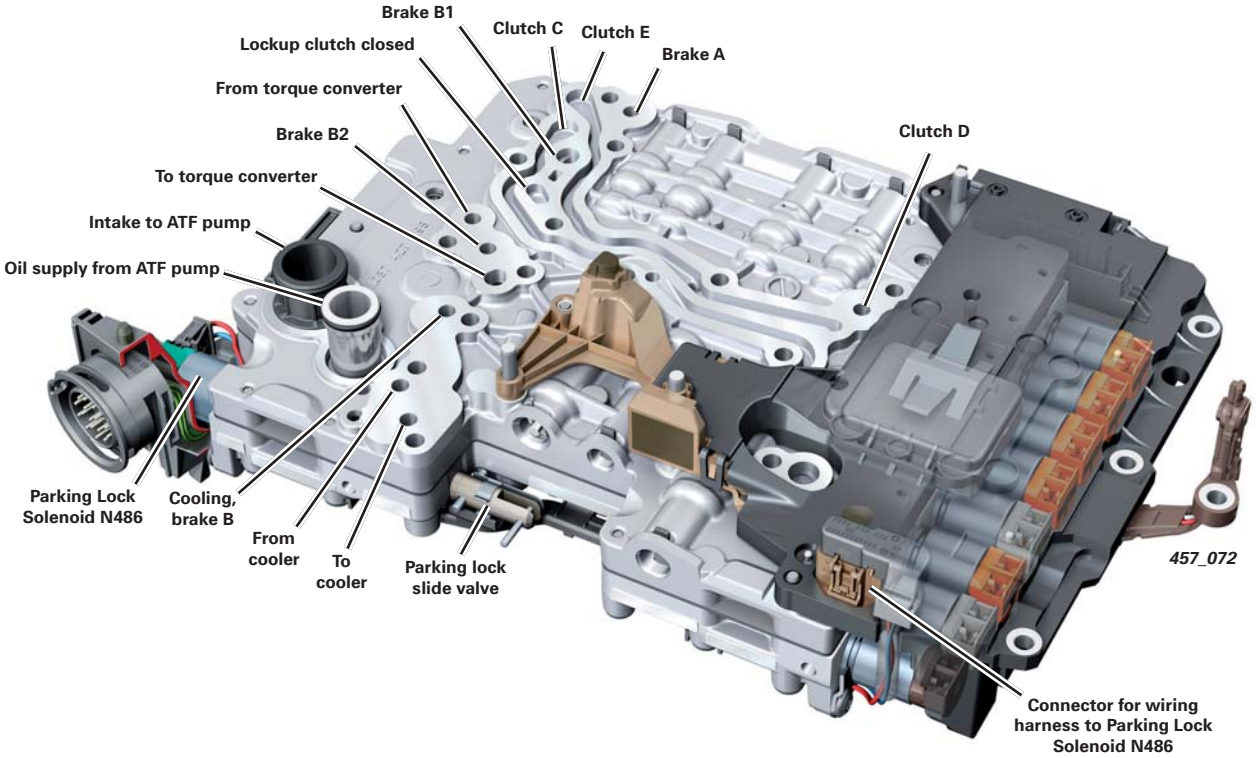
Parking Lock Solenoid N486

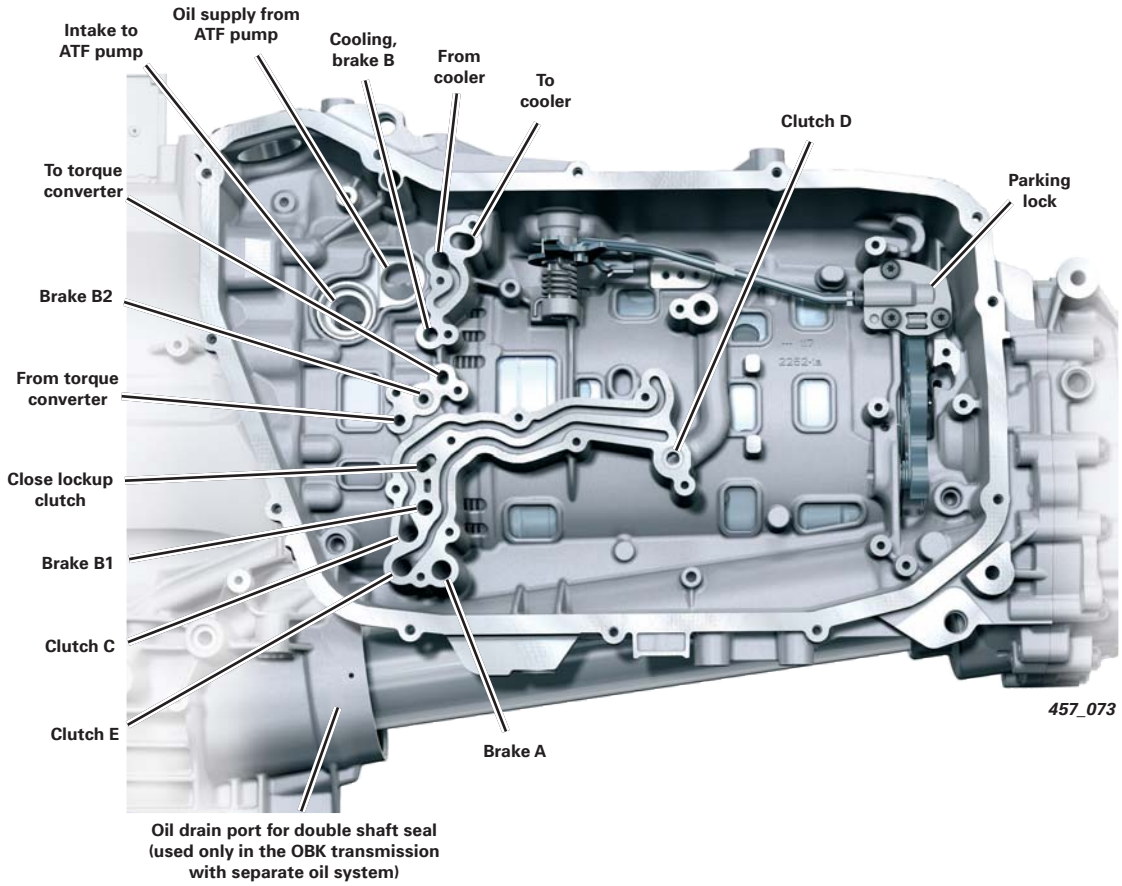
457_071

Operating voltage	< 16 V
Pick-up voltage	> 8 V
Resistance at 20°C	25 ohms +/- 2 ohms

N486 holds the parking lock slide valve in the “parking lock disengaged” position.

Hydraulic Interfaces





Transmission Control Module J217 Temperature Monitoring

With the integration of TCM J217 (Mechatronic) into the ATF lubricated section of the transmission, monitoring of the ATF temperature becomes critical.

High temperatures have a significant impact on the service life and performance of electronic components. Temperatures over 248°F (120°C) shorten control module service life, and create system malfunctions.

To protect against overheating, countermeasures are taken when predetermined threshold temperatures are exceeded. The DSP (dynamic shift program) has separate Hotmode programs specifically for this purpose.

To measure the temperature of the microprocessor (main processor of J217) as accurately as possible, a substrate temperature sensor is integrated into the ceramic substrate of the semiconductor blocks so that it can measure the substrate temperature directly.

Hotmode

Hotmode is subdivided into three stages:

Stage 1

> 255.2°F (124°C) substrate temperature and 258.2°F (126°C) ATF temperature, as monitored by Transmission Fluid Temperature Sensor G93.

The shift points are adjusted to a higher rpm using the DSP function. The operating range, within which the lockup clutch is closed, is extended.

Stage 2

> 282.2°F (139°C) substrate temperature and 285.8°F (141°C) ATF temperature, as monitored by Transmission Fluid Temperature Sensor G93.

Engine torque is significantly reduced, depending on increasing temperature levels.

Stage 3

> 293°F (145°C) substrate temperature and 296.6°F (147°C) ATF temperature, as monitored by Transmission Fluid Temperature Sensor G93.

For protection against overheating of the TCM (associated with malfunctioning and/ or component damage), power supply to the solenoid valves is disconnected. The transmission loses positive engagement, and a fault is stored in the event logger.

< = less than

> = greater than

All temperature specifications refer to the software version valid at the time of the printing of this SSP. The temperature specifications for other software versions can differ.

Oil Temperature Spectrum Monitoring

J217 checks the current transmission temperature range at regular intervals using G93. The measurement data is stored. From this data, the thermal load on the transmission is determined throughout its life cycle. This is referred to as an oil temperature spectrum.

A spectrum is a collection of measured data or readings of any size which can be used for statistical evaluation by analysis and quantification.

The oil temperature spectrum is used by the manufacturer for analyzing component damage to the E module of the Mechatronics.

Mechatronic Sensors

Transmission Input Speed Sensor G182, Transmission Output Speed Sensor G195 and Parking Lock Sensor G747 are Hall-type sensors.

Sensors G93, G182, G195, and G747 are integral to the E module. The E module cannot be replaced separately. In the event of a fault in one of the specified components, the complete Mechatronic module must be replaced.

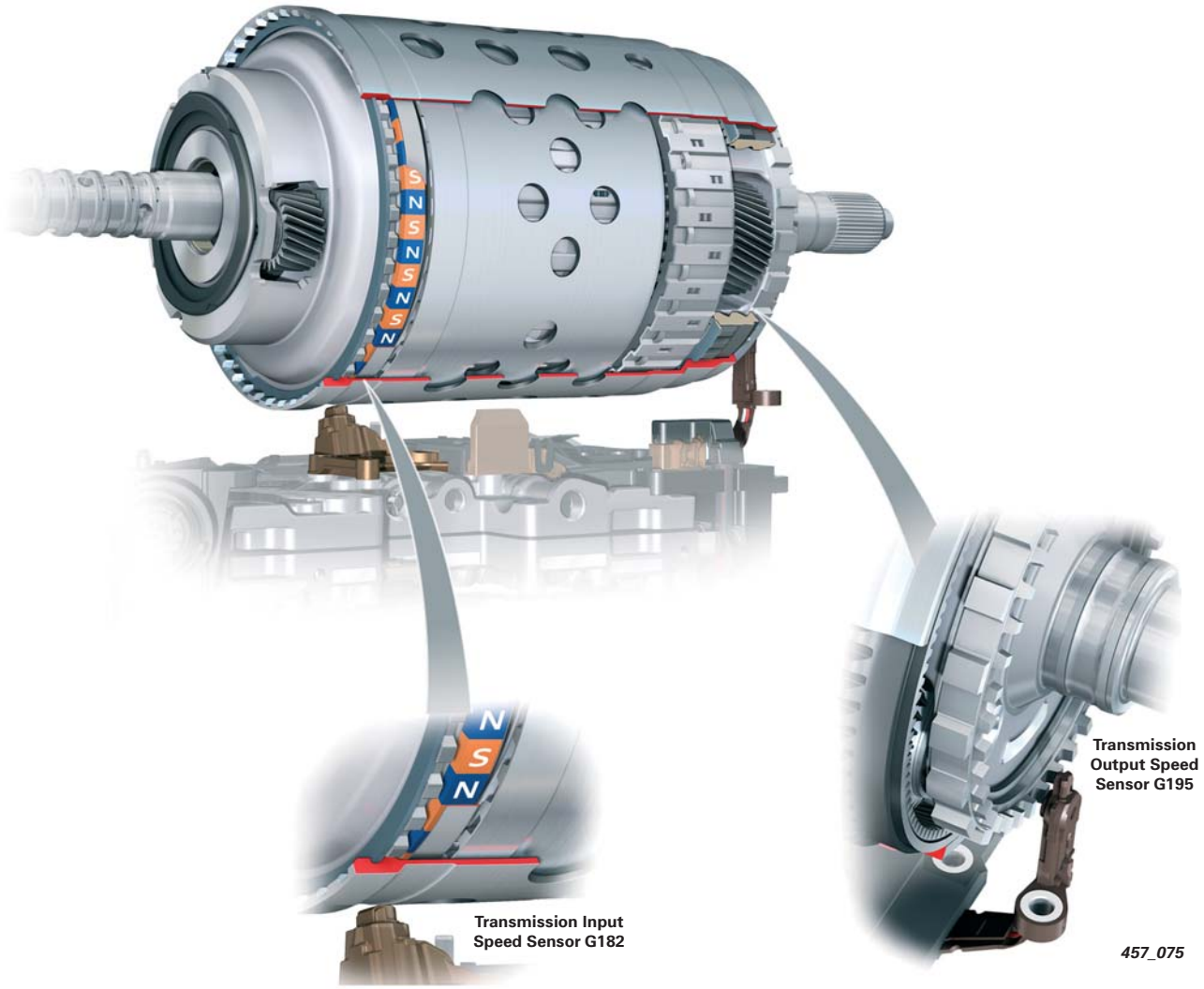
Transmission Input Speed Sensor G182
Transmission Output Speed Sensor G195

G182 has an encoder wheel with a magnetic ring. The encoder wheel is connected to planetary carrier 2. G182 measures the rotational speed of the planetary carrier of the second planetary gearset (PT2).

Planetary carrier 2 interlocks to the turbine shaft. Turbine input speed equals transmission input speed.

The cylinder connecting planetary carrier 1 to ring gear 4 is located above the magnetic ring encoder wheel. The cylinder is made of a high strength aluminum alloy. Because the cylinder is not magnetic, the magnetic fields produced by the magnetic ring act upon G182 through the cylinder. Metal swarf or debris on the encoder wheel can affect its performance.

Both G182 and G195 are referred to as “intelligent sensors”. They recognize the rotation direction and changes in magnetic field strength, adapting gap tolerances between the sensor and encoder wheel.



Parking Lock

Electro-hydraulically operated, the parking lock is controlled by the Mechatronics module. It can be controlled either manually by the driver (using the shift control) or automatically by the Auto P function.

The transmission portion of the parking lock mechanism is similar to those of other transmissions. It is engaged by spring force, is electro-hydraulically controlled, and is electro-magnetically protected.

The following components engage, disengage, and hold the parking lock.

1. Engaging the parking lock:

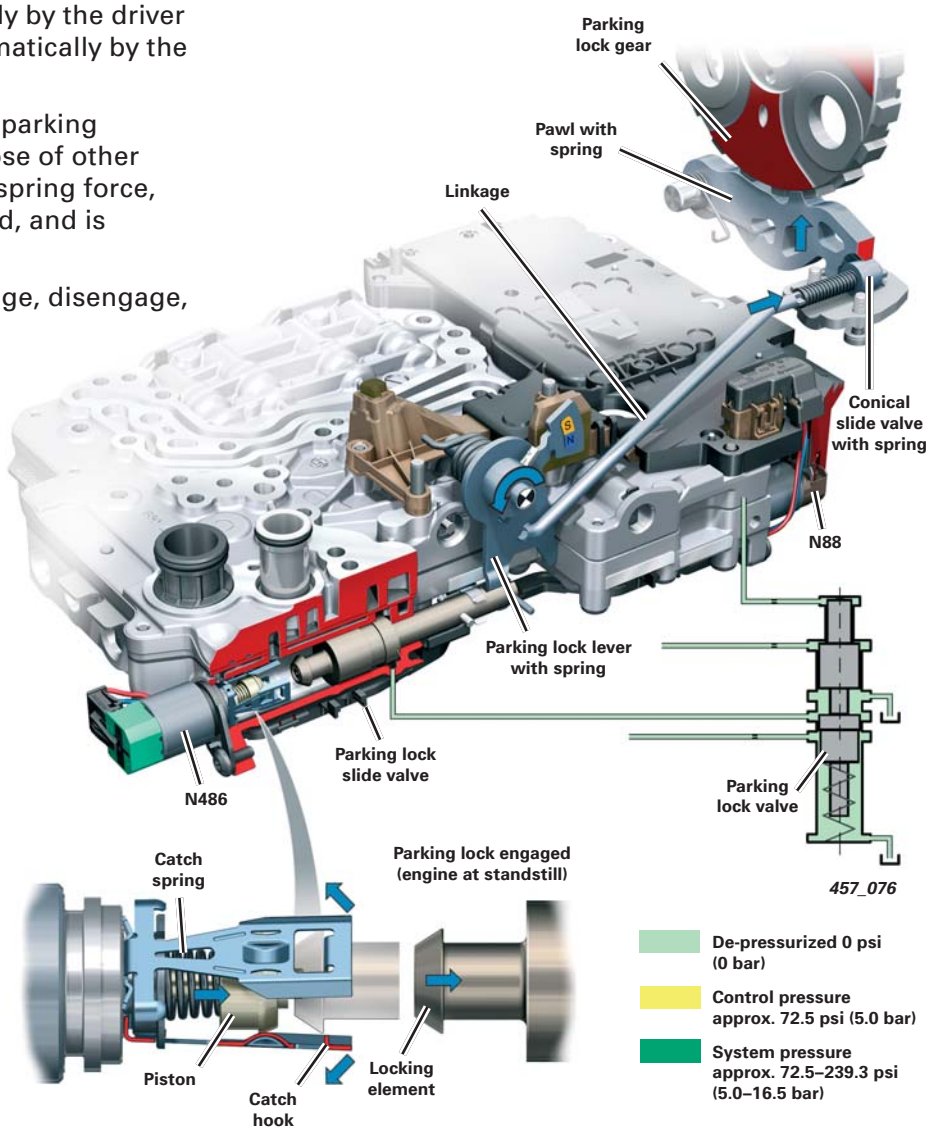
- Parking lock spring
- Parking lock lever
- Linkage
- Conical slide valve with spring
- Pawl

2. Disengaging the parking lock:

- Solenoid Valve N88
- Parking lock valve
- Parking lock slide valve

3. Holding the disengaged parking lock:

- Parking Lock Solenoid



Engaging the Parking Lock

If Solenoid Valve 1 N88 and Parking Lock Solenoid N486 are de-energized, the parking lock is engaged (for example, when the engine is switched OFF or when gear P is selected). The parking lock valve then moves into its normal position and the cylinder chamber of the parking lock slide valve is depressurized and evacuated.

When solenoid N486 is de-energized, the piston of N486 pushes the catch springs apart. The catch hooks release both the locking element and the parking lock slide valve. The spring of the parking lock lever pushes the pawl into the parking lock gear. The parking lock is then engaged.

Disengaging the Parking Lock

To disengage the parking lock, the engine must be running. If the engine is not running, the parking lock can still be disengaged using the parking lock emergency release.

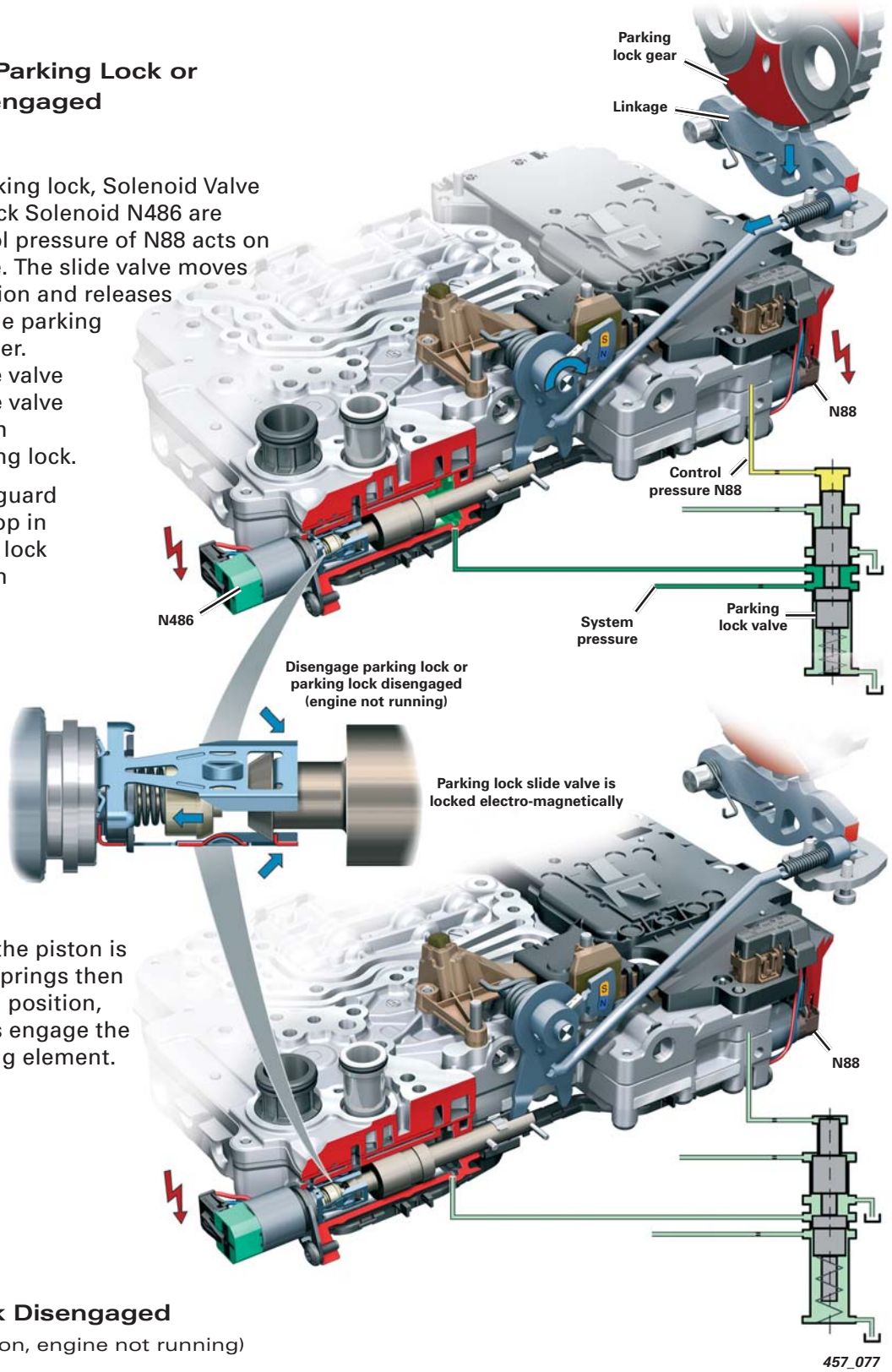
The parking lock is disengaged by electro-hydraulic activation of the parking lock slide valve. The hydraulic force is several times greater than the spring force of the spring on the parking lock lever. The necessary hydraulic pressure is produced by the ATF pump.

Disengaging the Parking Lock or Parking Lock Disengaged

(engine running)

To disengage the parking lock, Solenoid Valve 1 N88 and Parking Lock Solenoid N486 are energized. The control pressure of N88 acts on the parking lock valve. The slide valve moves into its working position and releases system pressure to the parking lock slide valve cylinder. The parking lock slide valve pulls the conical slide valve out of the pawl, which disengages the parking lock.

As an additional safeguard against a possible drop in pressure, the parking lock slide valve is locked in position using N486 (see next page).



If N486 is energized, the piston is retracted. The catch springs then return to their normal position, while the catch hooks engage the shoulder of the locking element.

Hold Parking Lock Disengaged

(neutral holding position, engine not running)

To keep the parking lock disengaged after the engine has been turned OFF, the selector lever must be moved into “N” before turning OFF the engine.

The pressure in the system is reduced as described under “Engaging the parking lock” on the previous page. N486 stays energized. The parking lock slide valve is then held in position by the catch springs. This neutral holding position is maintained for a limited time only because it uses battery power.

Parking Lock Limp-Home Function

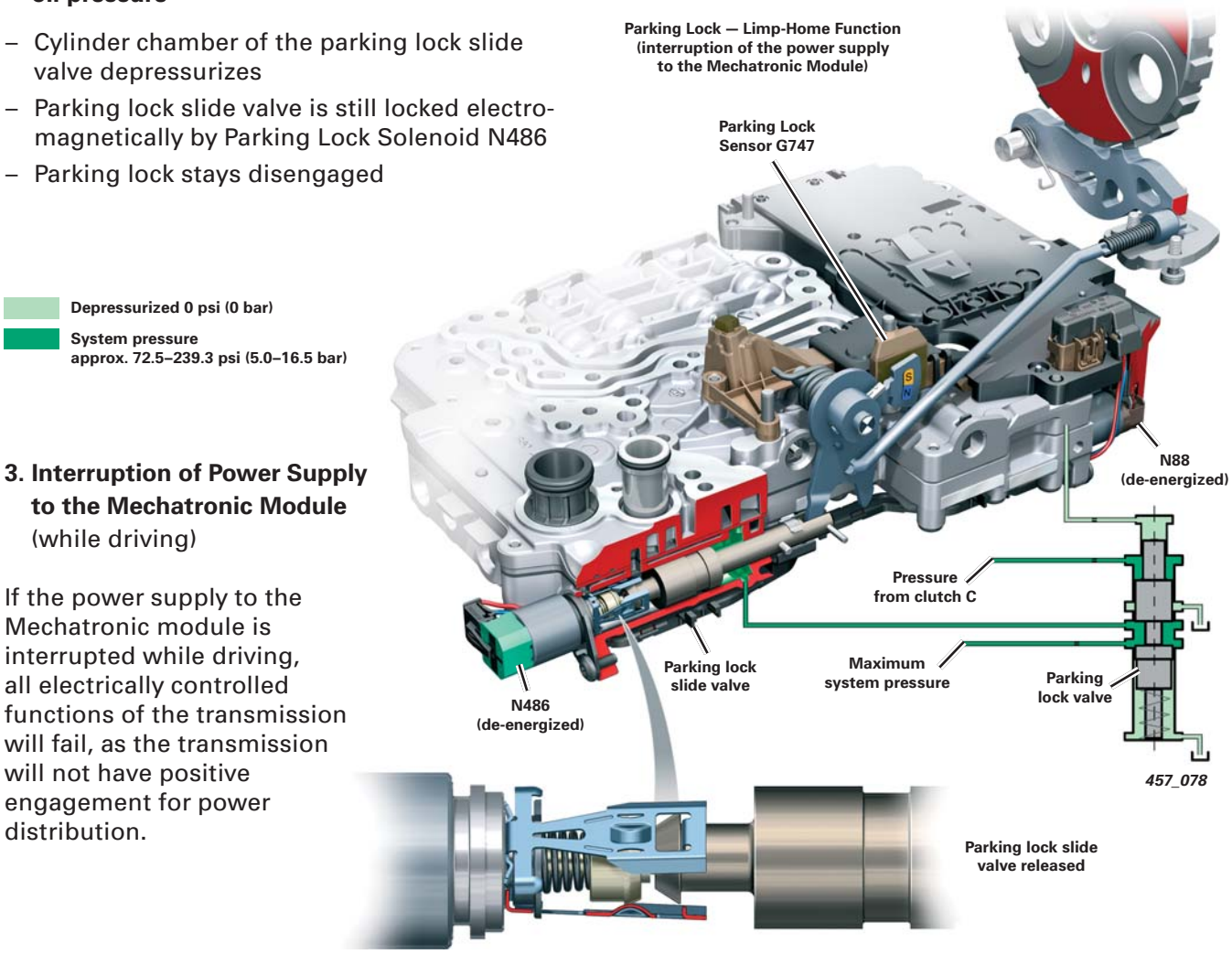
This function prevents unwanted engagement of the parking lock while driving if a malfunction occurs. Safeguards are provided for the following three situations:

1. Failure of Solenoid Valve 1 N88 or insufficient oil pressure

- Cylinder chamber of the parking lock slide valve depressurizes
- Parking lock slide valve is still locked electro-magnetically by Parking Lock Solenoid N486
- Parking lock stays disengaged

2. Failure of Parking Lock Solenoid N486

- Parking lock slide valve is held in position by hydraulic pressure
- Parking lock stays disengaged



3. Interruption of Power Supply to the Mechatronic Module (while driving)

If the power supply to the Mechatronic module is interrupted while driving, all electrically controlled functions of the transmission will fail, as the transmission will not have positive engagement for power distribution.

The parking lock valve is pushed into its working position against the pressure of the spring, and system pressure is introduced to the cylinder chamber of the parking lock slide valve. The parking lock stays disengaged.

As long as the engine is running, system pressure is provided by the ATF pump. System pressure is fed to clutch C by a hydraulic limp-home circuit. The parking lock valve is connected to the pressure duct leading to clutch C, which exerts pressure on the annular face of the valve piston.

If the engine is turned OFF, the pressure in the system drops and the parking lock is engaged by the force of the spring exerted upon the parking lock lever. The limp-home circuit is designed so that clutch C (the parking lock system) stays depressurized when the engine is restarted. The parking lock stays disengaged.

Even if engaged, clutch C or clutch E has to be activated so that the limp-home circuit is functional. If the power supply is interrupted while the gear selector is in position “R” or “N”, the parking lock is engaged unless either of the two clutches has previously been activated.

Parking Lock Sensor G747

The position of the parking lock is monitored by the Transmission Control Module via G747, which has two Hall sensors. These sensors are operated by a permanent magnet on the parking lock lever.

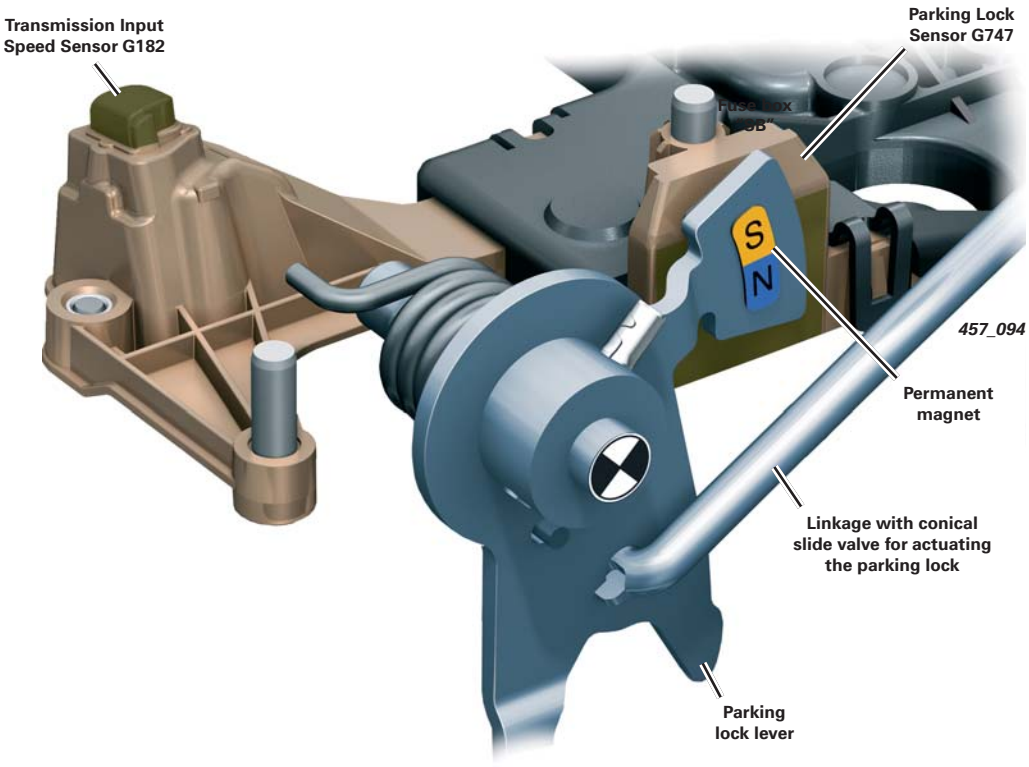
The P sensor determines and recognizes the following positions:

P engaged –> intermediate position –> P not engaged

The intermediate position does not normally exist during operation and is defined as a fault after a predetermined monitoring time.

G747 has the following tasks:

1. Monitoring the proper functioning of the parking lock
2. Engine-start enabling in P (the sensor signal is directly converted to a P/N signal by the TCM)
3. Display in the instrument cluster “Gearbox in position P”
4. Display in the instrument cluster when the parking lock emergency release is actuated



If G747 fails or is faulty (for example, intermediate position), the following will happen:

– Fault message in the Driver Information System display
– System pressure will be set to maximum (to ensure that the parking lock slide valve has maximum power)
– Engagement of the parking lock is not indicated in the instrument cluster display

Neutral Idle Control

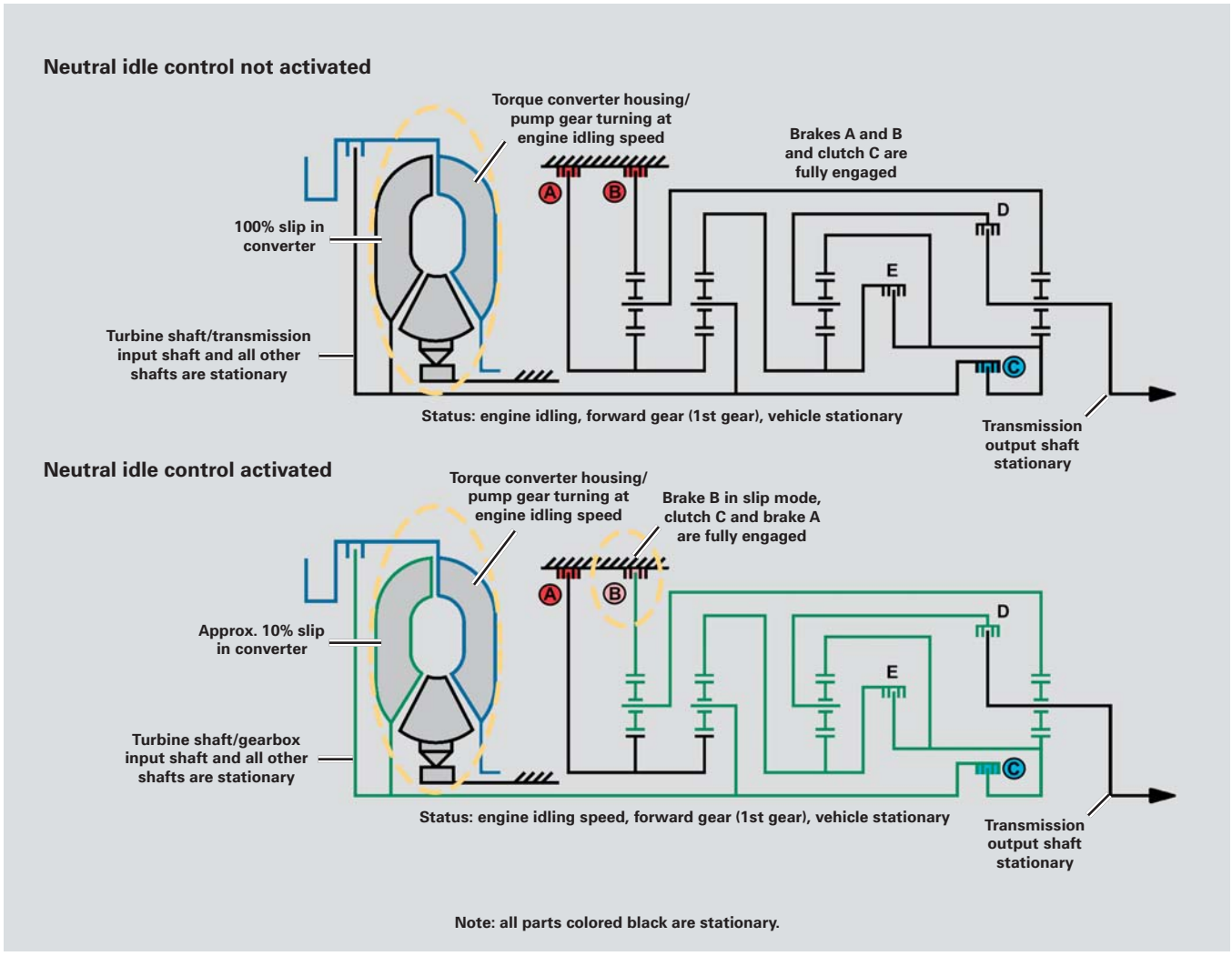
The neutral idle control system (also referred to as NIC) significantly improves fuel economy in city traffic. This is achieved by interrupting the transmission of converter loss torque when the engine is idling, when driving forward, when the vehicle is stationary, and when the foot brake is applied. Engine idling torque is also reduced to a minimum when stopped at traffic lights.

In addition to fuel efficiency, acoustics and ride comfort are also improved. With less load on the engine, it runs more smoothly and quietly. Reducing torque to a small residual amount keeps brake pedal force to a minimum.

The neutral idle control is activated in the OBK transmission by opening brake B, which interrupts the transmission of multiplying torque to ring gear 1.

Torque is then diverted to brake B, which is operated with slip in neutral idle mode. Brake B is specially rated for continuous duty in neutral idle mode. It is also cooled in a controlled fashion when activated by the hydraulic unit.

This second generation neutral idle control sets new standards in comfort and fuel economy. In addition to reducing converter residual torque, response to positive engagement has been improved.



457_081

Transmission Adaptation

To ensure good shift quality, it is necessary that the five shift elements (brakes A and B, and clutches C, D, and E) are correctly adapted.

For example, the adaptation values are deleted after a software update is performed on the system. An adaptation cycle via the VAS Scan Tool must then be initiated. The exact procedures are explained in Guided Functions and Guided Fault Finding.

The following adaptation procedures are used:

- Shift adaptation (during an upshift or downshift). Shift adaptation is mainly used for quick adaptation (start adaptation).
- Slip adaptation
- Pulse adaptation (continuous adaptation of the shift elements)

Quick Shift Adaptation

From an ATF temperature of 104°F (40°C)

Shift elements can be adapted for upshifts up to four times by shift adaptation at loads of up to 110 lb ft (150 Nm).

Brake A 6 –> 7 shift

Brake B 6 –> 5 rolling gearshift

Clutch C 2 –> 3 shift

Clutch D 3 –> 4 shift

Clutch E 1 –> 2 and 5 –> 6 shift

Quick Slip Adaptation

From an ATF temperature of 104°F (40°C)

In neutral idle mode, brake B is additionally adapted by means of slip adaptation. “General boundary conditions” must be observed. This adaptation takes approximately seven seconds.

The quick adaptation and pulse adaptation run concurrently, with the corresponding adaptation initiated depending on which conditions are met first. This is the quick adaptation (limited to four).

Pulse Adaptation

ATF temperature 122°F – 230°F (50°C – 110°C)

“General boundary conditions” must be observed.

Brake A 6th gear selector cable,
load: 59.0 – 132.7 lb ft (80 – 180 Nm)
turbine speed 1200 – 2100 rpm
(charging pressure/quick charge time)

Brake B 7th gear selector cable,
load: 59.0 – 132.7 lb ft (80 – 180 Nm)
turbine speed 1200 – 2100 rpm 1/min
(quick charge time only, the charging pressure of brake B is adapted for rolling gearshift 6 –> 5)

Clutch C 4th gear selector cable,
load: 22.1 – 73.7 lb ft (30 – 100 Nm)
turbine speed 1200 – 1700 rpm
(charging pressure/quick charge time)

Clutch D 3rd gear selector cable,
load: 22.1 – 73.7 lb ft (30 – 100 Nm)
turbine speed 1200 – 1700 rpm
(charging pressure/quick charge time)

Clutch E 7th gear selector cable,
load: 59.0 – 132.7 lb ft (80 – 180 Nm)
turbine speed 1200 – 2100 rpm
(charging pressure/quick charge time)

Adaptation Result

An evaluation of shift quality is mandatory. The number of adaptations can be checked by referring to the corresponding measured value (for example, analysis 3 for the charging pressure adaptation of brake A). Each count should have a value of at least three. The individual shift elements can be adapted separately, if required.

No vehicle should be returned to the customer if one or more shift elements are not adapted.

Displays and Warnings

System malfunctioning or protective functions of the transmission are indicated in the instrument cluster by a warning lamp (transmission fault icon) and as textual driver information. The following messages can be displayed.

Display 1

Icon 

Text **Transmission malfunction:**
You may continue driving

This message informs the driver of transmission-related faults they might not otherwise notice. The Transmission Control Module (TCM) is able to use a substitute signal (substitute program) when impaired. The fault can have little or no affect on performance. The purpose of the warning is to prompt drivers to take the vehicle to an authorized Audi service center at their earliest opportunity to have the fault checked out.

Display 2

Icon 

Text **Transmission malfunction:**
You can continue driving in D only

This message indicates that the transmission has activated its emergency limp-home program, which holds the gear until either “N” for Neutral is selected or the engine is switched OFF. There is no drive when the gear is reselected or when the engine is re-started.

Display 3

Icon 

Text **Transmission malfunction:**
You may continue driving (limited functionality)

This message indicates a system fault in which the transmission can only select certain gears or cannot select any gears at all (a defined gear is held). Vehicle operation can be very limited (for example, no acceleration on grades, limited acceleration, and limited speed).

Display 4

Icon 

Text **Transmission malfunction:**
No reverse gear (you can continue driving)

This message indicates a system fault in which the transmission can only select certain gears or cannot select any gears at all (a defined gear is held). Vehicle operation can be very limited (for example, no acceleration on gradients). Reversing is not possible because the transmission cannot select reverse.

Display 5

Icon 

Text **Vehicle may roll! Cannot shift to P.**
Please apply parking brake

This message indicates that the parking lock emergency release is actuated. Neutral position “N” is also indicated.

Display 6

Icon without icon
(with warning tone)

Text **Vehicle may roll.**
Selector lever not in P.

This message appears together with a warning tone if “P” for Park is not selected after switching OFF the ignition.

Special Features of Adaptive Cruise Control (ACC) Mode

When accelerating in ACC mode, the transmission only downshifts into second gear when the vehicle comes to a stop. The vehicle then drives away in second gear. This provides a softer start without any need for shifting gears.

On inclines greater than a defined amount, as determined by a map in the TCM, the transmission downshifts into first gear. The vehicle then drives away in first gear.

Encoding J217

In the TCM, the following functions can be activated and deactivated by encoding:

1st digit	Country/variant code	1 = RoW, 2 = USA
2nd digit	Neutral idle control	1 = active, 0 = not active
3rd digit	Automatic upshift before engine cut-out rpm	1 = active, 0 = not active
4th digit	Tiptronic function in D/S	1 = active, 0 = not active
5th digit	Unassigned	—

6 - digit code: X X X X X X

6. 5. 4. 3. 2. 1.

Note: The TCM must be encoded using the Software Version Management

Adapting the Gear Indicator

In the TCM, the gear indicator can be activated and deactivated separately for gears D and S. The gear indicator is always active in Tiptronic mode, is active in RoW-spec vehicles, and is inactive in US-spec vehicles. After replacing the Mechatronics or after a software update, a system check must be made for correct adaptation of the gear indicator.

Limp-Home and Substitute Programs

The OBK transmission does not have a hydro-mechanical limp-home function. No drive is available if no voltage is present. The limp-home and substitute programs have been updated to ensure a high degree of availability in case of a fault.

Towing

If a vehicle with an OBK transmission must be towed, Audi's standard towing guidelines for automatic transmissions must be observed. These guidelines can be found in the Owner's Manual:

- Actuate the parking lock emergency release
- Do not exceed a maximum towing speed of 31.0 mph (50 kph)
- Do not exceed a maximum towing distance of 31.0 mi (50 km)
- The vehicle must not be towed with the front or rear axle raised off the ground

Reasons:

When the engine is not running, the oil pump is not driven and there is no flow of lubricant to certain parts of the transmission. Severe transmission damage can result if the towing guidelines are not observed.

Important

The parking lock must be released and the parking lock emergency release device actuated when the vehicle is being towed. Failure to do so will engage the parking lock. Mechanically, the parking lock cannot engage at speeds over 4.4 mph (7 kph), but it can incur damage.

Shift-by-Wire Control System

Overview

A new “shift-by-wire” operating and gearshift actuation system has been introduced on the 2011 Audi A8. This means:

- Shift-by-wire is designed for maximum ease of use
- Little force is required to shift gears
- Actuating forces and shift throws can be configured individually
- There is no mechanical connection between the selector lever and the transmission
- The system works by processing driver inputs and does not have a **mechanical** fail-safe level
- The parking lock is electro-hydraulically actuated. A mechanical emergency release component allows the parking lock to be released in the event of a fault so the vehicle can be moved.

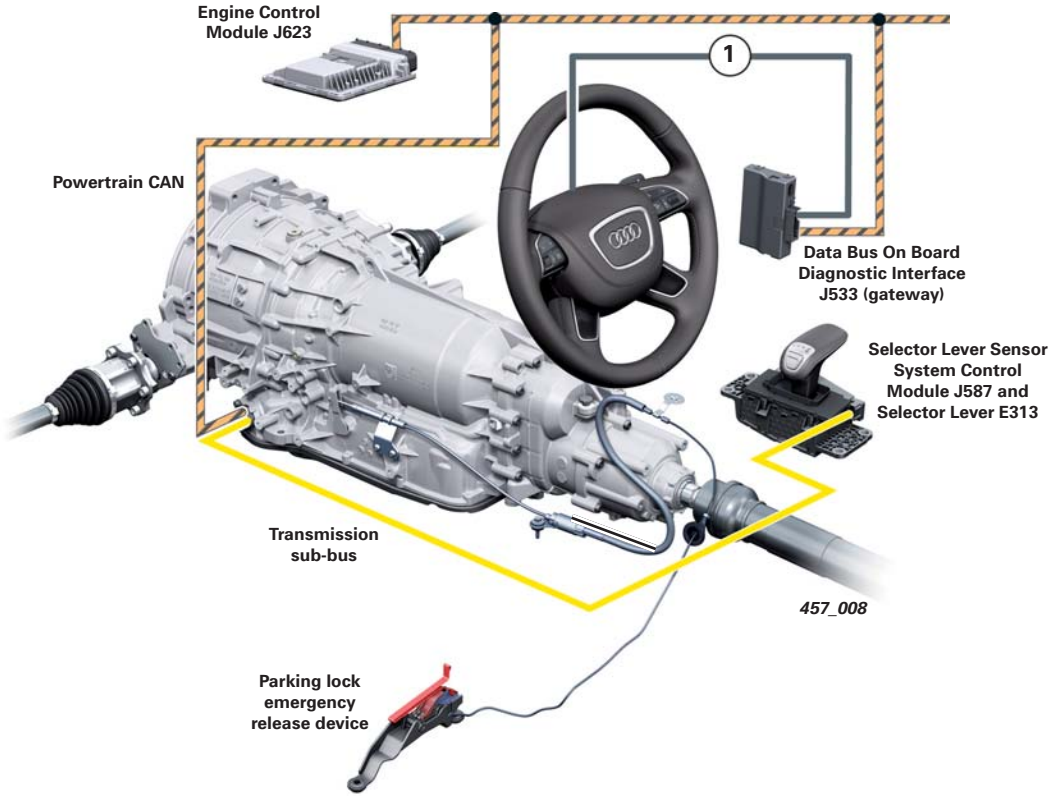
Advantages

- New scope for configuring the shift control system, for example, design, size, positioning in vehicle, and operation
- Increased scope for new comfort and safety functions, for example, engaging the automatic parking lock
- Simplified assembly of the shift control system and transmission, no adjustment work required
- Improved acoustics in the vehicle interior due to the separation of the shift control system and transmission

With regard to the improved acoustics, a shift cable, which usually interconnects the transmission and the shift control mechanism, transmits sound waves into the vehicle interior. These sound waves can pass through the shift cable bushing and into the body relatively easily. Sound-insulating effectiveness depends on stress-free installation of the shift cable.

Signal Characteristic (1)

E438/439 > Multifunction Steering Wheel Control Module J453 > by LIN bus > Steering Column Electronics Control Module J527 > by Convenience CAN > Data Bus On Board Diagnostic Interface J533 > by Powertrain CAN > Transmission Control Module J217

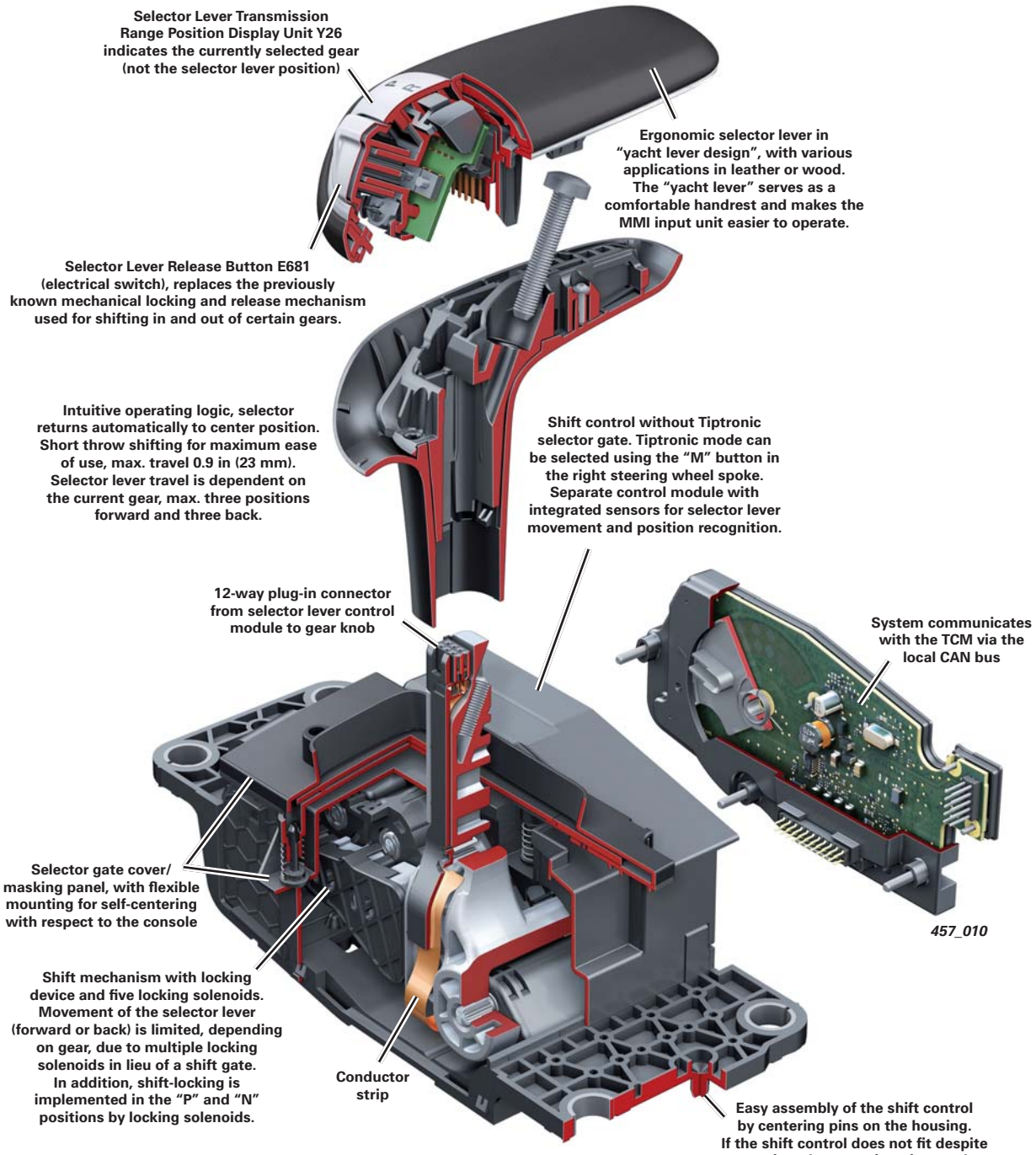


Tiptronic Mode

The Tiptronic gate is no longer required. The driver can change to Tiptronic mode and back to Auto mode using the “M” (Manual) button in the right steering wheel spoke. Otherwise, the Tiptronic function is as previously described (Tiptronic in D or S).

The system also changes back from Tiptronic mode to Auto mode if the selector lever is moved. Gearshifts can only be performed using the paddles on the steering wheel.

Shift Control System Features



Operation

Shift-by-wire has made possible a new shift control design. After selecting a gear, the selector lever returns to its original (normal) position in much the same way as a joystick. The selector lever position no longer shows the gear or function selected.

Example 1

The transmission is in “Park” position (P), but the selector lever is in its center position. To avoid confusion between the terms “selector lever position”, “gear” and “function mode”, we will call this center position “X”.

A logical operating design was developed so that the shift control can be operated comfortably and intuitively. From its center position “X”, the selector lever has three positions forward and three positions back.

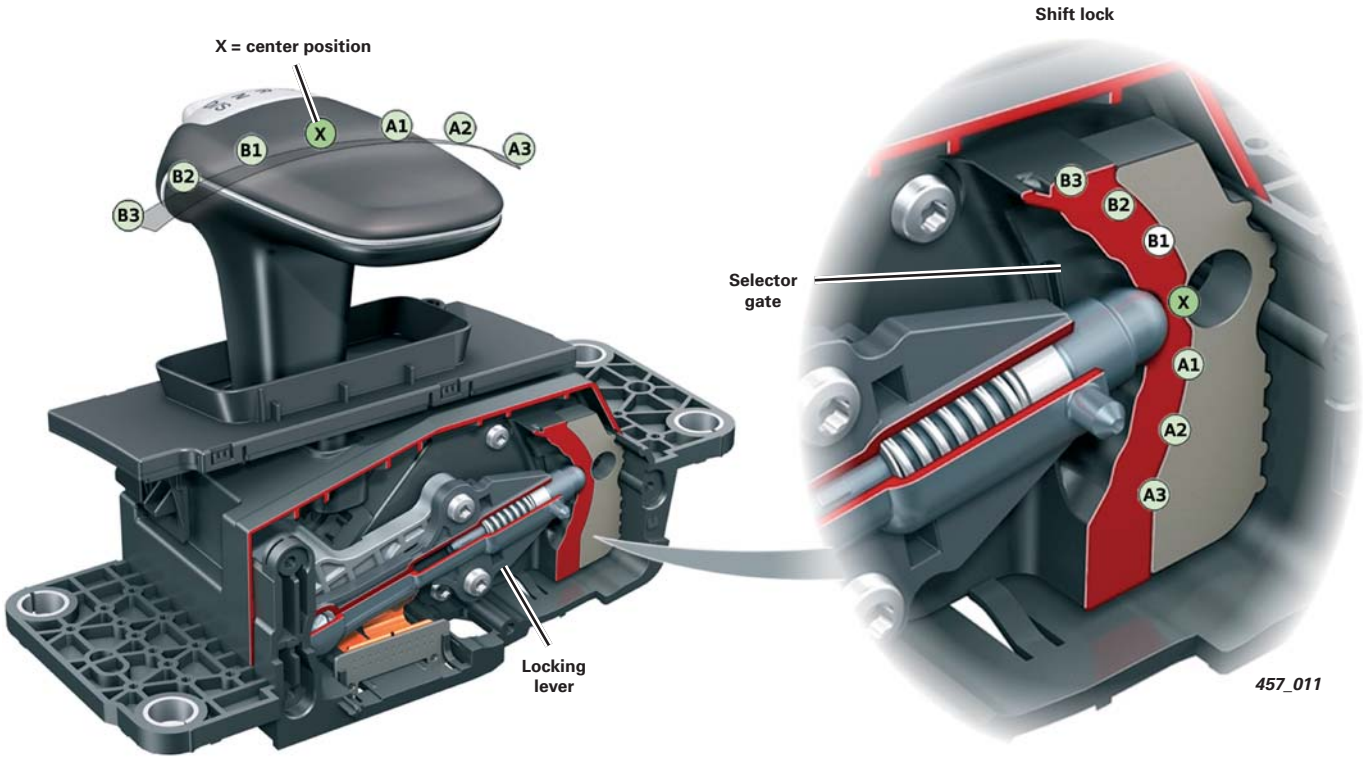
The locking device applies defined actuating forces and provides short, precise shift throws. Five locking solenoids suppress illogical selector lever movements, which promotes logical and intuitive operation.

Example 2

If the transmission is in “Park”, the selector lever cannot be moved forward but it can be moved up to three positions back, as when the driver wants to shift from “P” to “D” (1st step P > R, 2nd step R > N, 3rd step N > D). This corresponds to the actuation logic of a conventional shift control system.

For the following gearshifts, the button must be pushed and/or the foot brake applied:

P >	Button and foot brake
R > P	Button
N > D	Foot brake
D/S > N	Button
N > R	Button and foot brake



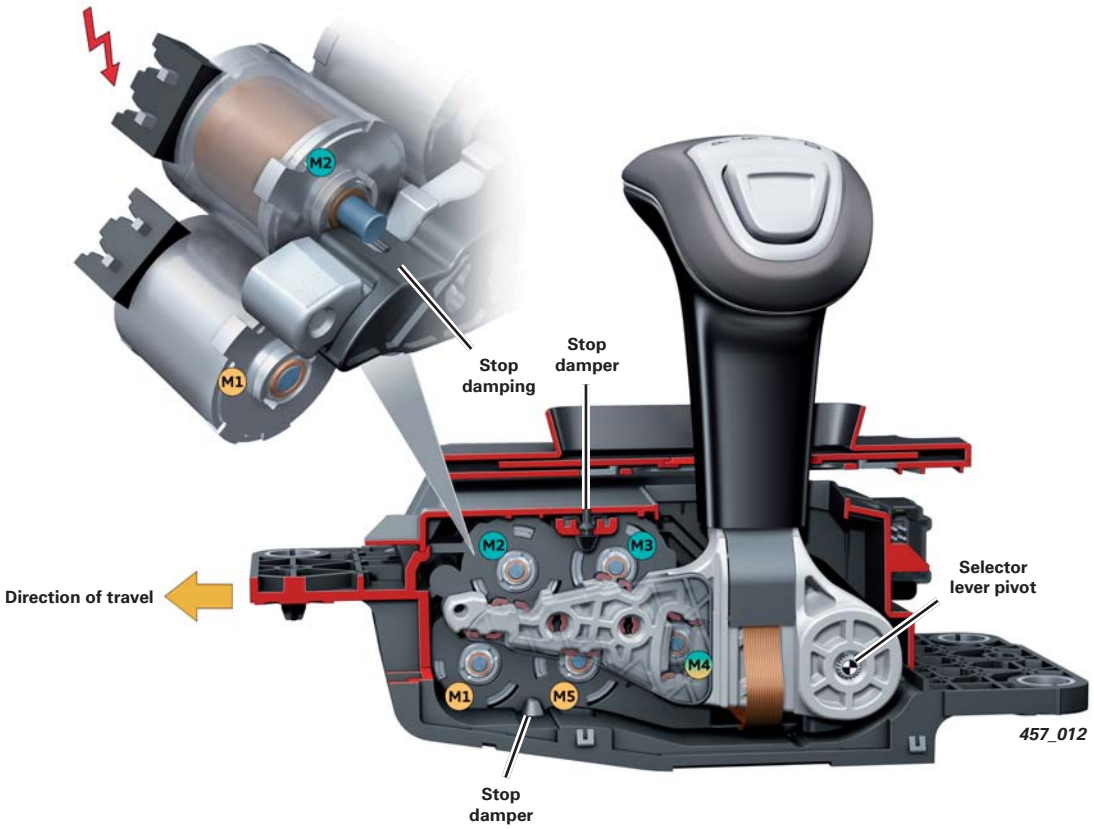
Note

The “N” lock is active approximately one second after “N” is selected.

Shift Schematic

The shift movements of the selector lever are limited by five locking solenoids, resulting in logical and intuitive operation for the driver. They are activated by Selector Lever Sensor System Control Module J587, relative to the selected gear.

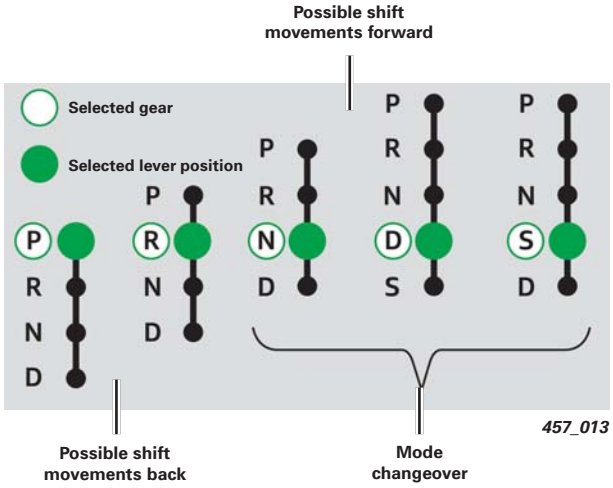
As previously, the unlock button must be pushed and/or the foot brake applied to shift out of gear. For example, the button must be pushed and the foot brake applied when shifting out of “P”.

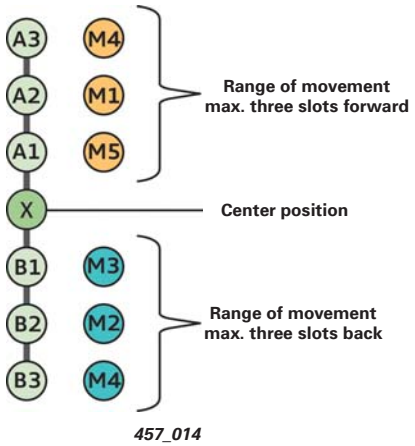


M1	Selector Lever Lock Solenoid 1 N496
M2	Selector Lever Lock Solenoid 2 N497
M3	Selector Lever Lock Solenoid 3 N498
M4	Selector Lever Lock Solenoid 4 N499
M5	Selector Lever Lock Solenoid 5 N500

M1	Suppresses shift movements to A2 and A3 (only A1 is enabled)
M2	Suppresses shift movements to B2 and B3 (only B1 is enabled)
M3+M5	Lacks the selector lever in center position X (with P lock and N lock)
M4	Suppresses shift movements to A3 and B3 (A1, A2 and B1, B2 are enabled)
M5+M3	Locks the selector lever in center position X (with P lock and N lock)

Shift Schematic





Gears can be selected either by repeatedly flicking the selector lever slot by slot in a desired direction or by directly moving the selector lever up to as many as three slots (as per the previous operating logic).

The S gear can be selected from gear D. To change from D to S or from S to D, select B1 (pull selector lever 1 notch back). If the “dynamic” mode is selected with “Audi drive select”, S is automatically engaged.

Selector Lever Sensor System Control Module J587

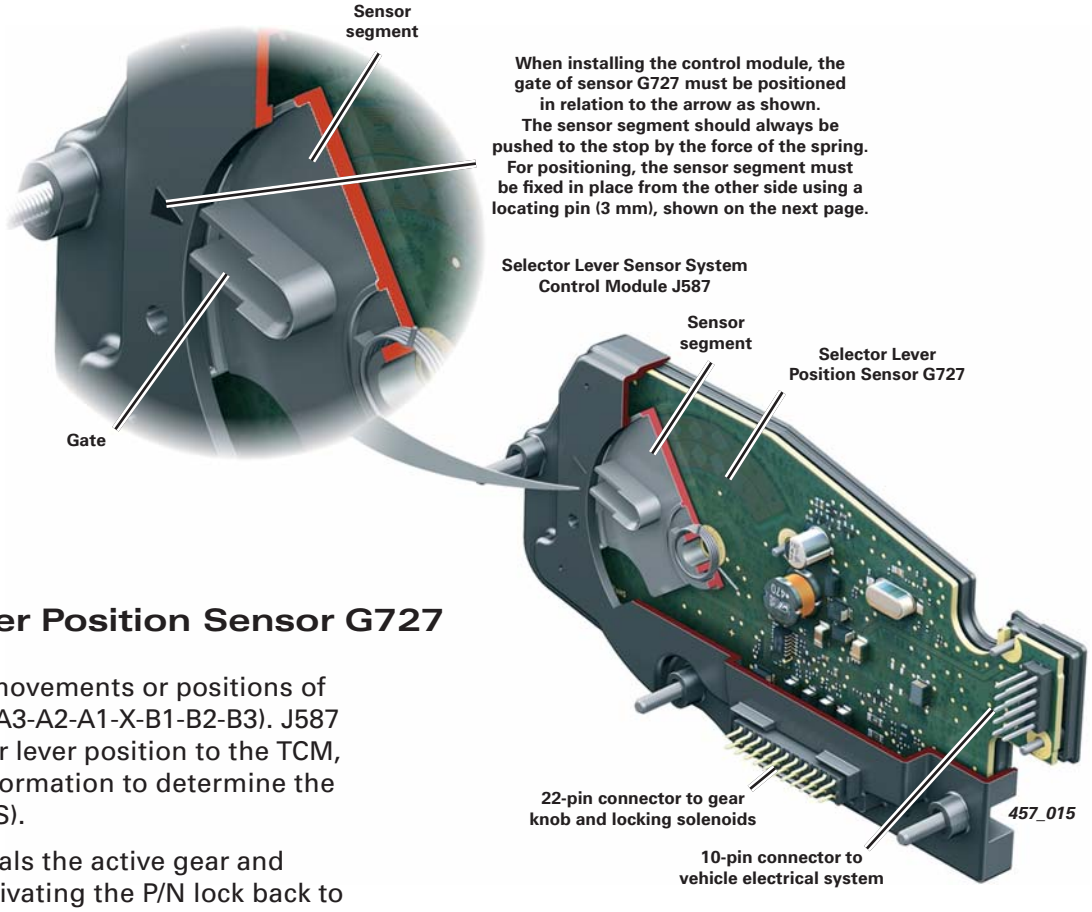
J587 forms a functional unit together with Selector Lever Position Sensor G727. This unit is responsible for detecting driver inputs, for evaluating signals and communicating with Transmission Control Module J217, and for all control and diagnostic functions of the shift control system.

Characteristics and special features at a glance:

- Address word 81
- Data protocol UDS
- Separate CAN connection to J217
- Independent event logger (max. eight entries)
- 24 MVBs are available for diagnostics
- Output Check Diagnosis (in VSD mode only)
- J587 can be replaced separately
- No programming/encoding needed
- Updatable with the VAS Scan Tool

J587 has the following tasks:

- Determine the shift movements and position of the selector lever (together with G727) and relay the sensor signal to the TCM
- Select and activate the five locking solenoids for the P/N lock and shift throw limitation, according to the gear signaled back by the TCM
- Communicate with the TCM via a separate CAN bus
- Process the signal from Selector Lever Release Button E681 and relay this information to the TCM
- Activate Selector Lever Transmission Range Position Display Unit Y26 according to the gear signaled back by the TCM



Selector Lever Position Sensor G727

G727 records the movements or positions of the selector lever (A3-A2-A1-X-B1-B2-B3). J587 signals the selector lever position to the TCM, which uses this information to determine the gear (P, R, N, D, or S).

The TCM then signals the active gear and information for activating the P/N lock back to J587. Locking solenoids N496 to N500 and Y26 are activated based on this feedback.

The speed and brake signals which are required to generate the P/N lock signal are processed by the TCM.

Functions, Networking and Interfaces

Information to Transmission Control Module J217:

– Selector lever positions A3-A2-A1-X-B1-B2-B3
– Operating condition of selector lever release button E681
– Status of selector lever lock
– Status of event logger

Information from J217:

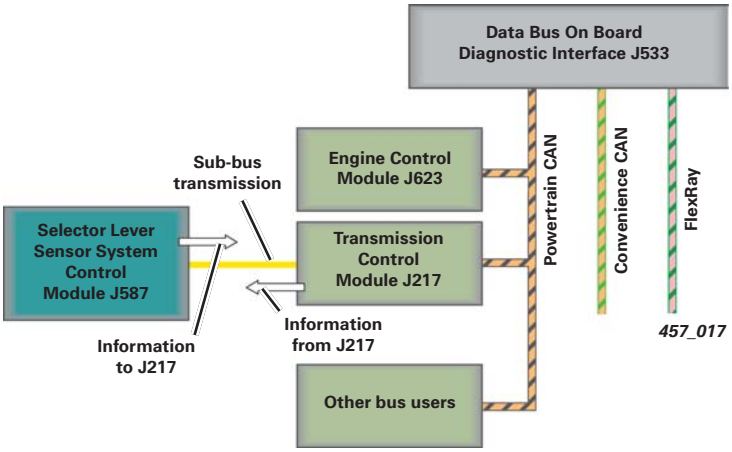
– Information — Gear (P, R, N, D, S)

The TCM determines gears based on "selector lever position information". Selector Lever Sensor System Control Module J587 uses this information to activate the locking solenoids and Selector Lever Transmission Range Position Display Unit Y26.

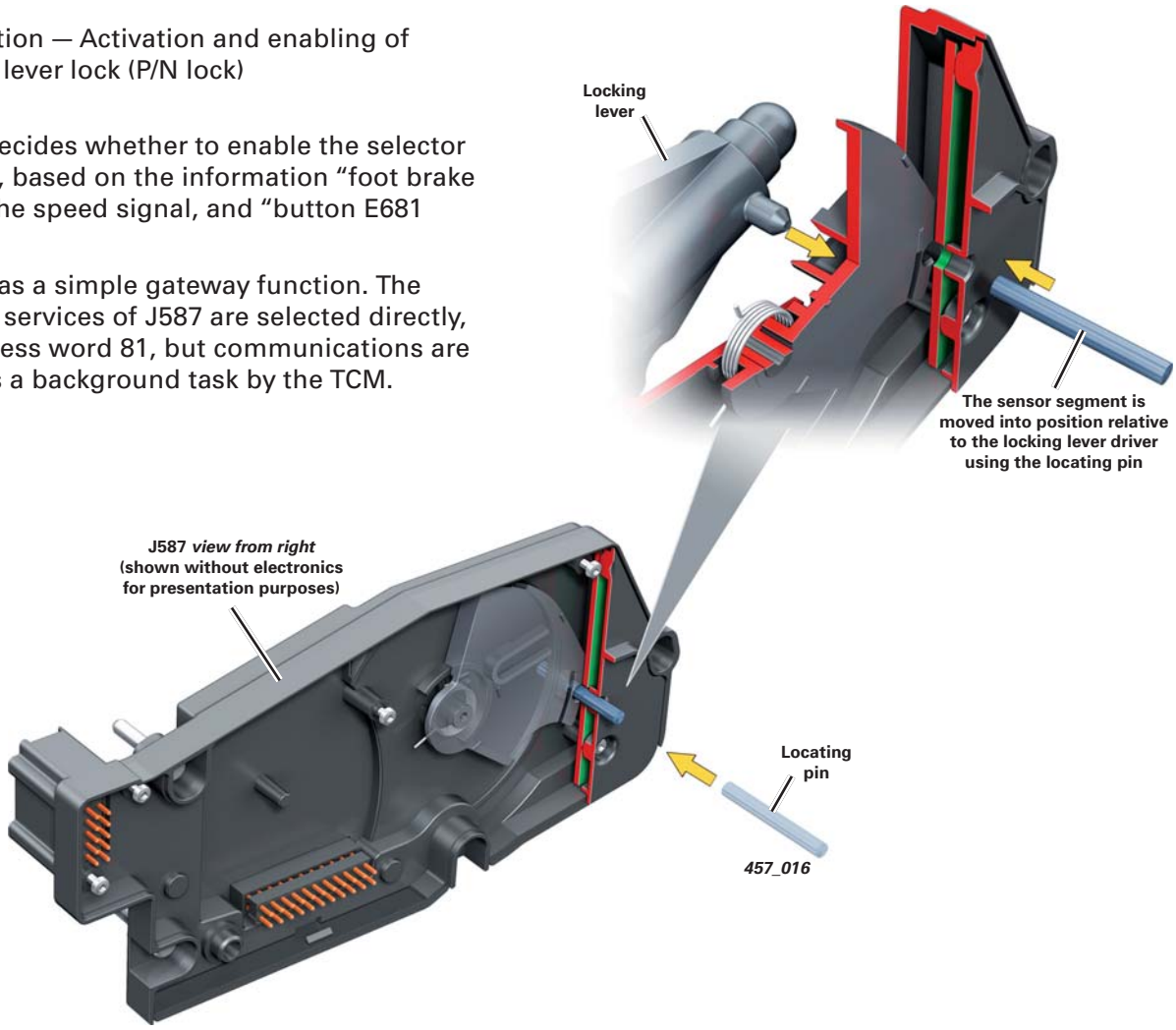
– Information — Activation and enabling of selector lever lock (P/N lock)

The TCM decides whether to enable the selector lock or not, based on the information "foot brake applied", the speed signal, and "button E681 pushed".

The TCM has a simple gateway function. The diagnostic services of J587 are selected directly, using address word 81, but communications are handled as a background task by the TCM.



Installing J587



Selector Lever Release Button E681

E681 is used for unlocking the selector lever, which is now unlocked electrically, not mechanically. To improve reliability, the button is configured as a circuit with two microswitches.

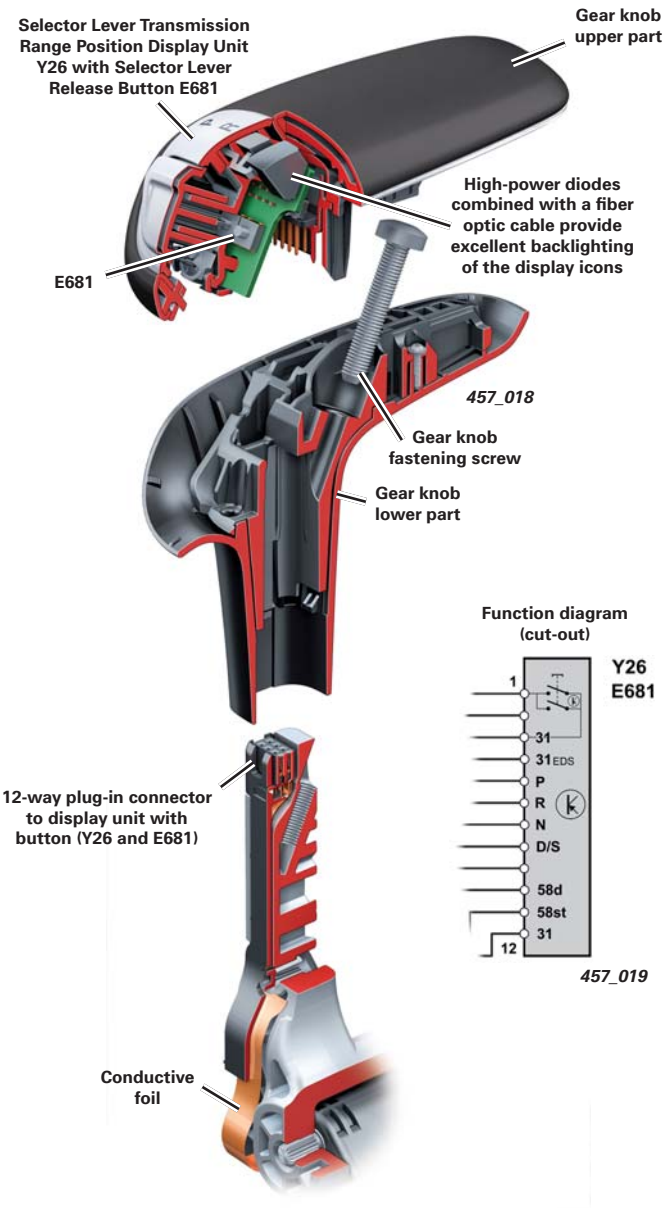
Both switches are monitored by self-diagnostics. If a switch is faulty, a fault will be indicated. However, the selector lever can still be actuated as long as a switch is still working.

Selector Lever Transmission Range Position Display Unit Y26

The display unit is integrated into the gear knob and indicates the current gear. To give the driver better information, the gear indicator (function lighting) stays ON for approximately 10 seconds after switching the ignition OFF. The locating light (see below) is switched by Vehicle Electrical System Control Module J519.

To protect the electronics of the shift control mechanism and the gear knob from excess voltage, electrostatic discharges caused by the driver are diverted to Selector Lever Sensor System Control Module J587 via a separate ground connection (refer to “terminal 31 ESD” in the functional diagram at right).

To remove the gear knob, unclip the upper part of the knob and remove the fastening screw. Care should be taken during installation to ensure that the masking panel is not damaged, and that it is correctly aligned.

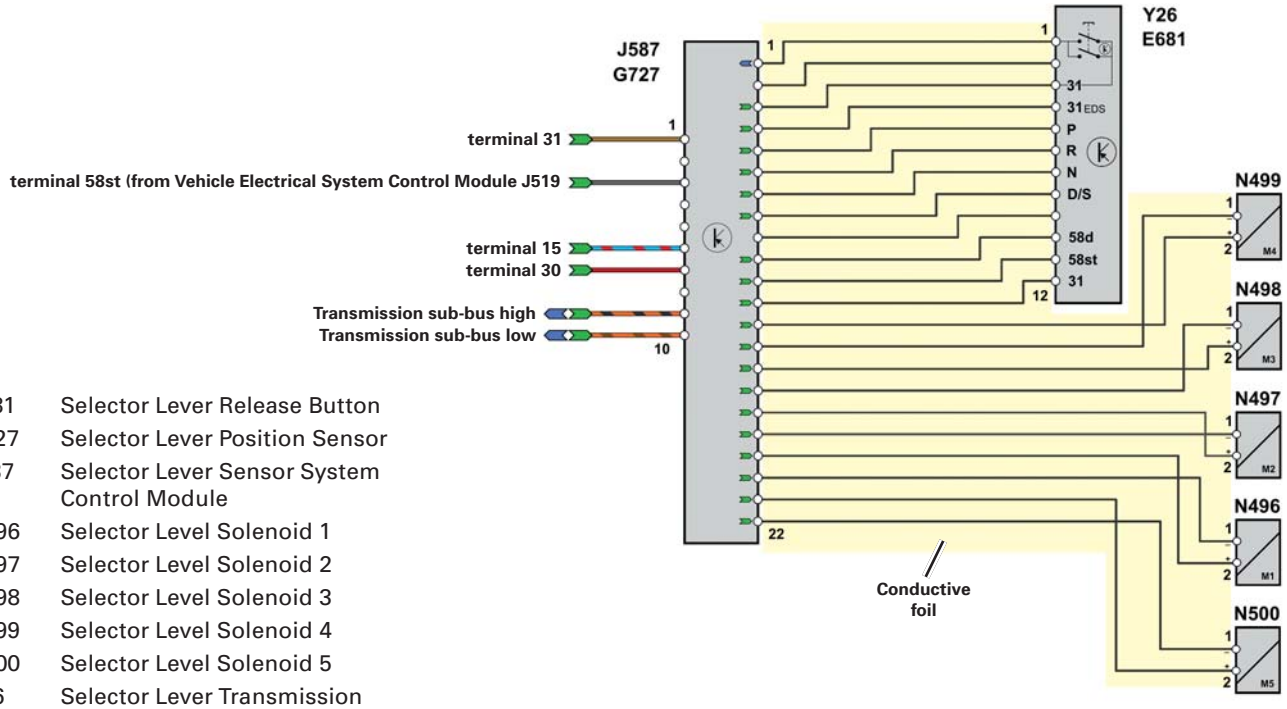


Wiring Diagram Legend	
58st	Locating light with defined dimming. All LEDs in Y26 are activated with low intensity so the selector lever can also be easily located in the dark (without “terminal 15” and/or “terminal 58d”)
58d	Dimming of the LEDs for the function lighting (P, R, N, D/S). Information on dimming level is sent by data bus to Selector Lever Sensor System Control Module J587, which in turn drives the display unit.
31 ESD	Ground connection for diverting electrostatic discharges
ESD	Electrostatic Discharge

Note

If the upper part of the gear knob is not working or is incorrectly installed, all locking solenoids will be deactivated. As a result, all selector lever positions can be selected. A DTC is stored in fault memory and a warning is displayed in the Driver Information System.

Selector Lever E313 Wiring Diagram



E681	Selector Lever Release Button
G727	Selector Lever Position Sensor
J587	Selector Lever Sensor System Control Module
N496	Selector Level Solenoid 1
N497	Selector Level Solenoid 2
N498	Selector Level Solenoid 3
N499	Selector Level Solenoid 4
N500	Selector Level Solenoid 5
Y26	Selector Lever Transmission Range Position Display Unit (Gear)

Gear Shift Indicators

Three displays inform the driver of the gears and, if adapted in the TCM, the actual gear position.

1. Display in gear knob (Y26)
2. Continuous display in the instrument cluster (bottom center)
3. Pop-up window in the instrument cluster (center)

Pop-up display of shift schematic for five seconds when the selector lever or the unlock button is operated

Info that Auto mode can restore by pulling back on the selector lever (or by pushing the "M" button on the steering wheel)

M = manual shifting (Tiptronic mode)

Gear indication in "D" can be activated or deactivated using the adaptation function of the VAS Scan Tool. In "M" (Manual mode) the actual gear position is always displayed.

Notes

Automatic Parking Lock (Auto P)

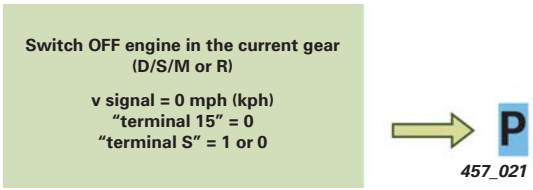
The Auto P function engages the parking lock automatically, without driver intervention. For example, when the engine is switched OFF (either using the ignition key or the START ENGINE STOP button).

The parking lock is engaged automatically when:

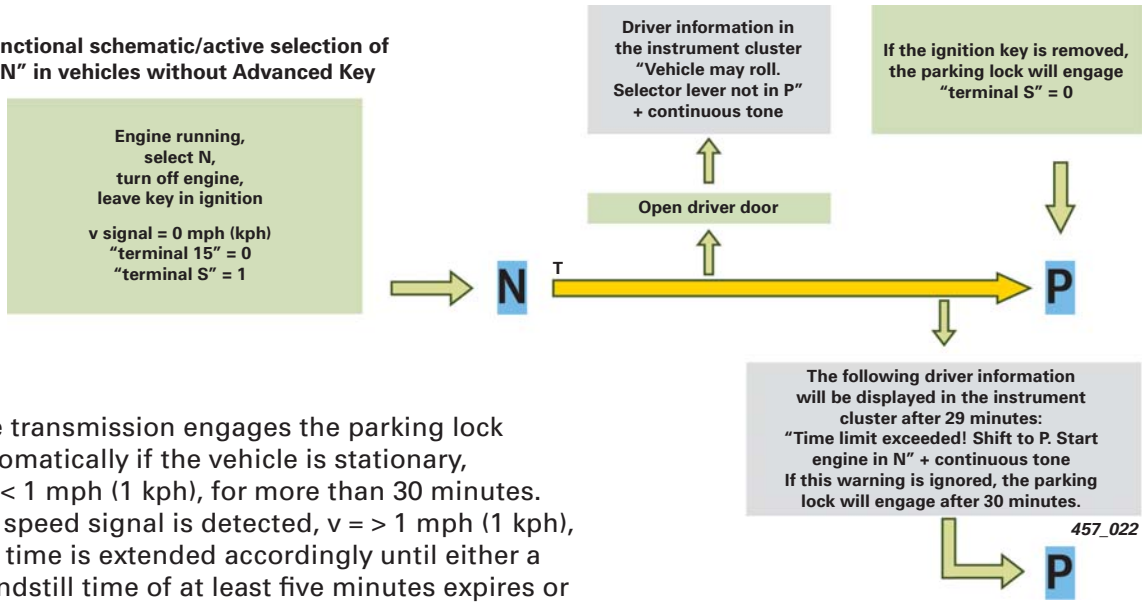
– Vehicle is stationary [speed < 1 mph (1 kph)]
– Gear D, S, or R is active
– Engine is switched OFF, “terminal 15” off (0)

To put the transmission into neutral, move the selector lever to “N” when the engine is running or operate or activate the emergency release device for the parking lock.

Functional schematic/Auto P



Functional schematic/active selection of “N” in vehicles without Advanced Key



The transmission engages the parking lock automatically if the vehicle is stationary, v = < 1 mph (1 kph), for more than 30 minutes. If a speed signal is detected, v = > 1 mph (1 kph), the time is extended accordingly until either a standstill time of at least five minutes expires or the vehicle battery goes dead.

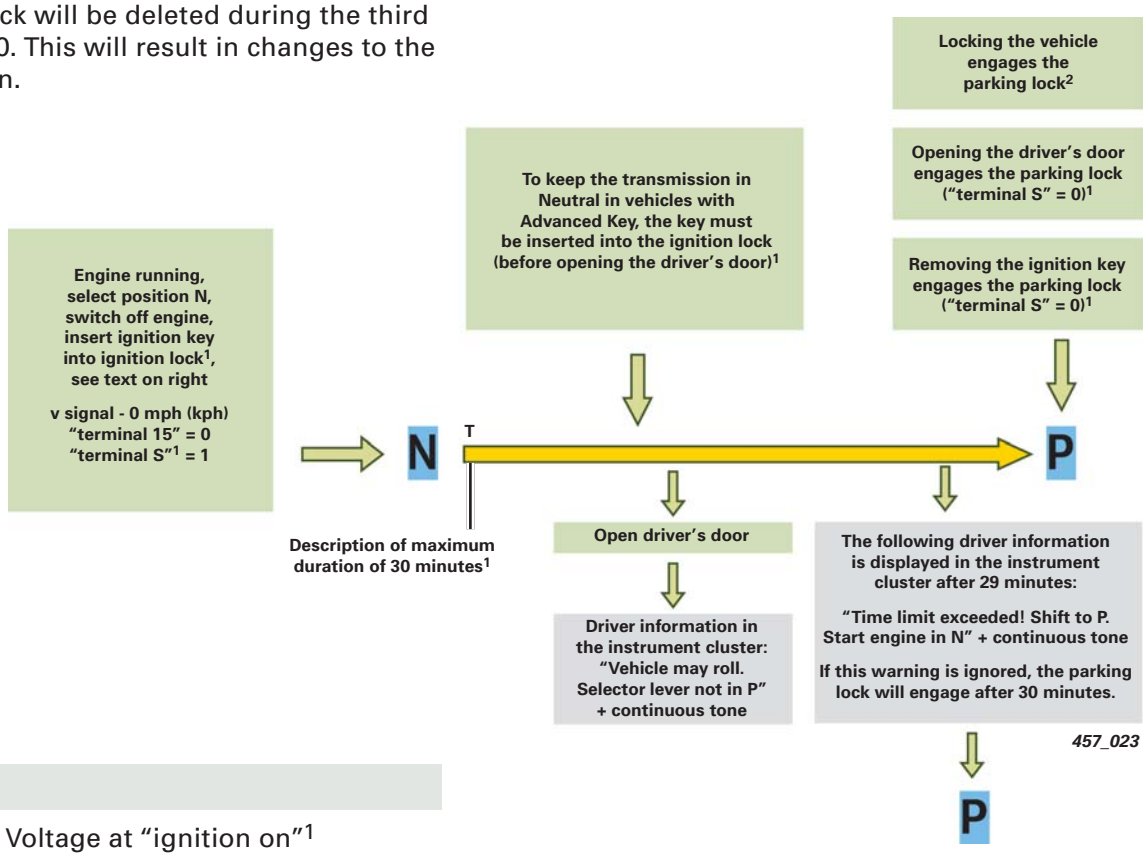
The holding phase in “N” draws an electrical current of approximately 800 mA to power the TCM, the selector lever control module, and the parking lock. A lengthy holding phase in position “N” will cause the battery to discharge. To avoid this, the parking lock emergency release device should be operated before a lengthy holding phase in “N”.

Possible Ways of Selecting Neutral “N”

1. Select position “N” (Neutral) with the shift control when the engine is running. There are differences between vehicles with and without the Advanced Key system (refer to functional schematics of “Auto P function”).
– Active selection of position “N” is for when the vehicle needs to be pushed, for example, in a car wash or at a dealership.
– When position “N” is actively selected, the TCM and the selector lever control module remain active (without “terminal 15”) and hold “N” for up to 30 minutes while the vehicle is stationary).
2. Engage position “N” using the parking lock emergency release device. For example, if the vehicle requires towing or is parked in Neutral.

Active Selection of Gear "N" in Vehicles with Advanced Key

The ignition lock will be deleted during the third quarter of 2010. This will result in changes to the Auto P function.



Legend	
"terminal 15"	Voltage at "ignition on"[1]
"terminal 5"	Indicates whether ignition key is in ignition lock (1) or not (0)
v signal	Speed signal (from transmission)
T	Duration in Neutral position
	Driver action/other conditions
	Action in transmission
	Display in instrument cluster

[1] Vehicles with Advanced Key **until** Q3 2010

[2] Vehicles with Advanced Key **from** Q3 2010

A new Advanced Key system will be introduced. The new system does not have an ignition lock.

Important

Information for vehicles with and without Advanced Key until Q3 2010: When using automated conveyor-type car wash systems, the Neutral position must be selected and the ignition key left inserted in the ignition lock so that the transmission stays in Neutral.

When towing the vehicle or after leaving the transmission in Neutral for lengthy periods of time, the parking lock emergency release device must be operated.

Do not forget to protect the vehicle against unintentional rolling away (using the parking brake, wheel chocks, etc.) if you have selected Neutral, or if the parking lock emergency release device has been activated.

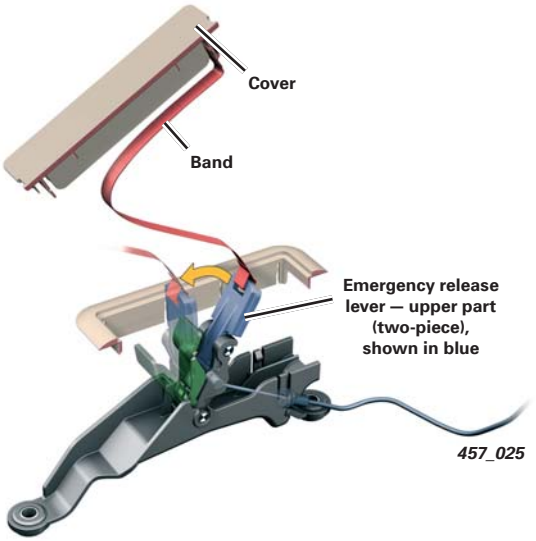
Parking Lock Emergency Release Device

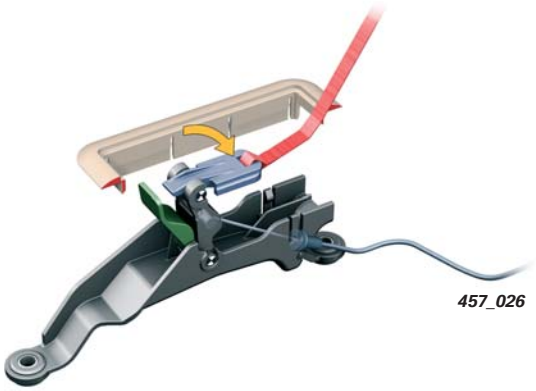
During normal operation, the parking lock is actuated / unlocked electro-hydraulically. The engine must be running to release the parking lock, with a sufficient supply of power required to hold the transmission in a Neutral holding phase, the time of which can vary.

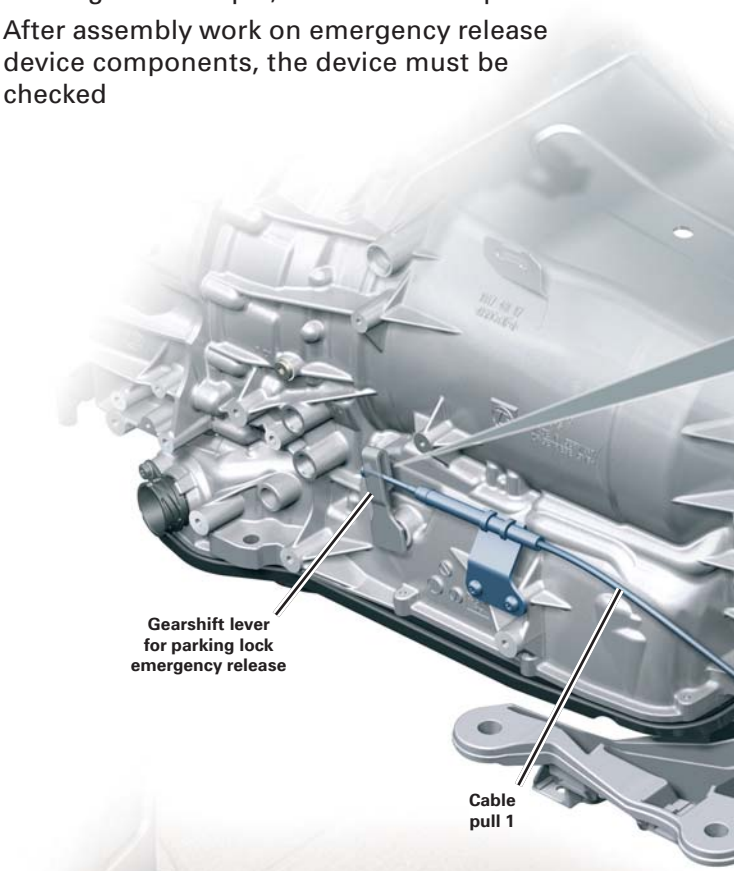
For these reasons, the shift-by-wire system requires an emergency release device for the parking lock.

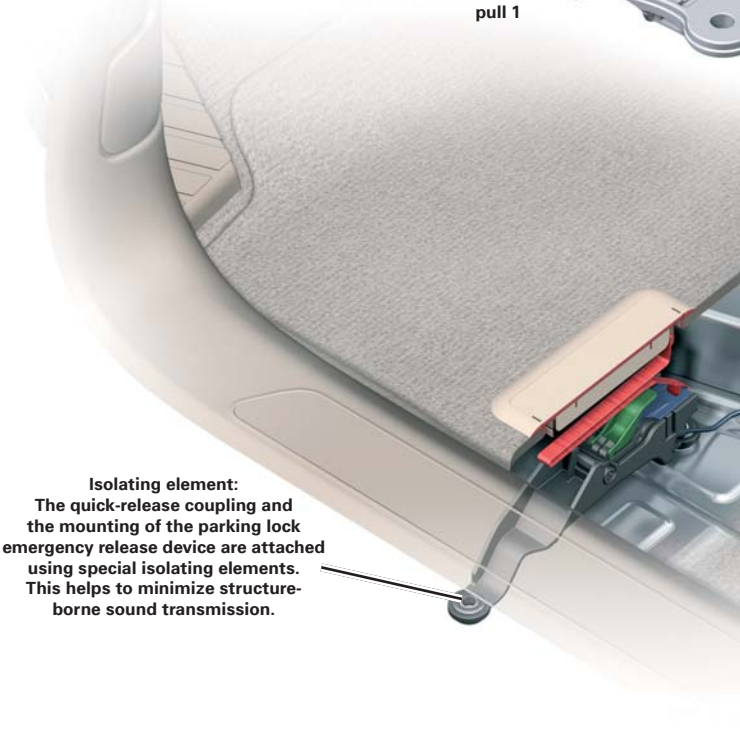
The emergency release device temporarily releases the parking lock and must be actuated in the following situations:

- When towing the vehicle
- If the parking lock cannot be released electro-hydraulically due to a malfunction
- To move the vehicle if there is not enough battery power to start the engine
- To move the vehicle when the engine is not running (for example, at the dealership)
- After assembly work on emergency release device components, the device must be checked







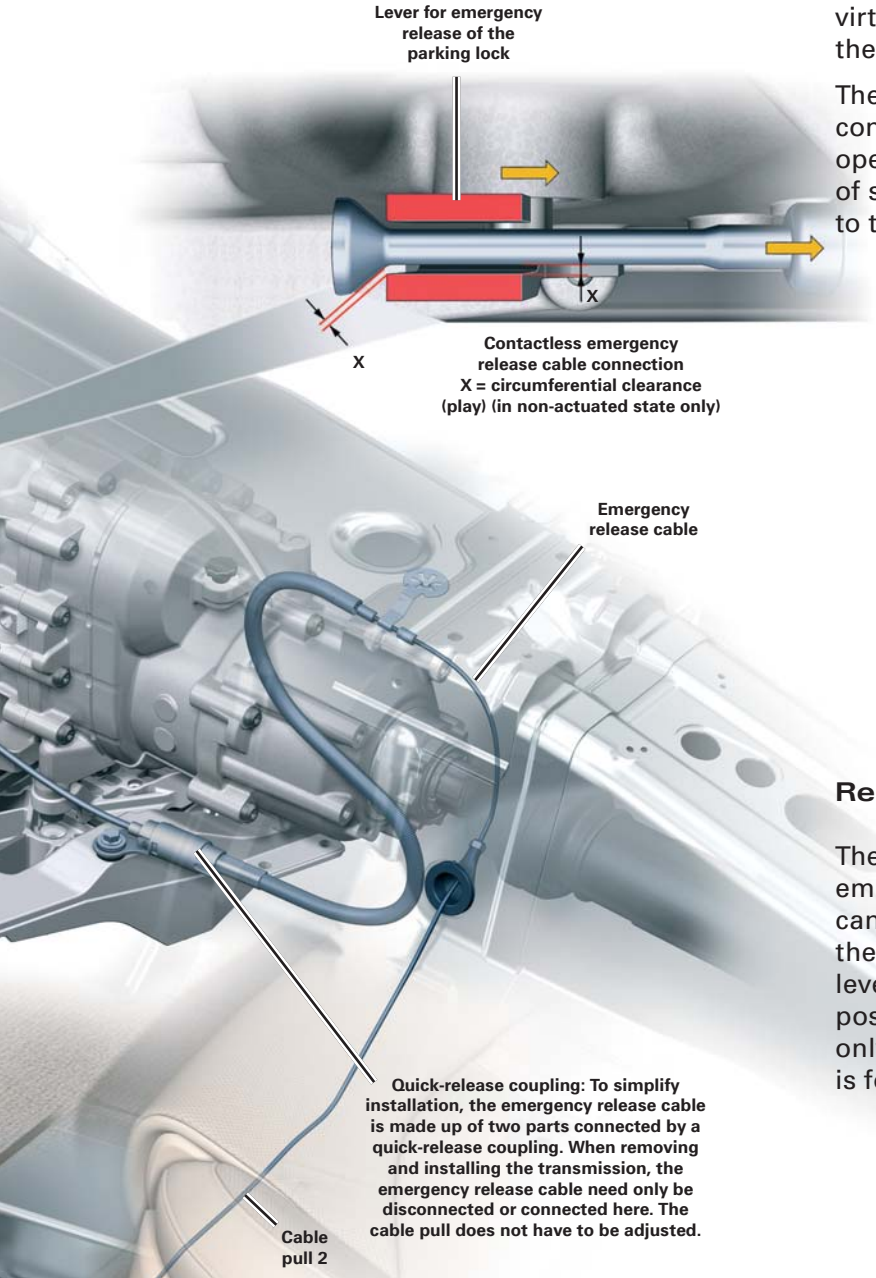


Releasing the Parking Lock

1. Remove the cover. Pull out the emergency release lever with the band until it engages and locks in an upright position.
2. The emergency release lever consists of two parts. The upper part must be folded down so that the lever cannot be unintentionally actuated with the feet. The cover is designed so that it cannot be installed in this condition and should be set aside.

When the parking lock emergency release device is operated, the warning lamp and gear indicator “N” light up in the instrument cluster. The driver warning is: “Vehicle may roll! Cannot shift to P. Please apply parking brake”.

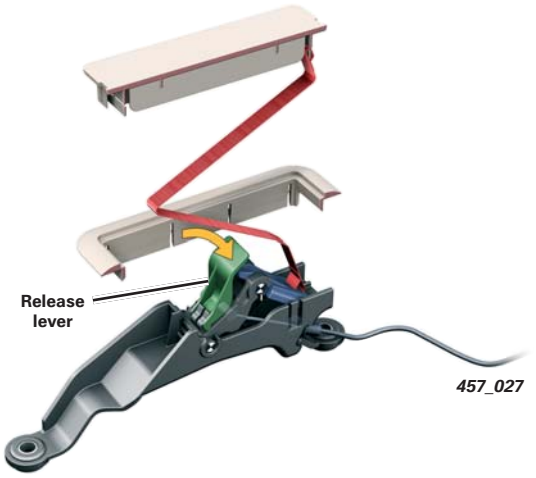
Warning lamp



Reduction of Structure-Born Sound

To curb and eliminate structure-born sound being transmitted to the vehicle interior, special design steps have been taken. For example, the connection between the emergency release cable and gearshift lever is unique. A rigid rod and a conical nipple are fitted on the end of the emergency release cable. The rod is guided virtually backlash free and without contact by the gearshift lever.

The rod and gearshift lever do not come into contact unless the emergency release device is operated. This largely eliminates the transmitting of structure-born sound from the transmission to the cable pull.



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Releasing the Parking Lock

The release lever (shown in green) unlocks the emergency release lever so that the parking lock can again be engaged. This is done by pushing the release lever against the emergency release lever and moving the lever back into its normal position. The cover is designed so that it can only be installed if the emergency release lever is folded down.

457_024

Note

After removing and installing the transmission or after assembly work on components of the emergency release device, a function check should be carried out as described in current service repair literature.

Rear Axle Drive OBC and OBF

Conventional Rear Axle Drive and Sport Differential

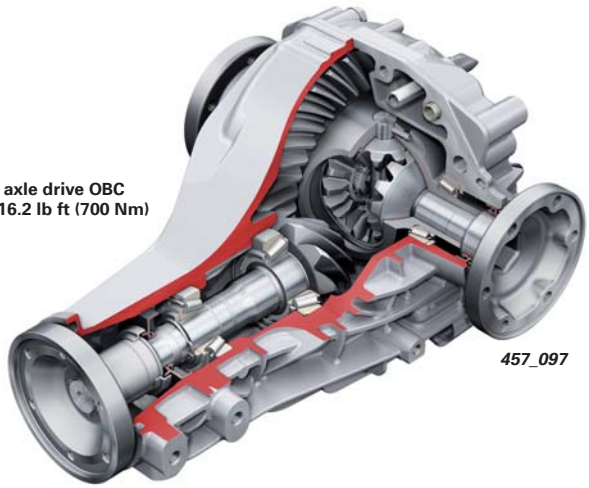
The 2011 Audi A8 is equipped with a conventional rear axle differential (OBC) as standard equipment. The sport differential (OBF) is installed on vehicles with the optional PPT Sport Package.

A major new feature of the sport differential is that All Wheel Drive Control Module J492 interfaces with the FlexRay data bus. This provides much better performance in every respect. J492 obtains all relevant current information on vehicle dynamics from Sensor Electronics Control Module J849 via the FlexRay.

Sport Differential with Start-Up Function

The sport differential in the 2011 Audi A8 is enhanced with a special start-up. Additional drive torque is directed to specific wheels to transmit the highest drive torque. If the rear left wheel starts to spin during acceleration, drive torque to the right (stationary) wheel is increased by activating the right Speed Modulation Unit.

Rear axle drive OBC
Up to 516.2 lb ft (700 Nm)



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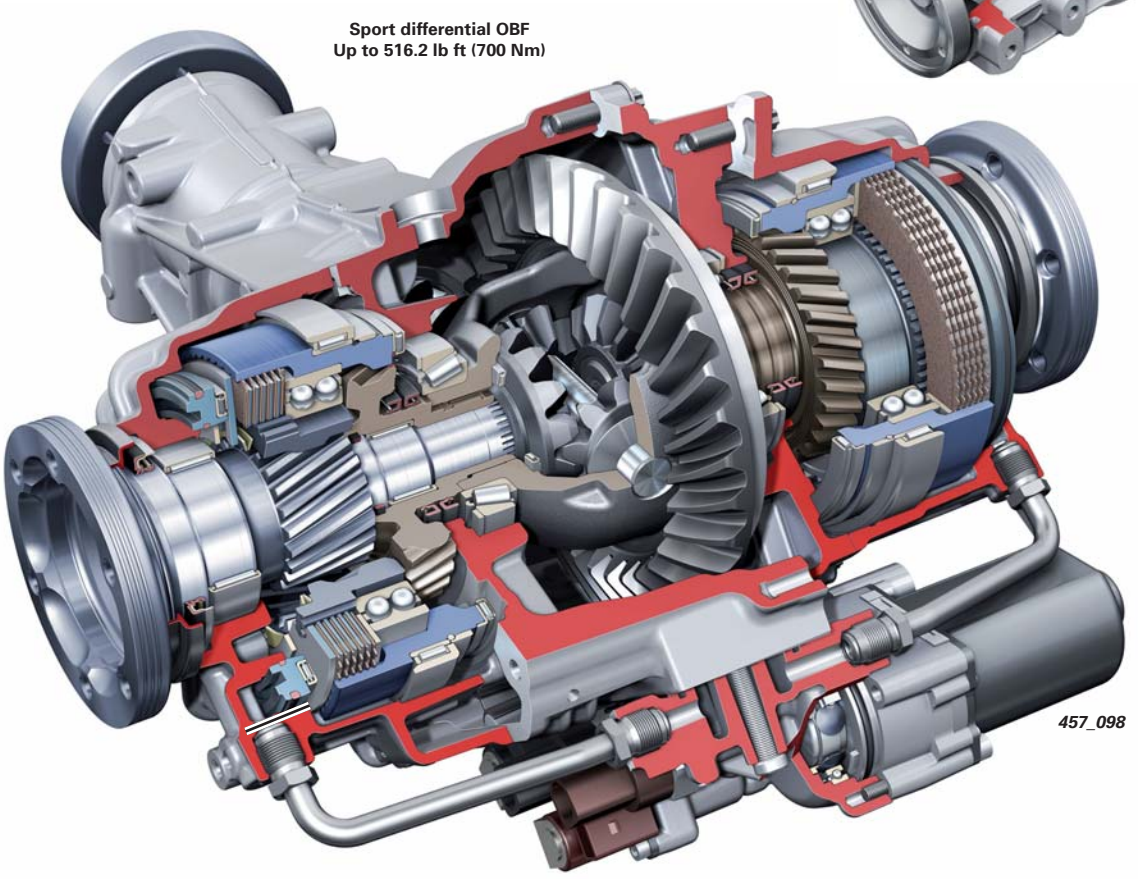
Sport differential OBF
Up to 516.2 lb ft (700 Nm)



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Reference

For a more complete description of the Audi Sport Differential, refer to Self-Study Program 990193, *Audi New Technology 2009 – 2010*.

Intelligent Torque Distribution

The 2011 Audi A8 features a new design called "intelligent torque distribution". This design is an enhanced version of the current Electronic Differential Lock (EDL) function. However, unlike the EDL system, the electronic transverse lock is active when cornering and intervenes before critical slip occurs at the wheels.

For this purpose, the control module computes the load taken off the wheels on the inside of the corner, as well as the load on the wheels on the outside of a corner when cornering. This calculation is based on measurement data acquired by the steering angle and transverse acceleration sensors.

The ABS control module uses this information to determine the ideal brake pressure for the wheels on the inside of the corner.

How it Works

A multiplying torque is produced when cornering through controlled braking of the wheels on the inside of a corner. As a result, additional drive torque is directed to the wheels on the outside of the corner. Cornering traction is made significantly better, and the vehicle is capable of higher cornering speeds and better handling.

The system reacts to changes in wheel load and not to wheel slip. Necessary brake pressure of 72.5 – 217.5 psi (5 – 15 bar) is relatively low, minimizing brake load and material stress.

Vehicles with the OBC standard rear axle drive have intelligent torque distribution on the front and rear axles. In vehicles with a sport differential, intelligent torque distribution is effective only on the front axle.

Physics

Driving physics dictate that maximum transmissible drive torque becomes greater with increasing transverse acceleration at the wheels on the outside of the corner, while decreasing to the same extent at the inner wheels.

This is due to the effect of centrifugal force acting on the vehicle's center of gravity and its line of action toward the outside of a corner. This results in what is known as "roll torque", which is exerted on the wheels. This roll torque reduces the wheel load on the inside of a corner and increases the wheel load on the outside of a corner.

Consequently, the wheels on the inside of the corner are not able to transmit as much torque as the wheels on the outside of the corner.

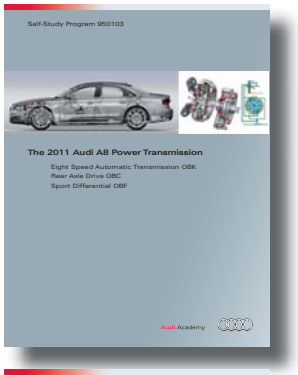
The open axle differentials distribute drive torque at a ratio of 1 : 1 to both wheels on an axle. If the maximum transmissible torque at the driven wheel on the inside of the corner decreases, the wheel on the outside of the corner will only be able to transmit the same amount of torque, even though the greater effective wheel load would theoretically allow it to transmit considerably more drive torque.

If the wheel on the inside of the corner loses drive torque, the entire powertrain will lose drive torque.

Self-Study Programs for the 2011 Audi A8

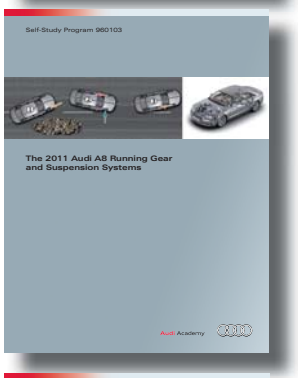
SSP 950103 The 2011 Audi A8 Power Transmission

- Eight-Speed Automatic Transmission OBK
- Shift-by-Wire Control System
- Rear Axle Drive OBC
- Sport Differential OBF



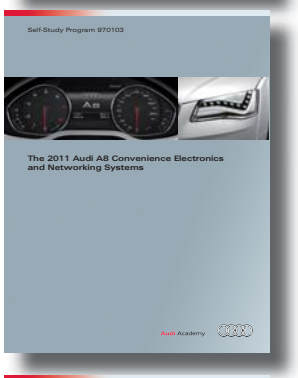
SSP 960103 The 2011 Audi A8 Running Gear and Suspension Systems

- Axle and Wheel Alignment
- Adaptive Air Suspension
- Brake System
- ESP
- Steering System
- Adaptive Cruise Control (ACC)



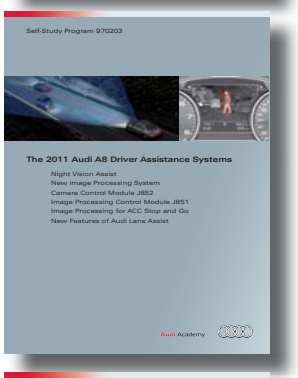
SSP 970103 The 2011 Audi A8 Convenience Electronics and Networking Systems

- Power Supply
- Network System
- FlexRay
- Exterior Lights
- Ambient Lighting



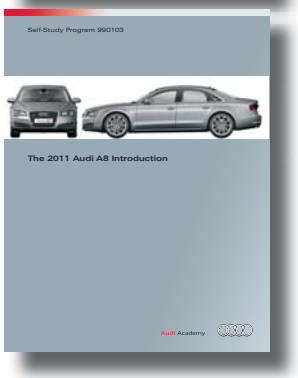
SSP 970203 The 2011 Audi A8 Driver Assistance Systems

- Night Vision Assist
- New Image Processing System
- Image Processing Functions for ACC Stop and Go
- Diagnostic Functions and System Calibration
- New Features of Audi Lane Assist



SSP 990103 The 2011 Audi A8 Introduction

- Body
- Passive and Active Safety
- Powertrain
- Audi Drive Select
- Heating, Ventilation, and Air Conditioning (HVAC)



Knowledge Assessment

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

The Knowledge Assessment is required for Certification.

You can find this Knowledge Assessment at:

www.accessaudi.com

From the accessaudi.com Homepage:

- Click on the “ACADEMY” tab
- Click on the “Academy Site” link
- Click on the “CRC/Certification” link
- Click on Course Catalog and select “950103 — The 2011 Audi A8 Power Transmission”

For assistance please call:

Audi Academy

Certification Resource Center (CRC)

1-877-283-4562

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

Or you may send an email to:

audicrchelpdesk@touchstone-group.com

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

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