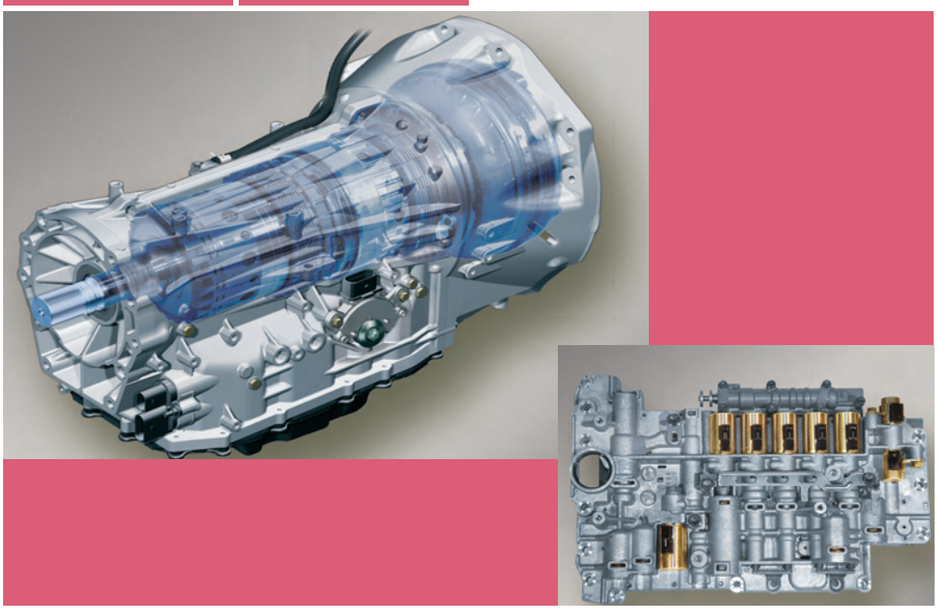
Service Training



The Audi 09D Automatic Transmission

Self-Study Program 951703

Audi of America, Inc.
Service Training
Printed in U.S.A.
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The Self-Study Program teaches the design and function of new vehicle models, automotive components, and technologies.

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

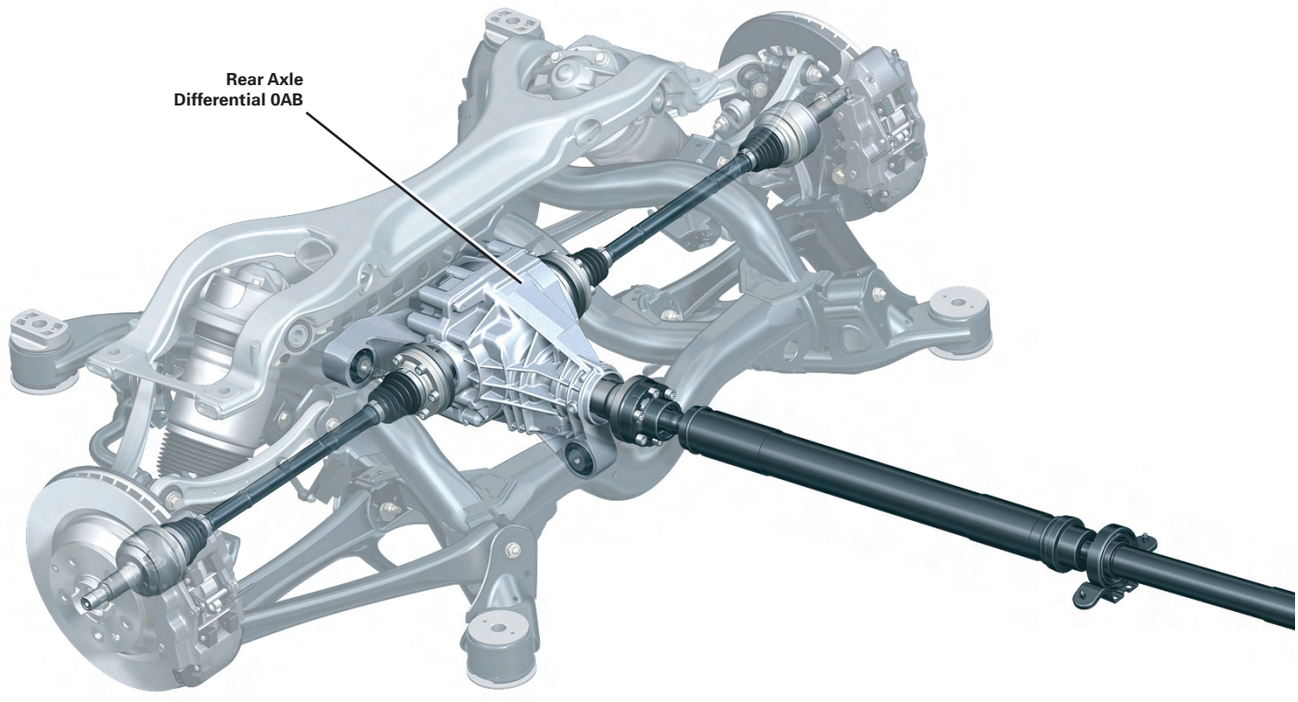


Introduction

The 09D Six-Speed Automatic Transmission in the Audi Q7

Unlike the Audi longitudinal AWD configurations where the front axle differential and transfer case are integrated with the transmission, the 09D six-speed automatic transmission in the Audi Q7 is designed as an independent component.

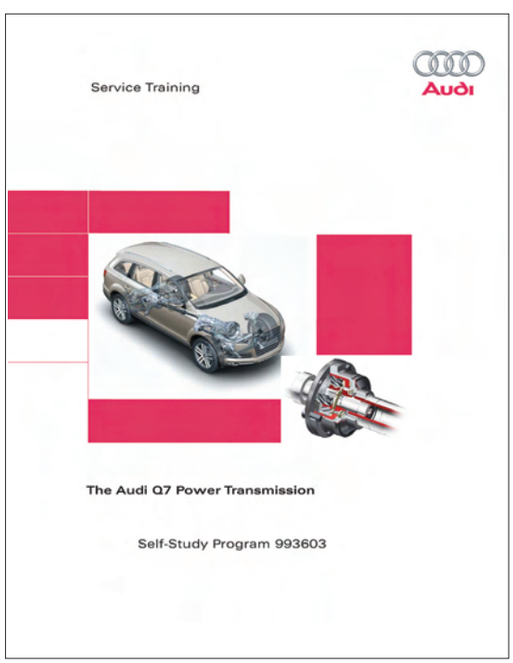
The powertrain of the Audi Q7 has a modular configuration. This means that the various subassemblies – the transmission, the front axle differential, and the transfer case – are separate units.



Note

In addition to the general descriptions of the 09D transmission, this Self-Study Program covers special features in the context of the Audi Q7.

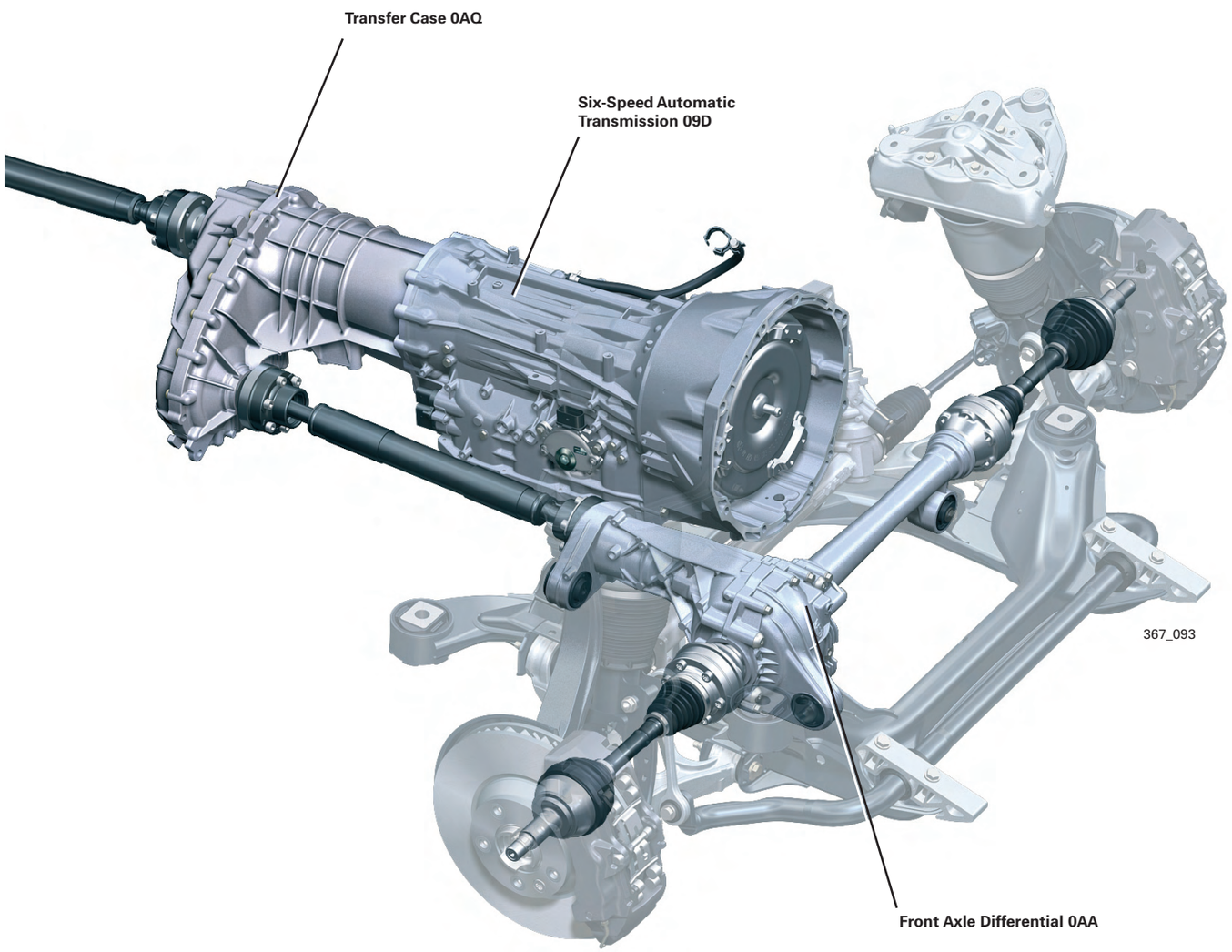
For information about the power transmission in the Audi Q7 and transfer case 0AQ, refer to Self-Study Program 993603, The Audi Q7 Power Transmission.



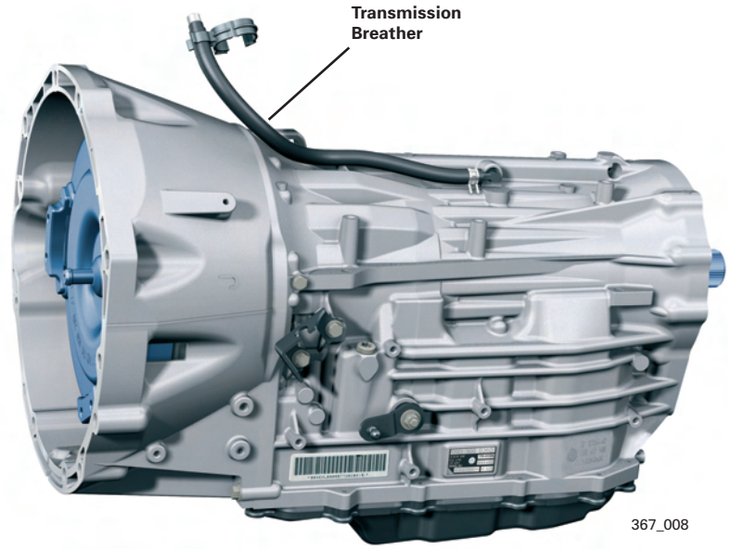
The 09D transmission can transmit up to 553.1 lb ft (750 Nm) of engine torque and is currently used in combination with the most powerful engines in the Audi Q7.

Special Features Designed for Off-Road Use

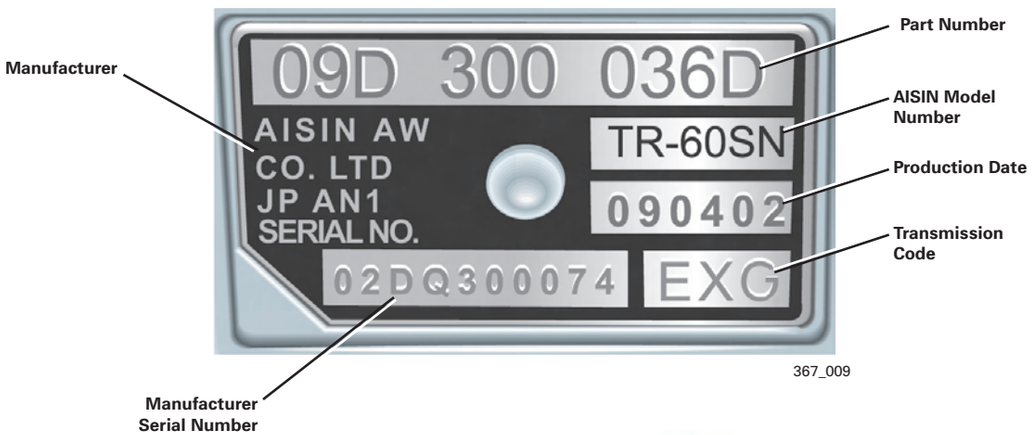
- A special low ATF pick-up point and a high ATF capacity ensure reliable oil intake in rough terrain.
- A large ATF cooler maintains the ATF temperature at a safe level.
- The elevated transmission breather hose prevents ingress of water into the transmission, even under adverse conditions.
- A large torque converter with lockup clutch reduces heat build-up in the ATF and allows power to be transmitted directly.



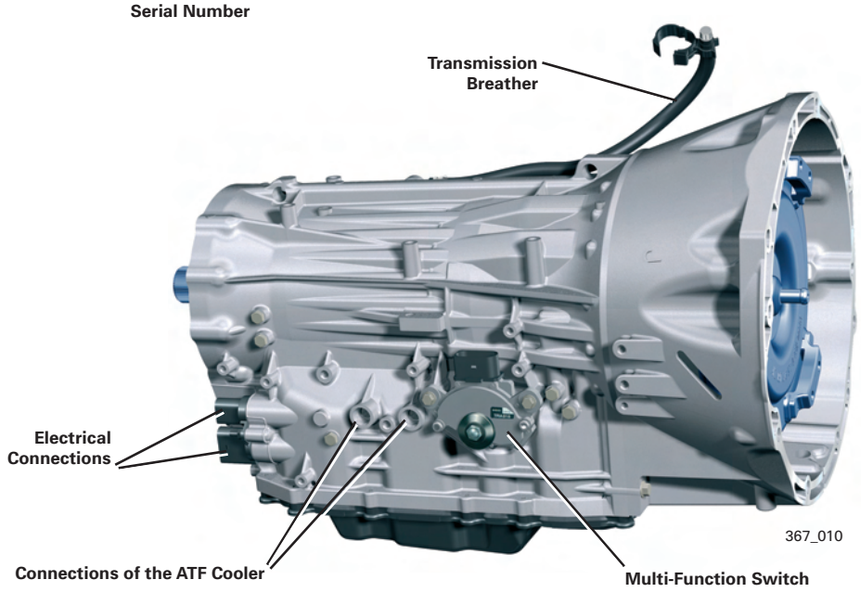
Specifications



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367_009

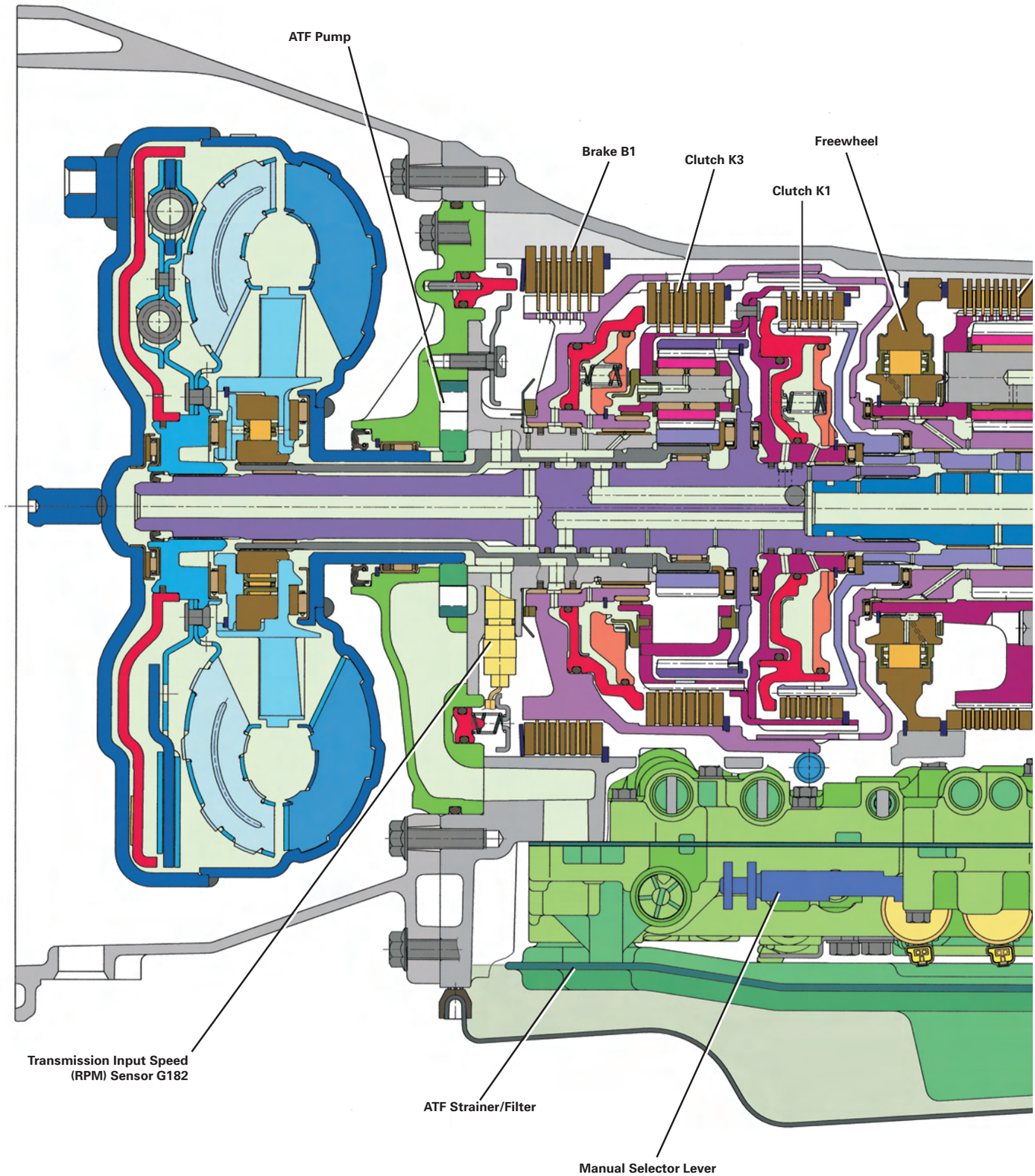


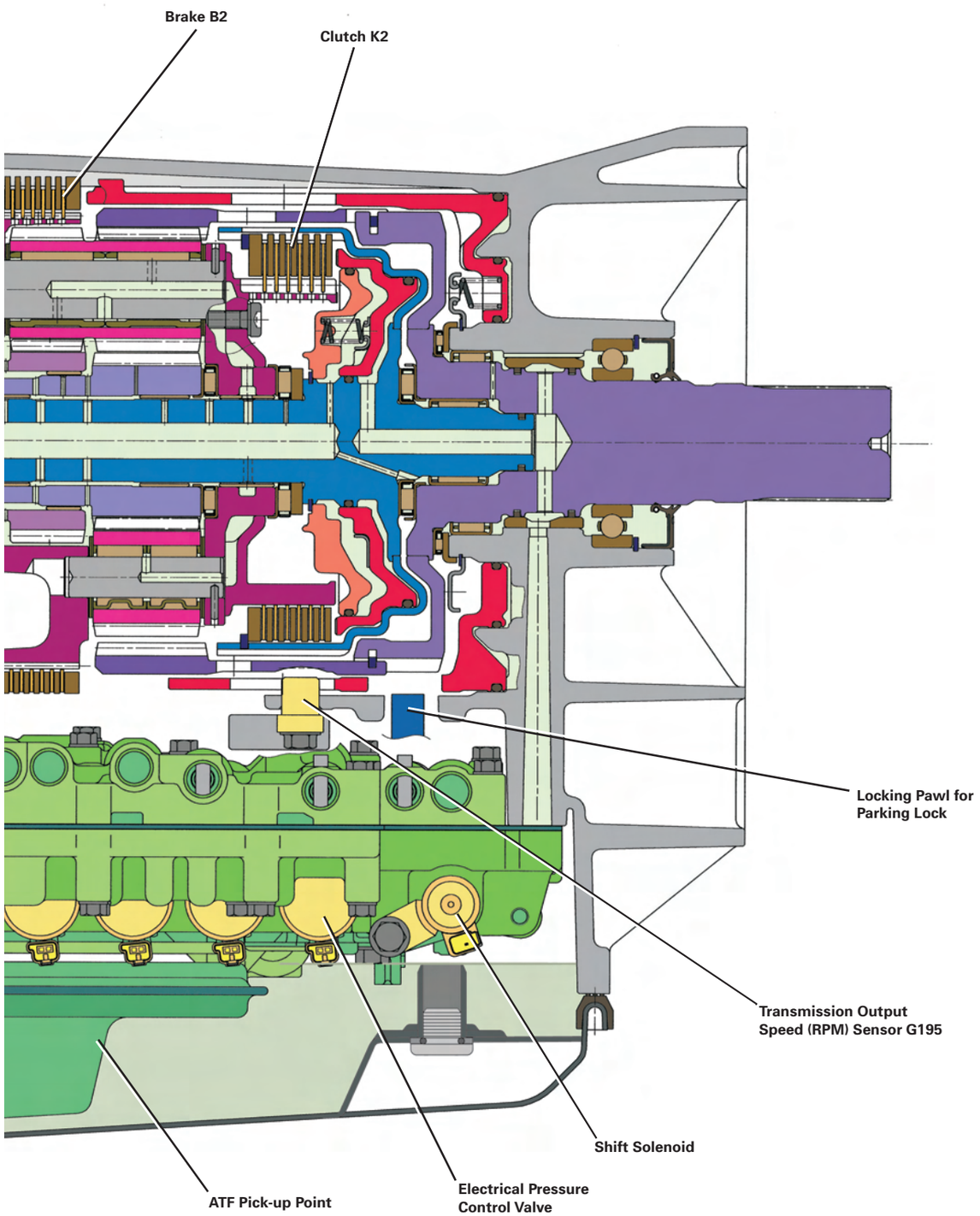
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Specifications

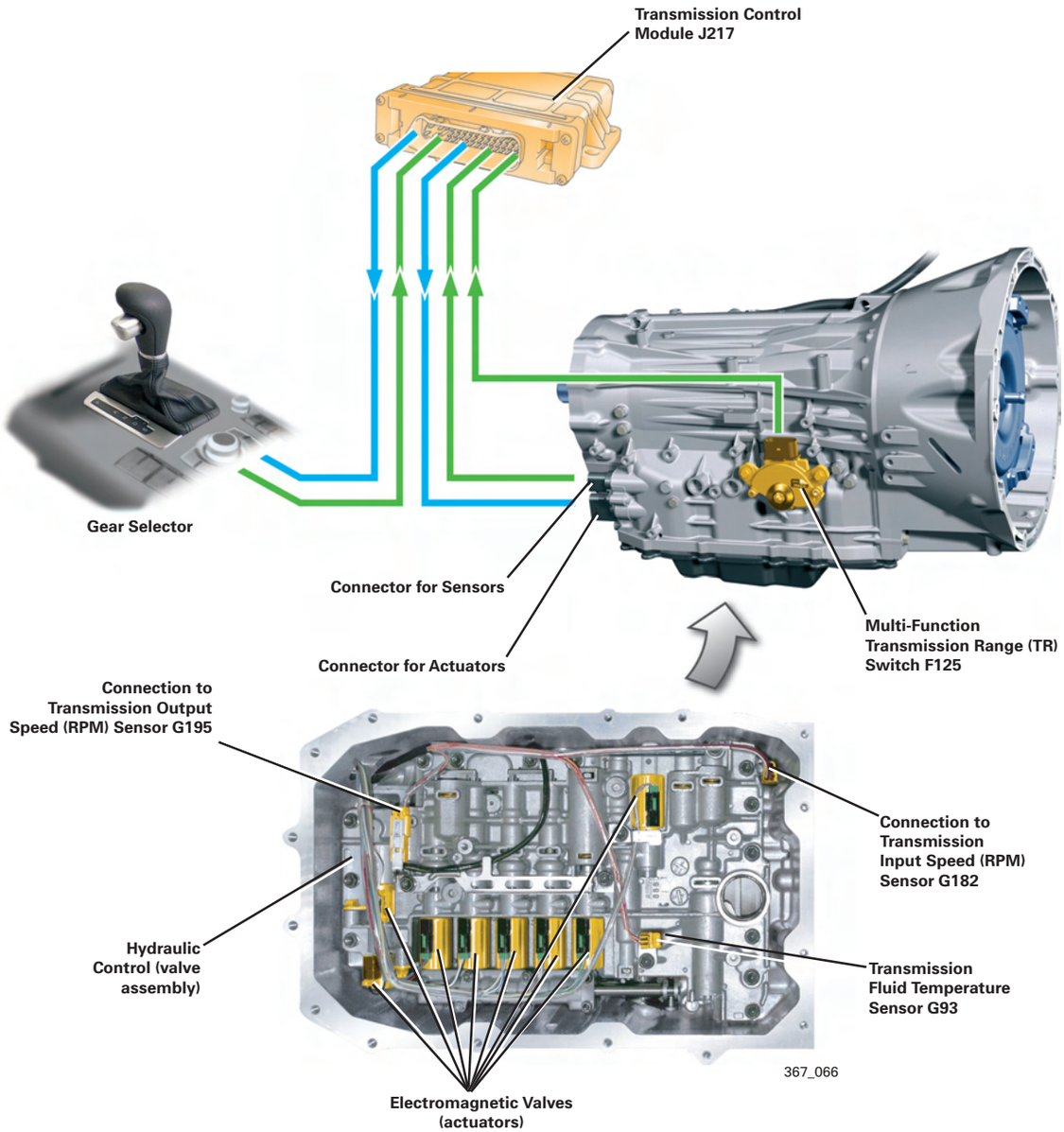
Developer/Manufacturer	AISIN AW CO. LTD Japan
Designations	Manufacturer: TR-60SN Audi AG: AL750-6Q Service: 09D
Transmission Type	Electro-hydraulically Controlled Six-Speed Planetary Gear (step automatic transmission) with a Planetary Gear Set Concept Based on the Lepelletier Principle. Hydro-dynamic Torque Converter with Slip-Controlled Lockup Clutch. Designed for Longitudinal Installation in Combination with a Transfer Case
Control	Hydraulic Control Module (valve assembly) in the Oil Sump with External Electronic Control Module. Dynamic Shift Program (DSP) with Separate Sport Program in “Position S” and Tiptronic Shift Program for Manual Gear Shifting (optionally available with Tiptronic steering wheel). Special Feature: in Tiptronic Mode, it is Possible to Start in Second Gear.
Maximum Torque	553.1 lb ft (750 Nm) Depending on Type
Ratios: Planetary Transmission	1st Gear 4.148 2nd Gear 2.370 3rd Gear 1.556 4th Gear 1.155 5th Gear 0.859 6th Gear 0.686 R Gear 3.394
Spread	6.05
ATF Specification	Refer to ETKA
ATF Service	Approximately 9.5 qt (9.0 L) (new filling) Lifetime Filling
Weight	Between 213.8 - 242.5 lb (97 - 110 kg)
Limp-Home Capability	3rd Gear and R Gear

Cutaway View of the 09D Transmission




Brake B2
Clutch K2
Locking Pawl for Parking Lock
Transmission Output Speed (RPM) Sensor G195
Shift Solenoid
Electrical Pressure Control Valve
ATF Pick-up Point

367_011



Bottom View of the Transmission — Looking at the Hydraulic Control (valve assembly)

Legend to Sectional View of Transmission

- Hydraulic Parts, Hydraulic Control, ATF
- Components of Planetary Gear Sets
- Shafts and Gears
- Multi-Plate Clutches, Bearings, Washers, and Circlips
- Plastics, Seals, Rubber, and Washers
- Components of Shift Elements Cylinders, Pistons, and Air Sensor Plates
- Housings, Screws, and Bolts
- Electrical Components

Notes

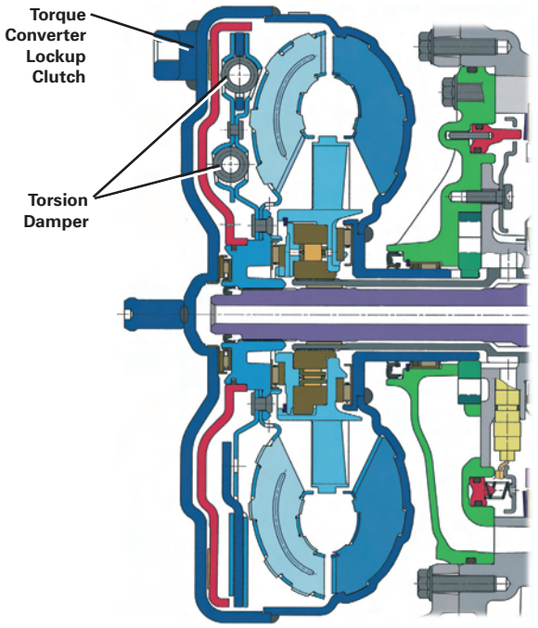
Torque Converter

In the 09D transmission, torque is transmitted from the engine to the transmission by a hydro-dynamic torque converter with slip-controlled lockup clutch.

Different types of torque converters are used depending on engine power output and characteristics.

They differ in respect of the following:
– size (capacity)
– torque conversion factor
– torque converter characteristic
– torsion damper
– lockup clutch configuration

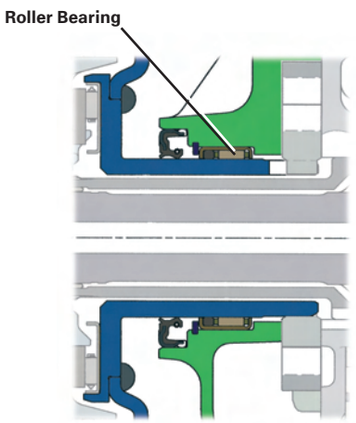
Configuration: Typical



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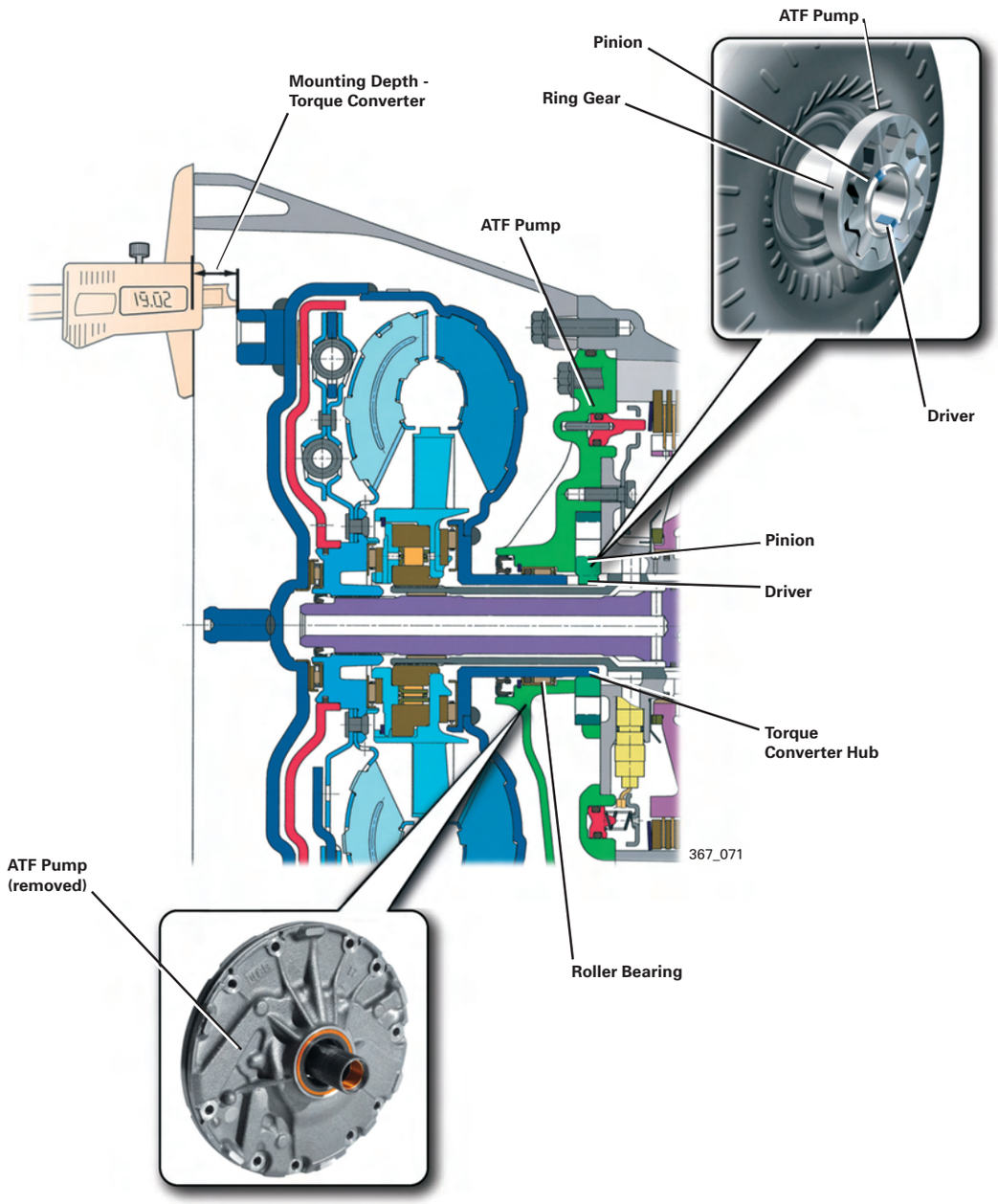
Mounting

The torque converter runs in a wear resistant roller bearing. This design provides a durable mounting particularly in operating states with slow oil feed (for example, during cold starting).



367_077

Torque Converter Mounting



Note

Always make sure the mounting bushings are installed correctly between the engine and the transmission. Missing bushings will result in irreparable damage to the roller bearing, the torque converter hub, and the shaft oil seal due to offset between the engine and the transmission.

Note

When installing the torque converter and before installing the transmission, special care must be taken to ensure the ATF pump drivers engage properly into the grooves on the torque converter hub. This can be checked by measuring the installed position of the torque converter (refer to the Workshop Manual).

Torque Converter Lockup Clutch

Design

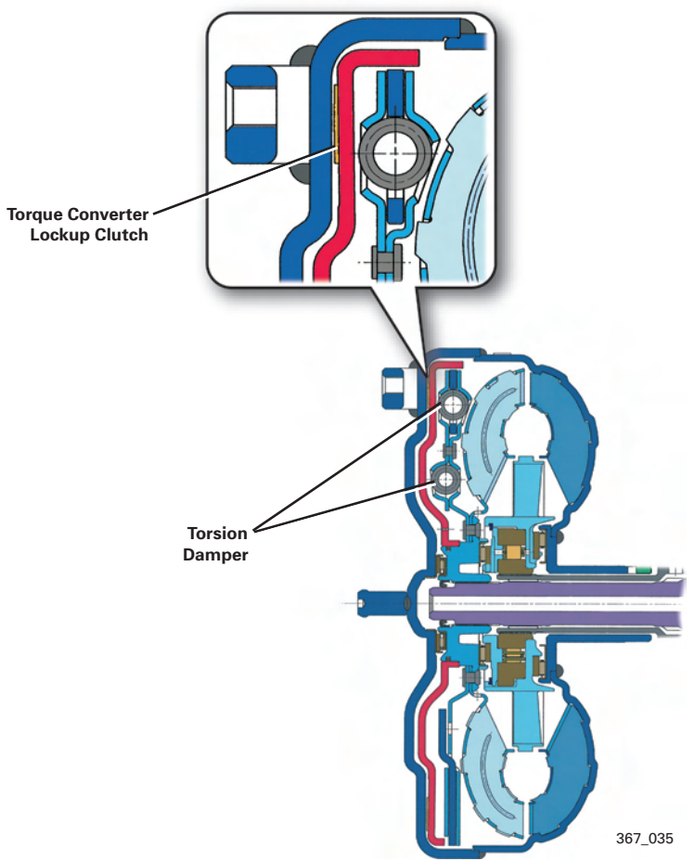
The torque converter has a lockup clutch with integrated torsion dampers. The torsion dampers reduce torsional vibration when the torque converter lockup clutch is closed. This allows the operating range “converter lockup clutch closed” to be extended.

Basically, distinctions are made between the following functional states:

– Converter Lockup Clutch - Open
– Converter Lockup Clutch - Controlled Operation
– Converter Lockup Clutch - Closed

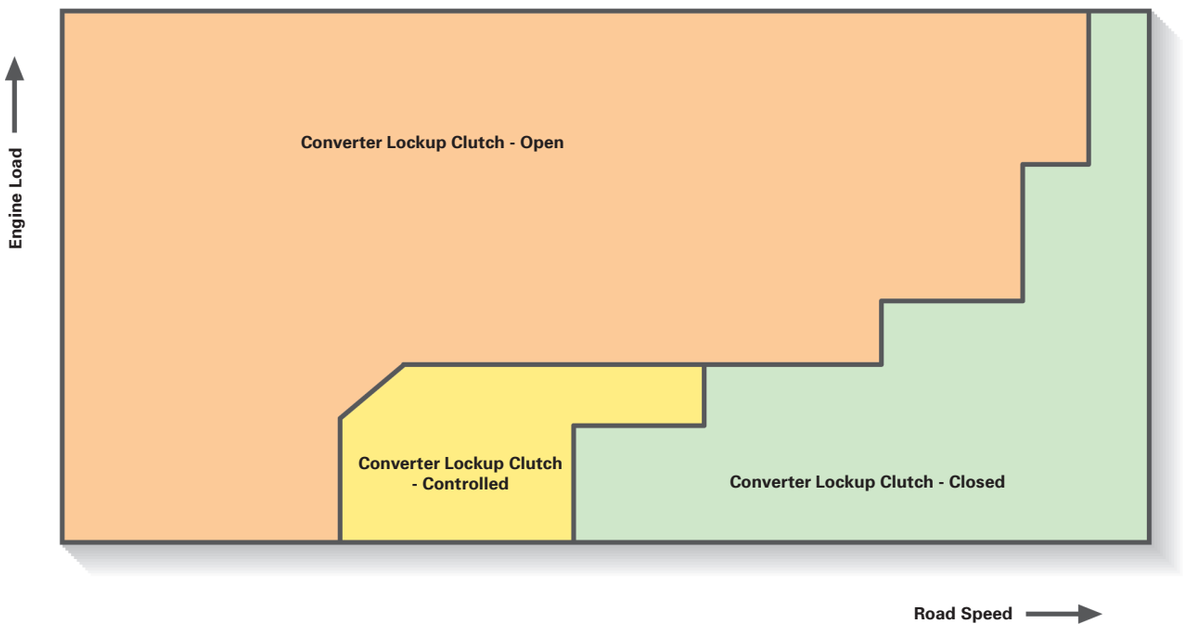
During normal vehicle operation, the lockup clutch is engaged in 4th gear and higher (upwards of speeds of approximately 24.8 mph [40 kph]).

Configuration: Typical



Controlled Operation

At defined operating points, the lockup clutch is operated with a low slip (controlled operation). Controlled operation provides better fuel economy than with the converter lockup clutch open and better driving comfort than with the converter lockup clutch closed.



367_039

In Tiptronic mode and in the “S” program, the converter lockup clutch is closed at the earliest possible moment. The direct frictional engagement between the engine and the transmission accentuates the sporty driving feel.

In the hill-climbing program, the converter lockup clutch is closed in 3rd gear.

In the Hot-mode program, the lockup clutch is no longer operated in a controlled manner, but is closed early to reduce heat transfer due to friction in the lockup clutch and hydro-dynamic power transmission.

Reference
Please see page 47 for a description of the Hot-mode program.

Oil Supply/Lubrication

ATF (Automatic Transmission Fluid)

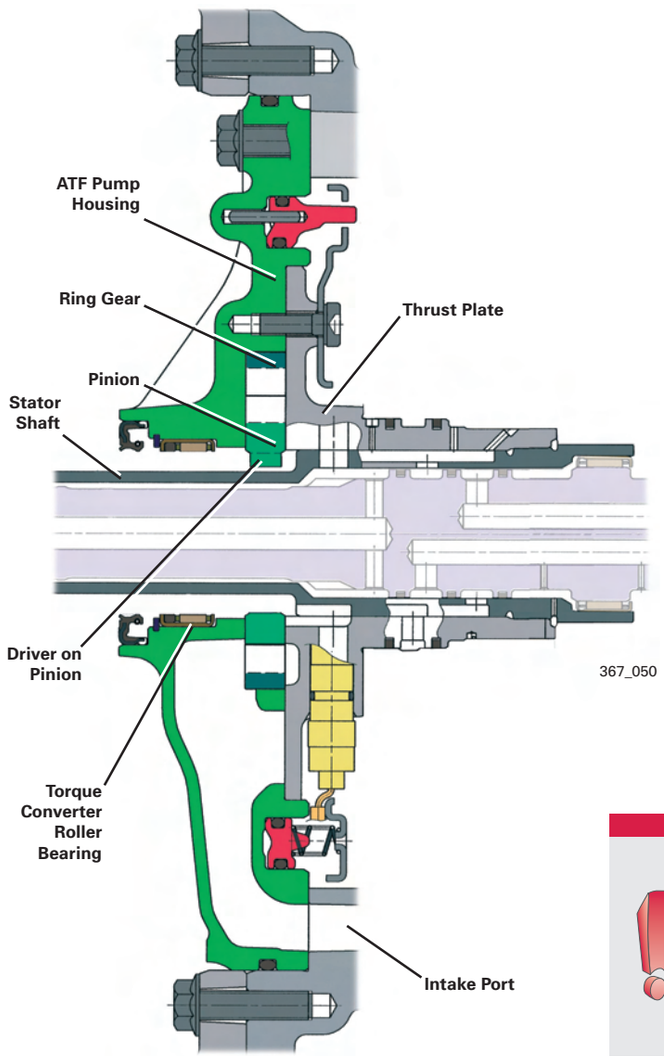
As mentioned previously, the 09D transmission is designed as an independent component, without the usual integrated transfer case and front axle differential. This is why the 09D transmission only has a single ATF oil supply.

The exacting requirements with regard to shift quality, functional reliability, and ease of maintenance put extreme demands on the ATF.

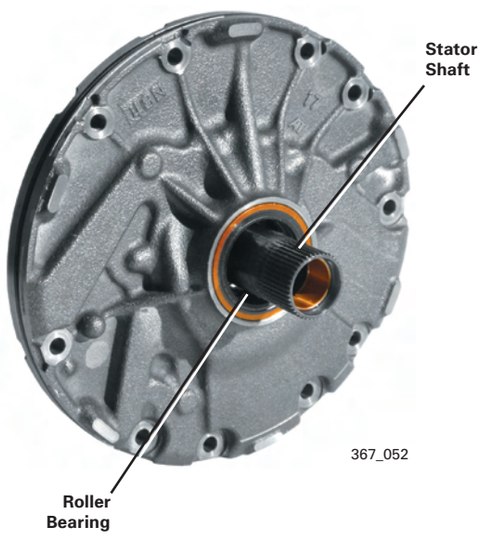
The ATF is a key factor influencing the coefficient of friction of the clutches and brakes. For this reason, ATF development is carried out in parallel with the design and testing phases.

No ATF change is normally needed within the maintenance intervals. If the ATF has to be changed after repairs or for some other reason, the adaption values must be cleared and an adaption drive performed using the VAS Scan Tool. Refer to the "Transmission Adaption" section on page 55.

ATF Pump



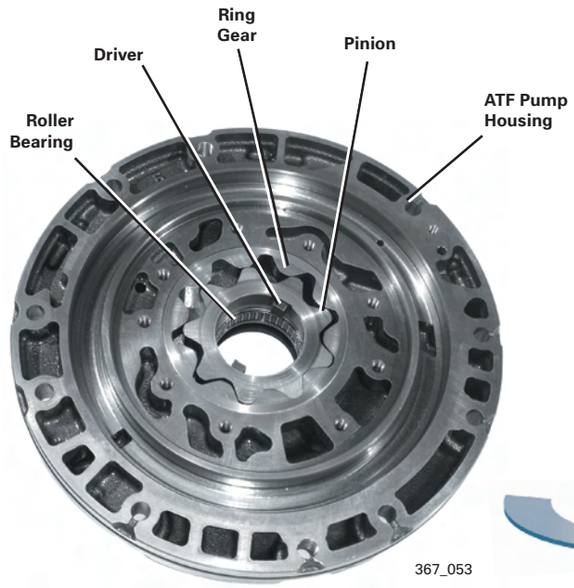
ATF Pump (fully assembled)

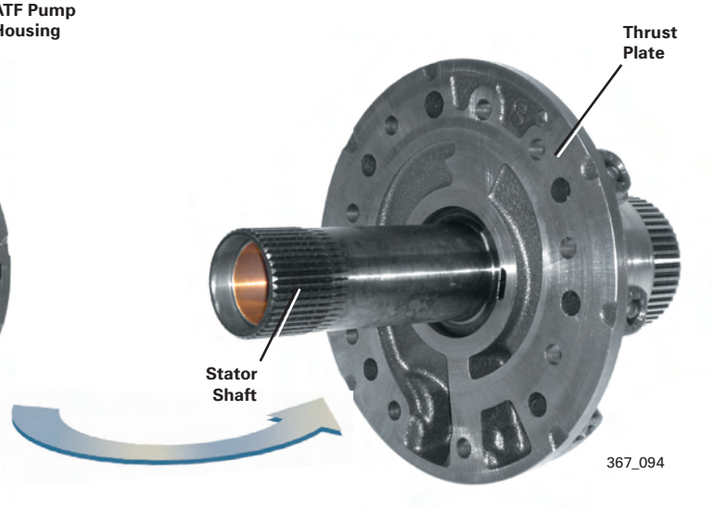


Note

Only use the ATF specified for the 09D transmission.

Use a separate, dedicated ATF fluid container for Special Tool VAG 1924 to avoid contaminating the ATF.





The ATF pump is designed as an internal gear pump (duocentric pump). It is directly driven by the engine via the converter housing and the converter hub.

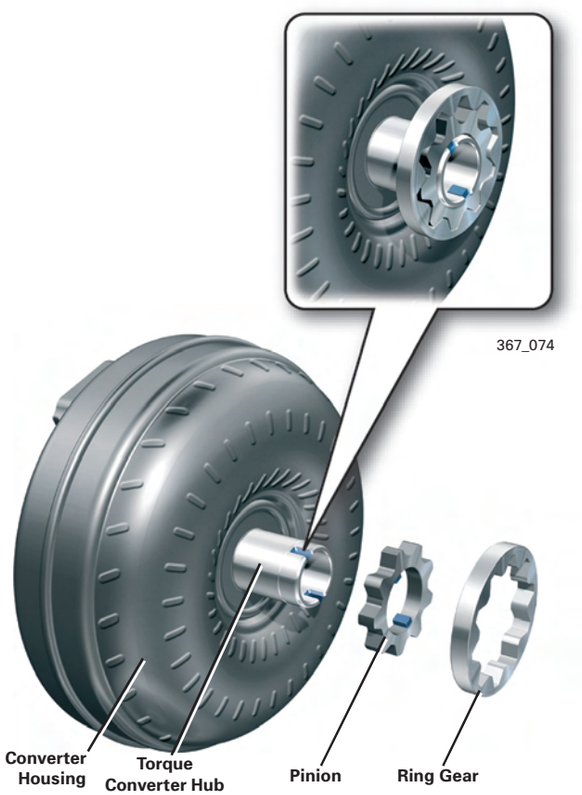
Two grooves on the torque converter hub engage the pinion drivers. The torque converter hub runs on low-friction bearings in the pump housing.

Note

Always make sure the mounting bushings are installed correctly between the engine and the transmission. Missing bushings will result in irreparable damage to the roller bearing, the torque converter hub, and the shaft oil seal due to an offset between the engine and the transmission.

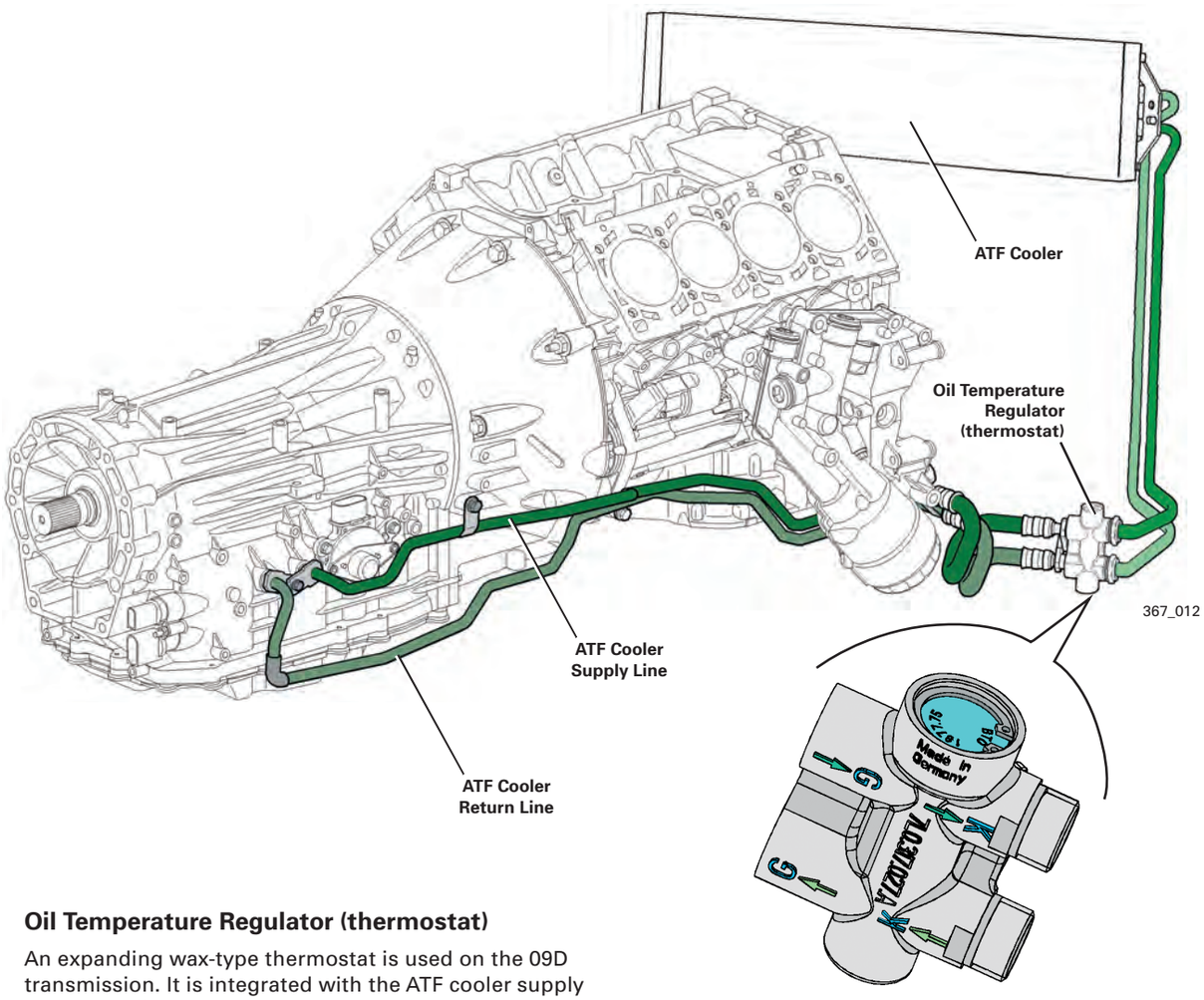
Note

When installing the torque converter and before installing the transmission, special care must be taken to ensure the ATF pump drivers engage properly into the grooves on the torque converter hub. This can be checked by measuring the installed position of the torque converter (refer to the Workshop Manual).



ATF Cooling

ATF cooling is thermostat-controlled by means of an oil-to-air heat exchanger (ATF cooler). The ATF cooler is mounted in front of the A/C condenser.



Oil Temperature Regulator (thermostat)

An expanding wax-type thermostat is used on the 09D transmission. It is integrated with the ATF cooler supply and return lines.

Note

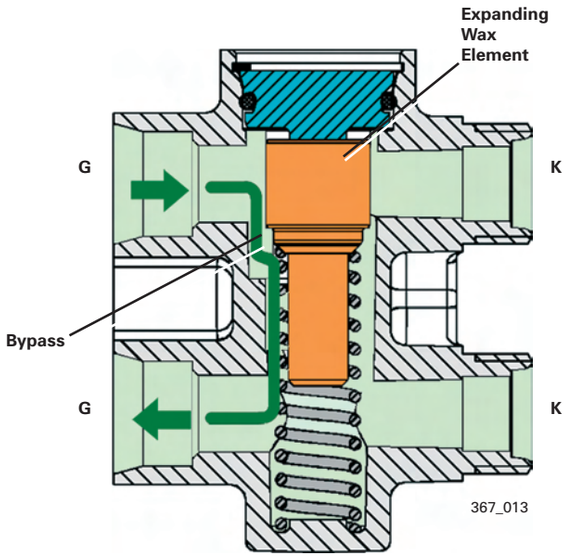
Please note that impurities in the ATF (for example, abrasion, chips, emulsions) are distributed throughout the ATF cooling system and deposit here. The cooling system must, therefore, be flushed thoroughly before repair or replacement. The lines must be disconnected from the thermostat and the cooler in order to flush out individual components.

Make sure all contaminants are removed. If in doubt, components such as the ATF cooler or thermostat must be replaced. Residual contaminants will lead to further damage of the transmission. Always follow the Workshop Manual instructions when servicing the ATF system.

Thermostat Closed

The expanding wax element acts as the thermostat slide valve and regulates the ATF feed to the cooler. In the closed state, a small fraction of the ATF flows through the bypass, thereby heating the expanding wax element.

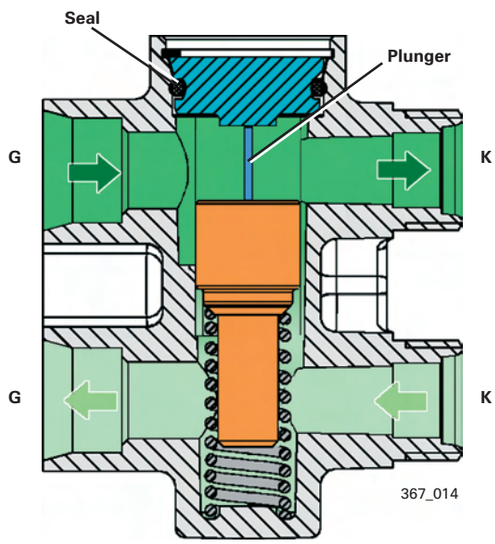
At a temperature of approximately 167 °F (75 °C), the plunger of the expanding wax element begins to press downwards against the force of the spring, thereby opening the inlet to the cooler (see next figure).



G = From or To Transmission
K = From or To Cooler

Thermostat Open

At a temperature of approximately 194 F (90 C), the thermostat is fully open.



Note

Contaminants can clog the thermostat bypass, thereby impairing the function of or disabling the thermostat. This can cause the transmission to overheat! At an ambient temperature of 77 °F (25 °C) and during normal vehicle operation, the ATF temperature barely exceeds 230 °F (110 °C).

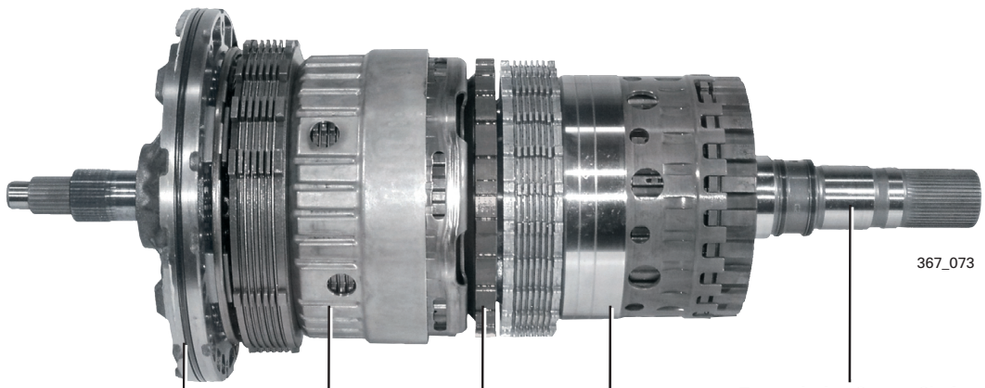
Note

If the cooling system has been opened during repairs (thereby draining the ATF cooler), the ATF temperature must be raised to at least 194 °F (90 °C) by performing a test drive in order to set the ATF level correctly. This ensures the ATF cooler is filled. The ATF level must be set after the ATF has cooled to normal test temperature (refer to Workshop Manual).

Planetary Gear Set

The 09D transmission is based on the Lepelletier planetary gear set concept (six forward gears and one reverse gear).

The Lepelletier planetary gear set is based on a single planetary gear set (primary planetary gear set) and a Ravigneaux planetary gear set (secondary planetary gear set) further down the drive train.



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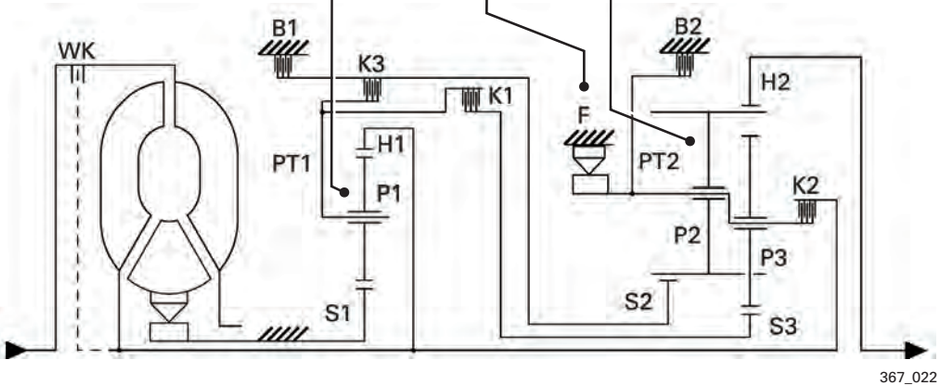
Transmission Output Shaft

ATF Pump

Single Planetary Gear Set (primary planetary gear set)

Freewheel F

Ravigneaux Planetary Gear Set (secondary planetary gear set)



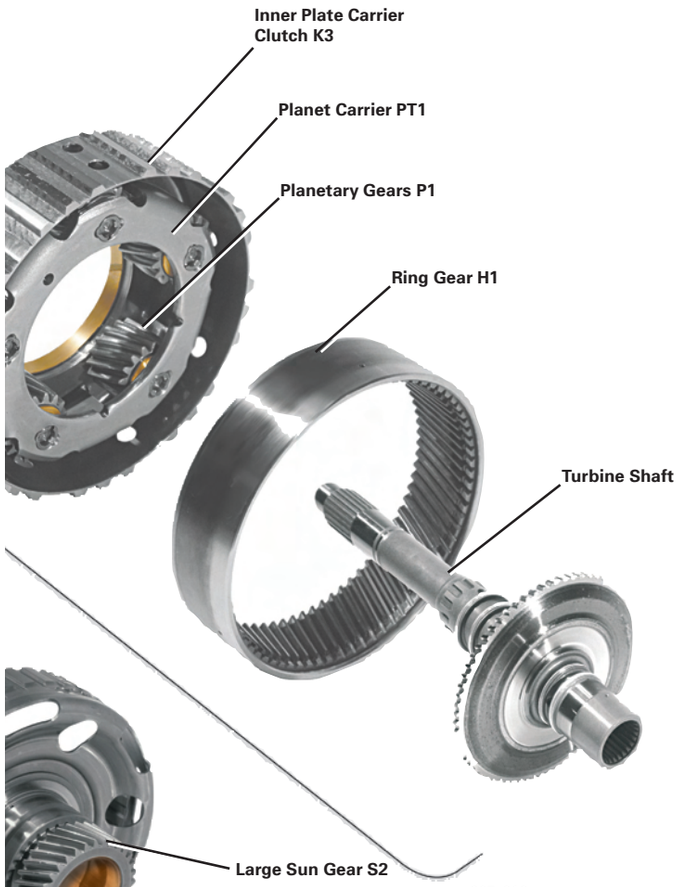
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Sun Gear S1

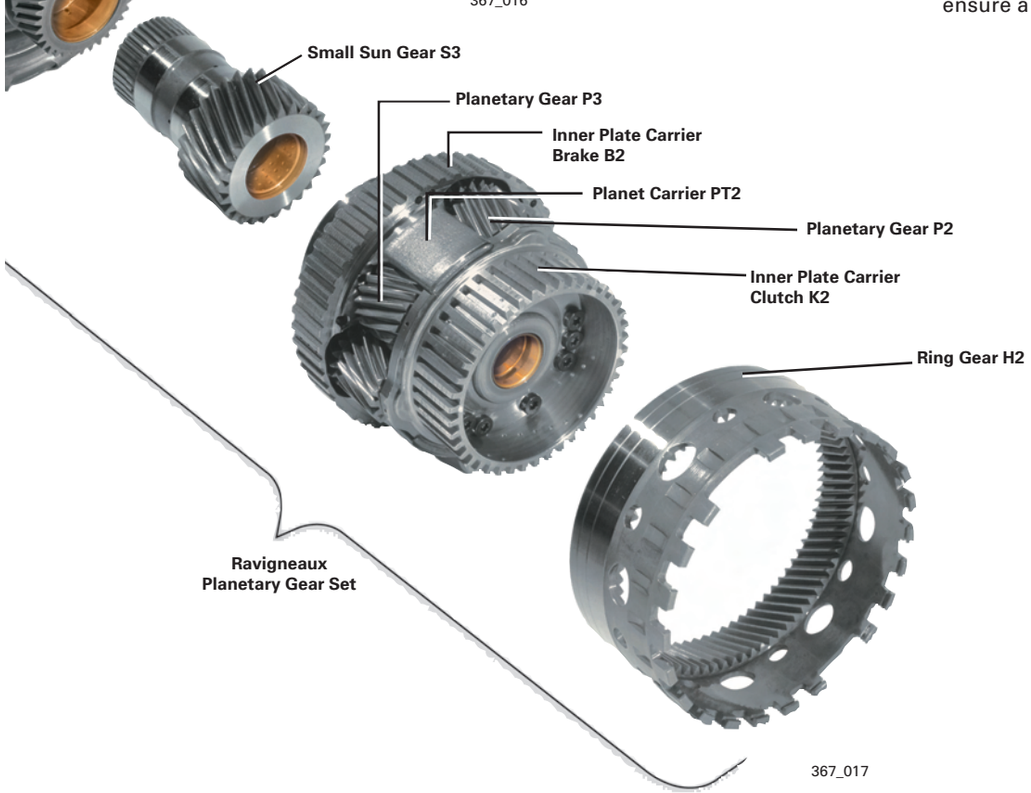


Single Planetary Gear Set





367_016



367_017

The special feature of the Lepelletier planetary gear set is that the sun gears and the planet carrier of the Ravigneaux gear set are driven at different speeds. This provides a large number of ratios.

The sun gears of the Ravigneaux gear seat are driven at the reduced output speed of the single planetary gear set. The planet carrier of the Ravigneaux gear seat is driven at transmission input speed.

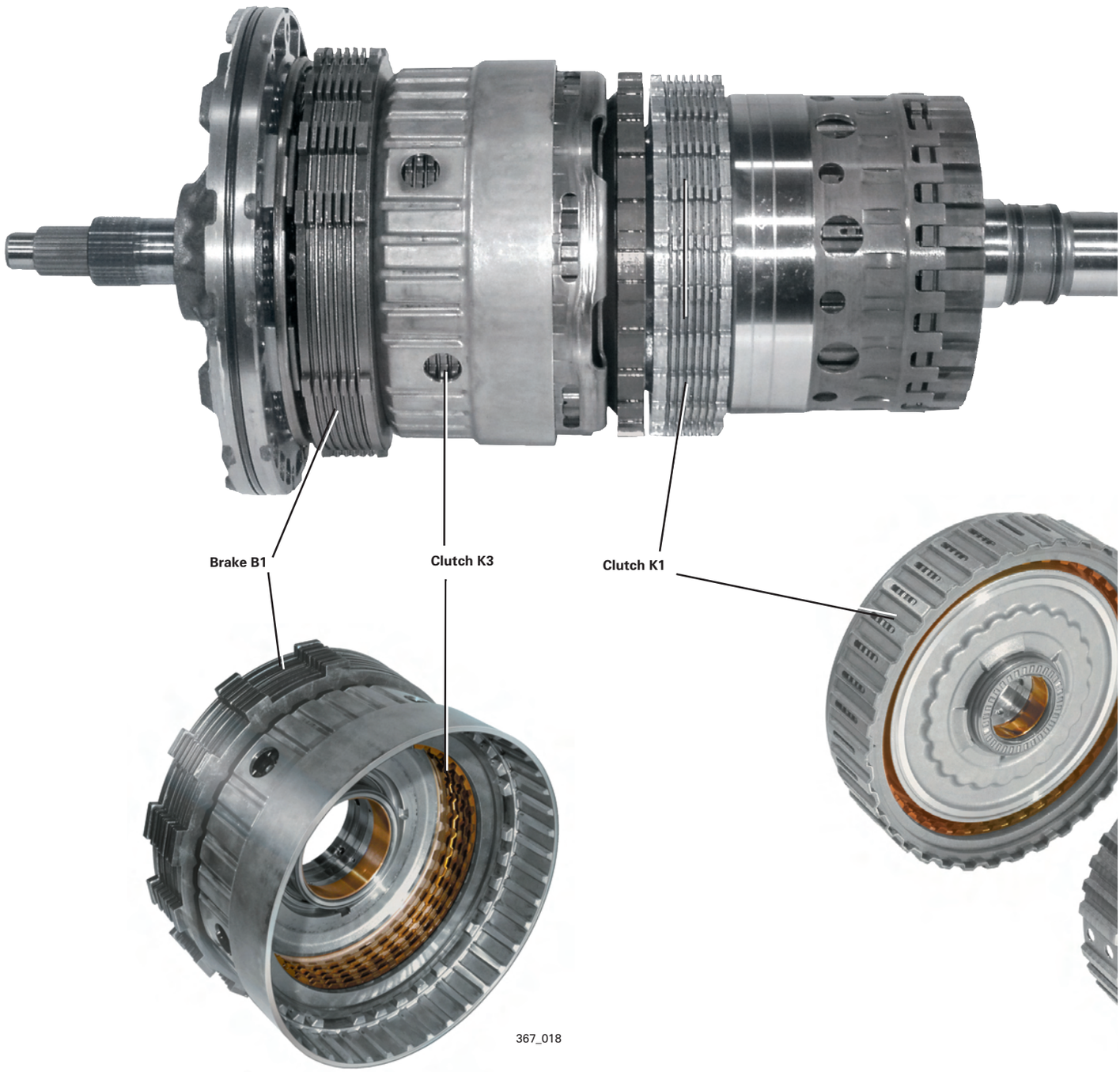
A feature of the Lepelletier planetary gear set is that only five shift elements are required for engaging all six forward gears and reverse gear.

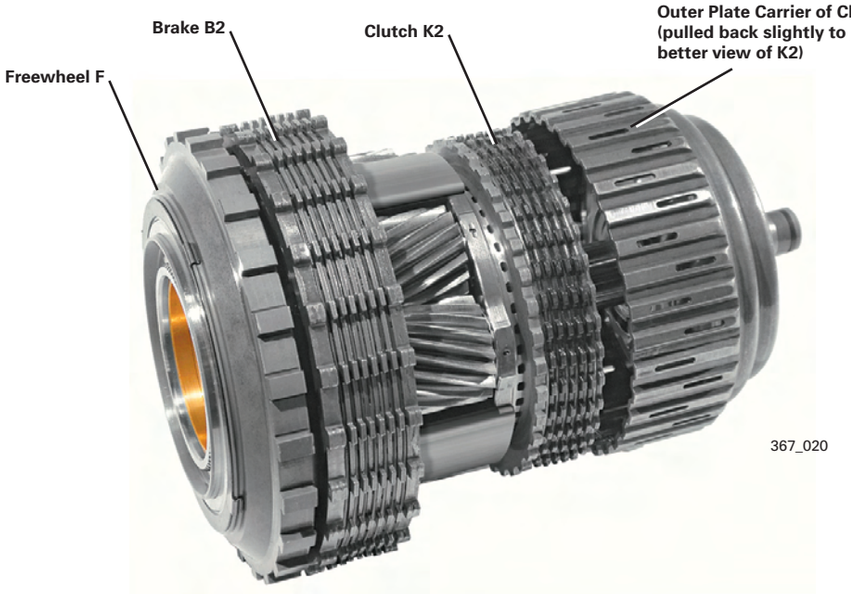
Advantages of the Lepelletier Planetary Gear Set Concept

- It allows a very compact design, despite a wider ratio spread and more gear steps.
- It has much fewer components, significantly reducing weight and cost of manufacture.
- The wide ratio spread, the closer ratios, and the reduced number of gear shifting components ensure a high level of efficiency.

Shift Elements

A continuous flow of power and different ratios can be obtained in a planetary gear set by introducing torque into a corresponding component (for example, on the planet carrier) and by holding a different component stationary (for example, the sun gear) or interconnecting two components of a planetary gear set (for example, connecting the planet carrier to the sun gear).





367_020



367_073

The shift elements (brakes and clutches), in combination with the planetary gear sets, establish a flow of power and execute gear shifts under load, without any interruption in tractive power.

The following shift elements are used:

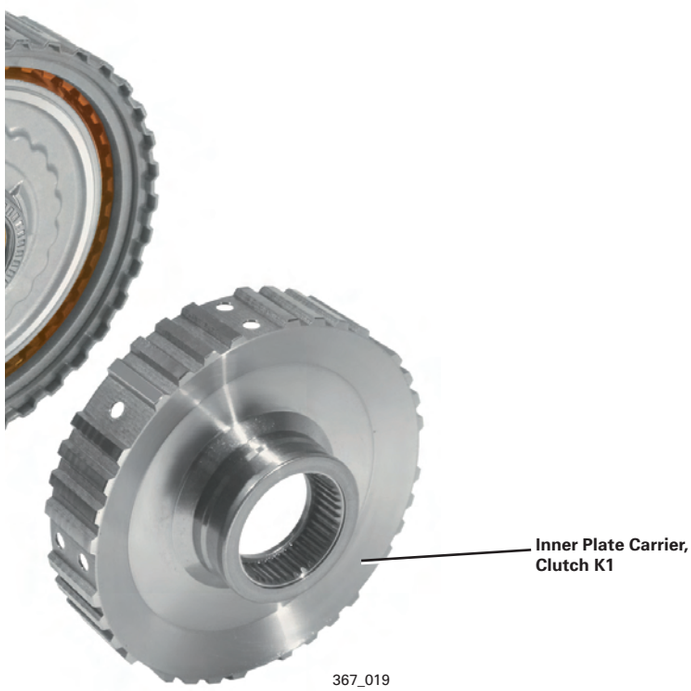
– Three Planetary Multi-plate Clutches (K1, K2, and K3)
– Two Fixed Plate Brakes (B1 and B2)
– One Freewheel (F)

Clutches K1, K2, and K3 introduce engine torque into the planetary gear set. All clutches have a dynamic pressure compensation function, with the result that clutch response is independent of engine speed.

Brakes B1 and B2, or freewheel F, establish a torque counter-point with the transmission housing.

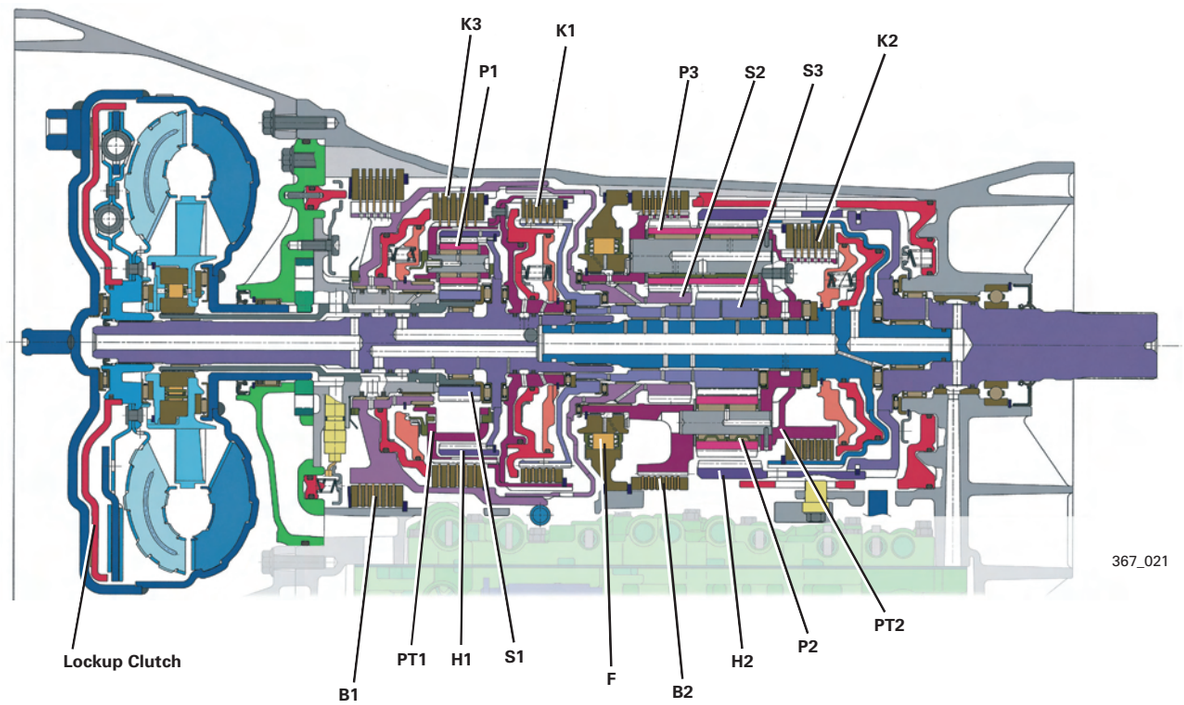
All clutches and brakes are activated indirectly by electronic pressure control valves.

Freewheel F, which is also a shift element, is arranged in parallel with brake B2. During automatic operation, it takes over the function of brake B2. The freewheel simplifies electro-hydraulic shift control when selecting gears and when shifting up and down between 1st and 2nd gear.

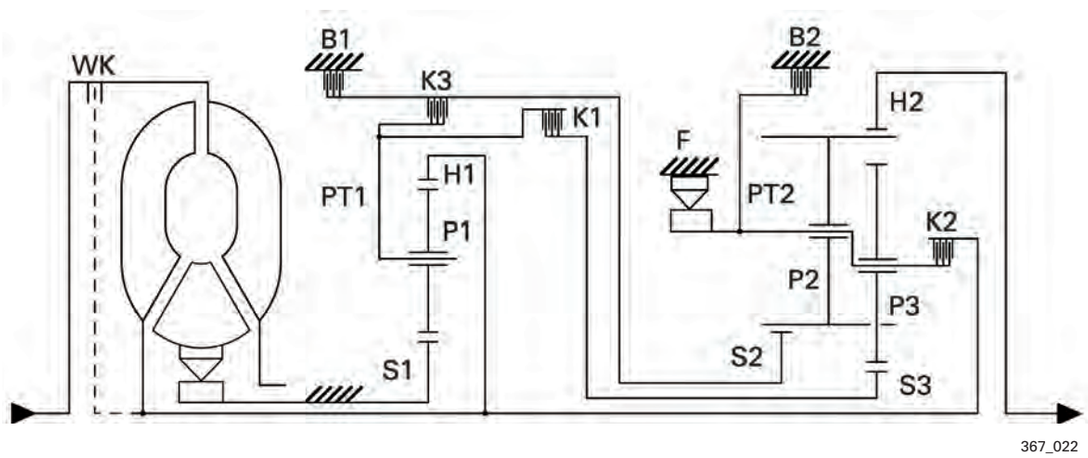


367_019

Overview of Planetary Gear Set/Shift Elements



Schematic Power Flow Diagram



Primary Planetary Gear Set

Component:			Connected to:
H1	–	Ring Gear 1	Turbine Shaft (drive)/Clutch K2
P1	–	Planetary Gears 1	Power Transmission in Planetary Gear Set
S1	–	Sun Gear 1	Stationary
PT1	–	Planet Carrier 1	Clutches K1 and K3

Secondary Planetary Gear Set

Component:			Connected to:
H2	–	Ring Gear 2	Output
P2	–	Planetary Gears 2, Long	Power Transmission in Planetary Gear Set
P3	–	Planetary Gears 3, Short	Power Transmission in Planetary Gear Set
S2	–	Sun Gear 2, Large	Clutch K3/Brake B1
S3	–	Sun Gear 3, Small	Clutch K1
PT2	–	Planet Carrier 2	Clutch K2/Brake B2/Freewheel F

Clutches, Brakes, Freewheel

Component:			Task:
H2	–	Clutch 1	Planet Carrier PT1 (primary gear set) Connected to Small Sun Gear S3 (secondary gear set)
K2	–	Clutch 2	Turbine Shaft (input) Connected to Planet Carrier PT2 of the Secondary Planetary Gear Set
K3	–	Clutch 3	Planet Carrier PT1 (primary gear set) Connected to Small Sun Gear S2 (secondary gear set)
B1	–	Brake 1	Holds Large Sun Gear S2 (secondary gear set) Stationary
B2	–	Brake 2	Holds Planet Carrier PT2 (secondary gear set) Stationary
F	–	Freewheel	Holds Planet Carrier PT2 (secondary gear set) Stationary Counter to the Direction of Rotation of the Drive and is Used when Driving Under Throttle in 1st Gear (no engine brake)

Converter Lockup Clutch



367_031

Function of the Shift Elements

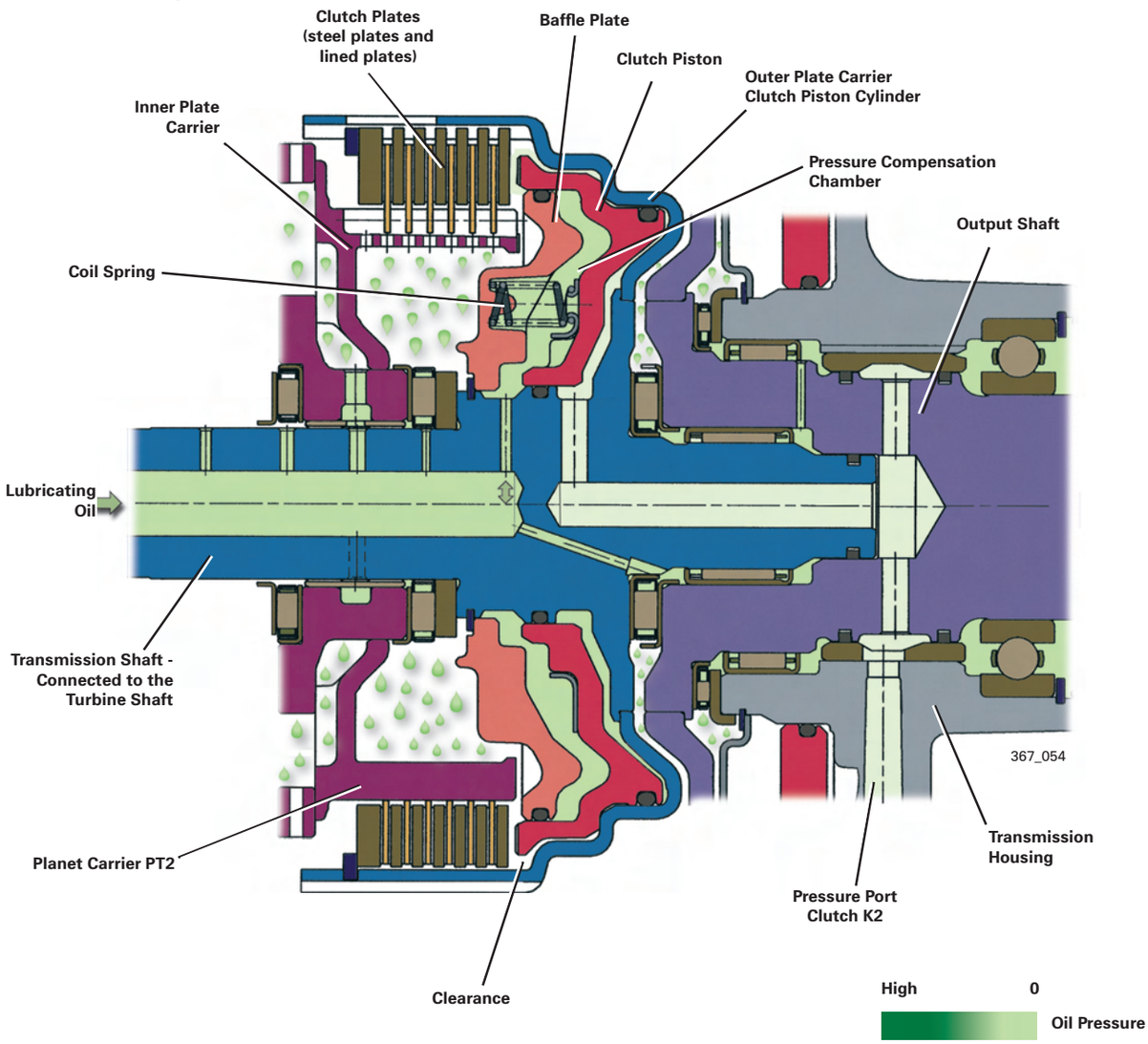
Clutches and Brakes

The function of the shift elements is explained here using clutch K2, which is exemplary of clutches K1 and K3, as well as brakes B1 and B2. Unlike the clutches, the brakes require no dynamic pressure compensation, because their clutch pistons and cylinders are non-rotating and therefore are not subject to a dynamic increase in pressure.

The shift elements are actuated hydraulically. Pressure oil is supplied to the shift elements by the valve assembly through stationary and rotating ports in the transmission housing, on the shafts, and on other components. Lube oil is supplied to the bearings and the shift elements in the same manner.

The clutch plate carriers are perforated, allowing the ATF to flow through each clutch from the inside outwards (normally when the clutch is open). The design of the lined plates and the centrifugal force are conducive to oil flow through the clutches.

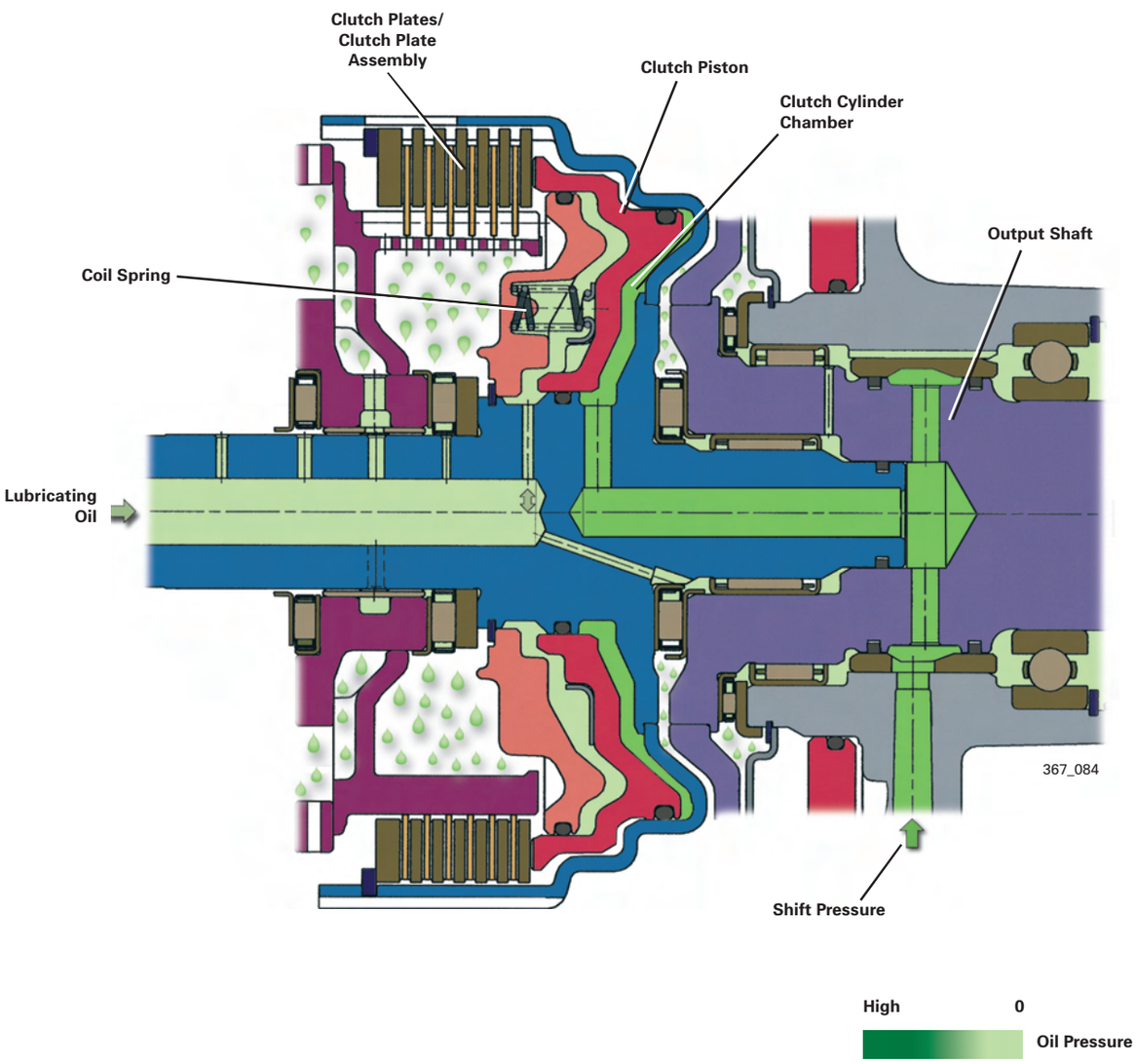
Clutch K2 - Open



In order to close the clutch, oil pressure is directed into the clutch cylinder chamber. The clutch piston compresses the clutch plate assembly, and the clutch engages when the required oil pressure is reached. If the clutch cylinder chamber is pressureless, the clutch piston is forced back into its initial position by spring pressure (in this case, by multiple coil springs). A clearance is maintained between the clutch piston and the clutch plate assembly so friction can be minimized when the clutch is open.

In order to match transmission efficiency to the engine as best possible, the number of clutch plates is adapted to the engine power output. Drag losses of open clutches are thus kept to a minimum.

Clutch K2 - Closed



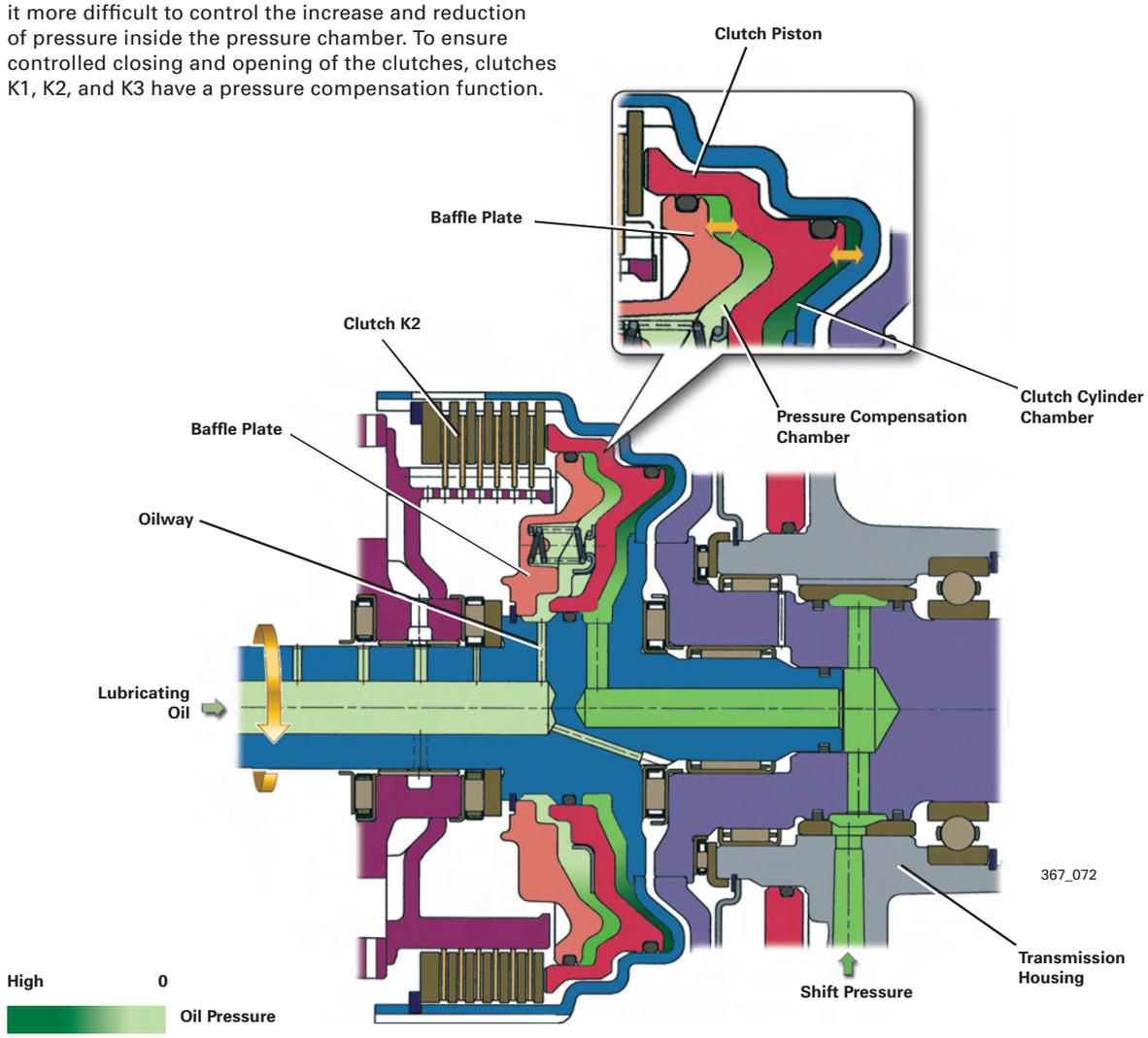
Dynamic Pressure Compensation in Clutches

At high engine speeds, due to rotation, the oil is subject to high centrifugal forces inside the clutch cylinder chamber.

This causes the pressure inside the clutch cylinder chamber to increase towards the largest radius. This process is referred to as “dynamic pressure increase.”

Dynamic pressure increase is best avoided because it unduly increases the surface pressure and makes it more difficult to control the increase and reduction of pressure inside the pressure chamber. To ensure controlled closing and opening of the clutches, clutches K1, K2, and K3 have a pressure compensation function.

It allows gearshifts to be controlled precisely, and this, in turn, greatly enhances shift comfort. Leaks in the pressure equalization chamber can, at high engine speeds, lead to uncontrolled frictional engagement of the clutch and damage it.



Principle/Mode of Operation (example - K2)

The clutch pistons are swept by ATF on both sides. This is caused by means of a baffle plate. The baffle plate creates a sealed space leading to the clutch piston. This space is referred to as the pressure compensation chamber. The pressure compensation chamber is filled with low pressure via an oil passage branching off the main oil line.

The ATF in the pressure compensation chamber is subjected to the same centrifugal forces (dynamic pressure increase) as the ATF in the clutch cylinder chamber. This compensates for the increase in force acting upon the clutch piston (due to dynamic pressure increase).

Freewheel

The freewheel transmits torque in one direction of rotation only. No torque is transmitted in the opposite direction.

In the 09D transmission, the freewheel is used for driving away in 1st gear. The freewheel holds planet carrier PT2 stationary and thus allows power to flow.

Principle/Mode of Operation

The freewheel in the 09D transmission is a sprag type freewheel. It consists of an outer ring (positively connected to the transmission housing), an inner ring (positively connected to planet carrier PT2), and sprags located between the inner and outer rings. The sprags are asymmetrically shaped and accommodated in the space between the inner and outer rings.

Direction of Rotation

In the direction of rotation of the planet carrier (inner ring), the sprags change their orientation without creating any resistance, because of their shape.

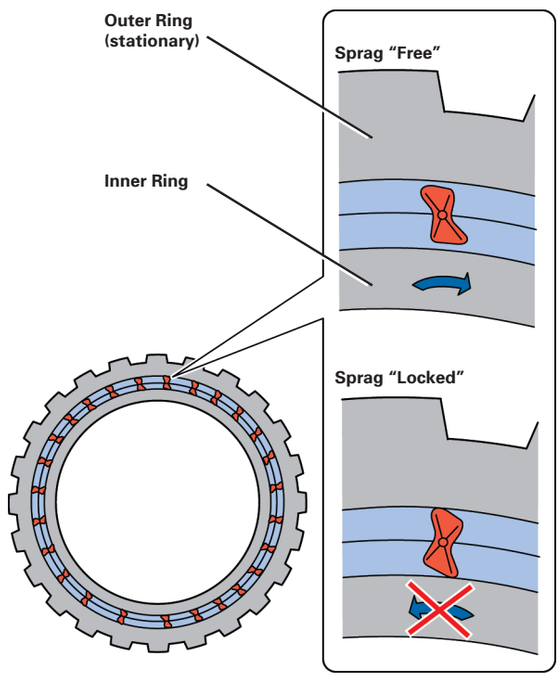
Locking Direction

In the locking direction of the planet carrier (inner ring), the sprags stand up because of their shape, and fill the annular space between the inner and outer rings in such a way that the inner and outer rings are positively engaged. In this instance, the planet carrier is held stationary, since the outer ring is positively connected to the transmission housing.

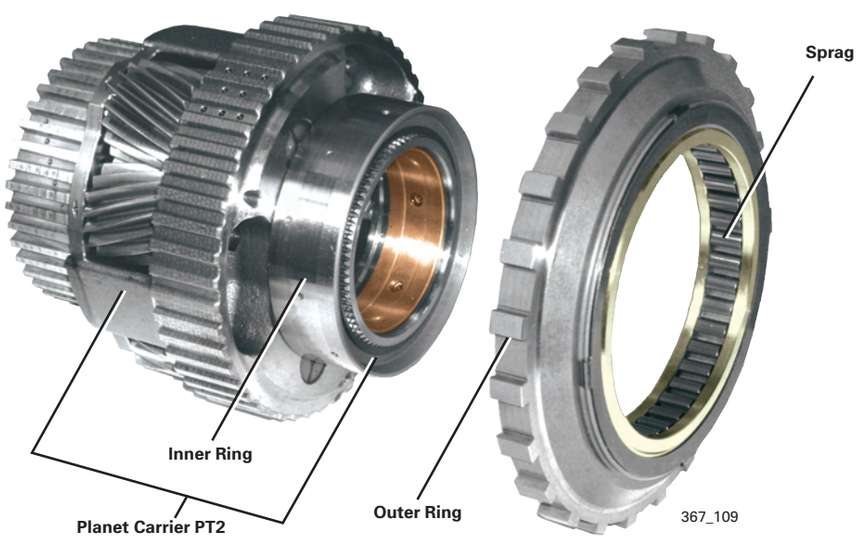
Note

Due to the freewheel, no engine braking effect is available in 1st gear during normal automatic operation.

If the freewheel is faulty, no power flow will be possible in 1st gear during normal automatic operation. In this case, a flow of power can be achieved by selecting 1st gear using the Tiptronic function.



367_110



367_109

Hydraulic Control

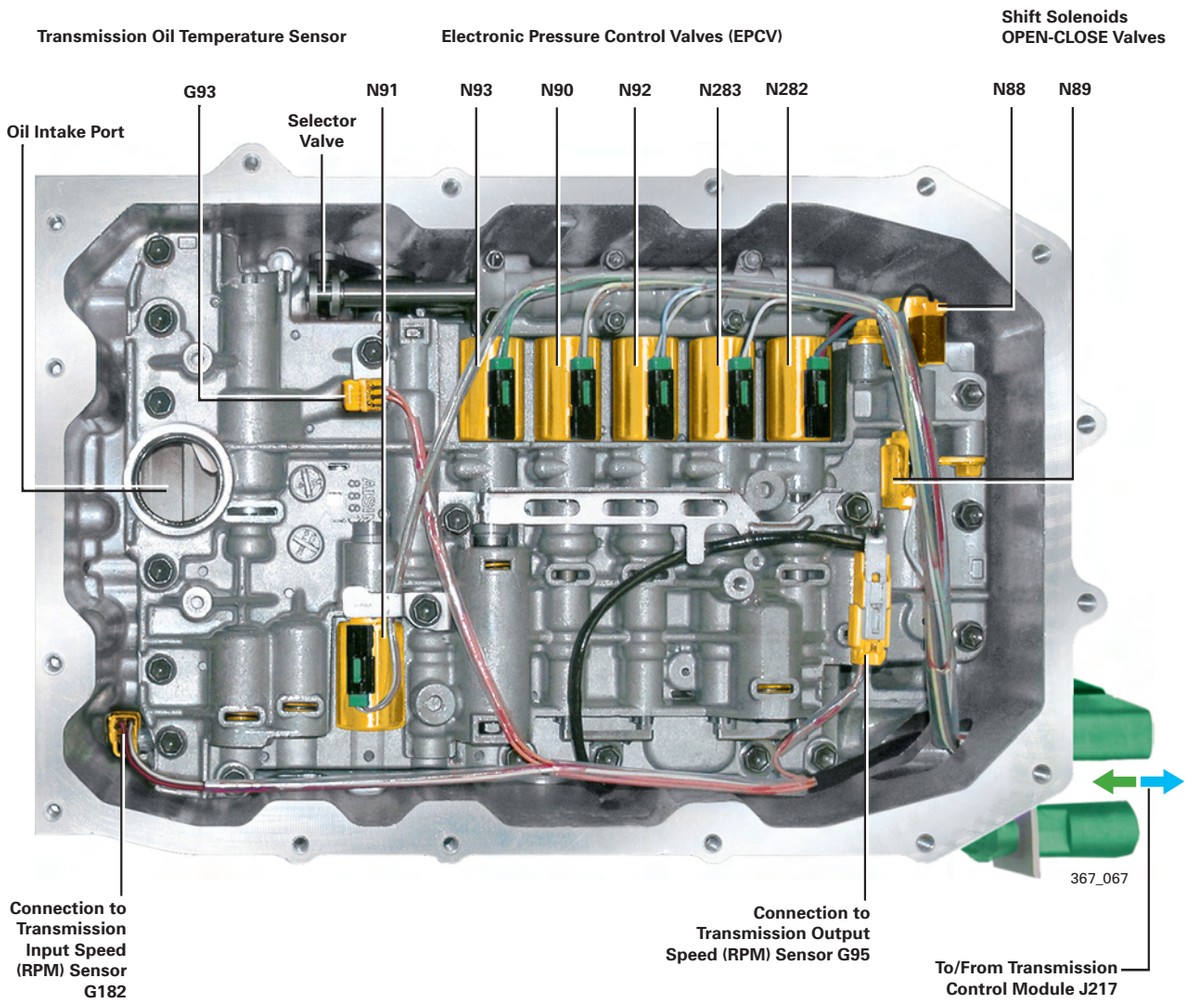
Valve Assembly

The clutches and brakes (shift elements) are controlled by the valve assembly by means of hydraulic shift control valves (gate valves). The gate valves are controlled by electromagnetic valves, which, in turn, are activated by Transmission Control Module J217.

In addition to the shift elements, the valve assembly controls the lockup clutch and the various pressures throughout the transmission (for example, main pressure, control pressure, torque converter pressure, lubricating pressure, etc.). The valve assembly is largely responsible for oil supply and therefore for proper functioning of the transmission.

The valve assembly consists of the following components:

- Mechanically Actuated Selector Valve
- Hydraulic Shift Control Valves
- Two Electrically Controlled Shift Solenoids (3/2-way valves)
- Six Electronic Pressure Control Valves (modulating valves)
- ATF Temperature Sensor



Bottom View of Valve Assembly

Electromagnetic Valves

In the case of the electromagnetic valves, a distinction is made between shift solenoids with two switching positions (OPEN - CLOSE) and electronic pressure control valves (known as EPCVs or modulating valves).

The shift solenoids (N88/N89) are 3/2-way valves or OPEN-CLOSE valves.

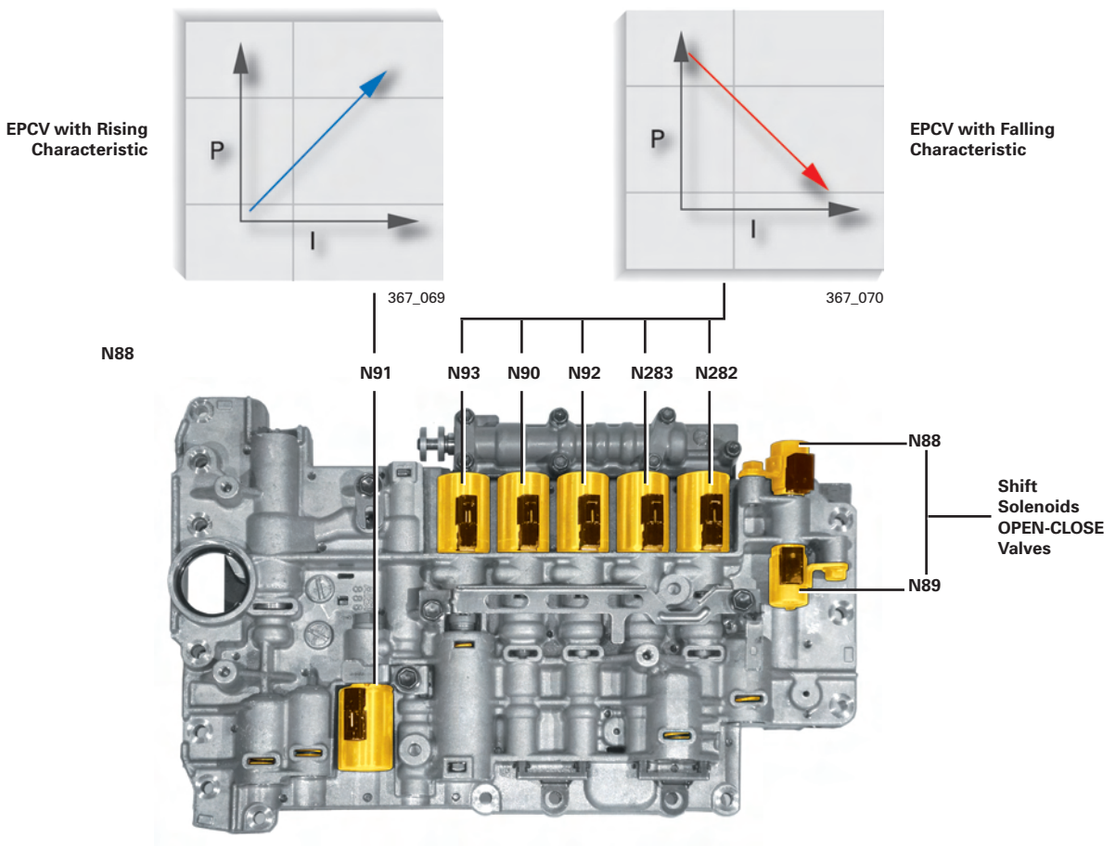
3/2 valve means the valves have three connections and two switching positions (open/closed or OPEN–CLOSE). These valves are used for switching hydraulic shift control valves.

The EPCVs convert an electrical current to a proportional, hydraulic control pressure. This control pressure, in turn, activates hydraulic shift control valves, which control the “working pressure” of the shift elements (the lockup clutch and the master pressure).

Two types of EPCVs are used.

EPCVs with a rising characteristic increase pilot pressure (P) as a function of rising control current (I) - no current - zero pilot pressure (0 mA = 0 bar).

EPCVs with a falling characteristic reduce pilot pressure as a function of rising control current - no current - maximum pilot pressure.



Effects of Malfunctioning

If the self-diagnostics detect a faulty electromagnetic valve, the limp-home mode is normally activated. Electrical and mechanical malfunctions have very different effects due to the complexity of the electrohydraulic control system. The effects may be confined to the actual malfunctioning system (for example, in the case of N91, the lockup clutch), but they can also cause the vehicle to enter limp-home mode if safe operation is no longer assured.

Examples:

N93 controls the master pressure. If EPCV N93 fails, the transmission will operate at maximum system pressure. The effects are “clunky” shifting from “P” or “N” to “D/S” or “R” and during gearshifting in general.

EPCV N91 controls the lockup clutch. If EPCV N91 fails, the lockup clutch cannot be activated and therefore remains open.

Shift Logic

	Solenoid Logic								Gear Shifting Component Logic					
	3/2 Valves		Electronic Pressure Control Valves						Clutches, Brakes, Freewheel					
	N89	N88	N92	N282	N90	N283	N93	N91	K1	K2	K3	B1	B2	F
P														
N														
Reverse (R) Gear														
First Gear	T	T											T	
Second Gear														
Third Gear	T/Z	z												
Fourth Gear	T/Z	z												
Fifth Gear	T/Z	z												
Sixth Gear		z												

384_030

Function Assignments of the Electromagnetic Valves

N90 Controls Clutch K3
N91 Controls the Torque Converter Lockup Clutch
N92 Controls Clutch K1
N93 Controls the Master Pressure/System Pressure
N282 Controls Clutch K2
N283 Controls Brake B1

Solenoid valves N88 and N89 are used for controlling gearshifts from 4th to 6th gear and are activated (energized) temporarily or alternately during gearshift operations.

Solenoid valves N88 and N89 also control brake B2 in 1st gear - Tiptronic mode (for the engine brake).

Note

Function is inverse to electrical current applied, since EPCVs N92, N93, N282, and N283 have a falling characteristic. This means a shift element is operated if the corresponding EPCV is not activated.

Legend of Solenoid Valve Logic

Solenoid Valve is Not Activated (current approximately 100 mA) or Shift Element Open

Solenoid Valve is Activated (solenoid valve open)

Solenoid Valve is Activated (current approximately 1.0 A)

Corresponding Clutch Closed

Corresponding Brake Closed

Freewheel Locked

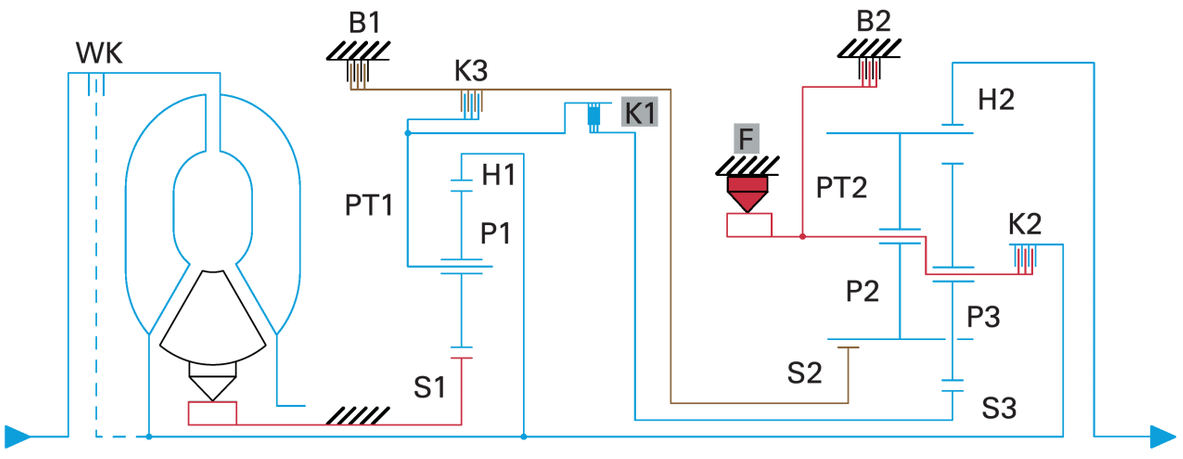
The Current Applied to the Solenoid Valve Differs Depending on its Operating State

T – Tiptronic Mode (1st gear with engine brake)

Z – Solenoid Valves are Activated Only Temporarily During Gearshifts

Description of Gear/Torque Curve

1st Gear i = 4.148
(i = Gear Ratio)



Shift Elements: Clutch K1 - Freewheel F

The turbine shaft drives ring gear H1 of the primary planetary gear set. Ring gear H1 drives planetary gears P1, which revolve around stationary sun gear S1.

Planet carrier PT1 is driven in this way. Clutch K1 connects PT1 to sun gear S3 and introduces torque into the secondary planetary gear set.

Freewheel F locks planet carrier PT2. Torque is transmitted from sun gear S3 to short planetary gears P3 and, in turn, to long planetary gears P2.

The torque multiplied by PT2 is transmitted to ring gear H2, which is connected to the transmission output shaft.

Since 1st gear is implemented via freewheel F, no power is transmitted when coasting in 1st gear. When coasting, the wheels drive the engine. Freewheel F rotates counter to its locking direction (in the freewheeling direction), with the result that the engine braking effect cannot be used.

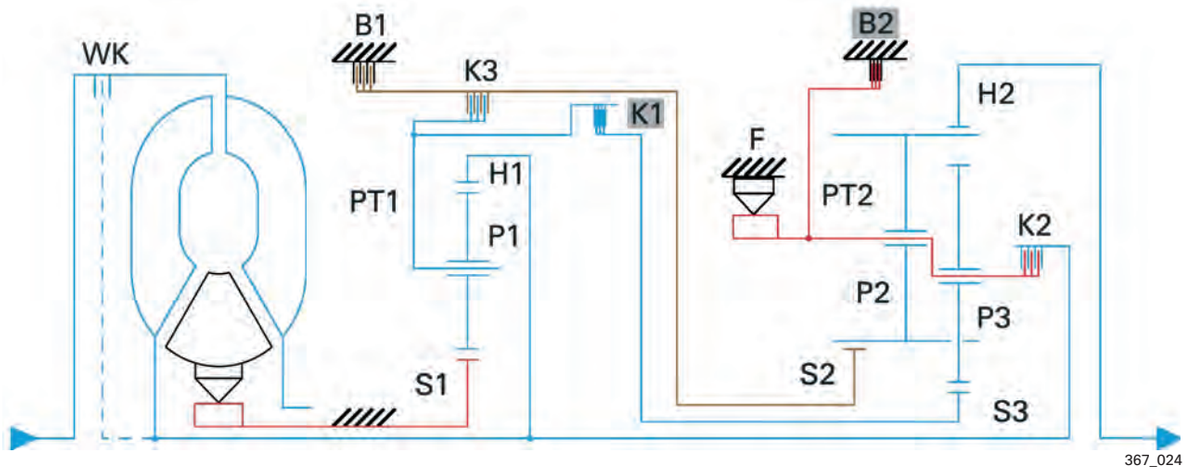
To be able to utilize the engine braking effect in 1st gear, Tiptronic mode must be selected.

Torque Curve/Power Flow

Parts are Stationary
or are Held Stationary

Parts Rotate without being
Involved in the Flow of Power

1st Gear in Tiptronic Mode (with engine braking effect)



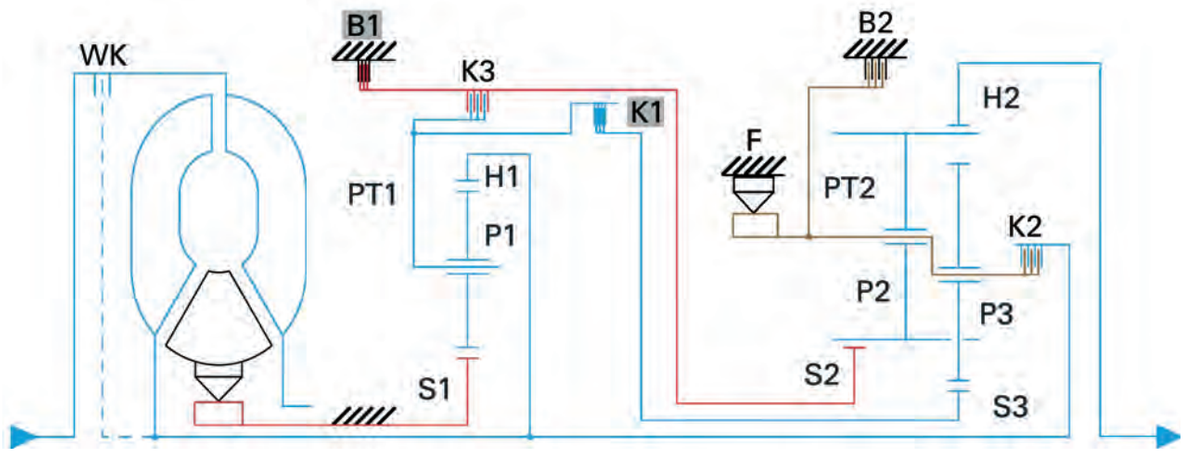
367_024

Shift Elements: Clutch K1 - Brake B2

The engine braking effect will be utilized in 1st gear under special driving situations - for example, on steep downhill gradients - by selecting 1st gear in Tiptronic mode (B2 closed).

The engine braking effect will only be utilized in 1st gear by closing brake B2. Brake B2 locks planet carrier PT2 like freewheel F. Unlike F, however, B2 holds PT2 stationary in both directions of rotation. This is necessary in order to engage reverse and utilize the engine braking effect in 1st gear.

2nd Gear i = 2.370



367_025

Shift Elements: Clutch K1 - Brake B1

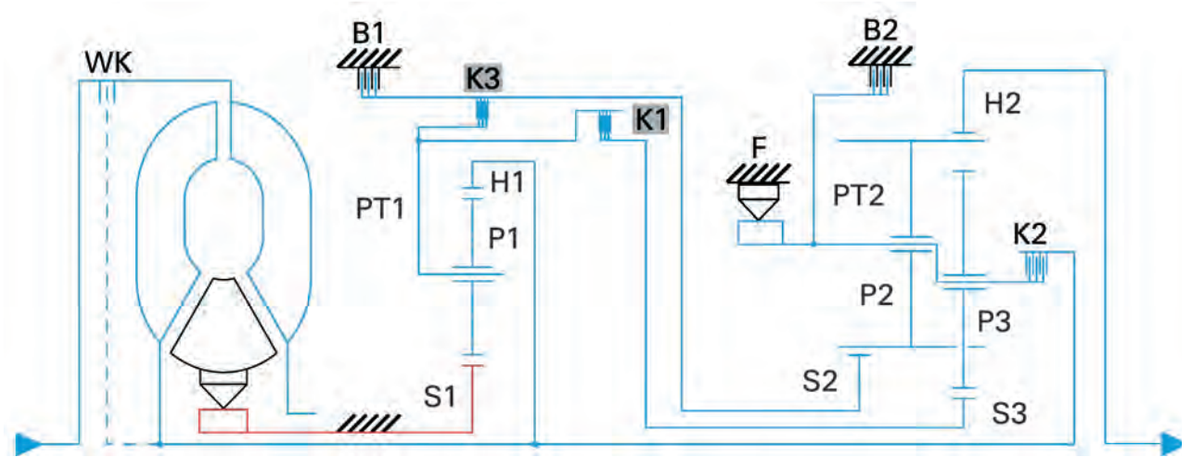
The turbine shaft drives ring gear H1 of the primary planetary gear set. Ring gear H1 drives planetary gears P1, which revolve around stationary sun gear S1.

Planet carrier PT1 is driven in this way. Clutch K1 connects PT1 to sun gear S3 and introduces torque into the secondary planetary gear set.

Brake B1 locks large sun gear S2 in place. Torque is transmitted from sun gear S3 to short planetary gears P3 and, in turn, long planetary gears P2.

Long planetary gears P2 roll around stationary sun gear S2 and drive ring gear H2, which is connected to the transmission output shaft.

3rd Gear i = 1.556



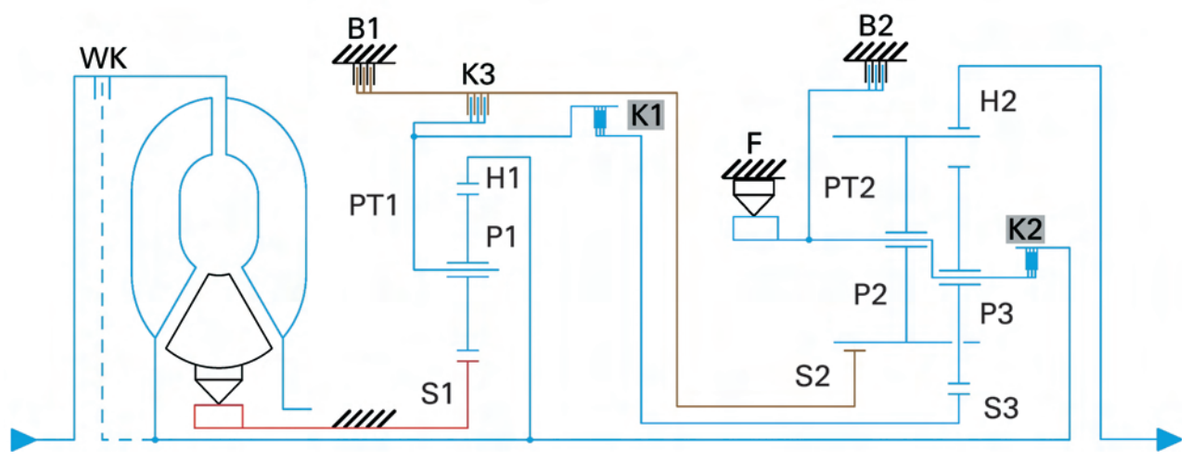
367_026

Shift Elements: Clutch K1 - Clutch K3

The turbine shaft drives ring gear H1 of the primary planetary gear set. Ring gear H1 drives planetary gears P1, which revolve around stationary sun gear S1. Planet carrier PT1 is driven in this way.

Clutch K1 connects PT1 to sun gear S3 and introduces torque into the secondary planetary gear set. Clutch K3 likewise introduces torque into the secondary planetary gear set driving sun gear S2. The secondary planetary gear set is locked when clutches K1 and K3 close. Torque is now transmitted directly from the primary planetary gear set to the transmission output shaft.

4th Gear i = 1.155



367_027

Shift Elements: Clutch K1 - Clutch K2

The turbine shaft drives ring gear H1 of the primary planetary gear set and the outer plate carrier of clutch K2.

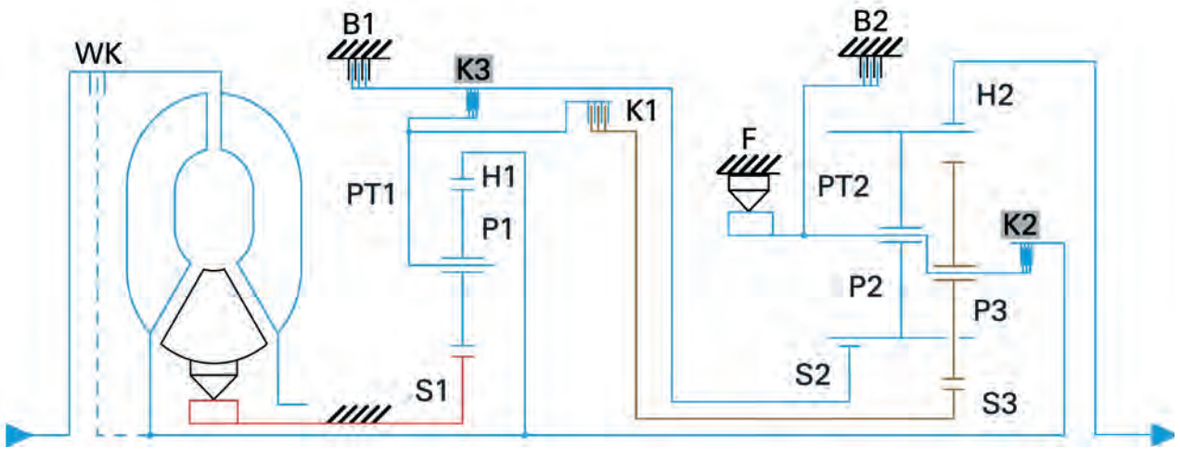
Ring gear H1 drives planetary gears P1, which revolve around stationary sun gear S1. Planet carrier PT1 is driven in this way.

Clutch K1 connects PT1 to sun gear S3 and introduces torque into the secondary planetary gear set.

Clutch K2 connects the turbine shaft to planet carrier PT2, and likewise introduces torque into the secondary planetary gear set.

Long planetary gears P2, which mesh with short planetary gears P3, together with planet carrier PT2, drive ring gear H2, which is connected to the transmission output shaft.

5th Gear i = 0.859



367_028

Shift Elements: Clutch K2 - Clutch K3

The turbine shaft drives ring gear H1 of the primary planetary gear set and the outer plate carrier of clutch K2.

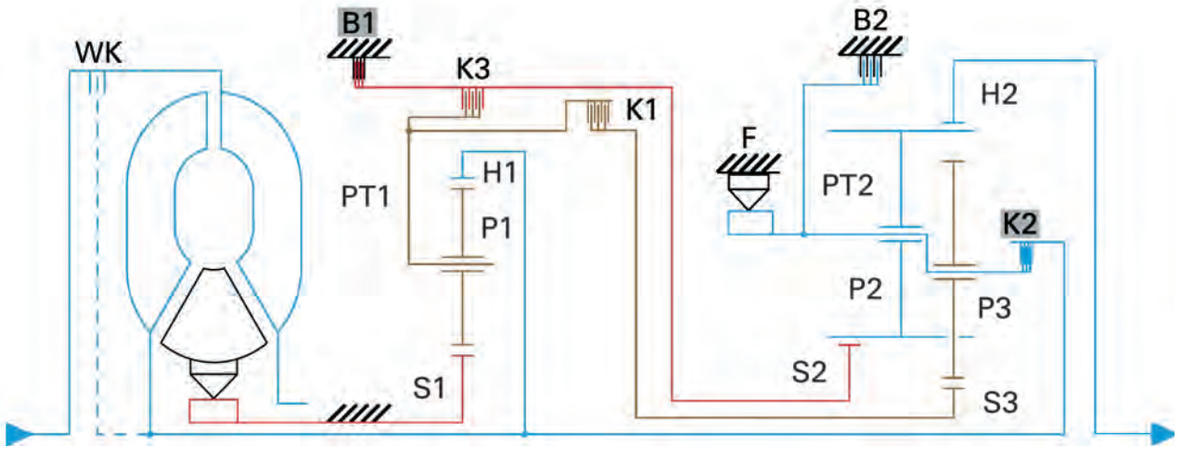
Ring gear H1 drives planetary gears P1, which revolve around stationary sun gear S1. Planet carrier PT1 is driven in this way.

Clutch K3 connects PT1 to sun gear S2 and thus introduces torque into the secondary planetary gear set.

Clutch K2 connects the turbine shaft to the planet carrier of secondary planetary gear set PT2, and likewise introduces torque into the secondary planetary gear set.

Long planetary gears P2, together with planet carrier PT2 and sun gear S2, drive ring gear H2, which is connected to the transmission output shaft.

6th Gear i = 0.686



367_029

Shift Elements: Clutch K2 - Brake B1

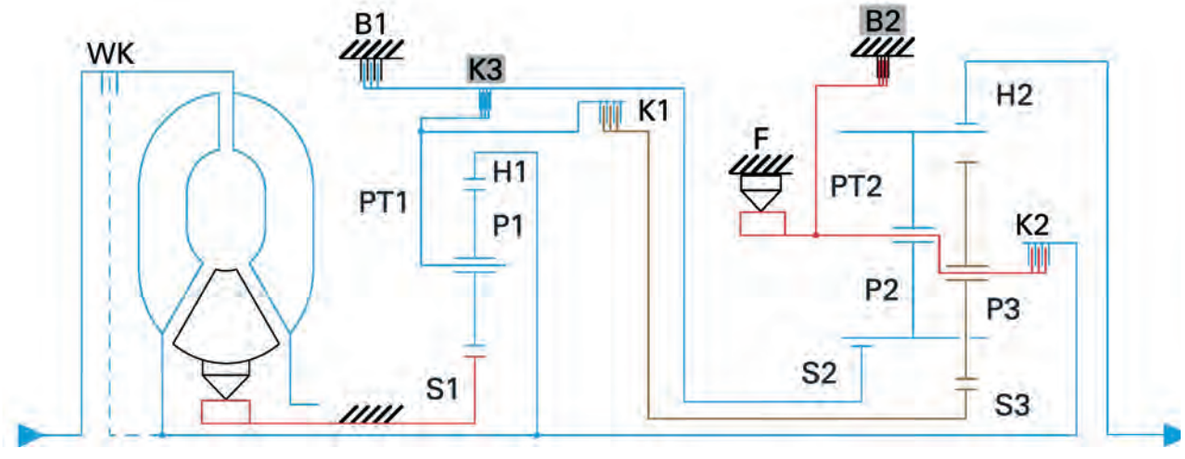
Brake B1 locks in place sun gear S2.

Clutch K2 connects the turbine shaft to the planet carrier of secondary planetary gear set PT2 and introduces torque into the secondary planetary gear set.

Long planetary gears P2 roll around stationary sun gear S2 and drive ring gear H2, which is connected to the transmission output shaft. Clutches K1 and K3 are open.

The primary planetary gear set is not involved in the power transmission process.

R Gear i = 3.394



367_028

Shift Elements: Clutch K3 - Brake B2

The turbine shaft drives ring gear H1 of the primary planetary gear set. Ring gear H1 drives planetary gears P1, which revolve around stationary sun gear S1. Planet carrier PT1 is driven in this way.

Clutch K3 connects PT1 to sun gear S2 and introduces torque into the secondary planetary gear set.

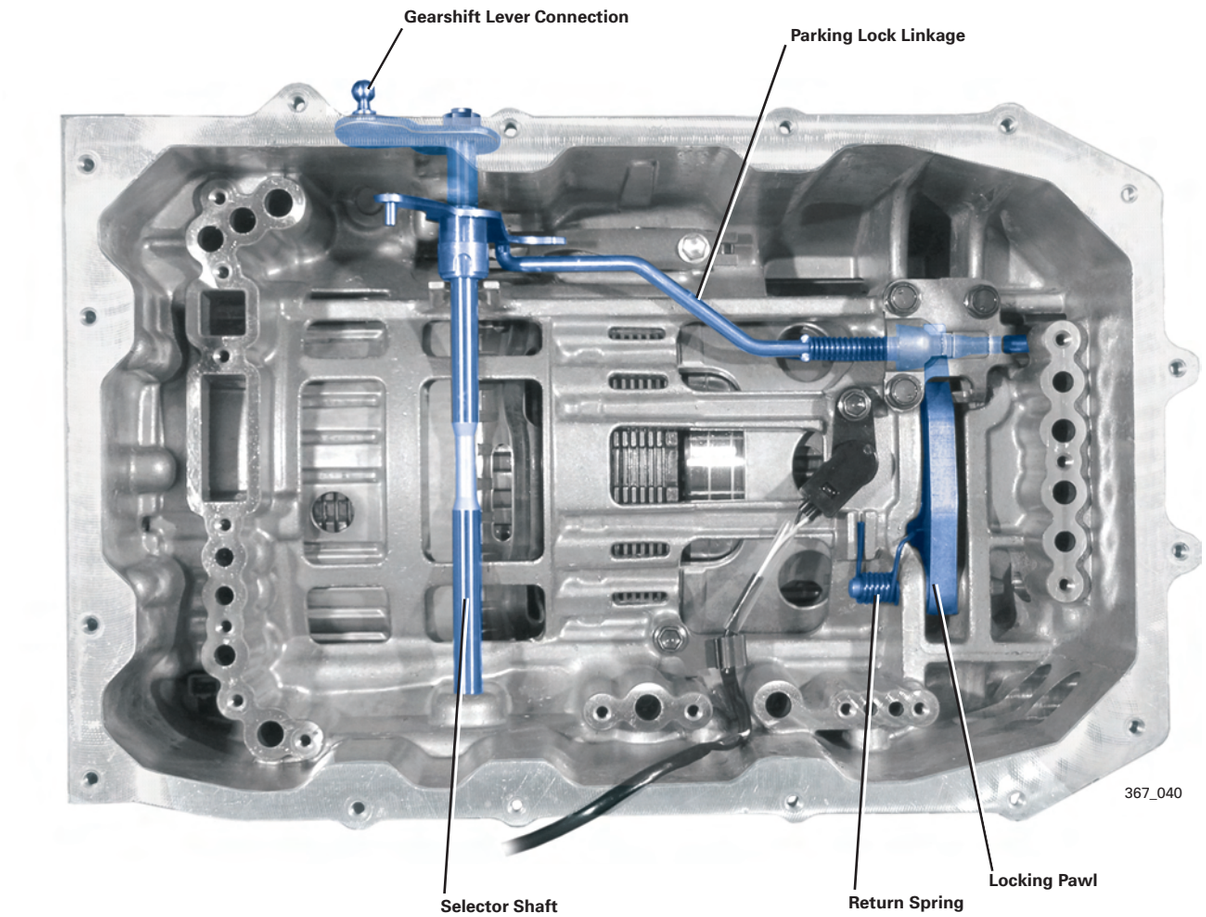
Brake B2 locks planet carrier PT2 in place. Torque is transmitted from sun wheel S2 to long planetary gears P2.

The torque multiplied by PT2 is transmitted to ring gear H2, which is connected to the transmission output shaft. At the same time, ring gear H2 (output) is driven counter to the direction of engine rotation.

Parking Lock

The parking lock is a device which prevents the vehicle from rolling away.

It is actuated by the selector lever via a Bowden cable.



The parking lock gear is rigidly connected to the transmission output shaft.

This enables the locking pawl, which engages the teeth of the parking lock gear, to lock the transfer case. It is not possible to secure the vehicle to prevent it from rolling away when the front axle is raised on one side (for example, when changing a wheel using the car jack). It is necessary to apply the parking brake.

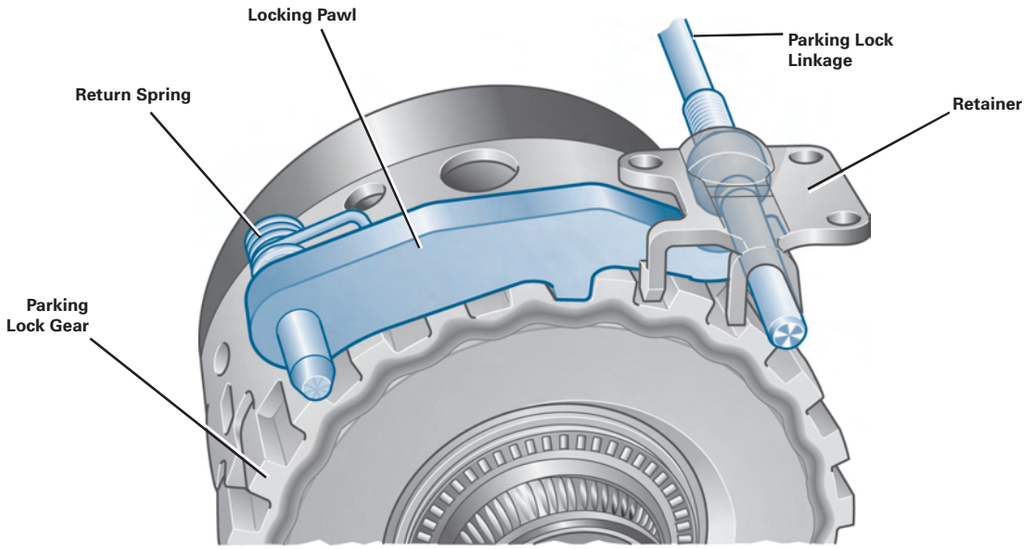
To reduce strain and premature wear of the selector lever cable and enable the selector lever to be engaged more easily, the parking brake should always be applied on steep gradients before shifting the selector lever into the “P” position.

This reduces tension at the pawl and parking lock gear. Before driving away, shift the selector lever out of “P” before releasing the parking brake.

Note

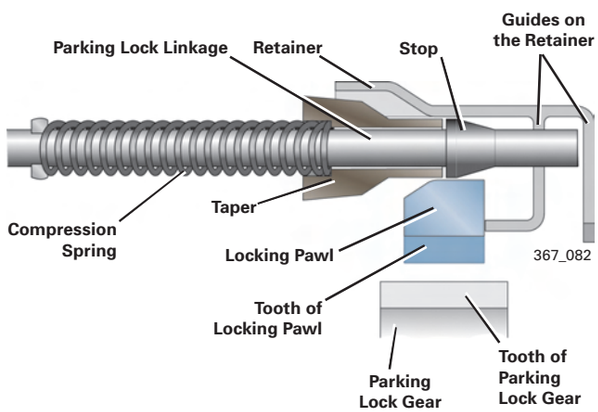
For safety reasons, the shape and flank angle of the locking pawl, the parking lock gear teeth and the compression force of the locking pawl are configured in such a way that the locking pawl does not engage when the vehicle speed is greater than 4.3 mph (7 kph).

If the parking lock is inadvertently actuated at a speed above 4.3 mph (7 kph), the locking pawl will ride loudly over the teeth of the parking lock gear.



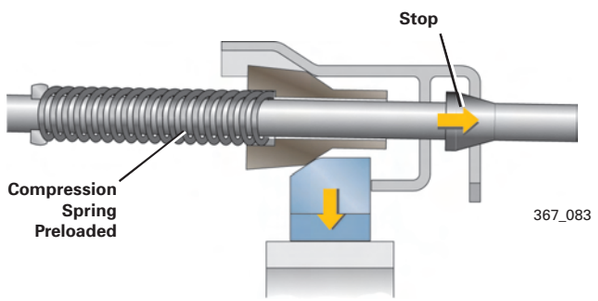
Selector Lever Positions R/N/D/S

In selector lever positions R/N/D/S, the parking lock linkage is in a position in which the taper is not engaging the locking pawl. The locking pawl is held in an initial position with sufficient clearance to the teeth of the parking lock gear by the return spring.



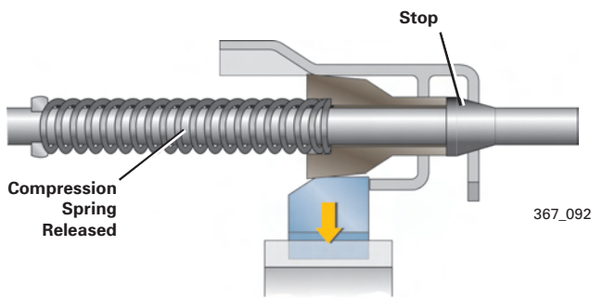
Selector Lever Position "P" (parking lock gear tooth opposed to locking pawl tooth)

In selector lever position "P" the taper is thrust between the retainer and the locking pawl. The locking pawl is pushed towards the parking lock gear. If the tooth of the locking pawl is opposed to a tooth of the parking lock gear, the taper is preloaded by the compression spring. This preload acts across the diagonal of the taper and in turn exerts a preloading force on the locking pawl.

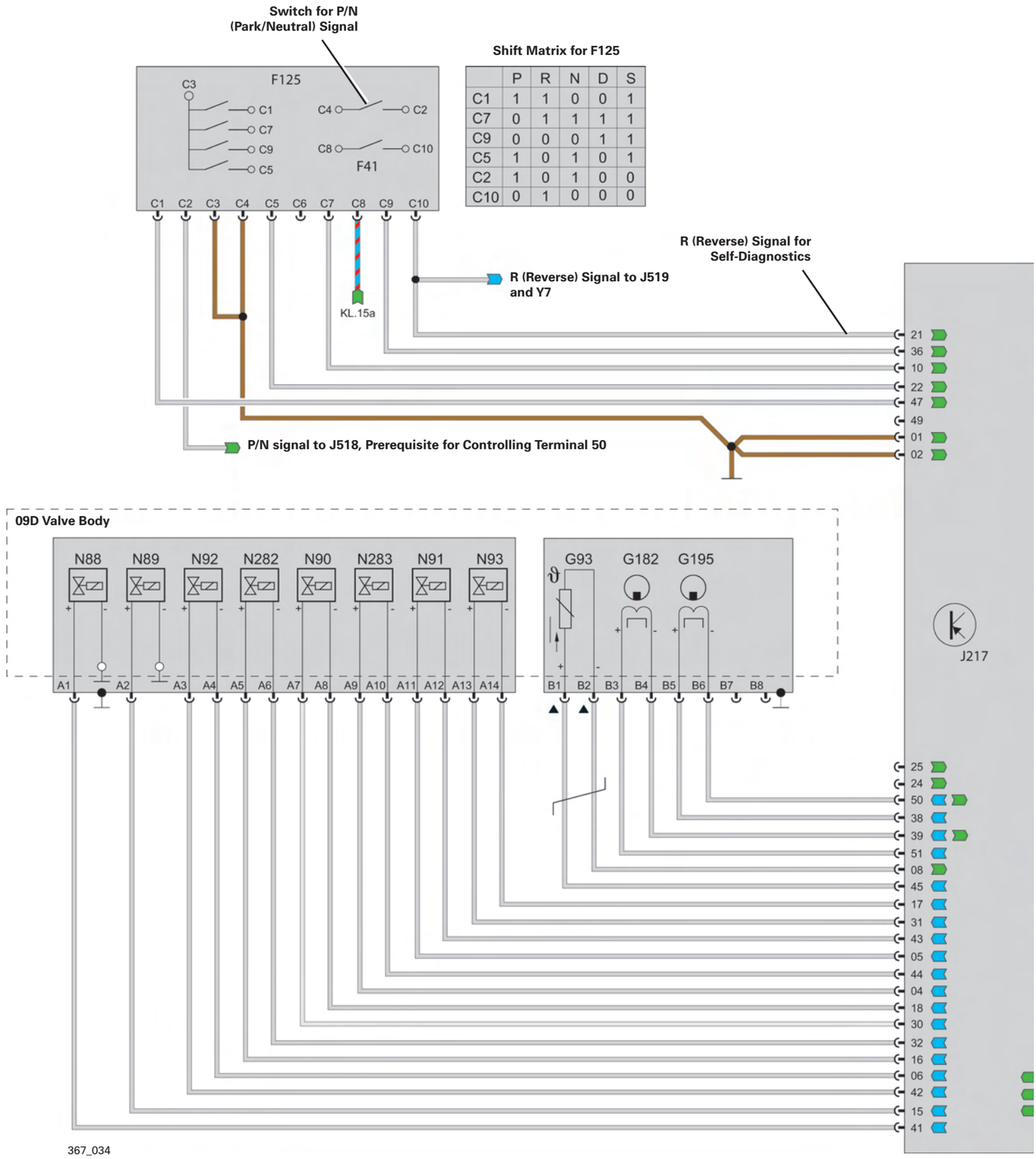


Selector Lever Position "P" (locking pawl engages)

When the vehicle moves (the parking lock gear rotates further), the locking pawl is automatically pressed by the preloaded taper into the next tooth space on the parking lock gear.



Function Diagram — 09D Transmission on the Audi Q7



367_034

Note

Always use the current version of the current flow diagram to troubleshoot the vehicle.

E313 Selector Lever
E415 Access/Start Authorization Switch

F41 Back-up Switch
F125 Multi-Function Transmission Range (TR) Switch

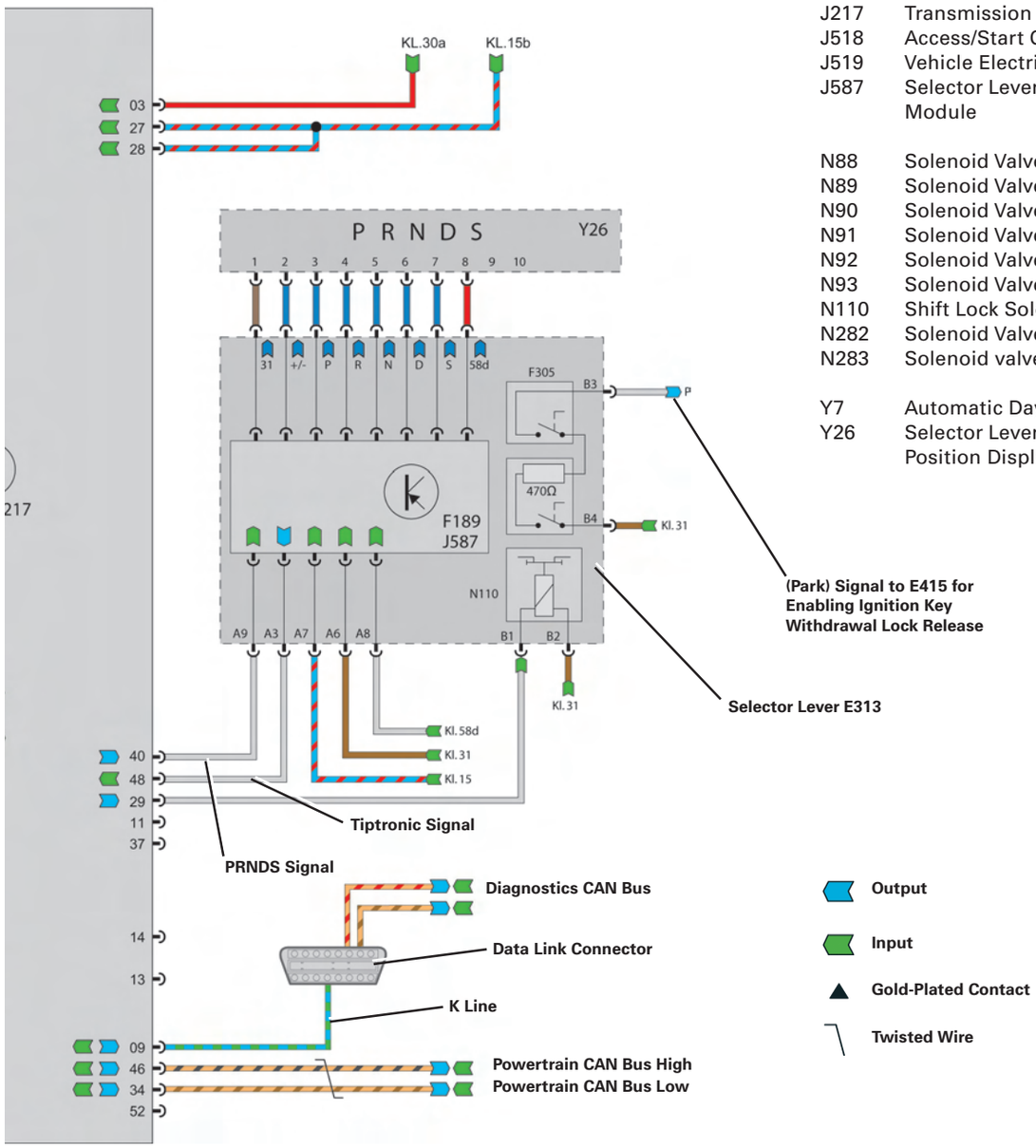
F189 Tiptronic Switch
F305 Transmission Park Selector Switch

G93 Transmission Fluid Temperature Sensor
G182 Transmission Input Speed (RPM) Sensor
G195 Transmission Output Speed (RPM) Sensor

J217 Transmission Control Module
J518 Access/Start Control Module
J519 Vehicle Electrical System Control Module
J587 Selector Lever Sensor System Control Module

N88 Solenoid Valve 1
N89 Solenoid Valve 2
N90 Solenoid Valve 3
N91 Solenoid Valve 4
N92 Solenoid Valve 5
N93 Solenoid Valve 6
N110 Shift Lock Solenoid
N282 Solenoid Valve 9
N283 Solenoid valve 10

Y7 Automatic Day/Night Interior Mirror
Y26 Selector Lever Transmission Range (TR) Position Display Unit



Transmission Control Module J217

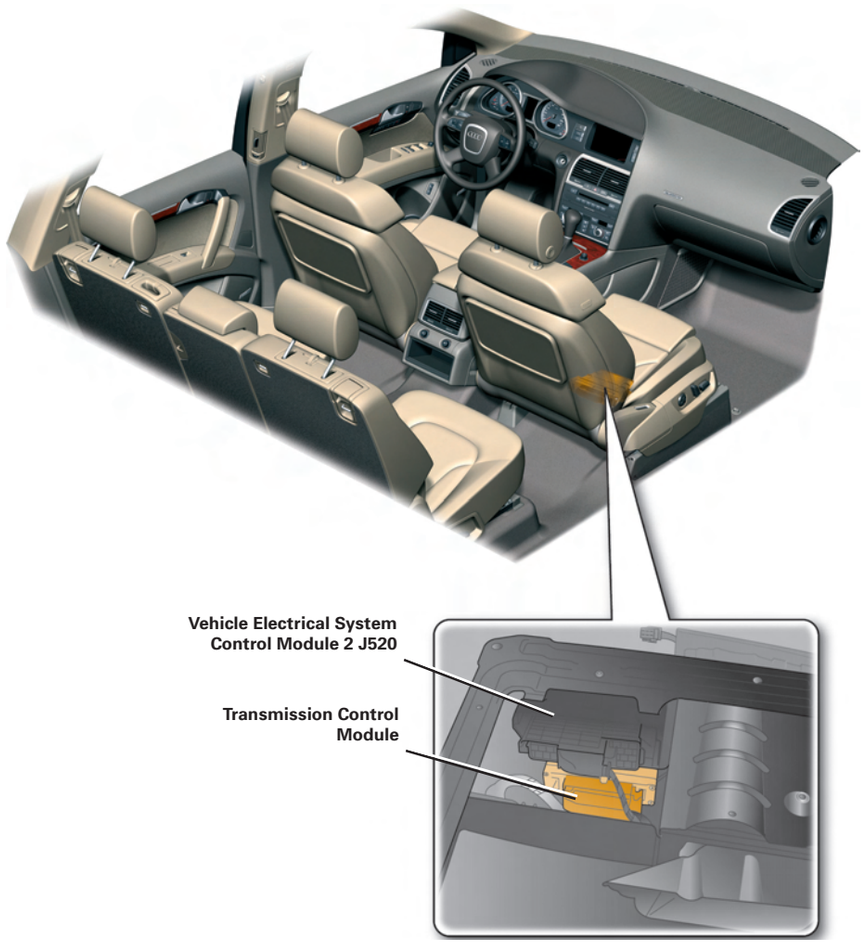
The Transmission Control Module (TCM) on the Audi Q7 is located under the front right seat below Vehicle Electrical System Control Module 2 J520.

The TCM is manufactured by AISIN AW Co. Ltd. of Japan. The control module programming can be updated using the VAS Scan Tools.

Note

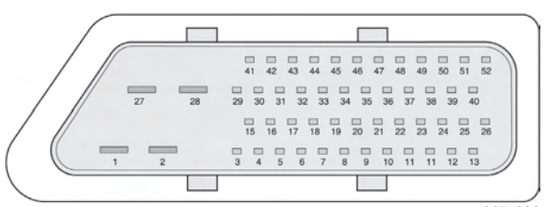
After replacing the Transmission Control Module, the basic setting procedure must be performed using the Scan Tool (under “Guided Fault Finding”).

The adaption values have to be cleared after specific repair work on the transmission (for example, change of ATF, etc.) or after replacing the transmission.



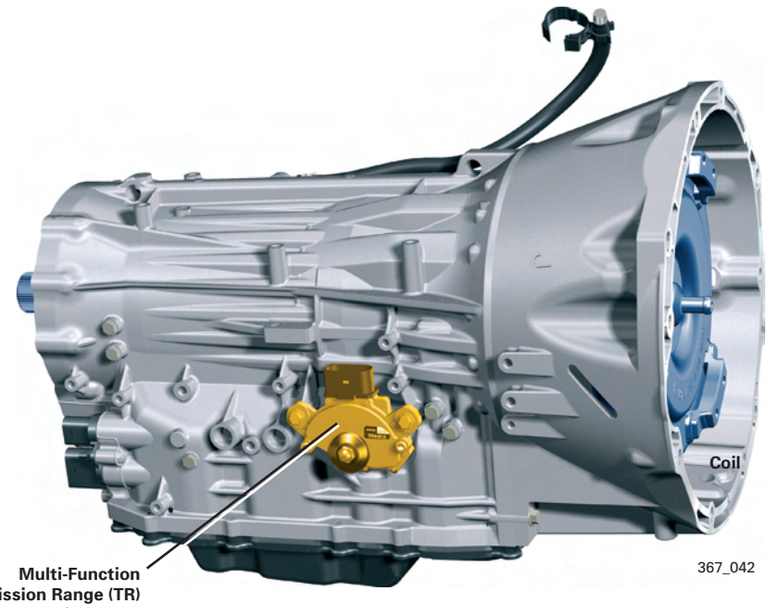
367_055

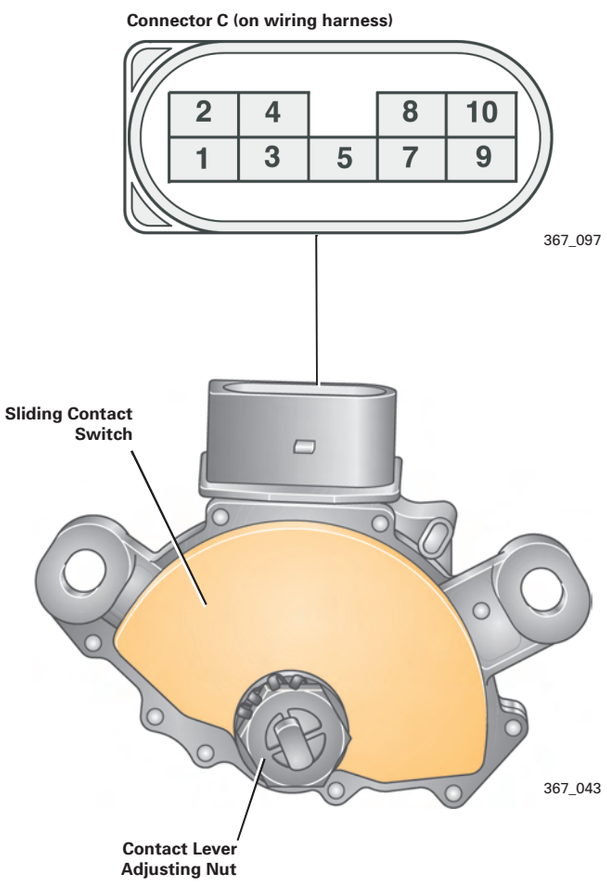
The control module has a 52-pin connector. VAS adapter cable 1598/48 is available for static and dynamic measurements on the system.



367_096

Multi-Function Transmission Range (TR) Switch F125





Multi-Function Transmission Range (TR) Switch F125 has the following tasks and controls the following functions:

- Starter inhibitor control.
- P/N lock control (activation of Shift Lock Solenoid N110).
- It identifies the vehicle operating states forward/ reverse/neutral/sport program, and this information is used by Transmission Control Module J217 for controlling the transmission.
- It identifies backing up or the intention to reverse for use in controlling all functions relevant to backing up, for example, backup lights, anti-dazzle rearview mirror, acoustic parking system, trailer towing mode, mirror fold-back, etc.

Effects of Signal Failure

Faults in F125 manifest themselves in very different ways. The effects vary depending on which switch contacts or interfaces are affected. The following can occur:

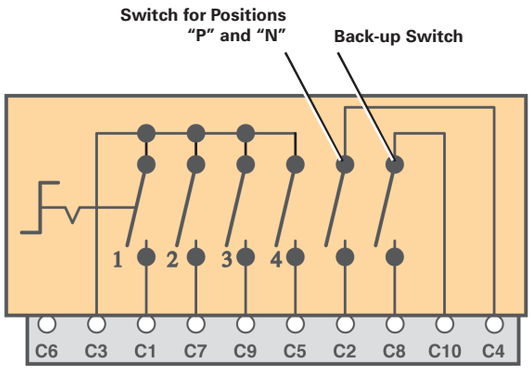
- Engine Does Not Start (starter does not turn)
- No Transmission Power Flow
- Transmission MIL Enters Electrical or Mechanical Limp-home Mode
- Transmission MIL Comes on (inverted LEDs on shift indicator)
- P/N Lock does not Function Properly
- DTC Entry

Contact Assignments — Multi-Function Switch

The multi-function switch is a mechanical multiposition switch with six sliding contacts.

- Four Switches for Identification of Selector Valve Position and Selector Lever Position
- One Switch for Activating Functions Relevant to Reversing (F41)
- One Switch for Starter Control in Selector Lever Positions “P” and “N”

Since the switch contact is fully mechanical, F125 can be checked using an ohmmeter.

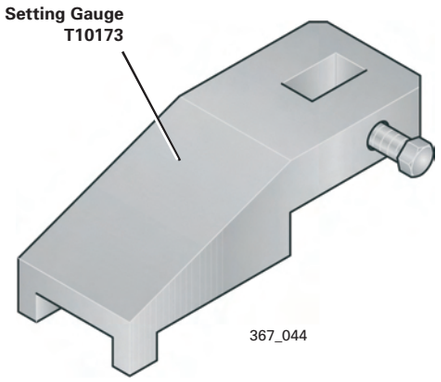


384_041

Shift Logic F125
Coding of Connector C (on the wiring harness)

	P/N Signal		R Signal		Position Signal					Data Block 9/4. Value
	C2	C4	C10	C8	C3	C1	C7	C9	C5	
P	○	○			○	●			●	1001 / 1101
R			○	○	○	●	●			1100 / 1101
N	○	○			○		●		●	0101 / 0111
D					○		●	●		0110 / 0111
S					○	●	●	●	●	1111

367_099



Multi-Function Transmission Range (TR) Switch F125

Use setting gauge T1073 to set the multi-function switch. Please follow the instructions given in the Workshop Manual.

Note

Special care must be taken to ensure the correct torque is applied to the contact lever adjusting nut. If the nut is over-torqued, the multi-function switch will move stiffly and the rubber seals will be damaged. If the nut is not tightened sufficiently, it can lead to ATF leaking at the multi-function switch.

Note

The multi-function switch must be set after installation or if the wrong gear is indicated in the Instrument Cluster display (refer to Workshop Manual).

Transmission Input Speed (RPM) Sensor G182

G182 is integrated in the ATF pump housing and measures the direct transmission input speed (turbine speed) by means of a ring gear on the transmission input shaft.

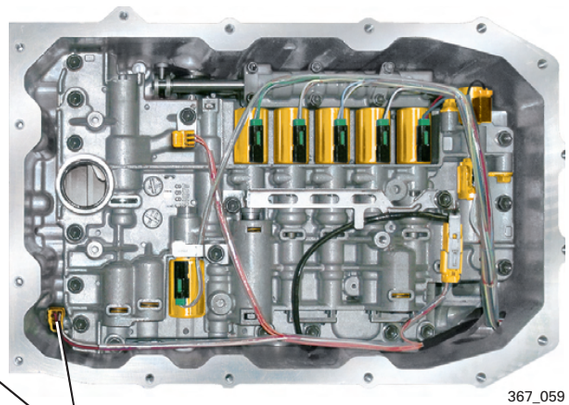
The Transmission Control Module requires the exact turbine speed for the following functions:

- Control, Adaption, and Monitoring of Gearshifts and Gear Selection
- Regulation and Monitoring of Converter Lockup Clutch
- Diagnosis of Shift Elements and Plausibility Checking of Engine RPM and Transmission Output Speed

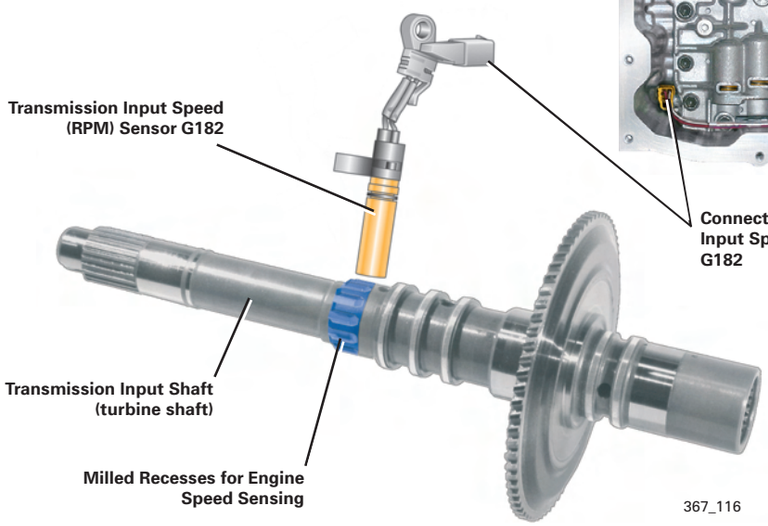
Note

Due to torque converter slip, the transmission input speed (turbine speed) is not equivalent to the engine speed (except when the torque converter lockup clutch is fully closed).

Bottom View of Transmission



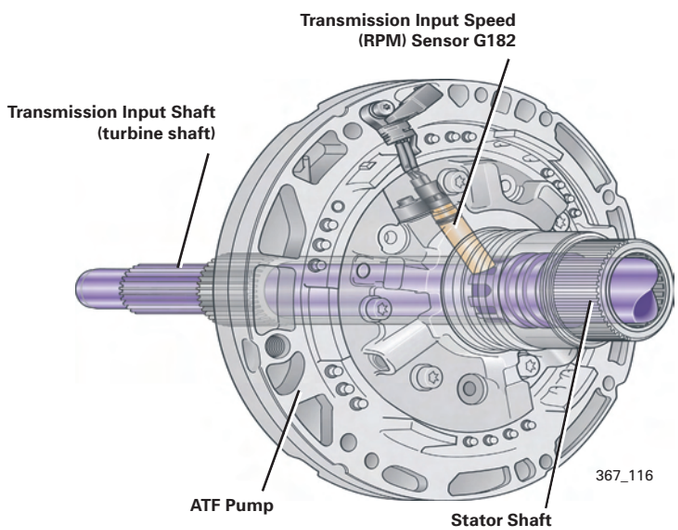
367_059



367_116

Protective/Substitute Function in Case of Failure

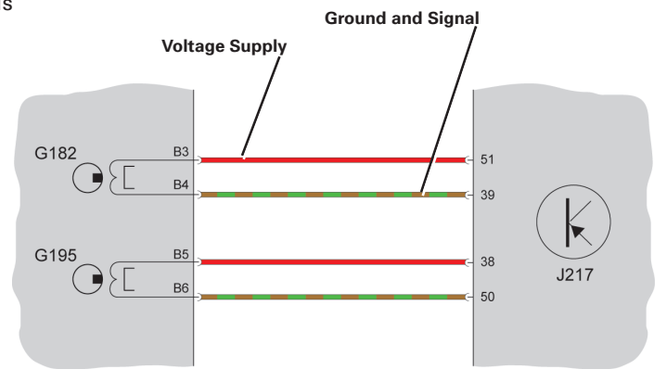
- Engine RPM is Used as a Substitute Value
- No Adaption of Gearshifts
- No Controlled Operation of Converter Lockup Clutch (open or closed only)
- No Pressure Regulation when Selecting Gear (for example, N-D or N-R), -Clunky- Shift Action



367_116

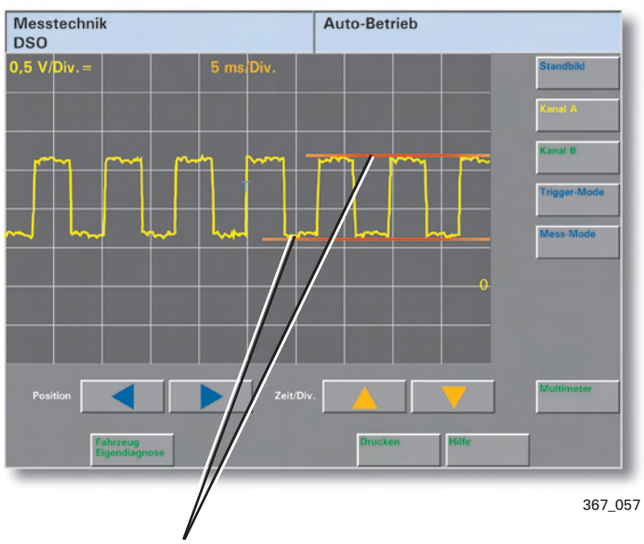
Function

G182 is based on the Hall principle. The output signal is a square-wave signal whose frequency is proportional to turbine speed.



367_037

DSO Image - Signal from G182



367_057

Voltage level when the turbine shaft is stationary, i.e. gear selected, driving speed 0 mph/kph (depending on whether a tooth space or a tooth is located in front of the sensor)

DSO Connection for G182

- Black Probe Tip Pin 1
- Red Probe Tip Pin 39

Test Conditions:

- Engine Idling
- Selector Lever Position “N” or “P”

Auxiliaries:

- VAS 5051
- VAG 1598/48 with 1598/42

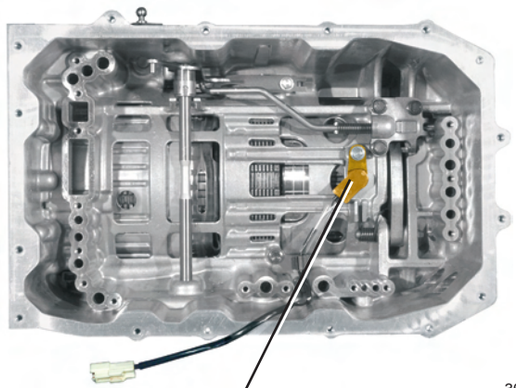
Transmission Output Speed (RPM) Sensor G195

G195 is located behind the valve assembly. It is bolted to the transmission housing and measures the transmission output speed at the ring gear of the Ravigneaux planetary gear set. The ring gear has special milled recesses for this purpose and serves as an encoder disc.

One of the principal signals of the electronic transmission control system is the transmission output speed. There is a direct correlation between transmission output speed and driving speed.

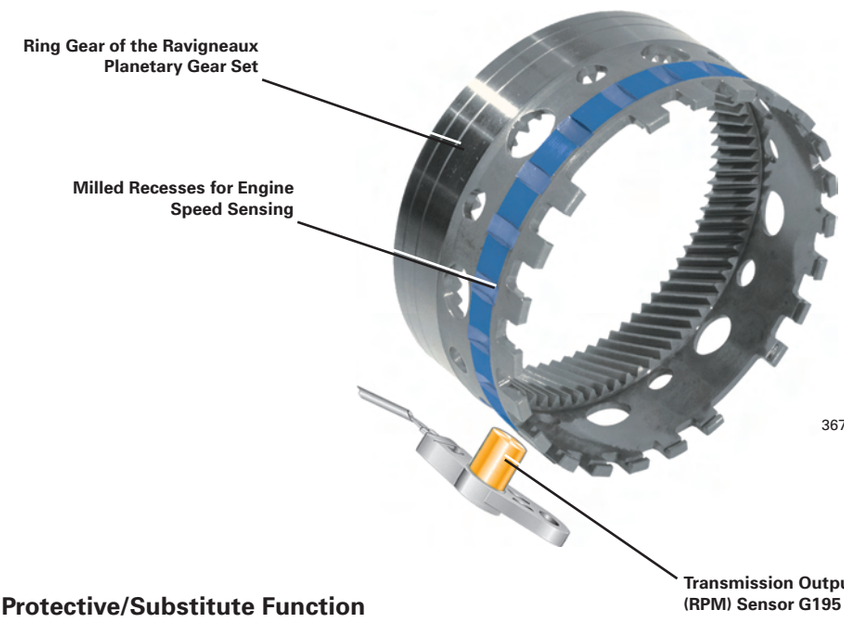
The transmission output speed is required for the following functions:

- Shift Point Selection
- Dynamic Shift Program (DSP), for example, Driving Status Evaluation
- Shift Component and Plausibility Checking of Engine and Turbine Speed (gear monitoring)



367_049

Transmission Output Speed (RPM) Sensor G195



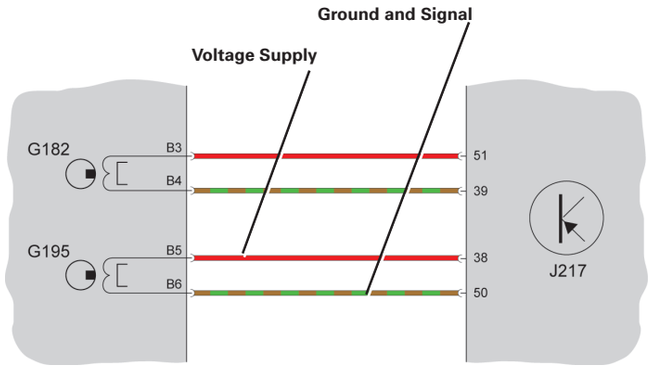
367_048

Protective/Substitute Function in Case of Failure

- The Wheel Speed Value Generated by the ESP Control Module is used as a Substitute Value (via CAN bus)
- Limited DSP Capability

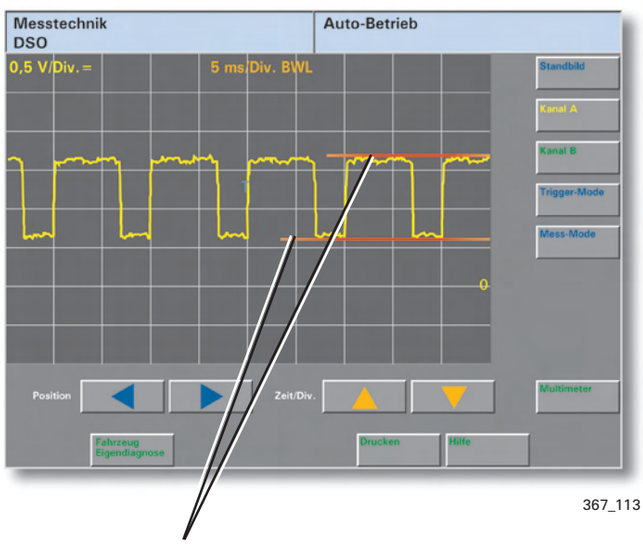
Function

G195 is based on the Hall principle. The output signal is a square-wave signal, the frequency of which is a function of transmission output speed (driving speed).



367_037

DSO Image - Signal from G195



367_113

Voltage level at a road speed of 0 mph/kph (depending on whether a tooth space or a tooth is located in front of the sensor)

DSO Connection for G195

- Black Probe Tip Pin 1
- Red Probe Tip Pin 50

Test Conditions:

- Road Speed Approximately 6.2 mph (10 kph)
- Selector Lever in “D” Position, Engine Idling (vehicle raised on lift)

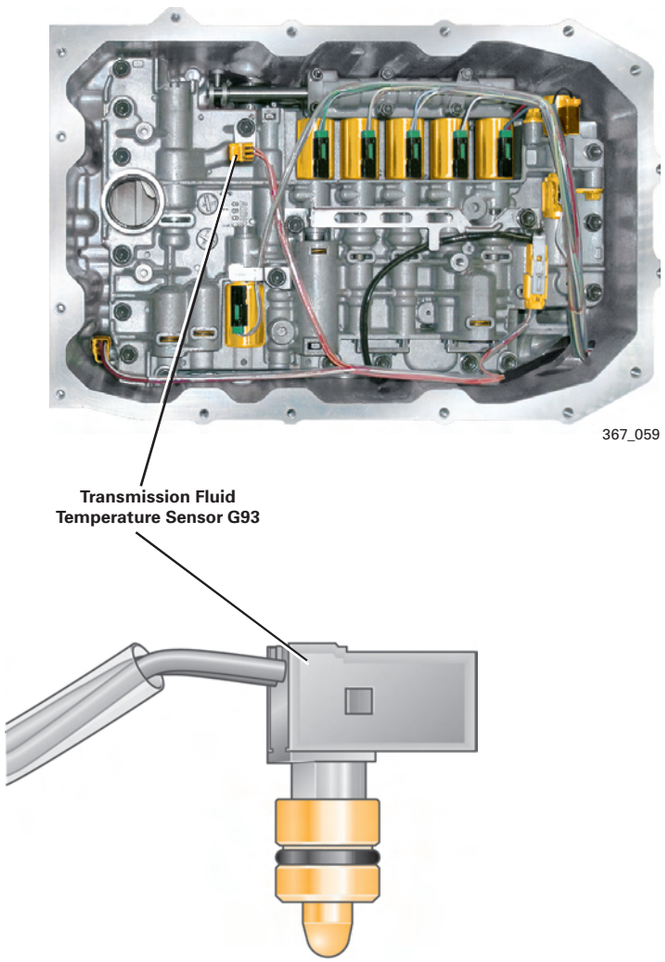
Auxiliaries:

- VAS 5051
- VAG 1598/48 with 1598/42

Transmission Fluid Temperature Sensor G93

G93 is integrated inside the valve assembly and is submerged in ATF. It generates an ATF temperature signal for Transmission Control Module J217.

G93 is an NTC (Negative Temperature Coefficient) resistor and an integral part of the wiring harness.



The ATF temperature is required for the following functions:

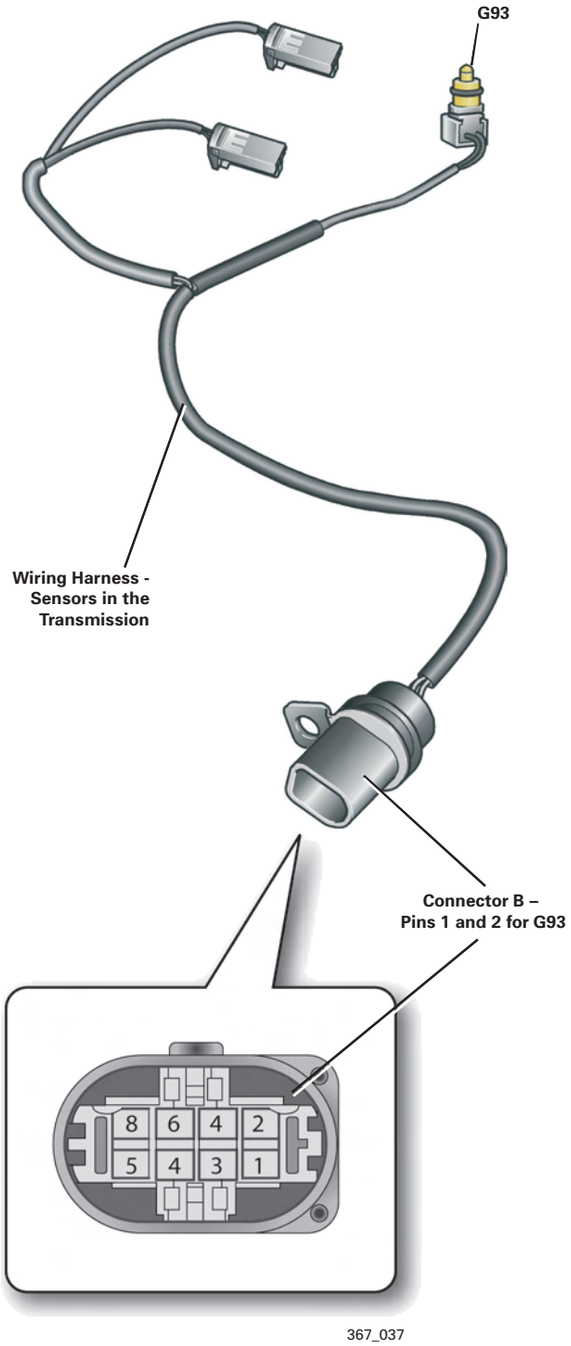
- To adapt shift pressures (system pressure) and to increase and reduce pressure during gearshifts
- To activate and deactivate temperature dependent functions (warm-up program, converter lockup clutch, etc.)
- To activate transmission protection measures if ATF temperature is too high (Hot-mode)
- To activate transmission adaption functions (EPCV control current)

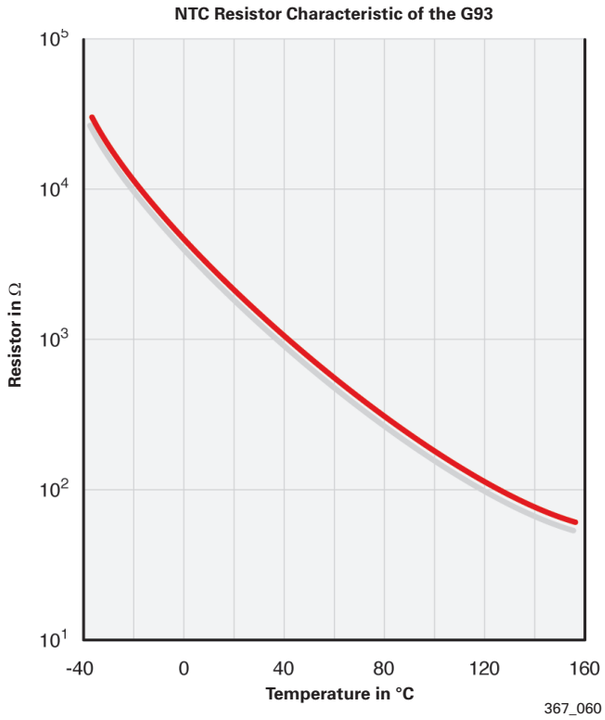
As protection against overheating, countermeasures (Hot-mode) are taken when defined temperature threshold values are exceeded.

Hot-mode Stage 1 (approximately 302 °F [150 °C]): The shift characteristics are adjusted towards higher engine speeds using the DSP function, the operating range for the torque converter lockup clutch being closed is extended.

Hot-mode Stage 2 (approximately 338 °F [170 °C]): Engine torque is reduced.

Wiring Harness with G93





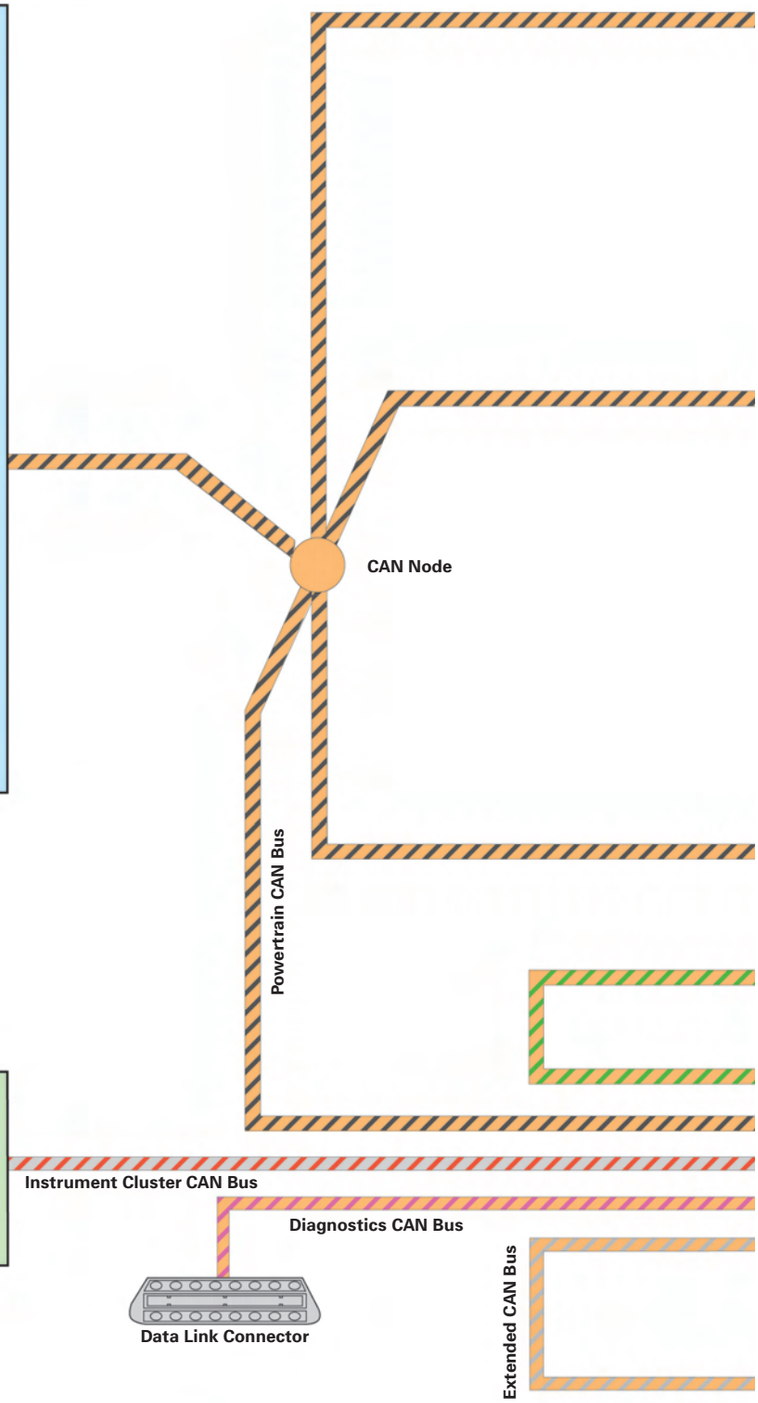
Protective/Substitute Function in Case of Failure

- A Substitute Value is Generated from the Engine Temperature and Operating Time.
- There is no Controlled Operation of Converter Lockup Clutch (open or closed only).
- There is no Shift Pressure Adaption (which usually results in clunkier gearshifts).

CAN Data Exchange — 09D Transmission on the Audi Q7

J217 – Transmission Control Module
- System Status
- Fault Memory Entry/Status
- Selector Mechanism Active
- Coding in Engine Control Module
- Momentary Gear or Target Gear
- Selector Lever Position
- Motion Resistance Index
- Information on Emergency Running Mode and Self-Diagnosis
- OBD Status
- Nominal Idling Speed
- Torque Gradient Limitation (converter/transmission protection)
- Converter/Transmission Protection Status
- Selector Lever Position Display
- Nominal Engine Torque (transmission intervention)
- CAN Sleep Indication
- Torque Converter Lockup Clutch Status
- Self-Diagnosis/Measured Data
- Compressor "Off"
- Cooling Demand
- Turbine Speed

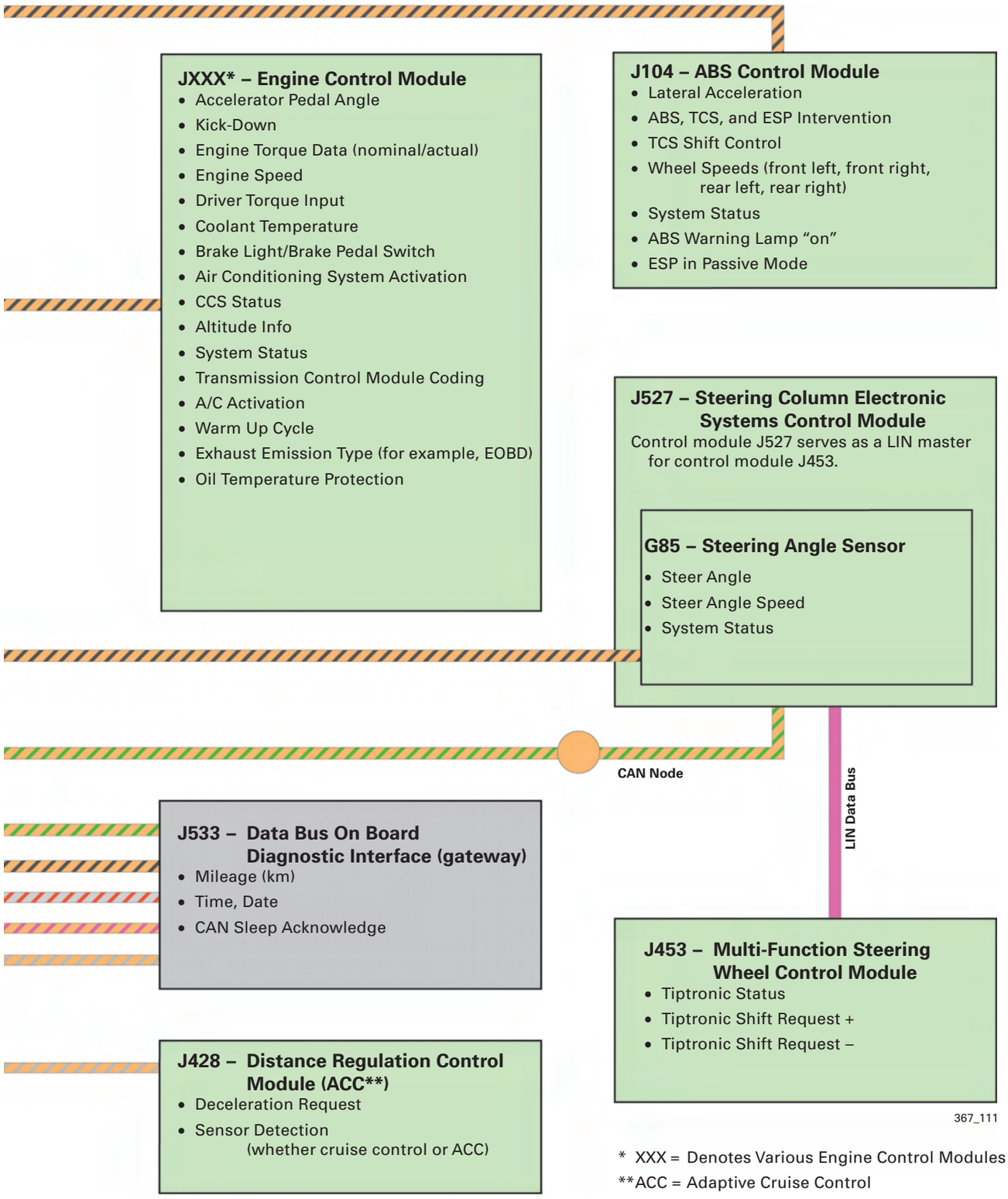
J285 – Instrument Cluster Control Module
- Ambient Temperature
- Mileage



Note
The CAN information exchange processes shown here refer only to information relevant to the transmission.

= Information Sent by the Transmission Control Module

= Information Received by the Transmission Control Module



* XXX = Denotes Various Engine Control Modules

**ACC = Adaptive Cruise Control

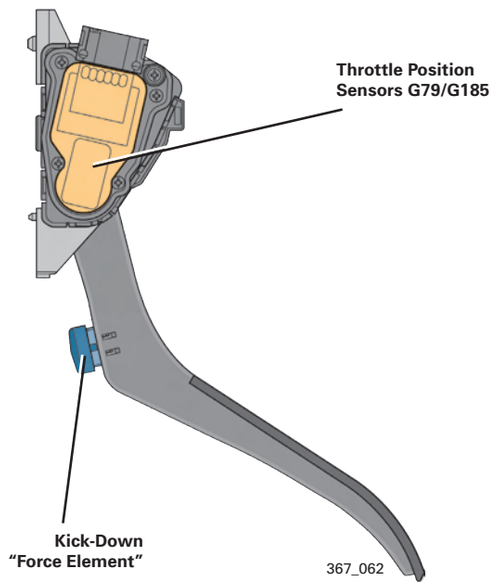
Interfaces/Auxiliary Signals

Kick-Down Information

There is no separate switch for kick-down information. A “force element” is integrated in the accelerator position sensor in place of a stop buffer (for manual transmissions). The force element produces a “mechanical pressure point” which conveys an authentic “kickdown feel” to the driver. When the driver engages the kickdown, the full-load voltage of throttle position sensors G79 and G185 is exceeded.

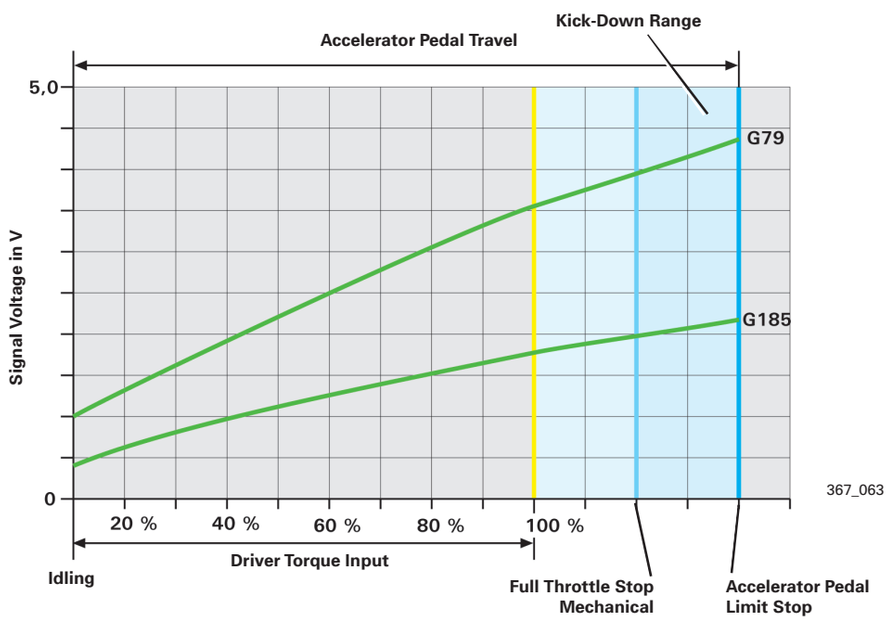
If a defined voltage threshold in the engine control module is reached, this is interpreted as a kickdown request by the driver, and the automatic transmission is informed (via the powertrain CAN bus). The kick-down point can only be checked using the Scan Tool.

Accelerator Pedal in Audi Q7



Note

If the accelerator pedal module or the engine control module is replaced, the kick-down point must be re-adapted.



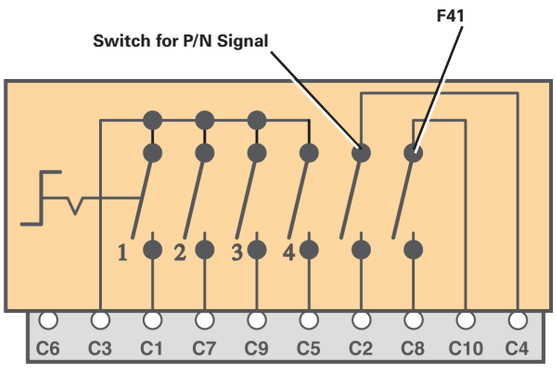
Distributed Functions in the Audi Q7

Starter Inhibitor/Starter Control

The starter control/starter inhibitor function is implemented via Access/Start Control Module J518.

The P/N signal (ground), a requirement for start enabling, is generated by a separate switch in Multi-Function Transmission Range (TR) Switch F125. The P/N signal is transmitted to J518 via a discrete line.

J518 only enables Engine Control Module J623 to activate terminal 50 in selector lever position “P” or “N.” For self-diagnostic purposes, the selector lever position is also indicated to J518 via the databus.



Multi-Function Transmission Range (TR) Switch F125

Back-up Switch F41

Multi-Function Transmission Range (TR) Switch F125 supplies a voltage signal (R signal) to Vehicle Electrical System Control Module J519 and other control modules which utilize the R signal.

The R signal is required for the following functions and systems:

- Back-up Light
- Anti-Dazzle RearView Mirror
- Self-Diagnosis of Transmission Control Module J217

The back-up lights are activated by Comfort System Central Control Module 2. The information path is as follows: F41 > discrete line Vehicle Electrical System Control Module J519 > Comfort System Central Control Module 2 J773 via the convenience CAN > discrete line to back-up lights.

The R signal is also sent to Transmission Control Module J217 via a discrete line.

The self-diagnostics in J217 utilize the R signal to check the plausibility of Multi-Function Transmission Range Switch F125.

If the R signal is faulty, the transmission enters limp-home mode.

Dynamic Shift Program DSP

As a modern automatic transmission, the 09D also features the latest generation of the Dynamic Shift Program (DSP).

The DSP evaluates vehicle operating parameters such as motion resistance (for example, uphill gradient), route profile (for example, corner), and driver type (driving style).

The main parameters used to compute the gear selection have not changed fundamentally compared to previous automatic transmissions. Due to the increased networking of the Transmission Control Module and other vehicle systems, such as engine, ESP, and steering angle sensor, today a larger volume of information is available, providing an even better description of momentary driving status and driving style for the Transmission Control Module.

Tiptronic Shift Strategy

– Automatic Upshift Upon Reaching Maximum Engine Speed.
– Automatic Downshift when Engine Speed Drops Below Minimum Threshold.
– Kick-Down.
– Drive-Away in Second Gear by Selecting Second Before driving Off.[1)]
– Upshift Prevention and Downshift Prevention.[2)]

1) The vehicle is normally driven away in first gear. It can also be driven away **in second gear** by shifting up into second before driving off (with steering wheel Tiptronic or selector lever). This makes driving away easier on low friction road surfaces, for example, on icy or snow-covered roads.

2) In addition to manual gearshifting, the Tiptronic function is, for example, necessary for making use of the engine braking effect. The selector lever gate (with positions “D” and “S”) does not allow intervention in order to prevent upshifts or downshifts. The Tiptronic function (selector lever in Tiptronic gate) can be used to maintain the actual gear position or to select a different gear within the shift limits. In this way, as mentioned, it is possible to use the engine braking effect and prevent repeated shifting back-and-forth between gears (for example, in trailer towing mode).

Sport Program “S”

In the selector lever “S” position, a performance-oriented shift program is available to the driver.

When the Transmission Control Module is informed that the selector lever is in the “S” position, it alters the shift characteristic so it is biased toward higher engine speeds. This enhances driving dynamics.

When the selector lever is in the “S” position, the DSP also adapts to driver inputs (driver type analysis) and driving situations.

The “S” program also has the following special features:

– If the selector lever is moved into the “S” position under constant acceleration, the transmission kicks down within defined limits.
– To ensure a more direct driving response to movement of the accelerator, the vehicle is, where possible, operated with the converter lockup clutch closed.
– If sixth gear is configured as an overdrive gear, only gears 1 to 5 are selected.

Limp-home Mode

In the event of faults/malfunctions which activate the mechanical limp-home mode, 3rd gear is always selected during vehicle operation in any gear up to third.

If the transmission is already in fourth, fifth, or sixth gear, the momentary gear is maintained until the selector lever is moved into neutral or the ignition is switched off.

When driving away again (with the selector lever in either the “D” or “S” position), or restarting the engine, third gear is always selected.

Reverse gear is available (R gear lock is disabled).

The maximum system pressure is set and, as a result, maximum shift pressure is applied to the shift elements. This results in harsh gear engagements.

The converter lockup clutch stays open.



367_064

Towing

When the vehicle is towed, the ATF pump is not driven. As a result, the rotating parts are not lubricated.

To avoid serious transmission damage, the following conditions must be met:

- The Selector Lever Must be in the “N” Position.
- A Maximum Towing Speed of 30 mph (50 kph) must not be Exceeded.
- A Maximum Towing Distance of 30 mi (50 km) must not be Exceeded.

If the battery is disconnected or dead, the selector lever emergency release device must be operated in order to move the selector lever from the “P” to the “N” position.

Note

Towing procedures may vary; always follow the Owner’s Manual instructions for towing a vehicle.

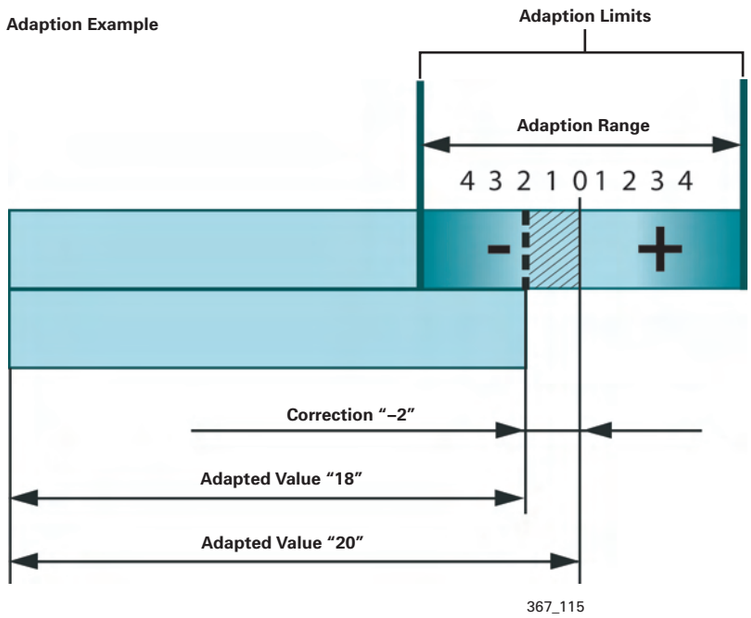
Transmission Adaption – 09D Transmission

Introduction

A prerequisite for good and consistent shift quality, in addition to the design, is precision control of the shift elements. This is the purpose of the transmission adaption feature. In order to maintain constant shift quality during the entire service life of the transmission, it is necessary to continuously adapt the various open and closed-loop control parameters and save acquired adaption data. These adjustments and the teach-in process are collectively defined as “adaption.”

The task of the adaption function is to compensate for production tolerances in transmission components and changes which occur during their service life.

The adaption values serve as corrective values, or so-called offsets, which are either added to or subtracted from the default values (applied values) stored in the Transmission Control Module.



Note

Transmission adaption is a very complex subject. Only basic principles and general topics are discussed in the content of this Self-Study Program. You will find further information in the relevant Service Training Course.

Mechanical and Hydraulic Influencing Factors

The shift elements are actuated hydraulically. For this reason, allowance must be made for the characteristics of the electrical and mechanical control valves. The resistances produced by mechanical friction in components, as well as the pressure of the piston return springs, have to be overcome. In addition, attention must be paid to the filling of all ports, lines, and cylinder chambers, as well as the clutch clearance. All of these are factors which affect the overall gearshifting sequence, not to mention the parameters which apply to the shift elements themselves.

Shift Element Parameters

Clutch torque is dependent on the following parameters:
- Type of Engine.
- Contact Pressure (clutch pressure).
- Coefficient of Friction.

Note:
These parameters must always be in correct correlation with each other so that a specific amount of torque can be transmitted.

The **type** is defined in design terms and therefore constant. **Contact pressure** is regulated by the clutch pressure. **Clutch pressure** is the parameter which is used to control clutch torque and which is most easily influenced. The **coefficient of friction** is a parameter which changes continuously during vehicle operation and throughout the service life of the vehicle.

Now, therefore, let us look the variable parameters, clutch pressure, and coefficient of friction.

The coefficient of friction is dependent on the following influencing factors:
- Materials of the Friction Partners (specification, quality, aging, and wear).
- ATF (specification, quality, aging, and wear)
- ATF Temperature
- Clutch Temperature
- Clutch Slip

In addition to the previously mentioned mechanical and hydraulic influencing factors, the above influencing factors have to be compensated by adaption.

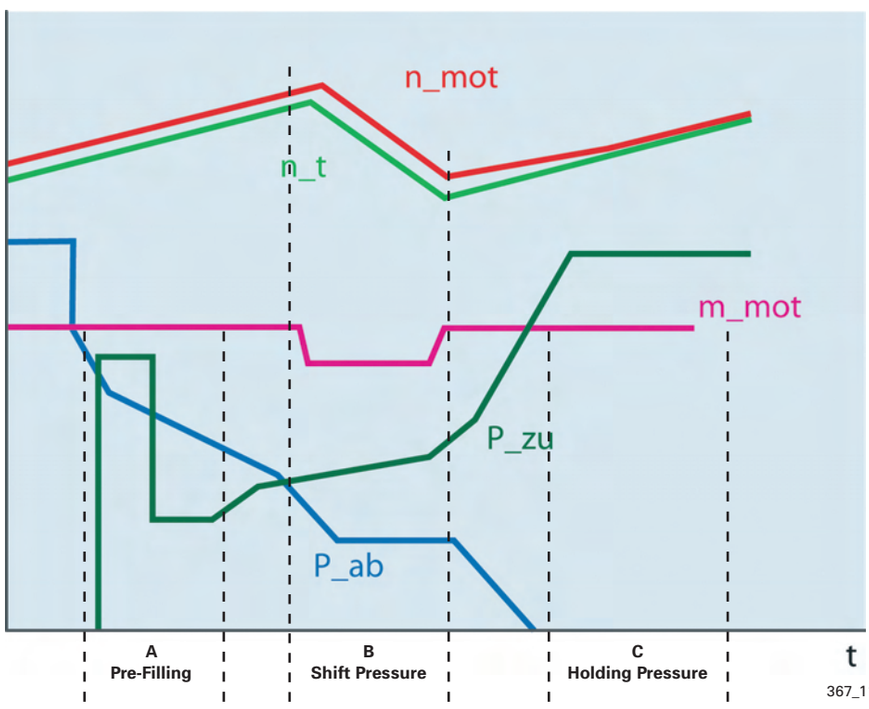
Fig. 367_117 shows, in a simplified manner, the sequence of a so-called overlap gearshift (upshift under acceleration) and the adaption ranges within which adaption processes take place.

In an overlap gearshift, the power-transmitting clutch maintains the torque at a reduced pressure level until the engaging clutch has taken up the torque. To make the gearshift sequence as comfortable as possible and to conserve the clutches, engine torque is reduced while the overlap gearshift is being performed.

Upshift Under Acceleration Sequence

Legend

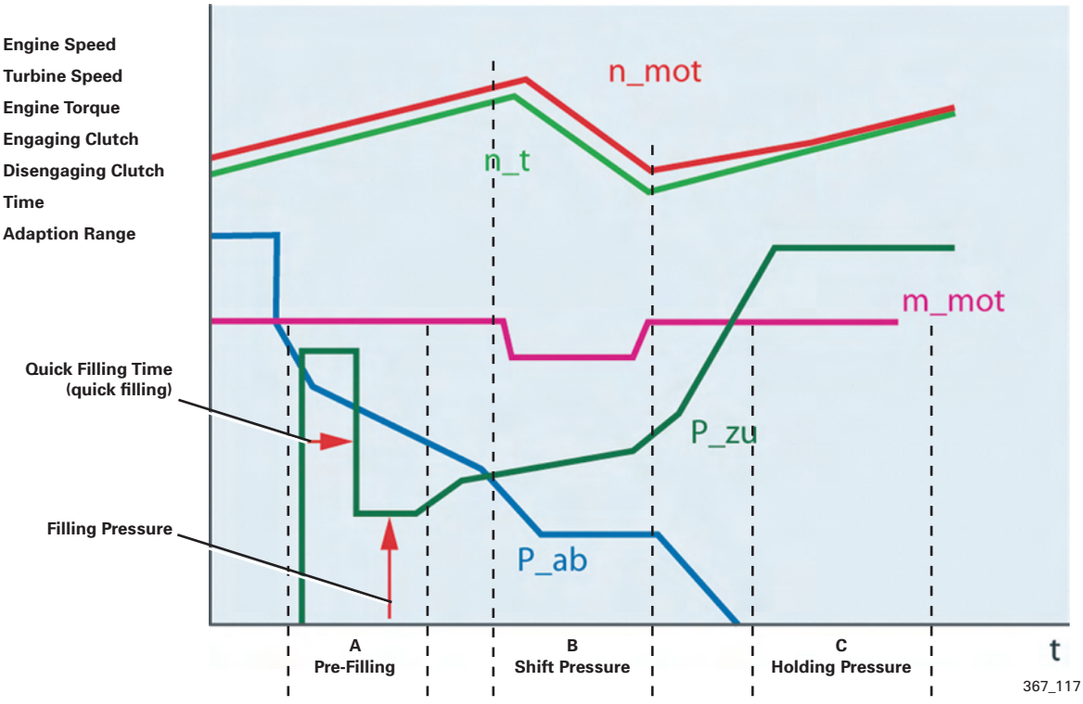
n_mot	=	**Engine Speed**
n_t	=	**Turbine Speed**
m_mot	=	**Engine Torque**
P_zu	=	**Engaging Clutch**
P_ab	=	**Disengaging Clutch**
t	=	**Time**
A, B, C	=	**Adaption Range**



Upshift Under Acceleration Sequence

Legend

n_mot	=	Engine Speed
n_t	=	Turbine Speed
m_mot	=	Engine Torque
P_zu	=	Engaging Clutch
P_ab	=	Disengaging Clutch
t	=	Time
A, B, C	=	Adaption Range



The following aspects of the gearshift sequence are adapted:

- Quick Filling Time (pre-filling)
- Filling Pressure (pre-filling)
- Shift Pressure (engaging and disengaging clutch)
- Holding Pressure

Quick Filling Time = period during which increased pressure is applied to the clutch in order to engage the clutch assembly and fill the clutch cylinder chamber.

Filling Pressure = pressure which is required to compress the clutch plate assembly to the point where the clutch just comes into engagement but a significant amount of this torque is still not transmitted.

Shift Pressure = pressure which acts during the slip phase.

Holding Pressure = pressure required to keep the clutch securely closed.

Adaptions are made during gearshift cycles and when the vehicle is stationary with the engine operating at idling speed.

The following **adaption conditions** must be met so adaptions can be performed:

- ATF Temperature Must be Between 151 °F and 230 °F (66 °C and 110 °C).
- Engine Load Must be Within Defined Range (very low engine load or low accelerator pedal angle).
- No Faults Registered in Fault Memory of the Transmission Control Module.
- Defined driving state (for example, certain adaptions are only performed when vehicle is stationary and when engine is running at idling speed).
- Good Road Conditions (no uphill gradient or downhill gradient, straight road).

The transmission adaption status is established over a prolonged period of time in service. A further feature of the Transmission Control Module is that the adaption frequency is reduced with increasing mileage. This means the adaption frequency of a transmission with low mileage or with cancelled adaption values is very high. On the other hand, transmissions with high mileage have longer adaption intervals.

Deleting Adaption Values

The adaption values of the 09D transmission are preserved even if the power supply to the Transmission Control Module is cut off (for example, battery is disconnected, etc.); however, they can be deleted using the Basic Setting test plan of the Scan Tool.

Basic Setting can be used not only to delete adaption values, but also to program in the kick-down point and activate the steering wheel Tiptronic function (if available).

The following are situations when the basic setting procedure must be performed:

- After Replacing the Transmission
- After Replacing the Transmission Control Module J217
- After Changing the ATF
- After Repair Work on the Transmission (for example, replacing the valve assembly, clutch repairs)
- After Replacing or After Removing and Installing Throttle Position Sensors G79/G185
- After Complaints About Shift Comfort
- Possibly After Engine Repairs (for example, after replacing the engine, engine control module, etc.)
- Possibly After a Software Flash Update

It is recommended to perform an adaption drive after deleting adaption values or carrying out the basic setting procedure.

An adaption drive must always be performed after deleting adaption values due to complaints about shift comfort.

Adaption Drive

Step 1:
First, the previously mentioned adaption conditions must be fulfilled.

Step 2:
When the engine is operating at idling speed, the vehicle is stationary, and the brake is applied, move the selector lever from “N” to “D” and keep it in position “D” for at least three seconds. Repeat this procedure five times, then carry out the same procedure for the gearshift from “N” to “R.”

Step 3:
Accelerate the vehicle in selector lever position “D” from a standing start until 6th gear is engaged and the vehicle is travelling at a speed of approximately 50 mph (80 kph), or more. **An accelerator pedal angle between 25% and 30% must be maintained (check this using the Scan Tool).** After this, allow the vehicle to coast and then bring it to a standstill within 60 seconds by applying minimal brake pressure. Repeat this procedure 10 times.

Step 4:
Shift quality assessment.

Transmission Periphery

Gear Selector

The gear selector mechanism is connected mechanically to the transmission via the selector lever cable.

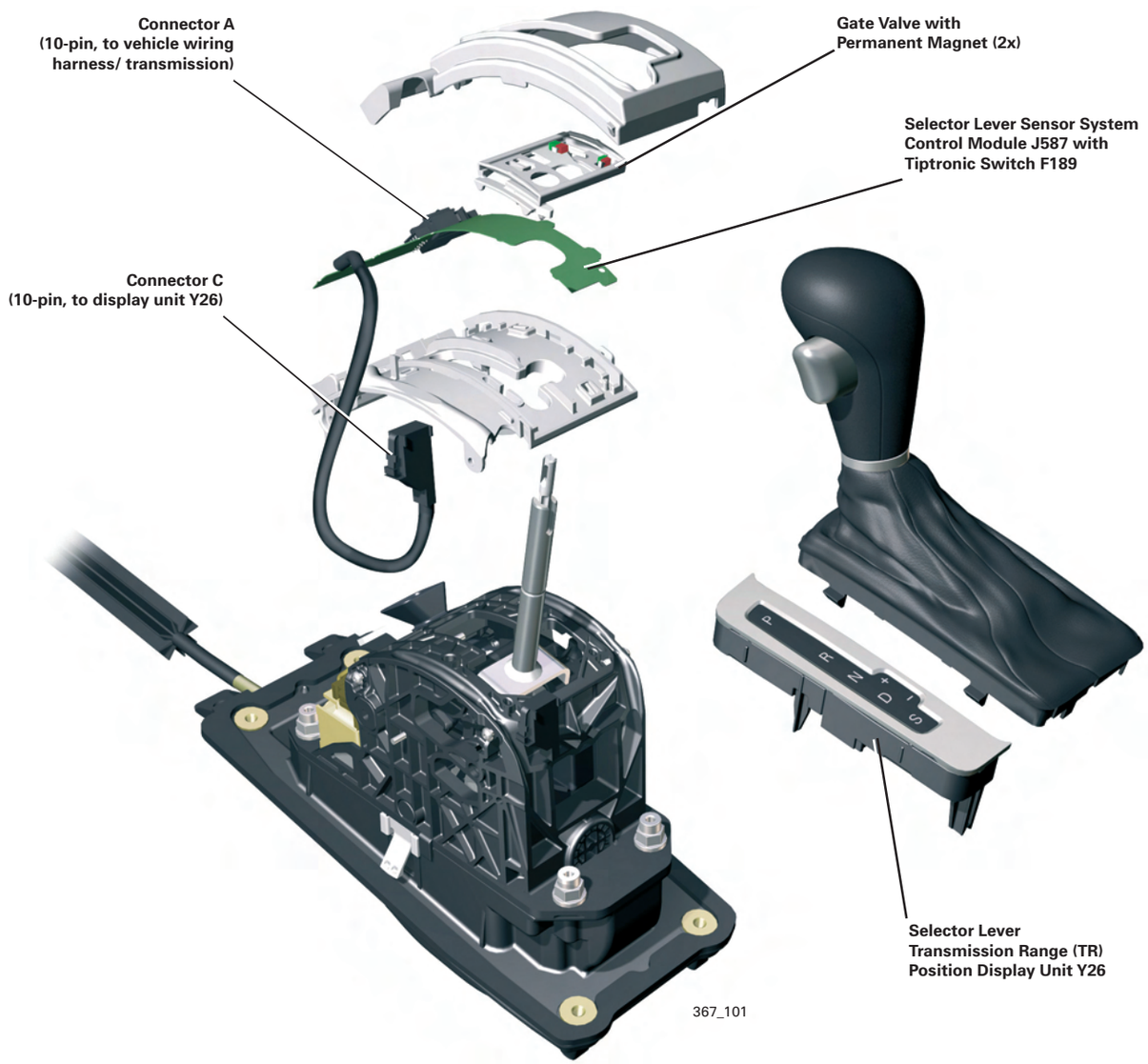
It also performs several tasks and functions, for which an electrical connection exists to the Transmission Control Module and the vehicle periphery.

Mechanical Functions

- Actuation of Parking Lock
- Actuation of Selector Valve of Hydraulic Valve Body
- Actuation of Multi-Function Switch on Transmission
- P/N Lock (shift lock)

Electrical Functions

- P/N Lock Control
- Ignition Key Withdrawal Lock
- Activation of Selector Lever Transmission Range (TR) Position Display Unit
- Tiptronic Function

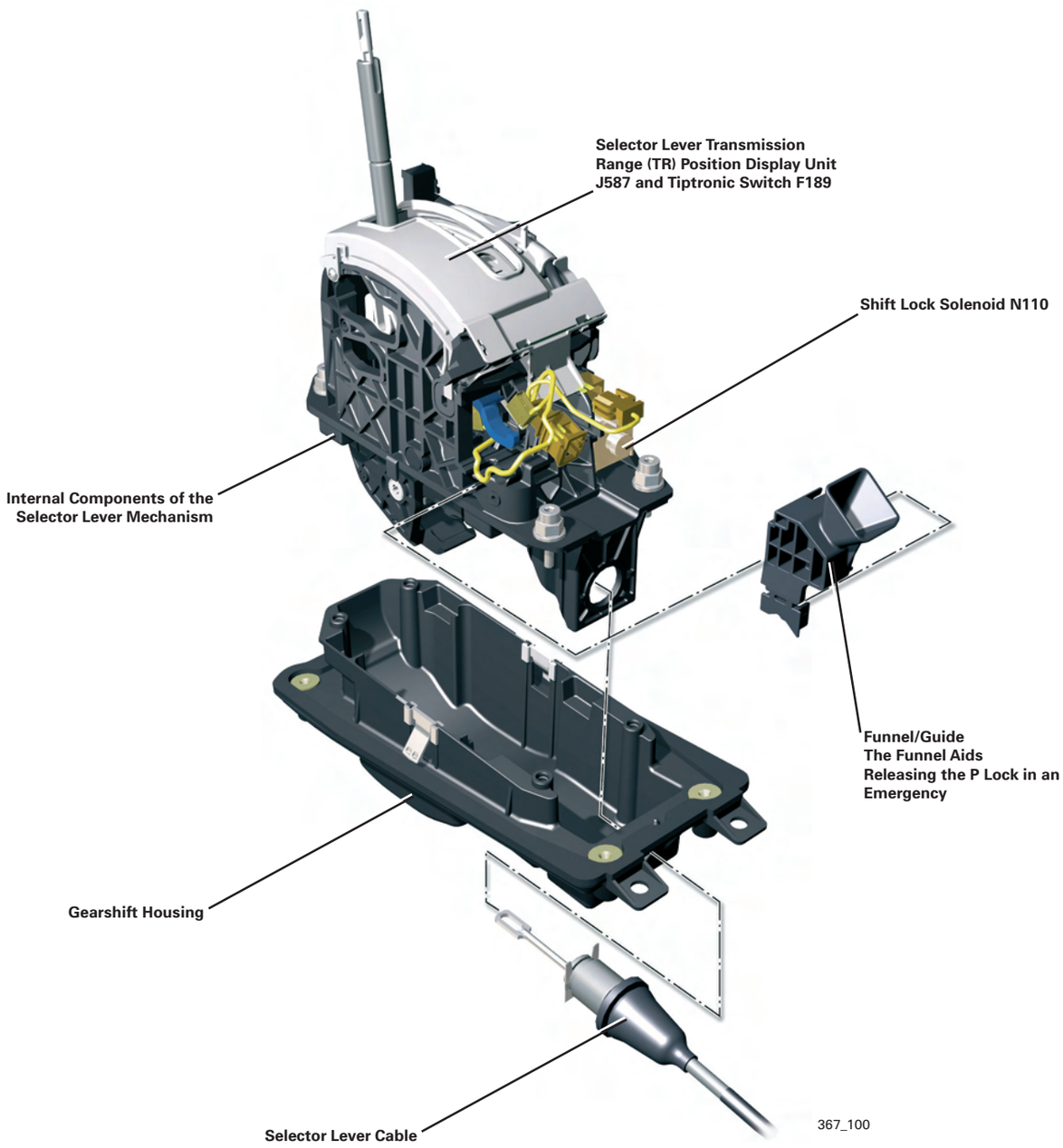


The design and functioning of the selector lever mechanism on the Audi Q7 are largely identical to the mechanism on the 2005 Audi A6 (up to approximately mid-2006).

Here are the main differences:

The selector lever mechanism can be removed from the interior of the vehicle in order to make repairs (for example, to replace microswitch F305).

When replacing the selector lever mechanism, the selector housing (installed from the outside) remains in the vehicle. Only the internal components of the mechanism need to be replaced.

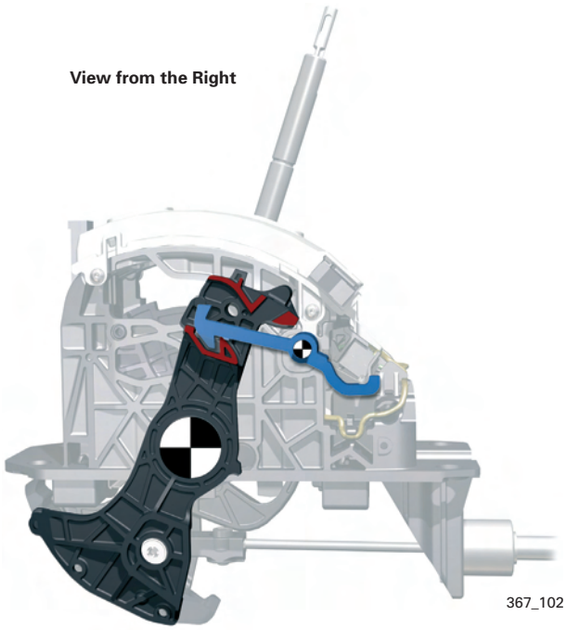


Shift Locks (P lock and P/N lock)

Basically, a distinction is made between the P/N lock while driving and the P/N lock with the ignition “on” and locking of the selector lever in the “P” position with the ignition key removed (P lock).

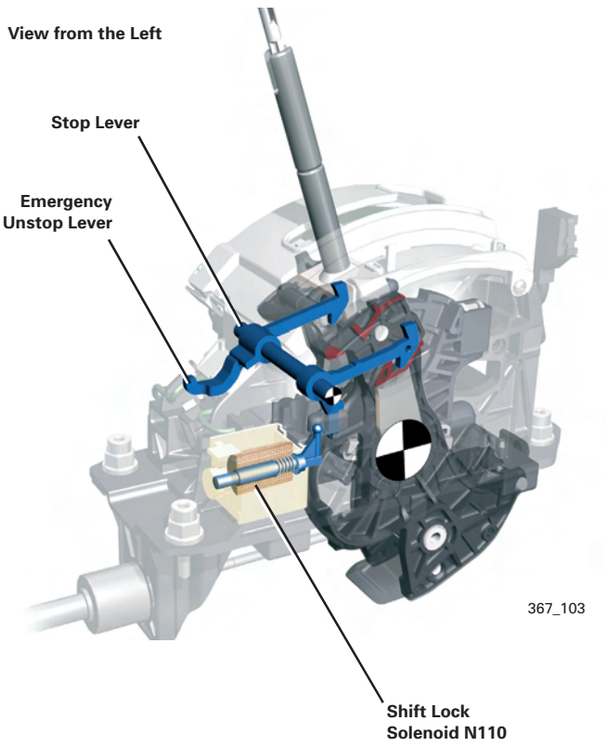
The kinematics of the locking mechanism are designed in such a way that locking is possible both in the de-energized state of the N110 (position “P”) and in the energized state (position “N”).

View from the Right



367_102

View from the Left



367_103

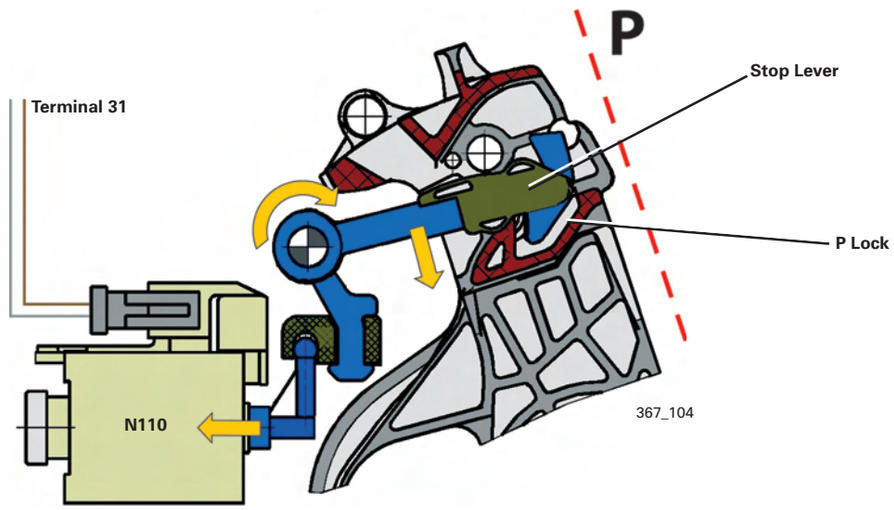
Shift Lock – Selector Lever Position “P”

Locking of the selector lever in position “P” is ensured by the automatic locking of the stop lever in this position.

If N110 is de-engergized, the stop lever (assisted by a spring in solenoid N110) drops automatically (by gravity) into the P lock as soon as the selector lever is moved into the “P” position.

To release the shift lock, solenoid N110 is energized, with the result that the solenoid pushes the stop lever back out of the P lock.

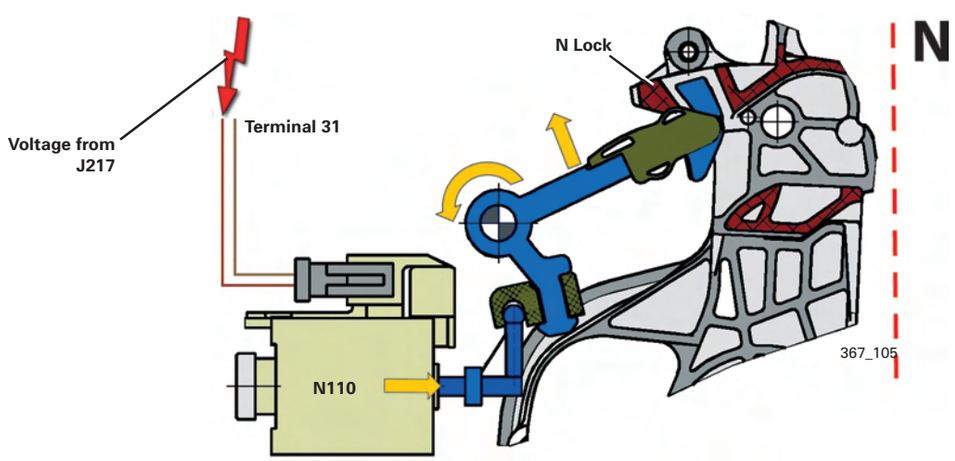
In the event of a fault or power failure, the selector lever remains locked in position. There is an emergency release mechanism for such cases.



Shift Lock – Selector Lever Position “N”

If the selector lever is in the “N” position, N110 is activated and pushes the upper hook of the stop lever into the N lock and locks the selector lever.

To release the shift lock, N110 is de-energized, and the stop lever drops down. (Refer to the Shift Lock - Selector Lever Position “P” explanation.)



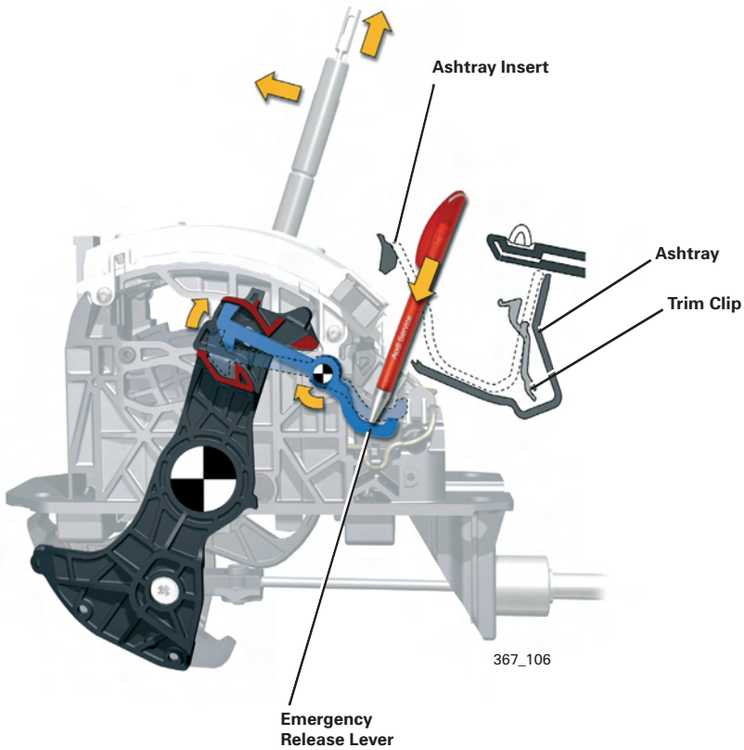
Emergency Release – P Lock

Due to the fact the P lock is only unlocked when N110 is activated, the selector lever remains locked in position "P" in the event of a malfunction (for example, dead battery, failure of solenoid N110, etc.).

To enable the vehicle to be moved in such a situation, there is an emergency release lever on the left-hand side of the stop lever.

The emergency release mechanism can be accessed by removing the ashtray insert and the trim clip behind it.

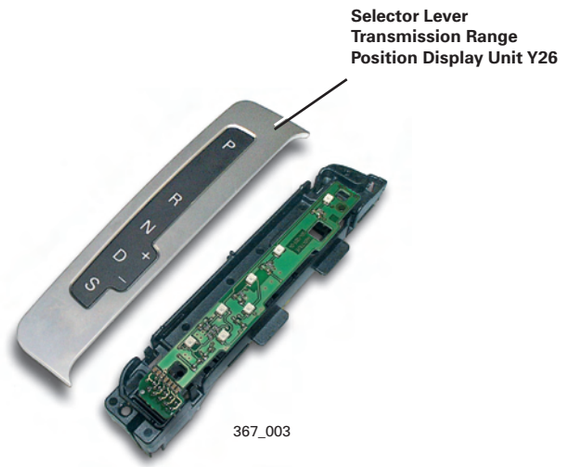
The stop lever is unlocked by pushing down on the emergency unlocking lever (for example, using a ball point pen). At the same time, the button on the selector lever must be pressed and the selector lever pulled back.

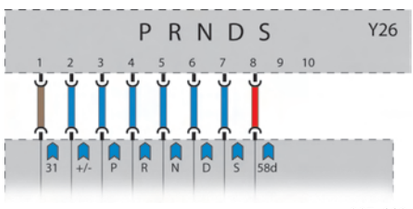


Selector Lever Transmission Range Position Display Unit Y26

The LEDs on the display unit are powered by Selector Lever Sensor System Control Module J857 and activated according to the selector lever position.

The brightness of the LEDs is controlled via terminal 58d (PWM signal, dimming) and varies with voltage level (generated by J587). This means the LED, which indicates the current selector lever position, is activated by a "pulsed voltage" of approximately 12V, while approximately 4V are applied to all other LEDs.





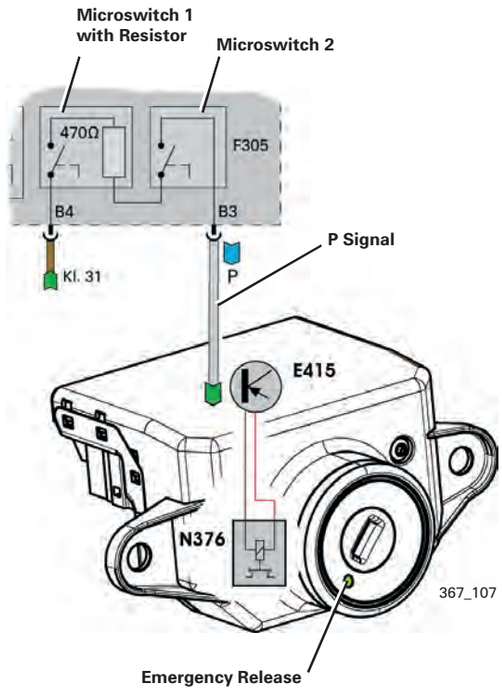
Ignition Key Withdrawal Lock

The ignition key withdrawal lock is actuated automatically by a mechanical locking mechanism integrated in Access/Start Authorization Switch E415.

The ignition key withdrawal lock is released electromechanically by brief activation of Ignition Switch Key Lock Solenoid N376. For this purpose, E415 requires information on selector lever “P” position.

The information on selector lever position “P” is supplied by Transmission Park Selector Switches F305. These two switches are connected in series and form a unit.

In selector lever “P” position, the two switches are closed and deliver a ground signal directly to E415. If the ignition is turned to the “off” position, solenoid N376 is energized by E415 for a short time, and an unlocking mechanism cancels the ignition key lock.

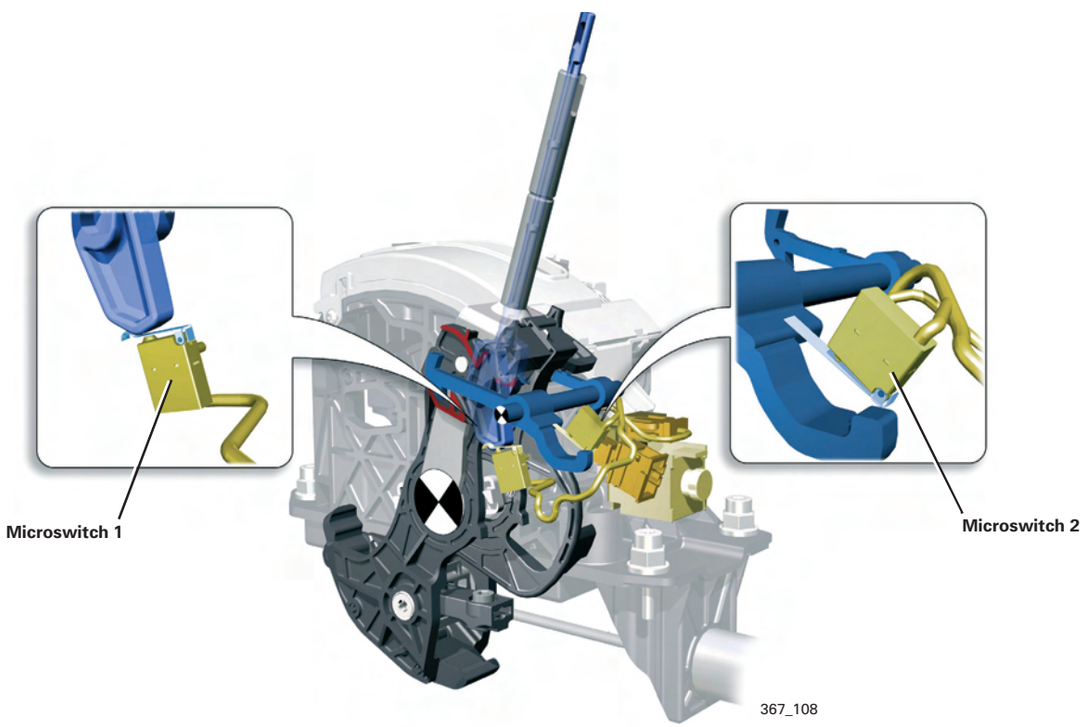


For safety reasons, two microswitches are installed.

Microswitch 1 is closed when the selector lever button is released in selector lever position “P” (button is not pressed).

The series-connected resistor enables the signal line to be diagnosed.

Microswitch 2 is closed when the stop lever for the P/N lock is in its home position. It signals when the selector lever is actually locked in the “P” position.



Selector Lever Sensor System Control Module J587

The functions of the Selector Lever Sensor System Control Module are limited to generating the Tiptronic signal for the Tiptronic function (from F189) and the P/R/N/D/S signal for activating Selector Lever Transmission Range Position Display Unit Y26.

P/R/N/D/S Signal

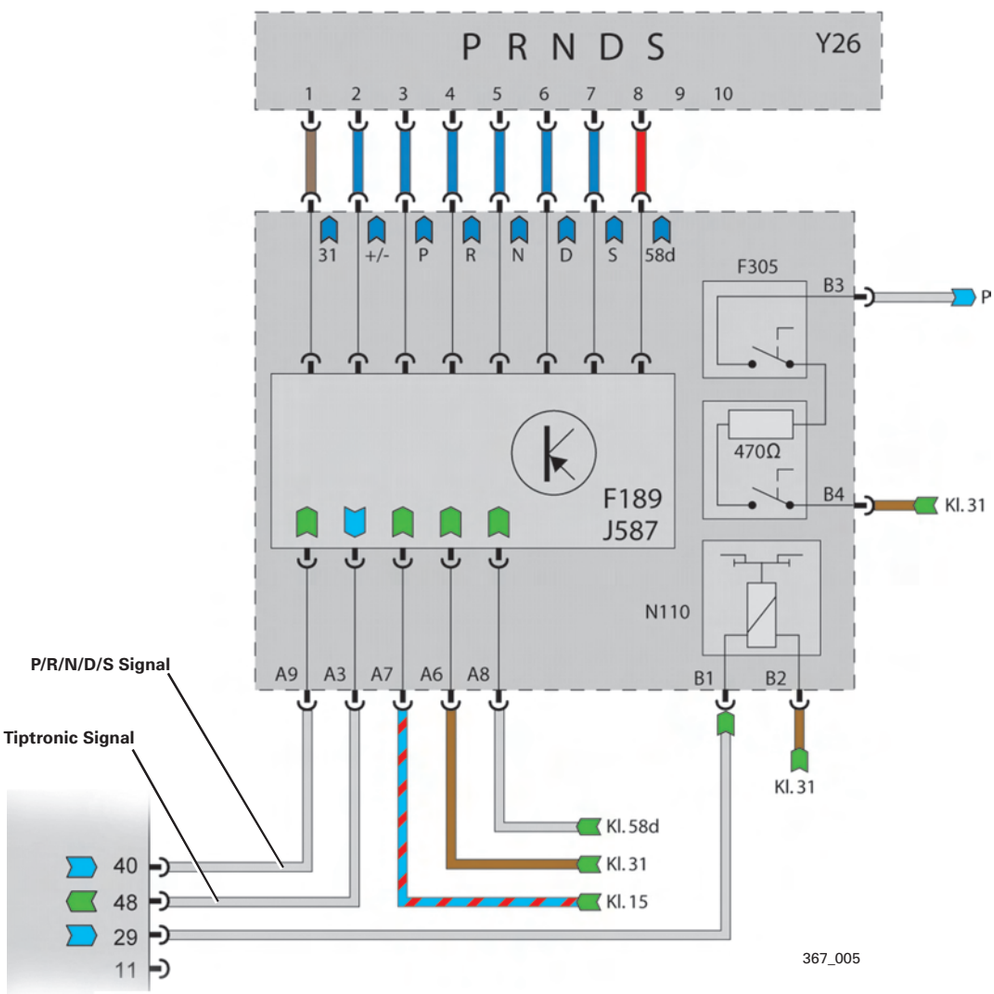
The information on the selector lever position (P/R/N/D/S signal) is sent from the Transmission Control Module to the selector lever sensor system in the form of a frequency-modulated square-wave signal (FMR signal). The relevant LEDs on display unit Y26 are then activated.

A defined signal frequency is assigned to each selector lever position (see DSO images). The selector lever sensor system evaluates the signal and activates the relevant LED on display unit Y26 (ground activation).

Advantages

- Synchronous Indication of Selector Lever Position in Instrument Panel and on Selector Lever
- Cost Savings through Simplification of Selector Lever Sensor System Control Module J587 (elimination of additional Hall sensors)

Functional Diagram of the Gear Selector Mechanism with 09D Transmission



F189 Tiptronic Switch
F305 Transmission Park Selector Switch
J587 Selector Lever Sensor System Control Module
N110 Shift Lock Solenoid
Y26 Selector Lever Transmission Range Position Display Unit

DSO Images of the P/R/N/D/S Signals

DSO Connection

– Black Probe Tip Pin 6*
– Red Probe Tip Pin 9*

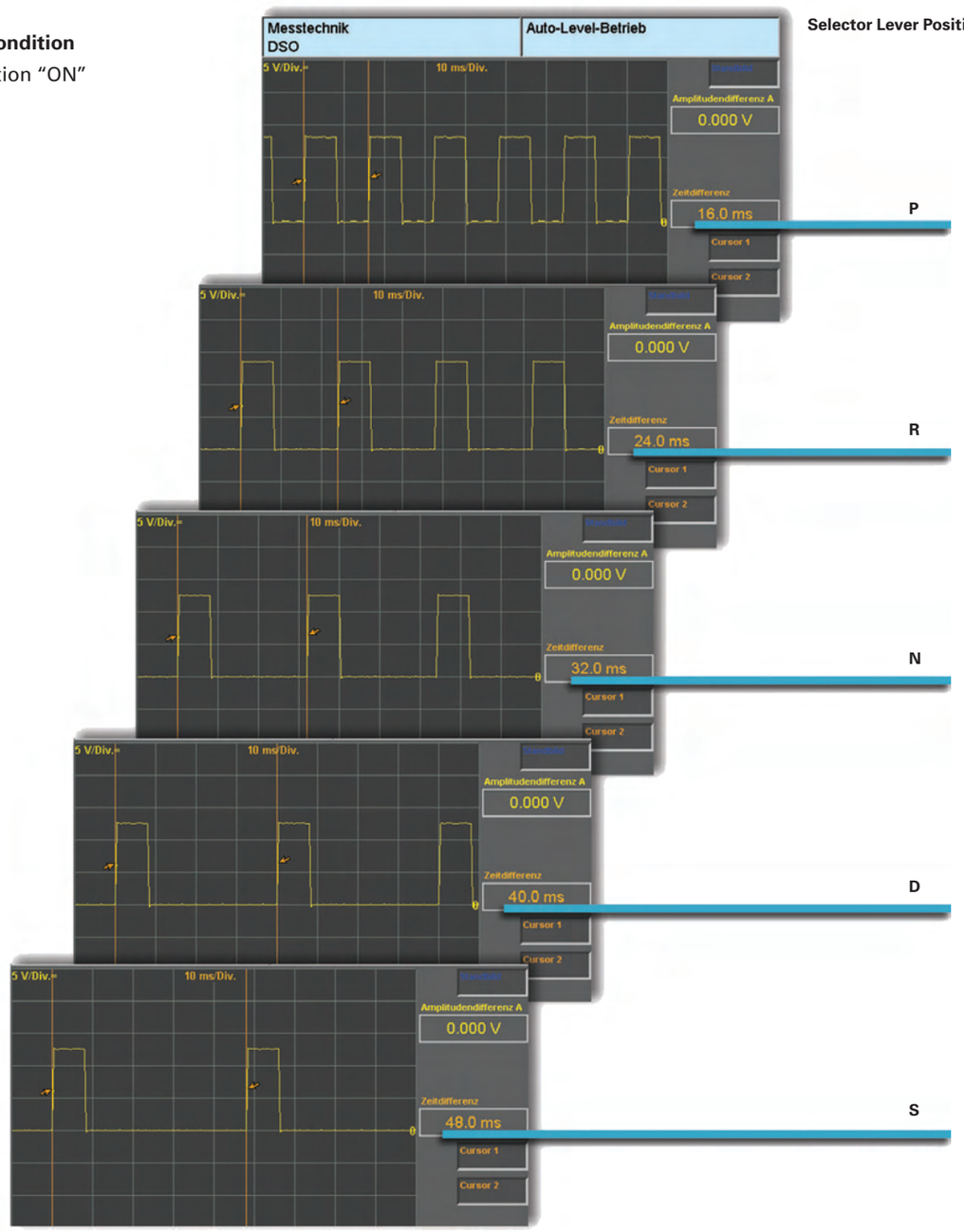
* Pin on connector A or test adapter VAG 1598/42

Test Equipment

– VAG 1598/54 with 1598/42
– VAS 5051

Test Condition

– Ignition “ON”



367_006

Tiptronic Signal

The information of the selector lever in the Tiptronic gate (selector lever in Tip+ position or selector lever in Tip– position) is transferred via a discrete line (see DSO images) to the Transmission Control Module in the form of a frequency-modulated square-wave signal (FMR signal).

Advantages

– Higher Operational Reliability - only one line to control module is required (instead of three), thereby reducing the number of potential fault sources.
– Improved Self-Diagnosis

DSO Images of the Tiptronic Signal

DSO Port

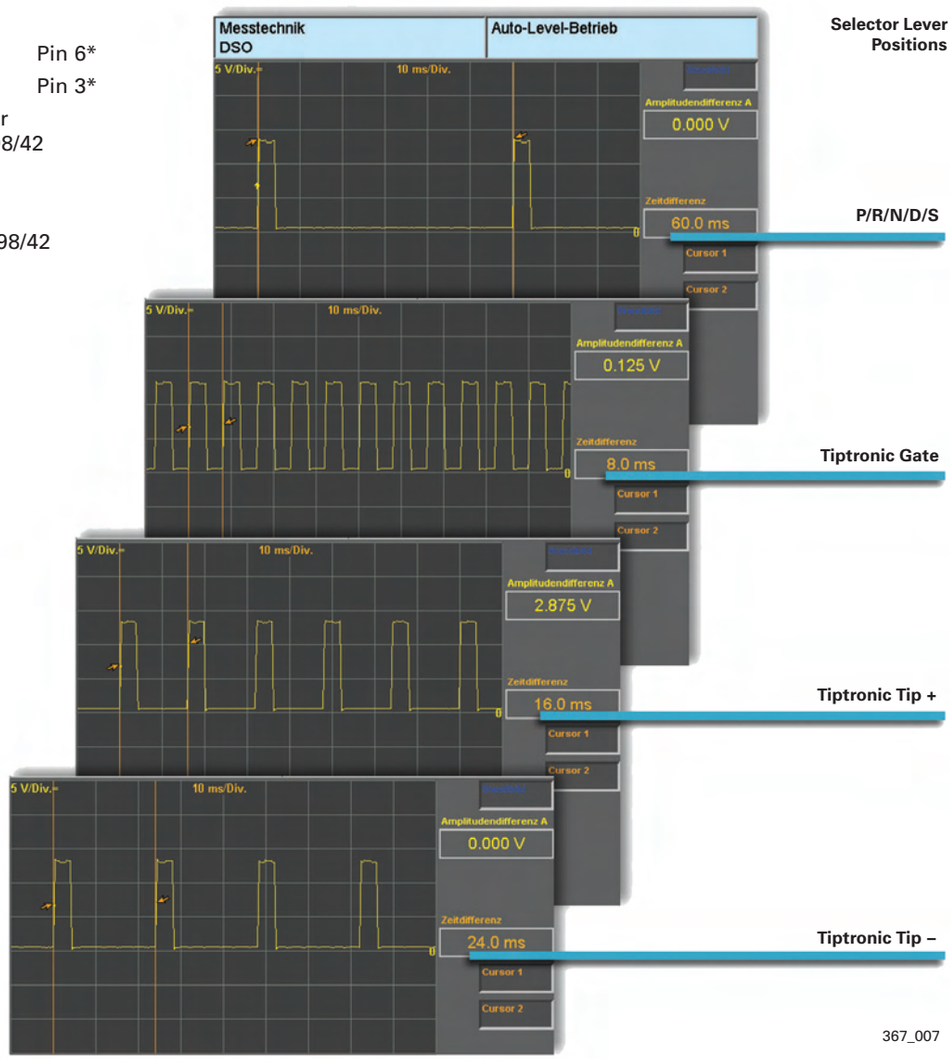
– Black Probe Tip Pin 6*
– Red Probe Tip Pin 3*
* Pin on connector A or test adapter VAG 1598/42

Test Equipment

– VAG 1598/54 with 1598/42
– VAS 5051

Test Condition

– Ignition “ON”



Test adaptor VAG 1598/54 is available in combination with test box VAG 1598/42 for testing the signals to and from the **gear selector mechanism.**

Test adaptor VAG 1598/48 is available in combination with test box VAG 1598/42 for testing the signals to and from the **09D transmission.**

Notes

Glossary

Ratio Spread

In the context of transmissions, the “spread” of a transmission is its “range of ratios.” The ratio spread is the ratio of the lowest (first) and highest (sixth) gear ratios. The ratio spread value is obtained by dividing the lowest gear ratio by the highest gear ratio.

Example (using the 09G transmission):

First Gear	4.148
Sixth Gear	0.686
	4.148 : 0.686 = 6.05 (value rounded up)

Wide ratio spread offers advantages. In addition to a high starting torque ratio (for high tractive power), a low end torque multiplication ratio is achieved. The latter provides a reduction in engine speed, which in turn reduces noise levels and improves fuel economy.

A wide ratio spread requires a certain number of gears in order to avoid overly large speed differentials during gearshifts (ratio steps). When changing gear, engine speed must not be allowed to enter low-torque RPM ranges which will adversely affect or prevent acceleration.

The best solutions are multiple gears or a continuously variable transmission ratio, as used in the multitronic transmission.

Transmission Adaption

A transmission type is, depending on torque and engine type, adapted to different engine variants through:

- Number of Plate Pairs used for Clutches and Brakes
- Adaptation of ATF Pressure to Clutches and Brakes
- Configuration of Gear Pairs, Planetary Gear Sets (for example, four planetary gears instead of three), Shafts, and Mountings
- Transmission Housing Reinforcement
- Transmission Ratios of Final Drive and Idlers
- Size of Torque Converter
- Torque Converter Characteristic (torque conversion factor or torque converter multiplication)

The ratios of the individual gears are generally constant.

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Knowledge Assessment

An on-line Knowledge Assessment (exam) is available for this SSP.

The Knowledge Assessment may or may not be 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

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Notes

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