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9-Speed Automatic Transmission (725.0) · AKUBIS® direct special • Final Test · Go

Hand-outs for participants

T0831E
As at 06.09.2013

Mercedes-Benz

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The training documents are not subject to the ongoing update service. When working at the vehicle, always use the most upto- date workshop aids (e.g. EPC net, WIS net, DAS, special tools) provided by the manufacturer for the vehicle in question.

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Note: The term "employee" always refers to both female and male members of staff.

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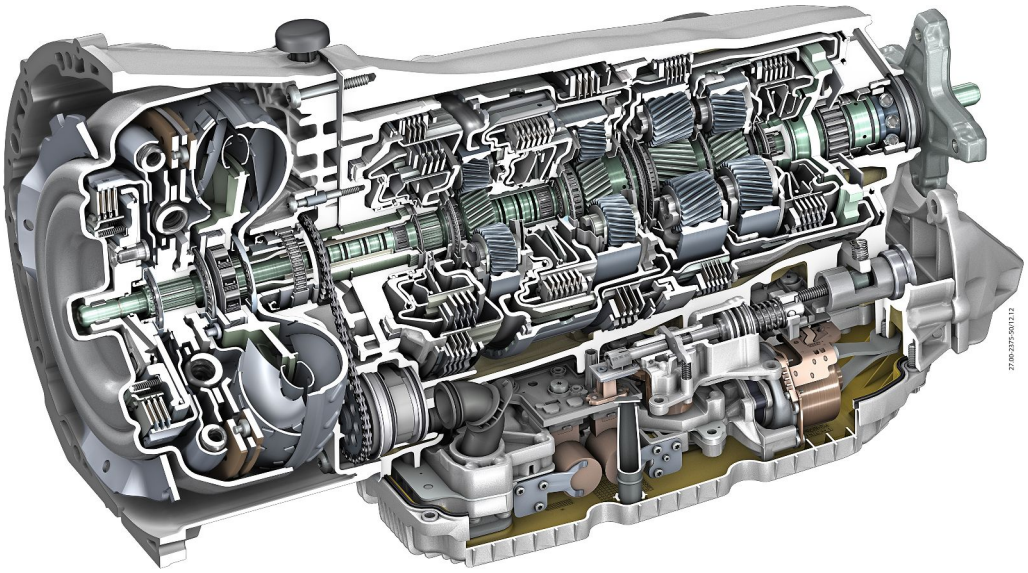
1 Orientation

1.1 Preface

The automatic transmission 9G-TRONIC 725.0 is a completely new electronically controlled automatic transmission with 9 forward gears and one reverse gear. The ratios for the gear ranges are implemented by planetary gear sets. In this automatic transmission, all transmission functions and control components are combined into one assembly module. Thanks to the fully integrated transmission control controller unit located in the automatic transmission, the interfaces to the wire harness in the vehicle are minimized.



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Thanks to the use of the new fully integrated transmission control (VGS), the following additional advantages result:

- High electromagnetic compatibility (avoidance of the reciprocal influencing of several electronic components)
- Fast power regulation as well as the compensation of on-board electrical system fluctuations, which leads to increased shift quality
- Exact determination of shifting-relevant measurements as well as fast evaluation of the determined values

An increased service life, reduced fuel consumption and maximum shifting comfort result thanks to:

- A new transmission design with 9 gears and a gear ratio spread of 9.150
- Newly optimized transmission components
- The lowering of the working pressure
- The implementation of a completely new software with additional comfort and dynamic functions
- New actuator design with two pumps

The transmission can be subdivided into the following assemblies:

- Torque converters with torsional dampers, centrifugal pendulum and torque converter lockup clutch
- New oil pump (primary pump) with off-axis design to generate the oil pressure required and to ensure lubrication of the actuators and bearing points
- Electric transmission oil pump to generate the oil pressure required and to ensure lubrication of the actuators and bearing points with the engine OFF and for support of the primary pump
- Transmission housing with the mechanical transmission components (planetary gear sets, park pawl operated electro-hydraulically, multidisk clutches and multidisk brakes)
- Fully integrated transmission control controller unit with integrated fully integrated transmission control unit

2 General information on transmission 725.011

2.1 General information on transmission 725.011

Vehicle Variants

Type	Model designation	Engine	Transmission	Market launch
E 350 BlueTEC	212.026	642.852	725.011	09/13
E 350 BlueTEC	212.226	642.852	725.011	09/13

Vehicle variant overview

Type	Engine	Market launch
C/X218	OM642 LS	09/14
C/X218	OM651	09/14
C/X218	M278	09/14
C/A207	OM642 LS	09/14
C/A207	OM651	09/14
W/S212	OM651	09/14

Technical data

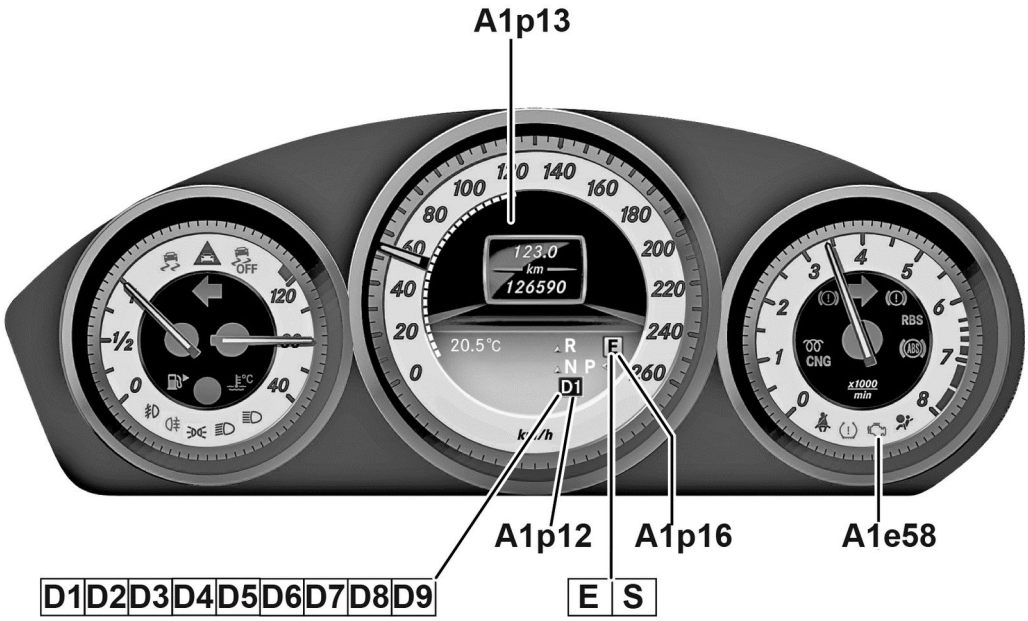
Automatic transmission	Unit	725.011
Designation		W9A 700
Gearshift		9-speed, automatic
Number of ratios		9 + R
Steering axis inclination		9,150
Automatic transmission weight (including torque converters and automatic transmission fluid)	kg	94,8
ATF (yellow/gold) GTL	L	Approx. 10
Max. rpm 1st to 7th gear	rpm	7000
8th gear	rpm	5900
9th gear	rpm	5000
Overall length	mm	644 to 649 depending on joint flange and torque converters
Starting device		Hydraulic torque converter
Max. input torque	Nm	700

2.2 Control and display concept

The control and display concept is design such that the driver has the maximum overview of the current operating condition of all relevant systems as well as all driving information on the gear, gear range and transmission mode selection made.
The following selector lever positions are recorded using the DIRECT SELECT lever:

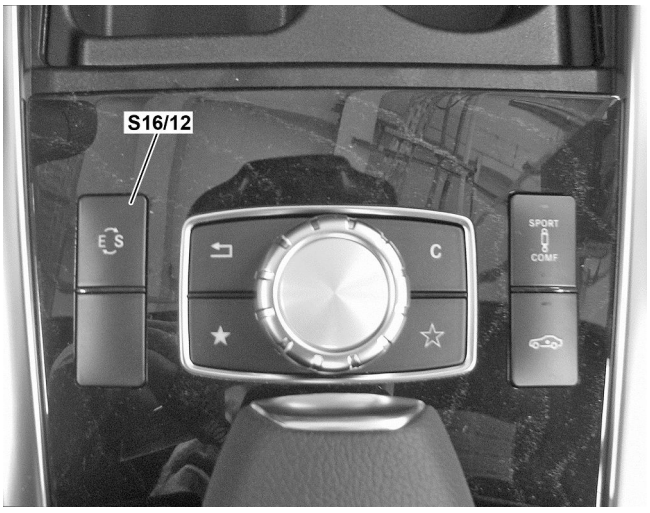
- "R", reverse gear
- "N", neutral and start position (no power transmission, vehicle can be freely moved)

- "D1 to D9", all 9 forward gears are available. In order to change from one selector lever position to the next, the DIRECT SELECT lever must be subjected to a greater pressure (higher power level required). By actuating the park pawl on the DIRECT SELECT lever, at a vehicle speed < 8 km/h the park pawl is activated.



A1e58	Engine diagnosis indicator lamp	**A1p13**	Multifunction display
A1p12	Gear indicator	**A1p16**	Transmission mode display

Using the button in the center console, you can shift between the transmission modes "E" (Economy) and "S" (Sport). In combination with the special equipment AMG sports package there is also the mode "M" (Manual).



S16/12	Automatic transmission transmission mode button

In the Sport "S" and Economy "E" transmission modes, the driver can select the following functions by pressing the steering wheel downshift button or the steering wheel upshift button:

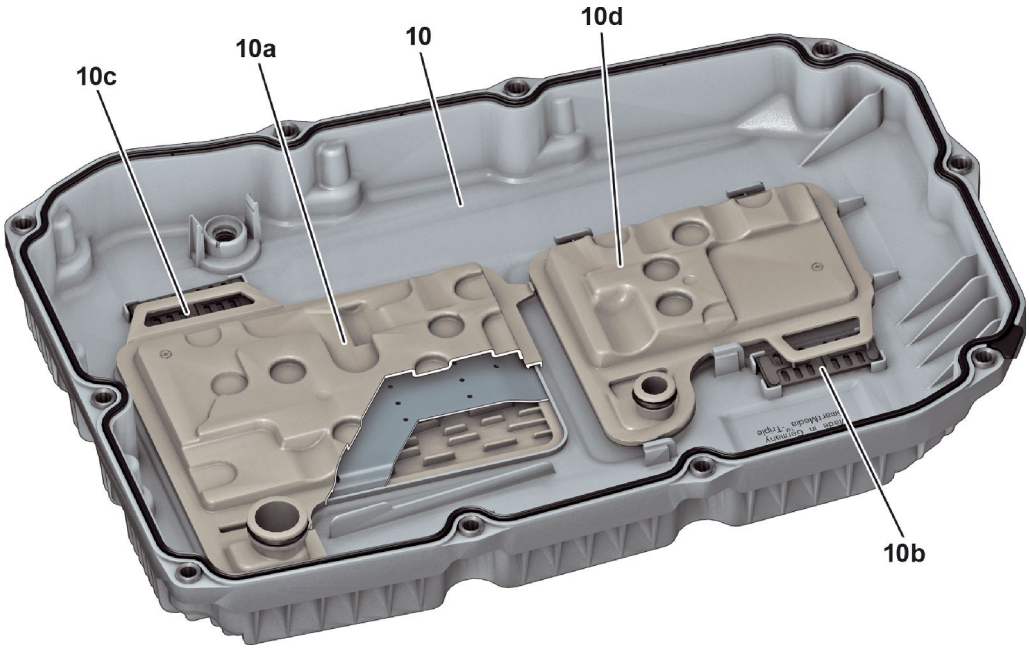
- By pressing the steering wheel gearshift buttons in transmission mode "E" or "S", the short-term M mode (KZM) is activated. This enables the driver to change gears with the aid of the steering wheel gearshift buttons without previously selecting the M mode. The previous gear limitation/shift into optimum gear (SOG) function by pressing the steering wheel gearshift buttons is discontinued.
- In contrast to the permanent M mode, KZM is automatically deactivated again after a certain period. This time interval starts anew after every additional actuation of a button. Furthermore, the activation of the function is expanded depending on wide open throttle and lateral acceleration.
- Compared with transmission mode "S", a shorter shift range (shifting at a lower engine speed) and hence a lower drive torque are available when starting off both forwards and backwards in transmission mode "E". This results in more economical and comfortable driving as the gears are not exploited to their limits.
- In Manual "M" transmission mode, the individual gears "1" to "9" can be shifted to directly via the steering wheel downshift button or the steering wheel upshift button.

The transmission mode "M" is no longer active after a status change on the part of circuit 15. Starting-off then always occurs in the default transmission mode.

2.3 Maintenance information

Maintenance

- Oil change interval as per NAT2FE+ **every 125,000 km/5 years**
- Exchange of both oil filters in the oil pan, the oil pan must be replaced for this as the filters are permanently integrated into the oil pan **every 125,000 km/5 years**
- Exchange of the pressure oil filter on the front integral carrier **based on service sheet specification**
- Use of the new automatic transmission fluid **Shell ATF D97** (Mercedes-Benz Specifications for Operating Fluids 236.16)
  The new automatic transmission fluid has the following part number:
  A001 989 92 03



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10	Oil pan	**10c**	Magnet for metal abrasion
10a	Primary pump oil filter	**10d**	Electric transmission oil pump oil filter
10b	Magnet for metal abrasion		

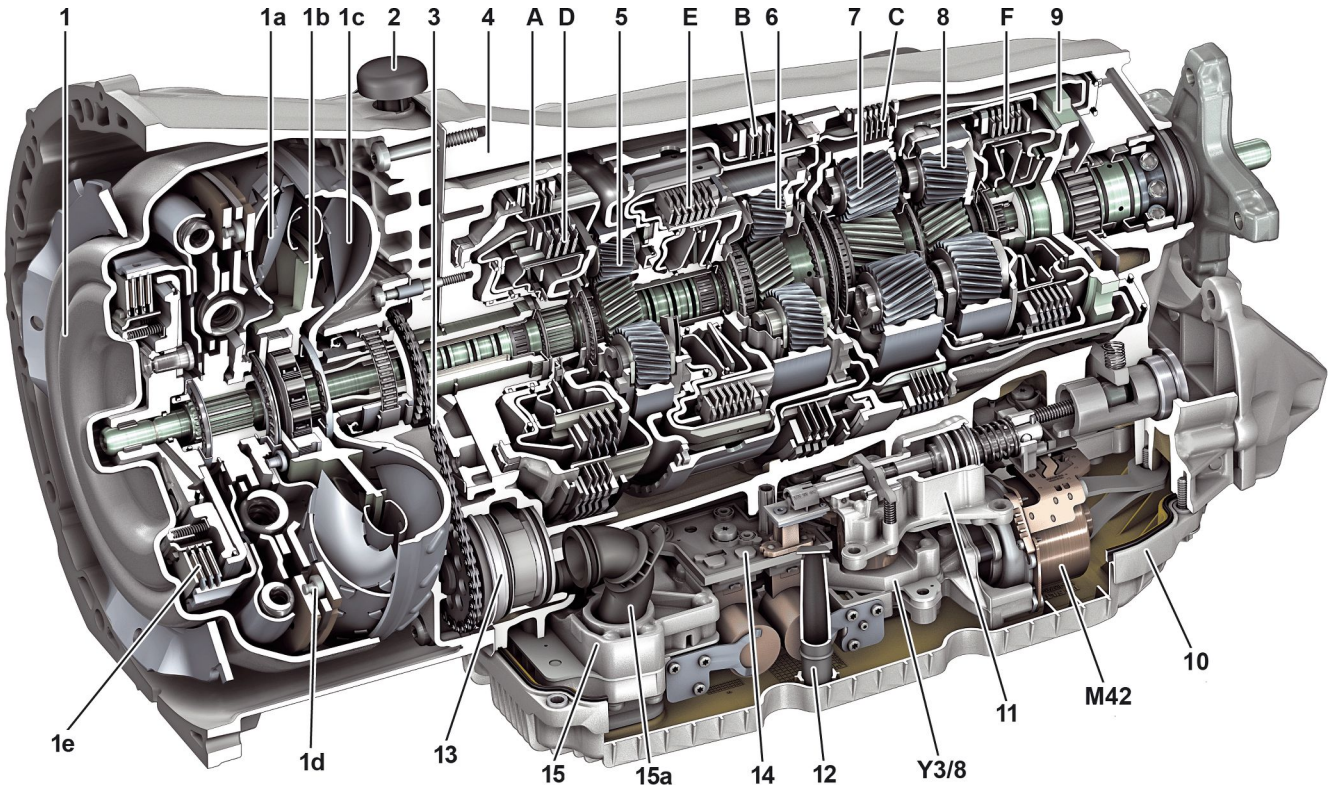
Oil level check

The oil level is checked using an overflow method.
If an oil level check is performed, a routine must be started via Xentry. It can then be performed in a temperature window between 35 °C and 45 °C.

In addition, the new special tool “adapter” (**W725 589 00 90 00**) for the oil filling unit is required to fill the oil.

3 725.011 system components and system functions

3.1 725.011 transmission components



1	Torque converter cover
1a	Turbine wheel
1b	Stator
1c	Impeller
1d	Centrifugal pendulum
1e	Torque converter lockup clutch
2	Transmission housing ventilation
3	Oil pump drive chain
4	Transmission housing
5	Planetary gear set 1
6	Planetary gear set 2
7	Planetary gear set 3
8	Planetary gear set 4
9	Park pawl gear
10	Oil pan

11	Piston housing of electrohydraulic park pawl actuator
12	Guide tube
13	Oil pump
14	Supporting body for VGS
15	Cover/shift valve body
15a	Pressure pipes and intake manifolds
A	B08 multidisk brake
b	B05 multidisk brake
c	B06 multidisk brake
I	K81 multidisk clutch
E	K38 multidisk clutch
F	K27 multidisk clutch
M42	Electric transmission oil pump
Y3/8	Fully integrated transmission control controller unit

3.2 Actuated shift elements

	A (B08)	B (B05)	C (B06)	D (K81)	E (K38)	F (K27)
1st gear		•	•		•	
2nd gear			•	•	•	
3rd gear		•	•	•		
4th gear		•	•			•
5th gear		•		•		•
6th gear				•	•	•
7th gear		•			•	•
8th gear	•				•	•
9th gear	•	•				•
Neutral “N”		•	•			
Reverse gear “R”	•	•	•			

Automatic transmission 725.011 is able to skip gear ranges. It is thus possible to shift from 9th gear directly into 4th gear, for example. In this case, only the brake B08 is switched off in 9th gear and the brake B06 is actuated in 4th gear.
The transmission is able to skip the gear ranges in which a shift element is switched off and a shift element is activated. As a result, faster and more direct shift operations are possible.

3.3 Torque converter

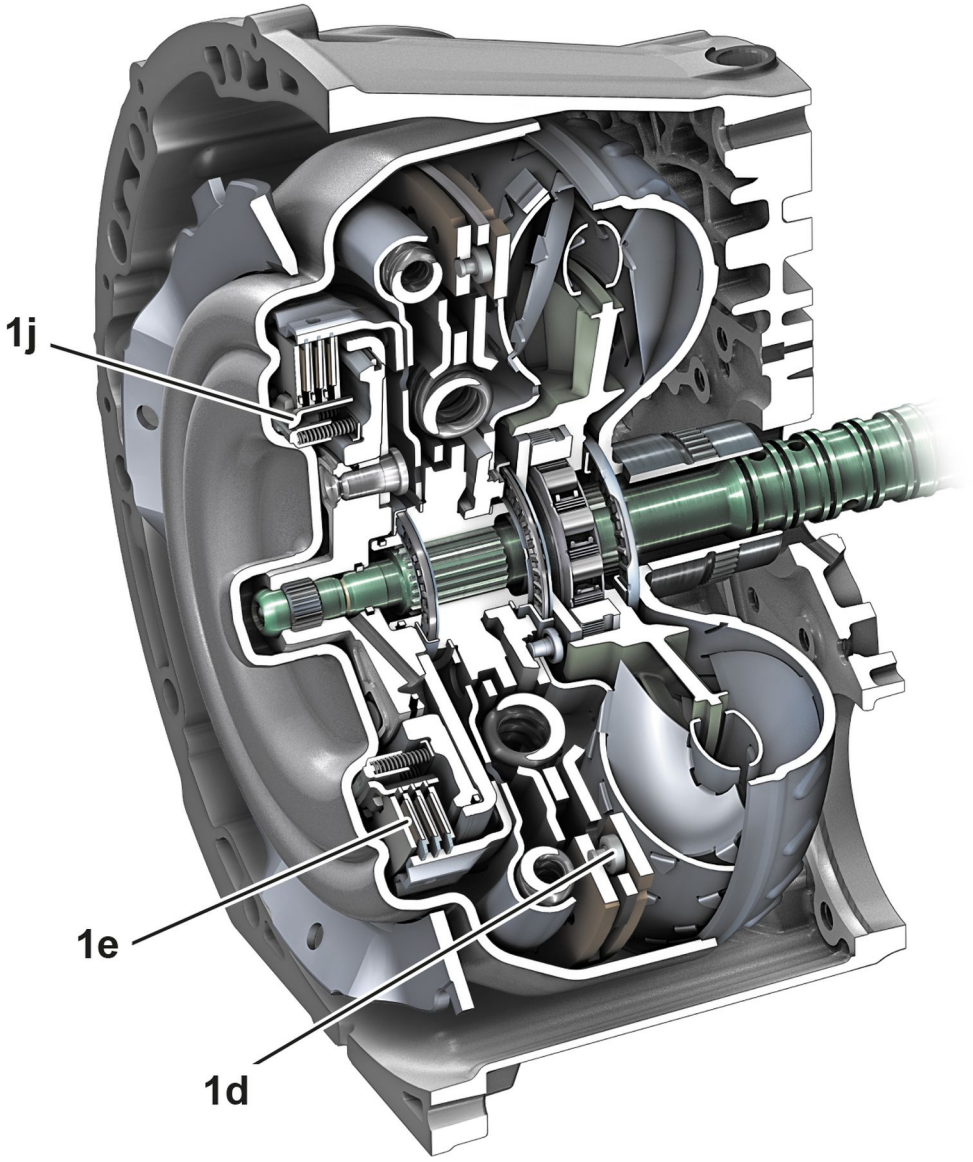
The impeller is connected to the engine and the turbine wheel is connected to the drive shaft. The stator is connected to the transmission housing via the freewheel and the stator shaft.

The oil in the torque converter is continuously circulated so that heat created during the operating phase can be dissipated via the transmission cooler.

The impeller conveys oil outwards through the impeller blades due to centrifugal force acting on it to the turbine wheel, which is then driven. The turbine wheel blades direct the oil to the impeller blades, which in turn feed the oil to the impeller. Torque increase takes place as a result of this deflection at the stator supported by the freewheel against the transmission housing.

The torque conversion peaks at the starting-off point with the impeller rotating and the turbine wheel at a standstill.

The rotational speed of the turbine wheel continuously comes further into line with the impeller over the course of the acceleration phase, i.e. the rpm difference decreases until almost the same rpm exists at the coupling point of the torque converter lockup clutch. If the coupling point is reached, the stator also rotates freely.



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1d	Centrifugal pendulum	**1j**	External plate carrier
1e	Disk pack		

3.4 Fully integrated transmission control controller unit

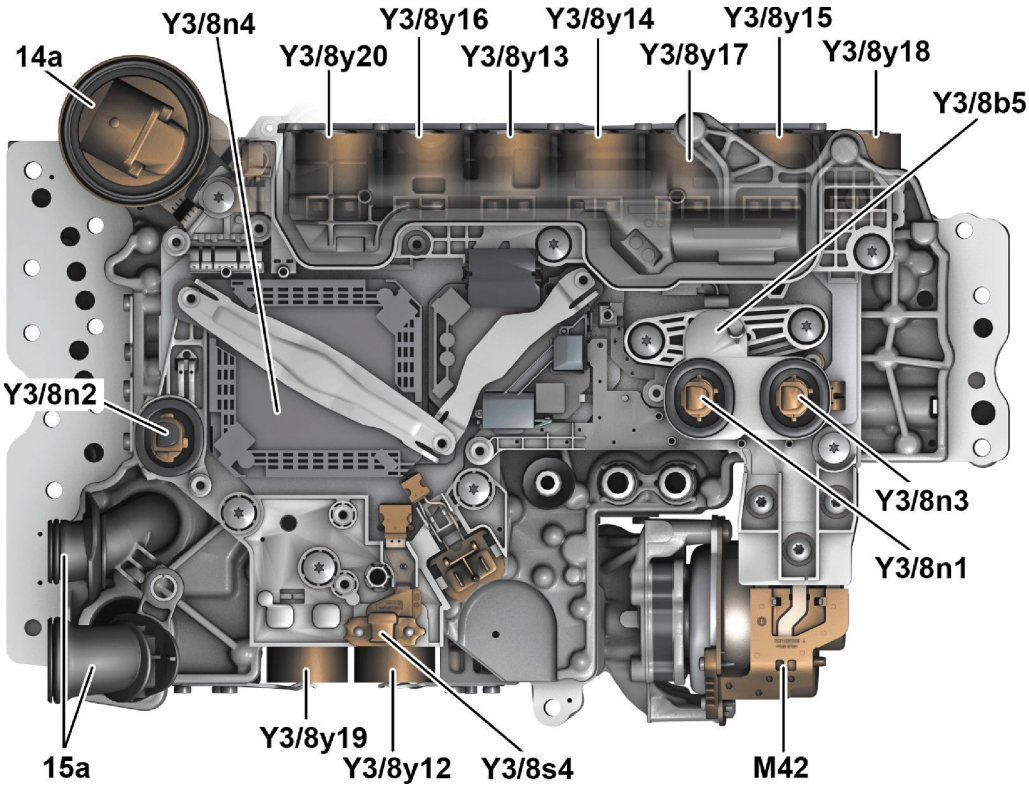
The fully integrated transmission control controller unit is connected to the CAN network of the vehicle and evaluates the incoming signals and requests from other control units or actuates the internal actuators in accordance with this information. In addition, it evaluates the signals of the sensor system and forwards these to the control units involved.

The following actuators are actuated and/or functions are performed by the fully integrated transmission control unit according to the sensor and CAN input signals:

- Shift valves and solenoids
- Electric transmission oil pump
- Hydraulic park pawl actuation
- Electrohydraulic park pawl release

Special features of the fully integrated transmission control controller unit are:

- The electric transmission oil pump
- All shift valves and solenoids are located on the fully integrated transmission control controller unit
- The complete sensor system (comprising rpm, temperature, pressure and position sensors) is part of the fully integrated transmission control controller unit
- The fully integrated transmission control unit is integrated in the fully integrated transmission control controller unit



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14a	Transmission plug
15a	Pressure pipes and intake manifolds
M42	Electric transmission oil pump
Y3/8b5	Pressure sensor
Y3/8n1	Turbine wheel rpm sensor
Y3/8n2	Rpm sensor for internal transmission rpm
Y3/8n3	Output shaft rpm sensor
Y3/8n4	Fully integrated transmission control unit
Y3/8s4	Park pawl position sensor
Y3/8y12	Lubrication pressure solenoid
Y3/8y13	K81 clutch control solenoid
Y3/8y14	K38 clutch control solenoid
Y3/8y15	K27 clutch control solenoid
Y3/8y16	B08 multidisk brake control solenoid
Y3/8y17	B05 multidisk brake control solenoid
Y3/8y18	B06 multidisk brake control solenoid
Y3/8y19	Working pressure solenoid
Y3/8y20	Torque converter lockup clutch solenoid

3.5 Rpm sensor system

3 rpm sensors are located on the fully integrated transmission control controller unit. Using these sensors, safe, faster and more direct gear changes are enabled. All sensors are permanently attached to the fully integrated transmission control controller unit and cannot be replaced individually.

Rpm sensor for internal transmission rpm

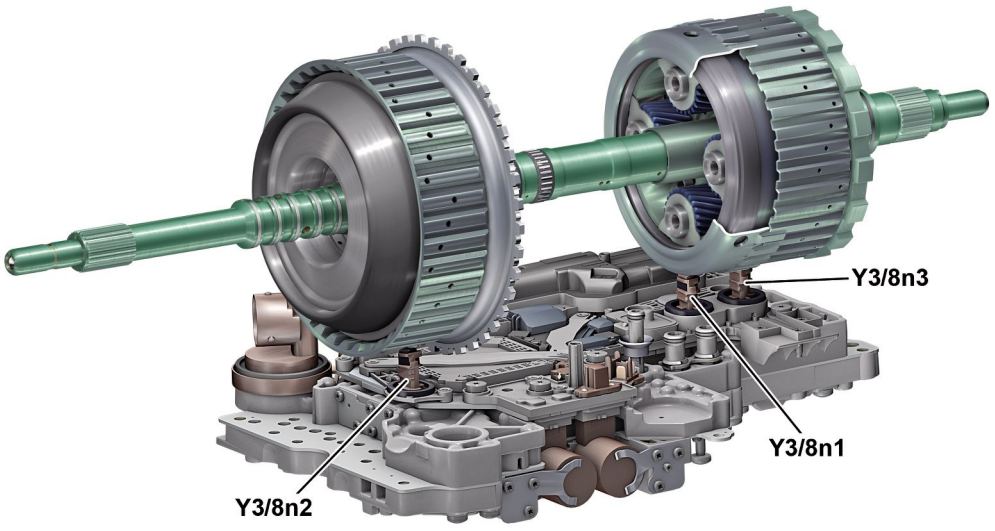
The internal transmission rpm is recorded by an active sensor (differential Hall sensor with integrated magnet). The K81 external plate carrier is used as the passive sensor element for the internal rpm.

Turbine wheel rpm sensor

The turbine wheel rpm is recorded by a passive sensor (differential Hall sensor). A rotor that is pressed onto the planet carrier of the P4 planetary gear set is used as an active sensor element for the turbine speed.

Output shaft rpm sensor

The output speed is recorded by an active sensor with direction of rotation detection (differential Hall sensor with integrated magnet). The K27 external plate carrier that is welded to the output shaft is used as the passive sensor element for the output speed.



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Y3/8n1	Turbine wheel rpm sensor	**Y3/8n3**	Output shaft rpm sensor
Y3/8n2	Rpm sensor for internal transmission rpm		

All sensors are permanently attached to the fully integrated transmission control controller unit and cannot be replaced individually. In the first 6 to 8 months after market launch, the entire EHS must be replaced.

4 Oil supply and transmission cooling

4.1 Oil feed

The oil pump (primary pump) ensures the oil supply of the electrohydraulically controlled automatic transmission while the combustion engine is running. The oil pump is driven via a drive chain (off-axis design) by the drive shaft. The oil pump is installed at the bottom in the transmission bell housing behind the torque converter in the external plate carrier.

Oil supply with stopped combustion engine

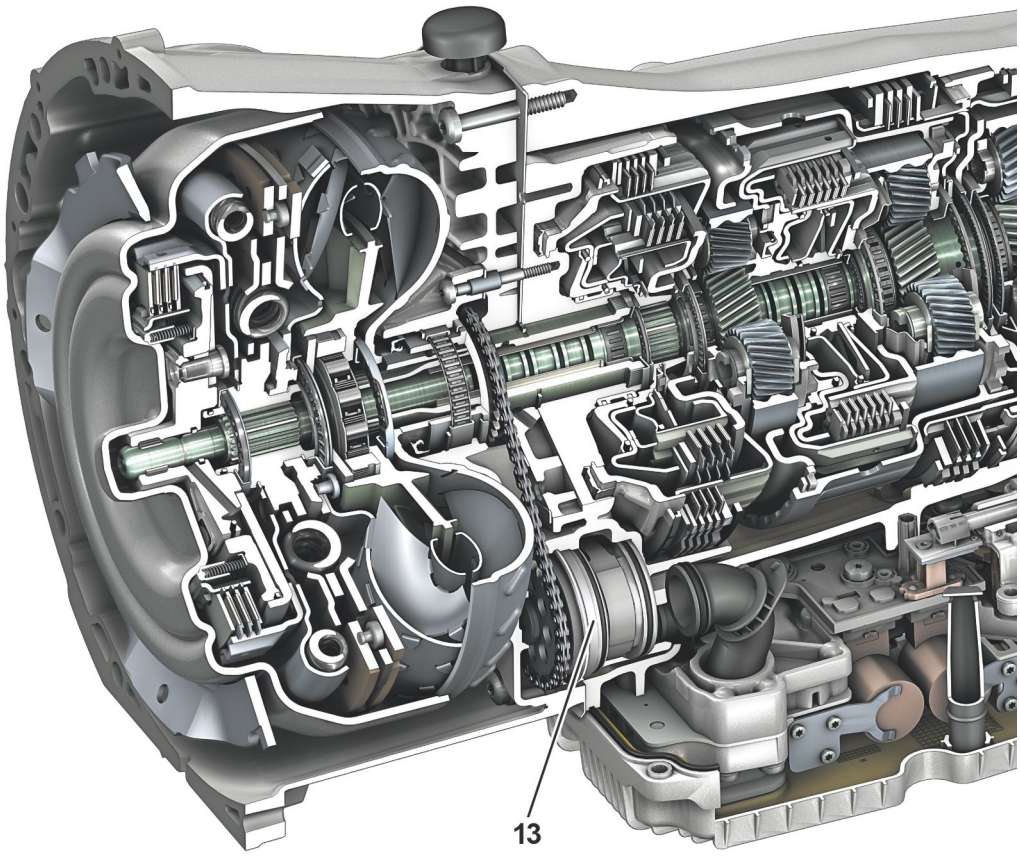
If the oil supply fails with a stopped combustion engine, all control elements and actuators change to the basic state under no load and the automatic transmission is no longer force-fit.

When the engine is started and the oil supply has been built up, the gear position has to be changed from "N" to "D". The resulting delay between the intent to start off and the time at which the vehicle does start off is noticeably minimized thanks to the electric transmission oil pump. The electric transmission oil pump is actuated in start/stop mode with the combustion engine stopped and takes on the basic supply of the control elements and actuators here. A defined basic pressure is thus maintained.

The electric transmission oil pump also supports the primary pump when the combustion engine is running at low rpm. The volumetric flow rate delivered by the electric transmission oil pump as required is requested in the low-rpm range of the combustion engine during shift operations (filling of the actuator) or with increased cooling requirements.

Transmission housing ventilation

The breather is located at the top on the transmission housing. A duct cast into the transmission bell housing connects the transmission interior with the breather. In the event of temperature-dependent volume changes of the automatic transmission fluid and air, the transmission housing ventilation ensures the pressure compensation in the transmission housing.



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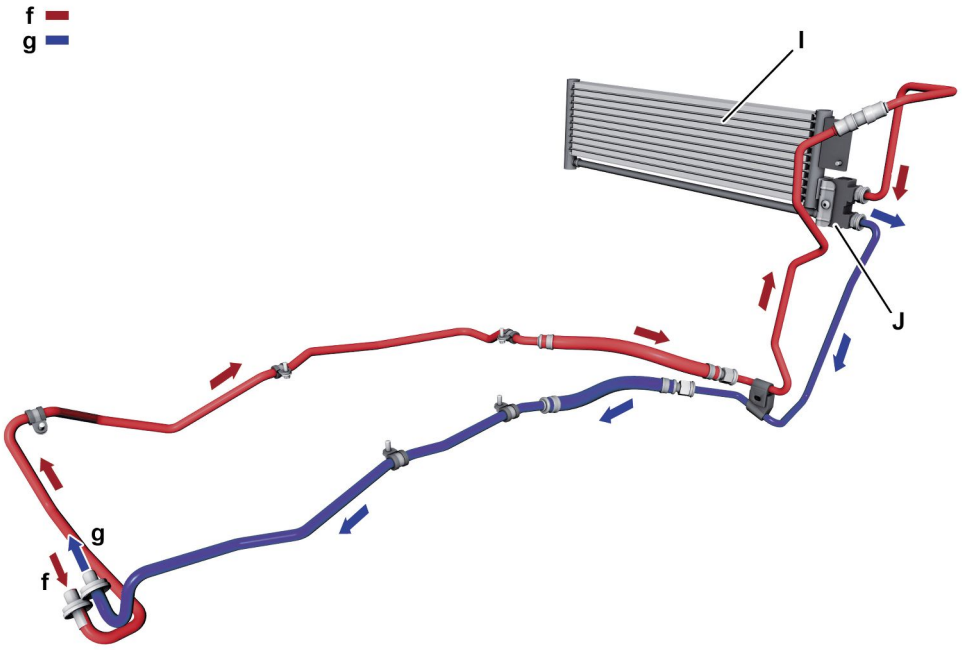
13	Oil pump (primary pump)

4.2 Transmission oil cooling

The transmission oil cooling system lowers the transmission oil temperature, thus preventing damage to the transmission through overheating.

The automatic transmission fluid is extracted from the oil pan by a mechanical pump in the transmission and pumped via the feed to the transmission oil thermostat. The transmission oil thermostat directs the automatic transmission fluid at a transmission fluid temperature < 70 °C back to the transmission via the return flow.

At a transmission fluid temperature > 90 °C, the transmission oil thermostat is completely opened and the automatic transmission fluid flows through the transmission cooler before it flows back to the transmission via the return flow.



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I	Transmission cooler	**F**	Automatic transmission fluid feed
Y	Transmission oil thermostat	**G**	Automatic transmission fluid return flow

4.3 Electric transmission oil pump

The electric transmission oil pump has the following tasks:

- Support of the working pressure supply (boosting)
- Support of cooling and lubrication
- Start/stop capability
- Emergency engaging and emergency release of the park pawl

Support of the working pressure supply (boosting)

With an increased volumetric flow requirement (e.g. during shift operations), the electric transmission oil pump supports the mechanically driven primary pump as required. The volumetric flow rate for the electric transmission oil pump additionally provided here counteracts drops in working pressure due to insufficient supply in these situations.

Support of cooling and lubrication

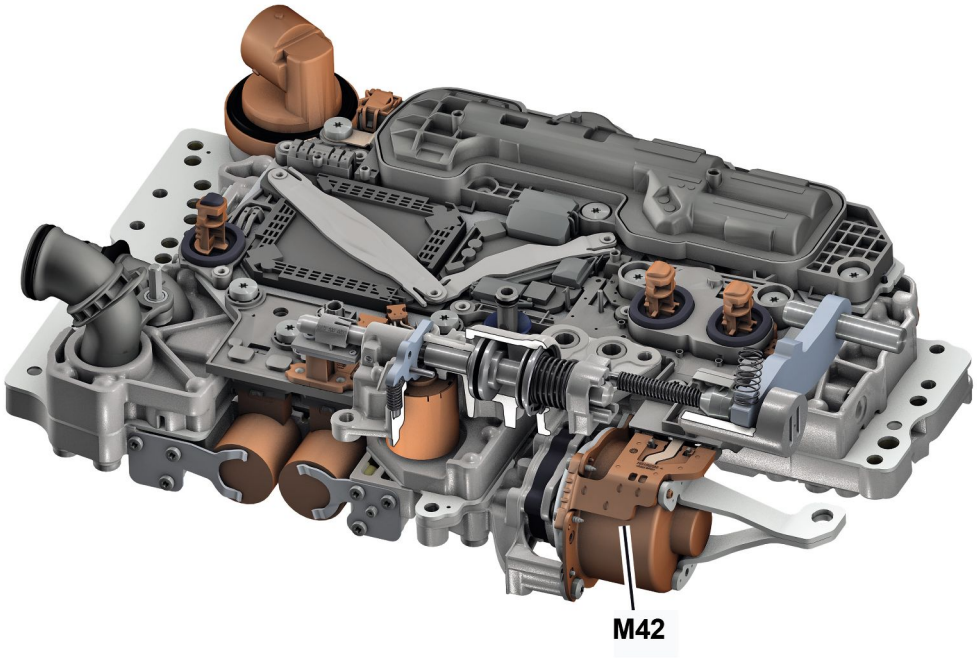
The electric transmission oil pump is actuated as required with high cooling and lubrication requirements in order to provide an additional volumetric flow rate. Thanks to the option of providing an additional volumetric flow rate as required, the primary oil pump could be considerably downsized and the CO2 output thus decreased.

Start/stop capability

With the combustion engine stopped during the stop phase, the electric transmission oil pump sets the basic pressure level and thus keeps the hydraulic ducts of the electrohydraulic control and the piston chambers of the actuators filled. Exactly the amount is subsequently delivered here that is required to compensate for the leakage of the electrohydraulic actuator thanks to the flow-regulated operation of the electric transmission oil pump. This operation enables minimizing the power consumption of the electric transmission oil pump at the start/stop operating point to the bare minimum.

Emergency engaging and emergency release of the park pawl

With an intact park pawl lift solenoid, the electric transmission oil pump activates the park pawl hydraulically (not P) with the combustion engine stopped; it is engaged mechanically via a spring. If the park pawl lift solenoid is defective, the park pawl actuator is released hydraulically. The electric transmission oil pump is requested with the combustion engine stopped here. Emergency release/emergency engaging is only possible in the direction of "P", not from "P" to "not P".



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M42	Electric transmission oil pump

The oil supply to the electric transmission oil pump occurs via a separate filter integrated in the oil pan. The extracted automatic transmission fluid is fed into the working pressure duct of the electrohydraulic control by the electric transmission oil pump.

With pure operation of the electric transmission oil pump, leakage via the stationary oil pump is avoided using a check valve.

5 Limp-home mode and Emergency-P

5.1 Limp-home mode

In order to guarantee a safe driving state and to prevent damage to the automatic transmission, the fully integrated transmission control unit switches to limp-home mode if critical faults occur. With solenoid faults, the affected gear is blocked and no longer actuated. The vehicle can thus be driven to the nearest Mercedes-Benz service outlet.

5.2 Emergency-P

In the event of faults at the park pawl lift solenoid that lead to the notched lever of the parking lock actuator no longer being released by the park pawl lift solenoid in position "not P", this can be compensated for in that the notched lever release pin hydraulically opens the notched lever. The hydraulic pressure required for this is generated by the electric transmission oil pump with the combustion engine stopped.

If the Emergency-P function is activated, the locking of the piston rod is removed by the notched lever (by the energized park pawl lift solenoid or, with sufficient hydraulic pressure, hydraulically by the notched lever release pin), the lubrication pressure solenoid is energized and the hydraulic cylinder is no longer under pressure in direction "not P". The preload spring is supported on the piston rod guide of the piston housing and thus moves the piston rod to shift position "P".

Notes