

Feel the difference

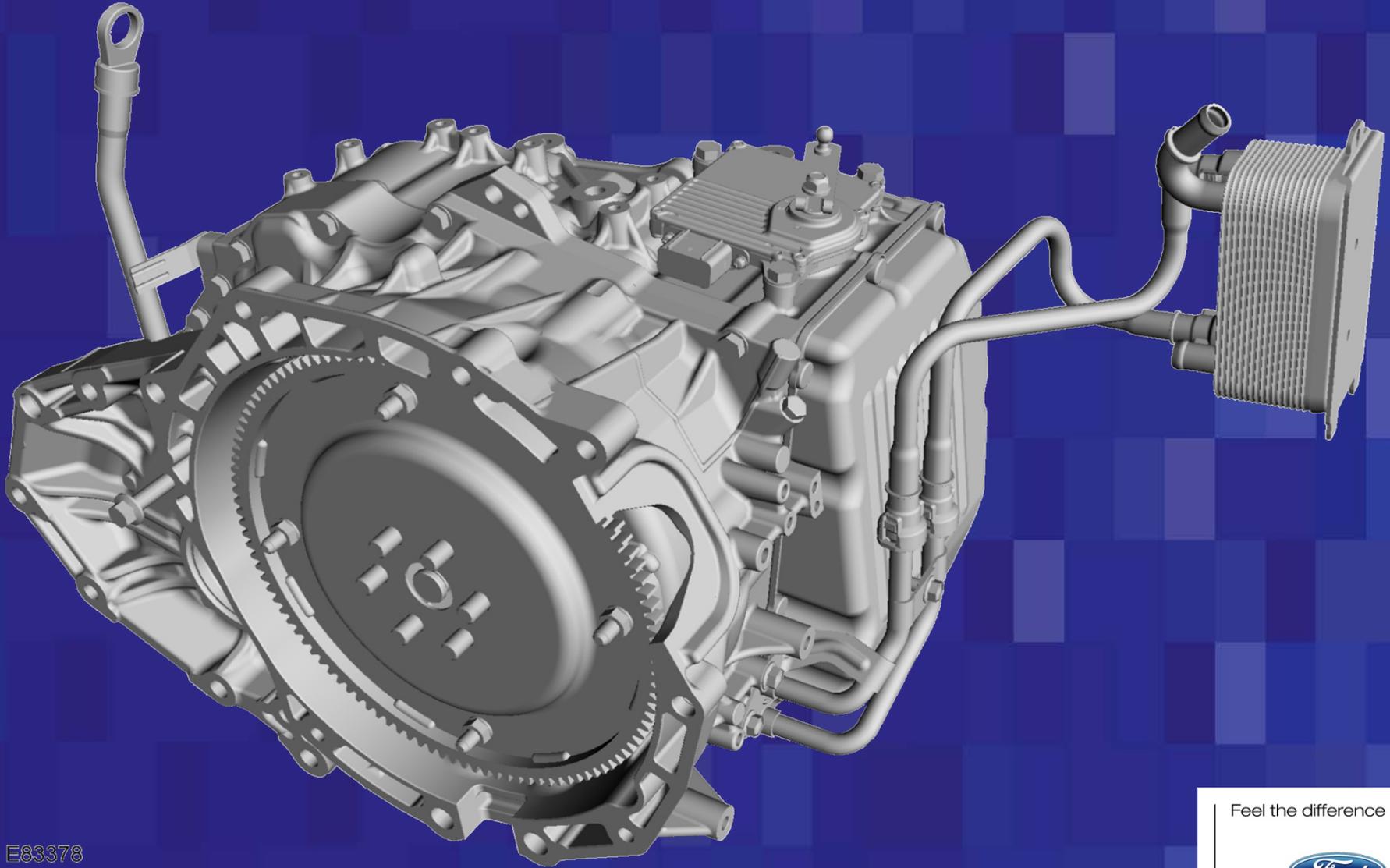


6-Speed Automatic Transaxle AWF21

Feel the difference



New Automatic Transaxle (AWF21)



E83378

Feel the difference



Overview

Features

Feel the difference



General

- Developed by “AISIN AW CO.,LTD.”
- 6-speed automatic transaxle
- Compact, lightweight, electronically controlled
- TCM with integrated TR-sensor fitted to gearbox housing
- Two planetary gears in line, the rear one is a Ravigneaux planetary gear (Lepelletier gear set)

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General

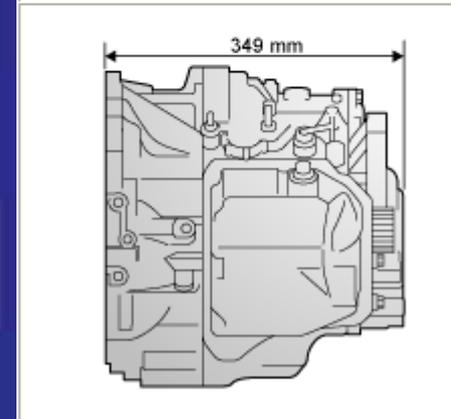
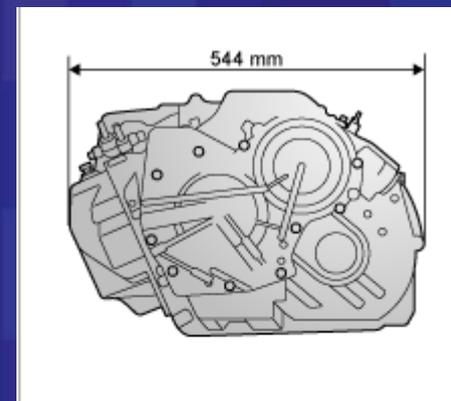
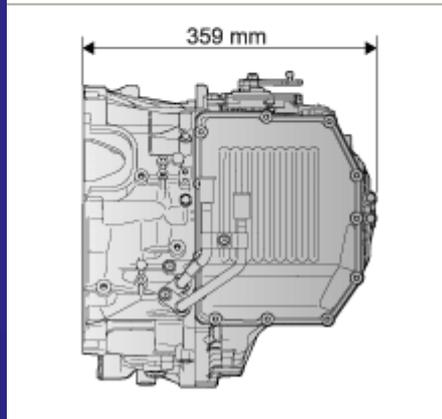
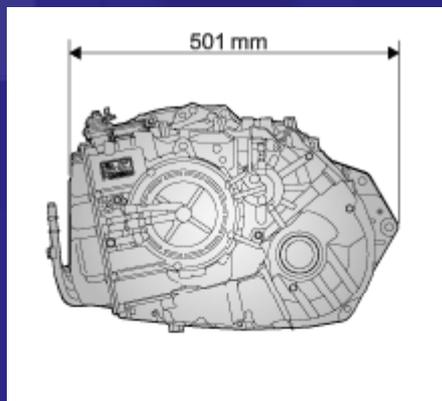
- Driver can choose between normal and sport mode gearshift programs & select shift function
- Oil capacity of 7 litres
- Weight: 95 kg
- Used in Mondeo (CD345) and S-Max/Galaxy (CD340)
 - 2,3 L Duratec-HE
 - 2.0 L Duratorq-TDCi

Feel the difference



New Automatic Transaxle (AWF21)

| AWF21 6 speed | Conventional 5 speed |
|-------------------|----------------------|
| Max torque 450 Nm | Max torque 350 Nm |
| Weight 95 Kg | Weight 87 Kg |



Feel the difference



Gear Ratios

| Gear | Ratio |
|--------------------------|-------|
| 1st gear | 4,148 |
| 2nd gear | 2,370 |
| 3rd gear | 1,556 |
| 4th gear | 1,155 |
| 5th gear | 0,859 |
| 6th gear | 0,686 |
| Reverse | 3,394 |
| 2.0 Duratorq-TDCi (Diff) | 3,33 |
| 2.3 L Duratec-HE (Diff) | 3,75 |

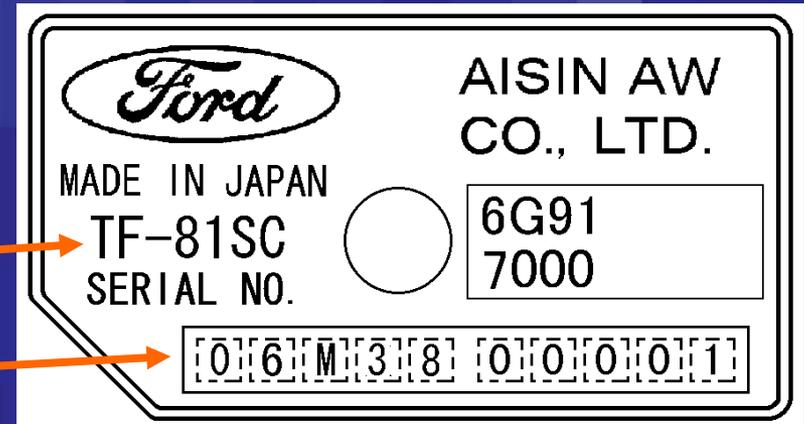
Feel the difference



Identification plate



1. Type of automatic transaxle
2. Serial number



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Basic Construction

- Three shafts
- Three multi plate clutches
- A roller type one-way clutch
- Two brakes
 - one brake band (for higher torque)
 - one multi plate brake
- The final drive is integrated into the transaxle housing.

Feel the difference



Features – Lock up control

The TCC can be operated in “full lock up” and “slip lock up” mode.

Smooth lock up control is performed based on output rpm signal, signals from the ECU (engine rpm and throttle opening), and vehicle speed.

The slip rate is controlled by comparing the engine speed and the transmission input shaft speed signal (TSS).

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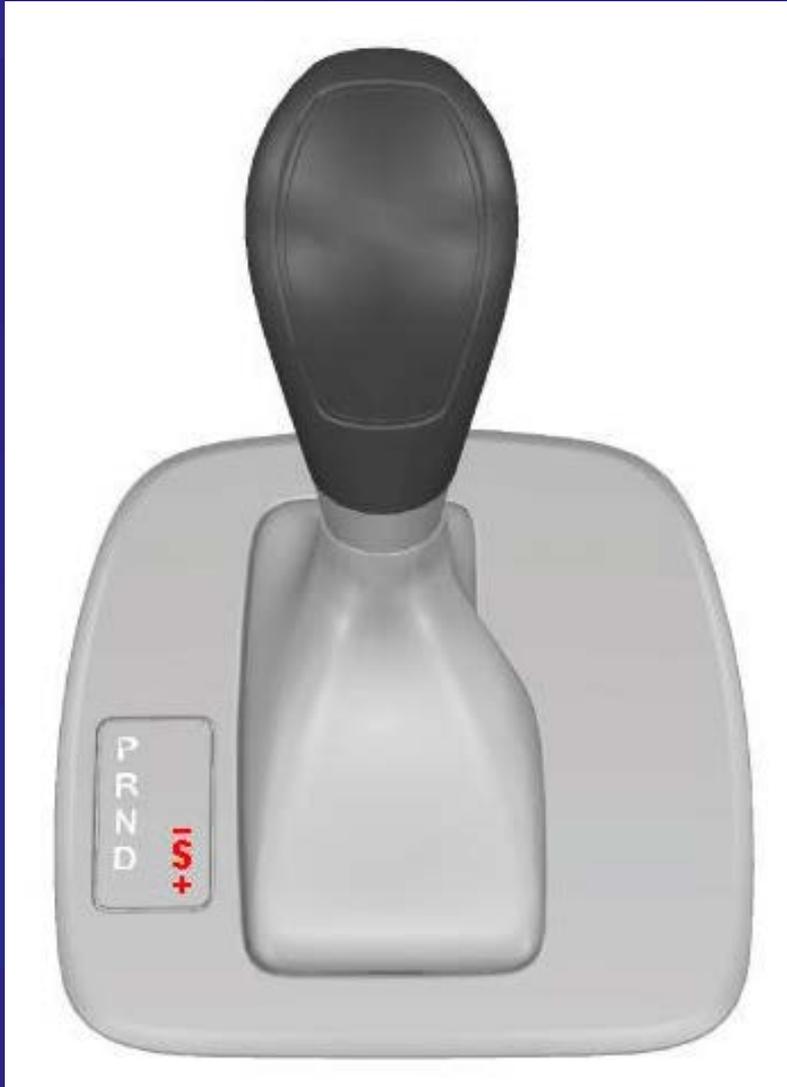
Features – Self Learning Control

Since TCM performs shift control learning and garage shift control learning, it provides smooth clutch engagement during shifting gears and smooth and delicate shifting while driving.

Feel the difference



Features – Select Shift Mode



By moving the shift lever from "D" into the manual shift position "S" a sporty shift strategy is achieved.

With shifting into + (upshift) or - (downshift), the driver can select the desired gear, enabling sporty driving that feels like a manual transmission.

Feel the difference



Features – Neutral Control

When the vehicle is stopped in “D”, the transmission enters a neutral condition by releasing the clutch. By reducing the actuation pressure, the load on the engine is lightened, fuel economy is enhanced, and idling vibration is reduced.

When the vehicle stops on an upslope during Neutral control, creep force is not generated. In this case, B1 allows safe vehicle start by preventing it from moving down the slope. This is called "hill hold".

Only 2.0 L Duratorq-TDCi

Engine has reached working temperature

Feel the difference



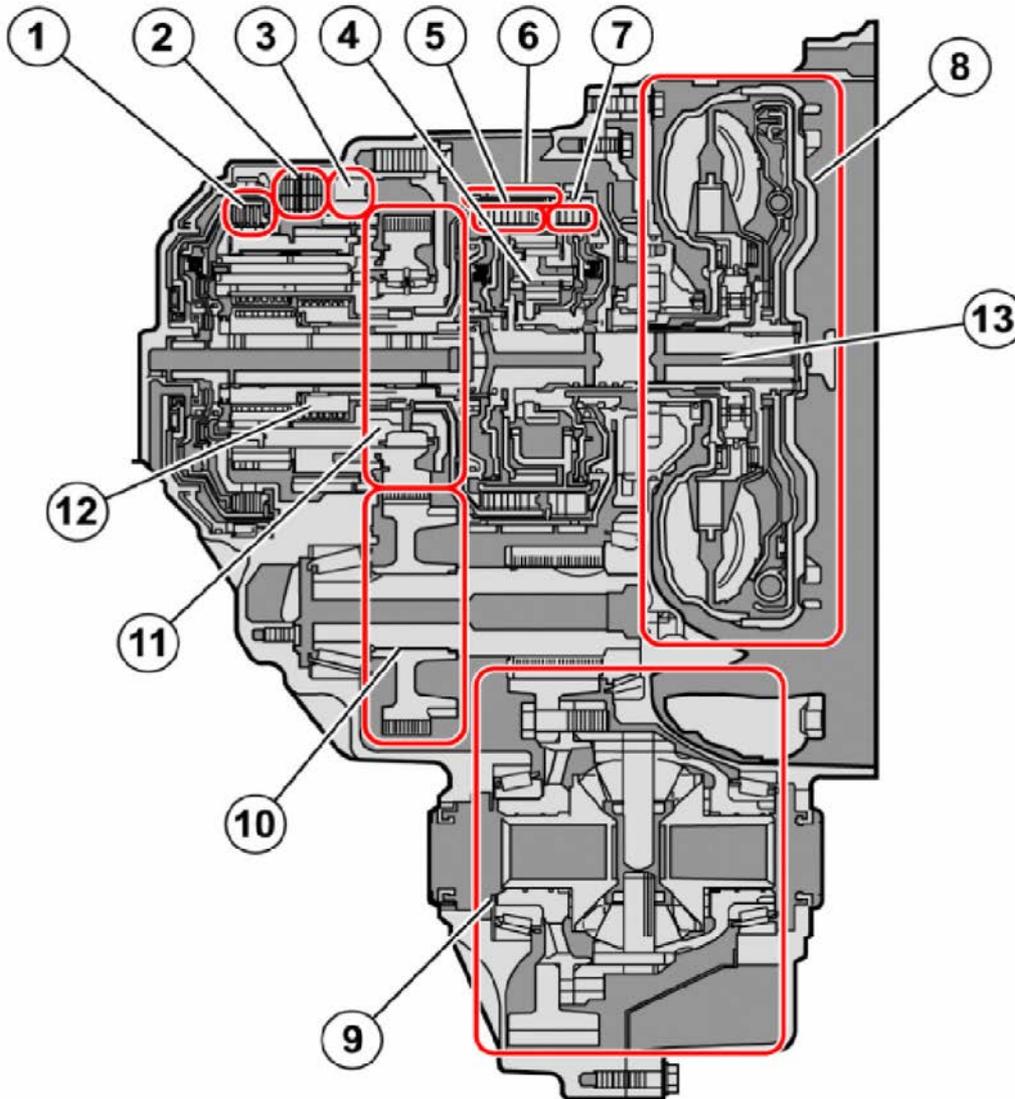
Components

Description of internal and external units

Feel the difference



Construction

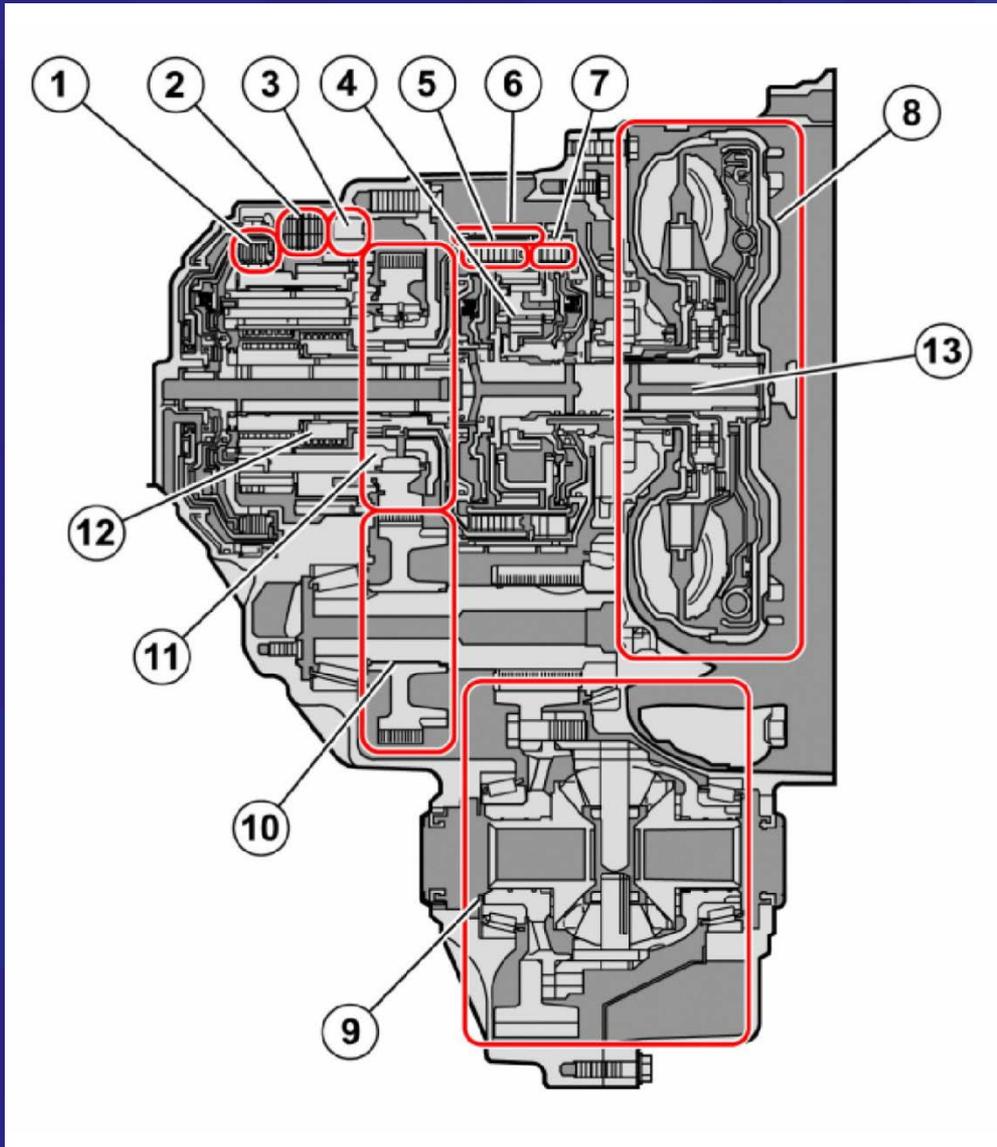


1. C2 clutch
2. B2 brake
3. F1 roller type one-way clutch
4. Front planetary gearbox
5. C1 clutch
6. B1 brake (brake band)
7. C3 clutch

Feel the difference



Construction



- 8. Torque converter
- 9. Differential unit
- 10. Intermediate shaft
- 11. Output shaft
- 12. Rear planetary gearbox, Ravigneaux
- 13. Turbine shaft

Feel the difference



Clutches & Brakes

- **C1-Clutch:** Connects the front planetary carrier to the rear planetary rear sun gear
- **C2-Clutch:** Connects the turbine shaft to the rear planetary carrier
- **C3-Clutch:** Connects the front planetary carrier to the rear planetary middle sun gear

Feel the difference



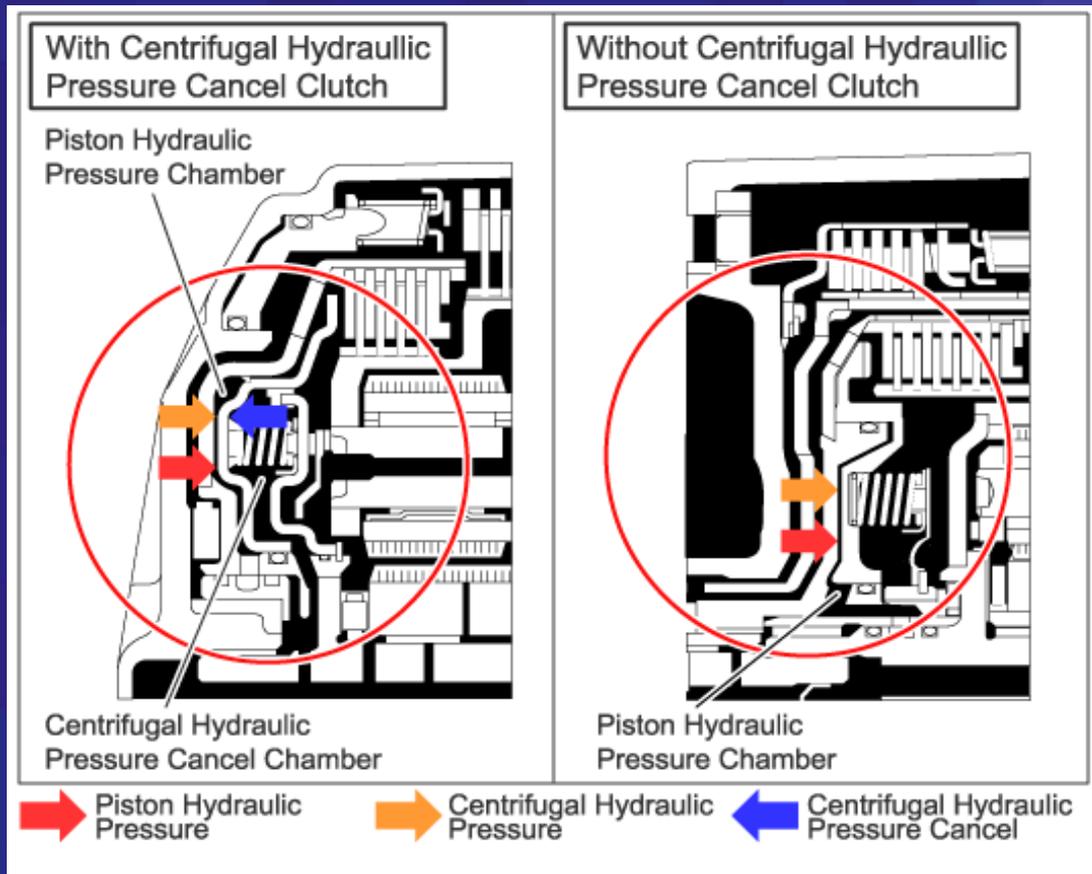
Clutches & Brakes

- **B1-Brake:** Locks the rear planetary middle sun gear
- **B2-Brake:** Locks the rear planetary carrier
- **F1-Roller type one-way clutch:** Locks the counterclockwise rotation of the rear planetary carrier

Feel the difference



Centrifugal force compensation clutches



The C1, C2 and C3 clutch are designed as centrifugal force compensation clutches.

Feel the difference



Centrifugal force compensation clutches

When the clutch chamber is pressurized, the clutch piston pushes against the clutch discs and actuates the clutch. As the clutch drum rotates at transmission input speed, a centrifugal force arises as well as the hydraulic pressure; this force increases with rotational speed.

In some operating conditions, this effect may result in imprecise and thereby harsh gear shifting.

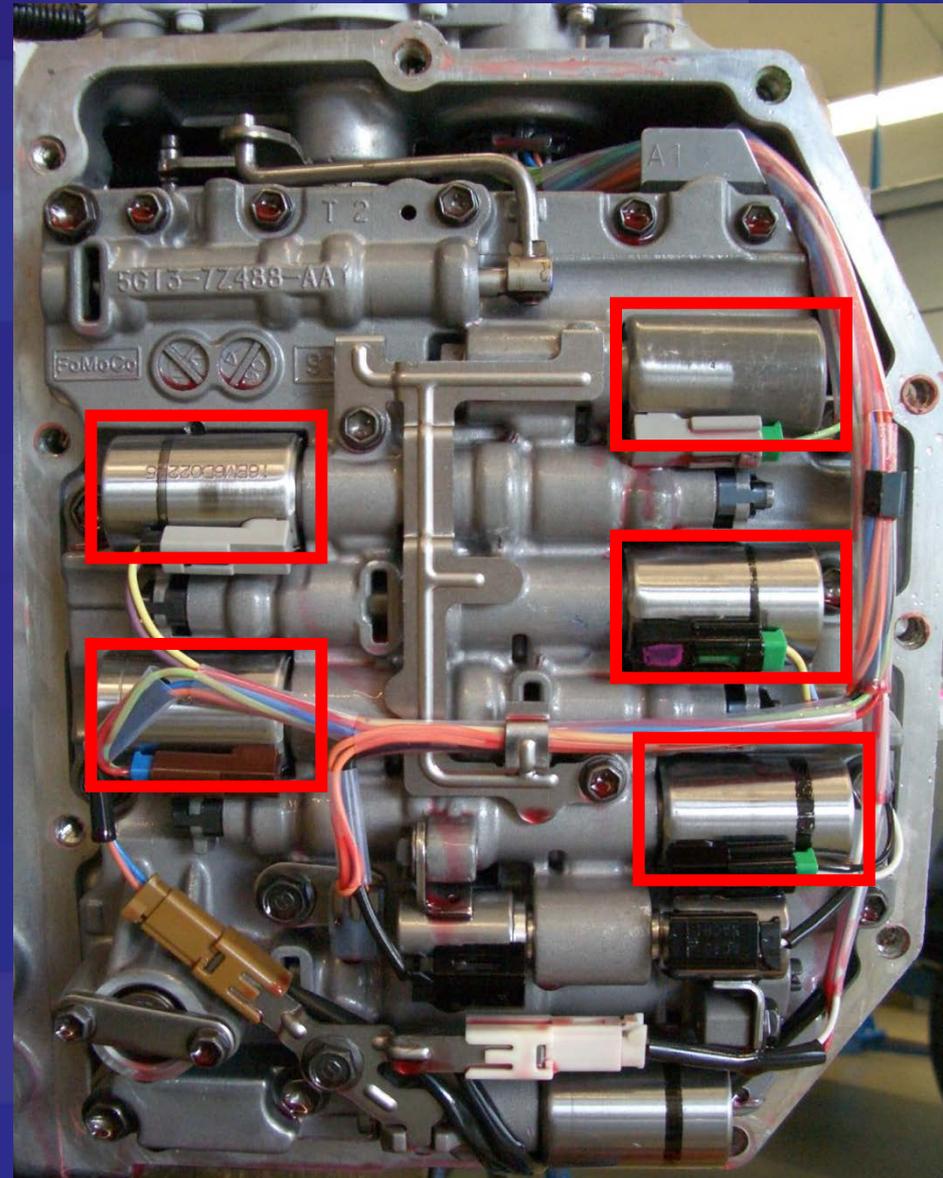
To prevent this, the compensation chamber is filled with transmission fluid. A centrifugal force will also arise in the compensation chamber as a function of the rotational speed of the transaxle; this centrifugal force acts against the centrifugal force in the clutch chamber. The two forces cancel each other out.

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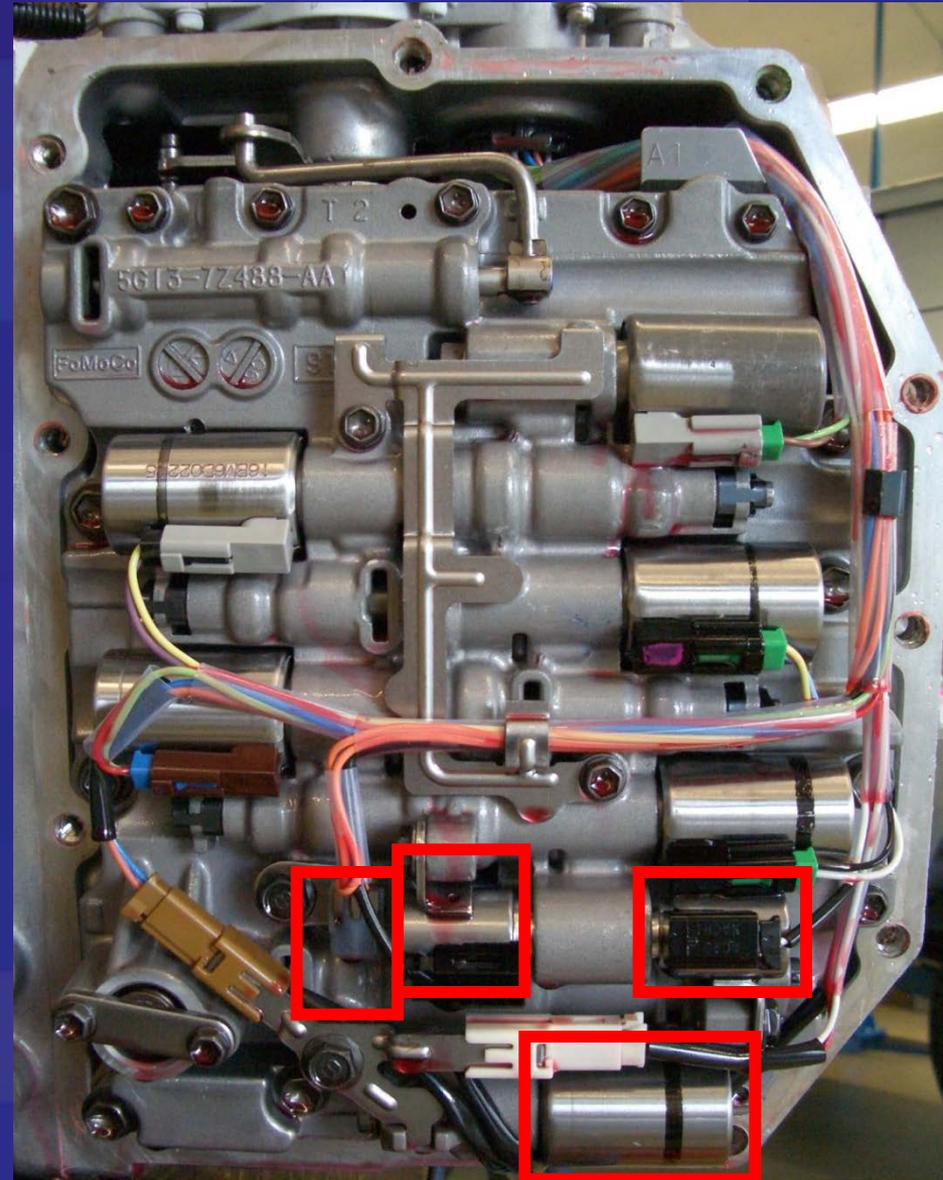
Valve Body

1. PWM solenoid valve – TCC (**SLU**)
2. PWM solenoid valve – 1./2./3./4. gear clutch (**SLC1**)
3. PWM solenoid valve – 3./5./R. gear clutch (**SLC3**)
4. PWM solenoid valve – 4./5./6. gear clutch (**SLC2**)
5. PWM solenoid valve – 2./6. gear brake (**SLB1**)



Valve Body

6. TFT sensor
7. Solenoid valve – Engine brake (**S1**)
8. Solenoid valve – Engine brake (**S2**)
9. Solenoid valve – Main pressure (**SLT**)



Solenoid valves

- **SLC1, SLC2, SLC3:** The solenoid valves control which clutches are used
- **S1 and S2 :** Primarily control engine braking in 1st gear
- **SLU:** Controls the lockup function, and is also used during certain gearshift processes
- **SLT:** Controls the transmission system pressure

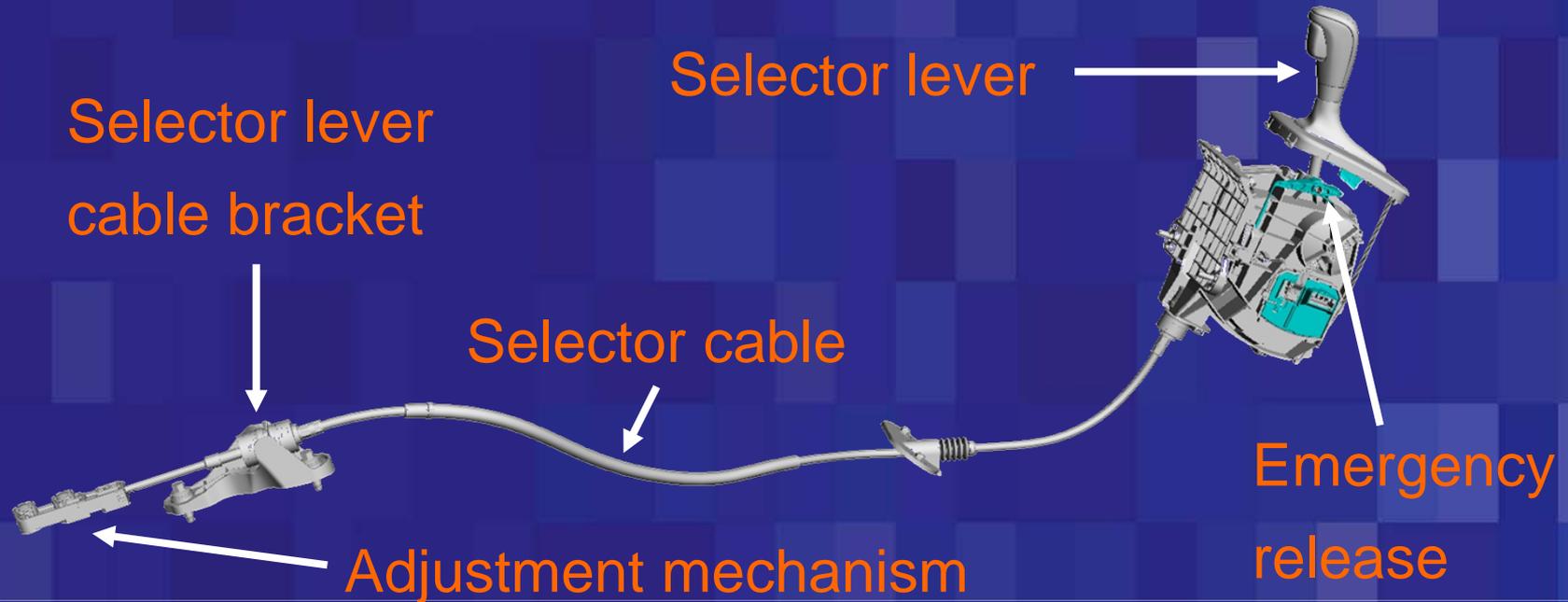
Feel the difference



Solenoid valves, clutches and brakes

| Operating | | ○ | | | | | | | | | | | |
|----------------|-------------|-------|-------|-------|----|----|--------|----|----|-------|----|----------------|---|
| Not operating | | - | | | | | | | | | | | |
| Shift position | Solenoid | | | | | | Clutch | | | Brake | | One-way clutch | |
| | SLC 1 | SLC 2 | SLC 3 | SLB 1 | S1 | S2 | C1 | C2 | C3 | B1 | B2 | F1 | |
| P | | ○ | ○ | ○ | ○ | - | - | - | - | - | - | - | - |
| R | $V \leq 10$ | ○ | ○ | - | ○ | - | - | - | - | ○ | - | ○ | - |
| | $V > 10$ | ○ | ○ | ○ | ○ | ○ | ○ | - | - | - | - | ○ | - |
| N | | ○ | ○ | ○ | ○ | - | - | - | - | - | - | - | - |
| D | 1st | - | ○ | ○ | ○ | - | - | ○ | - | - | - | - | ○ |
| | E/G B | - | ○ | ○ | ○ | ○ | ○ | ○ | - | - | - | ○ | ○ |
| | 2nd | - | ○ | ○ | - | - | - | ○ | - | - | ○ | - | - |
| | 3rd | - | ○ | - | ○ | - | - | ○ | - | ○ | - | - | - |
| | 4th | - | - | ○ | ○ | - | - | ○ | ○ | - | - | - | - |
| | 5th | ○ | - | - | ○ | - | - | - | ○ | ○ | - | - | - |
| | 6th | ○ | - | ○ | - | - | - | - | ○ | - | ○ | - | - |

External controls



The selector lever must be set to "D" when performing the adjustment.

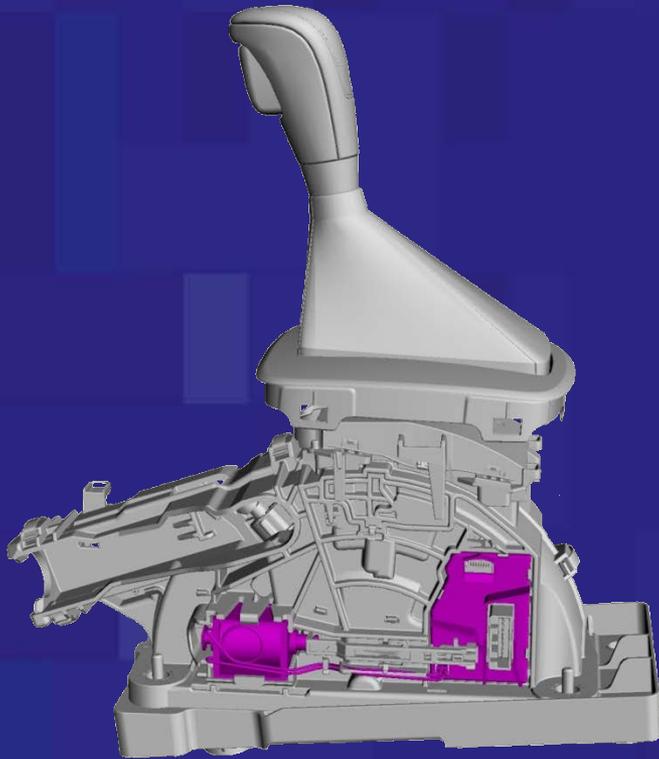
The emergency release for the selector lever lock is located underneath the selector lever gaiter.

A vibration mass damper is fitted.

Feel the difference



External controls



Integrated components

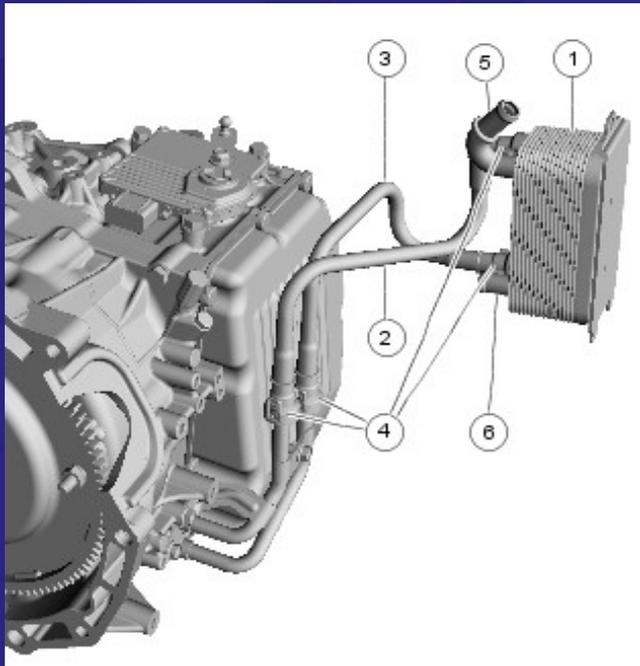
- Select-shift switch module (connected via LIN-Bus to the TCM)
- Selector lever lock solenoid
- Switch for ignition key removal inhibitor
- LED's for shift position display

TR-sensor → TCM via LIN → Module select shift →
→ LED gear display

Feel the difference



Transmission fluid cooling



1. Transmission fluid cooler
2. Transmission fluid cooler supply
3. Transmission fluid cooler return
4. Quick-release coupling
5. Radiator supply
6. Radiator return

The transmission fluid cooler is positioned behind the radiator.

To prevent wrong fitment, the quick-release couplings are colour-coded.

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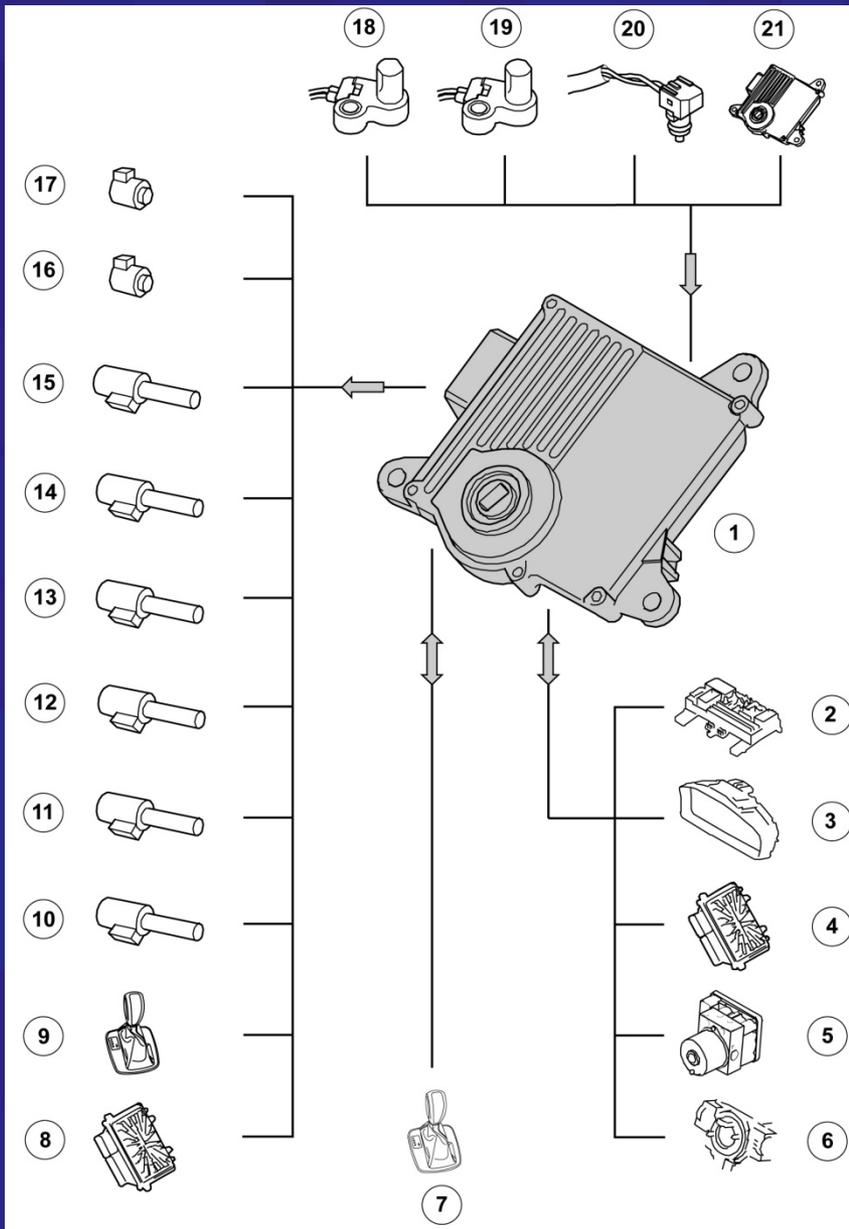
Transmission Control

Overview, strategies, sensors, actuators

Feel the difference



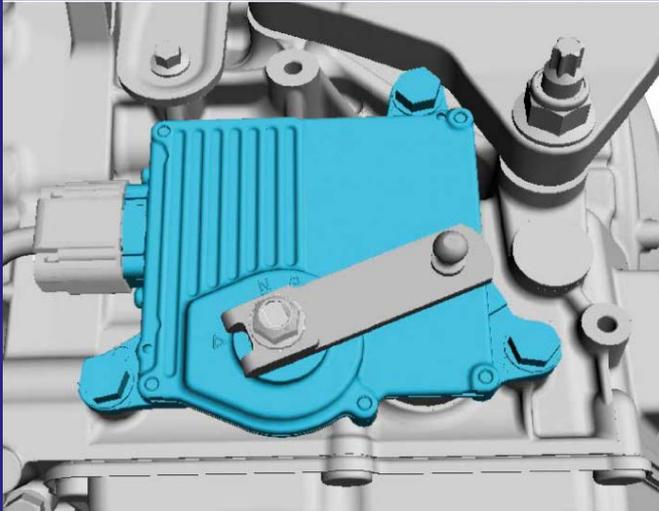
Overview



Feel the difference



TCM with integrated TR-Sensor



Function: Driving & driver condition depending gearshift point determination. Controlling the solenoid valves

Adaptions: Target is smooth shifting. For activation the temperature must be between 65 °C and 110 °C and a constant throttle position is of need.

Can be reset with IDS

Feel the difference



Strategies

- Sport mode, lever in position “S”
- Manual mode, lever in position “S”
- Lever from “N” → “R”
- Self-test and diagnostic
- Limp home mode 1 & mode 2
- Overheating
- Cold start mode
- Uphill / Downhill
- Altitude correction
- Neutral control, hill hold (only Diesel)

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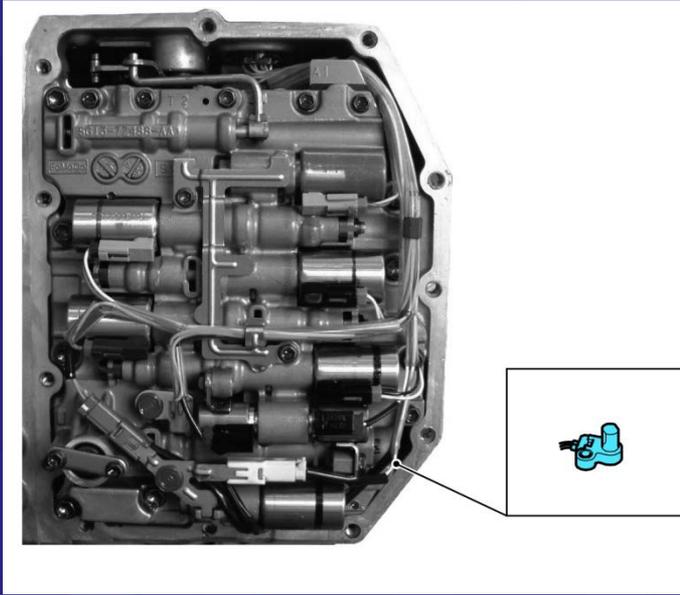
TCC Strategies

- **Function:** controlled by TCM. Depending on engine speed, throttle angle (PCM data) and the vehicle speed a linear actuation of the TCC is achieved.
- **Full lock-up mode:** less fuel consumption
- **Slip lock-up mode:** driving comfort

Feel the difference



TSS Sensor



Function

input shaft speed signal to calculate parameters for:

torque reduction during shifting,

torque converter slip,

shifting points,

lock-up function,

actual gear ratio

Faulty condition

Emergency mode 1 (only 3rd gear)

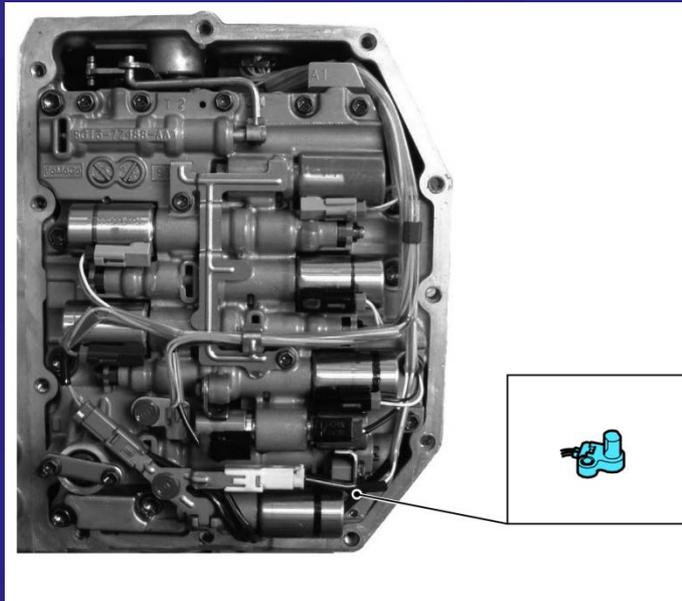
Torque limitation

MIL on

Feel the difference



OSS Sensor



Function

output shaft speed signal to calculate parameters for:

Degree of torque reduction which must be requested during shifting,

torque converter slip,

shifting points,

lock-up function,

actual gear ratio

vehicle speed

Faulty condition

Emergency mode 1 (only 3rd gear)

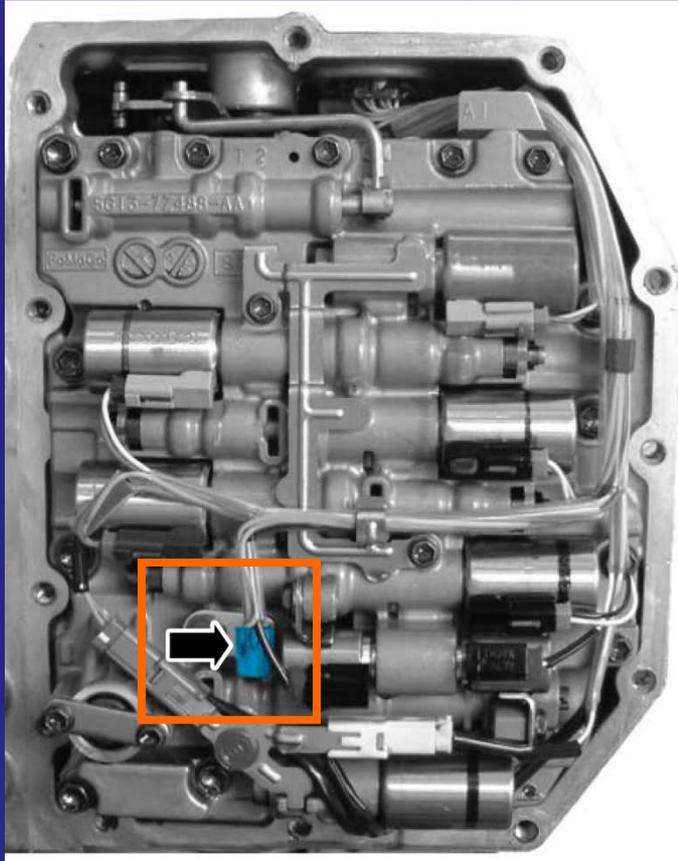
Torque limitation

MIL on

Feel the difference



TFT Sensor



Function

NTC sensor to measure the fluid temperature

Faulty condition

No TCC slip lock-up mode

No control of neutral position

No self-learning control

Message in cluster

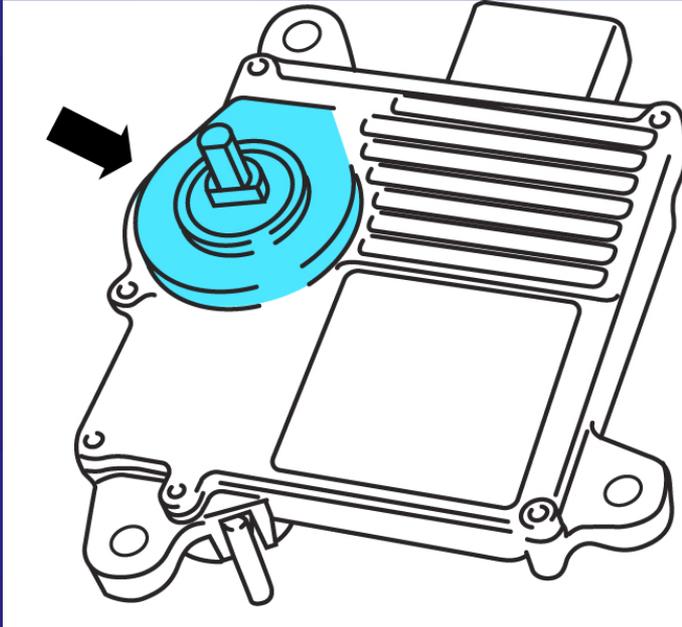
MIL on

Default value 80 °C

Feel the difference



TR Sensor



Function

Informs the TCM of the selector lever position.

Faulty condition

Emergency mode 1 (only 3rd gear)

No gearshift is performed

Engine starting is blocked (short circuit)

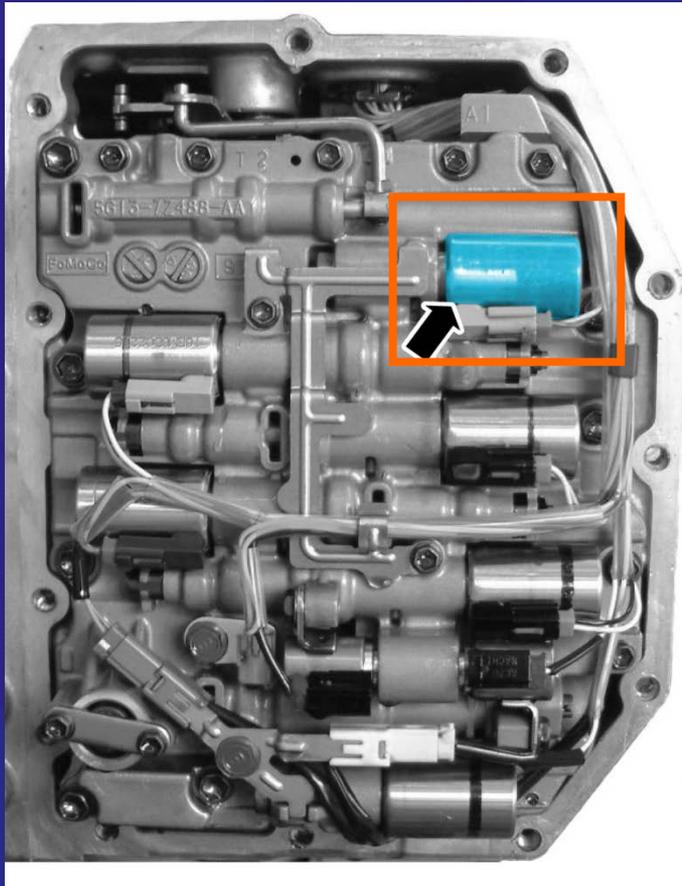
Message in cluster

DTC is set

Feel the difference



Solenoid valve TCC (SLU)



Function

Controlled via TCM to operate the TCC in accordance with the vehicle operation situation.

Faulty condition

No control of TCC

No self-learning control

Message in cluster

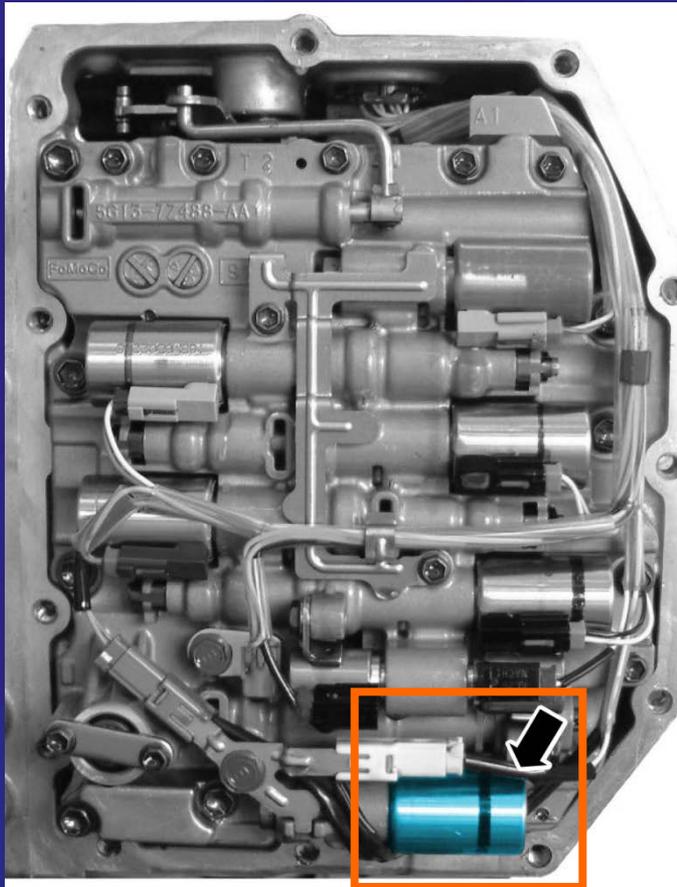
DTC is set

Engine start avoidance (SLU permanently active)

Feel the difference



Solenoid valve main pressure (SLT)



Function

Proportionally adaptation of main line pressure for judder free gear shifting.

Controlled by TCM.

Faulty condition

Undesired slip at acceleration

Harsh down shifting

Emergency mode 1

Message in cluster

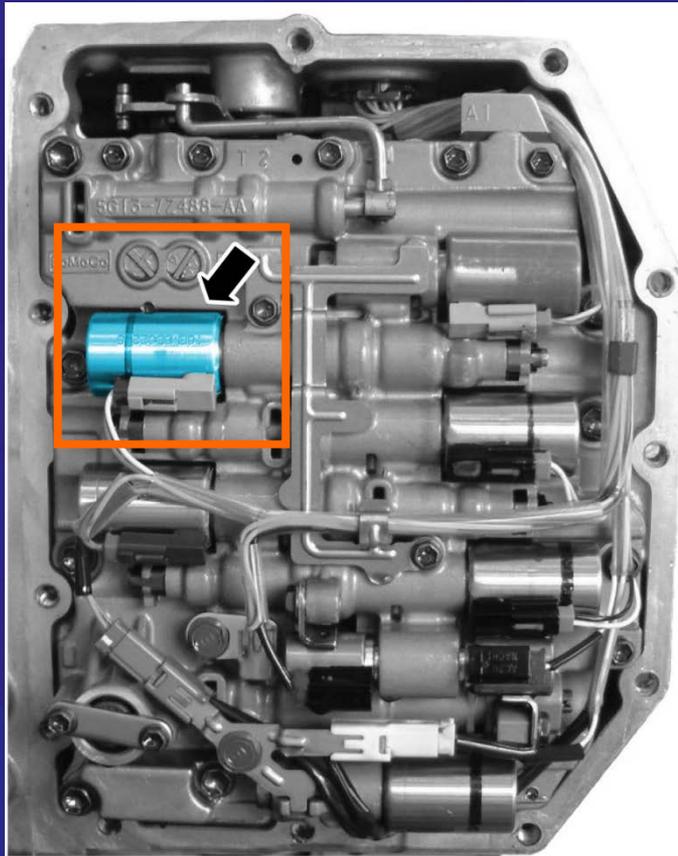
MIL on

DTC is set

Feel the difference



Solenoid valve (SLC1)



Function

Controls multi-plate clutch C1 for 1st, 2nd, 3rd and 4th gear.

Currentless open

Faulty condition

remains open under faulty condition,
C1 → maximum pressure.

Emergency mode 1

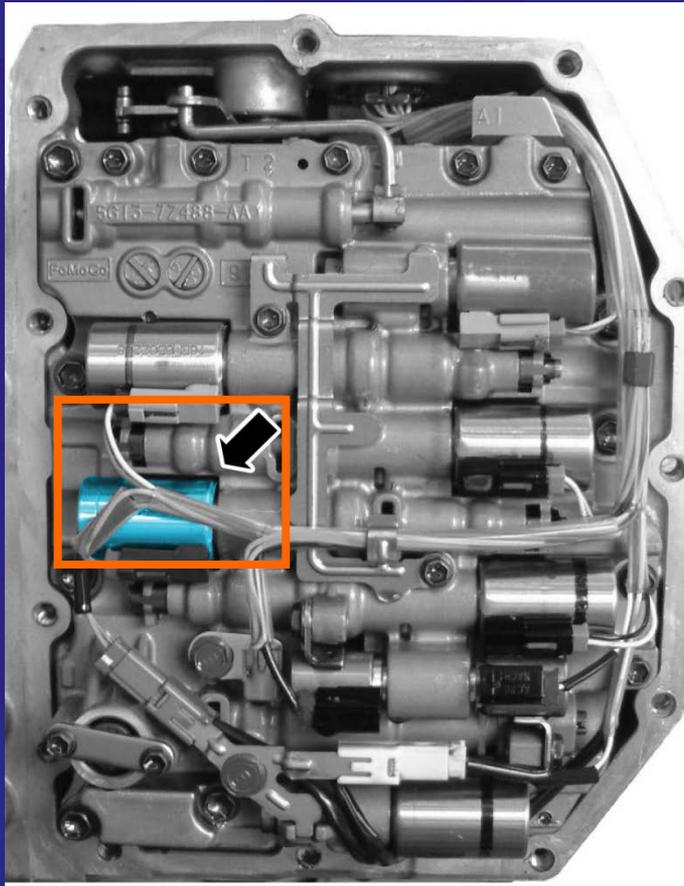
Message in cluster

MIL on

Feel the difference



Solenoid valve (SLC2)



Function

Controls multi-plate clutch C2 for 4th, 5th and 6th gear.

Currentless open

Faulty condition

remains open under faulty condition,
C2 → maximum pressure.

Emergency mode 1

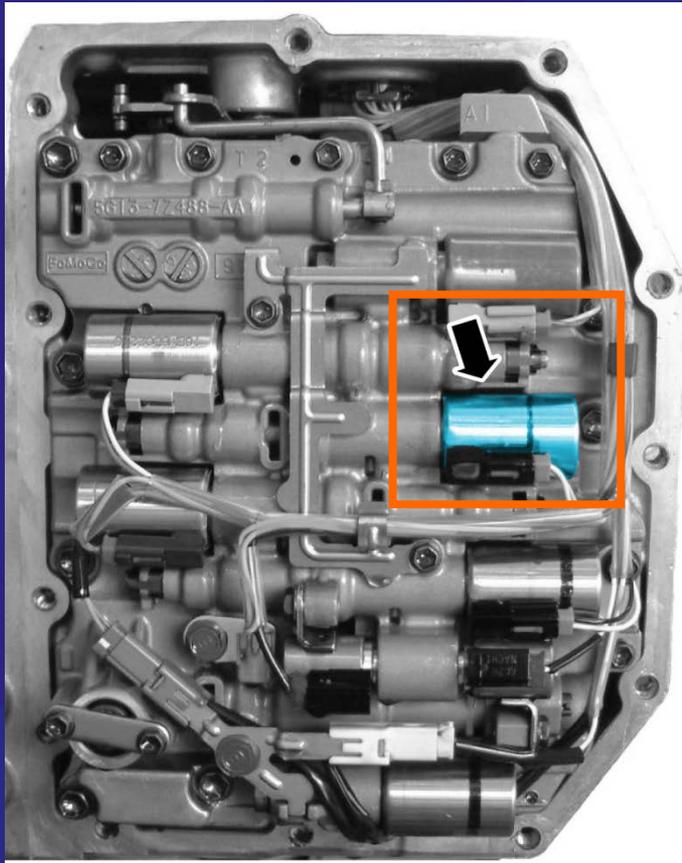
Message in cluster

MIL on

Feel the difference



Solenoid valve (SLC3)



Function

Controls multi-plate clutch C3 for 3rd, 5th and reverse gear.

Currentless open

Faulty condition

remains open under faulty condition,
C3 → maximum pressure.

Emergency mode 1

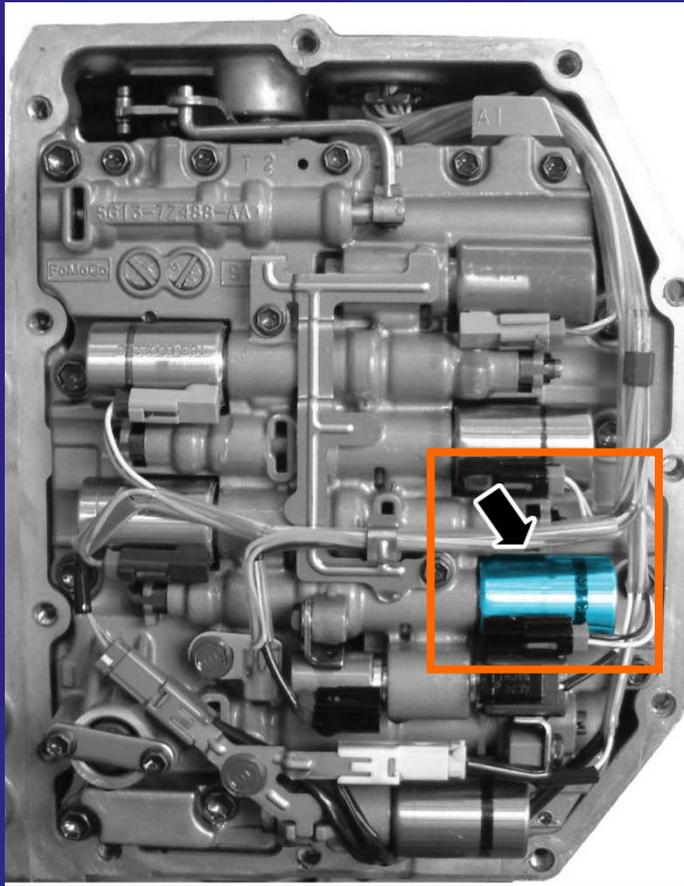
Message in cluster

MIL on

Feel the difference



Solenoid valve (SLB1)



Function

Controls brake band B1 for 2nd and 5th gear.

Currentless open

Faulty condition

remains open under faulty condition,
B1 → maximum pressure.

Emergency mode 1

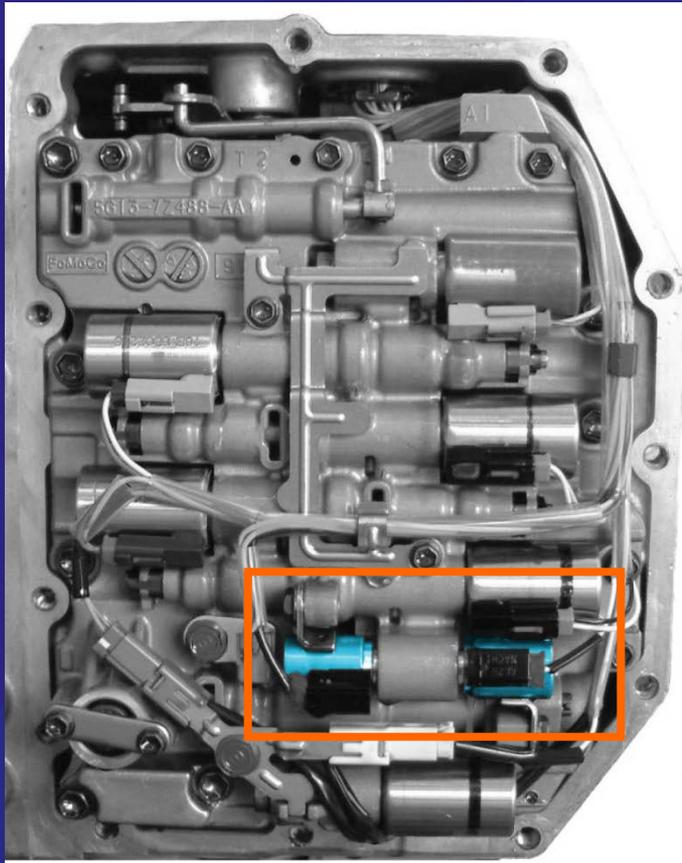
Message in cluster

MIL on

Feel the difference



Solenoid valve (S1/S2)



Function

Controls brake B2 for the engine brake.

Faulty condition

Emergency mode 1

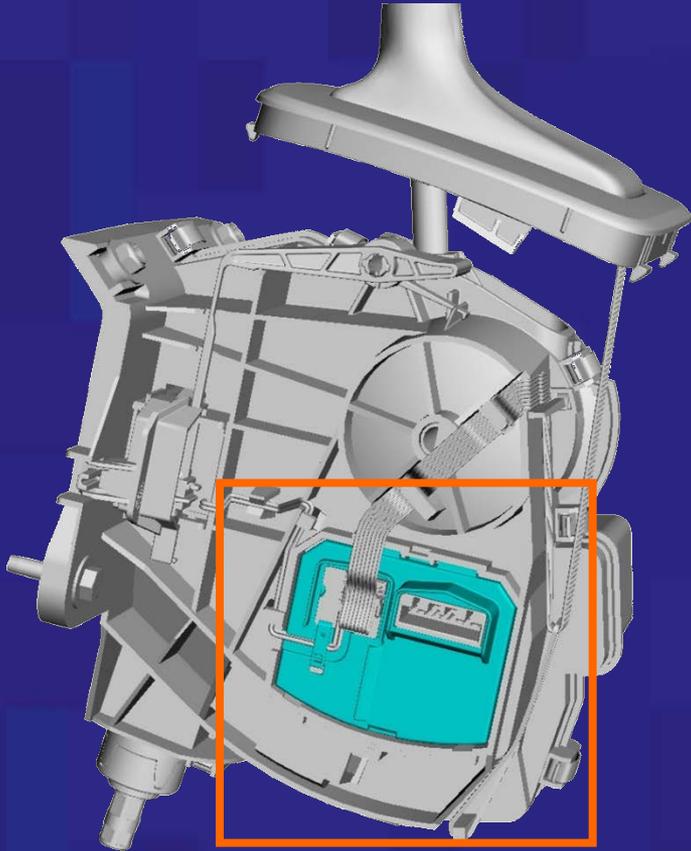
Message in cluster

MIL on

Feel the difference



Select shift module



Function

- Detection of selector lever position via position Hall sensor.
- Manual up- and downshift.
- Controls ignition key interlock.
- Locked or released in “P” via selector lever lock magnet.
- Voltage supply via TCM.
- Connected via LIN to TCM
- Plug & play exchange

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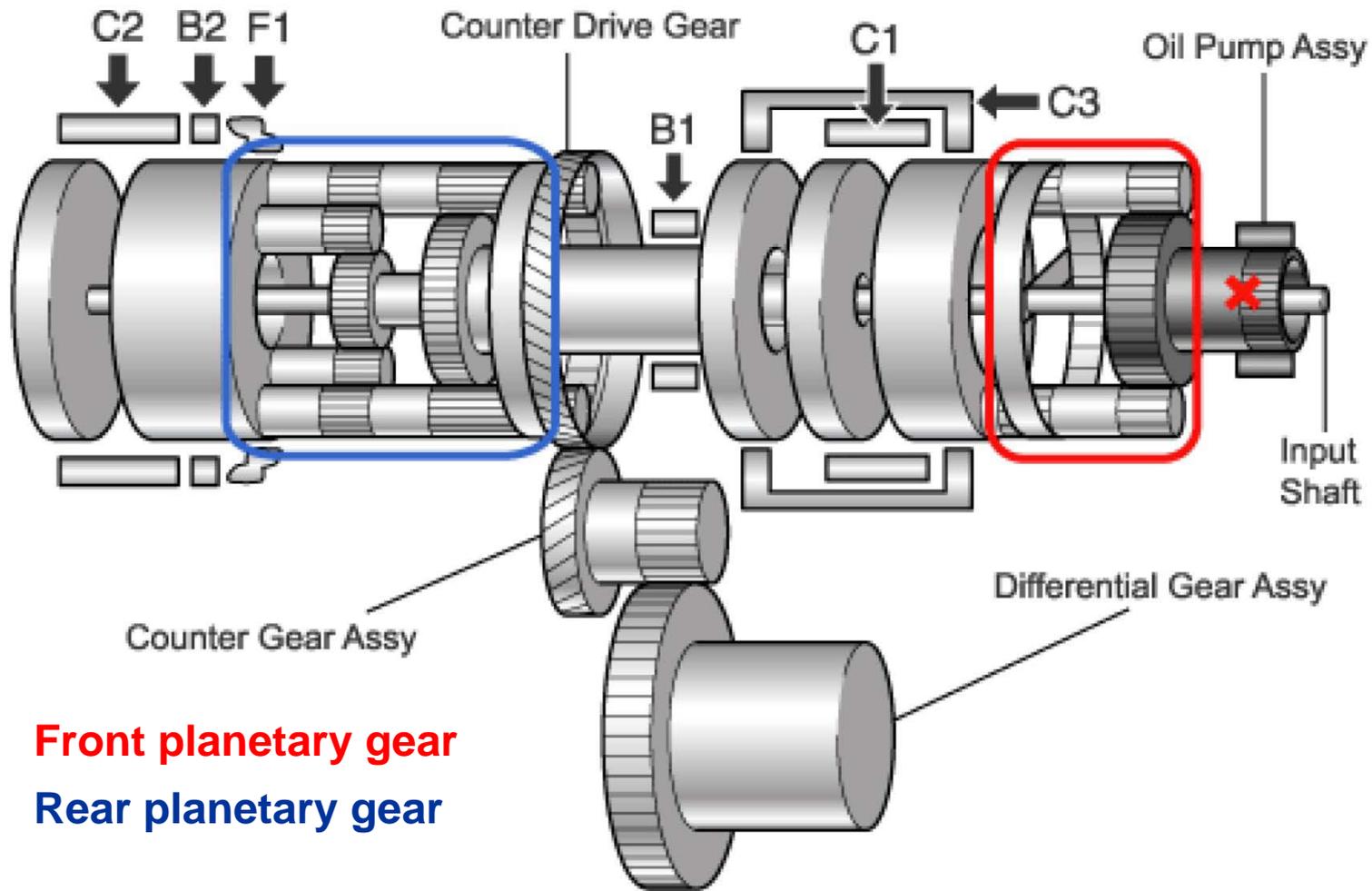


Powerflow

Feel the difference



Powerflow Overview



Feel the difference



Powerflow



Feel the difference



Service and Diagnostic

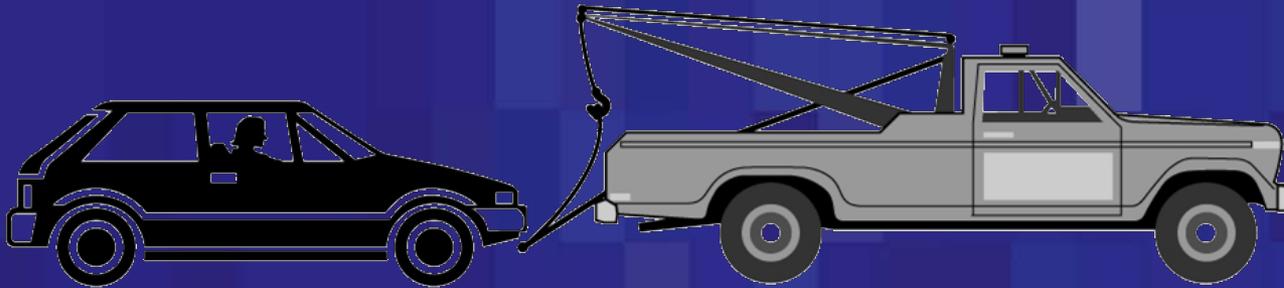
Service instructions, allowed repairs, IDS and DTC's

Feel the difference



Basic service instructions

- Knowing & understanding the concern
- Visual inspection
- Towing
- Push, tow or jump starting

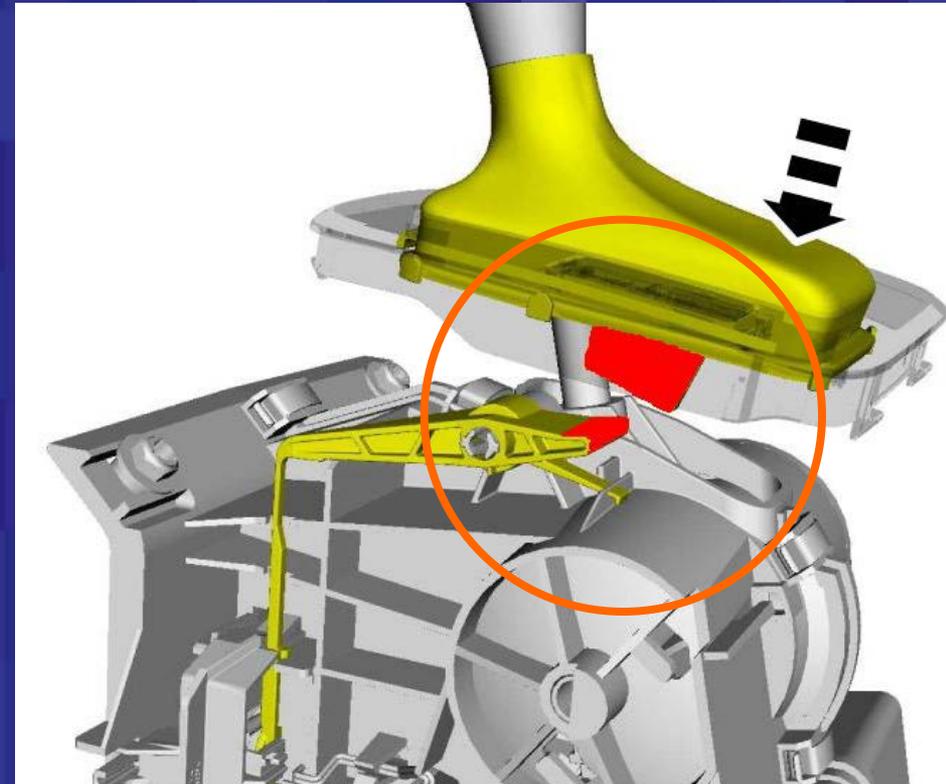
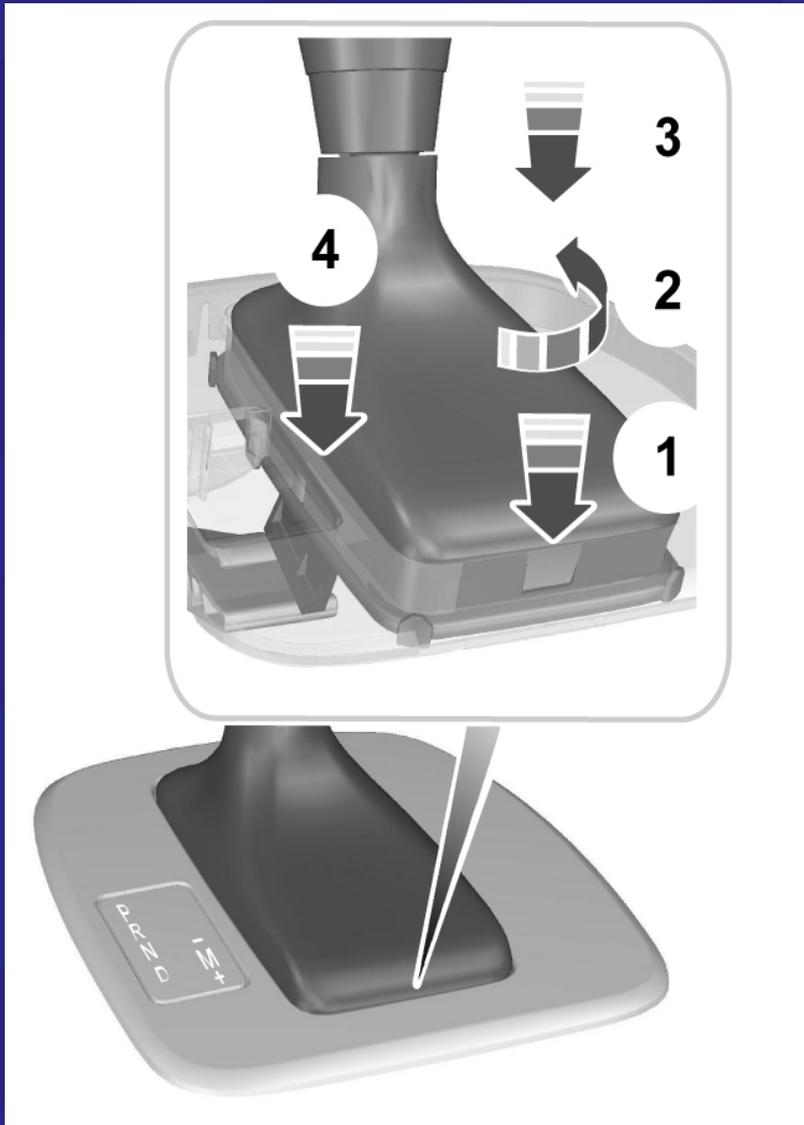


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Selector lever emergency release

S-Max / Galaxy

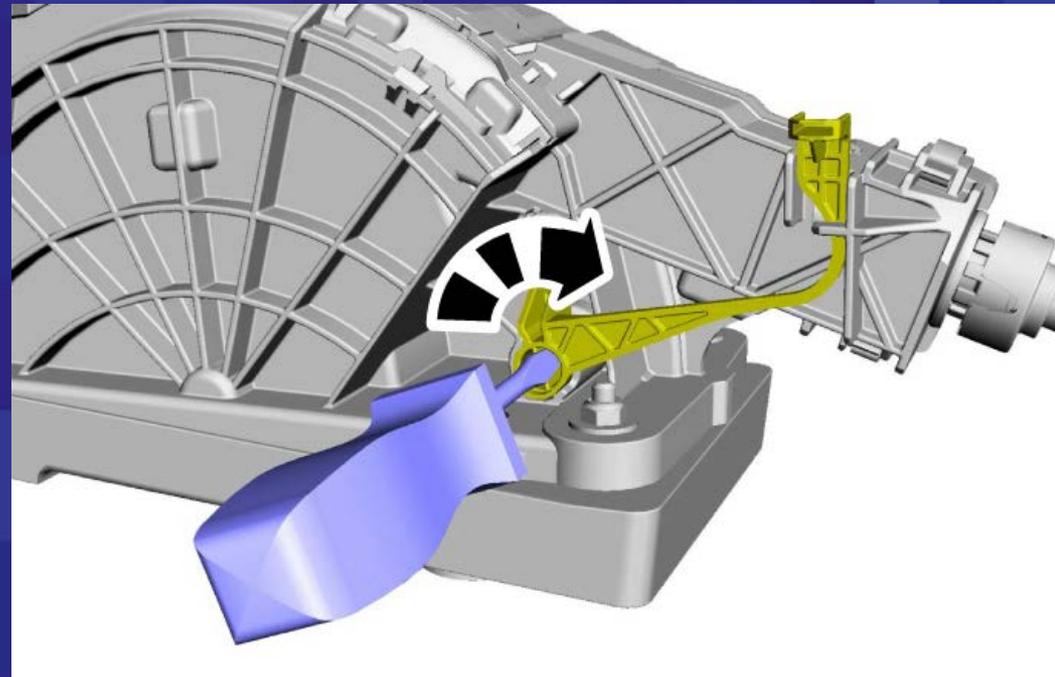
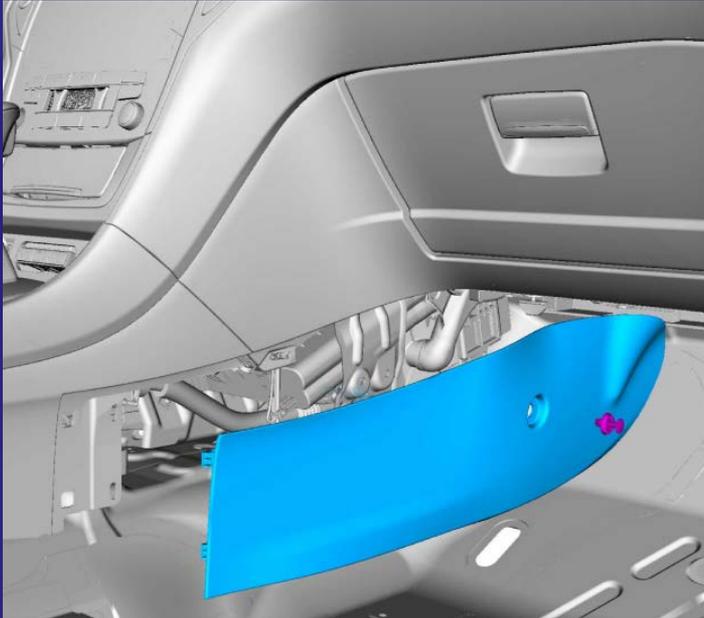


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Selector lever emergency release

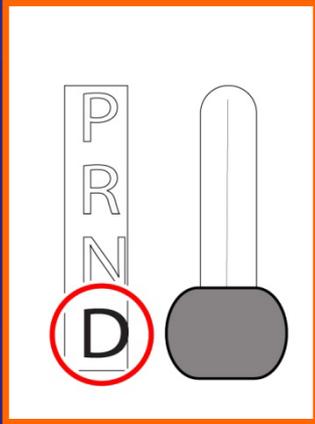
Mondeo 2007.5



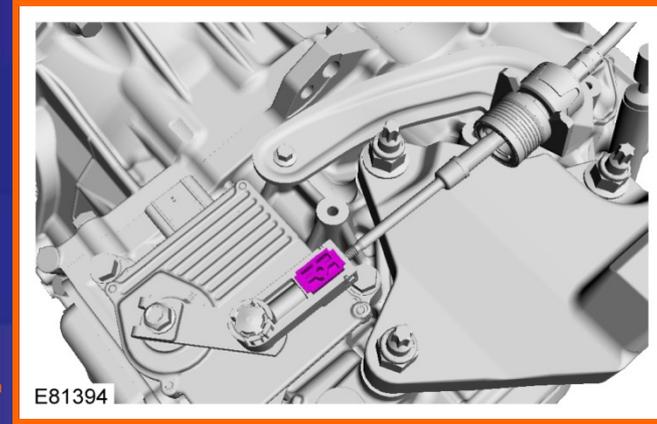
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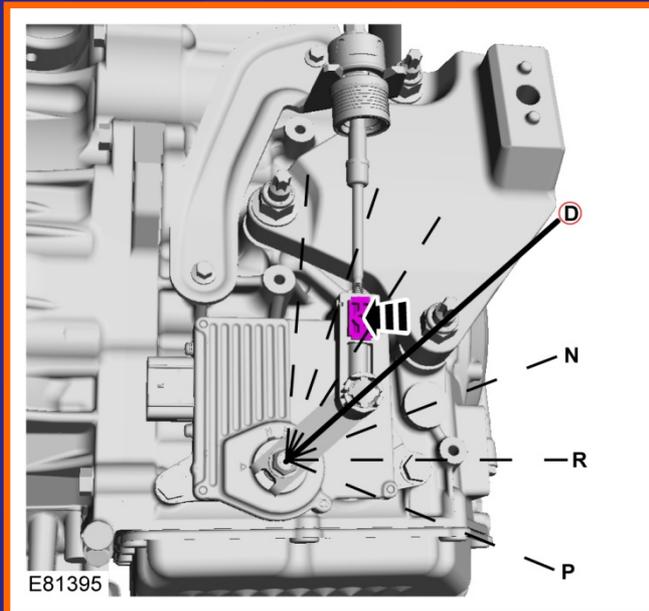
Selector cable adjustment



Selector lever
position "D"



Release lock of the
adjusting mechanism

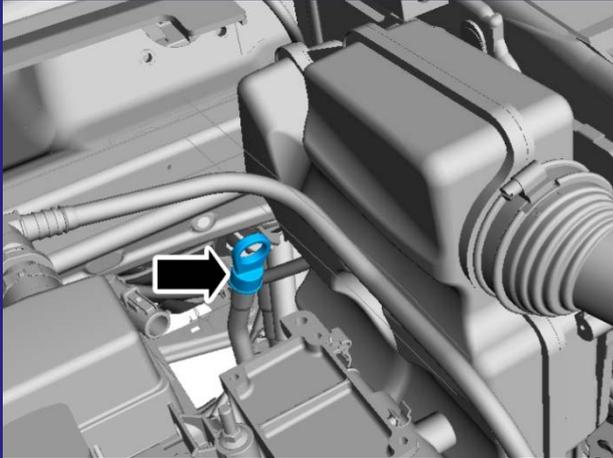


Selector lever and
gearshift mechanism
must be in position "D"

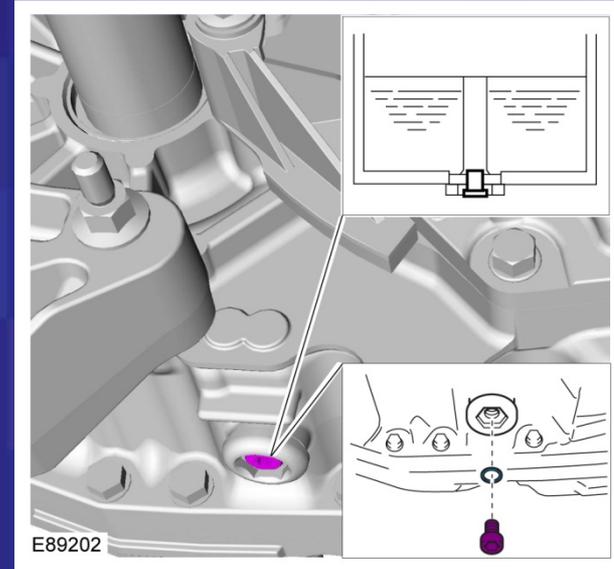
Feel the difference



Fluid level check



2.3L
petrol
engine



Diesel
engine

- Engine running at idle
- Transaxle fluid temperature (50 °C – 60 °C) or (53 °C – 57 °C) tbe
- Selector lever through all positions
- Selector lever in position “P”
- Oil specification WSS-M2C924-A
- 7.0L

Feel the difference



| | | | | | | |
|--------|-----------|-----------|-----------|-----------|-----------|-------|
| Temp. | 100 - 110 | 110 - 120 | 120 - 130 | 130 - 140 | 140 - 150 | > 150 |
| Points | 2 | 6 | 12 | 24 | 50 | 100 |

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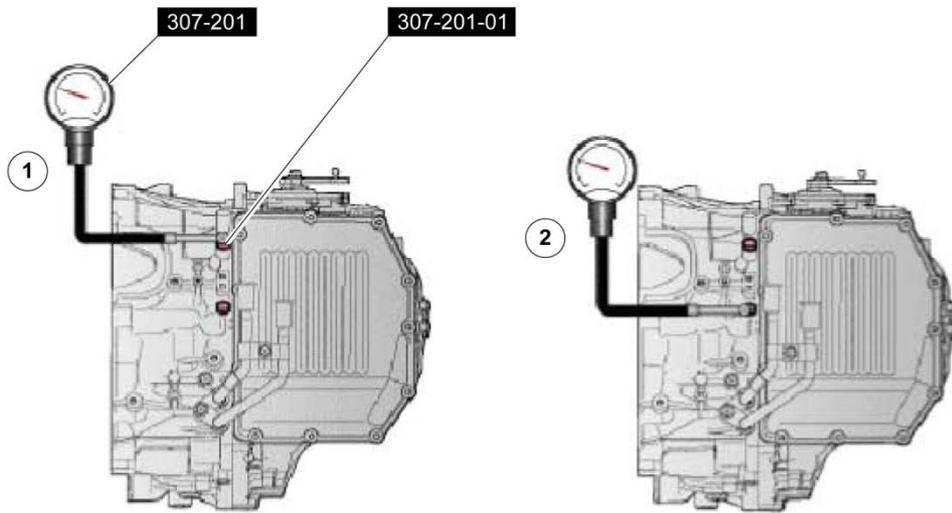
Feel the difference



Results and possible faults

Feel the difference





1. Connection for “D”
2. Connection for “R”

Feel the difference



1. Values of “D” and “R” range are lower than the standards

2. Oil pressure of throttle is stable at “D” & “R” range

Feel the difference

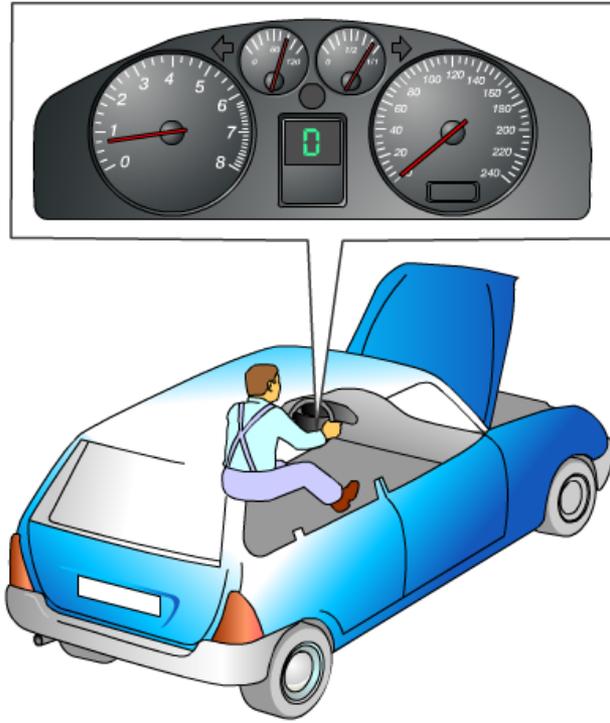


3. Current value remains the same at “D” & “R” range for throttle

4. R range pressure is lower than “D” range

Feel the difference





Feel the difference



1. Values of “D” and “R” ranges are lower than the standards
2. Only the value of “D” range is higher than the standard

Feel the difference

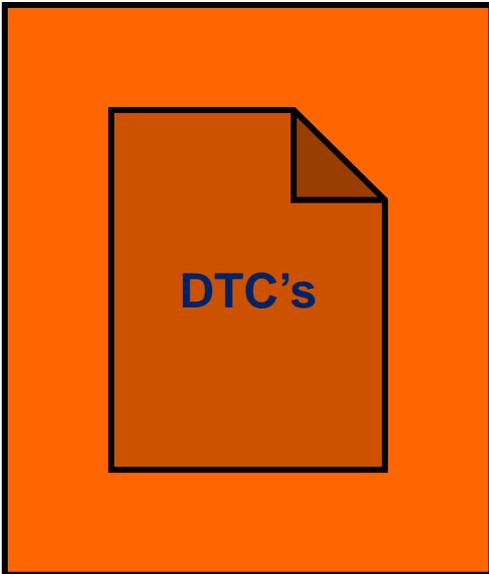


3. Only the value of “R” range is higher than the standard

4. Values of both “D” and “R” ranges are higher than the standards

Feel the difference



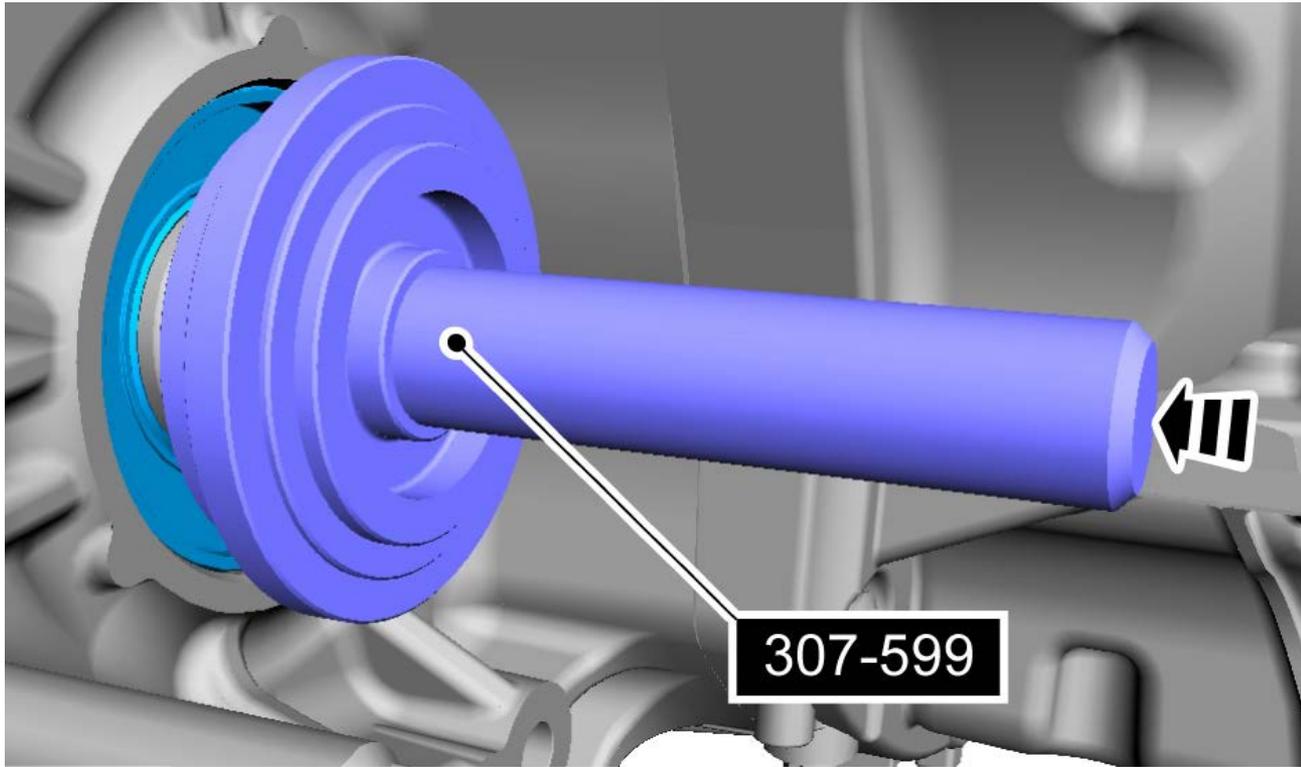


Feel the difference



Feel the difference





Feel the difference

