

PUBLISHED: 25-AUG-2020
2020.0 DEFENDER (LE), 311-01

AUTOMATIC TRANSMISSION

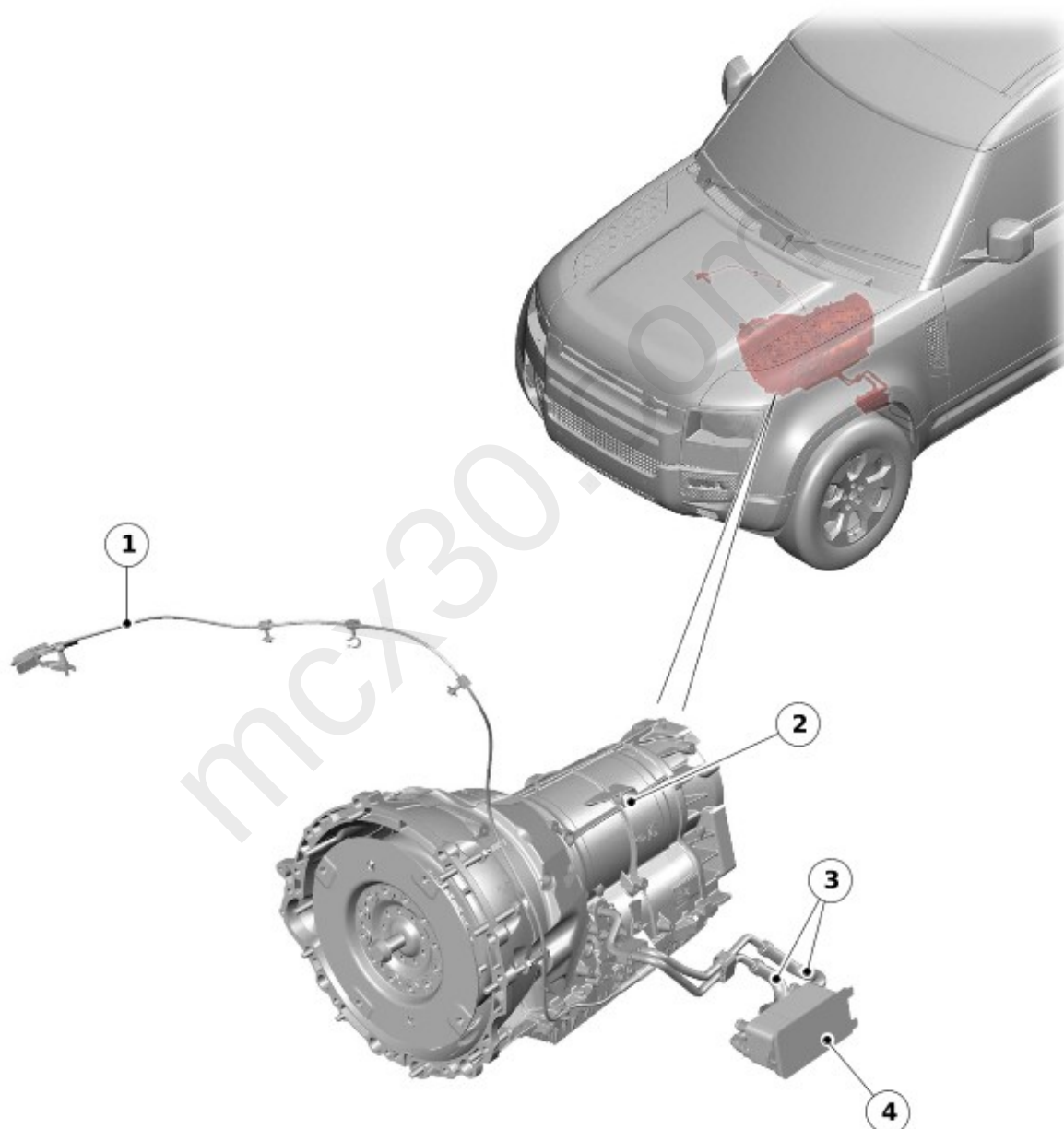
**TRANSMISSION DESCRIPTION - VEHICLES WITH:
8HP76 8-SPEED AUTOMATIC TRANSMISSION, AWD**

[G2391364]

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COMPONENT LOCATION

COMPONENT LOCATION - 1 OF 2 - AUTOMATIC TRANSMISSION



E250996

ITEM	DESCRIPTION
1	Emergency Park Release (EPR) lever
2	Automatic transmission

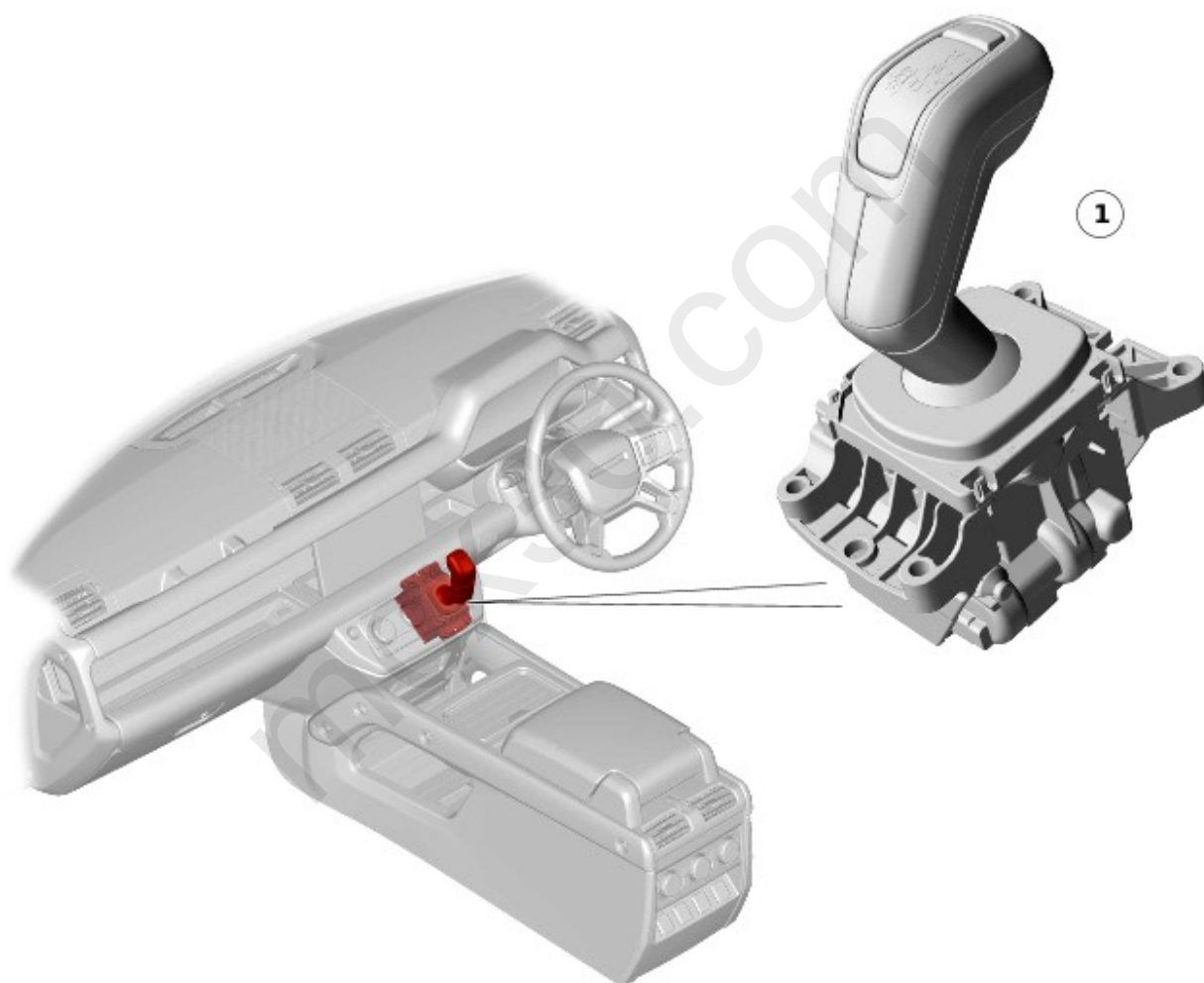
ITEM	DESCRIPTION
3	Automatic Transmission Fluid (ATF) cooler pipes
4	ATF cooler

COMPONENT LOCATION - 2 OF 2 - TRANSMISSION CONTROL



NOTE:

Right Hand Drive (RHD) variant shown, Left Hand Drive (LHD) variant is similar.



E251002

ITEM	DESCRIPTION
1	Transmission Control Switch (TCS)

The 8HP76 transmission is an electronically controlled, hydraulically operated, 8 speed automatic unit. The 8HP76 transmission is similar in design to the 1st generation 8HP70, but has the following major differences:

Disc Separation

Wave springs integrated within the transmission shift elements allow for improved drainage of ATF back to the transmission fluid pan. This reduces drag across open shift elements for improved efficiency.

Spool Valve Mechatronic

Increased use of the finer tolerance spool valves in place of 8HP Gen 1 transmission poppet valve technology improves the efficiency of the transmission hydraulic circuit.

90% Mechanical Vane Pump

The mechanical vane pump is a comparable technology to the 8HP Gen 1 transmission, with a reduced pump volume. The smaller pump volume reduces pumping losses when still meeting the pressure demand due the improved hydraulic circuit efficiency due to increased use of spool valve technology.

Optimized Brake B

A new piston design offers increased controllability for higher shift quality, as well as improved drainage of ATF back to the transmission fluid pan, which reduces drag across open shift elements for improved efficiency.

Wider Ratio Spread

The new transmission ratios are better matched to customer demands for improved low speed ascent vehicle capability and improved vehicle efficiency.

The 8HP76 transmission has the following features:

- Designed to be maintenance free.
- The ATF is 'fill for life'.
- The torque converter features a controlled slip feature with electronically regulated control of lock-up, creating a smooth transition to the fully locked condition.
- Shift programs controlled by the Transmission Control Module (TCM).
- Adaptive Shift Strategy (ASIS), to provide continuous adaption of shift changes to suit the driving style of the driver, which can vary from sporting to economical.
- Connected to the Powertrain Control Module (PCM) through the FlexRay systems bus for communications.
- Default mode if major faults occur.
- Diagnostics available from the TCM through FlexRay systems bus.

On vehicles featured with the stop/start system, the 8HP76 automatic transmission is equipped with a Hydraulic Impulse Storage (HIS). The HIS device makes sure that pressurized ATF is available to the shift elements as quickly as possible when the engine is started.

The transmission selections are made using the TCS in the floor console.

For additional information, refer to: [External Controls - Vehicles With: 8HP76 8-Speed Automatic Transmission, AWD \(311-02 Automatic Transmission External Controls, Description and Operation\)](#).

DESCRIPTION

AUTOMATIC TRANSMISSION

The automatic transmission comprises the main transmission housing which contains all of the transmission components.

A fluid pan is attached to the lower face of the transmission housing and is secured with bolts. The fluid pan is sealed to the transmission housing with a gasket. Removal of the fluid pan allows access to the mechatronic valve block and the electric ATF pump. The fluid pan has magnets located at the rear which collect any ferrous metallic particles present in the ATF.

The ATF filter is located inside the fluid pan. If the ATF becomes contaminated or after any service work, the fluid pan with integral ATF filter must be replaced.

The transmission does not have a bowden cable for park lock operation. This is initiated electronically when the TCS is moved to the PARK (P) position. An EPR mechanism is provided to release the park interlock if a failure occurs.

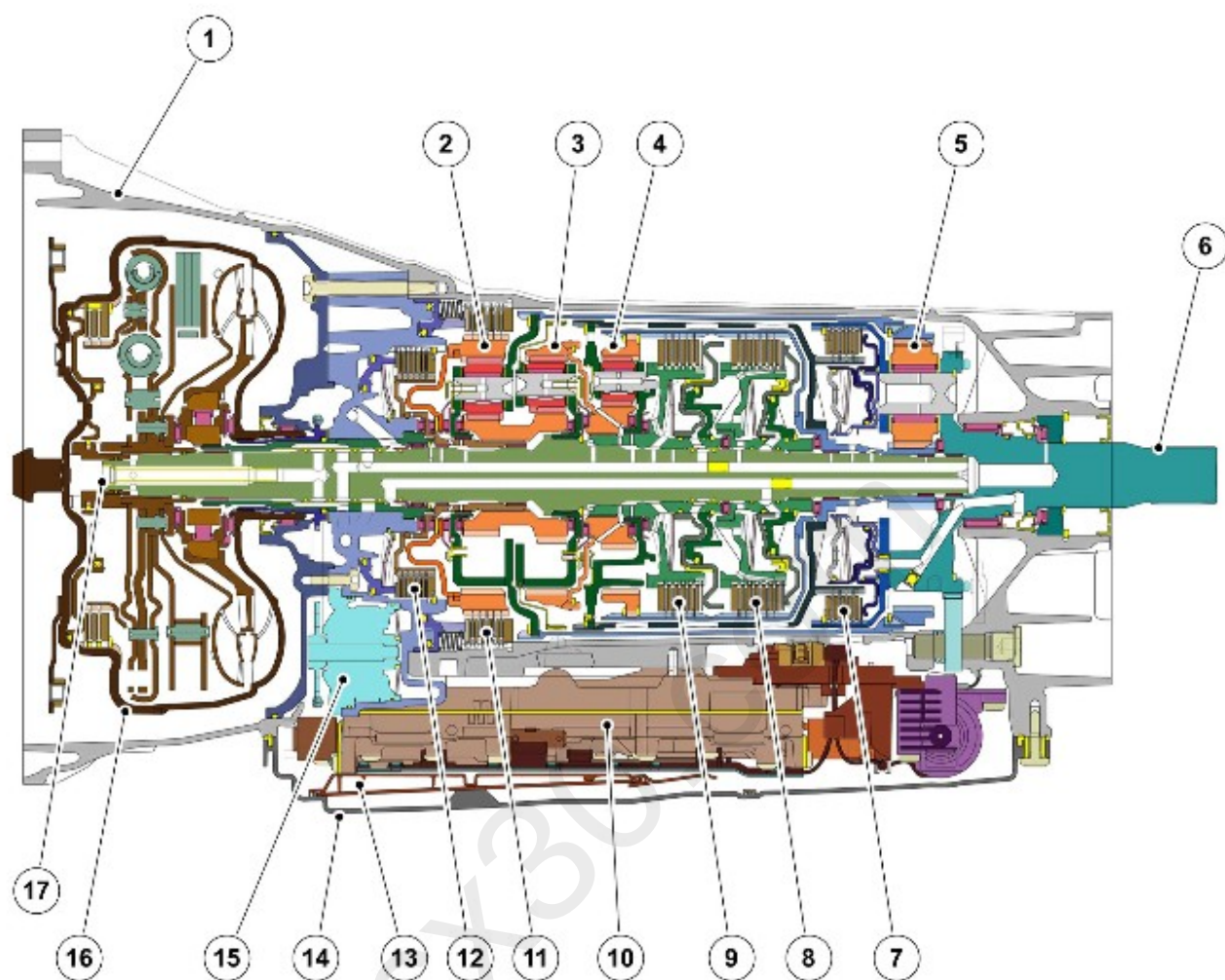
A feature of the 8 speed transmission is decoupling of the transmission when the vehicle is at a standstill. Normally the transmission remains in gear with the torque converter slipping and the vehicle is prevented from moving by applying the brake. The system disengages 1 of the transmission clutches and only a minimum rotating load remains. This has the effect of further reducing fuel consumption.

The integral torque converter housing provides protection for the torque converter assembly and also provides the attachment for the transmission to the engine. The torque converter is a non-serviceable assembly which also contains the lock-up clutch mechanism.

The transmission housing contains the following major components:

- Input shaft.
- Output shaft.
- Mechatronic valve block which contains the solenoids, speed sensors and the TCM.
- 3 rotating multi-plate drive clutches.
- 2 fixed multi-plate brake clutch.
- 4 planetary gear sets.

TRANSMISSION SECTIONAL VIEW

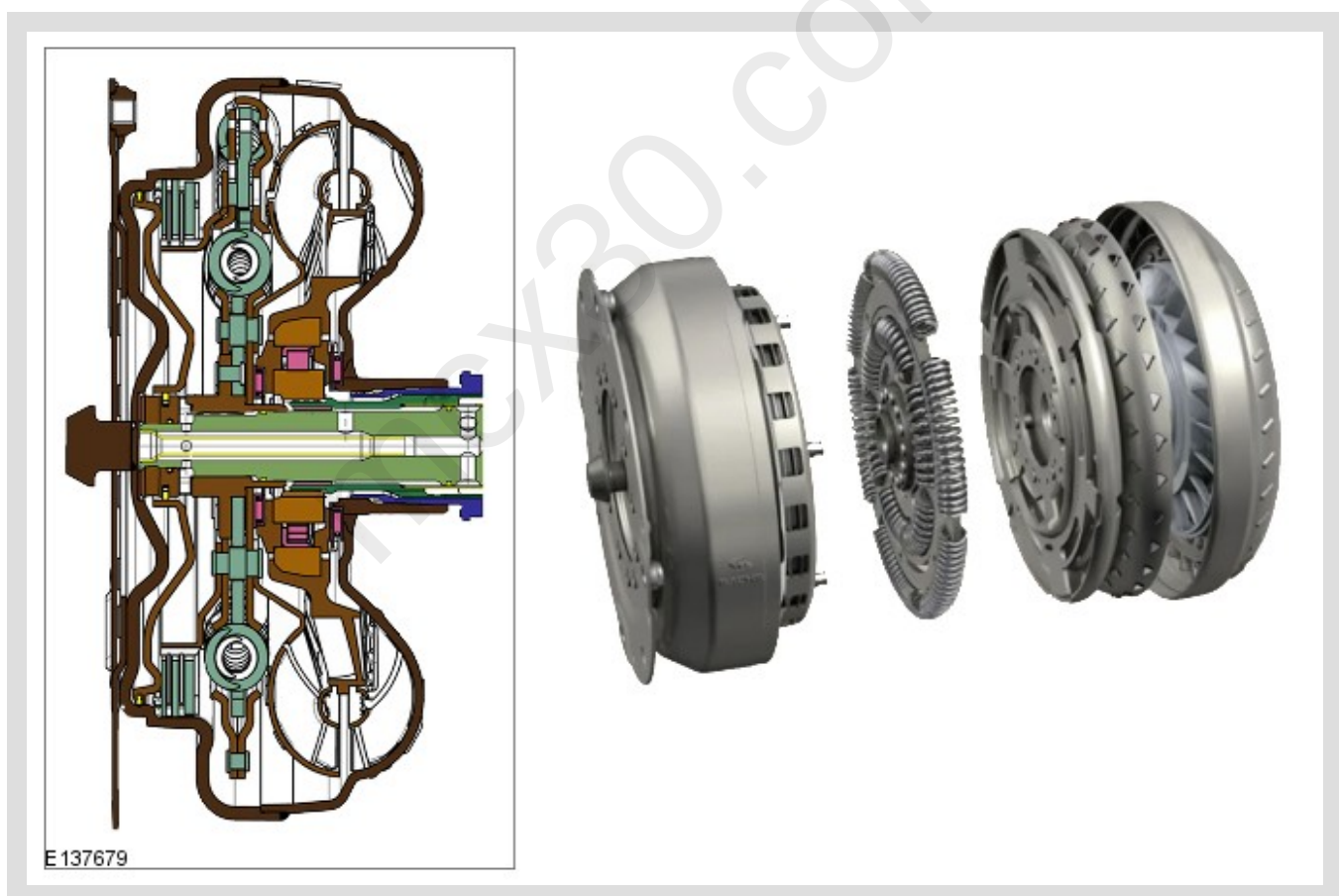


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ITEM	DESCRIPTION
1	Transmission housing
2	Gear set 1
3	Gear set 2
4	Gear set 3
5	Gear set 4
6	Output shaft
7	Clutch D

ITEM	DESCRIPTION
8	Clutch C
9	Clutch E
10	Mechatronic valve block
11	Brake B
12	Brake A
13	Fluid filter
14	Fluid pan
15	ATF pump
16	Torque converter
17	Input shaft

TORQUE CONVERTER



A torsional damper torque converter is used on 8HP76 transmissions.

The torsional damper enables a more direct engine connection for highly efficient power transmission when starting and shifting. The inner spring set is connected directly to the transmission, the outer spring set responds to torque from the engine through the lock-up clutch. When the lock-up clutch is applied, the hydro-dynamic circuit is by-passed and torque is transferred directly to the transmission input shaft. In comparison to conventional torque converters, the

torsional damper applies the lock-up clutch earlier. This improves driving comfort at low engine speeds and increases fuel efficiency by enabling the engine to be operated at lower Revolutions Per Minute (RPM) levels.

When the converter lock-up clutch is not applied, torque is transferred hydro-dynamically. Power from the engine is transmitted through the pump and turbine to the transmission input shaft. When the converter lock-up clutch is applied, the hydro-dynamic circuit is by-passed, torque is transferred directly through the lock-up clutch and the tandem spring sets. The turbine inertia is coupled between the 2 spring sets which improves disengagement, helps reduce wear on the transmission and improve noise insulation.

The torque converter is the coupling element between the engine and the transmission and is located in the torque converter housing, on the engine side of the transmission. The driven power from the engine crankshaft is transmitted hydraulically and mechanically through the torque converter to the transmission. The torque converter is connected to the engine by a drive plate attached to the rear of the crankshaft.

AUTOMATIC TRANSMISSION FLUID PUMP

The mechanical ATF pump is an integral part of the transmission. The ATF pump is used to supply hydraulic pressure for the operation of the control valves and clutches. The ATF pump also passes the ATF through the ATF cooler and to lubricate the gears and shafts.

The mechanical ATF pump is a double stroke, vane type pump and is located below the transmission input shaft. The pump is driven by a chain drive from a sprocket located on the input shaft.

MECHATRONIC VALVE BLOCK

The mechatronic valve block is located in the bottom of the transmission and is covered by the fluid pan.

The valve block houses the following components:

- The TCM
- Speed sensors
- Electrical actuators
- Control valves.

The above components provide all electro-hydraulic control for all transmission functions.

The Mechatronic valve block comprises the following components:

- The TCM
- Park lock solenoids (quantity 2)
- Hydraulic spool valves (quantity 10)
- Temperature sensor
- Turbine speed sensor
- Output shaft speed sensor.

SENSORS

Speed Sensors

The turbine speed sensor and the output shaft speed sensor are Hall effect type sensors located in the mechatronic valve block and are not serviceable items. The TCM monitors the signals from each sensor to determine the input (turbine) speed and the output shaft speed.

The turbine speed is monitored by the TCM to calculate the slip of the torque converter clutch and internal clutch slip. This signal allows the TCM to accurately control the slip timing during shifts and adjust clutch application or release pressure for overlap shift control.

The output shaft speed is monitored by the TCM and compared to engine speed signals received on the FlexRay system bus from the PCM. Using a comparison of the 2 signals the TCM calculates the transmission slip ratio for plausibility and maintains adaptive pressure control.

Temperature Sensor

The temperature sensor is also located in the mechatronic valve block. The TCM uses the temperature sensor signals to determine the temperature of the ATF. These signals are used by the TCM to control the transmission operation. The TCM uses the temperature signals to promote faster warm-up in cold conditions. The TCM also uses the temperature signal to assist with ATF cooling by controlling the transmission operation when high ATF temperatures are experienced. If the sensor fails, the TCM uses a default value and a Diagnostic Trouble Code(s) (DTC) is stored in the TCM.

MULTIPLE CLUTCH BRAKE – TYPICAL

There are 3 drive clutches and 2 brakes used in the transmission. Each clutch comprises a number of friction plates dependent on the output controlled. A typical clutch consists of a number of alternating steel plates and plates with friction material bonded to each face.

The clutch plates are held apart mechanically by a diaphragm spring and hydraulically by dynamic pressure. The pressure is derived from a lubrication channel which supplies fluid to the bearings and clutch cooling. The fluid is passed through a drilling in the input shaft into the chamber between the baffle plate and the piston. To prevent inadvertent clutch application due to pressure build up produced by centrifugal force, the fluid in the dynamic pressure equalization chamber overcomes any centrifugal pressure in the piston chamber. It holds the piston off the clutch plate assembly.

When clutch application is required, main pressure from the mechanical ATF pump is applied to the piston chamber from the supply port. This main pressure overcomes the low pressure fluid present in the dynamic pressure equalization chamber. The piston moves, against the pressure applied by the diaphragm spring, and compresses the clutch plate assembly. When the main pressure falls, the diaphragm spring pushes the piston away from the clutch plate assembly, disengaging the clutch.

PLANETARY GEAR SETS

The 8 forward gears and the reverse gear are produced by a combination of 4 simple planetary gear sets, 3 clutches and 2 brakes. The front 2 gear sets share a common sun gear. Power is output always through the planetary carrier of the 4th gearset.

The 5 shift elements comprising 3 clutches and 2 brakes, are responsible for all 8 forward and reverse gears. High efficiency is achieved by the use of only 2 shift elements disengaged in each gear which reduces drag and so increases the efficiency.

OVER TEMPERATURE MESSAGES

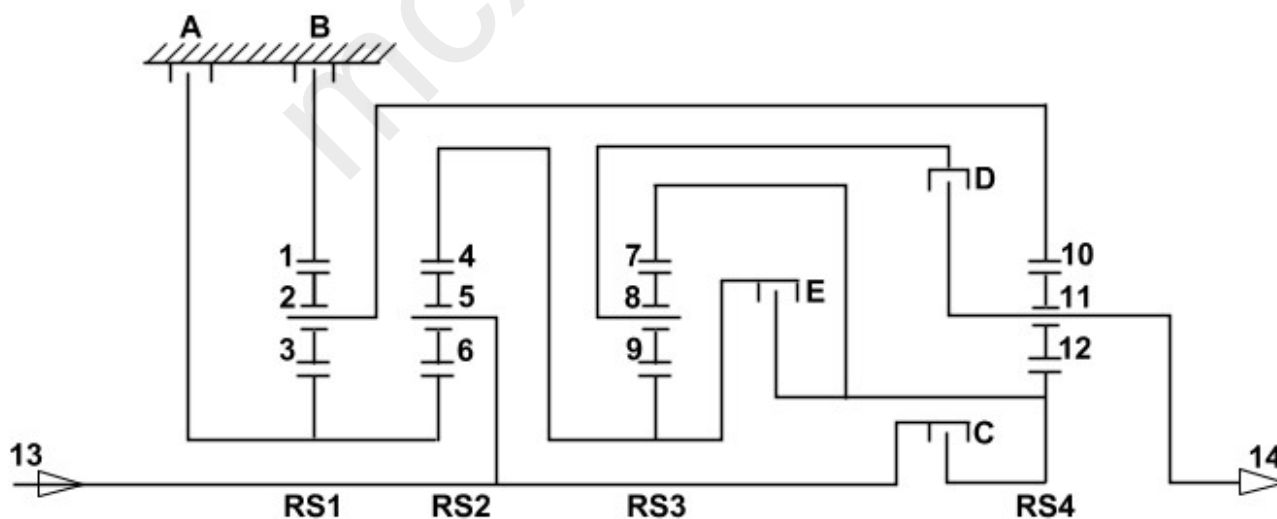
The transmission clutch temperatures are modeled within the TCM. The 8HP76 transmission incorporates additional monitoring of the torque converter as this is worked hard on low speed crawl situations. The TCM uses algorithms to detect high load on the launch clutch and when detected provides a message to the driver to select low-range. Further monitoring then provides a critical warning to the driver with a notification sound from the Instrument Panel Cluster (IPC) to select low-range if this first message is ignored.

OPERATION

POWER FLOWS

Operation of the transmission is controlled by the TCM, which electrically activates various solenoids to control the transmission gear selection.

All gear shifts from 1st to 8th and 8th to 1st are known as 'overlap' shifts. Overlap shifts are during a gear shift 1 clutch must remain capable of transmitting torque at a reduced main pressure until the other clutch is ready to accept the torque.



E131258

ITEM	DESCRIPTION
A	Multiplate brake
B	Multiplate brake
C	Multiplate brake
D	Multiplate brake
E	Multiplate brake
1	Ring gear of planetary gear set 1
2	Planetary gears of planetary gear set 1
3	Sun gear of planetary gear set 1
4	Ring gear of planetary gear set 2
5	Planetary gears of planetary gear set 2
6	Sun gear of planetary gear set 2
7	Ring gear of planetary gear set 3
8	Planetary gears of planetary gear set 3
9	Sun gear of planetary gear set 3
10	Ring gear of planetary gear set 4
11	Planetary gears of planetary gear set 4
12	Sun gear of planetary gear set 4
13	Power input from torque converter
14	Power output to output shaft

Engine torque is transferred, through operation of single or combinations of clutches to the 4 planetary gear trains. All gear trains are controlled by reactionary inputs from brake clutches to produce the 8 forward gears and 1 reverse gear.

The ratios are as follows:

GEAR	1ST	2ND	3RD	4TH	5TH	6TH	7TH	8TH	REVERSE
Ratio	5.500	3.520	2.200	1.720	1.317	1.000	0.823	0.640	-3.993

SHIFT ELEMENTS

The shift elements, clutches and brakes are actuated hydraulically. ATF pressure is applied to the required clutch and /or brake, pressing the plates together and allowing drive to be transmitted through the plates. The purpose of the shift elements is to perform power-on shifts with no interruption to traction and smooth transition between gear ratios.

INSTRUMENT PANEL CLUSTER

The virtual display IPC is connected to the Body Control Module (BCM)/ Gateway Control Module (GWM) on the High Speed (HS) Controller Area Network (CAN) Human Machine Interface (HMI) systems bus. The TCM is connected to the BCM/ GWM on the FlexRay systems bus. Transmission status is transmitted by the TCM and displayed to the driver in 1 of 2 displays on the IPC.

For additional information, refer to: [Engine Cooling - INGENIUM I4 2.0L Petrol](#) (303-03B Engine Cooling - INGENIUM I4 2.0L Petrol/INGENIUM I4 2.0L Petrol - PHEV, Description and Operation).

MALFUNCTION INDICATOR LAMP

The Malfunction Indicator Lamp (MIL) is located on the Instrument Cluster (IC) display. Transmission related faults which may affect the vehicle emissions illuminates the MIL.

The MIL is illuminated by the PCM on receipt of a relevant fault message from the TCM on the FlexRay system bus. The nature of the fault can be diagnosed using the Jaguar Land Rover (JLR) approved diagnostic equipment which reads the DTC, stored in the TCM memory.

TRANSMISSION STATUS DISPLAY

The transmission status display is located in the tachometer of the IPC and in the message center when in sport mode. The display shows the TCS position or the selected gear when in manual and sport modes.

The following table shows the displays and their descriptions:

SYMBOL	DESCRIPTION
P	PARK (P) selected
R	REVERSE (R) selected
N	NEUTRAL (N) selected
D *	DRIVE(D) and temporary manual mode selected (* = current gear)
S *	SPORT (S) mode selected (* = current gear)
1	1st gear selected (manual Command Shift mode)
2	2nd gear selected (manual Command Shift mode)
3	3rd gear selected (manual Command Shift mode)
4	4th gear selected (manual Command Shift mode)
5	5th gear selected (manual Command Shift mode)
6	6th gear selected (manual Command Shift mode)
7	7th gear selected (manual Command Shift mode)
8	8th gear selected (manual Command Shift mode)

MESSAGE CENTER

The message center is located in the virtual display IPC. The message center display relays vehicle status and operating information to the driver and can display messages relating to a number of vehicle systems. If a transmission fault occurs, the message 'GEARBOX FAULT' is displayed in the message center.

For additional information, refer to: [Engine Cooling - INGENIUM I4 2.0L Petrol](#) (303-03B Engine Cooling - INGENIUM I4 2.0L Petrol/INGENIUM I4 2.0L Petrol - PHEV, Description and Operation).

TRANSMISSION CONTROL MODULE

The TCM outputs signals to control the hydraulic operation of the transmission. Signals are sent to the shift control solenoid valves and the Electronic Pressure Regulating Solenoids (EPRSs).

The TCM processes signals from the transmission speed and temperature sensors, the TCS, the PCM and other vehicle systems.

From the received signal inputs and pre-programed data, the TCM calculates the:

- Correct gear
- Torque converter clutch setting
- Optimum pressure settings for gear shift and lock-up clutch control.

The PCM supplies the engine management data over the FlexRay systems bus. The TCM requires engine data to efficiently control the transmission operation, for example:

- Flywheel torque
- Accelerator pedal angle
- Engine temperature.

The steering angle sensor and the Anti-Lock Brake System Control Module (ABS) also supply data to the TCM on the FlexRay systems bus. The TCM uses data from these systems to suspend gear changes when the vehicle is cornering and/or the ABS is controlling braking or traction control.

The BCM/ GWM supplies steering wheel paddle data over the FlexRay systems bus. The TCM uses this to schedule driver requested upshifts and downshifts.

Using the signal inputs and the memorized data, the TCM control program computes:

- The correct gear and torque converter lock-up clutch setting
- The optimum pressure settings for gear shift and lock-up clutch control.

Special output side modules (power output stages, current regulator circuits), allow the TCM to control the solenoid valves and pressure regulators. This allows the TCM to precisely control the hydraulics of the automatic transmission. In addition, the amount and duration of engine interventions are supplied to the engine management through the FlexRay systems bus.

The TCM determines the position of the TCS using signals from the TCS through the HS CAN Underbody (UN) systems bus.

The TCM transmits the position of the TCS and any manual gear selected on the FlexRay systems bus to the BCM/GWM. This information is shown in the gear selector display in the IPC.

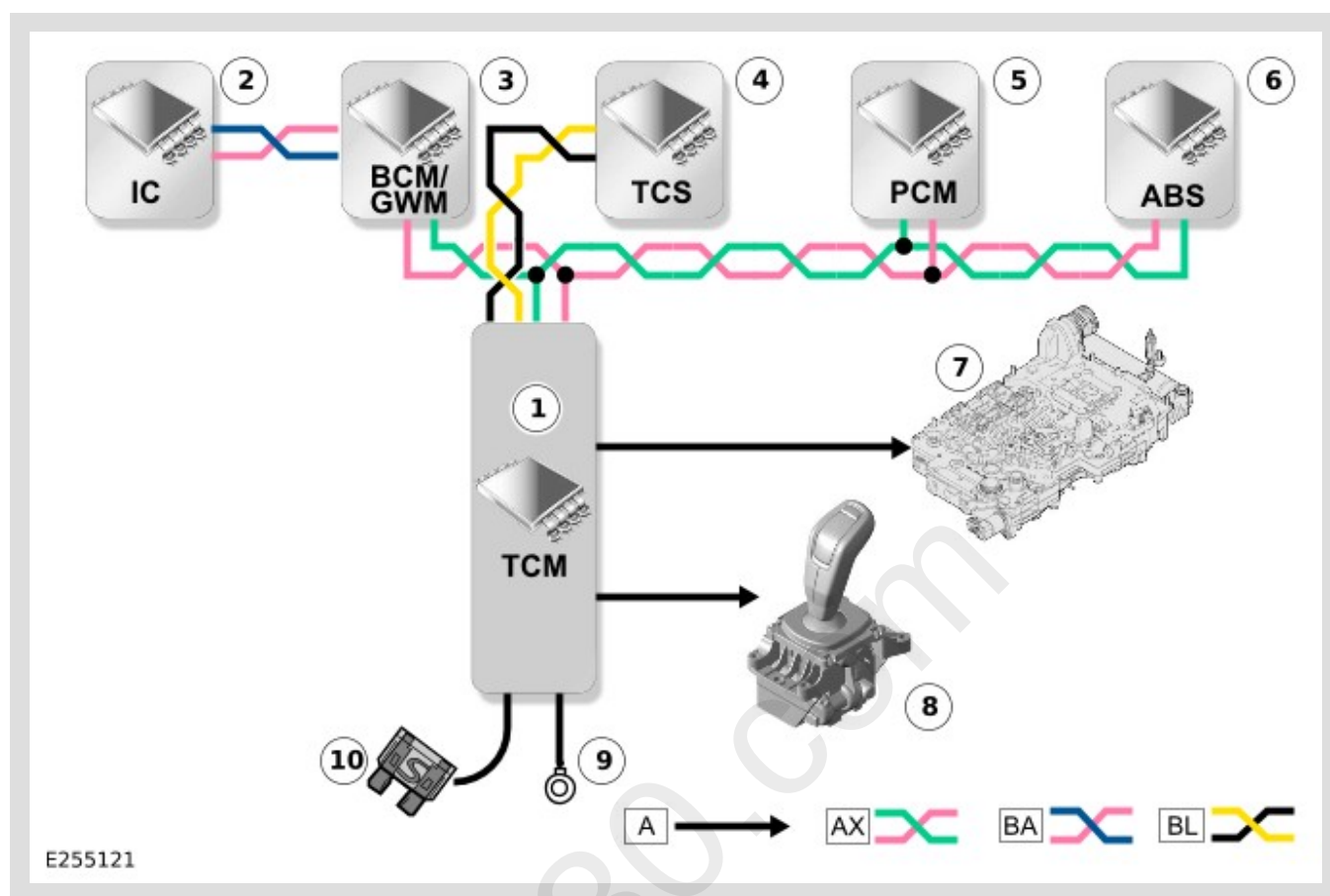
ENGINE STALL

If the engine stalls it coasts down in gear, with the transmission providing drive to the engine. A restart can be attempted at this point and the engine may start and the driver can continue.

If the coast down speed reduces such that the engine speed is less than 100 RPM, the transmission switches to NEUTRAL (N). DRIVE (D) illumination flashes in the IPC. The driver needs to select NEUTRAL (N) or PARK (P) and then press the brake pedal to restart the engine.

If the ignition switch is pressed when driving, the message 'ENGINE STOP BUTTON PRESSED' is displayed in the message center. There is no change to the ignition state. If the driver requires to switch off the engine, the ignition switch must be pressed for a second time. The engine is stopped and is back driven by the transmission as the vehicle coasts down.

CONTROL DIAGRAM



A = HARDWIRED: AX = FLEXRAY BUS: BA = HS CAN HMI SYSTEMS BUS: BL = HS CAN UNDERBODY (UN) SYSTEMS BUS.

ITEM	DESCRIPTION
1	TCM
2	IPC
3	BCM/ GWM
4	TCS
5	PCM
6	ABS
7	Mechatronic valve block
8	TCS
9	Ground
10	Power supply

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