

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

AUTOMATIC TRANSMISSION

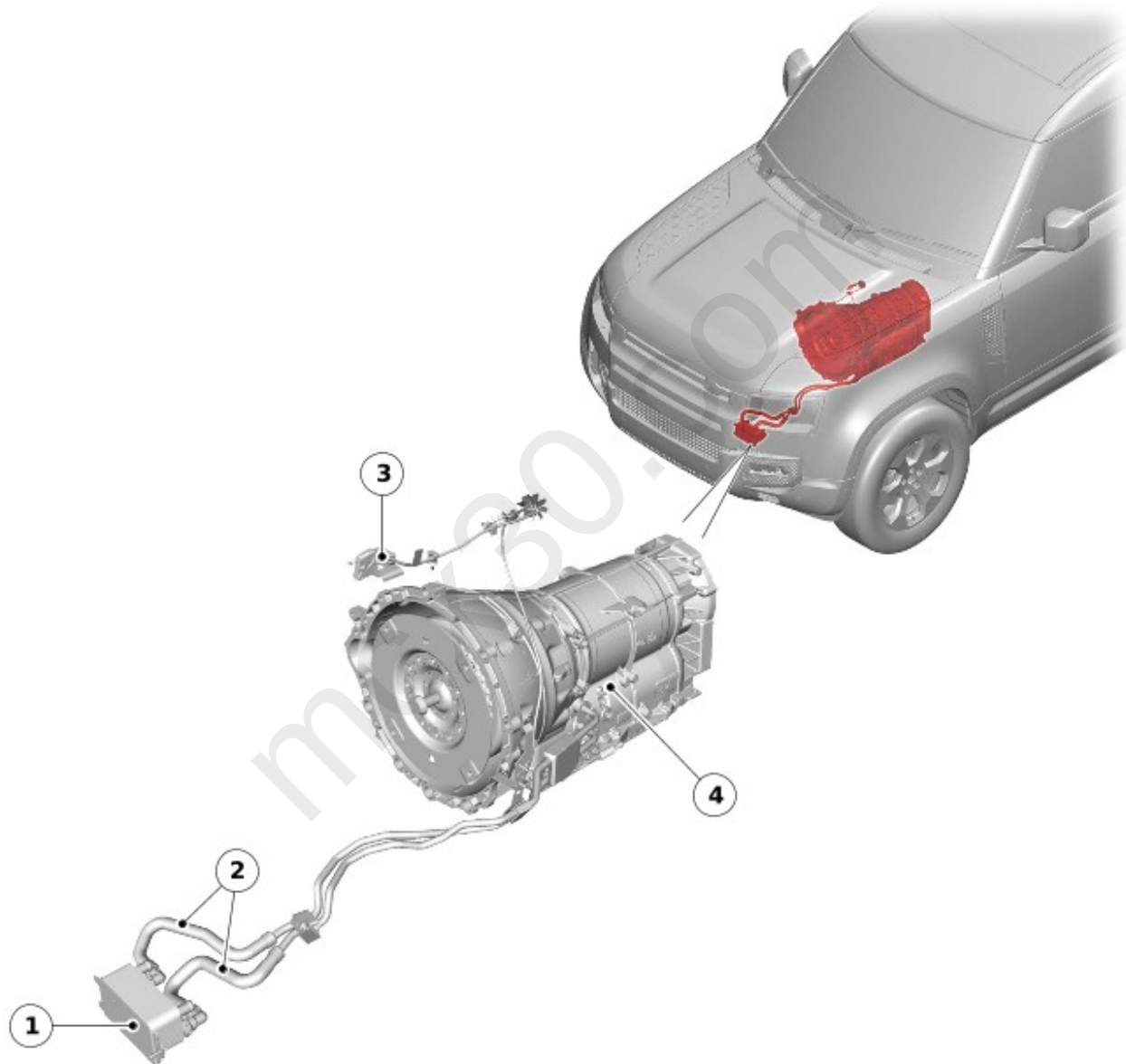
TRANSMISSION DESCRIPTION - VEHICLES WITH: 8HP70 8-SPEED AUTOMATIC TRANSMISSION AWD

[G2413231]

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COMPONENT LOCATION

COMPONENT LOCATION - 1 OF 2 - AUTOMATIC TRANSMISSION



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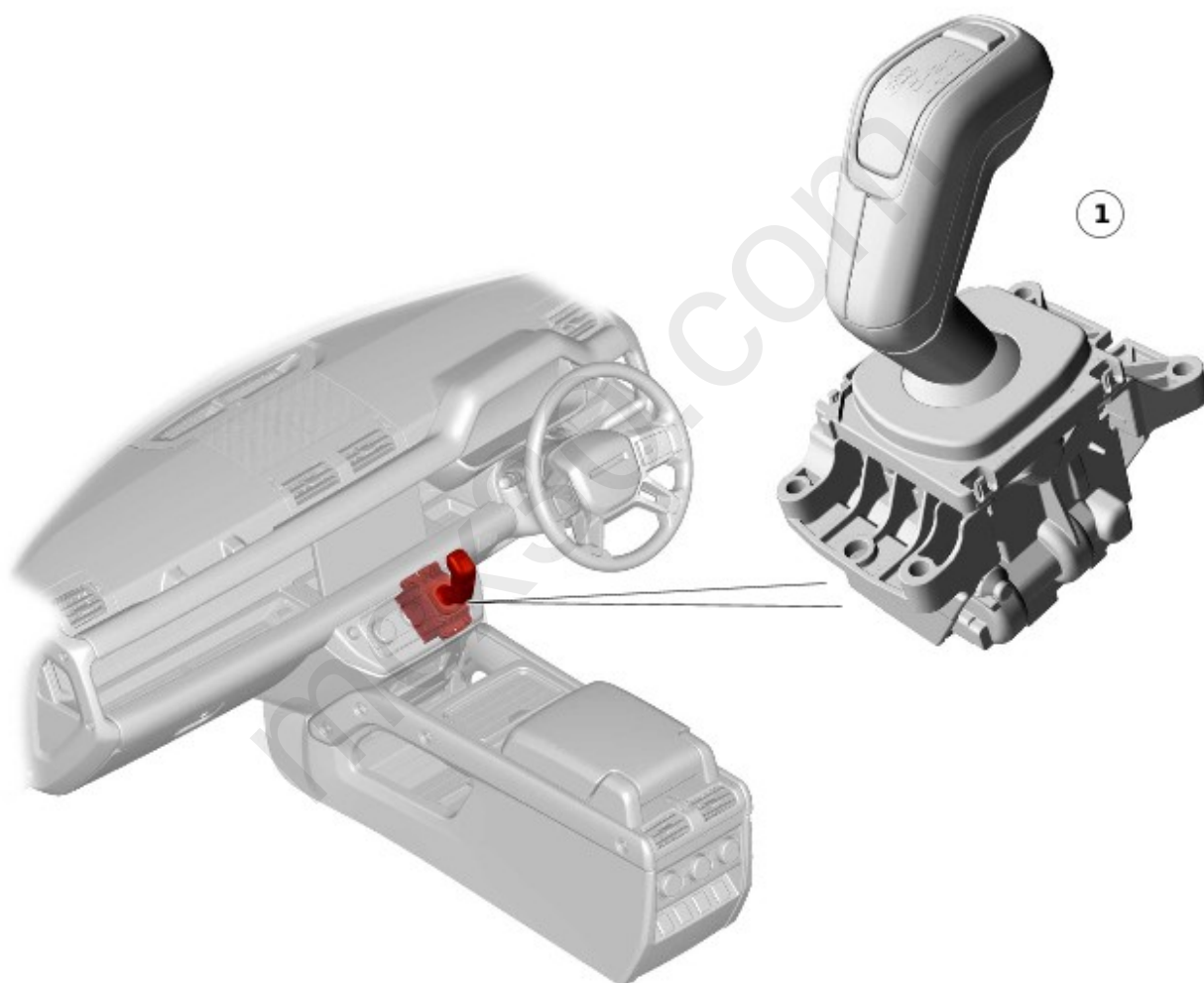
ITEM	DESCRIPTION
1	Automatic Transmission Fluid (ATF) cooler
2	ATF cooler pipes

ITEM	DESCRIPTION
3	Emergency Park Release (EPR) lever
4	Automatic transmission

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)

OVERVIEW

The 8HP70 transmission is an electronically controlled, hydraulically operated, 8 speed automatic unit.

A single unit known as the mechatronic valve block is located inside the transmission.

The mechatronic valve block contains the following control components:

- Hydraulic control elements
- Electronic control elements
- The Transmission Control Module (TCM).

The 8HP70 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 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 the FlexRay systems bus.

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

For additional information, refer to: [External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD](#) (311-02 Automatic Transmission External Controls, Description and Operation).

On vehicles featured with the stop/start system, the 8HP70 automatic transmission is equipped with a Hydraulic Impulse Storage (HIS) device. The HIS ensures pressurized ATF is available to the shift elements as quickly as possible when the engine is started.

DESCRIPTION

TRANSMISSION

The transmission comprises the main casing which houses all of the transmission components. The main casing also incorporates an integral torque converter housing.

A fluid pan is attached to the lower face of the main housing and is secured with bolts. The fluid pan is sealed to the main housing with a gasket. Removal of the fluid pan allows access to the mechatronic valve block. 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 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.

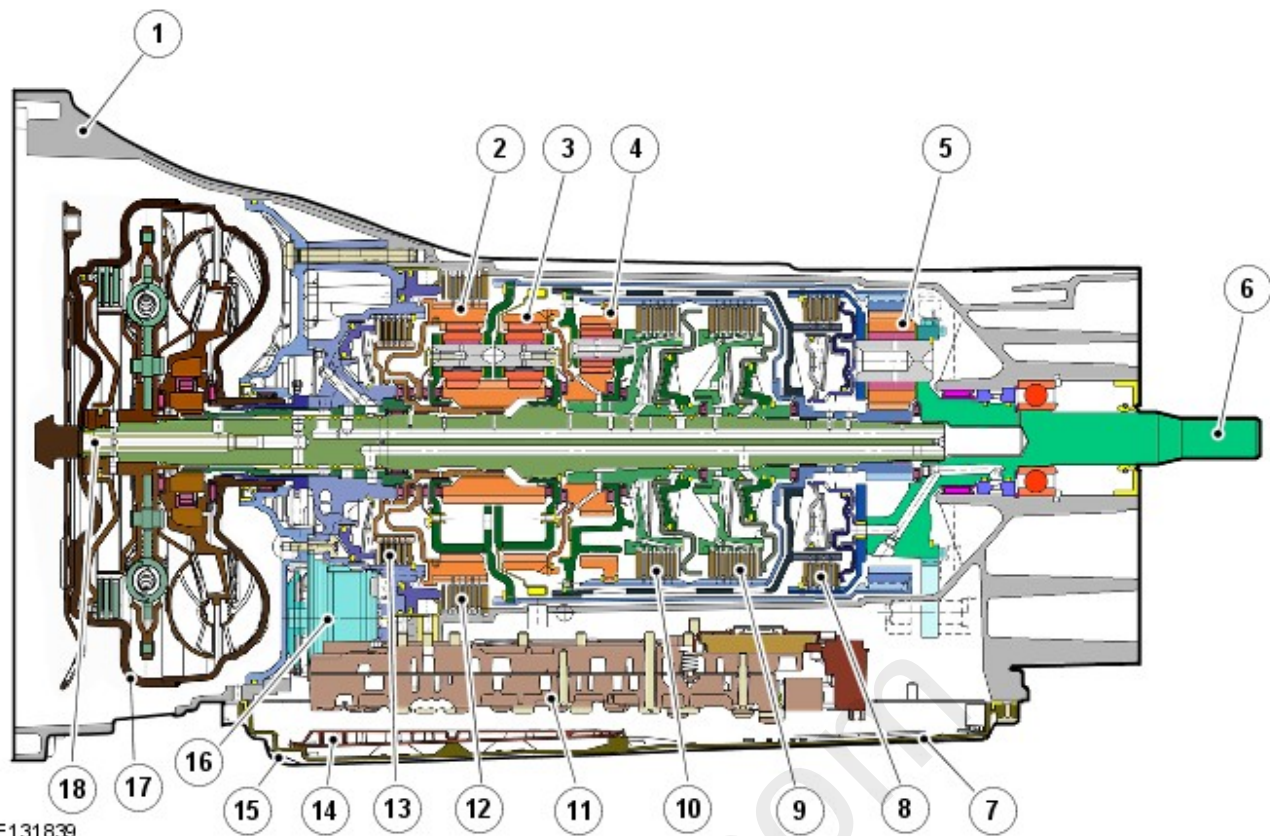
The ATF pump is driven by a simplex chain and 2 drive gears from the input shaft. The ATF pump is a double stroke vane cell pump which delivers 50 cm³ of ATF per revolution.

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 main casing contains the following major components:

- Input shaft
- Output shaft
- Mechatronic valve block which contains the solenoids, speed sensors and the Transmission Control Module (TCM)
- 3 rotating multiplate drive clutches
- 2 fixed multiplate brake clutches
- 4 planetary gear trains.

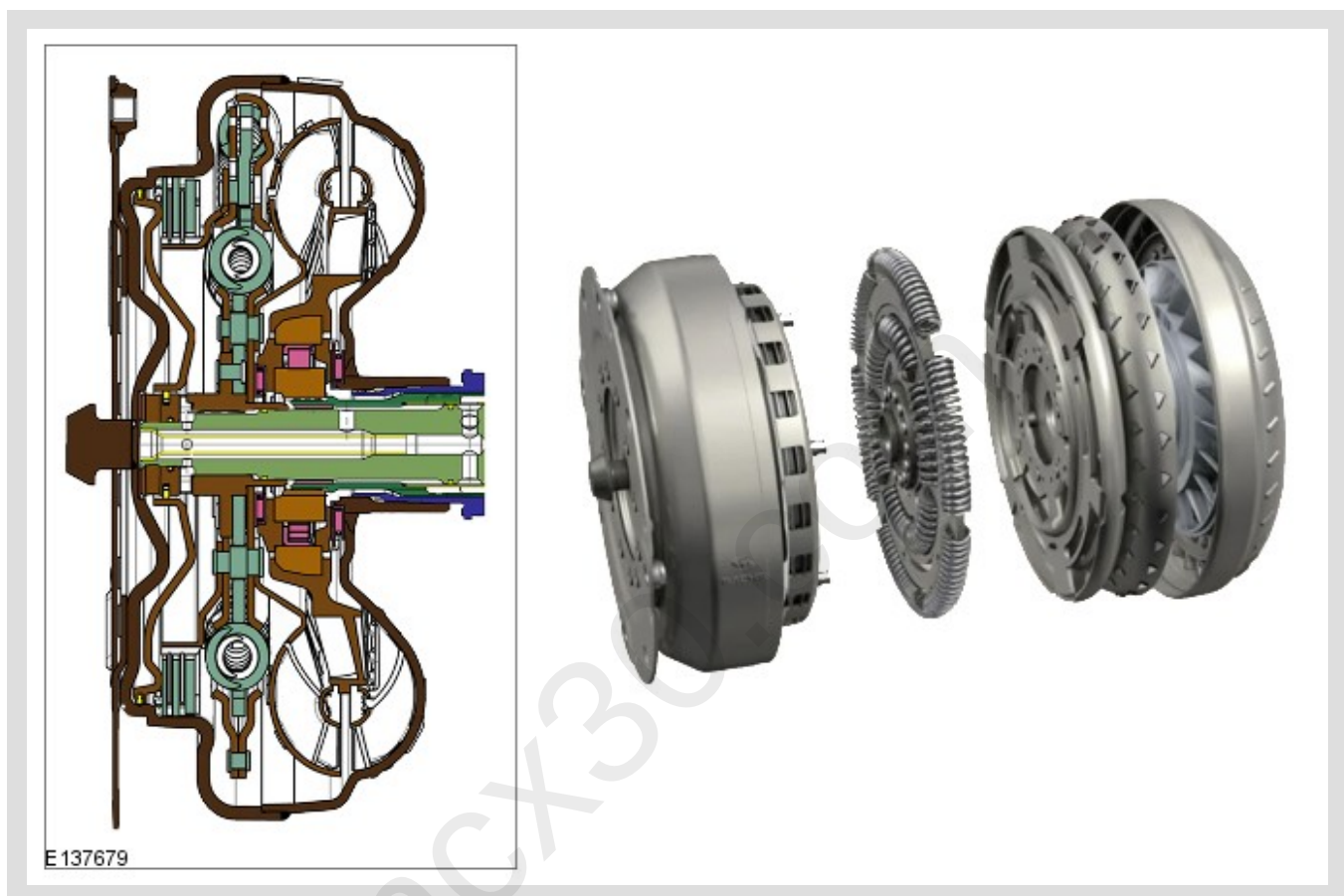
Transmission Sectional View



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	Drain plug
8	Clutch D
9	Clutch C
10	Clutch E
11	Mechatronic valve block
12	Brake B
13	Brake A
14	Fluid filter
15	Fluid pan

ITEM	DESCRIPTION
16	ATF pump
17	Torque converter
18	Input shaft

TORQUE CONVERTER



A torsional damper torque converter is used on 8HP70 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.

The torque converter comprises a torsional damper, an impeller, a stator and a turbine. The torque converter is a sealed unit with all components located between the converter housing cover and the impeller. The 2 components are welded together to form a sealed, fluid filled housing. With the impeller brazed to the converter housing cover, the impeller is therefore driven at engine crankshaft speed.

The converter housing drive plate has 4 threaded bosses, which provide for attachment of the engine drive plate. The threaded bosses also provide for location of special tools which are required to remove the torque converter from the torque converter housing.

Lock-Up Clutch

The torque converter lock-up clutch is hydraulically controlled by an Electronic Pressure Regulating Solenoid (EPRS), which is controlled by the TCM.

This allows the torque converter to have 3 states of operation as follows:

- Fully engaged
- Controlled slip variable engagement
- Fully disengaged.

The torque converter pressure valve reduces system pressure and guarantees the pressure needed for the torque converter. It also limits the maximum torque converter pressure, to prevent the torque converter from expanding.

The EPRS is operated by Pulse Width Modulated (PWM) signals from the TCM to give full, partial or no lock-up of the torque converter.

The lock-up clutch is a hydro-mechanical device which eliminates torque converter slip, improving fuel consumption. The engagement and disengagement is controlled by the TCM to allow a certain amount of controlled 'slip'. This allows a small difference in the rotational speeds of the impeller and the turbine which results in improved shift quality. The lock-up clutch comprises a piston and a clutch comprising of friction and steel plates.

In the unlocked condition, the oil pressure supplied to the piston chamber is reduced and the pressure in the turbine chamber is allowed to push the piston back. In this condition the clutch plates are released and torque converter slip is permitted.

In the locked condition, the lock-up clutch spool valves are actuated by the EPRS. Pressurized ATF is directed into the lock-up clutch piston. The piston moves with the pressure and pushes the clutch plates together. As the pressure increases, the friction between the clutch plates increases, finally resulting in full lock-up of the clutch plates. In this condition there is direct mechanical drive from the engine crankshaft to the transmission planetary gear train.

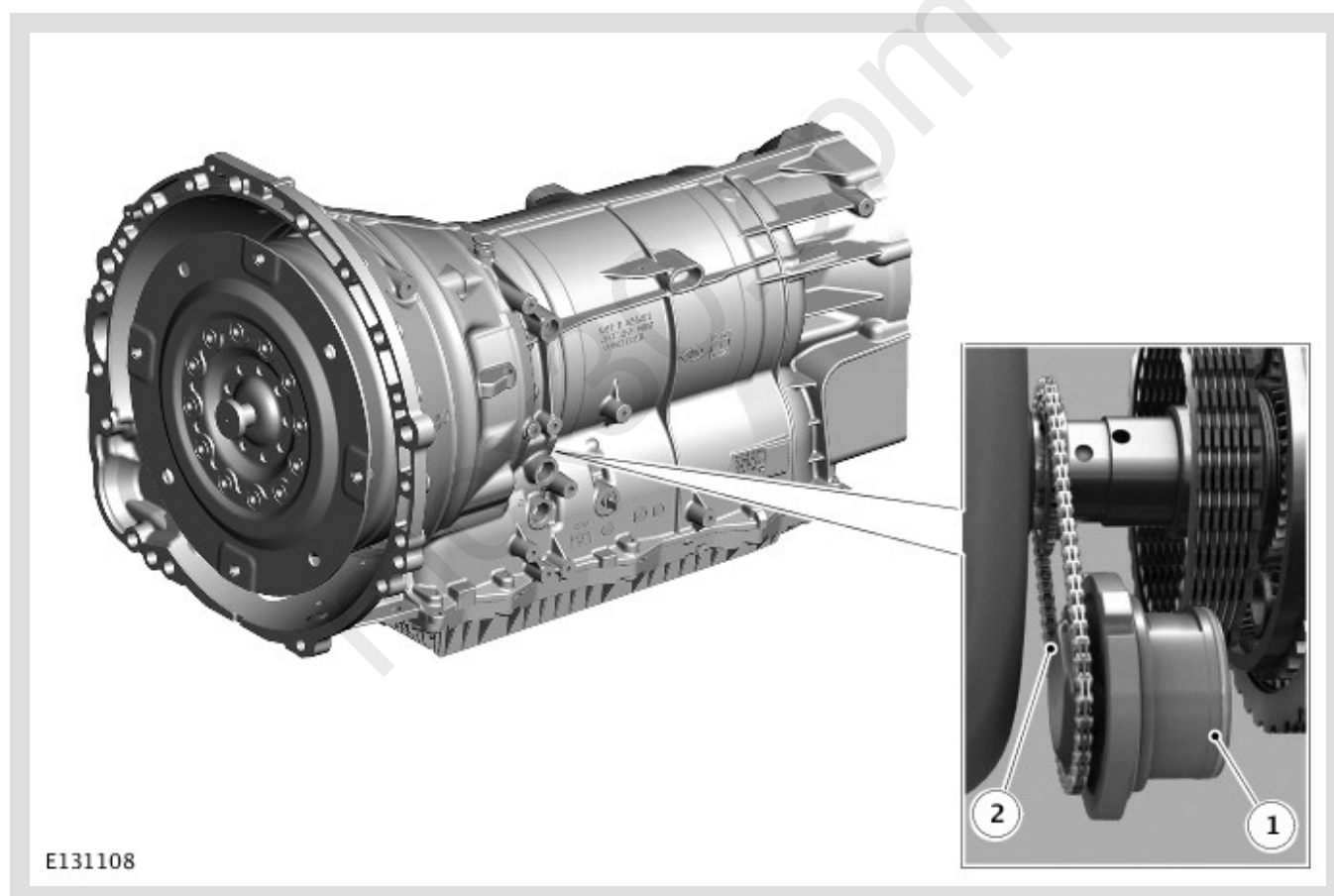
The Transmission Idle Control feature is a standstill decoupling feature for the 8 speed transmission. When the vehicle comes to a standstill with the brakes applied and the TCS is in DRIVE (D) the converter is disconnected from the driveline. This results that that only a slight residual load remains, which further reduces the fuel consumption. Decoupling is by actuating clutch B in the transmission, and is dependent on load and output speed.

AUTOMATIC TRANSMISSION FLUID PUMP

The 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 transmission cooler and the transmission to lubricate the gears and shafts.

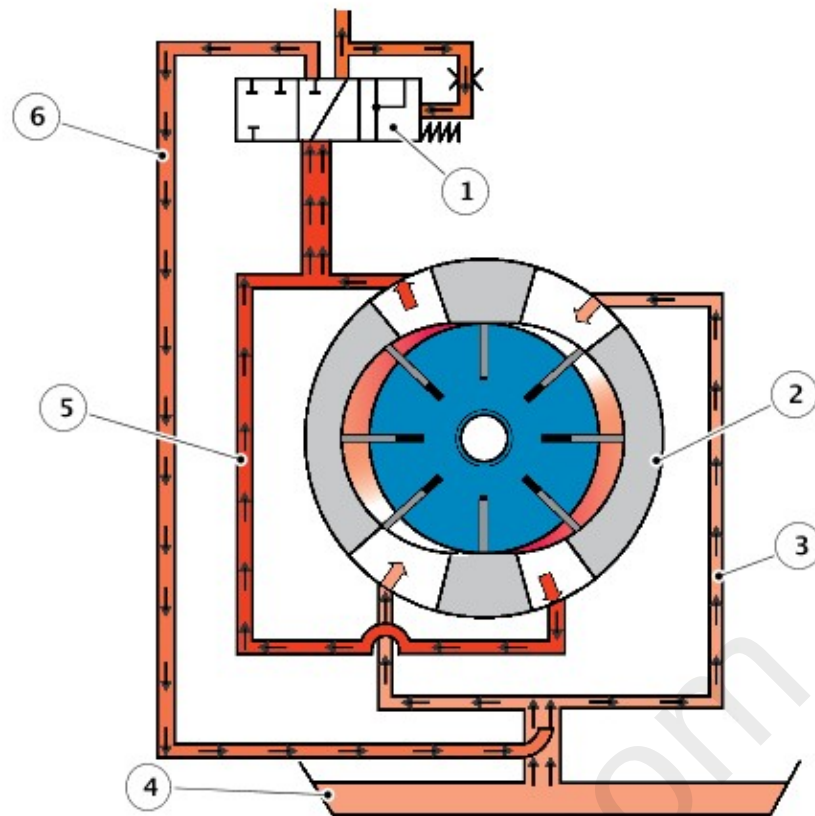
The ZF 8HP70 ATF pump is a double stroke, vane type pump and is located below the transmission input shaft. The pump is driven by a chain drive from a sprocket located on the torque converter. The pump has a delivery rate of 50 cm³ per revolution. The drive sprocket is driven at engine speed through a splined connection in the torque converter shell.

Automatic Transmission Fluid Pump Location



ITEM	DESCRIPTION
1	Vane pump
2	Chain drive from torque converter cover

Automatic Transmission Fluid Pump Schematic Diagram



E131109

ITEM	DESCRIPTION
1	System pressure valve
2	ATF pump
3	Intake pipe
4	Oil pan
5	Pressure pipe
6	Recycling of redundant fluid

The ATF pump comprises the following components:

- A sprocket
- A rear cover with bearing
- A front cover with bearing
- A cylinder
- A rotor shaft and a rotor with vanes.

A pressure relief valve is equipped in the pressure outlet gallery from the pump, but is not an integral part of the pump itself.

A sprocket is located around the transmission input shaft. Splines on the torque converter nose and the sprocket make a positive drive sure. A simplex chain transmits the rotation of the torque converter cover into rotation of the pump rotor shaft through a second sprocket equipped to the rotor shaft. The gearing of the 2 sprockets rotates the ATF pump rotor shaft at a speed slightly higher than the RPM of the torque converter cover. The torque converter cover is directly connected to the engine crank.

The ATF pump contains 7 vanes which are attached to the rotor and rotate within the camshaft shaped cylinder. As the vanes rotate, the eccentricity of the central hole in the cylinder causes the space between the vanes to increase. This causes a depression between the vanes and fluid is drawn into the space between the vanes through a suction port connected to the fluid pan. The fluid passes through the fluid pan filter before it is drawn into the ATF pump.

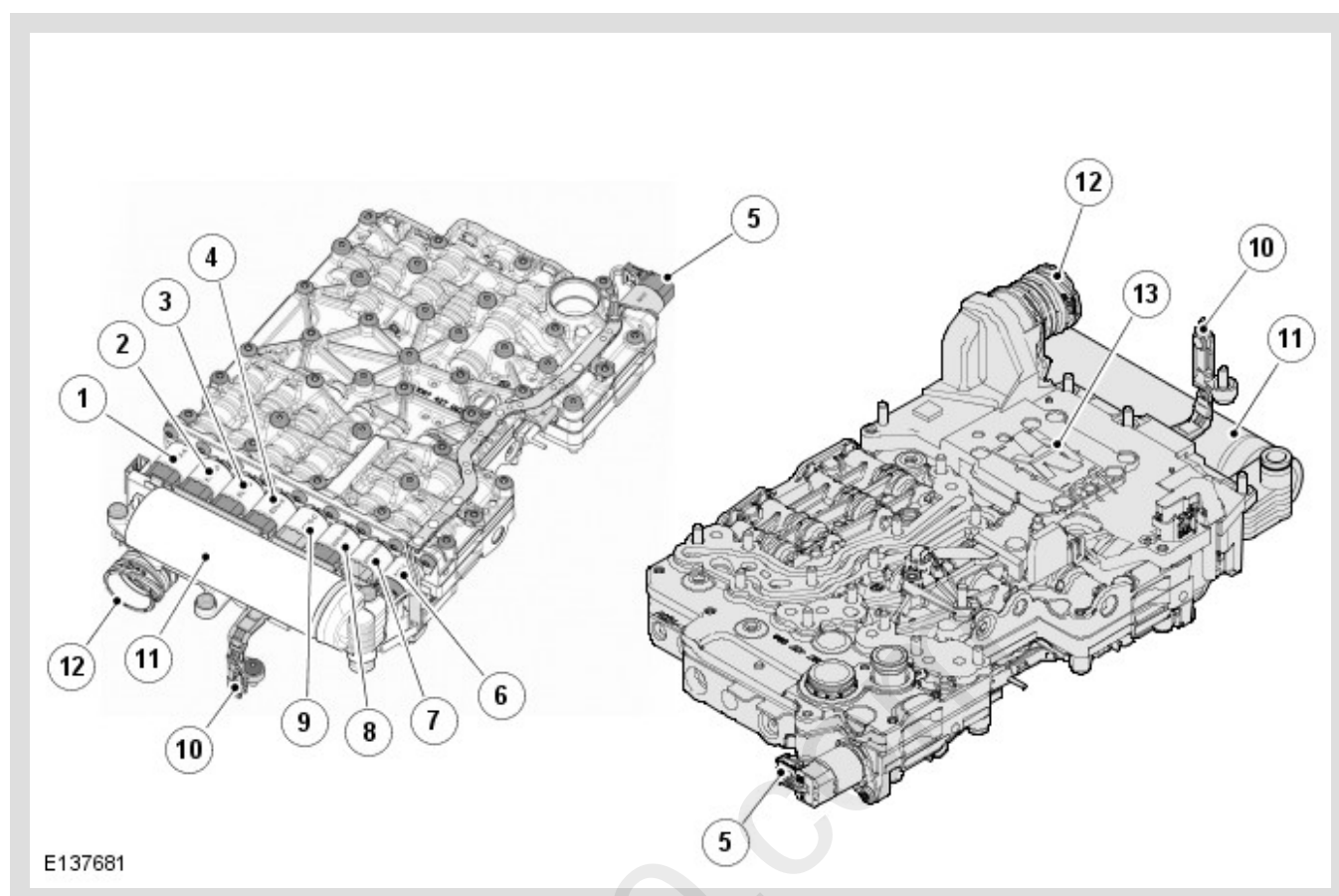
As the rotor shaft rotates further, the inlet port is closed by the vanes which have drawn in fluid, trapping the fluid in the space between the vanes. The eccentric hole in the cylinder causes the space between the vanes to decrease and consequentially compresses and pressurizes the fluid trapped between them.

Further rotation of the rotor shaft moves the vanes towards the outlet port. As the vanes pass the outlet port the pressurized fluid passes from the space between the vanes into the pressure gallery to the pressure relief valve.

As the ATF pump is a double stroke vane pump, this sequence is repeated twice per revolution of the rotor shaft.

The pressure relief valve controls the pressure and flow of ATF delivered to the transmission valve block, torque converter and other components. Pressure is controlled by a relief valve which limits the maximum system pressure to 32 bar (464 psi). The pressure control maintains a constant pressure of ATF irrespective of torque converter input shaft rotational speed. A metering orifice is subject to the pump output pressure. If the pressure in the orifice reaches a predetermined level, a spring loaded ball in the flow control valve is lifted from its seat. The pressurized ATF is allowed to recirculate through the pump.

MECHATRONIC VALVE BLOCK



ITEM	DESCRIPTION
1	Electronic Pressure Regulating Solenoid (EPRS) A - A brake valve
2	EPRS D - D clutch valve
3	EPRS B - B brake valve
4	EPRS E - E clutch valve
5	Magnetic Valve (MV) 2 - magnet-valve 2 for electrical park interlock (hold out of park)
6	MV 1 - pressure reducing valve
7	EPRS SYS - system pressure valve
8	EPRS WK - Torque converter lock-up clutch valve
9	EPRS C - C clutch valve
10	Transmission output shaft speed sensor
11	Hydraulic Impulse Storage (HIS) - if equipped
12	Electrical connector
13	Transmission Control Module (TCM) - hidden

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

The mechatronic valve block houses the following components:

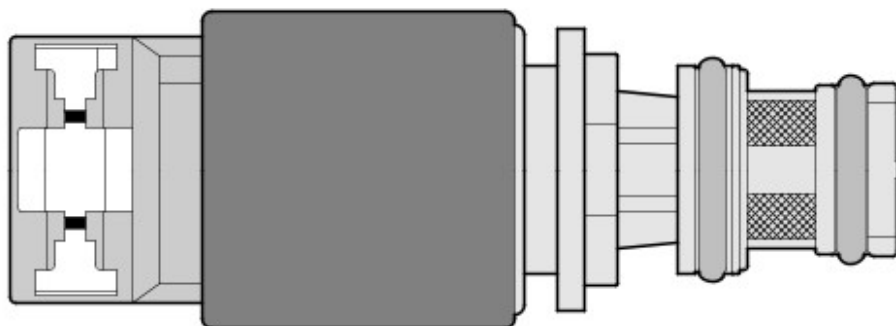
- The TCM
- Electrical actuators
- Speed sensors
- Control valves
- The Hydraulic Impulse Storage (HIS) (if equipped).

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

The mechatronic valve block comprises the following components:

- The TCM
- 7 Electronic Pressure Regulating Solenoids (EPRS)
- 2 park lock solenoids
- 21 hydraulic spool valves
- Temperature sensor
- Turbine speed sensor
- Output shaft speed sensor
- The HIS (if equipped).

Electronic Pressure Regulator Solenoids



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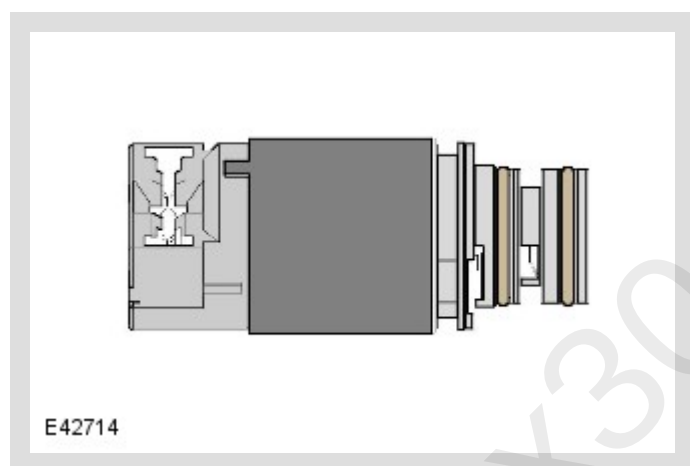
The 7 Electronic Pressure Regulator Solenoids (EPRS) are located in the valve block. The solenoids are controlled by PWM signals from the TCM. The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation.

EPRS A, B, D, E and WK supply a higher control pressure as the signal amperage increases and can be identified by an orange connector cap. The TCM operates the solenoids using PWM signals. The TCM monitors engine load and clutch slip and varies the solenoid duty cycle accordingly. The solenoids have a 12V operating voltage and a pressure range of 0 - 4.7 bar (0 - 68 psi).

EPRS C and SYS supply a lower control pressure as the signal amperage increases and can be identified by a gray connector cap. The TCM monitors engine load and clutch slip and varies the solenoid duty cycle accordingly. The solenoids have a 12V operating voltage and a pressure range of 4.7 - 0 bar (68 - 0 psi).

The resistance of the solenoid coil winding for EPRS is $5.05\ \Omega$ at 20°C (68°F).

Control Solenoid (MV 1)

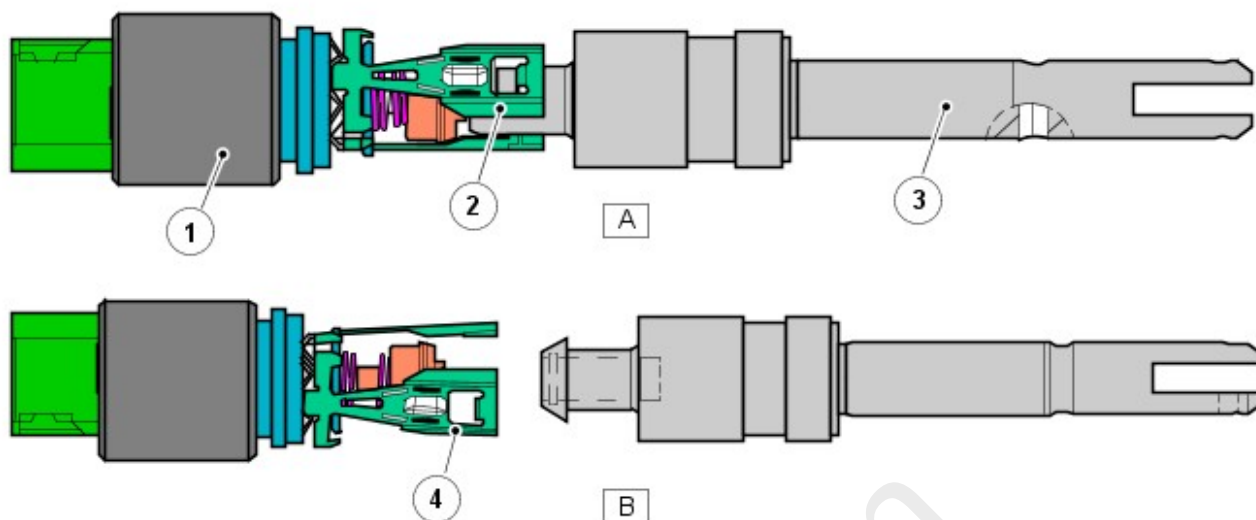


A shift control solenoid Magnetic Valve 1 (MV1) is located in the valve block. The solenoid is controlled by the TCM and converts electrical signals into hydraulic control signals to control clutch application.

The shift control solenoid is an open/closed, on/off solenoid which is controlled by the TCM connecting the solenoid to ground. The TCM also supplies power to the solenoid. The TCM energizes the solenoid in a programmed sequence for clutch application for gear ratio changes and shift control.

The resistance of the solenoid coil winding for solenoid is between 10 to 11 Ω at 20°C (68°F).

Control Solenoid (MV 2)



E 131254

ITEM	DESCRIPTION
A	Solenoid in locked (energized) condition - park lock released
B	Solenoid in unlocked (de-energized) condition - park lock engaged
1	Solenoid
2	Claw - locked
3	Piston
4	Claw - unlocked

A control solenoid Magnetic Valve 2 (MV 2) is located in the valve block. The solenoid is controlled by the TCM and converts electrical signals into hydraulic control signals to control the electronic park lock function.

The control solenoid is an on/off solenoid which is controlled by the TCM by connecting the solenoid to ground.

When the park position is deselected, control solenoid MV2 resets the parking lock valve in the mechatronic valve block. This is achieved by the TCM providing the ground for the solenoid which is energized, releasing the claws from retaining the park lock piston. Main ATF pressure acting on the parking lock piston, pushes the piston back to release the lock.

When the park position is selected, control solenoid MV2 is de-energized. The ATF pressure at the parking lock cylinder piston is vented and the mechanical interlock of the piston is opened. A pre-tensioned torsion spring at the

park lock disc pulls the piston into the 'park' position. In the 'park' position the piston engages with the control solenoid claws and is locked in the park position. An emergency release wire cable can be used to release the parking lock manually if an electrical failure occurs.

The resistance of the solenoid coil winding for solenoid is 25 Ohms at 20 °C (68 °F).

When the neutral "N" position is selected and the engine is turned off, the ATF pressure at the park lock cylinder piston is released. The current supply to the control solenoid MV2 remains. The park lock cylinder piston is still held in the unlocked position by the spring force acting on the park lock disc. This prevents the park lock plate from engaging the parking lock. This allows the vehicle to be moved when the engine is not running for a short time. Should the battery voltage fall below the level required to maintain the solenoid in the energized condition, the park lock is engaged.

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.

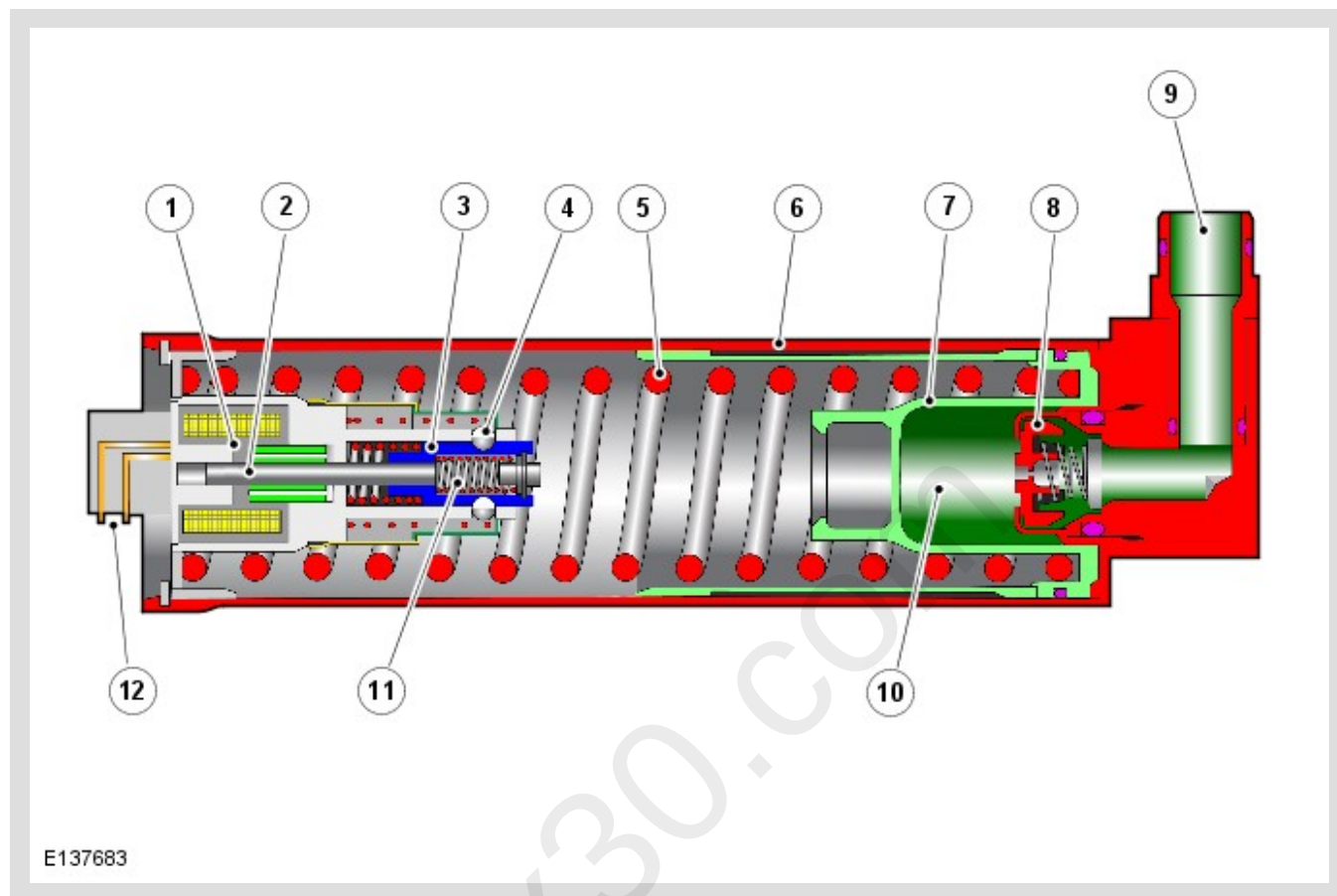
Spool Valves

The valve block contains spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by ATF pressure.

Each spool valve is located in its spool bore and held in a default (unpressurized) position by a spring. The spool bore has a number of ports which allow ATF to flow to other valves and clutches to enable transmission operation. Each spool has a piston which is waisted to allow ATF to be diverted into the applicable ports when the valve is operated.

When ATF pressure moves a spool, 1 or more ports in the spool bore are covered or uncovered. ATF is prevented from flowing or is allowed to flow around the applicable waisted area of the spool and into another uncovered port. The ATF is either passed through galleries to actuate another spool, operate a clutch or is returned to the fluid pan.

HYDRAULIC IMPULSE STORAGE



ITEM	DESCRIPTION
1	Solenoid
2	Magnetic core
3	Keeper
4	Balls
5	Piston spring
6	Accumulator cylinder
7	Piston
8	1-way restrictor
9	Inlet/outlet port
10	Piston - ATF volume
11	Keeper spring

ITEM	DESCRIPTION
12	Electrical connector

The Hydraulic Impulse Storage (HIS) system is equipped to vehicles with the auto stop/start system.

The HIS system comprises a cylindrical accumulator which contains an electro-mechanical locking unit, a spring actuated piston and a 1-way restrictor. The accumulator is located at the rear of the mechatronic valve block. The accumulator is secured in position with 3 screws and sealed into a port in the transmission housing with an O-ring seal.

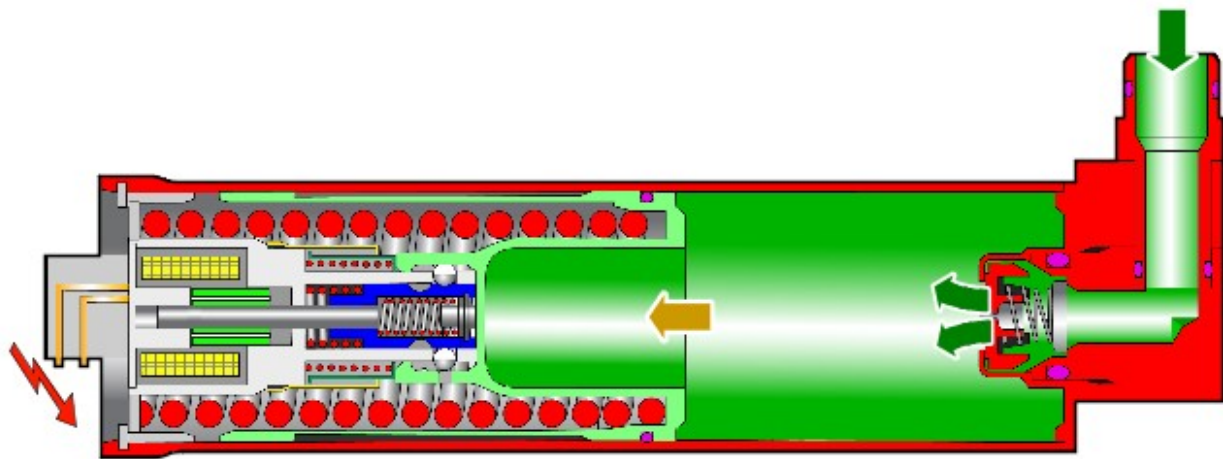
The electro-mechanical locking unit comprises a low-current solenoid, a spring-loaded keeper incorporating a magnetic core and a number of balls. The keeper has a detent into which the balls locate during filling of the HIS when the ATF pump produces pressure.

The 1-way restrictor is located in the inlet/outlet port of the accumulator. The restrictor provides a controlled charging of the HIS to allow a small volume flow of ATF. This makes sure that the operation of the transmission shift elements are not compromised by a sudden drop in ATF pressure. The restrictor allows a charging time for the HIS of approximately 5 seconds. When discharge is required, the restrictor allows full flow from the cylinder.

The filling process for the HIS has several steps:

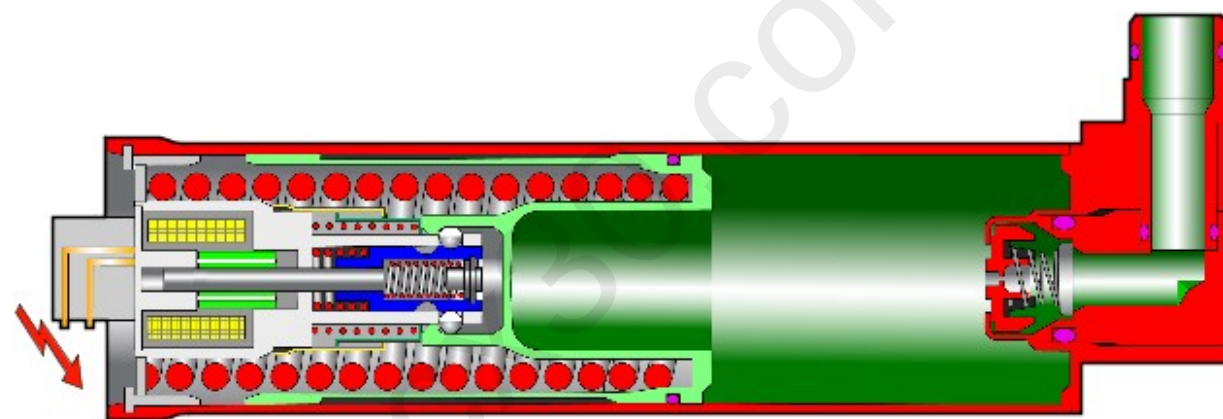
- When the engine is running and the ATF pump produces pressure, the 1-way restrictor allows a controlled flow of ATF which acts on the piston.
- The ATF pressure moves the piston into the accumulator cylinder. A retaining ring on the piston passes over the balls which are at this point located in the keeper detent.
- As the piston continues to move, a spring in the center of the keeper moves the locking cylinder and the magnetic core towards the solenoid windings and into the final fully charged position. The energized solenoid holds the magnetic core and the balls are lifted from the detent by the movement of the keeper, locking the piston in the charged position. The HIS is now electro-mechanically locked and ready for an engine stop to occur.
- When the engine is stopped, the ATF pump also stops and ATF pressure is decayed. The pressure acting on the piston is also decayed and the piston moves to be held in the locked position by the balls. The energy required for hydraulic filling during engine start is now stored in the tensioned piston spring. The solenoid remains energized to hold the keeper in position and the balls out of the detent to lock the piston.

Charging



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Charged

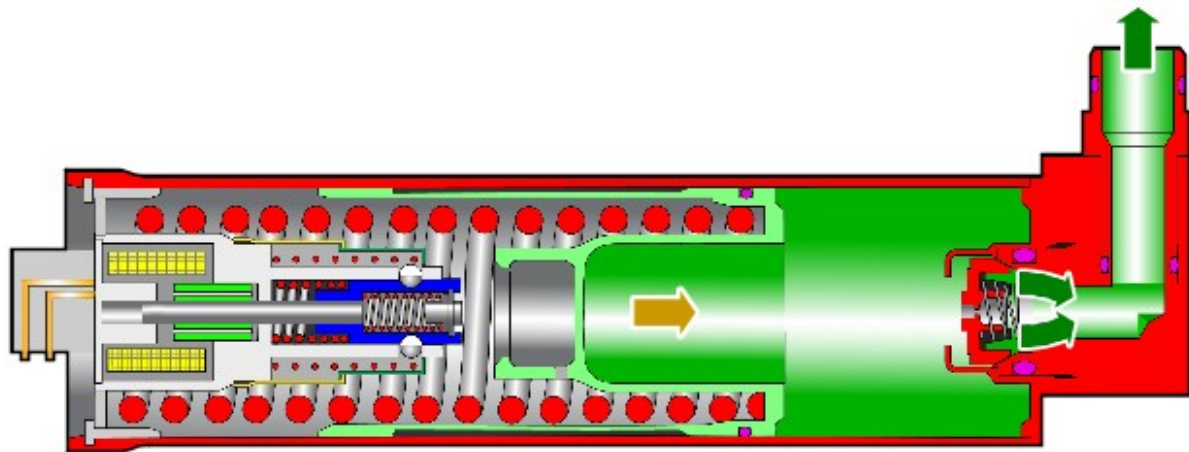


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Engine start process:

- When the engine is restarted, the solenoid holding current is removed, which starts the unlocking process.
- The magnetic core is released and the keeper is moved towards the piston under spring pressure. The balls fall into the detent in the keeper, releasing the piston.
- The piston is moved under spring pressure, pushing out the volume of ATF. The 1-way restrictor opens fully to allow unrestricted flow of ATF from the accumulator cylinder into the transmission housing. The process is completed between 300 and 350 ms.
- When the engine is started, the ATF pump produces flow and pressure to provide seamless transmission shift element engagement as soon as the engine is started.

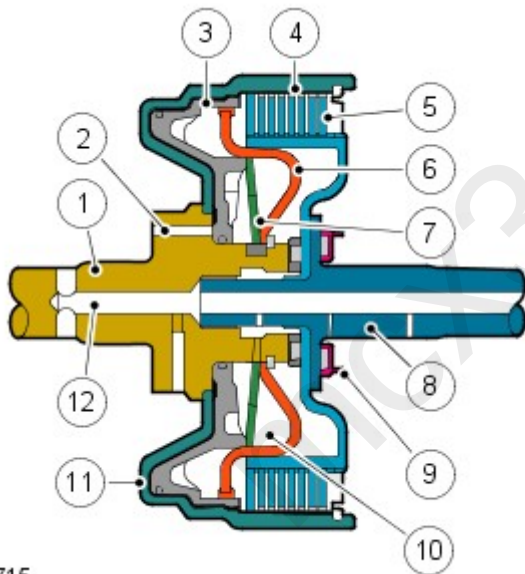
Discharging



E137686

DRIVE CLUTCHES

Multiplate Clutch or Brake – Typical



E42715

ITEM	DESCRIPTION
1	Input shaft
2	Main pressure supply port
3	Piston
4	Cylinder – external plate carrier
5	Clutch plate assembly
6	Baffle plate (for clutch, not brake)

ITEM	DESCRIPTION
7	Diaphragm spring
8	Output shaft
9	Bearing
10	Dynamic pressure equalization chamber
11	Piston chamber
12	Lubrication channel

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 and holds the piston off the clutch plate assembly.

When clutch application is required, main pressure from the 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 TRAINS

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 fourth gearset.

The 5 shift elements, comprises 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.

Planetary Gear Sets 1, 2 and 3

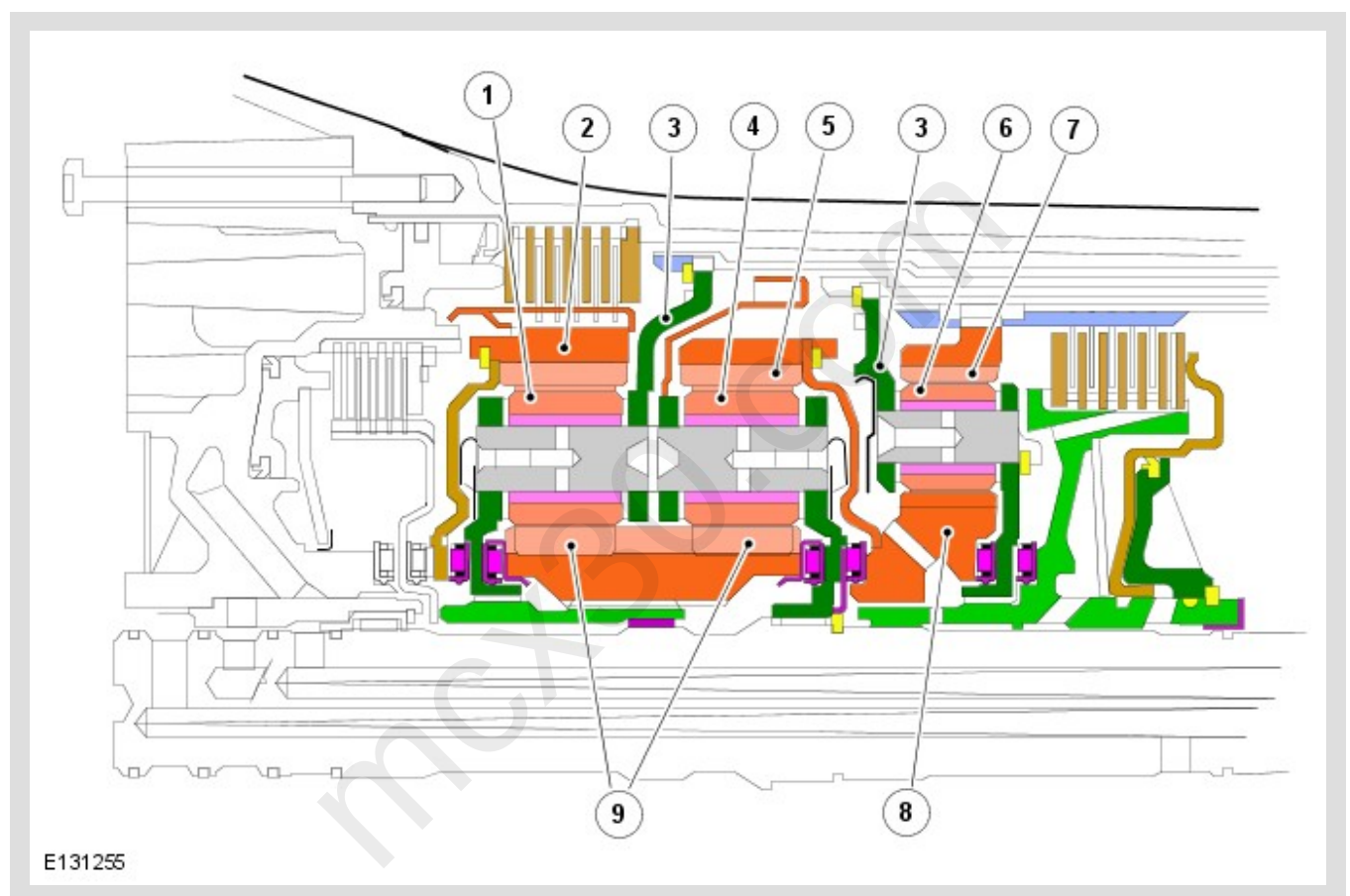
The planetary gear sets 1 and 2 comprise:

- Sunwheel - shared by both gear sets
- 3 or 4 planetary gears per gear set
 - NOTE: Ingenium I4 2.0L Diesel engine installation has 3 planetary gears in gearset 2, all other engine variants have 4 planetary gears.

- Planetary gear carrier (spider) per gear set
- Ring gear per gear set.

The planetary gear set 3 comprises:

- Sunwheel
- 3 planetary gears
- Planetary gear carrier (spider)
- Ring gear.



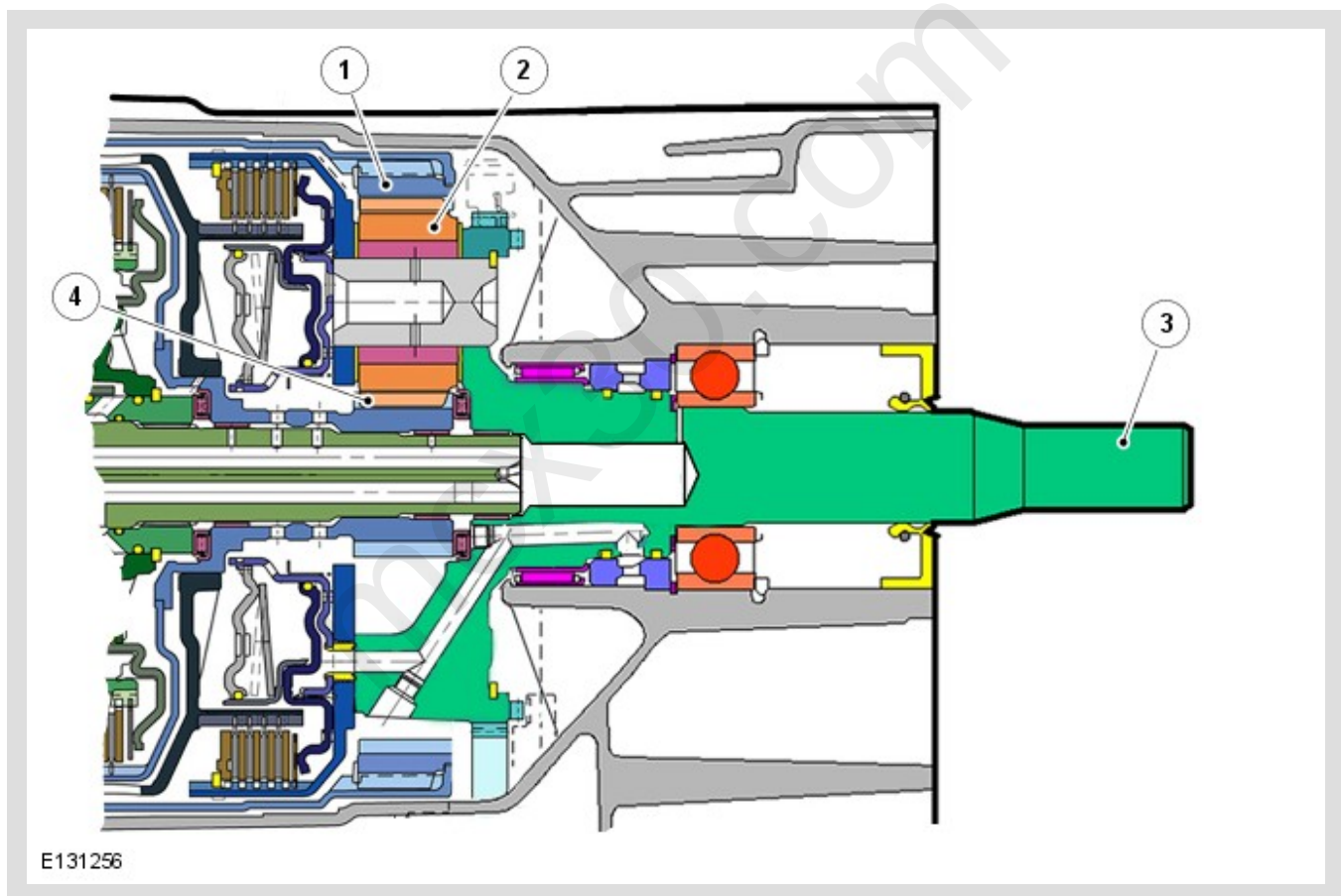
ITEM	DESCRIPTION
1	Planetary gears - gear set 1
2	Ring gear - gear set 1
3	Planetary gear carrier (spider)
4	Planetary gears - gear set 2
5	Ring gear - gear set 2
6	Planetary gears - gear set 3
7	Ring gear - gear set 3

ITEM	DESCRIPTION
8	Sun wheel - gear set 3
9	Sun wheel - joint gear sets 1 and 2

Planetary Gear Set 4

The planetary gear set 4 comprises:

- Sunwheel
- 4 planetary gears
- Planetary gear carrier (spider) - output shaft
- Ring gear.



ITEM	DESCRIPTION
1	Ring gear
2	Planetary gears
3	Output shaft / gear carrier
4	Sun wheel

TRANSMISSION CONTROL MODULE

The TCM is an integral part of the mechatronic valve block which is located at the bottom of the transmission, within the fluid pan. The TCM is the main controlling component of the transmission.

The TCM processes signals from the transmission speed and temperature sensors, PCM and other vehicle systems. From the received signal inputs and pre-programed data, the module calculates the correct gear, torque converter clutch setting and optimum pressure settings for gear shift and lock-up clutch control.

OPERATION

POWER FLOWS

Operation of the transmission is controlled by the TCM, which electrically activates various solenoids to control the transmission gear selection. The sequence of solenoid activation is based on programed information in the TCM memory and physical transmission operating conditions such as:

- Vehicle speed
- Throttle position
- Engine load
- TCS position.

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.

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	4.714	3.143	2.106	1.667	1.285	1.000	0.839	0.667	3.317

Shift Elements



E131259

ITEM	DESCRIPTION
1	Brake A
2	Brake B
3	Gear set 1
4	Gear set 2
5	Gear set 3
6	Clutch E
7	Clutch C
8	Clutch D
9	Gear set 4

The shift elements, clutches and brakes are actuated hydraulically. Fluid 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 Instrument Panel Cluster (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.

Automatic transmission status is transmitted from the TCM to the virtual display IPC through the BCM/ GWM. Transmission status is indicated to the driver by a message in the message center or illumination of a warning indicator. 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: [Air Conditioning](#) (412-01 Climate Control, Description and Operation).

Malfunction Indicator Lamp

The Malfunction Indicator Lamp (MIL) is located in the virtual display IPC. 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 virtual display IPC. The display shows the TCS 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 CommandShift mode)
2	2nd gear selected (manual CommandShift mode)
3	3rd gear selected (manual CommandShift mode)
4	4th gear selected (manual CommandShift mode)
5	5th gear selected (manual CommandShift mode)
6	6th gear selected (manual CommandShift mode)

SYMBOL	DESCRIPTION
7	7th gear selected (manual CommandShift mode)
8	8th gear selected (manual CommandShift 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: [Air Conditioning](#) (412-01 Climate Control, 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 Valves (EPRS).

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
- Engine speed
- 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 precise 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 speed of the engine is less than 100 RPM, the transmission switches to NEUTRAL (N) and '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 start/stop switch is pressed when driving, the message 'ENGINE STOP BUTTON PRESSED' is displayed in the message center but there is no change to the ignition state. If the driver requires to switch off the engine, the start/stop switch must be pressed for a second time. The engine is stopped and is back driven by the transmission as the vehicle coasts down.

Cold Start Neutral



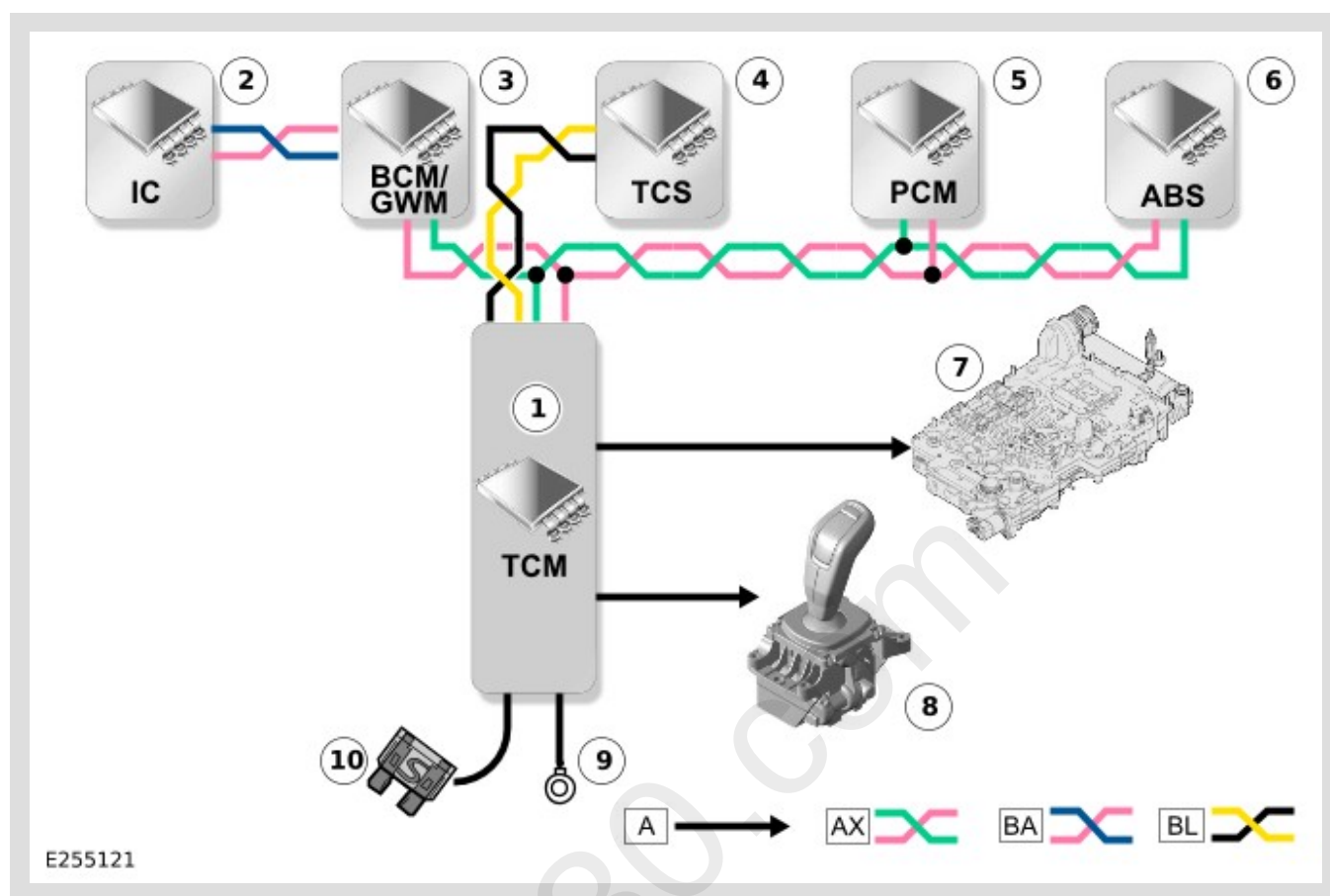
NOTE:

The Cold Start Neutral (CSN) function has been introduced on 8HP70 transmissions for all petrol engine variants from 18MY onwards.

Cold Start Neutral (CSN) is a software function. The software function operates when the engine is cold. When the driver selects DRIVE (D) or SPORT (S) with their foot on the brake, the transmission delays the engagement of gear. This allows the engine speed to remain high. If the driver releases the brake the engine speed reduces to idle and the transmission engages the gear. The function is also exited and the transmission engages the gear if while the driver has their foot on the brake the engine reaches operating temperature.

Previous transmissions would engage the gear when the driver selected DRIVE (D) or SPORT (S). This resulted in a noticeable gear engagement. The introduction of CSN delays gear engagement until either the driver releases the brake or the engine reaches operating temperature. The purpose of the function is to assist in maintaining engine management control during the warm up cycle. Some customers may indicate that there is a delay in gear selection or an elevated engine speed (circa 1,600 RPM) but this is normal with CSN.

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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