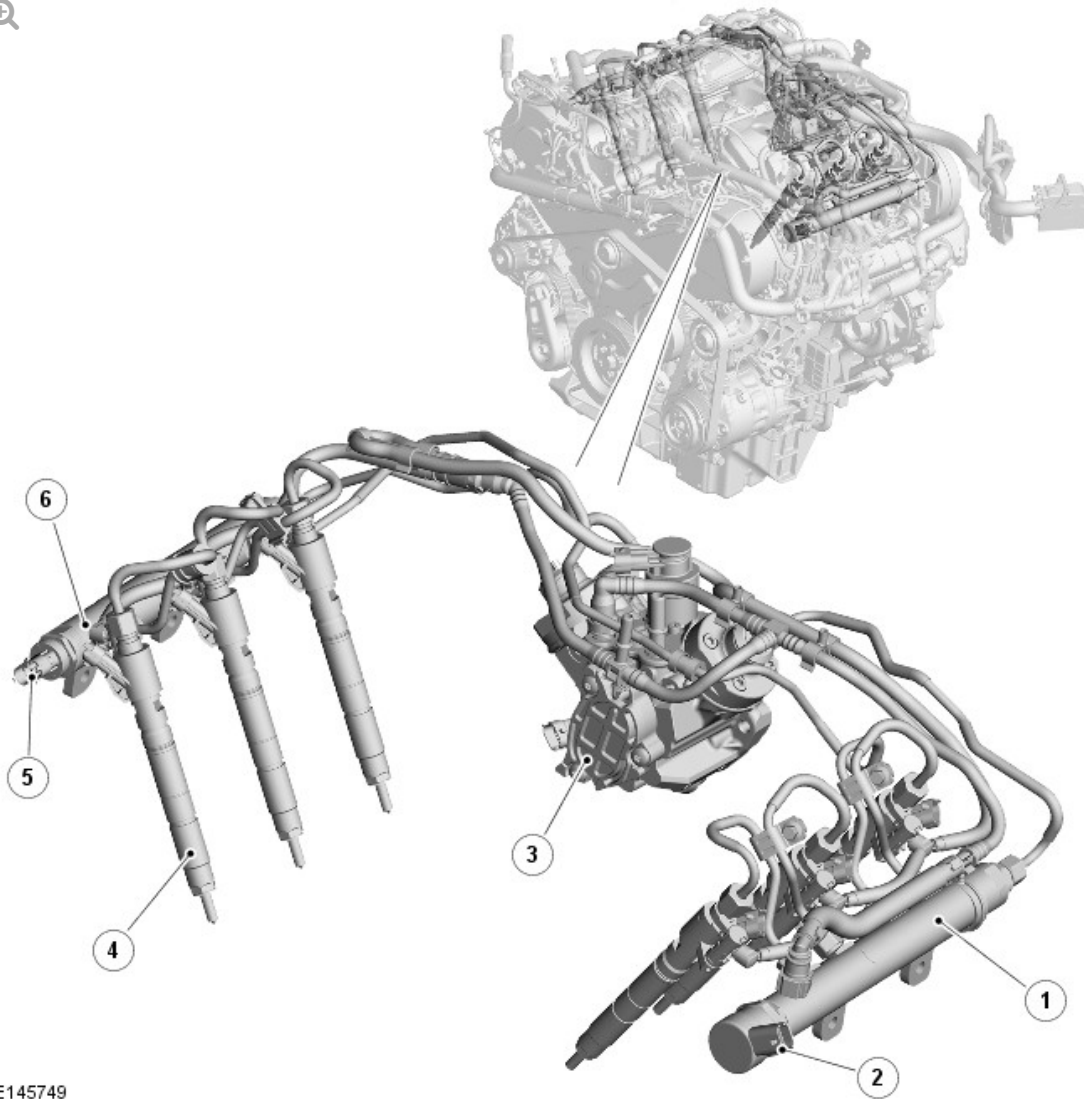


2016.0 RANGE ROVER (LG), 303-04

FUEL CHARGING AND CONTROLS - TDV6 3.0L DIESEL

DESCRIPTION AND OPERATION

COMPONENT LOCATION



E145749

ITEM	DESCRIPTION
1	Fuel rail - Bank 2
2	Fuel rail Pressure Control Valve (PCV)
3	High Pressure (HP) fuel pump
4	Fuel injector (6 off)
5	Fuel Rail Pressure (FRP) sensor
6	Fuel rail - Bank 1

OVERVIEW

The TDV6 3.0L diesel engine is equipped with a High Pressure (HP) common

rail fuel injection system. With this fuel injection process, a HP fuel pump delivers a uniform level of pressure to the shared fuel lines (the common rails), which serve all 6 fuel injectors. Pressure is controlled to the optimum level for smooth operation.

The common rail system supports a pre and pilot injection depending on engine operating conditions, which reduces combustion noise levels, more commonly referred to as 'diesel knock'.

Fuel injection pressure is generated independently of engine speed and fuel injection events.

The fuel injection timing and volume are calculated by the Engine Control Module (ECM), which then energizes the appropriate piezo actuated injector.

The common rail fuel injection system has the following features:

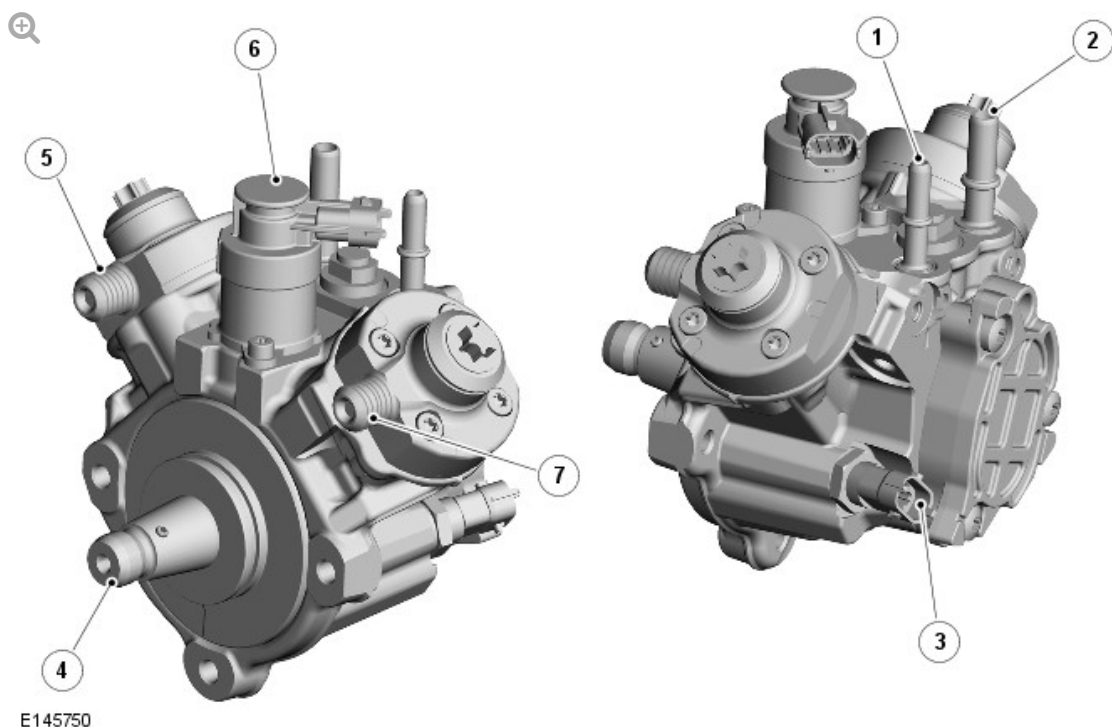
- High fuel injection pressures of up to 2000 bar (29007 lbf/in²) for greater atomization of fuel (increasing performance and lowering emissions)
- Variable injection to optimize combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system.

The system features the following components:

- HP fuel pump
- Fuel rails
- HP and LP (Low Pressure) fuel pipes
- Fuel injectors.

DESCRIPTION

HIGH PRESSURE (HP) FUEL PUMP



ITEM	DESCRIPTION
1	Low Pressure (LP) fuel return connection
2	Low Pressure (LP) fuel supply connection
3	Fuel temperature sensor
4	Drive shaft
5	Fuel outlet to Bank 2 fuel rail
6	Fuel metering valve
7	Fuel outlet to Bank 1 fuel rail

The HP fuel pump is a 2 piston radial plunger pump. The pump has the ability to produce a maximum pressure of 2000 bar (29007 lbf/in²).

The HP fuel pump is driven from the Bank 2 cylinder head exhaust camshaft via a toothed belt. The drive from the belt rotates a cam within the pump which operates a plunger within each pumping element. A procedure and special tools are required for pump or belt replacement to time the pump. For additional information, refer to:

[Engine](#) (303-01A Engine - TDV6 3.0L Diesel - Gen 2/TDV6 3.0L Diesel, Description and Operation),
[Engine](#) (303-01F Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation),
[Fuel Pump](#) (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

The HP fuel pump comprises 2 HP pumping elements, a fuel metering valve, an internal transfer pump and a fuel temperature sensor.

The fuel is delivered to the internal transfer pump via the external fuel filter and an electric fuel pump which is located in the fuel tank. For additional information, refer to:

[Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation),
[Fuel Tank and Lines](#) (310-01E Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).

The fuel metering valve is located in the feed port between the HP pumping elements and the internal transfer pump. The fuel metering valve is a variable position solenoid-operated valve that is controlled by the ECM. The fuel metering valve determines the amount of fuel that is delivered from the internal transfer pump to the HP pumping elements. When there is no signal to the fuel metering valve, the valve is closed and there is no fuel delivery.

The fuel from the internal transfer pump is passed to the HP pumping elements at a constant pressure known as transfer pressure. The transfer pressure is controlled by an internal Pressure Relief Valve (PRV). Once the fuel enters each of the HP pumping elements the pressure rises rapidly, with each element providing a HP supply to one of the fuel rails. The pressure is controlled by the fuel rail Pressure Control Valve (PCV) and the Fuel Rail Pressure (FRP) sensor.

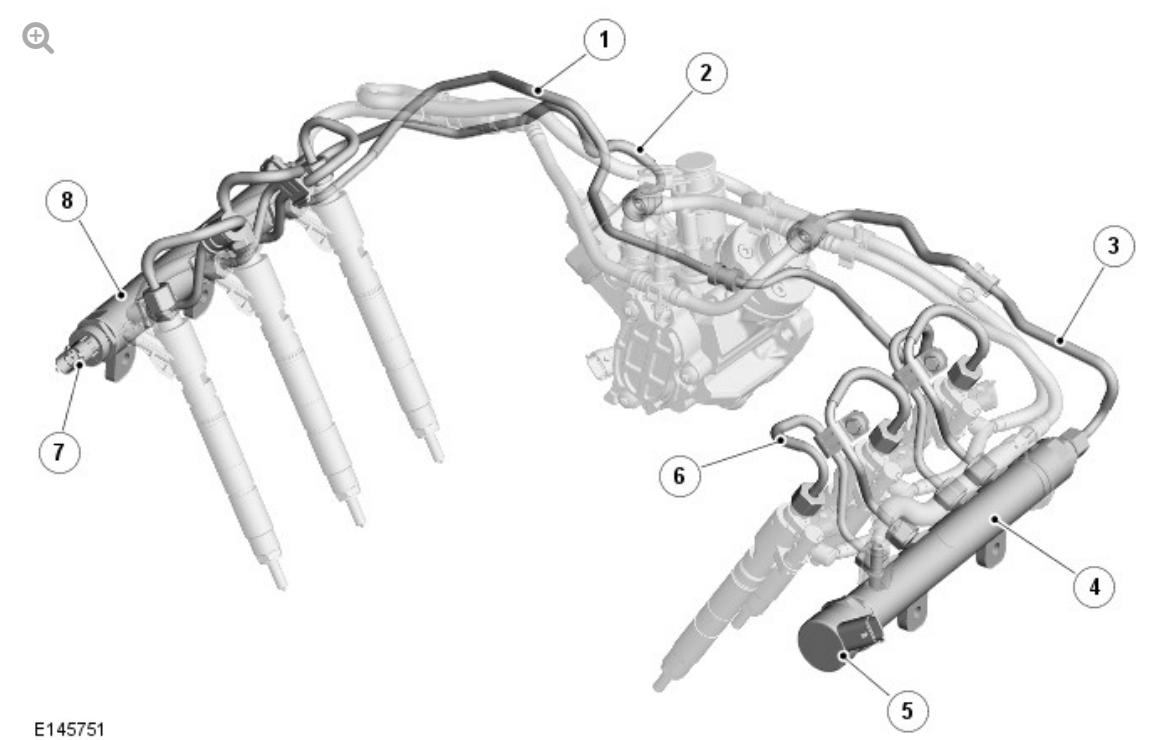
A controlled amount of fuel is allowed to leak-off from the internal transfer pump. This fuel cools and lubricates the internal components of the HP fuel

pump, then returns to the fuel tank through the LP fuel return line.

The fuel temperature sensor is located on the rear of the HP fuel pump. It measures the fuel temperature in the LP side of the HP fuel pump. The ECM continually monitors this signal to determine the fuel temperature to prevent overheating of the fuel system. The ECM will also make fine adjustments to fuel injection quantity to adjust for fuel temperature.

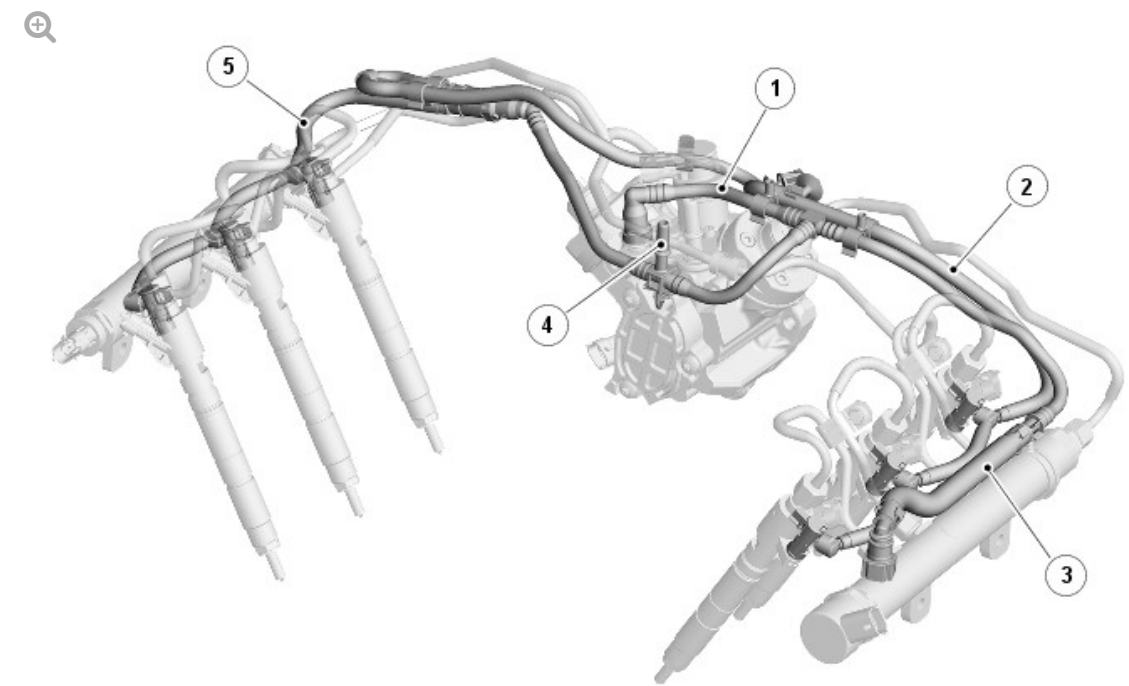
FUEL RAILS

Fuel Rails and High Pressure (HP) Fuel Lines



ITEM	DESCRIPTION
1	Fuel rail balance pipe
2	Supply pipe to Bank 1 fuel rail
3	Supply pipe to Bank 2 fuel rail
4	Fuel rail - Bank 2
5	Fuel Pressure Control Valve (PCV)
6	Supply pipe to fuel injector (6 off)
7	Fuel Rail Pressure (FRP) sensor

Low Pressure (LP) Fuel Lines



E145752

ITEM	DESCRIPTION
1	High Pressure (HP) fuel pump fuel return tube
2	Bank 2 fuel injector leak-back tube
3	Fuel rail Pressure Control Valve (PCV) fuel return tube
4	Fuel return connection to fuel cooler
5	Bank 1 fuel injector leak-back tube

Two fuel rails are used with each rail supplying high pressure fuel to 3 fuel injectors.

Each rail has 5 threaded connections which provide for the attachment of the HP fuel supply from the HP fuel pump, the balance pipe and connections for the 3 injectors supplied with fuel from that rail.

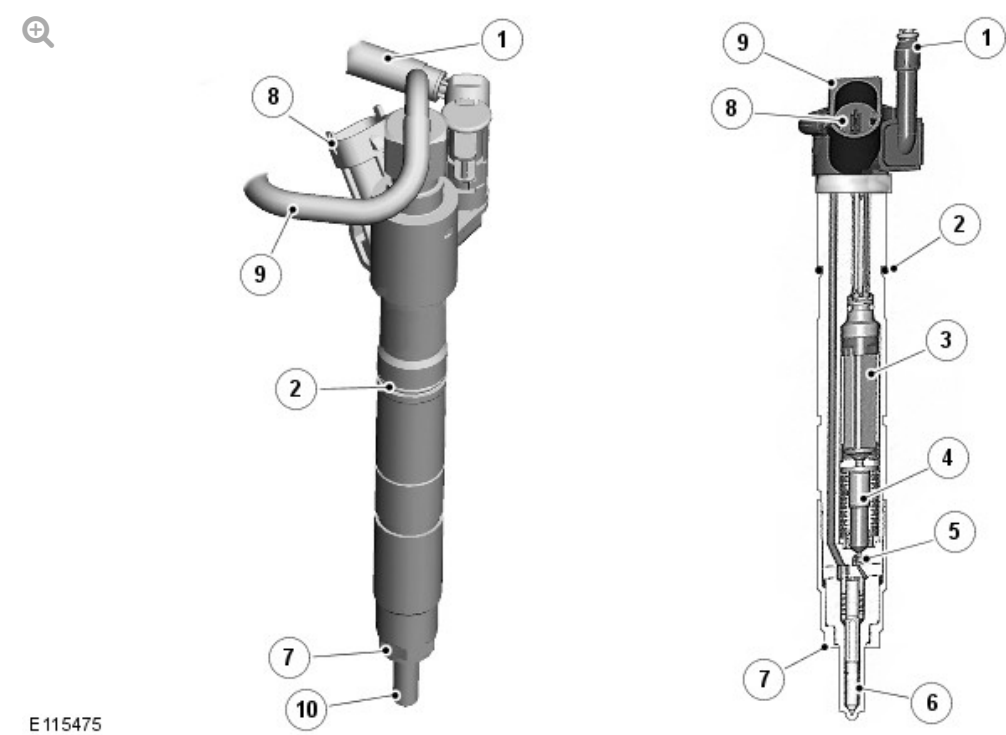
The fuel pressure in the rails is detected by the FRP sensor which is located

in the front of the Bank 1 fuel rail. The Bank 2 fuel rail houses a fuel rail PCV. The ECM controls the fuel rail PCV using signals from the FRP sensor. Fuel released by the fuel rail PCV flows into the LP fuel return line.

The FRP sensor is a piezo-resistive type sensor containing an actuating diaphragm. Deflection of the diaphragm provides a proportional signal (output) voltage to the ECM, dependant on the fuel pressure within the fuel rail.

Both rails are connected together with a balance pipe which ensures the pressure in both rails is equal, even though each rail is supplied from a different pumping element in the HP fuel pump.

FUEL INJECTORS



E115475

ITEM	DESCRIPTION
1	Fuel return
2	O-ring seal
3	Piezo stack actuator
4	Hydraulic coupler

5	Control valve
6	Nozzle body
7	Copper sealing washer
8	Electrical connector
9	High Pressure (HP) feed
10	Nozzle

CAUTION:

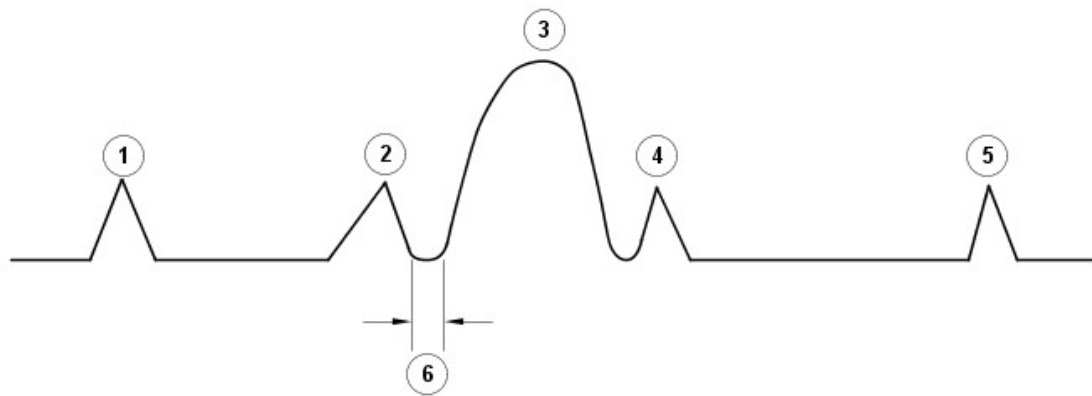
Each injection event is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from, the injector. Never disconnect the wiring connector when the vehicle is running. The injector may remain open thus causing engine damage.

Six fuel injectors are used in the fuel system. A piezo actuator in each injector is electronically controlled by the ECM to operate the injector in response to engine speed and load conditions.

Each injector has an electrical connector which connects the injector to the engine harness. A fuel connection on the top of the injector provides for the HP fuel inlet from the related fuel rail. A second fuel connection allows fuel leakage within the injector to drain into the LP fuel return line.

Each injector is located in a machined hole in the cylinder head and is sealed in the cylinder head with a copper sealing washer and an O-ring seal. The injector is retained in the cylinder head with a clamp plate and 2 bolts. If an injector is removed or replaced, a new copper sealing washer and a clamp plate must be used when refitting the injector.

The injector can operate up to 5 times during one combustion cycle depending on engine speed and load. The injection sequence can occur as follows:



E107577

- 1** Pilot injection - occurs before the main injection and improves fuel and air mixing
- 2** Pre-injection - shortens the main injection's ignition delay and therefore reduces the generation of nitrous oxides
- 3** Main injection - delivers the required engine torque
- 4** After injection - occurs after the main injection and assists the re-burn of any remaining particulate matter
- 5** Post injection - helps manage the temperature of the exhaust gas for more effective exhaust-gas after-treatment
- 6** Injection delay 0.4 ms.

Each injector is calibrated to the ECM and applicable cylinder to which it is fitted. Therefore, if an injector is removed it must be refitted to the cylinder from which it was removed. If a new injector is fitted, a calibration routine using Land Rover approved diagnostic equipment must be performed to calibrate the injector unique code to the ECM.

The operating voltage of the injector is between 110 and 163 Volts depending on engine speed and load and care must be taken when working in the vicinity of the injectors. The pressure increases linearly from 200 to 1200 bar (2900 to 17404 lbf/in²).

Each injector has an electrical resistance value of between 150 - 250 kOhms.

OPERATION

ENGINE STARTING

During starting, the fuel rail pressure must be at least 120 bar (1740 lbf/in²). Should the pressure be below this figure, the injectors will not operate, resulting in the vehicle not starting.

ENGINE STOPPING

To stop the engine the ECM stops energizing the actuators in the fuel injectors, therefore, no fuel is injected and the engine speed drops to zero. For additional information, refer to:

[Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation),

[Electronic Engine Controls](#) (303-14F Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).

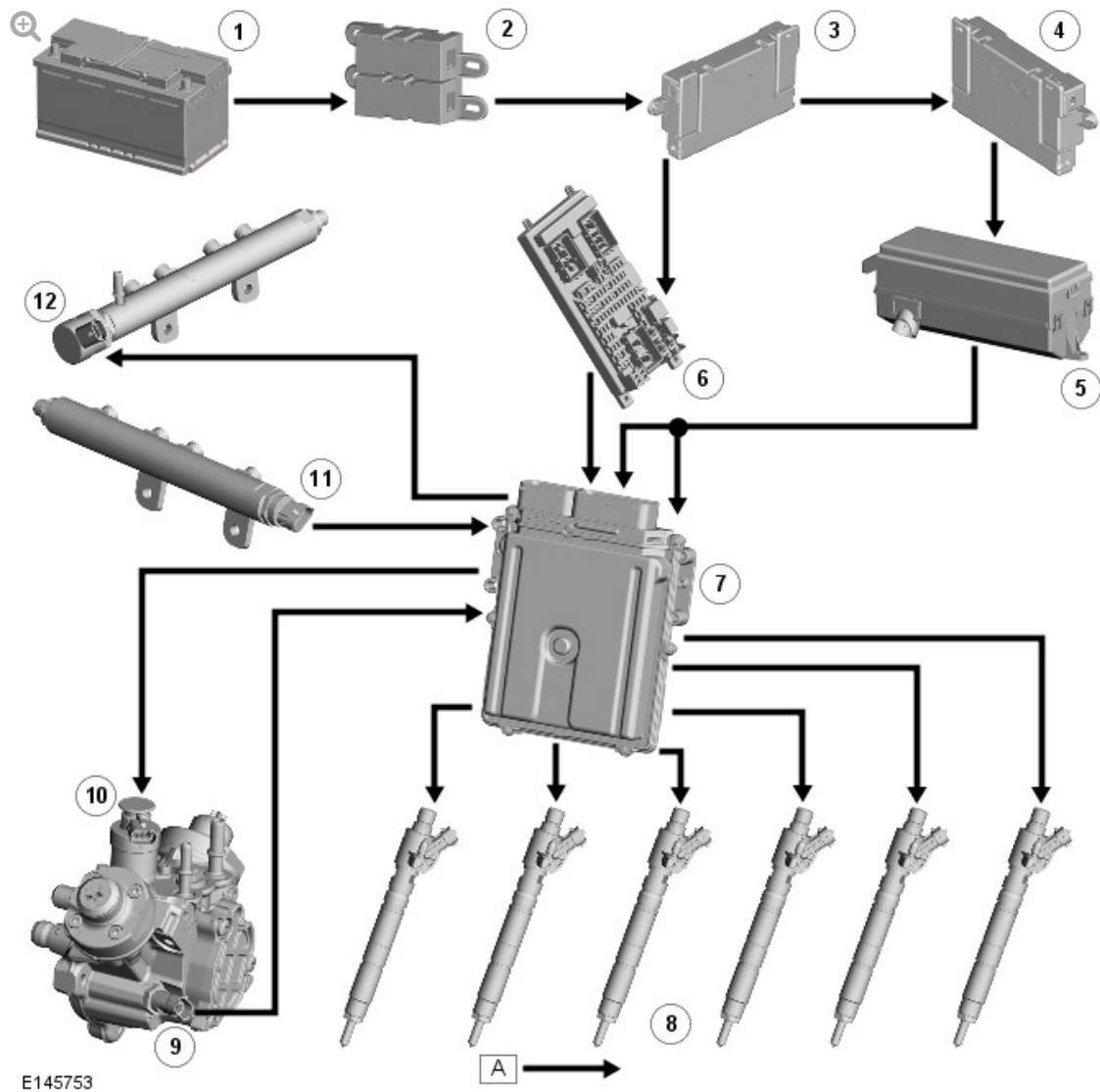
HIGH PRESSURE (HP) FUEL PUMP

When the HP fuel pump is rotated, pressure is created when the fuel metering valve is open and the fuel rail PCV is closed. Both valves are electronically controlled by the ECM to allow variable fuel delivery and pressure control. When the ECM actuates the fuel injectors, the fuel rail pressure drop is off-set by additional fuel being delivered to the fuel rails by the fuel rail PCV. The fuel pressure in the system is reduced within a few seconds after the engine has stopped as the fuel rail PCV no longer has the holding current it requires, and therefore opens. No residual pressure remains in the system and the fuel is released into the LP fuel return line through the open fuel rail PCV.

CONTROL DIAGRAM

NOTE:

A = Hardwired.



ITEM	DESCRIPTION
1	Battery
2	Battery Junction Box 2 (BJB2)
3	Battery Junction Box (BJB)
4	Auxiliary Junction Box (AJB)
5	Engine Junction Box (EJB)
6	Central Junction Box (CJB)

7	Engine Control Module (ECM)
8	Fuel injector (6 off)
9	Fuel temperature sensor
10	Fuel metering valve
11	Fuel Rail Pressure (FRP) sensor
12	Fuel rail Pressure Control Valve (PCV)