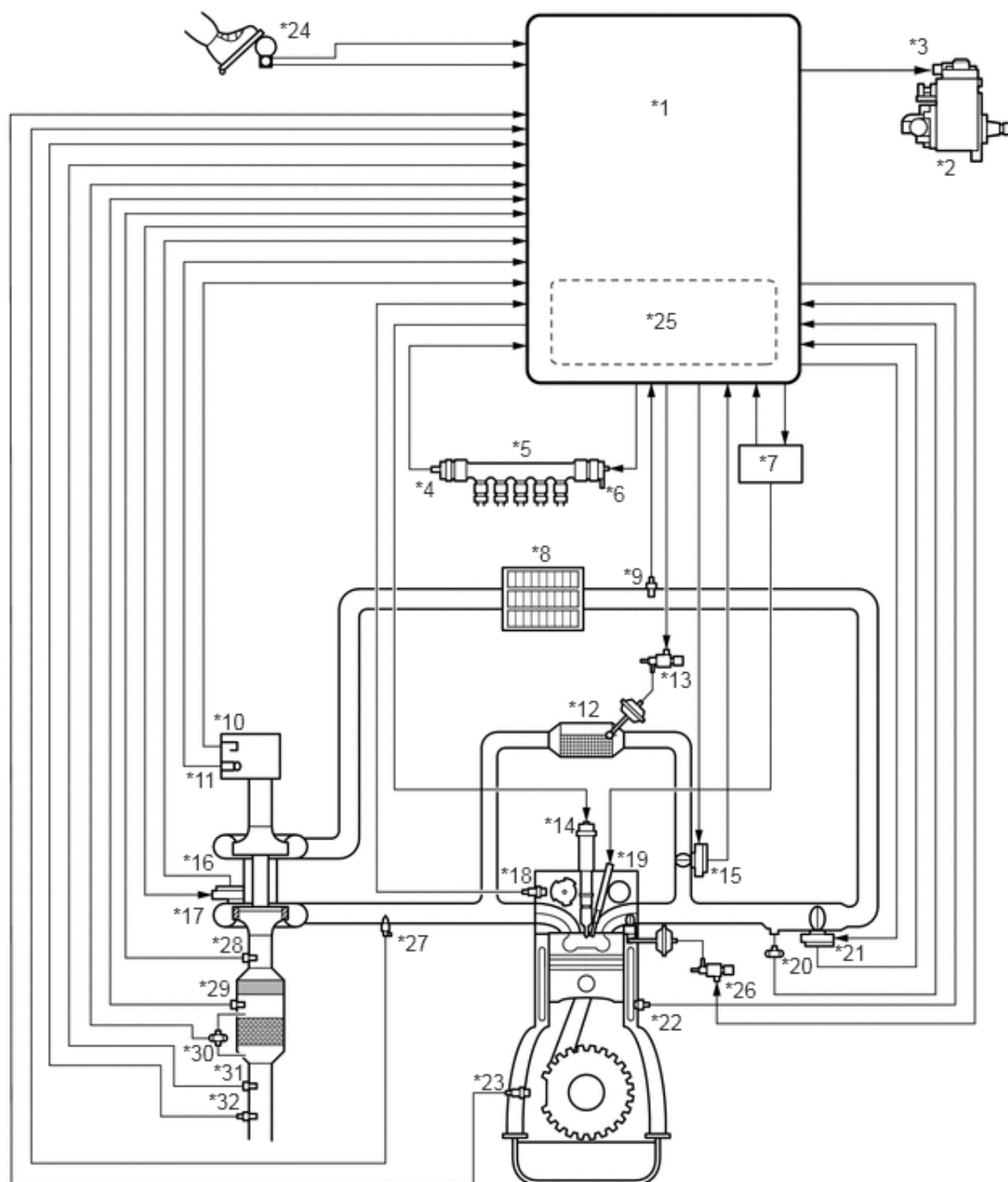


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1GD-FTV ENGINE CONTROL ECD SYSTEM(w/ DPF) SYSTEM DESCRIPTION

ENGINE CONTROL SYSTEM



*1	ECM	*2	Fuel Supply Pump Assembly
*3	Pre-stroke Control Valve	*4	Fuel Pressure Sensor
*5	Common Rail Assembly	*6	Pressure Discharge Valve

*7	Glow Plug Controller	*8	Intercooler
*9	Intake Air Temperature Sensor (Turbo)	*10	Mass Air Flow Meter Sub-assembly
*11	Intake Air Temperature Sensor (Built Into Mass Air Flow Meter Sub-assembly)	*12	EGR Cooler Sub-assembly
*13	Vacuum Switching Valve Assembly (for EGR Bypass Valve)	*14	Injector Assembly
*15	Electric EGR Control Valve Assembly	*16	Turbocharger Sub-assembly
*17	Turbocharger Nozzle Vane Control Actuator	*18	Camshaft Position Sensor
*19	Glow Plug	*20	Manifold Absolute Pressure Sensor
*21	Diesel Throttle Body Assembly	*22	Engine Coolant Temperature Sensor
*23	Crankshaft Position Sensor	*24	Accelerator Pedal Position Sensor
*25	Atmospheric Pressure Sensor	*26	Vacuum Switching Valve Assembly (for Swirl Control Valve)
*27	Exhaust Fuel Addition Injector Assembly	*28	Exhaust Gas Temperature Sensor
*29	No. 2 Exhaust Gas Temperature Sensor	*30	Differential Pressure Sensor Assembly
*31	No. 3 Exhaust Gas Temperature Sensor	*32	Air Fuel Ratio Sensor

DIESEL PARTICULATE FILTER SYSTEM DESCRIPTION

- a. Diesel Particulate Filter System comprehensively regulates engine control (consists of a catalytic system and a fuel injection system) that purifies particulate matter (PM) by diesel engines. The catalytic system purifies hydrocarbons (HC) and carbon monoxides (CO), and reduces PM with a catalytic converter with the Diesel Particulate Filter (DPF). The fuel injection system adds fuel into the exhaust port using the exhaust fuel addition injector to produce maintain a proper catalyst temperature for PM forced regeneration.

- b. DPF components:

Component	Description
DPF catalytic converter	Reduces PM.
DOC catalytic converter	Reduces HC and CO.
Exhaust Fuel Addition Injector Assembly	Adds fuel into the exhaust port in order to raise catalyst temperature for PM forced regeneration.
<ul style="list-style-type: none"> Exhaust gas temperature sensor No. 2 Exhaust gas temperature sensor No. 3 Exhaust gas temperature sensor 	Used for estimating the DPF catalytic converter temperature and adjusting fuel addition by ECM while PM forced regeneration is performed. Also detects the DPF catalytic converter temperature to prevent the catalytic converter temperature from rising too high.
Differential Pressure Sensor Assembly	Detects the volume of PM deposits and any incorrect vacuum hose arrangement on the DPF catalytic converter.
Air fuel ratio sensor	Used for controlling the air-fuel ratio. By controlling the air-fuel ratio, combustion control and PM forced regeneration are properly regulated.

- c. Diagnostics Trouble Codes (DTCs) table for DPF:

HINT:

This table indicates typical DTC combinations for each malfunction occurrence.

Trouble Area	Malfunction	DTC No.
DPF catalytic converter	Deteriorated or clogged	P0420*, P062F, P200C*, P200E*, P244B*, P2458*, P2463*
Exhaust Fuel Addition Injector Assembly	Stuck open	P20CF
	Stuck closed	P0420*, P2458*
	Low fuel addition volume	P0420*, P244B*, P2458*, P2463
	Open in exhaust fuel addition injector circuit	P0420*, P20CB, P2458*

	Short in exhaust fuel addition injector circuit	P0420*, P20CF, P20CB, P2458*
	Open or short in exhaust fuel addition injector circuit	P0420*, P200C*, P200E, P20CF*, P20CB, P2458*
Exhaust gas temperature sensor	Open in exhaust gas temperature sensor circuit	P0420*, P0545, P0546, P200C*, P200E*, P2032, P2033, P2080, P2084, P242B, P242C, P242D, P2458*
	Short in exhaust gas temperature sensor circuit	P0420*, P0545, P0546, P200C*, P200E*, P2002*, P2032, P2033, P2080, P2084, P242B, P242C, P242D, P2458*
	Exhaust gas temperature sensor	P0420*, P0545, P0546, P200C*, P200E*, P2032, P2033, P2080, P2084, P242B, P242C, P242D, P2458*
Differential Pressure Sensor Assembly	Open in differential pressure sensor circuit	P0420*, P2458*, P2454, P2455, P2463*
	Short in differential pressure sensor circuit	P0420*, P2458*, P2454, P2455, P2463*
	Differential pressure sensor	P0420*, P2458*, P2454, P2455, P2463*
	Differential pressure sensor clogged	P0420*, P2458*, P2453, P2463*
	Incorrect vacuum hose arrangement of the differential pressure sensor	P0420*, P2458*, P2453, P2463*
Air fuel ratio sensor	Open or short in air fuel ratio sensor or heater circuit	P0031, P0032, P2237, P2238, P2239, P2252, P2253, P244B*, P2463*
	Air fuel ratio sensor	P0031, P0032, P2195, P2238, P2239, P2252, P2253, P244B*, P2463*
Exhaust gas leaks	Exhaust gas leaks	P0420*, P2458*
Fuel leaks	Fuel leaks in fuel addition injector	P0420*, P2002*, P200C*, P200E*, P20CF*, P244B*, P2458*, P2463*
Fuel supply pump assembly	Correct fuel pressure cannot be fed to the exhaust fuel addition injector	P0420*, P244B*, P2458*, P2463*

*: There may be no DTC output depending on the condition of the malfunction.

d. Diagnostics trouble code description for DPF:

DTC No.	Description
P0031	Open in air fuel ratio sensor heater control circuit (Low output)
P0032	Short in air fuel ratio sensor or heater circuit (High output)
P0420	DPF catalytic converter insufficient temperature increase
P0545	Open or short in exhaust gas temperature sensor circuit (B1S1) (Low output)
P0546	Open or short in exhaust gas temperature sensor circuit (B1S1) (High output)
P2002	DPF catalytic converter thermal deterioration
P200C	DPF catalytic converter abnormally high exhaust gas temperature
P200E	Catalyst system temperature too high bank 1
P2032	Open or short in exhaust gas temperature sensor circuit (B1S2) (Low output)
P2033	Open or short in exhaust gas temperature sensor circuit (B1S2) (High output)
P2080	Exhaust gas temperature sensor circuit range/performance (B1S1)
P2084	Exhaust gas temperature sensor circuit range/performance (B1S2)
P20CD	Open in exhaust fuel addition injector assembly circuit

P20CF	Exhaust fuel addition injector assembly stuck open
P2195	Air fuel ratio sensor stuck lean
P2237	Air fuel ratio sensor pumping current circuit/open
P2238	Open or short in air fuel ratio sensor or heater circuit (Low output)
P2239	Open or short in air fuel ratio sensor or heater circuit (High output)
P2252	Open or short in air fuel ratio sensor or heater circuit (Low output)
P2253	Open or short in air fuel ratio sensor or heater circuit (High output)
P242B	Exhaust gas temperature sensor circuit range / performance (B1S3)
P242C	Open or short in exhaust gas temperature sensor circuit (B1S3) (Low output)
P242D	Open or short in exhaust gas temperature sensor circuit (B1S3) (High output)
P244A	DPF catalytic converter excessive differential pressure (Low input)
P244B	DPF catalytic converter excessive differential pressure (High input)
P2453	Differential pressure sensor is clogged or has incorrect vacuum hose arrangement
P2454	Open or short in differential pressure sensor circuit (Low output)
P2455	Open or short in differential pressure sensor circuit (High output)
P2458	Diesel particulate filter regeneration duration
P2463	DPF catalytic converter soot deposition

COMMON RAIL SYSTEM DESCRIPTION

a. Common rail system:

The common rail system uses high-pressure fuel for improved fuel economy. This system also provides robust engine power while suppressing engine vibration and noise.

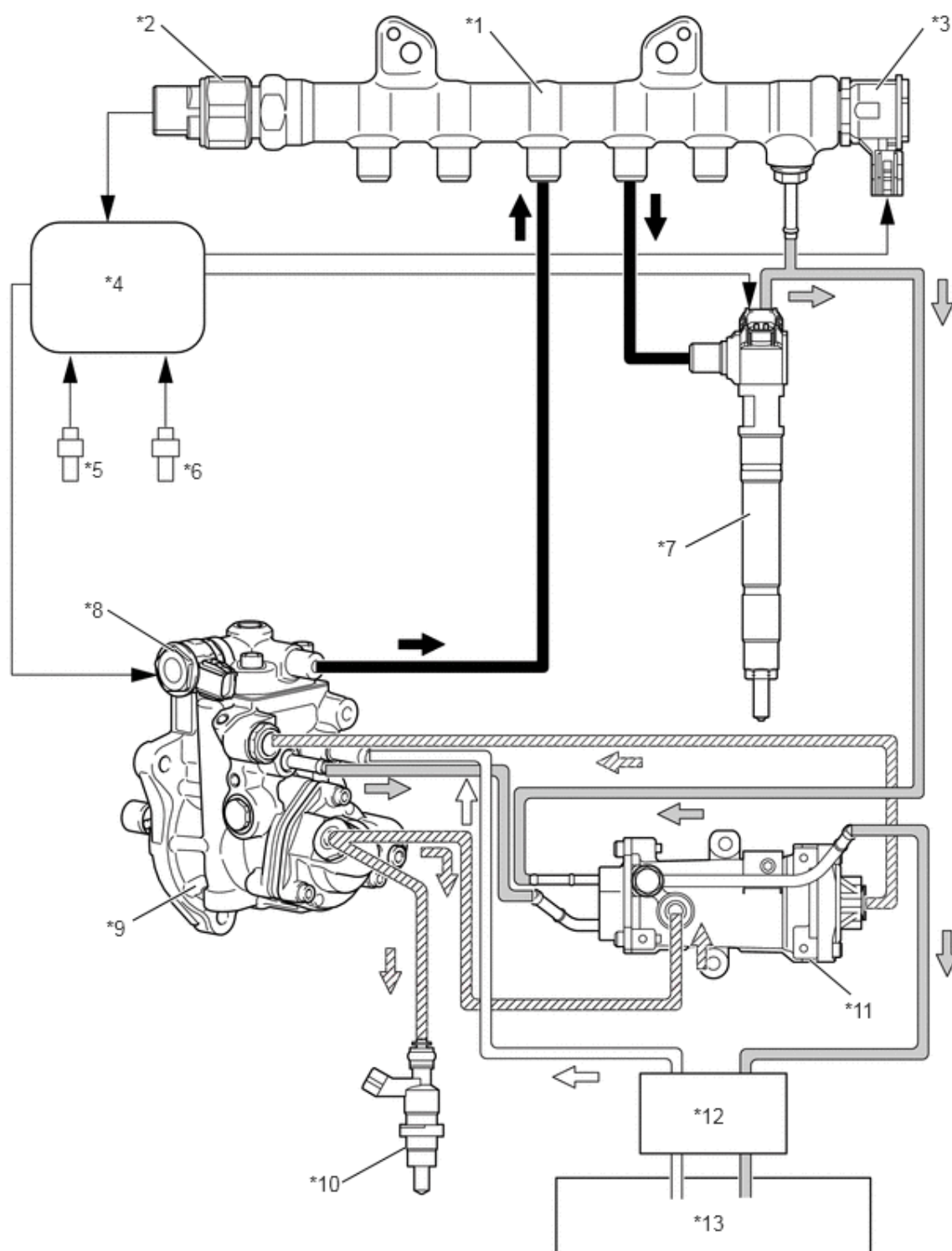
This system stores fuel in the common rail, which has been pressurized and supplied by the fuel supply pump assembly. By storing fuel at high-pressure, the common rail system can provide fuel at stable fuel injection pressures, regardless of engine speed or engine load.

The ECM provides an electric current to the solenoid valve in each injector assembly to regulate the fuel injection timing and volume. The ECM also monitors the internal fuel pressure of the common rail using the fuel pressure sensor. The ECM causes the fuel supply pump assembly to supply the fuel necessary to obtain the target fuel pressure.



In addition, this system uses a solenoid valve inside each injector assembly to open and close the fuel passages. Therefore, both fuel injection time and fuel injection volume can be precisely regulated by the ECM.

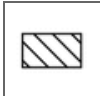
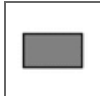
The common rail system allows a multi stage fuel injection process. In order to soften combustion shock, this system performs "pilot-injection" prior to the "main-injection". This helps to reduce engine vibration and noise.

The system also performs "after-injection", which burns off fuel that was added during "pilotinjection" and "main-injection" and remained unburned, to increase the exhaust temperature for the DPF.



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*1	Common Rail Assembly	*2	Fuel Pressure Sensor
*3	Pressure Discharge Valve	*4	ECM
*5	Crankshaft Position Sensor	*6	Camshaft Position Sensor
*7	Injector Assembly	*8	Pre-stroke Control Valve
*9	Fuel Supply Pump Assembly	*10	Exhaust Fuel Addition Injector Assembly
*11	Pressurised Fuel Filter	*12	Fuel Filter Assembly
*13	Fuel Tank Assembly	-	-
	Fuel (High Pressure)		Fuel (Suction)

	Fuel (Feed Pressure)		Fuel (Return)
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HINT:

If there is a problem with a fuel return pipe, as bleeding air from the fuel system may not be able to be performed properly in certain instances, such as after replacing an injector assembly, etc., the engine startability may deteriorate.

b. Common rail system components:

Component	Description
Common rail assembly	Stores high-pressure fuel produced by supply pump
Fuel supply pump assembly	<ul style="list-style-type: none"> Operated by crankshaft via timing chain Supplies high-pressure fuel to common rail
Injector assembly	Injects fuel to combustion chamber based on signals from ECM
Fuel pressure sensor	Monitors internal fuel pressure of common rail and sends signals to ECM
Pressure discharge valve	Based on signals from ECM, opens valve when sudden deceleration occurs, or when ignition switch is off to prevent fuel pressure from becoming too high
Pre-stroke control valve	Based on signals from ECM, adjusts fuel volume supplied to common rail and regulates internal fuel pressure
Check valve	Keeps pressure that discharges from injector

c. Diagnostic trouble code (DTC) table for the common rail system:**HINT:**

This table indicates typical DTC combinations for each malfunction occurrence.

Trouble Area	Malfunction	DTC No.
Injector assembly	Open or short in injector circuit	P0093*, P0201, P0202, P0203, P0204, P062D
	Stuck open	P0093
	Stuck closed	P0301, P0302, P0303, P0304
Fuel pressure sensor	Open or short in fuel pressure sensor circuit or pressure sensor output fixed	P0087, P0190, P0191, P0192, P0193
Pressure discharge valve	Open or short in pressure discharge valve circuit	P0088*, P0093*, P1229*, P1271, P1272
	Stuck open	P0093
	Stuck closed	P0088*, P1272
Pre-stroke control valve	Open or short in pre-stroke control valve circuit	P0627, P1229, P0088*
	Stuck open	P0088*, P1229
Common rail system (Fuel system)	Fuel leaks in high-pressure area	P0093

*: There may be no DTC output depending on the condition of the malfunction.

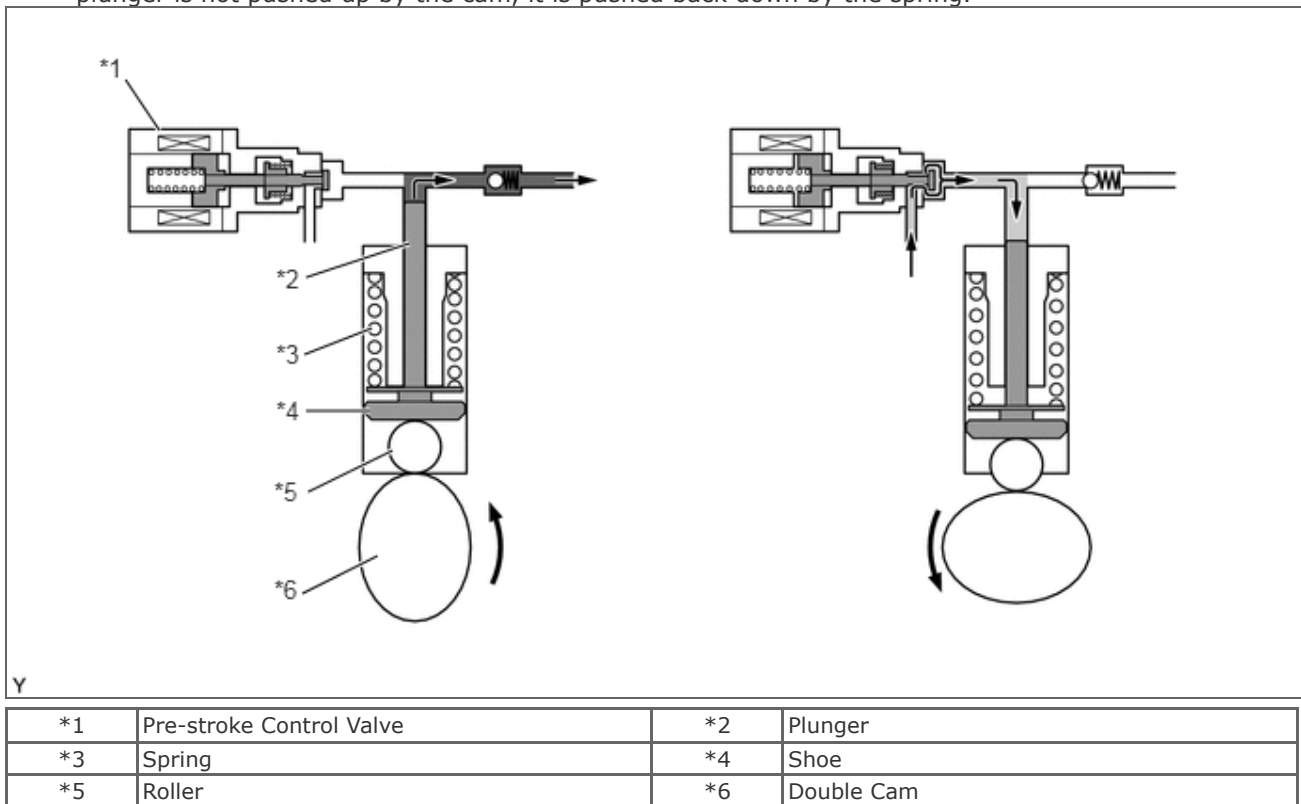
d. Diagnostic trouble code description for the common rail system:

DTC No.	Description
P0087	Fuel pressure sensor output does not change
P0088	Internal fuel pressure too high (240000 kPa [2447 kgf/cm ² , 34800 psi] or more)
P0093	Fuel leaks in high-pressure areas

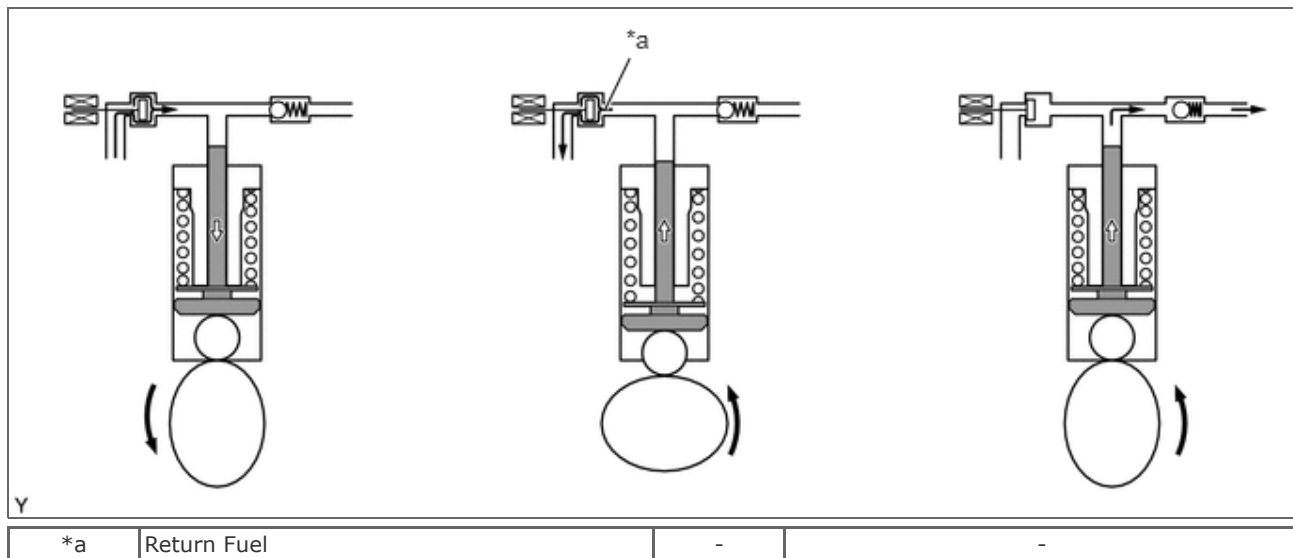
P0190	Open or short in fuel pressure sensor circuit (output voltage is too low or too high)
P0192	Open or short in fuel pressure sensor circuit (output voltage is too low)
P0193	Open or short in fuel pressure sensor circuit (output voltage is too high)
P0201	Open or short in No. 1 injector circuit
P0202	Open or short in No. 2 injector circuit
P0203	Open or short in No. 3 injector circuit
P0204	Open or short in No. 4 injector circuit
P0301	Cylinder 1 misfire detected
P0302	Cylinder 2 misfire detected
P0303	Cylinder 3 misfire detected
P0304	Cylinder 4 misfire detected
P0627	Open or short in pre-stroke control valve circuit
P062D	ECM internal error
P1229	Fuel over-feed
P1271	Open or short in pressure discharge valve circuit
P1272	Pressure discharge valve stuck close

FUEL SUPPLY PUMP OPERATION SYSTEM DESCRIPTION

- a. When the cam rotates the roller is pushed up, and in turn the plunger is pushed upward as well. When the plunger is not pushed up by the cam, it is pushed back down by the spring.



- b. The ECM controls the timing of the pre-stroke control valve opening to regulate the fuel quantity. Consequently, the fuel pressure in the common rail is controlled to the target injection pressure.
- c. The longer the pre-stroke control valve remains open, the quantity of pressure-fed strokes will decrease, as well as the fuel discharge quantity.
- d. Pumping will start when the fuel pressure has become higher than the common rail pressure.



- e. The less time the pre-stroke control valve remains open, the quantity of pressure-fed strokes will increase, as well as the fuel discharge quantity.
- f. Pumping will start when the fuel pressure has become higher than the common rail pressure.

