■ENGINE CONTROL SYSTEM

1. General

The engine control system of the 1VD-FTV engine has the following systems:

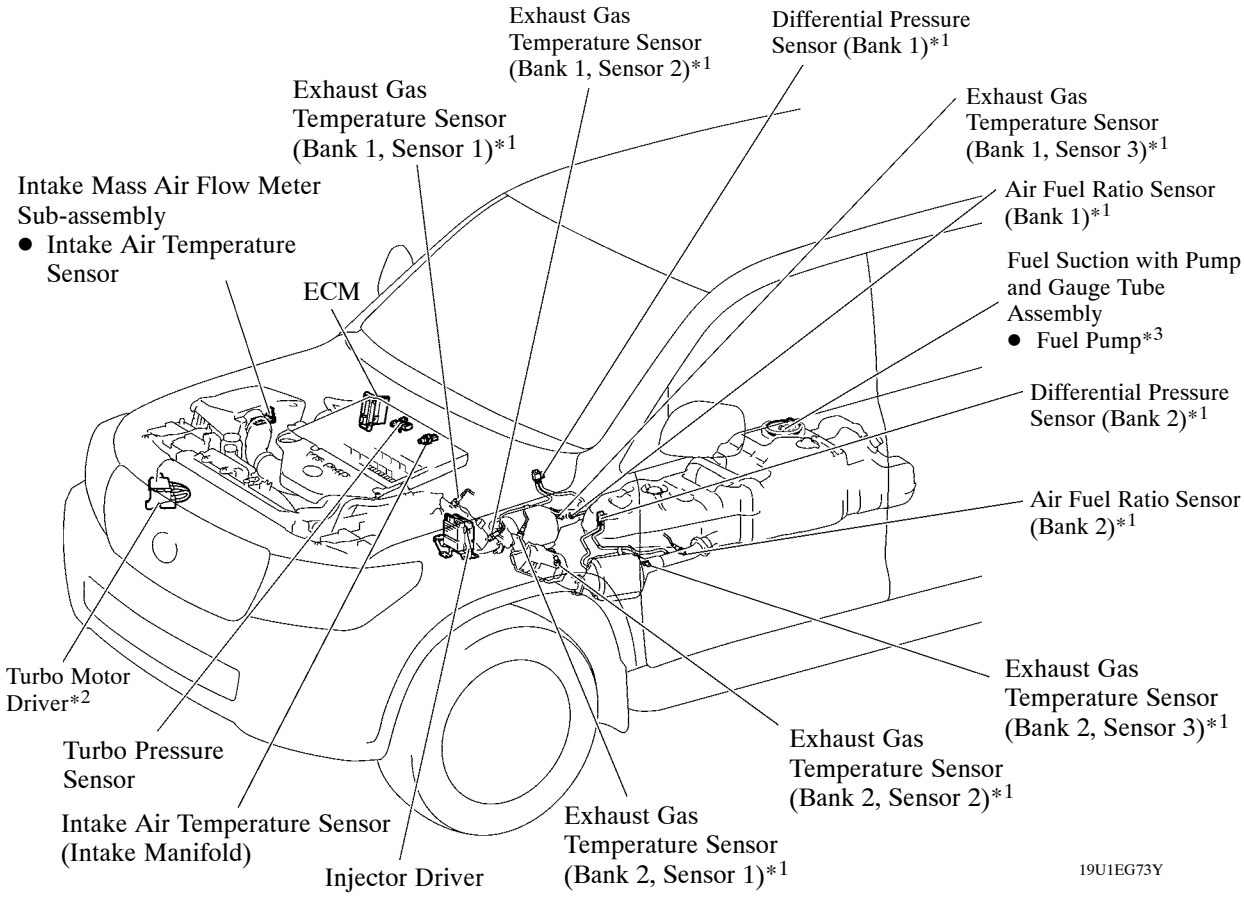
System	Outline	EURO 5	Except EURO 5
Fuel Injection Volume Control	Based on the signals received from the sensors, the ECM determines the fuel injection volume in accordance with the engine condition.	○	○
Fuel Injection Timing Control	Based on the signals received from the sensors, the ECM determines the fuel injection timing in accordance with the engine condition.	○	○
During Starting Control	To facilitate startability, the ECM optimally controls the injection volume and injection timing during starting.	○	○
Idle Speed Control	The ECM determines the idle speed in accordance with the engine condition, and controls the fuel injection volume in order to maintain the target idle speed.	○	○
Fuel Pressure Control (See page 174)	Based on the signals received from the sensors, the ECM controls fuel pressure using the Suction Control Valve (SCV) and fuel pressure discharge valve in accordance with engine operating conditions.	○	—
	Based on the signals received from the sensors, the ECM controls fuel pressure using the Suction Control Valve (SCV) in accordance with the engine conditions.	—	○
Pilot Injection Control	Based on the signals received from the sensors, the ECM determines pilot injection volume/timing and interval (between pilot injection and main injection) in accordance with the engine conditions.	○	○
Glow Plug Control	Controls the length of time when the current is applied to the glow plugs in accordance with the engine coolant temperature.	○	○
Throttle Control	● Based on the signals received from the various sensors, the ECM determines throttle valve position in accordance with the engine conditions. ● Fully closes the throttle valve in order to reduce vibration when the engine is stopped.	○	○
Turbocharger Control (See page 175)	Based on the signals received from the sensors, the ECM controls the actuator in accordance with the engine conditions.	○	—
	Based on the signals received from the sensors, the ECM controls the actuator via the turbo motor driver in accordance with the engine conditions.	—	○
Fuel Pump Control*1	Based on the signals from the sensors, the ECM operates the fuel pump to optimally control the transfer of the fuel from the fuel sub tank to the fuel tank.	—	○
EGR Control	Based on the signals received from the sensors, the ECM determines the EGR volume via the EGR valve and throttle valve in accordance with the engine conditions.	○	○*2

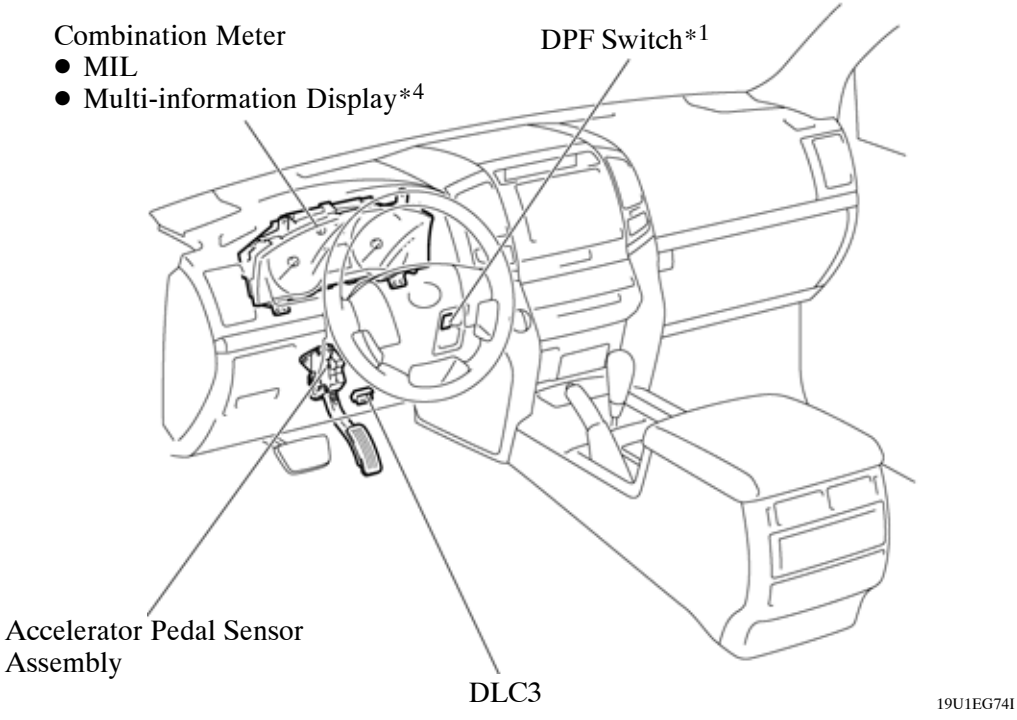
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System	Outline	EURO 5	Except EURO 5
Engine Mounting Control	When the engine speed and the vehicle speed are low, this control utilizes vacuum to soften the engine mounting characteristics in order to restrain the engine vibration.	○	○
Oil Maintenance Management	When the ECM determines engine oil deterioration, the engine oil change reminder light turns on to inform the driver.	○	—
Starter Control*3	Once the engine switch is pushed, this control continues to operate the starter until the engine is started.	○	○
Air Conditioner Cut-off Control	By controlling the air conditioner compressor on or off in accordance with the engine conditions, driveability is maintained.	○	○
Catalyst Support Control (See page 176)	Based on the signals received from the sensors, the ECM controls the exhaust fuel addition injector assembly to purify the Particulate Matter (PM) that is captured in the filter with catalyst.	○	—
Air Fuel Ratio Sensor Heater Control	Maintains the temperature of the air fuel ratio sensors at an appropriate level to increase the detection accuracy of the exhaust gas oxygen concentration.	○	—
Engine Immobiliser	Prohibits fuel injection if an attempt is made to start the engine with an invalid key.	○	○
Diagnosis	When the ECM detects a malfunction, it records the malfunction and memorizes information related to the fault.	○	○
Fail-safe	When the ECM detects a malfunction, it stops or controls the engine according to the data already stored in the memory.	○	○
Brake Override System	Restricts the driving torque when the brake pedal is applied while the accelerator pedal is depressed. (For the Activation Conditions and Inspection Method, refer to the Repair Manual.)	○	○

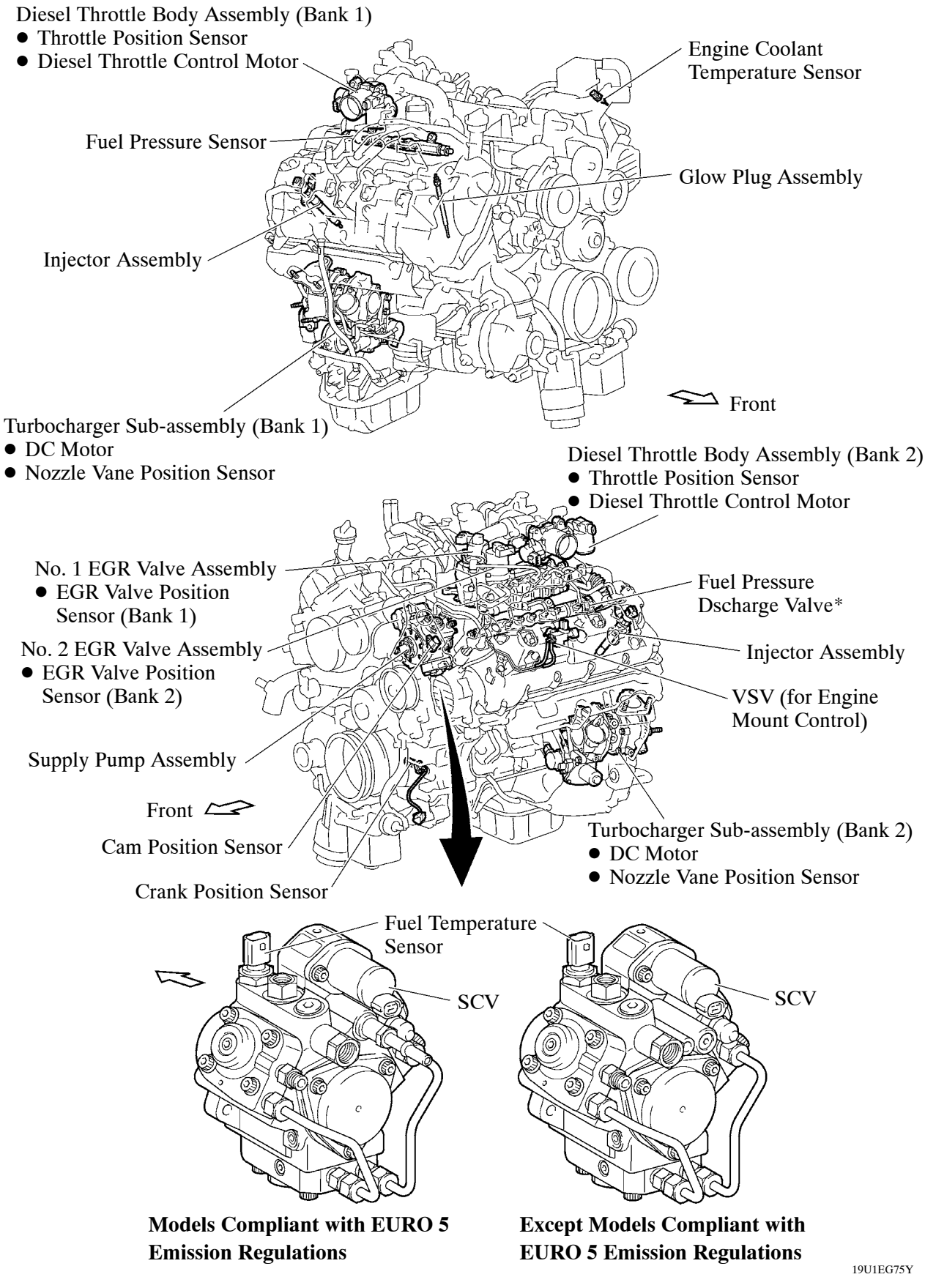
: New
○: Applicable
—: Not applicable
*1: Models with dual fuel tank
*2: Models compliant with EURO 2, EURO 3 and EURO 4 emission regulations
*3: Models with entry and start system

2. Layout of Main Components





*1: Models compliant with EURO 5 emission regulations
*2: Except models compliant with EURO 5 emission regulations
*3: Models with dual fuel tank
*4: Models with Optitron type combination meter



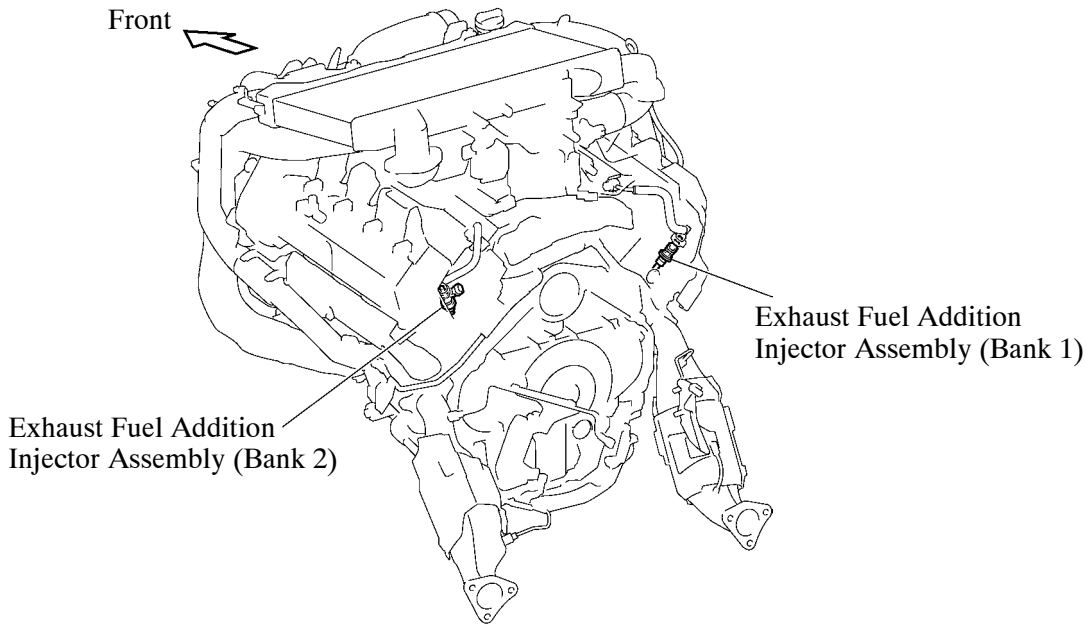
Models Compliant with EURO 5 Emission Regulations

Except Models Compliant with EURO 5 Emission Regulations

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*: Models compliant with EURO 5 emission regulations

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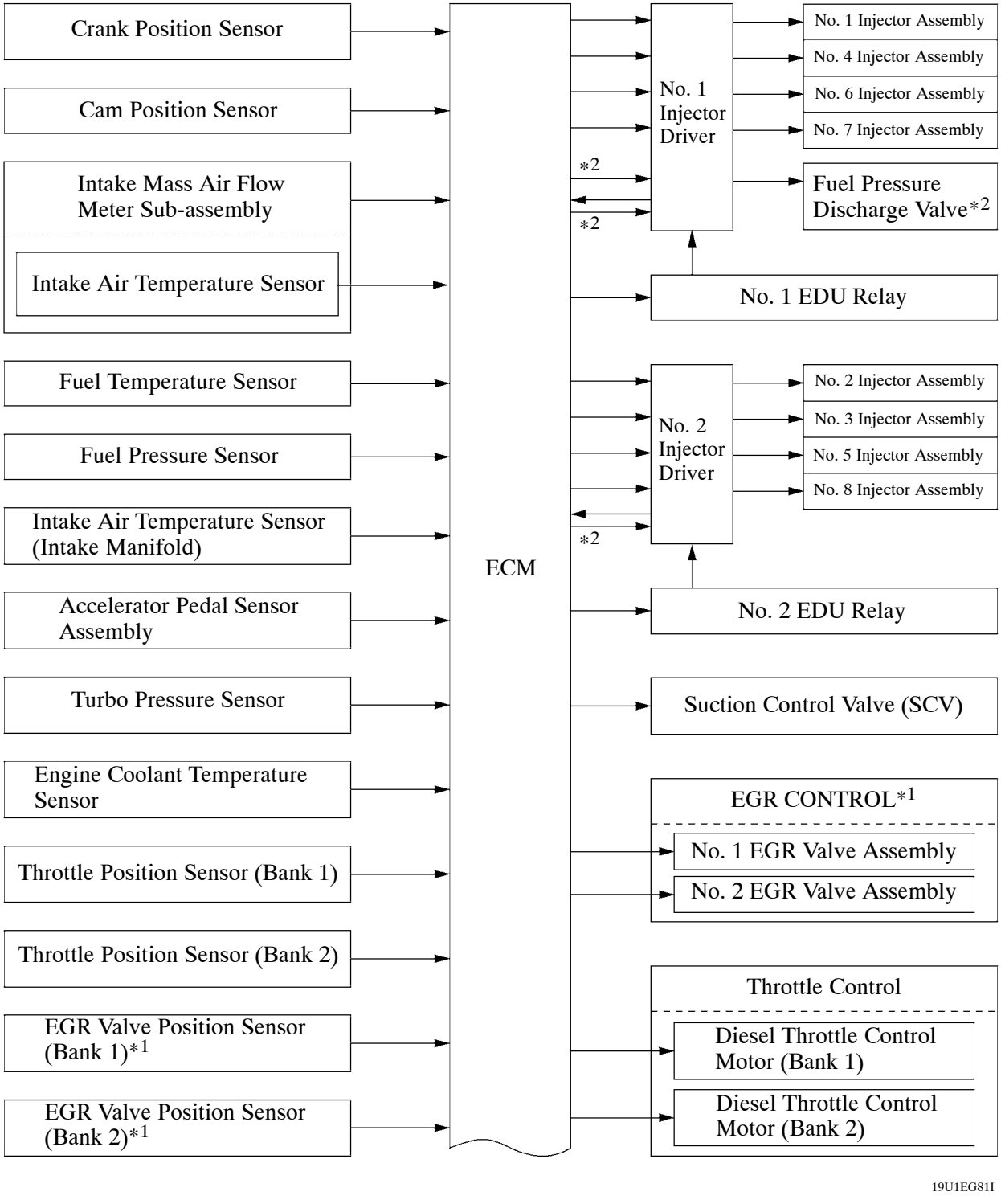


Models Compliant with EURO 5 Emission Regulations

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3. Construction

The configuration of the engine control system is as shown in the following chart:

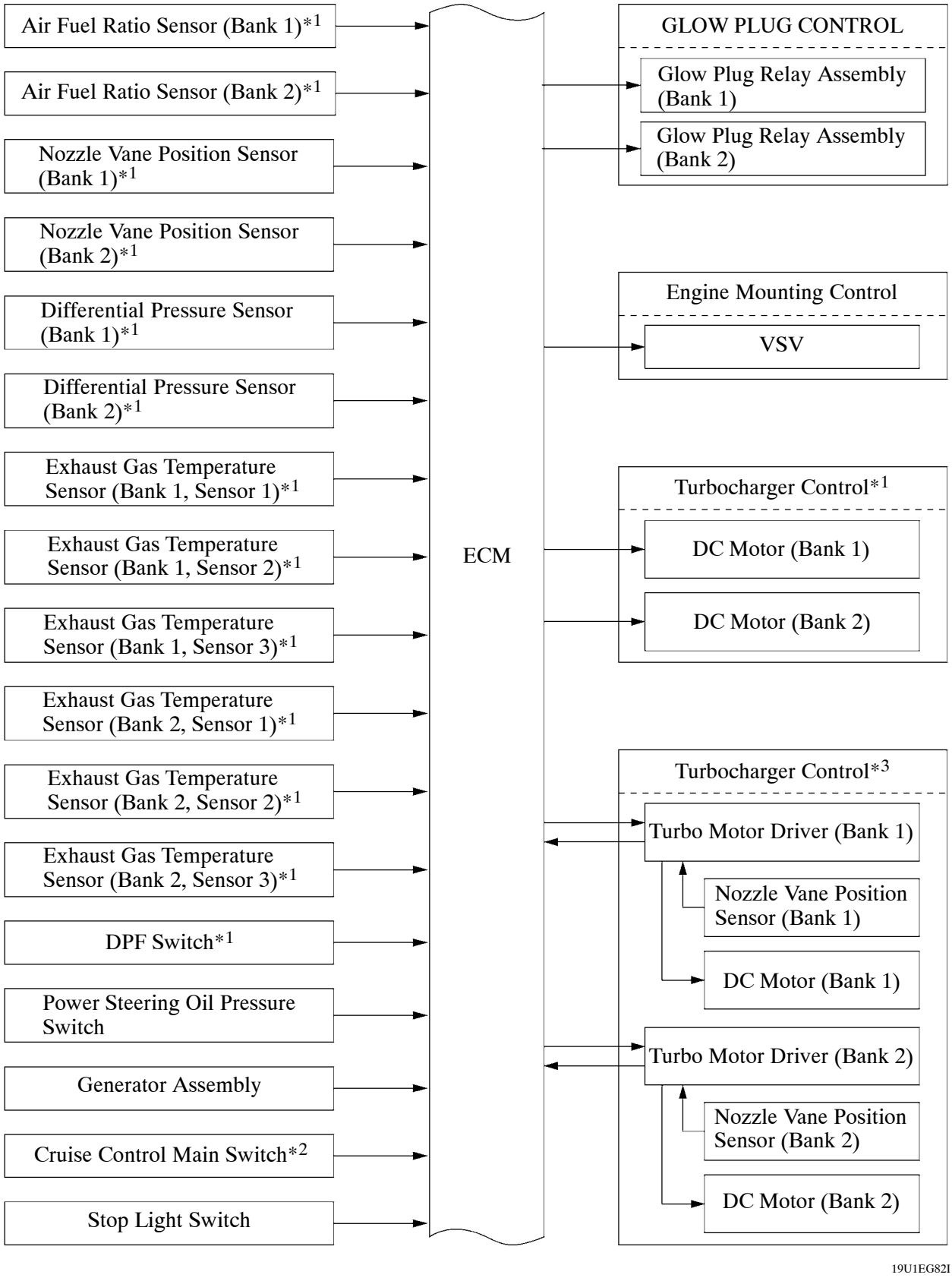


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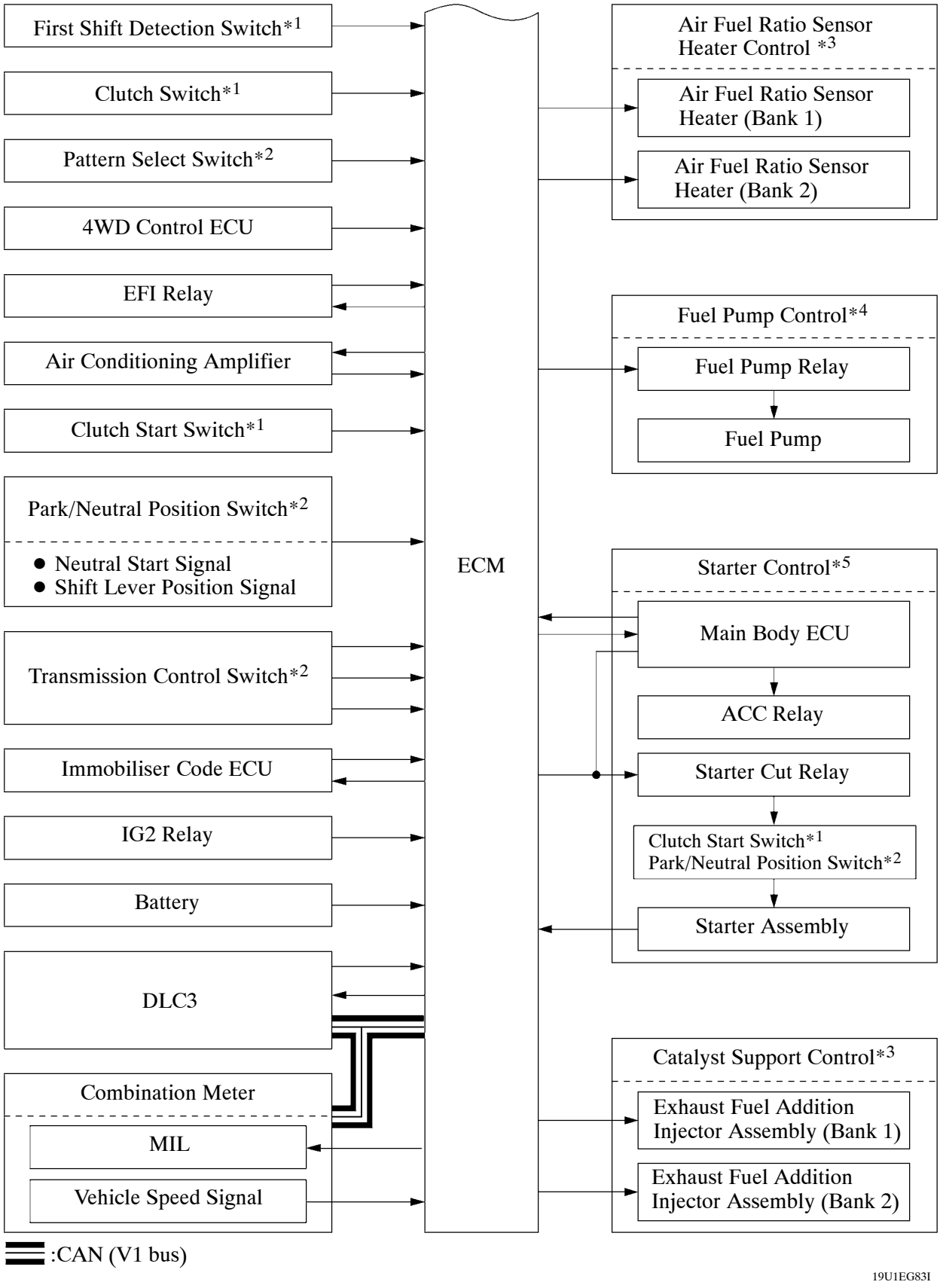
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*1: Models compliant with EURO 2, EURO 3, EURO 4 and EURO 5 emission regulations
*2: Models compliant with EURO 5 emission regulations

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*1: Models compliant with EURO 5 emission regulations
*2: Models with cruise control system
*3: Except models compliant with EURO 5 emission regulations



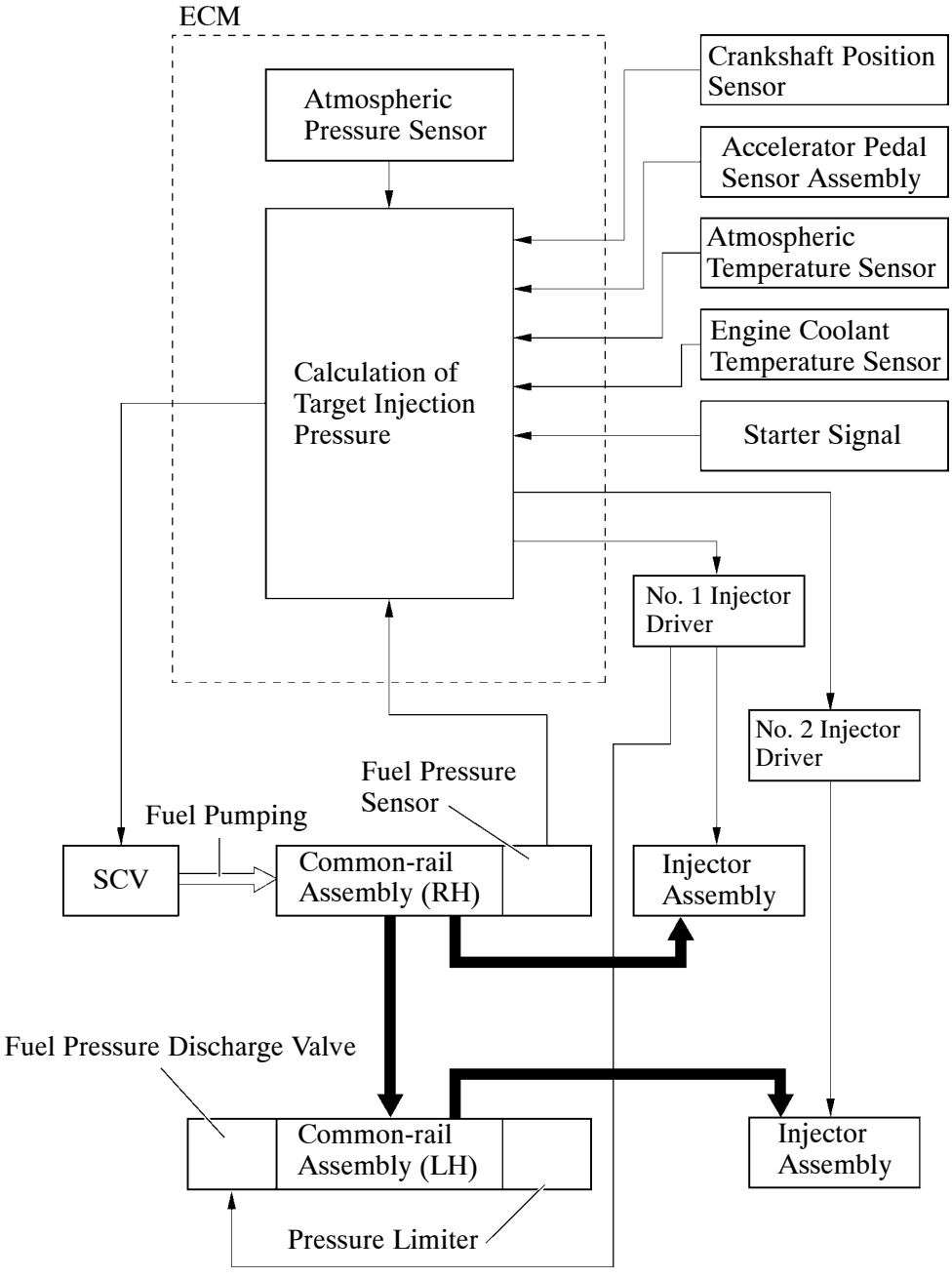
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*1: Models with manual transmission
*2: Models with automatic transmission
*3: Models compliant with EURO 5 emission regulations
*4: Models with dual fuel tank
*5: Models with entry and start system

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4. Fuel Pressure Control

- On the models compliant with EURO 5 emission regulations, the ECM calculates the target injection pressure (32 MPa to 200 MPa) based on the signals from the accelerator pedal sensor assembly and the crank position sensor. To control fuel pressure, signals sent to the Suction Control Valve (SCV) of the supply pump assembly regulate the suction volume, and signals sent to the fuel pressure discharge valve of the common-rail assembly via the No. 1 injector driver regulate the discharge volume, so that the pressure detected by the fuel pressure sensor matches the target injection pressure.
- A pressure limiter mechanically relieves the pressure if the internal pressure of the common-rail assembly rises abnormally.



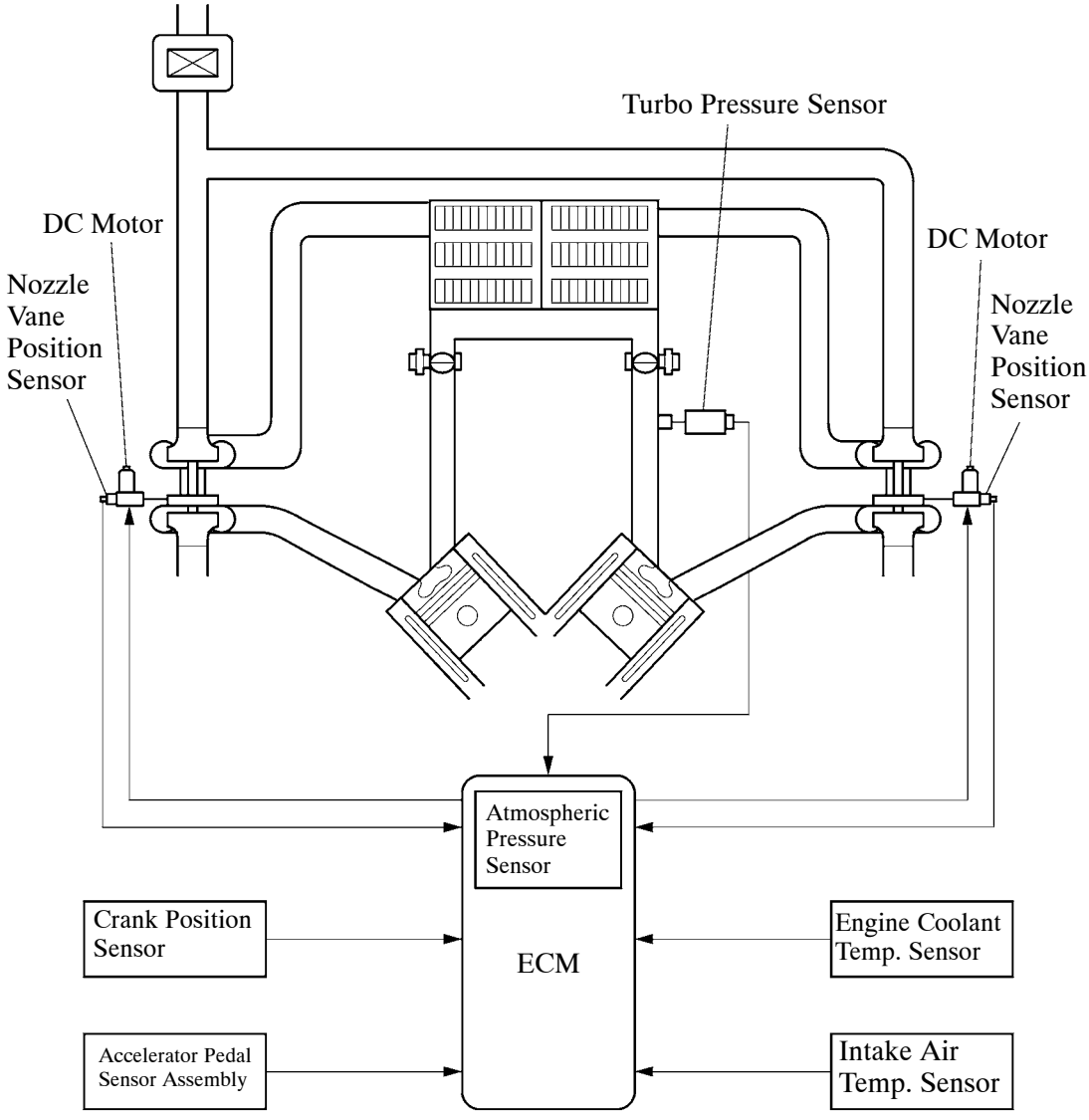
Models Compliant with EURO 5 Emission Regulations 19U1EG50I

5. Turbocharger Control

General

- On the models compliant with EURO 5 emission regulations, the turbocharger control has been changed. The turbo motor driver has been discontinued and the ECU controls the actuator directly. The basic operation is the same as that of the conventional one.
- The ECM controls nozzle vane positions in the turbocharger sub-assemblies on each bank in order to obtain the calculated target turbo pressure appropriate to the engine operation conditions.
- The ECM calculates the optimal nozzle vane position in accordance with the driving conditions (engine speed, injection volume, atmospheric pressure, and engine coolant temperature etc.), and controls the nozzle vane position in accordance with the optimal nozzle vane position and the actual nozzle vane position signal provided by the nozzle vane position sensor.

▶ System Diagram ◀



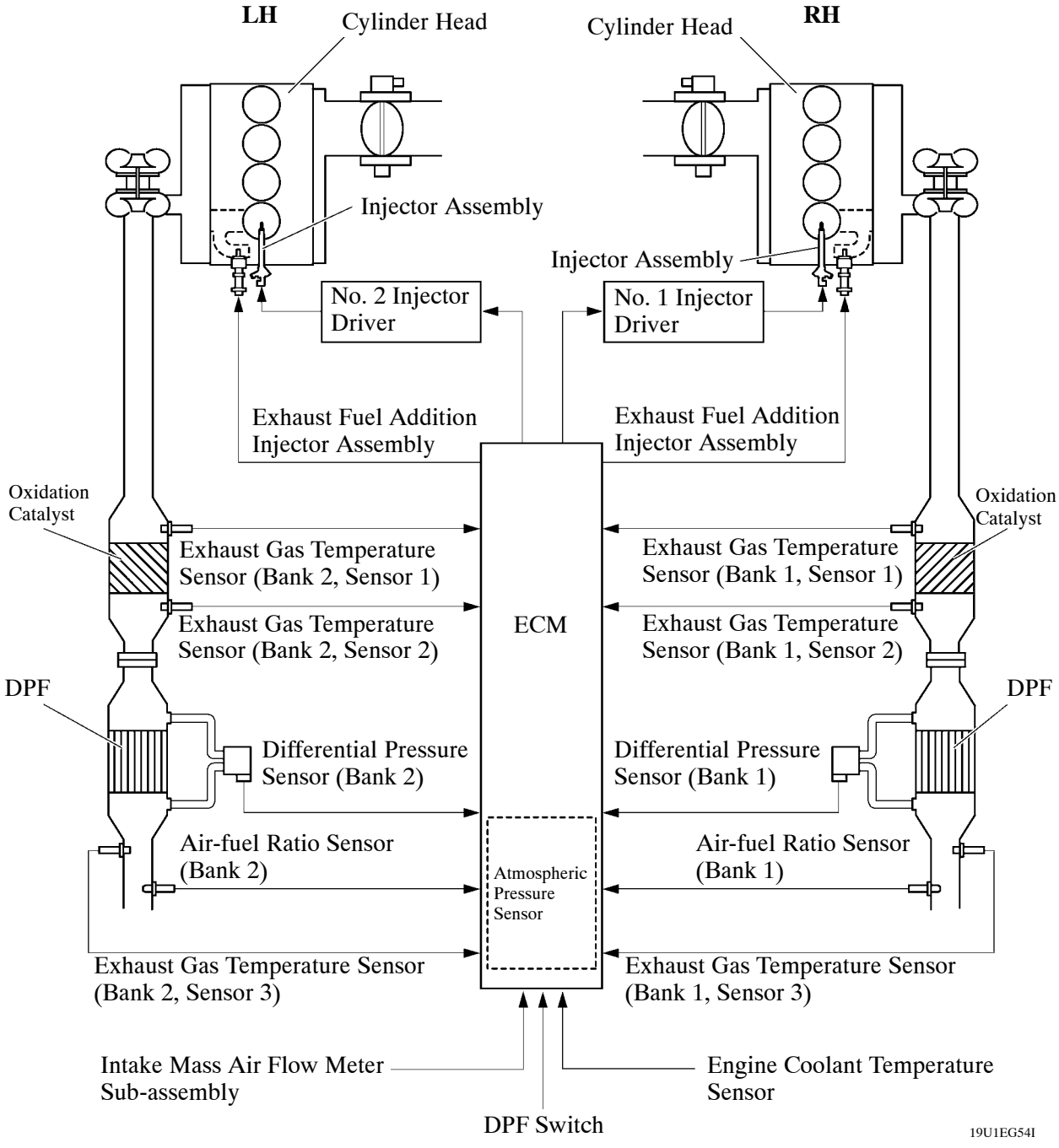
Models Compliant with EURO 5 Emission Regulations

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6. Catalyst Support Control

General

This control makes the ECM control the exhaust fuel addition injector assembly to purify the Particulate Matter (PM) captured in the filter with catalyst.
The ECM judges the Diesel Particulate Filter (DPF) condition based on injection timing, injection volume, signals from various sensors to control the injector assemblies and exhaust fuel addition injector assemblies for catalyst support control.



Construction

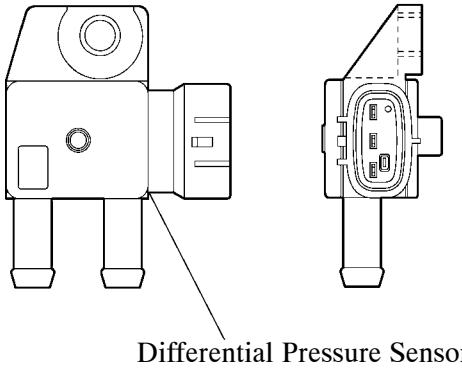
1) General

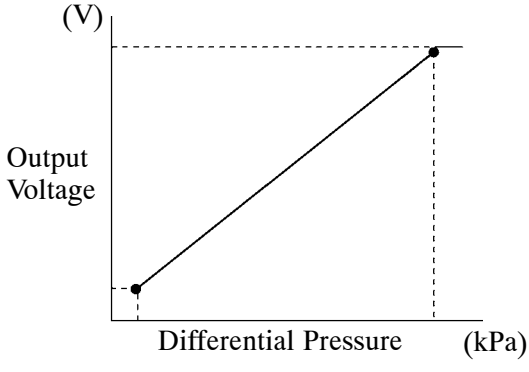
The main components of the catalyst support control are as follows:

Component	Quantity	Function
Diesel Particulate Filter (DPF)	2 (1 each bank)	Captures PM.
ECM	1	Controls the catalyst support control based on signals from each sensor.
Exhaust Fuel Addition Injector Assembly	2 (1 each bank)	Injects fuel into the fuel injection passage of the cylinder head.
Differential Pressure Sensor	2 (1 each bank)	Monitors the differential pressure before and after the DPF to detect whether the DPF is clogged.
Exhaust Gas Temperature Sensor	6 (3 each bank)	Located before the oxidation catalyst, and before and after the DPF, these sensors detect the exhaust gas temperature.
Air Fuel Ratio Sensor (Bank 1, Sensor 1)	1	Detects the oxygen concentration in exhaust gas.
Air Fuel Ratio Sensor (Bank 2, Sensor 1)	1	

2) Differential Pressure Sensor

- The differential pressure sensor measures the pressure differences between before and after the DPF with PM in order to detect clogging.
- The sensor is mounted on the transmission. The DPF and the sensor are connected with pipes and hoses.

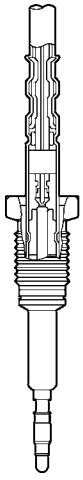


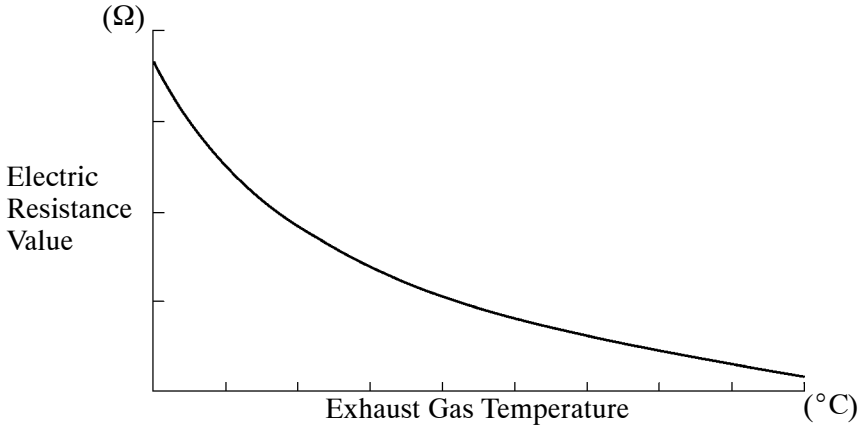


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3) Exhaust Gas Temperature Sensor

An exhaust gas temperature sensor, which is a thermistor type, is installed before the oxidation catalyst, before the DPF and after the DPF, in order to detect the temperature of the exhaust gas.

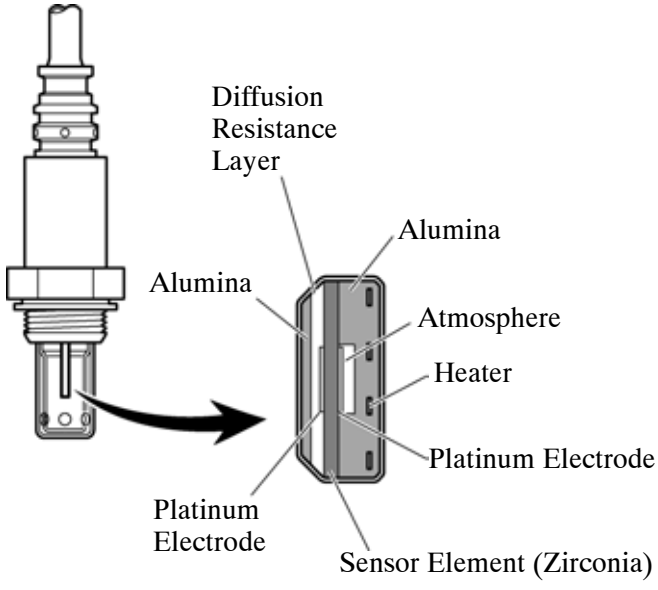




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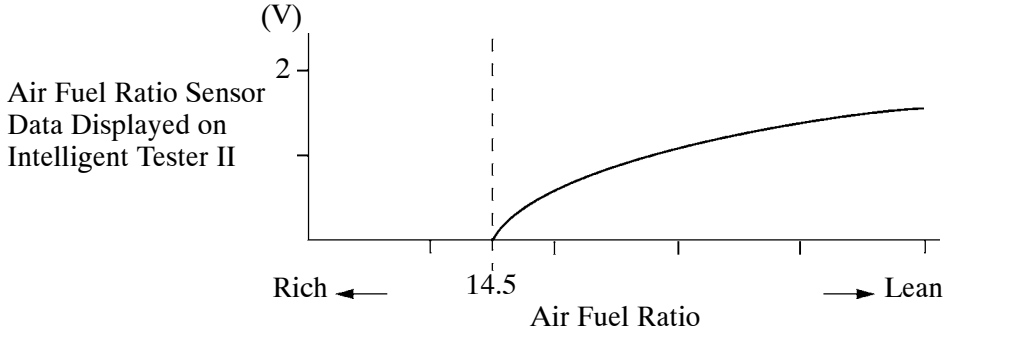
4) Air Fuel Ratio Sensor

- A planar type air fuel ratio sensor is used.
- The planar type air fuel ratio sensor uses alumina, which excels in heat conductivity and insulation, to integrate the sensor element with the heater, thus improving the warm-up performance of the sensor.
- This sensor is based on a sensor developed for gasoline engines. The cover has been changed for diesel engine application in order to eliminate the influences of the sensor temperature and PM. This sensor, which is mounted after the DPF, detects the air fuel ratio after the gas has been reduced.



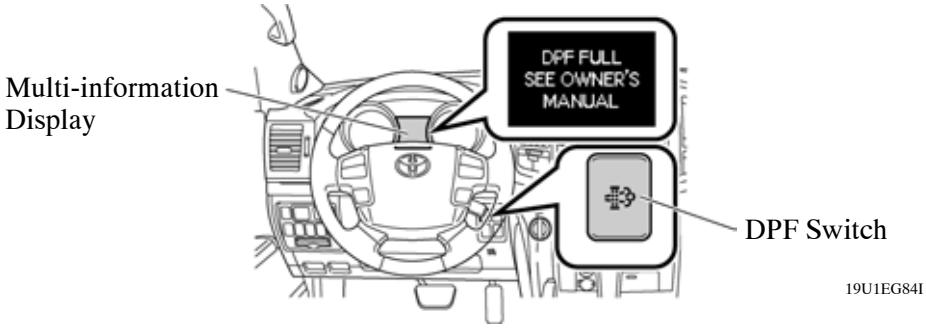
19U1EG79I

- The air fuel ratio sensor data is approximately proportional to the existing air fuel ratio. The air fuel ratio sensor converts the oxygen density to a current and sends it to the ECM.
- As a result, the detection precision of the air fuel ratio has been improved. The air fuel ratio sensor data can be read using an intelligent tester II.



Operation

- The DPF captures Particulate Matter (PM) in the exhaust gas to purify the exhaust gas. When the temperature of the DPF increases, the PM which has accumulated in the DPF is oxidized and emitted as CO_2 and H_2O.
- If the PM which has accumulated in the DPF exceeds an expected amount, the temperature may be in danger of becoming extraordinarily high when the accumulated PM is oxidized, and there may be an abnormal increase in DPF pressure loss, which could lead to engine damage. For this reason, PM regeneration is necessary to regularly oxidize the PM accumulated in the DPF.
- The ECM calculates the state of engine combustion via signals from each sensor. Based on this, the ECU calculates the amount of PM that has accumulated in the DPF (“A”). The ECM also uses signals from the exhaust gas temperature sensor to calculate the amount of accumulated PM that has been reduced by oxidation (“B”). In addition, the ECM calculates the amount of PM accumulated in the DPF based on “A” and “B”.
- When the amount of PM accumulated in the DPF exceeds a predetermined volume, PM regeneration will be forcibly performed to oxidize the PM. If the PM accumulation amount exceeds the predetermined volume, or if the output value of the differential pressure sensor exceeds a predetermined value, the ECM changes the combustion control in the following order: it increases the exhaust gas temperature, forcibly increases the DPF temperature by injecting the fuel from the exhaust fuel addition injector assemblies and oxidizes the PM accumulated in the DPF.
- PM regeneration is automatically performed to keep the DPF normal. However, the DPF temperature cannot be increased enough to perform PM regeneration when driving at an extremely low speed or when driving for an extraordinarily short time. As this situation could be hazardous to the DPF if it continues for a long time, a warning needs to be given to the driver. At this time, “DPF FULL SEE OWNER’S MANUAL” will be displayed on the multi-information display as a warning message.
- If the warning message is displayed, the driver can perform PM regeneration by driving at an appropriate speed or using the DPF switch with the vehicle idling. The message will disappear when the accumulated PM in the DPF decreases to the normal level.
- When driving while “DPF FULL SEE OWNER’S MANUAL” is being displayed, “DPF FULL ENGINE SERVICE REQUIRED” will be displayed on the multi-information display. In this case, the driver can conduct PM regeneration using the DPF switch while idling.
- In addition, if the driver keeps driving without conducting PM regeneration even though the warning message is displayed, PM will keep accumulating in the DPF which could cause a hazardous situation. In this case, the ECM controls the engine output and torque to protect the engine, and the MIL will turn on. In this situation, PM regeneration is not possible, and the driver will have to replace the DPF at a Toyota dealer.



Service Tip

- The ECM confirms activation of the oxidation catalyst by the output value of the exhaust gas temperature sensor exceeding the predetermined value.
- When replacing the front exhaust pipe with a new one, it is necessary to perform initialization of the DPF deteriorate data history in the ECM by using an intelligent tester II.
- When replacing the ECM with a new one, it is necessary to read DPF deteriorate data history from the installed ECM and then transfer that data history to the new ECM by using an intelligent tester II. When the DPF deteriorate data history is not transferred, Diagnostic Trouble Code (DTC) P1601 is stored in the ECM, and the MIL comes on.
- When replacing both the front exhaust pipe and the ECM, it is necessary to perform initialization of the DPF deteriorate data history in the ECM using an intelligent tester II. When DPF deteriorate history initialization is not performed, DTC P1601 is stored in the ECM and the MIL comes on.