

8. Engine Control System

General

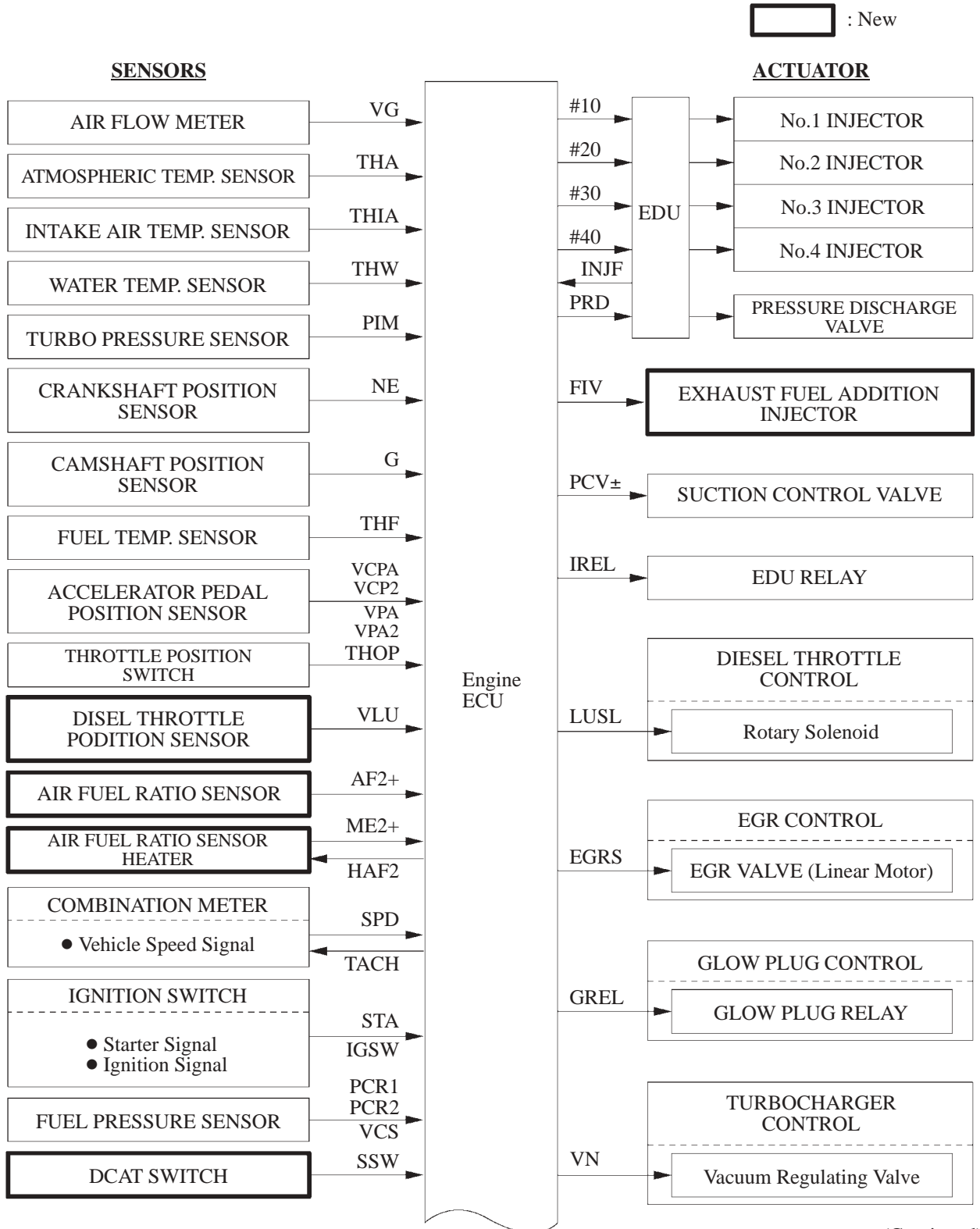
Along with the adoption of the D-CAT, the following controls have been added:

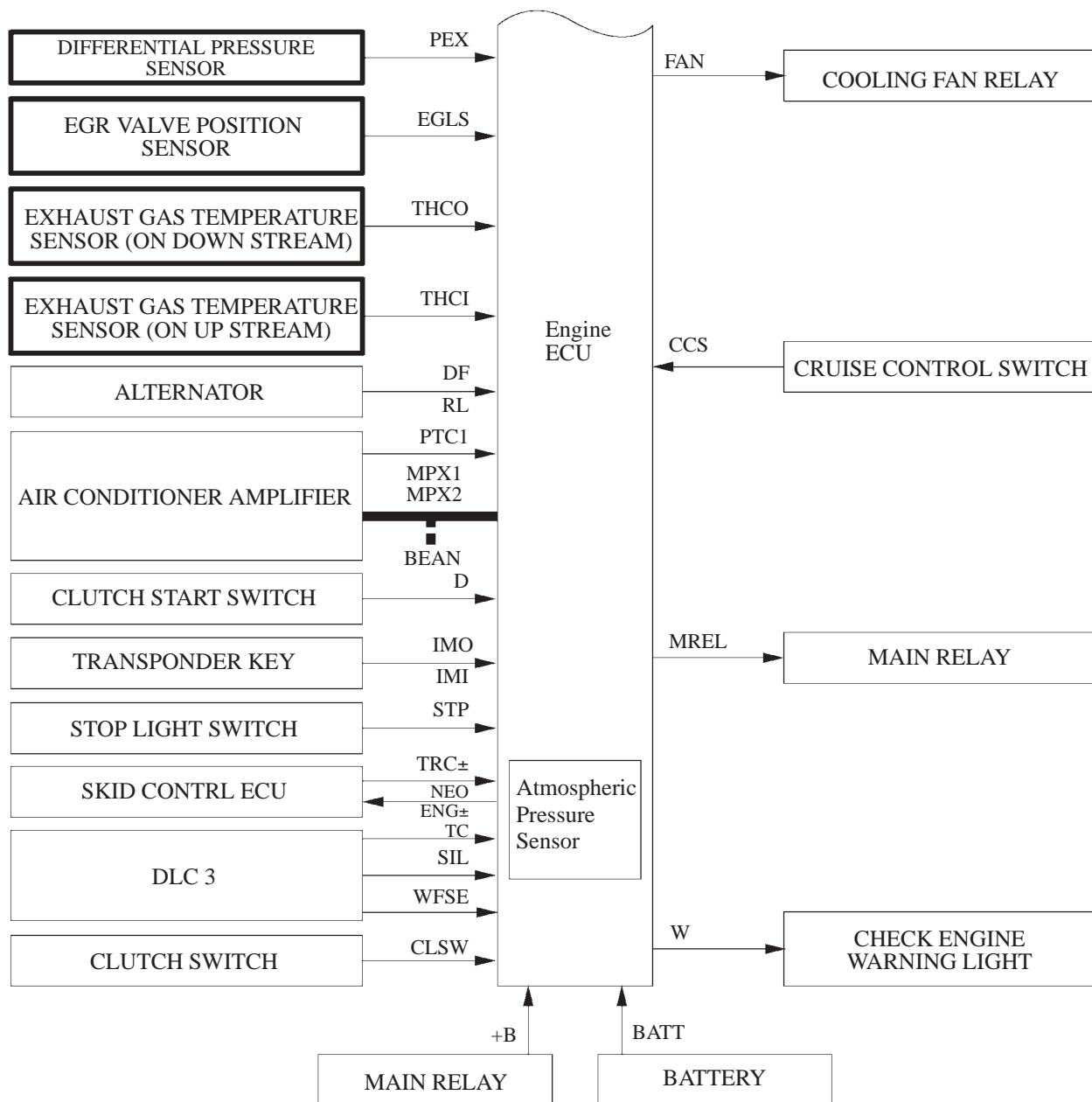
► System Comparison List ◄

System	Outline	With D-CAT	Without D-CAT
Fuel Injection Volume Control	Based on the signals received from the sensors, the engine ECU determines the fuel injection volume in accordance with the engine condition.	○	○
Fuel Injection Timing Control	Based on the signals received from the sensors, the engine ECU determines the fuel injection timing in accordance with the engine condition.	○	○
DPNR Catalyst Support Control (See page 90)	Adds fuel into the exhaust gas in order to reduce PM and NOx.	○	—
Fuel Pressure Control	Based on the signals received from the sensors, the engine ECU determines the fuel pressure via SCV (Suction Control Valve) and pressure discharge valve in accordance with the engine condition.	○	○
Pilot Injection Control	Based on the signals received from the sensors, the engine ECU determines pilot injection volume/timing, and interval (between pilot injection and main injection) in accordance with the engine condition.	○	○
Idle Speed Control	The engine ECU determines the idle speed in accordance with the engine condition, and controls the fuel injection volume in order to maintain the target idle speed.	○	○
Glow Plug Control	Controls the length of time when the current is applied to the glow plugs, in accordance with engine coolant temperature.	○	○
EGR Control	Based on the signals received from the sensors, the engine ECU determines the EGR volume via EGR valve and intake restrictor valve in accordance with the engine condition.	○	○
Turbo Pressure Control	Based on the signals received from the sensors, the engine ECU controls the actuator via VRV in accordance with the engine condition.	○	○
Intake Restrictor Valve Control	Fully close the intake restrictor valve in order to reduce the vibration when the engine is stopped.	○	○
Air Conditioner Cut-off Control	By controlling the air conditioner compressor ON or OFF in accordance with the engine condition, drivability is maintained.	○	○
Engine Immobilizer	Prohibits fuel injection if an attempt is made to start the engine with an invalid ignition key.	○	○
Diagnosis (See page 91)	When the engine ECU detects a malfunction, the engine ECU diagnoses and memorizes the failed section.	○	○
Fail-Safe	When the engine ECU detects a malfunction, the engine ECU stops or controls the engine according to the data already stored in the memory.	○	○

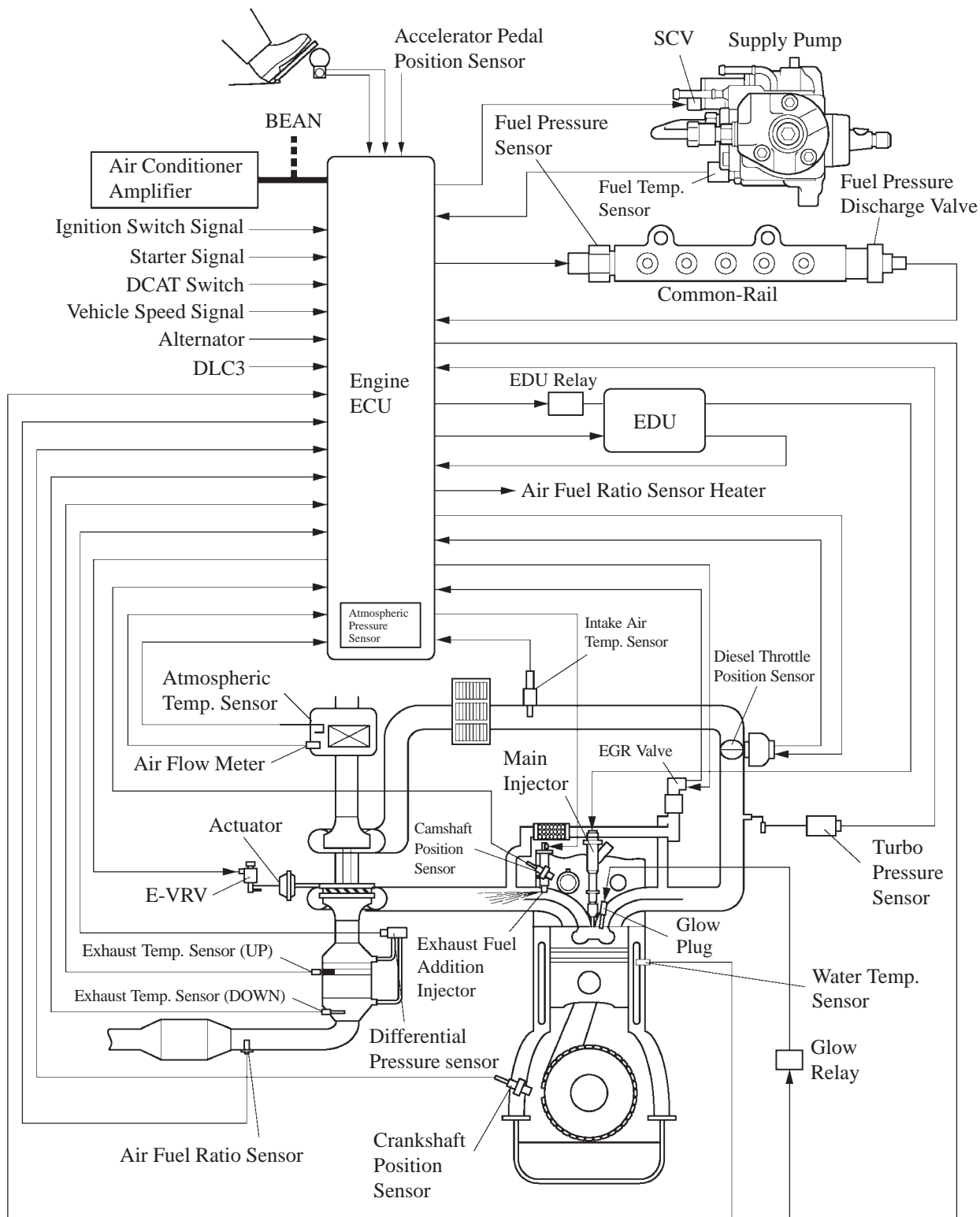
Construction

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

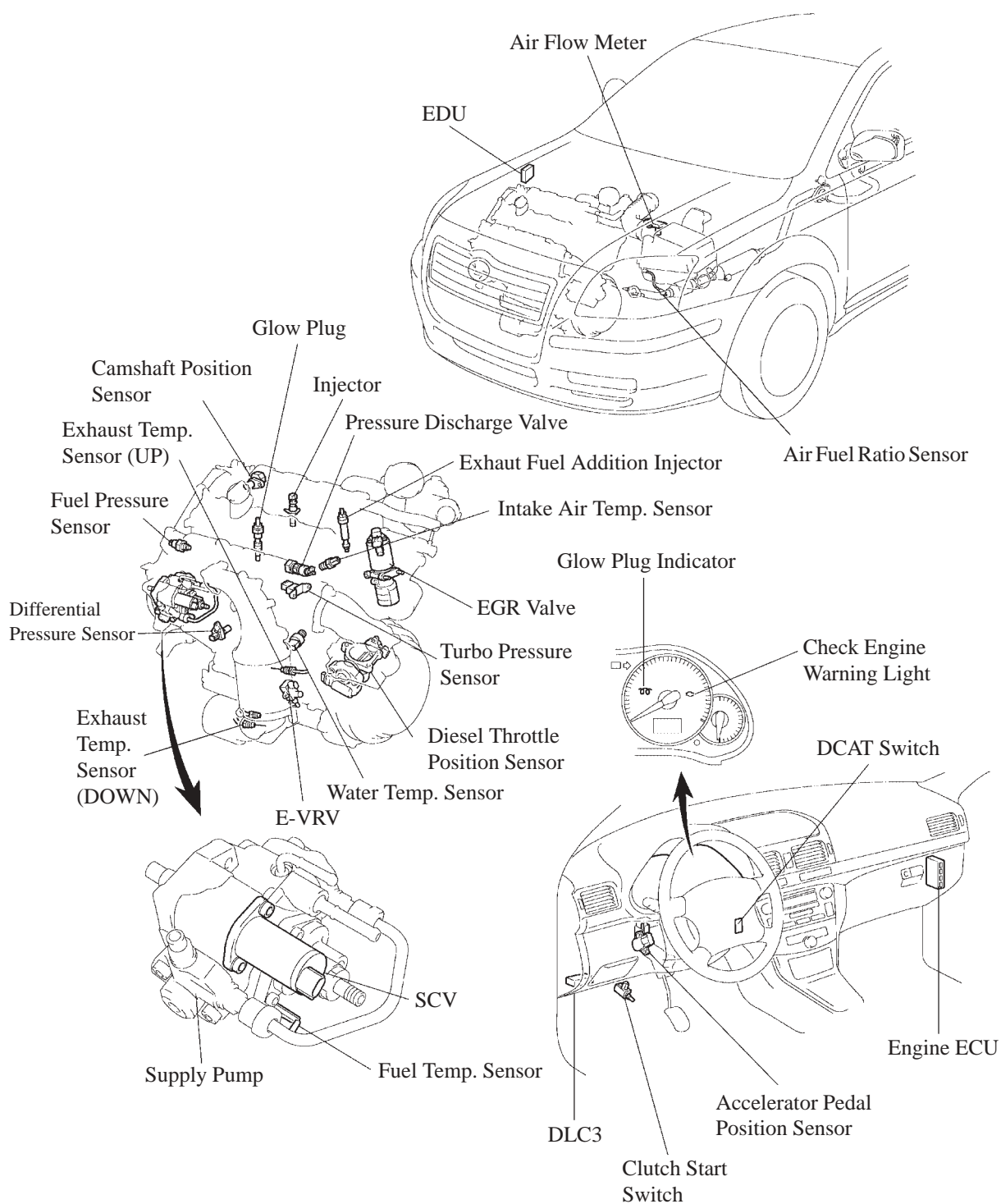




Engine Control System Diagram



Layout of Main Components



Main Components of Engine Control System

1) General

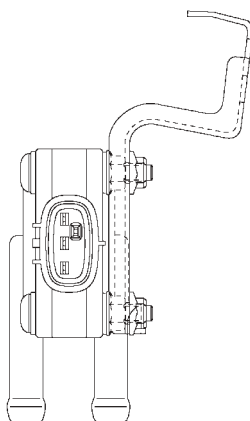
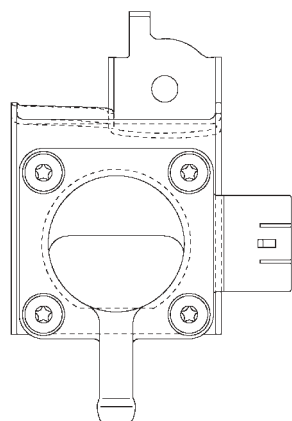
The main components of the 1CD-FTV engine With D-CAT control system are as follows:

☐ : New

Components	Outline	Quantity	
		With D-CAT	Without D-CAT
Engine ECU	32-bit	1	←
Air Flow Meter	Hot- wire Type	1	←
Crankshaft Position Sensor (Rotor Teeth)	Pick-up Coil Type (36-2)	1	←
Camshaft Position Sensor (Rotor Teeth)	Pick-up Coil Type (1)	1	←
Accelerator Pedal Position Sensor	Linear Type	2 (Main, Sub)	←
Fuel Pressure Sensor	Semiconductor Strain Gauge Type (Two Circuits)	1	←
EDU	DC/DC Converter	1	←
Differential Pressure Sensor	Semiconductor Strain Gauge Type	1	—
Exhaust Gas Temperature Sensor (UP, DOWN)	Thermister Type	2	—
Air Fuel Ratio Sensor	Type with Heater (Cup Type)	1	—
EGR Valve Position Sensor	Contact point type	1	—
Diesel Throttle Position Sensor	Non-contact point type	1	—
DCAT Switch	DCAT Switch For switching to fuel with sulphur content	1	—

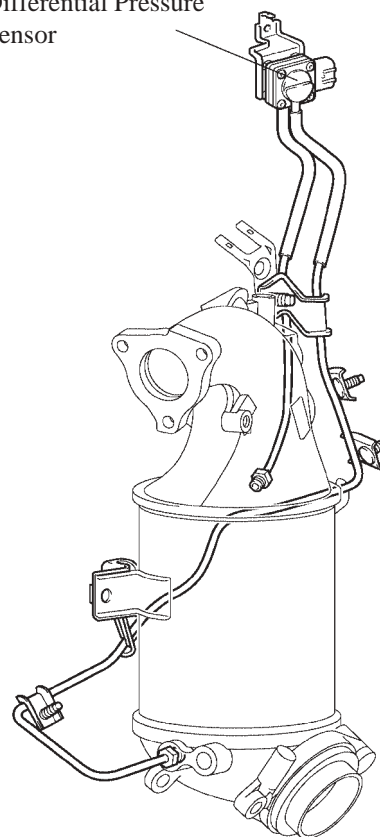
2) Differential Pressure Sensor

- The differential pressure sensor measures the pressure differences between front and back of the DPNR catalyst with PM in order to detect the clogging.
- The sensor is mounted on the side of the vehicle, where the effects of vibration are minimal. The DPNR catalyst and the sensor are connected with pipes.

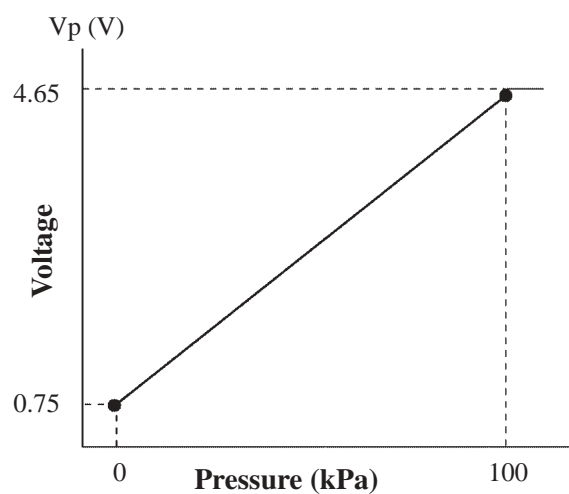


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Differential Pressure
Sensor



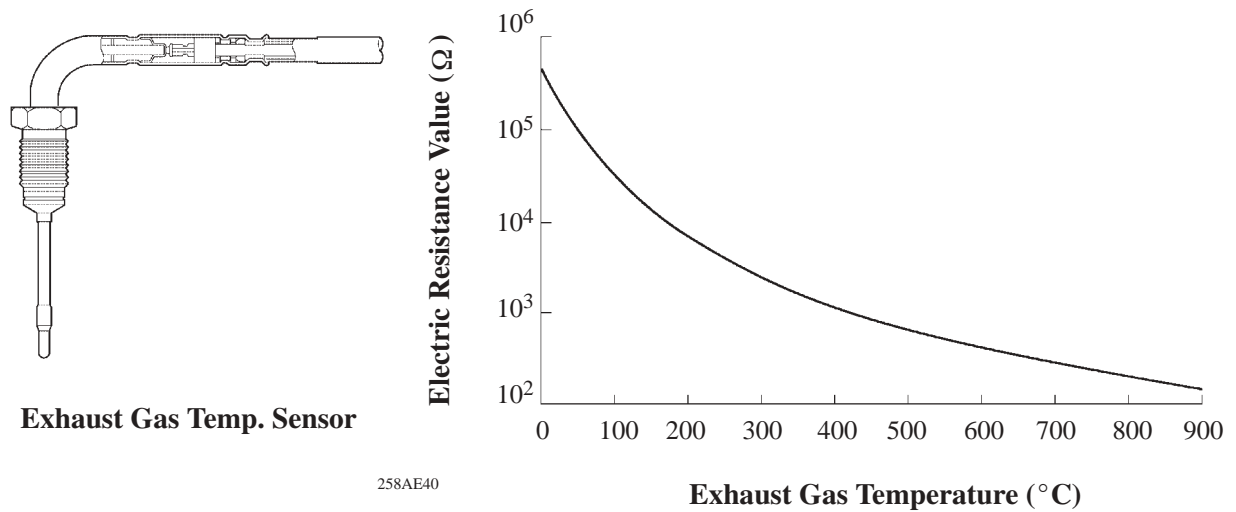
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3) Exhaust Gas Temp. Sensor

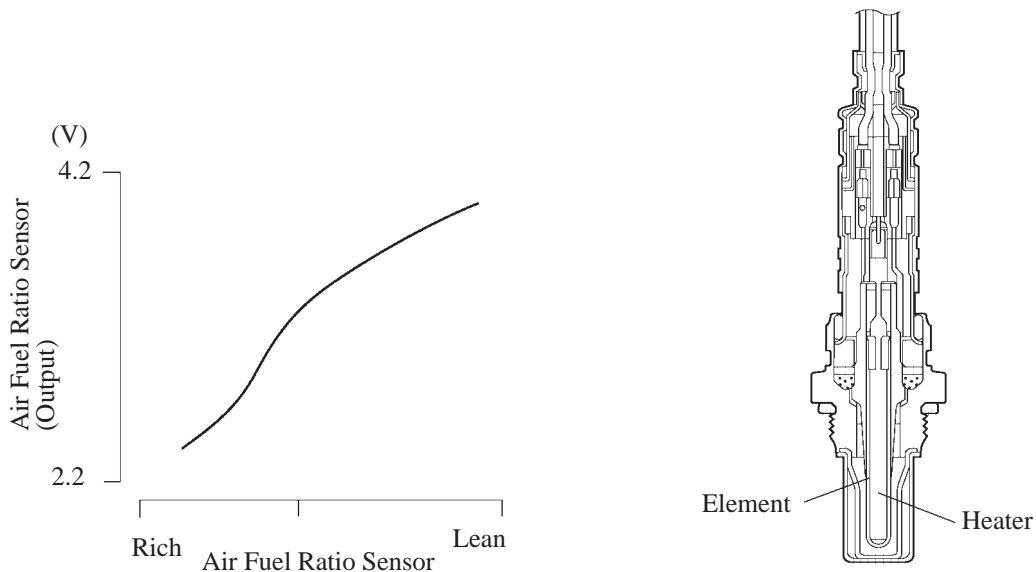
The exhaust gas temperature sensor, which is a thermister type, is installed in front and back of the DPNR catalyst, in order to detect the temperature of the catalyst.



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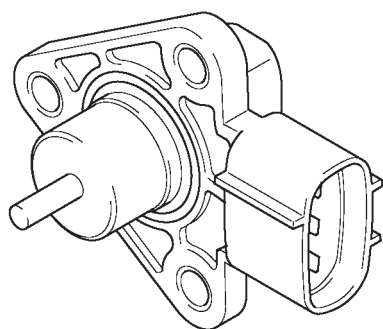
4) Air Fuel Ratio Sensor

This sensor is based on a sensor that has been developed for gasoline engines. Its cover has been changed for diesel engine applications in order to eliminate the influences of the sensor temperature and the PM. This sensor, which is mounted after the DPNR catalyst, detects the air-fuel ratio after the gases have been reduced.

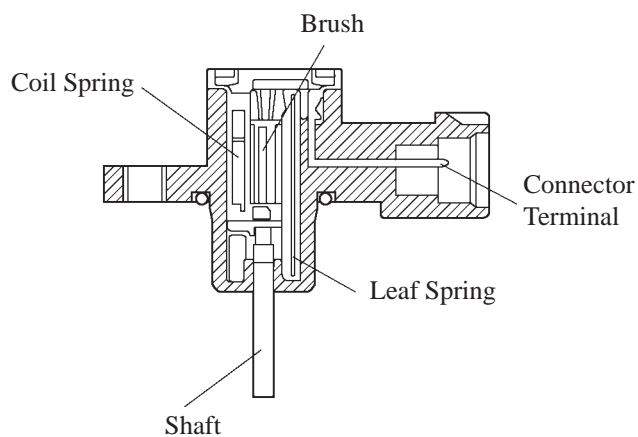


5) EGR Position Sensor

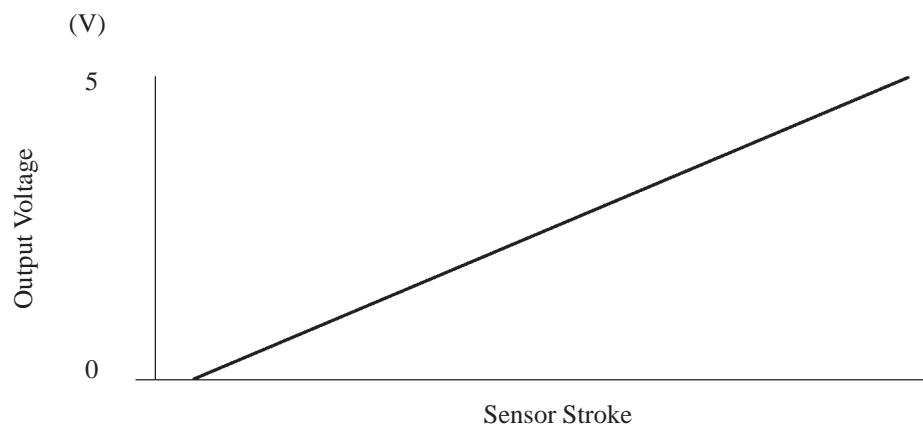
EGR Position Sensor detects the amount of lift of the EGR valve and sends the corresponding signal to the engine ECU.



EGR Position Sensor



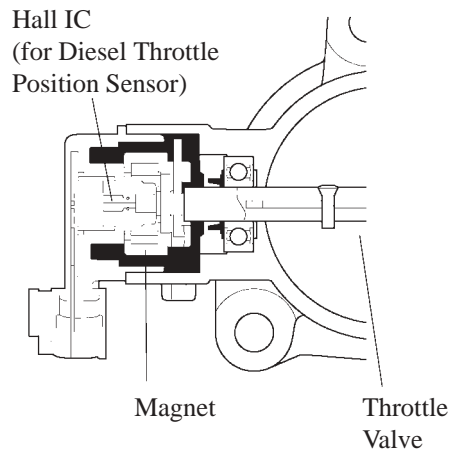
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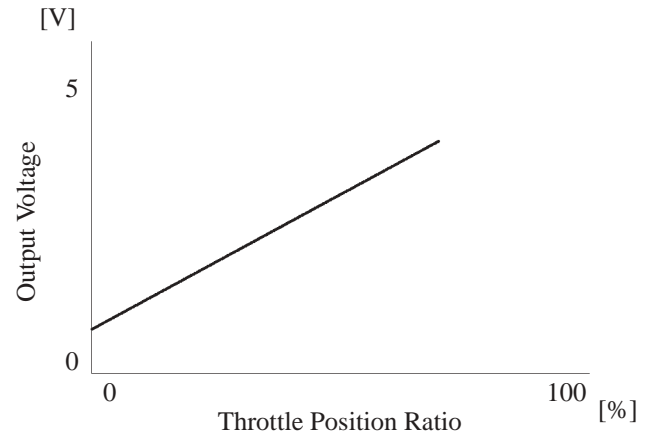
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6) Diesel Throttle Position Sensor

The Diesel throttle position sensor is mounted on the throttle body, to detect the opening angle of the throttle valve, the throttle position sensor converts the magnetic flux density that changes when the magnetic yoke (located on the same axis as the throttle shaft) rotates around the hall IC into electric signals to operate the throttle control motor.



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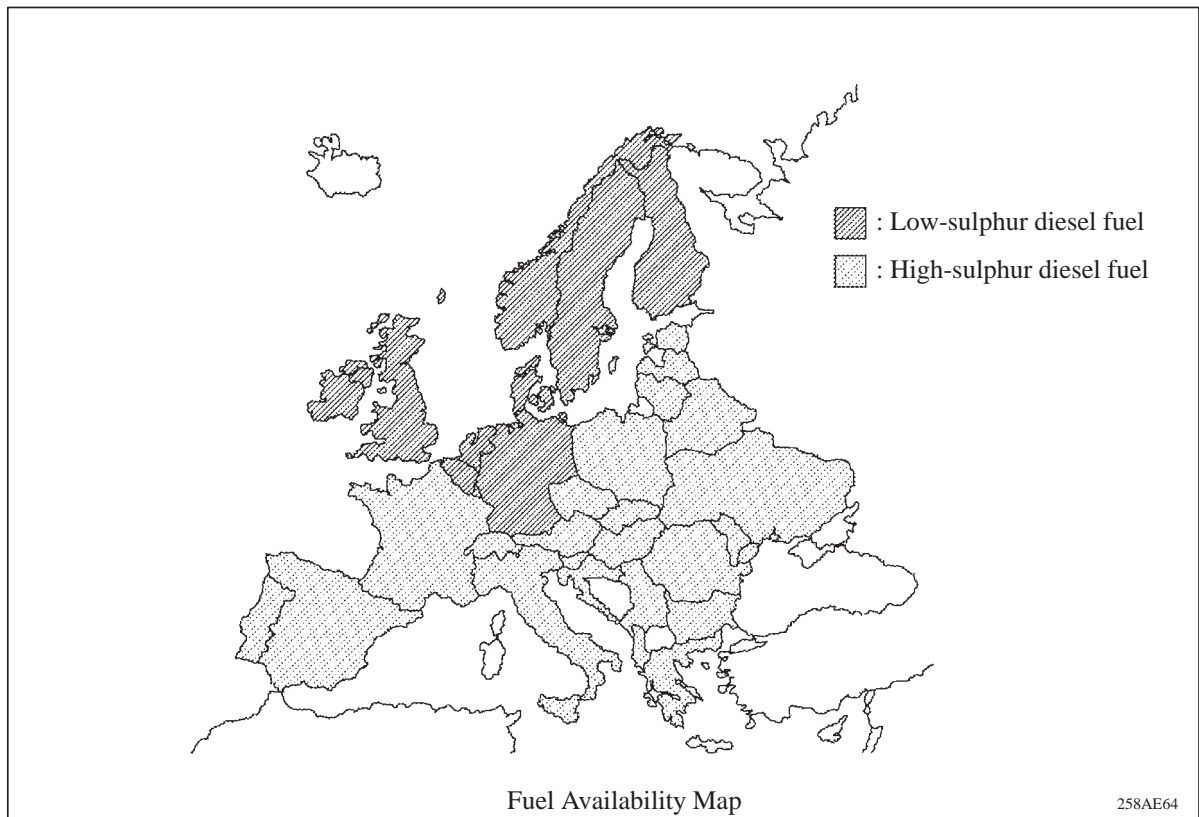


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7) DCAT Switch

The ability of this system is brought into full play through the use of low-sulphur diesel fuel. If high-sulphur diesel fuel must be used temporarily because low-sulphur diesel fuel is unavailable, the driver can turn this switch ON to minimize damage to the DPNR catalyst.

*: The map below shows the countries in which low-sulphur diesel fuel is available (as of September 2003).



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DPNR Catalyst Support Control

1) General

The DPNR catalyst support control is divided into the following: during NO_x storage, NO_x reduction, PM reclaiming control, and sulphur poison recovery control.

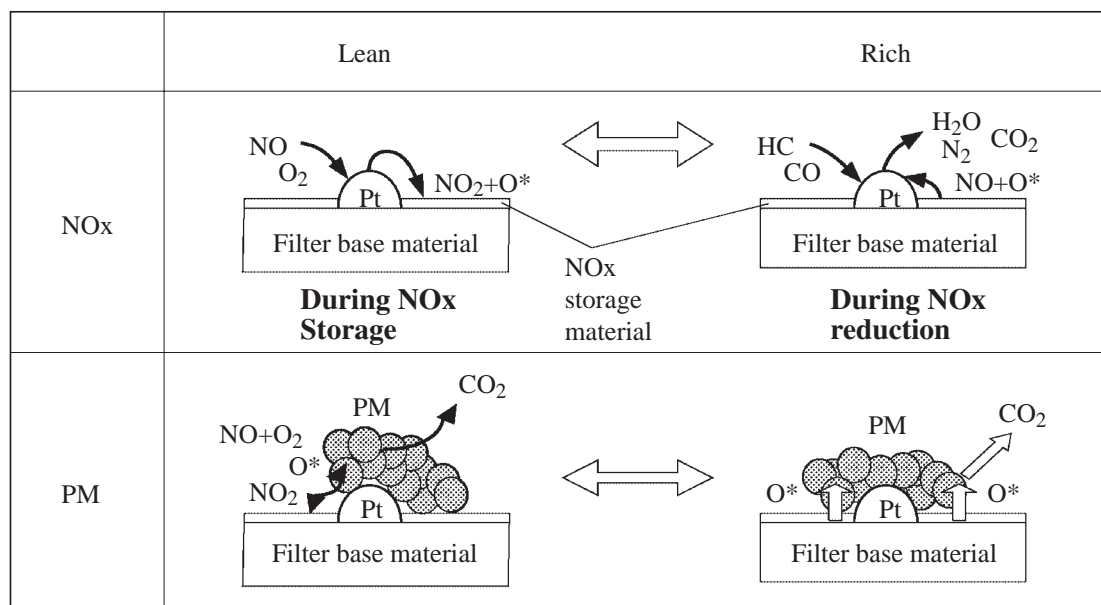
DPNR catalyst support control	Air-fuel ratio control of exhaust gas	Main reduction substances	Main storage substances
During NO _x storage	Lean	PM, HC, CO	NO _x , SO _x
During NO _x reduction	Rich	NO _x , PM, HC, CO	SO _x
During PM reclaiming control	Lean	PM	—
During sulphur poison recovery control	Rich/Lean	SO _x	—

2) During NO_x storage

- Normally, the air-fuel ratio of the diesel engine is in the lean state, and the NO_x becomes stored in the NO_x storage material in the form of nitrate (NO₂).
- The active oxygen (O) that is created at that time oxidizes the PM. Thereafter, the excess oxygen from the surrounding area oxidizes the PM at once, which becomes discharged in the form of CO₂.

3) During NO_x Reduction

- The air-fuel ratio of the exhaust gas is enriched momentarily by the EGR and the exhaust fuel addition. As a result, NO and a large amount of oxygen are created in the DPNR catalyst, and when the HC and CO in the exhaust gas increase, the NO becomes reduced to N₂ by HC and CO.
- At this time, the large amount of active oxygen that is created in the catalyst promotes the oxidation of the PM, which is discharged in the form of CO₂.



Diagnosis

1) General

- The diagnosis system of the 1CD-FTV with D-CAT engine uses the EURO-OBD (Europe On-Board Diagnosis) that complies with European regulations.
- When the Engine ECU detects a malfunction, the Engine ECU makes a diagnosis and memorizes the failed section. Furthermore, the check engine warning light in the combination meter illuminates to inform the driver.
- At the same time, the DTCs (Diagnostic Trouble Codes) are stored in memory. The DTCs can be read by connecting a hand-held tester.
- The DTCs have been further divided to correspond to SAE codes.
- Along with the addition of the D-CAT, DTCs (Diagnostic Trouble Codes) have been added.
- For details, see the Avensis Repair Manual (Pub. No. RM1045E).

Fail-Safe

When the Engine ECU detects a malfunction, the Engine ECU stops or controls the engine according to the data already stored in the memory as the following conditions.

► Fail-Safe Control List ◀

: New

DTC	Fail-safe Operation	Fail-safe Deactivation Conditions
P0087	VTA is fixed at 10 %	IG OFF
P0088	VTA is fixed at 10 %.	IG OFF
P0093	After fail-safe driving control is performed for 1 minute, engine stalls.	IG OFF
P0095, P0097, P0098	Intake air temperature is fixed at 150°C (302°F).	Returned to normal condition
P0105, P0107, P0108	Turbo pressure is set at fixed value.	Returned to normal condition
P0115, P0117, P0118	When fuel temp. sensor operates normal and intake air temp. is less than 15°C (59°F), value of fuel temp. sensor is substituted. When fuel temp. sensor operates normal and intake air temp. is more than 20°C (68°F), value is fixed at 110°C (230°F). When the fuel temp. sensor is abnormal, value is fixed at 40°C (104°F).	Returned to normal condition
P0168	Out put limit	Returned to normal condition
P0180, P0182, P0183	Fuel temperature is fixed at 40°C (104.0°F).	Returned to normal condition
P0190, P0191, P0192, P0193	VTA is fixed at 10 %.	IG OFF
P0120, P0122, P0123	Open circuit in diesel throttle position sensor Accelerator opening limit at 30%	IG OFF
P0200	VTA is fixed at 25 %.	IG OFF
P0335	Out put limit	Returned to normal condition
P048	VTA is fixed at 25 %.	IG OFF
P0405, P0406	Open circuit in EGR position sensor Accelerator opening limit at 30%	IG OFF
P0500	Vehicle speed is fixed at 0 km/h (0 mph).	Vehicle speed \geq 10 km/h (6 mph)
P1229	VTA is fixed at 10 %.	IG OFF
P1271	VTA is fixed at 25 %.	IG OFF
P1272	VTA is fixed at 25 %.	IG OFF
P1425, P1427, P1428	Open circuit in differential pressure sensor No operation occurs	—
P2120, P2122, P2123, P2125, P2127, P2128, P2138	Out put limit	+B OFF
P0544, P0545, P0546, P2031, P2032, P2033	Open circuit in exhaust gas temperature sensor Accelerator opening limit at 30%	IG OFF
P2047	Open circuit in exhaust fuel addition injector Accelerator opening limit at 30%	IG OFF