■ENGINE CONTROL SYSTEM

1. General

The engine control system for the 2AD-FTV engine has following features. The engine ECU that controls this system is made by DENSO.

System	Outline
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.
Fuel Pressure Control (See page EG-104)	Based on the signals received from the sensors, the engine ECU controls fuel pressure using the SCV (Suction Control Valve) according to the engine condition.
Pilot Injection Control	Based on the signals received from the various 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 water temperature.
EGR Control	Based on the signals received from the sensors, the engine ECU determines the EGR volume via EGR valve and diesel throttle control 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 E-VRV in accordance with the engine condition.
Intake Throttle Control	Based on the signals received from the various sensors, the engine ECU determines diesel throttle control valve position in accordance with the engine condition.
	Fully close the diesel throttle control valve in order to reduce the vibration when the engine is stopped.
Cooling Fan Control (See page EG-53)	Cooling fan operation is controlled by signals from the engine ECU based on the water temperature sensor signal and the condition of the air conditioner operation.
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 key.

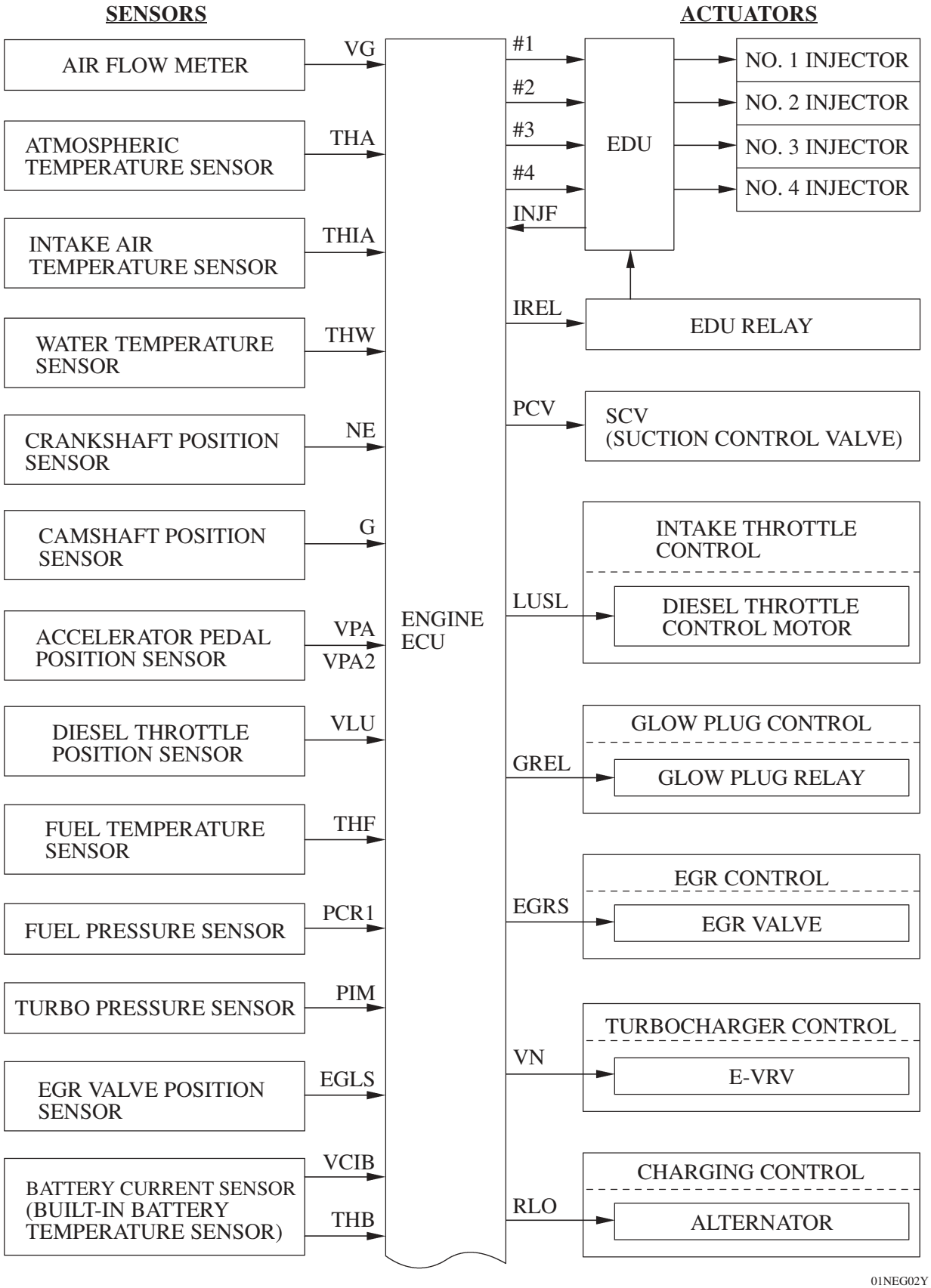
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System	Outline
Cranking Hold Function* (Starting Control) (See page EG-55)	Once the engine switch is pushed, this control continues to operate the starter until the engine is started.
Charging Control (See page EG-57)	The engine ECU regulates the charging voltage of the alternator in accordance with the driving conditions and the charging state of the battery.
Oil Maintenance Management System (See page EG-105)	When the engine ECU determines engine oil and oil filter deterioration, the master warning light and engine oil change reminder light turn on to inform the driver.
Diagnosis (See page EG-107)	When the engine ECU detects a malfunction, the engine ECU diagnoses and memorizes the failed section.
Fail-safe (See page EG-108)	When the engine ECU detects a malfunction, the engine ECU stops or controls the engine according to the data already stored in the memory.

*: Models with Smart Entry & Start System

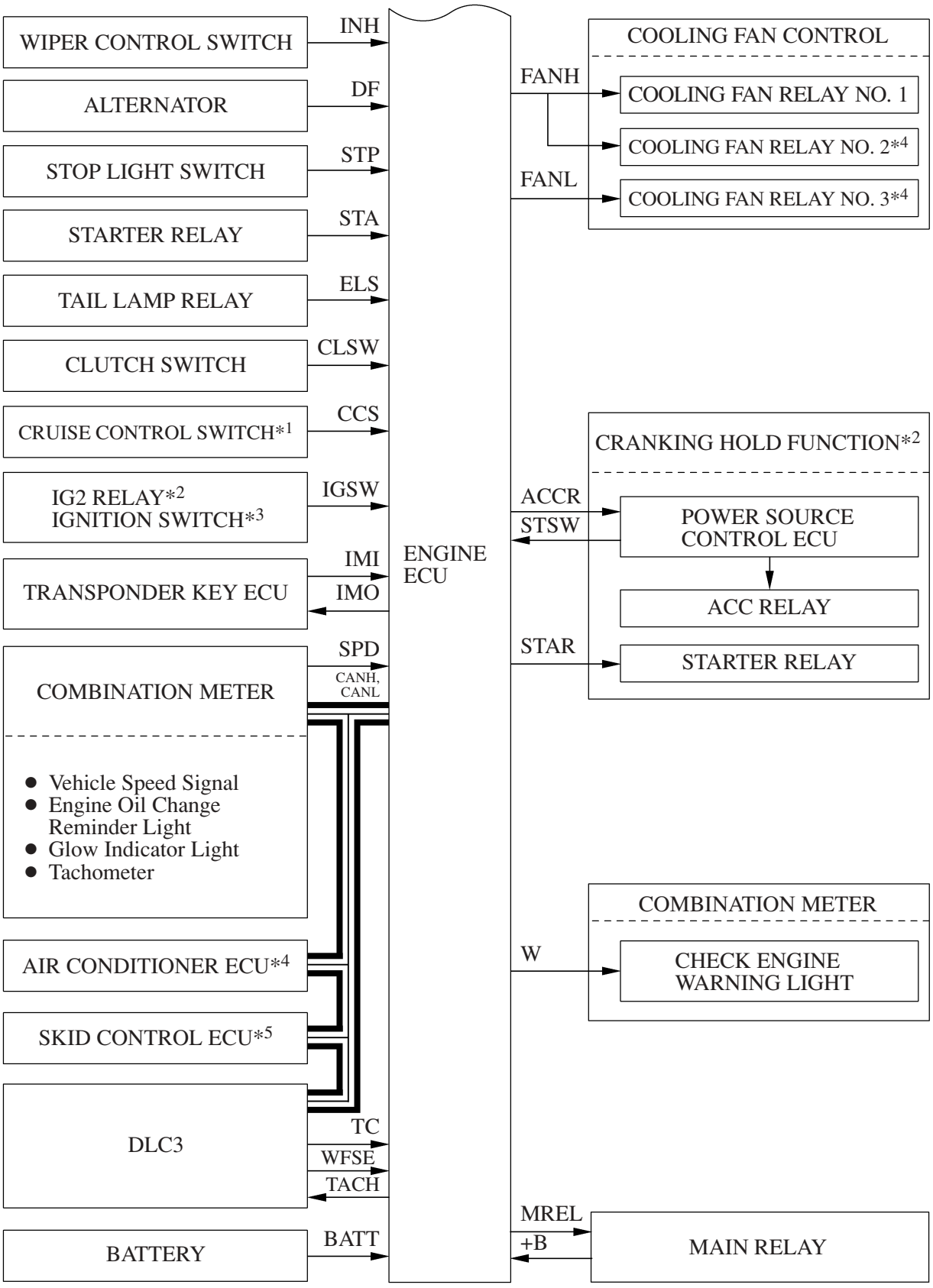
2. Construction

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



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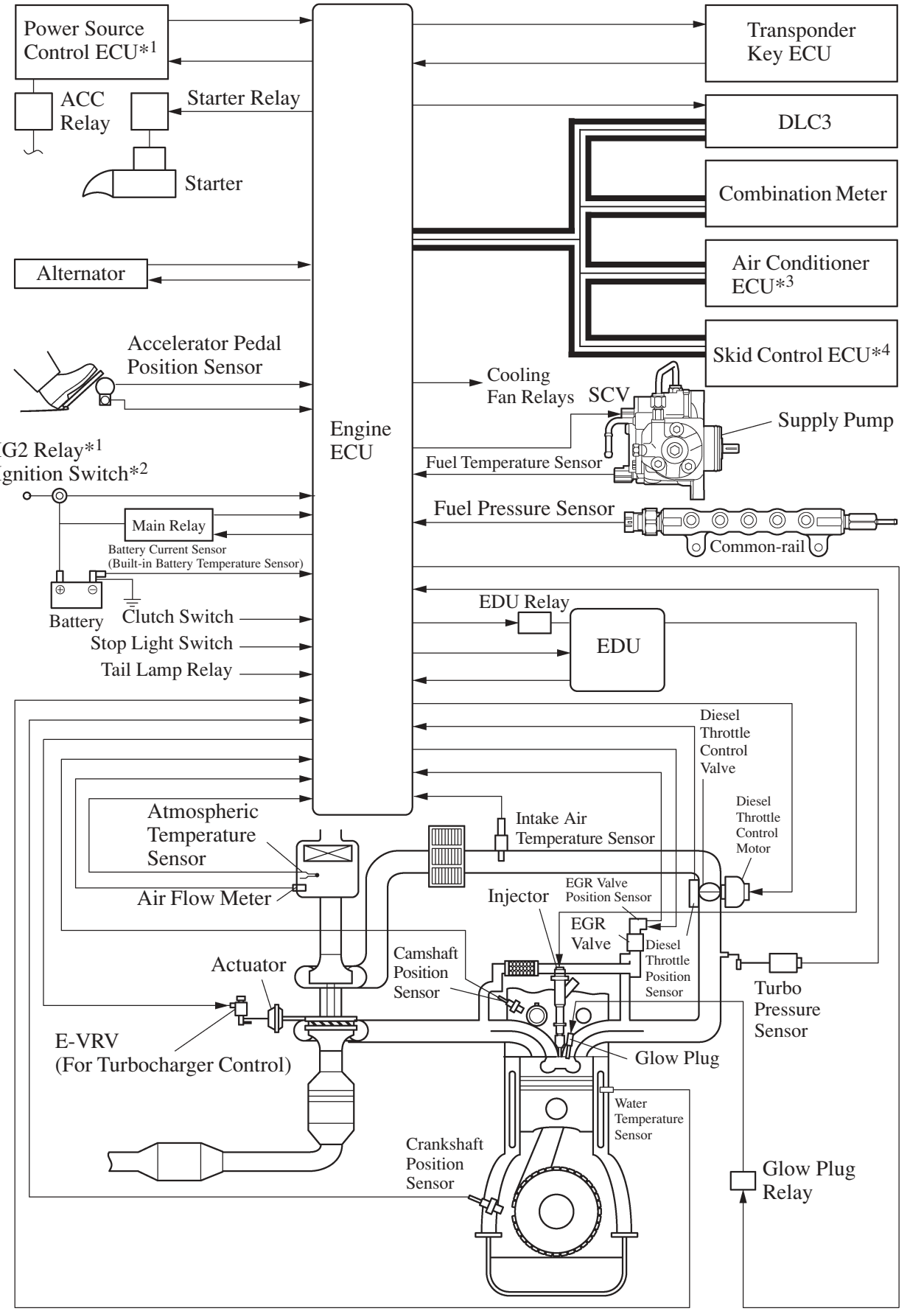
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01NEG03Y

*1: Models with Cruise Control System
*2: Models with Smart Entry & Start System
*3: Models without Smart Entry & Start System
*4: Models with Air Conditioner
*5: Models with Vehicle Stability Control System

EG

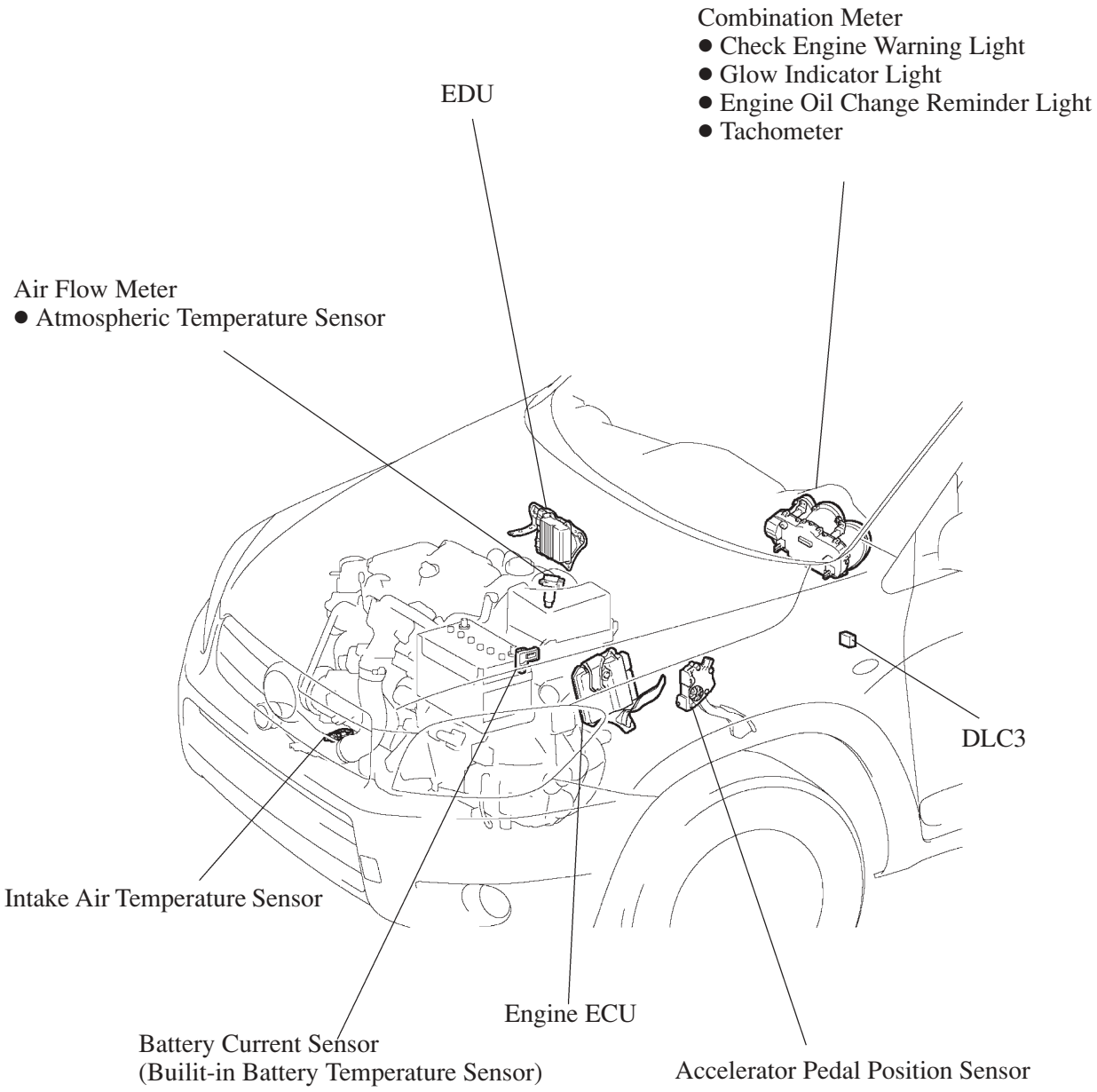
3. Engine Control System Diagram



01NEG12Y

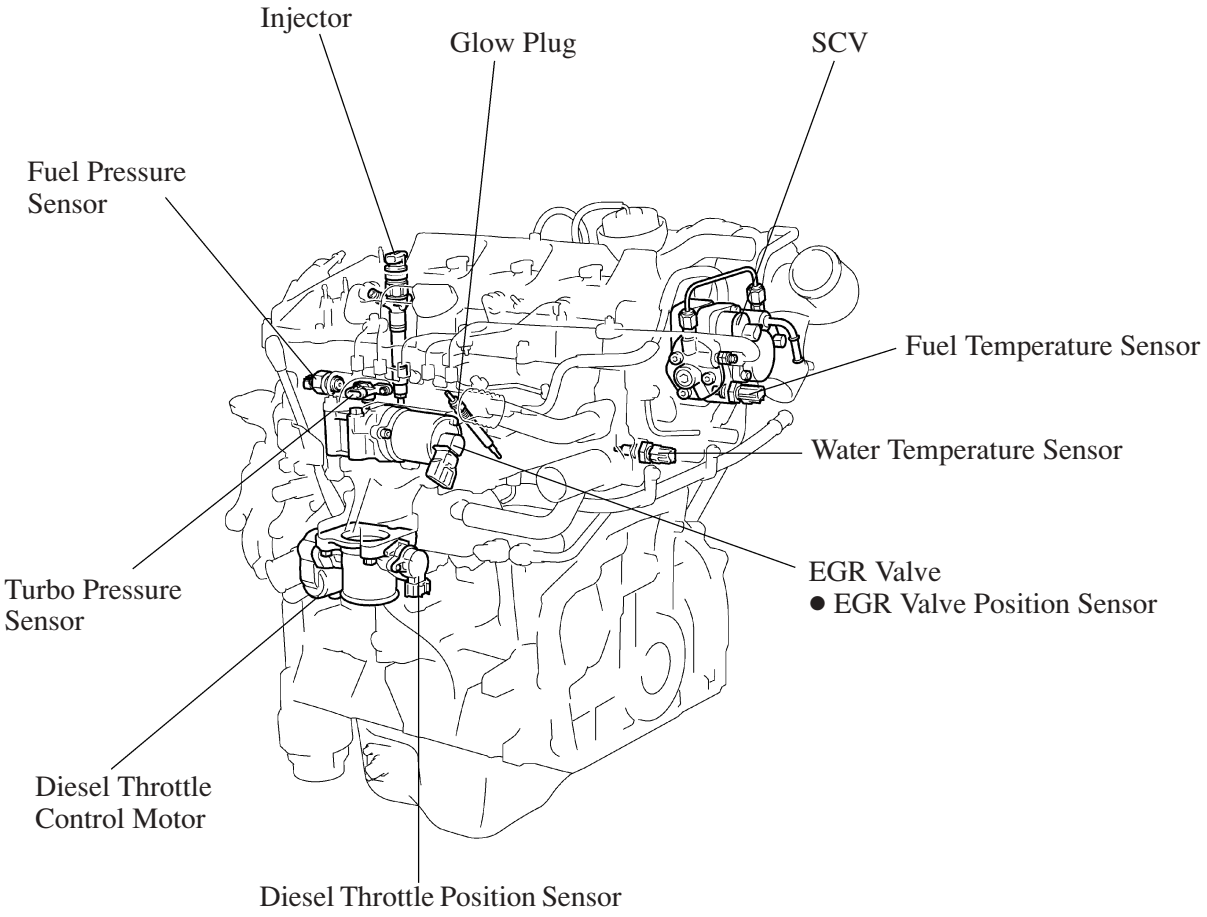
*1: Models with Smart Entry & Start System
*2: Models without Smart Entry & Start System
*3: Models with Air Conditioner
*4: Models with Vehicle Stability Control System

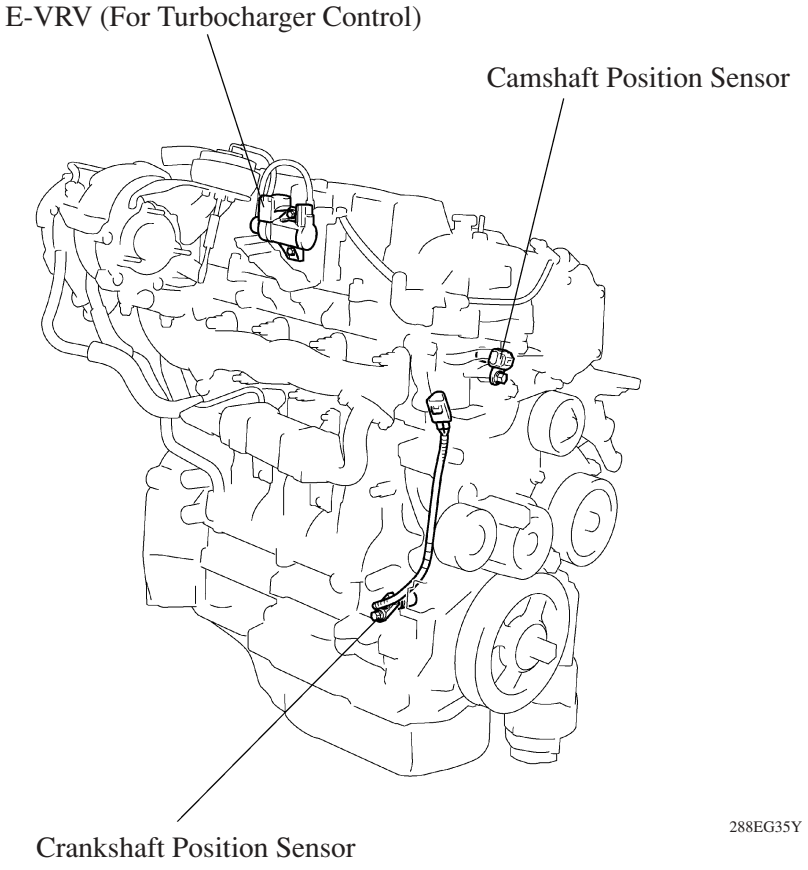
4. Layout of Main Components



01NEG51T

EG


Injector
Glow Plug
SCV
Fuel Pressure Sensor
Fuel Temperature Sensor
Water Temperature Sensor
EGR Valve
● EGR Valve Position Sensor
Turbo Pressure Sensor
Diesel Throttle Control Motor
Diesel Throttle Position Sensor


E-VRV (For Turbocharger Control)
Camshaft Position Sensor
Crankshaft Position Sensor
288EG35Y

5. Main Components of Engine Control System

General

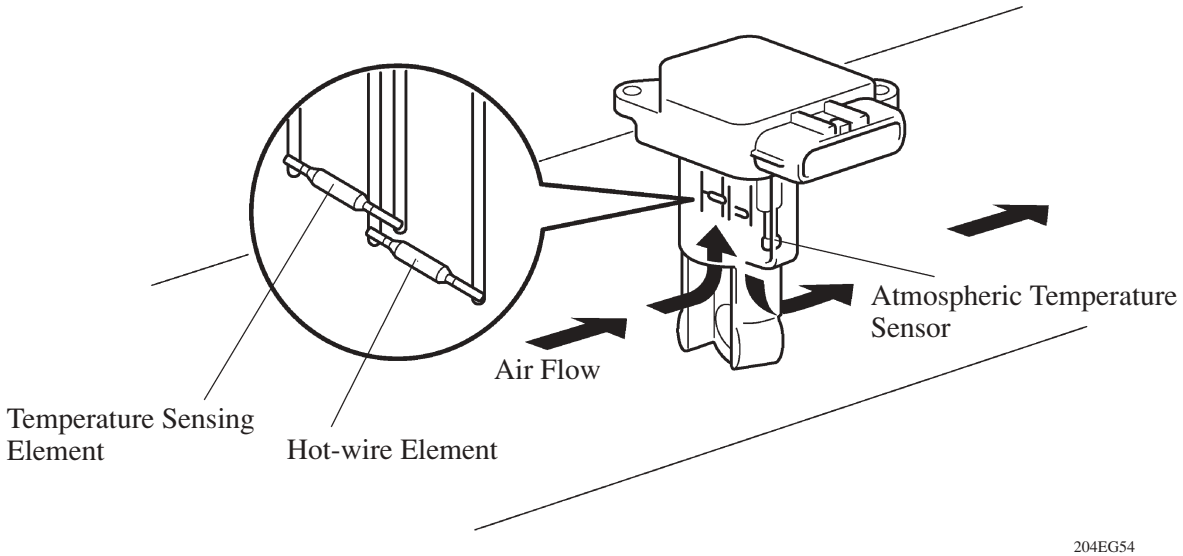
The main components of the 2AD-FTV engine control system are as follows:

Component	Outline	Quantity
Engine ECU	32-bit CPU	1
EDU	Including a Built-in DC-DC Converter	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
Fuel Pressure Sensor	Semiconductor Strain Gauge Type	1
Accelerator Pedal Position Sensor	Non-contact Type	1
Diesel Throttle Position Sensor	Non-contact Type	1

Air Flow Meter

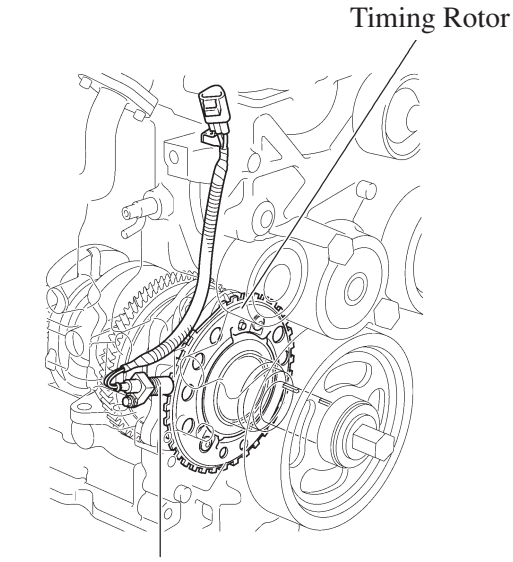
The air flow meter of diesel engine uses precise fuel injection volume control and EGR control to realize clean emission.

- The plug-in type air flow meter is used, and this allows a portion of the intake air to flow through the detection area. By directly measuring the mass and the flow rate of the intake air, the detection precision is ensured and the intake air resistance is reduced.
- The air flow meter has a built-in atmospheric temperature sensor.

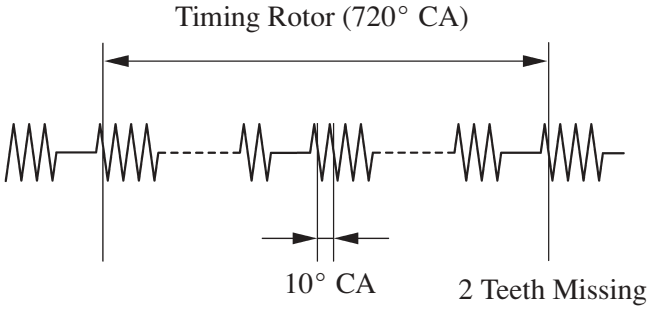


Crankshaft Position Sensor

The timing rotor of the crankshaft consists of 34 teeth, with 2 teeth missing. The crankshaft position sensor outputs the crankshaft rotation signals every 10°, and the missing teeth are used to determine the top-dead-center.



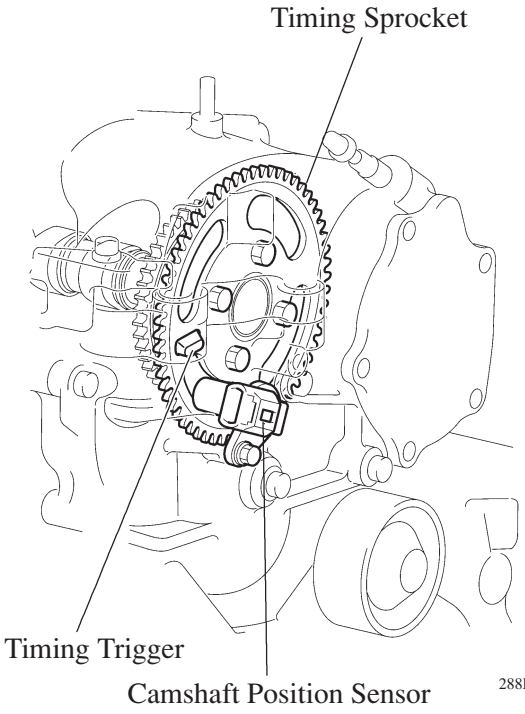
288EG44C



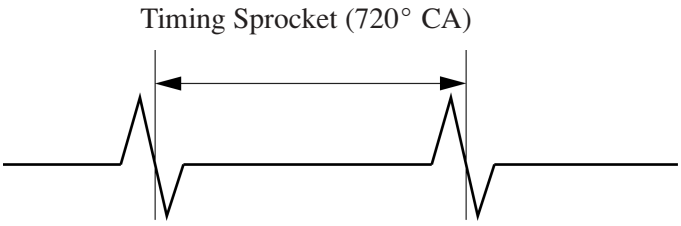
240EG90

Camshaft Position Sensor

The pick-up coil type camshaft position sensor is used to detect the camshaft position. The sensor generates one signal in every two revolutions of the crankshaft by using the timing trigger of the timing sprocket.



288EG45C



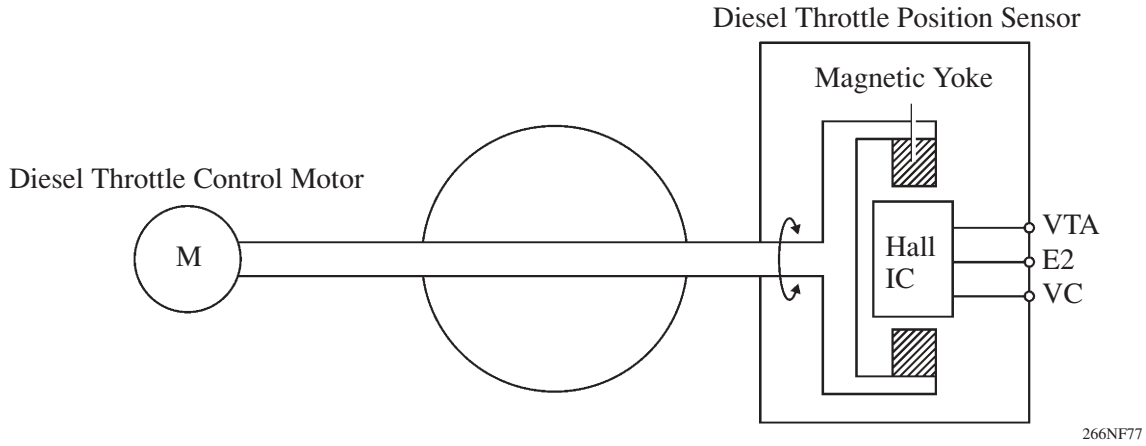
288EG95C

Accelerator Pedal Position Sensor

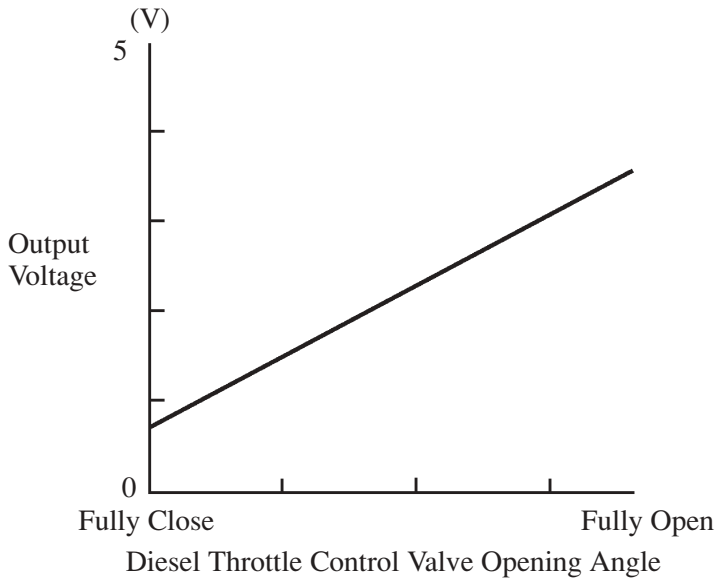
The same accelerator pedal position sensor as for the 1AZ-FE engine and 2AZ-FE engine models are used. For details, see page 43 in 1AZ-FE and 2AZ-FE engines.

Diesel Throttle Position Sensor

The non-contact type diesel throttle position sensor uses a Hall IC which is integrated with the throttle body. A magnetic yoke surrounds the Hall IC. The Hall IC converts the changes in the magnetic flux at that time into electrical signals and outputs them as a diesel throttle control valve effort to the engine ECU.



▶ Output Characteristic ◀

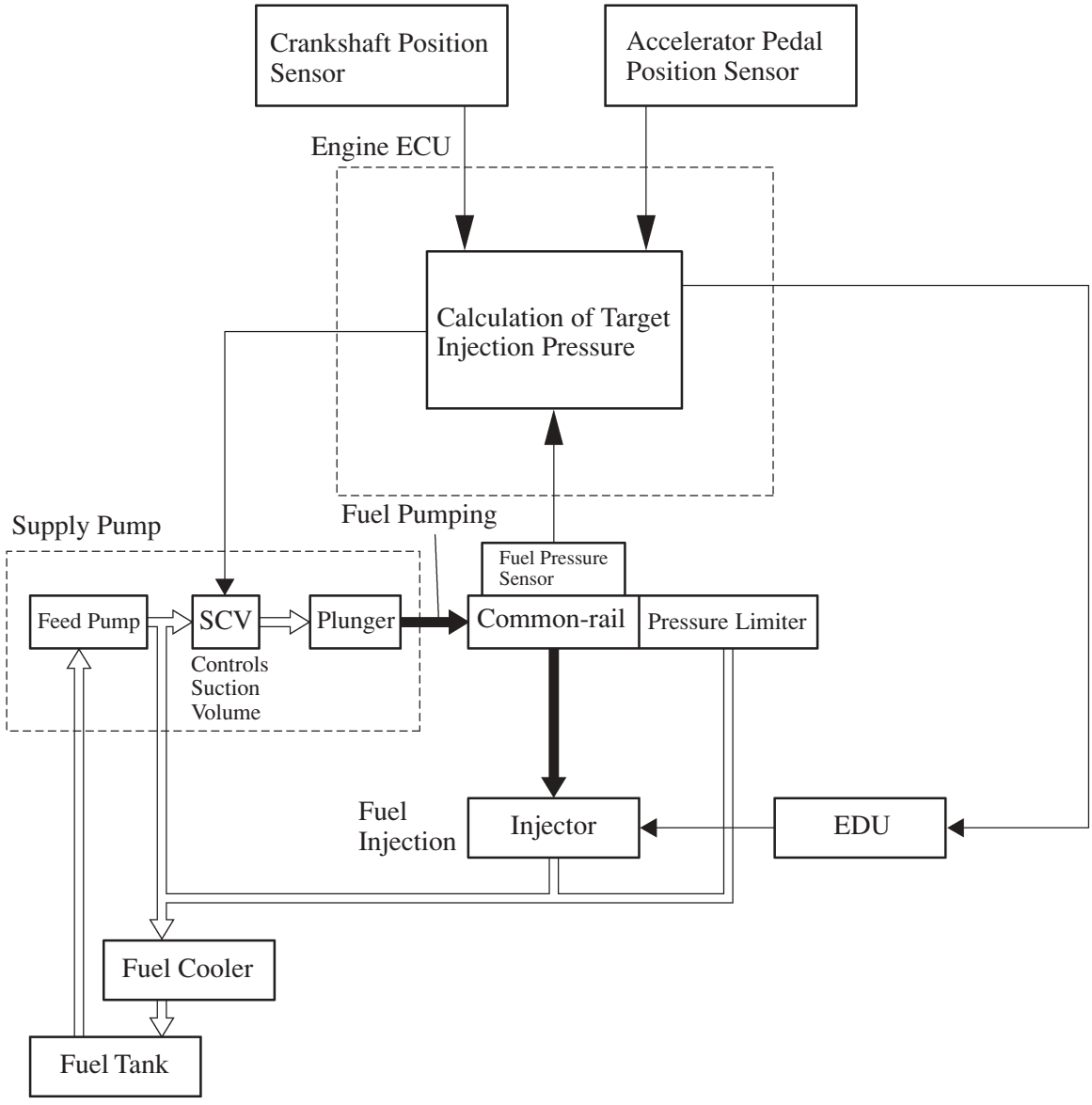


Service Tip

The inspection method differs from that of the contact type throttle position sensor because this sensor uses a Hall IC. For details, refer to the RAV4 Repair Manual (Pub. No. RM01N0E).

6. Fuel Pressure Control

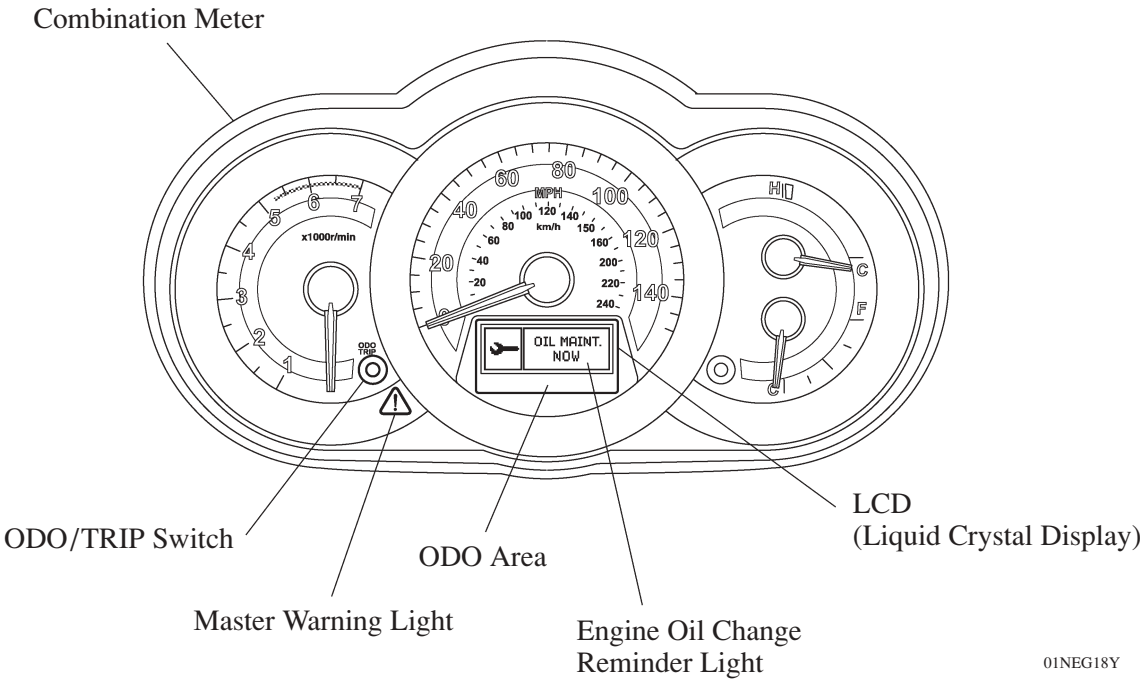
Engine ECU calculates the target injection pressure (25 – 170 MPa) based on the engine conditions which are the signals from the accelerator pedal position sensor and the crankshaft position sensor.
To control fuel pressure, signals sent to SCV (Suction Control Valve) of the supply pump regulate the suction volume, so that the pressure detected by the fuel pressure sensor matches the target injection pressure.



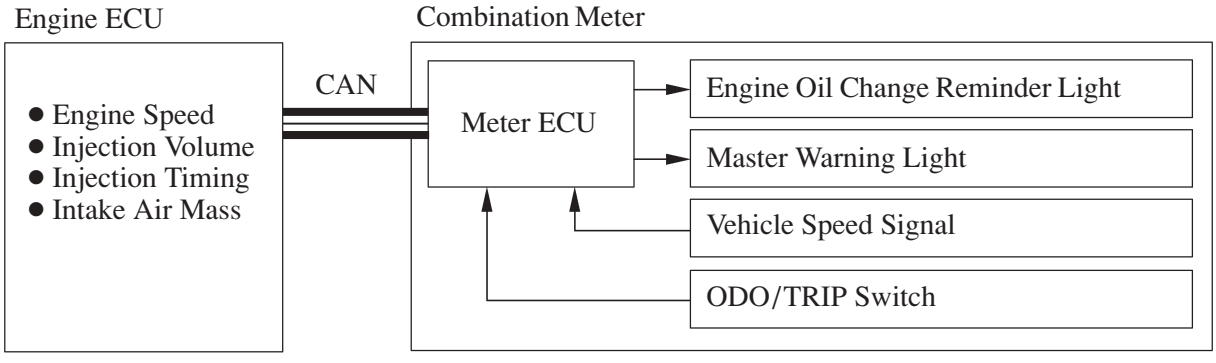
7. Oil Maintenance Management System

General

- An oil maintenance management system is used. This system determines the deterioration conditions of the engine oil and oil filter, and illuminates the master warning light and engine oil change reminder light to inform the driver when the engine oil and the oil filter must be changed. Accordingly, the maintenance intervals (30,000 km maximum) that correspond to the actual deterioration conditions of the engine oil and oil filter have been realized.
- This system indirectly determines the deterioration of the engine oil and oil filter based on the information provided by the engine ECU.



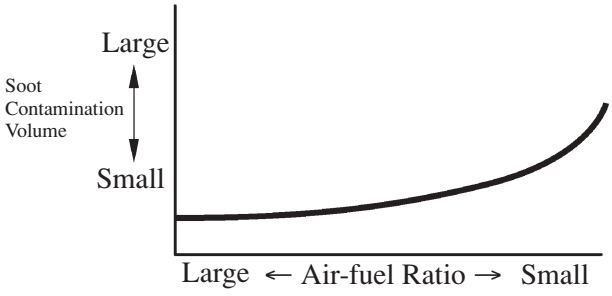
System Diagram



System Operation

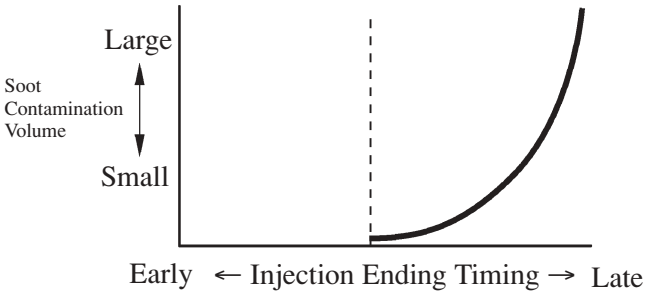
This system determines the deterioration of the engine oil and oil filter in accordance with the soot volume in the engine oil and oil filter. The engine ECU calculates the soot volume in the engine oil in accordance with the vehicle speed, engine speed, injection timing, injection volume, and intake air mass, and the soot volume in the oil filter in accordance with the engine speed and injection volume. When the calculated value of the soot volume exceeds a predetermined value, the engine ECU will illuminate the master warning light and engine oil change reminder light. Thus, this system informs the driver that the engine oil and the oil filter must be changed.

▶ Soot Generation Conditions ◀



Relationship to Air-fuel Ratio

224EG35



Relationship to Injection Ending Timing

224EG36

- In addition to controlling the illumination of the master warning light and engine oil change reminder light by counting the soot volume, the engine ECU illuminates the master warning light and engine oil change reminder light when the vehicle's driven distance reaches 30,000 km. Thus, this function enhances the reliability of the system.

NOTICE

This system does not determine the deterioration of the engine oil and oil filter based on the elapsed time. Even if the engine oil change reminder light does not illuminate, the engine oil and oil filter should be changed at 2 -year intervals at the maximum.

Counter Reset

The accumulated mileage/kilometrage memorized in the engine ECU can be reset by the following procedures.

1) Models with Smart Entry & Start System

- Push the engine switch to select the IG-ON mode.
- Make sure that the LCD screen is in the TRIP A mode.
- Push the engine switch to serect the OFF mode.
- While pressing the ODO/TRIP switch, push the engine switch to serect the IG-ON mode. At this time, the LCD screen will indicate "OIL MAINT. RESET". After selecting the IG-ON mode, hold down the ODO/TRIP switch for more than 5 seconds. When the LCD screen shows "000000", release the ODO/TRIP switch.
- After the LCD screen indicates "000000" for about 1 second, it indicates the TRIP A mode. At the same time, the "OIL MAINT. RESET" will disappear from the LCD screen.
- This completes the reset procedure.

2) Models without Smart Entry & Start System

- Turn the ignition switch ON.
- Make sure that the LCD screen is in the TRIP A mode.
- Turn the ignition switch OFF.
- While pressing the ODO/TRIP switch, turn the ignition switch ON. At this time, the LCD screen will indicate "OIL MAINT. RESET". After turning the ignition switch ON, hold down the ODO/TRIP switch for more than 5 seconds. When the LCD screen shows "000000", release the ODO/TRIP switch.
- After the LCD screen indicates "000000" for about 1 second, it indicates the TRIP A mode. At the same time, the "OIL MAINT. RESET" will disappear from the LCD screen.
- This completes the reset procedure.

8. Diagnosis

- The diagnosis uses the EURO-OBD (Europe On-Board Diagnosis) that complies with European regulations.
- When the engine ECU detects a malfunction, the engine ECU makes DTCs (Diagnostic Trouble Codes) and memorizes the failed section. Furthermore, the check engine warning light in the combination meter illuminates to inform the driver.
- The engine ECU will also store the DTCs of the malfunctions. The DTCs can be accessed by using the intelligent tester II.
- For details, refer to the RAV4 Repair Manual (Pub. No. RM01N0E).

Service Tip

To clear the DTC that is stored in the engine ECU, use an intelligent tester II, and disconnect the battery terminal or remove the EFI fuse for 1 minute or longer.

9. 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.

▶ Fail-safe Chart ◀

DTC	Fail-safe Operation	Fail-safe Deactivation Conditions
P0087	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P0088	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P0093	After shunt driving control is performed for 1 minute, engine stalls.	Engine switch OFF*1 / Ignition switch OFF*2
P0095, P0097, P0098	Intake air (intake manifold) temperature is fixed at 145°C (293°F).	"Pass" condition detected
P0100, P0102, P0103	Limits the engine power.	"Pass" condition detected
P0105, P0107, P0108	Turbo pressure is fixed value.	"Pass" condition detected
P0110, P0112, P0113	Intake air (air flow meter) temperature is fixed value.	"Pass" condition detected
P0115, P0117, P0118	Fuel temperature is fixed at specified value.	"Pass" condition detected
P0120, P0122, P0123	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P0168	Limits the engine power.	"Pass" condition detected
P0180, P0182, P0183	Fuel temperature is fixed at 40°C (104°F).	"Pass" condition detected
P0190, P0192, P0193	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P0200	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P0234	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P0335	Limits the engine power.	"Pass" condition detected
P0340	Limits the engine power.	"Pass" condition detected
P0400	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P0405, P0406, P0488	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P0500	Vehicle speed is fixed at 0 km/h (0 mph).	"Pass" condition detected
P0627	Limits the engine power.	"Pass" condition detected

*1: Models with Smart Entry & Start System

*2: Models without Smart Entry & Start System

(Continued)

DTC	Fail-safe Operation	Fail-safe Deactivation Conditions
P1229	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P1251	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P1611	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P2120, P2121, P2122, P2123, P2125, P2127, P2128, P2138	Limits the engine power.	Engine switch OFF*1 / Ignition switch OFF*2
P2226, P2228, P2229	Atmospheric pressure is fixed value.	“Pass” condition detected

*1: Models with Smart Entry & Start System
*2: Models without Smart Entry & Start System