■ ENGINE CONTROL SYSTEM

1. General

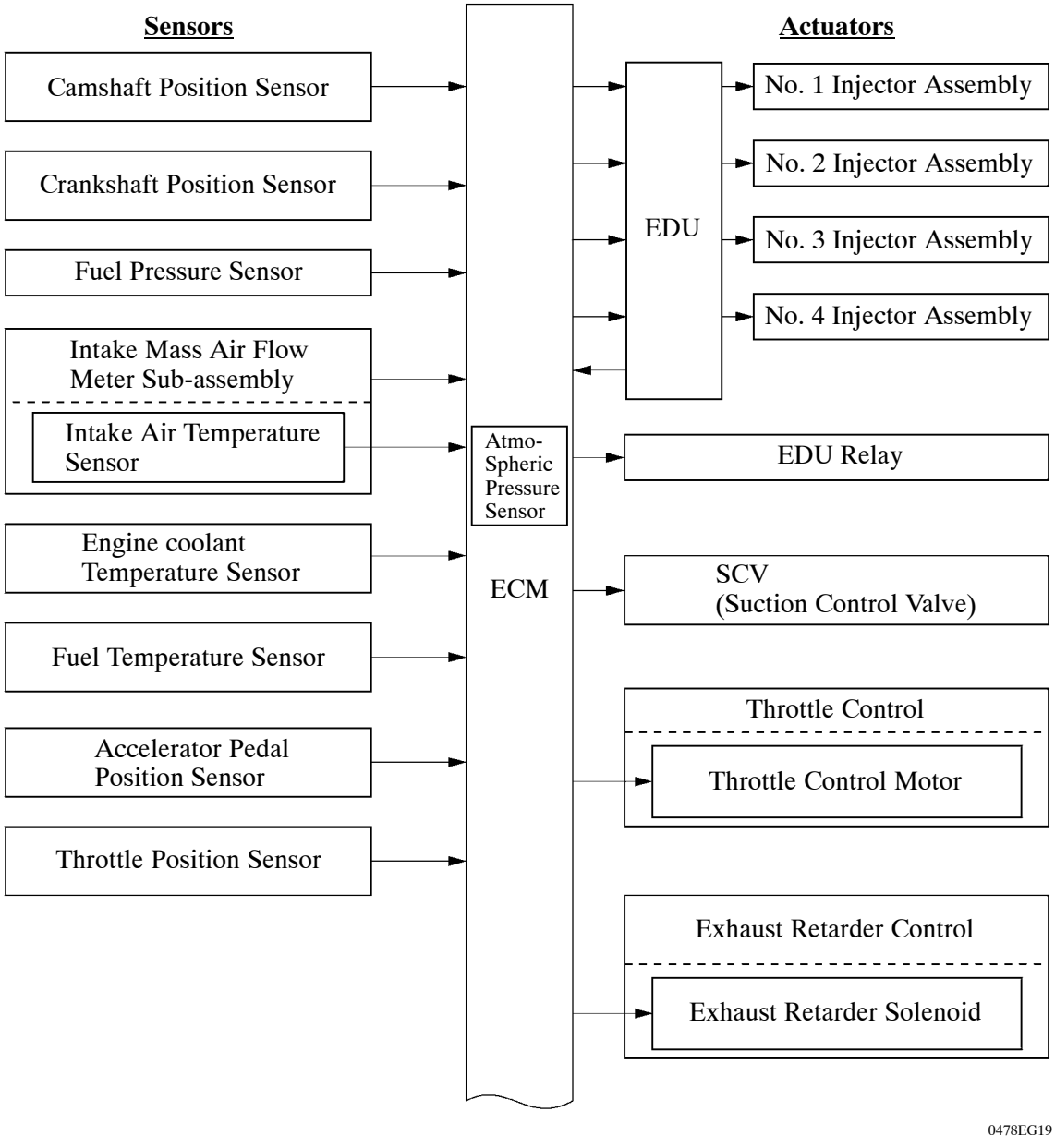
The engine control system of the N04C-VL engine consists of the following systems.

System	Outline
Fuel Injection Volume Control	Controls the injection volume by calculating an optimal level in accordance with the conditions of the engine.
Pilot Injection Control	Pilot injection is a method that provides auxiliary fuel injection.
Fuel Injection Timing Control	Controls the injection timing by calculating the optimal fuel injection timing in accordance with the conditions of the engine.
Fuel Pressure Control	Controls the fuel pressure by sending signals to the suction control valve of the injection or supply pump assembly in accordance with the operating conditions of the engine.
Throttle Control	Controls the extent of the opening of the throttle valve in accordance with the engine conditions.
Idle Speed Control	Controls the idle speed by calculating the target speed in accordance with the conditions of the engine.
Idle Speed Fluctuation Stabilization Control	Detects the fluctuations in the engine speed for each cylinder and makes injection volume corrections.
Air Conditioning Cut-off Control*	Cuts off the air conditioning during acceleration to ensure proper drivability.
Exhaust Retarder Control	Closes the exhaust retarder valve in order to apply the engine brake.
Diagnosis	If a malfunction occurs in the system, this function illuminates an indicator light to alert the driver. Also, it is possible to diagnose the area of the malfunction by shorting the terminals.
Fail Safe	If a failure occurs in the sensor signals, this function continues control through the use of the standard values stored in the ECM, or causes the engine to stop.

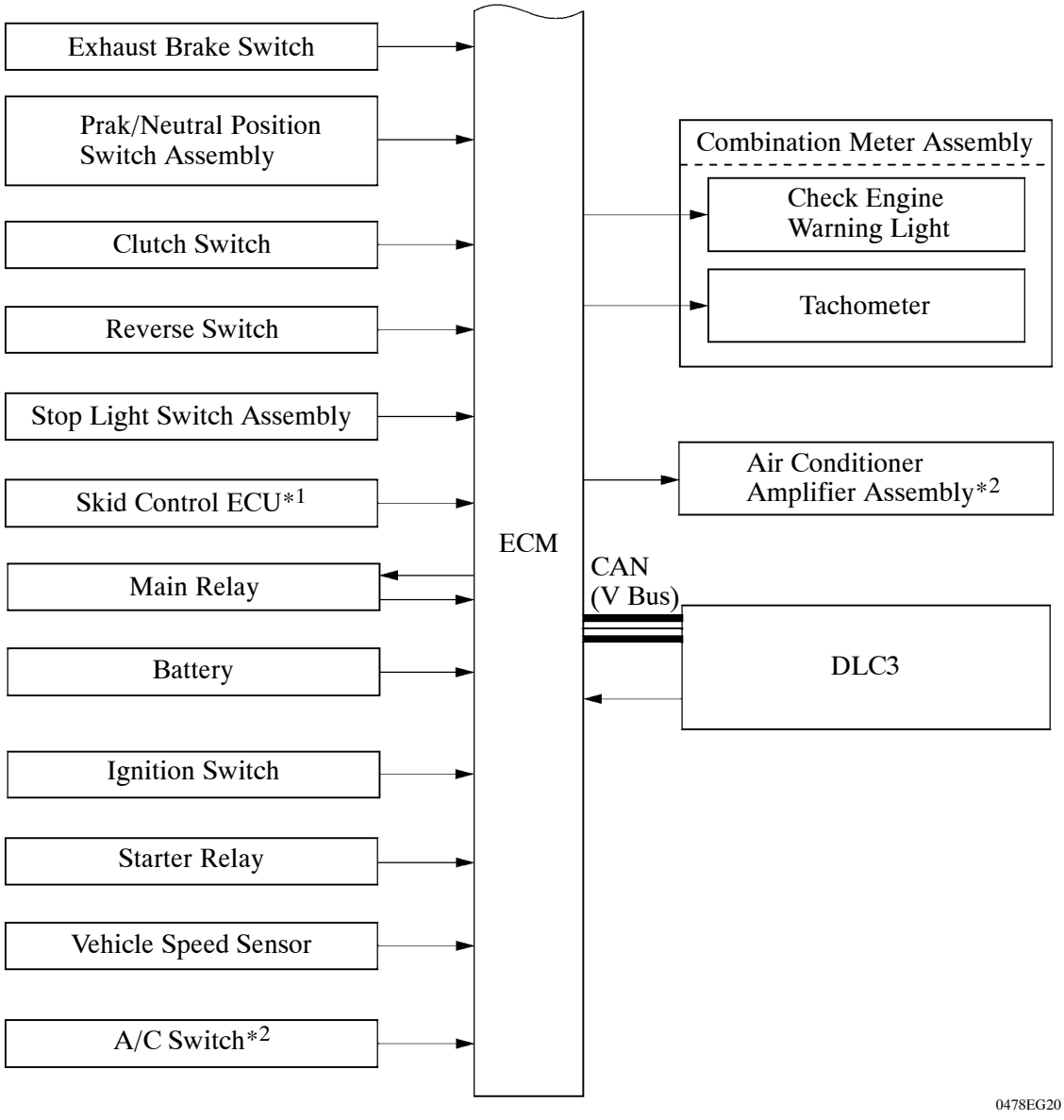
*: Models with Air Conditioner

2. Construction

The configuration of the engine control system of the N04C-VL engine is as shown in the following chart.

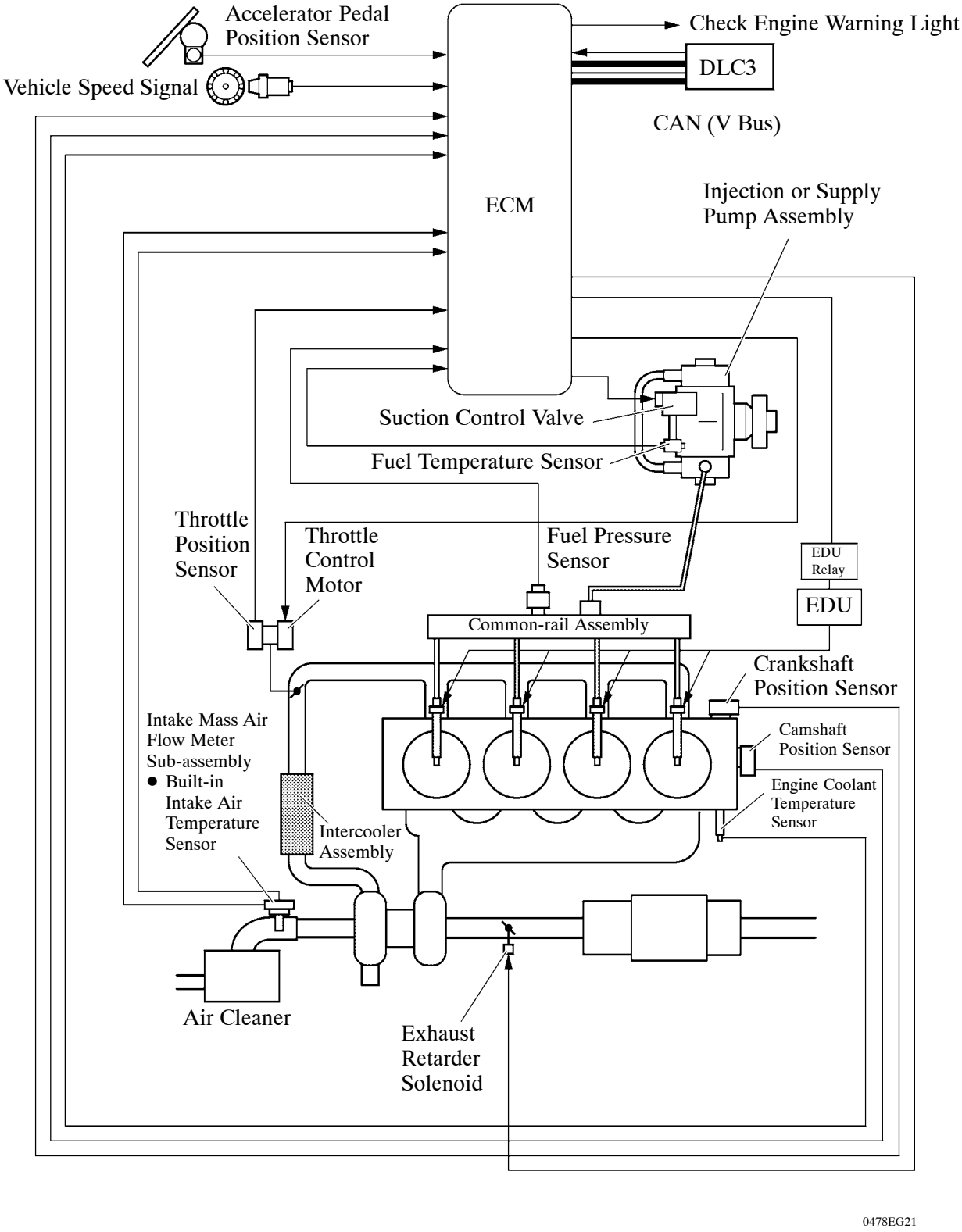


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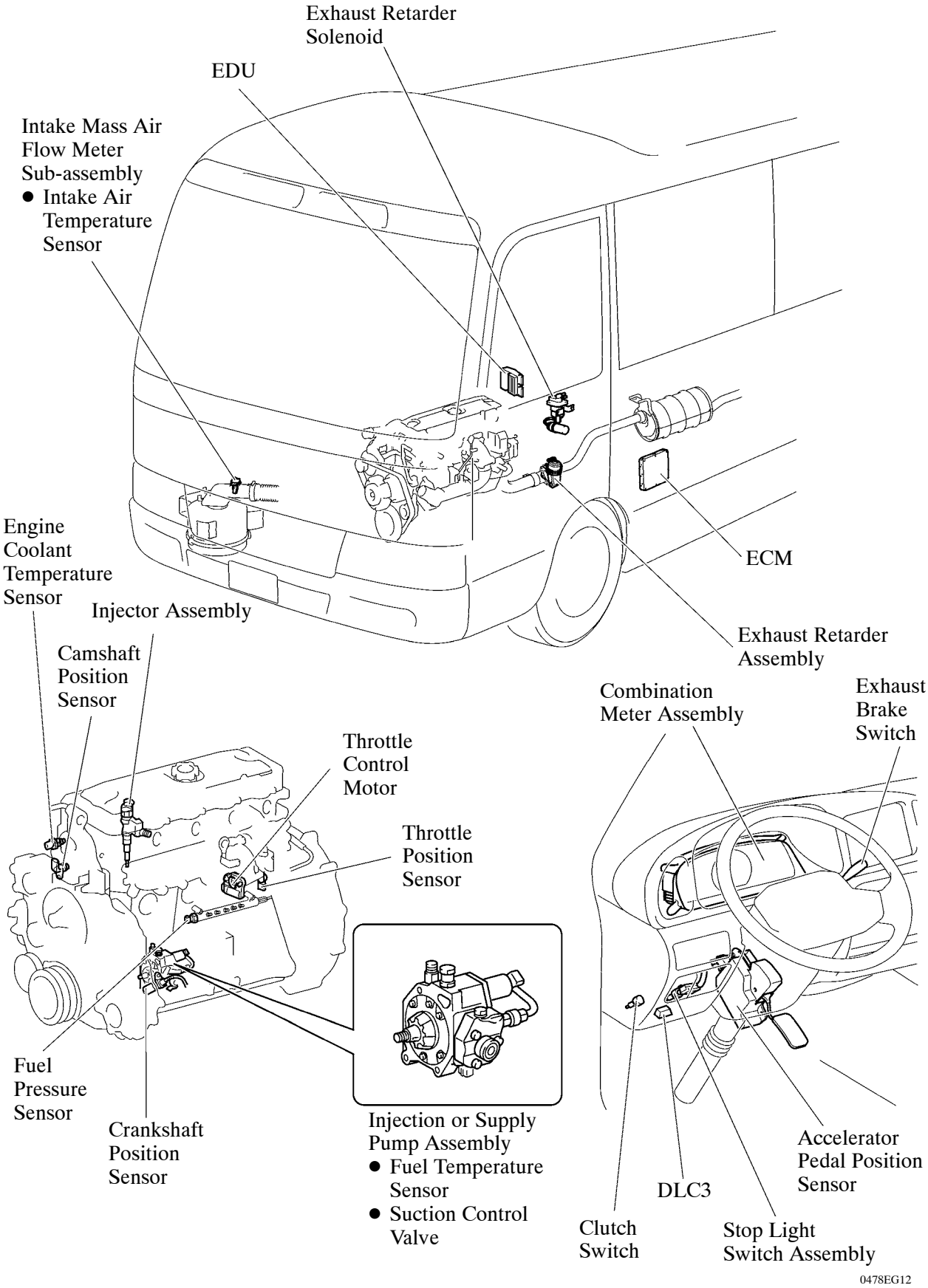
*1: Models with ABS
*2: Models with Air Conditioner

3. System Diagram



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4. Layout of Main Components



5. Main Components of Engine Control System

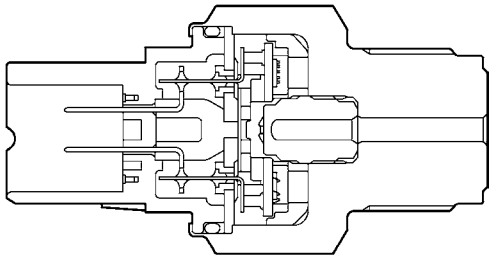
1) General

- The following table compares the main components.
- The control voltage for each component of the engine control system, including the ECM, has been set to 12 V.

Component	Outline
Engine Coolant Temperature Sensor	Detects the water temperature.
Fuel Pressure Sensor	Detects the fuel pressure in the common-rail assembly.
Fuel Temperature Sensor	Detects the fuel temperature in the injection or supply pump assembly.
Crankshaft Position Sensor	Detects the engine speed from the crankshaft position.
Camshaft Position Sensor	Identifies the cylinder from the rotation of the rotor.
Intake Mass Air Flow Meter Sub-assembly (Intake Air Temperature Sensor)	The temperature of intake air will be detected by an internal thermistor.
Starter Signal	Detects the starter voltage signal at the time the engine is started.
Vehicle Speed Sensor	Detects the vehicle speed.
Throttle Position Sensor	Detects the opening angle of the throttle valve.
Accelerator Pedal Position Sensor	Mounted on the accelerator pedal. Detects the position of the accelerator pedal.
Injector	Precisely injects fuel.
Suction Control Valve	Controls the volume of fuel to be supplied to the common-rail assembly.
Exhaust Retarder Solenoid	Opens and closes the exhaust retarder assembly.
Throttle Control Motor	Uses a step motor to restrict the intake passage.
EDU	Controls the volume of fuel injected by the injectors.

2) Fuel Pressure Sensor

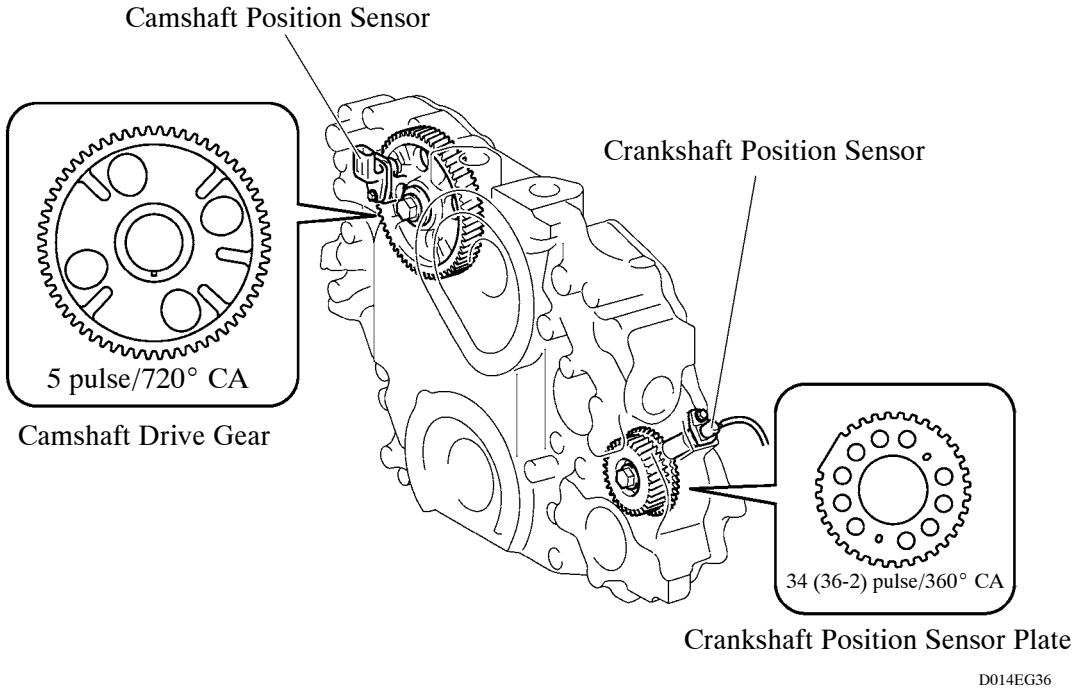
The fuel pressure sensor, which is mounted on the common-rail assembly, outputs a signal that represents the fuel pressure in the common-rail assembly to the ECM in order to constantly regulate the fuel at an optimal pressure.



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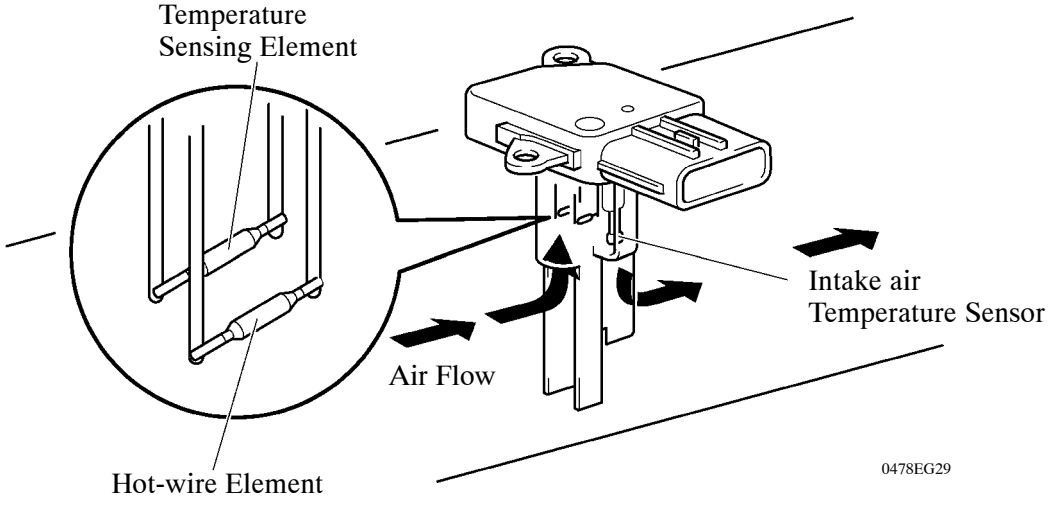
3) Crankshaft Position Sensor and Camshaft Position Sensor

A crankshaft position sensor is mounted on the crankshaft position sensor plate and a camshaft position sensor is mounted on the camshaft drive gear in order to detect the engine speed and identify the cylinders, respectively.



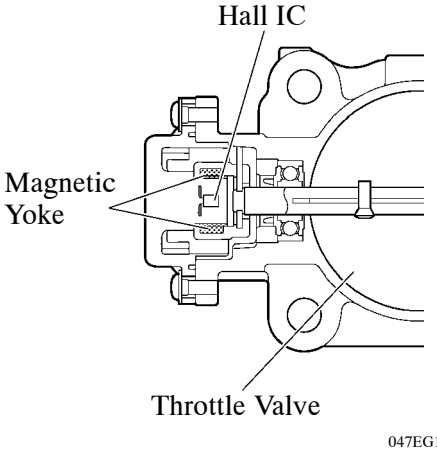
4) Air Flow Meter

- The intake mass air flow meter sub-assembly has a built-in intake air temperature sensor.
- The atmospheric temperature sensor detects the air temperature in the area around the intake mass air flow meter sub-assembly to control the fuel injection volume.

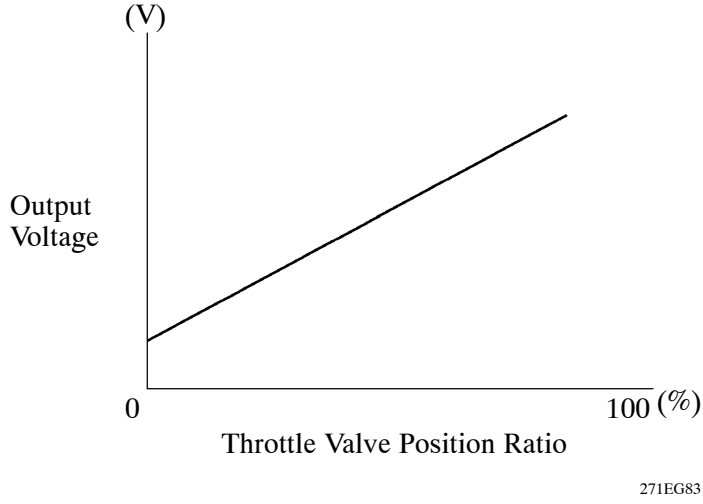


5) Throttle Position Sensor

The 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 valve shaft) rotates around the Hall IC into electric signals to operate the throttle control motor.

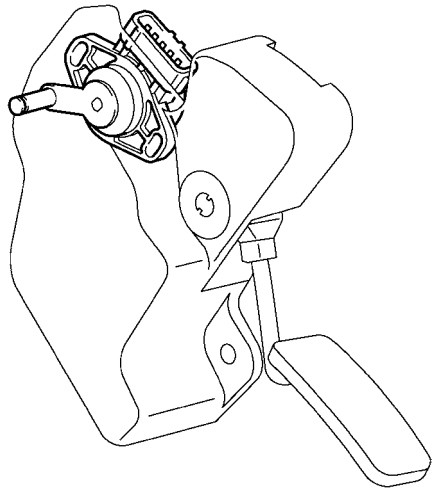


▶ Output Characteristic ◀

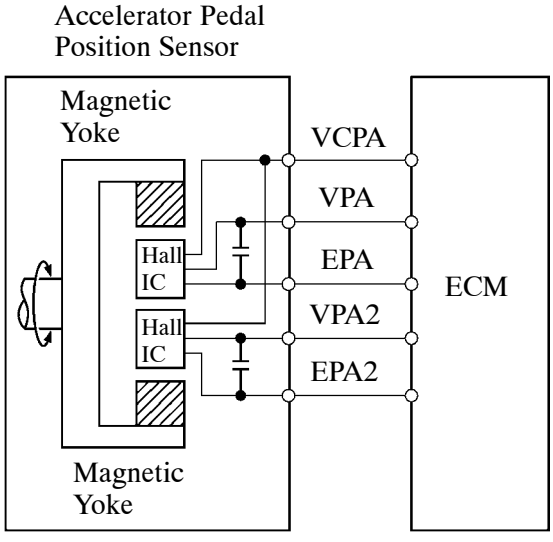


6) Accelerator Pedal Position Sensor

- This sensor converts the accelerator pedal depressed angles into electric signals with two differing characteristics and outputs them to the ECM. One is the VPA signal that linearly outputs the voltage along the entire range of the accelerator pedal depressed angle. The other is the VPA2 signal that outputs offset voltage.

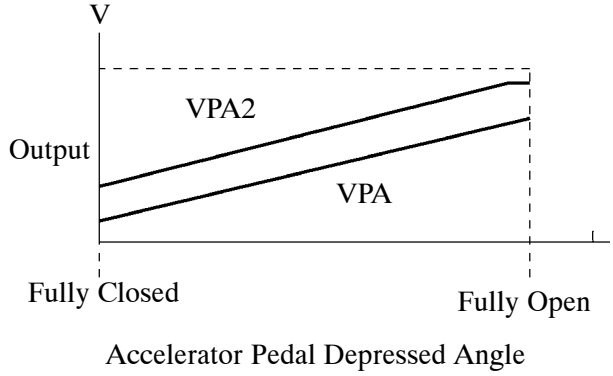


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▶ Output Characteristic ◀



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6. Fuel Injection Control

1) General

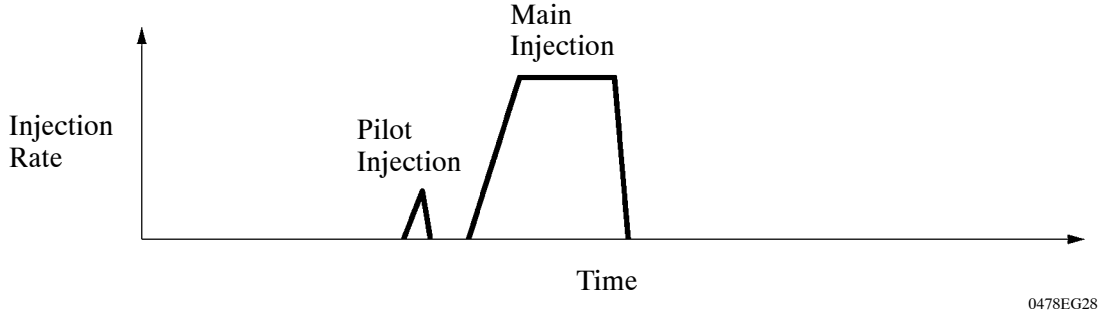
- The ECM transmits signals to the injector assembly via the EDU (Electronic Driver Unit) in order to control the fuel injection timing and injection volume.
- A constant fuel pressure, which is required by the injectors to properly inject fuel, is maintained by optimally controlling the fuel pressure.
- The fuel pressure sensor detects the pressure in the common-rail assembly and the injection or supply pump assembly delivers fuel in order to attain the target pressure in the common-rail assembly.
- Pilot injection is a method that provides auxiliary fuel injection intakes place. The purpose of pilot injection is to gently start the combustion of the fuel of the main injection in order to reduce combustion noise.

2) Fuel Pressure Control

The ECM calculates the target injection pressure in accordance with the throttle valve position and the engine speed. Based on the value of the fuel pressure sensor, the ECM controls the fuel delivery volume of the suction control valve in the injection or supply pump assembly in order to attain the target pressure in the common-rail assembly.

3) Multiple Injection Control

- The EDU (Electronic Driver Unit), which is capable of generating a high voltage and charging quickly, is used to actuate the pressurized fuel injectors at high speeds and deliver high-precision multiple injections.
- Multiple injection control divides the injection of fuel into the following stages: pilot injection and main injection. This enhances combustion efficiency and fuel economy, and achieves low noise.



Injection Type	Control	Result
Pilot Injection	Injects fuel slightly ahead of the main injection.	Achieves low noise
Main Injection	Injects fuel for normal combustion.	Achieves high torque

4) Idle Speed Control

Idle speed control regulates the fuel injection volume in order to attain an optimal engine speed during idling.

5) Correction

The system corrects the injection timing and injection volume of the main injection and the pilot injection in accordance with the signals provided by the sensors.

Correction Items	Correction
Intake Air Temperature Correction	When the intake air temperature is low, this type of correction increases the fuel volume to compensate for the high air density.
Post-warm-up Fuel Increase Correction	When the water temperature is low, this type of correction increases the fuel volume to ensure proper drivability while the engine is cold.
Intake Air Pressure Correction	When the intake air mass is low, this type of correction reduces the fuel volume.

6) Fuel Cut-off

a. Deceleration Fuel Cut-off

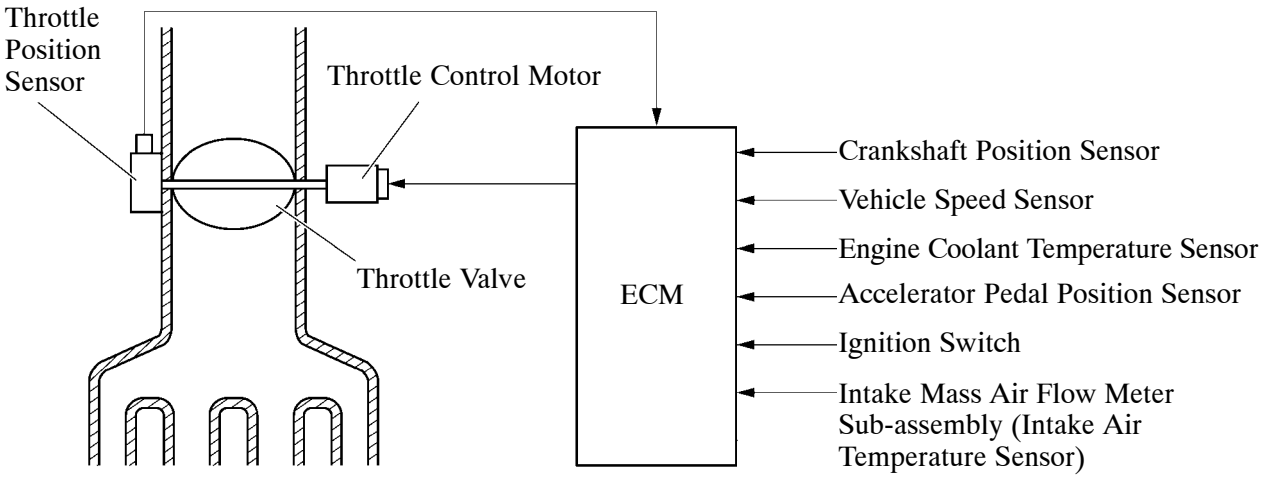
When the vehicle is decelerating and the engine speed is idle engine speed or higher, this control stops the injection of fuel in order to achieve better fuel economy. The engine speed for fuel cut-off and restoration will be high when the water temperature is low.

b. Fuel Cut-off According to Engine Speed

When the engine speed is 3650 rpm or higher, this control stops the injection of fuel to prevent the engine from over-revving.

7. Throttle Control

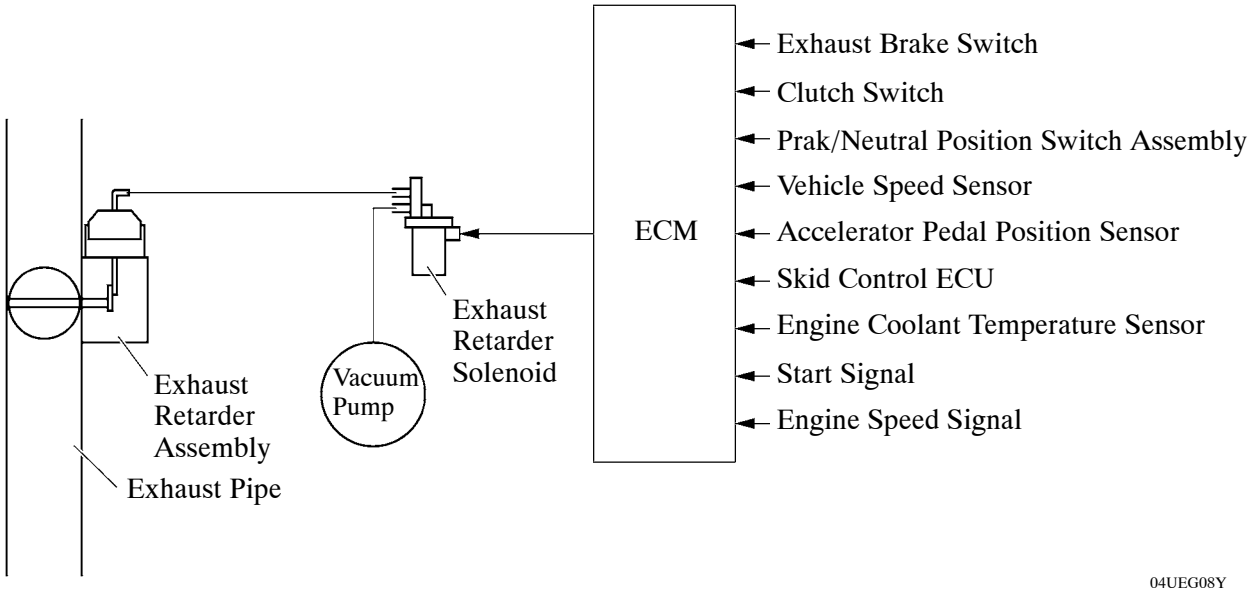
- The opening of the throttle valve is controlled by the ECM in accordance with the engine conditions. As a result, the noise that is generated during idling and deceleration, as well as the noise and vibration that are generated when the engine is stopped, has been reduced.
- The throttle control prevents overrunning and vibrations when stopping the engine.



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8. Exhaust Retarder Control

The engine braking effect is boosted by closing a valve provided in the exhaust pipe and narrowing the exhaust gas passage.



▶ System Components and Functions ◀

Component	Function
Exhaust Retarder Solenoid	Switches between atmospheric pressure and negative pressure applied to the vacuum cylinder, opening and closing the exhaust retarder valve.
Exhaust Brake Switch	Pulling the exhaust brake switch (incorporated in the wiper control switch) toward the driver activates the exhaust retarder and causes the indicator light in the combination meter to illuminate.
Clutch Switch	Detects clutch engagement according to clutch pedal operation; depressing the clutch pedal turns off current to the exhaust retarder solenoid.
Prak/Neutral Position Switch Assembly	Detects engagement of neutral or any other gear.
Vehicle Speed Sensor	Built into speedometer; detect vehicle speed and send it to the ECM.

▶ Objectives and Operating Conditions for Exhaust Retarder ◀

Objective	Operating Conditions
Exhaust Brake	● Exhaust brake switch is ON. ● Clutch is not operating. ● Accelerator pedal is not operating. ● Vehicle speed is more than predetermined value. ● Transmission is not in neutral. ● ABS is not operating.
Long time Idling Control	● Vehicle is stopped. ● Engine is idling for a long time. ● Clutch is not operating. ● Accelerator pedal is not operating. ● Transmission is in neutral.

9. Diagnosis

- When the ECM detects a malfunction, it outputs DTCs (Diagnosis Trouble Codes) 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 are stored in memory. The DTCs can be read by connecting an Global TechStream (GTS).
- For details, refer to the Repair Manual.

10. Fail Safe

When the ECM detects a malfunction, it stops or controls the engine according to the data already stored in the memory. For details, refer to the Repair Manual.