

## 6. Engine Control System

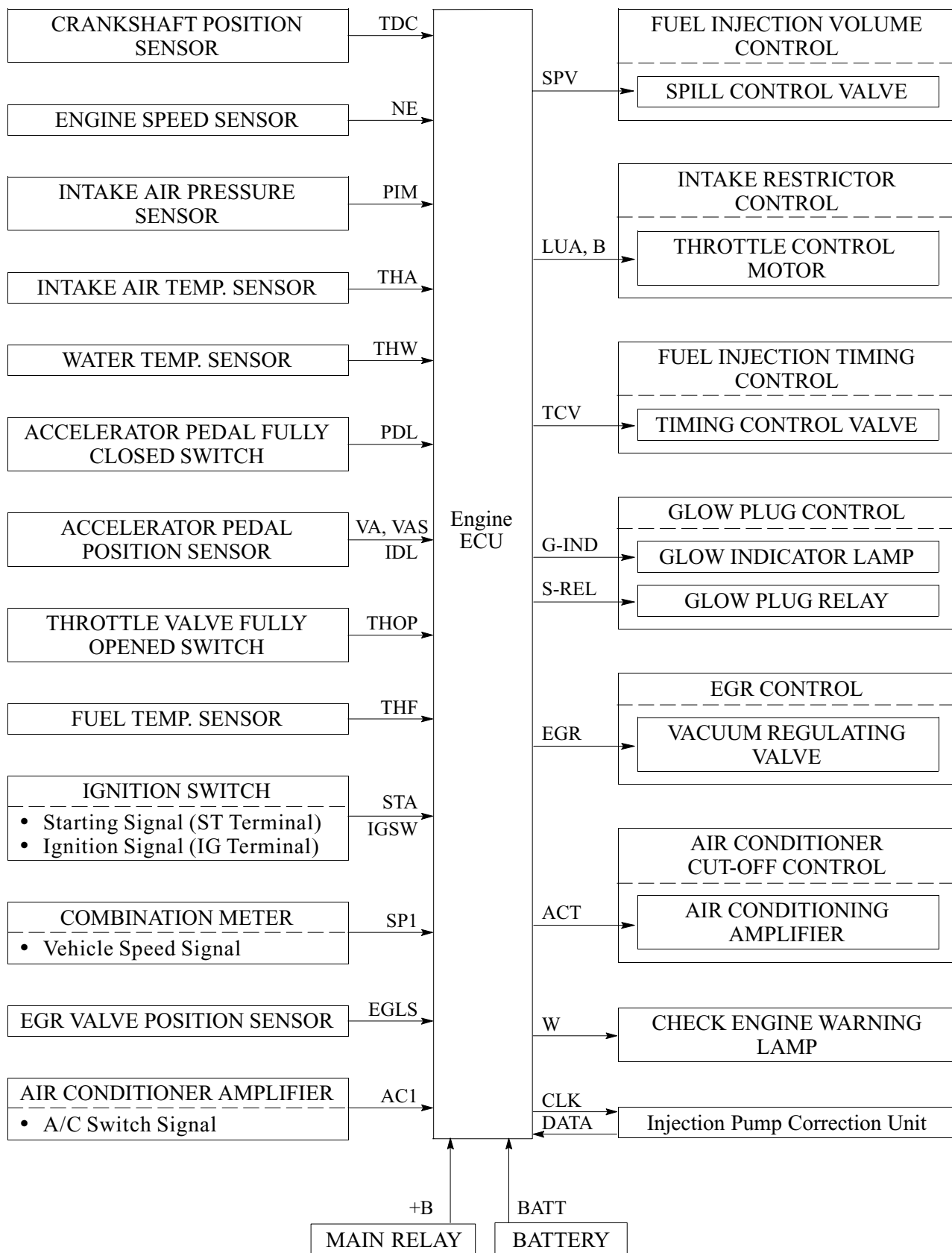
### General

The engine control system for the 5L-E engine has following system.

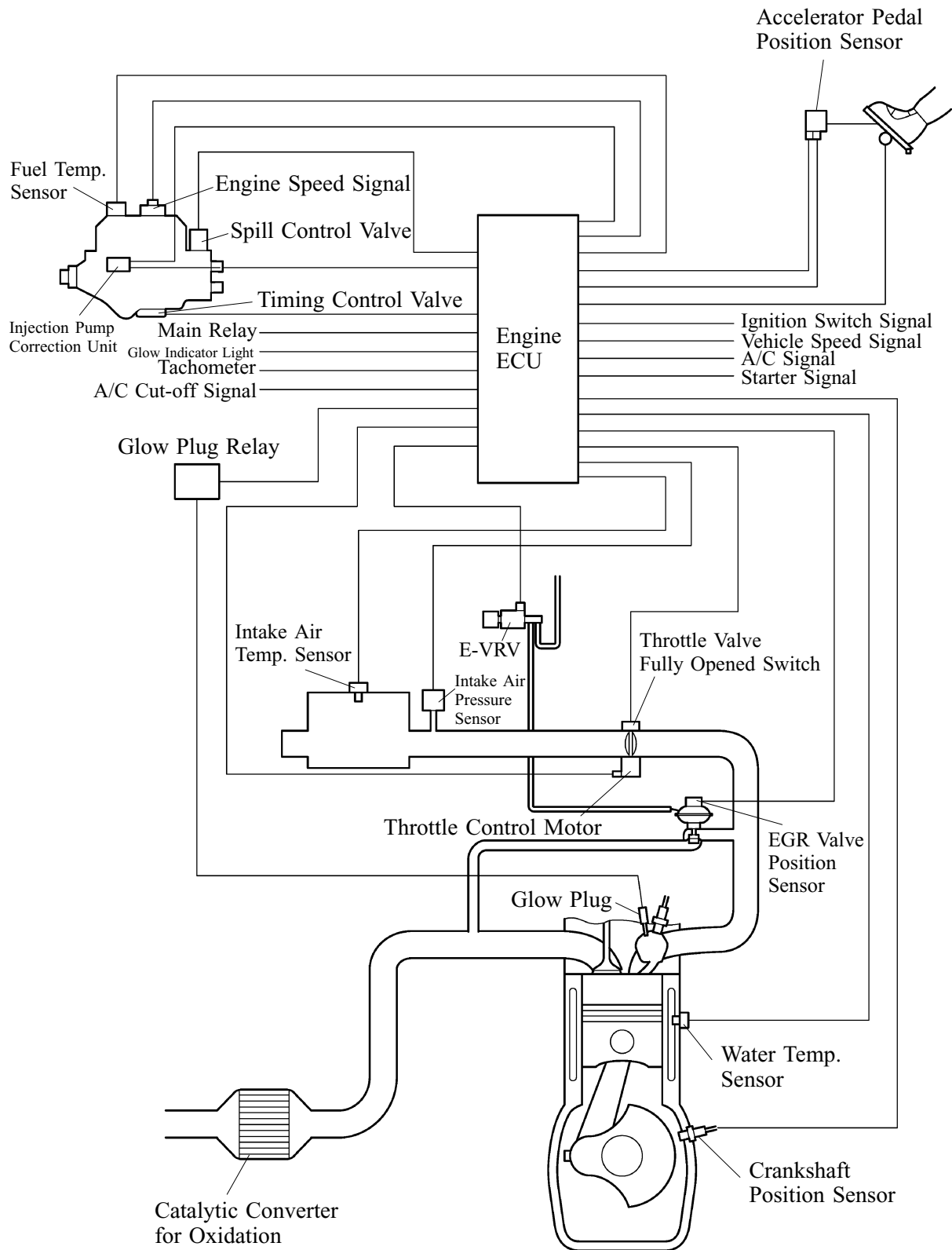
System		Outline
Diesel EFI	Fuel Injection Volume Control ( <a href="#">See page 21</a> )	Based on the signals received from the sensors, the engine ECU determines the fuel injection volume in accordance with the engine condition.
	Fuel Injection Timing Control ( <a href="#">See page 23</a> )	Based on the signals received from the sensors, the engine ECU determines the fuel injection timing in accordance with the engine condition.
	Idle Speed Control ( <a href="#">See page 24</a> )	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.
Intake Restrictor Control ( <a href="#">See page 25</a> )		Fully close the throttle in order to reduce the vibration when the engine is stopped.
EGR Control ( <a href="#">See page 26</a> )		Based on the signals received from the sensors, the engine ECU determines the EGR volume via EGR valve and throttle valve in accordance with the engine condition.
Air Conditioner Cut-off Control		By controlling the air conditioner compressor ON or OFF in accordance with the engine condition, drivability is maintained.
Diagnosis		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

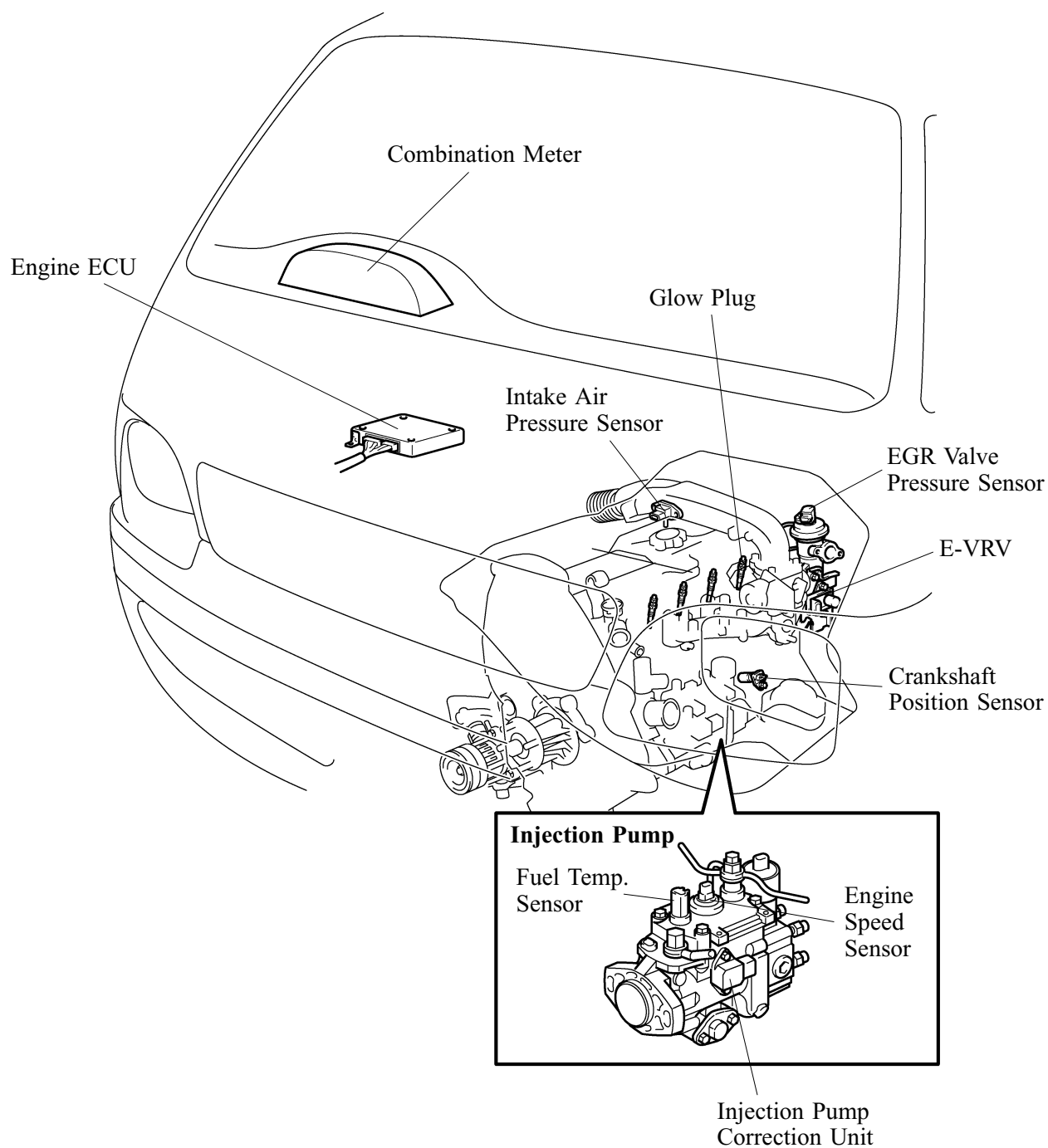
The configuration of the engine control system in 5L-E engine is shown in the following chart.



## Engine Control System Diagram



## Layout of Main Component



## Main Component of Engine Control System

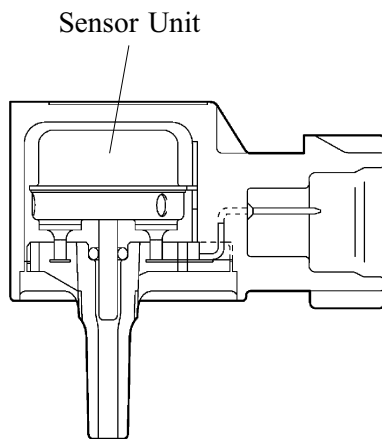
### 1) General

The main components of the 5L-E engine control system are as follows:

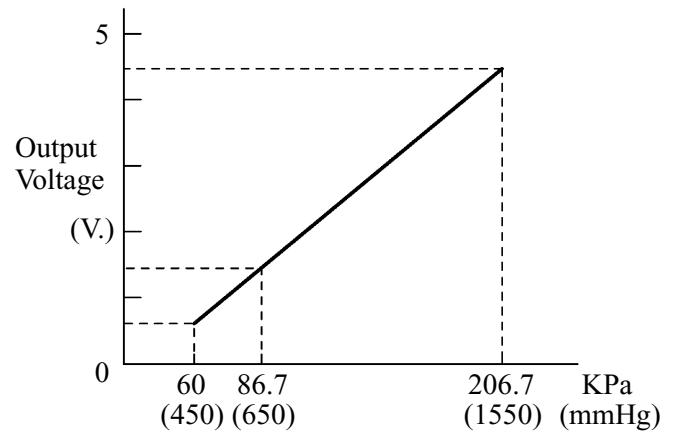
Components	Outline	Quantity
Intake Air Pressure Sensor	Semi-conductor Type	1
Crankshaft Position Sensor (Protrusion)	Pick-up Coil Type (1)	1
Engine Speed Sensor (Rotor Teeth)	Pick-up Coil Type (56)	1
Accelerator Pedal Position Sensor	Linear Type	2 (Main, Sub)
Injection Pump	Electronically Controlled Type	1

### 2) Intake Air Pressure Sensor

- The intake air pressure sensor is mounted on the intake manifold.
- It consists of a semiconductor which utilizes the characteristic of a silicon chip that changes its electrical resistance when pressure is applied to it. The sensor converts the pressure into an electrical signal, and sends it to the engine ECU in an amplified form.
- The signal from this sensor is used for Diesel EFI control and EGR control.



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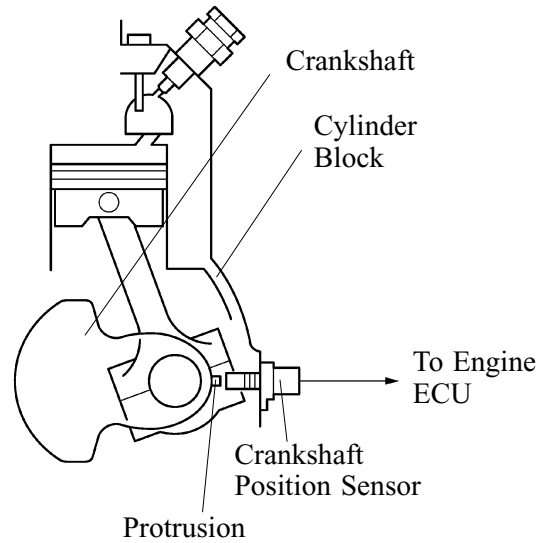


Absolute Pressure  
**Intake Air Pressure Sensor  
Output Characteristics**

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### 3) Crankshaft Position Sensor

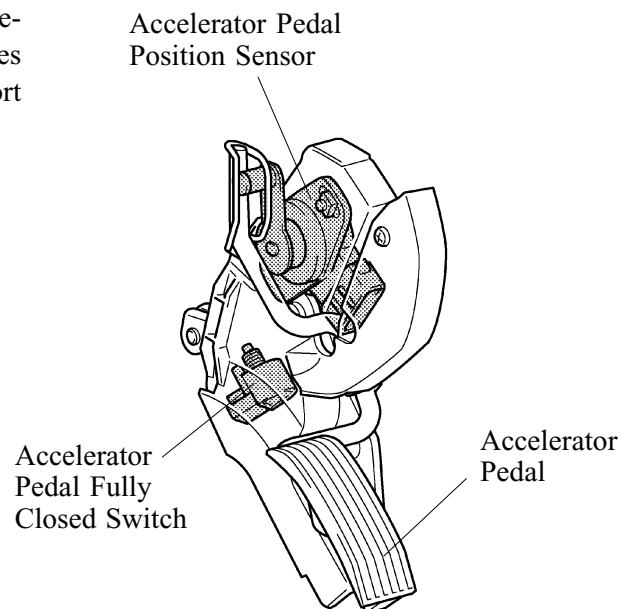
The crankshaft position sensor is attached to the cylinder block. Using the protrusion that is provided on the crankshaft, the sensor generates one signal for every revolution. This signal is then sent to the engine ECU as a crankshaft position signal.



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### 4) Accelerator Pedal Position Sensor

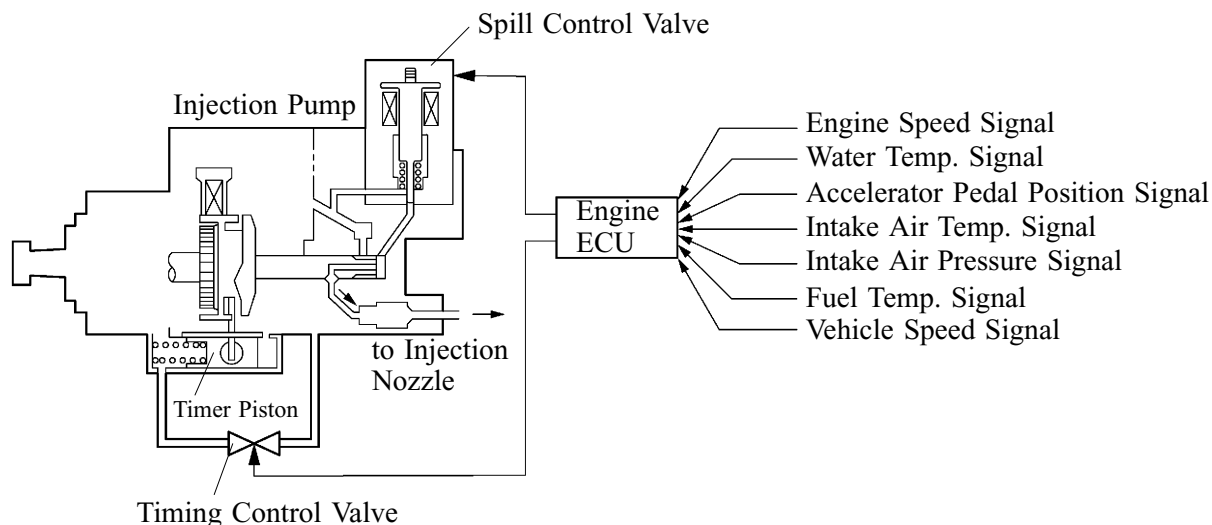
The accelerator pedal position sensor uses a resistance circuit that outputs voltage that changes linearly in relation to the amount of pedal effort that is applied to the accelerator pedal.



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## Fuel Injection Volume Control

Based on sensor signals, the engine ECU controls the fuel injection volume by calculating the fuel injection volume that is appropriate for the engine condition.



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## 1) Function of Engine ECU

The engine ECU calculates the basic injection volume based on the accelerator pedal opening and engine speed, and the maximum injection volume for the engine condition. The two injection volumes are compared, and the lesser of the two is selected. A correction value, which is obtained via the fuel pump calibration unit, is added to that injection volume, thus determining the fuel injection volume.

### a. Basic Injection Volume

Determined in accordance with the throttle opening and the engine speed.

### b. Maximum Injection Volume

Based on the signals received from the sensors, correction values are added to the theoretically required injection volume (basic maximum injection volume) to determine the maximum injection volume during engine operation.

### Basic maximum injection volume

Determined in accordance with the engine speed.

### Intake air pressure correction

Corrects the basic maximum injection volume in accordance with the intake air pressure.

**Intake air temperature correction**

Corrects the variance in the air-fuel ratio that is created by the difference in the density of the intake air in accordance with the intake air temperature. The higher the intake air temperature becomes, the smaller the injection volume becomes.

**Fuel temperature correction**

Corrects the variance in the injection volume that is created by the difference in the density of the fuel in accordance with the fuel temperature. The higher the fuel temperature becomes, the larger the injection volume becomes.

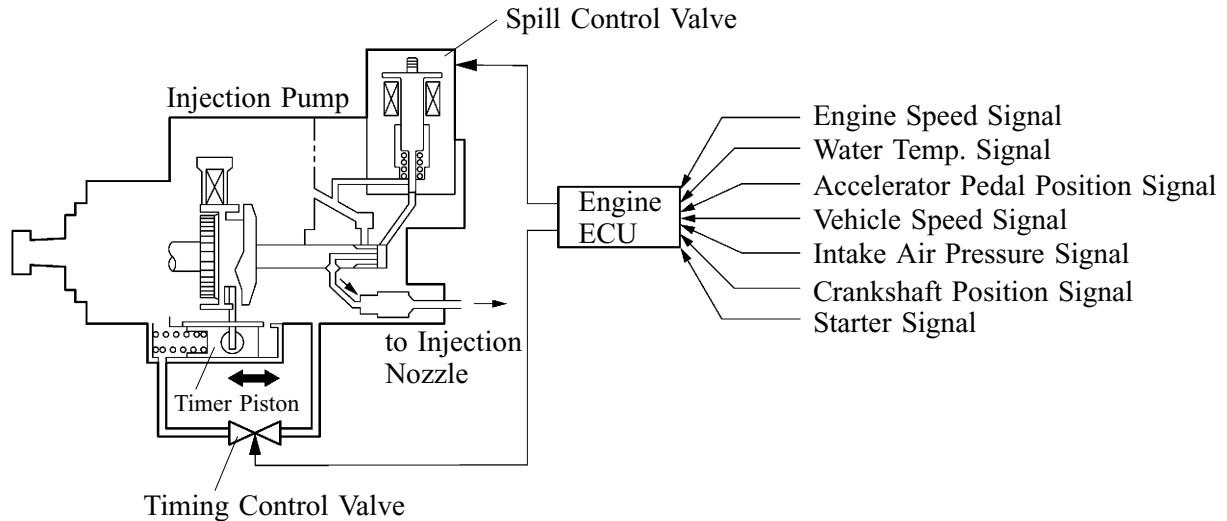
**c. Starting Injection Volume Control**

Determines the fuel injection volume during starting in accordance with the starting signal and the water temperature signal. When the engine is cold, the lower the water temperature becomes, the larger the injection volume becomes.



## Fuel Injection Timing Control

Based on the signals received from the sensors, the engine ECU calculates and controls the fuel injection timing to be optimal for the engine condition.



215EG14

### 1) Function of Engine ECU

The engine ECU adds the corrections from the sensor signals to the basic fuel injection timing to calculate the fuel injection timing that is optimal for the engine condition.

#### a. Basic Injection Timing

The basic injection timing determined in accordance with the injection volume and the engine speed.

#### b. Injection Timing Correction

##### Intake air pressure correction

Corrects the basic fuel injection timing in accordance with the intake air pressure. The injection timing is advanced when the intake air pressure is low such as in the case of high altitude areas.

##### Water temperature correction

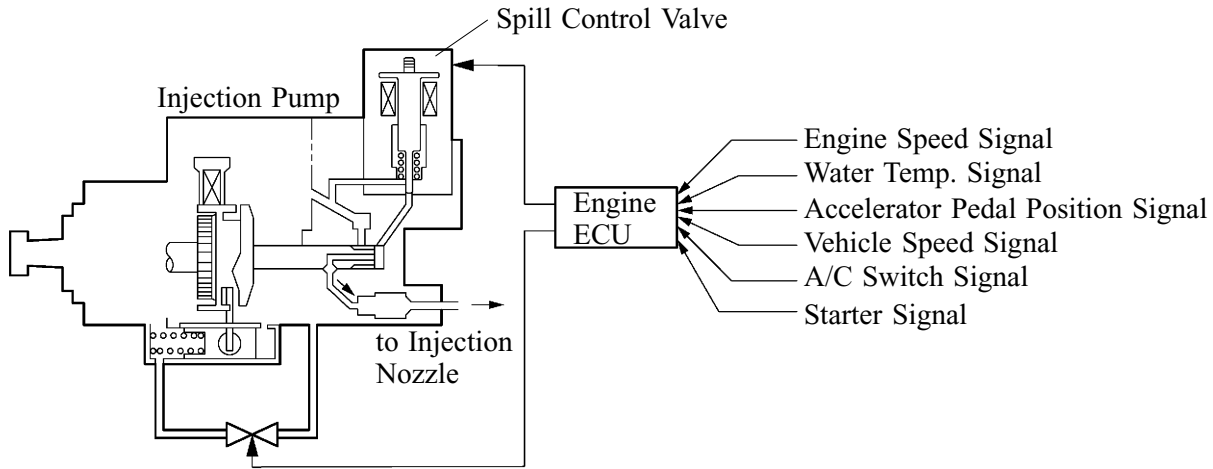
Corrects the basic fuel injection timing in accordance with the water temperature. The injection timing is advanced when the water temperature is low.

#### c. Starting Injection Timing Control

The starting injection timing is determined in accordance with the starting signal, water temperature signal, and engine speed. The injection timing is advanced when the water temperature is low and engine speed is high.

## Idle Speed Control

In this system, the engine ECU calculates the target engine speed in accordance with the engine condition, and determines the fuel injection volume, thus controlling the idle speed.



215EG15

### 1) Function of Engine ECU

#### a. Feedback Control

During idling, the feedback control controls the injection volume to achieve the target idle speed, if there is a difference between the target idle speed calculated by the engine ECU and the actual idle speed.

#### b. Warm-Up Control

Controls the injection volume during warm-up, in accordance with water temperature, to achieve an optimal fast idle speed.

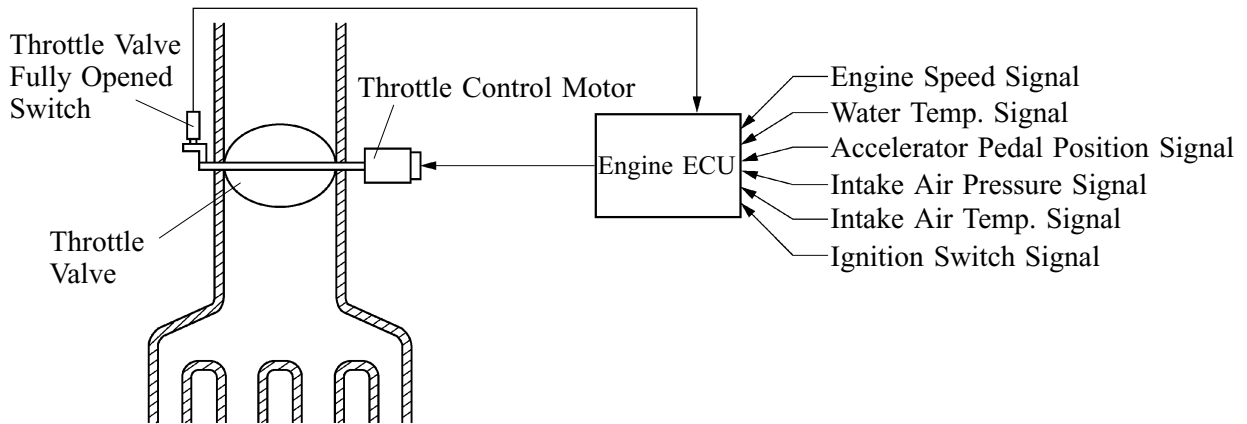
#### c. Engine Speed Changes Estimate Control

Immediately after the air conditioner switch is engaged, the idle speed can be affected by the change in the load that is applied to the engine. To prevent this symptom, the engine speed-change estimate control increases or decreases the injection volume before the idle speed changes.

## Intake Restrictor Control

The engine ECU controls the opening of the throttle valve that is installed on the intake manifold in accordance with the operating conditions of the engine.

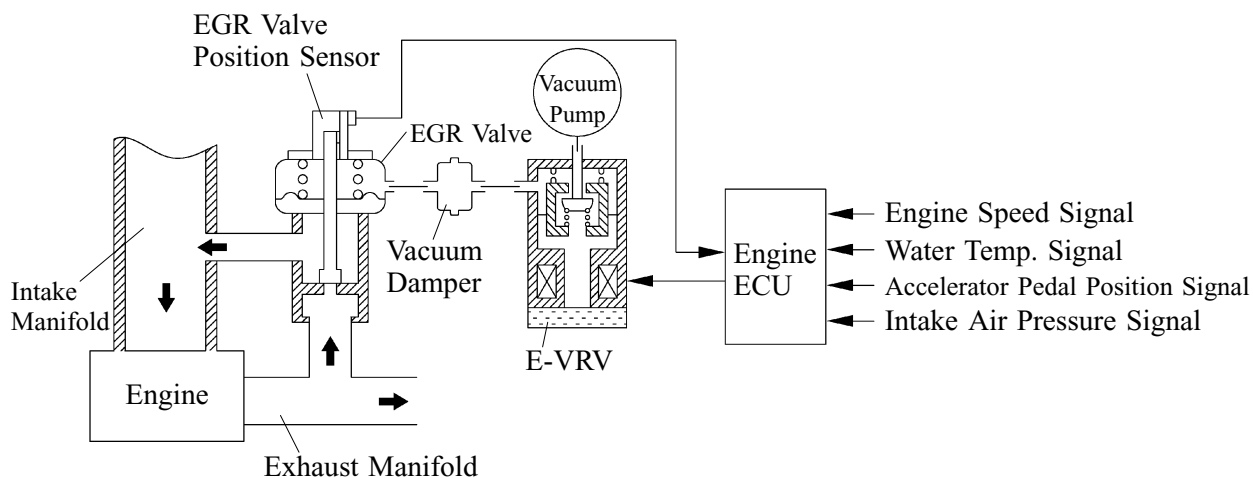
This reduces the noise that is generated during idling and deceleration, as well as the noise and vibration that are generated when the engine is stopped. When the EGR is operating, the throttle valve moves in the closing direction to increase the intake manifold vacuum, thus introducing a greater amount of EGR gas into the cylinders.



## EGR Control

- By sensing the engine driving condition and actual amount of the EGR valve opening, the engine ECU electrically operates the E-VRV, which controls the magnitude of vacuum introduced into diaphragm of EGR valve and throttle opening position with stepping motor and the amount of recirculating exhaust gas is regulated. EGR valve opening lift is controlled by modulated negative pressure.
- The EGR function is stopped under the conditions given below to ensure drivability and to reduce diesel smoke.
  - 1) The water temperature is below 20°C (68°F).
  - 2) The vehicle is driven under high load conditions.
  - 3) During deceleration.

### ► System Diagram ◀



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## Diagnosis

When the engine ECU detects a malfunction, the engine ECU makes a diagnosis and memorizes the failed section. Furthermore, check engine warning lamp in the combination meter illuminates or blinks to inform the driver. The engine will also store the DTCs (Diagnosis Trouble Code) of the malfunctions. The DTCs can be accessed by connecting SST (09843-18040) to the DLC3 terminals Tc and CG, and reading the blinking of the check engine warning lamp. They can also be accessed by connecting a hand-held tester.

## 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. For details, refer to see the 5L/5L-E Engine Repair Manual (Pub.No.RM890E).