■ ENGINE CONTROL SYSTEM

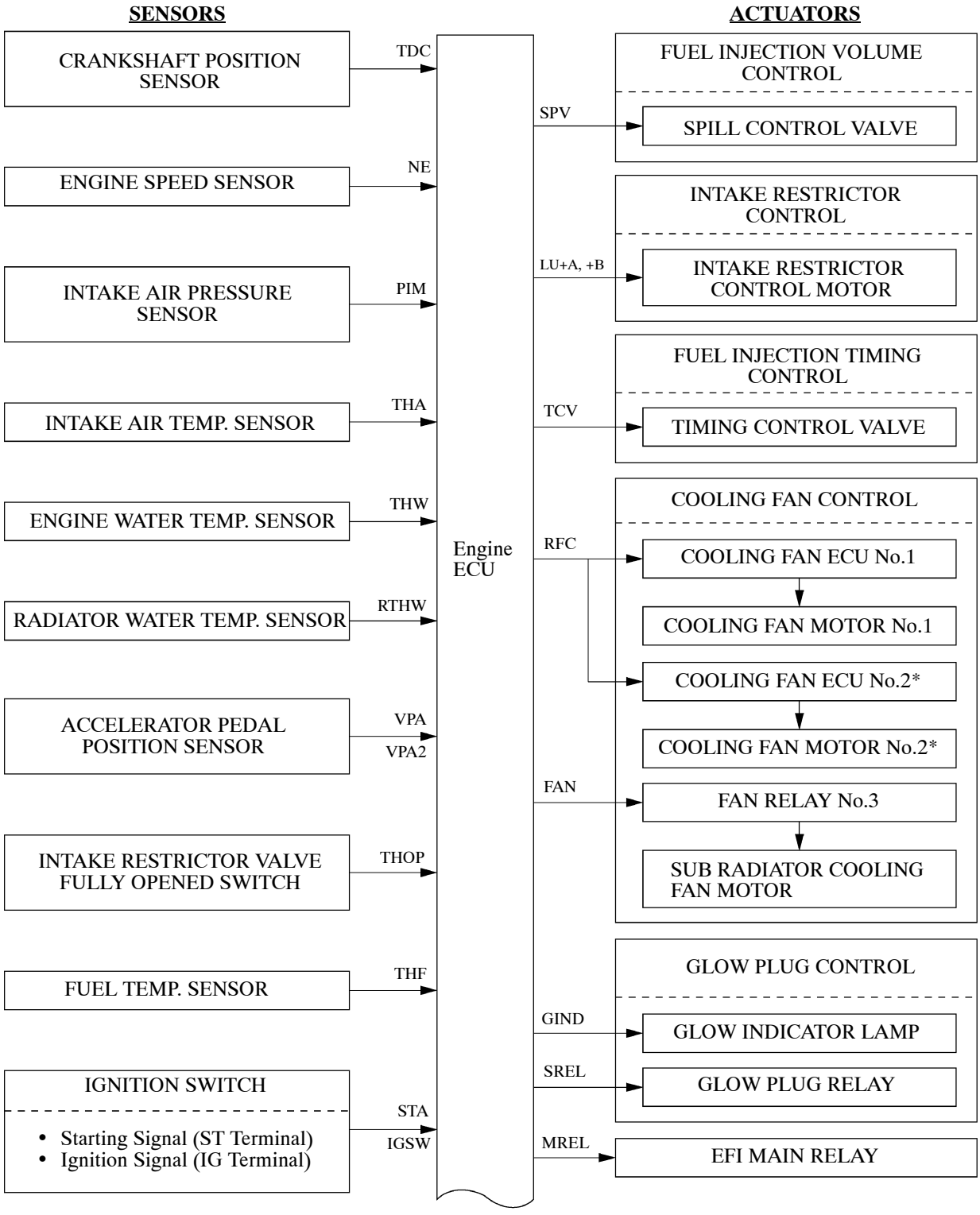
1. General

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

System		Outline
Diesel EFI	Fuel Injection Volume Control (See page EG-138)	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 (See page EG-140)	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 (See page EG-141)	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.
Intake Restrictor Control (See page EG-142)		Fully closes 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.
Cooling Fan Control (See page EG-143)		• The engine ECU steplessly controls the speed of the radiator cooling fan in accordance with the engine coolant temperature, vehicle speed, engine speed and air conditioner operating conditions. In addition, the engine ECU switches the sub radiator cooling fan ON/OFF according to the engine coolant temperature. • The above improves the cooling performance.
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.

2. Construction

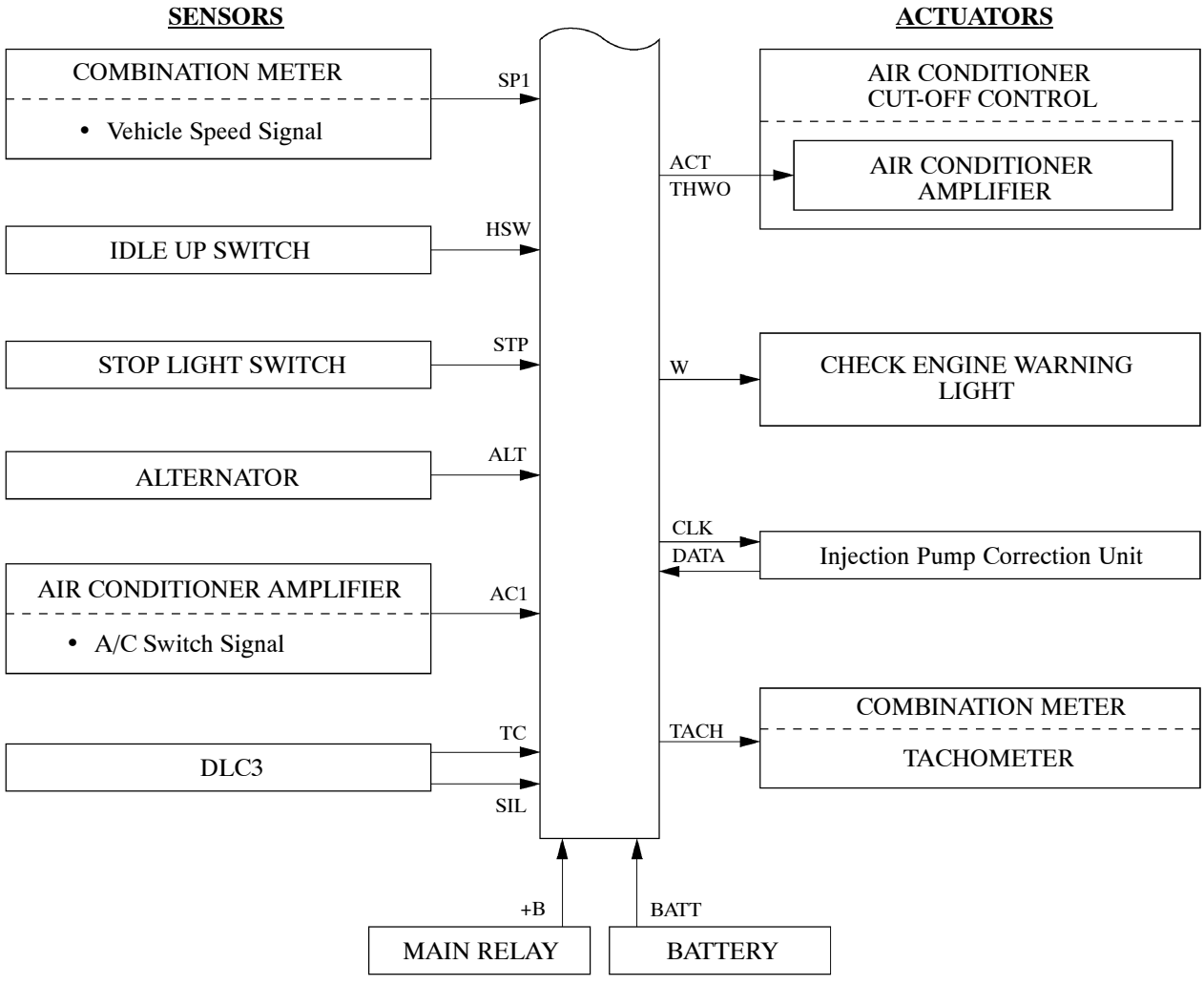
The configuration of the engine control system in 5L-E engine is shown in the following chart.



(Continued)

*: for Models with Air Conditioner

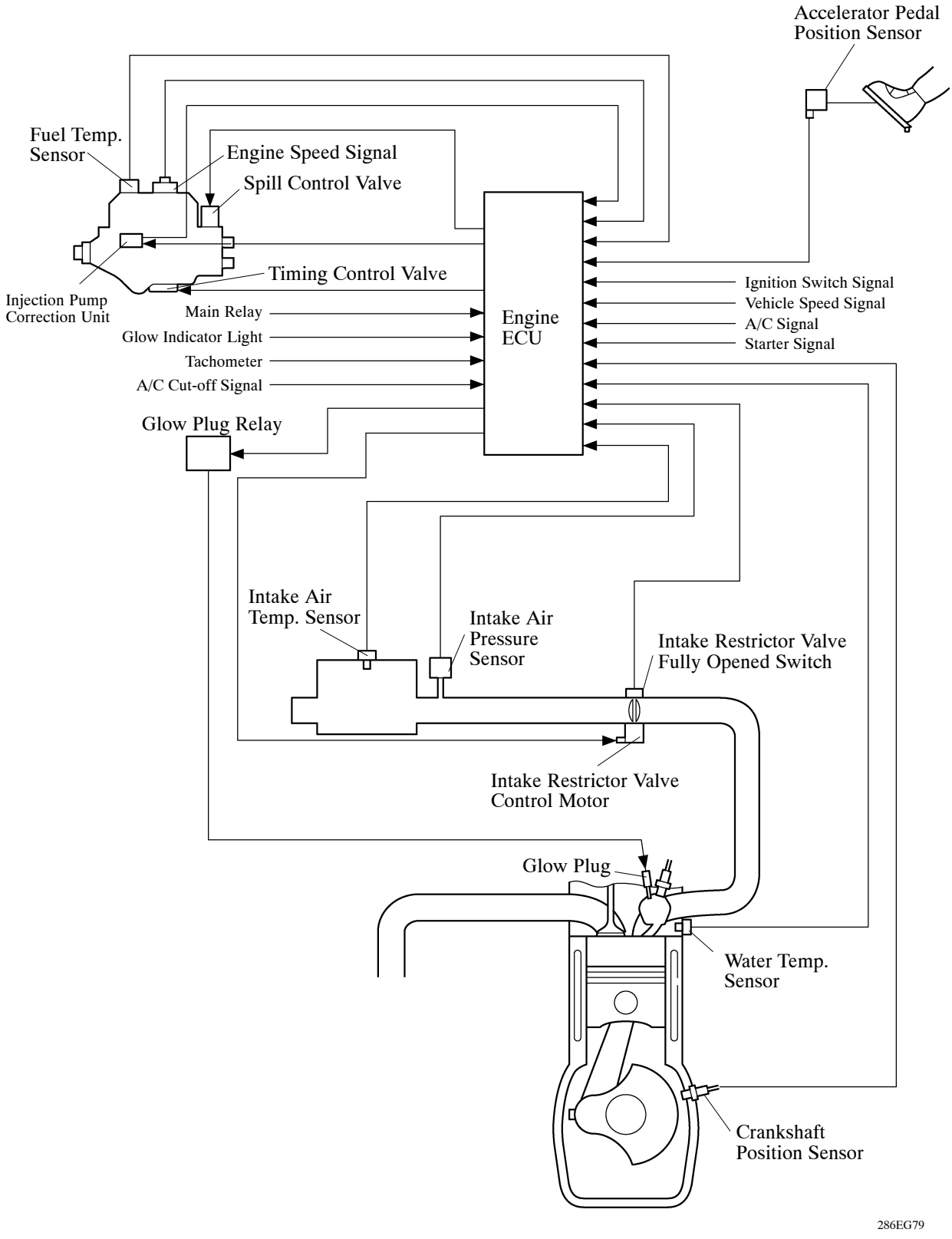
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SENSORS
ACTUATORS
COMBINATION METER
• Vehicle Speed Signal
SP1
AIR CONDITIONER CUT-OFF CONTROL
AIR CONDITIONER AMPLIFIER
ACT
THWO
IDLE UP SWITCH
HSW
STOP LIGHT SWITCH
STP
W
CHECK ENGINE WARNING LIGHT
ALTERNATOR
ALT
CLK
DATA
Injection Pump Correction Unit
AIR CONDITIONER AMPLIFIER
• A/C Switch Signal
AC1
COMBINATION METER
TACHOMETER
TACH
DLC3
TC
SIL
+B
BATT
MAIN RELAY
BATTERY

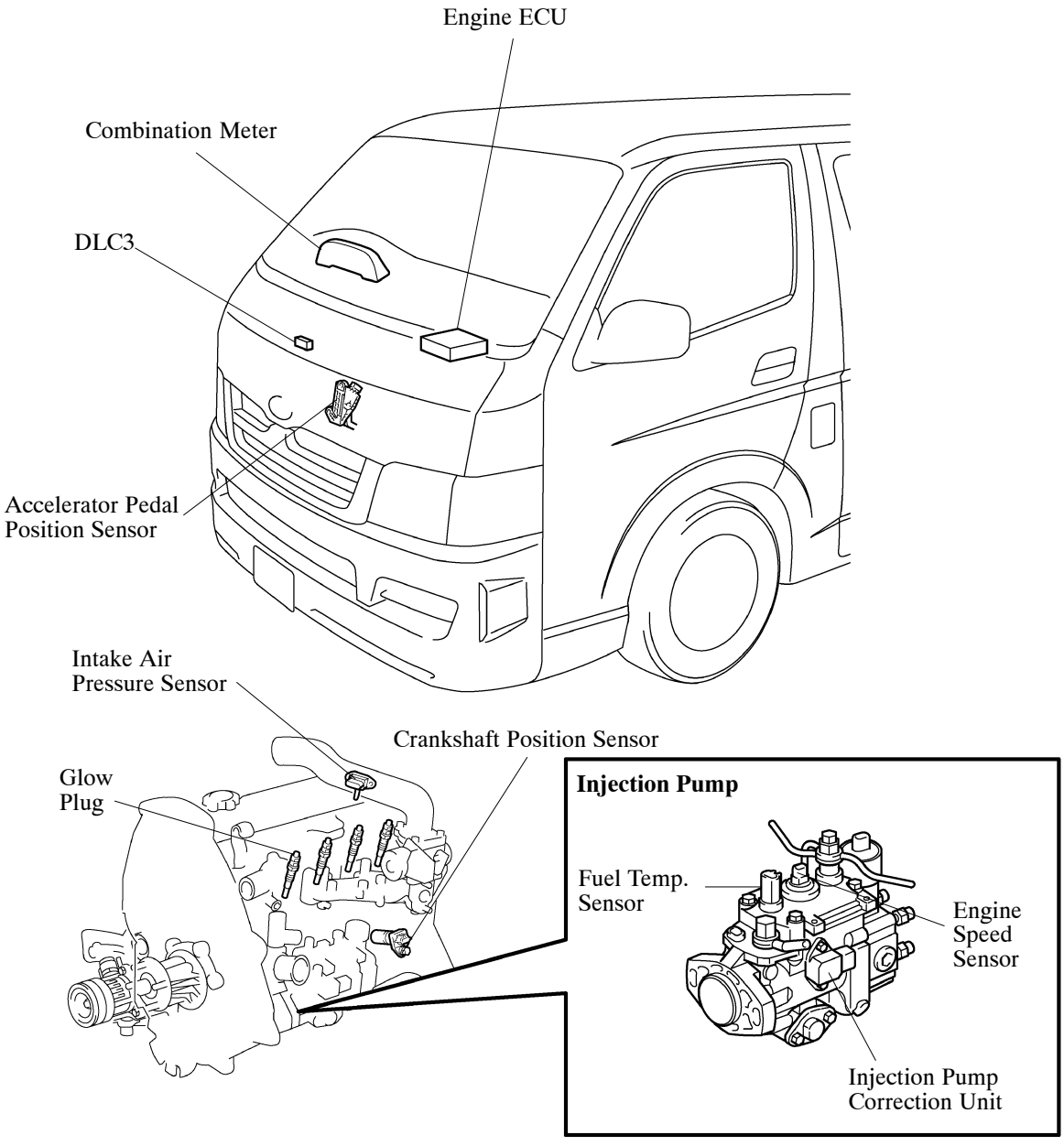
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3. Engine Control System Diagram



4. Layout of Main Components



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5. Main Components of Engine Control System

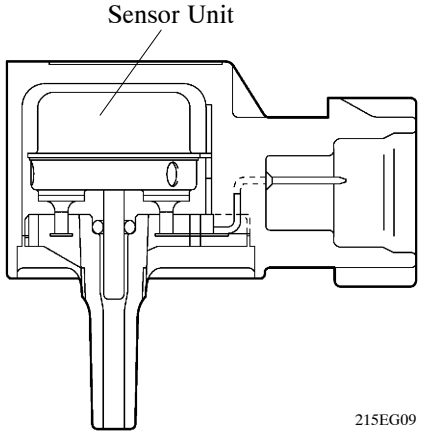
General

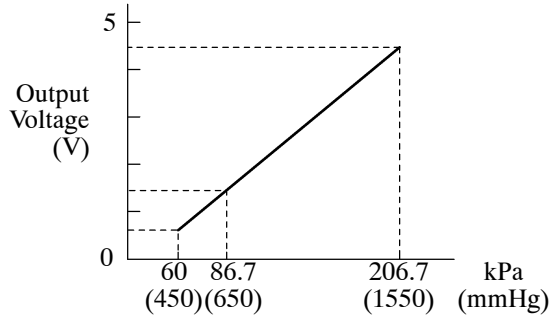
The main components of the 5L-E engine control system are as follows:

Component	Outline	Quantity
Intake Air Pressure Sensor	Semiconductor 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	Distributor Type (Electronically Controlled)	1

Intake Air Pressure Sensor

- The intake air pressure sensor is mounted on the intake air connector.
- This sensor detects the atmospheric pressure for intake air pressure correction.
- 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.





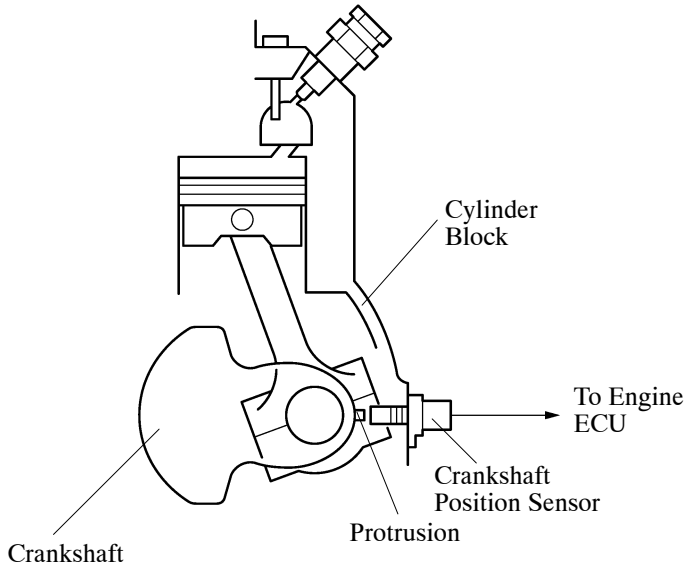
Intake Air Pressure Sensor Output Characteristics

Accelerator Pedal Position Sensor

For details, see page EG-46 in the 2TR-FE engine.

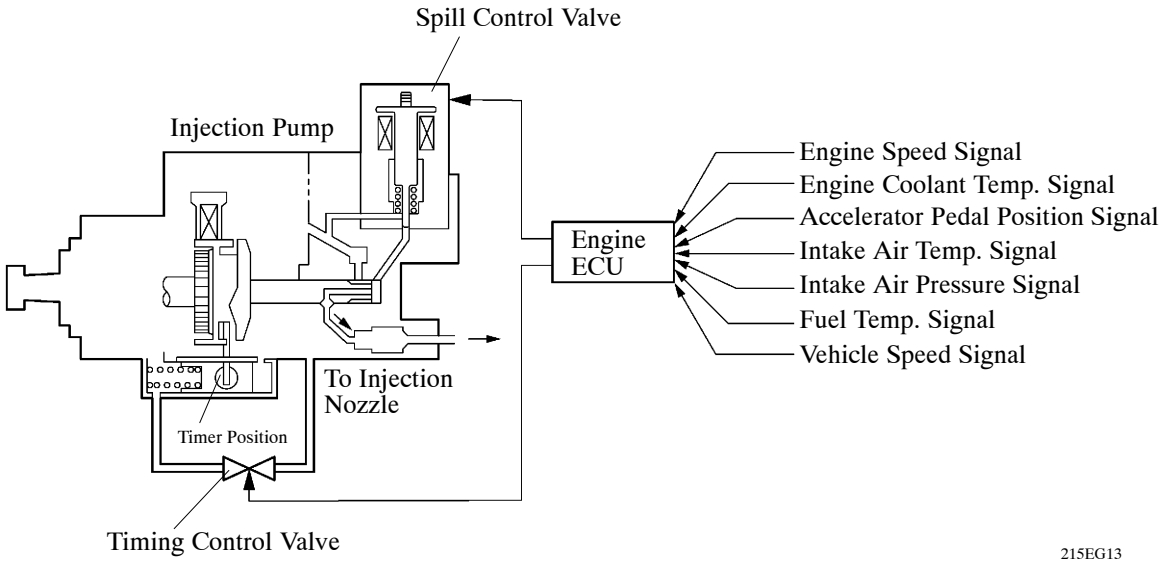
Crankshaft Position Sensor

The crankshaft position sensor is installed 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.



6. 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.



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.

1) Basic Injection Volume

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

2) 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.

a. Basic maximum injection volume

Determined in accordance with the engine speed.

b. Intake air pressure correction

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

c. 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.

d. Fuel temperature correction

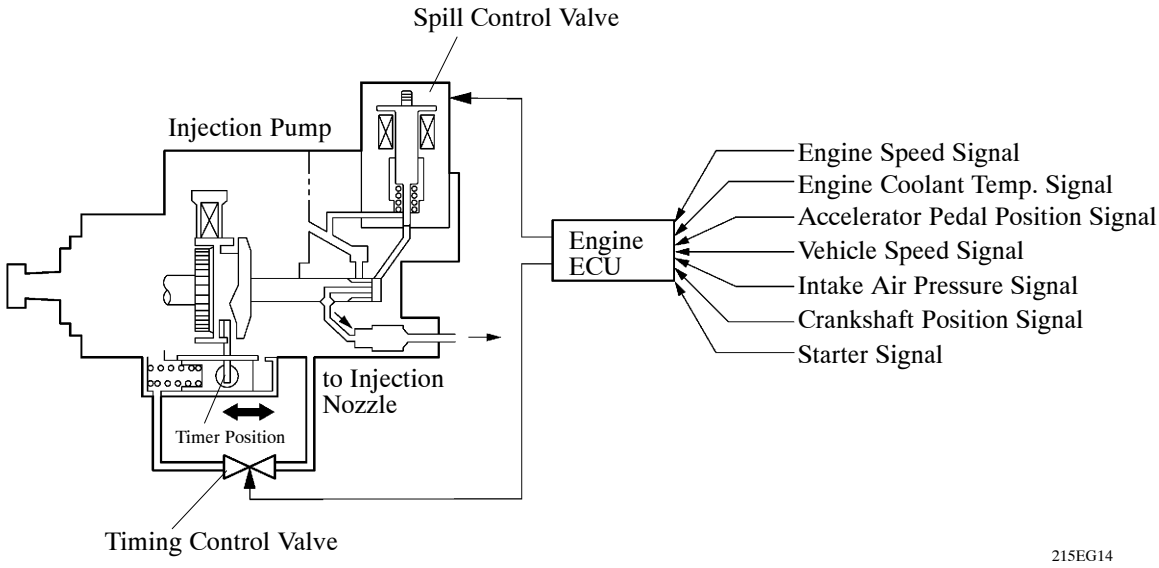
Corrects the variance in the injection volume that is created by the difference in the density of the fuel in accordance with the fuel temperature. The higher the fuel temperature becomes, the larger the injection volume becomes.

3) Starting Injection Volume Control

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

7. Fuel Injection Timing Control

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



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.

1) Basic Injection Timing

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

2) Injection Timing Correction

a. 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.

b. Water temperature correction

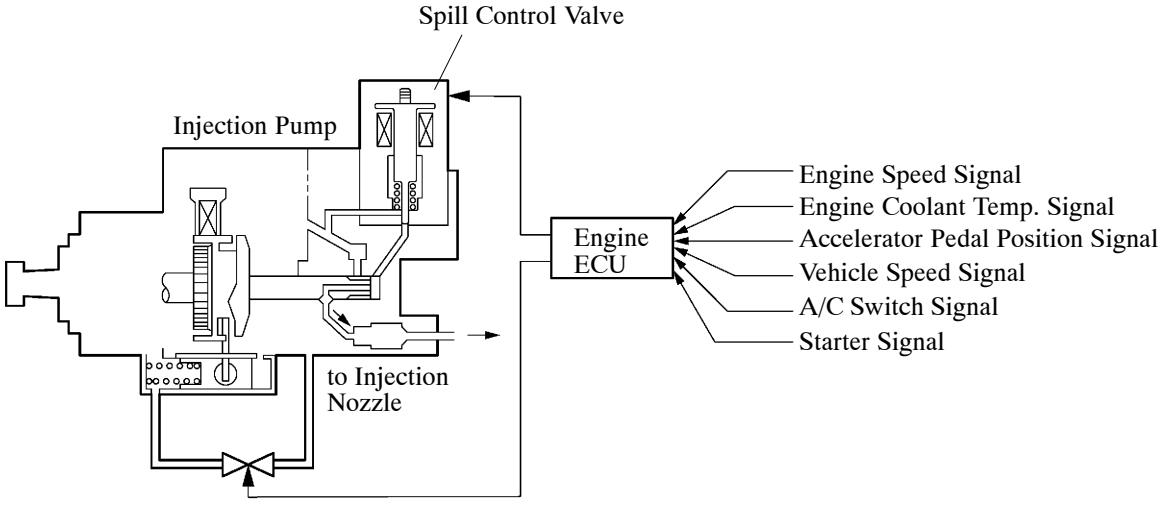
Corrects the basic fuel injection timing in accordance with the engine coolant temperature. The injection timing is advanced when the engine coolant temperature is low.

3) Starting Injection Timing control

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

8. 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.



Function of Engine ECU

1) 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.

2) Warm-Up Control

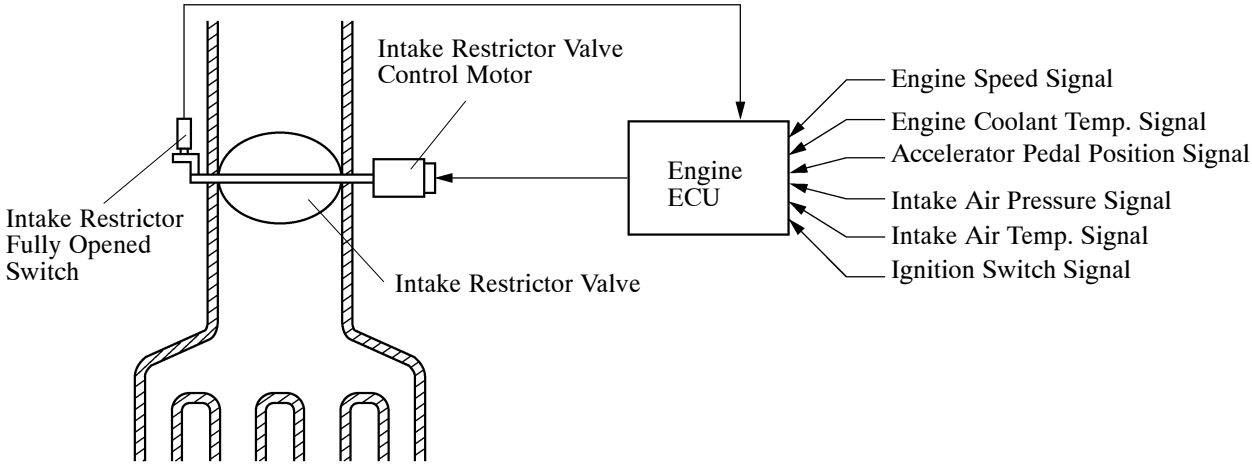
Controls the injection volume during warm-up, in accordance with engine coolant temperature, to achieve an optimal fast idle speed.

3) Engine Speed Change 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.

9. Intake Restrictor Control

The engine ECU controls the opening of the intake restrictor 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.



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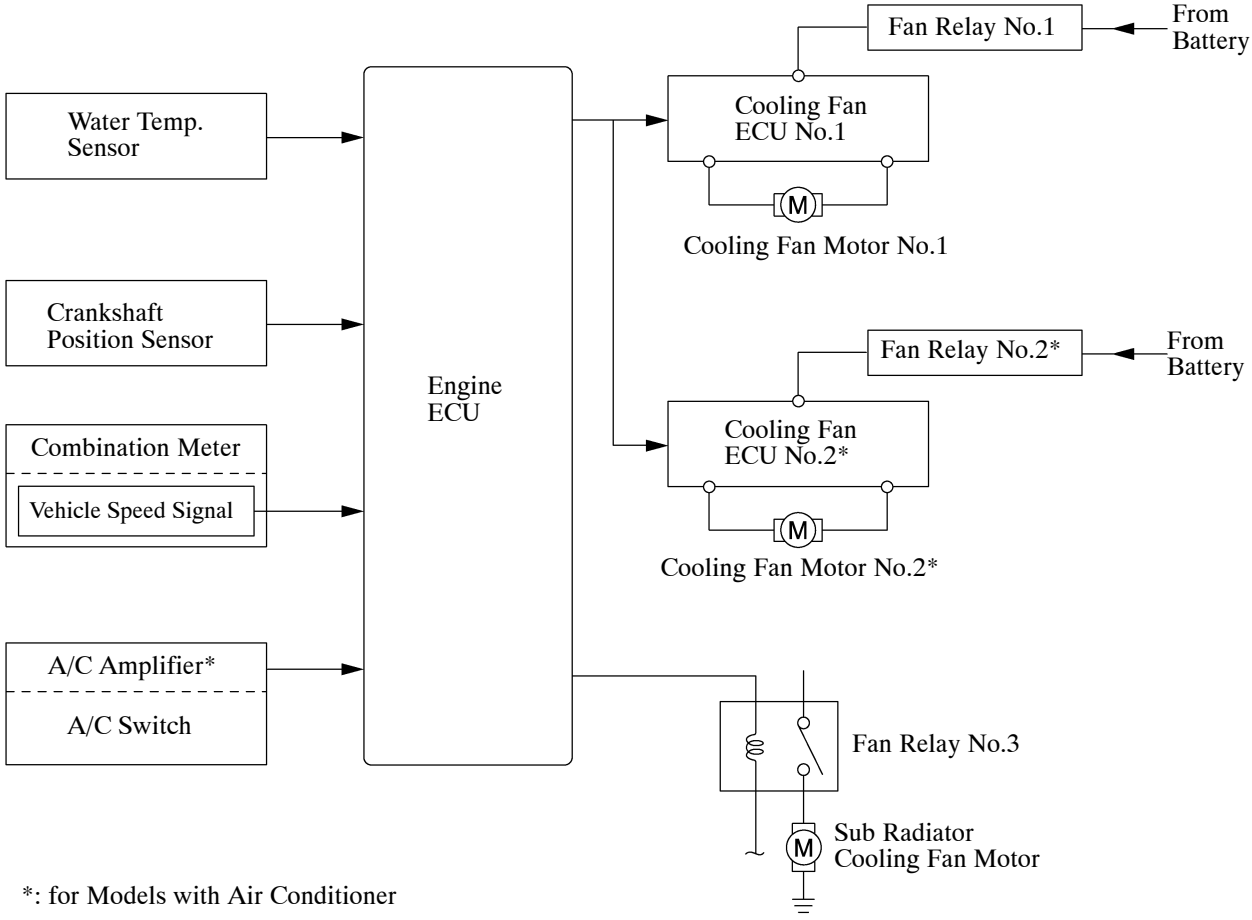
10. Cooling Fan Control

General

Radiator cooling fan control and sub radiator cooling fan control are used.

- For details on the radiator cooling fan control, see page EG-62 in 2TR-FE engine.
- For details on the sub radiator cooling fan control, see page EG-116 in 2KD-FTV engine.

▶ Wiring Diagram ◀



*: for Models with Air Conditioner

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Operation

1) Radiator Cooling Fan

For details, see page EG-63 in 2TR-FE engine.

2) Sub Radiator Cooling Fan

The basic operations are the same as for the 2KD-FTV engine models. The difference is the coolant temperature when the fan is switched ON/OFF. For details, see page EG-117 in 2KD-FTV engine.

▶ Sub Radiator Cooling Fan Operating Temperature ◀

Cooling Fan Operation		ON	OFF
Engine Coolant Temperature	°C (°F)	93 (199)	88 (190)

11. Diagnosis

When the engine ECU detects a malfunction, the engine ECU makes a diagnosis and memorizes the failed section. Furthermore, check engine warning light in the combination meter illuminates or blinks to inform the driver. The engine will also store the DTCs (Diagnosis Trouble Codes) 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 light. They can also be accessed by connecting a intelligent tester II .

12. 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 the Hiace Repair Manual (Pub No. RM1171E).