■ENGINE CONTROL SYSTEM

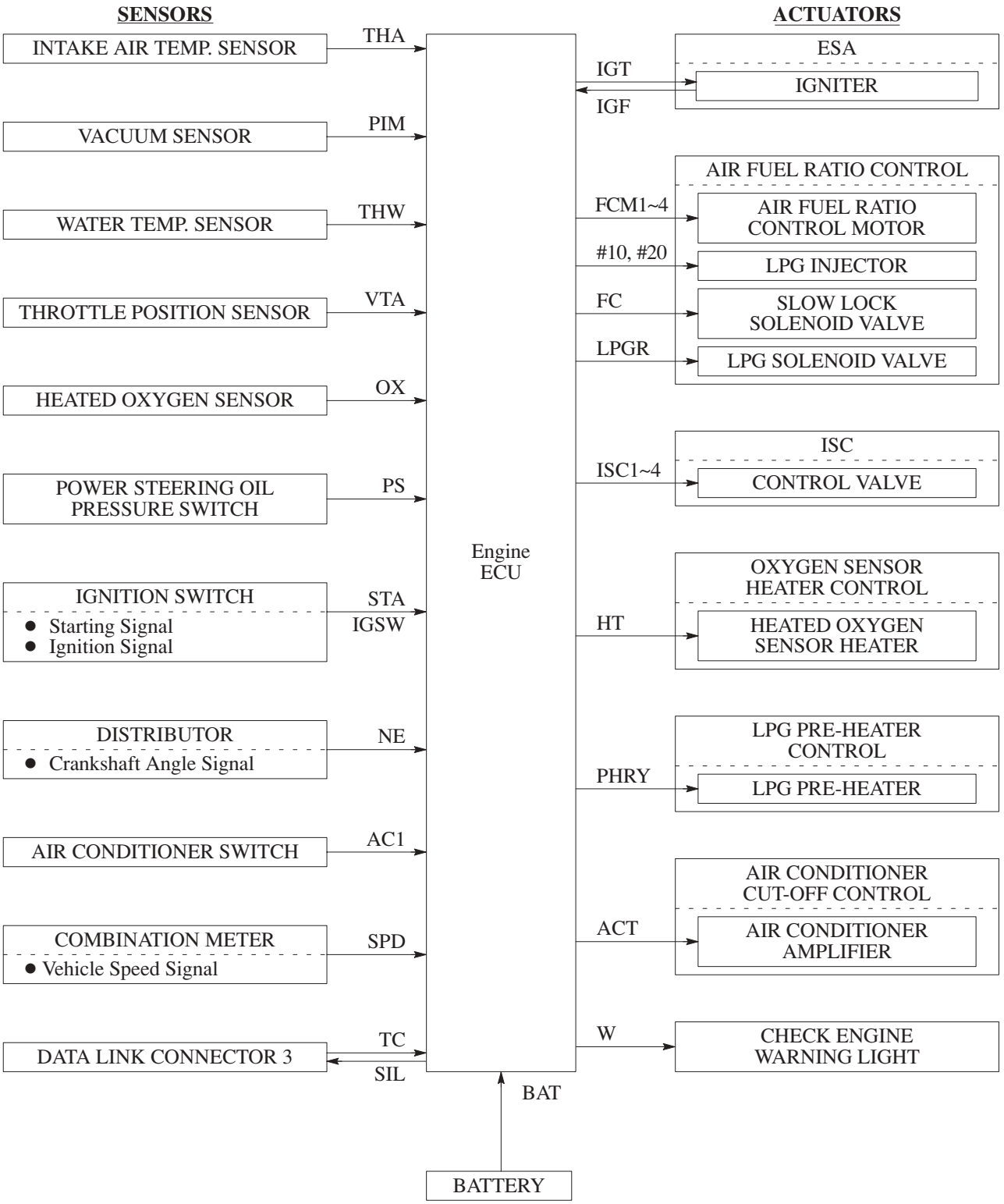
1. General

The enigne control system of the 1BZ-FPE engine perform the following types of control:

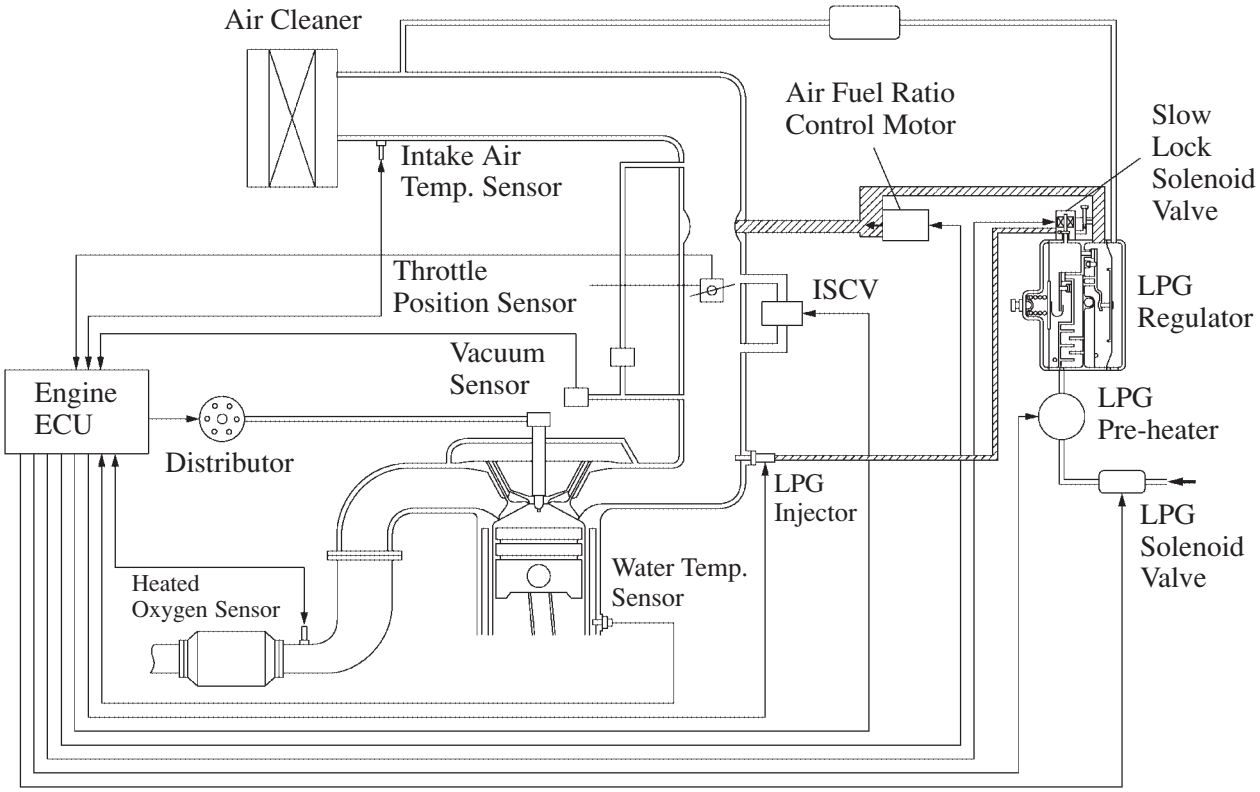
Basic Control	Air Fuel Ratio Control
	● Air Fuel Ratio Control Motor Control ● LPG Injector Control ● Slow Lock Solenoid Valve Control ● LPG Solenoid Valve Control
	ESA (Electronic Spark Advance)
Low Noise & Vibration	Idle Speed Control
	● Feed Back Control ● Warm Up Control ● Engine Speed Change Estimate Control
Drivability	Air Conditioner Cut-off Control
Low Emission	Oxygen Sensor Heater Control
Startability	LPG Pre-heater Control
Serviceability & Reliability	Diagnosis
	Fail-Safe

2. Construction

The configuration of the engine control system in the 1BZ-FPE engine in the new Coaster is shown in the following chart.

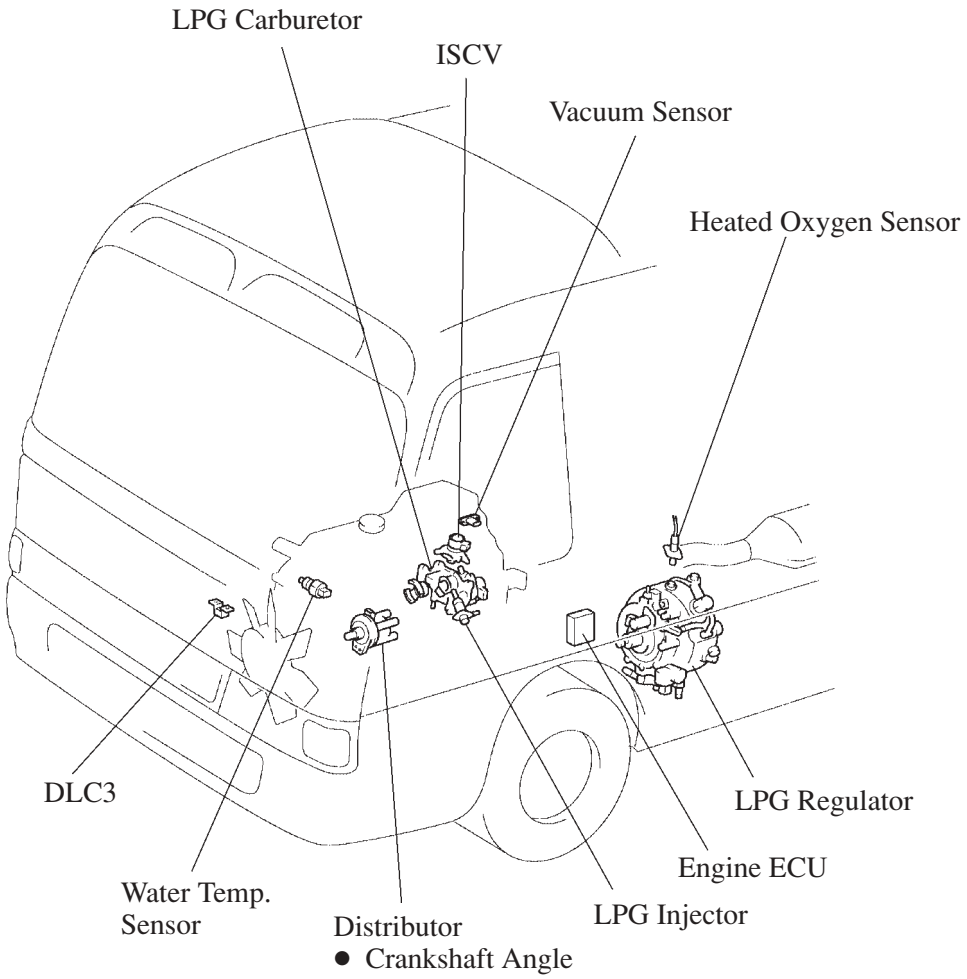


3. Engine Control System Diagram



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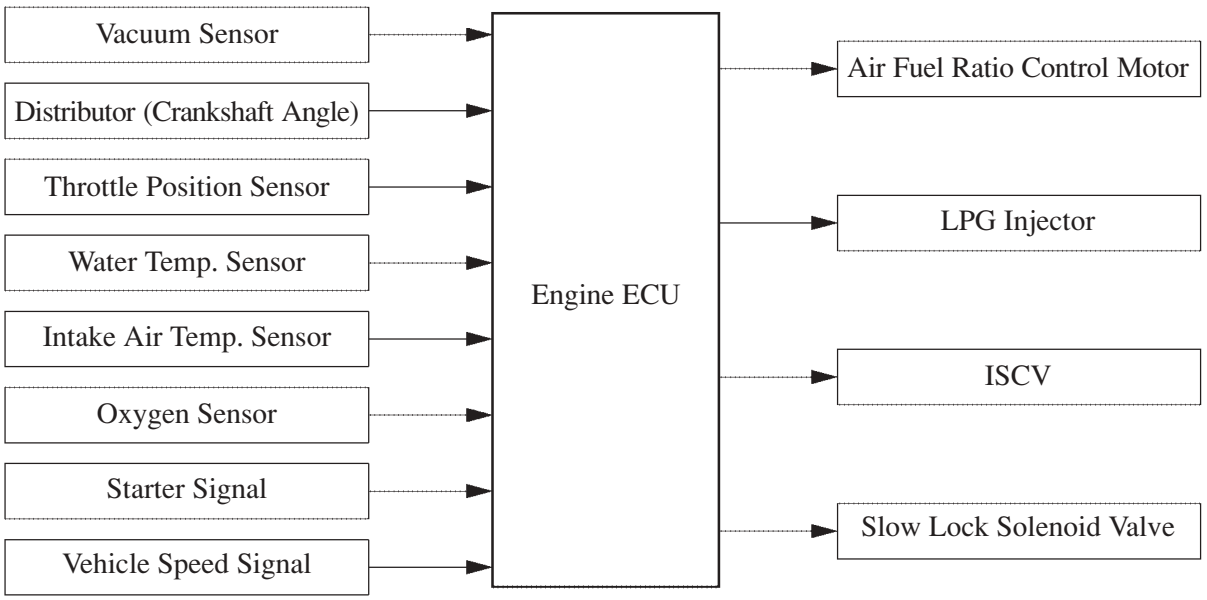
4. Layout of Main Components



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5. Air Fuel Ratio Control

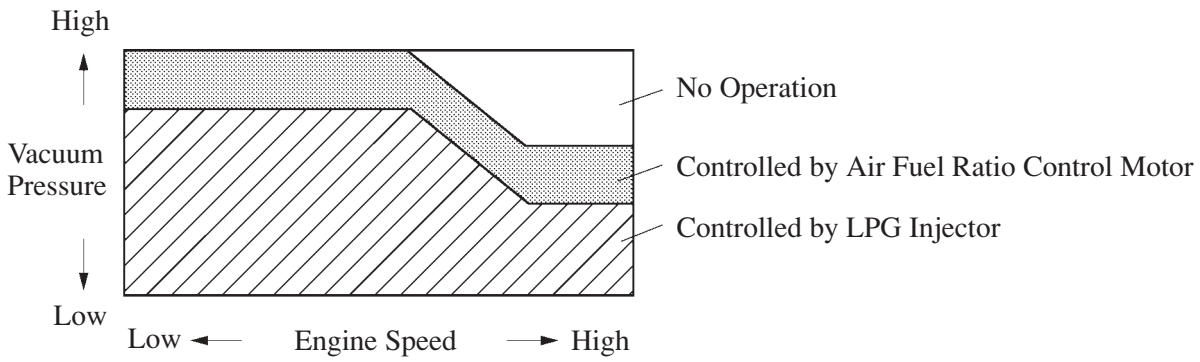
Based on the sensor signal, the engine ECU controls the air fuel ratio by calculating the fuel flow volume that is appropriate for the engine condition.
This control realizes an optimal air-fuel ratio at all times by making fuel corrections through the feedback control effected by both the air-fuel ratio control motor and the LPG injector.



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▶ Feed Back Control ◀



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Air Fuel Ratio Control Motor Control

- The air-fuel ratio control motor provided in the LPG carburetor controls the fuel flow volume in the main passage.
- A step motor has been adopted for the air-fuel ratio control motor, which varies in 0 to 100 steps.

1) Basic Fuel Flow Volume

Determined in accordance with the intake manifold pressure and the engine speed.

2) Maximum Fuel Flow Volume

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

a. Basic Maximum Fuel Flow Volume

Determined in accordance with the engine speed.

b. Intake Air Temperature Correction

Increases the fuel flow volume when the intake air temperature is low because the air density becomes high.

c. Water Temperature Correction

The lower the water temperature, the greater the fuel flow volume becomes in order to ensure drivabilil-ty immediately following cold-starting.

d. Learning Correction

Under air-fuel ratio feedback control, this function learns and corrects the deviation from the stoichio-metric air-fuel ratio when the water temperature is higher than 70°C.

e. Heavy Load Correction

When the engine ECU determines a heavy load condition based on the signals from the sensors, this function increases the fuel flow volume.

LPG Injector Control

The LPG injector that is provided in the LPG carburetor injects correction fuel.

1) Basic Injection Time

Determined in accordance with the intake manifold pressure and the engine speed.

2) Injection Time Correction

a. Intake Air Temperature Correction

Corrects by increasing the fuel flow volume when the intake air temperature is low because the air density becomes high.

b. Water Temperature Correction

Corrects by decreasing the fuel flow volume when the water temperature is low to prevent the air-fuel ratio from becoming too rich.

c. Learning Correction

Under air-fuel ratio feedback control, this function learns and corrects the deviation from the stoichiometric air-fuel ratio when the water temperature is higher than 70°C.

Slow Lock Solenoid Valve Control

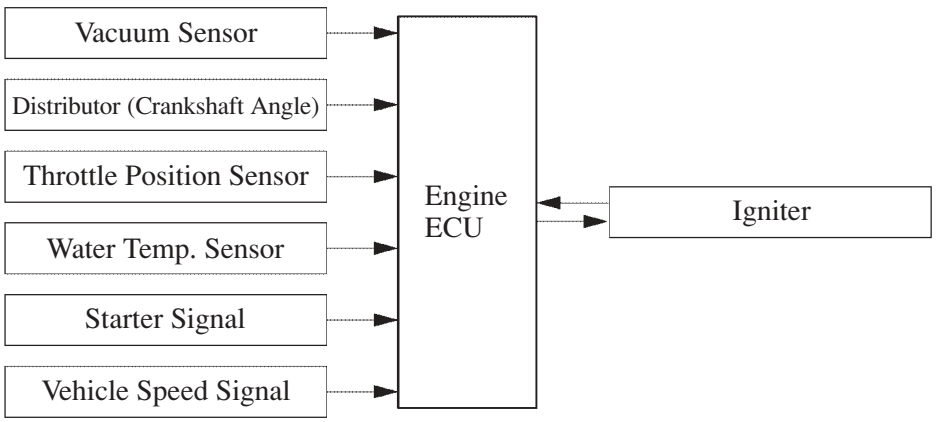
When the engine speed is higher than the fuel cutoff rpm during deceleration, the slow lock solenoid valve provided in the LPG regulator cuts off the fuel in the slow passage in order to improve fuel economy.

LPG Solenoid Valve Control

When the engine is started, the valve opens in accordance with the signals from the engine ECU, in order to send the fuel to the LPG regulator.
When the engine speed is high (3000 rpm under no-load, or 4100 rpm while driving), the valve closes to prevent the engine from overrunning.

6. ESA (Electronic Spark Advance)

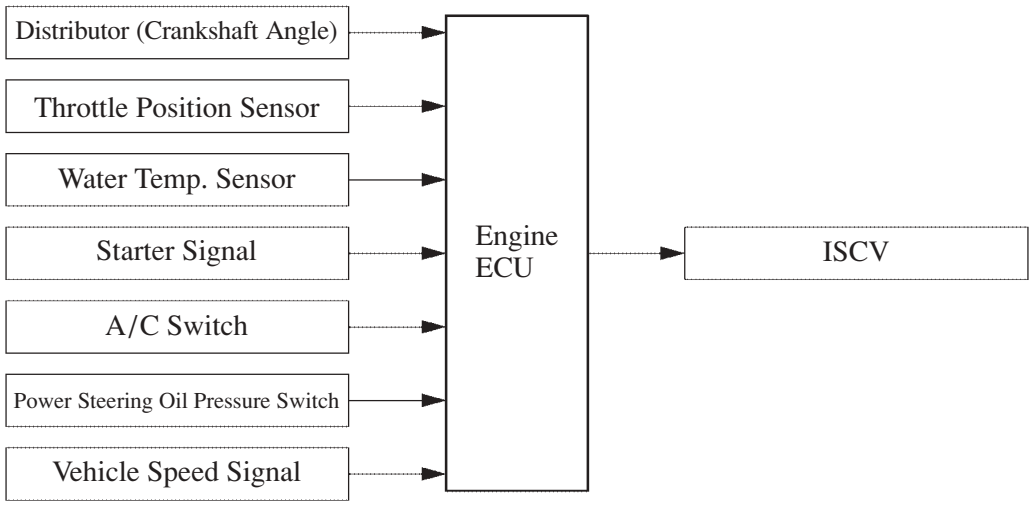
This system selects the optimal ignition timing in accordance with the signals received from the sensors and sends the (IGT) ignition signal to the igniter. The default ignition timing is set to 12° BTDC.



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7. ISC (Idle Speed Control)

In this system, the engine ECU calculates the target engine speed in accordance with the engine condition, and determined the bypass air volume, thus controlling the idle speed.



Function of Engine ECU

1) Feedback Control

During idling, the feedback control controls the bypass air 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 bypass air volume during warm-up to achieve and optimal fast idle speed in accordance with water temperature.

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 bypass air volume before the idle speed changes.

8. Diagnosis

- If the engine ECU detects any problem with a sensor or an electrical circuit, it turns ON the check engine warning light in the combination meter to inform the driver. In addition, the malfunction code will be stored in memory.
- An M-OBD (Multiplex On-Board Diagnostic) system has been adopted to improve serviceability. For details of the diagnostic trouble codes, active test, etc. refer to the 1BZ-FPE Engine Repair Manual Supplement (Pub. No. RM943E).

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 Control List ◀

Location of malfunction	Description of Control
Vacuum Sensor	In case of a signal malfunction, the air-fuel ratio deviates, causing the engine to run poorly. In this case, the engine ECU fixes the ignition timing and the air-fuel ratio control motor to preset values.
Water Temp. Sensor and Intake Air Temp. Sensor	In case of a signal malfunction, the use of the values from the sensors will make the air-fuel ratio become too rich or too lean, which could causes the engine to stall or to run poorly during cold operation. Therefore, the engine ECU fixes the air-fuel ratio to the stoichiometric ratio and uses the constant values of 80°C water temperature and 20°C intake air temperature to perform the calculation.
ISCV	In case of an ISCV malfunction, the engine ECU retards the ignition timing.
Ignition Coil	In case of a malfunction in the ignition system, such as an open circuit in the ignition coil, the catalyst could be become overheated due to engine misfire. Therefore, if the ignition signal (IGF) is not input twice or more in a row, the engine ECU determined that a malfunction occurred in the ignition system and stops only the injection of fuel into the cylinder with the malfunction.

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