■ENGINE CONTROL SYSTEM

1. General

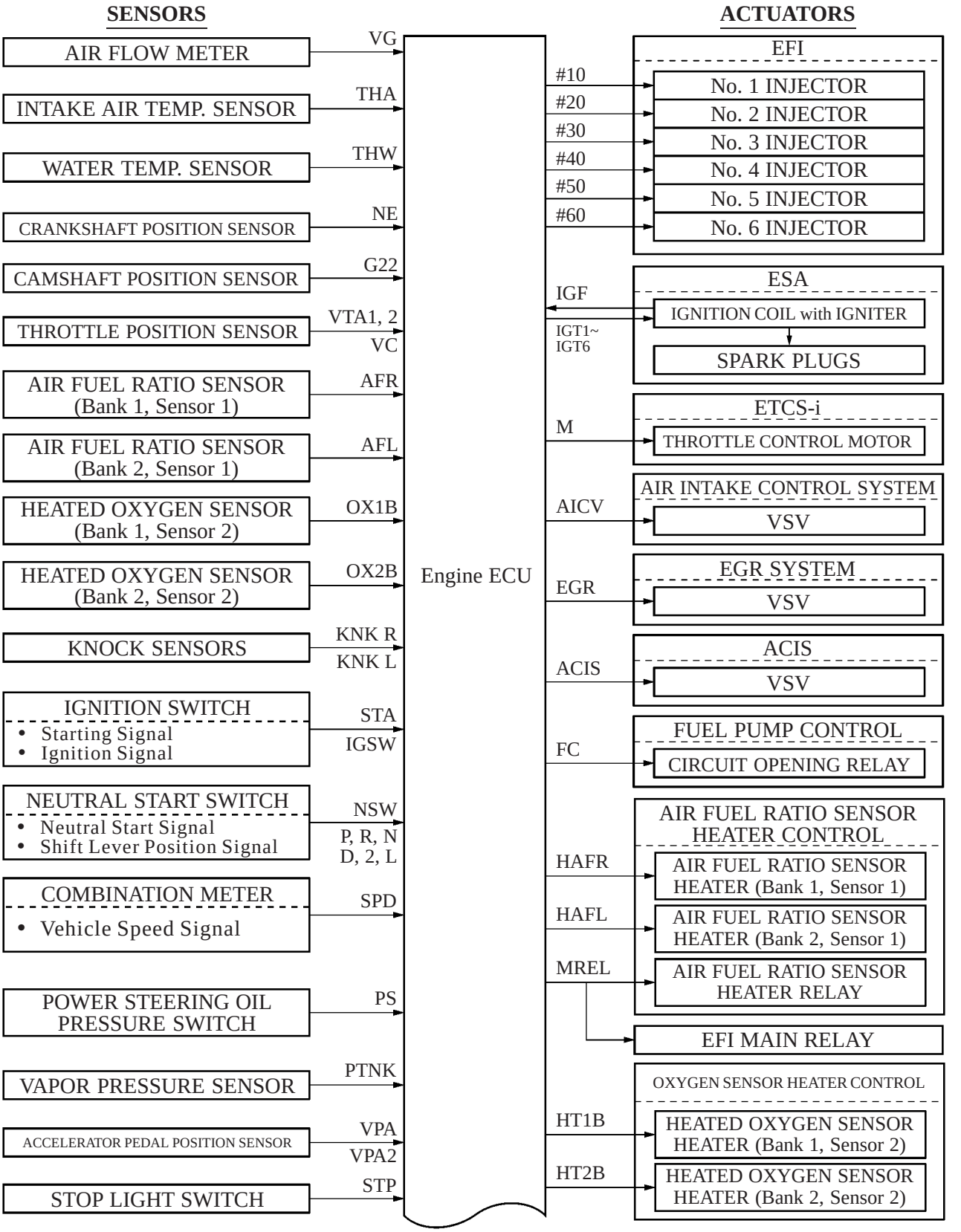
The engine control system of the 1MZ-FE engine has following system.

System	Outline	New	Previous
EFI (Electronic Fuel Injection) (For details, see page EG-76)	• An L-type EFI system directly detects the intake air mass with a hot wire type air flow meter. • The fuel injection system is a sequential multiport fuel injection system.	○	←
ESA (Electronic Spark Advance) (For details, see page EG-76)	Ignition timing is determined by the engine ECU based on signals from various sensors. The engine ECU corrects ignition timing in response to engine knocking.	○	←
ETCS-i (Electronic Throttle Control System-intelligent) (For details, see page EG-77)	Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort and the condition of the engine and the vehicle.	○	—
ACIS (Acoustic Control Induction System) (For details, see page EG-79)	The intake air passages are switched according to the engine speed and throttle valve opening angle to provide high performance in all speed ranges.	○	←
Air Intake Control System (For details, see page EG-82)	The intake air duct is divided into two areas, and the engine ECU controls the variable intake valve and the actuator that are provided in one of the areas to reduce the amount of engine noise.	○	—
Fuel Pump Control	Fuel pump operation is controlled by signal from the engine ECU.	○	←
Air Fuel Ratio Sensor, Oxygen Sensor Heater Control	Maintains the temperature of the air fuel ratio sensor or oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	○	←
EGR (Exhaust Gas Recirculation) System	• This system recirculates a portion of the exhaust gases through the intake in order to reduce the amount of NOx in the exhaust gases. • Cuts off EGR according to the engine condition to maintain drivability of the vehicle and durability of the EGR components.	○	←
Evaporative Emission Control	The engine ECU controls the purge flow of evaporative emission (HC) in the charcoal canister in accordance with engine conditions.	○	←
Air Conditioner Cut-off Control	By turning the air conditioner compressor ON or OFF in accordance with the engine condition, drivability is maintained.	○	←
Engine Immobiliser	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid ignition key.	○	←
Diagnosis (For details, see page EG-83)	When the engine ECU detects a malfunction, the engine ECU diagnoses and memorizes the failed section.	○	←
	To increase the speed for processing the signals, the 32-bit CPU of the engine ECU has been adopted.	○	—
Fail-Safe (For details, see page EG-84)	When the engine ECU detects a malfunction, the engine ECU stops or controls the engine according to the data already stored in the memory.	○	←

EG

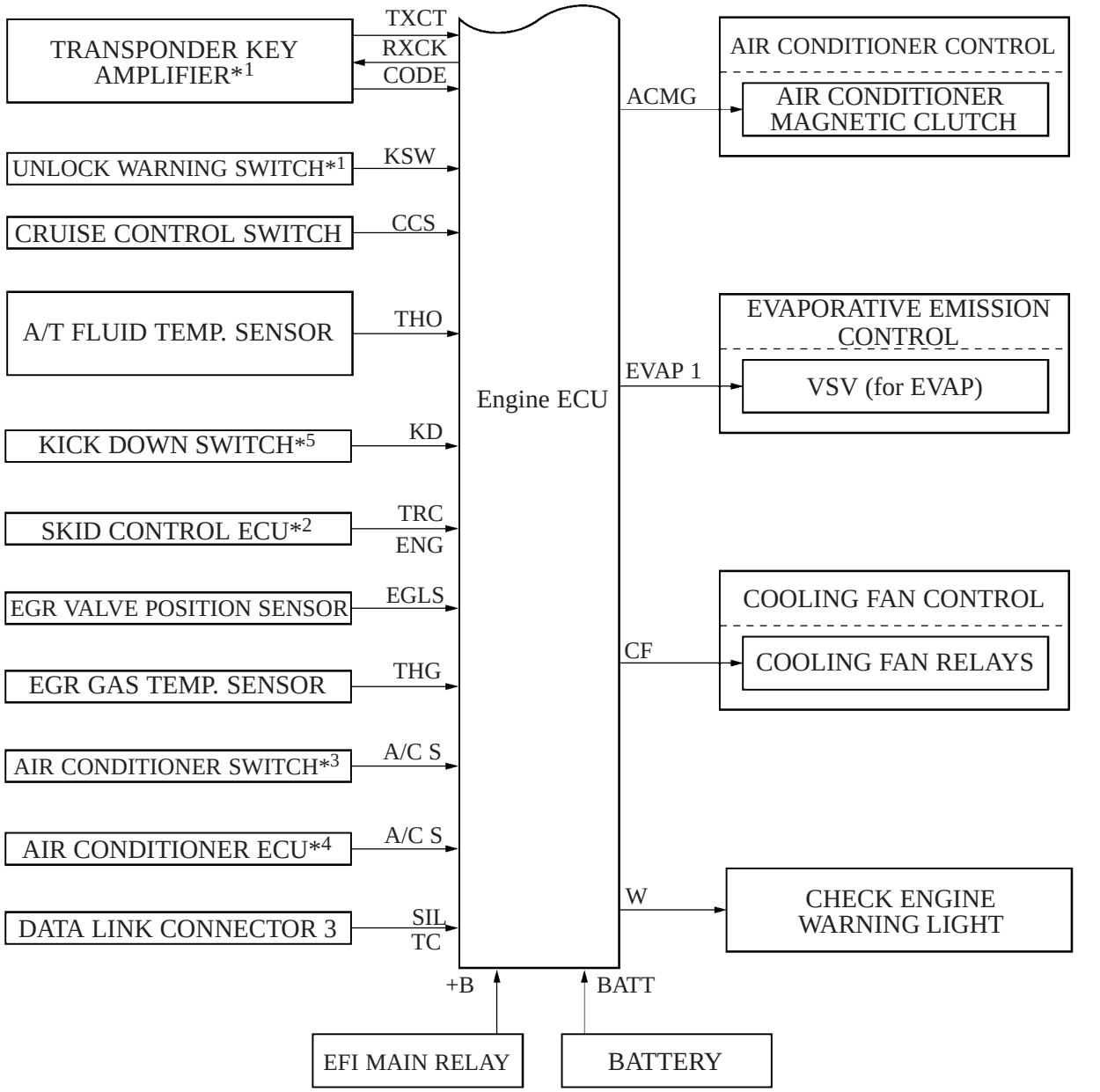
2. Construction

The configuration of the engine control system in the 1MZ-FE engine in the '02 Camry is as shown in the following chart.



(Continued)

208EG36

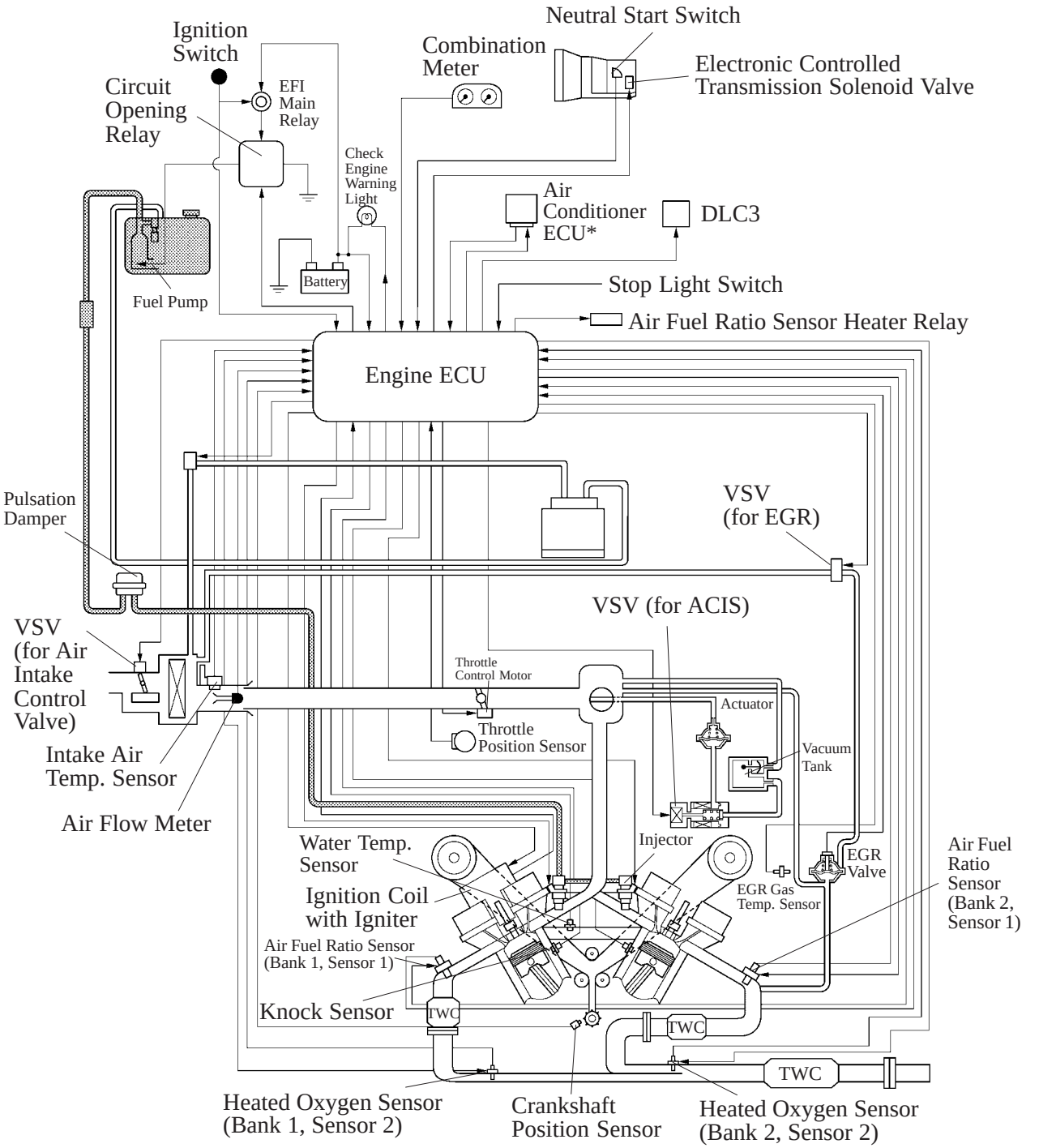


208EG60

*1: with Engine Immobiliser System
*2: with VSC System
*3: with Manual Air Conditioning System
*4: with Automatic Air Conditioning System

EG

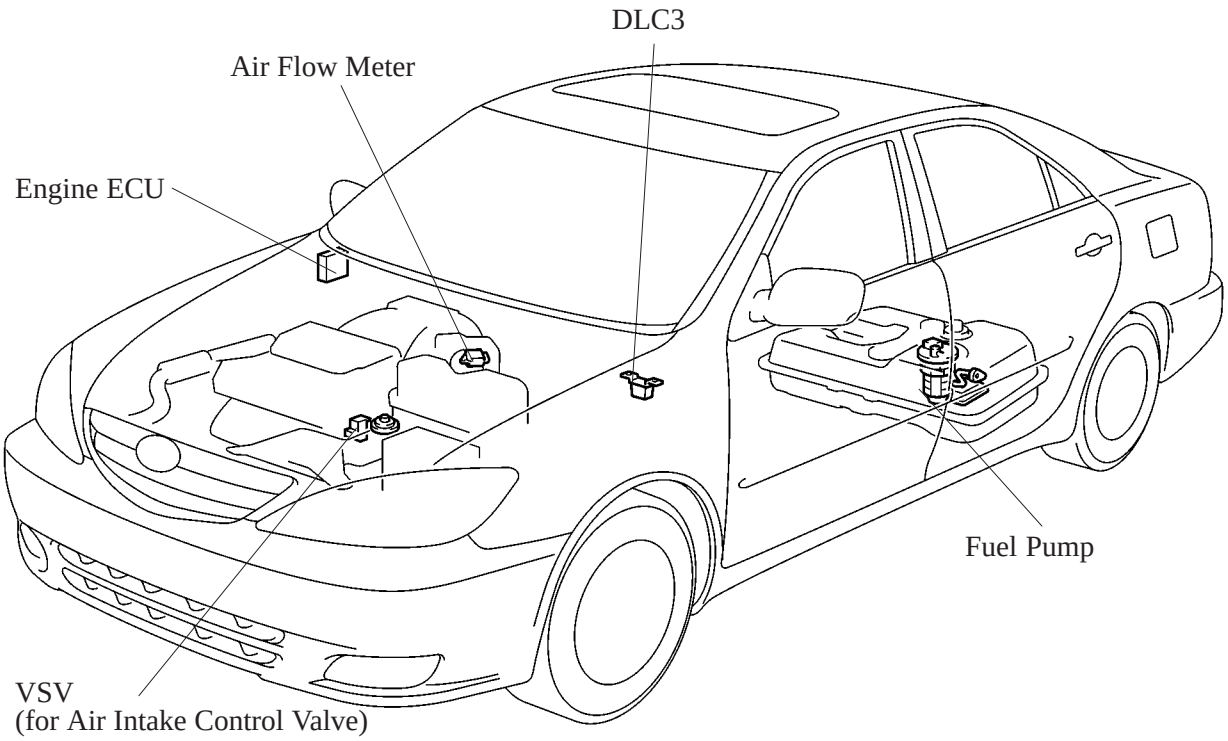
3. Engine Control System Diagram

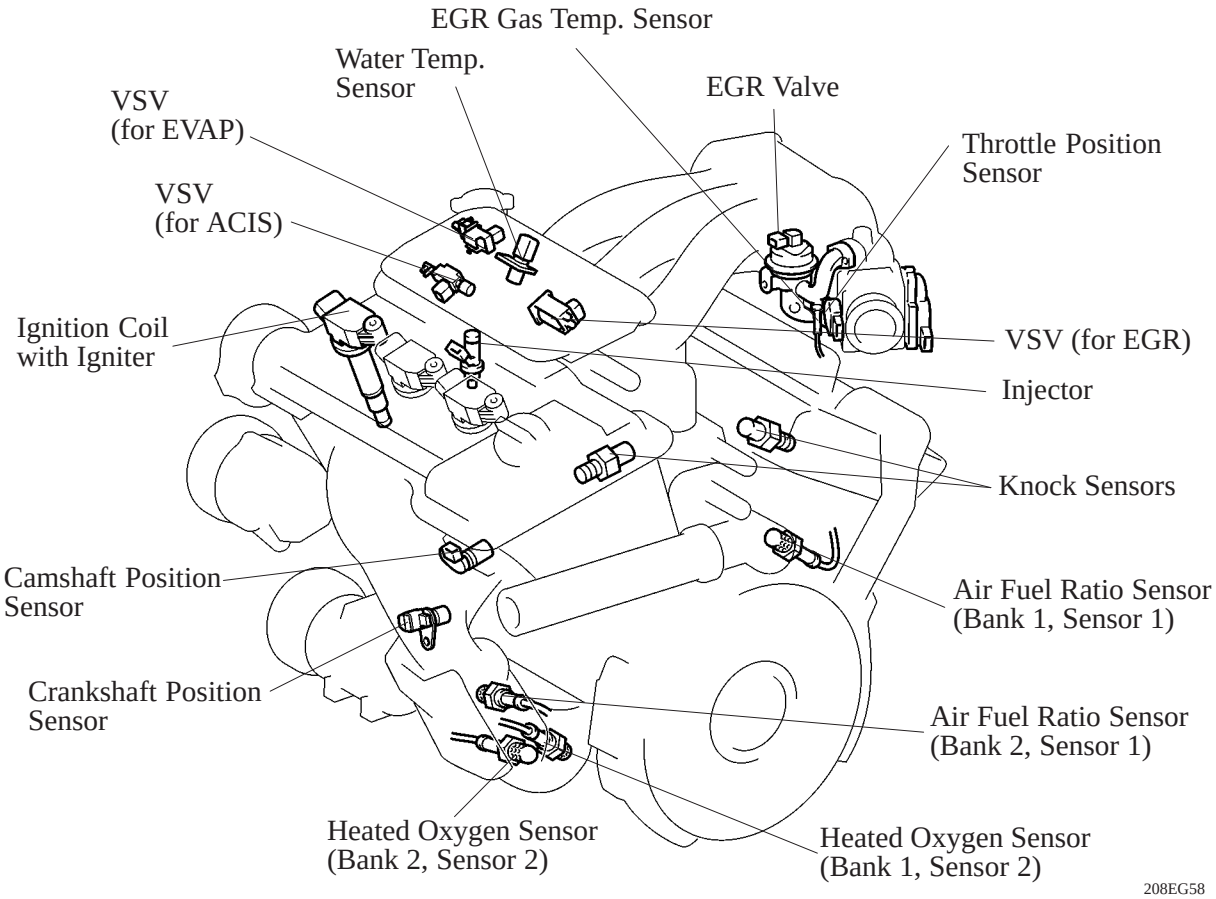


208EG57

*: with Automatic Air Conditioner System

4. Layout of Main Component





5. Main Components of Engine Control System

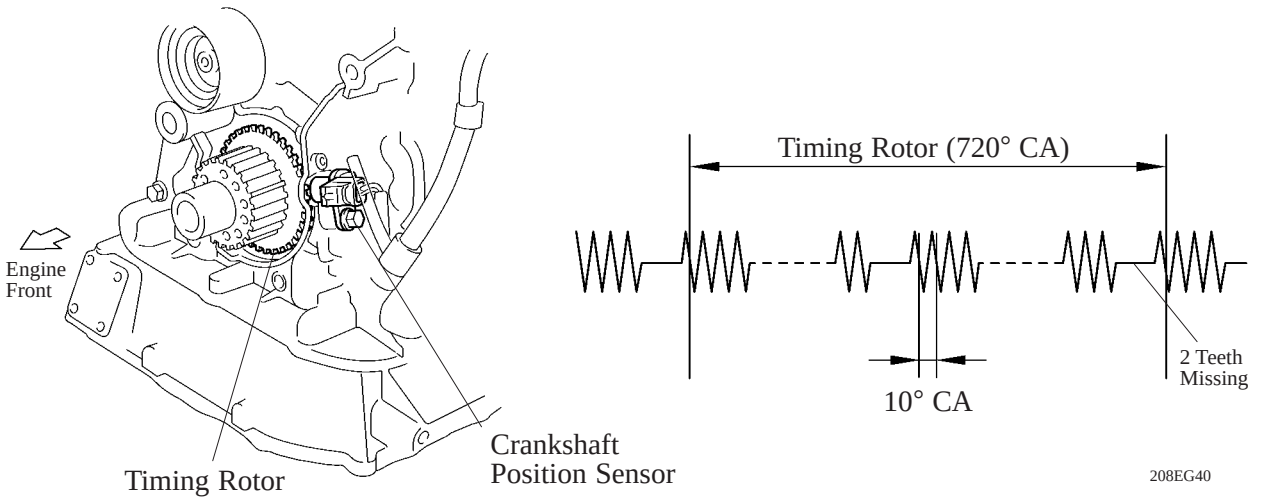
General

The following table compares the main components.

Components	New		Previous	
	Outline	Quantity	Outline	Quantity
Engine ECU	32-bit CPU	1	16-bit CPU	1
Air Flow Meter (For details, see page EG-37)	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 (3)	1	←	
Throttle Position Sensor	Linear Type	1	←	
Accelerator Pedal Position Sensor (For details, see page EG-39)	Linear Type	1	—	
Knock Sensor	Built-in Piezoelectric Type	1	←	
Air Fuel Ratio Sensor (Bank 1, Sensor 1) (Bank 2, Sensor 1)	with Heater Type	2	←	
Oxygen Sensor (Bank 1, Sensor 2) (Bank 2, Sensor 2)	with Heater Type	2	with Heater Type	1
Injector	12-hole Type	6	4-hole Type	6

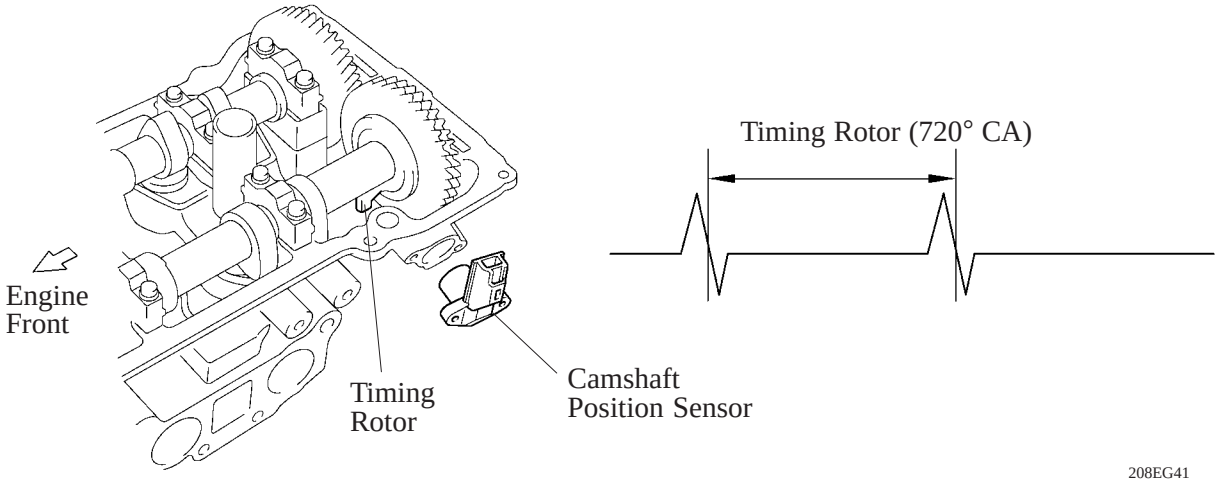
Crankshaft Position Sensor

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.



Camshaft Position Sensor

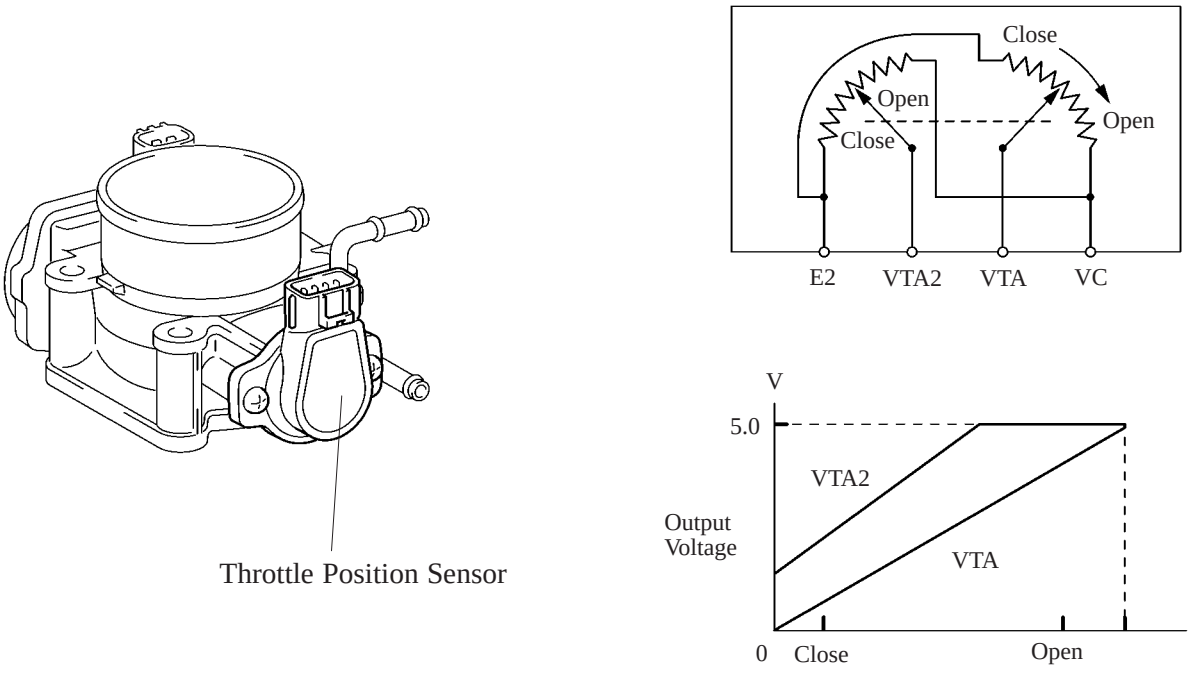
The camshaft position sensor is mounted on the left side cylinder head. To detect the camshaft position, a timing rotor that is provided on the camshaft is used to generate 1 pulses for every 2 revolutions of the crankshaft.



208EG41

Throttle Position Sensor

This sensor converts the throttle valve opening angles into electronic signals with two differing characteristics and outputs them to the engine ECU. One is the VTA signal that linearly outputs the voltage along the entire range of the throttle valve opening angle. The other is the VTA 2 signal that outputs an offset voltage.



208EG42

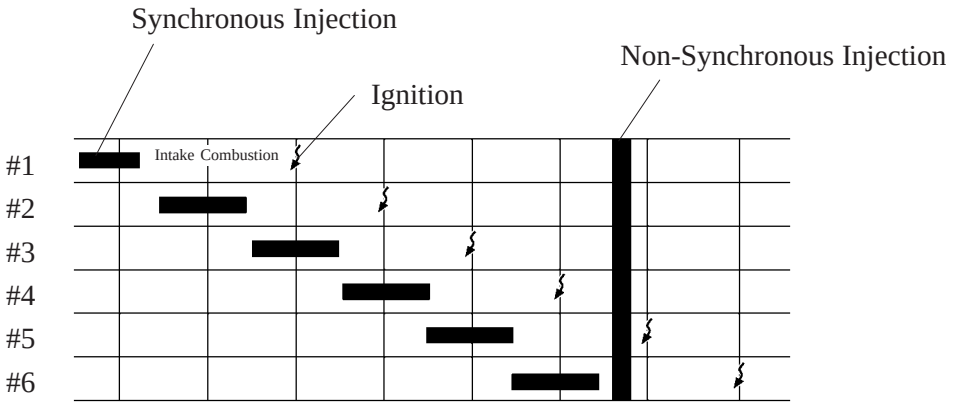
6. EFI (Electronic Fuel Injection) System

- An L-type EFI system directly detects the intake air mass with a hot wire type air flow meter.
- An independent injection system (in which fuel is injected once into each cylinder for each two revolution of the crankshaft) has been adopted.
- There are two types of fuel injection:

  a) One is synchronous injection in which corrections based on the signals from the sensors are added to the basic injection duration so that injection occurs always at the same timing.

  b) The other is non-synchronous injection in which injection is effected by detecting the requests from the signals of the sensors regardless of the crankshaft angle.

Furthermore, to protect the engine and improve fuel economy, the system effects fuel cutoff in which the injection of fuel is stopped temporarily in accordance with the driving conditions.



Independent Injection

208EG43

7. ESA (Electronic Spark Advance)

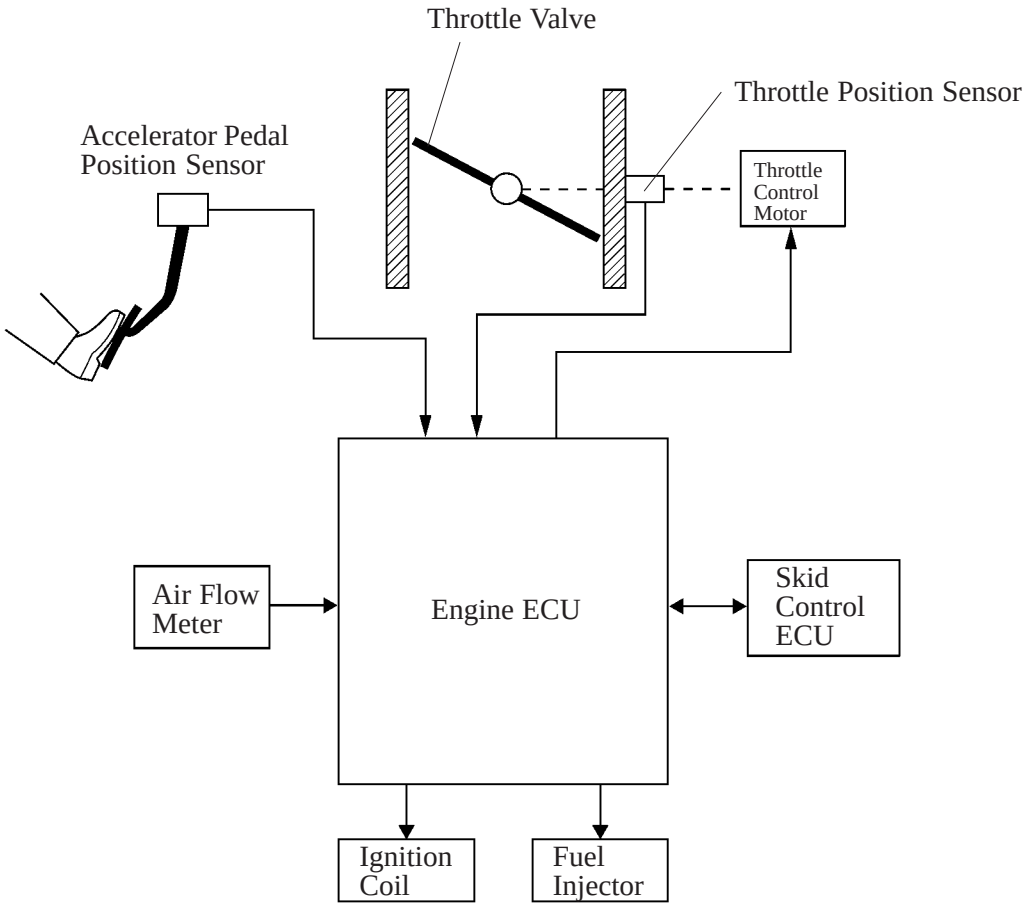
This system selects the optimal ignition timing in accordance with the signals received from the sensors and sends the (IGT) ignition signal to the igniter. The default ignition timing is set to 5° BTDC.

8. ETCS-i (Electronic Throttle Control System-intelligent)

General

- In the conventional throttle body, the throttle valve opening in determined invariably by the amount of the accelerator pedal effort. In contrast, the ETCS-i uses the engine ECU to calculate the optimal throttle valve opening that is appropriate for the respective driving condition and uses a throttle control motor to control the opening.
- The accelerator cable and link have been discontinued, and an a accelerator position sensor has been provided on the accelerator pedal.

▶ System Diagram ◀



Operation

1) General

The engine ECU drives the throttle control motor by determining the target throttle valve opening in accordance with the respective vehicle operating condition.

- Idle Speed Control
- Shift Shock Reduction Control
- Cruise Control

2) Idle Speed Control

Controls the engine ECU and the throttle valve in order to constantly effect ideal idle speed control.

3) Shift Shock Reduction Control

The throttle control is synchronized to the ECT (Electronically Controlled Transmission) control during the shifting of the transmission in order to reduce the shift shock.

4) TRC Throttle Control

As part of the TRC system, the throttle valve is closed by a demand signal from the skid control ECU if an excessive amount of slippage is created at a driving wheel, thus facilitating the vehicle in ensuring stability and driving force.

5) VSC Coordination Control

In order to bring the effectiveness of the VSC system control into full play, the throttle valve opening angle is controlled by effecting a coordination control with the skid control ECU.

6) Cruise Control

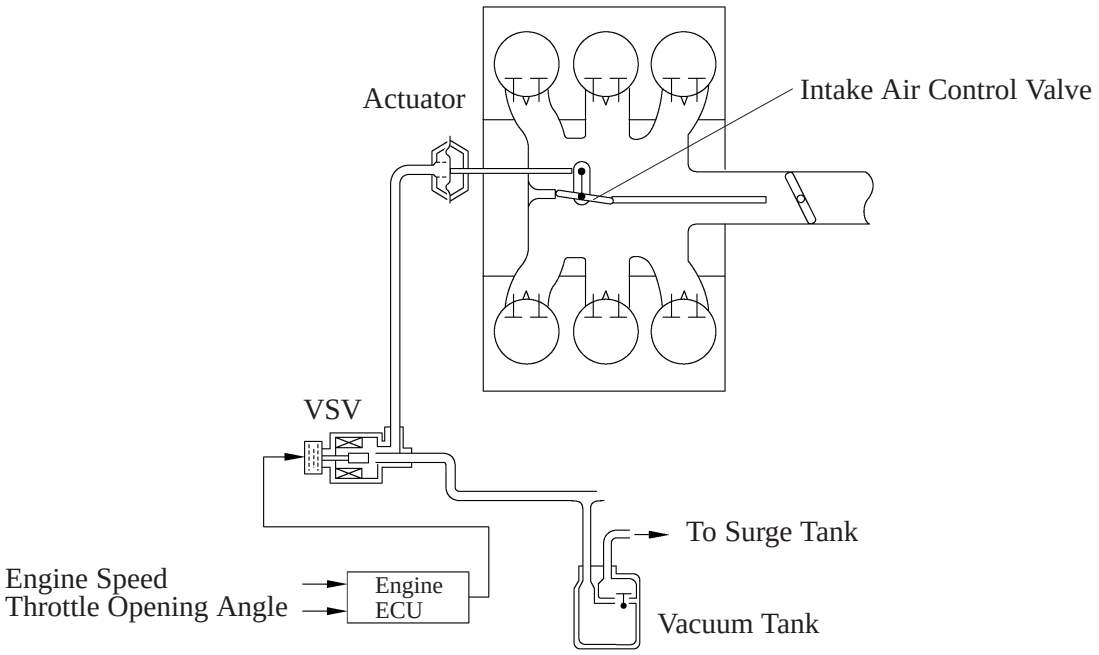
An engine ECU with an integrated cruise control ECU directly actuates the throttle valve to effect the operation of the cruise control.

9. ACIS (Acoustic Control Induction System)

General

The ACIS is realized by using a bulkhead to divide the intake manifold into 2 stages, with an intake air control valve in the bulkhead being opened and closed to vary the effective length of the intake manifold in accordance with the engine speed and throttle valve opening angle. This increases the power output in all ranges from low to high speed.

▶ System Diagram ◀

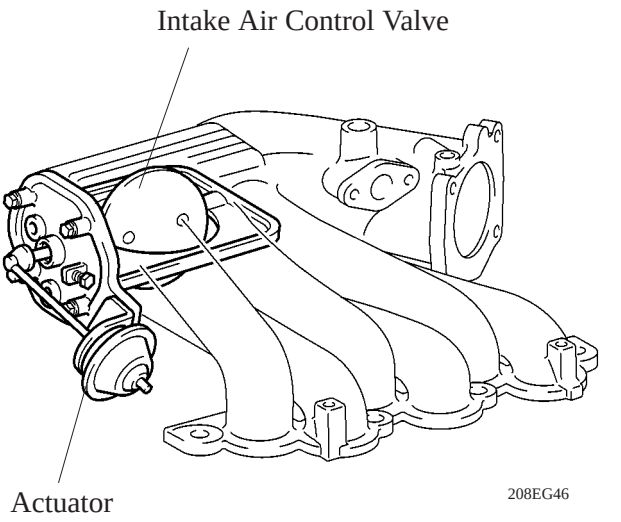


208EG45

General

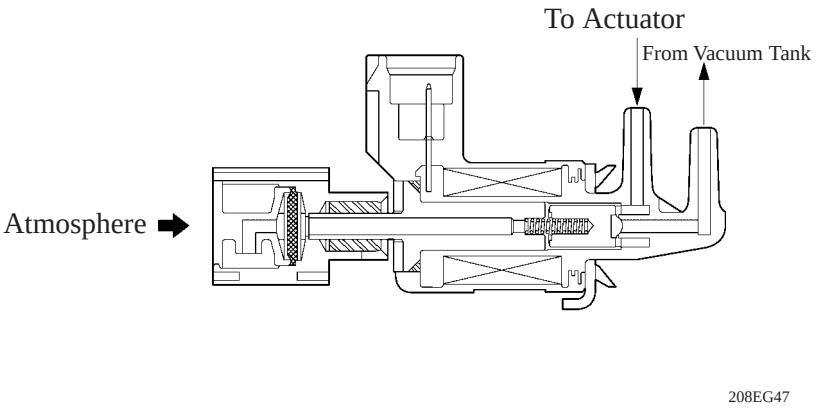
1) Intake Air Control Valve

The intake air control valves, which are provided in the intake air chamber, open and close to change the effective length of the intake manifold in two stages.



2) VSV (Vacuum Switching Valve)

Controls the vacuum that is applied to the actuator by way of the signal (ACIS) that is output by the engine ECU.



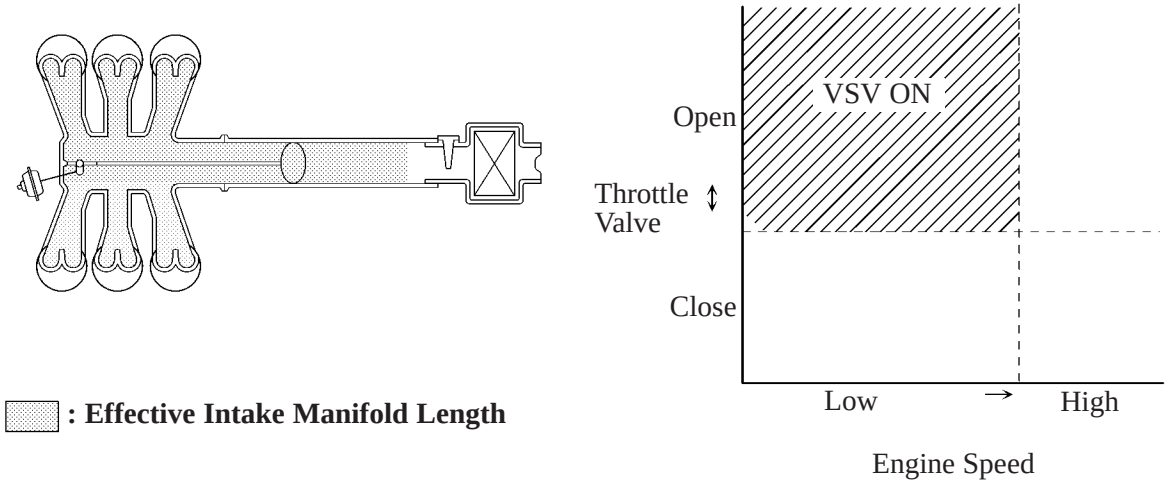
3) Vacuum Tank

Equipped with an internal check valve, the vacuum tank stores the vacuum that is applied to the actuator in order to maintain the intake air control valve fully closed even during low-vacuum conditions.

Operation

1) When the Intake Control Valve Closes (VSV ON)

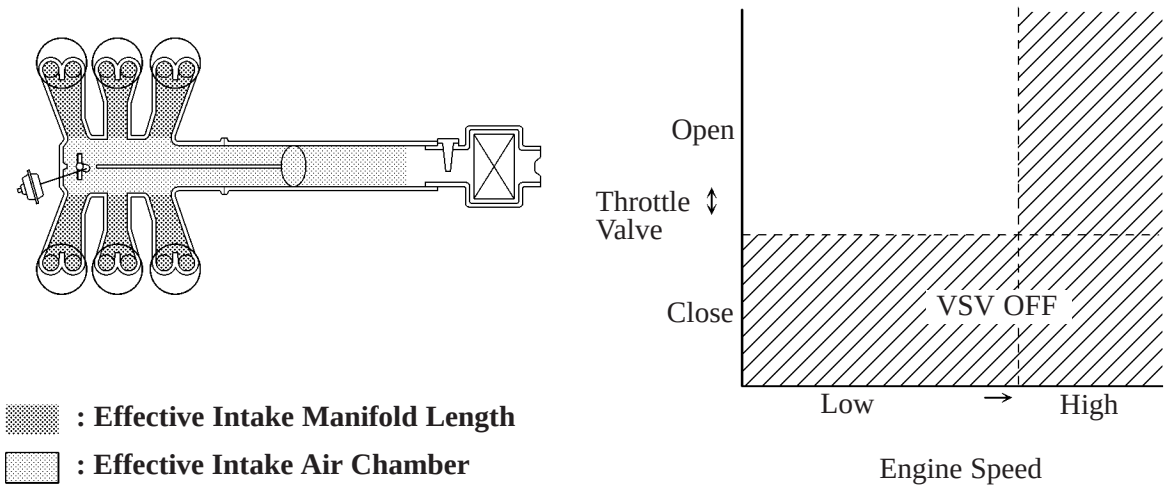
The engine ECU activates the VSV to match the longer pulsation cycle so that the negative pressure acts on the diaphragm chamber of the actuator. This closes the control valve. As a result, the effective length ofthe intake manifold is lengthened and the intake efficiency in the low-to-medium speed range is improved due to the dynamic effect of the intake air, thereby increasing the power output.



208EG48

2) When the Intake Control Valve Open (VSV OFF)

The engine ECU deactivates the VSV to match the shorter pulsation cycle so that atmospheric air is led into the diaphragm chamber of the actuator and opens the control valve. When the control valve is open, the effective length of the intake air chamber is shortened and peak intake efficiency is shifted to the high engine speed range, thus providing greater output at high engine speeds.



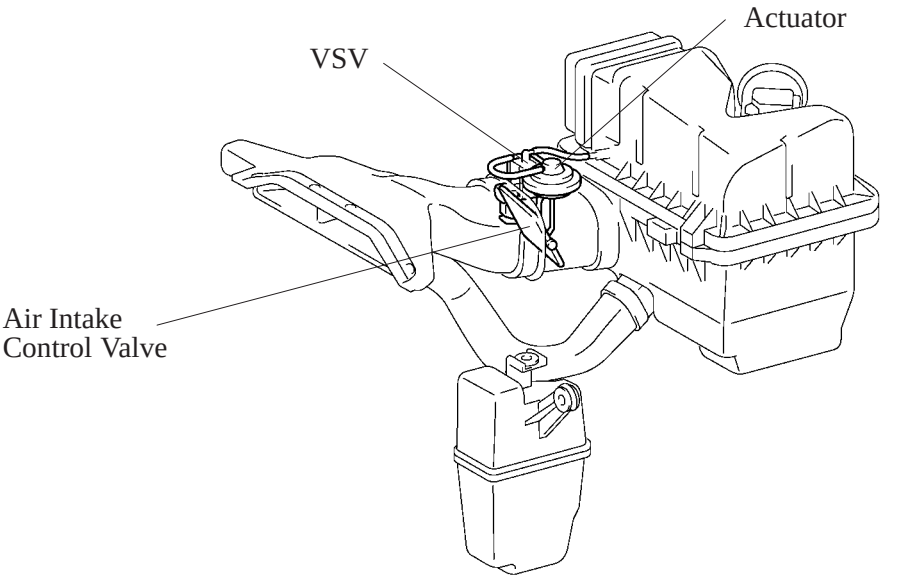
208EG49

10. Air Intake Control System

General

The air cleaner inlet is divided into two areas, and an air intake control valve and an actuator have been provided in one of the areas.
As a result, a reduction in intake noise in the low-speed range and an increase in the power output in the high-speed range have been realized.

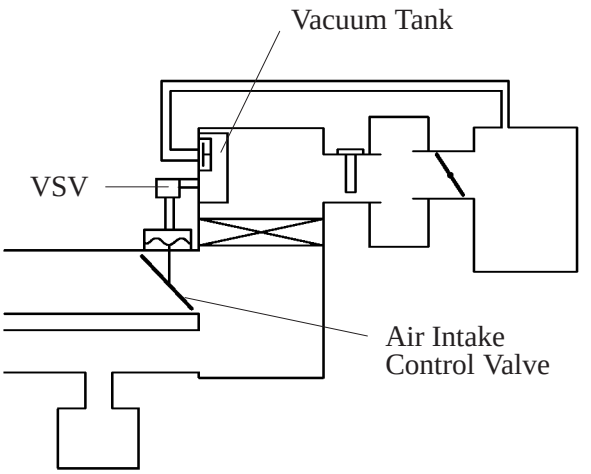
▶ Layout of Components ◀

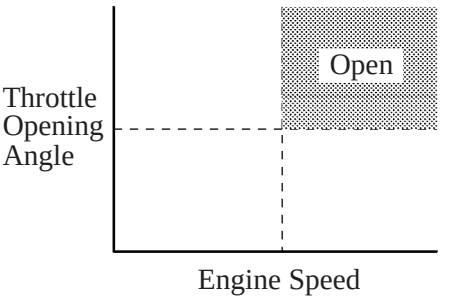


208EG50

Operation

When the engine is operating in the low-to mid-speed range, this control operates the air intake control valve to close one side of the air cleaner inlet.
When the engine is operating in the high-speed range, this control operates the air intake control valve to open both side of the air cleaner inlet to effect the intake of air.





Air Intake Control Valve Condition

208EG51

11. Diagnosis

When the engine ECU detects a malfunction, the engine ECU makes a diagnosis and memorizes the failed section.
Furthermore, the check engine warning light in the combination meter illuminates or blinks to inform the driver.
The engine ECU will also store the DTCs of the malfunctions.
The DTCs can be accessed the use of the hand-held tester.

Service Tip

The length of time to clear the DTC via the battery terminal has been changed from the previous 10 seconds to 1 minute.

— Changes (from previous Camry) —

The DTCs (Diagnostic Trouble Codes) listed below have been added or discontinued.

▶ Added DTCs ◀

DTC No.	Detection Item
P0156	O_2 Sensor Circuit Malfunction (Bank 2, Sensor 2)
P0161	O_2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 2)
P0430	Catalyst System Efficiency Below Threshold (Bank 2)
P0605	Internal Control Module Read Only Memory (ROM) Error
P1120	Accelerator Pedal Position Sensor Circuit Malfunction
P1121	Accelerator Pedal Position Sensor Range/ Performance Problem
P1125	Throttle Control Motor Circuit Malfunction
P1127	ETCS Actuator Power Source Circuit Malfunction
P1128	Throttle Control Motor Lock Malfunction
P1129	Electric Throttle Control System Malfunction
P1633	ECM Malfunction (ETCS Circuit)

▶ Discontinued DTCs ◀

DTC No.	Detection Item
P0130	O_2 Sensor Circuit Malfunction (Bank 1, Sensor 1)
P0133	O_2 Sensor Circuit Slow Response (Bank 1, Sensor 1)
P0135	O_2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)
P0150	O_2 Sensor Circuit Malfunction (Bank 2, Sensor 1)
P0153	O_2 Sensor Circuit Slow Response (Bank 2, Sensor 1)
P0155	O_2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 1)

12. Fail-Safe

General

When the engine ECU detects a malfunction, the engine ECU stops or controls the engine according to the data already stored in the memory.

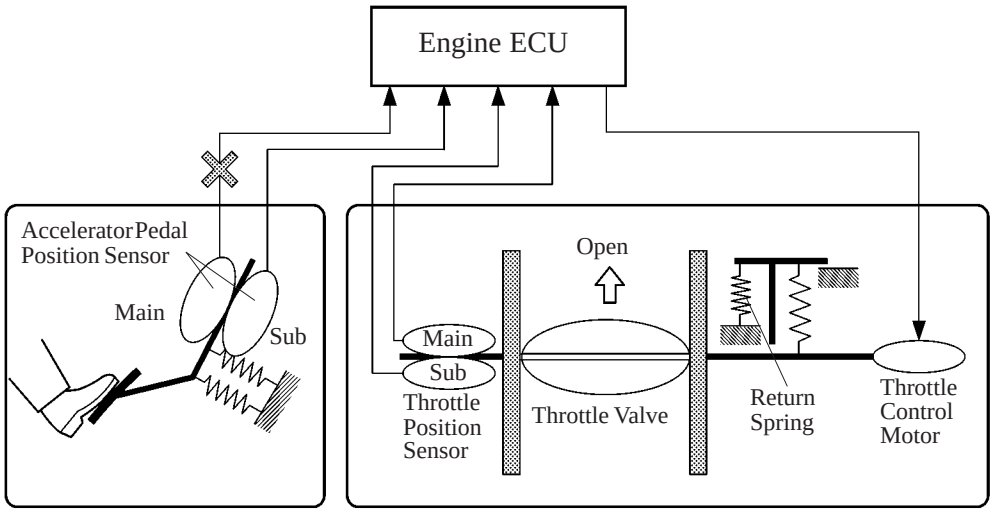
▶ Fail-Safe Control List ◀

: New

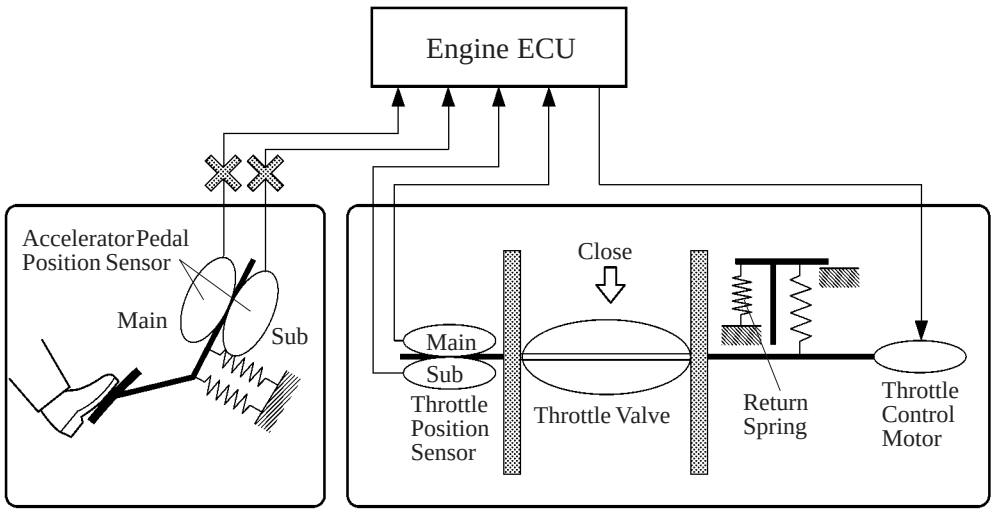
Location of Malfunction	Description Control
Air Flow Meter	In case of a signal malfunction, the engine could operate poorly or the catalyst could overheat if the engine continues to be controlled with the signals from the sensors. Therefore, the engine ECU effects control by using the values in the engine ECU or stops the engine.
Accelerator Pedal Position Sensor (For details, see page EG-85)	In case of a signal malfunction, the engine ECU calculates the accelerator pedal opening angle that is limited by the dual system sensor value and continues effecting throttle valve control. If both system malfunction, the engine ECU considers that the accelerator pedal is fully closed.
Throttle Position Sensor (For details, see page EG-86)	In case of a signal malfunction, the engine ECU cuts off the current to the throttle control motor. The throttle valve returns to the prescribed opening by the force of the return spring. The engine ECU then adjusts the engine output by controlling the fuel injection and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue driving.
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.
Knock Sensor	In case of a malfunction in the knock sensor or in the knocking signal system (open or short circuit), the engine could become damaged if the timing is advanced despite the presence of knocking. Therefore, if a malfunction is detected in the knock sensor system, the engine ECU turns the timing retard correction of the knock sensor into the maximum retard value.
Ignition Coil (with Igniter)	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 (IGF) ignition signal is not input twice or more in a row, the engine ECU determines that a malfunction occurred in the ignition system and stops only the injection of fuel into the cylinder with the malfunction.

Fail-Safe of Accelerator Pedal Position Sensor

- The accelerator pedal position sensor comprises two (main, sub) sensor circuits. If a malfunction occurs in either one of the sensor circuits, the engine ECU detects the abnormal signal voltage difference between these two sensor circuit and switches to the limp mode. In the limp mode, the remaining circuit is used to calculate the accelerator pedal opening, in order to operate the vehicle under limp mode control.



- If both systems malfunction, the engine ECU detects the abnormal signal voltage between these two sensor circuits and regards that the opening angle of the accelerator pedal is fully opened and then continues the throttle control. At this time, the vehicle can be driven within its idling range.



Fail-Safe of Throttle Position Sensor

- The throttle position sensor comprises two (main, sub) sensor circuits. If a malfunction occurs in either one of the sensor circuits, the engine ECU detects the abnormal signal voltage difference between these two sensor circuits, cuts off the current to the throttle control motor, and switches to the limp mode.Then, the force of the return spring causes the throttle valve to return and stay at the prescribed opening. At this time, the vehicle can be driven in the limp mode while the engine output is regulated through the control of the fuel injection and ignition timing in accordance with the accelerator opening.
- The same control as above is effected if the engine ECU detects a malfunction in the throttle control motor system.

