■ENGINE CONTROL SYSTEM

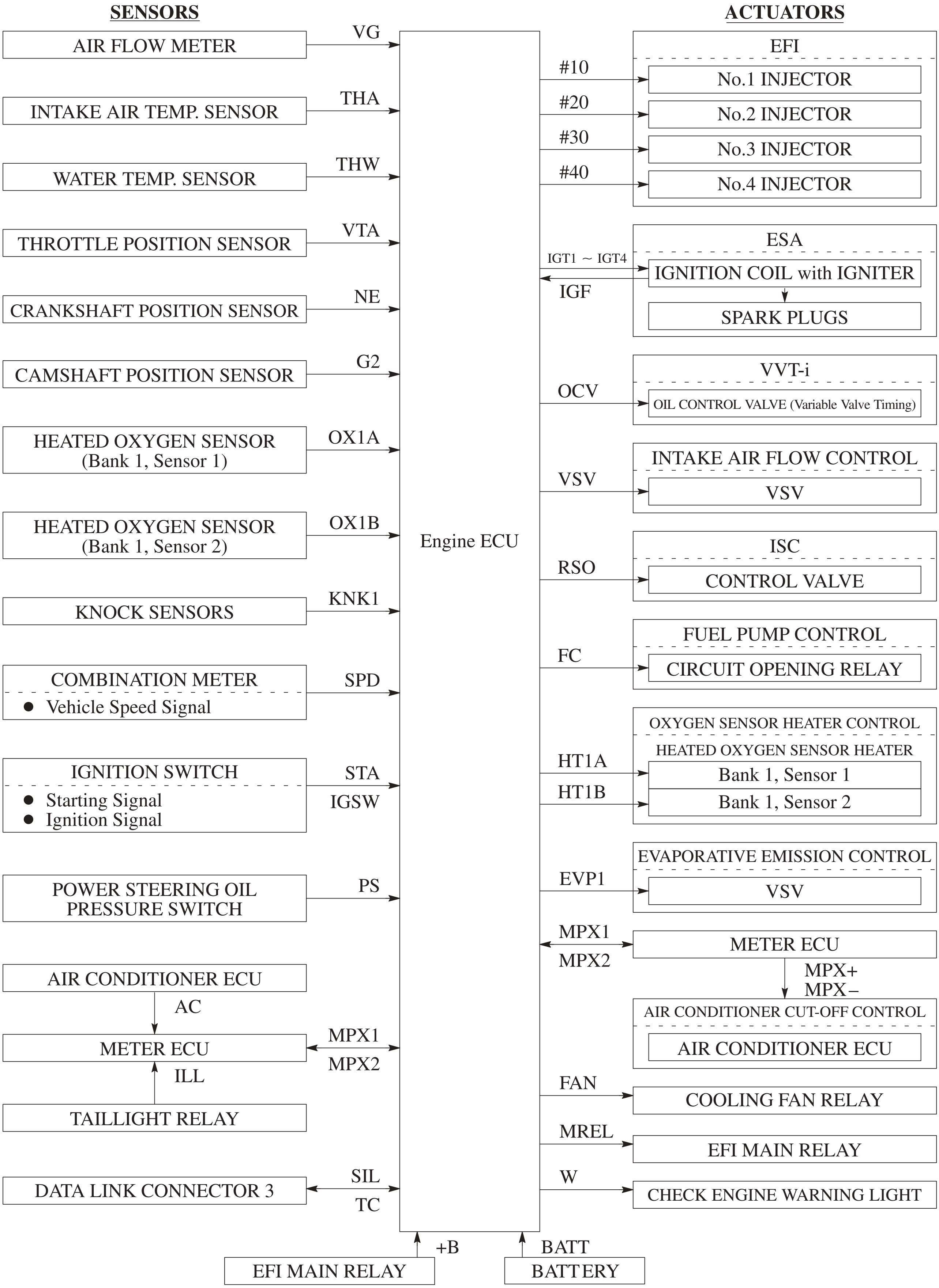
1. General

The engine control system for the 1ZZ-FE engine has following system.

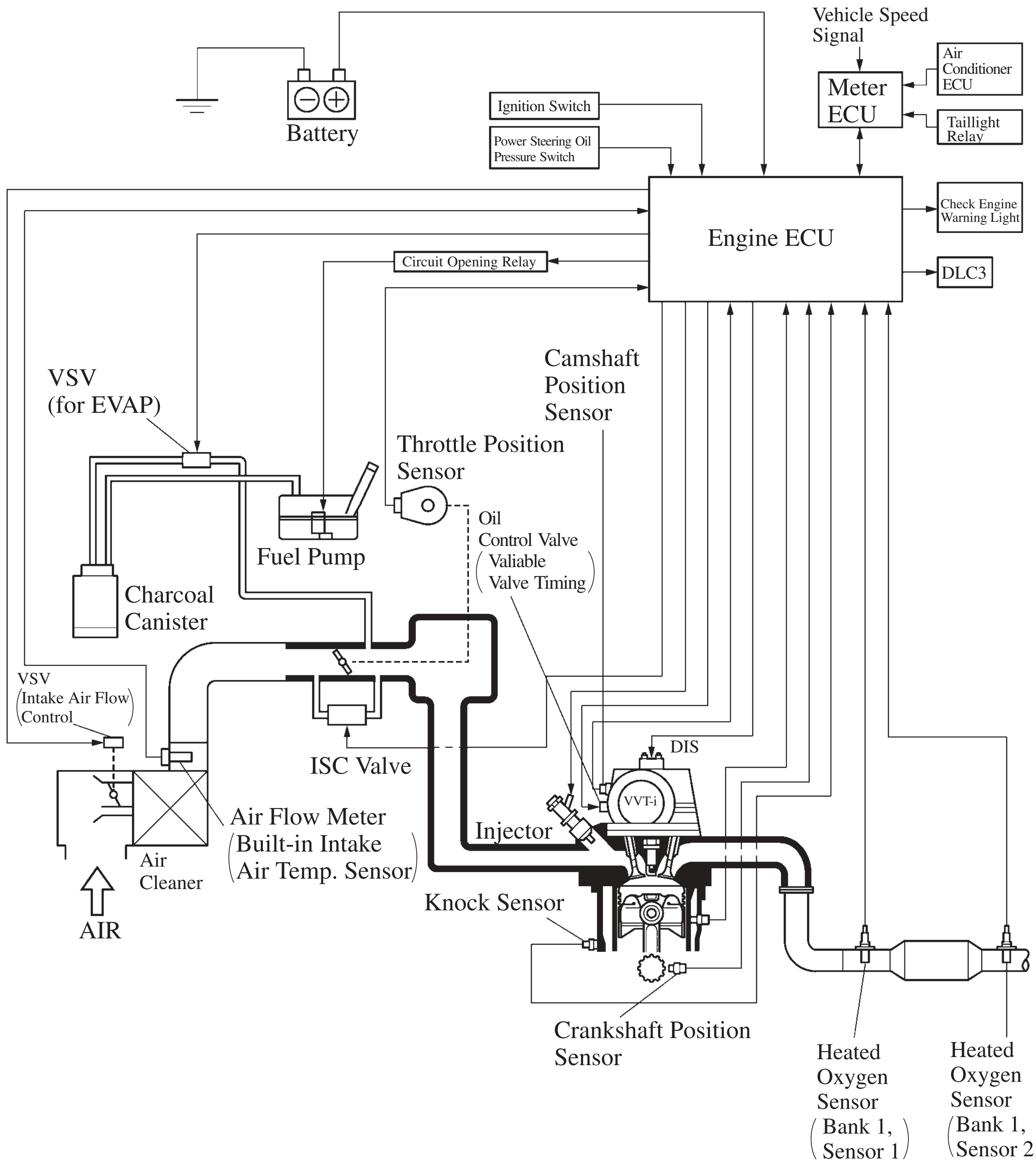
System	Outline
EFI (Elcetronic Fuel Injection)	● An L-type EFI system directly detects the intake air volume with a hot-wire type air flow meter. ● The fuel injection system is a sequential multiport fuel injection system.
ESA (Electronic Spark Advance)	Ignition timing is determined by the engine ECU based on signals from various sensors. The engine ECU corrects ignition timing in response to engine knocking.
ISC (Idle Speed Control)	A rotary solenoid type ISC valve controls the fast idle and idle speeds.
Intake Air Flow Control	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.
VVT-i (Variable Valve Timing-intelligent)	Controls the intake camshaft to an optimal valve timing in accordance with the engine condition.
Fuel Pump Control	● Fuel pump operation is controlled by signal from the engine ECU. ● To stop the fuel pump during operation of the SRS airbag. For details, see page 54.
Oxygen Sensor Heater Control	Maintains the temperature of the oxygen sensors at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.
Evaporative Emission Control	The engine ECU controls the purge flow of evaporative emissions (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	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 memory.

2. Construction

The configuration of the engine control system in the 1ZZ-FE engine in the new CELICA is as shown in the following chart.



3. Engine Control System Diagram



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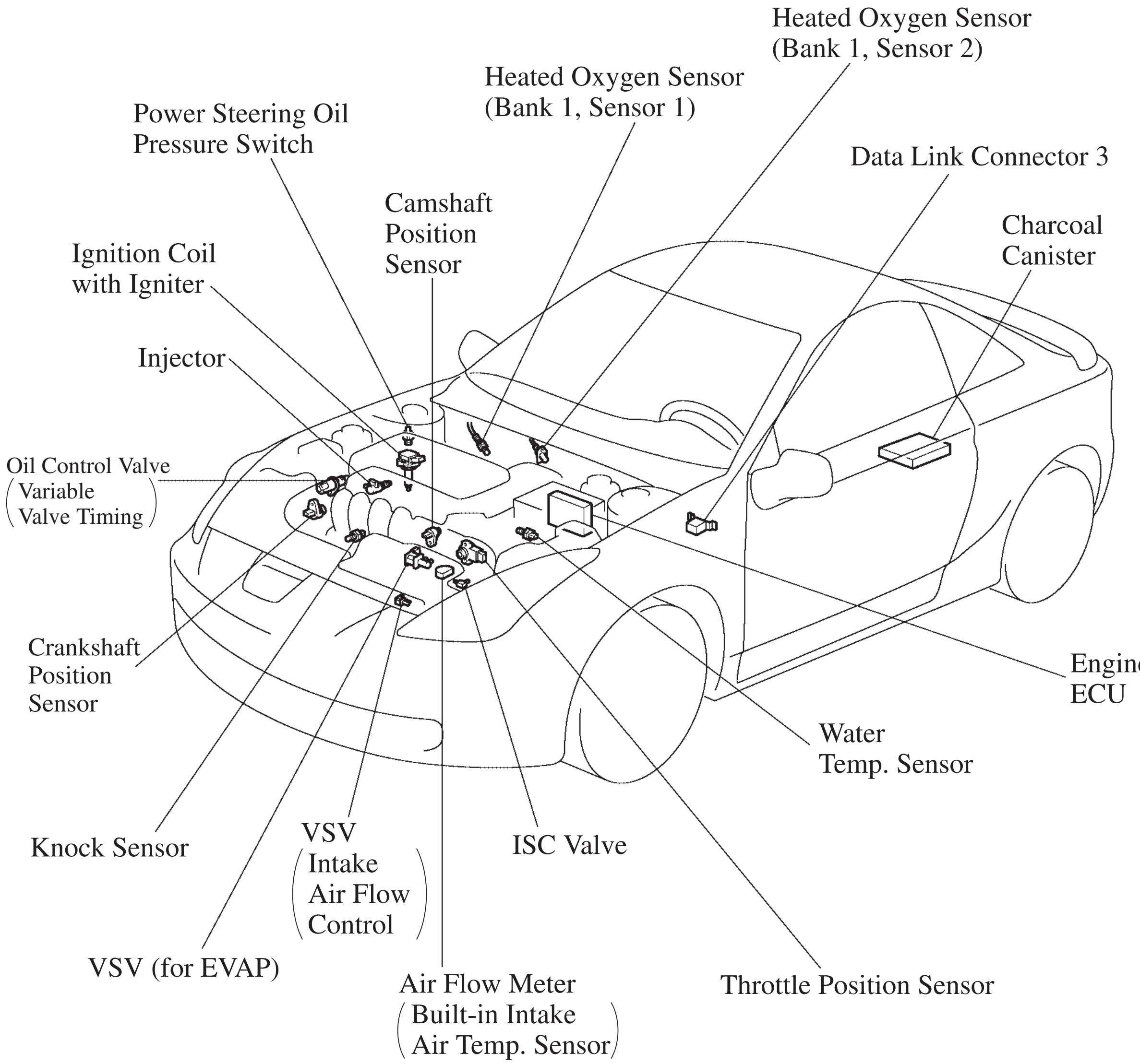
4. Layout of Main Components



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5. Main Components of Engine Control System

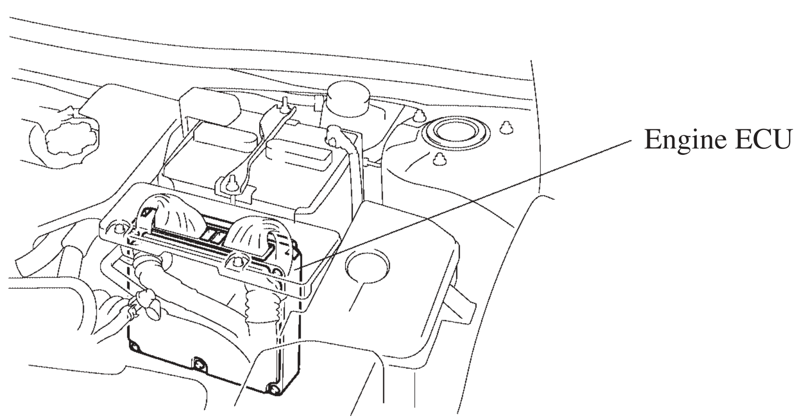
General

The main components of the 1ZZ-FE engine control system are as follows:

Components	Outline	Quantity
Mass Air Flow Meter	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
Knock Sensor	Built-In Piezoelectric Element Type	1
Oxygen Sensor	Heated Oxygen Sensor (Bank 1, Sensor 1) (Bank 1, Sensor 2)	2
Injector	12-Hole Type	4
ISC Valve	Rotary Solenoid Type (1-Coil Type)	1

Engine ECU

The engine ECU is installed in the engine ECU box in the engine compartment. As result, the wiring harness has been shorted, thus realizing weight reduction.



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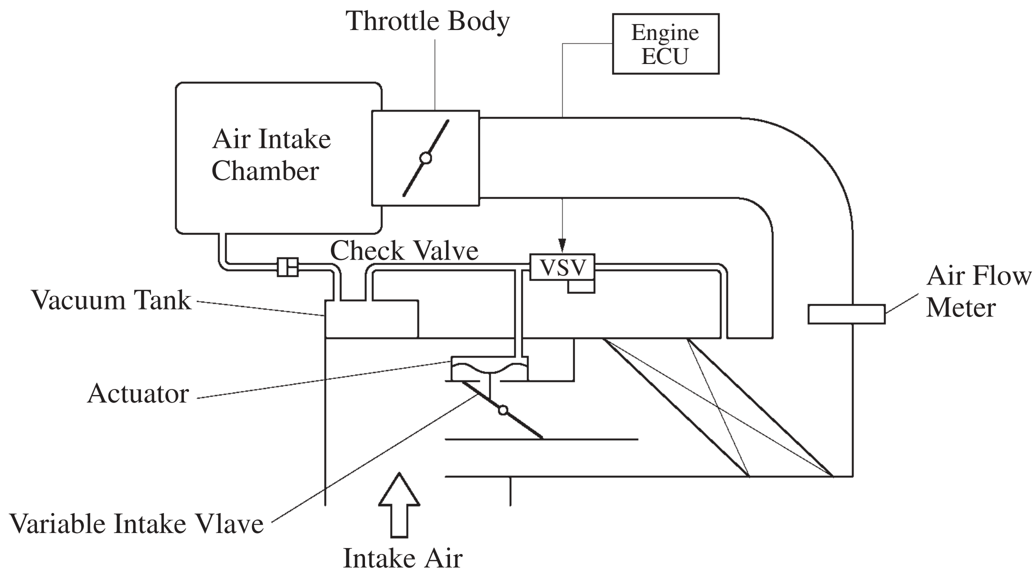
6. Intake Air Flow Control

The intake air duct is divided into two areas, and a variable intake valve and an actuator have been provided in one of the areas. When the engine is operating in the low-to mid-speed range, this control operates the variable intake valve to close one side of the intake air duct. When the engine is operating in the high-speed range, it turns OFF the variable intake valve, allowing both sides of the intake air duct to effect the intake of air. Accordingly, the level of engine noise has been reduced without using an intake resonator.



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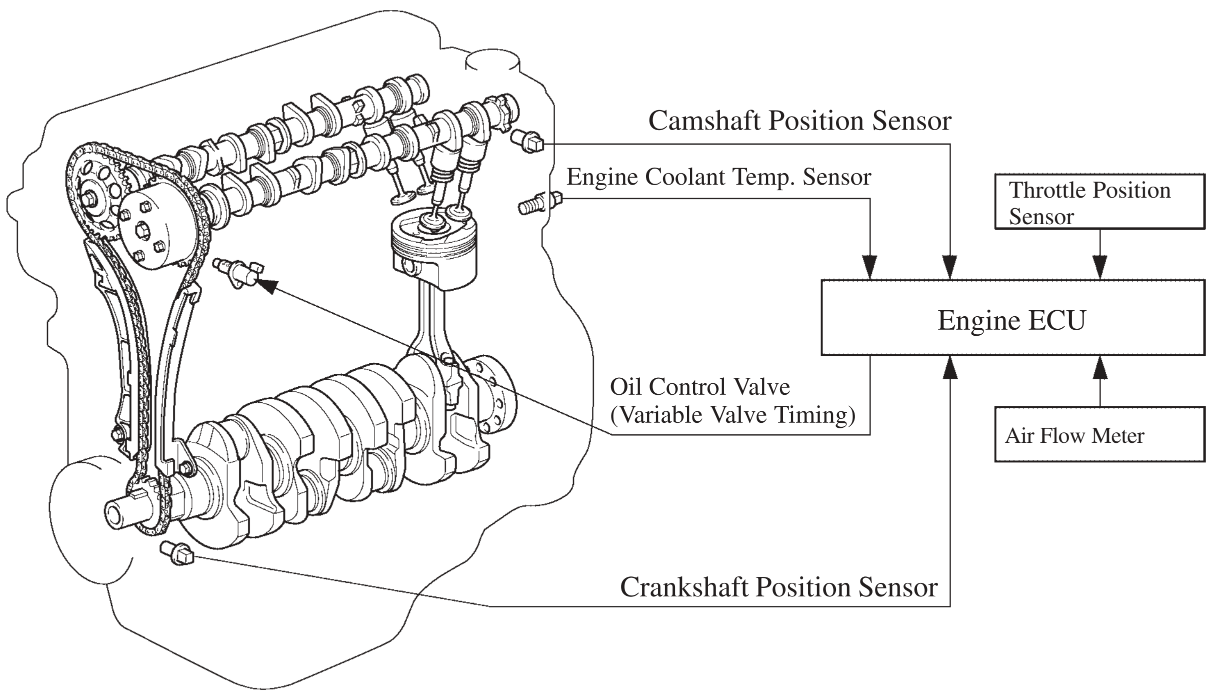
7. VVT-i (Variable Valve Timing-intelligent) System

General

This system controls the intake camshaft valve timing so as to obtain balance between the engine output, fuel consumption and emission control performance. The actual intake side valve timing is feed back by means of the camshaft position sensor for constant control to the target valve timing.



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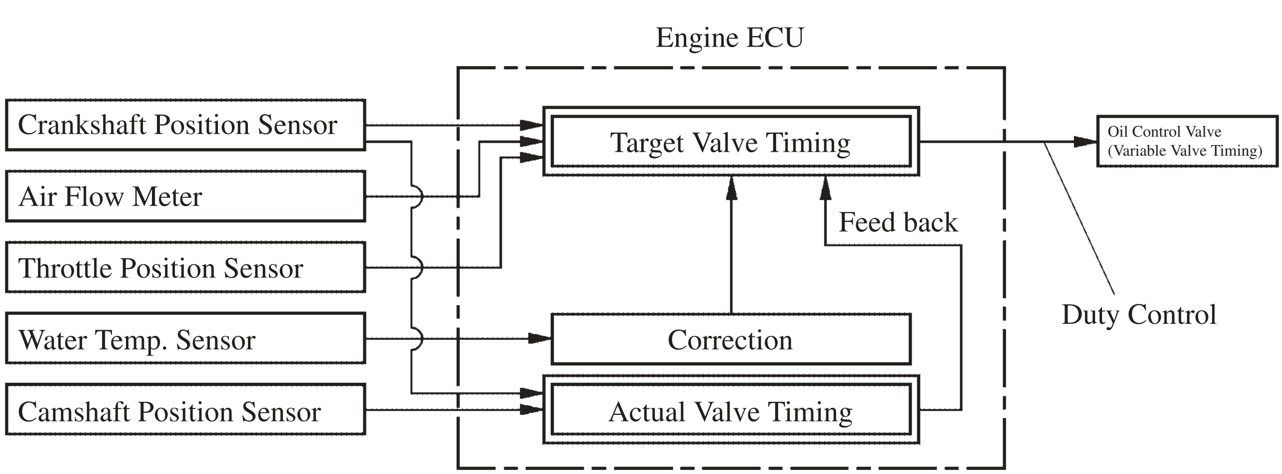

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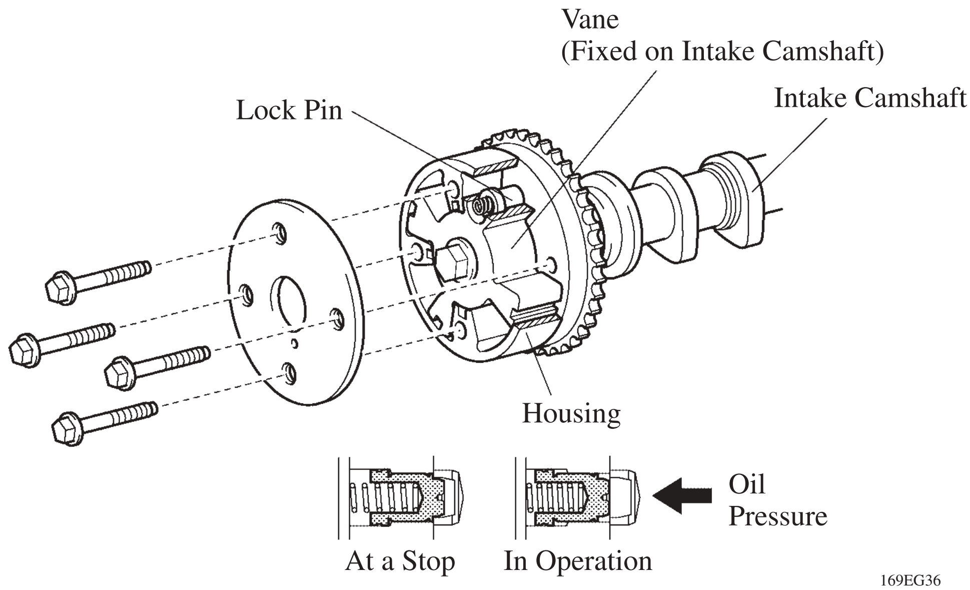
Construction

1) VVT-i Controller

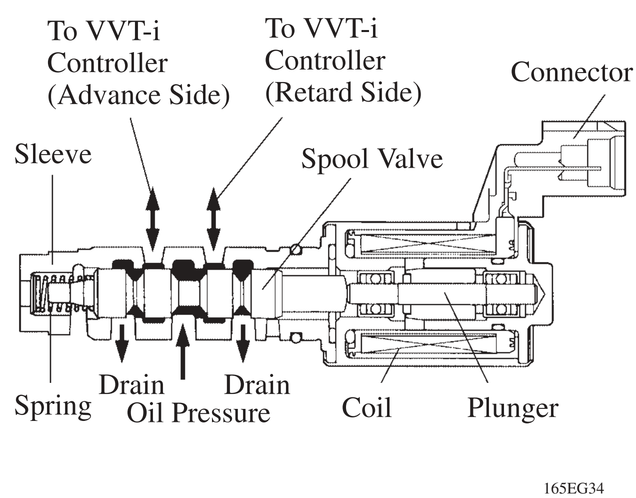
This controller consists of the housing driven from the timing chain and the vane coupled with the intake camshaft.
The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously.
When the engine is stopped, the intake camshaft will be in the most retarded state to ensure startability.
When hydraulic pressure is not applied to the VVT-i controller immediately after the engine has been started, the lock pin locks the movement of the VVT-i controller to prevent a knocking noise.



Lock Pin

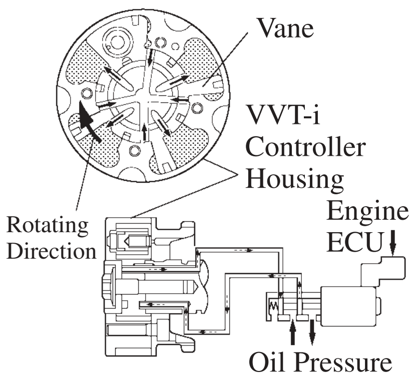
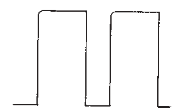
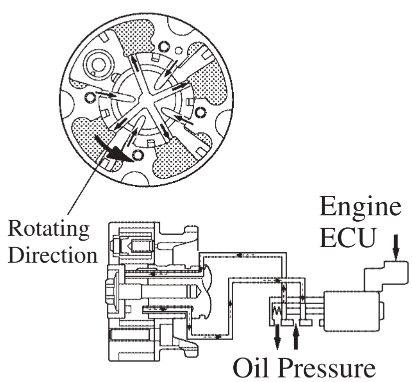
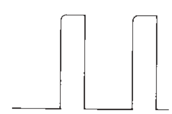
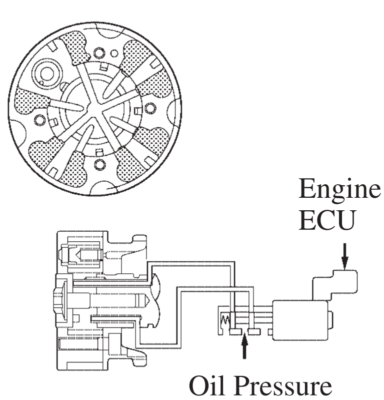
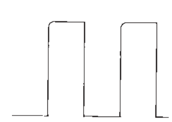
2) Oil Control Valve (Variable Valve Timing)

The oil control valve (variable valve timing) controls the spool valve position in accordance with the duty control from the engine ECU thus allocating the hydraulic pressure that is applied to the VVT-i controller to the advance and the retard side. When the engine is stopped, the oil control valve (variable valve timing) is in the most retarded state.



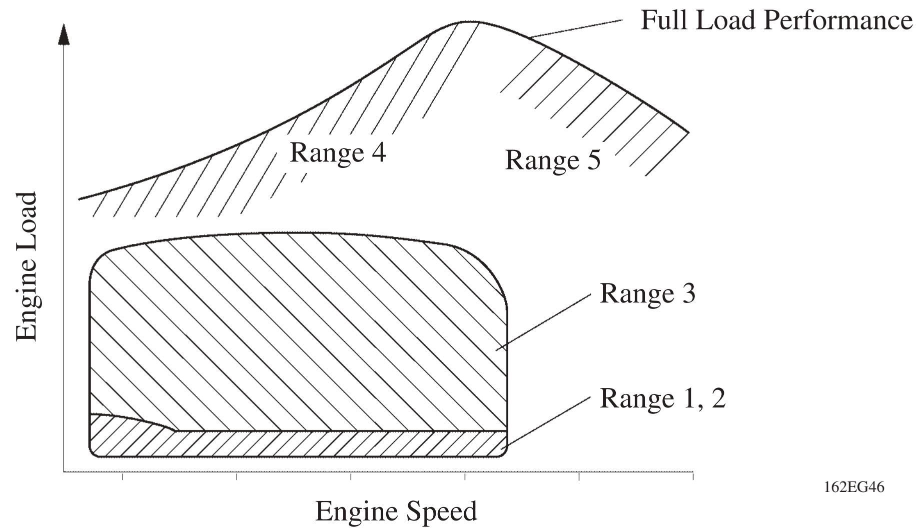
Operation

- The oil control valve (variable valve timing) selects the path to the VVT-i controller according to the advance, retard or hold signal from the engine ECU. The VVT-i controller rotates the intake camshaft in the timing advance or retard position or holds it according to the position where the oil pressure is applied.

	Operation	Oil Control Valve Drive Signal	Description
Advance	 169EG37	Advance Signal  Duty Ratio 157EG35	When the oil control valve (variable valve timing) is positioned as illustrated at left by the advance signal from the engine ECU, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.
Retard	 169EG38	Retard Signal  Duty Ratio 157EG36	When the oil control valve (variable valve timing) is positioned as illustrated at left by the retard signal from the engine ECU, the resultant oil pressure is applied to the timing retard side vane chamber to rotate the camshaft in the timing retard direction.
Hold	 169EG39	Hold Signal  Duty Ratio 157EG37	The engine ECU calculates the target timing angle according to the traveling state to perform control as described above. After setting at the target timing, the valve timing is held by keeping the oil control valve (variable valve timing) in the neutral position unless the traveling state changes. This adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.

- In proportion to the engine speed, intake air volume, throttle position and water temperature, the engine ECU calculates an optimal valve timing under each driving condition and control the oil control valve (variable valve timing). In addition, engine ECU uses signal from the camshaft position sensor and the crankshaft position sensor to detect the actual valve timing, thus performing feed back control to achieve the target valve timing.

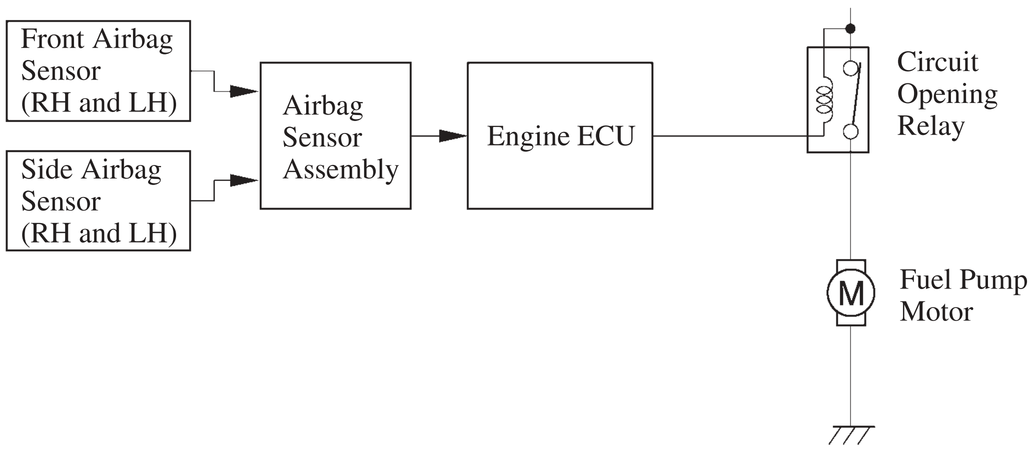
▶ Operation During Various Driving Conditions (Conceptual Diagram) ◀



Operation State	Range	Valve Timing	Objective	Effect
During Idling	1	TDC IN EX Latest timing	Minimizing overlap to reduce blow back to the intake side	Stabilized idling rpm Better fuel economy
At Light Load	2	IN EX To retard side	Decreasing overlap to eliminate blow back to the intake side	Ensured engine stability
At Medium Load	3	IN EX To advance side	Increasing overlap to increase internal EGR for pumping loss elimination	Better fuel economy Improved emission control
In Low to Medium Speed Range with Heavy Load	4	IN EX To advance side BDC	Advancing the intake valve close timing for volumetric efficiency improvement	Improved torque in low to medium speed range
In High Speed Range with Heavy Load	5	IN EX To retard side	Retarding the intake valve close timing for volumetric efficiency improvement	Improved output
At Low Temperatures	–	IN EX Latest timing	Minimizing overlap to prevent blow back to the intake side for reduction of fuel increase at low temperatures, and stabilizing the idling rpm for decreasing fast idle rotation	Stabilized fast idle rpm Better fuel economy
Upon Starting/ Stopping the Engine	–	IN EX Latest timing	Minimizing overlap to minimize blow back to the intake side	Improved startability

8. Fuel Pump Control

A fuel cut control has been adopted to stop the fuel pump when the SRS airbag is deployed, thus helping reduce fuel leakage.
In this system, the airbag deployment signal from the airbag sensor assembly is detected by the engine ECU, which turns OFF the circuit opening relay.
After the fuel cut control has been activated, turning the ignition switch from OFF to ON cancels the fuel cut control, thus engine can be restarted.



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9. Engine Immobiliser System

The engine immobiliser system has been designed to prevent the vehicle from being stolen. This system uses a engine ECU that stores the ID code of the authorized ignition key. If an attempt is made to start the engine using an unauthorized key, the engine ECU prohibit fuel delivery and ignition, effectively disabling the engine. The basic construction and operation are the same as those of the current CAMRY.