

## ■ ENGINE CONTROL SYSTEM

### 1. General

The engine control system of the Avensis Verso/Picnic's 1AZ-FE engine is basically the same in construction and operation as that of the RAV4's 1AZ-FE engine.

The engine control system of the Avensis Verso/Picnic's 1AZ-FE engine and RAV4's 1AZ-FE engine are compared below.

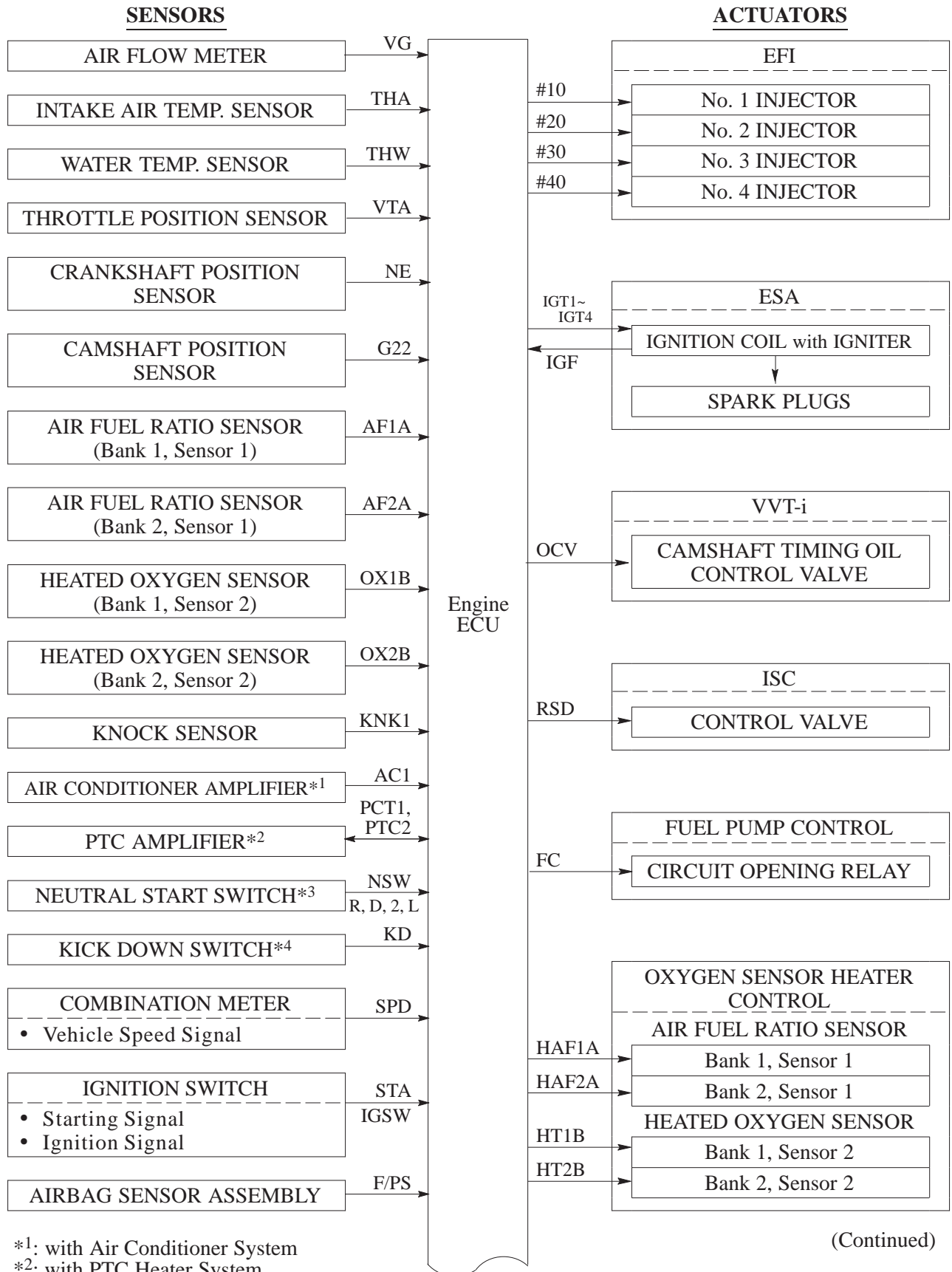
System	Outline	Avensis Verso/ Picnic	RAV4
EFI (Electronic Fuel Injection)	<ul style="list-style-type: none"> <li>An L-type EFI system directly detects the intake air volume with a hot-wire type air flow meter.</li> <li>The fuel injection system is a sequential multiport fuel injection system.</li> </ul>	○	○
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.	○	○
VVT-i (Variable Valve Timing-intelligent) (See page EG-30)	Controls the intake camshaft to an optimal valve timing in accordance with the engine condition.	○	○
Fuel Pump Control (See page EG-35)	<ul style="list-style-type: none"> <li>Fuel pump operation is controlled by signal from the engine ECU.</li> <li>To stop the fuel pump while the SRS driver's and front passenger's airbags are in operation.</li> </ul>	○	○
Air Fuel Ratio Sensor, Oxygen Sensor Heater Control	Maintains the temperature of the air fuel ratio sensor and oxygen sensor 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*1	By turning the air conditioner compressor ON or OFF in accordance with the engine condition, drivability is maintained.	○	○
Cooling Fan Control (See page EG-36)	Radiator cooling fan operation is controlled by signals from engine ECU based on the water temperature sensor signal (THW) and the condition of the air conditioner operation.	○	—
Engine Immobiliser*2	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.	○	○

\*1: with Air Conditioner System

\*2: with Engine Immobiliser System

## 2. Construction

The configuration of the engine control system in the 1AZ-FE engine in the new Avensis Verso/Picnic is as shown in the following chart.



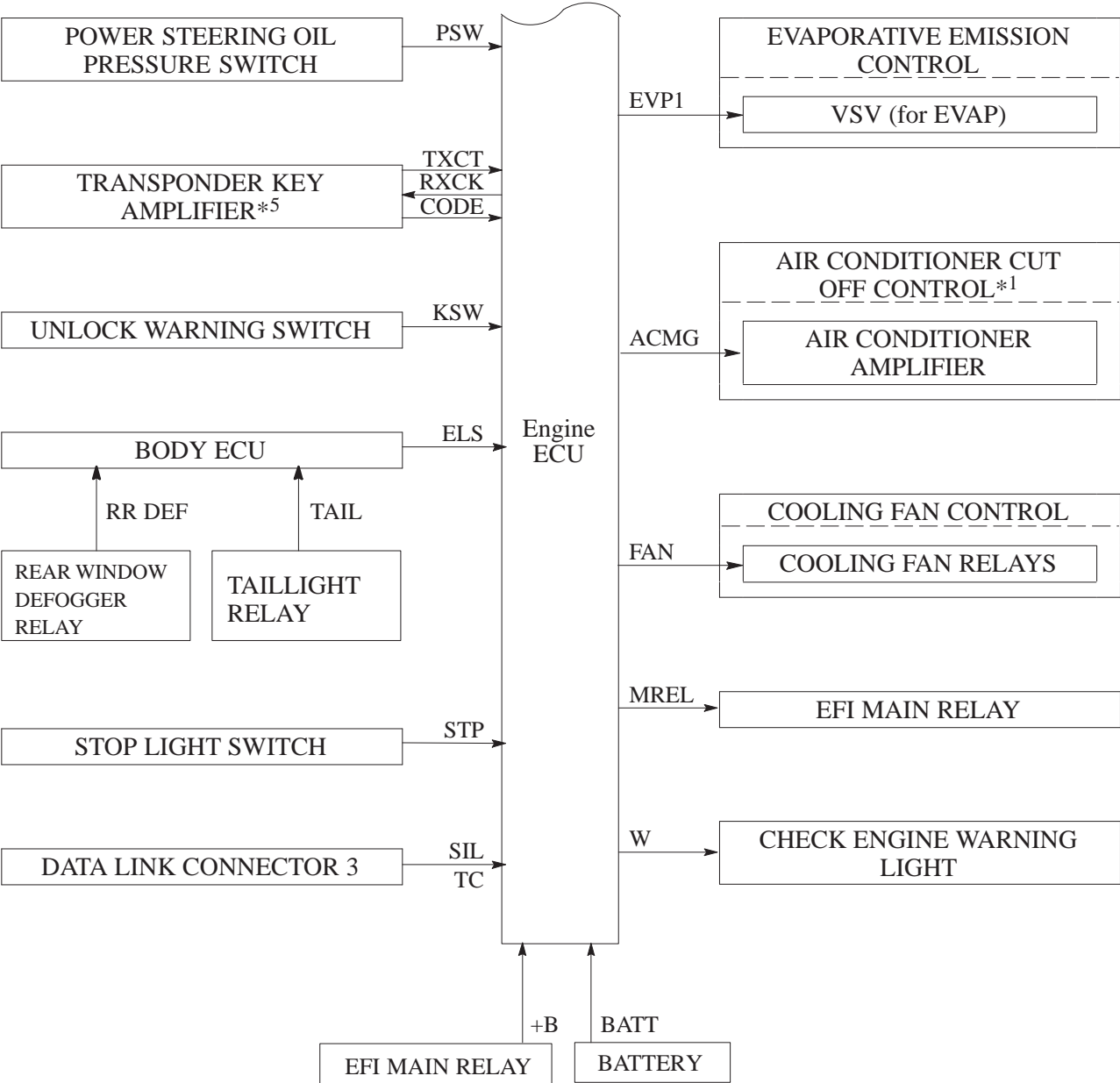
\*1: with Air Conditioner System

\*2: with PTC Heater System

\*3: Only for Automatic Transaxle

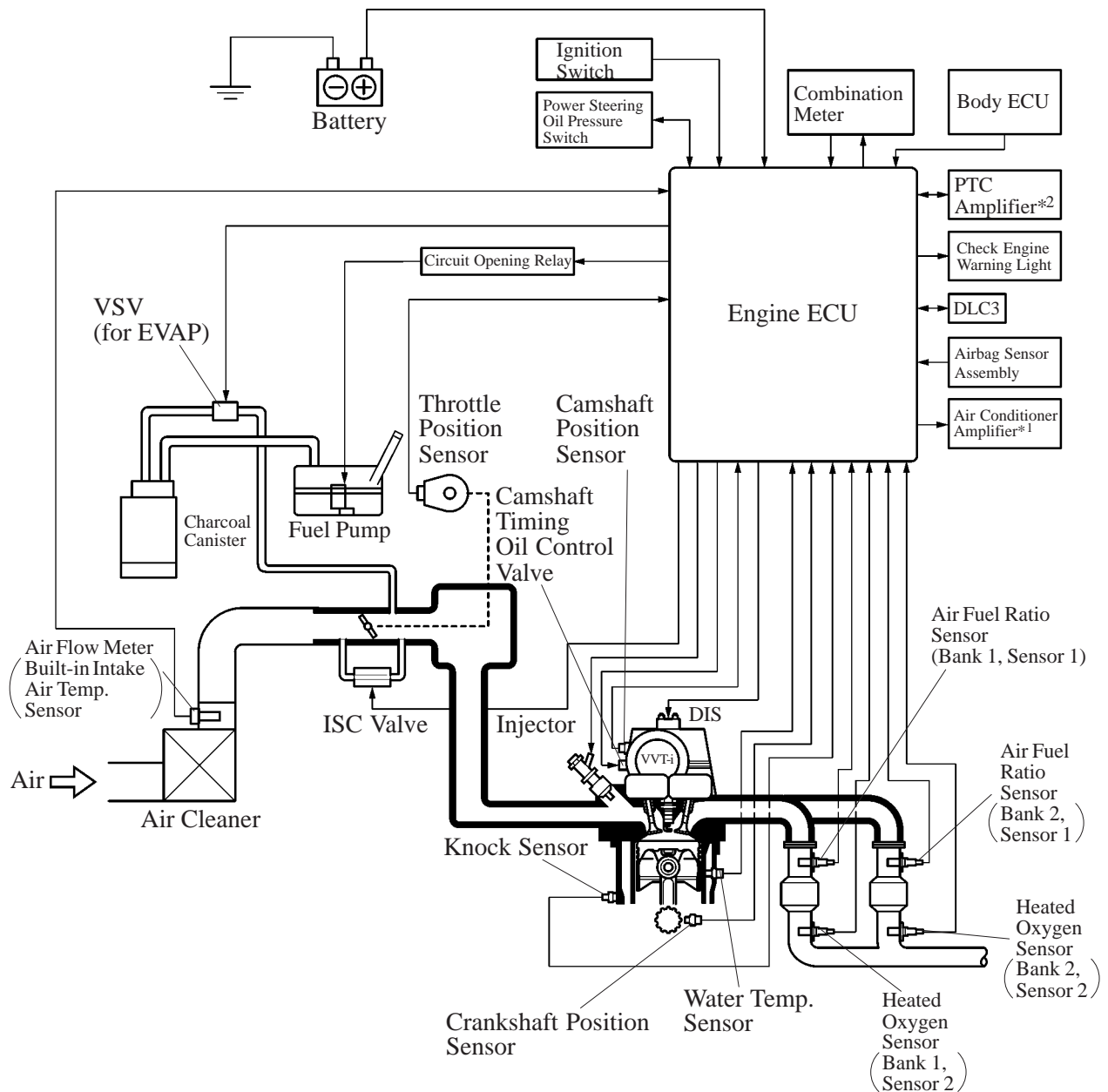
\*4: LHD models with automatic transaxle for Europe only

(Continued)



\*<sup>5</sup>: with Engine Immobiliser System

### 3. Engine Control System Diagram

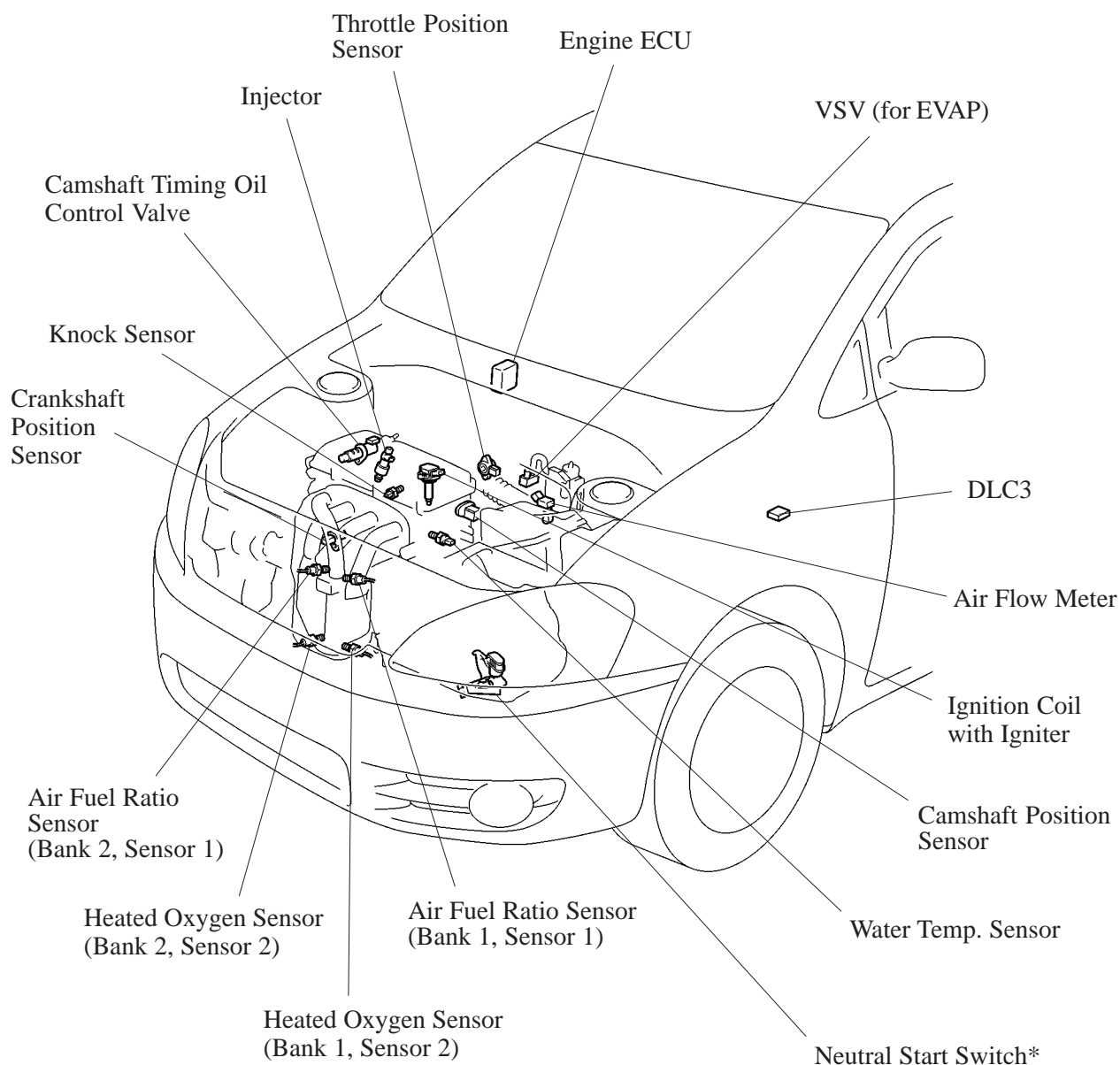


\*1: With Air Conditioner System

\*2: With PTC Heater System

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## 4. Layout of Main Components



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\*: Only for Automatic Transaxle

## 5. Main Components of Engine Control System

### General

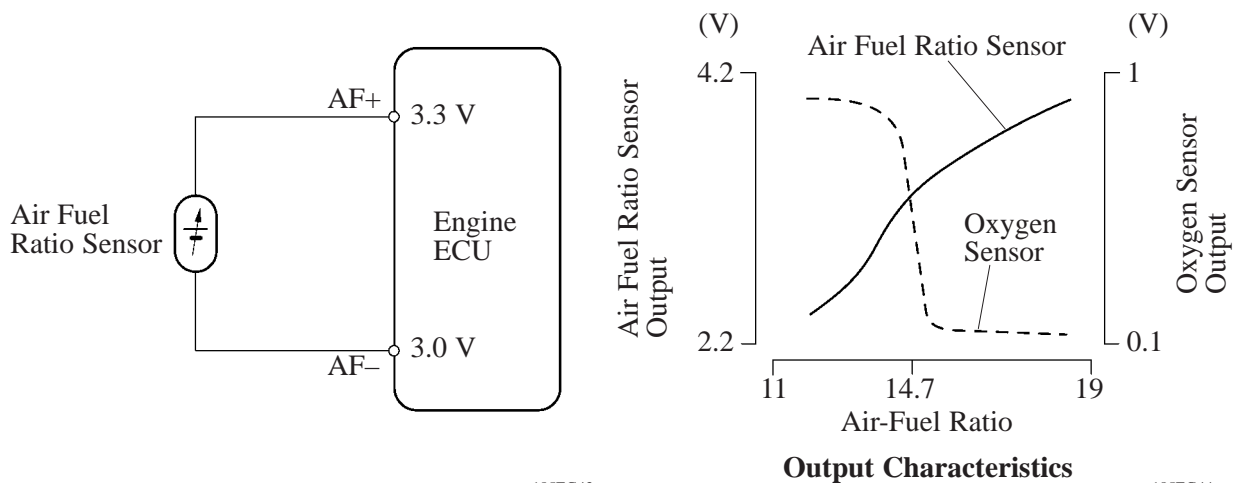
The main components of the 1AZ-FE engine control system are as follows:

Components	Outline	Quantity
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
Air Fuel Ratio Sensor (Bank 1, Sensor 1) (Bank 2, Sensor 1)	Type with heater	2
Oxygen Sensor (Bank 1, Sensor 2) (Bank 2, Sensor 2)	Type with heater	2
Injector	12-Hole Type	4
ISC Valve	Rotary Solenoid Type (1-Coil Type)	1

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### Air Fuel Ratio Sensor

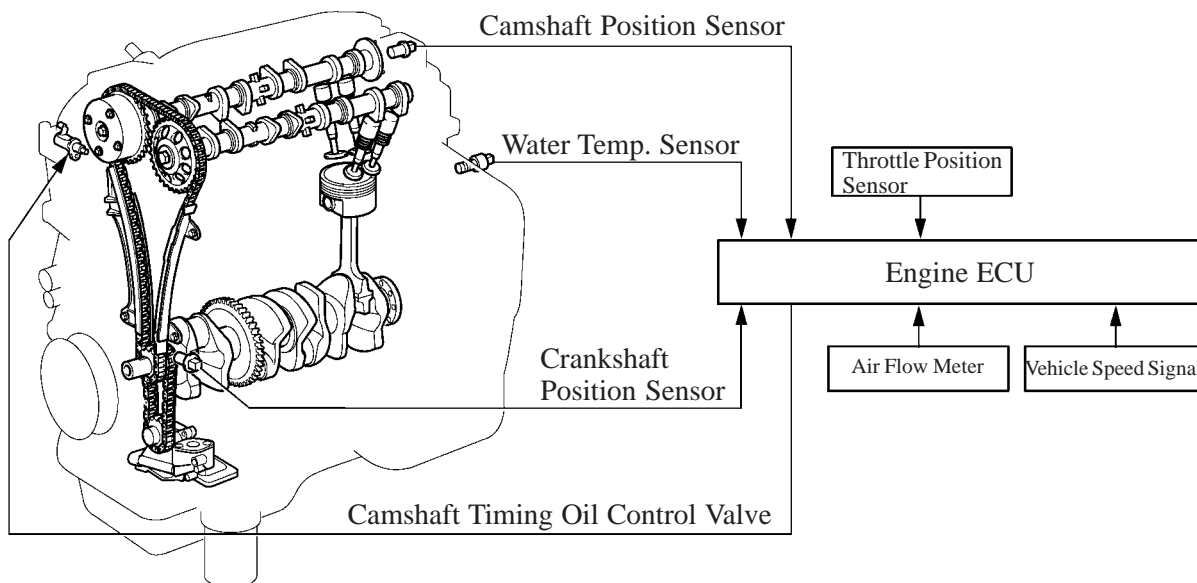
As illustrated below, the conventional oxygen sensor is characterized by a sudden change in its output voltage at the threshold of the stoichiometric air-fuel ratio (14.7 : 1). In contrast, the air-fuel ratio sensor outputs a voltage that is approximately proportionate to the existing air-fuel ratio by converting the oxygen density to the voltage. As a result, the detection precision of the air-fuel ratio has been improved.



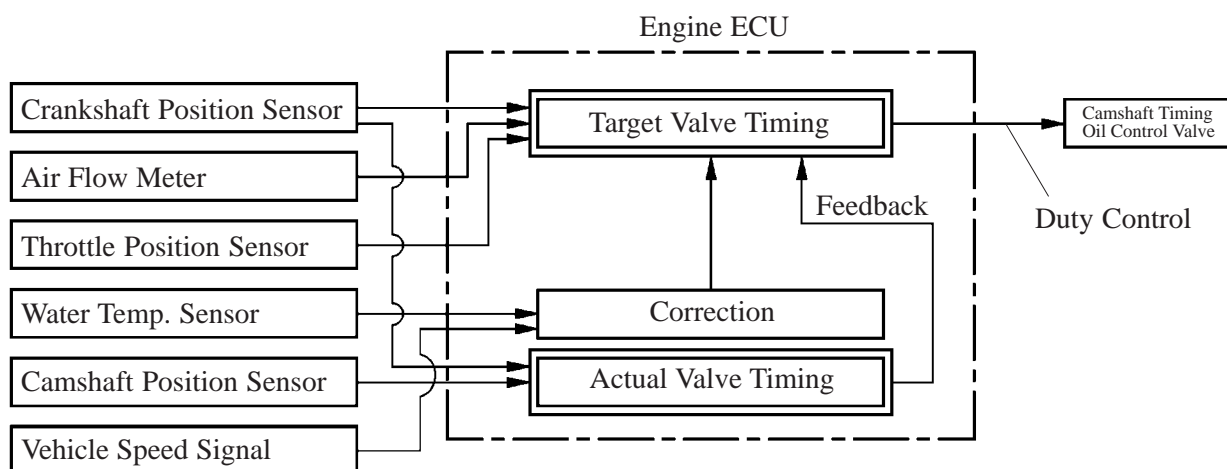
## 6. VVT-i (Variable Valve Timing-intelligent) System

### General

The VVT-i system is designed to control the intake camshaft within a wide range of  $50^\circ$  (of crankshaft angle) to provide a valve timing that is optimally suited to the engine condition, thus realizing improved torque in all the speed ranges and fuel economy, and reduce exhaust emissions. The actual intake valve timing is feedback by means of the camshaft position sensor for constant control to the target valve timing.



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## Construction

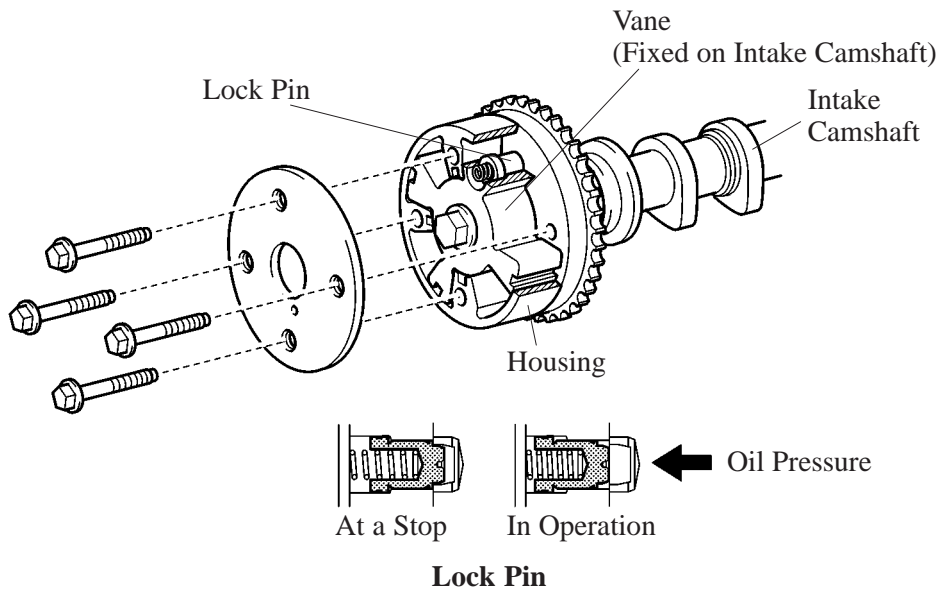
### 1) VVT-i Controller

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.

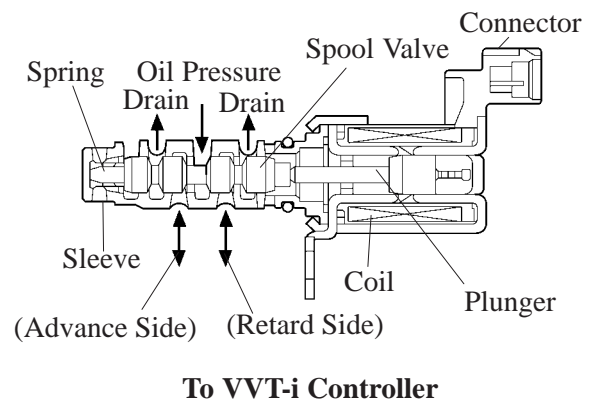
When hydraulic pressure is not applied to the VVT-i controller immediately after the engine has been started, the lock pin locks the movement of the VVT-i controller to prevent a knocking noise.



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### 2) Camshaft Timing Oil Control Valve

The camshaft timing oil control valve 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 camshaft timing oil control valve is in the most retarded state.



**To VVT-i Controller**

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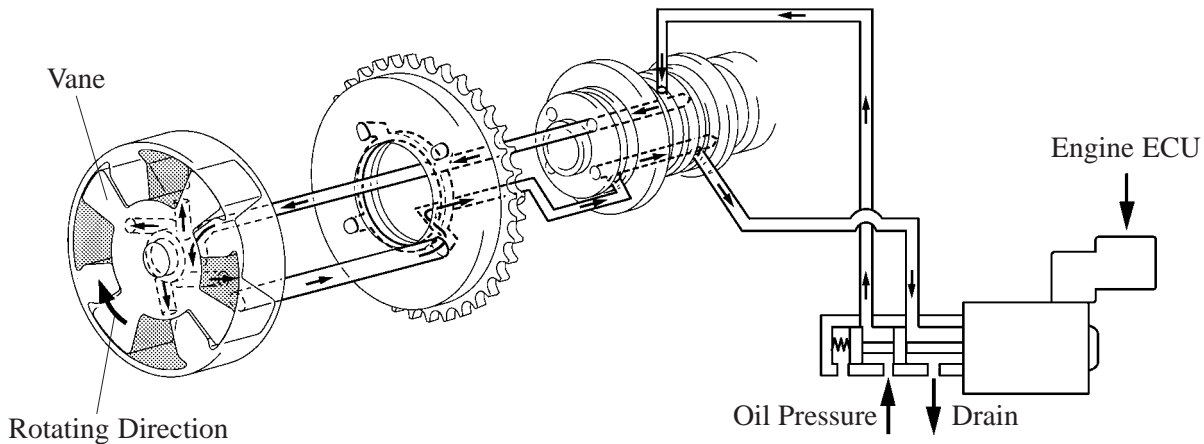


## Operation

- The camshaft timing oil control valve selects the oil 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.

### 1) Advance

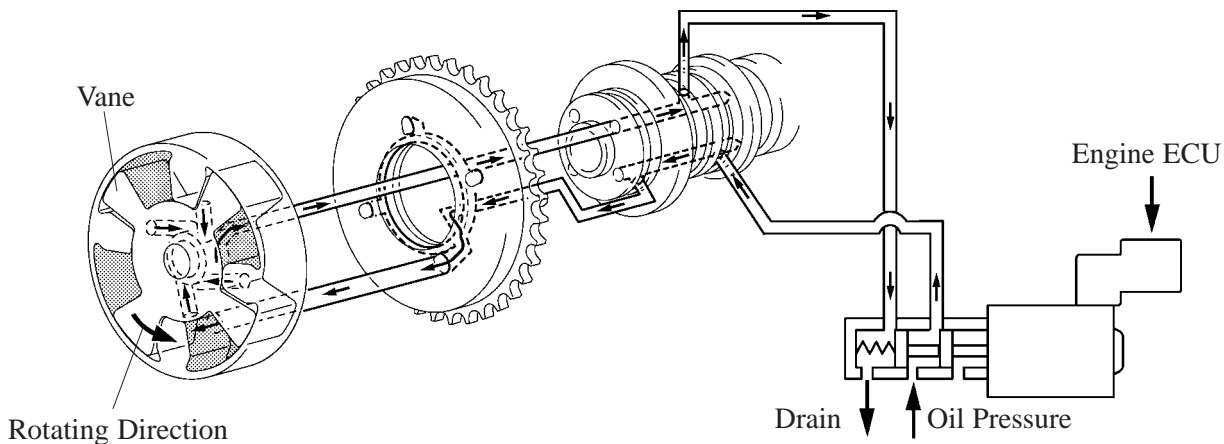
When the camshaft timing oil control valve is positioned as illustrated below by the advance signal from the engine ECU, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.



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### 2) Retard

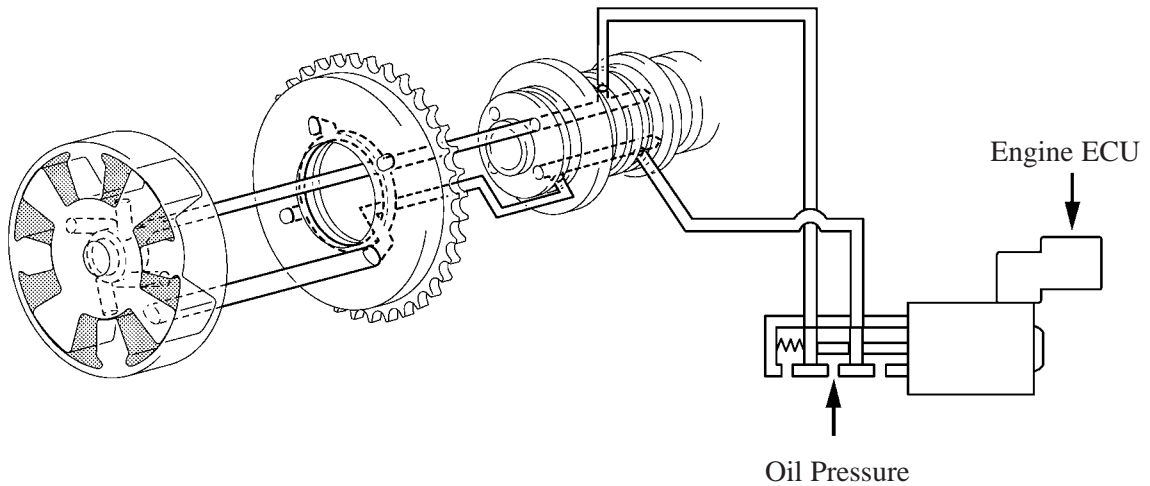
When the camshaft timing oil control valve is positioned as illustrated below by the retard signal from the engine ECU, the resultant oil pressure is applied to the timing retard side vane chamber to rotate the camshaft in the timing retard direction.



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### 3) Hold

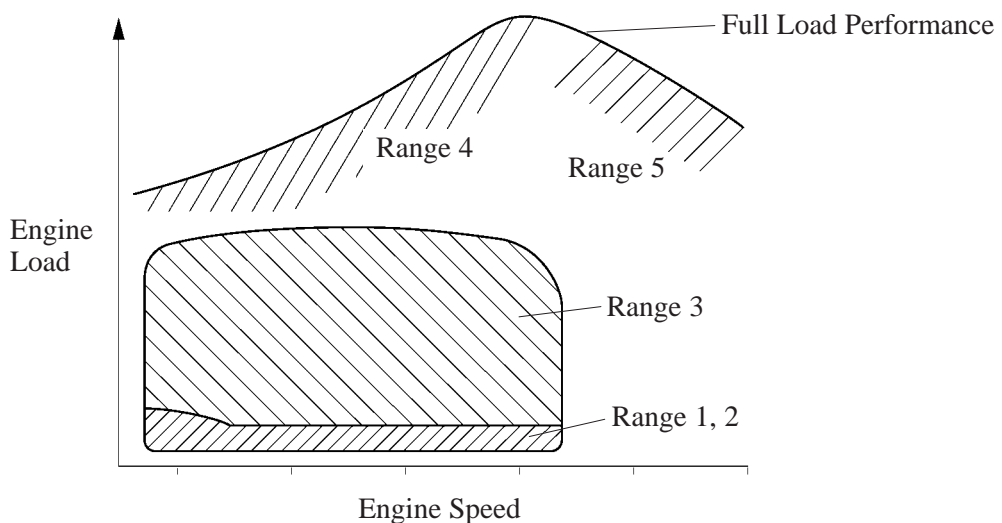
The engine ECU calculated the target timing angle according to the traveling state to perform control as described in the previous page. After setting at the target timing, the valve timing is held by keeping the camshaft timing oil control valve in the neutral position unless the traveling state changes. The adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.



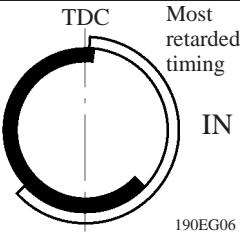
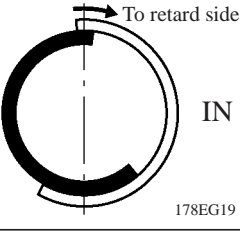
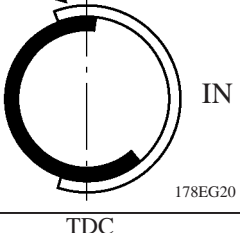
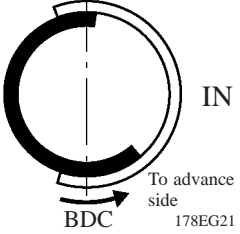
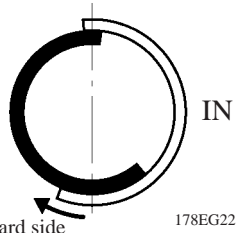
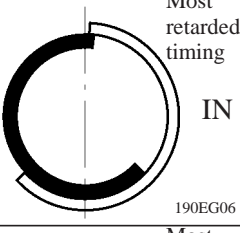
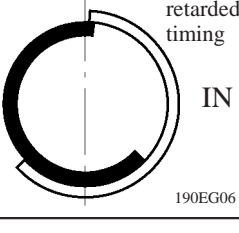
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- In proportion to the engine speed, intake air volume, throttle position and water temperature, the engine ECU calculates an optimal valve timing under each driving condition and controls the camshaft timing oil control valve. In addition, the engine ECU uses signal from the camshaft position sensor and the crankshaft position sensor to detect the actual valve timing, thus it is possible to perform feedback control to achieve the target valve timing.

### ► Operation During Various Driving Conditions (Conceptual Diagram) ◀



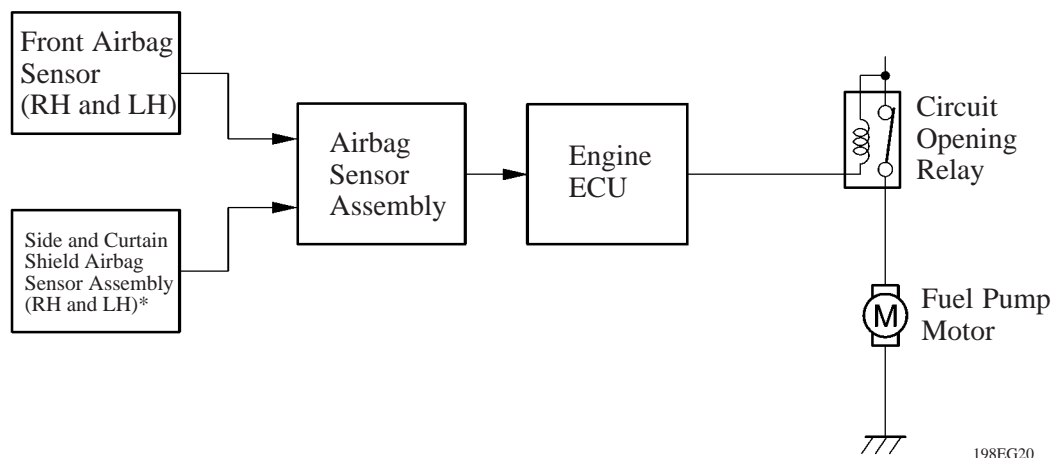
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Operation State	Range	Valve Timing	Objective	Effect
During Idling	1	 <p>190EG06</p>	Most retarded timing reduces blow back to the intake side	Stabilized idling rpm Better fuel economy
At Light Load	2	 <p>178EG19</p>	Decreasing overlap to eliminate blow back to the intake side	Ensured engine stability
At Medium Load	3	 <p>178EG20</p>	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	 <p>178EG21</p>	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	 <p>178EG22</p>	Retarding the intake valve close timing for volumetric efficiency improvement	Improved output
At Low Temperatures	—	 <p>190EG06</p>	Most retarded timing to prevent blow back to the intake side leads to the lean burning condition, and stabilizes the idle speed at fast idling	Stabilized fast idle rpm Better fuel economy
Upon Starting/ Stopping the Engine	—	 <p>190EG06</p>	Most retarded timing minimizes blow back to the intake side	Improved startability

## 7. Fuel Pump Control

A fuel cut control is adopted to stop the fuel pump when the airbag is deployed at the front or side\* collision. In this system, the airbag deployment signal from the airbag sensor assembly is detected by the engine ECU, and it 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.



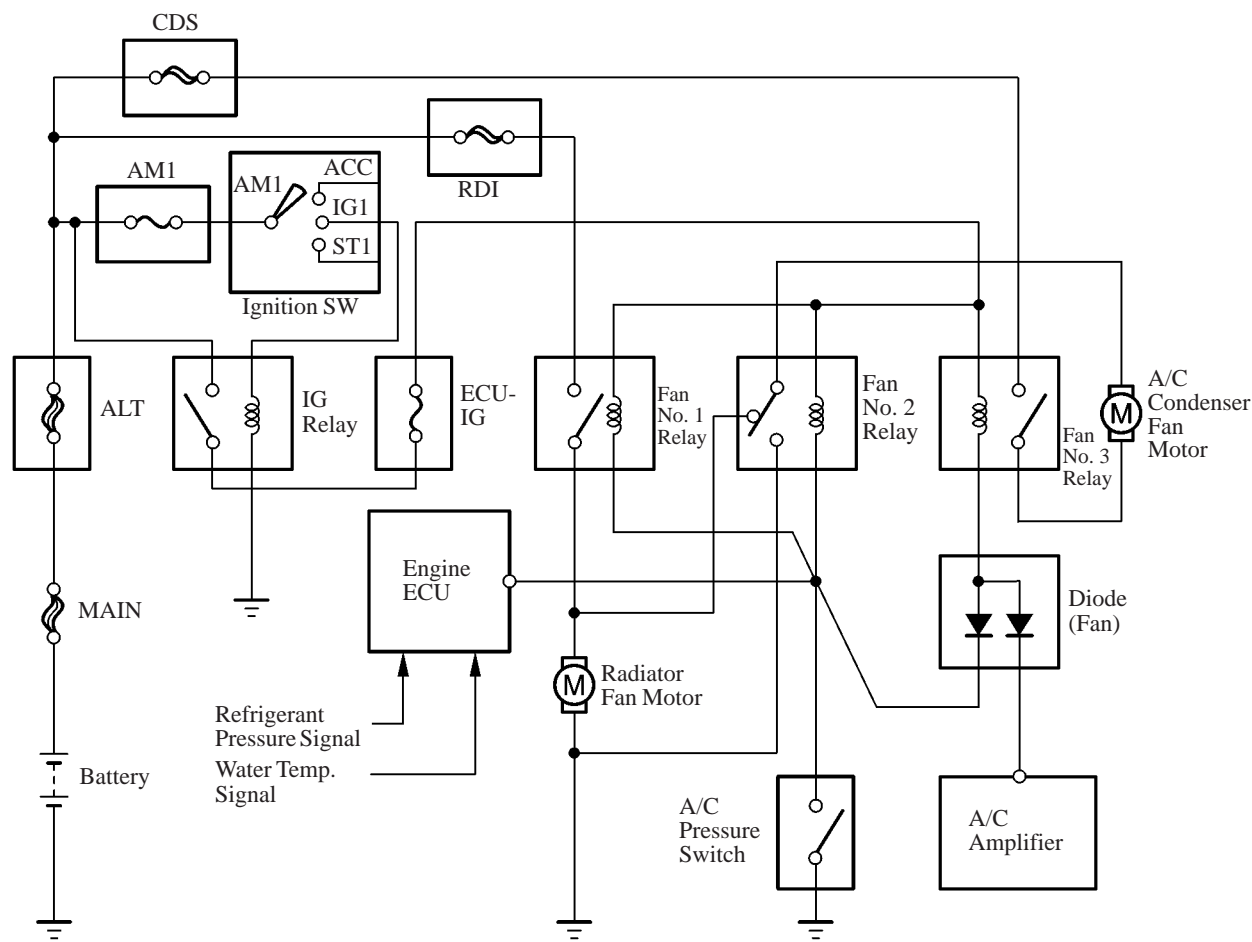
\*: with SRS Side and Curtain Shield Airbag System

8. Cooling Fan Control

In contrast to the previous electric cooling fan system, the cooling fan main relay and the water temperature switch have been discontinued. Instead, by sharing the water temperature sensor to control the fan motor, a simpler system has been realized.

This cooling fan control turns 3 fan relays ON/OFF in accordance with the water temperature and the operating conditions of the air conditioner system. When it is ON, the control is switched to operate the 2 fan motors at Low (serial) or High (parallel).

► Wiring Diagram ◀



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► Cooling Fan Operation ◀

Air Conditioner Condition		Water Temperature	
Compressor	Refrigerant Pressure	About 83°C (181°F) or Lower	About 90°C (194°F) or Higher
OFF	1.2 MPa (12.5 kgf/cm <sup>2</sup> ) or Lower	OFF	High
ON	1.2 MPa (12.5 kgf/cm <sup>2</sup> ) or Lower	Low	High
	1.5 MPa (15.5 kgf/cm <sup>2</sup> ) or Higher	High	High