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| **Title:** 2AR-FE ENGINE CONTROL: SFI SYSTEM: ENGINE CONTROL; 2013 MY RAV4 [12/2012 - ] | | |

# ENGINE CONTROL

## 1. FUNCTION OF MAIN COMPONENTS

(a) The main components of the engine control system are as follows:

| COMPONENT | OUTLINE | QUANTITY | FUNCTION |
|---|---|---|---|
| ECM | Forest 2 | 1 | The ECM optimally controls the engine control system to suit the operating conditions of the engine in accordance with the signals provided by the sensors. |
| Air Fuel Ratio Sensor (Bank 1, Sensor 1) | Type with Heater (Planar Type) | 1 | Detects the oxygen concentration in the exhaust emissions by measuring the electromotive force which is generated in the sensor itself. |
| Oxygen Sensor (Bank 1, Sensor 2) | Type with Heater (Cup Type) | 1 | |
| Intake Mass Air Flow Meter Sub-assembly | Hot-wire Type | 1 | Uses a built-in hot-wire to directly detect the intake air mass. |
| Intake Air Temperature Sensor | Thermistor Type | 1 | Detects the intake air temperature. |
| Engine Coolant Temperature Sensor | Thermistor Type | 1 | Detects the engine coolant temperature. |
| Crank Position Sensor [Rotor Teeth] | Pick-up Coil Type [36 - 2] | 1 | Detects the engine speed and performs the cylinder identification. |
| Camshaft Position Sensor [Rotor Teeth] | Magnetic Resistance Element (MRE) Type [3] | 2 | Performs the cylinder identification. |
| Throttle Position Sensor | Non-contact Type | 1 | Detects the throttle valve opening angle. |
| Accelerator Pedal Sensor Assembly | Non-contact Type | 1 | Detects the amount of pedal effort applied to the accelerator pedal. |
| Tumble Control Valve Position Sensor | Non-contact Type | 1 | Detects the tumble control valve opening angle. |
| | Built-in | | |

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| Knock Control Sensor | Piezoelectric Element Type (Flat Type) | 1 | Detects an occurrence of engine knocking indirectly from the vibration of the cylinder block caused by the occurrence of engine knocking. |
| Camshaft Timing Oil Control Valve Assembly | Solenoid Type | 2 | Changes the oil passage to the VVT-i controller in response to signals from the ECM. |
| Throttle Control Motor | DC Motor | 1 | Regulates the opening of the throttle valve in accordance with the signals from the ECM. |
| Fuel Injector Assembly | 12-hole Type | 4 | The fuel injector assembly is an electromagnetically-operated nozzle which injects fuel in accordance with the signals from the ECM. |
| Ignition Coil Assembly | Type with Igniter | 4 | Incorporates an igniter and provides a high level of voltage necessary for ignition in accordance with signals from the ECM. |
| Duty Vacuum Switching Valve (VSV for ACIS) | Solenoid Type | 1 | Controls the actuator for ACIS in accordance with ECM signals. |
| Spark Plug | Iridium-tipped Type | 4 | Sparks a high level of voltage from the ignition coil assembly inside the cylinder. |

**2. SYSTEM CONTROL**

(a) The engine control system has the following features. The ECM controls these systems:

| SYSTEM | | OUTLINE |
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| Sequential Multiport Fuel Injection (SFI) | | • An L-type SFI system detects the intake air mass with a hot-wire type intake mass air flow meter sub-assembly.<br>• The fuel injection system is a sequential multiport fuel injection system. |
| Electronic Spark Advance (ESA) | | Ignition timing is determined by the ECM based on signals from various sensors. The ECM corrects ignition timing in response to engine knocking. |
| Electronic Throttle Control System-intelligent (ETCS-i) | | Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort, the throttle valve opening control request from the ECM, and the condition of the engine and the vehicle. |
| Dual Variable Valve Timing-intelligent (Dual VVT-i) | | Regulates operation of the intake and exhaust camshafts to ensure an optimal valve timing in accordance with the engine condition. |
| Acoustic Control Induction System (ACIS) | | The intake air passages are switched in accordance with the engine speed and throttle valve opening angle to provide high performance in all speed ranges. |
| Tumble Control | | Controls fully closes the tumble control valve during cold start and cold running conditions to improve exhaust emissions while the engine is running cold. |
| | 2WD | • Based on signals from the ECM, the fuel pump control ECU assembly controls the fuel pump. |

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| Fuel Pump Control | | • The fuel pump is stopped when any of the Supplemental Restraint System (SRS) airbags are deployed. |
| | AWD | • Fuel pump operation is controlled by signals from the ECM.<br>• The fuel pump is stopped when any of the Supplemental Restraint System (SRS) airbags are deployed. |
| Air Conditioning Cut-off Control | | By turning the air conditioning compressor assembly on or off in accordance with the engine condition, driveability is maintained. |
| Cooling Fan Control | | Radiator cooling fan operation is controlled by signals from the ECM based on the engine coolant temperature sensor signal (THW) and the operating condition of the air conditioning system. |
| Starter Control* | | Once the engine switch is pushed, this control continues to operate the starter until the engine has started. |
| Air Fuel Ratio Sensor and 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. |
| Engine Immobiliser | | Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid key. |
| Brake Override System | | The driving torque is restricted when both the accelerator and brake pedals are depressed. |
| Diagnosis | | When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section. |
| Fail-safe | | When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in memory. |

*: Models with smart key system