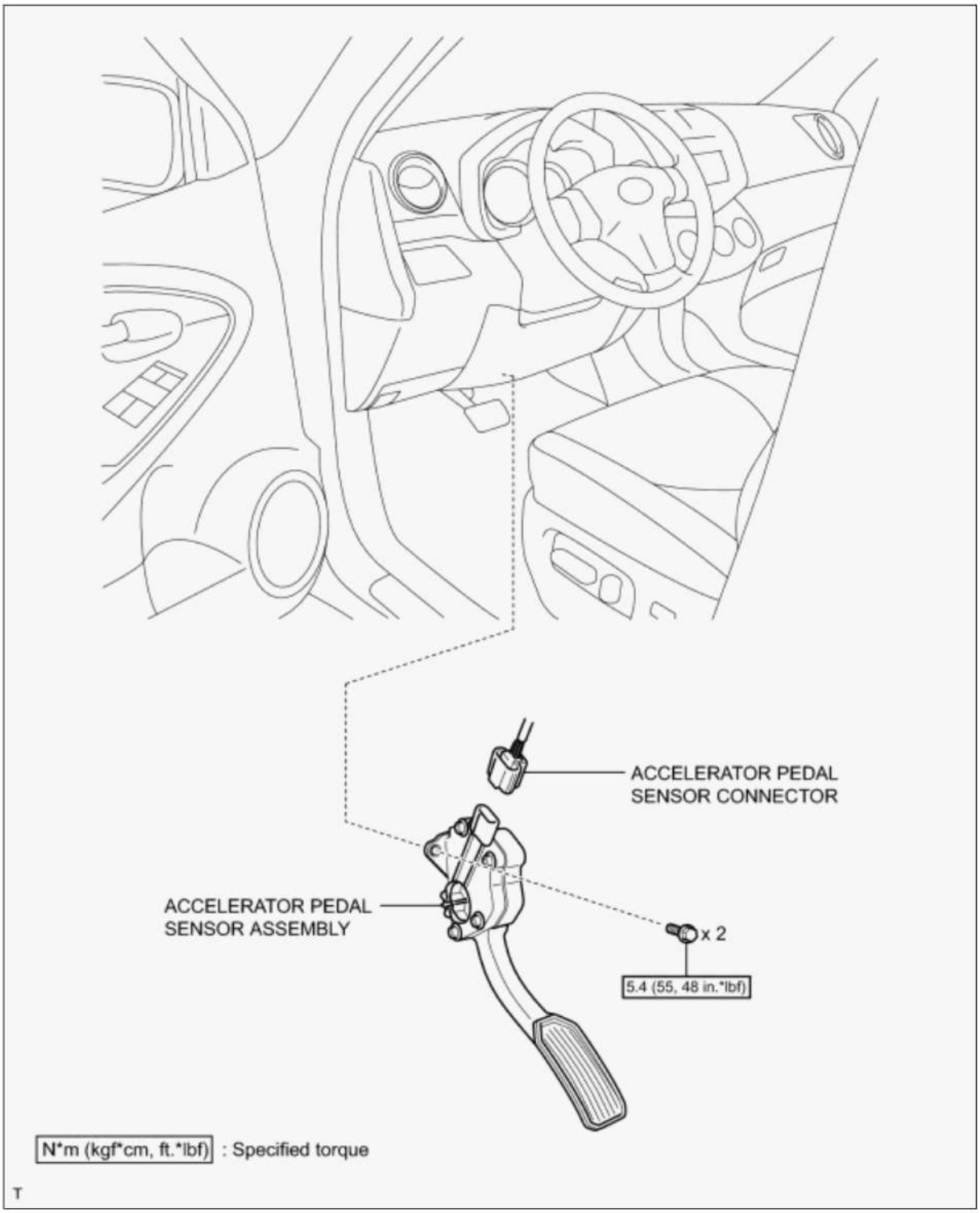
Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UK02XX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ACCELERATOR PEDAL ROD: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION



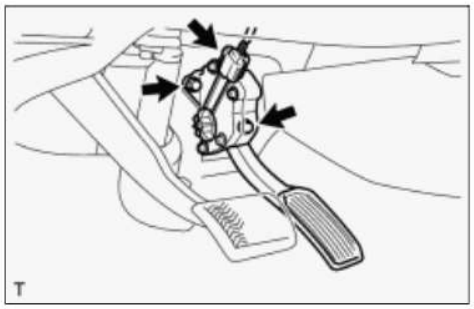
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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UJ032X
Title: 2AR-FE ENGINE CONTROL SYSTEM: ACCELERATOR PEDAL ROD: INSTALLATION (2011 RAV4)		

INSTALLATION

1. INSTALL ACCELERATOR PEDAL SENSOR ASSEMBLY



(a) Install the accelerator pedal sensor with the 2 bolts.

Torque: 5.4 N·m (55 kgf·cm, 48in·lbf)

(b) Connect the accelerator pedal sensor connector.

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001AMX02AX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ACCELERATOR PEDAL ROD: ON-VEHICLE INSPECTION (2011 RAV4)		

ON-VEHICLE INSPECTION

1. INSPECT ACCELERATOR PEDAL SENSOR ASSEMBLY

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accel Sensor Out No. 1 and Accel Sensor Out No. 2.

(e) Read the value displayed on the Techstream.

Standard Voltage:

Accel Sensor Out No. 1

CONDITION	SPECIFIED CONDITION
Accelerator pedal is released	0.5 to 1.1 V
Accelerator pedal is depressed	2.6 to 4.5 V

Standard Voltage:

Accel Sensor Out No. 2

CONDITION	SPECIFIED CONDITION
Accelerator pedal is released	1.2 to 2.0 V
Accelerator pedal is depressed	3.4 to 5.0 V

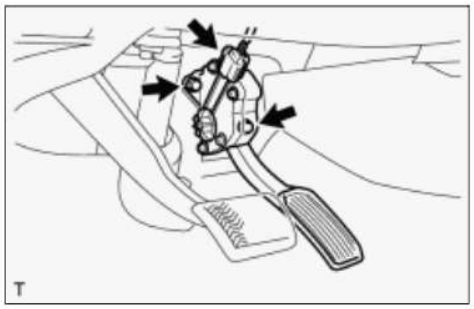
If the result is not as specified, check the accelerator pedal sensor assembly, wire harness and ECM.

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UL02XX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ACCELERATOR PEDAL ROD: REMOVAL (2011 RAV4)		

REMOVAL

1. REMOVE ACCELERATOR PEDAL SENSOR ASSEMBLY



(a) Disconnect the accelerator pedal sensor connector.

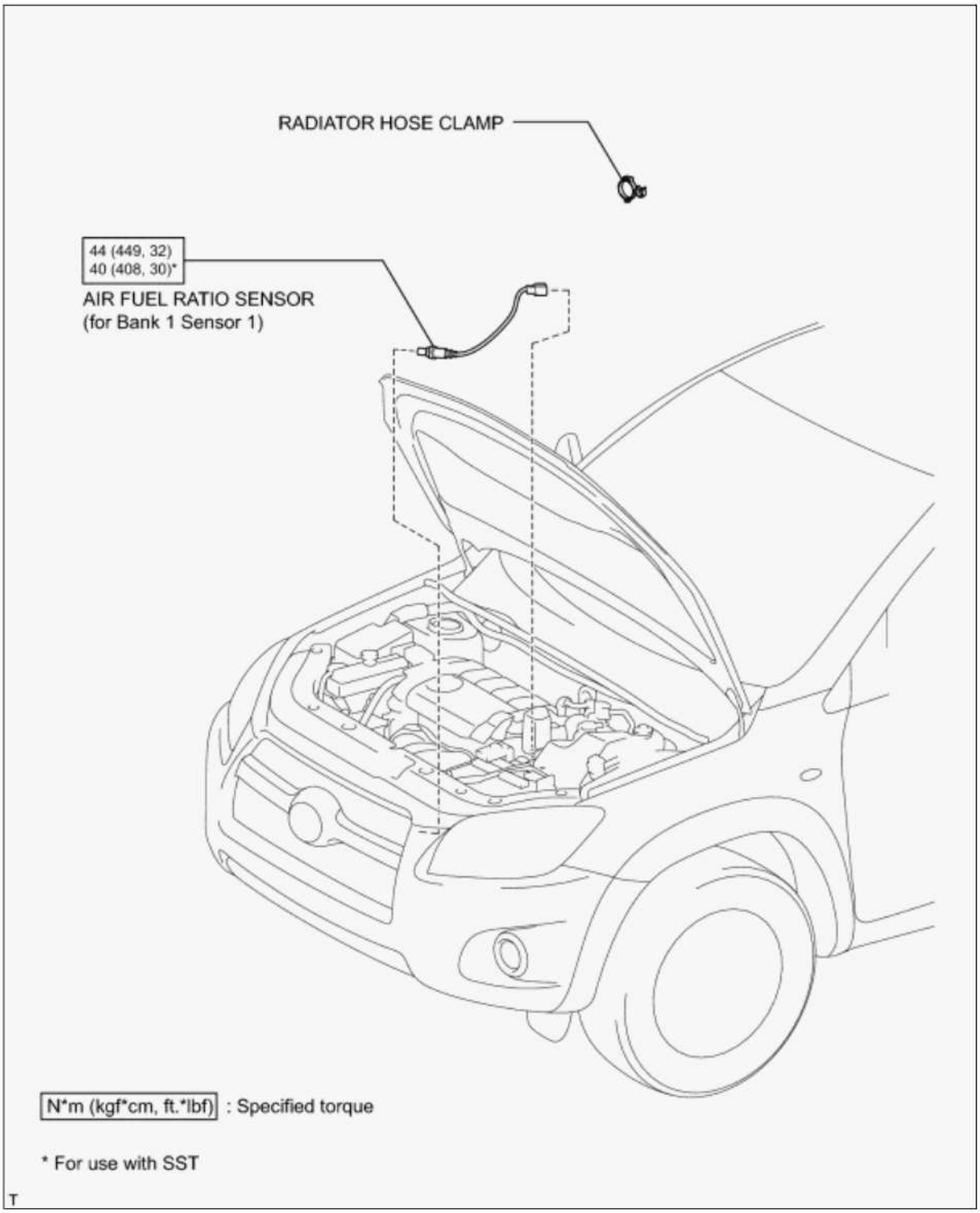
(b) Remove the 2 bolts and accelerator pedal sensor.

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001RO201DX
Title: 2AR-FE ENGINE CONTROL SYSTEM: AIR FUEL RATIO SENSOR: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION



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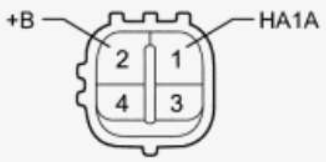
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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001Z1P01GX
Title: 2AR-FE ENGINE CONTROL SYSTEM: AIR FUEL RATIO SENSOR: INSPECTION (2011 RAV4)		

INSPECTION

1. INSPECT AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

Component without harness connected:
(Air Fuel Ratio Sensor)



(a) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

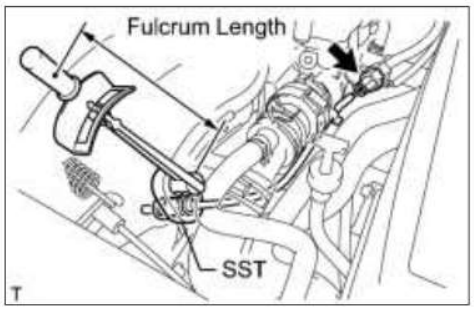
TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω

If the reult is not as specified, replace the air fuel ratio sensor.

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001RO101IX
Title: 2AR-FE ENGINE CONTROL SYSTEM: AIR FUEL RATIO SENSOR: INSTALLATION (2011 RAV4)		

INSTALLATION



1. INSTALL AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

(a) Using SST, install the sensor to the exhaust manifold.

SST: 09224-00010
without SST - Torque: 44 N·m (449 kgf·cm, 32ft·lbf)
with SST - Torque: 40 N·m (408 kgf·cm, 30ft·lbf)

HINT:

- Use a torque wrench with a fulcrum length of 300 mm (11.8 in.).
- Make sure SST and the wrench are connected in a straight line.

(b) Connect the sensor connector.

2. INSTALL RADIATOR HOSE CLAMP INFO

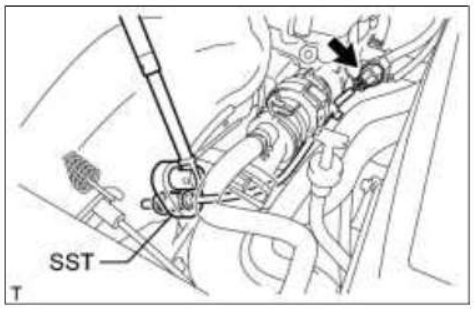
3. INSPECT FOR EXHAUST GAS LEAK

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001RO301FX
Title: 2AR-FE ENGINE CONTROL SYSTEM: AIR FUEL RATIO SENSOR: REMOVAL (2011 RAV4)		

REMOVAL

1. REMOVE RADIATOR HOSE CLAMP INFO



2. REMOVE AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)

(a) Disconnect the sensor connector.

(b) Using SST, remove the sensor from the exhaust manifold.

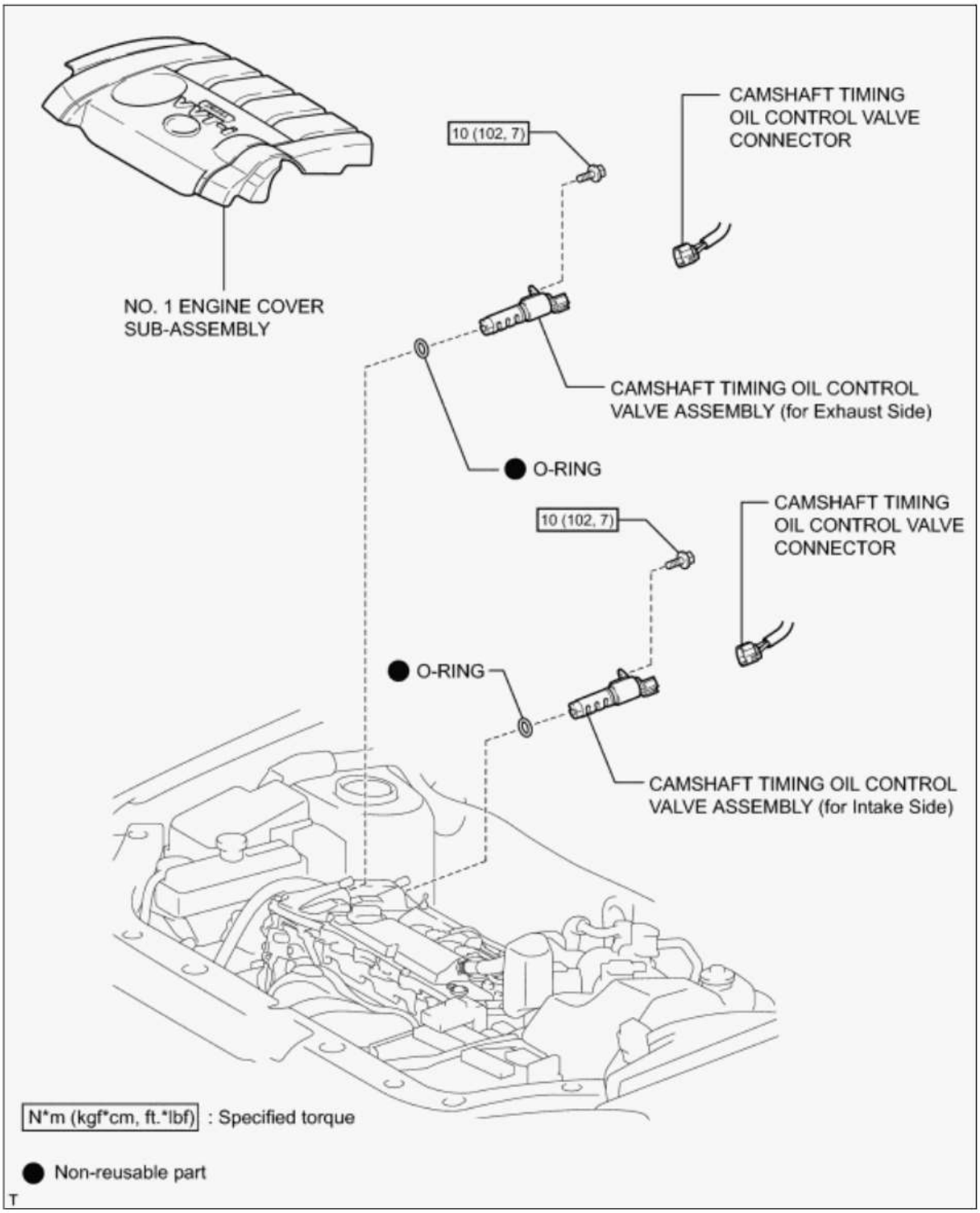
SST: 09224-00010

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U2010X
Title: 2AR-FE ENGINE CONTROL SYSTEM: CAMSHAFT OIL CONTROL VALVE: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION



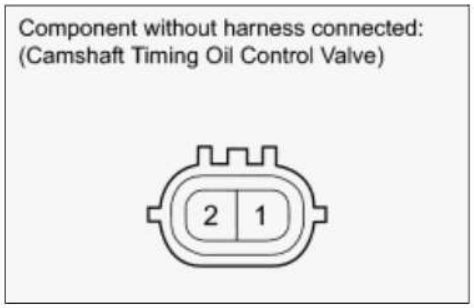
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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U101OX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CAMSHAFT OIL CONTROL VALVE: INSPECTION (2011 RAV4)		

INSPECTION

1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

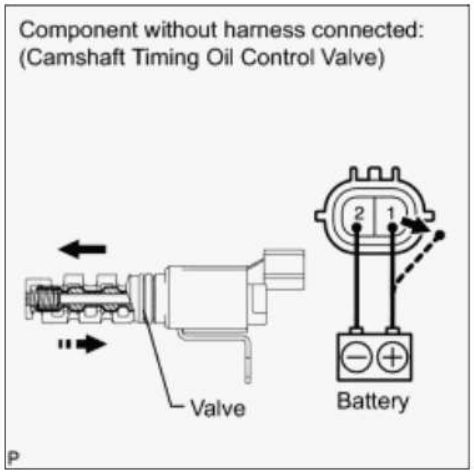


(a) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

If the result is not as specified, replace the oil control valve assembly.



(b) Connect the battery positive (+) lead to terminal 1 and negative (-) lead to terminal 2, and check the movement of the valve.

OK:

CONDITION	SPECIFIED CONDITION
Battery positive (+) voltage is applied	Valve moves in left arrow direction shown in illustration
Battery positive (+) voltage is cut off	Valve moves in right arrow direction shown in illustration

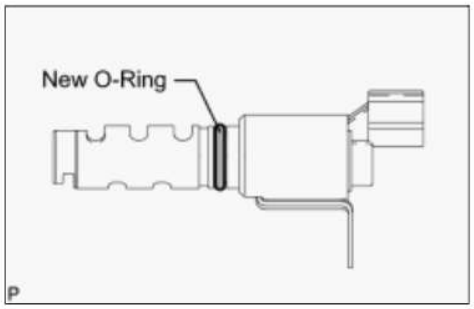
If the result is not as specified, replace the oil control valve assembly. If the valve cannot return properly because of foreign matter, a small pressure leak in the advanced direction may occur and a DTC may be stored.

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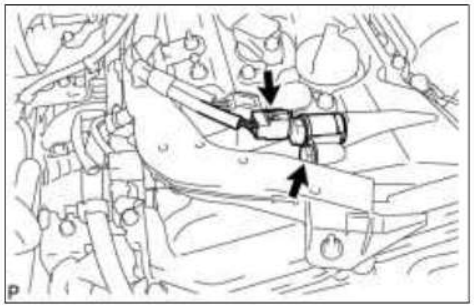
Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U001TX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CAMSHAFT OIL CONTROL VALVE: INSTALLATION (2011 RAV4)		

INSTALLATION

1. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Exhaust Side)



(a) Apply a light coat of engine oil to a new O-ring, and install it to the oil control valve.



(b) Install the oil control valve with the bolt.

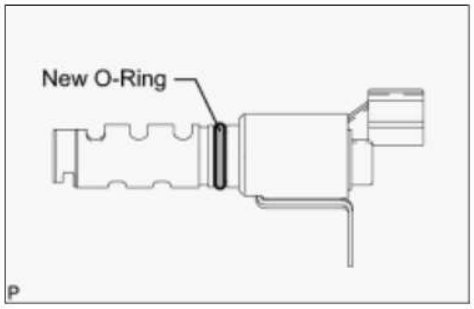
Torque: 10 N·m (102 kgf·cm, 7ft·lbf)

NOTICE:

- Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).
- Be careful that the O-ring is not cracked or moved out of place when installing the oil control valve.

(c) Connect the oil control valve connector.

2. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Intake Side)

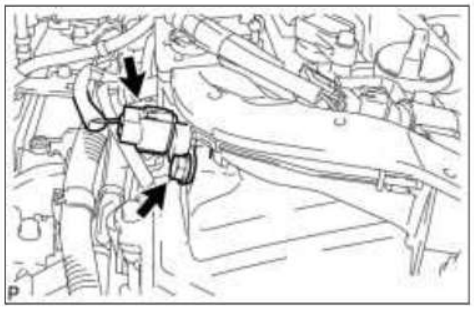


(a) Apply a light coat of engine oil to a new O-ring, and install it to the oil control valve.

(b) Install the oil control valve with the bolt.

Torque: 10 N·m (102 kgf·cm, 7ft·lbf)

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NOTICE:

- Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).
- Be careful that the O-ring is not cracked or moved out of place when installing the oil control valve.

(c) Connect the oil control valve connector.

3. INSPECT FOR OIL LEAK INFO

4. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY INFO

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U401QX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CAMSHAFT OIL CONTROL VALVE: ON-VEHICLE INSPECTION (2011 RAV4)		

ON-VEHICLE INSPECTION

1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

(a) Connect the Techstream to the DLC3.

(b) Start the engine and turn the Techstream on.

(c) Warm up the engine.

(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).

(e) Check the engine speed while operating the Oil Control Valve (OCV) using the Techstream.

Standard Condition:

TESTER OPERATION	SPECIFIED CONDITION
OCV is OFF	Normal engine speed
OCV is ON	Soon after OCV switched from OFF to ON, engine idles roughly or stalls

If the operation is not as specified, check the oil control valve, wire harness and ECM.

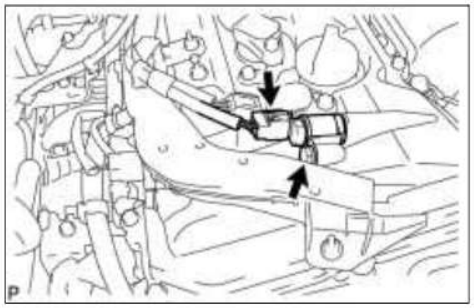
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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U301QX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CAMSHAFT OIL CONTROL VALVE: REMOVAL (2011 RAV4)		

REMOVAL

1. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY INFO

2. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Exhaust Side)

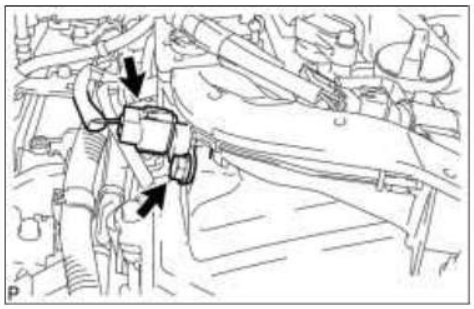


(a) Disconnect the oil control valve connector.

(b) Remove the bolt and oil control valve.

(c) Remove the O-ring from the oil control valve.

3. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Intake Side)



(a) Disconnect the oil control valve connector.

(b) Remove the bolt and oil control valve.

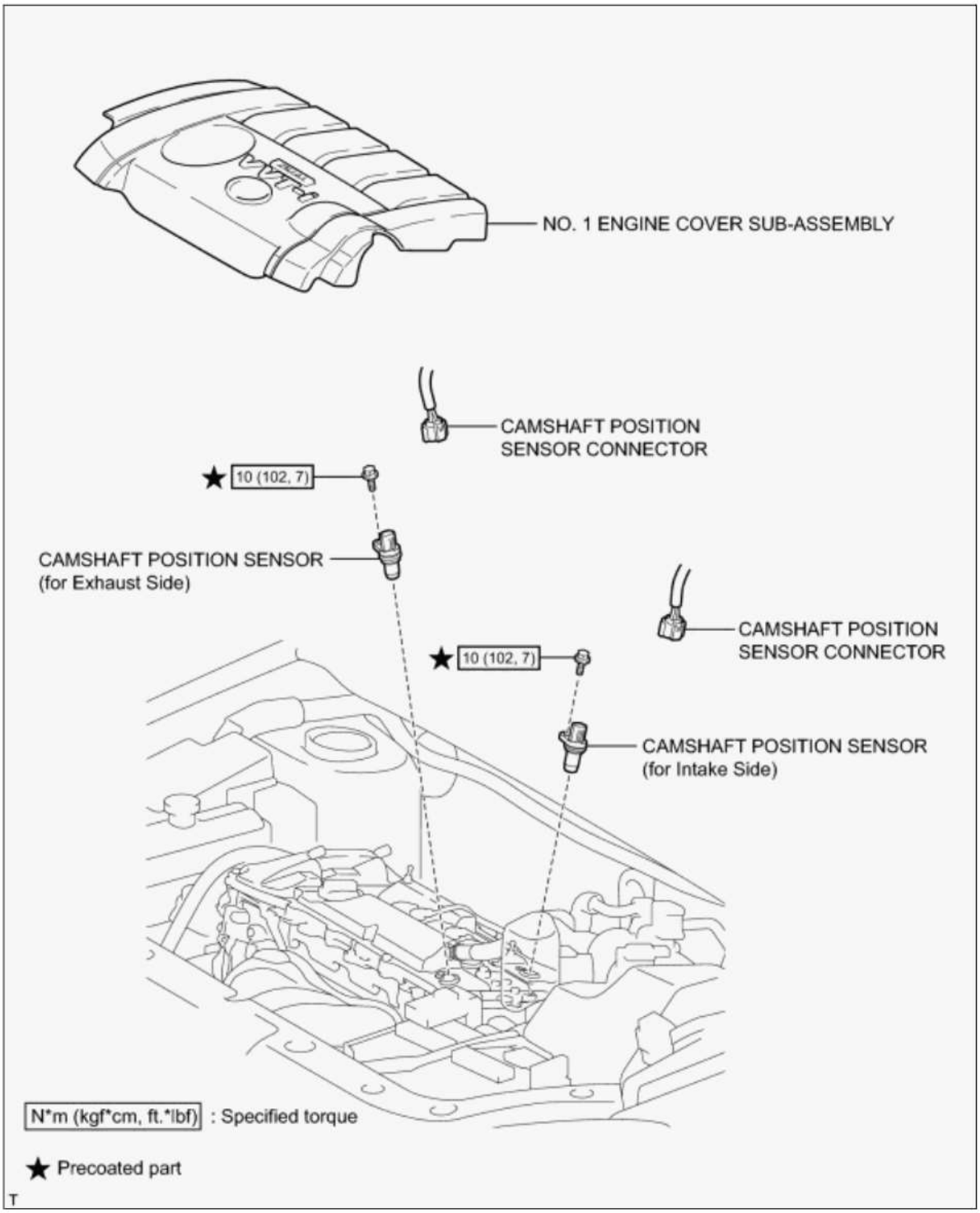
(c) Remove the O-ring from the oil control valve.

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017V602FX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CAMSHAFT POSITION SENSOR: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION



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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017V403KX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CAMSHAFT POSITION SENSOR: INSTALLATION (2011 RAV4)		

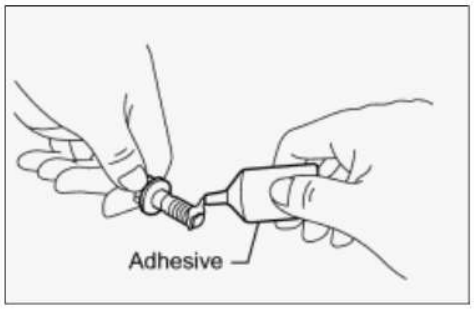
INSTALLATION

1. INSTALL CAMSHAFT POSITION SENSOR (for Exhaust Side)

(a) Apply a light coat of engine oil to the O-ring of the sensor.

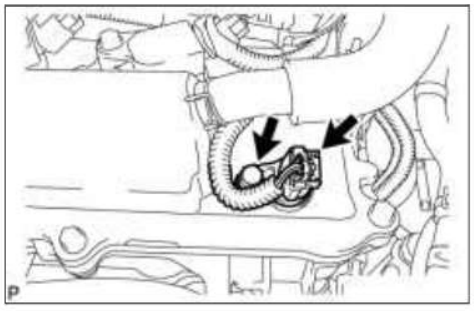
NOTICE:

Make sure that the O-ring is not cracked or jammed when installing the sensor.



(b) Apply adhesive to 2 or 3 threads of the bolt.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent.



(c) Install the sensor with the bolt.

Torque: 10 N·m (102 kgf·cm, 7ft·lbf)

(d) Connect the sensor connector.

2. INSTALL CAMSHAFT POSITION SENSOR (for Intake Side)

(a) Apply a light coat of engine oil to the O-ring of the sensor.

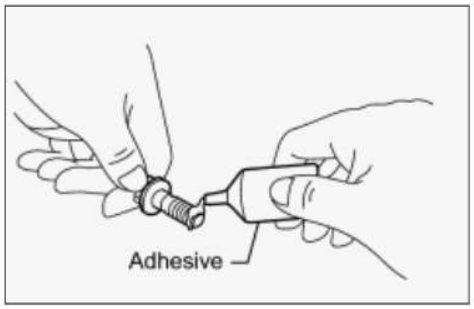
NOTICE:

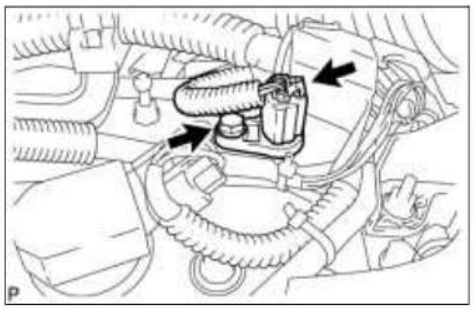
Make sure that the O-ring is not cracked or jammed when installing the sensor.

(b) Apply adhesive to 2 or 3 threads of the bolt.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent.

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(c) Install the sensor with the bolt.

Torque: 10 N·m (102 kgf·cm, 7ft·lbf)

(d) Connect the sensor connector.

3. INSPECT FOR OIL LEAK

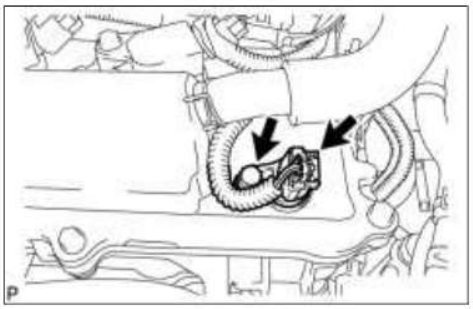
4. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY INFO

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017V703IX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CAMSHAFT POSITION SENSOR: REMOVAL (2011 RAV4)		

REMOVAL

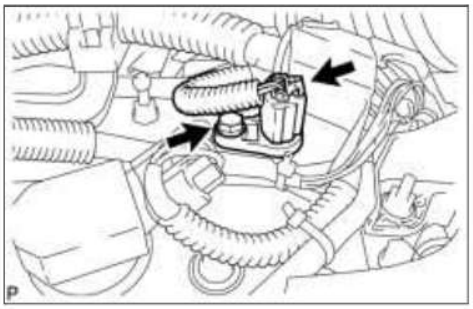
1. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY INFO



2. REMOVE CAMSHAFT POSITION SENSOR (for Exhaust Side)

(a) Disconnect the sensor connector.

(b) Remove the bolt and sensor.



3. REMOVE CAMSHAFT POSITION SENSOR (for Intake Side)

(a) Disconnect the sensor connector.

(b) Remove the bolt and sensor.

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001BA300XX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CIRCUIT OPENING RELAY: ON-VEHICLE INSPECTION (2011 RAV4)		

ON-VEHICLE INSPECTION

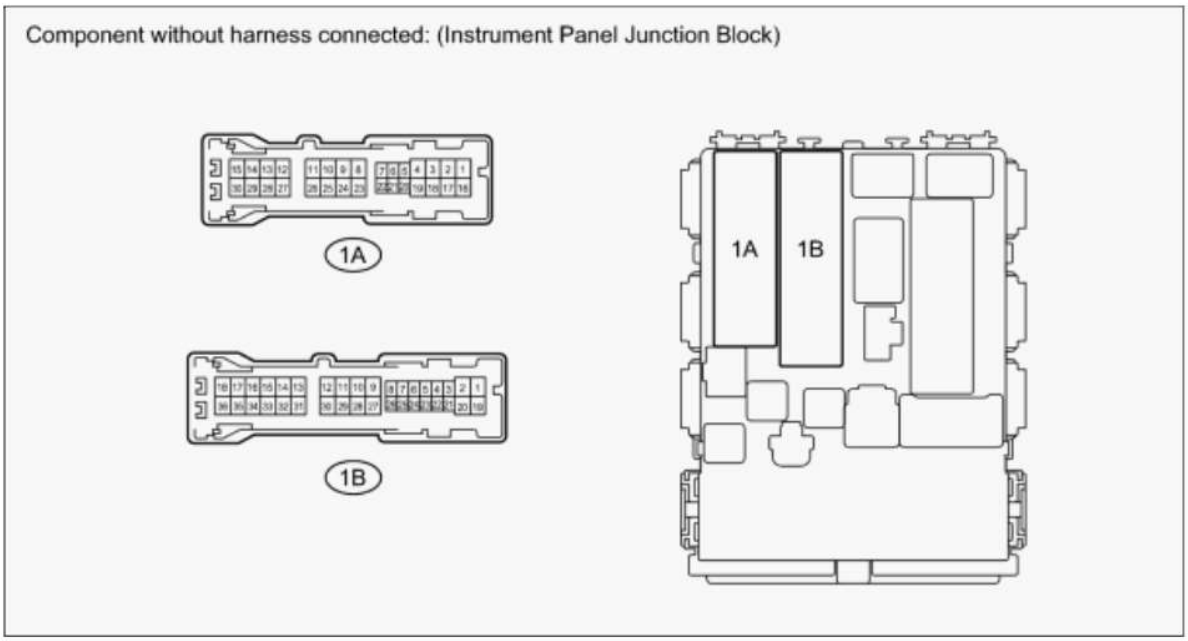
1. INSPECT INSTRUMENT PANEL JUNCTION BLOCK (C/OPN RELAY)

NOTICE:

The circuit opening relay is built into the instrument panel junction block.

(a) Measure the resistance of the circuit opening relay circuit.

Component without harness connected: (Instrument Panel Junction Block)



(1) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1B-11 - 1A-8	Battery voltage is not applied to terminals 1E-5 and 1D-1	10 kΩ or higher
1B-11 - 1A-8	Battery voltage is applied to terminals 1E-5 and 1D-1	Below 1 Ω

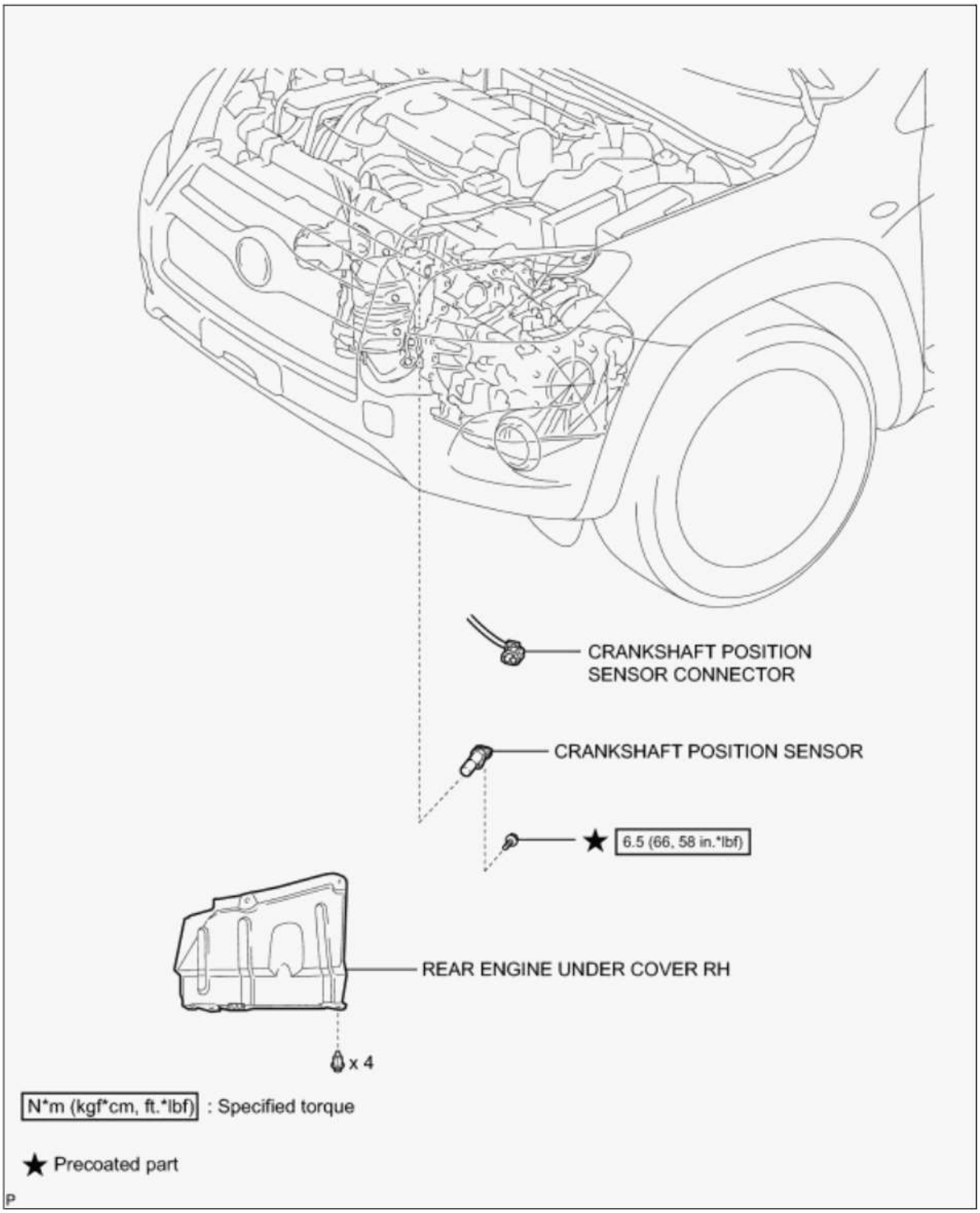
If the result is not as specified, replace the instrument panel junction block.

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017VA019X
Title: 2AR-FE ENGINE CONTROL SYSTEM: CRANKSHAFT POSITION SENSOR: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION



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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017V901AX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CRANKSHAFT POSITION SENSOR: INSPECTION (2011 RAV4)		

INSPECTION

1. INSPECT CRANKSHAFT POSITION SENSOR

(a) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Component without harness connected:
(Crankshaft Position Sensor)



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 - 2	Cold	1630 to 2740 Ω
	Hot	2065 to 3225 Ω

HINT:

In the table above, the terms "Cold" and "Hot" refer to the temperature of the coils. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

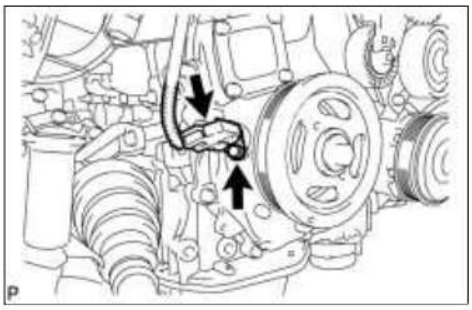
If the result is not as specified, replace the crankshaft position sensor.

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017V801JX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CRANKSHAFT POSITION SENSOR: INSTALLATION (2011 RAV4)		

INSTALLATION

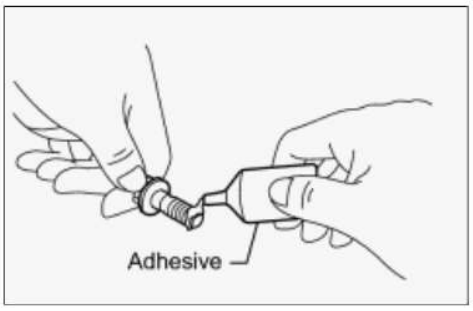
1. INSTALL CRANKSHAFT POSITION SENSOR



(a) Apply a light coat of engine oil to the O-ring of the sensor.

NOTICE:

Make sure that the O-ring is not cracked or jammed when installing the sensor.



(b) Apply adhesive to 2 or 3 threads of the bolt.

Adhesive:
Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent.

(c) Install the sensor with the bolt.

Torque: 6.5 N·m (66 kgf·cm, 58in·lbf)

(d) Connect the sensor connector.

2. INSPECT FOR OIL LEAK

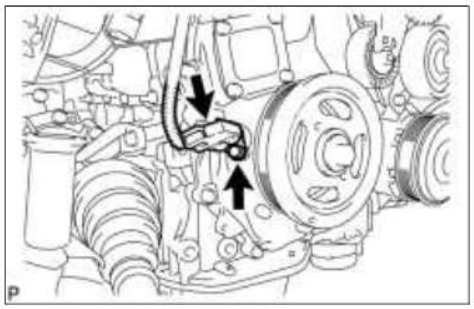
3. INSTALL REAR ENGINE UNDER COVER RH INFO

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017VB01FX
Title: 2AR-FE ENGINE CONTROL SYSTEM: CRANKSHAFT POSITION SENSOR: REMOVAL (2011 RAV4)		

REMOVAL

1. REMOVE REAR ENGINE UNDER COVER RH INFO



2. REMOVE CRANKSHAFT POSITION SENSOR

(a) Disconnect the sensor connector.

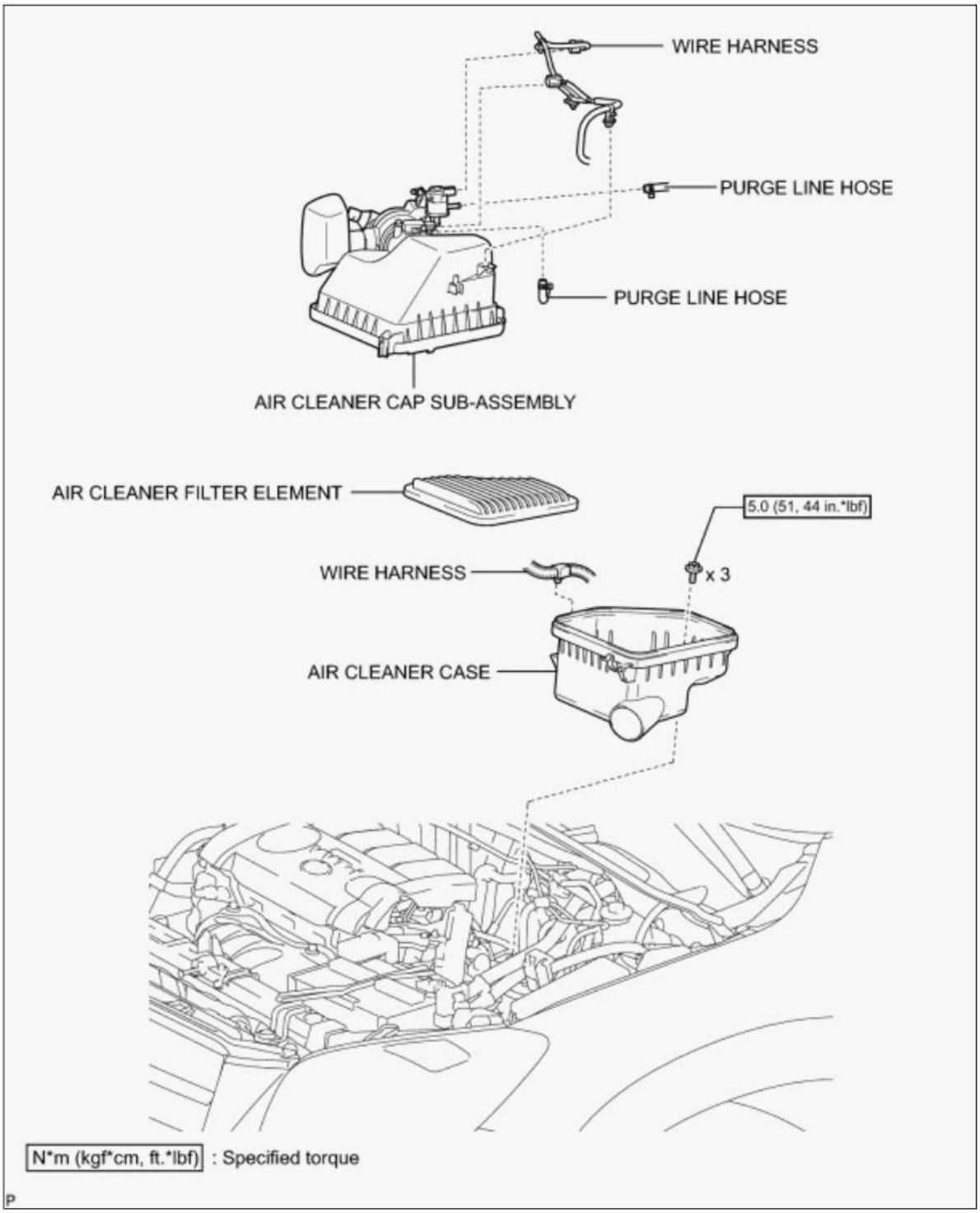
(b) Remove the bolt and sensor.

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UN02CX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ECM: COMPONENTS (2011 RAV4)		

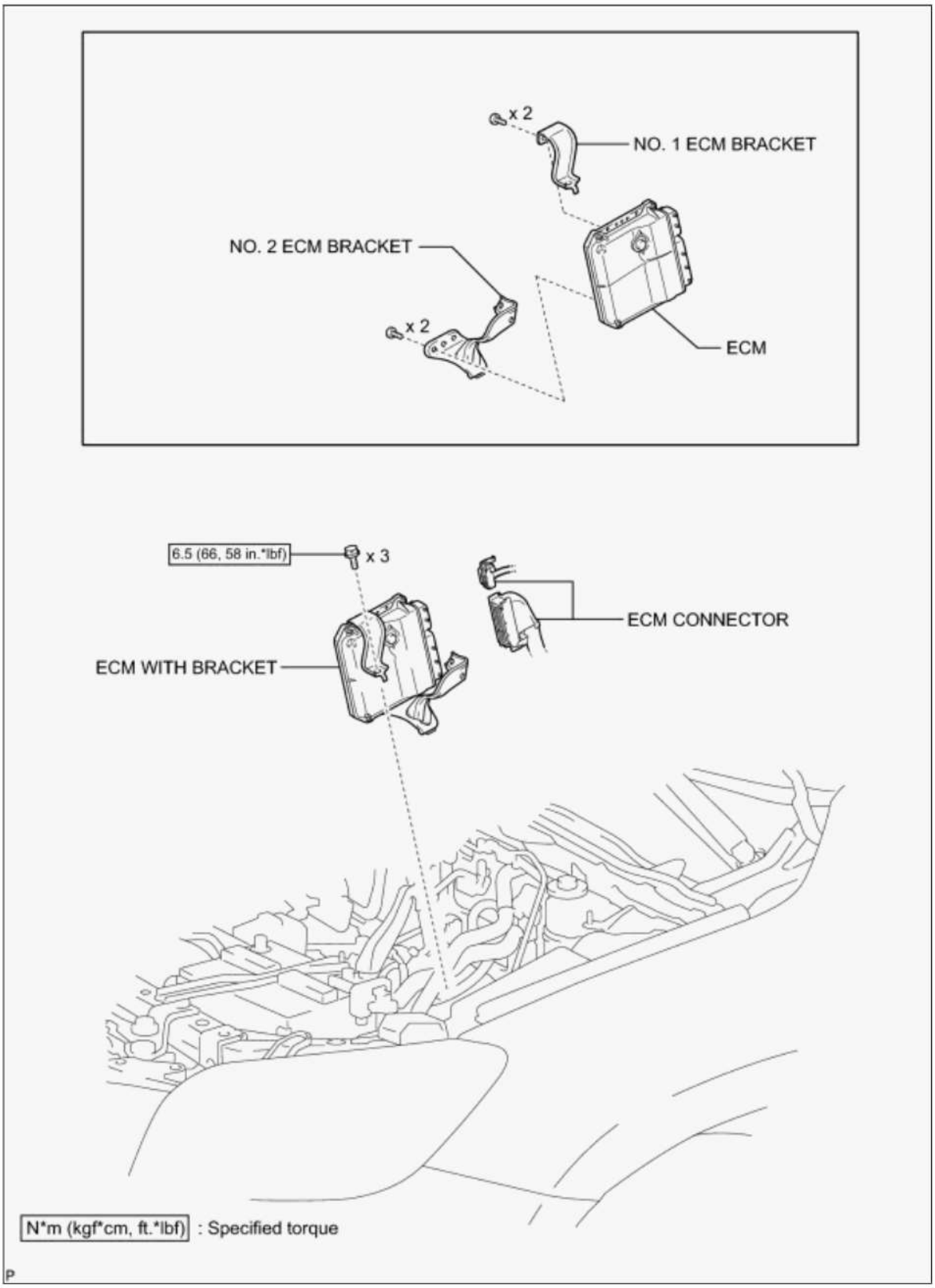
COMPONENTS

ILLUSTRATION



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ILLUSTRATION

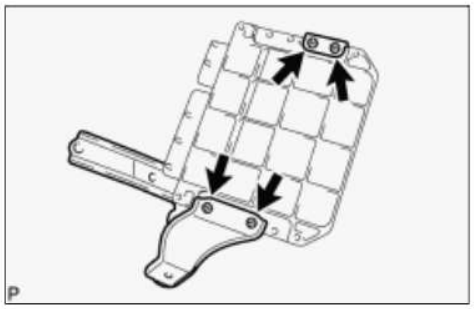


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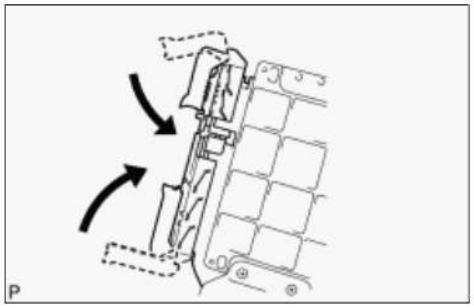
Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UM02RX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ECM: INSTALLATION (2011 RAV4)		

INSTALLATION

1. INSTALL ECM



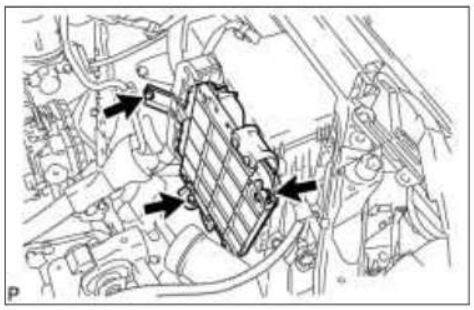
(a) Install the 2 brackets to the ECM with the 4 screws.



(b) Connect the 2 ECM connectors and lower the 2 levers.

NOTICE:

- When connecting the connector, make sure that dirt, water and other foreign matter is not stuck between the connector and ECM.
- Make sure that the 2 levers are securely lowered.



(c) Install the ECM with bracket with the 3 bolts.

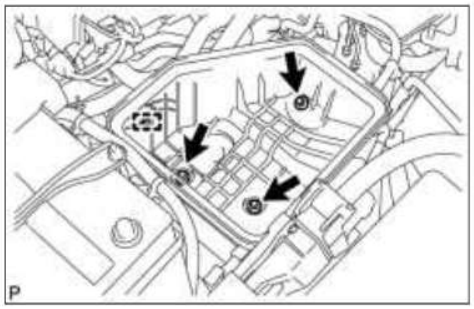
Torque: 6.5 N·m (66 kgf·cm, 58in·lbf)

2. INSTALL AIR CLEANER CASE

(a) Install the air cleaner case with the 3 bolts.

Torque: 5.0 N·m (51 kgf·cm, 44in·lbf)

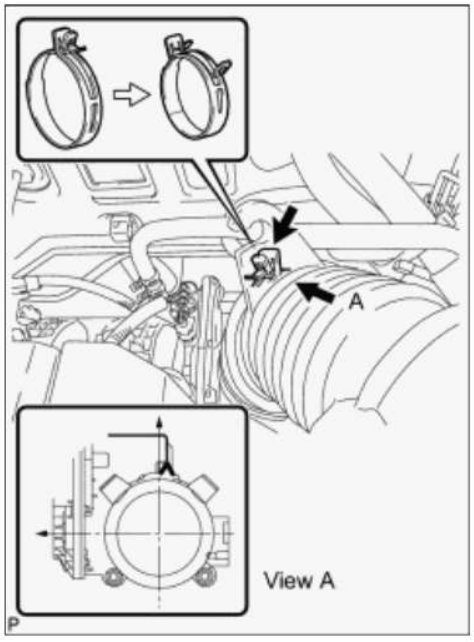
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(b) Connect the harness clamp.

3. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

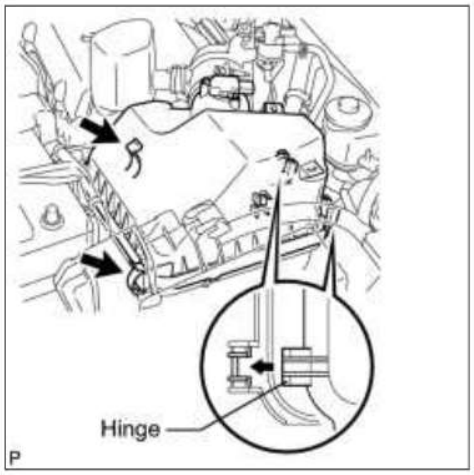
(a) Install the air cleaner filter element to the air cleaner case.

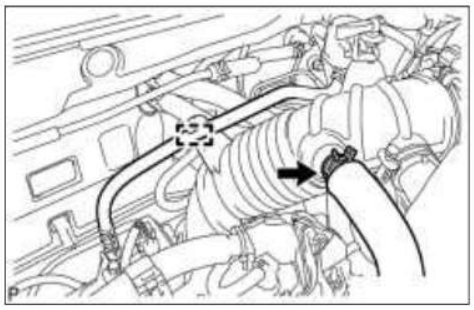


(b) Align the protrusion on the end of the air cleaner hose with the edge of the throttle body and connect the hose. Then, release the lock of the air cleaner hose clamp to secure the clamp.

(c) Insert the hinge part of the air cleaner cap into the air cleaner case, then attach the 2 hook clamps.

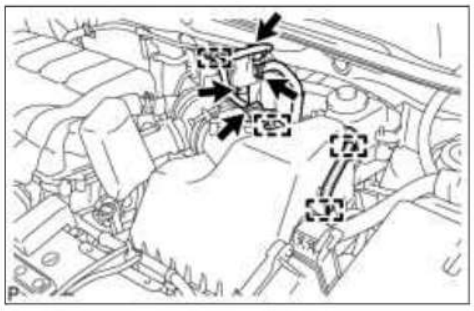
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(d) Connect the purge line hose to the clamp.

(e) Connect the No. 2 ventilation hose to the air cleaner hose.



(f) Connect the 2 purge line hoses to the purge VSV.

(g) Connect the 4 wire harness clamps.

(h) Connect the purge VSV connector.

(i) Connect the mass air flow meter connector.

4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

5. PERFORM REGISTRATION

(a) When replacing the ECM, input the Vehicle Identification Number (VIN) into the new ECM INFO .

(b) When replacing the ECM, perform the vehicle stability control system recognition in the new ECM INFO .

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6. RESET MEMORY

(a) When replacing the ECM, perform the RESET MEMORY procedure (A/T initialization).

(1) Check the vehicle type.

Result

RESULT	PROCEED TO
for 4WD	INFO
for 2WD	INFO

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UO02PX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ECM: REMOVAL (2011 RAV4)		

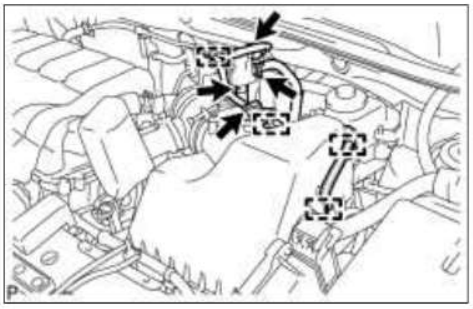
REMOVAL

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to disable the SRS system.

2. REMOVE AIR CLEANER CAP SUB-ASSEMBLY

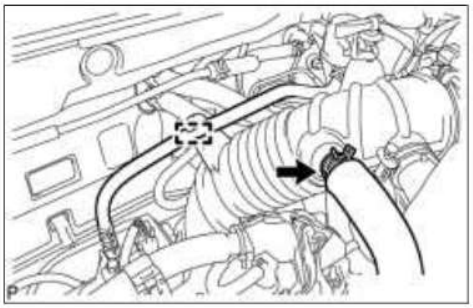


(a) Disconnect the mass air flow meter connector.

(b) Disconnect the purge VSV connector.

(c) Disconnect the 4 wire harness clamps.

(d) Disconnect the 2 purge line hoses.

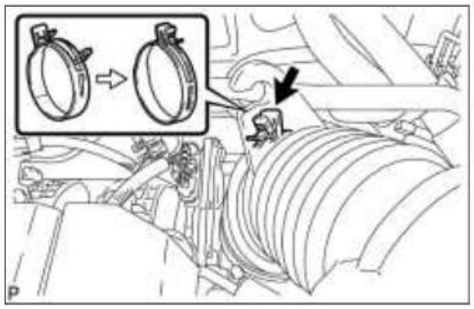


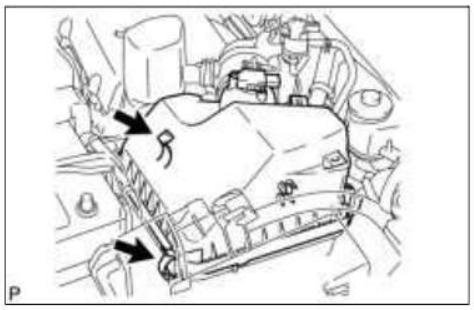
(e) Disconnect the No. 2 ventilation hose from the air cleaner hose.

(f) Disconnect the purge line hose from the clamp.

(g) Lock the No. 1 air cleaner hose clamp, and then disconnect the No. 1 air cleaner hose from the throttle body.

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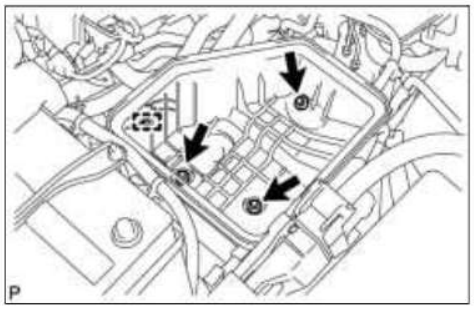




(h) Detach the 2 hook clamps, and then remove the air cleaner cap.

(i) Remove the air cleaner filter element from the air cleaner case.

3. REMOVE AIR CLEANER CASE



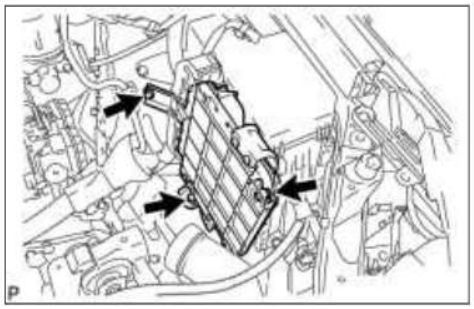
(a) Disconnect the harness clamp.

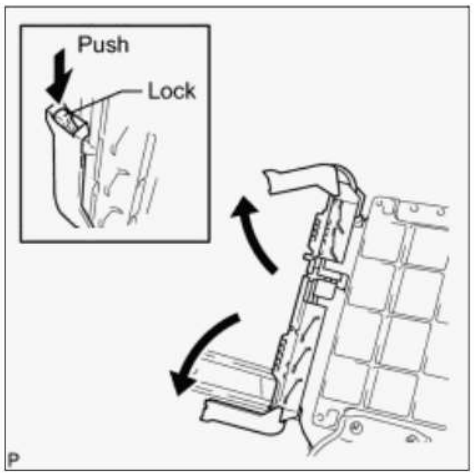
(b) Remove the 3 bolts and air cleaner case.

4. REMOVE ECM

(a) Remove the 3 bolts of the ECM with bracket.

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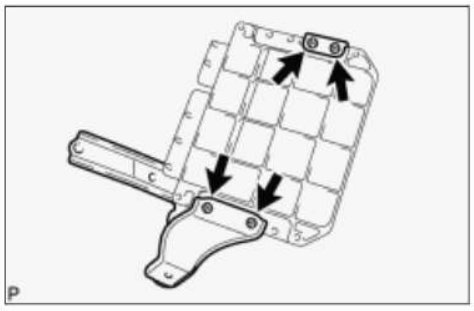
(b) Disconnect the 2 ECM connectors.

NOTICE:

After disconnecting the connector, make sure that dirt, water and other foreign matter does not contact the connector.

(1) Raise the 2 levers while pushing the locks on the 2 levers, and disconnect the 2 ECM connectors.

(c) Remove the ECM with bracket.



(d) Remove the 4 screws and 2 ECM brackets.

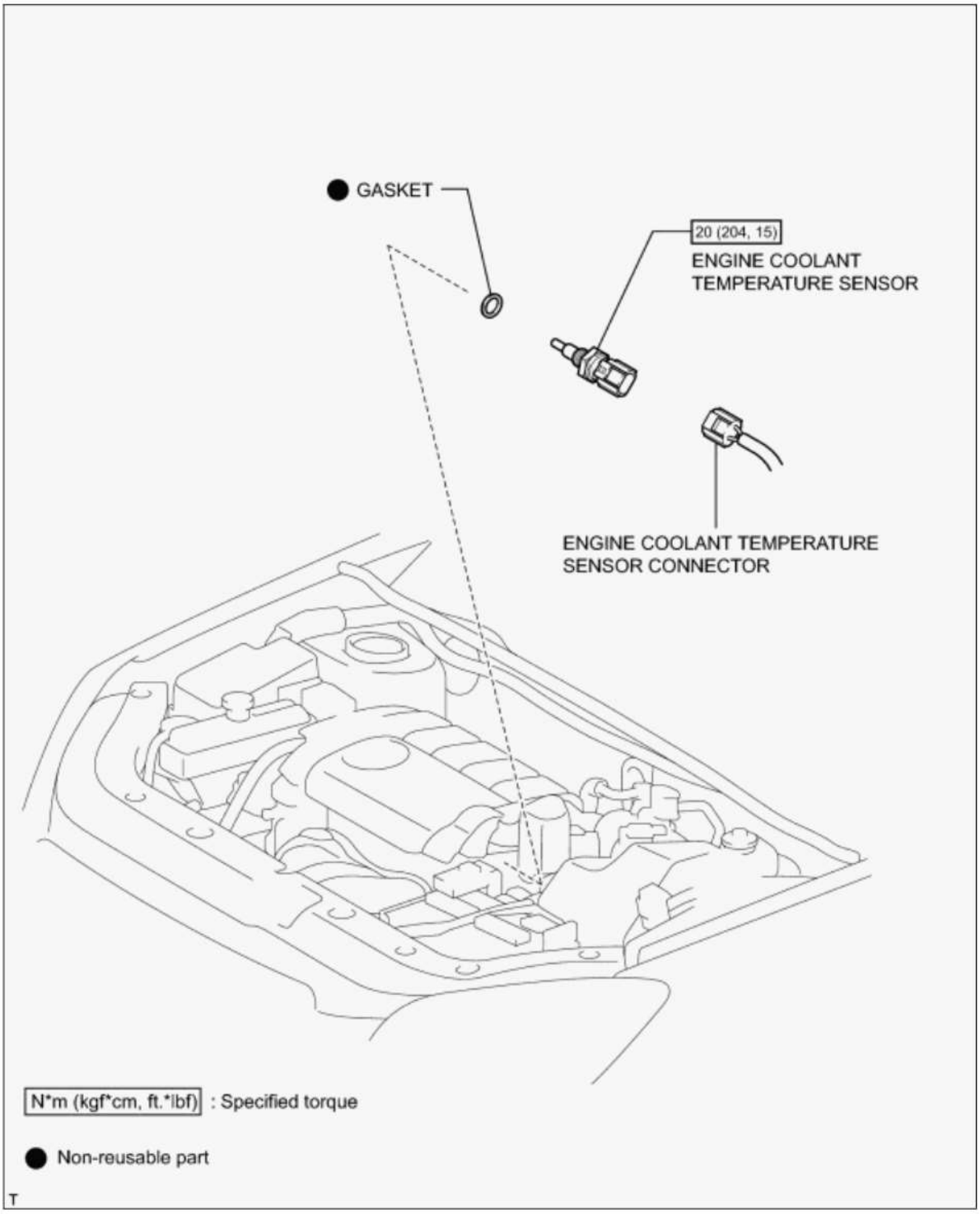
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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U801QX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ENGINE COOLANT TEMPERATURE SENSOR: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION

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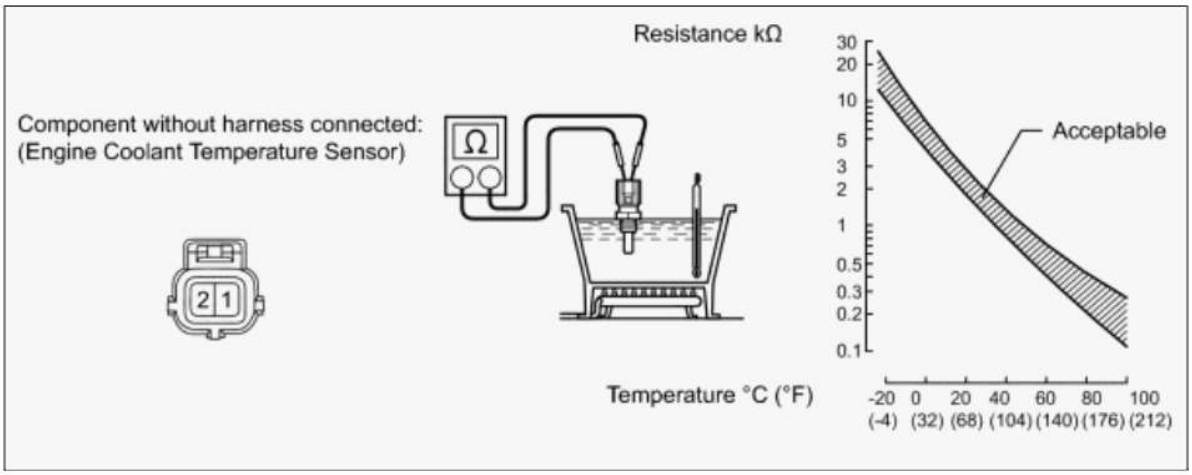


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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U701WX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ENGINE COOLANT TEMPERATURE SENSOR: INSPECTION (2011 RAV4)		

INSPECTION

1. INSPECT ENGINE COOLANT TEMPERATURE SENSOR



(a) Partially immerse the sensor in water and warm up the water.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 - 2	20°C (68°F)	2.32 to 2.59 kΩ
1 - 2	80°C (176°F)	0.310 to 0.326 kΩ

NOTICE:

When checking the sensor in water, keep the terminals dry. After the check, wipe the sensor dry.

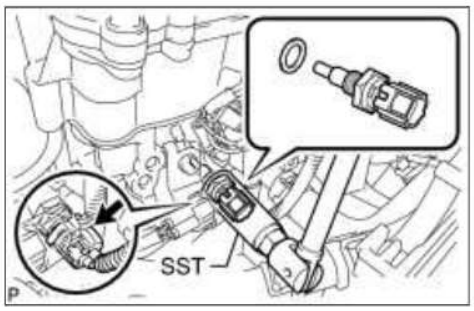
If the result is not as specified, replace the engine coolant temperature sensor.

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U6022X
Title: 2AR-FE ENGINE CONTROL SYSTEM: ENGINE COOLANT TEMPERATURE SENSOR: INSTALLATION (2011 RAV4)		

INSTALLATION

1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR



(a) Install a new gasket to the sensor.

(b) Using SST, install the sensor.

SST: 09817-33190

Torque: 20 N·m (204 kgf·cm, 15ft·lbf)

(c) Connect the sensor connector.

2. ADD ENGINE COOLANT INFO

3. INSPECT FOR COOLANT OIL LEAK

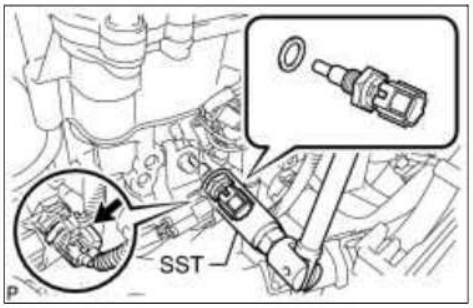
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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017U901XX
Title: 2AR-FE ENGINE CONTROL SYSTEM: ENGINE COOLANT TEMPERATURE SENSOR: REMOVAL (2011 RAV4)		

REMOVAL

1. DRAIN ENGINE COOLANT INFO

2. REMOVE ENGINE COOLANT TEMPERATURE SENSOR



(a) Disconnect the sensor connector.

(b) Using SST, remove the sensor and gasket.

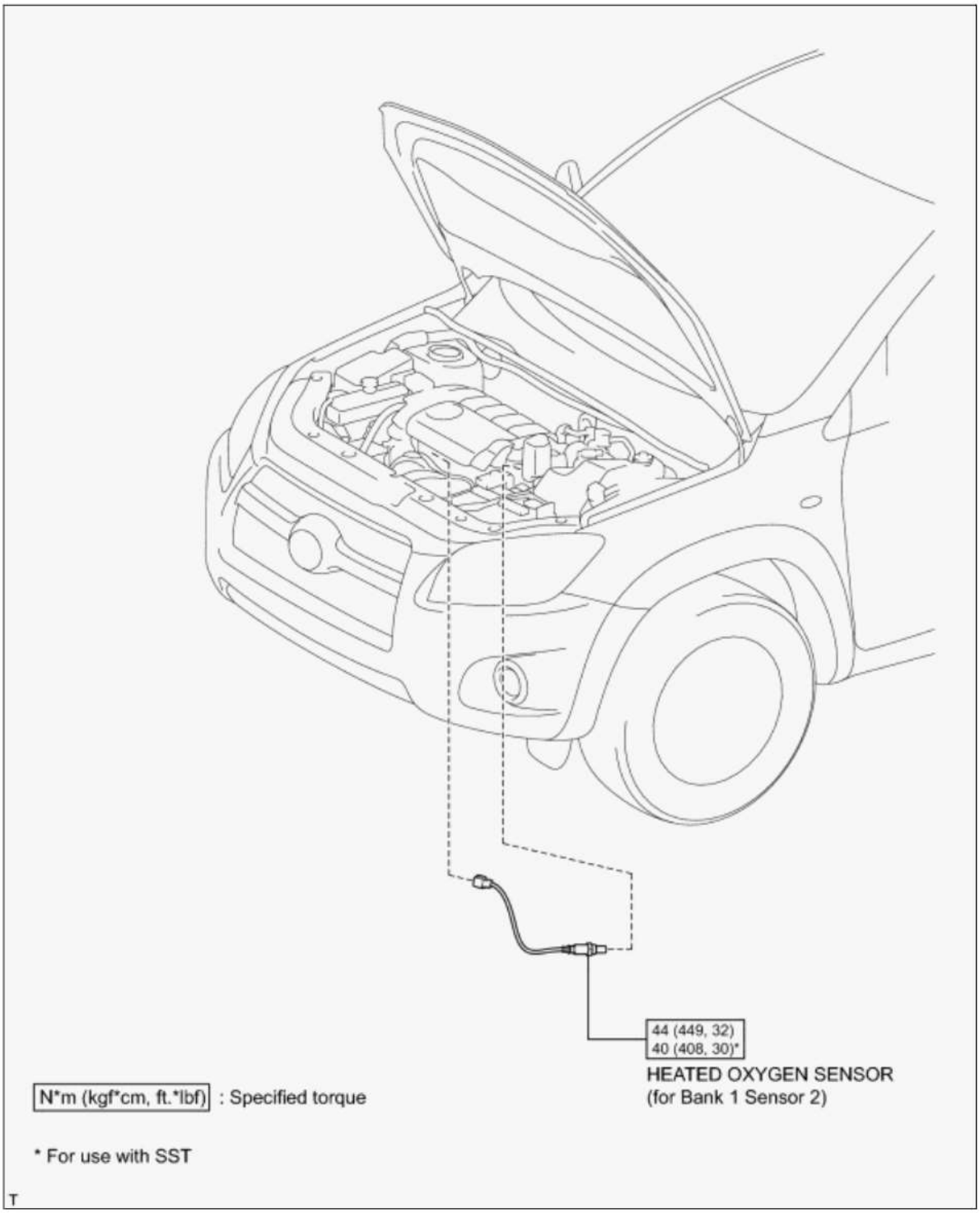
SST: 09817-33190

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001ROO019X
Title: 2AR-FE ENGINE CONTROL SYSTEM: HEATED OXYGEN SENSOR: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION



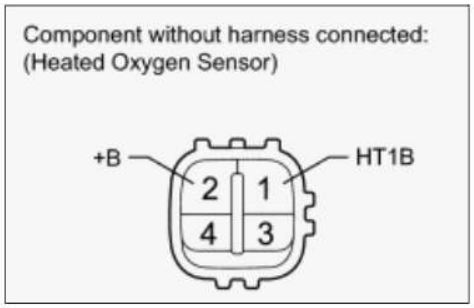
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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001Z1X01DX
Title: 2AR-FE ENGINE CONTROL SYSTEM: HEATED OXYGEN SENSOR: INSPECTION (2011 RAV4)		

INSPECTION

1. INSPECT HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)



(a) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

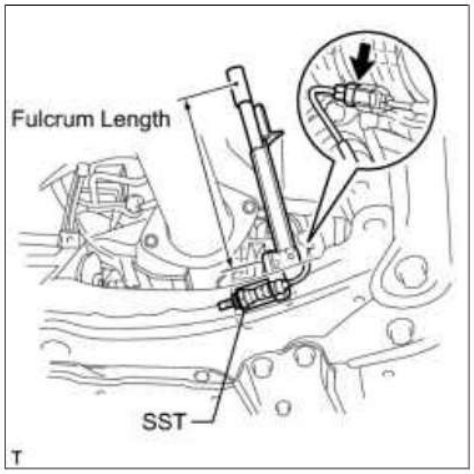
TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω

If the result is not as specified, replace the heated oxygen sensor.

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001RON01EX
Title: 2AR-FE ENGINE CONTROL SYSTEM: HEATED OXYGEN SENSOR: INSTALLATION (2011 RAV4)		

INSTALLATION



1. INSTALL HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

(a) Using SST, install the sensor to the front exhaust pipe.

SST: 09224-00010

without SST - Torque: 44 N·m (449 kgf·cm, 32ft·lbf)

with SST - Torque: 40 N·m (408 kgf·cm, 30ft·lbf)

HINT:

- Use a torque wrench with a fulcrum length of 300 mm (11.8 in.).
- Make sure SST and wrench are connected in a straight line.

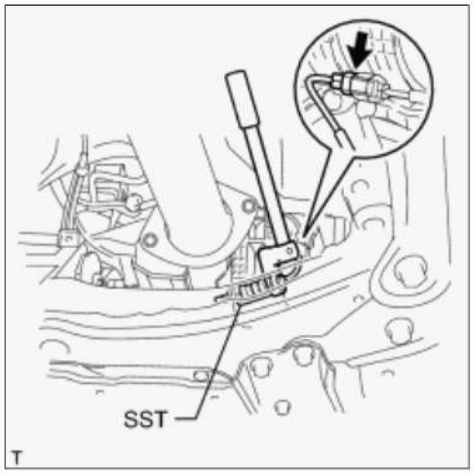
(b) Connect the sensor connector.

2. INSPECT FOR EXHAUST GAS LEAK

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001ROP01BX
Title: 2AR-FE ENGINE CONTROL SYSTEM: HEATED OXYGEN SENSOR: REMOVAL (2011 RAV4)		

REMOVAL



1. REMOVE HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)

(a) Disconnect the sensor connector.

(b) Using SST, remove the sensor from the front exhaust pipe.

SST: 09224-00010

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001GHH025X
Title: 2AR-FE ENGINE CONTROL SYSTEM: IGNITION RELAY NO. 1: ON-VEHICLE INSPECTION (2011 RAV4)		

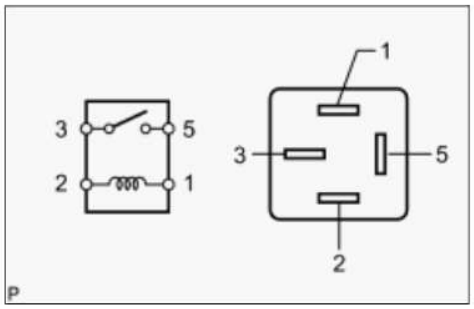
ON-VEHICLE INSPECTION

1. INSPECT IG1 RELAY

(a) Remove the IG1 relay from the instrument panel junction block.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
3 - 5	Battery voltage is applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the IG1 relay.

(c) Install the IG1 relay to the instrument panel junction block.

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001BT2020X
Title: 2AR-FE ENGINE CONTROL SYSTEM: IGNITION RELAY NO. 2: ON-VEHICLE INSPECTION (2011 RAV4)		

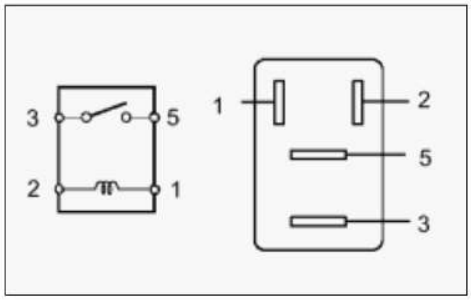
ON-VEHICLE INSPECTION

1. INSPECT IG2 RELAY

(a) Remove the IG2 relay from the engine room No. 1 relay block.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
3 - 5	Battery voltage is not applied to terminals 1 and 2	10 kΩ or higher
3 - 5	Battery voltage is applied to terminals 1 and 2	Below 1 Ω

If the result is not as specified, replace the IG2 relay.

(c) Install the IG2 relay to the engine room No. 1 relay block.

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000014TJ023X
Title: 2AR-FE ENGINE CONTROL SYSTEM: INTEGRATION RELAY: ON-VEHICLE INSPECTION (2011 RAV4)		

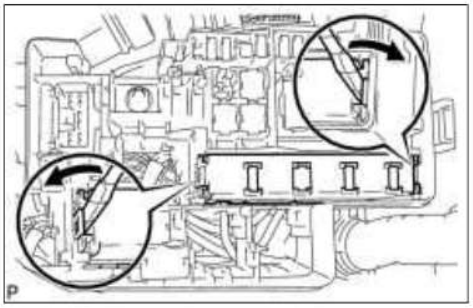
ON-VEHICLE INSPECTION

NOTICE:

- The EFI MAIN and A/F relays are built into the integration relay.
- Some relays are built into the integration relay. The integration relay cannot be disassembled. If there is a malfunction in the circuit of the integration relay, replace the integration relay.

1. REMOVE INTEGRATION NO.1 RELAY

(a) Remove the engine room No. 1 relay block cover.



(b) Using a screwdriver, detach the 2 claws and disconnect the integration relay from the engine room No. 1 relay block.

HINT:

Tape the screwdriver tip before use.

(c) Disconnect the 3 connectors from the integration relay.

2. INSPECT INTEGRATION NO.1 RELAY (EFI MAIN RELAY)

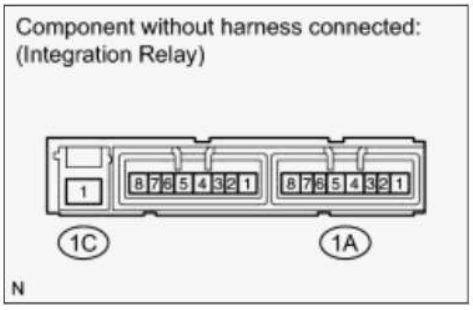
(a) Measure the resistance of the EFI MAIN fuse.

(1) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
EFI MAIN fuse	Always	Below 1 Ω

If the result is not as specified, replace the EFI MAIN fuse.



(b) Measure the resistance of the EFI MAIN relay circuit.

(1) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION

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1C-1 - 1A-4	Battery voltage is not applied to terminals 1A-3 and 1A-2	10 kΩ or higher
1C-1 - 1A-4	Battery voltage is applied to terminals 1A-3 and 1A-2	Below 1 Ω

If the result is not as specified, replace the integration relay.

3. INSPECT INTEGRATION NO.1 RELAY (A/F RELAY)

(a) Measure the resistance of the A/F fuse.

(1) Measure the resistance according to the value(s) in the table below.

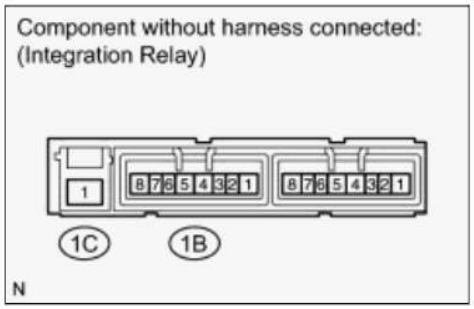
Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A/F fuse	Always	Below 1 Ω

If the result is not as specified, replace the A/F fuse.

(b) Measure the resistance of the A/F relay circuit.

(1) Measure the resistance according to the value(s) in the table below.



Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1C-1 - 1B-8	Battery voltage is not applied to terminals 1B-7 and 1B-6	10 kΩ or higher
1C-1 - 1B-8	Battery voltage is applied to terminals 1B-7 and 1B-6	Below 1 Ω

If the result is not as specified, replace the integration relay.

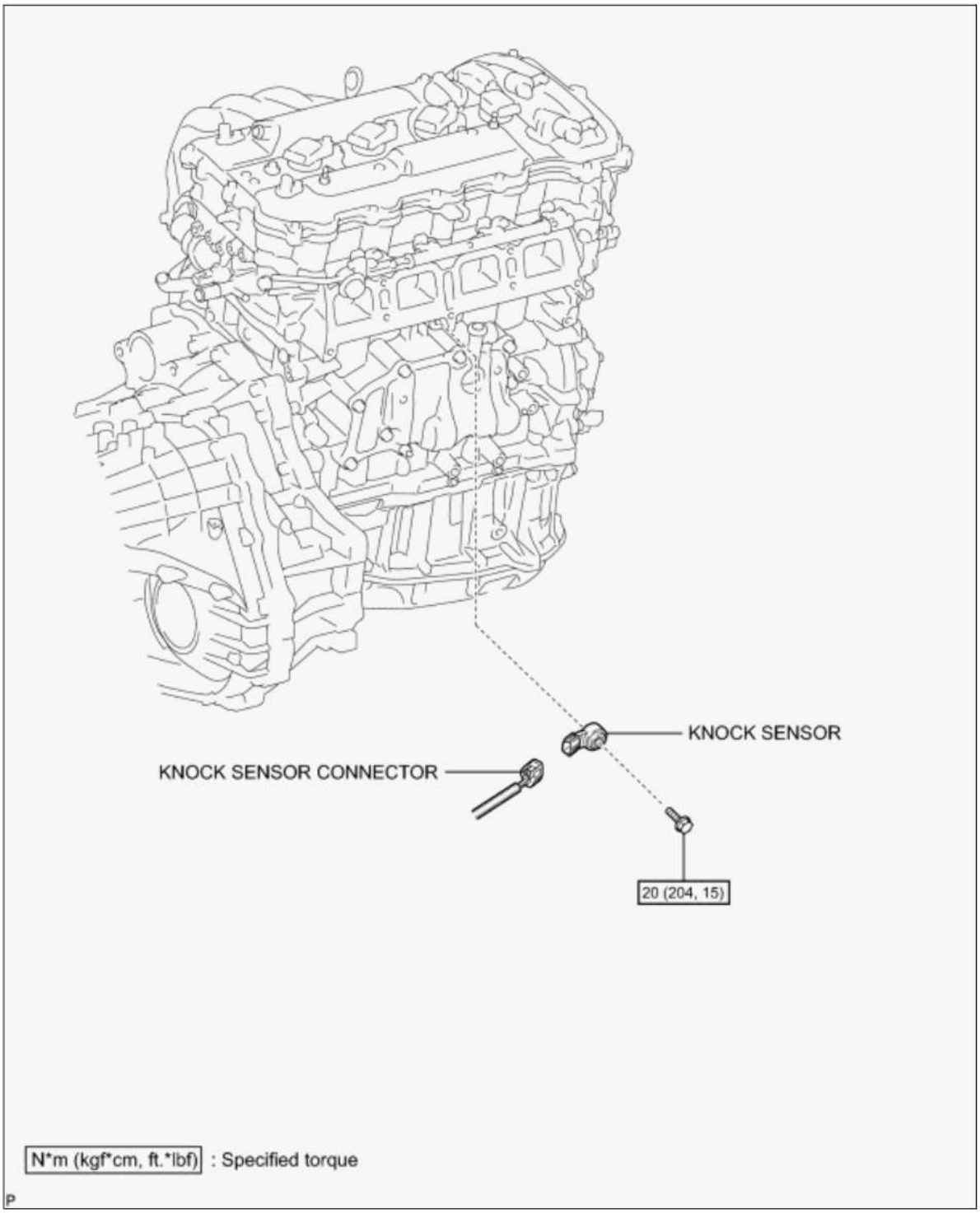
4. INSTALL INTEGRATION NO.1 RELAY

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UH024X
Title: 2AR-FE ENGINE CONTROL SYSTEM: KNOCK SENSOR: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION



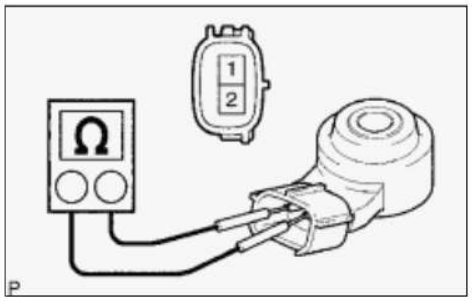
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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UG01XX
Title: 2AR-FE ENGINE CONTROL SYSTEM: KNOCK SENSOR: INSPECTION (2011 RAV4)		

INSPECTION

1. INSPECT KNOCK SENSOR



(a) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 - 2	20°C (68°F)	120 to 280 kΩ

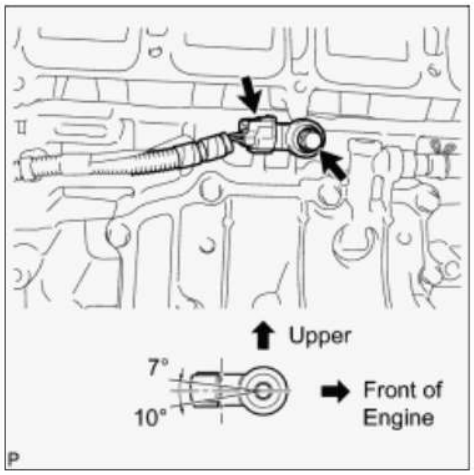
If the result is not as specified, replace the knock sensor.

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UF04XX
Title: 2AR-FE ENGINE CONTROL SYSTEM: KNOCK SENSOR: INSTALLATION (2011 RAV4)		

INSTALLATION

1. INSTALL KNOCK SENSOR



(a) Install the sensor with the bolt so that the sensor is angled as shown in the illustration.

Torque: 20 N·m (204 kgf·cm, 15ft·lbf)

NOTICE:

The acceptable installation angle of the sensor is between 7° upward and 10° downward from the horizontal position.

(b) Connect the sensor connector.

2. INSTALL INTAKE MANIFOLD

(a) Install the intake manifold INFO .

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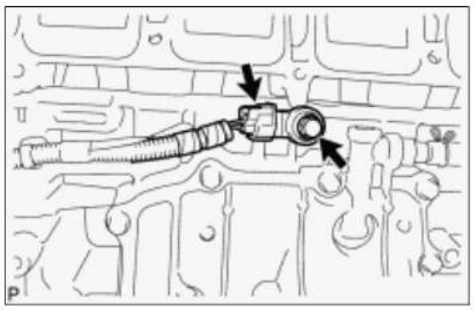
Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UI04ZX
Title: 2AR-FE ENGINE CONTROL SYSTEM: KNOCK SENSOR: REMOVAL (2011 RAV4)		

REMOVAL

1. REMOVE INTAKE MANIFOLD

(a) Remove the intake manifold INFO .

2. REMOVE KNOCK SENSOR



(a) Disconnect the sensor connector.

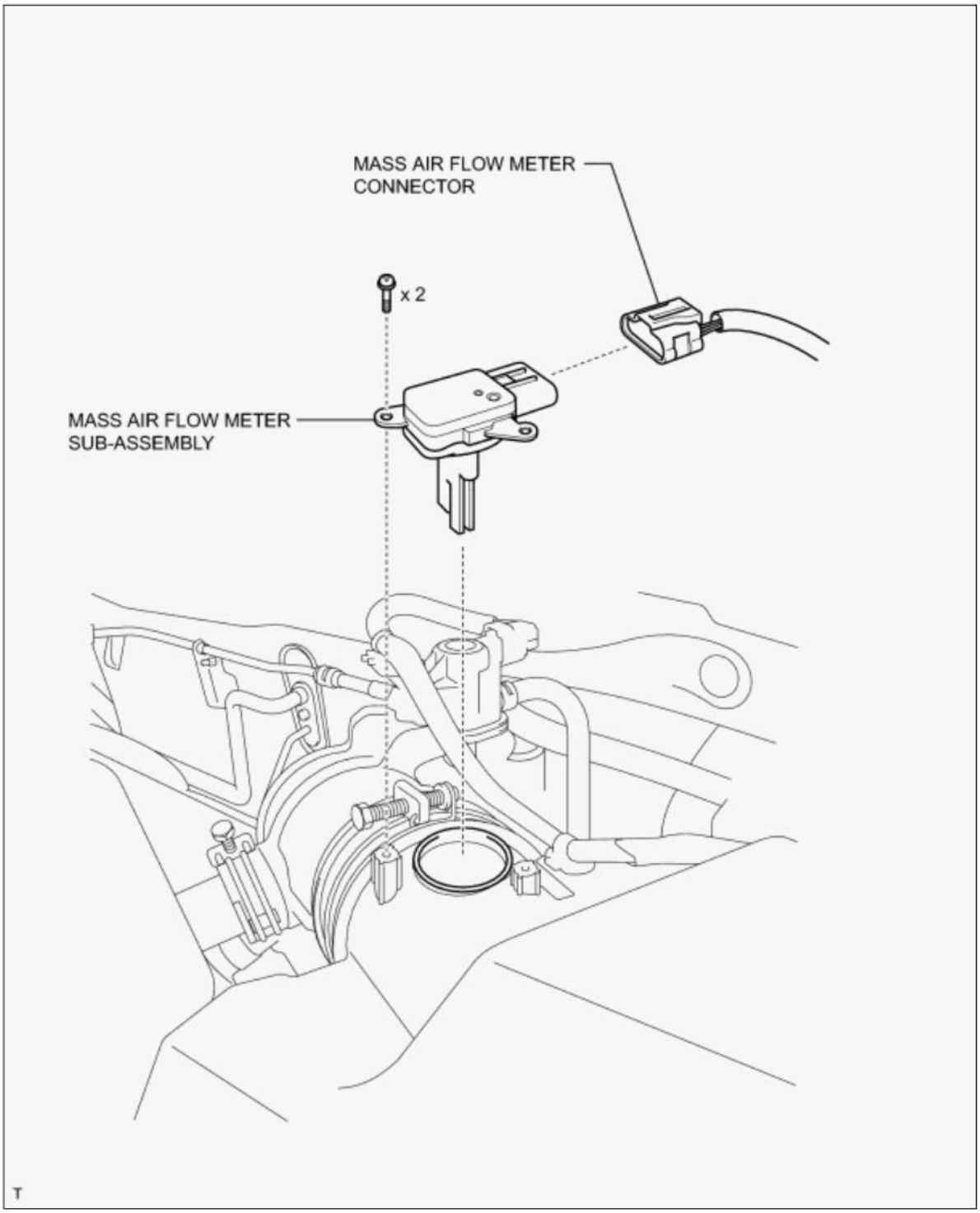
(b) Remove the bolt and sensor.

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017TX01OX
Title: 2AR-FE ENGINE CONTROL SYSTEM: MASS AIR FLOW METER: COMPONENTS (2011 RAV4)		

COMPONENTS

ILLUSTRATION



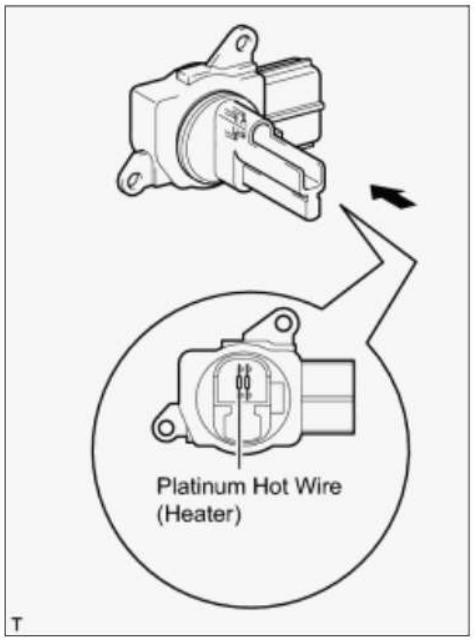
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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000035WH00GX
Title: 2AR-FE ENGINE CONTROL SYSTEM: MASS AIR FLOW METER: INSPECTION (2011 RAV4)		

INSPECTION

1. INSPECT MASS AIR FLOW METER SUB-ASSEMBLY

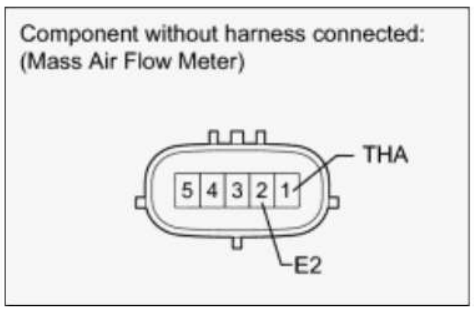


(a) Perform a visual check for any foreign matter on the platinum hot wire (heater) of the mass air flow meter shown in the illustration.

OK:

There is no foreign material.

(b) Check the intake air temperature sensor (built into the mass air flow meter).



(1) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 (THA) - 2 (E2)	-20°C (-4°F)	13.6 to 18.4 kΩ
1 (THA) - 2 (E2)	20°C (68°F)	2.21 to 2.69 kΩ
1 (THA) - 2 (E2)	60°C (140°F)	0.49 to 0.67 kΩ

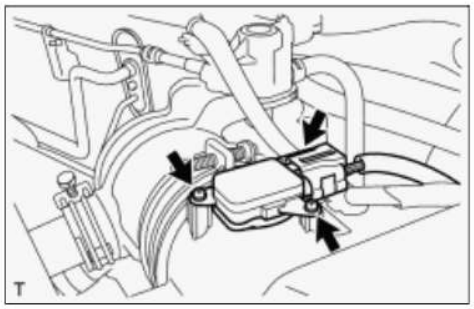
If the result is not as specified, replace the mass air flow meter sub-assembly.

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017TV01YX
Title: 2AR-FE ENGINE CONTROL SYSTEM: MASS AIR FLOW METER: INSTALLATION (2011 RAV4)		

INSTALLATION

1. INSTALL MASS AIR FLOW METER SUB-ASSEMBLY



(a) Install the mass air flow meter with the 2 screws.

NOTICE:

Make sure that the O-ring is not cracked or jammed when installing the mass air flow meter.

(b) Connect the mass air flow meter connector.

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001RYE022X
Title: 2AR-FE ENGINE CONTROL SYSTEM: MASS AIR FLOW METER: ON-VEHICLE INSPECTION (2011 RAV4)		

ON-VEHICLE INSPECTION

NOTICE:

- Perform the MAF meter inspection according to the procedures below.
- Only replace the MAF meter when the MAF value in the Data List (with the engine stopped) is not within the normal operating range or there is foreign matter on the MAF meter platinum hot wire (heater).

1. INSPECT MASS AIR FLOW METER SUB-ASSEMBLY

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON (do not run the engine).

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

(e) Wait 30 seconds, and read the values on the Techstream.

Standard:

ITEM	CONDITION	SPECIFIED CONDITION
MAF	• Engine not running • 30 seconds after turning ignition switch to ON	Less than 0.45 g/sec.

If the result is not as specified, replace the mass air flow meter sub-assembly.

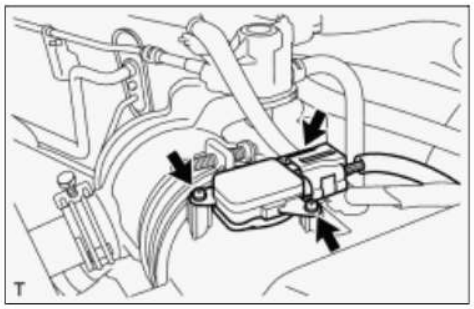
If the result is as specified, inspect the mass air flow meter sub-assembly INFO .

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017TY01TX
Title: 2AR-FE ENGINE CONTROL SYSTEM: MASS AIR FLOW METER: REMOVAL (2011 RAV4)		

REMOVAL

1. REMOVE MASS AIR FLOW METER SUB-ASSEMBLY



(a) Disconnect the mass air flow meter connector.

(b) Remove the 2 screws and mass air flow meter.

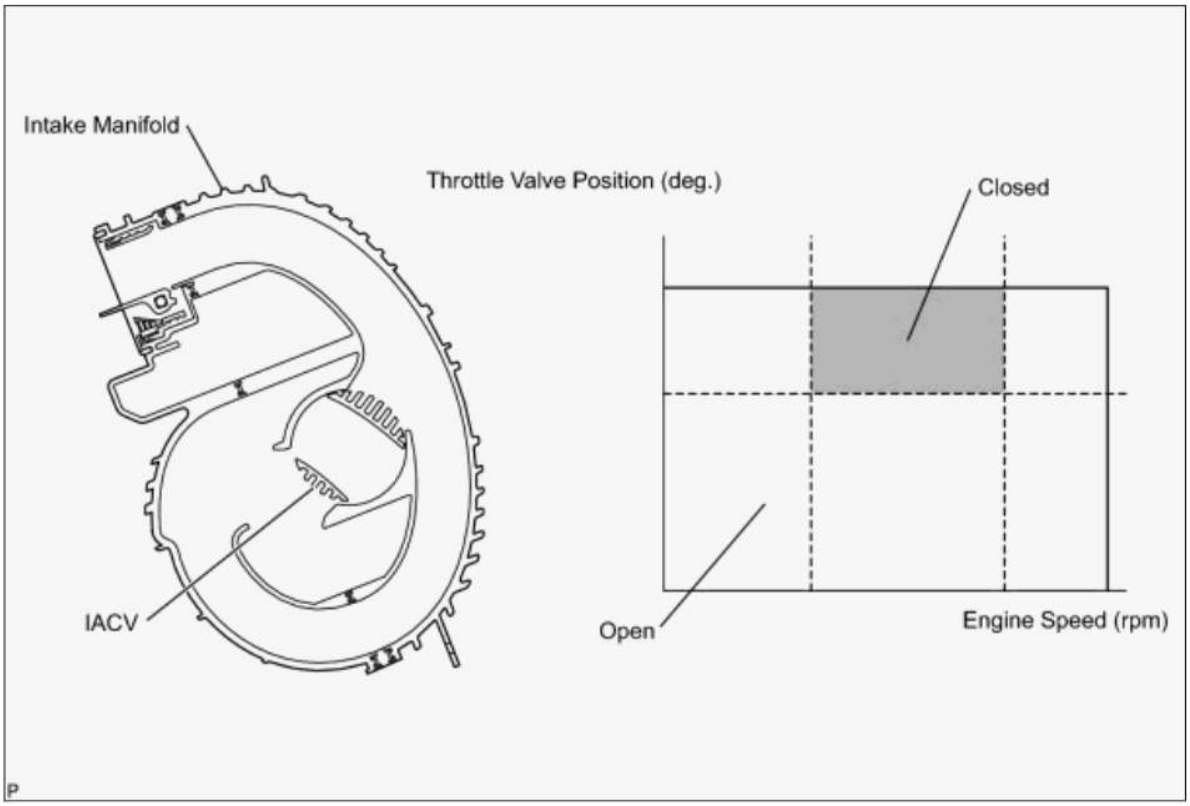
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Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM00000222503BX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: ACIS Control Circuit (2011 RAV4)		

ACIS Control Circuit

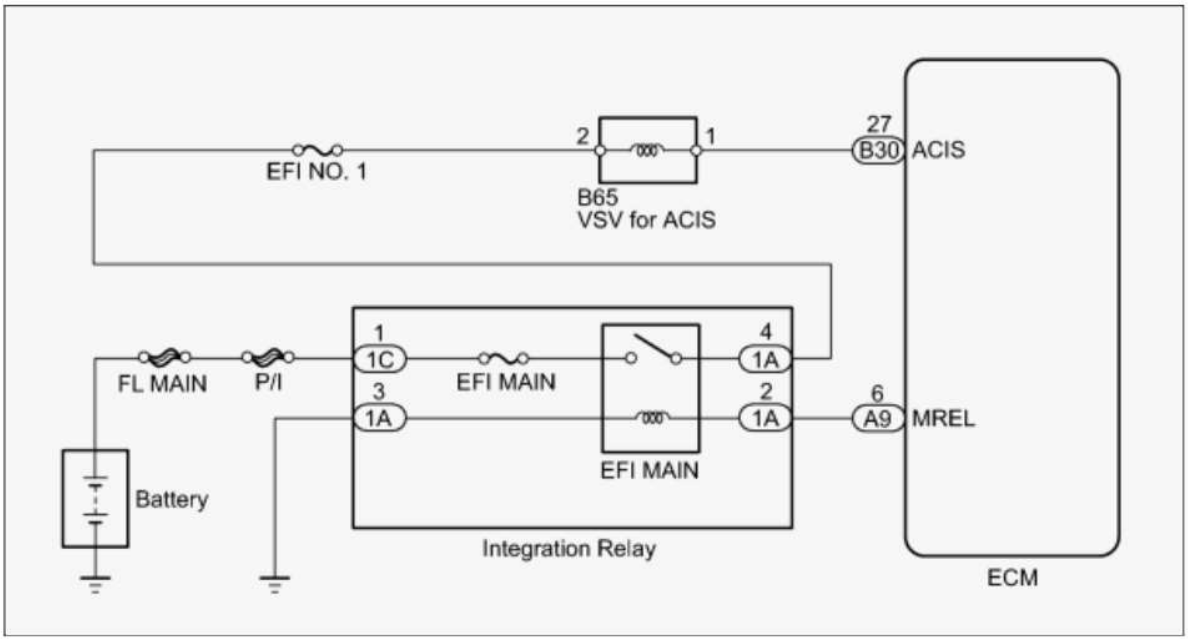
DESCRIPTION

This circuit opens and closes the Intake Air Control Valve (IACV) in response to the engine load in order to increase the intake efficiency (ACIS: Acoustic Control Induction System).



WIRING DIAGRAM

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INSPECTION PROCEDURE

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

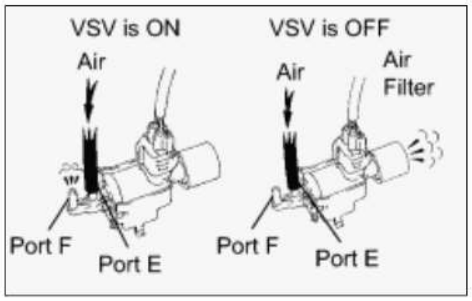
PROCEDURE

1.	**PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE VSV FOR ACIS)**

(a) Disconnect the vacuum hose from port F on the vacuum switching valve (for ACIS).

(b) Connect the Techstream to the DLC3.

(c) Start the engine.



(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Active the VSV for Intake Control.

(e) Operate the VSV for ACIS.

(f) Check the VSV air flow when switching the VSV on and off.

OK:

TEST CONDITION	SPECIFIED CONDITION
VSV is ON	Air from port E flows out through port F
VSV is OFF	Air from port E flows out through air filter

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NG ▶ INSPECT VACUUM SWITCHING VALVE

OK ▼

2.	CHECK VACUUM HOSES (VACUUM SWITCHING VALVE - INTAKE AIR CONTROL VALVE, INTAKE MANIFOLD)

(a) Check the vacuum hoses INFO .

NG ▶ REPAIR OR REPLACE VACUUM HOSES

OK ▼

3.	INSPECT INTAKE MANIFOLD (INTAKE AIR CONTROL VALVE)

(a) Inspect the intake air control valve INFO .

NG ▶ REPLACE INTAKE MANIFOLD

OK ▶ PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE

4.	INSPECT VACUUM SWITCHING VALVE

(a) Inspect the vacuum switching valve INFO .

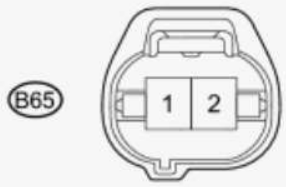
NG ▶ REPLACE VACUUM SWITCHING VALVE

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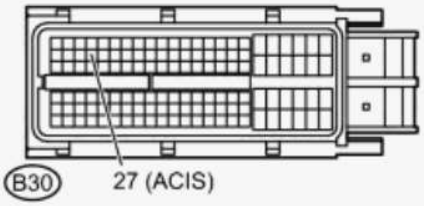
OK

5.	**CHECK HARNESS AND CONNECTOR (VACUUM SWITCHING VALVE - ECM AND INTEGRATION RELAY)**

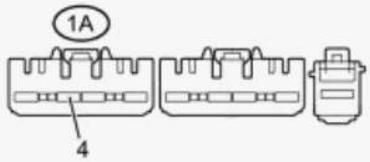
Front view of wire harness connector:
(to VSV for ACIS)



Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Integration Relay)



(a) Disconnect the intake air control valve connector.

(b) Disconnect the ECM connector.

(c) Remove the integration relay from the engine room relay block.

(d) Disconnect the integration relay connector.

(e) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B65-1 - B30-27 (ACIS)	Always	Below 1 Ω
B65-2 - 1A-4	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B65-1 or B30-27 (ACIS) - Body ground	Always	10 kΩ or higher
B65-2 or 1A-4 - Body ground	Always	10 kΩ or higher

(f) Reconnect the intake air control valve connector.

(g) Reconnect the ECM connector.

(h) Reconnect the integration relay connector.

(i) Install the integration relay.

NG **REPAIR OR REPLACE HARNESS OR**

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CONNECTOR

OK ▶ REPLACE ECM

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDM0DYX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: BASIC INSPECTION (2011 RAV4)		

BASIC INSPECTION

When a malfunction is not confirmed by the DTC check, troubleshooting should be carried out for all circuits considered to be possible causes of the problem. In many cases, by carrying out the basic engine check shown in the following flowchart, the location of the problem can be found quickly and efficiently. Therefore, using this check is essential when engine troubleshooting.

1.	**CHECK BATTERY VOLTAGE**

NOTICE:

Carry out this check with the engine stopped and the ignition switch off.

Result

RESULT	PROCEED TO
11 V or higher	OK
Below 11 V	NG

NG ▶ **CHARGE OR REPLACE BATTERY**

OK ▼

2.	**CHECK WHETHER ENGINE CRANKS**

NG ▶ INFO **PROCEED TO PROBLEM SYMPTOMS TABLE**

OK ▼

3.	**CHECK WHETHER ENGINE STARTS**

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NG ▶ GO TO STEP 6

OK ▼

4.	CHECK AIR FILTER

(a) Visually check that the air filter is not excessively contaminated with dirt or oil.

NG ▶ INFO REPLACE AIR FILTER

OK ▼

5.	CHECK IDLING SPEED

NG ▶ TROUBLESHOOT IDLING SPEED AND PROCEED TO NEXT STEP

OK ▼

6.	CHECK FUEL PRESSURE

NG ▶ TROUBLESHOOT FUEL PRESSURE AND PROCEED TO NEXT STEP

OK ▼

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7.	CHECK FOR SPARK

NG ▶ TROUBLESHOOT SPARK AND PROCEED TO NEXT STEP

OK ▶ INFO PROCEED TO PROBLEM SYMPTOMS TABLE

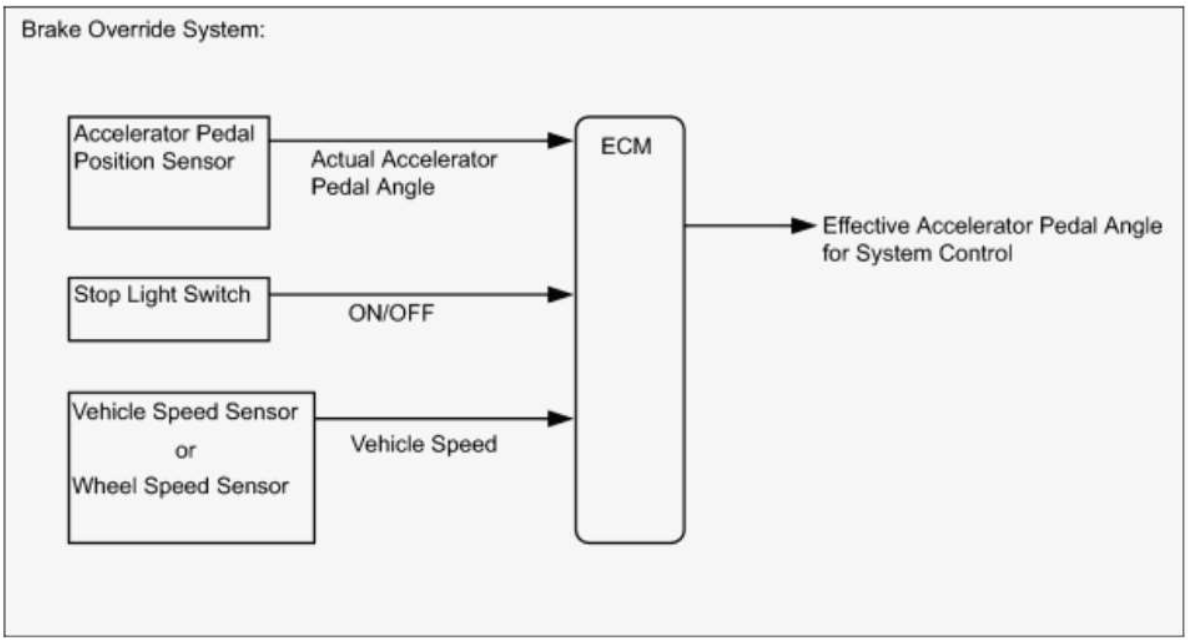
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Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000004G8F00EX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: Brake Override System (2011 RAV4)		

Brake Override System

DESCRIPTION

When the vehicle is being driven with the accelerator pedal depressed, depressing the brake pedal without releasing the accelerator pedal will activate the brake override system to restrict driving torque. The conditions for activating the brake override system as well as the items that are controlled are explained below.



Activation Conditions:

- Vehicle is running at or above the specified speed.
- The accelerator pedal is depressed beyond a specified level, and then the brake pedal is depressed.

NOTICE:

The vehicle may not enter the brake override system control due to the relation of the accelerator pedal angle and the vehicle's speed.

Items Controlled:

- Driving torque is restricted.

HINT:

During brake override system control, the value for the accelerator pedal angle (which is used for engine control) is forcibly reduced to a specified value. For this reason, the Data List value for Accelerator Position (applied to electronic throttle control) will be replaced with a specified value regardless of the actual accelerator pedal angle (Accel Sens. No. 1 Volt %, Accel Sens. No. 2 Volt %)

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Deactivation Conditions:

- When the Stop Light Switch turns OFF or the actual accelerator pedal angle increases or decreases beyond the specified range.

INSPECTION PROCEDURE

Inspection Method

Drive at 10 km/h (6.25 mph), depress the accelerator pedal by 1/2 to 3/4 and keep it in that position. Under these conditions, if the engine speed decreases to 1000 rpm when the brake pedal is depressed, then the brake override system has been activated.

CAUTION:

When carrying out the inspection, use a place where you are able to carry it out safely and also pay close attention to your surroundings.

Also, when driving make absolutely sure that all road traffic laws, such as speed limits, are observed.

HINT:

- Under normal conditions, the Accelerator Position value changes in response to the Accel Sens. No. 1 Volt % value. For more information on the numerical values, refer to the Data List INFO .
- If the Data List values of Accelerator Position and Accel Sens. No. 1 Volt % do not match, and the value of Accelerator Position changes but the value of Accel Sens. No. 1 Volt % is constant, this confirms that brake override system has activated. (Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.)

NOTICE:

The brake override system restricts driving torque if the brake pedal is depressed when driving with the accelerator pedal depressed. If a customer reports experiencing loss of torque after the accelerator and brake pedals have both been intentionally depressed, explain to the customer that this is not a malfunction, and that the customer should avoid depressing both the accelerator and brake pedals at the same time.

Example: While operating the accelerator pedal, the customer uses their left foot to operate the brake pedal.

PROCEDURE

1.	**CHECK DTC OUTPUT**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Enter the following menus: System Select / Health Check.

(d) Check DTCs.

Result

RESULT	PROCEED TO
No DTC output	A

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RESULT	PROCEED TO
DTC output	B

B ▶ **GO TO DTC CHART**

A ▼

2.	READ VALUE USING TECHSTREAM (STOP LIGHT SWITCH AND ST1)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Enter the following menus: Powertrain / Engine and ECT / Data List / Stop Light Switch and ST1.

(d) Check the Data List indication when the brake pedal is depressed and released.

OK:

TECHSTREAM DISPLAY	CONDITION	SPECIFIED CONDITION
Stop Light Switch	Brake pedal released	OFF
	Brake pedal depressed	ON
ST1	Brake pedal released	OFF
	Brake pedal depressed	ON

NG ▶ **INSPECT STOP LIGHT SWITCH ASSEMBLY**

OK ▼

3.	INSPECT BRAKE PEDAL

(a) Inspect and adjust the brake pedal INFO .

HINT:

If the stop light switch turns ON too late, the start of brake override system control may be delayed; if it turns

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ON too soon, brake override system control may begin too early, so conduct inspection of the brake pedal and stop light switch assembly.

NG ▶ **REPAIR OR REPLACE BRAKE PEDAL**

OK ▼

4.	**READ VALUE USING TECHSTREAM (ACCELERATOR PEDAL POSITION SENSOR)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Enter the following menus: Powertrain / Engine and ECT / Data List / Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %.

(d) Read the value displayed on the Techstream.

OK:

TECHSTREAM DISPLAY	CONDITION	SPECIFIED CONDITION
Accel Sens. No. 1 Volt %	Accelerator Pedal Released → Depressed → Released	Values smoothly change following accelerator pedal operation
Accel Sens. No. 2 Volt %		

HINT:

For numerical values of Accel Sens. No. 1 Volt % and Accel Sens. No. 2 Volt %, refer to the Data List INFO **.**

NG ▶ **REPLACE ACCELERATOR PEDAL SENSOR ASSEMBLY**

OK ▼

5.	**READ VALUE USING TECHSTREAM (VEHICLE SPEED)**

(a) Connect the Techstream to the DLC3.

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(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Start the engine.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / Vehicle Speed.

(e) Read the value displayed on the Techstream.

Standard:

TECHSTREAM DISPLAY	CONDITION	SPECIFIED CONDITION
Vehicle Speed	Vehicle stopped, engine running	0 km/h (0 mph)
	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG ▶ **GO TO VEHICLE SPEED SENSOR "A"**

OK ▼

6.	**READ VALUE USING TECHSTREAM (FR, FL, RR, RL WHEEL SPEED)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Start the engine.

(d) Enter the following menus: Chassis / ABS/VSC/TRAC / Data List / FR Wheel Speed, FL Wheel Speed, RR Wheel Speed and RL Wheel Speed.

(e) Read the value displayed on the Techstream.

Standard:

TECHSTREAM DISPLAY	CONDITION	SPECIFIED CONDITION
FR Wheel Speed	Vehicle stopped, engine running	0 km/h (0 mph)

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TECHSTREAM DISPLAY	CONDITION	SPECIFIED CONDITION
FL Wheel Speed RR Wheel Speed RL Wheel Speed	Vehicle running at constant speed between 16.1 to 64.4 km/h (10 to 40 mph)	No large fluctuations when driving at a constant speed

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

Data can be captured relatively easily by using the snapshot function in the Data List. Confirm the data after performing the drive test.

NG ▶ **INSPECT FRONT OR REAR SPEED SENSOR**

OK ▶ **END**

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDQ0HDX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: CHECK FOR INTERMITTENT PROBLEMS (2011 RAV4)		

CHECK FOR INTERMITTENT PROBLEMS

HINT:

Inspect the vehicle ECM using check mode. Intermittent problems are easier to detect with the Techstream when the ECM is in check mode. In check mode, the ECM uses 1 trip detection logic, which is more sensitive to malfunctions than normal mode (default), which uses 2 trip detection logic.

1. Clear DTCs INFO .
2. Switch the ECM from normal mode to check mode using the Techstream INFO .
3. Perform a simulation test INFO .
4. Check and wiggle the harness(es), connector(s) and terminal(s) INFO .

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDL0EMX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: CHECK MODE PROCEDURE (2011 RAV4)		

CHECK MODE PROCEDURE

HINT:

Techstream only:

Compared to normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect malfunctions that cannot be detected in normal mode.

NOTICE:

All the stored DTCs and freeze frame data are cleared if: 1) the ECM is changed from normal mode to check mode or vice versa; or 2) the ignition switch is turned from ON to ACC or off while in check mode. Before changing modes, always check and note any DTCs and freeze frame data.

1. CHECK MODE PROCEDURE

(a) Check and ensure the following conditions:

(1) Battery voltage is 11 V or higher.

(2) Throttle valve is fully closed.

(3) Transmission is in the P or N (neutral) position.

(4) A/C switch is off.

(b) Turn the ignition switch off.

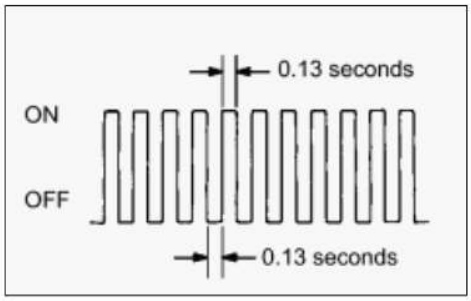
(c) Connect the Techstream to the DLC3.

(d) Turn the ignition switch to ON.

(e) Turn the Techstream on.

(f) Enter the following menus: Powertrain / Engine and ECT / Utility / Check Mode.

(g) Switch the ECM from normal mode to check mode.



(h) Check that the MIL flashes as shown in the illustration.

(i) Start the engine.

(j) Check that the MIL turns off.

(k) Simulate the conditions of the malfunction described by the customer.

(l) Check DTCs and freeze frame data using the Techstream.

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDR085X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: CHECKING MONITOR STATUS (2011 RAV4)		

CHECKING MONITOR STATUS

The purpose of the monitor result (mode 06) is to allow access to the results for on-board diagnostic monitoring tests of specific components/systems that are not continuously monitored. Examples are the catalyst and evaporative emission (EVAP) system.

The monitor result allows the OBD II scan tool to display the monitor status, test value, minimum test limit and maximum test limit. These data are displayed after the vehicle has been driven to run the monitor.

When the test value is not between the minimum test limit and maximum test limit, the ECM (PCM) interprets this as a malfunction. When the component is not malfunctioning, if the difference of the test value and test limit is very small, the component will malfunction in the near future.

Perform the following procedure to view the monitor status. Although this procedure references the Lexus/Toyota diagnostic tester, it can be checked using a generic OBD II scan tool. Refer to your scan tool operator's manual for specific procedures.

1. PERFORM MONITOR DRIVE PATTERN

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and the Techstream on.

(c) Clear DTCs INFO .

(d) Drive the vehicle in accordance with the applicable drive pattern described in Readiness Monitor Drive Pattern INFO . Do not turn the ignition switch off.

NOTICE:

The test results will be lost if the ignition switch is turned off.

2. ACCESS MONITOR RESULT

(a) Enter the following menus: Powertrain / Engine and ECT / Monitor / Current Monitor / Result.

(b) Confirm the monitor status for each component.

HINT:

The monitor status for each component is displayed in the Result column.

- Pass: The component is functioning normally.
- Fail: The component is malfunctioning.

(c) Display the test results for a monitor by selecting the icon in the Details column for that monitor.

(d) Display the test value for an item listed under Test Results by selecting the icon in the Details column for that item.

3. CHECK COMPONENT STATUS

(a) Compare the test value with the minimum test limit and maximum test limit.

(b) If the test value is between the minimum test limit and maximum test limit, the component is functioning normally. If not, the component is malfunctioning. The test value is usually significantly more or less than the test limit. If the test value is on the borderline of the test limit, the component will malfunction in the near future.

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HINT:

The monitor result might on rare occasions be Pass even if the malfunction indicator lamp (MIL) is illuminated. This indicates the system malfunctioned on a previous driving cycle. This might be caused by an intermittent problem.

4. MONITOR RESULT INFORMATION

If you use a generic scan tool, multiply the value by the scaling value listed below.

A/F Sensor (Sensor 1)

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$01	$8E	Multiply by 0.001	V	A/F sensor deterioration level
$01	$91	Multiply by 0.004	mA	A/F sensor current

HO2 Sensor (Sensor 2)

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$02	$07	Multiply by 0.001	V	Minimum sensor voltage
$02	$08	Multiply by 0.001	V	Maximum sensor voltage
$02	$8B	Multiply by 0.001	Seconds	0.35 - 0.2 V sensor switch time
$02	$8D	Multiply by 0.001	Seconds	Duration that sensor voltage drops to 0.2 V during fuel cut
$02	$8F	Multiply by 0.0003	g	Maximum oxygen storage capacity

Catalyst

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$21	$A9	Multiply by 0.0003	No dimension	Oxygen storage capacity of catalyst

Advance/Retarded VVT Intake Side

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$35	$81	Multiply by 0.01	Seconds	Forced movement of oil control valve time

Advance/Retarded VVT Exhaust Side

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$35	$85	Multiply by 0.01	Seconds	Forced movement of oil control valve time

EVAP

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$3D	$C9	Multiply by 0.001	kPa	Test value for small leak (P0456)
$3D	$CA	Multiply by 0.001	kPa	Test value for gross leak (P0455)

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MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$3D	$CB	Multiply by 0.001	kPa	Test value for leak detection pump stuck OFF (P2401)
$3D	$CD	Multiply by 0.001	kPa	Test value for leak detection pump stuck ON (P2402)
$3D	$CE	Multiply by 0.001	kPa	Test value for vent valve stuck OFF (P2420)
$3D	$CF	Multiply by 0.001	kPa	Test value for vent valve stuck ON (P2419)
$3D	$D0	Multiply by 0.001	kPa	Test value for reference orifice low flow (P043E)
$3D	$D1	Multiply by 0.001	kPa	Test value for reference orifice high flow (P043F)
$3D	$D4	Multiply by 0.001	kPa	Test value for purge VSV stuck closed (P0441)
$3D	$D5	Multiply by 0.001	kPa	Test value for purge VSV stuck open (P0441)
$3D	$D7	Multiply by 0.001	kPa	Test value for purge flow insufficient (P0441)

Rear Oxygen Sensor Heater

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$42	$91	Multiply by 0.001	Ohm	Oxygen sensor heater resistance bank 1 sensor 2

Misfire

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$A1	$0B	Multiply by 1	Time	Total EWMA* misfire count of all cylinders in last ten driving cycles
$A1	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of all cylinders in last driving cycle is displayed. • While engine is running, total misfire count of all cylinders in current driving cycle is displayed.
$A2	$0B	Multiply by 1	Time	Total EWMA* misfire count of cylinder 1 in last ten driving cycles
$A2	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 1 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 1 in current driving cycle is displayed.
$A3	$0B	Multiply by 1	Time	Total EWMA* misfire count of cylinder 2 in last ten driving cycles
$A3	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 2 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 2 in current driving cycle is displayed.

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MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$A4	$0B	Multiply by 1	Time	Total EWMA* misfire count of cylinder 3 in last ten driving cycles
$A4	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 3 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 3 in current driving cycle is displayed.
$A5	$0B	Multiply by 1	Time	Total EWMA* misfire count of cylinder 4 in last ten driving cycles
$A5	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 4 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 4 in current driving cycle is displayed.

HINT:

***: EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles (calculated)**

Calculation: 0.1 x (current counts) + 0.9 x (previous average) Initial value for (previous average) = 0

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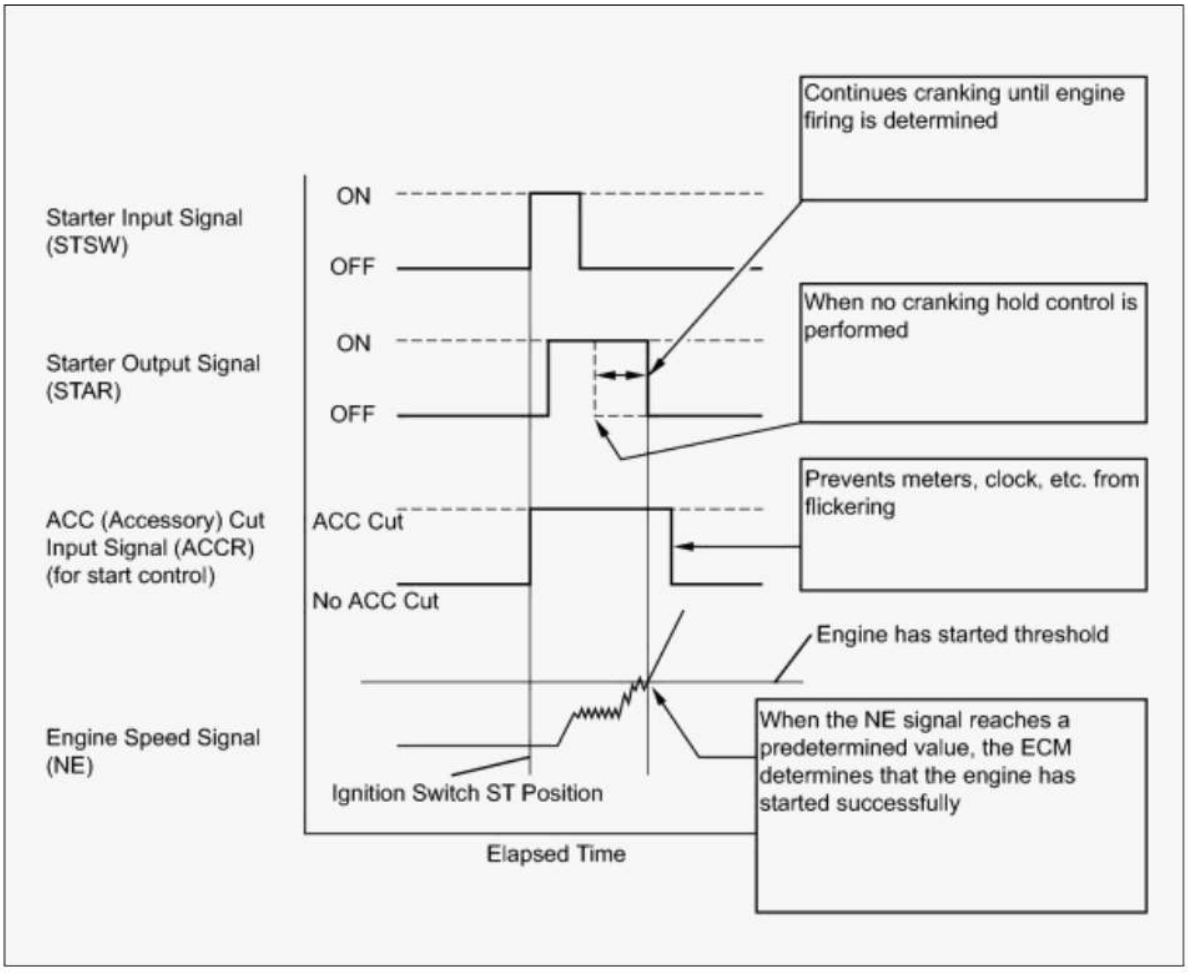
Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001FLC05ZX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: Cranking Holding Function Circuit (2011 RAV4)		

Cranking Holding Function Circuit

DESCRIPTION

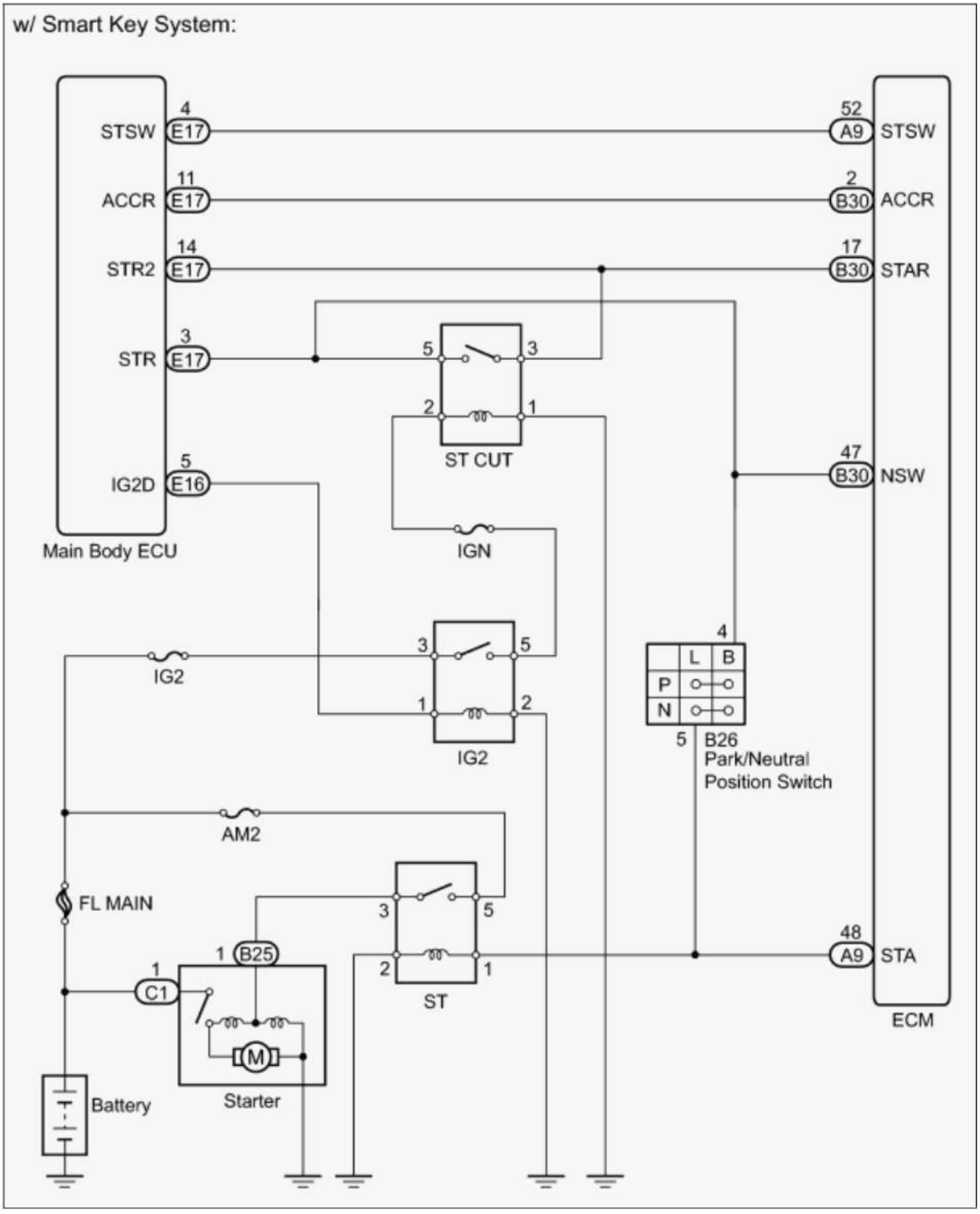
The cranking holding control system continues energizing the ST relay after the ECM detects the starter signal (STSW signal) from the main body ECU until the ECM performs a judgment of "engine started". Furthermore, the ECM outputs an accessory cut signal (ACCR signal) to the ACC relay during cranking to prevent flickering of the combination meter, clock, audio system, and other components.

When the ECM detects the STSW signal, the ECM outputs the starter relay drive signal (STAR signal) to the starter relay through the clutch start switch or park/neutral position switch, and then the engine is cranked. The ECM stops outputting the STAR signal when a variety of conditions are met, such as when the NE signal reaches a predetermined value and when the engine speed is stable. Also, the ECM monitors the ST relay operating conditions based on the STA terminal voltage status.



WIRING DIAGRAM

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INSPECTION PROCEDURE

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

PROCEDURE

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1.	**CHECK START SYSTEM**

(a) Confirm the engine starting system.

Result

RESULT	PROCEED TO
Engine switch	A
Ignition switch	B

B ▶ **PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE**

A ▼

2.	**CHECK CRANKING**

(a) Check the cranking of the engine.

Result

RESULT	PROCEED TO
Cranking possible but holding control does not operate	A
Does not crank	B
Cranking possible and holding control operates	C

B ▶ **CHECK SMART KEY SYSTEM**

C ▶ **PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE**

A ▼

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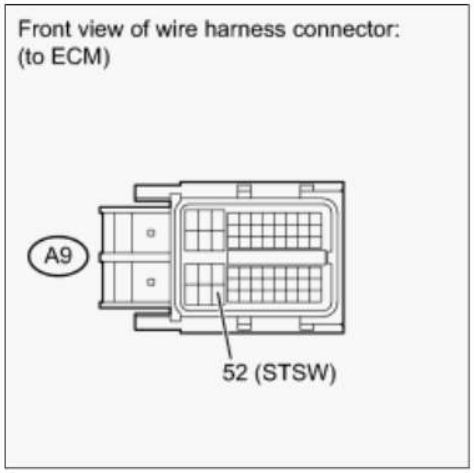
3.	INSPECT ECM (STSW TERMINAL VOLTAGE)

(a) Disconnect the ECM connector.

(b) Move the shift lever to P.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A9-52 (STSW) - Body ground	Engine cranking	11 to 14 V

(d) Reconnect the ECM connector.

NG ▶ **CHECK HARNESS AND CONNECTOR (ECM - MAIN BODY ECU)**

OK ▼

4.	CHECK HARNESS AND CONNECTOR (ECM - CLUTCH START SWITCH OR PARK/NEUTRAL POSITION SWITCH ASSEMBLY - MAIN BODY ECU)

(a) Remove the ST CUT relay from the No. 7 relay block.

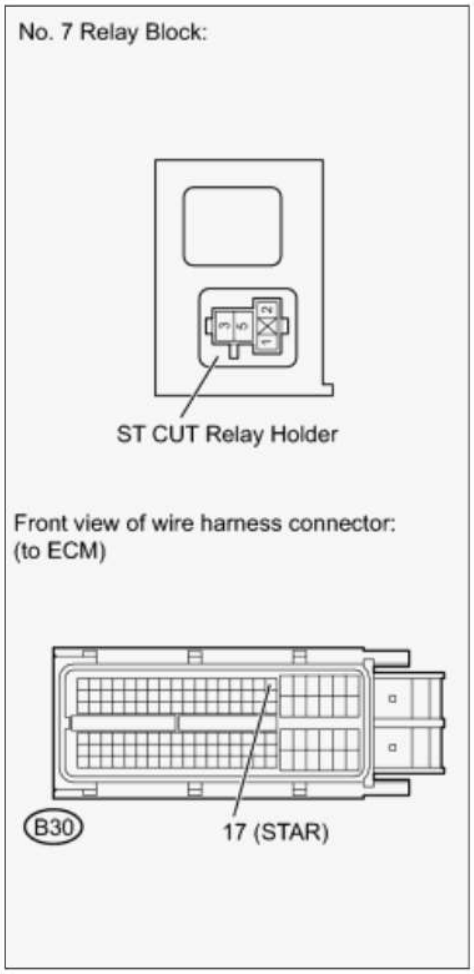
(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED

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		CONDITION
ST CUT relay (3) - B30-17 (STAR)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
ST CUT relay (3) or B30-17 (STAR) - Body ground	Always	10 kΩ or higher

(d) Reconnect the ECM connector.

(e) Reinstall the ST CUT relay.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

5.	**CHECK HARNESS AND CONNECTOR (ECM - MAIN BODY ECU)**

(a) Disconnect the main body ECU connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
E17-4 (STSW) - A9-52 (STSW)	Always	Below 1 Ω

Standard Resistance (Check for short):

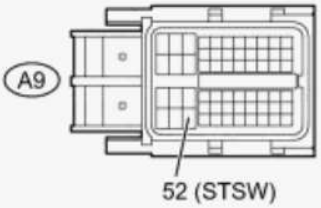
TESTER CONNECTION	CONDITION	SPECIFIED

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Front view of wire harness connector:
(to Main Body ECU)



Front view of wire harness connector:
(to ECM)



		CONDITION
E17-4 (STSW) or A9-52 (STSW) - Body ground	Always	10 kΩ or higher

(d) Reconnect the main body ECU connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **CHECK SMART KEY SYSTEM**

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Last Modified: 9-7-2011	6.4 U	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDN0F8X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: DATA LIST / ACTIVE TEST (2011 RAV4)		

DATA LIST / ACTIVE TEST

1. DATA LIST

HINT:

Using the Techstream to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTICE:

In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

(a) Warm up the engine.

(b) Turn the ignition switch off.

(c) Connect the Techstream to the DLC3.

(d) Turn the ignition switch to ON.

(e) Turn the Techstream on.

(f) Enter the following menus: Powertrain / Engine and ECT / Data List.

(g) According to the display on the Techstream, read the Data List.

TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Vehicle Speed	Vehicle speed/ Min.: 0 km/h, Max.: 255 km/h	Actual vehicle speed	The speed indicated on the speedometer.
Engine Speed	Engine speed/ Min.: 0 rpm, Max.: 16383 rpm	600 to 700 rpm: Idling	-
Calculate Load	Load calculated by ECM/ Min.: 0%, Max.: 100%	• 10 to 30%: Idling • 10 to 30%: Running without load (2500 rpm)	-
Vehicle Load	Vehicle load/ Min.: 0%, Max.: 25700%	Actual vehicle load	-
MAF	Air flow rate from Mass Air Flow (MAF) meter/ Min.: 0 g/sec., Max.:	1 to 3 g/sec.: Idling	If the value is approximately 0.0 g/sec.: • The Mass Air Flow (MAF)

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
	655.35 g/sec.		meter power source circuit is open. • VG circuit is open or shorted. If the value is 160.0 g/sec. or more: • The E2G circuit is open.
Atmosphere Pressure	Atmospheric pressure/ Min.: 0 kPa, Max.: 255 kPa	Equivalent to atmospheric pressure (absolute pressure)	-
Coolant Temp	Engine coolant temperature/ Min.: -40°C, Max.: 140°C	80 to 100°C (176 to 212°F): After warming up	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (284°F), the sensor circuit is shorted.
Intake Air	Intake air temperature/ Min.: -40°C, Max.: 140°C	Equivalent to ambient air temperature	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (284°F), the sensor circuit is shorted.
Ambient Temperature	Ambient temperature/ Min.: -40°C, Max.: 215°C	Actual ambient temperature	-
Engine Run Time	Engine run time/ Min.: 0 seconds, Max.: 65535 seconds	Time after engine start	Service data.
Initial Engine Coolant Temp	Initial engine coolant temperature/ Min.: -40°C, Max.: 120°C	Close to ambient air temperature	Service data.
Initial Intake Air Temp	Initial intake air temperature/ Min.: -40°C, Max.: 120°C	Close to ambient air temperature	Service data.
Battery Voltage	Battery voltage/ Min.: 0 V, Max.: 65.5 V	11 to 14 V: Idling	-
Accelerator Position	Accelerator pedal position Min.: 0%, Max.: 399.99%	Actual accelerator pedal position	-
Accel Sens. No. 1 Volt %	Absolute Accelerator Pedal Position (APP) No. 1/ Min.: 0%, Max.: 100%	10 to 22%: accelerator pedal released 52 to 90%: accelerator pedal fully depressed	-

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Accel Sens. No. 2 Volt %	Absolute APP No. 2/ Min.: 0%, Max.: 100%	24 to 40%: accelerator pedal released 68 to 100%: accelerator pedal fully depressed	-
Accel Sensor Out No. 1	APP sensor No. 1 voltage/ Min.: 0 V, Max.: 4.98 V	0.5 to 1.1 V: accelerator pedal released 2.6 to 4.5 V: accelerator pedal fully depressed	-
Accel Sensor Out No. 2	APP sensor No. 2 voltage/ Min.: 0 V, Max.: 4.98 V	1.2 to 2.0 V: accelerator pedal released 3.4 to 4.98 V: accelerator pedal fully depressed	-
Accelerator Idle Position	Whether or not accelerator pedal position sensor detecting idle/ ON or OFF	ON: Idling	-
Accel Fully Close Learn #1	Accelerator fully closed learned value No. 1/ Min.: 0 deg, Max.: 124.5 deg	-	ETCS service data.
Accel Fully Close Learn #2	Accelerator fully closed learned value No. 2/ Min.: 0 deg, Max.: 124.5 deg	-	ETCS service data.
Throttle Sensor Volt %	Throttle valve opening percentage according to throttle position sensor/ Min.: 0%, Max.: 100%	• 10 to 22%: Accelerator pedal released • 64 to 96%: Accelerator pedal fully depressed	Value calculated based on the voltage at terminal VTA1
Throttl Sensor #2 Volt %	Throttle valve opening percentage according to throttle position sensor No. 2/ Min.: 0%, Max.: 100%	• 42 to 62%: Accelerator pedal released • 92 to 100%: Accelerator pedal fully depressed	Value calculated based on the voltage at terminal VTA2
ST1	Brake pedal signal/ ON or OFF	ON: Brake pedal depressed	-
System Guard	System guard/ ON or OFF	-	ETCS service data.

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Open Side Malfunction	Open side malfunction/ ON or OFF	-	ETCS service data.
Throttle Idle Position	Whether or not throttle position sensor detecting idling/ ON or OFF	• ON: Accelerator pedal released • OFF: Accelerator pedal fully depressed	-
Throttle Require Position	Required throttle position/ Min.: 0 V, Max.: 4.9 V	0.5 to 1.1 V: Idling	-
Throttle Sensor Position*	Throttle position sensor/ Min.: 0%, Max.: 100%	• 0%: Accelerator pedal released • 50 to 80%: Accelerator pedal fully depressed	Recognition value for throttle opening angle on ECM
Throttle Position No. 1	Throttle position sensor No. 1 output voltage/ Min.: 0 V, Max.: 4.9 V	• 0.5 to 1.1 V: Accelerator pedal released • 3.2 to 4.8 V: Accelerator pedal fully depressed • 0.6 to 1.4 V: Fail-safe operating	-
Throttle Position No. 2	Throttle position sensor No. 2 output voltage/ Min.: 0 V, Max.: 4.9 V	• 2.1 to 3.1 V: Accelerator pedal released • 4.6 to 4.9 V: Accelerator pedal fully depressed • 2.1 to 3.1 V: Fail-safe operating	-
Throttle Position Command	Throttle position command value/ Min.: 0 V, Max.: 4.9 V	0.5 to 4.8 V	-
Throttle Sens Open Pos #1	Throttle sensor opener position No. 1/ Min.: 0 V, Max.: 4.9 V	0.6 to 1.4 V	ETCS service data.

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Throttle Sens Open Pos #2	Throttle sensor opener position No. 2/ Min.: 0 V, Max.: 4.9 V	1.7 to 2.5 V	ETCS service data.
Throttle Motor Current	Throttle actuator current/ Min.: 0 A, Max.: 19.9 A	0 to 3.0 A: Idling	ETCS service data.
Throttle Motor DUTY	Throttle actuator/ Min.: 0%, Max.: 100%	10 to 22%: Idling after engine warmed up	ETCS service data.
Throttle Motor Duty (Open)	Throttle actuator duty ratio (open)/ Min.: 0%, Max.: 100%	0 to 40%: Idling	ETCS service data.
Throttle Motor Duty (Close)	Throttle actuator duty ratio (close)/ Min.: 0%, Max.: 100%	0 to 40%: Idling	ETCS service data.
Throttle Fully Close Learn	Throttle valve fully closed (learned value)/ Min.: 0, Max.: 4.98 V	0.4 to 1.0 V: Accelerator pedal released	-
+BM Voltage	+BM voltage/ Min.: 0, Max.: 19.9	10 to 15 V: Idling	ETCS service data.
Actuator Power Supply	Actuator power supply/ ON or OFF	ON: Idling	ETCS service data.
Injector (Port)	Injection period of the No. 1 cylinder/ Min.: 0 ms, Max.: 32.64 ms	1.0 to 3.0 ms: Idling	-
Injection Volum (Cylinder 1)	Injection volume (cylinder 1)/ Min.: 0 ml, Max.: 2.048 ml	0.05 to 0.15 ml: Idling	The quantity of fuel injection volume for 10 times.
Fuel Pump/Speed Status	Fuel pump/speed status/ ON or OFF	-	-
Vacuum Pump	Key-off EVAP system pump status/ ON or OFF	-	-
TCV Status	TCV status/ ON or OFF	ON: Cold engine start	-
EVAP (Purge) VSV	Purge VSV control duty/ Min.: 0%, Max.: 100%	0 to 50%: Idling, under purge control	The order signal from the ECM.

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Evap Purge Flow	Purge flow/ Min.: 0%, Max.: 102.3%	0 to 10%: Idling	-
Purge Density Learn Value	Learned value of purge density/ Min.: -50, Max.: 350.000	-40 to 0%: Idling	Service data.
Vapor Pressure Pump	Vapor pressure/ Min.: 33.853 kPa (253.918 mmHg), Max.: 125.596 kPa (942.048 mmHg)	Approximately 100 kPa (750 mmHg): Ignition switch ON	The EVAP system pressure is monitored by the canister pressure sensor.
Vapor Pressure (Calculated)	Calculated EVAP system pressure/ Min.: -5.632 kPa (-42.243 mmHg), Max.: 715.264 kPa (5364.923 mmHg)	Approximately 100 kPa (750 mmHg): Ignition switch ON	-
EVAP System Vent Valve	Key-off EVAP system vent valve status/ ON or OFF	-	-
EVAP Purge VSV	VSV status for EVAP control/ ON or OFF	-	-
Purge Cut VSV Duty	Purge cut VSV duty/ Min.: 0%, Max.: 399.99%	-	-
Target Air-Fuel Ratio	Air-fuel ratio/ Min.: 0, Max.: 1.998	0.8 to 1.2: During idling	-
AF Lambda B1 S1	Short-term fuel trim (for Bank 1 Sensor 1)/ Min.: 0, Max.: 1.99	• Value less than 1 (0.000 to 0.999) = Rich • 1 = Stoichiometric air-fuel ratio • Value more than 1 (1.001 to 1.999) = Lean	-
AFS Voltage B1 S1	Air fuel ratio sensor output voltage (for Bank 1 Sensor 1)/ Min.: 0 V, Max.: 7.99	2.6 to 3.8 V: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check voltage output of the sensor.

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
	V		
AFS Current B1 S1	Air fuel ratio sensor current (for Bank 1 Sensor 1)/ Min.: -128 mA, Max.: 127.99 mA	-0.5 to 0.5 mA: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
A/F Heater Duty #1	A/F heater duty ratio Min.: 0%, Max.: 399.99%	0 to 100%	-
O2S B1 S2	Heated oxygen sensor output voltage (for Bank 1 Sensor 2)/ Min.: 0 V, Max.: 1.27 V	0.0 to 0.9 V: Vehicle driven at 70 km/h (44 mph)	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check voltage output of the sensor.
O2S Impedance B1S2	Sub heated oxygen sensor impedance (for Bank 1 Sensor 2)/ Min.: 0 Ω, Max.: 21247.67 Ω	5 to 15000 Ω	After driving for approx. 10 min. in an urban area.
O2 Heater B1 S2	Heated oxygen sensor heater/ ON or OFF	-	-
O2 Heater Curr Val B1 S2	Heated oxygen sensor current (for Bank 1 Sensor 2)/ Min.: 0 A, Max.: 4.99 A	-	-
Short FT #1	Short-term fuel trim of bank 1/ Min.: -100%, Max.: 99.2%	-20 to +20%	This item refers to the short-term fuel compensation used to maintain the air-fuel ratio at the stoichiometric air-fuel ratio.
Long FT #1	Long-term fuel trim of bank 1/ Min.: -100%, Max.: 99.2%	-20 to +20%	This item refers to the overall fuel compensation carried out in the long-term to compensate a continual deviation of the short-term fuel trim from the central value.
Total FT #1	Total fuel trim of bank 1 Average value for fuel trim system of bank 1/ Min.: -0.5, Max.: 0.496	-0.28 to 0.2: Idling	-

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Fuel System Status #1	Fuel system status (Bank 1)/ OL, CL, OL Drive, OL Fault or CL Fault	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OL Drive: Open loop due to driving conditions (fuel enrichment). • OL Fault: Open loop due to a detected system fault. • CL Fault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
Fuel System Status #2	Fuel system status (Bank 2)/ OL, CL, OL Drive, OL Fault or CL Fault	Unused	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OL Drive: Open loop due to driving conditions (fuel enrichment). • OL Fault: Open loop due to a detected system fault. • CL Fault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
IGN Advance	Ignition timing advance for No. 1 cylinder/ Min.: -64 deg., Max.: 63.5 deg.	BTDC 0 to 15°: Idling	-
Knock Feedback Value	Feedback value of knocking/ Min.: -64° CA, Max.: 1983.9° CA	-20 to 0° CA: Vehicle driven at 70 km/h (44 mph)	Service data.
Knock Correct Learn Value	Correction learned value of knocking/ Min.: -64° CA, Max.: 1983.9° CA	0 to 20° CA: Vehicle driven at 70 km/h (44 mph)	Service data.

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
ACIS VSV	VSV status for ACIS control/ ON or OFF	-	-
IAC Sensor Voltage	Intake air control valve position sensor output voltage/ Min.: 0 V, Max.: 4.99 V	-	If valve is 0.2 V or less • IAC1 circuit shorted • VCIA circuit open If valve is 4.8 V or higher • VCIA and IAC1 circuit short-circuited • IAC1 circuit open • EIA1 circuit open
Intake Air Control Position	Intake air control valve position/ Min.: -250°, Max.: 249.99°	-	-
VVT Control Status #1	Variable valve timing (VVT) control status (Bank 1)/ ON or OFF	-	-
VVT Aim Angle #1	VVT aim angle (Bank 1)/ Min.: 0%, Max.: 100%	0 to 100%	VVT duty signal value during forced operation.
VVT Change Angle #1	VVT change angle (Bank 1)/ Min.: 0° FR, Max.: 60° FR	0 to 55° FR: Idling	Displacement angle during forced operation.
VVT OCV Duty #1	VVT OCV operation duty (Bank 1)/ Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for forced operation.
VVT Ex Hold Lrn Val #1	VVT exhaust hold duty ratio learned value (Bank 1)/ Min.: 0%, Max.: 100%	0 to 80%: Idling	-
VVT Ex Chg Angle #1	VVT exhaust change angle (for Bank 1)/ Min.: 0° FR, Max.: 60° FR	0 to 45° FR: Idling	Displacement angle during forced operation.
VVT Ex OCV Duty #1	VVT exhaust OCV duty (for Bank 1)/ Min.: 0%, Max.: 100%	0 to 100%: Idling	Requested duty value for forced operation.

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Catalyst Temp B1 S1	Catalyst temperature (for Bank 1 Sensor 1)/ Min.: -40°C, Max.: 6513.5°C	-	-
Catalyst Temp B1 S2	Catalyst temperature (for Bank 1 Sensor 2)/ Min.: -40°C, Max.: 6513.5°C	-	-
Starter Signal	Starter signal/ ON or OFF	ON: Cranking	-
Starter Control	Starter switch status/ ON or OFF	ON: Cranking	-
Power Steering Signal Record	Power steering switch signal/ ON or OFF	-	-
Starter Relay	Starter relay status/ ON or OFF	ON: Cranking	-
ACC Relay	ACC relay status/ ON or OFF	ON: Cranking	-
Neutral Position SW Signal	PNP switch status/ ON or OFF	ON: P or N position	-
Stop Light Switch	Stop light switch/ ON or OFF	ON: Brake pedal depressed	-
A/C Signal	A/C switch status/ ON or OFF	ON: A/C ON	-
Idle Up Signal	Idle up signal/ ON or OFF	-	-
Closed Throttle Position SW	Closed throttle position switch/ ON or OFF	• ON: Throttle fully closed • OFF: Throttle open	-
Fuel Cut Condition	Fuel cut condition/ ON or OFF	ON: Fuel cut operating	-
Immobiliser Communication	Immobiliser communication/ ON or OFF	ON: Normal	-
Check Mode	Check mode/ ON or OFF	ON: Check mode ON	Refer to Check Mode Procedure INFO .
SPD Test Result	Check mode result for vehicle speed sensor/	-	-

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
	Compl or Incmpl		
Misfire Test Result	Check mode result for misfire monitor/ Compl or Incmpl	-	-
OXS1 Test Result	Check mode result for heated oxygen sensor (Bank 1)/ Compl or Incmpl	-	-
Complete Parts Monitor	Comprehensive component monitor/ Not Avl or Avail	-	-
Fuel System Monitor	Fuel system monitor/ Not Avl or Avail	-	-
Misfire Monitor	Misfire monitor/ Not Avl or Avail	-	-
EGR/VVT Monitor	EGR/VVT monitor/ Not Avl or Avail	-	-
EGR/VVT Monitor	EGR/VVT monitor/ Compl or Incmpl	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor/ Not Avl or Avail	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor/ Compl or Incmpl	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor/ Not Avl or Avail	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor/ Compl or Incmpl	-	-
EVAP Monitor	EVAP monitor/ Not Avl or Avail	-	-
EVAP Monitor	EVAP monitor/ Compl or Incmpl	-	-
Catalyst Monitor	Catalyst monitor/ Not Avl or Avail	-	-
Catalyst Monitor	Catalyst monitor/ Compl or Incmpl	-	-
Component Monitor ENA	Comprehensive component monitor/ Unable or Enable	-	-

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Component Monitor CMPL	Comprehensive component monitor/ Compl or Incmpl	-	-
Fuel System Monitor ENA	Fuel system monitor/ Unable or Enable	-	-
Fuel System Monitor CMPL	Fuel system monitor/ Compl or Incmpl	-	-
Misfire Monitor ENA	Misfire monitor/ Unable or Enable	-	-
Misfire Monitor CMPL	Misfire monitor/ Compl or Incmpl	-	-
EGR/VVT Monitor ENA	EGR/VVT monitor/ Unable or Enable	-	-
EGR/VVT Monitor CMPL	EGR/VVT monitor/ Compl or Incmpl	-	-
Heater Monitor ENA	O2S (A/FS) heater monitor/ Unable or Enable	-	-
Heater Monitor CMPL	O2S (A/FS) heater monitor/ Compl or Incmpl	-	-
O2S(A/FS) Monitor ENA	O2S (A/FS) monitor/ Unable or Enable	-	-
O2S(A/FS) Monitor CMPL	O2S (A/FS) monitor/ Compl or Incmpl	-	-
A/C Monitor ENA	A/C monitor/ Unable or Enable	-	-
A/C Monitor CMPL	A/C monitor/ Compl or Incmpl	-	-
2nd Air Monitor ENA	2nd air monitor/ Unable or Enable	-	-
2nd Air Monitor CMPL	2nd air monitor/ Compl or Incmpl	-	-
EVAP Monitor ENA	EVAP monitor/ Unable or Enable	-	-
EVAP Monitor CMPL	EVAP monitor/ Compl or Incmpl	-	-
Heated Cat Monitor ENA	Heated catalyst monitor/	-	-

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
	Unable or Enable		
Heated Cat Monitor CMPL	Heated catalyst monitor/ Compl or Incmpl	-	-
Catalyst Monitor ENA	Catalyst monitor/ Unable or Enable	-	-
Catalyst Monitor CMPL	Catalyst monitor/ Compl or Incmpl	-	-
TC Terminal	TC terminal status/ ON or OFF	-	-
# Codes (Include History)	Number of codes/ Min.: 0, Max.: 255	-	The number of stored DTCs.
MIL	MIL status/ ON or OFF	ON: MIL on	-
MIL ON Run Distance	MIL on run distance/ Min.: 0 km, Max.: 65535 km	Distance after DTC stored	-
Running Time from MIL ON	Running time from MIL on/ Min.: 0 minutes, Max.: 65535 minutes	Equivalent to running time after MIL on	-
Time after DTC Cleared	Time after DTC cleared/ Min.: 0 minutes, Max.: 65535 minutes	Equivalent to time after DTCs cleared	-
Distance from DTC Cleared	Distance after DTC cleared/ Min.: 0 km, Max.: 65535 km	Equivalent to driven distance after DTCs cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared/ Min.: 0, Max.: 255	-	The number of warm-up cycles after the DTC is cleared.
Dist Batt Cable Disconnect	Distance after battery cable disconnected/ Min.: 0 km, Max.: 65535 km	Total distance vehicle driven after battery cable disconnected	-
IG OFF Elapsed Time	Time after ignition switch off/ Min.: 0 minutes, Max.: 655350 minutes	Cumulative time after ignition switch off	-

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
OBD Requirements	OBD requirement	OBD2	-
Number of Emission DTC	Emission-related DTCs	-	The number of emission-related DTCs.
TC and TE1	TC and TE1 terminal of DLC3/ ON or OFF	-	-
Ignition Trig. Count	Ignition counter/ Min.: 0, Max.: 800	0 to 800	-
Cylinder #1 Misfire Count to Cylinder #4 Misfire Count	Misfire counter of cylinder 1 to 4/ Min.: 0, Max.: 255	0 to 16	-
All Cylinders Misfire Count	All cylinders misfire counter/ Min.: 0, Max.: 255	0 to 16	-
Misfire RPM	Engine speed for first misfire range/ Min.: 0 rpm, Max.: 6375 rpm	0 rpm: Misfire 0	-
Misfire Load	Engine load for first misfire range/ Min.: 0 g/rev, Max.: 3.98 g/rev	0 g/rev: Misfire 0	-
Misfire Margin	Misfire monitoring/ Min.: -100%, Max.: 99.21%	-100 to 99.2%	The misfire detecting margin.
Catalyst OT MF F/C	Catalyst over temperature misfire prevention F/C/ Not Avl or Avail	Avail: Cat OT MF F/C available Not Avl: Cat OT MF F/C not available	-
Cat OT MF F/C History	Catalyst over temperature misfire prevention F/C history/ ON or OFF	ON: Fuel cut operation history exists	-
Cat OT MF F/C Cylinder #1	Display of fuel cut operation in No. 1 cylinder (if certain level of misfire malfunction is detected)/	ON: Fuel cut operating	-

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
	ON or OFF		
Cat OT MF F/C Cylinder #2	Display of fuel cut operation in No. 2 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #3	Display of fuel cut operation in No. 3 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #4	Display of fuel cut operation in No. 4 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Tumble C.V Duty Ratio	Intake air control valve duty ratio/ Min.: -128%, Max.: 127%	-	-
Electric Fan Motor	Electric fan motor status/ ON or OFF	-	-
Idle Fuel Cut Prohibit	Prohibition of fuel cut at idle/ ON or OFF	-	-
Idle Fuel Cut	Fuel cut idle/ ON or OFF	ON: Fuel cut operation	Idle Fuel Cut is "ON" when the throttle valve is fully closed and the engine speed is more than 2800 rpm.
FC TAU	Fuel cut TAU: Fuel cut during very light load/ ON or OFF	ON: Fuel cut operation	The fuel cut being performed under a very light load to prevent the engine combustion from becoming incomplete.
Electrical Load Signal 1	Electrical load signal/ ON or OFF	-	-
Electrical Load Signal 3	Electrical load signal/ ON or OFF	-	-

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TESTER DISPLAY	MEASUREMENT ITEM/RANGE	NORMAL CONDITION	DIAGNOSTIC NOTE
Model Code	Model code	-	The identifying model code: ASA3#
Engine Type	Engine type	-	The identifying engine type: 2ARFE
Cylinder Number	Number of cylinders/ Min.: 0, Max.: 255	-	The identifying number of cylinders: 4
Transmission Type	Transmission type	-	The identifying transmission type: ECT 4th
Destination	Destination	-	The identifying destination: A (America)
Model Year	Model year/ Min.: 1900, Max.: 2155	-	The identifying model year: 200#
System Identification	System identification	-	The identifying engine system: Gasoline (gasoline engine)
Engine Speed of Cyl #1	Engine speed for cylinder 1/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Engine Speed of Cyl #2	Engine speed for cylinder 2/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Engine Speed of Cyl #3	Engine speed for cylinder 3/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Engine Speed of Cyl #4	Engine speed for cylinder 4/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.
Av Engine Speed of All Cyl	Engine speed for all cylinders/ Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test.

HINT:

- *: Excluding throttle valve opening percentage due to Idle Speed Control (ISC).
- Normal Condition: If no idling conditions are specified, make sure the shift lever is in N or P, and the A/C switch and all accessory switches are off.

2. ACTIVE TEST

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HINT:

Using the Techstream to perform Active Tests allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Tests early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Tests.

(a) Warm up the engine.

(b) Turn the ignition switch off.

(c) Connect the Techstream to the DLC3.

(d) Turn the ignition switch to ON.

(e) Turn the Techstream on.

(f) Enter the following menus: Powertrain / Engine and ECT / Active Test.

(g) According to the display on the Techstream, perform the Active Test.

TESTER DISPLAY	TEST PART	CONTROL RANGE	DIAGNOSTIC NOTE
Control the Injection Volume	Change injection volume	-12.5 to 24.8%	• All the injectors are tested at the same time. • Perform the test at less than 3000 rpm. • The injection volume can be changed in 1% graduations within the control range.
Control the Injection Volume for A/F Sensor	Change injection volume	Lower by -12.5% or increase by 25%	• Perform the test at less than 3000 rpm. • Control the Injection Volume for A/F Sensor enables the checking and graphing of the A/F (Air Fuel Ratio) sensor and Heated Oxygen (HO2) sensor voltage outputs. • To conduct the test, enter the following menus: Active Test / Control the Injection Volume for A/F Sensor / Data List / A/F Control System / AFS Voltage B1 S1 and O2S B1 S2.
Activate the VSV for Intake Control	Activate VSV for intake control	ON/OFF	-
Activate the VSV for Evap Control	Activate purge VSV control	ON/OFF	-
Control the Fuel Pump / Speed	Activate fuel pump (C/OPN Relay)	ON/OFF	The test is possible when the following conditions are met:

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TESTER DISPLAY	TEST PART	CONTROL RANGE	DIAGNOSTIC NOTE
			• The ignition switch is ON. • The engine is stopped.
Connect the TC and TE1	Turn on and off TC and CG (TE1) connection	ON/OFF	• ON: TC and TE1 are connected. • OFF: TC and TE1 are disconnected.
Control the Idle Fuel Cut Prohibit	Prohibit idling fuel cut control	ON/OFF	The idling fuel-cut is turned ON when the throttle valve is fully closed and the engine speed is more than 2800 rpm.
Prohibit the Catalyst OT Misfire prevent F/C	Prohibit catalyst overheat malfunction prevention fuel cut operation during misfire	ON/OFF ON: Fuel cut prohibited	Confirm that the vehicle is stopped and the engine speed is 3000 rpm or less.
Control the Electric Cooling Fan	Control electric cooling fan motor	ON/OFF	-
Activate the Starter Relay	Activate the starter relay	ON/OFF	The engine is stopped.
Activate the ACC Cut Relay	Activate the ACC CUT relay	ON/OFF	The engine is stopped.
Control the ETCS Open/Close Slow Speed	Throttle actuator	Close/Open	The test is possible when the following conditions are met: • The ignition switch is ON. • The engine is stopped. • The accelerator pedal is fully depressed (APP: 58 degrees or more).
Control the ETCS Open/Close Fast Speed	Throttle actuator	Close/Open	
Control the VVT Linear (Bank1)	Control VVT (Bank 1)	Between -128 and 127%	• The engine stalls or idles roughly when the VVT actuator is operated at 100%. • The test is possible during idle.
Control the VVT System (Bank1)	Turn on and off OCV (Camshaft Timing Oil Control Valve)	ON/OFF	• The engine stalls or idles roughly when the OCV is turned ON. • The engine is running and idles normally when the OCV is OFF. • The test is possible during idle.
Control the VVT Exhaust Linear (Bank 1)	Control VVT (Bank 1)	Between -128 and 127%	• The engine stalls or idles roughly when the VVT actuator is operated at 100%. • The test is possible during idle.

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TESTER DISPLAY	TEST PART	CONTROL RANGE	DIAGNOSTIC NOTE
Activate the Vacuum Pump	Leak detection pump	ON/OFF	-
Activate the VSV for Vent Valve	Vent valve	ON/OFF	-
Control the IAC Duty Ratio	Control intake air control valve duty ratio	Between -100 and 100%	-
Control the Cylinder #1 Fuel Cut	Cylinder #1 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*1
Control the Cylinder #2 Fuel Cut	Cylinder #2 injector fuel cut	ON/OFF	
Control the Cylinder #3 Fuel Cut	Cylinder #3 injector fuel cut	ON/OFF	
Control the Cylinder #4 Fuel Cut	Cylinder #4 injector fuel cut	ON/OFF	
Control the All Cylinder Fuel Cut	All cylinder fuel cut	ON/OFF	
Check the Cylinder Compression*2	Check the cylinder compression pressure (measuring engine speed for each cylinder)	ON/OFF	Fuel injection and ignition stop in all the cylinders.

NOTICE:

***1: If the display of the Catalyst OT MF F/C item of the Data List is Not Avl, perform this Active Test with the vehicle stopped and the engine idling. If the display of the Catalyst OT MF F/C item of the Data List is Avail, perform this Active Test as described below.**

1. Stop the engine and turn the ignition switch to ON to turn Control the Cylinder #1 Fuel Cut (to Control the Cylinder #4 Fuel Cut) ON.
2. Start the engine.

HINT:

***2: When cranking the engine, each cylinder measures the engine speed.**

In this Active Test, the fuel and ignition of all cylinders is cut. The engine must then be cranked for approximately 10 seconds. At this time, the speed of each cylinder is measured. If the speed of one cylinder is more than the other cylinders, it can be determined that the compression pressure of that cylinder is lower than the other cylinders.

1. Warm up the engine.
2. Turn the ignition switch off.
3. Connect the Techstream to the DLC3.
4. Turn the ignition switch ON.

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5. Turn the Techstream on.
6. Enter the following menus: Powertrain / Engine and ECT / Active Test / Check the Cylinder Compression.

HINT:

To display the entire Data List, press the pull down menu button next to Primary. Then select Compression.

7. Push the snapshot button to turn the snapshot function on.

HINT:

Using the snapshot function, data can be recorded during the Active Test.

8. While the engine is not running, press the RIGHT or LEFT button to change Check the Cylinder Compression to ON.

HINT:

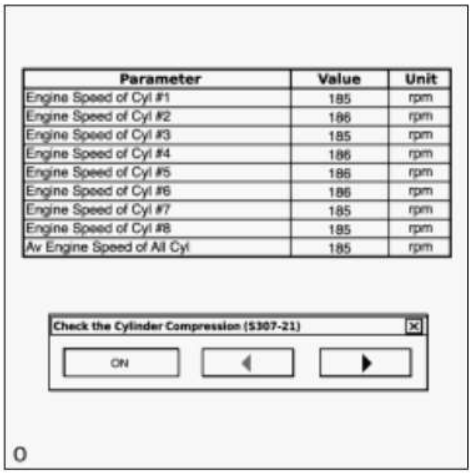
After performing the above procedure, Check the Cylinder Compression will start. Fuel injection for all cylinders is prohibited and each cylinder engine speed measurement enters standby mode.

9. Crank the engine for about 10 seconds.

HINT:

Continue to crank the engine until the values change from the default value (51199 rpm).

10.



Monitor the engine speed (Engine Speed of Cyl #1 to #4) displayed on the Techstream.

HINT:

At first, the Techstream displays extremely high cylinder engine speed values. After approximately 10 seconds of engine cranking, each cylinder engine speed measurement will change to the actual engine speed.

NOTICE:

- Do not crank the engine continuously for 20 seconds or more.
- If it is necessary to crank the engine again after Check the Cylinder Compression has been changed to ON and the engine has been cranked once, press Exit to return to the Active Test menu screen. Then change Check the Cylinder Compression to ON and crank the engine.
- Use a fully-charged battery.

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11. Stop cranking the engine, and then change "Check the Cylinder Compression" to OFF after the engine stops.

NOTICE:

If the Active Test is changed to OFF while the engine is being cranked, the engine will start.

12. Push the snapshot button to turn the snapshot function off.
13. Select "Stored Data" on the Techstream screen, select the recorded data and display the data as a graph.

HINT:

If the data is not displayed as a graph, the change of the values cannot be observed.

14. Check the change in engine speed values.

HINT:

As the data values of the Active Test return to their default values when cranking is stopped, the engine speed value of each cylinder cannot be observed. Therefore, it is necessary to use the data recorded with the snapshot function to check the engine speed values recorded during cranking.

3. SYSTEM CHECK (Only for Techstream)

HINT:

Performing a System Check in the Utility menu enables the system, which consists of multiple actuators, to be operated without removing any parts. In addition, it can show whether or not any DTCs are stored, and can detect potential malfunctions in the system.

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Utility.

(e) Perform the System Check by referring to the table below.

TESTER DISPLAY	TEST PART	CONTROL RANGE	DIAGNOSTIC NOTE
Evaporative System Check (Automatic Mode)	Perform 5 steps in order to operate EVAP key-off monitor automatically	35°C (95°F) or less	• If no DTCs in Pending after performing this test, system functioning normally • Refer to EVAP System INFO
Evaporative System Check (Manual Mode)	Perform 5 steps in order to operate EVAP key-off monitor manually	35°C (95°F) or less	• Used to detect malfunctioning parts • Refer to EVAP System INFO

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDC0AIX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: DEFINITION OF TERMS (2011 RAV4)		

DEFINITION OF TERMS

TERMS	DEFINITION
Monitor Description	Description of what ECM monitors and how it detects malfunctions (monitoring purpose and details).
Related DTCs	Group of diagnostic trouble codes that are output by ECM based on same malfunction detection logic.
Typical Enabling Condition	Preconditions that allow ECM to detect malfunctions. With all preconditions satisfied, ECM stores DTC when monitored value(s) exceeds malfunction threshold(s).
Sequence of Operation	Order of monitor priority, applied if multiple sensors and components involved in single malfunction detection process. Each sensor and component monitored in turn, when previous detection operation completed.
Required Sensor/Components	Sensors and components used by ECM to detect each malfunction.
Frequency of Operation	Number of times ECM checks for each malfunction during each driving cycle. "Once per driving cycle" means ECM only performs checks for that malfunction once during single driving cycle. "Continuous" means ECM performs checks for that malfunction whenever enabling conditions met.
Duration	Minimum time for which ECM must detect continuous deviation in monitored value(s) in order to store DTC. Timing begins when Typical Enabling Conditions met.
Malfunction Thresholds	Value beyond which ECM determines malfunctions exist and stores DTCs.
MIL Operation	Timing of MIL illumination after malfunction detected. "Immediate" means ECM illuminates MIL as soon as malfunction detected. "2 driving cycles" means ECM illuminates MIL if same malfunction detected second time during next sequential driving cycle.

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDJ0JBX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: DIAGNOSIS SYSTEM (2011 RAV4)		

DIAGNOSIS SYSTEM

1. DESCRIPTION

When troubleshooting OBD II (On-Board Diagnostics) vehicles, the Techstream (complying with SAE J1987) must be connected to the DLC3 (Data Link Connector 3) of the vehicle. Various data in the vehicle's ECM (Engine Control Module) can be then read.

OBD II regulations require that the vehicle's on-board computer illuminate the MIL (Malfunction Indicator Lamp) on the instrument panel when the computer detects a malfunction in:



a. The emission control system and components.
b. The powertrain control components (which affect vehicle emissions).
c. The computer itself.

In addition, the applicable DTCs prescribed by SAE J2012 are stored in the ECM memory. If the malfunction does not recur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain stored in the ECM memory.

To check the DTCs, connect the Techstream to the DLC3. The Techstream displays output DTCs, freeze frame data, and a variety of engine data. The DTCs and freeze frame data can be cleared with the Techstream. In order to enhance OBD function on vehicles and develop the Off-Board diagnosis system, Controller Area Network (CAN) communication is used in this system. CAN is a network which uses a pair of data transmission lines spanning multiple computers and sensors. It allows for high speed communications between the systems and simplification of the wire harness connections.

2. NORMAL MODE AND CHECK MODE

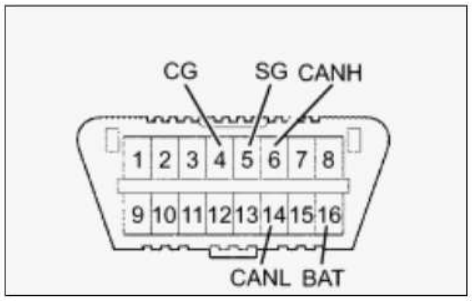
The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms and increasing the ability of the system to detect malfunctions, including intermittent problems (Techstream only).

3. 2 TRIP DETECTION LOGIC

When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent drive cycle, the MIL is illuminated (2nd trip).

4. DLC3 (Data Link Connector 3)

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SYMBOL (TERMINAL NO.)	TERMINAL DESCRIPTION	CONDITION	SPECIFIED CONDITION
SIL (7) - SG (5)	Bus "+" line	During transmission	Pulse generation
CG (4) - Body ground	Chassis ground	Always	Below 1 Ω
SG (5) - Body ground	Signal ground	Always	Below 1 Ω
BAT (16) - Body ground	Battery positive	Always	11 to 14 V
CANH (6) - CANL (14)	CAN bus line	Ignition switch off*	54 to 69 Ω
CANH (6) - Battery positive	HIGH-level CAN bus line	Ignition switch off*	6 kΩ or higher
CANH (6) - CG (4)	HIGH-level CAN bus line	Ignition switch off*	200 Ω or higher
CANL (14) - Battery positive	LOW-level CAN bus line	Ignition switch off*	6 kΩ or higher
CANL (14) - CG (4)	LOW-level CAN bus line	Ignition switch off*	200 Ω or higher

NOTICE:

***: Before measuring the resistance, leave the vehicle as is for at least 1 minute and do not operate the ignition switch, any other switches or the doors.**

If the result is not as specified, the DLC3 may have a malfunction. Repair or replace the harness and connector.

HINT:

The DLC3 is the interface prepared for reading various data from the vehicle ECM. After connecting the cable of Techstream to the DLC3, turn the ignition switch to ON and turn the Techstream on. If a communication failure message is displayed on the Techstream screen, a problem exists in either the vehicle or Techstream. In order to identify the location of the problem, connect the Techstream to another vehicle.

If communication is normal: Inspect the DLC3 on the original vehicle.

If communication is still not possible: The problem is probably in the Techstream itself. Consult the Service Department listed in the instruction manual.

5. FREEZE FRAME DATA

The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or

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stationary, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data stored at the time of a malfunction.

6. BATTERY VOLTAGE

Standard voltage:
11 to 14 V

If voltage is below 11 V, replace or recharge the battery before proceeding.

7. MIL (Malfunction Indicator Lamp)

(a) The MIL is illuminated when the ignition switch is first turned to ON (the engine is not running).

(b) The MIL turns off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.

HINT:

If the MIL is not illuminated when the ignition switch is first turned to ON, check the MIL circuit INFO .

8. ALL READINESS

HINT:

- With "All Readiness" you can check whether or not the DTC judgment has been completed by using the Techstream.
- You should check "All Readiness" after simulating malfunction symptoms or for validation after finishing repairs.

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTCs INFO .

(e) Perform the DTC judgment driving pattern to run the DTC judgment.

(f) Enter the following menus: Powertrain / Engine / Utility / All Readiness.

(g) Input the DTCs to be confirmed.

(h) Check the DTC judgment result.

TESTER DISPLAY	DESCRIPTION
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions

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TESTER DISPLAY	DESCRIPTION
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

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Last Modified: 9-7-2011	6.4 S	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDF0B8X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: DIAGNOSTIC TROUBLE CODE CHART (2011 RAV4)		

DIAGNOSTIC TROUBLE CODE CHART

HINT:

Parameters listed in the chart may not be exactly the same as yours depending on the type of instrument and other factors.

If any DTCs are output during a check mode DTC check, check the circuit for the DTCs listed in the table below. For details of each DTC, refer to the "See page" indicated.

SFI SYSTEM

DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	-Open or short in camshaft timing Oil Control Valve (OCV) circuit -OCV -ECM	Comes on	DTC stored	Applies	INFO
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	-Valve timing -Camshaft timing Oil Control Valve (OCV) -OCV filter -Camshaft timing gear assembly -ECM	Comes on	DTC stored	Applies	INFO
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	-Valve timing -Camshaft timing Oil Control Valve (OCV) -OCV filter -Camshaft timing gear assembly -ECM	Comes on	DTC stored	Applies	INFO
P0013	Camshaft Position "B" Actuator Circuit / Open (Bank 1)	-Open or short in camshaft timing oil control valve assembly (for exhaust camshaft) circuit -Camshaft timing oil control valve assembly (for exhaust camshaft) -ECM	Comes on	DTC stored	Applies	INFO
P0014	Camshaft Position "B" - Timing Over-Advanced or	-Valve timing -Camshaft timing oil control	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
	System Performance (Bank 1)	valve assembly (for exhaust camshaft) -Oil control valve filter -Camshaft timing gear assembly (for exhaust camshaft) -ECM				
P0015	Camshaft Position "B" - Timing Over-Retarded (Bank 1)	-Valve timing -Camshaft timing oil control valve assembly (for exhaust camshaft) -Oil control valve filter -Camshaft timing gear assembly (for exhaust camshaft) -ECM	Comes on	DTC stored	Applies	INFO
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	-Mechanical system (timing chain has jumped tooth or chain stretched) -Camshaft timing Oil Control Valve (OCV) -Camshaft timing gear assembly -ECM	Comes on	DTC stored	Applies	INFO
P0017	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)	-Mechanical system (timing chain has jumped tooth or chain stretched) -Camshaft timing Oil Control Valve (OCV) -Camshaft timing gear assembly -ECM	Comes on	DTC stored	Applies	INFO
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	-Open in Air Fuel Ratio (A/F) sensor heater circuit -A/F sensor heater (sensor 1) -ECM power source circuit -ECM	Comes on	DTC stored	Applies	INFO
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	-Short in Air Fuel Ratio (A/F) sensor heater circuit -A/F sensor heater (sensor 1) -ECM power source circuit -ECM	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	-Open in Heated Oxygen (HO2) sensor (sensor 2) heater circuit -HO2 sensor (sensor 2) heater -ECM power source circuit -ECM	Comes on	DTC stored	Applies	INFO
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	-Short in Heated Oxygen (HO2) sensor (sensor 2) heater circuit -HO2 sensor (sensor 2) heater -ECM power source circuit -ECM	Comes on	DTC stored	Applies	INFO
P0101	Mass Air Flow Circuit Range / Performance Problem	-Mass Air Flow (MAF) meter -Air induction system -PCV hose connections	Comes on	DTC stored	-	INFO
P0102	Mass or Volume Air Flow Circuit Low Input	-Open or short in Mass Air Flow (MAF) meter circuit -MAF meter -ECM	Comes on	DTC stored	Applies	INFO
P0103	Mass or Volume Air Flow Circuit High Input	-Open or short in Mass Air Flow (MAF) meter circuit -MAF meter -ECM	Comes on	DTC stored	Applies	INFO
P0111	Intake Air Temperature Sensor Gradient Too High	-Mass air flow meter	Comes on	DTC stored	Applies	INFO
P0112	Intake Air Temperature Circuit Low Input	-Short in Intake Air Temperature (IAT) sensor circuit -IAT sensor (built into mass air flow meter) -ECM	Comes on	DTC stored	Applies	INFO
P0113	Intake Air Temperature Circuit High Input	-Open in Intake Air Temperature (IAT) sensor circuit -IAT sensor (built into mass air flow meter) -ECM	Comes on	DTC stored	Applies	INFO
P0115	Engine Coolant Temperature Circuit Malfunction	-Open or short in Engine Coolant Temperature (ECT) sensor circuit	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
		-ECT sensor -ECM				
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	-Thermostat -Engine Coolant Temperature (ECT) sensor	Comes on	DTC stored	Applies	INFO
P0117	Engine Coolant Temperature Circuit Low Input	-Short in Engine Coolant Temperature (ECT) sensor circuit -ECT sensor -ECM	Comes on	DTC stored	Applies	INFO
P0118	Engine Coolant Temperature Circuit High Input	-Open in Engine Coolant Temperature (ECT) sensor circuit -ECT sensor -ECM	Comes on	DTC stored	Applies	INFO
P011B	Engine Coolant Temperature / Intake Air Temperature Correlation	-Intake Air Temperature (IAT) sensor -Engine Coolant Temperature (ECT) sensor -ECM	Comes on	DTC stored	-	INFO
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction	-Throttle position sensor (built into throttle body) -ECM	Comes on	DTC stored	Applies	INFO
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	- Throttle Position (TP) sensor (built into throttle body) - Throttle Position sensor circuit - ECM	Comes on	DTC stored	Applies	INFO
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	-Throttle position sensor (built into throttle body) -Short in VTA1 circuit -Open in VC circuit -ECM	Comes on	DTC stored	Applies	INFO
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	-Throttle position sensor (built into throttle body) -Open in VTA1 circuit -Open in E2 circuit -Short between VC and VTA1 circuits -ECM	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	-Cooling system -Engine coolant temperature sensor -Thermostat	Comes on	DTC stored	Applies	INFO
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	-Thermostat -Cooling system -Engine coolant temperature sensor -ECM	Comes on	DTC stored	Applies	INFO
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	-Heated Oxygen (HO2) sensor (sensor 2) -Air-Fuel Ratio (A/F) sensor (sensor 1) -Gas leak from exhaust system -Fuel pressure -Fuel injector -PCV valve and hose -Air induction system	Comes on	DTC stored	-	INFO
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	-Open or short in Heated Oxygen (HO2) sensor (sensor 2) circuit -HO2 sensor (sensor 2) -HO2 sensor heater (sensor 2) -Air-Fuel Ratio (A/F) sensor (sensor 1) -Gas leak from exhaust system	Comes on	DTC stored	Applies	INFO
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	-Short in Heated Oxygen (HO2) sensor (sensor 2) circuit -HO2 sensor (sensor 2) -ECM -Air-Fuel Ratio (A/F) sensor (sensor 1)	Comes on	DTC stored	-	INFO
P0139	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)	-Short in Heated Oxygen (HO2) sensor (sensor 2) circuit -HO2 sensor (sensor 2) -ECM	Comes on	DTC stored	-	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)	-Open or short in Heated Oxygen (HO2) sensor (sensor 2) heater circuit -HO2 sensor (sensor 2) heater -ECM power source circuit -ECM	Comes on	DTC stored	Applies	INFO
P0171	System Too Lean (Bank 1)	-Air induction system -Injector blockage -Mass air flow meter -Engine coolant temperature sensor -Fuel pressure -Gas leak from exhaust system -Open or short in air fuel ratio sensor (sensor 1) circuit -Air fuel ratio sensor (sensor 1) -EFI NO. 2 fuse -PCV valve and hose -PCV hose connections -ECM -Wire harness or connector	Comes on	DTC stored	Applies	INFO
P0172	System Too Rich (Bank 1)	-Injector leak or blockage -Mass air flow meter -Engine coolant temperature sensor -Ignition system -Fuel pressure -Gas leak from exhaust system -Open or short in air fuel ratio sensor (sensor 1) circuit -Air fuel ratio sensor (sensor 1) -EFI NO. 2 fuse -ECM -Wire harness or connector	Comes on	DTC stored	Applies	INFO
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	-Throttle position sensor (built into throttle body) -ECM	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	-Throttle position sensor (built into throttle body) -Short in VTA2 circuit -Open in VC circuit -ECM	Comes on	DTC stored	Applies	INFO
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	-Throttle position sensor (built into throttle body) -Open in VTA2 circuit -Open in E2 circuit -Short between VC and VTA2 circuits -ECM	Comes on	DTC stored	Applies	INFO
P0300	Random / Multiple Cylinder Misfire Detected	-Open or short in engine wire harness -Connector connection -Vacuum hose connections -Ignition system -Fuel injector -Fuel pressure -Mass Air Flow (MAF) meter -Engine Coolant Temperature (ECT) sensor -Compression pressure -Valve clearance -Valve timing -PCV valve and hose -PCV hose connections -Air induction system -ECM -Tumble Control Valve (TCV)	Comes on/Blinks*1	DTC stored	Applies	INFO
P0301	Cylinder 1 Misfire Detected	-Same as DTC P0300	Comes on/Blinks*1	DTC stored	Applies	INFO
P0302	Cylinder 2 Misfire Detected	-Same as DTC P0300	Comes on/Blinks*1	DTC stored	Applies	INFO
P0303	Cylinder 3 Misfire Detected	-Same as DTC P0300	Comes on/Blinks*1	DTC stored	Applies	INFO
P0304	Cylinder 4 Misfire Detected	-Same as DTC P0300	Comes on/Blinks*1	DTC stored	Applies	INFO
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	-Short in knock sensor circuit -Knock sensor -ECM	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	-Open in knock sensor circuit -Knock sensor -ECM	Comes on	DTC stored	Applies	INFO
P0335	Crankshaft Position Sensor "A" Circuit	-Open or short in Crankshaft Position (CKP) sensor circuit -CKP sensor -Crankshaft position sensor plate -ECM	Comes on	DTC stored	Applies	INFO
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	-Open or short in Crankshaft Position (CKP) sensor circuit -CKP sensor -Crankshaft position sensor plate -ECM	-	DTC stored	Applies	INFO
P0340	Camshaft Position Sensor Circuit Malfunction	-Open or short in camshaft position sensor circuit for intake camshaft -Camshaft position sensor for intake camshaft -Camshaft timing gear for intake camshaft -Timing chain jumped tooth for intake camshaft -ECM	Comes on	DTC stored	Applies	INFO
P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)	-Open or short in camshaft position sensor circuit for intake camshaft -Camshaft position sensor for intake camshaft -Camshaft timing gear for intake camshaft -Timing chain jumped tooth for intake camshaft -ECM	Comes on	DTC stored	Applies	INFO
P0343	Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)	-Open or short in camshaft position sensor circuit for intake camshaft -Camshaft position sensor for intake camshaft -Camshaft timing gear for intake camshaft -Timing chain jumped tooth	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
		for intake camshaft -ECM				
P0351	Ignition Coil "A" Primary / Secondary Circuit	-Ignition system -Open or short in IGF1 or IGT1 circuit between ignition coil and ECM -No. 1 ignition coil -ECM	Comes on	DTC stored	Applies	INFO
P0352	Ignition Coil "B" Primary / Secondary Circuit	-Ignition system -Open or short in IGF1 or IGT2 circuit between ignition coil and ECM -No. 2 ignition coil -ECM	Comes on	DTC stored	Applies	INFO
P0353	Ignition Coil "C" Primary / Secondary Circuit	-Ignition system -Open or short in IGF1 or IGT3 circuit between ignition coil and ECM -No. 3 ignition coil -ECM	Comes on	DTC stored	Applies	INFO
P0354	Ignition Coil "D" Primary / Secondary Circuit	-Ignition system -Open or short in IGF1 or IGT4 circuit between ignition coil and ECM -No. 4 ignition coil -ECM	Comes on	DTC stored	Applies	INFO
P0365	Camshaft Position Sensor "B" Circuit (Bank 1)	-Open or short in exhaust camshaft position sensor circuit -Exhaust camshaft position sensor -Camshaft timing gear for exhaust camshaft -Timing chain jumped tooth for exhaust camshaft -ECM	Comes on	DTC stored	Applies	INFO
P0367	Camshaft Position Sensor "B" Circuit Low Input (Bank 1)	-Open or short in exhaust camshaft position sensor circuit -Exhaust camshaft position sensor -Camshaft timing gear for exhaust camshaft	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
		-Timing chain jumped tooth for exhaust camshaft -ECM				
P0368	Camshaft Position Sensor "B" Circuit High Input (Bank 1)	-Open or short in exhaust camshaft position sensor circuit -Exhaust camshaft position sensor -Camshaft timing gear for exhaust camshaft -Timing chain jumped tooth for exhaust camshaft -ECM	Comes on	DTC stored	Applies	INFO
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	-Gas leak from exhaust system -Air fuel ratio sensor (sensor 1) -Heated oxygen sensor (sensor 2) -Exhaust manifold (TWC: Front Catalyst) -Center exhaust pipe assembly (TWC: Rear Catalyst)	Comes on	DTC stored	Applies	INFO
P043E	Evaporative Emission System Leak Detection Reference Orifice Low Flow	-Canister pump module (reference orifice, leak detection pump, vent valve) -Connector/wire harness (canister pump module - ECM) -EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) -ECM	Comes on	DTC stored	-	INFO
P043F	Evaporative Emission System Reference Orifice High Flow	-Canister pump module (reference orifice, leak detection pump, vent valve) -Connector/wire harness (canister pump module - ECM) -EVAP system hose (pipe from air inlet port to canister pump module, canister filter,	Comes on	DTC stored	-	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
		fuel tank vent hose) -ECM				
P0441	Evaporative Emission Control System Incorrect Purge Flow	-Purge VSV -Connector/wire harness (purge VSV - ECM) -ECM -Canister pump module -Leak from EVAP system -Leak from EVAP line (purge VSV - intake manifold)	Comes on	DTC stored	-	INFO
P0443	Evaporative Emission Control System Purge Control Valve Circuit	-Open or short in purge VSV circuit -Purge VSV -ECM	Comes on	DTC stored	Applies*2	INFO
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	-Canister pump module -Connector/wire harness (canister pump module - ECM) -EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) -ECM	Comes on	DTC stored	-	INFO
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	-Canister pump module -Connector/wire harness (canister pump module - ECM) -EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) -ECM	Comes on	DTC stored	Applies	INFO
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	-Canister pump module -Connector/wire harness (canister pump module - ECM) -EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) -ECM	Comes on	DTC stored	Applies	INFO
P0455	Evaporative Emission Control System Leak	-Fuel tank cap (loose) -Leak from EVAP line	Comes on	DTC stored	-	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
	Detected (Gross Leak)	(canister - fuel tank) -Leak from EVAP line (purge VSV - canister) -Canister pump module -Leak from fuel tank -Leak from canister				
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	-Fuel tank cap (loose) -Leak from EVAP line (canister - fuel tank) -Leak from EVAP line (purge VSV - canister) -Canister pump module -Leak from fuel tank -Leak from canister	Comes on	DTC stored	-	INFO
P0500	Vehicle Speed Sensor "A"	-Open or short in speed signal circuit -Speedometer circuit (wheel speed sensor, skid control ECU) -Combination meter -ECM	Comes on	DTC stored	Applies	INFO
P0504	Brake Switch "A" / "B" Correlation	-Short in stop light switch signal circuit -STOP fuse -IGN fuse -Stop light switch -ECM	-	DTC stored	Applies	INFO
P0505	Idle Control System Malfunction	-ETCS (Electronic Throttle Control System) -Air induction system -PCV hose connections -ECM	Comes on	DTC stored	Applies	INFO
P050A	Cold Start Idle Air Control System Performance	-Throttle body -Mass air flow meter -PCV system -Air cleaner filter element -Air induction system -VVT system -ECM -Wire harness or connector	Comes on	DTC stored	-	INFO
P050B	Cold Start Ignition Timing Performance	-Throttle with motor body assembly	Comes on	DTC stored	-	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
		-Mass air flow meter -PCV system -Air cleaner filter element -Air induction system -VVT system -ECM -Wire harness or connector				
P0560	System Voltage	-Open in back up power source circuit -Battery -Battery terminals -EFI MAIN fuse -ECM	Comes on	DTC stored	Applies	INFO
P0604	Random Access Memory (RAM)	-ECM	Comes on	DTC stored	Applies	INFO
P0606	ECM / PCM Processor	-ECM	Comes on	DTC stored	Applies	INFO
P0607	Control Module Performance	-Exhaust gas leak -Heated Oxygen (HO2) sensor -ECM	Comes on	DTC stored	-	INFO
P060A	Internal Control Module Monitoring Processor Performance	-ECM	Comes on	DTC stored	Applies	INFO
P060B	Internal Control Module A/D Processing Performance	-ECM	Comes on	DTC stored	Applies	INFO
P060D	Internal Control Module Accelerator Pedal Position Performance	-ECM	Comes on	DTC stored	Applies	INFO
P060E	Internal Control Module Throttle Position Performance	-ECM	Comes on	DTC stored	Applies	INFO
P0617	Starter Relay Circuit High	-Park/Neutral Position (PNP) switch or clutch start switch -ST relay circuit -Ignition switch -ECM	Comes on	DTC stored	Applies	INFO
P062F	Internal Control Module EEPROM Error	ECM	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
P0630	VIN not Programmed or Mismatch - ECM / PCM	-ECM	Comes on	DTC stored	Applies	INFO
P0657	Actuator Supply Voltage Circuit / Open	-ECM	Comes on	DTC stored	Applies	INFO
P0724	Brake Switch "B" Circuit High	-Short in stop light switch signal circuit -Stop light switch -ECM	Comes on	DTC stored	Applies	INFO
P101D	A/F Sensor Heater Circuit Performance Bank 1 Sensor 1 Stuck ON	-ECM	Comes on	DTC stored	Applies	INFO
P102D	O2 Sensor Heater Circuit Performance Bank 1 Sensor 2 Stuck ON	-ECM	Comes on	DTC stored	Applies	INFO
P1607	Cruise Control Input Processor	-ECM	Comes on	DTC stored	Applies	INFO
P2004	Intake Manifold Runner Control Stuck Open (Bank 1)	-DC motor for TCV circuit -DC motor for TCV -TCV position sensor -TCV -ECM	Comes on	DTC stored	Applies	INFO
P2006	Intake Manifold Runner Control Stuck Closed (Bank 1)	-DC motor for TCV circuit -DC motor for TCV -TCV position sensor -TCV -ECM	Comes on	DTC stored	Applies	INFO
P2009	Intake Manifold Runner Control Circuit Low (Bank 1)	-Open or short in DC motor for TCV circuit -Intake manifold (DC motor for TCV) -ECM	Comes on	DTC stored	Applies	INFO
P2010	Intake Manifold Runner Control Circuit High (Bank 1)	-Open or short in DC motor for TCV circuit -Intake manifold (DC motor for TCV) -ECM	Comes on	DTC stored	Applies	INFO
P2014	Intake Manifold Runner Position Sensor / Switch Circuit (Bank 1)	-Open or short in TCV position sensor circuit -TCV position sensor -ECM	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
P2016	Intake Manifold Runner Position Sensor / Switch Circuit Low (Bank 1)	-Open or short in TCV position sensor circuit -TCV position sensor -ECM	Comes on	DTC stored	Applies	INFO
P2017	Intake Manifold Runner Position Sensor / Switch Circuit High (Bank 1)	-Open or short in TCV position sensor circuit -TCV position sensor -ECM	Comes on	DTC stored	Applies	INFO
P2102	Throttle Actuator Control Motor Circuit Low	-Open in throttle actuator circuit -Throttle actuator -ECM	Comes on	DTC stored	Applies	INFO
P2103	Throttle Actuator Control Motor Circuit High	-Short in throttle actuator circuit -Throttle actuator -Throttle valve -Throttle body -ECM	Comes on	DTC stored	Applies	INFO
P2111	Throttle Actuator Control System - Stuck Open	-Throttle actuator -Throttle body -Throttle valve -ECM	Comes on	DTC stored	Applies	INFO
P2112	Throttle Actuator Control System - Stuck Closed	-Throttle actuator -Throttle body -Throttle valve -ECM	Comes on	DTC stored	Applies	INFO
P2118	Throttle Actuator Control Motor Current Range / Performance	-Open in ETCS power source circuit -Battery -Battery terminals -ETCS fuse -ECM	Comes on	DTC stored	Applies	INFO
P2119	Throttle Actuator Control Throttle Body Range / Performance	-Electronic Throttle Control System (ETCS) -ECM	Comes on	DTC stored	Applies	INFO
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	-Accelerator Pedal Position (APP) sensor -ECM	Comes on	DTC stored	Applies	INFO
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range /	-Accelerator Pedal Position (APP) sensor -ECM	Comes on	DTC stored	Applies	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
	Performance					
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	-Accelerator Pedal Position (APP) sensor -Open in VCP1 circuit -Open or ground short in VPA circuit -ECM	Comes on	DTC stored	Applies	INFO
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	-Accelerator Pedal Position (APP) sensor -Open in EPA circuit -ECM	Comes on	DTC stored	Applies	INFO
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	-Accelerator Pedal Position (APP) sensor -ECM	Comes on	DTC stored	Applies	INFO
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	-Accelerator Pedal Position (APP) sensor -Open in VCP2 circuit -Open or ground short in VPA2 circuit -ECM	Comes on	DTC stored	Applies	INFO
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	-Accelerator Pedal Position (APP) sensor -Open in EPA2 circuit -ECM	Comes on	DTC stored	Applies	INFO
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	-Short between VTA1 and VTA2 circuits -Throttle position sensor (built into throttle body) -ECM	Comes on	DTC stored	Applies	INFO
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	-Short between VPA and VPA2 circuits -Accelerator Pedal Position (APP) sensor -ECM	Comes on	DTC stored	Applies	INFO
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	-Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit -A/F sensor (sensor 1) -A/F sensor (sensor 1) heater -A/F sensor heater circuit -Air induction system -Fuel pressure	Comes on	DTC stored	-	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
		-Fuel injector -ECM				
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	-Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit -A/F sensor (sensor 1) -A/F sensor (sensor 1) heater -A/F sensor heater circuit -Air induction system -Fuel pressure -Fuel injector -ECM	Comes on	DTC stored	-	INFO
P2237	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)	-Open in Air Fuel Ratio (A/F) sensor (sensor 1) circuit -A/F sensor (sensor 1) -ECM	Comes on	DTC stored	Applies	INFO
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	-Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit -A/F sensor (sensor 1) -ECM	Comes on	DTC stored	Applies	INFO
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	-Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit -A/F sensor (sensor 1) -ECM	Comes on	DTC stored	Applies	INFO
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	-Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit -A/F sensor (sensor 1) -ECM	Comes on	DTC stored	Applies	INFO
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	-Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit -A/F sensor (sensor 1) -ECM	Comes on	DTC stored	Applies	INFO
P2401	Evaporative Emission Leak Detection Pump Stuck OFF	-Canister pump module (reference orifice, leak detection pump, vent valve) -Connector/wire harness (canister pump module - ECM)	Comes on	DTC stored	-	INFO

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DTC CODE	DETECTION ITEM	TROUBLE AREA	MIL	MEMORY	DTC FOR MEXICO MODELS	SEE PAGE
		-EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) -ECM				
P2402	Evaporative Emission Leak Detection Pump Stuck ON	-Canister pump module (reference orifice, leak detection pump, vent valve) -Connector/wire harness (canister pump module - ECM) -EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) -ECM	Comes on	DTC stored	-	INFO
P2419	Evaporative Emission System Switching Valve Control Circuit Low	-Canister pump module (reference orifice, leak detection pump, vent valve) -Connector/wire harness (canister pump module - ECM) -EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) -ECM	Comes on	DTC stored	-	INFO
P2420	Evaporative Emission System Switching Valve Control Circuit High	-Canister pump module (reference orifice, leak detection pump, vent valve) -Connector/wire harness (canister pump module - ECM) -ECM	Comes on	DTC stored	-	INFO
P2610	ECM / PCM Internal Engine Off Timer Performance	-ECM	Comes on	DTC stored	Applies	INFO
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	-Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit -A/F sensor -A/F sensor heater -ECM	Comes on	DTC stored	-	INFO

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*1: The MIL flashes when a catalyst-damaging misfire is detected.
*2: Only for Mexico Models





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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDK0J9X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: DTC CHECK / CLEAR (2011 RAV4)		

DTC CHECK / CLEAR

NOTICE:

When the diagnosis system is changed from normal mode to check mode or vice versa, all DTCs and freeze frame data recorded in normal mode are cleared. Before changing modes, always check and make a note of DTCs and freeze frame data.

HINT:

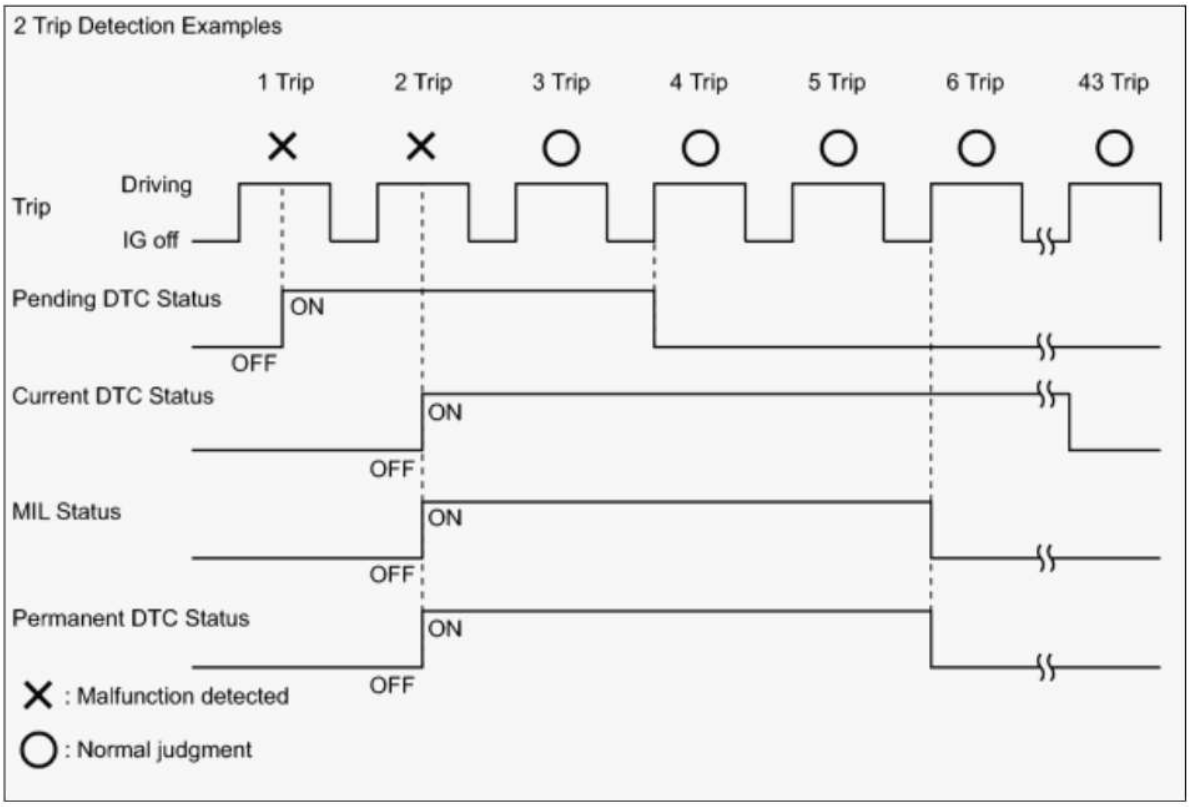
- DTCs which are stored in the ECM can be displayed on the Techstream. The Techstream can display the current, pending and permanent DTCs.
- If a malfunction is detected during the current driving cycle, current and permanent DTCs are stored.
- Some DTCs are not stored if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.
- Current and pending DTCs can be cleared by using the Techstream or by disconnecting the cable from the negative battery terminal. However, permanent DTCs cannot be cleared using either of these two methods.
- After clearing current DTCs using the Techstream (or by disconnecting the cable from the negative battery terminal), permanent DTCs can be cleared when the system is determined to be normal for the relevant DTCs and then the universal trip is performed. The driving pattern to obtain a normal judgment is described under the "CONFIRMATION DRIVING PATTERN" for the respective DTC.

2 Trip Detection Examples

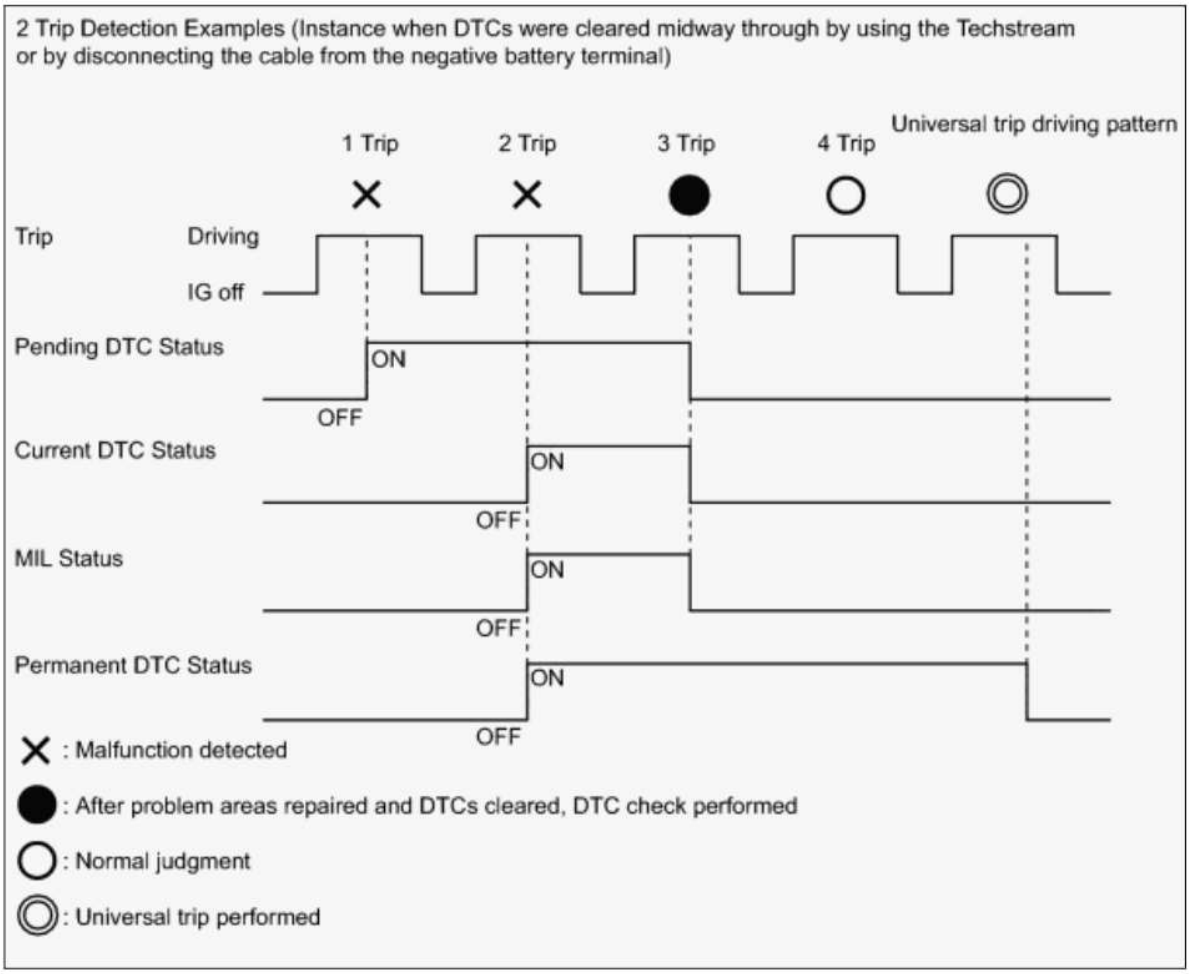
Pending DTC	Store condition	Malfunction detected
	Clear condition	System determined to be normal or DTCs cleared using Techstream or Cable disconnected from negative battery terminal
Current DTC	Store condition	Malfunction detected (2nd trip)
	Clear condition	No malfunctions in 40 driving cycles or DTCs cleared using Techstream or Cable disconnected from negative battery terminal
Permanent DTC	Store condition	Malfunction detected (2nd trip)
	Clear condition	Ignition switch turned to ON after normal judgment obtained in 3 consecutive driving cycles or After DTCs cleared using Techstream or cable disconnected from negative battery terminal, normal judgment obtained and universal trip performed (not for misfire

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		and fuel system DTCs) or After DTCs cleared using Techstream or cable disconnected from negative battery terminal, malfunction not detected when universal trip driving performed (misfire and fuel system DTCs)
MIL	ON	Malfunction detected (2nd trip)
	OFF	Ignition switch turned to ON after normal judgment obtained in 3 consecutive driving cycles or DTCs cleared using Techstream or Cable disconnected from negative battery terminal



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HINT:

- Obtaining a normal judgment and performing a universal trip driving pattern can be done in the same driving cycle or in different driving cycles.
- It is unnecessary to obtain a normal judgment if the DTCs are misfire or fuel system DTCs.

1. CHECK DTC

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Check the DTC(s) and freeze frame data, and then write them down.

(f) Check the details of the DTC(s) INFO .

2. CLEAR DTC (Pending and Current DTC)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Clear the DTCs.

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3. CLEAR DTC (Pending and Current DTC without using Techstream)

(a) Perform either of the following operations:

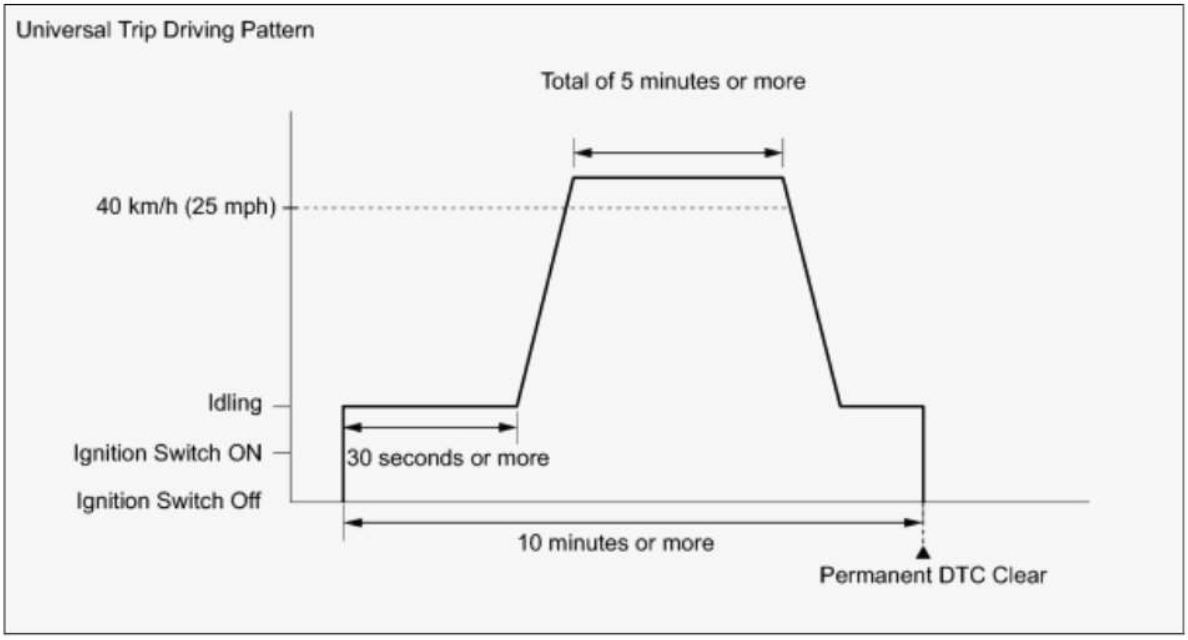
(1) Disconnect the cable from the negative (-) battery terminal for more than 1 minute.

(2) Remove the EFI MAIN and ETCS fuses from the engine room relay block located inside the engine compartment for more than 1 minute.

4. CLEAR PERMANENT DTC

HINT:

Even if the following procedure is not performed, permanent DTCs are cleared by obtaining a normal judgment during 3 consecutive driving cycles.



(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Check if permanent DTCs are stored.

HINT:

If permanent DTCs are not output, it is not necessary to continue this procedure.

(f) Clear DTCs.

(g) Perform the respective confirmation driving patterns in order to obtain a normal judgment for the output DTCs.

HINT:

- Confirmation driving patterns do not need to be performed for misfire and fuel system DTCs.
- For the confirmation driving pattern, refer to the procedures for the relevant DTC INFO .

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(h) Perform the universal trip.

HINT:

The driving pattern to obtain a normal judgment and the universal trip driving can be performed consecutively in the same driving cycle.

1. Idle the engine for 30 seconds or more.
2. Drive the vehicle at 40 km/h (25 mph) or more for a total of 5 minutes or more.

   HINT:

   It is possible to complete the drive pattern even if the vehicle decelerates to less than 40 km/h (25 mph) during the driving cycle provided that the vehicle is driven at 40 km/h (25 mph) or more for a total of 5 minutes.

3. Allow 10 minutes or more to elapse from the time the engine is started.

(i) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(j) Check that the permanent DTCs have been cleared.

HINT:

The permanent DTCs are cleared when the universal trip is completed.





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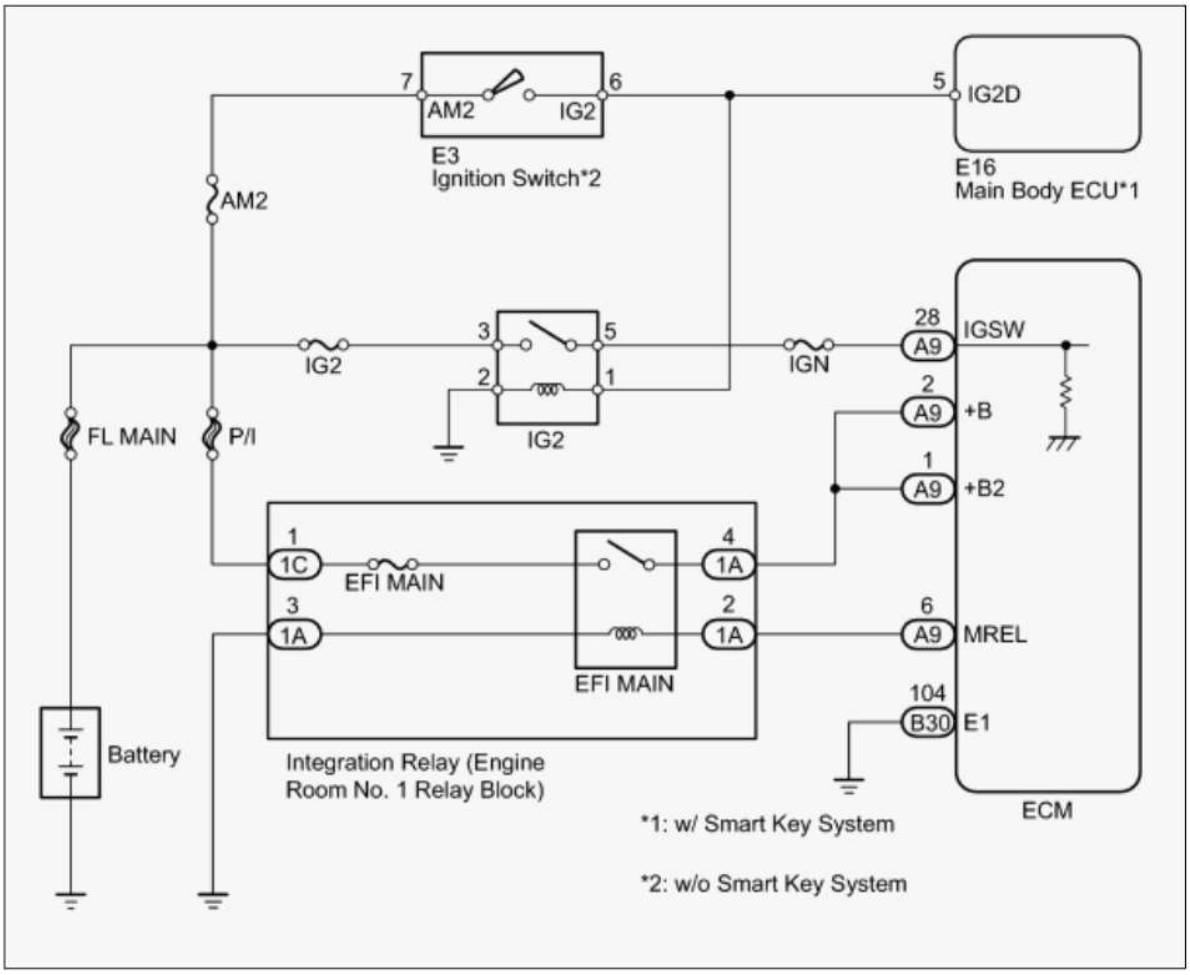
Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001DN8042X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: ECM Power Source Circuit (2011 RAV4)		

ECM Power Source Circuit

DESCRIPTION

When the ignition switch is turned to ON, battery voltage is applied to IGSW of the ECM. The output signal from the MREL terminal of the ECM causes a current to flow to the coil, closing the contacts of the integration relay (EFI MAIN relay) and supplying power to either terminal +B or +B2 of the ECM.

WIRING DIAGRAM



INSPECTION PROCEDURE

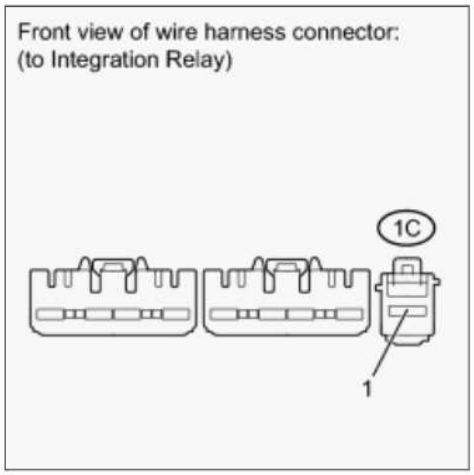
NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

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PROCEDURE

1.	**CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - BATTERY)**



(a) Remove the integration relay from the engine room No. 1 relay block.

(b) Disconnect the integration relay connector.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
Engine room relay block (1C-1) - Body ground	Always	11 to 14 V

(d) Reinstall the integration relay.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR (INTEGRATION RELAY - BATTERY)**

OK ▼

2.	**INSPECT INTEGRATION NO.1 RELAY (EFI MAIN RELAY)**

(a) Inspect the EFI MAIN relay INFO .

NG ▶ **REPLACE INTEGRATION NO.1 RELAY**

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OK



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Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000YEQ070X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: EVAP System (2011 RAV4)		

EVAP System

RELATED DTCS

DTCS	MONITORING ITEMS	SEE PAGE
P043E	Reference orifice clogged (built into canister pump module)	INFO
P043F	Reference orifice high-flow (built into canister pump module)	
P0441	• Purge VSV (Vacuum Switching Valve) stuck closed • Purge VSV stuck open • Purge flow	INFO
P0451	• Canister pressure sensor (built into canister pump module) noise • Canister pressure sensor (built into canister pump module) signal becomes fixed/flat	INFO
P0452	Canister pressure sensor (built into canister pump module) voltage low	
P0453	Canister pressure sensor (built into canister pump module) voltage high	
P0455	EVAP gross leak	INFO
P0456	EVAP small leak	
P2401	Leak detection pump stuck OFF (built into canister pump module)	INFO
P2402	Leak detection pump stuck ON (built into canister pump module)	
P2419	Vent valve stuck closed (built into canister pump module)	INFO
P2420	Vent valve stuck open (vent) (built into canister pump module)	INFO
P2610	Soak timer (built into ECM)	INFO

If any EVAP system DTCs are output, the malfunctioning area can be determined using the table below.

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DTCs / Malfunctioning Areas	P043E P043F	P0441	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
Reference orifice clogged	●							●	●	
Reference orifice high-flow	●							●	●	
Purge VSV stuck open		●				●				
Purge VSV stuck closed		●								
Canister pressure sensor fixed			●							
Canister pressure sensor noise			●							
Canister pressure sensor low output				●						
Canister pressure sensor high output					●					
Gross leak		●				●				
Small leak							●			
Leak detection pump stuck OFF	●							●	●	
Leak detection pump stuck ON	●							●	●	
Vent valve stuck closed	●							●	●	
Vent valve stuck open (vent)										●

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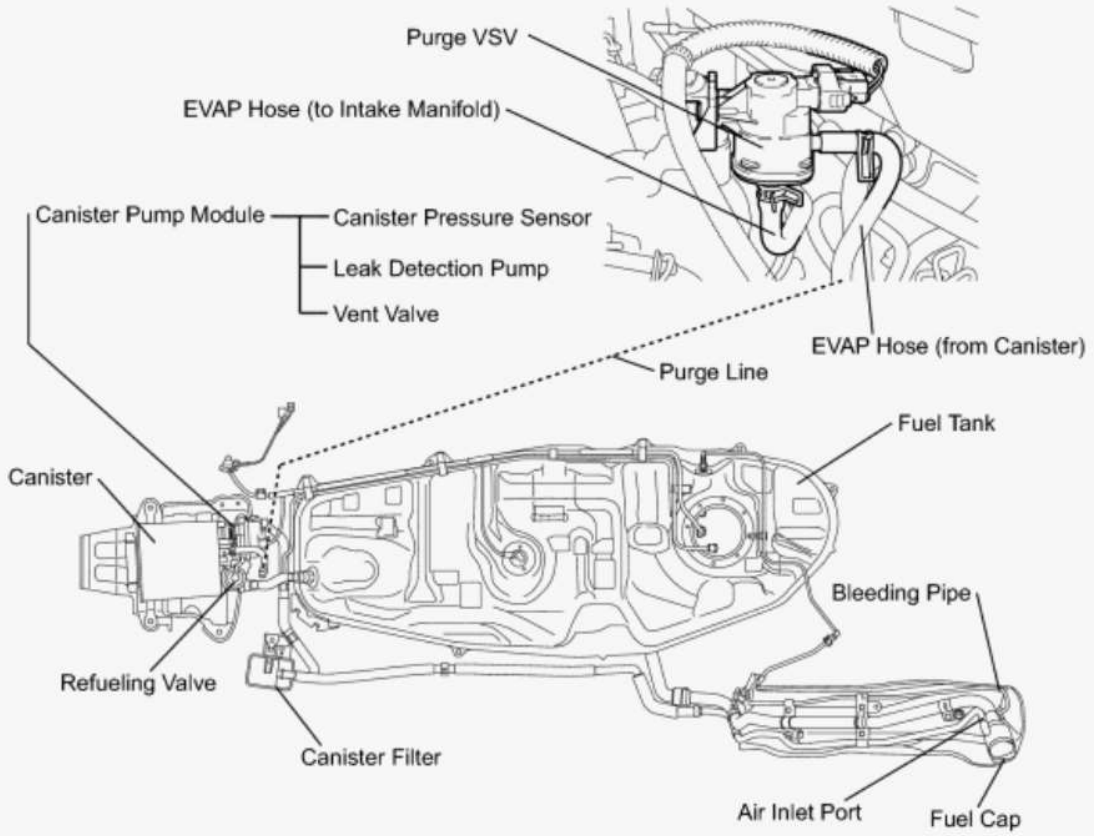
NOTICE:

If the reference pressure difference between the first and second checks is more than the specification, all the DTCs relating to the reference pressure (P043E, P043F, P2401, P2402 and P2419) are stored.

DESCRIPTION

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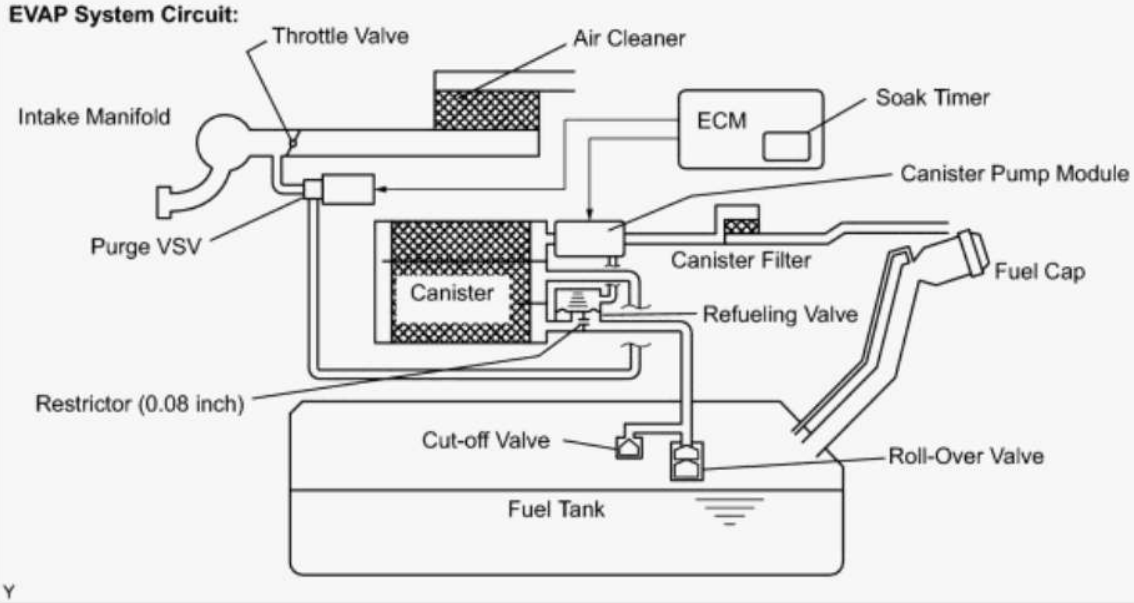
Location of EVAP (Evaporative Emission) System:



NOTE:

The canister is located near the fuel tank, underneath the body.

EVAP System Circuit:



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NOTICE:

In the EVAP system of this vehicle, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmospheric side of the canister.

While the engine is running, if a predetermined condition (closed loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged into the intake manifold. The ECM changes the duty-cycle ratio of the purge VSV to control the purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when negative pressure (vacuum) is applied to the canister.

The following two monitors run to confirm the appropriate EVAP system operation.

1. Key-off monitor

This monitor checks for EVAP (Evaporative Emission) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the ignition switch is turned off. At least 5 hours are required for the fuel to cool down to stabilize the EVAP pressure, thus making the EVAP system monitor more accurate.

The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system, and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:

***: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.**

2. Purge flow monitor

The purge flow monitor consists of two monitors. The 1st monitor is conducted every time and the 2nd monitor is activated if necessary.

- The 1st monitor

  While the engine is running and the purge VSV (Vacuum Switching Valve) is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.

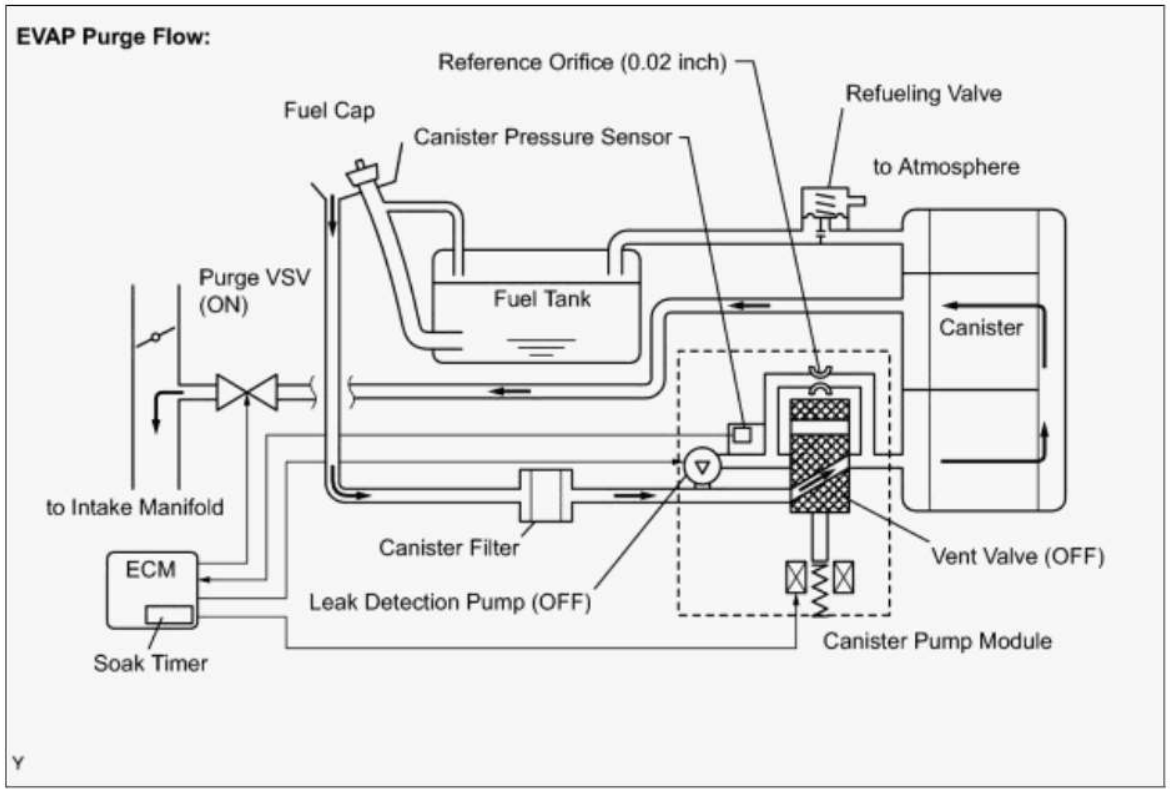
- The 2nd monitor

  The vent valve is turned OFF (open) and the EVAP pressure is measured. If the variation in the pressure is below 0.5 kPa-g (3.75 mmHg-g), the ECM interprets this as the purge VSV being stuck closed, illuminates the MIL and stores DTC P0441 (2 trip detection logic).

Atmospheric pressure check:

In order to ensure reliable malfunction detection, the variation between the atmospheric pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

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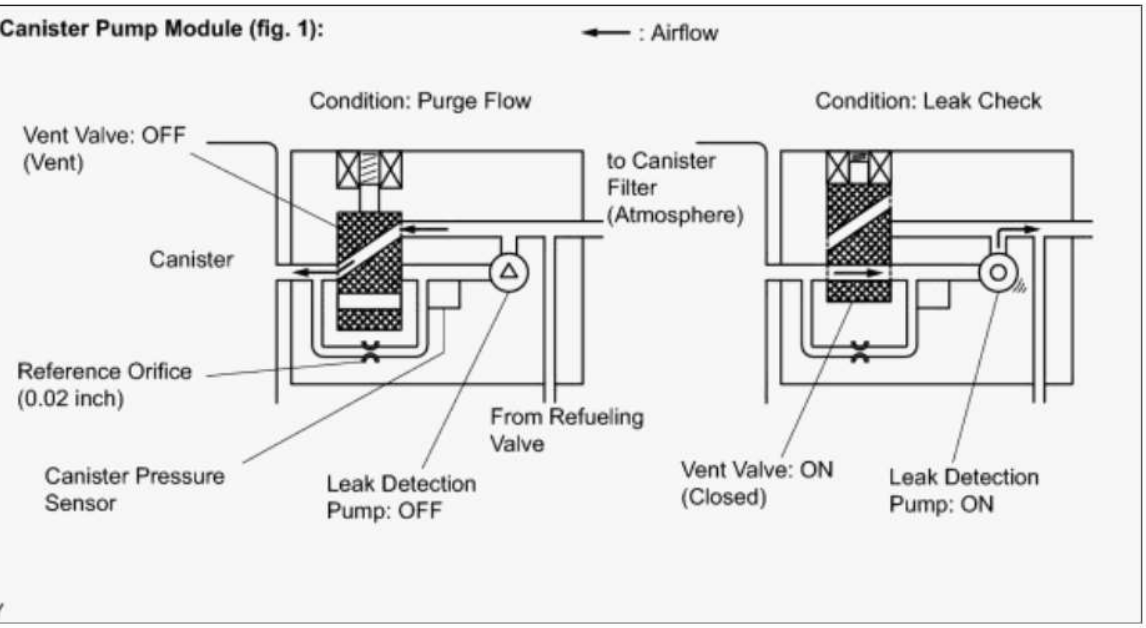


COMPONENTS	OPERATIONS
Canister	Contains activated charcoal to absorb EVAP (Evaporative Emissions) generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100% full.
Purge VSV (Vacuum Switching Valve)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty-cycle ratio (current-carrying time) (Open: ON; Closed: OFF).
Refueling valve	Controls EVAP pressure from fuel tank to canister. Valve consists of diaphragm, spring and restrictor (diameter: 0.08 inch). When fuel vapor and pressure inside fuel tank increase, valve opens. While EVAP purged, valve closes and restrictor prevents large amount of vacuum from affecting pressure in fuel tank. Valve opened while refueling.
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after ignition switch turned off. This allows fuel to cool down, stabilizing EVAP pressure. When approximately 5 hours elapsed, ECM activates (refer to fig. 3).
Canister pump module	Consists of (a) to (d) below. Canister pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning on vent valve (closed) and operating leak detection pump (refer to fig. 1).
(b) Canister pressure sensor	Indicates pressure as voltages. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure (refer to fig. 2).

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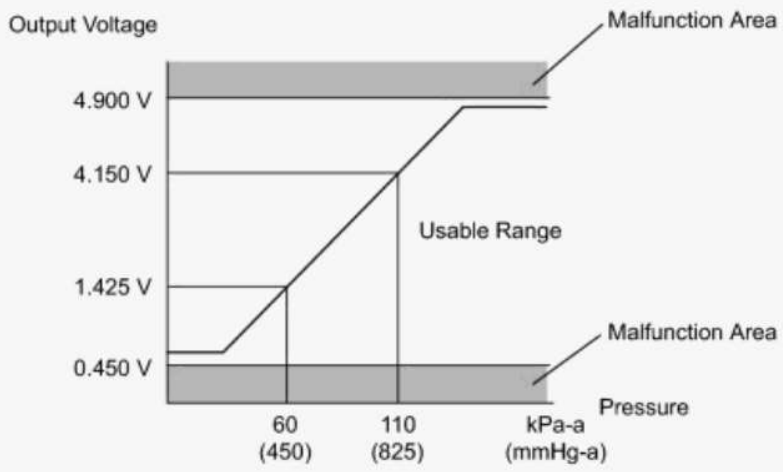
COMPONENTS	OPERATIONS
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning off vent valve and operating leak detection pump, to monitor reference pressure. Reference pressure indicates small leak of EVAP.

Canister Pump Module (fig. 1):



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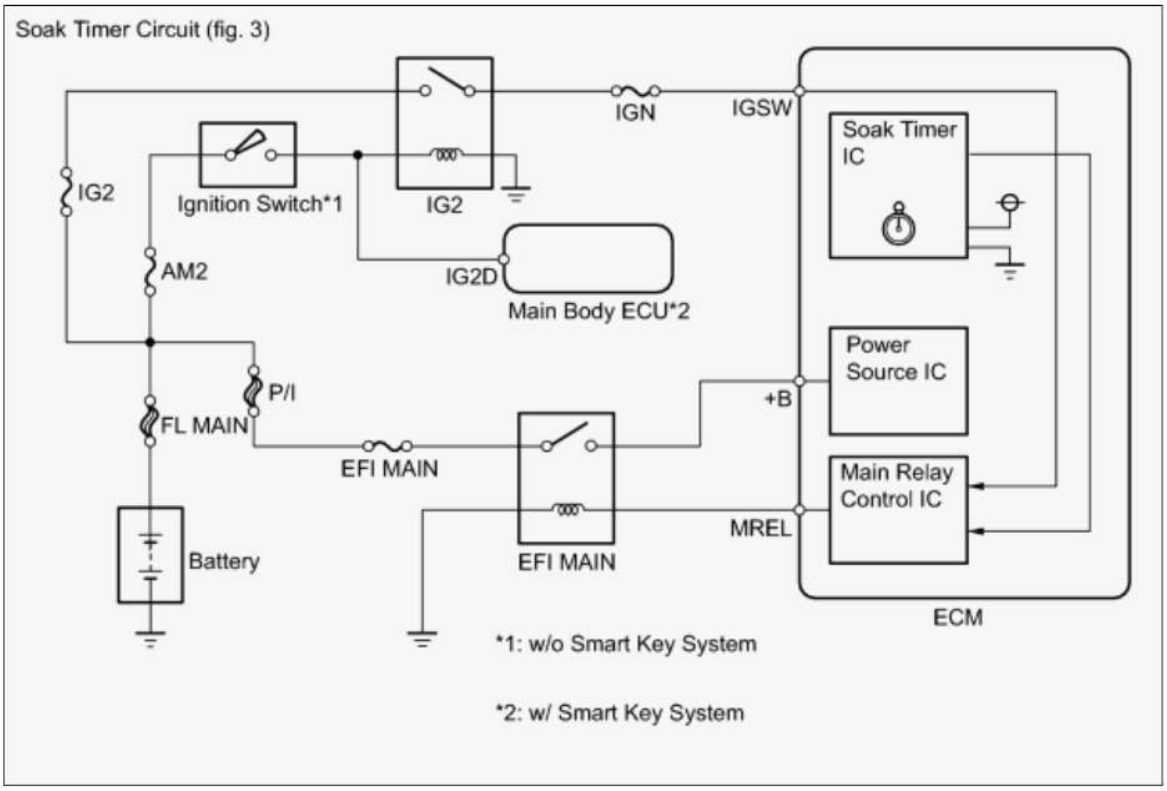
Canister Pressure Sensor Specification (fig. 2):



HINT:

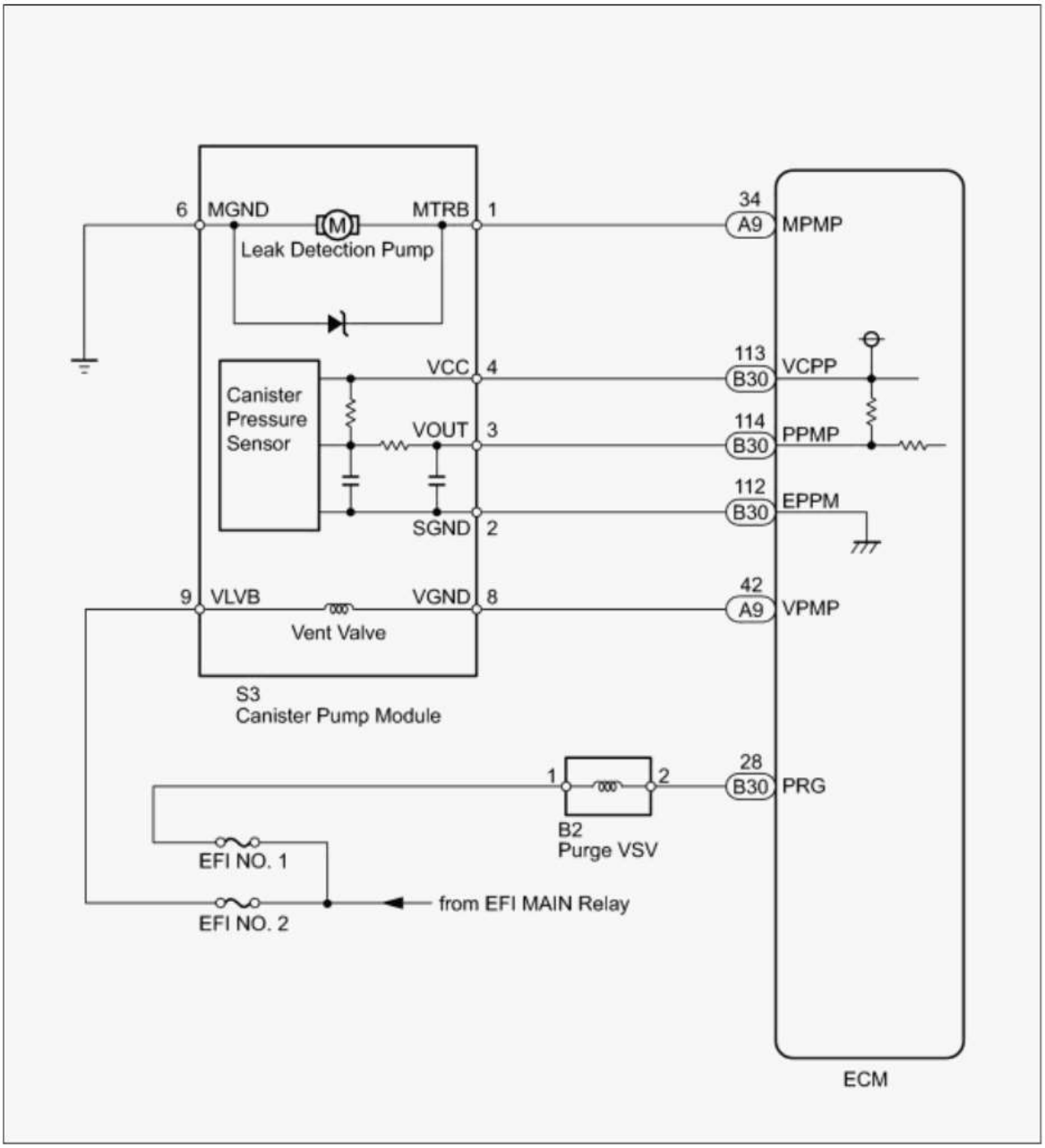
Standard atmospheric pressure is 101.3 kPa-a (760 mmHg-a)

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WIRING DIAGRAM

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INSPECTION PROCEDURE

NOTICE:

- Inspect the fuses of circuits related to this system before performing the following inspection procedure.
- The Techstream is required to conduct the following diagnostic troubleshooting procedure.

HINT:

- Using the Techstream monitor results enables the EVAP (Evaporative Emission) system to be confirmed.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	CONFIRM DTC

(a) Turn the ignition switch off and wait for 10 seconds.

(b) Turn the ignition switch to ON.

(c) Turn the ignition switch off and wait for 10 seconds.

(d) Connect the Techstream to the DLC3.

(e) Turn the ignition switch to ON and turn the Techstream on.

(f) Enter the following menus: Powertrain / Engine and ECT / Trouble Code.

(g) Confirm DTCs and freeze frame data.

If any EVAP system DTCs are output, the malfunctioning area can be determined using the table below.

NOTICE:

If the reference pressure difference between the first and second checks is more than the specification, all the DTCs relating to the reference pressure (P043E, P043F, P2401, P2402 and P2419) are stored.

DTCs / Malfunctioning Areas	P043E P043F	P0441	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
Reference orifice clogged	●							●	●	
Reference orifice high-flow	●							●	●	
Purge VSV stuck open		●				●				
Purge VSV stuck closed		●								
Canister pressure sensor fixed			●							
Canister pressure sensor noise			●							
Canister pressure sensor low output				●						
Canister pressure sensor high output					●					
Gross leak		●				●				
Small leak							●			
Leak detection pump stuck OFF	●							●	●	
Leak detection pump stuck ON	●							●	●	
Vent valve stuck closed	●							●	●	
Vent valve stuck open (vent)										●

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NEXT

2.	**PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)**

NOTICE:

- The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by the Techstream. It takes a maximum of approximately 18 minutes.
- Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.
- Do not run the engine during this operation.
- When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the temperature below 35°C (95°F).

(a) Clear DTCs INFO .

(b) Enter the following menus: Powertrain / Engine and ECT / Utility / System Check / Evaporative System Check / Automatic Mode.

(c) After the Evaporative System Check is completed, check for pending DTCs. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

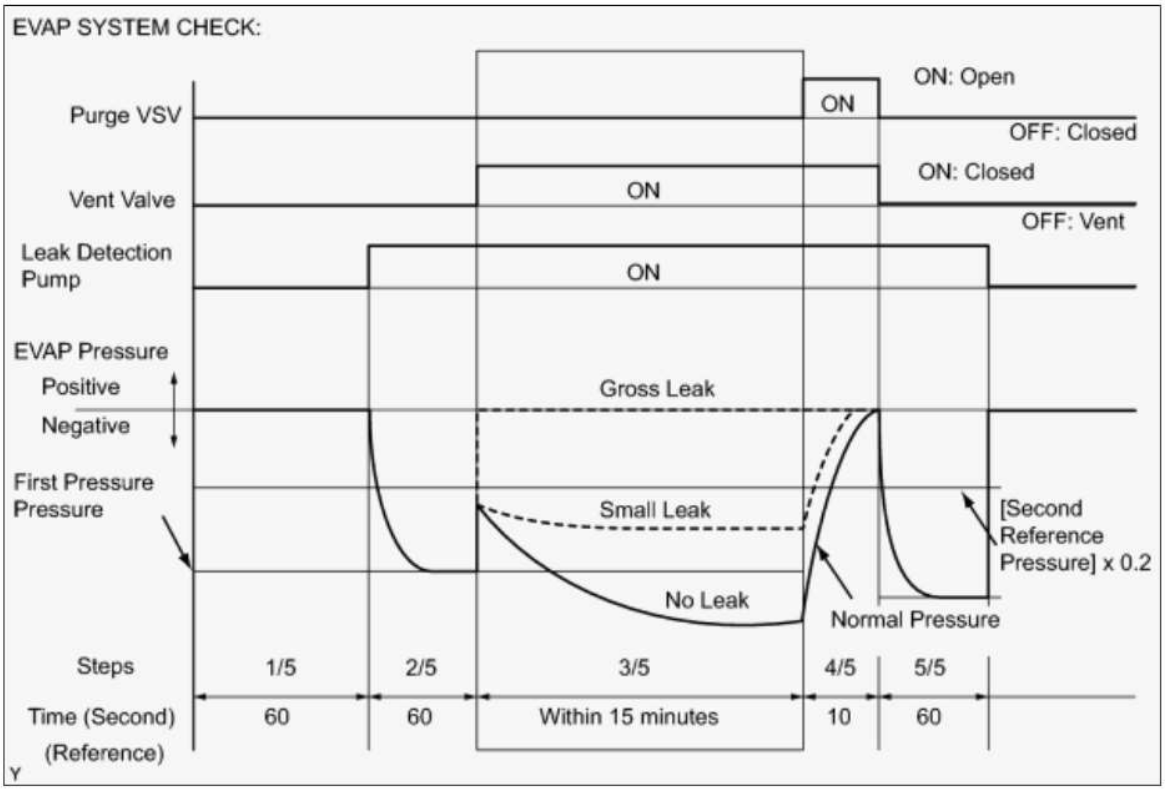
HINT:

If no pending DTCs are output, perform the Monitor Confirmation procedures (refer to the "Diagnostic Help" menu). After this confirmation, check for pending DTCs. If no DTCs are output, the evaporative system is normal.

NEXT

3.	**PERFORM EVAPORATIVE SYSTEM CHECK (MANUAL MODE)**

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NOTICE:

- In the Evaporative System Check (Manual Mode), perform the 5 Evaporative System Check steps manually using the Techstream.
- Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.
- Do not run the engine during this operation.
- When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the temperature below 35°C (95°F).

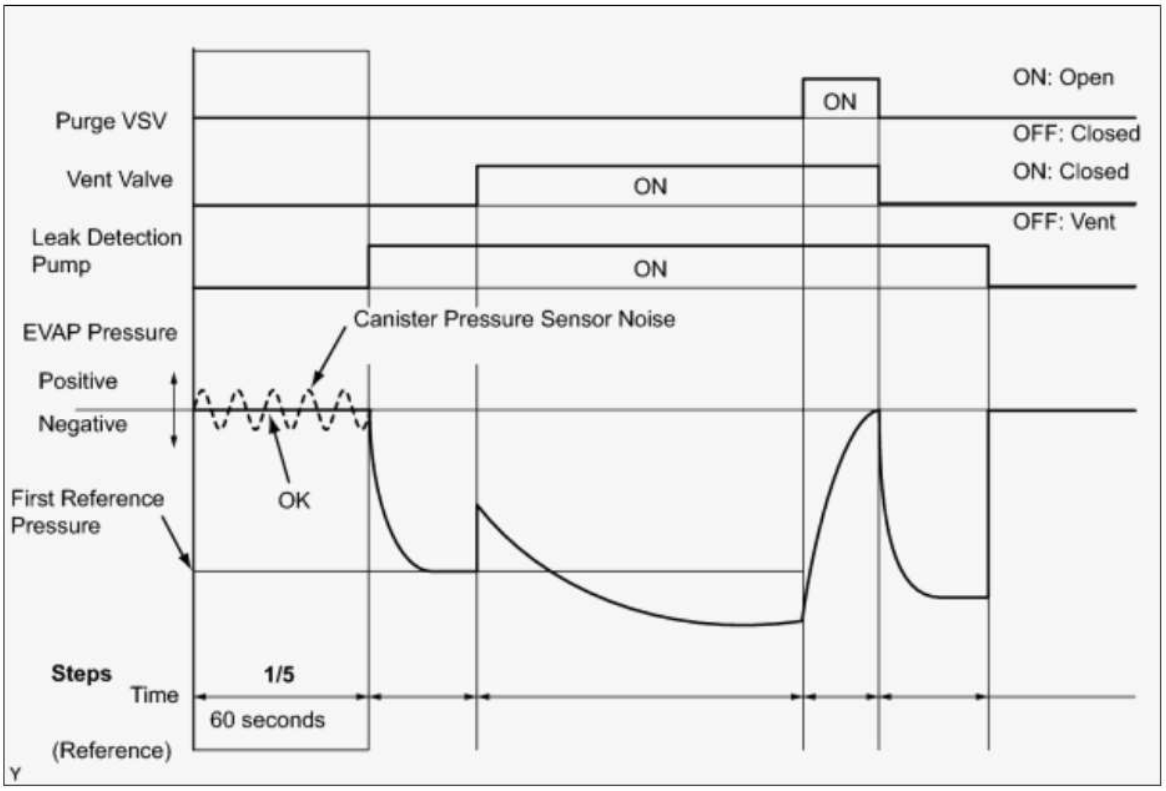
(a) Clear DTCs INFO .

(b) Enter the following menus: Powertrain / Engine and ECT / Utility / System Check / Evaporative System Check / Manual Mode.

NEXT

4.	**PERFORM EVAPORATIVE SYSTEM CHECK (STEP 1/5)**

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(a) Check the EVAP pressure in step 1/5.

Result:

DTCS*	TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
-	Virtually no variation in EVAP pressure	Not yet determined	A
P0451	EVAP pressure fluctuates by +/-0.3 kPa-g (2.25 mmHg-g) or higher	Canister pressure sensor noise	B

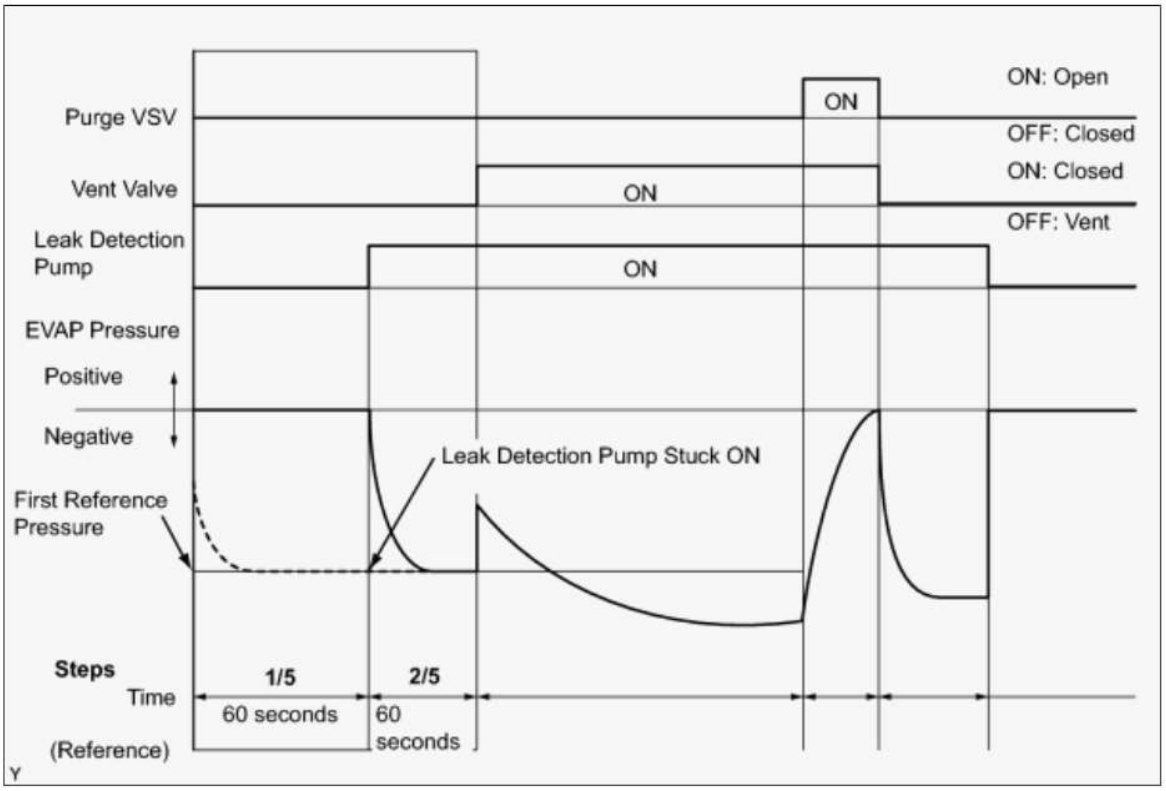
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "Confirm DTC" procedures above.

B ▶ **REPLACE CHARCOAL CANISTER ASSEMBLY**

A

5.	**PERFORM EVAPORATIVE SYSTEM CHECK (STEP 1/5 TO 2/5)**

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(a) Check the EVAP pressure in steps 1/5 and 2/5.

Result:

DTCS*	TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
-	Virtually no variation in EVAP pressure during step 1/5, then decreases to reference pressure	Not yet determined	A
P2402	Small difference between EVAP pressures during steps 1/5 and 2/5	Leak detection pump stuck ON	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "Confirm DTC" procedures above.

HINT:

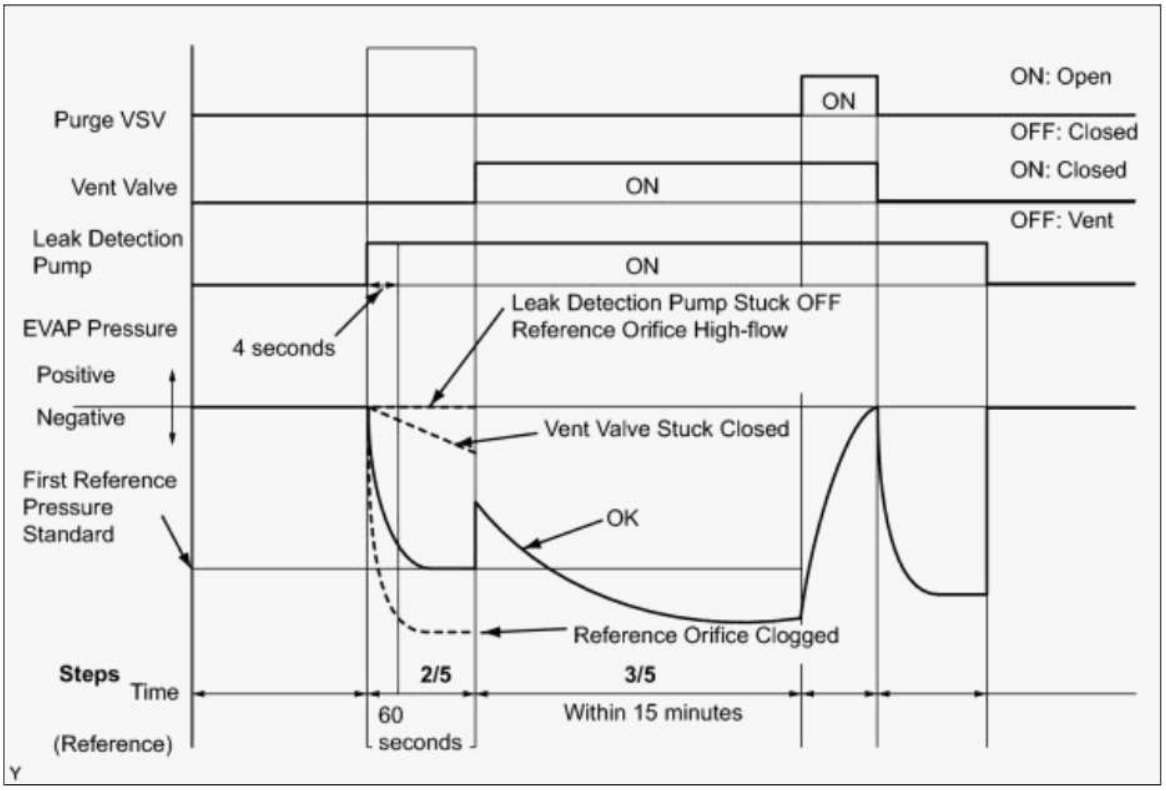
The first reference pressure is the value determined in step 2/5.

B ▶ **PERFORM ACTIVE TEST USING TECHSTREAM (VACUUM PUMP (ALONE))**

A

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6.	**PERFORM EVAPORATIVE SYSTEM CHECK (STEP 2/5)**



HINT:

Make a note of the pressures checked in steps (a) and (b) below.

(a) Check the EVAP pressure 4 seconds after the leak detection pump is activated*.

*: The leak detection pump begins to operate as step 1/5 finishes and step 2/5 starts.

(b) Check the EVAP pressure again when it has stabilized. This pressure is the reference pressure.

Result:

DTCS*	TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
-	EVAP pressure in step (b) between -4.85 kPa-g and -1.057 kPa-g (-36.4 mmHg-g and -7.93 mmHg-g)	Not yet determined	A
P043F and P2401	EVAP pressure in step (b) -1.057 kPa-g (-7.93 mmHg-g) or higher	• Reference orifice high-flow • Leak detection pump stuck OFF	B
P043E	EVAP pressure in step (b) below -4.85 kPa-g (-36.4 mmHg-g)	Reference orifice clogged	C

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DTCS*	TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
P2419	EVAP pressure in step (a) higher than -1 kPa-g (-7.5 mmHg-g)	Vent valve stuck closed	D

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "Confirm DTC" procedures above.

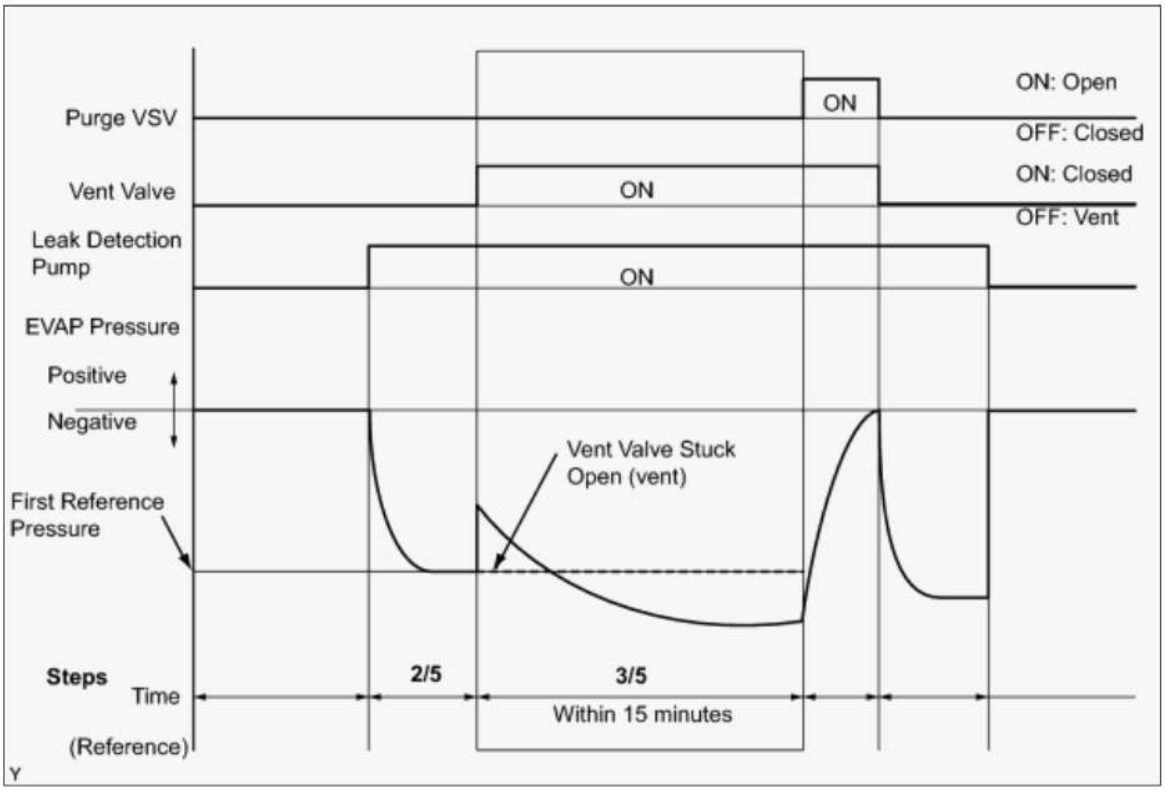
B ▶ **PERFORM EVAPORATIVE SYSTEM CHECK (STEP 3/5)**

C ▶ **REPLACE CHARCOAL CANISTER ASSEMBLY**

D ▶ **INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)**

A ▼

7.	PERFORM EVAPORATIVE SYSTEM CHECK (STEP 2/5 TO 3/5)



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(a) Check the EVAP pressure increase in step 3/5.

Result:

DTCS*	TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or higher within 10 seconds of proceeding from step 2/5 to step 3/5	Not yet determined	A
P2420	No variation in EVAP pressure despite proceeding from step 2/5 to step 3/5	Vent valve stuck open (vent)	B
P0451	No variation in EVAP pressure during steps 1/5 through 3/5	Canister pressure sensor malfunction fixed	C

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "Confirm DTC" procedures above.

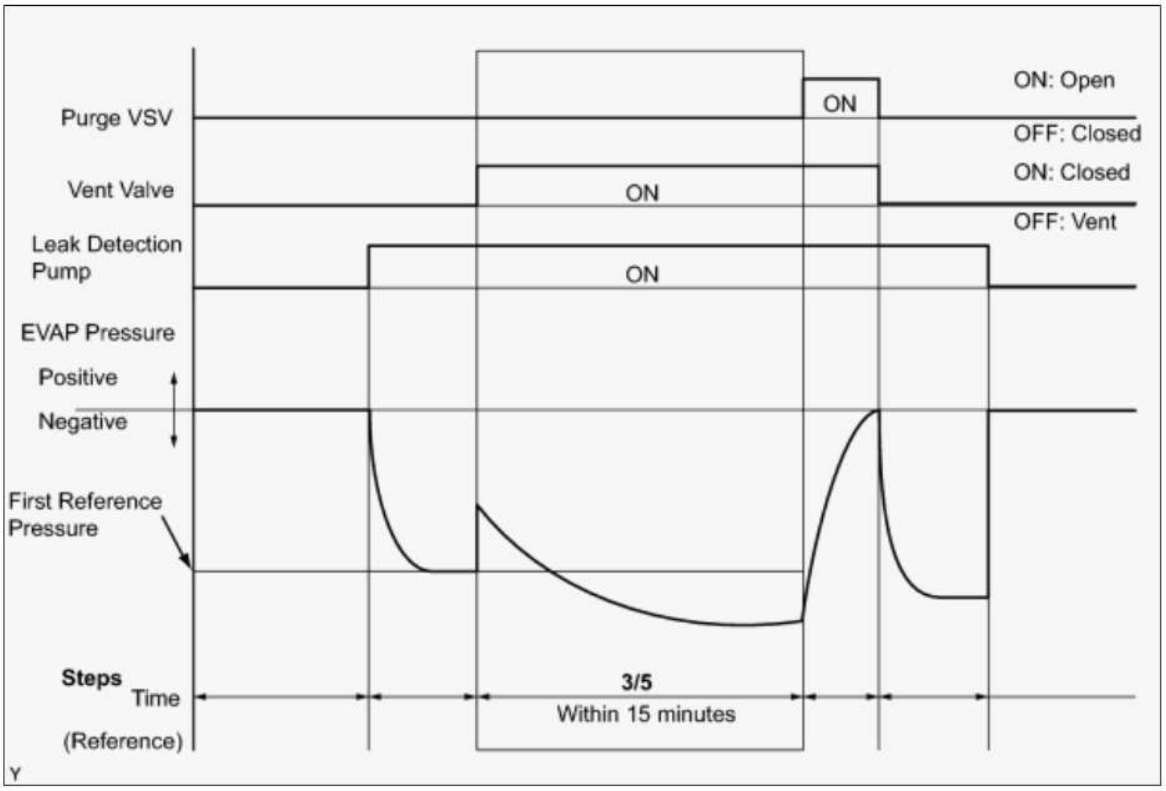
B ▶ **INSPECT CANISTER PUMP MODULE (POWER SOURCE FOR VENT VALVE)**

C ▶ **REPLACE CHARCOAL CANISTER ASSEMBLY**

A ▼

8.	**PERFORM EVAPORATIVE SYSTEM CHECK (STEP 3/5)**

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(a) Wait until the EVAP pressure change is below 0.1 kPa-g (0.75 mmHg-g) for 30 seconds.

(b) Measure the EVAP pressure and record it.

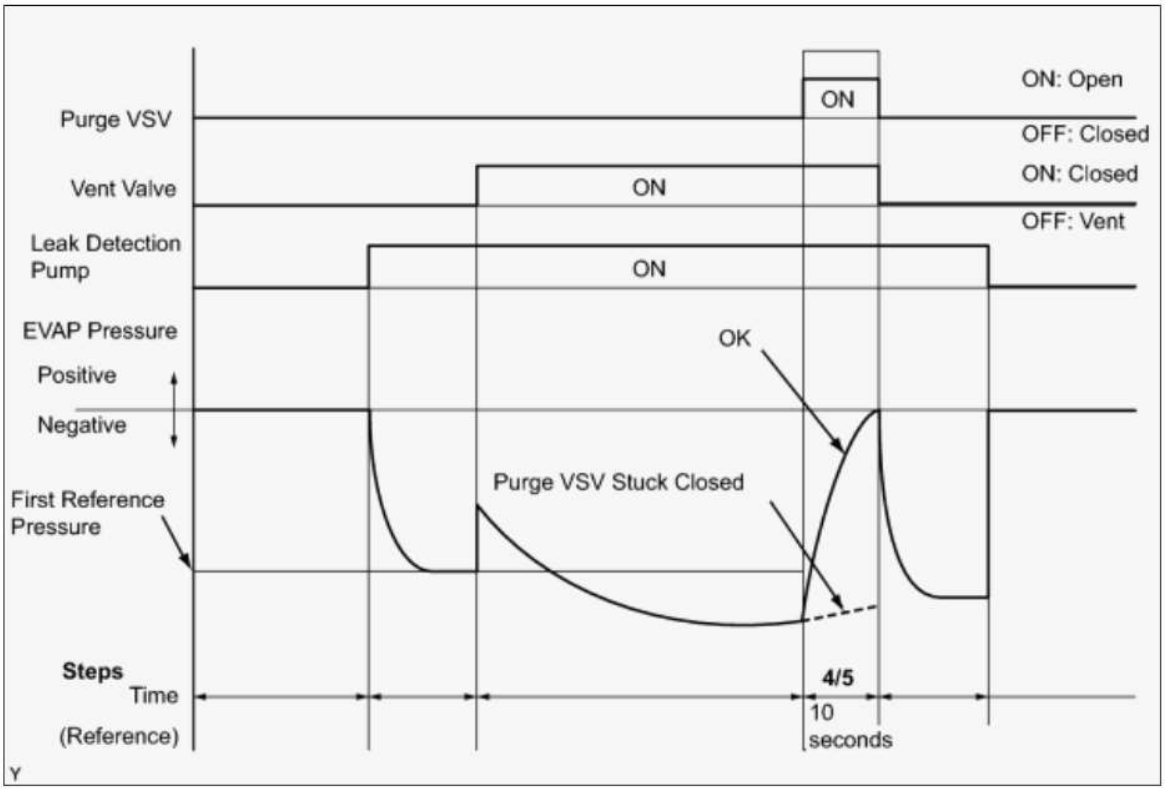
HINT:

A few minutes are required for the EVAP pressure to become saturated. When there is little fuel in the fuel tank, it takes up to 15 minutes.

NEXT

9.	**PERFORM EVAPORATIVE SYSTEM CHECK (STEP 4/5)**

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(a) Check the EVAP pressure in step 4/5.

Result:

DTCS*	TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or higher within 10 seconds of proceeding from step 3/5 to step 4/5	Not yet determined	A
P0441	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or higher within 10 seconds of proceeding from step 3/5 to step 4/5	Problems in EVAP hose between purge VSV and intake manifold	B
P0441	Variation in EVAP pressure below 0.3 kPa-g (2.25 mmHg-g) for 10 seconds, after proceeding from step 3/5 to step 4/5	Purge VSV stuck closed	C

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "Confirm DTC" procedures above.

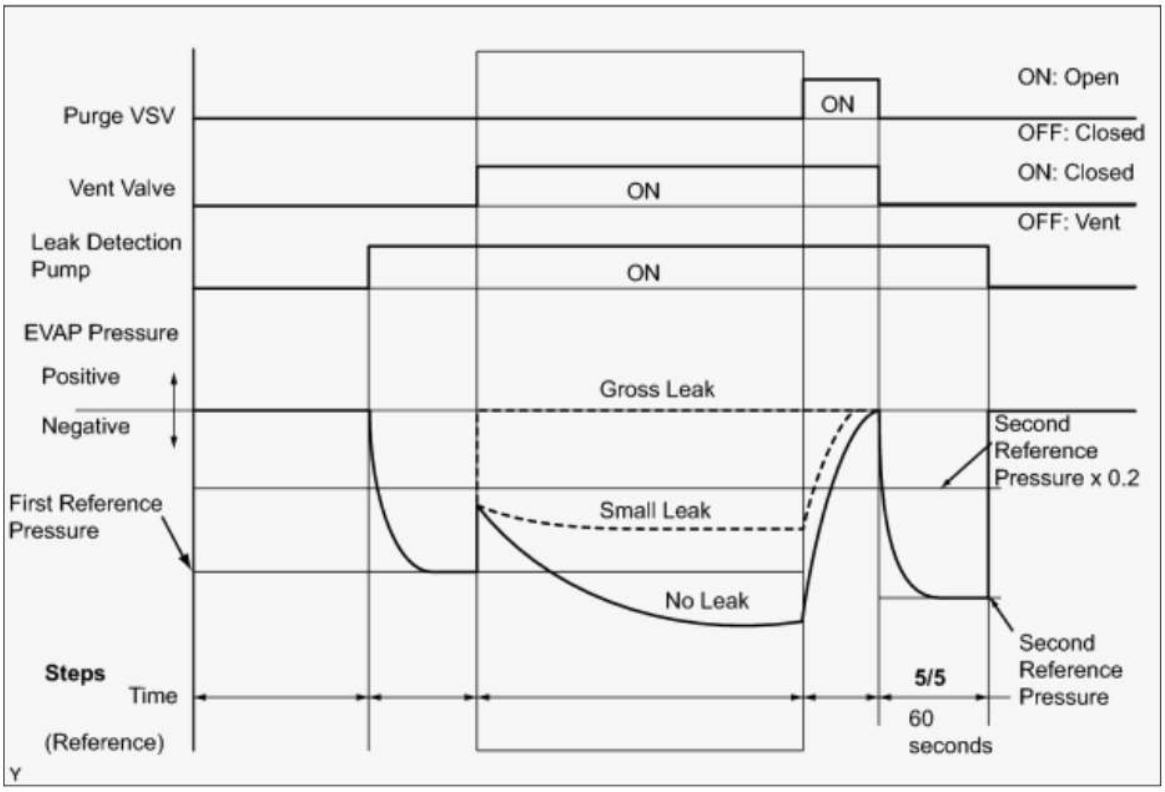
B ▶ **CHECK EVAP HOSE (PURGE VSV - INTAKE MANIFOLD)**

C ▶ **PERFORM ACTIVE TEST USING TECHSTREAM (PURGE VSV)**

A

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10.	PERFORM EVAPORATIVE SYSTEM CHECK (STEP 5/5)



(a) Check the EVAP pressure in step 5/5.

(b) Compare the EVAP pressure in step 3/5 and the second reference pressure (step 5/5).

Result:

DTCS*	TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
-	EVAP pressure (step 3/5) below second reference pressure (step 5/5)	Not yet determined (no leakage from evaporative system)	A
P0441 and P0455	EVAP pressure (step 3/5) higher than [second reference pressure (step 5/5) x 0.2]	• Purge VSV stuck open • EVAP gross leak	B
P0456	EVAP pressure (step 3/5) between second reference pressure and [second reference pressure x 0.2] (step 5/5)	Evaporative small leak	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "Confirm DTC"

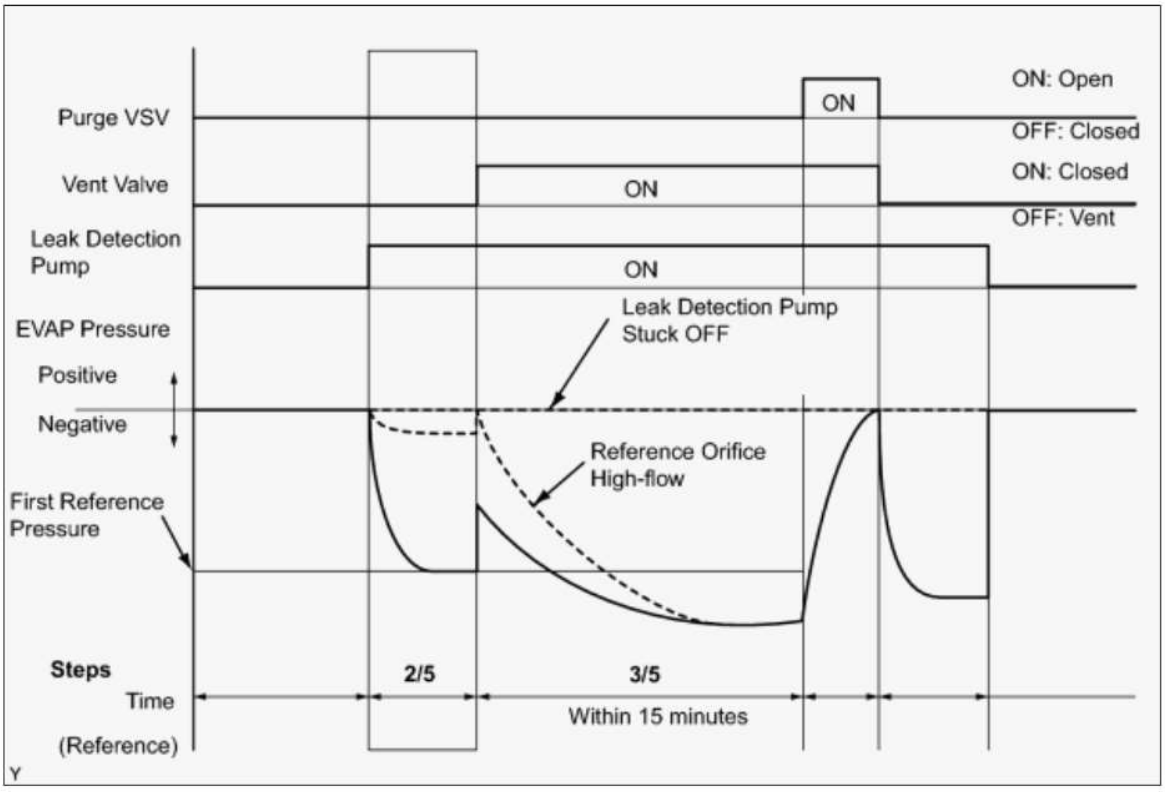
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procedures above.

A ▶ **REPAIR OR REPLACE PARTS AND COMPONENTS INDICATED BY OUTPUT DTCS**

B ▶ **PERFORM ACTIVE TEST USING TECHSTREAM (PURGE VSV)**

11.	**PERFORM EVAPORATIVE SYSTEM CHECK (STEP 3/5)**



(a) Check the EVAP pressure in step 3/5.

Result:

DTCS*	TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
P043F	EVAP pressure less than [reference pressure] measured at 2/5	Reference orifice high-flow	A
P2401	EVAP pressure almost same as [reference pressure] measured at 2/5	Leak detection pump stuck OFF	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "Confirm DTC" procedures above.

HINT:

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The first reference pressure is the value determined in step 2/5.

A ▶ **REPLACE CHARCOAL CANISTER ASSEMBLY**

B ▶ **PERFORM ACTIVE TEST USING TECHSTREAM (VACUUM PUMP (ALONE))**

12.	PERFORM ACTIVE TEST USING TECHSTREAM (PURGE VSV)

(a) Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the VSV for Evap Control.

(b) Disconnect the hose (connected to the canister) from the purge VSV.

(c) Start the engine.

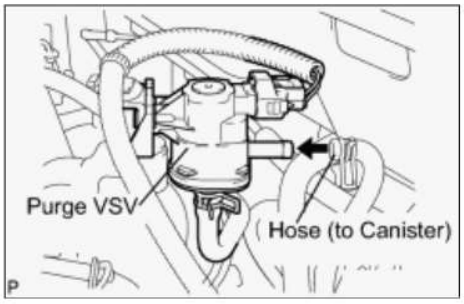
(d) Using the Techstream, turn off the purge VSV (EVAP VSV: OFF).

(e) Use your finger to confirm that the purge VSV has no suction.

(f) Using the Techstream, turn on the purge VSV (EVAP VSV: ON).

(g) Use your finger to confirm that the purge VSV has suction.

Result:



TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
No suction when purge VSV turned OFF, and suction applied when turned ON	Purge VSV normal	A
Suction applied when purge VSV turned OFF	Purge VSV stuck open	B
No suction when purge VSV turned ON	• Purge VSV stuck closed • Problems with EVAP hose between purge VSV and intake manifold	C

(h) Reconnect the hose.

B ▶ **INSPECT EVAP HOSE (PURGE VSV - INTAKE MANIFOLD)**
CHECK VACUUM SWITCHING VALVE (PURGE VSV)

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MANIFOLD)

A

13.	CHECK FUEL CAP ASSEMBLY

(a) Check that the fuel cap is correctly installed and confirm the fuel cap meets OEM specifications.

(b) Tighten the fuel cap firmly. (Only one click sound be heard.)

HINT:

If an EVAP tester is available, check the fuel cap using the tester.

1. Remove the fuel cap and install it onto a fuel cap adapter.
2. Connect an EVAP tester pump hose to the adapter, and pressurize the cap to 3.2 to 3.7 kPa (24 to 28 mmHg) using an EVAP tester pump.
3. Seal the adapter and wait for 2 minutes.
4. Check the pressure. If the pressure is 2 kPa (15 mmHg) or more, the fuel cap is normal.

Result:

TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
Fuel cap correctly installed	-	A
Fuel cap loose	• Fuel cap improperly installed • Defective fuel cap • Fuel cap does not meet OEM specifications	B
Defective fuel cap	-	B
No fuel cap	-	C

(c) Reinstall the fuel cap.

A ▶ LOCATE EVAP LEAK PART

B ▶ CORRECTLY REINSTALL OR REPLACE FUEL CAP

C ▶ REPLACE FUEL CAP

14.	INSPECT DUTY VACUUM SWITCHING VALVE (PURGE VSV)

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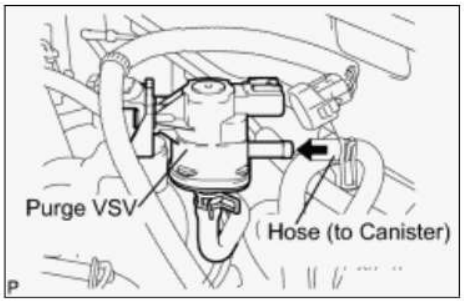
(a) Turn the ignition switch off.

(b) Disconnect the B2 purge VSV connector.

(c) Disconnect the hose (connected to the canister) from the purge VSV.

(d) Start the engine.

(e) Use your finger to confirm that the purge VSV has no suction.



Result:

TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
No suction	ECM	A
Suction applied	Purge VSV	B

(f) Reconnect the purge VSV connector.

(g) Reconnect the hose.

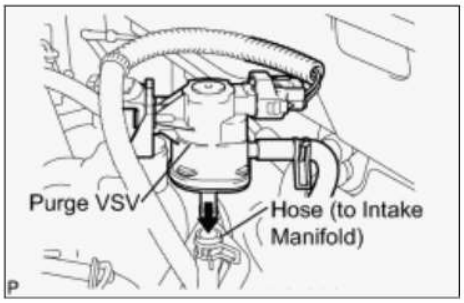
A ▶ **REPLACE ECM**

B ▶ **REPLACE DUTY VACUUM SWITCHING VALVE (PURGE VSV)**

15.	CHECK EVAP HOSE (PURGE VSV - INTAKE MANIFOLD)

(a) Disconnect the hose (connected to the intake manifold) from the purge VSV.

(b) Start the engine.



(c) Use your finger to confirm that the hose has suction.

Result:

TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
Suction applied	EVAP hose between purge VSV and intake manifold normal	A

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No suction	• Intake manifold port • EVAP hose between purge VSV and intake manifold	B

(d) Reconnect the hose.

B ▶ **INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)**

A ▼

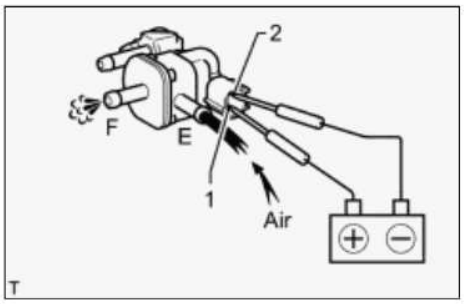
16.	**INSPECT DUTY VACUUM SWITCHING VALVE (PURGE VSV)**

(a) Remove the purge VSV.

(b) Apply battery voltage to the terminals of the purge VSV.

(c) Using an air gun, confirm that air flows from port E to port F.

Result:



TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
Air flows	Purge VSV normal	A
Air does not flow	Purge VSV	B

(d) Install the purge VSV.

B ▶ **REPLACE DUTY VACUUM SWITCHING VALVE (PURGE VSV)**

A ▼

17.	**CHECK HARNESS AND CONNECTOR (POWER SOURCE OF PURGE VSV)**

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(a) Disconnect purge VSV connector.

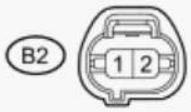
(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Result:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION	SUSPECTED TROUBLE AREAS	PROCEED TO
B2-1 - Body Ground	Ignition Switch ON	11 to 14 V	Normal	A
		Other than result above	Wire harness or connectors between purge VSV and ECM	B

Front view of wire harness connector: (to Purge VSV)



(d) Reconnect the purge VSV connector.

B ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

A ▼

18.	**CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)**

(a) Disconnect the ECM connector and the purge VSV connector.

(b) Measure the resistance according to the value(s) in the table below.

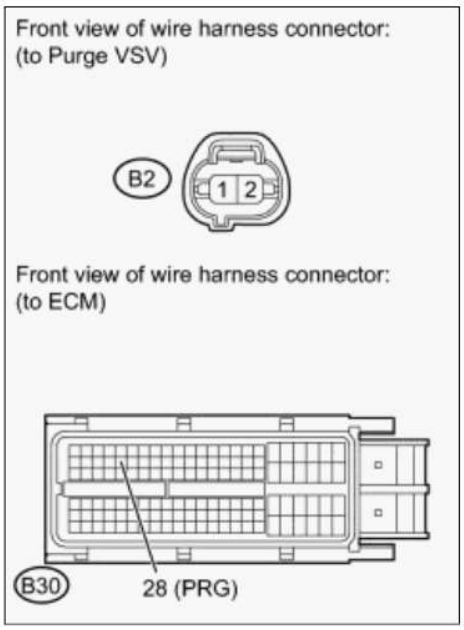
Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITIONS
B30-28 (PRG) - B2-2	Always	Below 1 Ω
B30-28 (PRG) - Body ground	Always	10 kΩ or higher
B2-2 - Body ground	Always	10 kΩ or higher

(c) Reconnect the purge VSV connector.

(d) Reconnect the ECM connector.

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OK ▶ **REPLACE ECM**

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

19.	INSPECT CANISTER PUMP MODULE (POWER SOURCE FOR VENT VALVE)

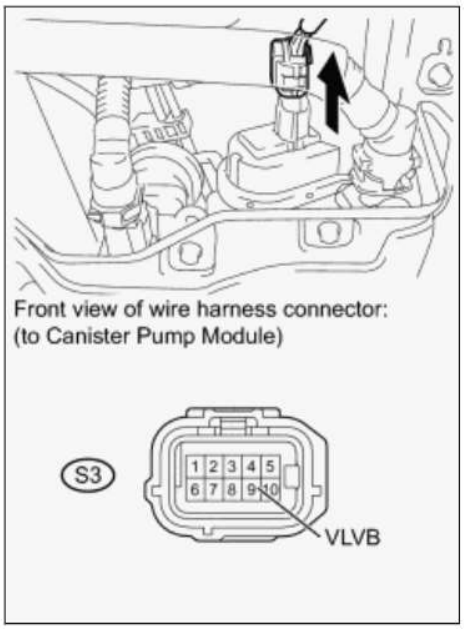
(a) Turn the ignition switch off.

(b) Disconnect the canister pump module connector.

(c) Turn the ignition switch to ON.

(d) Measure the voltage according to the value(s) in the table below.

Result:



TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION	SUSPECTED TROUBLE AREAS	PROCEED TO
S3-9 (VLVB) - Body ground	Ignition switch ON	9 to 14 V	1. Wire harness between vent valve and ECM 2. Vent valve 3. ECM	A
		Below 3 V	Power source wire harness of vent valve	B

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(e) Reconnect the canister pump module connector.

B ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

A

20.	INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)

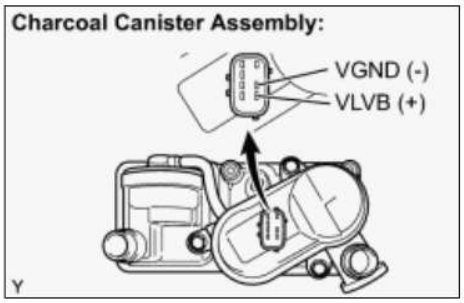
(a) Turn the ignition switch off.

(b) Disconnect the canister pump module connector.

(c) Apply battery voltage to the VLVB and VGND terminals of the canister pump module.

(d) Touch the canister pump module to confirm the vent valve operation.

Result:



TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
Operating	1. Wire harness between vent valve and ECM 2. ECM	A
Not operating	Vent valve	B

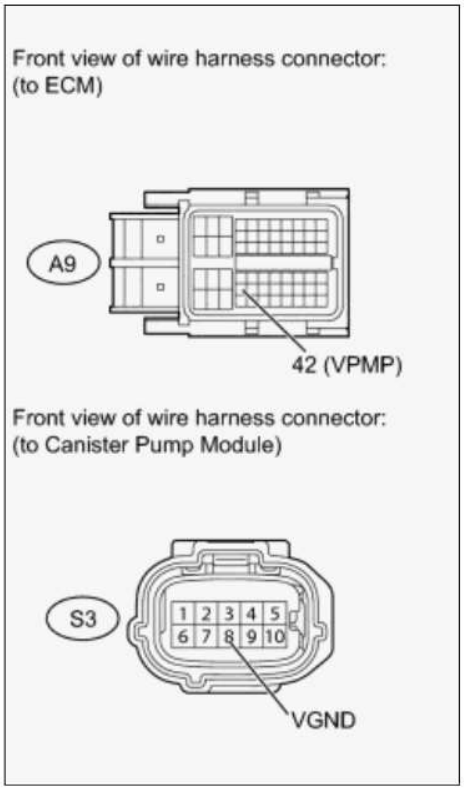
(e) Reconnect the canister connector.

B ▶ **REPLACE CHARCOAL CANISTER ASSEMBLY**

A

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21.	CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)



(a) Disconnect the ECM connector.

(b) Disconnect the canister pump module connector.

(c) Measure the resistance according to the value(s) in the table below.

Result:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	SUSPECTED TROUBLE AREAS	PROCEED TO
A9-42 (VPMP) - S3-8 (VGND)	Always	Below 1 Ω	ECM	A
		10 kΩ or higher	Wire harness between ECM and canister pump module	B

(d) Reconnect the ECM connector.

(e) Reconnect the canister pump module connector.

A ▶ **REPLACE ECM**

B ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

22.	PERFORM ACTIVE TEST USING TECHSTREAM (VACUUM PUMP (ALONE))

(a) Turn the ignition switch off.

(b) Disconnect the canister pump module connector.

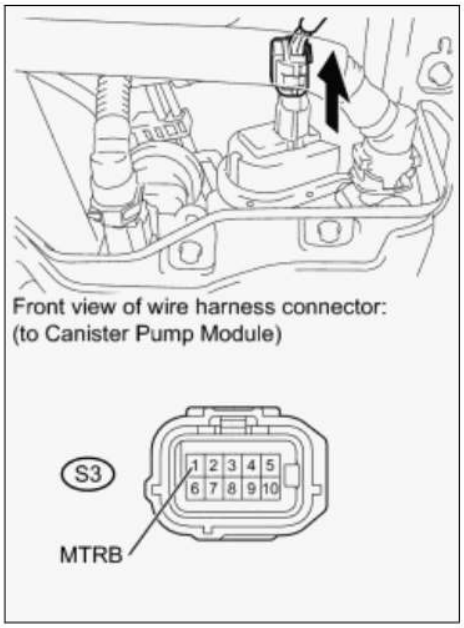
(c) Turn the ignition switch to ON.

(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Activate the Vacuum Pump.

(e) Measure the voltage according to the value(s) in the table below.

Result:

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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	SUSPECTED TROUBLE AREAS	PROCEED TO
S3-1 (MTRB) - Body ground	Leak detection pump ON and OFF (Active Test ON and OFF)	Below 3 V when OFF 11 to 14 V when ON	1. Wire harness between leak detection pump and body ground 2. Leak detection pump	A
		Below 3 V when OFF and ON	1. Wire harness between leak detection pump and ECM 2. ECM	B
		11 to 14 V when OFF and ON	ECM	C

B ▶ **CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)**

C ▶ **REPLACE ECM**

A ▼

23.	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - BODY GROUND)

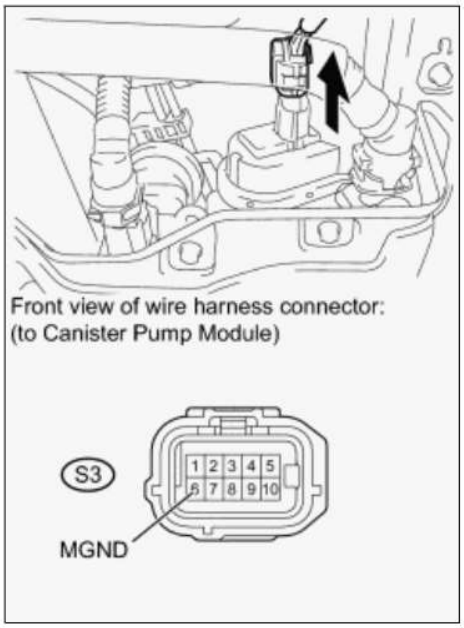
(a) Turn the ignition switch off.

(b) Disconnect the canister pump module connector.

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(c) Measure the resistance according to the value(s) in the table below.

Result:



Front view of wire harness connector:
(to Canister Pump Module)

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	SUSPECTED TROUBLE AREAS	PROCEED TO
S3-6 (MGND) - Body ground	Always	Below 1 Ω	Leak detection pump	A
		10 kΩ or higher	Wire harness between canister pump module and body ground	B

(d) Reconnect the canister pump module connector.

A ▶ **REPLACE CHARCOAL CANISTER ASSEMBLY**

B ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

24.	CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)

(a) Turn the ignition switch off.

(b) Disconnect the canister pump module connector.

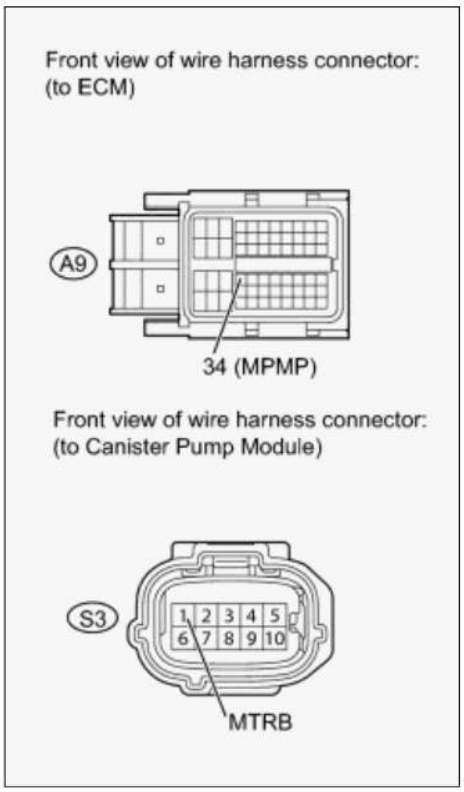
(c) Disconnect the ECM connector.

(d) Measure the resistance according to the value(s) in the table below.

Result:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	SUSPECTED TROUBLE AREAS	PROCEED TO
A9-34 (MPMP) - S3-1 (MTRB)	Always	Below 1 Ω	ECM	A
		10 kΩ or higher	Wire harness between ECM and canister pump	B

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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	SUSPECTED TROUBLE AREAS	PROCEED TO
			module	

(e) Reconnect the canister pump module connector.

(f) Reconnect the ECM connector.

A ▶ **REPLACE ECM**

B ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

25.	**INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)**

(a) Stop the engine.

(b) Disconnect the EVAP hose from the intake manifold.

(c) Start the engine.

(d) Use your finger to confirm that the port of the intake manifold has suction.

Result:

TEST RESULTS	SUSPECTED TROUBLE AREAS	PROCEED TO
Suction applied	EVAP hose between intake manifold and purge VSV	A
No suction	Intake manifold	B

(e) Reconnect the EVAP hose.

A ▶ **REPLACE EVAP HOSE (INTAKE MANIFOLD - PURGE VSV)**

B ▶ **INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)**

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26.	CORRECTLY REINSTALL OR REPLACE FUEL CAP

HINT:

- When reinstalling the fuel cap, tighten it until a click sound is heard.
- When replacing the fuel cap, use a fuel cap that meets OEM specifications, and tighten it until a click sound is heard to install it.

NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

27.	REPLACE FUEL CAP

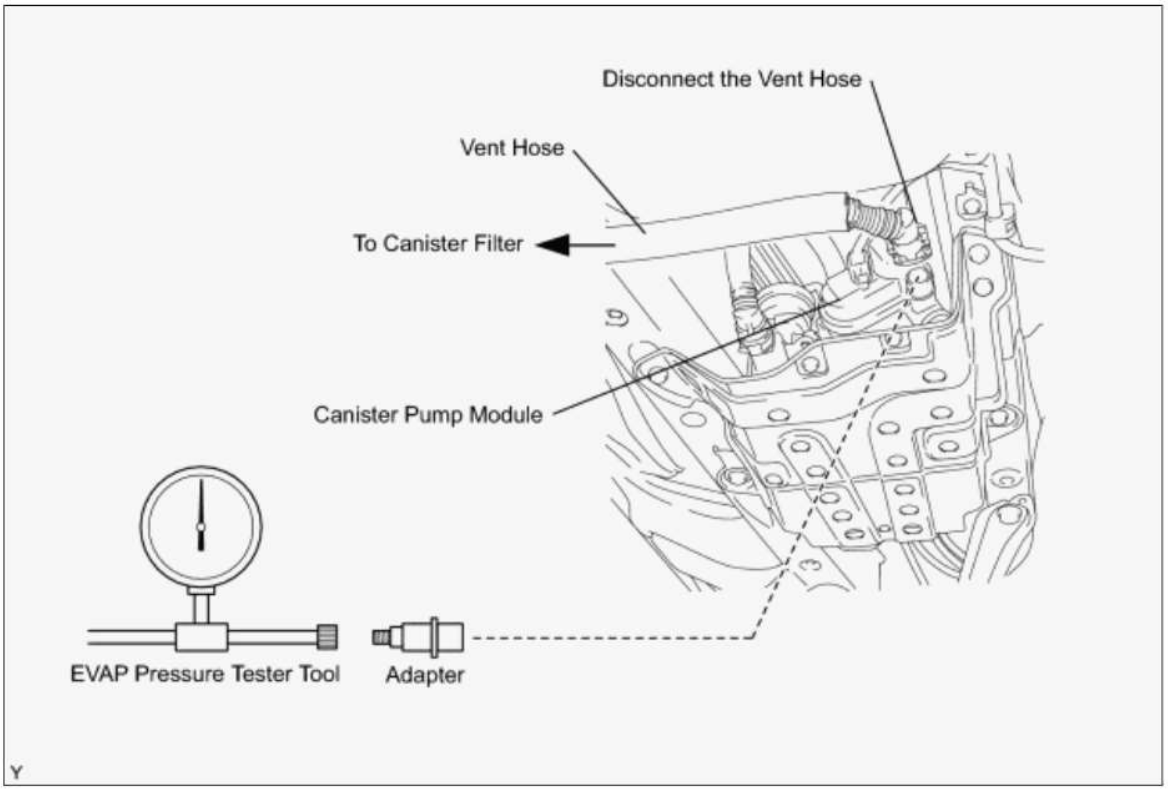
HINT:

When replacing the fuel cap, use a fuel cap that meets OEM specifications, and tighten it until a click sound is heard to install it.

NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

28.	LOCATE EVAP LEAK PART

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(a) Disconnect the vent hose.

(b) Connect the evaporative pressure tester tool to the canister pump module with the adapter.

(c) Pressurize the evaporative system to 3.2 to 3.7 kPa (24 to 28 mmHg).

(d) Apply soapy water to the piping and connecting parts of the evaporative system.

(e) Look for areas where bubbles appear. This indicates the leak point.

(f) Repair or replace the leak point.

HINT:

Disconnect the hose between the canister and fuel tank from the canister. Block the canister side and conduct an inspection. In this way, the fuel tank can be excluded as an area suspected of causing fuel leaks.

NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

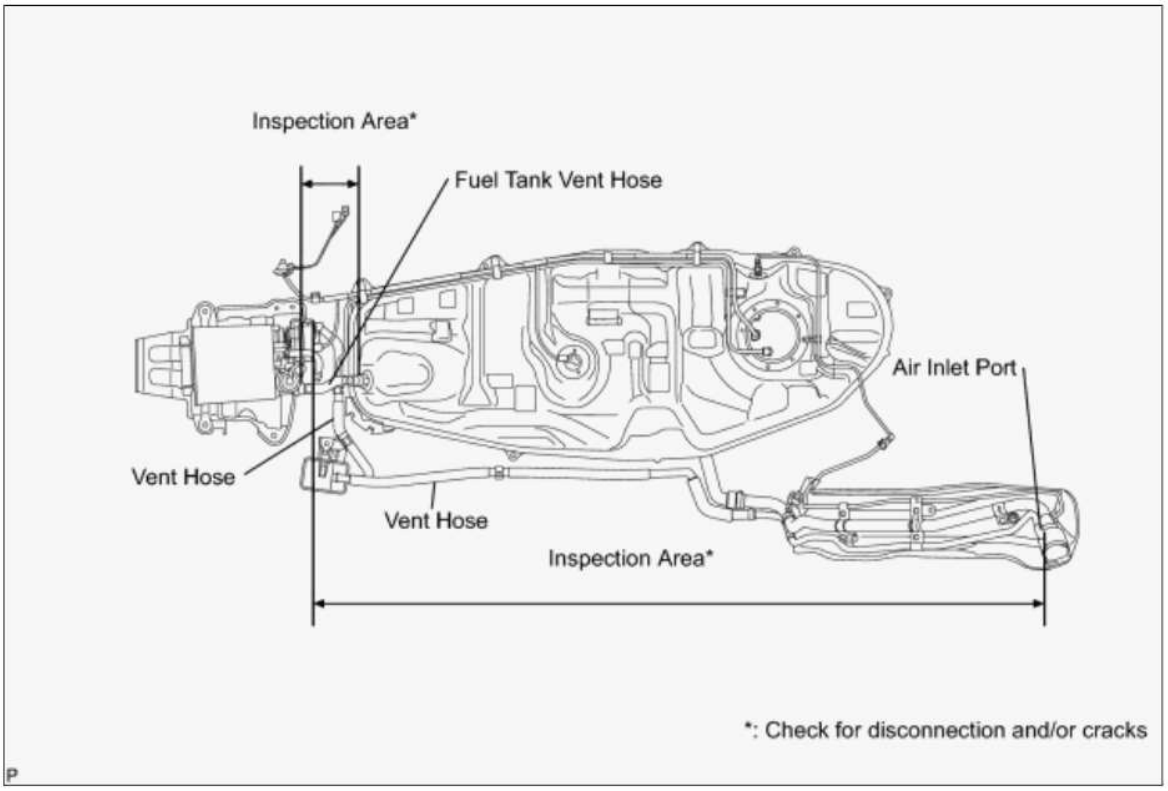
29.	REPLACE CHARCOAL CANISTER ASSEMBLY

(a) Replace the canister assembly INFO .

NOTICE:

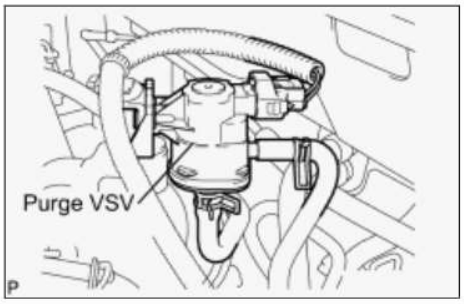
When replacing the canister, check the canister pump module interior and related pipes for water, fuel and other liquids. If liquids are present, check for disconnections and/or cracks in the following: 1) the pipe from the air inlet port to the canister pump module; 2) the canister filter; and 3) the fuel tank vent hose.

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NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

30.	REPLACE DUTY VACUUM SWITCHING VALVE (PURGE VSV)



(a) Disconnect the connector and hoses from the purge VSV.

(b) Remove the purge VSV.

(c) Install a new purge VSV.

(d) Reconnect the connector and hoses.

NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

31.	REPAIR OR REPLACE HARNESS OR CONNECTOR

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NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

32.	REPLACE EVAP HOSE (INTAKE MANIFOLD - PURGE VSV)

NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

33.	INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)

(a) Check that the EVAP purge port of the intake manifold is not clogged. If necessary, replace the intake manifold.

NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

34.	REPLACE ECM

(a) Replace the ECM INFO .

NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

35.	REPAIR OR REPLACE PARTS AND COMPONENTS INDICATED BY OUTPUT DTCS

(a) Repair the malfunctioning areas indicated by the DTCs that were confirmed when the vehicle was brought in.

NEXT ▶ PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

36.	PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)

NOTICE:

- The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by the Techstream. It takes a maximum of approximately 18 minutes.
- Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.

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- Do not run the engine in this step.
- When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing an Evaporative System Check, keep the temperature below 35°C (95°F).

(a) Clear DTCs INFO .

(b) Enter the following menus: Powertrain / Engine and ECT / Utility / System Check / Evaporative System Check / Automatic Mode.

(c) After the System Check is completed, check for pending DTCs. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

HINT:

If no pending DTCs are found, the repair has been successfully completed.

NEXT ▶ COMPLETED

CONFIRMATION DRIVING PATTERN

HINT:

After a repair, check Monitor Status by performing the Key-Off Monitor Confirmation and Purge Flow Monitor Confirmation described below.

1. KEY-OFF MONITOR CONFIRMATION

(a) Preconditions

The monitor will not run unless:

- The vehicle has been driven for 10 minutes or more (in a city area or on a freeway)
- The fuel tank is less than 90% full
- The altitude is less than 8000 ft (2400 m)
- The Engine Coolant Temperature (ECT) is between 4.4 and 35°C (40 and 95°F)
- The Intake Air Temperature (IAT) is between 4.4 and 35°C (40 and 95°F)
- The vehicle remains stationary (the vehicle speed is 0 km/h [0 mph])

(b) Monitor Conditions

1. Allow the engine to idle for at least 5 minutes.
2. Turn the ignition switch off and wait for 8 or 10.5 hours depending on certain vehicle conditions.

HINT:

Do not start the engine until after checking Monitor Status. If the engine is started, the steps described above must be repeated.

(c) Monitor Status

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Enter the following menus: Powertrain / Engine and ECT / Monitor / Evaporative System.
4. Check the Monitor Status displayed on the Techstream.

HINT:

If INCMP is displayed, the monitor is not complete. Make sure that the preconditions have been met, and perform the Monitor Conditions procedure again.

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2. PURGE FLOW MONITOR CONFIRMATION (P0441)

HINT:

Perform this monitor confirmation after the Key-Off Monitor Confirmation shows Complete.

(a) Preconditions

The monitor will not run unless:

- The vehicle has been driven for 10 minutes or more (in a city area or on a freeway)
- The ECT is between 4.4 and 35°C (40 and 95°F)
- The IAT is between 4.4 and 35°C (40 and 95°F)

(b) Monitor Conditions

1. Release the pressure from the fuel tank by removing and reinstalling the fuel tank cap.
2. Warm the engine up until the ECT reaches higher than 75°C (167°F).
3. Increase the engine speed to 3000 rpm once.
4. Allow the engine to idle and turn A/C ON for 1 minute.

(c) Monitor Status

1. Turn the ignition switch off (if it is ON or the engine is running).
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch ON and turn the Techstream on.
4. Enter the following menus: Powertrain / Engine and ECT / Monitor / Evaporative System.
5. Check the Monitor Status displayed on the Techstream.

HINT:

If INCMP is displayed, the monitor is not complete. Make sure that the preconditions have been met, and perform the Monitor Conditions procedure again.

MONITOR RESULT

Refer to Checking Monitor Status INFO .

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Last Modified: 9-7-2011	6.4 U	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDO0BFX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: FAIL-SAFE CHART (2011 RAV4)		

FAIL-SAFE CHART

If any of the following DTCs are stored, the ECM enters fail-safe mode to allow the vehicle to be driven temporarily or stops fuel injection.

DTC CODE	COMPONENT	FAIL-SAFE OPERATION	FAIL-SAFE DEACTIVATION CONDITION
P0031 P0032 P101D	Air Fuel Ratio (A/F) Sensor Heater	The ECM turns off the A/F sensor heater.	Ignition switch off
P0037 P0038 P102D	Heated Oxygen (HO2) Sensor Heater	The ECM turns off the HO2 sensor heater.	Ignition switch off
P0102 P0103	Mass Air Flow (MAF) Meter	The ECM calculates ignition timing according to the engine speed and throttle valve position.	Pass condition detected
P0112 P0113	Intake Air Temperature (IAT) Sensor	The ECM estimates the IAT to be 20°C (68°F).	Pass condition detected
P0115 P0117 P0118	Engine Coolant Temperature (ECT) Sensor	The ECM estimates the ECT to be 80°C (176°F).	Pass condition detected
P0120 P0121 P0122 P0123 P0220 P0222 P0223 P0604 P0606 P060A P060B P060D P060E P0657 P1607 P2102 P2103 P2111 P2112 P2118	Electronic Throttle Control System (ETCS)	The ECM cuts off throttle actuator current and the throttle valve is returned to a 6° throttle position by the return spring. The ECM then adjusts the engine output by controlling fuel injection (intermittent fuel-cut) and ignition timing in accordance with the accelerator pedal opening angle to allow the vehicle to continue at minimal speed*1.	Pass condition detected and then ignition switch turned off

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DTC CODE	COMPONENT	FAIL-SAFE OPERATION	FAIL-SAFE DEACTIVATION CONDITION
P2119 P2135			
P0300 P0301 P0302 P0303 P0304 *2	• Fuel Injector • Electronic Throttle Control System (ETCS)	When a catalyst-damaging misfire occurs (MIL blinking), the following fail-safe operation is performed for catalyst overheat malfunction prevention. 1. Under a low load and at a low engine speed: - Fuel cut is performed on the malfunctioning cylinder. 2. Under a high load and at a high engine speed: - Throttle valve opening angle control is performed. - Fuel cut is performed on all cylinders or the malfunction cylinder.	Pass condition detected and then ignition switch turned off
P0327 P0328	Knock Sensor	The ECM sets the ignition timing to maximum retard.	Ignition switch off
P0351 to P0354	Igniter	The ECM cuts the fuel.	Pass condition detected
P2120 P2121 P2122 P2123 P2125 P2127 P2128 P2138	Accelerator Pedal Position (APP) Sensor	The APP sensor has 2 sensor circuits: Main and Sub. If either circuit malfunctions, the ECM controls the engine using the other circuit. If both circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.	Pass condition detected and then ignition switch turned off

HINT:

- *1: The vehicle can be driven slowly when the accelerator pedal is depressed firmly and slowly. If the accelerator pedal is depressed quickly, the vehicle may speed up and slow down erratically.
- *2: Misfire-related fail-safe operations occur when catalyst overheat malfunctions occur.

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDS0GRX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: FREEZE FRAME DATA (2011 RAV4)		

FREEZE FRAME DATA

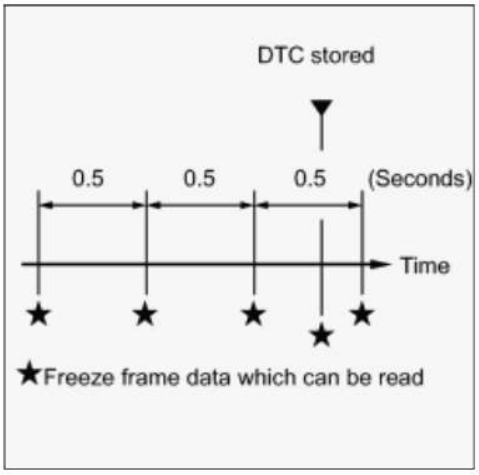
1. DESCRIPTION

The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

HINT:

If it is impossible to replicate the problem even though a DTC is output, confirm the freeze frame data.

The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using the Techstream, 5 separate sets of freeze frame data, including the data values at the time when the DTC is stored, can be checked.



- 3 data sets before the DTC is stored.
- 1 data set when the DTC is stored.
- 1 data set after the DTC is stored.

These data sets can be used to simulate the condition of the vehicle around the time of the occurrence of the malfunction. The data may assist in identifying the cause of the malfunction, and in judging whether it was temporary or not.

2. LIST OF FREEZE FRAME DATA

TESTER DISPLAY	MEASUREMENT ITEM	DIAGNOSTIC NOTE
Vehicle Speed	Vehicle speed	The speed indicated on the speedometer.
Engine Speed	Engine speed	-
Calculate Load	Calculated load	The load calculated by the ECM.
Vehicle Load	Vehicle load	The load percentage in terms of the maximum intake air flow amount.

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TESTER DISPLAY	MEASUREMENT ITEM	DIAGNOSTIC NOTE
MAF	Air flow rate from Mass Air Flow (MAF) meter	If the value is approximately 0.0 g/sec.: • The Mass Air Flow (MAF) meter power source circuit is open. • The VG circuit is open or shorted. If the value is 160.0 g/sec or more: • The E2G circuit is open.
Atmosphere Pressure	Atmospheric pressure	-
Coolant Temp	Engine coolant temperature	• If the value is -40°C (-40°F), the sensor circuit is open. • If the value is 140°C (284°F), the sensor circuit is shorted.
Intake Air	Intake air temperature	• If the value is -40°C (-40°F), the sensor circuit is open. • If the value is 140°C (284°F), the sensor circuit is shorted.
Ambient Temperature	Ambient temperature	-
Engine Run Time	Accumulated engine running time	-
Initial Engine Coolant Temp	Engine coolant temperature at engine start	-
Initial Intake Air Temp	Initial intake air temperature	-
Battery Voltage	Battery voltage	-
Accel Sens. No. 1 Volt %	Absolute accelerator pedal position No. 1	-
Accel Sens. No. 2 Volt %	Absolute accelerator pedal position No. 2	-
Throttle Sensor Volt %	Absolute throttle position sensor	The throttle opening angle recognized by the ECM. Read the value with the ignition switch ON.
Throttl Sensor #2 Volt %	Absolute throttle position sensor #2	The throttle opening angle recognized by the ECM. Read the value with the ignition switch ON.
Throttle Sensor Position	Throttle sensor positioning	The calculated value based on VTA1. Read the value with the ignition switch ON.
Throttle Motor DUTY	Throttle actuator	-

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TESTER DISPLAY	MEASUREMENT ITEM	DIAGNOSTIC NOTE
Injector (Port)	Injection period of No. 1 cylinder	-
Injection Volum (Cylinder1)	Injection volume (cylinder 1)	The quantity of fuel injection volume for 10 times.
Fuel Pump/Speed Status	Fuel pump/status	-
Vacuum Pump	Key-off EVAP system leak detection pump status	-
TCV Status	TCV status	-
EVAP (Purge) VSV	EVAP (purge) VSV control duty	The order signal from the ECM.
Evap Purge Flow	Ratio of evaporative purge flow to intake air volume	-
Purge Density Learn Value	Learned value of purge density	-
EVAP System Vent Valve	Key-off EVAP system vent valve status	-
EVAP Purge VSV	VSV status for EVAP control	-
Purge Cut VSV Duty	Purge cut VSV duty	-
Target Air-Fuel Ratio	Ratio compared to stoichiometric level	-
AF Lambda B1 S1	Fuel trim at A/F sensor	-
AFS Voltage B1 S1	A/F sensor output voltage for bank 1 sensor 1	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
AFS Current B1 S1	Air fuel ratio sensor output current for bank 1 sensor 1	-
A/F Heater Duty #1	A/F heater duty ratio	-
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
O2S Impedance B1 S2	Heated oxygen sensor impedance for bank 1 sensor 2	-
O2 Heater B1 S2	Heated oxygen sensor heater	-
O2 Heater Curr Val B1 S2	Heated oxygen sensor current for bank 1 sensor 2	-

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TESTER DISPLAY	MEASUREMENT ITEM	DIAGNOSTIC NOTE
Short FT #1	Short-term fuel trim of bank 1	Short-term fuel compensation is used to maintain the air-fuel ratio at the stoichiometric air-fuel ratio.
Long FT #1	Long-term fuel trim of bank 1	Overall fuel compensation is carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
Total FT #1	Total fuel trim of bank 1	-
Fuel System Status #1	Fuel system status (bank 1)	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the heated oxygen sensor as feedback for fuel control. • OL Drive: Open loop due to driving conditions (fuel enrichment). • OL Fault: Open loop due to a detected system fault. • CL Fault: Closed loop but the heated oxygen sensor, which is used for fuel control, is malfunctioning.
Fuel System Status #2	Fuel system status (bank 2)	
IGN Advance	Ignition timing advance for No. 1 cylinder	-
Knock Feedback Value	Feedback value of knocking	-
Knock Correct Learn Value	Learned knocking correction value	-
ACIS VSV	VSV for acoustic control induction system (ACIS)	-
IAC Sensor Voltage	Intake air control valve position sensor output voltage	-
Intake Air Control Position	Intake air control valve position	-
VVT Control Status #1	VVT control (bank 1) status	-
Catalyst Temp B1 S1	Estimated catalyst temperature (for sensor 1)	-
Catalyst Temp B1 S2	Estimated catalyst temperature (for sensor 2)	-
Starter Signal	Starter signal (STA terminal input status)	-
Starter Control	Starter switch status	-

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TESTER DISPLAY	MEASUREMENT ITEM	DIAGNOSTIC NOTE
Power Steering Signal Record	Power steering switch status	-
Starter Relay	Starter relay status	-
ACC Relay	ACC relay status	-
Neutral Position SW Signal	Park/neutral position switch status	-
Stop Light Switch	Stop light switch status	-
A/C Signal	A/C switch status	-
Idle Up Signal	Idle up signal	-
Closed Throttle Position SW	Closed throttle position switch	-
Fuel Cut Condition	Fuel-cut condition	-
Immobiliser Communication	Immobiliser communication	-
TC Terminal	TC terminal status	-
Time after DTC Cleared	Cumulative time after DTC cleared	-
Distance from DTC Cleared	Total distance vehicle driven after DTC cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared	-
Dist Batt Cable Disconnect	Total distance vehicle driven after battery cable disconnected	-
IG OFF Elapsed Time	Cumulative time after ignition switch off	-
TC and TE1	TC and CG (TE1) terminals of DLC3	-
Ignition Trig. Count	Ignition counter to calculated misfire count	-
Cylinder #1 Misfire Count	Misfire count of cylinder 1	-
Cylinder #2 Misfire Count	Misfire count of cylinder 2	-
Cylinder #3 Misfire Count	Misfire count of cylinder 3	-
Cylinder #4 Misfire Count	Misfire count of cylinder 4	-
All Cylinders Misfire Count	All cylinders misfire count	-

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TESTER DISPLAY	MEASUREMENT ITEM	DIAGNOSTIC NOTE
Misfire RPM	Average engine speed when misfire occurs	-
Misfire Load	Average engine load when misfire occurred	-
Misfire Margin	Margin to detect engine misfire	-
Catalyst OT MF F/C	Availability of fuel-cut function to prevent misfire causing catalyst overheat	-
Cat OT MF F/C History	History of fuel-cut function to prevent misfire causing catalyst overheat	-
Cat OT MF F/C Cylinder#1	Display of fuel cut operation in No. 1 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#2	Display of fuel cut operation in No. 2 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#3	Display of fuel cut operation in No. 3 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#4	Display of fuel cut operation in No. 4 cylinder (if certain level of misfire malfunction is detected)	-
Tumble C.V Duty Ratio	Intake air control valve duty ratio	-
Electric Fan Motor	Electric fan motor status	-
Idle Fuel Cut Prohibit	Prohibition of fuel cut at idle	-
Idle Fuel Cut	Fuel cut idle	ON: When the throttle valve is fully closed and the engine speed is more than 2800 rpm.
FC TAU	Fuel cut during very light load	The fuel cut is being performed under a very light load to prevent the engine combustion from becoming incomplete.
Electrical Load Signal 1	Electrical load signal	-
Electrical Load Signal 3	Electrical load signal	-





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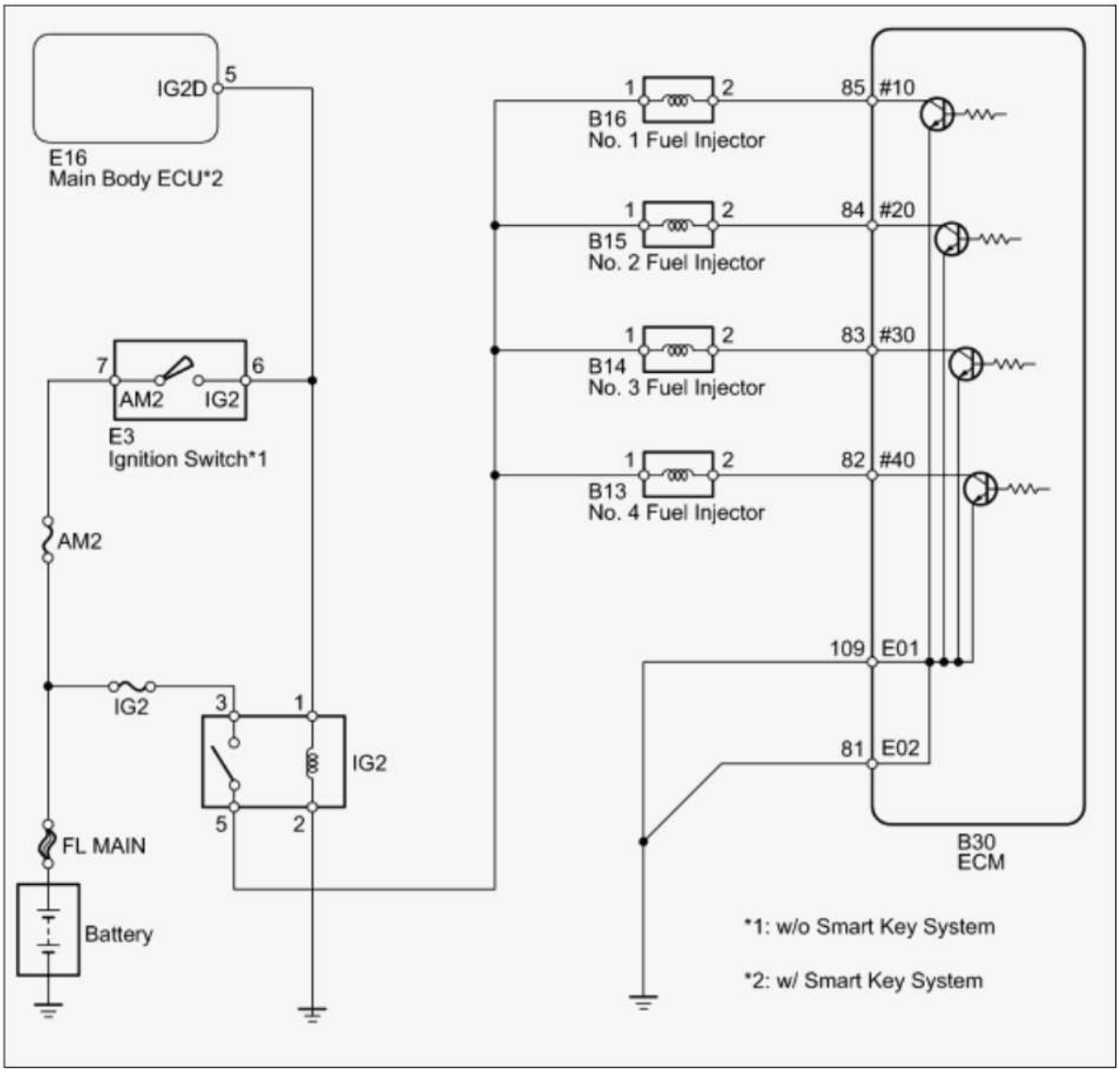
Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000ZRM07XX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: Fuel Injector Circuit (2011 RAV4)		

Fuel Injector Circuit

DESCRIPTION

The fuel injectors are located on the intake manifold. They inject fuel into the cylinders based on the signals from the ECM.

WIRING DIAGRAM



INSPECTION PROCEDURE

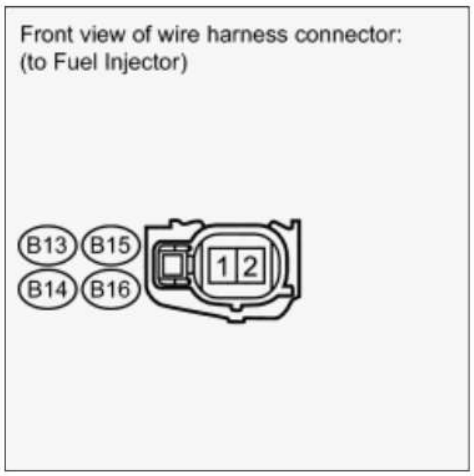
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NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

PROCEDURE

1.	**INSPECT FUEL INJECTOR (POWER SOURCE)**



(a) Disconnect the fuel injector connectors.

(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
B13-1 - Body ground	Ignition switch ON	11 to 14 V
B14-1 - Body ground	Ignition switch ON	11 to 14 V
B15-1 - Body ground	Ignition switch ON	11 to 14 V
B16-1 - Body ground	Ignition switch ON	11 to 14 V

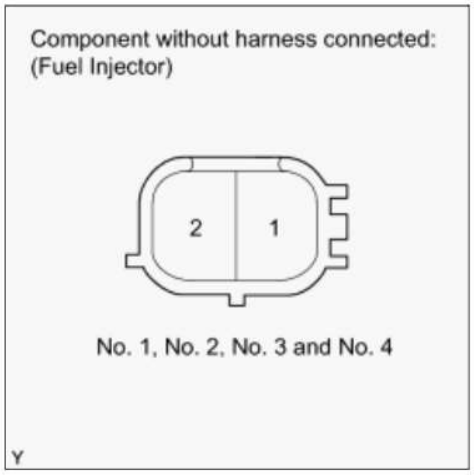
(d) Reconnect the fuel injector connectors.

NG ▶ **CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - IG2 RELAY)**

OK ▼

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2.	**INSPECT FUEL INJECTOR (INJECTOR RESISTANCE)**



(a) Disconnect the fuel injector connectors.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 - 2	20°C (68°F)	11.6 to 12.4 Ω

(c) Reconnect the fuel injector connectors.

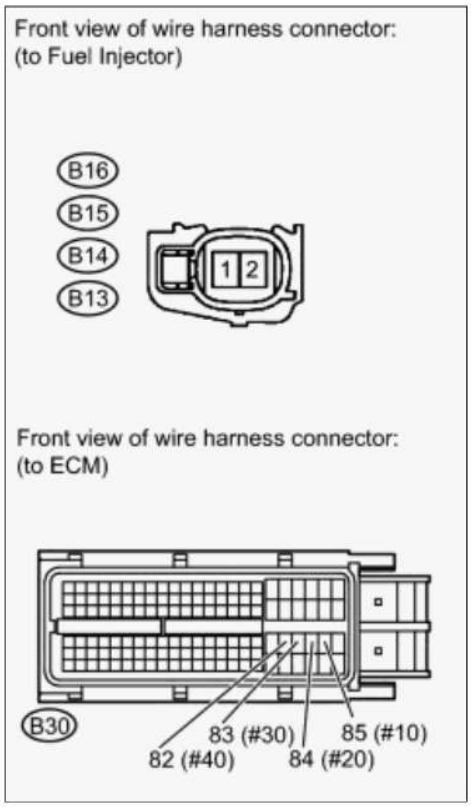
NG ▶ **REPLACE FUEL INJECTOR**

OK ▼

3.	**CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)**

(a) Disconnect the ECM connector.

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(b) Disconnect the fuel injector connectors.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B16-2 - B30-85 (#10)	Always	Below 1 Ω
B15-2 - B30-84 (#20)	Always	Below 1 Ω
B14-2 - B30-83 (#30)	Always	Below 1 Ω
B13-2 - B30-82 (#40)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B16-2 or B30-85 (#10) - Body ground	Always	10 kΩ or higher
B15-2 or B30-84 (#20) - Body ground	Always	10 kΩ or higher
B14-2 or B30-83 (#30) - Body ground	Always	10 kΩ or higher
B13-2 or B30-82 (#40) - Body ground	Always	10 kΩ or higher

(d) Reconnect the fuel injector connectors.

(e) Reconnect the ECM connector.

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NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

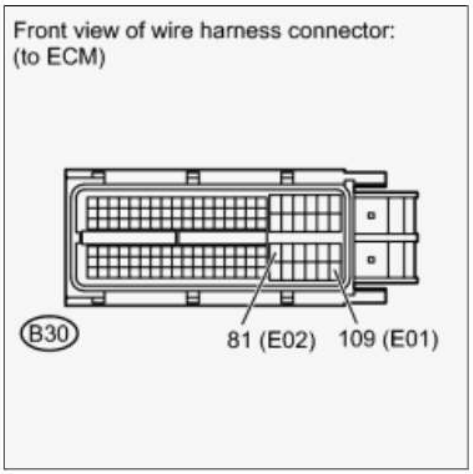
OK ▼

4.	**CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)**

(a) Disconnect the ECM connector.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-109 (E01) - Body ground	Always	Below 1 Ω
B30-81 (E02) - Body ground	Always	Below 1 Ω

(c) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

5.	**INSPECT FUEL INJECTOR (INJECTION AND VOLUME)**

(a) Check the fuel injector injection and volume INFO .

NG ▶ **REPLACE FUEL INJECTOR**

OK ▶ **PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE**

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6.	CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - IG2 RELAY)

(a) Disconnect the fuel injector connectors.

(b) Remove the IG2 relay from the No. 1 engine room relay block.

(c) Measure the resistance according to the value(s) in the table below.

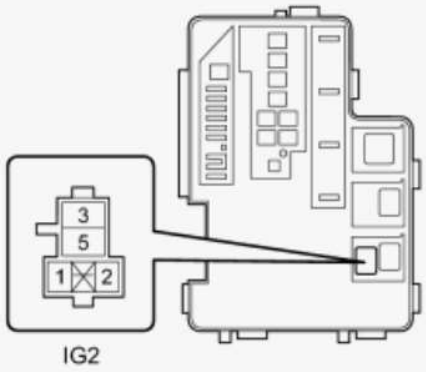
Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B16-1 - IG2 relay (5)	Always	Below 1 Ω
B15-1 - IG2 relay (5)	Always	Below 1 Ω
B14-1 - IG2 relay (5)	Always	Below 1 Ω
B13-1 - IG2 relay (5)	Always	Below 1 Ω

Front view of wire harness connector: (to Fuel Injector)



No. 1 Engine Room Relay Block:



Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B16-1 or IG2 relay (5) - Body ground	Always	10 kΩ or higher
B15-1 or IG2 relay (5) - Body ground	Always	10 kΩ or higher
B14-1 or IG2 relay (5) - Body ground	Always	10 kΩ or higher
B13-1 or IG2 relay (5) - Body ground	Always	10 kΩ or higher

(d) Reconnect the fuel injector connectors.

(e) Reinstall the IG2 relay.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **GO TO ECM POWER**

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SOURCE
CIRCUIT

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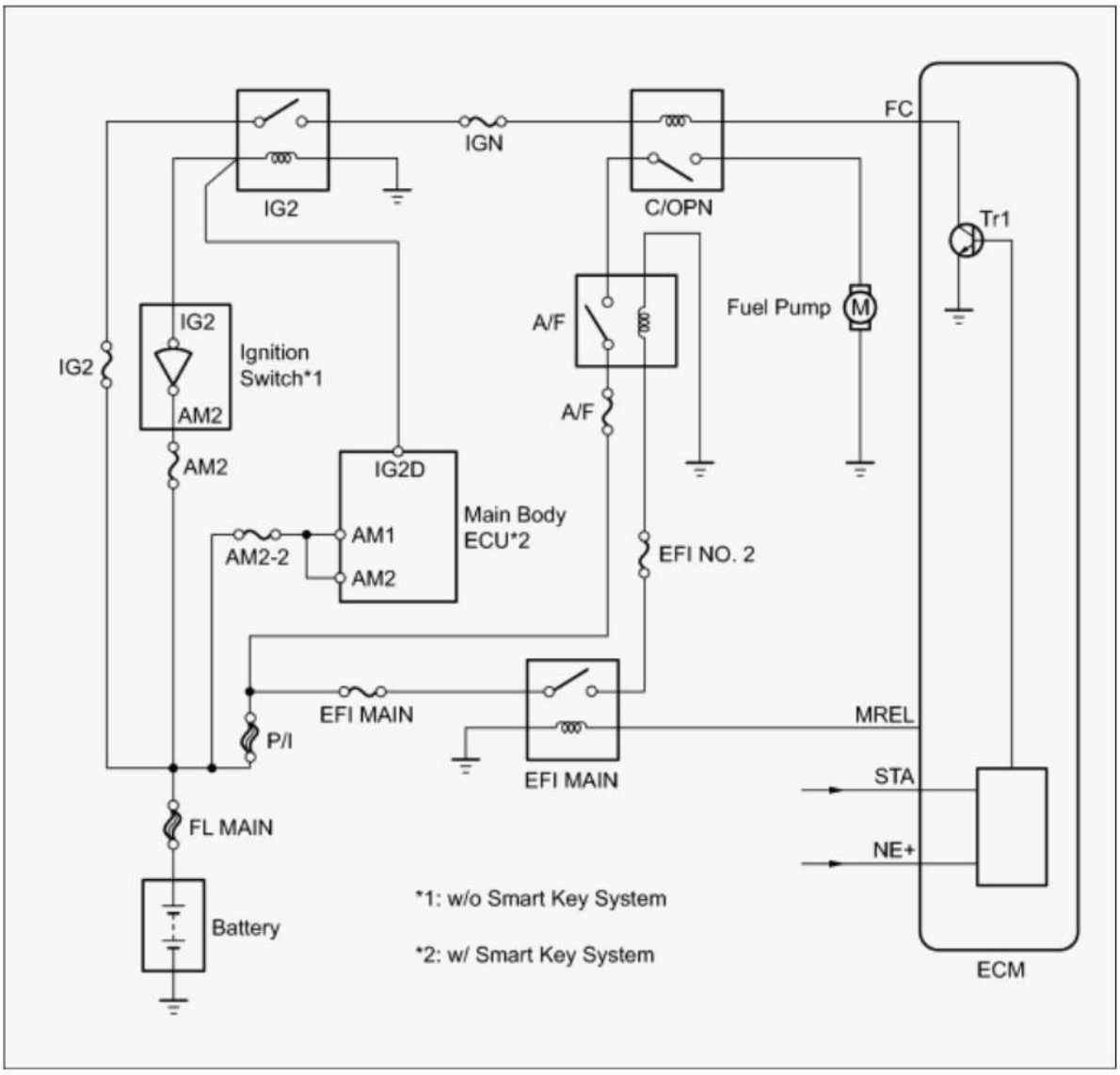
Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001DN702RX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: Fuel Pump Control Circuit (2011 RAV4)		

Fuel Pump Control Circuit

DESCRIPTION

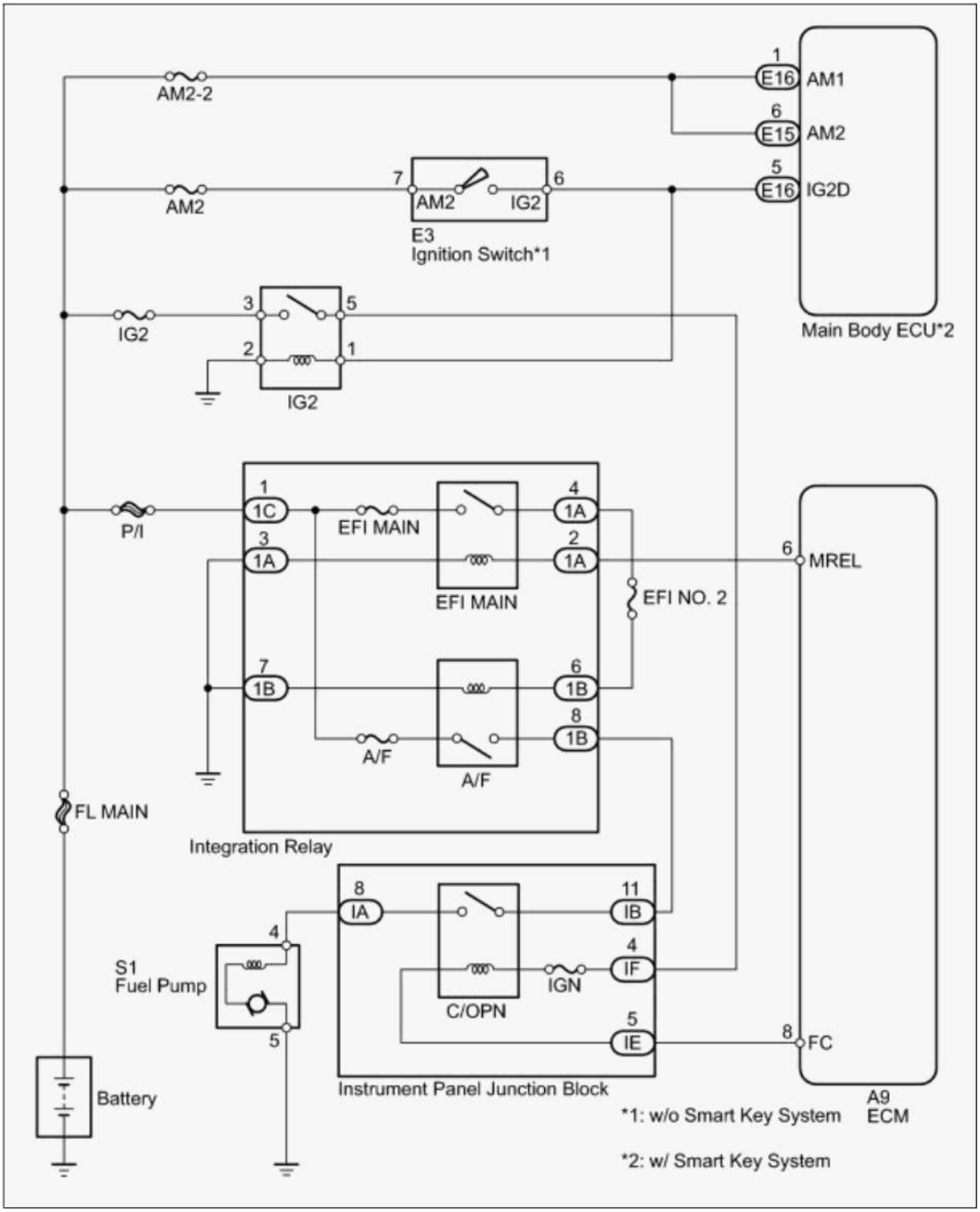
When the engine is cranked, the starter relay drive signal output from the STAR terminal of the ECM is input into the STA terminal of the ECM, and the NE signal generated by the crankshaft position sensor is also input into the NE+ terminal. The ECM interprets that the engine is cranked, and turns transistor Tr1 in the ECM internal circuit on. The current flows to the C/OPN (Circuit Opening) relay by turning Tr1 on. Then, the fuel pump operates.

While the NE signal is input into the ECM, when the engine is running, the ECM turns Tr1 on continuously.



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WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

PROCEDURE

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1.	**PERFORM ACTIVE TEST USING TECHSTREAM (ACTIVE THE FUEL PUMP SPEED CONTROL)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump / Speed.

(d) Check whether the fuel pump operating sound occurs when performing the Active Test on the Techstream.

OK:

Fuel pump operating sound occurs.

NG ▶ **INSPECT INSTRUMENT PANEL JUNCTION BLOCK (C/OPN RELAY INPUT VOLTAGE)**

OK ▼

2.	**READ VALUE USING TECHSTREAM (STARTER SIGNAL)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Enter the following menus: Powertrain / Engine and ECT / Data List / Starter Signal.

(d) Check the result when the ignition switch is turned to ON and START.

OK:

IGNITION SWITCH POSITION	STARTER SIGNAL
ON	OFF
START	ON

NG ▶ **REPAIR OR REPLACE STARTING SYSTEM**

OK

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3.	READ VALUE USING TECHSTREAM (ENGINE SPEED)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Enter the following menus: Powertrain / Engine and ECT / Data List / Engine Speed.

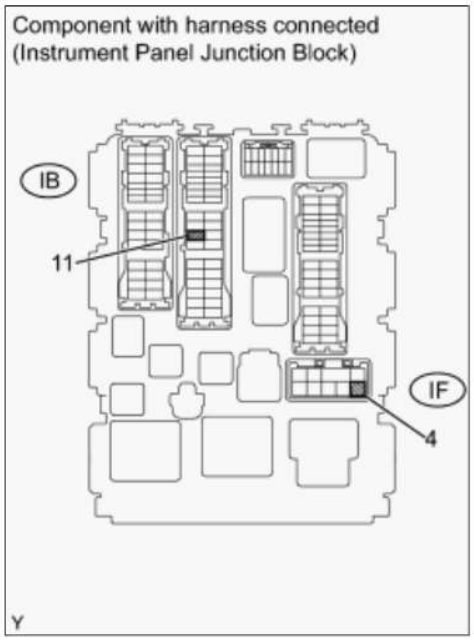
(d) Read the values displayed on the Techstream while cranking the engine.

OK:
Values are displayed continuously.

NG ▶ **REPAIR OR REPLACE CRANKSHAFT POSITION SENSOR CIRCUIT**

OK ▶ **REPLACE ECM**

4.	INSPECT INSTRUMENT PANEL JUNCTION BLOCK (C/OPN RELAY INPUT VOLTAGE)



(a) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
IB-11 - Body ground	Ignition switch off	Below 1 V
IF-4 - Body ground		
IB-11 - Body ground	Ignition switch ON	11 to 14 V
IF-4 - Body ground		

NG ▶ **INSPECT INTEGRATION NO.1 RELAY (A/F)**

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OK

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PD90H4X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: HOW TO PROCEED WITH TROUBLESHOOTING (2011 RAV4)		

HOW TO PROCEED WITH TROUBLESHOOTING

HINT:

***: Use the Techstream.**

1.	**VEHICLE BROUGHT TO WORKSHOP**

NEXT

2.	**CUSTOMER PROBLEM ANALYSIS**

NEXT

3.	**CONNECT TECHSTREAM TO DLC3**

HINT:

If the display indicates a communication fault in the Techstream, inspect the DLC3.

NEXT

4.	**CHECK DTC AND FREEZE FRAME DATA***

HINT:

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Record or print DTCs and freeze frame data if necessary.

NEXT

5.	**CLEAR DTC AND FREEZE FRAME DATA***

NEXT

6.	**CONDUCT VISUAL INSPECTION**

NEXT

7.	**SET CHECK MODE DIAGNOSIS***

NEXT

8.	**CONFIRM PROBLEM SYMPTOMS**

HINT:

If the engine does not start, first perform the "CHECK DTC" procedures and "CONDUCT BASIC INSPECTION" procedures below.

Result

RESULT	PROCEED TO

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RESULT	PROCEED TO
Malfunction does not occur	A
Malfunction occurs	B

B ▶ **GO TO STEP 10**

A ▼

9.	**SIMULATE SYMPTOMS**

NEXT ▼

10.	**CHECK DTC***

Result

RESULT	PROCEED TO
Trouble code output	A
No trouble code output	B

B ▶ **GO TO STEP 12**

A ▼

11.	**REFER TO DTC CHART**

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NEXT

12.	**CONDUCT BASIC INSPECTION**

Result

RESULT	PROCEED TO
Malfunctioning parts not confirmed	A
Malfunctioning parts confirmed	B

B **GO TO STEP 17**

A

13.	**REFER TO PROBLEM SYMPTOMS TABLE**

Result

RESULT	PROCEED TO
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B **GO TO STEP 17**

A

14.	**CHECK ECM POWER SOURCE CIRCUIT**

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NEXT

15.	**CONDUCT CIRCUIT INSPECTION**

Result

RESULT	PROCEED TO
Malfunction not confirmed	A
Malfunction confirmed	B

B **GO TO STEP 18**

A

16.	**CHECK FOR INTERMITTENT PROBLEMS**

NEXT

17.	**CONDUCT PARTS INSPECTION**

NEXT

18.	**IDENTIFY PROBLEM**

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NEXT

19.	ADJUST AND/OR REPAIR

NEXT

20.	CONDUCT CONFIRMATION TEST

NEXT END

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Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WZ10HAX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: MIL Circuit (2011 RAV4)		

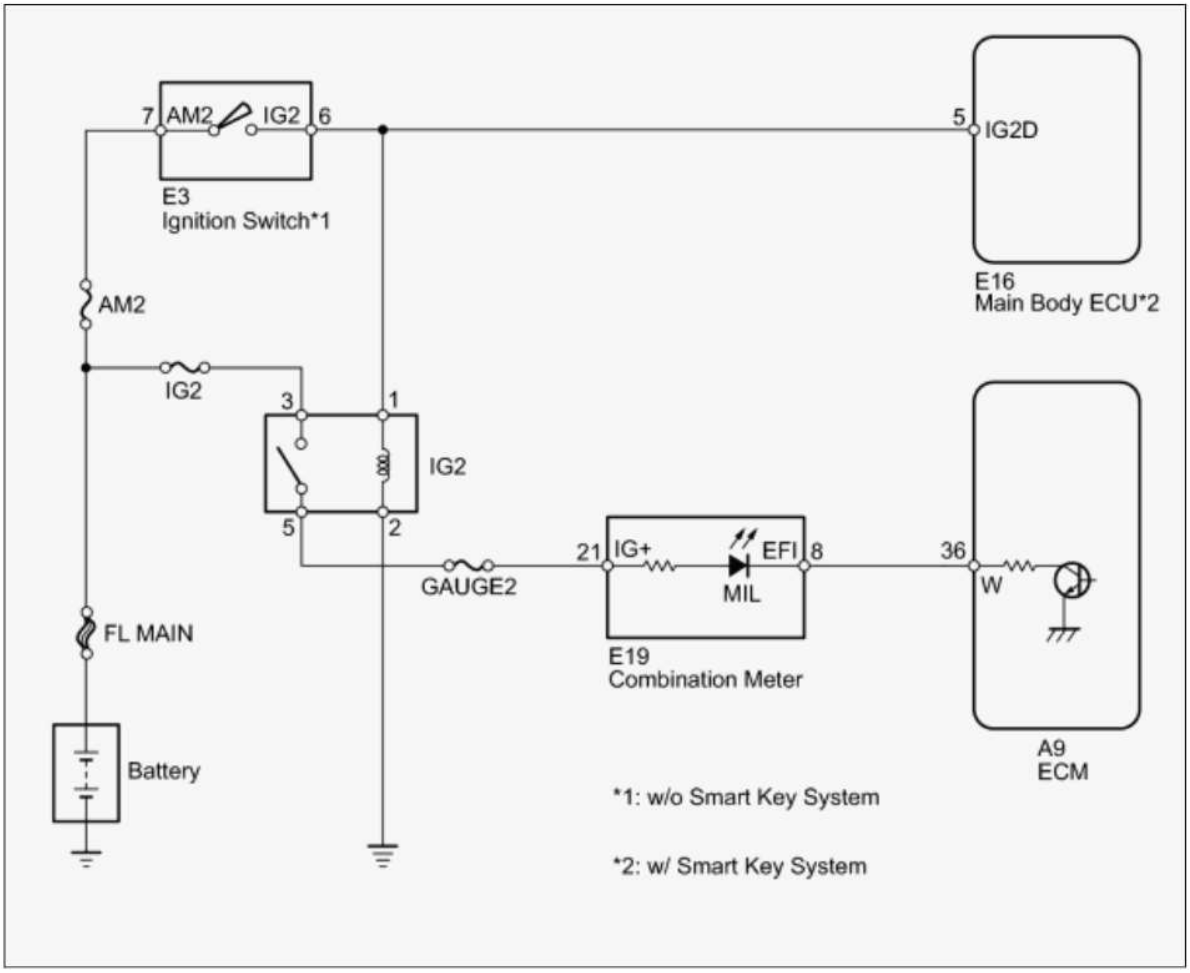
MIL Circuit

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunction detections by the ECM. When the ignition switch is turned to ON, power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.

The MIL operation can be checked visually: When the ignition switch is first turned to ON, the MIL turns on and then turns off. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using the Techstream.

WIRING DIAGRAM



INSPECTION PROCEDURE

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NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

PROCEDURE

1.	**CHECK THAT MIL IS ILLUMINATED**

(a) Check the MIL illumination condition.

MIL CONDITION	PROCEED TO
MIL remains on	A
MIL does not illuminate	B

B ▶ **CHECK THAT MIL IS ILLUMINATED**

A ▼

2.	**CHECK WHETHER MIL TURNS OFF**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Check if any DTCs are output. Note down any DTCs.

HINT:

Check for DTCs output from other ECUs which relate to the MIL.

(f) Clear the DTCs INFO .

(g) Check if the MIL turns off.

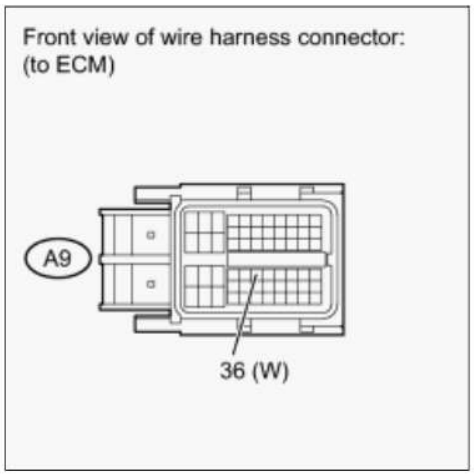
OK:
MIL turns off.

NG ▶ **CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)**

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OK ▶ **REPAIR CIRCUITS INDICATED BY OUTPUT DTCS**

3.	CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)



(a) Disconnect the ECM connector.

(b) Turn the ignition switch to ON.

(c) Check that the MIL is not illuminated.

OK:

MIL is not illuminated.

(d) Reconnect the ECM connector.

NG ▶ **CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)**

OK ▶ **REPLACE ECM**

4.	CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)

(a) Disconnect the ECM connector.

(b) Disconnect the combination meter connector.

(c) Measure the resistance according to the value(s) in the table below.

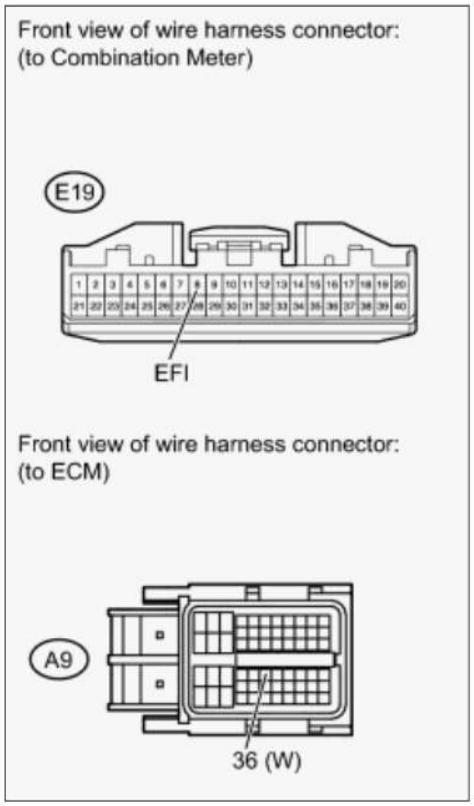
Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A9-36 (W) or E19-8 (EFI) - Body ground	Always	10 kΩ or higher

(d) Reconnect the ECM connector.

(e) Reconnect the combination meter connector.

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NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE COMBINATION METER ASSEMBLY**

5.	**CHECK THAT MIL IS ILLUMINATED**

(a) Check if the MIL is illuminated when the ignition switch is turned to ON.

OK:
MIL is illuminated.

NG ▶ **CHECK THAT ENGINE STARTS**

OK ▶ **SYSTEM OK**

6.	**CHECK THAT ENGINE STARTS**

(a) Turn the ignition switch to ON.

(b) Start the engine.

Result

RESULT	PROCEED TO
Engine starts	A

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RESULT	PROCEED TO
Engine does not start*	B

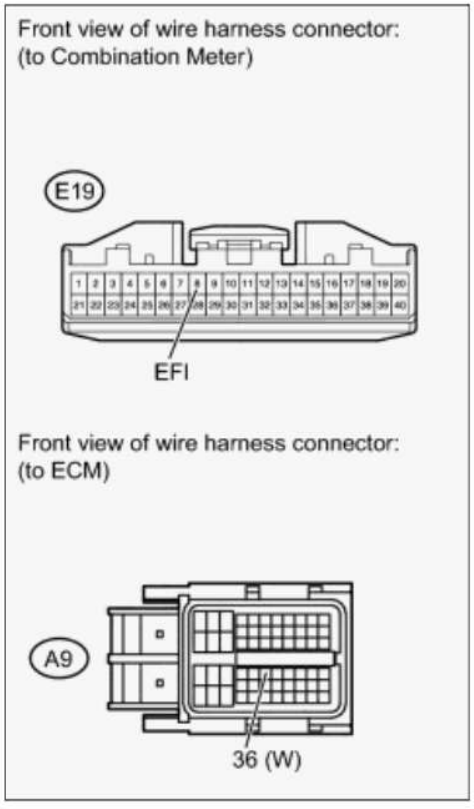
HINT:

***: The Techstream cannot communicate with the ECM.**

B ▶ **GO TO VC OUTPUT CIRCUIT**

A ▼

7.	CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)



(a) Disconnect the ECM connector.

(b) Disconnect the combination meter connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A9-36 (W) - E19-8 (EFI)	Always	Below 1 Ω

(d) Reconnect the ECM connector.

(e) Reconnect the combination meter connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE COMBINATION METER**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WC209JX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2A00: A/F Sensor Circuit Slow Response (Bank 1 Sensor 1) (2011 RAV4)		

DTC	**P2A00**	**A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)**

DESCRIPTION

HINT:

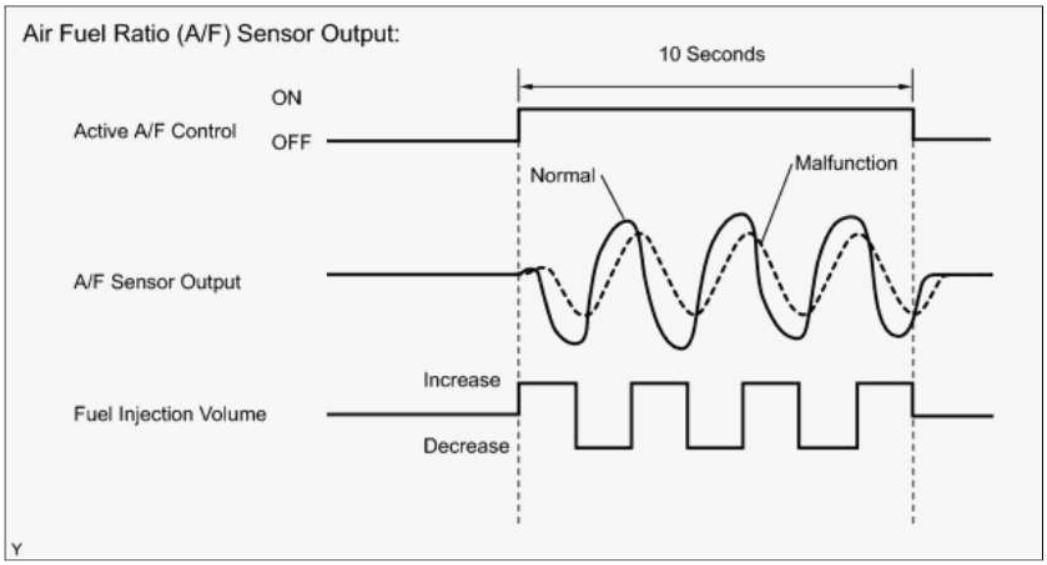
- Refer to DTC P2195 INFO .
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2A00	The calculated value for the Air Fuel Ratio (A/F) sensor response rate deterioration level is less than the threshold.	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor • A/F sensor heater • ECM

MONITOR DESCRIPTION

After the engine is warmed up, the ECM performs air-fuel ratio feedback control to maintain the air-fuel ratio at the stoichiometric level. In addition, active A/F control is performed for approximately 10 seconds after preconditions are met in order to measure the Air Fuel Ratio (A/F) sensor response rate. During active A/F control, the ECM forcibly increases and decreases the injection volume a certain amount, based on the stoichiometric air-fuel ratio learned during normal air-fuel ratio control, and measures the A/F sensor response rate. The ECM receives a signal from the A/F sensor while performing active A/F control and uses it to calculate the A/F sensor response rate deterioration level.

If the value for the A/F sensor response rate deterioration level is less than the threshold, the ECM interprets this as a malfunction and stores the DTC.



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MONITOR STRATEGY

Related DTCs	P2A00: Air Fuel Ratio (A/F) sensor (bank 1) slow response
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Vehicle speed sensor, Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	10 to 15 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0505 (IAC Valve)
Active A/F control	Performing
Active A/F control performed when following conditions met	-
Battery voltage	11 V or higher
Engine coolant temperature	75°C (167°F) or higher
Idling	OFF
Engine speed	Less than 4000 rpm
A/F sensor status	Activated
Fuel-cut	OFF
Engine load	10 to 70%
Shift position	2nd or more
Catalyst monitor	Not yet
Intake air amount	4 to 16 g/sec.

TYPICAL MALFUNCTION THRESHOLDS

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Response rate deterioration level	Below 0.12 V

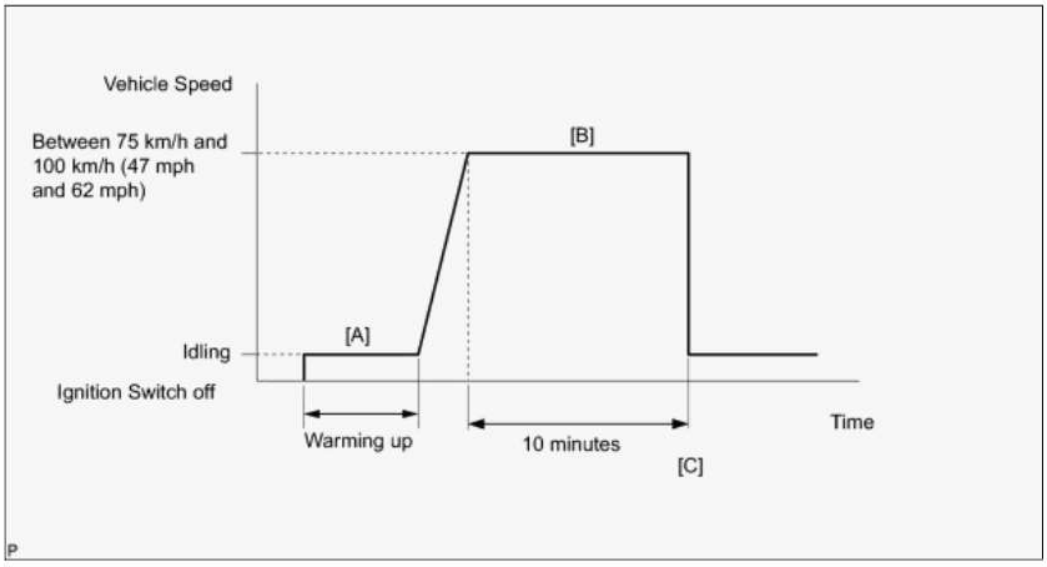
MONITOR RESULT

Refer to Checking Monitor Status INFO .

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the A/F sensor response monitor.



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream ON.
4. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
5. Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details.
6. Check that RES RATE B1S1 and RES RATE B2S1 are Incomplete.
7. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or higher) [A].
8. Drive the vehicle at a constant speed of between 75 and 100 km/h (47 and 62 mph) for 10 minutes [B].
9. Check the monitor result values on Techstream by entering the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details / RES RATE B1S1 and B2S1.
10. If the values indicated on the Techstream do not change, perform READINESS MONITOR DRIVE PATTERN for the A/F sensor and heated oxygen sensor INFO .
11. Note the value of the Monitor Result.
12. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
13. Input the DTC: P2A00.
14. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal

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TESTER DISPLAY	DESCRIPTION
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

15. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
16. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

17. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P2195 INFO .

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)
7. Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

HINT:

- The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

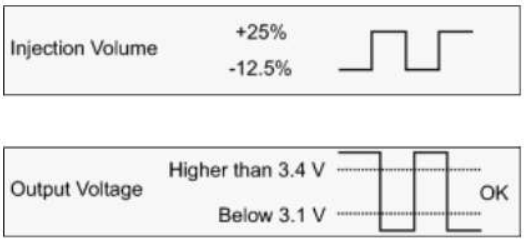
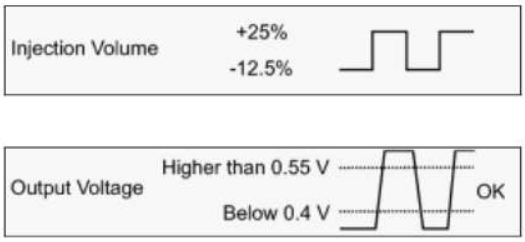
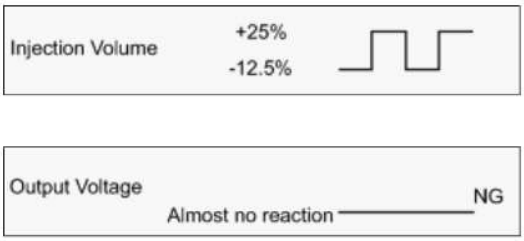
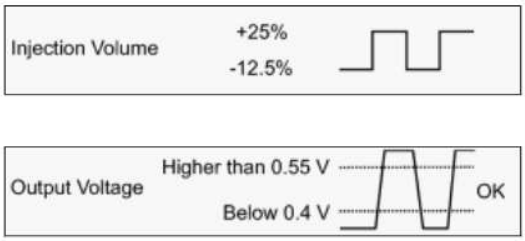
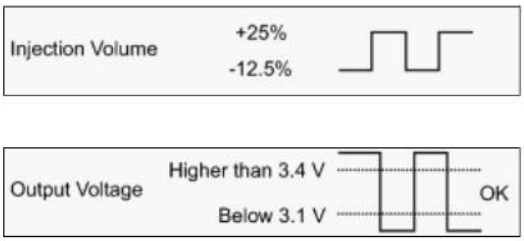
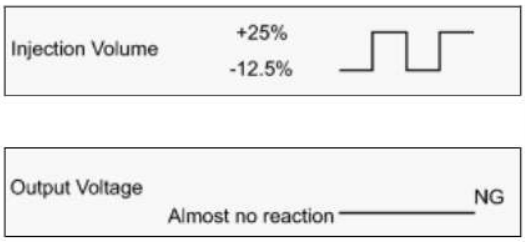
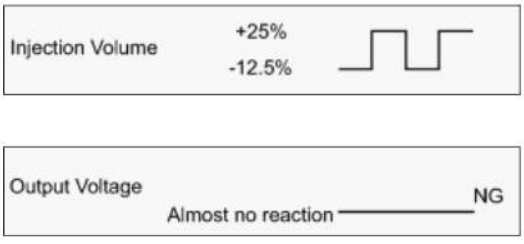
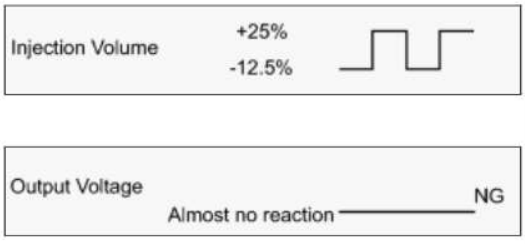
TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1 S1	+25%	Rich	Below 3.1 V

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TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
(A/F)	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.

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- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

HINT:

- DTC P2A00 may be also stored when the air-fuel ratio is stuck at rich or lean.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream ON.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P2A00	A
P2A00 and other DTCs	B

HINT:

If any DTCs other than P2A00 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)** INFO

NG ▶ **REPLACE AIR FUEL RATIO SENSOR**

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OK

3.	**CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)** INFO

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

4.	**PERFORM CONFIRMATION DRIVING PATTERN**

(a) Drive the vehicle according to the Confirmation Driving Pattern.

NEXT

5.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P2A00	A
No output	B

B ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A

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6.	**REPLACE AIR FUEL RATIO SENSOR**

(a) Replace the air fuel ratio sensor INFO .

NEXT

7.	**PERFORM CONFIRMATION DRIVING PATTERN**

(a) Drive the vehicle according to the Confirmation Driving Pattern.

NEXT

8.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

(e) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P2A00	B

B **CHECK ENGINE TO DETERMINE CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO**

A **END**

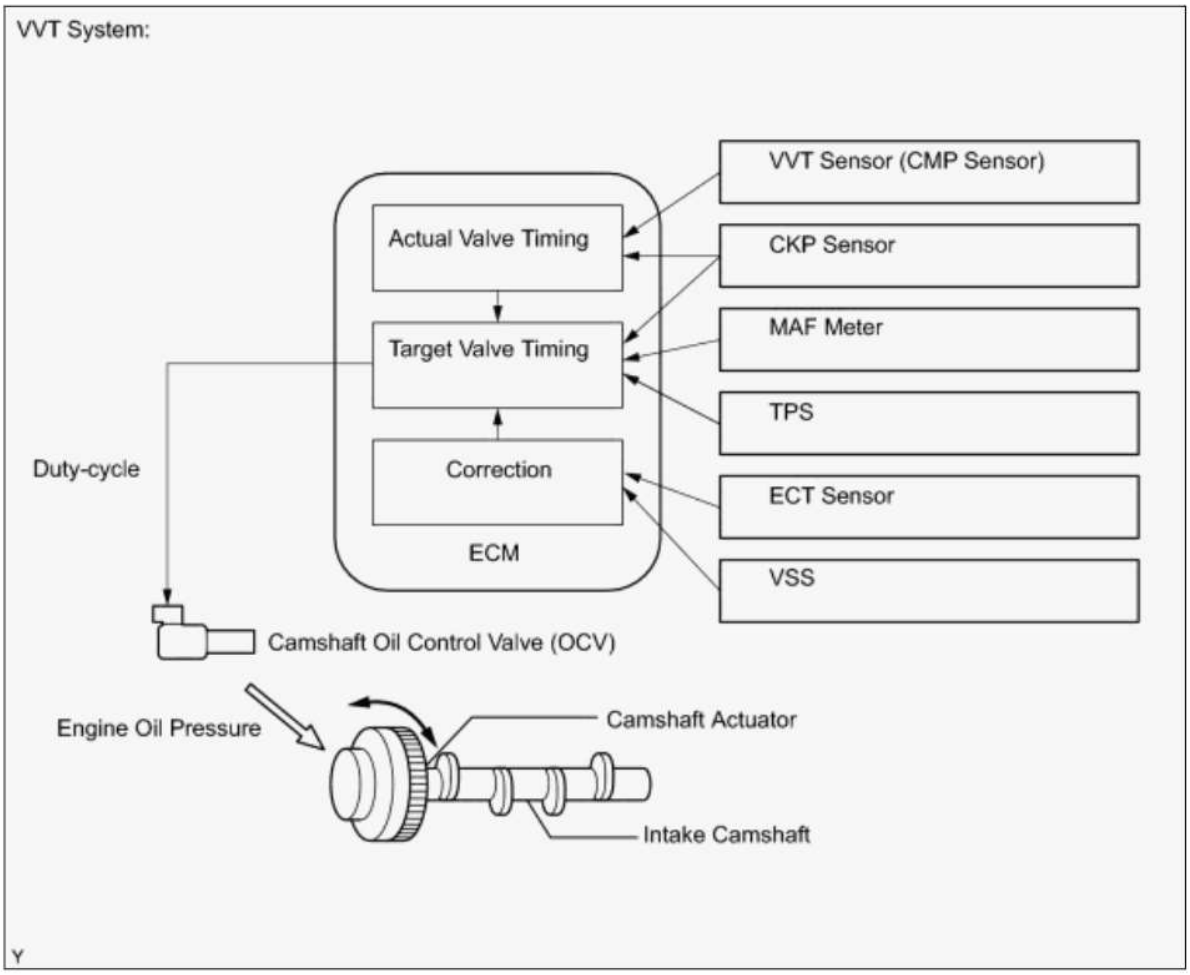
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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDW0DHX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0010: Camshaft Position "A" Actuator Circuit (Bank 1) (2011 RAV4)		

DTC	**P0010**	**Camshaft Position "A" Actuator Circuit (Bank 1)**

DESCRIPTION

The VVT (Variable Valve Timing) system adjusts the intake valve timing to improve driveability. The engine oil pressure turns the VVT controller to adjust the valve timing. The camshaft timing Oil Control Valve (OCV) is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0010	An open or short in the camshaft timing Oil Control Valve (OCV) circuit (1 trip detection logic).	• Open or short in OCV circuit • OCV • ECM

MONITOR DESCRIPTION

This DTC is designed to detect open or short circuits in the camshaft timing Oil Control Valve (OCV) circuit. If the OCV duty-cycle is excessively high or low while the engine is running, the ECM illuminates the MIL and stores the DTC.

MONITOR STRATEGY

Related DTCs	P0010: VVT OCV range check (bank 1)
Required Sensors/Components (Main)	VVT OCV
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None
Starter	OFF
Ignition switch	ON
Time after ignition switch turned from off to ON	0.5 seconds or more
When either condition below is met	Condition A or B
A. When all conditions below are met	Condition 1, 2 and 3
1. Battery voltage	11 to 13 V
2. CPU commanded duty	Less than 70%
3. Current cut status	Not cut
B. When all conditions below are met	Condition 1, 2 and 3
1. Battery voltage	13 V or higher
2. CPU commanded duty	Less than 80%

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3. Current cut status	Not cut

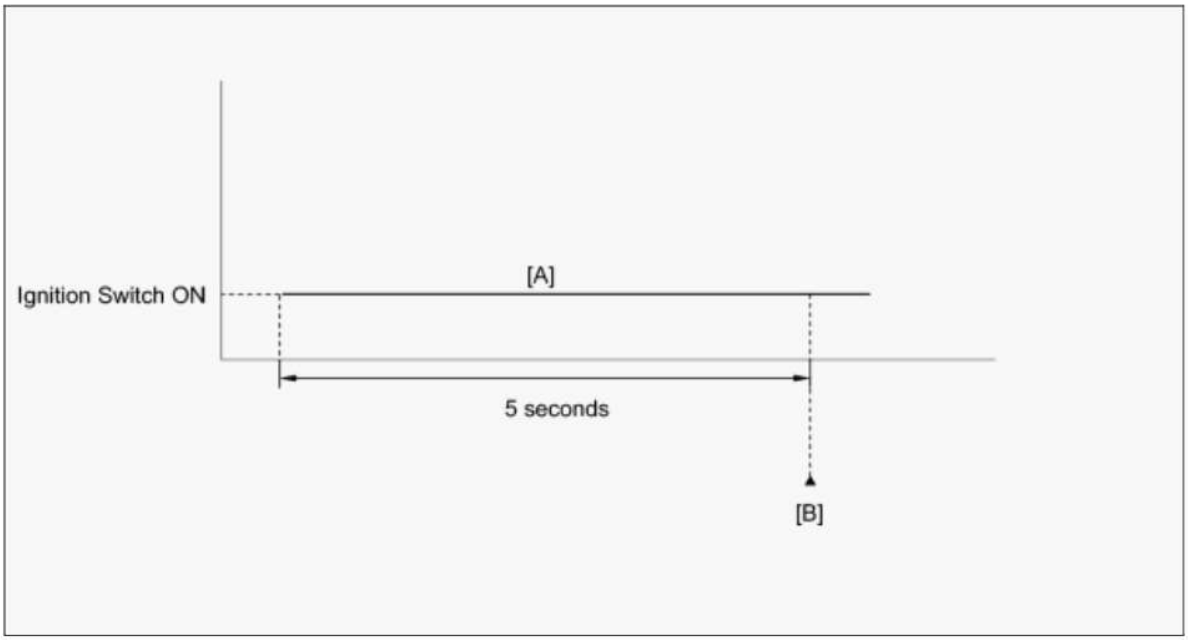
TYPICAL MALFUNCTION THRESHOLDS

VVT oil control valve condition	No operation record

COMPONENT OPERATING RANGE

VVT OCV duty ratio	3 to 100%

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on [A].
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation)
4. Wait 5 seconds.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0010.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal

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TESTER DISPLAY	DESCRIPTION
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

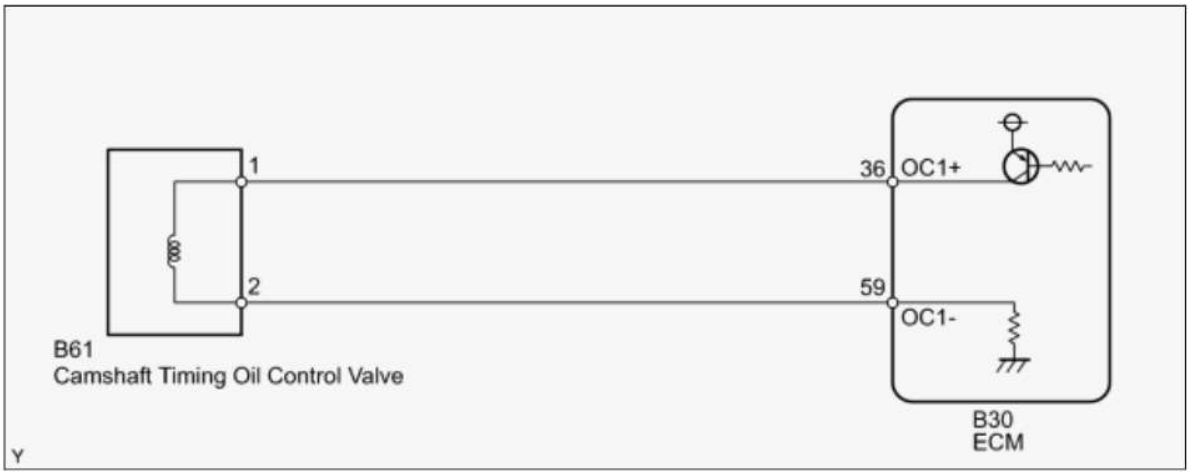
If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was

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moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ DTC OUTPUT**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs after recording the freeze frame data and DTCs INFO .

(e) Turn the ignition switch off.

(f) Start the engine and allow the engine to idle.

(g) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(h) Read DTCs.

Result

RESULT	PROCEED TO
P0010	A
No output	B

B ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A ▼

2.	**INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

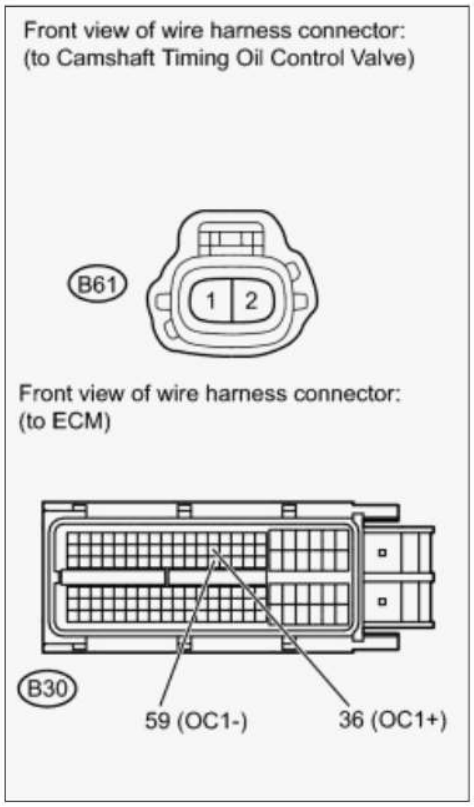
(a) Inspect the camshaft timing oil control valve assembly INFO .

NG ▶ **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

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OK

3.	**CHECK HARNESS AND CONNECTOR (OCV - ECM)**



(a) Disconnect the camshaft timing oil control valve connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B61-1 - B30-36 (OC1+)	Always	Below 1 Ω
B61-2 - B30-59 (OC1-)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B61-1 or B30-36 (OC1+) - Body ground	Always	10 kΩ or higher

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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B61-2 or B30-59 (OC1-) - Body ground	Always	10 kΩ or higher

(d) Reconnect the camshaft timing oil control valve connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDU0ELX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0011,P0012: Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1) (2011 RAV4)		

DTC	**P0011**	**Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)**

DTC	**P0012**	**Camshaft Position "A" - Timing Over-Retarded (Bank 1)**

DESCRIPTION

Refer to DTC P0010 INFO .

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0011	Intake valve timing is stuck at a certain value when in the advance range (1 trip detection logic).	• Valve timing • Camshaft timing Oil Control Valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0012	Intake valve timing is stuck at a certain value when in the retard range (2 trip detection logic).	

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft timing Oil Control Valve (OCV) and the VVT controller (camshaft timing gear assembly). The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when the following conditions 1 and 2 are met:

1. It takes 5 seconds or more to change the valve timing by 5°CA.

2. After the above condition 1 is met, the camshaft timing oil control valve is forcibly activated for 10 seconds.

These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.

MONITOR STRATEGY

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Related DTCs	P0011: Advanced camshaft timing P0012: Retarded camshaft timing
Required Sensors/Components (Main)	VVT OCV and VVT controller
Required Sensors/Components (Related)	Crankshaft position sensor Camshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: Immediate Retarded camshaft timing: 2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0010 (VVT Oil Control Valve) P0016 (VVT System - Misalignment) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor)
Battery voltage	11 V or higher
Engine speed	400 to 4000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

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TYPICAL MALFUNCTION THRESHOLDS

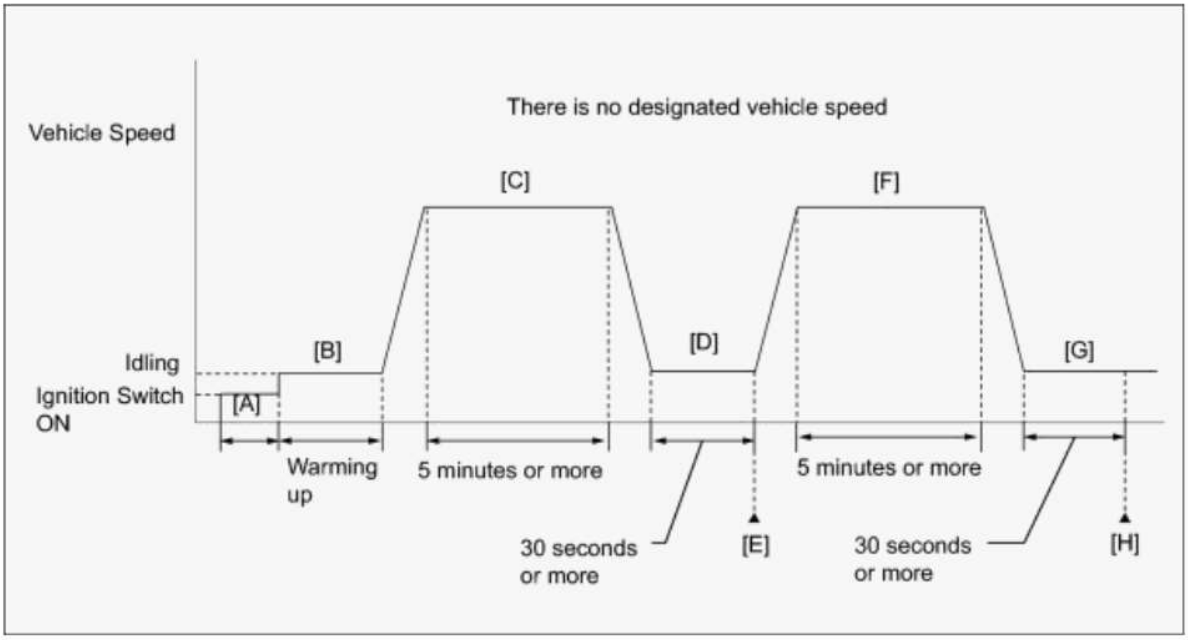
All of following conditions are met	-
Deviation of actual valve timing and target valve timing	More than 5° CA (Crankshaft Angle)
Valve timing	No change at advanced (retarded) valve timing

If the difference between the target and actual camshaft timings is more than the specified value, the ECM operates the VVT actuator. Then, the ECM monitors the camshaft timing change for 5 seconds.

MONITOR RESULT

Refer to Checking Monitor Status INFO .

CONFIRMATION DRIVING PATTERN



1. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
2. Start the engine and warm it up until the ECT reaches 75°C (167°F) or higher [B].
3. Drive the vehicle for 5 minutes or more [C].
4. Idle the engine for 30 seconds or more [D].
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0011 or P0012.
7. Check the DTC judgment result [E].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [F] through [H].

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8. Drive the vehicle for 5 minutes or more [F].
9. Idle the engine for 30 seconds or more [G].
10. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
11. Input the DTC: P0011 or P0012.
12. Check the DTC judgment result again [H].
13. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
14. Read Pending DTCs [H].

HINT:

If a pending DTC is output, the system is malfunctioning.

15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0010 INFO .

INSPECTION PROCEDURE

HINT:

- DTC P0011 or P0012 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC remains stored even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011 OR P0012)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

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RESULT	PROCEED TO
P0011 or P0012	A
P0011 or P0012 and other DTCs	B

HINT:

If any DTCs other than P0011 or P0012 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine.

(c) Turn the Techstream on.

(d) Turn the A/C switch on.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1).

(f) Check the engine speed while operating the camshaft timing oil control valve assembly (for intake camshaft) using the Techstream.

Result:

TECHSTREAM OPERATION	SPECIFIED CONDITION
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

HINT:

If the result is not acceptable, cool the engine and perform the Active Test again.

(g) Start the engine when the engine coolant temperature is 30°C (86°F) or less.

(h) Turn the Techstream on.

(i) Turn the A/C switch on.

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(j) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1).

(k) Check the engine speed while operating the camshaft timing oil control valve assembly (for intake camshaft) using the Techstream when the engine coolant temperature is 50°C (122°F) or less.

Result:

TECHSTREAM OPERATION	SPECIFIED CONDITION
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG ▶ **CHECK VALVE TIMING (CHECK FOR LOOSE TIMING CHAIN AND JUMPED TEETH)**

OK ▼

3.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0011 OR P0012)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine and warm it up.

(f) Switch the ECM from normal mode to check mode using the Techstream INFO .

(g) Drive the vehicle in accordance with the driving pattern described in the CONFIRMATION DRIVING PATTERN.

(h) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P0011 or P0012	B

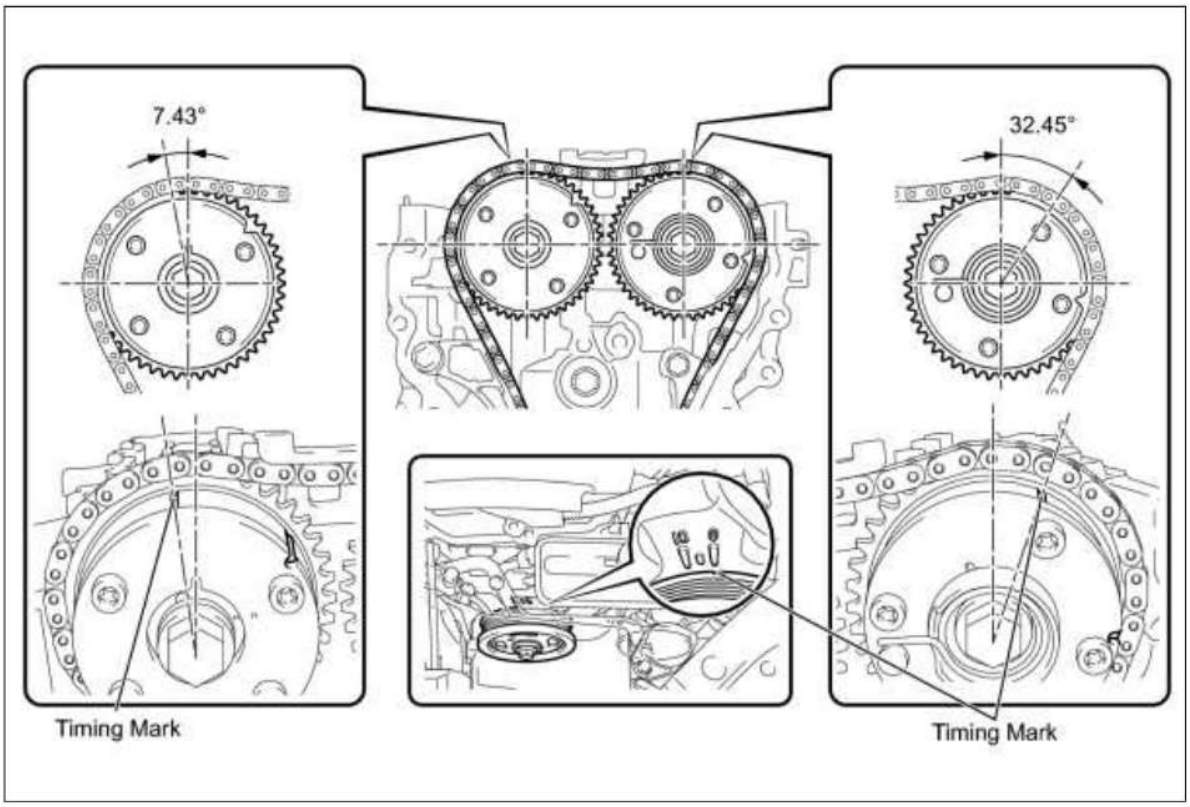
B ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A ▶ **CHECK VALVE TIMING (CHECK FOR LOOSE TIMING CHAIN AND JUMPED TEETH)**

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4.	CHECK VALVE TIMING (CHECK FOR LOOSE TIMING CHAIN AND JUMPED TEETH)

(a) Remove the cylinder head cover INFO .



(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

(c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks as shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

(d) Reinstall the cylinder head cover INFO .

NG ▶ ADJUST VALVE TIMING

OK ▼

5.	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

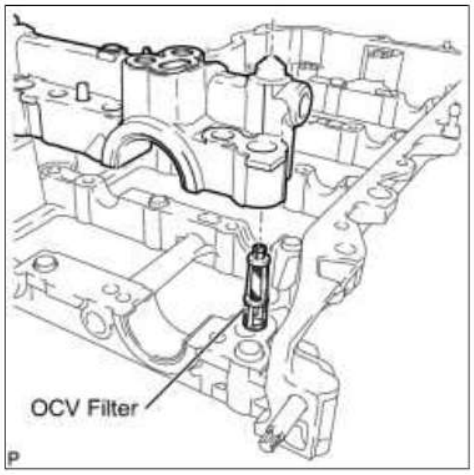
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(a) Inspect the camshaft timing oil control valve assembly INFO .

NG ▶ **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

OK ▼

6.	**INSPECT OIL CONTROL VALVE FILTER**



(a) Remove the oil control valve filter INFO .

(b) Check that the filter is not clogged.

OK:
Filter is not clogged.

(c) Reinstall the oil control valve filter INFO .

NG ▶ **CLEAN OIL CONTROL VALVE FILTER**

OK ▼

7.	**REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**

(a) Replace the camshaft timing gear assembly INFO .

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NEXT



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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000010BK08KX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P011B: Engine Coolant Temperature / Intake Air Temperature Correlation (2011 RAV4)		

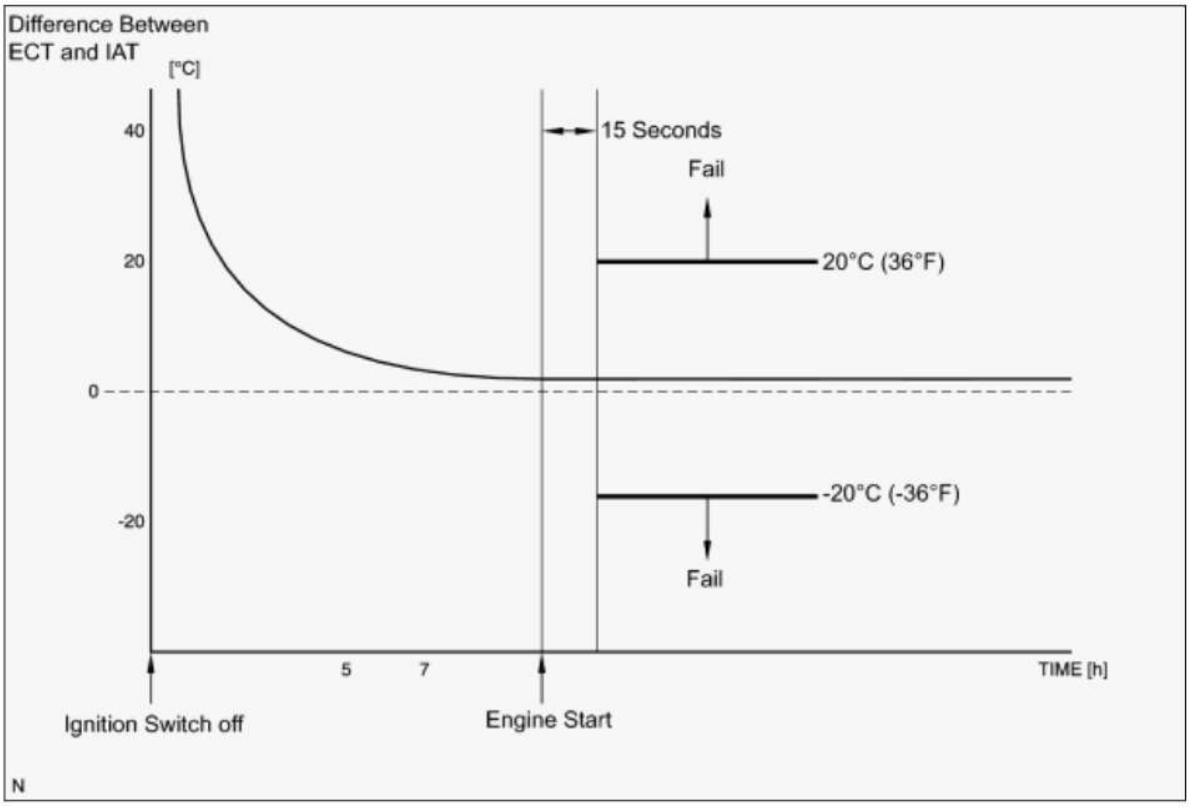
DTC	**P011B**	**Engine Coolant Temperature / Intake Air Temperature Correlation**

DESCRIPTION

The engine has two temperature sensors, an Engine Coolant Temperature (ECT) sensor and an Intake Air Temperature (IAT) sensor, to detect the temperature while the engine is in operation. A thermistor, whose resistance value varies according to the temperature, is built into each sensor. When the temperature is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes. Based on these temperature signals output from the sensors, the ECM determines the fuel injection time and the ignition timing to control the engine.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P011B	• All of the following conditions are met (2 trip detection logic): a. The battery voltage is 10.5 V or higher. b. 7 hours or more have elapsed since the engine stopped on the previous trip. c. 48 seconds after a cold engine start. d. The minimum Intake Air Temperature (IAT) after the engine starts is higher than -10°C (14°F). e. The average Engine Coolant Temperature (ECT) before the engine starts is higher than -10°C (14°F). f. The difference between the readings of the ECT and IAT is more than 20°C (36°F).	• IAT sensor • ECT sensor • ECM

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HINT:

- Waiting is required to prevent the temperature of the engine from affecting the readings. If the engine has been operated recently, it is not possible to accurately compare the readings.
- For diagnosis, in order to duplicate the detection conditions of the DTC, it is necessary to park the vehicle for 7 hours. Parking the vehicle for 7 hours ensures that the actual temperature of the ECT and IAT are very similar. When the vehicle has been parked for less than 7 hours, differences in the readings may exist, but this does not necessarily indicate a fault.

MONITOR DESCRIPTION

The ECM monitors the difference between the Engine Coolant Temperature (ECT) and the Intake Air Temperature (IAT) when the engine is started cold to accurately detect the engine temperature conditions. The monitor runs when the engine started cold after 7 hours or more have elapsed since the engine was stopped (ignition switch turned off) on the previous trip. If the difference between the ECT and the IAT on a cold start exceeds 20°C (36°F), the ECM interprets this as a malfunction in the ECT sensor circuit and IAT sensor circuit, and stores the DTC.

MONITOR STRATEGY

Related DTCs	P011B: Engine Coolant Temperature (ECT)/Intake Air Temperature (IAT) sensor correlation
Required Sensors/Components (Main)	ECT sensor IAT sensor

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Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	7 hours or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

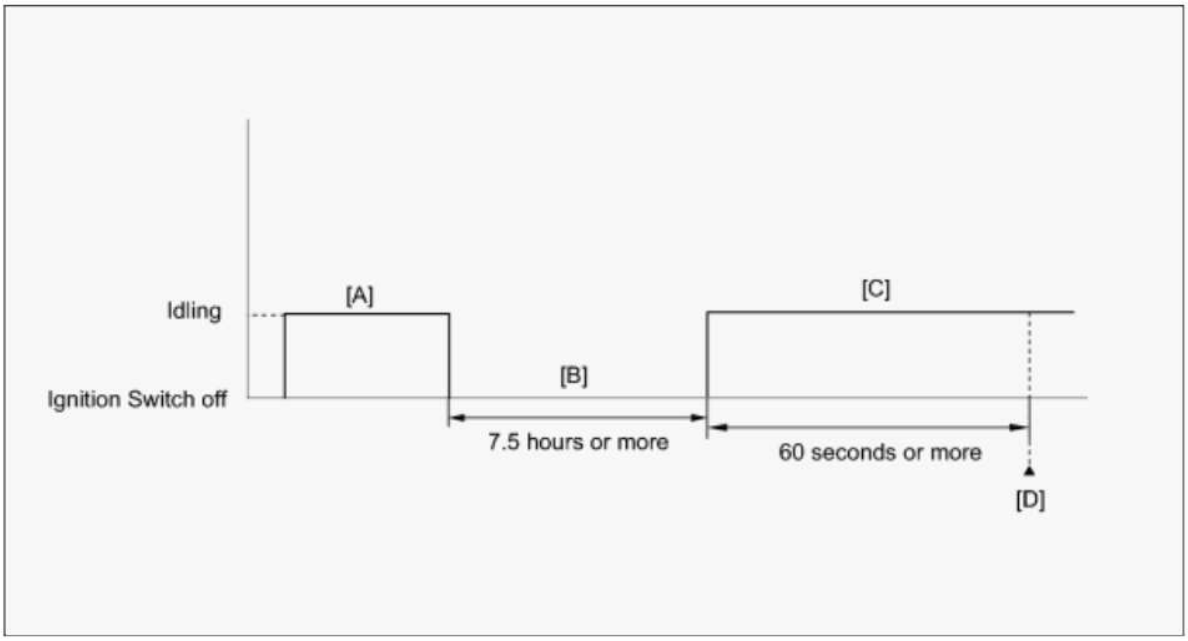
The monitor will run whenever these DTCs are not stored	P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P2610 (Soak Timer)
Both of following conditions met	Conditions 1 and 2
1. All of following conditions met	Conditions (a), (b), (c) and (d)
(a) Time after ignition switch ON and engine not running	Less than 20 seconds
(b) Soak Time	7 hours or more
(c) Battery voltage	10.5 V or higher
(d) Time after engine start	48 seconds or more
2. Either of the following conditions are met	Condition (a) and (b)
(a) Minimum IAT after engine start	-10°C (14°F) or higher
(b) Average ECT before engine start	-10°C (14°F) or higher

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TYPICAL MALFUNCTION THRESHOLDS

Deviated ECT and IAT	Below -20°C (-36°F) or higher than 20°C (36°F)

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Turn the ignition switch off.
5. With the engine stopped, leave the vehicle as is for 7.5 hours or more [B].
6. Start the engine and wait 60 seconds or more [C].
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P011B.
9. Check the DTC judgment result [D].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [A] through [D] again.

10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.

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11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P011B)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P011B	A
P011B and other DTCs	B

HINT:

If any DTCs other than P011B are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**READ VALUE USING TECHSTREAM (INTAKE AIR TEMPERATURE)**

(a) Leave the vehicle for 7 hours or more.

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HINT:

It is necessary to leave the vehicle for 7 hours or more to create conditions similar to the DTC detection conditions.

(b) Connect the Techstream to the DLC3.

(c) Turn the ignition switch to ON.

(d) Turn the Techstream on.

(e) Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

(f) Read the value displayed on the Techstream.

OK:
Difference between the intake air temperature and the actual outside air temperature is within 10°C (18°F).

HINT:

Temperature readings on the outside temperature gauge of the vehicle (if equipped) are not suitable for comparing to the IAT reading. The outside temperature gauge has a significant delay built in to prevent swings in the temperature display. Use an accurate thermometer to determine the outside air temperature.

NG ▶ **REPLACE MASS AIR FLOW METER**

OK ▼

3.	**READ VALUE USING TECHSTREAM (COOLANT TEMPERATURE)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / All Data / Coolant Temp.

(e) Read the value displayed on the Techstream.

OK:
The difference between the coolant temperature and the actual outside air temperature is within 10°C (18°F).

HINT:

If the result is not as specified, check that there are no heat sources such as a block heater in the engine compartment.

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NG ▶ REPLACE ENGINE COOLANT TEMPERATURE SENSOR

OK ▶ REPLACE ECM

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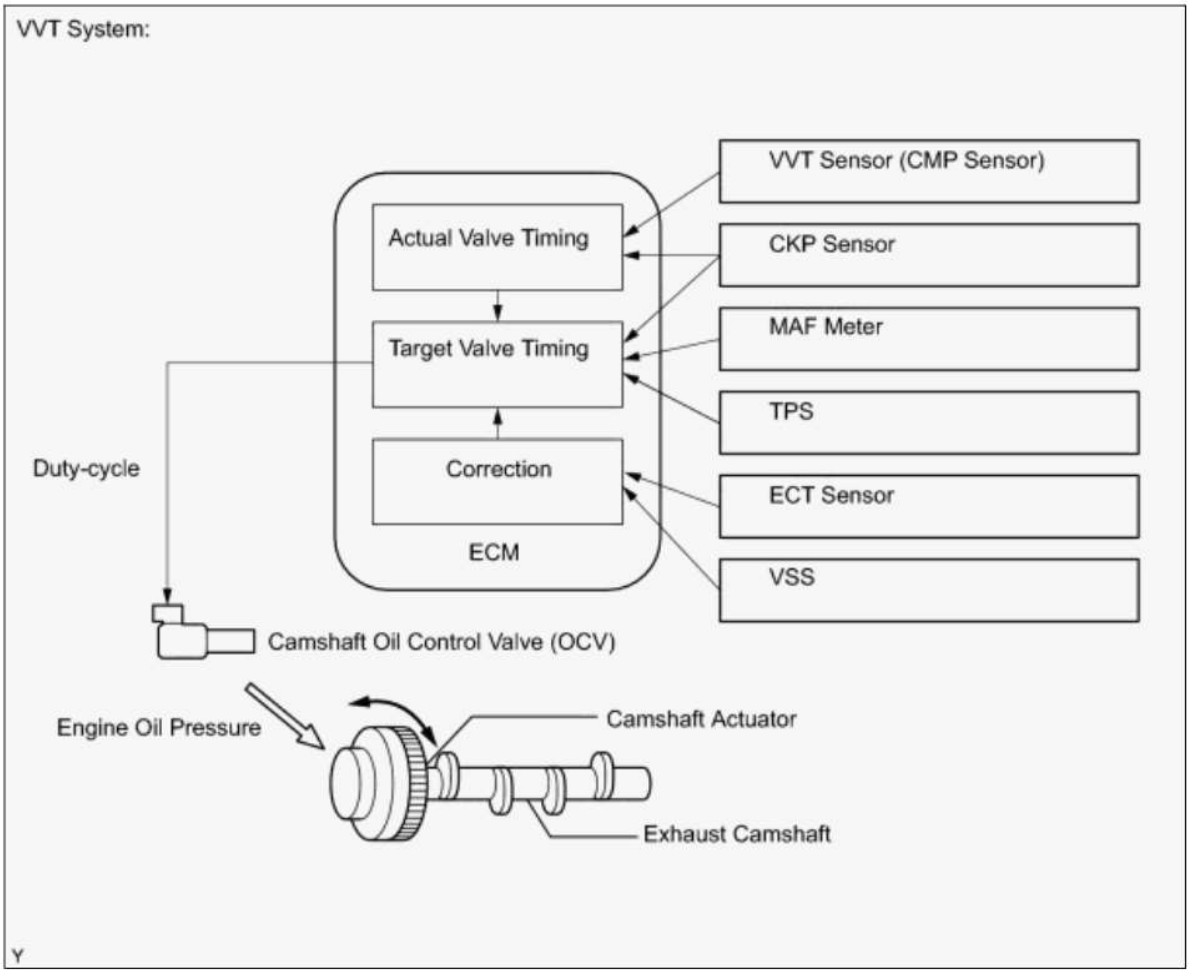
Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000XH708RX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0013: Camshaft Position "B" Actuator Circuit / Open (Bank 1) (2011 RAV4)		

DTC	**P0013**	**Camshaft Position "B" Actuator Circuit / Open (Bank 1)**

DESCRIPTION

The VVT (Variable Valve Timing) system adjusts the exhaust valve timing to improve driveability. The engine oil pressure turns the VVT controller to adjust the valve timing.

The camshaft timing oil control valve is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0013	An open or short in the camshaft timing oil control valve (for exhaust camshaft) circuit (1 trip detection logic).	• Open or short in camshaft timing oil control valve assembly (for exhaust camshaft) circuit • Camshaft timing oil control valve assembly (for exhaust camshaft) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect open or short circuits in the camshaft timing oil control valve (for exhaust camshaft) circuit. If the duty-cycle of the camshaft timing oil control valve assembly is excessively high or low while the engine is running, the ECM illuminates the MIL and stores the DTC.

MONITOR STRATEGY

Related DTCs	P0013 Exhaust camshaft timing oil control valve range check
Required Sensors/Components (Main)	Exhaust camshaft timing oil control valve
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None
All of following conditions met	-
Starter	OFF
Ignition switch	ON
Time after ignition switch turned from off to ON	0.5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

One of following conditions met	-
A. All of following conditions met	-
Battery voltage	11 to 13 V

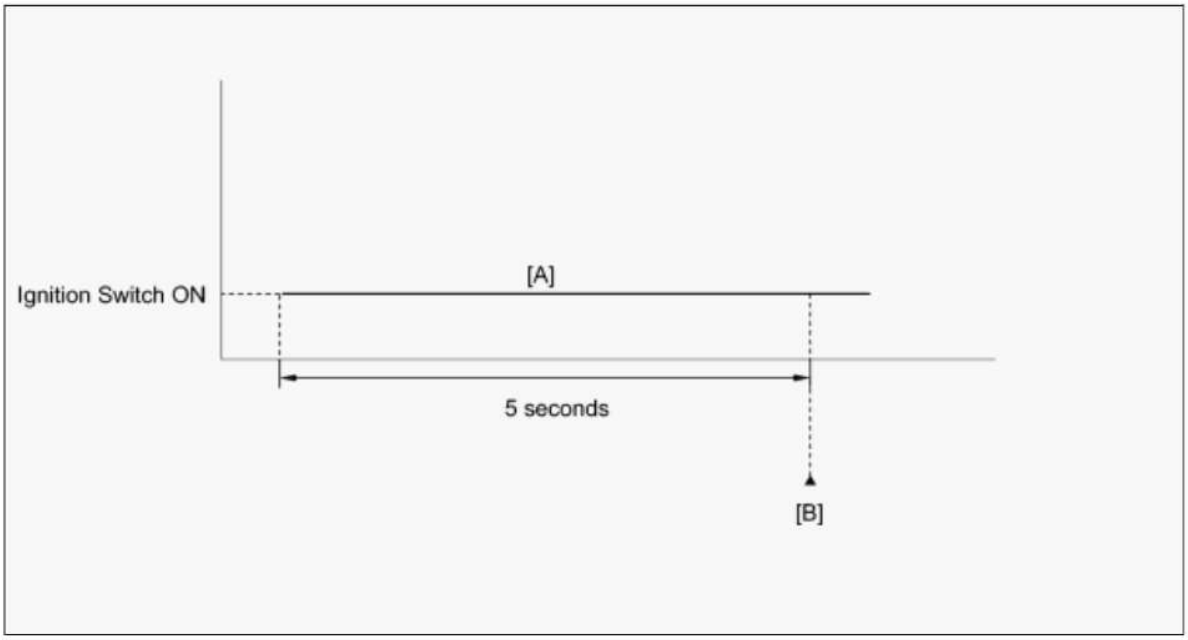
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Target duty ratio	Less than 70%
Output signal duty ratio	100%
B. All of following conditions met	-
Battery voltage	13 V or higher
Target duty ratio	Less than 80%
Output signal duty ratio	100%
C. All of following conditions met	-
Current cut status	Not cut
Output signal duty	3% or less

COMPONENT OPERATING RANGE

Camshaft timing oil control valve duty ratio	3 to 100%

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on [A].
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation).
4. Wait 5 seconds.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0013.
7. Check the DTC judgment result [B].

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TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

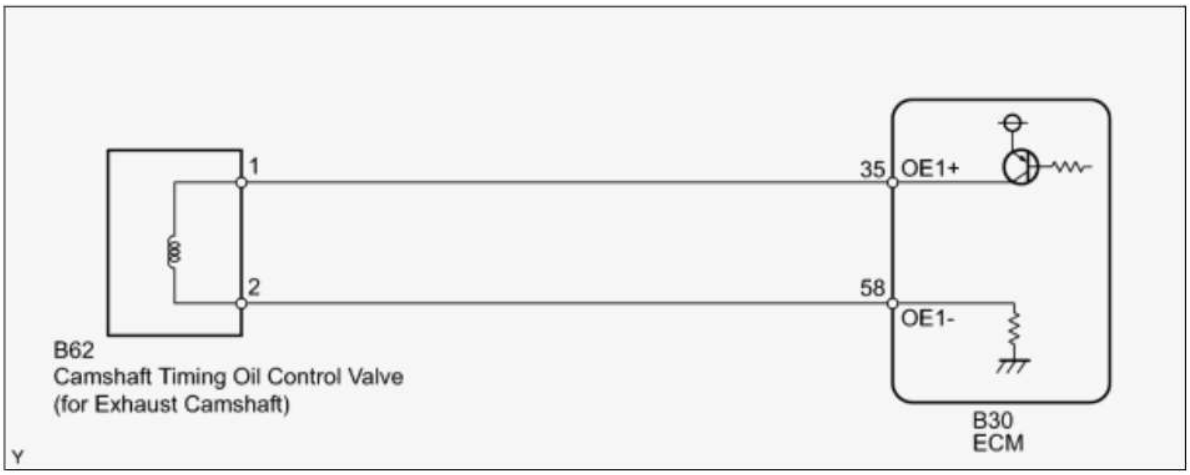
If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

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HINT:

- If DTC P0013 is output, check the VVT system (for exhaust camshaft) circuit.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

PROCEDURE

1.	**PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine.

(c) Turn the Techstream on.

(d) Turn the A/C switch on.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1).

(f) Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream.

Result:

TECHSTREAM OPERATION	SPECIFIED CONDITION
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

HINT:

If the result is not acceptable, cool the engine and perform the Active Test again.

(g) Start the engine when the engine coolant temperature is 30°C (86°F) or less.

(h) Turn the Techstream on.

(i) Turn the A/C switch on.

(j) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1).

(k) Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream when the engine coolant temperature is 50°C (122°F) or less.

Result:

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TECHSTREAM OPERATION	SPECIFIED CONDITION
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG ▶ **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

2.	**INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**

(a) Inspect the camshaft timing oil control valve assembly INFO .

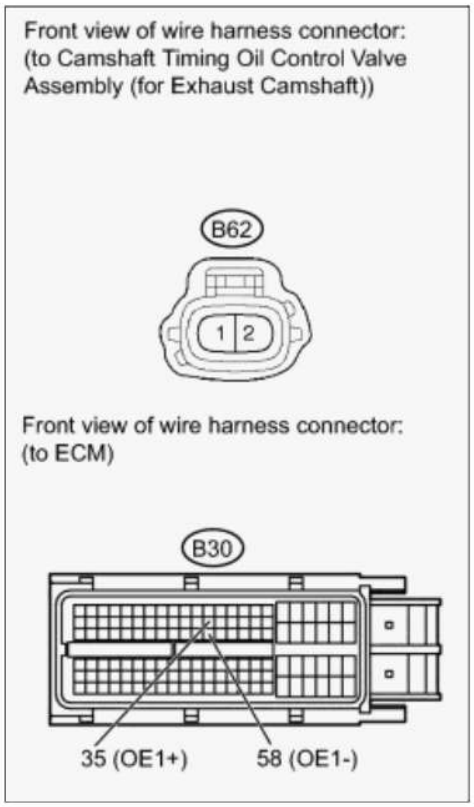
NG ▶ **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**

OK ▼

3.	**CHECK HARNESS AND CONNECTOR (CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY - ECM)**

(a) Disconnect the camshaft timing oil control valve assembly (for exhaust camshaft) connector.

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(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B62-1 - B30-35 (OE1+)	Always	Below 1 Ω
B62-2 - B30-58 (OE1-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B62-1 or B30-35 (OE1+) - Body ground	Always	10 kΩ or higher
B62-2 or B30-58 (OE1-) - Body ground	Always	10 kΩ or higher

(d) Reconnect the camshaft timing oil control valve assembly (for exhaust camshaft) connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000XH808YX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0014,P0015: Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1) (2011 RAV4)		

DTC	**P0014**	**Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)**

DTC	**P0015**	**Camshaft Position "B" - Timing Over-Retarded (Bank 1)**

DESCRIPTION

Refer to DTC P0013 INFO .

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0014	Exhaust valve timing is stuck at a certain value when in the advance range (2 trip detection logic).	• Valve timing • Camshaft timing oil control valve assembly (for exhaust camshaft) • Oil control valve filter • Camshaft timing gear assembly (for exhaust camshaft) • ECM
P0015	Exhaust valve timing is stuck at a certain value when in the retard range (1 trip detection logic).	

MONITOR DESCRIPTION

The ECM optimizes the exhaust valve timing using the VVT (Variable Valve Timing) system to control the exhaust camshaft. The VVT system includes the ECM, the camshaft timing oil control valve and the VVT controller (camshaft timing gear assembly). The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve assembly. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the exhaust camshaft.

If the difference between the target and actual exhaust valve timing is large, and changes in the actual exhaust valve timing are small, the ECM interprets this as a VVT controller stuck malfunction and stores a DTC.

Example:
A DTC is stored when the following conditions 1 and 2 are met for 10 seconds or more:

1. It takes 5 seconds or more to change the valve timing by 5°CA.

2. After the above condition 1 is met, the camshaft timing oil control valve is forcibly activated during 10 seconds.

These DTCs indicate that the VVT controller cannot operate properly due to camshaft timing oil control valve assembly malfunctions or the presence of foreign objects in the camshaft timing oil control valve assembly.

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MONITOR STRATEGY

Related DTCs	P0014: Advanced camshaft timing P0015: Retarded camshaft timing
Required Sensors/Components (Main)	Camshaft timing oil control valve and VVT controller
Required Sensors/Components (Related)	Crankshaft position sensor Camshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: 2 driving cycles Retarded camshaft timing: Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0013 (Exhaust VVT Oil Control Valve) P0017 (Exhaust VVT System - Misalignment) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor)
Battery voltage	11 V or higher
Engine speed	500 to 4000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Advanced Camshaft Timing

Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft Angle) for 5 seconds or more after the VVT hold duty ratio learned value reaches the upper or lower limit.
Valve timing	No change at advanced valve timing

Retarded Camshaft Timing

Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft Angle) for 5 seconds or more after the VVT hold duty ratio learned value reaches the upper or lower limit.

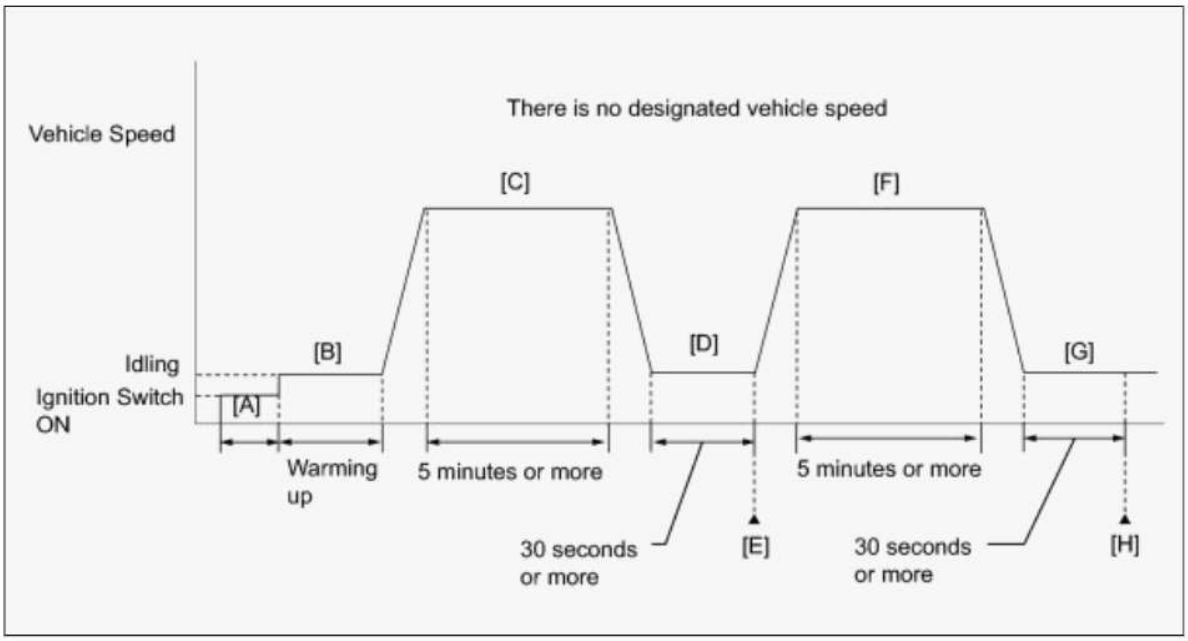
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Valve timing	No change at retarded valve timing

MONITOR RESULT

Refer to Checking Monitor Status INFO .

CONFIRMATION DRIVING PATTERN



1. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
2. Start the engine and warm it up until the ECT reaches 75°C (167°F) or higher [B].
3. Drive the vehicle for 5 minutes or more [C].
4. Idle the engine for 30 seconds or more [D].
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0014 or P0015.
7. Check the DTC judgment result [E].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions

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TESTER DISPLAY	DESCRIPTION
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [F] through [H].

8. Drive the vehicle for 5 minutes or more [F].
9. Idle the engine for 30 seconds or more [G].
10. Check the DTC judgment result again [H].
11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs [H].

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0013 INFO .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014 OR P0015)**

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(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read the DTCs.

Result

RESULT	PROCEED TO
DTC P0014 or P0015 is output	A
DTC P0014 or P0015 and other DTCs are output	B

HINT:

If any DTCs other than P0014 or P0015 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine.

(c) Turn the Techstream on.

(d) Turn the A/C switch on.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1).

(f) Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream.

Result:

TECHSTREAM OPERATION	SPECIFIED CONDITION
0% (OFF)	Normal engine speed

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TECHSTREAM OPERATION	SPECIFIED CONDITION
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

HINT:

If the result is not acceptable, cool the engine and perform the Active Test again.

(g) Start the engine when the engine coolant temperature is 30°C (86°F) or less.

(h) Turn the Techstream on.

(i) Turn the A/C switch on.

(j) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1).

(k) Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream when the engine coolant temperature is 50°C (122°F) or less.

Result:

TECHSTREAM OPERATION	SPECIFIED CONDITION
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG ▶ **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**

OK ▼

3.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P0014 OR P0015)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine and warm it up.

(f) Switch the ECM from normal mode to check mode using the Techstream INFO .

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(g) Drive the vehicle in accordance with the driving pattern described in the CONFIRMATION DRIVING PATTERN.

(h) Read the DTCs.

Result:

RESULT	PROCEED TO
DTC is not output	A
DTC P0014 or P0015 is output	B

B ▶ **ADJUST VALVE TIMING**

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

4.	**INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**

(a) Inspect the camshaft timing oil control valve assembly INFO .

NG ▶ **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**

OK ▼

5.	**INSPECT CAMSHAFT TIMING GEAR ASSEMBLY (FOR EXHAUST CAMSHAFT)**

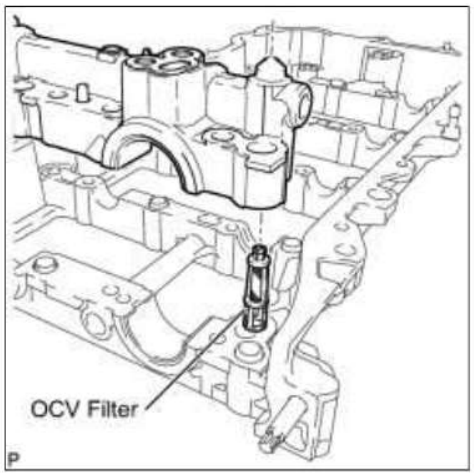
(a) Inspect the camshaft timing gear assembly (for exhaust camshaft) INFO .

NG ▶ **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (FOR EXHAUST CAMSHAFT)**

OK ▼

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6.	INSPECT OIL CONTROL VALVE FILTER



(a) Remove the oil control valve filter INFO .

(b) Check that the filter is not clogged.

OK:
Filter is not clogged.

(c) Reinstall the oil control valve filter INFO .

NG ▶ REPLACE OIL CONTROL VALVE FILTER

OK ▼

7.	ADJUST VALVE TIMING

(a) Adjust the valve timing INFO .

NEXT ▼

8.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0014 OR P0015)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine and warm it up.

(f) Switch the ECM from normal mode to check mode using the Techstream INFO .

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(g) Drive the vehicle in accordance with the driving pattern described in the CONFIRMATION DRIVING PATTERN.

(h) Read the DTCs.

Result:

RESULT	PROCEED TO
DTC is not output	A
DTC P0014 or P0015 is output	B

HINT:

DTC P0014 or P0015 is stored when foreign objects in the engine oil are caught in some part of the system. These codes remain stored for a short time even after the system returns to normal. These foreign objects may then be captured by the oil filter, thus eliminating the source of the problem.

B ▶ REPLACE ECM

A ▶ END

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDV0DLX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0016,P0017: Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A) (2011 RAV4)		

DTC	**P0016**	**Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)**

DTC	**P0017**	**Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)**

DESCRIPTION

The ECM optimizes the valve timing by using the VVT (Variable Valve Timing) system to control the intake and exhaust camshaft. The VVT system includes the ECM, the camshaft timing Oil Control Valve (OCV) and the VVT controller (camshaft timing gear assembly). The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake and exhaust camshaft.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0016	Deviations in the crankshaft and camshaft (for intake side) position sensor signals (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • Camshaft timing Oil Control Valve (OCV) • Camshaft timing gear assembly • ECM
P0017	Deviations in the crankshaft and camshaft (for exhaust side) position sensor signals (2 trip detection logic).	• Mechanical system (Timing chain has jumped tooth or chain stretched) • Camshaft timing Oil Control Valve (OCV) • Camshaft timing gear assembly • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake and exhaust camshaft positions and crankshaft position, the ECM checks the VVT learned value while the engine is idling. The VVT learned value is calibrated based on the camshaft positions and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learned value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores the DTC.

This DTC indicates that the intake and exhaust camshaft timing positions are incorrect with respect to the crankshaft, caused by factors such as the timing chain having jumped a tooth.

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This monitor begins to run after the engine has idled for 5 minutes.

MONITOR STRATEGY

Related DTCs	P0016: Camshaft Timing Misalignment at idling (for intake side) P0017: Camshaft Timing Misalignment at idling (for exhaust side)
Required Sensors/Components (Main)	VVT controller (camshaft timing gear assembly)
Required Sensors/Components (Related)	Camshaft position sensor Crankshaft position sensor
Frequency of Operation	Continuous
Duration	Less than 1 minute
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Intake Side

Monitor runs whenever following DTCs not stored	P0010 (VVT Oil Control Valve) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor)
Engine speed	500 to 1000 rpm

Exhaust Side

Monitor runs whenever following DTCs not stored	P0013 (Exhaust VVT Oil Control Valve) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor)
Engine speed	500 to 1000 rpm

TYPICAL MALFUNCTION THRESHOLDS

Intake Side

One of following conditions is met	-

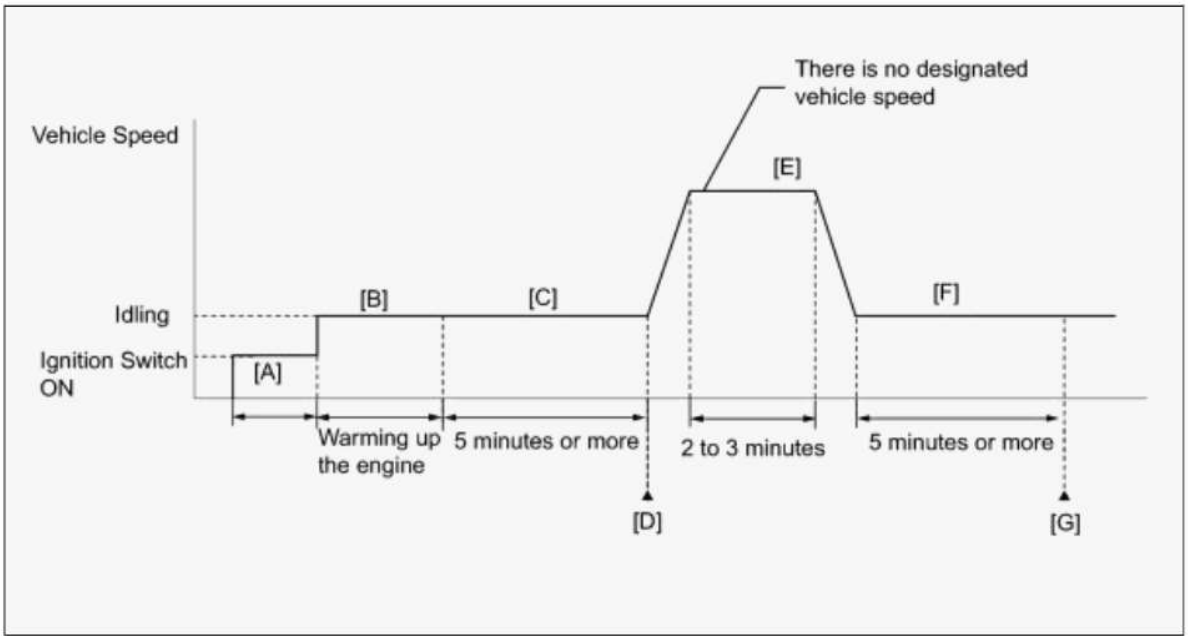
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VVT learned value at maximum retarded valve timing	Less than 22° CA (crankshaft angle)
VVT learned value at maximum retarded valve timing	More than 47° CA (crankshaft angle)

Exhaust Side

One of following conditions is met	-
VVT learned value at maximum advanced valve timing	Less than 82.5° CA (crankshaft angle)
VVT learned value at maximum advanced valve timing	More than 107.5° CA (crankshaft angle)

CONFIRMATION DRIVING PATTERN



1. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
2. Start the engine and warm it up until the ECT reaches 75°C (167°F) or higher [B].
3. Idle the engine for 5 minutes or more [C].
4. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
5. Input the DTC: P0016 or P0017.
6. Check the DTC judgment result [D].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal

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TESTER DISPLAY	DESCRIPTION
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [E] through [G].

7. Drive the vehicle for 2 to 3 minutes [E].
8. Idle the engine for 5 minutes or more [F].
9. Check the DTC judgment result [G].
10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
11. Read Pending DTCs [G].

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0335 INFO .

Refer to DTC P0340 INFO .

Refer to DTC P0365 INFO .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016 OR P0017)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0016 or P0017	A
P0016 or P0017 and other DTCs	B

HINT:

If any DTCs other than P0016 or P0017 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine.

(c) Turn the Techstream on.

(d) Warm up the engine.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 1) / All Data / VVT Change Angle #1, VVT Ex Chg Angle #1.

(f) Check that the VVT change angle varies when operating the camshaft timing oil control valve using

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the Techstream.

OK:
The VVT change angle value and engine speed vary.

NG ▶ **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

OK ▼

3.	**ADJUST VALVE TIMING**

(a) Adjust the valve timing INFO .

NEXT ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P0016 OR P0017)**

4.	**INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY** INFO

NG ▶ **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

OK ▼

5.	**INSPECT OIL CONTROL VALVE FILTER** INFO

NG ▶ **CLEAN OIL CONTROL VALVE FILTER**

OK ▼

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6.	REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

(a) Replace the camshaft timing gear assembly INFO .

NEXT

7.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0016 OR P0017)

(a) In order to clear the ECM learned values for valve timing, disconnect the cable from the negative (-) battery terminal for 1 minute.

(b) Reconnect the cable to the negative (-) battery terminal.

(c) Connect the Techstream to the DLC3.

(d) Turn the ignition switch to ON.

(e) Turn the Techstream on.

(f) Clear DTCs INFO .

(g) Drive the vehicle in accordance with the driving pattern described in the CONFIRMATION DRIVING PATTERN.

(h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(i) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P0016 or P0017	B

B ▶ **REPLACE ECM**

A ▶ **END**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WC10FBX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0031,P0032,P101D: Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1) (2011 RAV4)		

DTC	**P0031**	**Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)**

DTC	**P0032**	**Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)**

DTC	**P101D**	**A/F Sensor Heater Circuit Performance Bank 1 Sensor 1 Stuck ON**

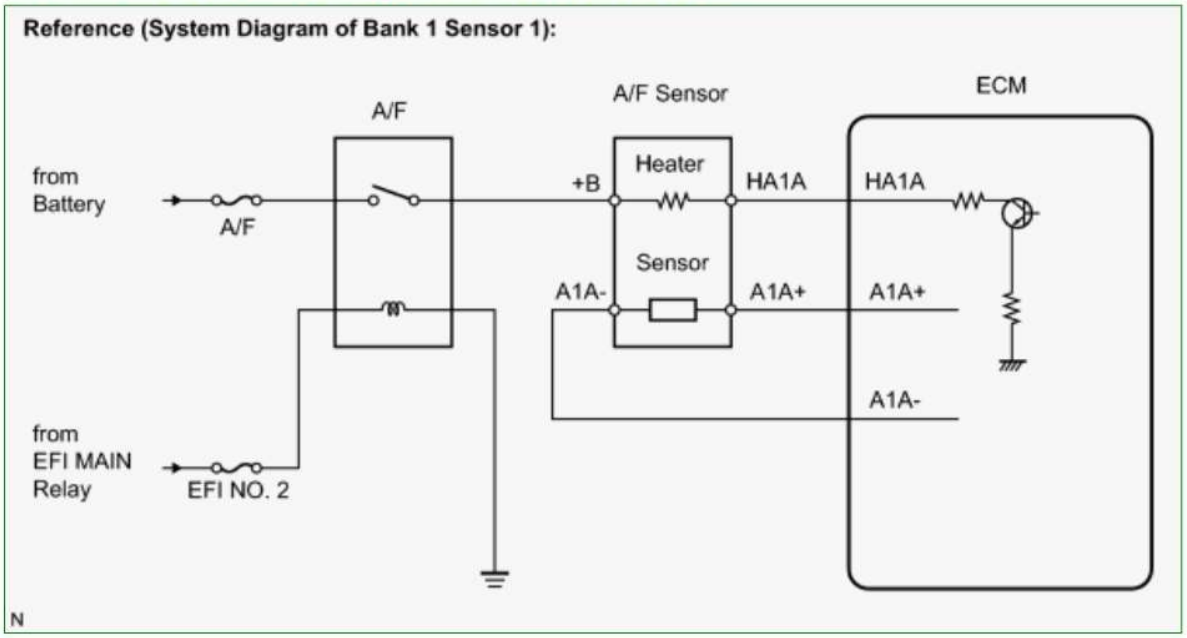
DESCRIPTION

Refer to DTC P2195 INFO .

HINT:

- When any of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the Air Fuel Ratio (A/F) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.
- Although the DTC titles say oxygen sensor, these DTCs relate to the A/F sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.

Reference (System Diagram of Bank 1 Sensor 1):



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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0031	The heater current is less than the specified value while the heater is operating (1 trip detection logic).	• Open in A/F sensor heater circuit • A/F sensor heater (sensor 1) • ECM power source circuit • ECM
P0032	An Air Fuel Ratio (A/F) sensor heater current failure (1 trip detection logic).	• Short in A/F sensor heater circuit • A/F sensor heater (sensor 1) • ECM power source circuit • ECM
P101D	The heater current is higher than the specified value while the heater is not operating (1 trip detection logic).	ECM

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel Ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum-coated zirconia and includes an integrated heating element.

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.

The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate the air-fuel ratio properly.

When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

MONITOR STRATEGY

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Related DTCs	P0031: Air Fuel Ratio (A/F) sensor heater open/short (Low electrical current) P0032: A/F sensor heater open/short (High electrical current) P101D: A/F sensor heater performance
Required Sensors/Components (Main)	A/F sensor heater
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	11 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not stored	None

P0031:

Monitor runs whenever following DTCs not stored	P101D (Air Fuel Ratio Sensor Heater)
Battery voltage	10.5 V or higher
Time after engine start	10 seconds or more
A/F sensor heater duty-cycle ratio	50% or more

P0032:

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Time after engine start	10 seconds or more
A/F sensor heater duty-cycle ratio	0% or more

P101D:

Monitor runs whenever following DTCs not stored	P0031 (Air Fuel Ratio Sensor Heater)
Battery voltage	10.5 V or higher
Time after engine start	10 seconds or more
A/F sensor heater duty-cycle ratio	10 to 60%
A/F sensor heater ON current	0.8 A or higher

TYPICAL MALFUNCTION THRESHOLDS

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P0031:

A/F sensor heater ON current	Below 0.8 A

P0032:

Hybrid IC high current limiter port	Fail

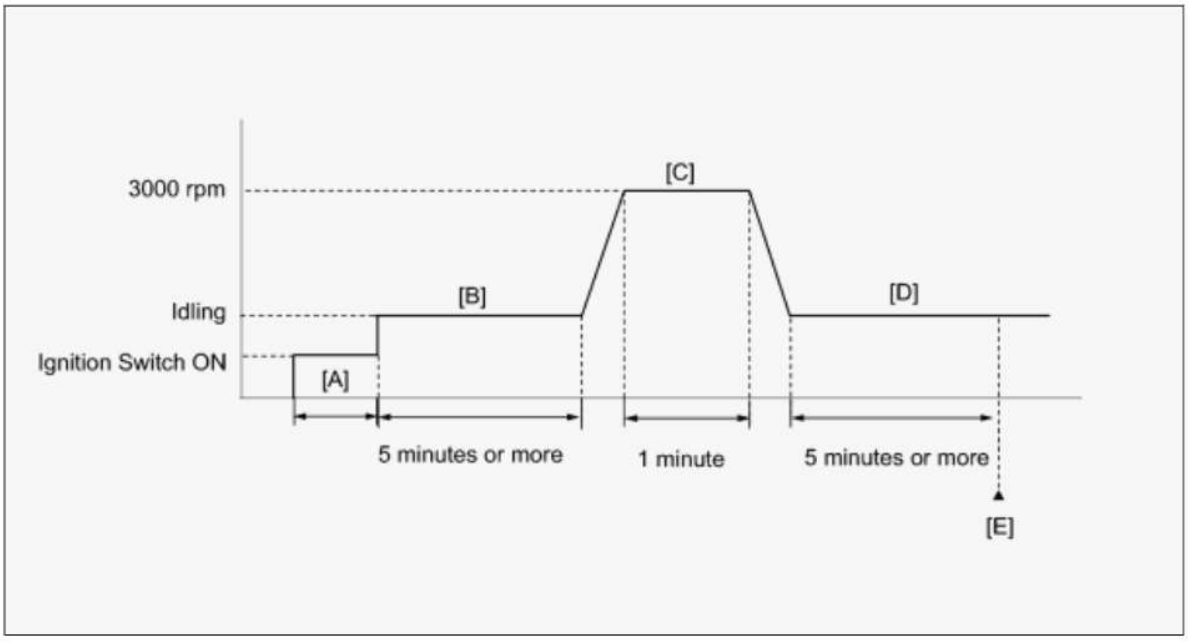
P101D:

Hybrid IC high current limiter port	Fail

COMPONENT OPERATING RANGE

A/F sensor heater resistance	1.8 to 3.4 Ω at 20°C (68°F)

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream ON.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and idle it for 5 minutes or more [B].
5. With the vehicle stationary, depress the accelerator pedal and maintain an engine speed of 3000 rpm for 1 minute [C].
6. Idle the engine for 5 minutes or more [D].
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P0031, P0032, or P101D.
9. Check the DTC judgment result [E].

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TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

10. If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [E] again.
11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- ○ If a permanent DTC is output, the system is malfunctioning.
- ○ If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P2195 INFO .

INSPECTION PROCEDURE

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

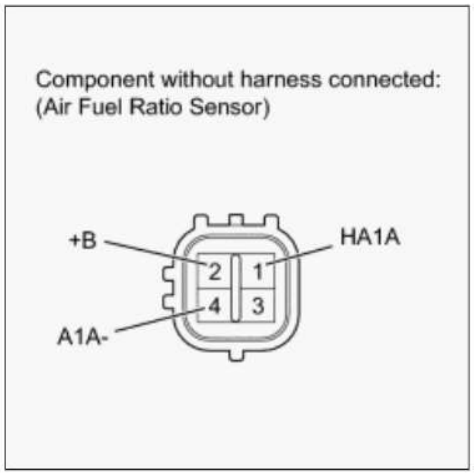
HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

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1.	INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the air fuel ratio sensor connector.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

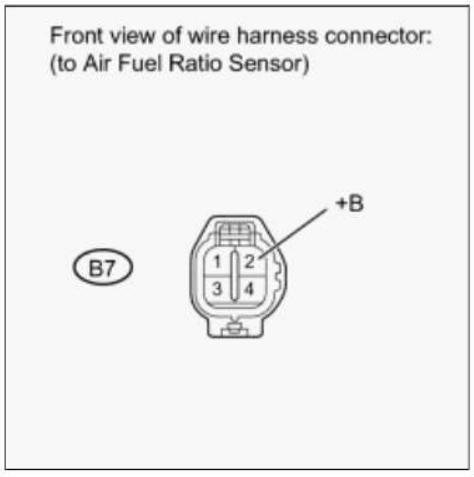
TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	Always	10 kΩ or higher

(c) Reconnect the air fuel ratio sensor connector.

NG ▶ **REPLACE AIR FUEL RATIO SENSOR**

OK ▼

2.	CHECK TERMINAL VOLTAGE (POWER SOURCE)



(a) Disconnect the air fuel ratio sensor connector.

(b) Turn the ignition switch to ON.

(c) Measure the resistance according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
B7-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

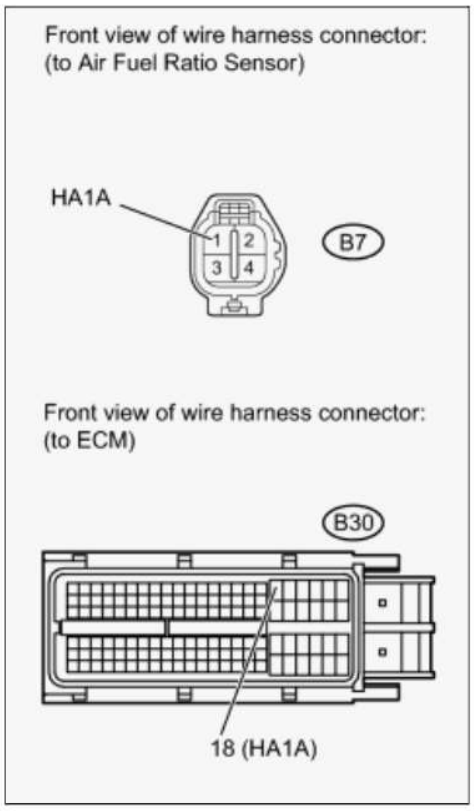
(d) Reconnect the air fuel ratio sensor connector.

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NG ▶ **INSPECT INTEGRATION NO.1 RELAY (A/F)**

OK ▼

3.	**CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)**



(a) Disconnect the air fuel ratio sensor connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B7-1 (HA1A) - B30-18 (HA1A)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B7-1 (HA1A) or B30-18 (HA1A) - Body ground	Always	10 kΩ or higher

(d) Reconnect the air fuel ratio sensor connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

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4.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0031, P0032 OR P101D)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine.

(f) Allow the engine to idle for 1 minute or more.

(g) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(h) Read DTCs.

Result

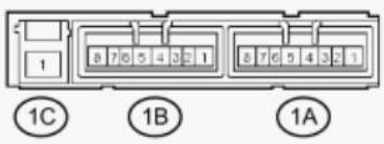
RESULT	PROCEED TO
No output	A
P0031, P0032 or P101D	B

B ▶ **REPLACE ECM**

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

5.	INSPECT INTEGRATION NO.1 RELAY (A/F)

Component without harness connected:
(Integration Relay)



(a) Remove the integration relay from the engine room No. 1 relay block.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1C-1 - 1B-8	Battery voltage not applied to terminals 1B-6 and 1B-7	10 kΩ or higher
	Battery voltage applied to terminals 1B-6 and 1B-7	Below 1 Ω

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(c) Reinstall the integration relay.

NG ▶ **REPLACE INTEGRATION NO.1 RELAY**

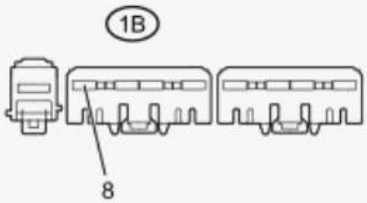
OK ▼

6.	CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - INTEGRATION RELAY)

Front view of wire harness connector:
(to Air Fuel Ratio Sensor)



Front view of wire harness connector:
(to Integration Relay)



(a) Disconnect the air fuel ratio sensor connector.

(b) Remove the integration relay (A/F relay) from the engine room No. 1 relay block INFO .

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B7-2 (+B) - 1B-8	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B7-2 (+B) or 1B-8 - Body ground	Always	10 kΩ or higher

(d) Reconnect the air fuel ratio sensor connector.

(e) Reinstall the integration relay.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **GO TO ECM POWER SOURCE CIRCUIT**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PFA0F9X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0037,P0038,P0141,P102D: Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2) (2011 RAV4)		

DTC	**P0037**	**Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)**

DTC	**P0038**	**Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)**

DTC	**P0141**	**Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)**

DTC	**P102D**	**O2 Sensor Heater Circuit Performance Bank 1 Sensor 2 Stuck ON**

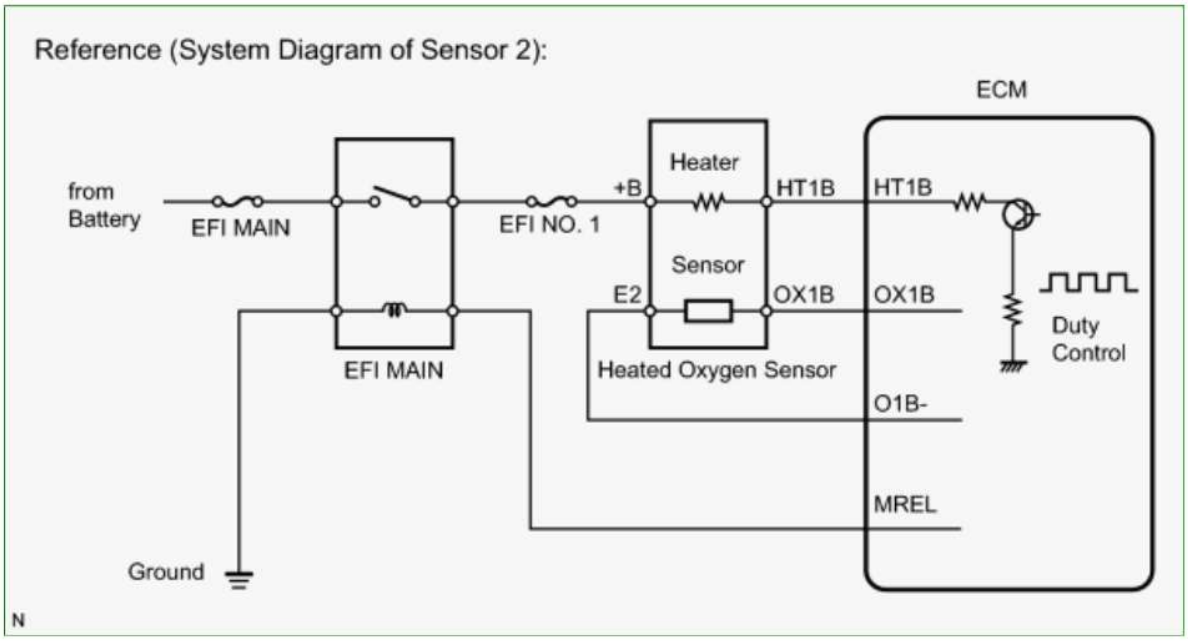
DESCRIPTION

Refer to DTC P0136 INFO .

HINT:

- Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.
- When any of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0037	The heater current less than the specified value while the heater is operating (1 trip detection logic).	• Open in HO2 sensor (sensor 2) heater circuit • HO2 sensor (sensor 2) heater • ECM power source circuit • ECM
P0038	The heater current is higher than the specified value while the heater is operating (1 trip detection logic).	• Short in HO2 sensor (sensor 2) heater circuit • HO2 sensor (sensor 2) heater • ECM power source circuit • ECM
P0141	The cumulative heater resistance correction value exceeds the threshold (2 trip detection logic).	• Open or short in HO2 sensor (sensor 2) heater circuit • HO2 sensor (sensor 2) heater • ECM power source circuit • ECM
P102D	The heater current is higher than the specified value while the heater is not operating (1 trip detection logic).	ECM

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR DESCRIPTION

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The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated oxygen sensor heater range check (P0037, P0038 and P102D):

The ECM monitors the current applied to the HO2 sensor heater to check the heater for malfunctions.

If the heater current is outside the normal range, the signal transmitted by the HO2 sensor becomes inaccurate. When the current in the HO2 sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

Heated oxygen sensor heater performance (P0141):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM determines that there is a malfunction in the HO2 sensor heater and stores DTC P0141.

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater (sensor 2) open/short (Low electrical current) P0038: Heated oxygen sensor heater (sensor 2) open/short (High electrical current) P0141: Heated oxygen sensor heater performance (sensor 2) P102D: Heated oxygen sensor heater ON stuck (sensor 2)
Required sensors/Components (Main)	Heated oxygen sensor heater (sensor 2)
Required sensors/Components (Related)	-
Frequency of operation	Continuous: P0037, P0038, P102D Once per driving cycle: P0141
Duration	0.5 seconds: P0037 Within 3 seconds: P0038 10 seconds: P0141 0.5 seconds: P102D
MIL operation	Immediate: P0037, P0038, P102D 2 driving cycles: P0141
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P0037 (Case 1):

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Monitor runs whenever following DTCs not stored	P0038 (Rear Oxygen Sensor Heater)
Battery voltage	10.5 V or higher
Engine	Running
Starter	OFF
Catalyst active A/F control	Not operating
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete
Heater OFF current learned value	Acquired

P0037 (Case 2):

Monitor runs whenever following DTCs not stored	P0038 (Rear Oxygen Sensor Heater)
Battery voltage	10.5 V or higher
Engine	Running
Starter	OFF
Catalyst active A/F control	Not operating
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete
Heated oxygen sensor heater OFF current	Higher than 3.5 A
Hybrid IC high current limiter port	Fail

P0038:

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Engine	Running
Starter	OFF
Catalyst active A/F control	Not operating
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete

P0141 (Case 1):

Monitor runs whenever following DTCs not stored	P0037, P0038 (Rear Oxygen Sensor Heater)
Battery voltage	10.5 V or higher
Fuel cut	OFF
Time after fuel cut ON to OFF	30 seconds or more
Accumulated heater ON time	100 seconds or more

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Learned heater OFF current operation	Complete

P0141 (Case 2):

Monitor runs whenever following DTCs not stored	None
Duration that rear heated oxygen sensor impedance is less than 15 kΩ	2 seconds or more

P102D:

Monitor runs whenever following DTCs not stored	P0037, P0038 (Rear Oxygen Sensor Heater)
Battery voltage	10.5 V or higher
Engine	Running
Starter	OFF
Catalyst active A/F control	Not operating
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete
Hybrid IC high current limiter port	Fail

TYPICAL MALFUNCTION THRESHOLDS

P0037 (Case 1):

Heater current - Learned heater OFF current	0.3 A or less

P0037 (Case 2):

Heated oxygen sensor heater ON current	1 A or less

P0038:

Hybrid IC high current limiter port	Fail
Heated oxygen sensor heater output	ON

P0141:

Accumulated heater resistance	Varies with sensor element temperature (Example: Higher than 23 Ω)

P102D:

Heated oxygen sensor heater ON current	Higher than 1 A

COMPONENT OPERATING RANGE

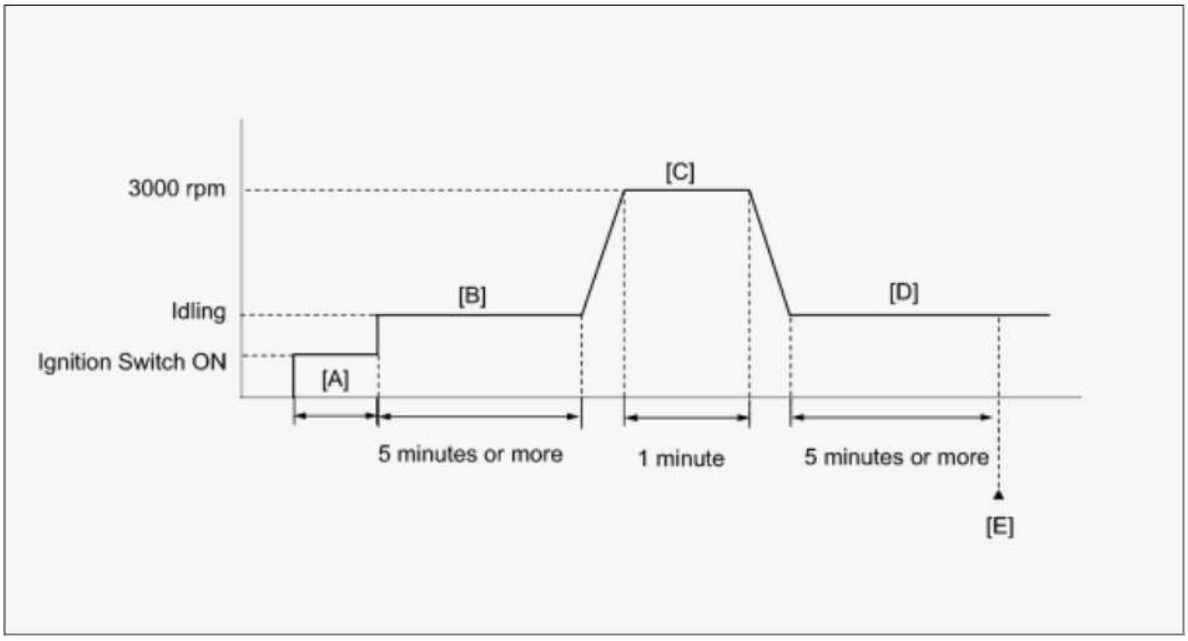
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Heated Oxygen (HO2) sensor heater current	0.4 to 1 A (when engine idles, HO2 sensor warmed up and battery voltage 11 to 14 V)

MONITOR RESULT

Refer to Checking Monitor Status INFO .

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream ON.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and idle it for 5 minutes or more [B].
5. With the vehicle stationary, depress the accelerator pedal and maintain an engine speed of 3000 rpm for 1 minute [C].
6. Idle the engine for 5 minutes or more [D].
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P0037, P0038, P0141, or P102D.
9. Check the DTC judgment result [E].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal

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TESTER DISPLAY	DESCRIPTION
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

10. If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [E] again.
11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0136 INFO .

INSPECTION PROCEDURE

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

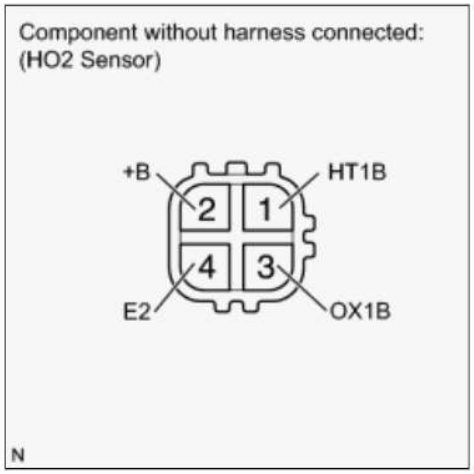
1.	**INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)**

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(a) Disconnect the heated oxygen sensor connector.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher

(c) Reconnect the heated oxygen sensor connector.

NG ▶ **REPLACE HEATED OXYGEN SENSOR**

OK ▼

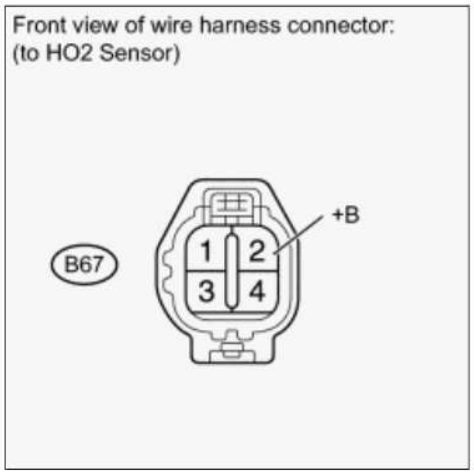
2.	**CHECK TERMINAL VOLTAGE (POWER SOURCE)**

(a) Disconnect the heated oxygen sensor connector.

(b) Turn the ignition switch to ON.

(c) Measure the resistance according to the value(s) in the table below.

Standard Voltage:



TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
B67-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

(d) Reconnect the heated oxygen sensor connector.

NG ▶ **CHECK HARNESS AND**

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CONNECTOR (HEATED OXYGEN SENSOR - INTEGRATION RELAY)

OK

3.	CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

(a) Disconnect the heated oxygen sensor connector.

(b) Disconnect the ECM connector.

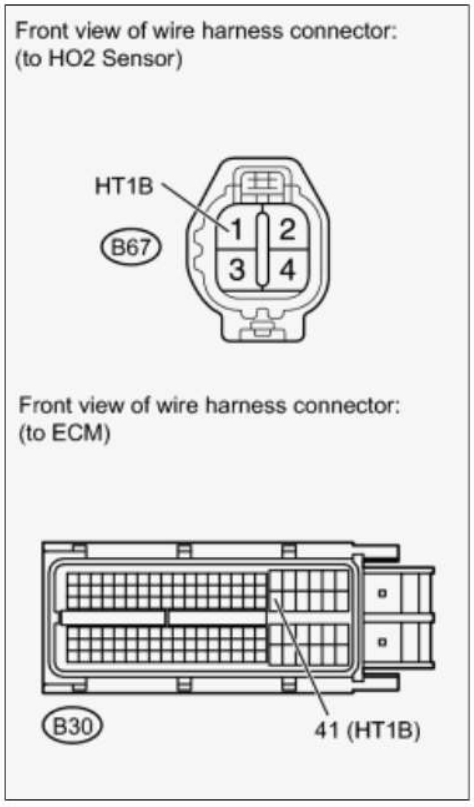
(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B67-1 (HT1B) - B30-41 (HT1B)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B67-1 (HT1B) or B30-41 (HT1B) - Body ground	Always	10 kΩ or higher



(d) Reconnect the heated oxygen sensor connector.

(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

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4.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P0037, P0038, P0141 OR P102D)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine.

(f) Allow the engine to idle for 1 minute or more.

(g) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(h) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P0037, P0038, P0141 or P102D	B

B ▶ **REPLACE ECM**

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

5.	**CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - INTEGRATION RELAY)**

(a) Disconnect the heated oxygen sensor connector.

(b) Remove the integration relay (EFI MAIN relay) from the engine room relay block INFO .

(c) Measure the resistance according to the value(s) in the table below.

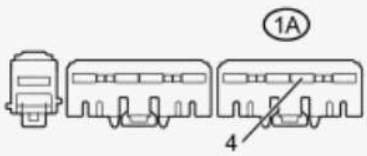
Standard Resistance (Check for open):

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Front view of wire harness connector:
(to HO2 Sensor)



Front view of wire harness connector:
(to Integration Relay)



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B67-2 (+B) - 1A-4	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B67-2 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher

(d) Reconnect the heated oxygen sensor connector.

(e) Reinstall the integration relay.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **GO TO ECM POWER SOURCE CIRCUIT**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002BHB034X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P043E,P043F,P2401,P2402,P2419: Evaporative Emission System Leak Detection Reference Orifice Low Flow (2011 RAV4)		

DTC	**P043E**	**Evaporative Emission System Leak Detection Reference Orifice Low Flow**

DTC	**P043F**	**Evaporative Emission System Reference Orifice High Flow**

DTC	**P2401**	**Evaporative Emission Leak Detection Pump Stuck OFF**

DTC	**P2402**	**Evaporative Emission Leak Detection Pump Stuck ON**

DTC	**P2419**	**Evaporative Emission System Switching Valve Control Circuit Low**

DTC SUMMARY

DTC NO.	MONITORING ITEM	MALFUNCTION DETECTION CONDITION	TROUBLE AREA	DETECTION TIMING	DETECTION LOGIC
P043E	Reference orifice clogged	P043E, P043F, P2401, P2402 and P2419 stored when one of following conditions met during key-off EVAP monitor: • Reference orifice clogged • Reference orifice high-flow • Leak detection pump OFF malfunction • Leak detection pump ON malfunction	• Canister pump module (Reference orifice, leak detection pump, vent valve) • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose)	While ignition switch off	2 trip
P043F	Reference orifice high-flow				
P2401	Leak detection pump stuck OFF				
P2402	Leak detection pump stuck ON				

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DTC NO.	MONITORING ITEM	MALFUNCTION DETECTION CONDITION	TROUBLE AREA	DETECTION TIMING	DETECTION LOGIC
P2419	Vent valve stuck closed	• Vent valve ON (closed) malfunction	• ECM		

HINT:

The reference orifice is located inside the canister pump module.

DESCRIPTION

The description can be found in EVAP (Evaporative Emission) System INFO .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] is the absolute pressure.
- [kPa-g (mmHg-g)] is the gauge pressure (relative pressure).
- On the Techstream, convert the unit of measurement according to the inspection procedure.

INSPECTION PROCEDURE

Refer to EVAP System INFO .

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

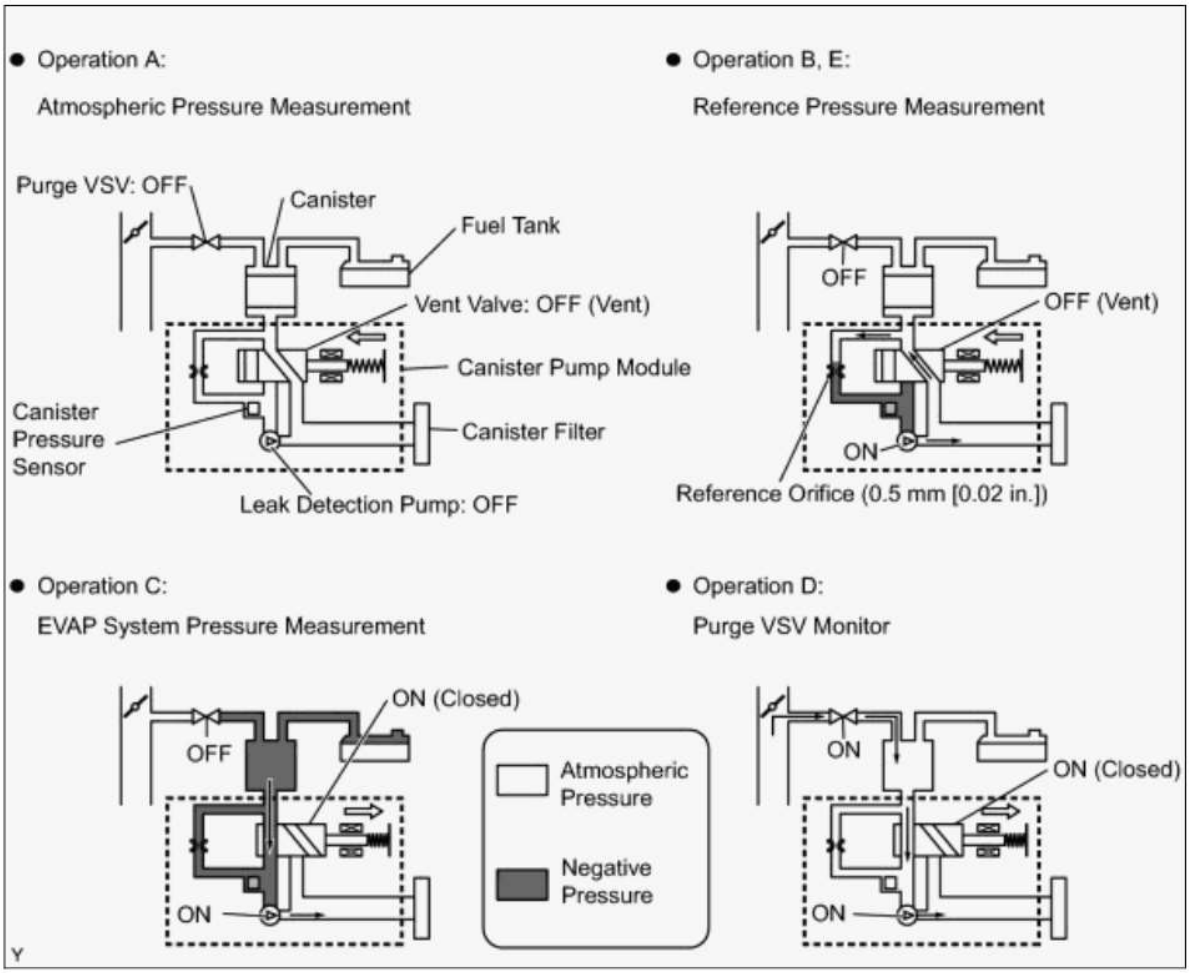
***: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.**

SEQUENCE	OPERATION	DESCRIPTION	DURATION
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 525 kPa-a (570 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	60 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds

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SEQUENCE	OPERATION	DESCRIPTION	DURATION
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

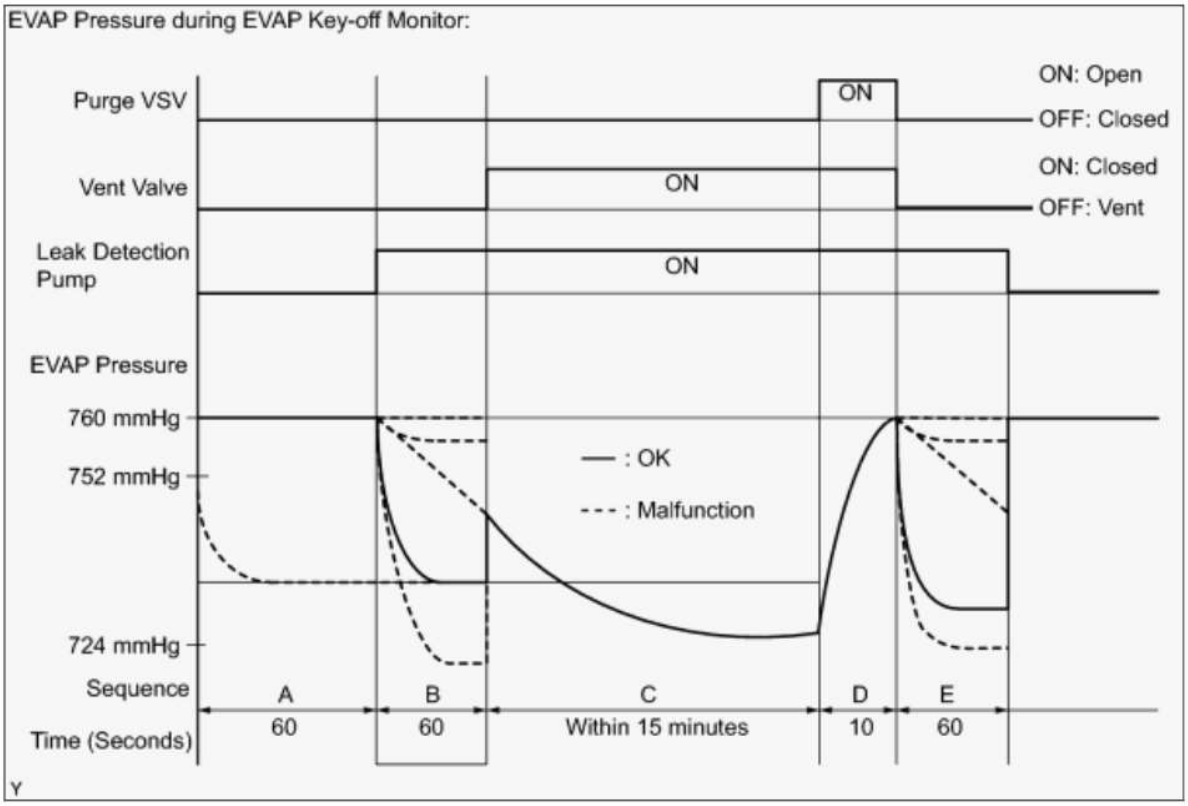
*: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.



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The leak detection pump creates negative pressure through the reference orifice (in operation B and E). When the system is normal, the EVAP pressure is between 724 to 752 mmHg* and saturated within a minute. If not, the ECM interprets this as a malfunction. The ECM illuminates the MIL and stores a DTC if this malfunction is detected in consecutive drive cycles.

*: Typical value.



MONITOR STRATEGY

Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 2 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0451, P0452, P0453 (EVAP System)
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)

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Battery voltage	10.5 V or higher
Vehicle speed	Less than 4 km/h (2.5 mph)
Ignition switch	off
Time after key-off	5, 7 or 9.5 hours
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key-off	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

TYPICAL MALFUNCTION THRESHOLDS

"Saturated" indicates that the EVAP pressure change is below 0.286 kPa-g (2.14 mmHg-g) in 60 seconds.

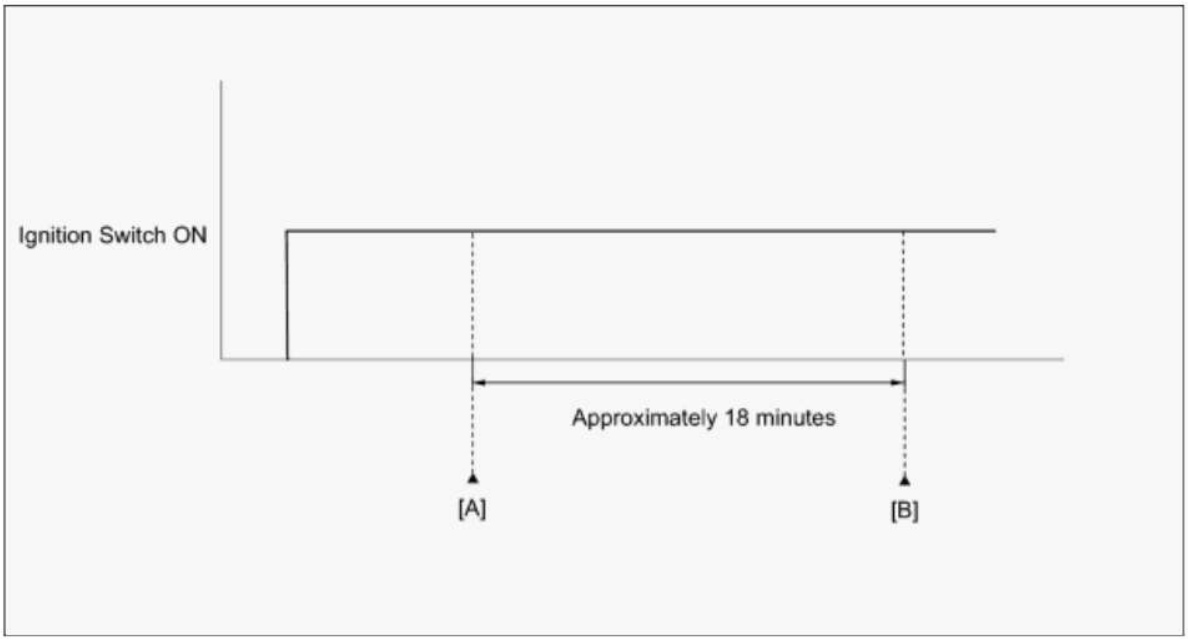
One of following conditions met	-
EVAP pressure just after reference pressure measurement started	Higher than -1 kPa-g (-7.5 mmHg-g)
Reference pressure	Below -4.85 kPa-g (-36.4 mmHg-g)
Reference pressure	-1.057 kPa-g (-7.93 mmHg-g) or higher
Reference pressure	Not saturated within 60 seconds
Reference pressure difference between first and second	0.7 kPa-g (5.25 mmHg-g) or higher

MONITOR RESULT

Refer to CHECKING MONITOR STATUS INFO .

CONFIRMATION DRIVING PATTERN

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NOTICE:

- The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by Techstream. It takes a maximum of approximately 18 minutes.
- Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.
- Do not run the engine during this operation.
- When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the fuel temperature below 35°C (95°F).

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Enter the following menus: Powertrain / Engine and ECT / Utility / Evaporative System Check / Automatic Mode.
5. After the "Evaporative System Check" is completed, check for All Readiness by entering the following menus: Powertrain / Engine and ECT / Utility / All readiness.
6. Input the DTC: P043E, P043F, P2401, P2402 or P2419.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions

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TESTER DISPLAY	DESCRIPTION
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001BFY05OX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P050A: Cold Start Idle Air Control System Performance (2011 RAV4)		

DTC	**P050A**	**Cold Start Idle Air Control System Performance**

MONITOR DESCRIPTION

This monitor will run when the engine is started at an engine coolant temperature of -10 to 50°C (14 to 122°F). The DTC is stored after the engine idles for 13 seconds (2 trip detection logic).

The DTC is designed to monitor the idle air control at cold start. When the engine is started at an engine coolant temperature of below 50°C (122°F), the ECM measures the accumulated mass air flow during engine idling. If the accumulated mass air flow does not reach the specified level within 10 seconds, the ECM interprets this as a malfunction. The MIL is illuminated and a DTC is stored when the malfunction is detected in consecutive driving cycles (2 trip detection logic).

The ETCS (Electronic Throttle Control System) controls the idle speed. The ETCS operates the throttle actuator to open and close the throttle valve, and adjusts the intake air amount to achieve the target idle speed.

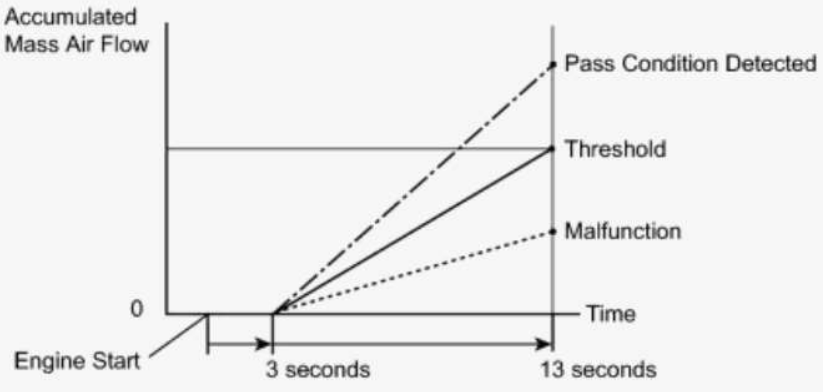
NOTICE:

When the cable is disconnected from the negative (-) battery terminal during inspections or repairs, the ISC (Idle Speed Control) learned values are cleared. This DTC cannot be stored with the ISC learned values cleared.

HINT:

The ISC learning is performed when the engine is warmed up and has been idling for 5 minutes.

P050A Detection Logic:



Engine Coolant Temperature: -10 to 50°C (14 to 122°F)

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P050A	Insufficient mass air flow at cold start (2 trip detection logic).	• Throttle body • Mass air flow meter • PCV system • Air cleaner filter element • Air induction system • VVT system • ECM • Wire harness or connector

MONITOR STRATEGY

Related DTCs	P050A: Cold start idle air speed control system
Required Sensors/Components (Main)	Throttle body
Required Sensors/Components (Related)	Mass air flow meter Engine Coolant Temperature (ECT) sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0010 (VVT Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust VVT Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire)

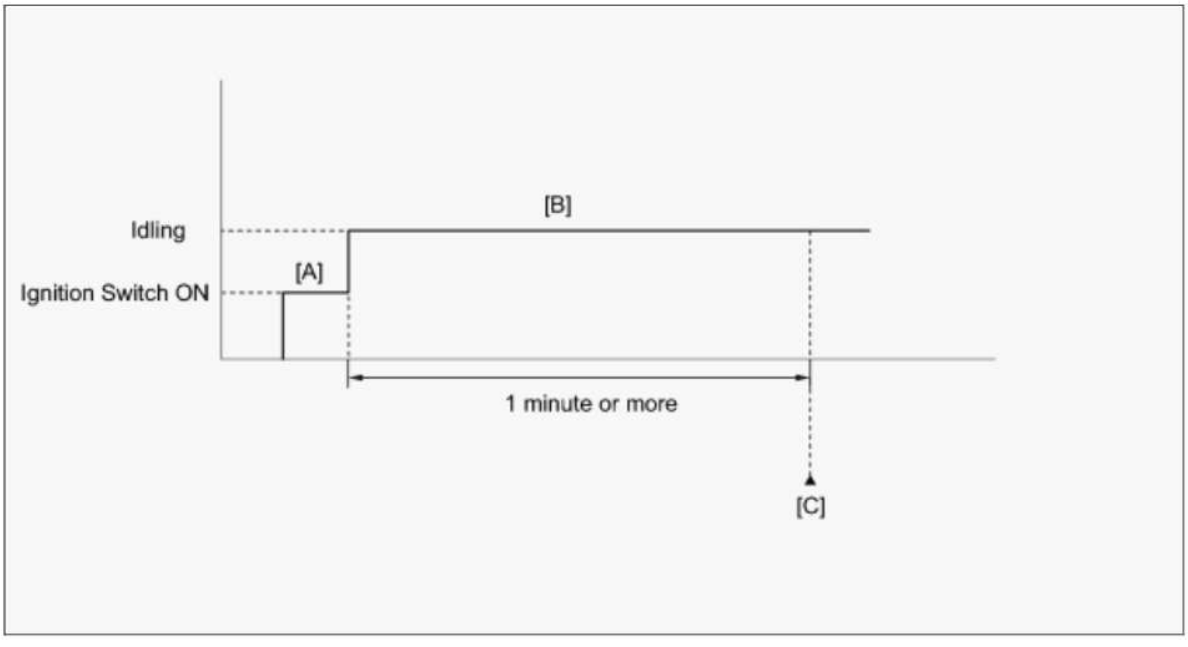
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	P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust VVT Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor) P0705 (Shift Lever Position Switch)
Battery voltage	8 V or higher
Time after engine start	3 seconds or more
Starter	OFF
ECT at engine start	-10°C (14°F) or higher
ECT	-10 to 50°C (14 to 122°F)
Engine idling time	3 seconds or more
Fuel-cut	OFF
Vehicle speed	Less than 3 km/h (1.875 mph)
Time after shift position changed	1 second or more
Atmospheric pressure	76 kPa (570 mmHg) or higher

TYPICAL MALFUNCTION THRESHOLDS

Accumulated mass air flow	Varies with ECT (Example: Less than 21.9 g)

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.

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2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.
5. Check that "Coolant Temp" in the Data List is within the range of -10 to 50°C.
6. Start the engine and warm it up until the coolant temperature is the same as the coolant temperature in the freeze frame data.
7. Idle the engine for 1 minute or more [B].
8. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
9. Input the DTC: P050A.
10. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, idle the engine for 3 minutes, let the engine cool down, and then perform steps [A] through [C].

11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

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Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

PROCEDURE

1.	**CHECK FOR ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P050A)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
DTC P050A is output	A
P050A and other DTCs are output	B

HINT:

If any DTCs other than P050A are output, troubleshoot those DTCs first.

NG ▶ **GO TO DTC CHART**

OK ▼

2.	**READ VALUE USING TECHSTREAM (FUEL TRIM)**

HINT:

Calculate the total fuel trim values to check the characteristic deviation of the mass air flow meter.

(a) Connect the Techstream to the DLC3.

(b) Start the engine and warm it up.

(c) Turn the Techstream on.

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(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Short FT #1 and Long FT #1.

(e) Read the values displayed on the Techstream.

(f) Add together the Short FT #1 and Long FT #1 values to obtain the total fuel trim.

OK:

Total of Short FT #1 and Long FT #1 values is between -20% and 20%.

NG ▶ **CHECK PCV HOSE**

OK ▼

3.	**INSPECT THROTTLE BODY**

(a) Check for deposits around the throttle valve and check the throttle valve condition.

OK:

No deposits around throttle valve and throttle valve moves smoothly.

OK ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P050A)**

NG ▶ **REPAIR OR REPLACE THROTTLE BODY**

4.	**REPAIR OR REPLACE THROTTLE BODY**

(a) Repair or replace the throttle body INFO .

NEXT ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P050A)**

5.	**CHECK PCV HOSE**

(a) Check the PCV hose connections INFO .

OK:

PCV hose is connected correctly and is not damaged.

NG ▶ **REPAIR OR REPLACE PCV SYSTEM**

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OK

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002TZB02AX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P050B: Cold Start Ignition Timing Performance (2011 RAV4)		

DTC	**P050B**	**Cold Start Ignition Timing Performance**

DESCRIPTION

This monitor will run when the engine is started at an engine coolant temperature of -10 to 50°C (14 to 122°F). The DTC is stored after the engine idles for 13 seconds (2 trip detection logic).

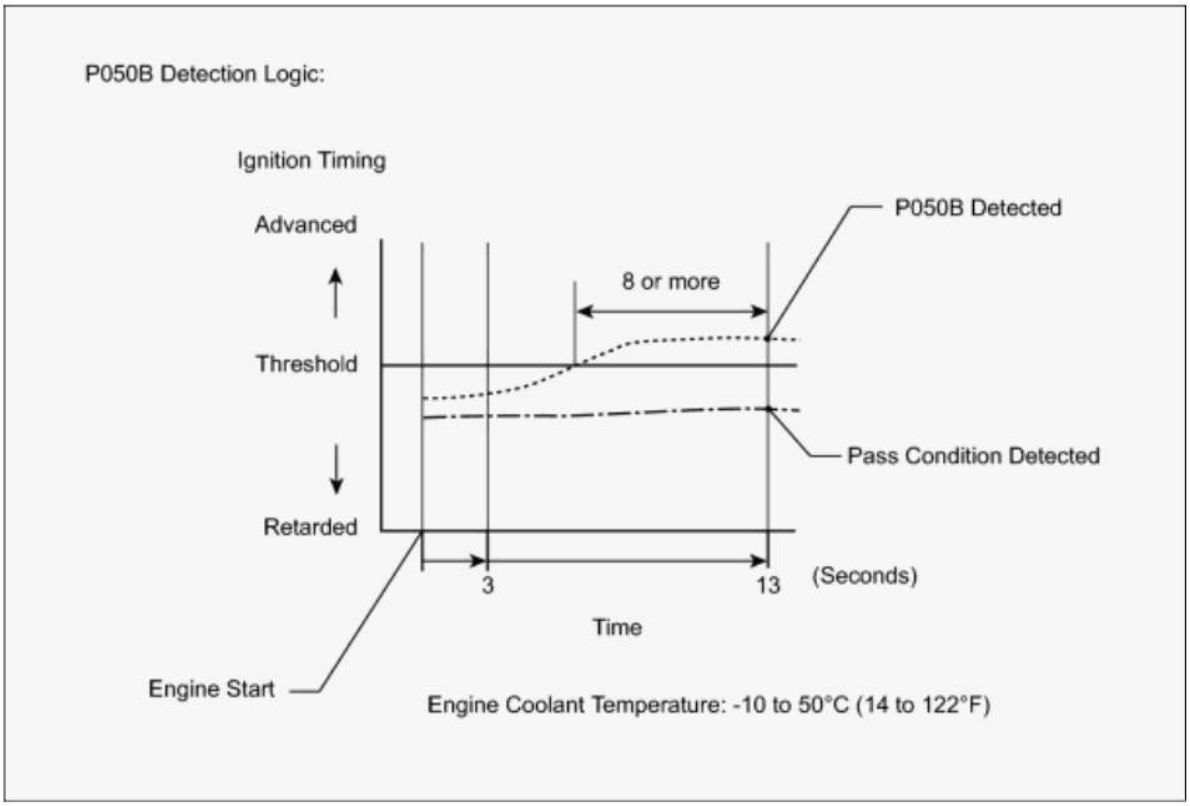
The DTC is designed to monitor the ignition timing at cold start. When the engine is started at an engine coolant temperature of below 50°C (122°F), the ECM checks the ignition timing during engine idling. If the ignition timing advances beyond the specified level within 10 seconds, the ECM interprets this as a malfunction. The MIL is illuminated and a DTC is stored when the malfunction is detected in consecutive driving cycles (2 trip detection logic).

NOTICE:

When the cable is disconnected from negative (-) battery terminal during inspections or repairs, the ISC (Idle Speed Control) learned values are cleared. This DTC cannot be stored with the ISC learned values cleared.

HINT:

The ISC learning is performed when the engine is warmed up and has been idling for 5 minutes.



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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P050B	Insufficient ignition timing retard at cold start (2-trip detection logic).	• Throttle with motor body assembly • Mass air flow meter • PCV system • Air cleaner filter element • Air induction system • VVT system • ECM • Wire harness or connector

MONITOR STRATEGY

Related DTCs	P050B: Cold start ignition timing performance
Required Sensors/Components (Main)	Throttle with motor body assembly
Required Sensors/Components (Related)	Mass air flow meter Engine Coolant Temperature (ECT) sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0010 (VVT Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust VVT Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor)

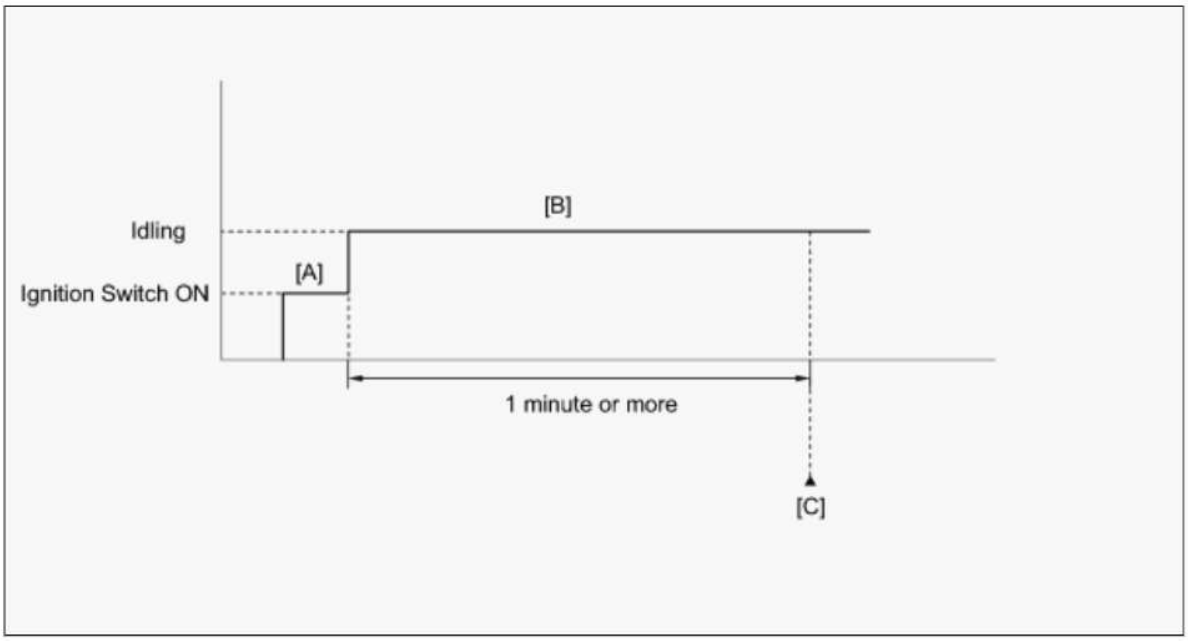
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	P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust VVT Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor) P0705 (Shift Lever Position Switch)
Battery voltage	8 V or higher
Time after engine start	3 seconds or more
Starter	OFF
ECT at engine start	-10°C (14°F) or higher
ECT	-10 to 50°C (14 to 122°F)
Engine idling time	3 seconds or more
Fuel-cut	OFF
Vehicle speed	Less than 3 km/h (1.875 mph)
Atmospheric pressure	76 kPa (570 mmHg) or higher

TYPICAL MALFUNCTION THRESHOLDS

Accumulated time when ignition timing retard value is cut off	5 seconds or more

CONFIRMATION DRIVING PATTERN



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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.
5. Check that "Coolant Temp" in the Data List is within the range of -10 to 50°C.
6. Start the engine and warm it up until the coolant temperature is the same as the coolant temperature in the freeze frame data.
7. Idle the engine for 1 minute or more [B].
8. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
9. Input the DTC: P050B.
10. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, idle the engine for 3 minutes, let the engine cool down, and then perform steps [A] through [C].

11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

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HINT:

- DTC P050B may be output when the engine has the symptoms listed below. If necessary, check the trouble areas listed below.

SYMPTOMS	FACTOR	TROUBLE AREA
Low idle speed when engine is cold (immediately after engine start)	Excessive engine friction	○ Engine oil deterioration ○ Drive belt tension ○ A/C compressor ○ Generator ○ P/S pump
Rough idle when engine is cold (immediately after engine start)	Abnormal combustion	Fuel quality

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK FOR ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P050B)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read the DTCs.

Result:

DISPLAY (DTC OUTPUT)	PROCEED TO
P050B is output	A
P050B and other DTCs are output	B

HINT:

If any DTCs other than P050B are output, troubleshoot those DTCs first.

B ▶ GO TO DTC CHART

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A

2.	**READ VALUE USING TECHSTREAM (FUEL TRIM)**

HINT:

Calculate the total fuel trim values to check the characteristic deviation of the mass air flow meter.

(a) Connect the Techstream to the DLC3.

(b) Start the engine and warm it up.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Short FT #1 and Long FT #1.

(e) Read the values displayed on the Techstream.

(f) Add together the Short FT #1 and Long FT #1 values to obtain the total Fuel Trim

OK:
Total of Short FT #1 and Long FT #1 values is between -20% and 20%.

NG ▶ **CHECK PCV HOSE**

OK

3.	**INSPECT THROTTLE BODY**

(a) Check for deposits around the throttle valve and check the throttle valve condition.

OK:
No deposits around throttle valve and throttle valve moves smoothly.

OK ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

NG ▶ **REPAIR OR REPLACE THROTTLE WITH MOTOR BODY ASSEMBLY**

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4.	**REPAIR OR REPLACE THROTTLE WITH MOTOR BODY ASSEMBLY**

(a) Repair or replace the throttle with motor body assembly INFO .

NEXT ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

5.	**CHECK PCV HOSE**

(a) Check the PCV hose connections INFO .

OK:
PCV hose is connected correctly and is not damaged.

NG ▶ **REPAIR OR REPLACE PCV HOSE**

OK ▼

6.	**CHECK AIR INDUCTION SYSTEM**

(a) Check the air induction system for vacuum leaks.

OK:
No leaks in the air induction system.

NG ▶ **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK ▼

7.	**INSPECT AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**

(a) Visually check that the air cleaner filter element is not excessively contaminated with dirt or oil.

OK:
The air cleaner filter element is not excessively contaminated with dirt or oil.

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NG ▶ **REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**

OK ▼

8.	**PERFORM ACTIVE TEST USING TECHSTREAM (OCV OPERATION)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine and turn the Techstream on.

(c) Warm up the engine.

(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).

(e) Check the engine speed while operating the Oil Control Valve (OCV) using the Techstream.

OK:

TESTER OPERATION	SPECIFIED CONDITION
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG ▶ **CHECK AND REPAIR VVT SYSTEM**

OK ▼

9.	**READ VALUE USING TECHSTREAM (MAF)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

(e) Allow the engine to idle until Coolant Temp reaches 75°C (167°F) or higher.

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(f) Read MAF with the engine speed at 3000 rpm.

Standard:
Between 9.38 g/sec. and 14.08 g/sec. (shift lever: N; A/C: Off).

OK ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

NG ▶ **CHECK HARNESS AND CONNECTOR**

10.	**REPAIR OR REPLACE PCV HOSE**

(a) Repair or replace the PCV hose.

NEXT ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

11.	**REPAIR OR REPLACE AIR INDUCTION SYSTEM**

(a) Repair or replace the air induction system.

NEXT ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

12.	**REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**

(a) Replace the air cleaner filter element sub-assembly.

NEXT ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

13.	**CHECK AND REPAIR VVT SYSTEM**

(a) Check and repair the VVT system.

NEXT ▼

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14.	CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)

NOTICE:

In this operation, the engine must be cold (approximately the same as the engine coolant temperature recorded in the freeze frame data).

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTCs INFO .

(e) Turn the ignition switch off.

(f) Turn the ignition switch to ON and turn the Techstream on.

(g) Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

(h) Check that the engine coolant temperature is between -10°C and 50°C (14 and 122°F).

(i) Start the engine and warm it up.

(j) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(k) Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

(l) Input the DTC: P050B.

(m) Check the DTC judgment result.

Result

RESULT	PROCEED TO
NORMAL (DTC is not output)	A
ABNORMAL (DTC P050B is output)	B

B ▶ CHECK HARNESS AND CONNECTOR

A ▶ CHECK FOR INTERMITTENT PROBLEMS

15.	CHECK HARNESS AND CONNECTOR

(a) Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM INFO .

HINT:

Repair any problems.

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NEXT



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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002Z1R043X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P060A: Internal Control Module Monitoring Processor Performance (2011 RAV4)		

DTC	**P060A**	**Internal Control Module Monitoring Processor Performance**

MONITOR DESCRIPTION

The main CPU and sub CPU of the ECM perform data communication between each other. The main CPU monitors the communications and WDC pulses from the sub CPU. When the signal malfunctions below are detected, the DTC is output.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P060A	An ECM sub CPU error.	ECM

MONITOR STRATEGY

Related DTCs	P060A: ECM CPU error
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of operation	Continuous
Duration	16 seconds
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

CPU reset	Occurred

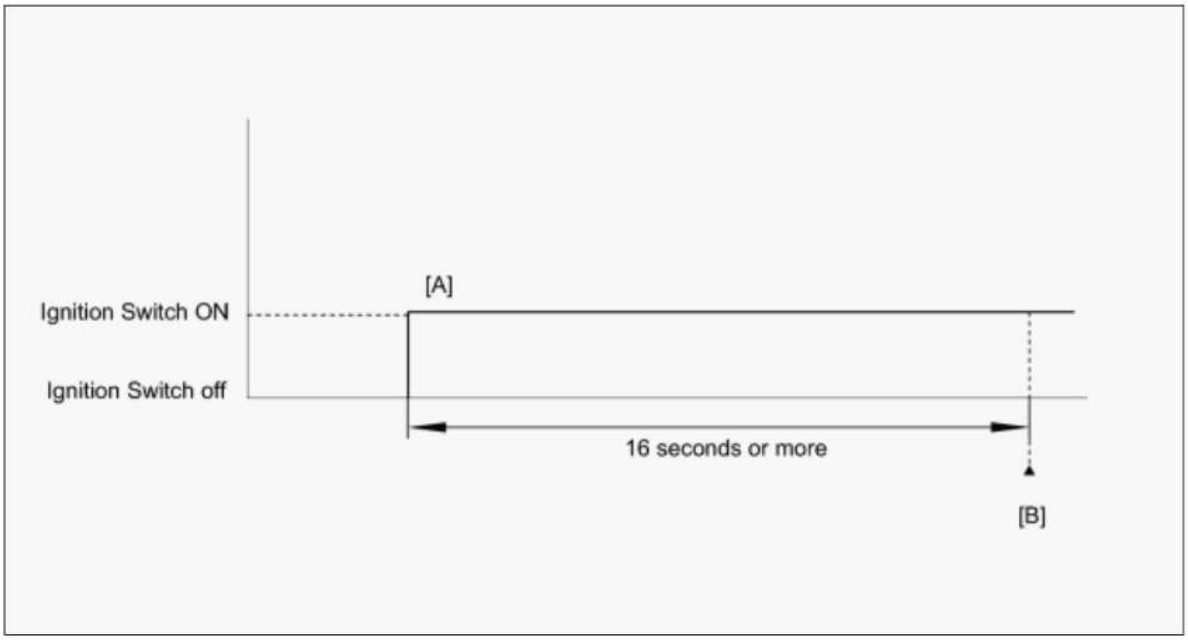
TYPICAL MALFUNCTION THRESHOLDS

When either condition below is met:	Condition 1 or 2
1. When all conditions below are met:	-
- CPU reset	1 time or more
- Learned TP - Learned APP	0.4 V or higher

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- Electronic throttle actuator	OFF
2. CPU reset	2 times or more

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 16 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P060A.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

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8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**READ OUTPUT DTC (DTC P060A)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTC INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Disconnect the Techstream.

(g) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(h) Connect the cable to the battery negative (-) battery terminal.

(i) Connect the Techstream to the DLC3.

(j) Turn the ignition switch to ON.

(k) Turn the Techstream on.

(l) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(m) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P060A	B

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B ▶ REPLACE ECM

A ▶ CHECK FOR INTERMITTENT PROBLEMS

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002Z1S06SX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P060B: Internal Control Module A/D Processing Performance (2011 RAV4)		

DTC	**P060B**	**Internal Control Module A/D Processing Performance**

DESCRIPTION

This DTC is stored when a communication error occurs in the ECM.

DTC CODE	DTC DETECTION CONDITION	TROUBLE AREA
P060B	An ECM main CPU communication error.	ECM

MONITOR STRATEGY

Related DTCs	None
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of operation	Once per driving cycle
Duration	16 seconds
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

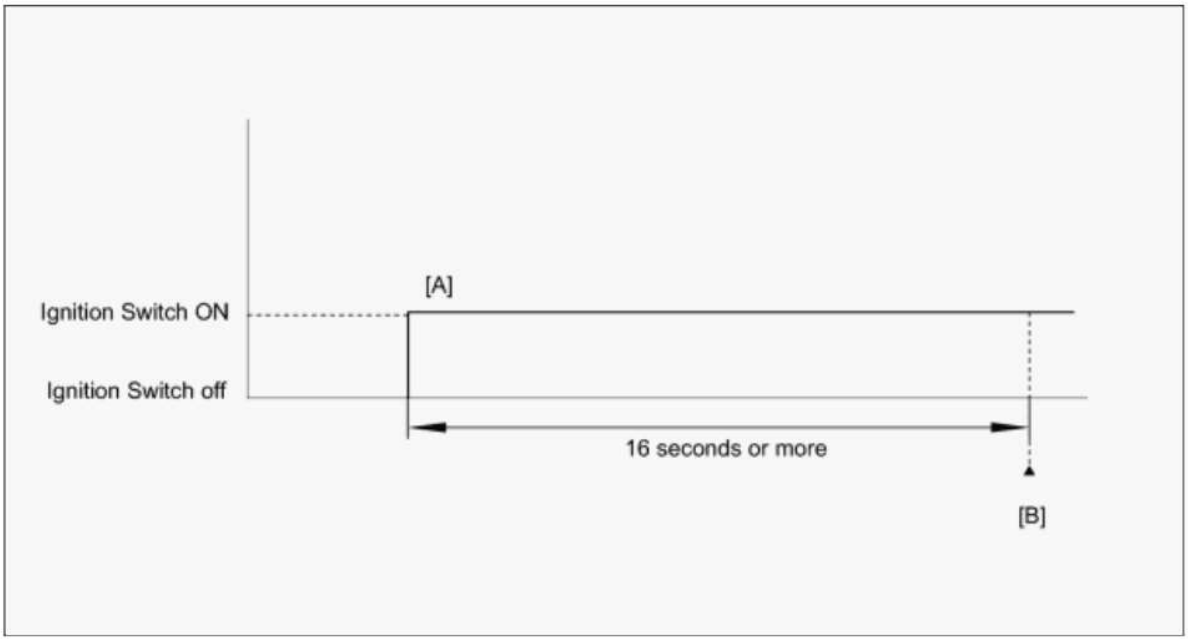
Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

When one of the following conditions is met	-
AD converter	Fail
Knock sensor circuit	Fail

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 16 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P060B.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

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HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**CHECK DTC**

(a) Clear DTC INFO .

(b) Turn the ignition switch off.

(c) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(d) Connect the cable to the negative (-) battery terminal.

(e) Turn the ignition switch to ON.

(f) Check DTC.

Result

RESULT	PROCEED TO
DTC is not output	A
DTC P060B is output	B
DTC P060B and P0327, P0328 are output	C

B ▶ **REPLACE ECM**

C ▶ **GO TO DTC (P0327, P0328)**

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002Z1S06RX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P060D: Internal Control Module Accelerator Pedal Position Performance (2011 RAV4)		

DTC	**P060D**	**Internal Control Module Accelerator Pedal Position Performance**

MONITOR DESCRIPTION

The ECM monitors the input signals of the Accelerator Pedal Position (APP) sensor No. 1. When the input signals and control signals are deviated, the DTC is stored.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P060D	An ECM main CPU error.	ECM

MONITOR STRATEGY

Related DTCs	P060D: Internal control module, Accelerator pedal position
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

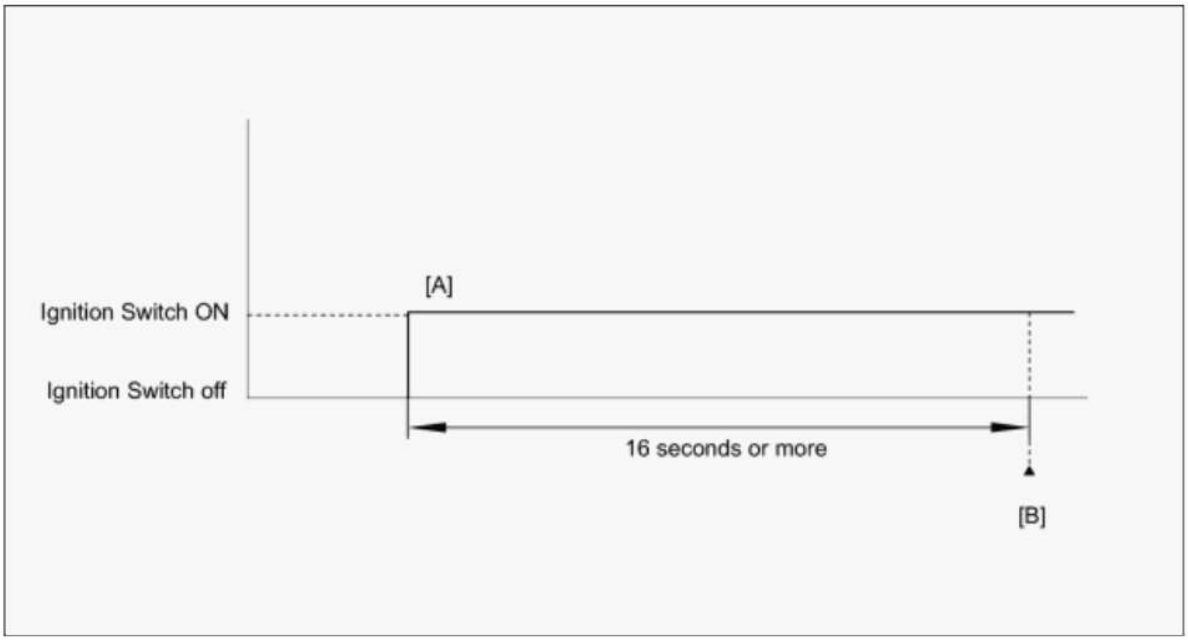
Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

Difference of main APP and sub APP	0.3 V or higher

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 16 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P060D.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

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HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**READ OUTPUT DTC (DTC P060D)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTC INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Disconnect the Techstream.

(g) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(h) Connect the cable to the negative (-) battery terminal.

(i) Connect the Techstream to the DLC3.

(j) Turn the ignition switch to ON.

(k) Turn the Techstream on.

(l) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(m) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P060D	B

B ▶ REPLACE ECM

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A CHECK FOR INTERMITTENT PROBLEMS

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002Z1T041X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P060E: Internal Control Module Throttle Position Performance (2011 RAV4)		

DTC	**P060E**	**Internal Control Module Throttle Position Performance**

MONITOR DESCRIPTION

The ECM monitors the input signals of the Throttle Position (TP) sensor No. 1 and stop light switch. As the ECM monitors the input signals of the TP sensor No. 1 and the STP signals of the stop light switch, if the input signals and control signals are deviated, the DTC is stored.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P060E	An ECM main CPU error.	ECM

MONITOR STRATEGY

Related DTCs	P060E: Internal control module, Throttle position
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

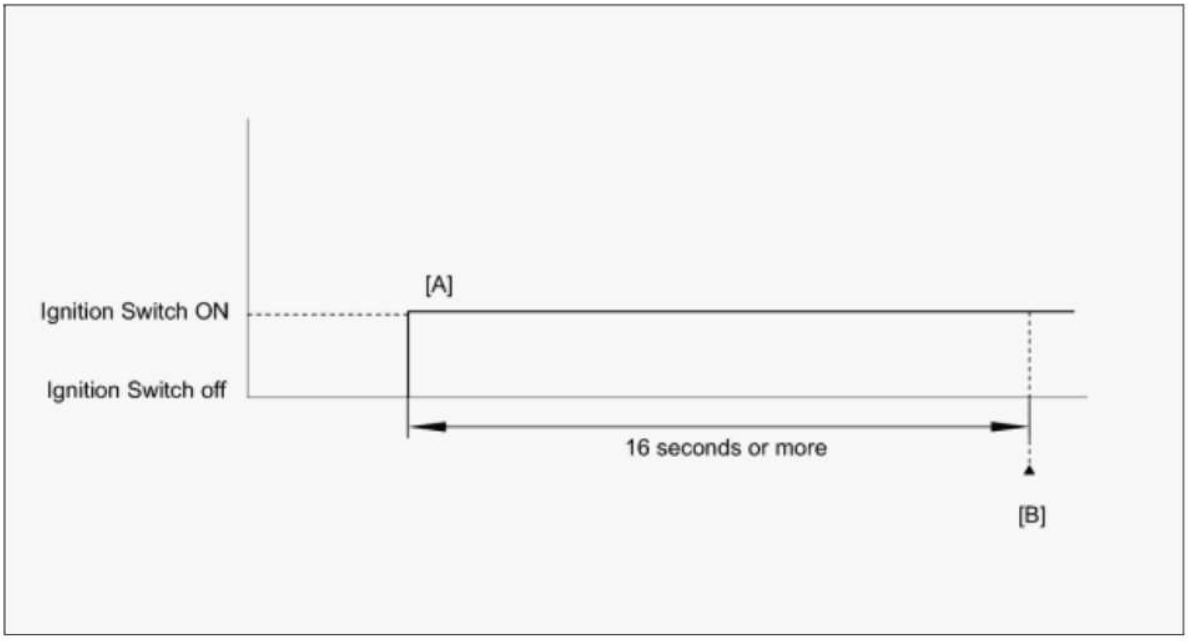
Monitor runs whenever following DTCs not stored	None
DMA communication error	Not detected

TYPICAL MALFUNCTION THRESHOLDS

When one of following conditions is met:	Condition 1 or 2
1. Difference of main TP and sub TP	0.3 V or higher
2. Value of main brake switch signal and sub brake switch signal	Different

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CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 16 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P060E.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

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8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**READ OUTPUT DTC (DTC P060E)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTC INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Disconnect the Techstream.

(g) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(h) Connect the cable to the negative (-) battery terminal.

(i) Connect the Techstream to the DLC3.

(j) Turn the ignition switch to ON.

(k) Turn the Techstream on.

(l) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(m) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P060E	B

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B ▶ REPLACE ECM

A ▶ CHECK FOR INTERMITTENT PROBLEMS

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000003Q7C01MX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P062F: Internal Control Module EEPROM Error (2011 RAV4)		

DTC	**P062F**	**Internal Control Module EEPROM Error**

DESCRIPTION

The ECM monitors its internal operation and it stores this DTC when it detects an internal malfunction.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P062F	An ECM internal error (EEPROM).	ECM

MONITOR DESCRIPTION

The ECM monitors its internal operation. If the internal operation is malfunctioning, the ECM illuminates the MIL and stores a DTC.

MONITOR STRATEGY

Related DTCs	P062F: Internal control module EEPROM error
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of operation	Once per driving cycle
Duration	11 seconds
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

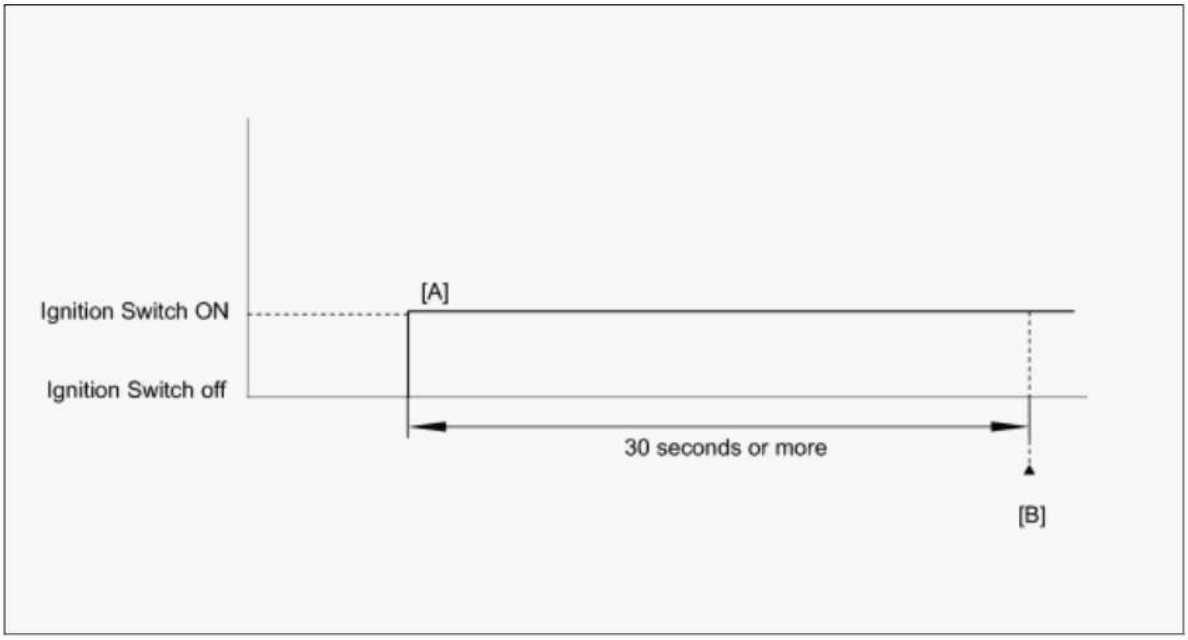
Monitor runs whenever following DTCs not stored	None
Time after engine start	10 seconds or more
Battery voltage	8 V or higher
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

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Permanent fault code data	Mismatch (3 times or more)

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 30 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P062F.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

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HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**READ OUTPUT DTC (DTC P062F)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTC INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Disconnect the Techstream.

(g) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(h) Connect the cable to the negative (-) battery terminal.

(i) Connect the Techstream to the DLC3.

(j) Turn the ignition switch to ON.

(k) Turn the Techstream on.

(l) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(m) Read DTCs.

Result

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RESULT	PROCEED TO
No output	A
P062F	B

B ▶ **REPLACE ECM**

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PF406MX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0101: Mass Air Flow Circuit Range / Performance Problem (2011 RAV4)		

DTC	**P0101**	**Mass Air Flow Circuit Range / Performance Problem**

DESCRIPTION

Refer to DTC P0102 INFO .

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0101	All of the following conditions continue for more than 10 seconds (2 trip detection logic): (a) The engine is running. (b) The engine coolant temperature is 70°C (158°F) or higher. (c) The Throttle Position (TP) sensor voltage is 0.24 to 2 V. (d) The average engine load value ratio is less than 0.83, or more than 1.23 (varies with estimated engine load). Average engine load value ratio = Average engine load based on mass air flow meter output / Average engine load estimated from driving conditions (e) The average air-fuel ratio is less than -20% or more than 20%.	• Mass Air Flow (MAF) meter • Air induction system • PCV hose connections

MONITOR DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and to provide an appropriate air-fuel ratio. Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air. By applying a specific electrical current to the wire, the ECM heats it to a specific temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to the MAF meter. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.

The ECM monitors the average engine load value ratio to check the MAF meter for malfunctions. The average engine load value ratio is obtained by comparing the average engine load calculated from the MAF meter output to the average engine load estimated from the driving conditions, such as the engine speed and the throttle opening angle. If the average engine load value ratio is below the threshold value, the ECM determines that the intake air volume is low, and if the average engine load value ratio is above the threshold value, the ECM determines that the intake air volume is high.

If this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is stored.

MONITOR STRATEGY

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Related DTCs	P0101: Mass air flow meter rationality
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Crankshaft Position (CKP) sensor Camshaft Position (CMP) sensor Engine Coolant Temperature (ECT) sensor Throttle Position (TP) sensor
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0335 (Crankshaft Position Sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0452, P0453 (EVAP System) P2401, P2402 (Leak Detection Pump) P2419, P2420 (Vent Valve)
Throttle position (TP sensor voltage)	0.24 to 2 V
Time after engine starts	5 seconds or more
Battery voltage	10.5 V or higher
Estimated load	30 to 70%
Engine coolant temperature	70°C (158°F) or higher

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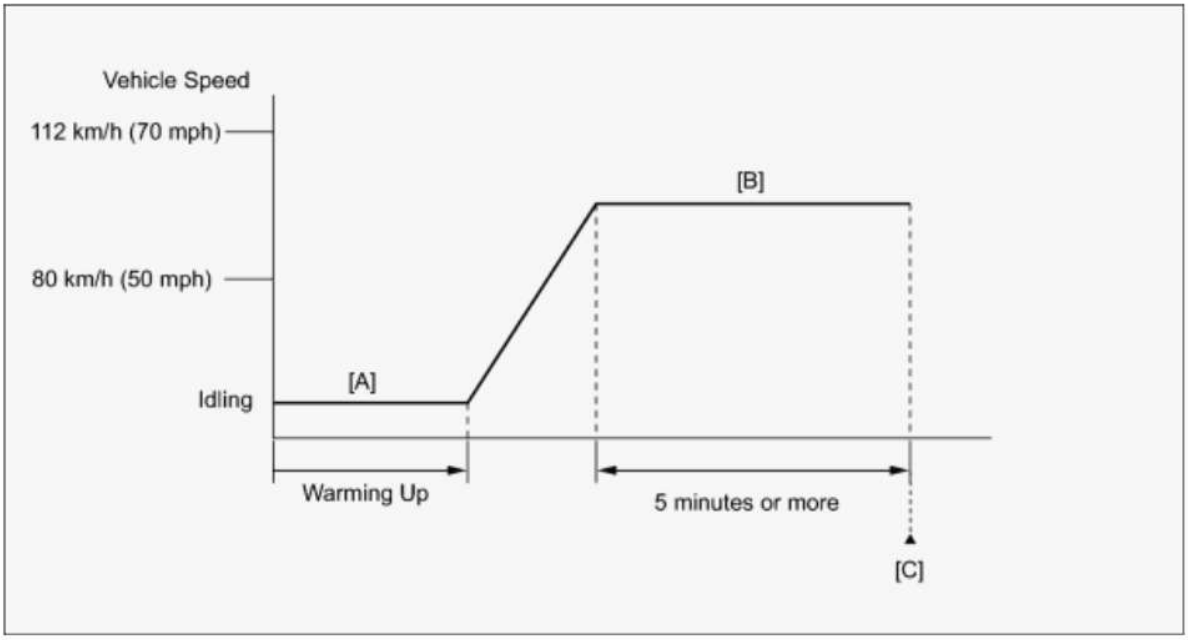
TYPICAL MALFUNCTION THRESHOLDS

Both of following conditions 1 and 2 met	-
1. Average engine load value ratio	Less than 0.83 or more than 1.23 (varies with estimated engine load)
2. Average air-fuel ratio	Less than -20% or more than 20%

WIRING DIAGRAM

Refer to DTC P0102 INFO .

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).
5. Start the engine and warm it up until the engine coolant temperature reaches 70°C (158°F) or higher [A].
6. Drive the vehicle at approximately 80 km/h (50 mph) to 112 km/h (70 mph) for 5 minutes or more [B].

HINT:

Drive while keeping the engine load as stable as possible.

7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P0101.
9. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU

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TESTER DISPLAY	DESCRIPTION
	memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0101)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

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RESULT	PROCEED TO
P0101	A
P0101 and other DTCs	B

HINT:

If any DTCs other than P0101 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A

▼

2.	CHECK AIR INDUCTION SYSTEM

(a) Check the air induction system for vacuum leakage INFO .

OK:

No leakage from air induction system.

NG ▶ **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

▼

3.	CHECK PCV HOSE CONNECTIONS

(a) Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG ▶ **REPAIR OR REPLACE PCV HOSE**

OK ▶ **REPLACE MASS AIR FLOW METER**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000U5B0DZX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0102,P0103: Mass or Volume Air Flow Circuit Low Input (2011 RAV4)		

DTC	**P0102**	**Mass or Volume Air Flow Circuit Low Input**

DTC	**P0103**	**Mass or Volume Air Flow Circuit High Input**

DESCRIPTION

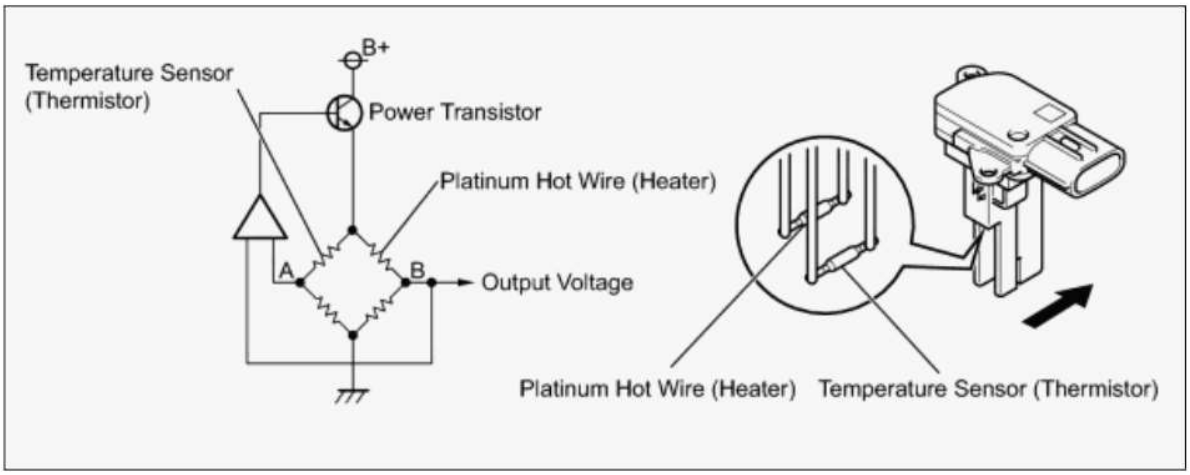
The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and to provide the appropriate air-fuel ratio.

Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air. By applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to the wire and internal thermistor. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.

The circuit is constructed so that the platinum hot wire and the temperature sensor create a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

When any of these DTCs is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine speed and throttle valve position. Fail-safe mode continues until a pass condition is detected.



DTC	DTC DETECTION CONDITION	TROUBLE AREA

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NO.		
P0102	The Mass Air Flow (MAF) meter voltage is below 0.2 V for 3 seconds. (1 trip detection logic: Engine speed is less than 4000 rpm) (2 trip detection logic: Engine speed is 4000 rpm or more)	• Open or short in MAF meter circuit • MAF meter • ECM
P0103	The Mass Air Flow (MAF) meter voltage is higher than 4.9 V for 3 seconds. (1 trip detection logic: Engine speed is less than 4000 rpm) (2 trip detection logic: Engine speed is 4000 rpm or more)	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:

When any of these DTCs are output, check the air-flow rate using the Techstream. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

MASS AIR FLOW RATE (G/SEC)	MALFUNCTION
Approximately 0.0	• Open in Mass Air Flow (MAF) meter power source circuit • Open or short in VG circuit
271.0 or more	• Open in EVG circuit

MONITOR DESCRIPTION

If there is a defect in the Mass Air Flow (MAF) meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this deviation as a malfunction in the MAF meter circuit and stores a DTC.

Example:

When the sensor output voltage remains below 0.2 V or higher than 4.9 V for more than 3 seconds, the ECM stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 3 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0102: Mass Air Flow (MAF) meter range check (Low voltage) P0103: MAF meter range check (High voltage)
Required Sensors/Components (Main)	MAF meter
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	3 seconds

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MIL Operation	Immediate: Engine speed less than 4000 rpm 2 driving cycles: Engine speed 4000 rpm or more
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

P0102:

MAF meter voltage	Below 0.2 V

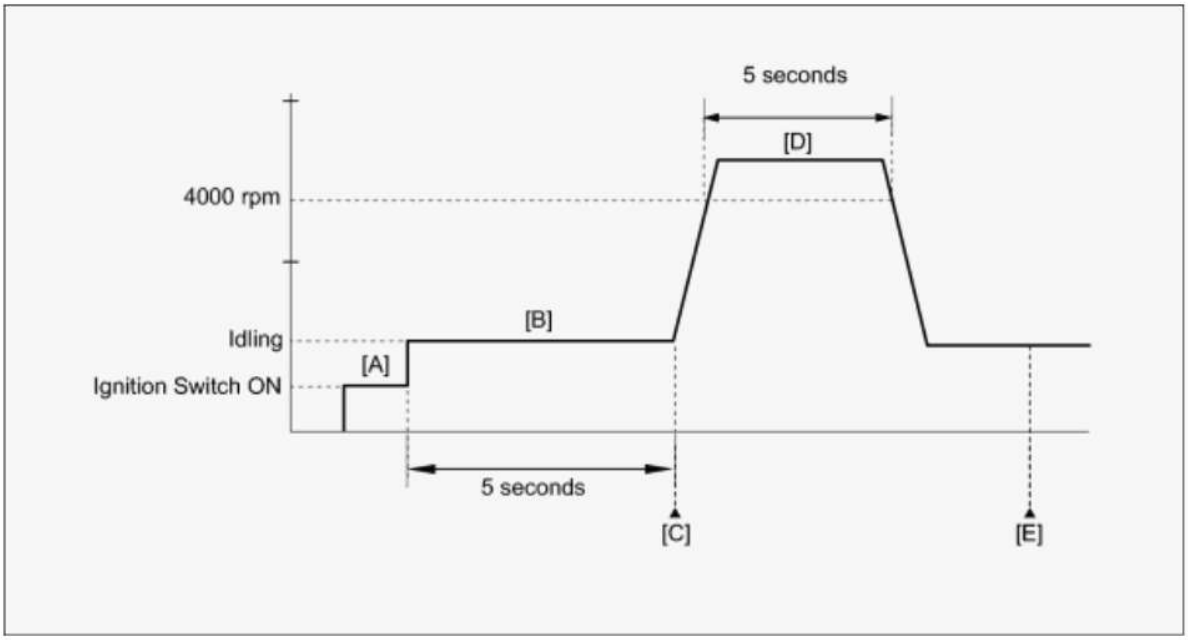
P0103:

MAF meter voltage	Higher than 4.9 V

COMPONENT OPERATING RANGE

MAF meter voltage	Between 0.4 V and 2.2 V

CONFIRMATION DRIVING PATTERN



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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).
4. Turn the ignition switch off and wait for at least 30 seconds.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Idle the engine for 5 seconds [B].
8. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes [C].
9. Read the pending DTCs.

HINT:

- If a pending DTC is output, the system is malfunctioning.
- If a pending DTC is not output, perform the following procedure.

10. Run the engine at an engine speed of 4000 rpm for 5 seconds [D].
11. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes [E].
12. Read the pending DTCs.

HINT:

- If a pending DTC is output, the system is malfunctioning.
- If a pending DTC is not output, perform the following procedure.

13. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
14. Input the DTC: P0102 or P0103.
15. Check the DTC judgment result.

TECHSTREAM DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows NORMAL, the system is normal.
- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [C] again.

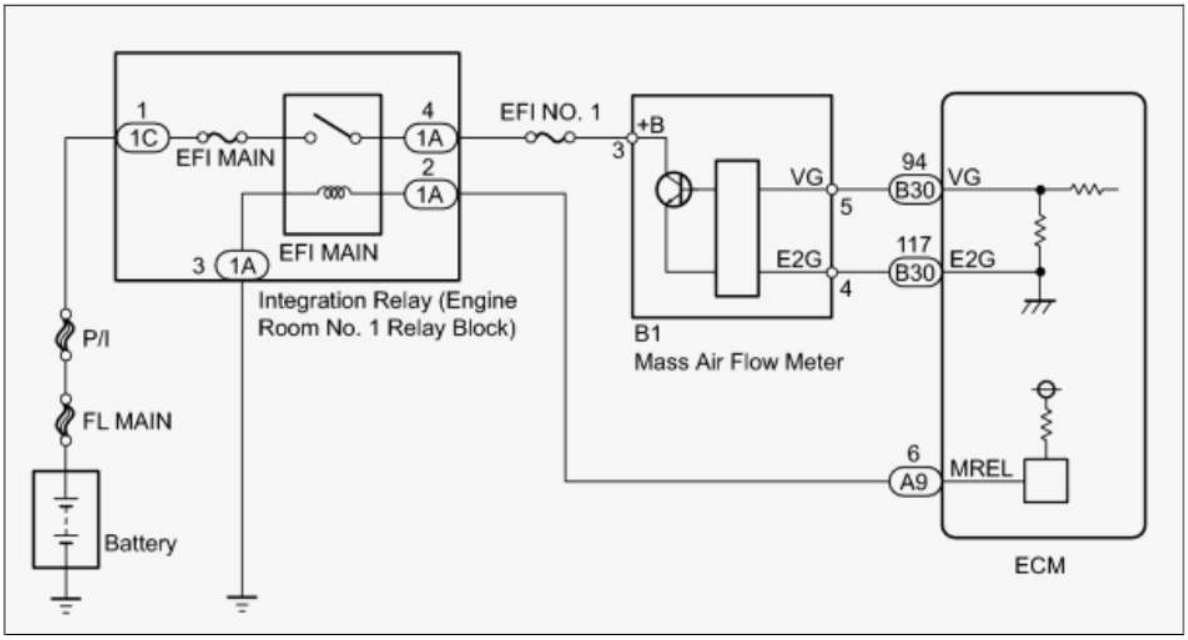
16. If no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

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- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (MASS AIR FLOW RATE)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF.

(e) Read the values displayed on the Techstream.

Result

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RESULT	PROCEED TO
0.0 g/sec.	A
271.0 g/sec. or more	B
Between 1.0 and 270.0 g/sec.*	C

HINT:

***: The value changes when the throttle valve is open or closed with the engine running.**

B ▶ **CHECK HARNESS AND CONNECTOR (SENSOR GROUND)**

C ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A ▼

2.	INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)

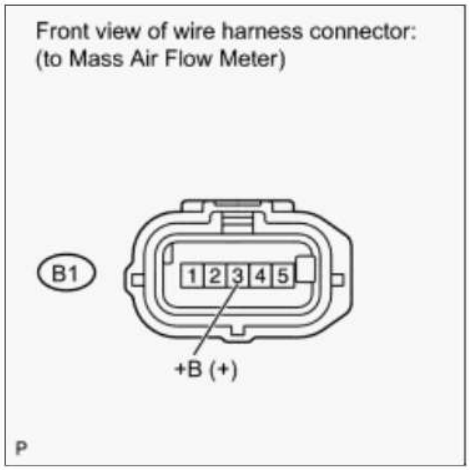
(a) Disconnect the mass air flow meter connector.

(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
B1-3 (+B) - Body ground	Ignition switch ON	11 to 14 V



(d) Reconnect the mass air flow meter connector.

NG ▶ **CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER**

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- INTEGRATION RELAY)

OK

3.	**INSPECT MASS AIR FLOW METER**

(a) Inspect output voltage.

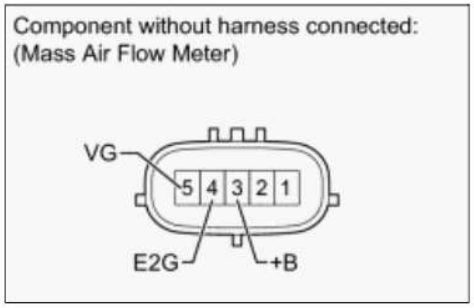
(1) Disconnect the mass air flow meter connector.

(2) Apply battery voltage across terminals +B and E2G.

(3) Connect the positive (+) tester probe to terminal VG, and the negative (-) tester probe to terminal E2G.

(4) Measure the voltage according to the value(s) in the table below.

Standard Voltage:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
5 (VG) - 4 (E2G)	Battery voltage applied across terminal +B and E2G	0.2 to 4.9 V

(5) Reconnect the mass air flow meter connector.

NG ▶ **REPLACE MASS AIR FLOW METER**

OK

4.	**CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**

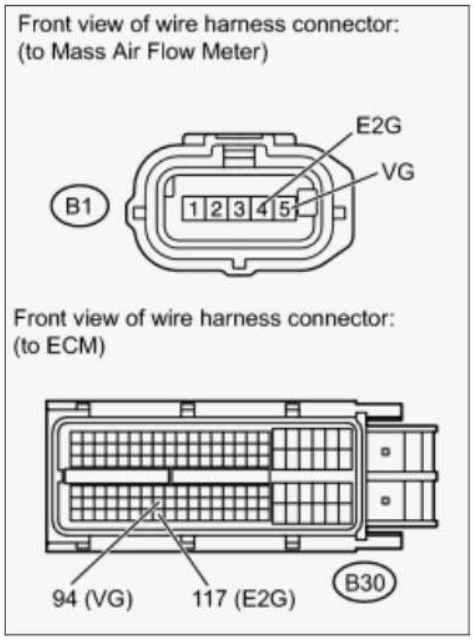
(a) Disconnect the mass air flow meter connector.

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(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-5 (VG) - B30-94 (VG)	Always	Below 1 Ω
B1-4 (E2G) - B30-117 (E2G)		

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-5 (VG) or B30-94 (VG) - Body ground	Always	10 kΩ or higher

(d) Reconnect the mass air flow meter connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

5.	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - INTEGRATION RELAY)

(a) Disconnect the mass air flow meter connector.

(b) Remove the integration relay (EFI MAIN relay) from the engine room No. 1 relay block.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-3 (+B) - 1A-4	Always	Below 1 Ω

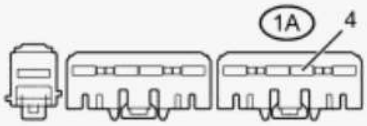
Standard Resistance (Check for short):

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Front view of wire harness connector:
(to Mass Air Flow Meter)



Front view of wire harness connector:
(to Integration Relay)



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-3 (+B) or 1A-4 - Body ground	Always	10 kΩ or higher

(d) Reconnect the mass air flow meter connector.

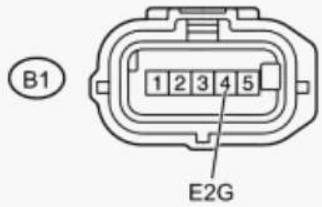
(e) Reinstall the integration relay.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **GO TO ECM POWER SOURCE CIRCUIT**

6.	CHECK HARNESS AND CONNECTOR (SENSOR GROUND)

Front view of wire harness connector:
(to Mass Air Flow Meter)



P

(a) Disconnect the mass air flow meter connector.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-4 (E2G) - Body ground	Always	Below 1 Ω

(c) Reconnect the mass air flow meter connector.

NG ▶ **CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**

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OK ▶ **REPLACE MASS AIR FLOW METER**

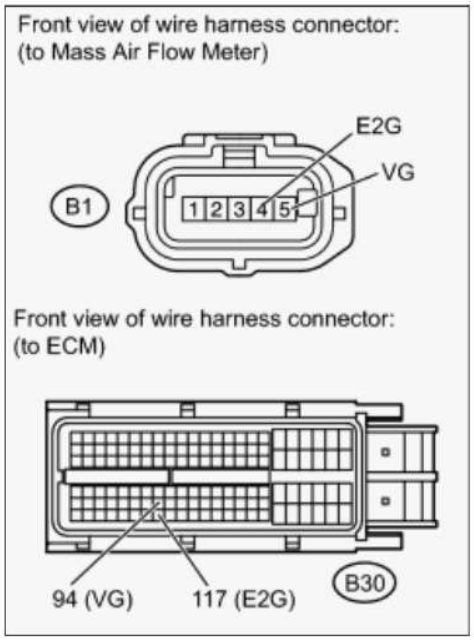
7.	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

(a) Disconnect the mass air flow meter connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-5 (VG) - B30-94 (VG)	Always	Below 1 Ω
B1-4 (E2G) - B30-117 (E2G)		

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-5 (VG) or B30-94 (VG) - Body ground	Always	10 kΩ or higher

(d) Reconnect the mass air flow meter connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

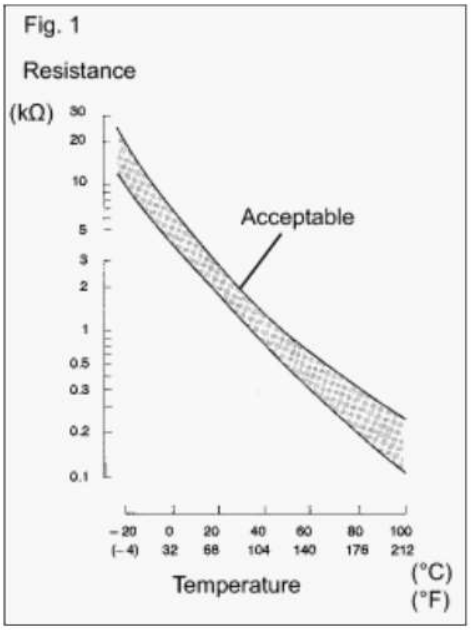
OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001WPH043X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0111: Intake Air Temperature Sensor Gradient Too High (2011 RAV4)		

DTC	**P0111**	**Intake Air Temperature Sensor Gradient Too High**

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0111	When either of the following conditions is met (2 trip detection logic): • In the duration between when the engine is warmed up and the next engine start, the change in the Intake Air Temperature (IAT) sensor output is below the threshold. • While the engine is warming up after a cold engine start, the change in the IAT sensor output is below the threshold.	Mass air flow meter

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MONITOR DESCRIPTION

After warmed engine stop

The ECM monitors the intake air temperature variation in the period from when the engine was warmed up on the previous trip until the next engine start. If the change in intake air temperature sensor output is less than the threshold, it is determined that a malfunction has occurred in the intake air temperature sensor. When this is detected, the MIL is illuminated and the DTC is stored.

After cold engine start

The monitor runs when the engine is started cold after 5 hours or more have elapsed since the engine stopped. If the intake air temperature sensor output variation until the engine has warmed up completely is less than the threshold, it is determined that a malfunction has occurred in the intake air temperature sensor. When this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is stored.

MONITOR STRATEGY

Related DTCs	P0111: Intake air temperature sensor rationality (After engine stop) P0111: Intake air temperature sensor rationality (After cold engine start)
Required Sensors/Components (Main)	Intake Air Temperature (IAT) sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	5 hours or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not stored	P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor)

After engine stop:

Time after engine start	10 seconds or more
Battery voltage	10.5 V or higher
ECT at ECM started by soak timer	-40°C (-40°F) or higher
ECT before engine stop	70°C (158°F) or higher
Time that MAF is low before engine stop	2100 seconds

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Accumulated MAF amount before engine stop	3108 g or more
Key-off duration	30 minutes

After cold engine start:

Key-off duration	5 hours
Time after engine start	10 seconds or more
ECT	70°C (158°F) or higher
Accumulated MAF amount	3108 g or more
Either of the following conditions 1 or 2 is met:	-
1. Duration while engine load is low	120 seconds or more
2. Duration while engine load is high	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

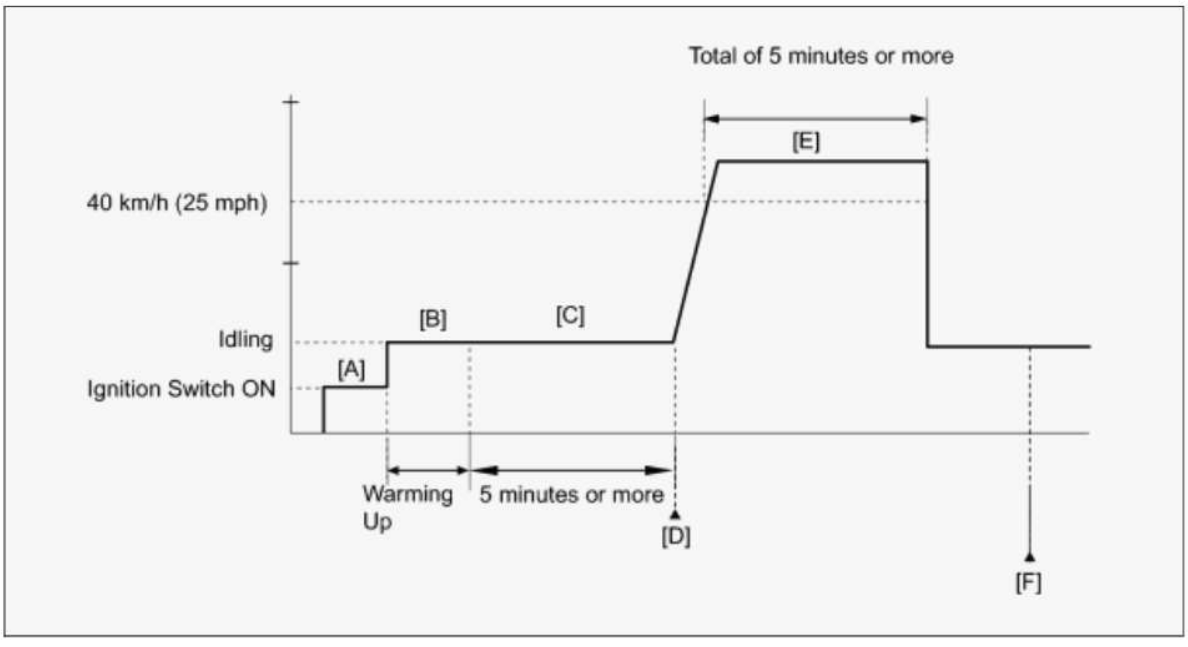
After engine stop:

IAT change	Below 1°C (2°F)

After cold engine start:

IAT change	Below 1°C (2°F)

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.

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2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and warm it up until the ECT reaches 75°C (167°F) or higher [B].
5. Idle the engine for 5 minutes or more [C].

HINT:

During steps [A] through [C], if the change in the intake air temperature is below 1°C (1.8°F), the intake air temperature sensor (MAF meter) is malfunctioning. It is not necessary to continue this procedure.

6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P0111.
8. Check the DTC judgment result [D].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [E] and [F].

9. Drive the vehicle at 40 km/h (25 mph) or more for a total of 5 minutes or more [E].
10. Check the DTC judgment result again [F].

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [E] and [F] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip

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and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0112 INFO .

INSPECTION PROCEDURE

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0111)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0111 and other DTCs	A
P0111	B

HINT:

If any DTCs other than P0111 are output, troubleshoot those DTCs first.

B ▶ **REPLACE MASS AIR FLOW METER**

A ▶ **GO TO DTC CHART**

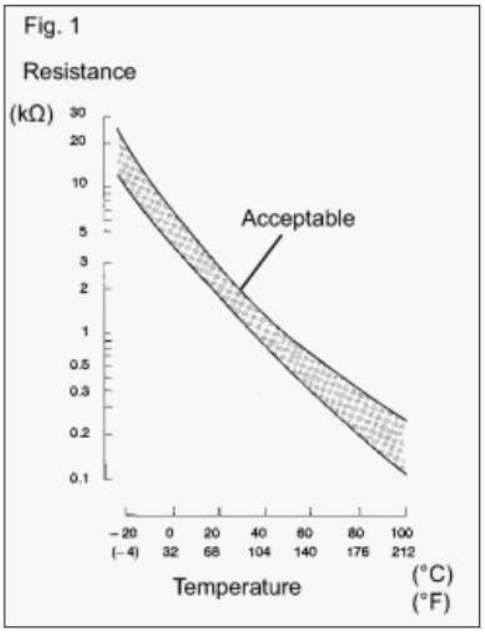
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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PF30DSX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0112,P0113: Intake Air Temperature Circuit Low Input (2011 RAV4)		

DTC	**P0112**	**Intake Air Temperature Circuit Low Input**

DTC	**P0113**	**Intake Air Temperature Circuit High Input**

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When DTC P0112 or P0113 is stored, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC	DTC DETECTION CONDITION	TROUBLE AREA

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NO.		
P0112	A short in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in IAT sensor circuit • IAT sensor (built into mass air flow meter) • ECM
P0113	An open in the Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in IAT sensor circuit • IAT sensor (built into mass air flow meter) • ECM

HINT:

When any of these DTCs are output, check the intake air temperature using the Techstream. Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

TEMPERATURE DISPLAYED	MALFUNCTION
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the Intake Air Temperature (IAT). When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and stores a DTC.

Example:

If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and stores DTC P0113. Conversely, if the output voltage is below 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.

If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0112: Intake Air Temperature (IAT) sensor range check (Low voltage) P0113: IAT sensor range check (High voltage)
Required Sensors/Components (Main)	IAT sensor
Required Sensors/Components (Related)	-

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Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

P0112:

IAT sensor voltage [IAT]	Below 0.18 V [140°C (284°F) or higher]

P0113:

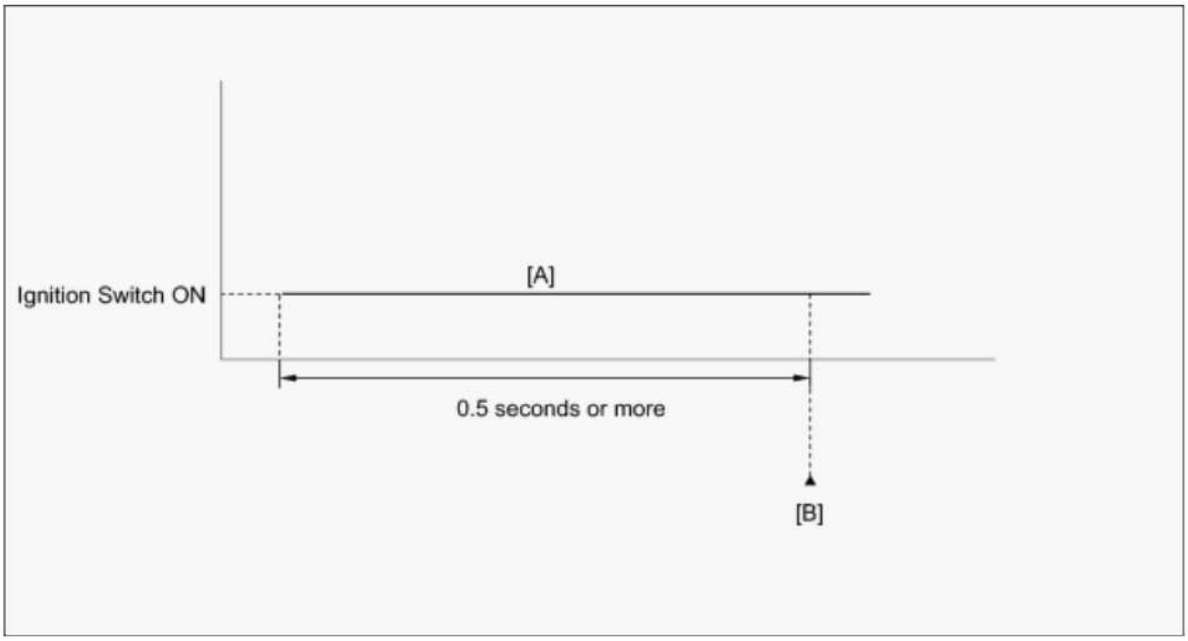
IAT sensor voltage [IAT]	Higher than 4.91 V [Below -40°C (-40°F)]

COMPONENT OPERATING RANGE

IAT sensor voltage [IAT]	0.18 to 4.91 V [-40 to 140°C (-40 to 284°F)]

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on [A].
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 0.5 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0112 or P0113.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip

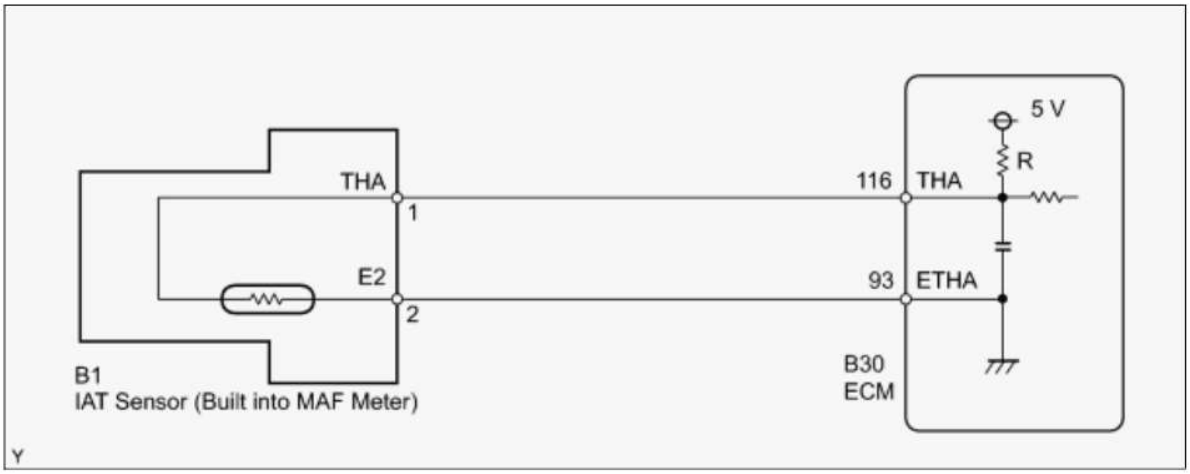
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and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (INTAKE AIR TEMPERATURE)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

(e) Read the value displayed on the Techstream.

OK:

Same as actual Intake Air Temperature (IAT).

Result

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RESULT	PROCEED TO
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:

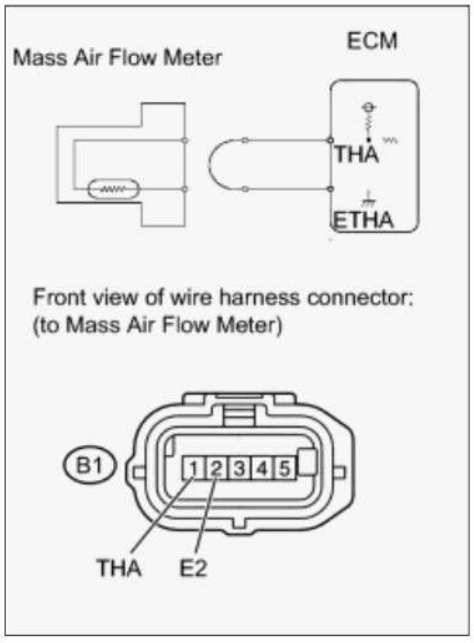
- If there is an open circuit, the Techstream indicates -40°C (-40°F).
- If there is a short circuit, the Techstream indicates 140°C (284°F) or higher.

B ▶ **READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS)**

C ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A ▼

2.	READ VALUE USING TECHSTREAM (CHECK FOR OPEN IN WIRE HARNESS)



(a) Disconnect the mass air flow meter connector.

(b) Connect terminals 1 (THA) and 2 (E2) of the MAF meter wire harness side connector.

(c) Connect the Techstream to the DLC3.

(d) Turn the ignition switch to ON.

(e) Turn the Techstream on.

(f) Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.

(g) Read the value displayed on the Techstream.

Standard value:
140°C (284°F) or higher

(h) Reconnect the mass air flow meter connector.

NG ▶ **CHECK HARNESS**

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AND CONNECTOR (MASS AIR FLOW METER - ECM)

OK ▶ **CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER**

3.	**CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**

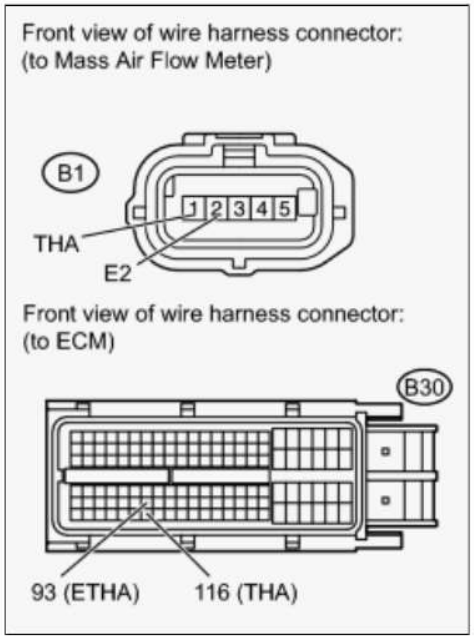
(a) Disconnect the mass air flow meter connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-1 (THA) - B30-116 (THA)	Always	Below 1 Ω
B1-2 (E2) - B30-93 (ETHA)	Always	Below 1 Ω



(d) Reconnect the mass air flow meter connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE**

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ECM

4.	READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS)

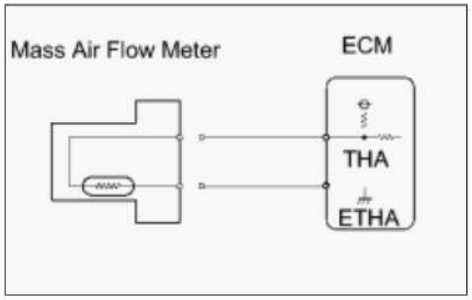
(a) Disconnect the mass air flow meter connector.

(b) Connect the Techstream to the DLC3.

(c) Turn the ignition switch to ON.

(d) Turn the Techstream on.

(e) Enter the following menus: Powertrain / Engine and ECT / All Data / Intake Air.



(f) Read the value displayed on the Techstream.

Standard value:
-40°C (-40°F)

(g) Reconnect the mass air flow meter connector.

NG ▶ CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

OK ▶ REPLACE MASS AIR FLOW METER

5.	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

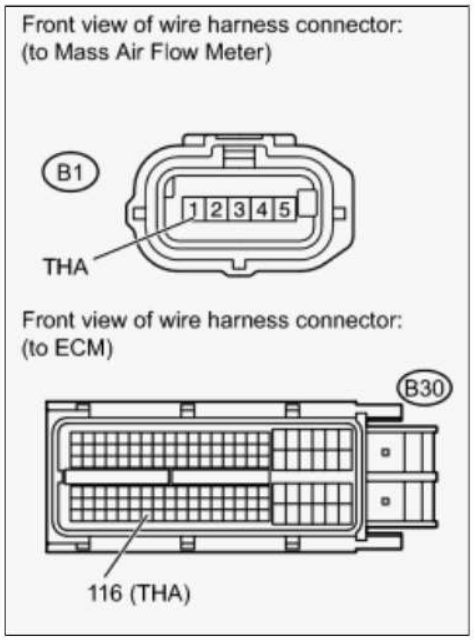
(a) Disconnect the mass air flow meter connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-1 (THA) or B30-116 (THA) - Body ground	Always	10 kΩ or higher

(d) Reconnect the mass air flow meter connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PF50EVX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0115,P0117,P0118: Engine Coolant Temperature Circuit Malfunction (2011 RAV4)		

DTC	**P0115**	**Engine Coolant Temperature Circuit Malfunction**

DTC	**P0117**	**Engine Coolant Temperature Circuit Low Input**

DTC	**P0118**	**Engine Coolant Temperature Circuit High Input**

DESCRIPTION

A thermistor, whose resistance value varies according to the Engine Coolant Temperature (ECT), is built into the ECT sensor. The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0115	An open or short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in ECT sensor circuit • ECT sensor • ECM
P0117	A short in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in ECT sensor circuit • ECT sensor • ECM
P0118	An open in the Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

When any of these DTCs are output, check the ECT using the Techstream. Enter the following menus: Powertrain

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/ Engine and ECT / Data List / All Data / Coolant Temp.

TEMPERATURE DISPLAYED	MALFUNCTION
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor circuit and stores a DTC.

Example:

If the sensor output voltage is higher than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and stores DTC P0118. Conversely, if the voltage output is below 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.

If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0115: Engine Coolant Temperature (ECT) sensor range check (Fluctuating) P0117: ECT sensor range check (Low voltage) P0118: ECT sensor range check (High voltage)
Required Sensors/Components (Main)	ECT sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

P0115:

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ECT sensor voltage	Below 0.14 V, or higher than 4.91 V

P0117:

ECT sensor voltage [ECT]	Below 0.14 V [Higher than 140°C (284°F)]

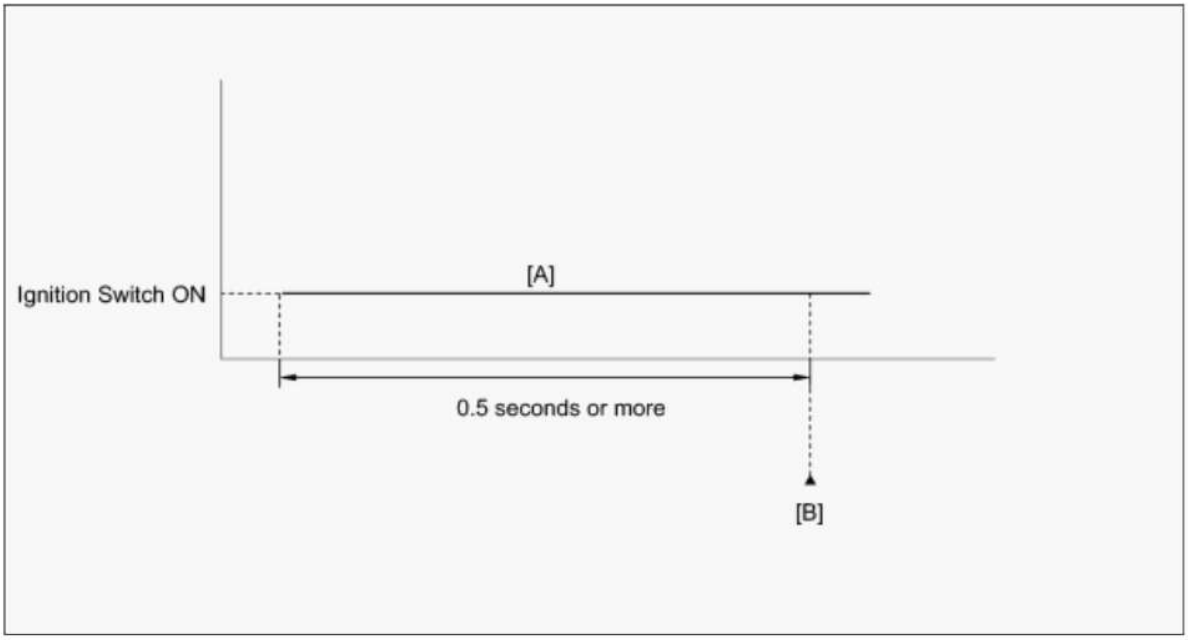
P0118:

ECT sensor voltage [ECT]	Higher than 4.91 V [Below -40°C (-40°F)]

COMPONENT OPERATING RANGE

ECT sensor voltage [ECT]	0.14 to 4.91 V [-40 to 140°C (-40 to 284°F)]

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on [A].
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 0.5 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0115, P0117 or P0118.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION

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TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

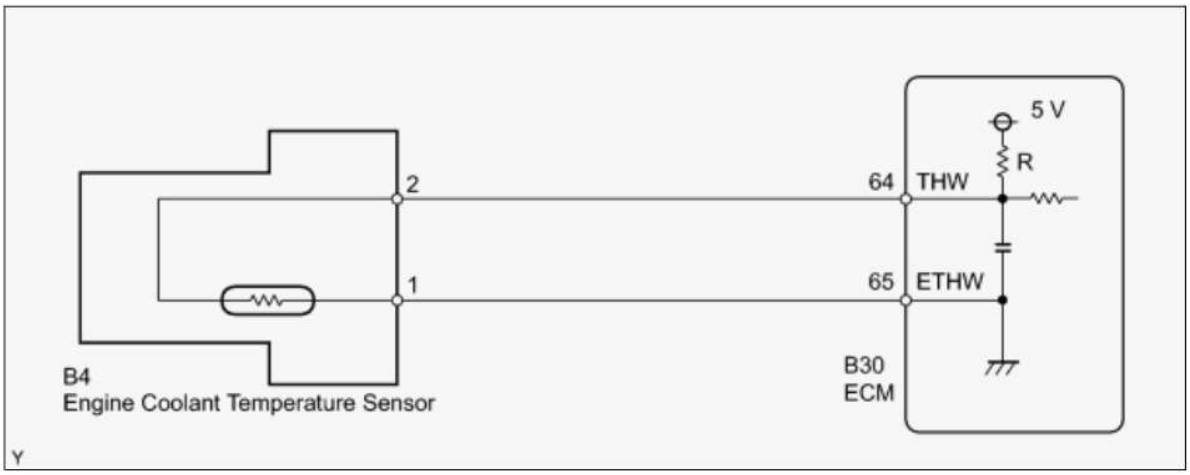
If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

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HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (ENGINE COOLANT TEMPERATURE)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

(e) Read the value displayed on the Techstream.

Standard value:
Between 80 and 100°C (167 and 212°F) with warm engine.

Result

RESULT	PROCEED TO
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80 and 100°C (176 and 212°F)	C

HINT:

- If there is an open circuit, the Techstream indicates -40°C (-40°F).
- If there is a short circuit, the Techstream indicates 140°C (284°F) or higher.

B ▶ **READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS)**

C ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A ▼

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2.	**READ VALUE USING TECHSTREAM (CHECK FOR OPEN IN WIRE HARNESS)**

(a) Disconnect the engine coolant temperature sensor connector.

(b) Connect terminals 1 and 2 of the engine coolant temperature sensor connector on the wire harness side.

(c) Connect the Techstream to the DLC3.

(d) Turn the ignition switch to ON.

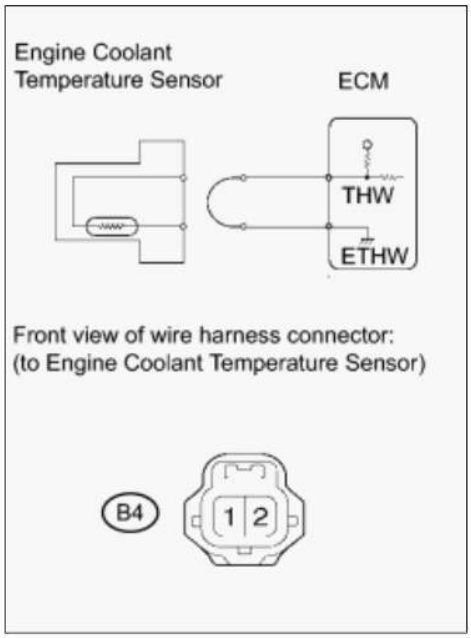
(e) Turn the Techstream on.

(f) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

(g) Read the value displayed on the Techstream.

Standard value:
140°C (284°F) or higher

(h) Reconnect the engine coolant temperature sensor connector.



NG ▶ **CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)**

OK ▶ **CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

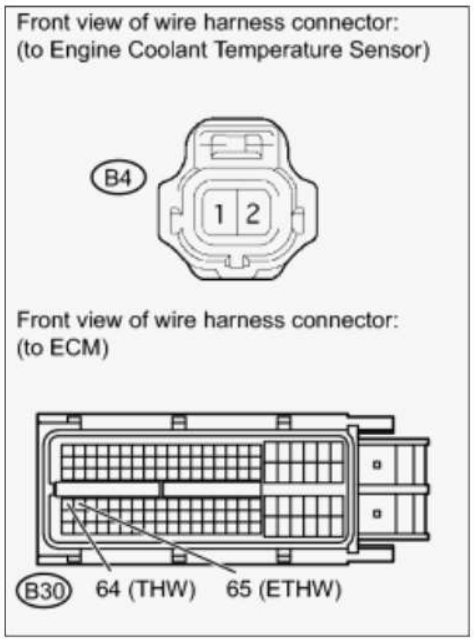
3.	**CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)**

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(a) Disconnect the engine coolant temperature sensor connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.



Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B4-2 - B30-64 (THW)	Always	Below 1 Ω
B4-1 - B30-65 (ETHW)	Always	Below 1 Ω

(d) Reconnect the engine coolant temperature sensor connector.

(e) Reconnect the ECM connector.

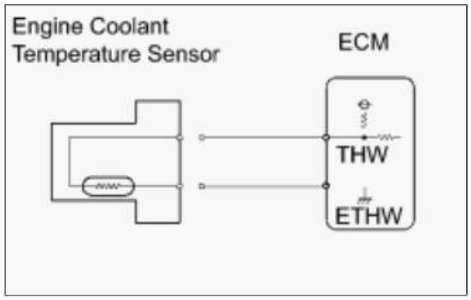
NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM**

4.	**READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS)**

(a) Disconnect the engine coolant temperature sensor connector.

(b) Connect the Techstream to the DLC3.



(c) Turn the ignition switch to ON.

(d) Turn the Techstream on.

(e) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

(f) Read the value displayed on the Techstream.

Standard value:
-40°C (-40°F)

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(g) Reconnect the engine coolant temperature sensor connector.

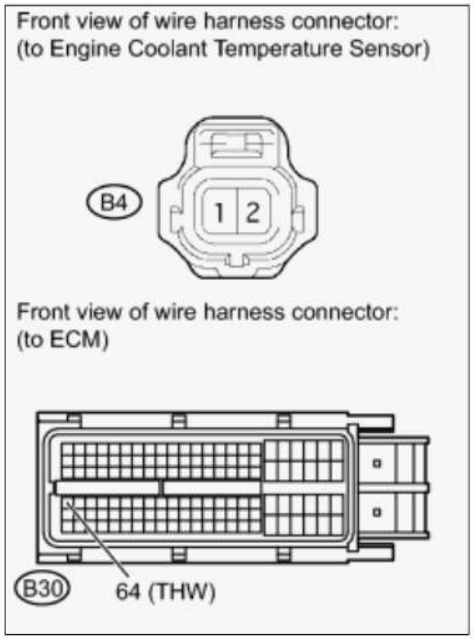
NG ▶ **CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)**

OK ▶ **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

5.	CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

(a) Disconnect the engine coolant temperature sensor connector.

(b) Disconnect the ECM connector.



(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B4-2 or B30-64 (THW) - Body ground	Always	10 kΩ or higher

(d) Reconnect the engine coolant temperature sensor connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PFB0FHX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0116: Engine Coolant Temperature Circuit Range / Performance Problem (2011 RAV4)		

DTC	**P0116**	**Engine Coolant Temperature Circuit Range / Performance Problem**

DESCRIPTION

Refer to DTC P0115 INFO .

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0116	When either of the following conditions is met (2 trip detection logic): • While the engine is warming up after a cold engine start, the change in the Engine Coolant Temperature (ECT) sensor output is below the threshold. • In the duration between when a warmed-up engine is stopped and the next cold engine start, the change in the ECT sensor output is below the threshold.	• Thermostat • ECT sensor
P0116	for Mexico Models: When either of the following conditions is met: Case 1: The Engine Coolant Temperature (ECT) is between 35 and 60°C (95 and 140°F) when the engine is started, and both of the following conditions are met (2 trip detection logic) (1) The vehicle is driven at varying speeds (accelerated and decelerated). (2) The ECT remains within 3°C (5.4°F) of the initial ECT. Case 2: The ECT is higher than 60°C (140°F) when the engine is started, and both of the following conditions are met (6 trip detection logic) (1) The vehicle is driven at varying speeds (accelerated and decelerated). (2) The ECT measurements remain within 1°C (1.8°F) of the initial ECT on 6 successive occasions.	• Thermostat • ECT sensor

MONITOR DESCRIPTION

Engine coolant temperature (ECT) sensor cold start monitor

The monitor runs when the engine is started cold. If the change in engine coolant temperature sensor output until the engine is warmed up completely is less than the threshold, it is determined that a malfunction has occurred in the engine coolant temperature sensor. When this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is stored.

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ECT sensor soak monitor

When more than 5 hours has elapsed since the engine was stopped, the ECM compares the engine coolant temperature from the time the warmed-up engine is stopped with the engine coolant temperature when the engine is started on the next trip. If the change in engine coolant temperature sensor output is less than the threshold, it is determined that a malfunction has occurred in the engine coolant temperature sensor. When this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is stored.

ECT sensor high side stuck monitor (only for Mexico models)

The ECM monitors the sensor voltage and uses this value to calculate the ECT. If the sensor voltage output deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the ECT sensor and stores the DTC.

Examples:

- Upon starting the engine, the ECT is between 35 and 60°C (95 and 140°F). If, after driving for 250 seconds, the ECT remains within 3°C (5.4°F) of the starting temperature, the DTC is stored (2 trip detection logic).
- Upon starting the engine, the ECT is higher than 60°C (140°F). If, after driving for 250 seconds, the ECT remains within 1°C (1.8°F) of the starting temperature, the DTC is stored (6 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0116: Engine coolant temperature (ECT) sensor cold start monitor P0116: ECT sensor soak monitor
Required Sensors/Components (Main)	ECT sensor
Required Sensors/Components (Related)	None
Frequency of Operation	Once per driving cycle
Duration	5 hours or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not stored	P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control)

ECT sensor cold start monitor:

Battery voltage	10.5 V or higher
Time after engine start	1 second or more

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ECT at engine start	Below 60°C (140°F)
Soak time	0 seconds or more
Accumulated MAF	1332 g or more
Fuel cut	OFF
Difference between ECT at engine start and IAT	Below 40°C (72°F)

ECT sensor soak monitor:

Battery voltage	10.5 V or higher
Engine	Running
Soak time	5 hours or more
Either condition (a) or (b) met	-
(a) ECT	60°C (140°F) or higher
(b) Accumulated MAF	3149 g or more

TYPICAL MALFUNCTION THRESHOLDS

ECT sensor cold start monitor:

ECT sensor value change	Below 5°C (9°F)

ECT sensor soak monitor:

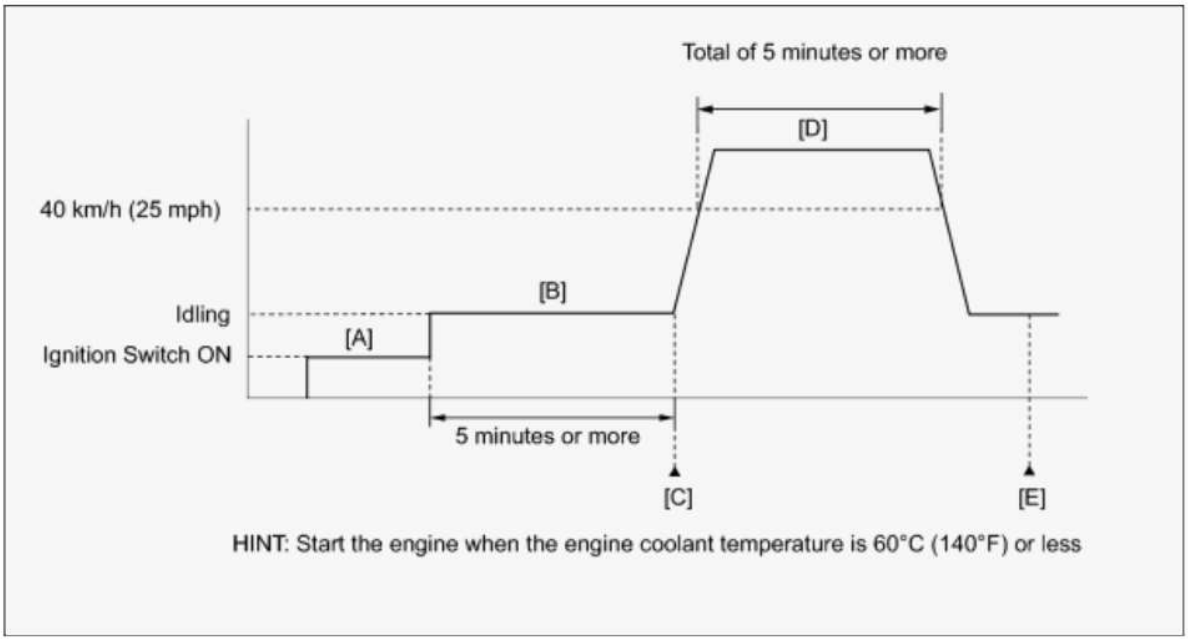
Difference between current ECT sensor value and previous ECT sensor value when engine stopped	Below 5°C (9°F)

COMPONENT OPERATING RANGE

ECT	ECT sensor value changes in accordance with actual ECT

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Enter the following menu items: Powertrain / Engine and ECT / Data List / Coolant Temp.
4. Check that the coolant temperature is 60°C (140°F) or less [A].
5. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
6. Start the engine and idle it for 5 minutes or more [B].

HINT:

If the engine coolant temperature does not change by 5°C (9°F) or higher, the ECT sensor is malfunctioning. It is not necessary to continue this procedure.

7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P0116.
9. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

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CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] and [E].

10. Drive the vehicle at 40 km/h (25 mph) or more for a total of 5 minutes or more [D].

HINT:

In the event of the drive pattern being interrupted (possibly due to factors such as traffic conditions), the drive pattern can be resumed.

11. Check the DTC judgment result again [E].

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] and [E] again.

12. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
13. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0117, P0118 or P0125 are output simultaneously with DTC P0116, the ECT sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0116)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

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(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0116	A
P0116 and other DTCs	B

B ▶ **GO TO DTC CHART**

A ▼

2.	**INSPECT THERMOSTAT**

(a) Remove the thermostat INFO .

(b) Measure the valve opening temperature of the thermostat.

Standard value:
80 to 84°C (176 to 183°F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

(c) Reinstall the thermostat INFO .

NG ▶ **REPLACE THERMOSTAT**

OK ▶ **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PF60F6X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0120-P0123,P0220,P0222,P0223,P2135: Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction (2011 RAV4)		

DTC	**P0120**	**Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction**

DTC	**P0121**	**Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem**

DTC	**P0122**	**Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input**

DTC	**P0123**	**Throttle / Pedal Position Sensor / Switch "A" Circuit High Input**

DTC	**P0220**	**Throttle / Pedal Position Sensor / Switch "B" Circuit**

DTC	**P0222**	**Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input**

DTC	**P0223**	**Throttle / Pedal Position Sensor / Switch "B" Circuit High Input**

DTC	**P2135**	**Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation**

DESCRIPTION

HINT:

- These DTCs relate to the Throttle Position (TP) sensor.

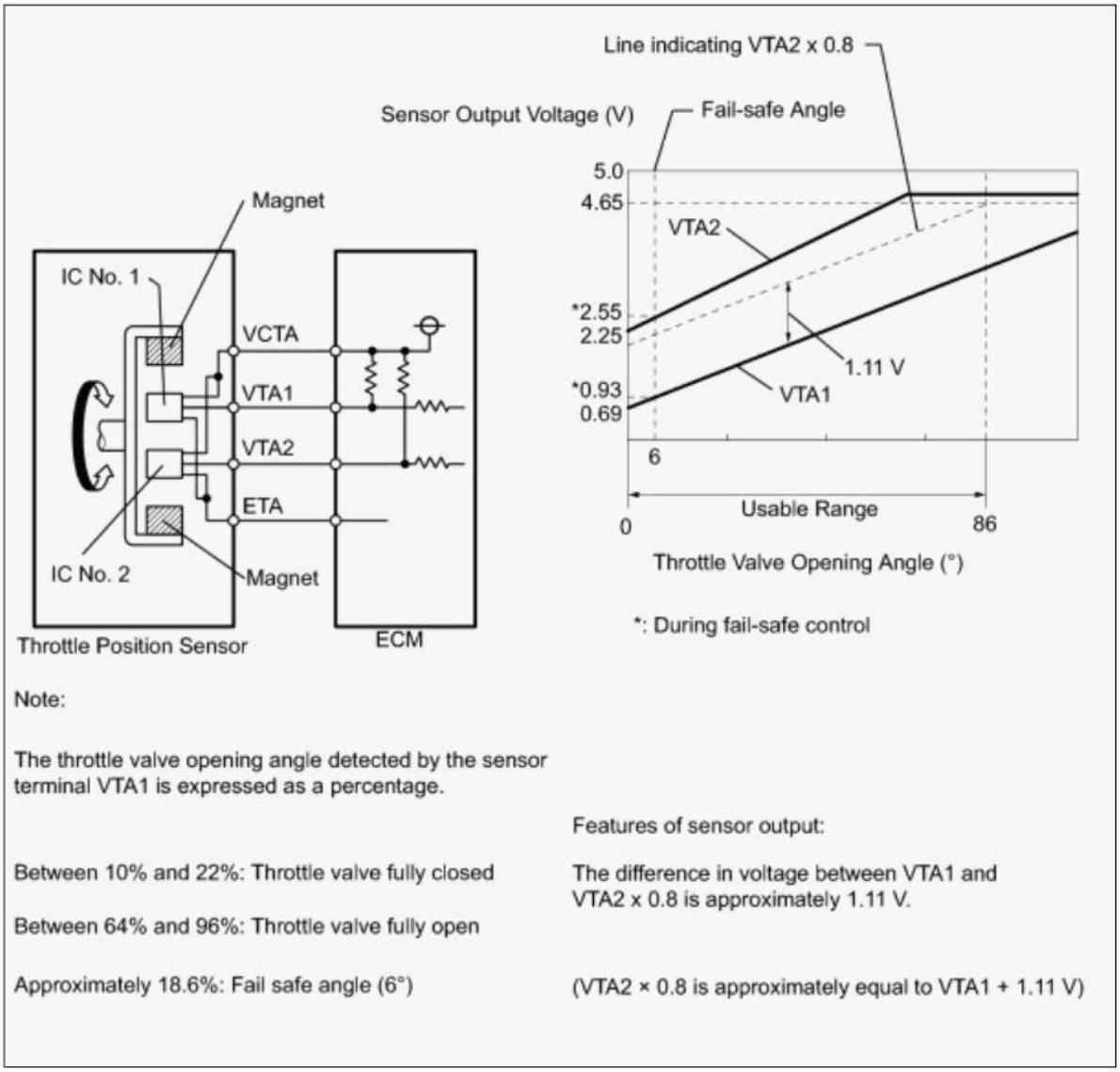
The Throttle Position (TP) sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type sensor. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.

The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the

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throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA1 terminals of the ECM.

As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • ECM

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0121	Difference between VTA1 and VTA2 voltages less than 0.8 V, or more than 1.6 V for 2 seconds (1 trip detection logic).	• Throttle Position (TP) sensor (built into throttle body) • Throttle Position sensor circuit • ECM
P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.54 V or higher for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher and VTA1 is between 0.2 V and 2.02 V for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
		• ECM
P2135	Either of the following conditions is met (1 trip detection logic): (a) The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • Throttle position sensor (built into throttle body) • ECM

HINT:

- When any of these DTCs are output, check the throttle valve opening angle using the Techstream. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.
- Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.
  Reference (Normal Condition):

TESTER DISPLAY	ACCELERATOR PEDAL FULLY RELEASED	ACCELERATOR PEDAL FULLY DEPRESSED
Throttle Position No. 1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 4.9 V

MONITOR DESCRIPTION

P0120, P0122, P0123, P0220, P0222, P0223 and P2135

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor circuit, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

P0121

This sensor transmits two signals: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. The ECM performs several checks to confirm the proper operation of the TP

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sensor and VTA1.

For each throttle opening angle, a specific voltage difference is expected between the outputs of VTA1 and VTA2. If the output voltage difference between the two signals deviates from the normal operating range, the ECM interprets this as a malfunction of the TP sensor. The ECM illuminates the MIL and stores the DTC.

If the malfunction is not repaired successfully, the DTC is stored 2 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0120: Throttle position sensor 1 range check (Fluctuating) P0121: Throttle position sensor rationality P0122: Throttle position sensor 1 range check (Low voltage) P0123: Throttle position sensor 1 range check (High voltage) P0220: Throttle position sensor 2 range check (Fluctuating) P0222: Throttle position sensor 2 range check (Low voltage) P0223: Throttle position sensor 2 range check (High voltage) P2135: Throttle position sensor range check (Correlation)
Required Sensors/Components (Main)	Throttle position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	2 seconds: P0120, P0122, P0123, P0220, P0222 and P0223 Within 2 seconds: P0121 0.5 seconds: P2135 Case 1 0.4 seconds: P2135 Case 2
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0120, P0122, P0123, P0220, P0222, P0223 and P2135

Monitor runs whenever following DTCs not stored	None
Either of following conditions met	-
A. Ignition switch ON	0.012 seconds or more
B. Electronic throttle actuator power	ON

P0121

Monitor runs whenever following DTCs not stored	P0120, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle position sensor)
Either of following conditions met	-
A. Ignition switch ON	ON
B. Electronic throttle actuator power	ON

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TYPICAL MALFUNCTION THRESHOLDS

P0120:

VTA1 voltage	0.2 V or less, or 4.54 V or higher

P0121:

When either condition below is met:	-
Difference of TP sensor voltage between VTA and VTA2 x 0.8	Higher than 1.6 V
Difference of TP sensor voltage between VTA and VTA2 x 0.8	Below 0.8 V

P0122:

VTA1 voltage	0.2 V or less

P0123:

VTA1 voltage	4.54 V or higher

P0220:

Either of following conditions met	-
A. VTA2 voltage	1.75 V or less
B. VTA2 voltage when VTA1 0.2 V or higher, and 2.02 V or less	4.8 V or higher

P0222:

VTA2 voltage	1.75 V or less

P0223:

VTA2 voltage when VTA1 0.2 V or higher, and 2.02 V or less	4.8 V or higher

P2135 Case 1:

Difference between VTA1 and VTA2 voltages	0.02 V or less

P2135 Case 2:

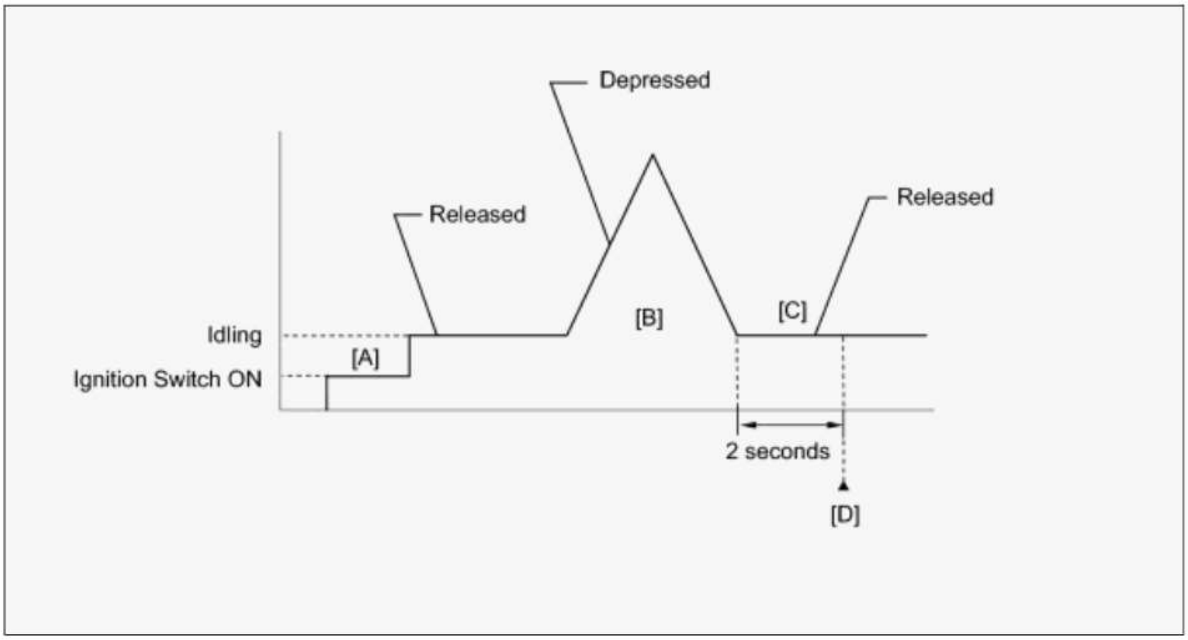
VTA1 voltage	0.2 V or less
VTA2 voltage	1.75 V or less

COMPONENT OPERATING RANGE

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VTA1 voltage	0.69 to 4.05 V
VTA2 voltage	2.25 to 4.8 V

CONFIRMATION DRIVING PATTERN



1. Enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch to ON and turn the Techstream on.
4. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
5. Start the engine.
6. With the vehicle stationary, fully depress and release the accelerator pedal [B].
7. Idle the engine for 2 seconds or more [C].
8. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
9. Input the DTC: P0120, P0121, P0122, P0123, P0220, P0222, P0223 or P2135.
10. Check the DTC judgment result [D].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions

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TESTER DISPLAY	DESCRIPTION
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [D] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

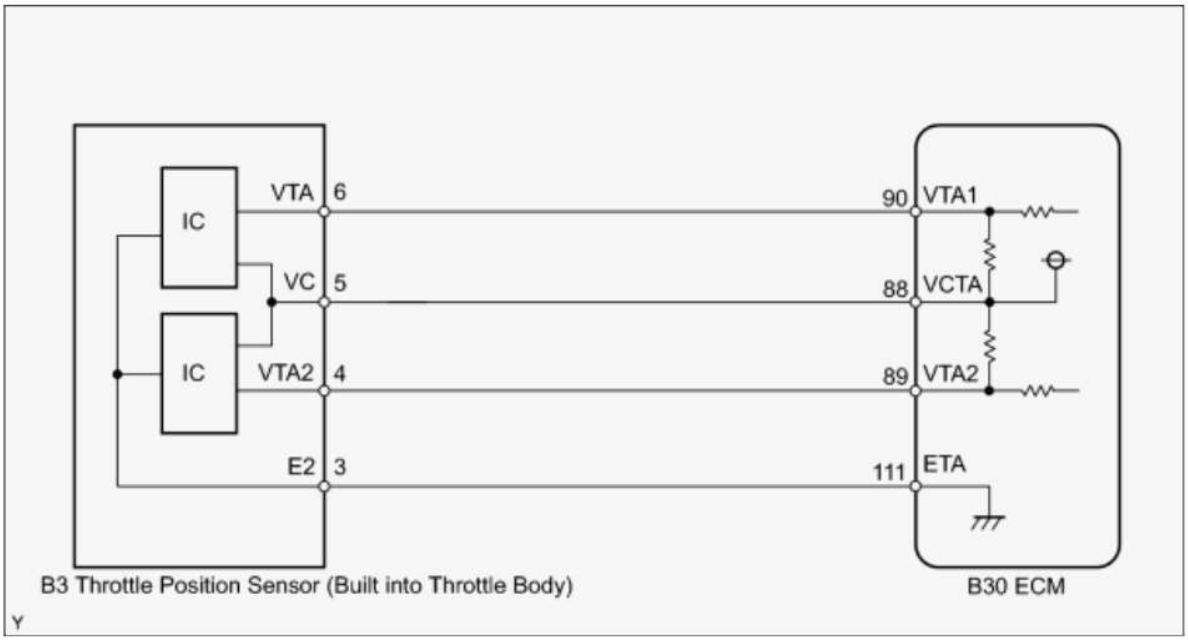
FAIL-SAFE

When any of these DTCs as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (THROTTLE POSITION SENSOR)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No. 1 and Throttle Position No. 2.

(e) Read the values displayed on the Techstream.

Result

WHEN ACCELERATOR PEDAL RELEASED		WHEN ACCELERATOR PEDAL DEPRESSED		TROUBLE AREA	PROCEED TO
THROTTLE POSITION NO. 1	THROTTLE POSITION NO. 2	THROTTLE POSITION NO. 1	THROTTLE POSITION NO. 2		

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WHEN ACCELERATOR PEDAL RELEASED		WHEN ACCELERATOR PEDAL DEPRESSED		TROUBLE AREA	PROCEED TO
THROTTLE POSITION NO. 1	THROTTLE POSITION NO. 2	THROTTLE POSITION NO. 1	THROTTLE POSITION NO. 2		
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 4.9 V	4.5 to 4.9 V	4.5 to 4.9 V	4.5 to 4.9 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 4.9 V	2.4 V to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 4.9 V	2.4 V to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	
0.7 V to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 4.9 V	0.7 V to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 4.9 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 4.9 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- DTC P0121 is stored when the VTA1 and VTA2 output voltages are not consistent with the sensor characteristics. Therefore, check the freeze frame data when this DTC is stored. Use the following formula to confirm the relative differences in voltage.

  Characteristic Sensor Output:

  VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

  VTA1: Throttle Position No. 1

  VTA2: Throttle Position No. 2
- If DTC P0121 is output, proceed to the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".

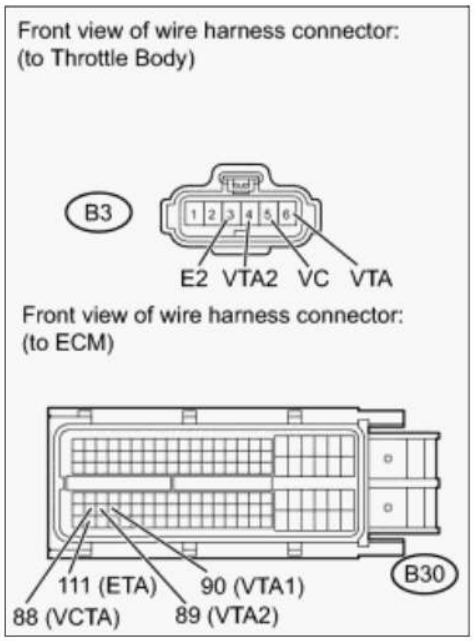
B ▶ **CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)**

A ▼

2.	**CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)**

(a) Disconnect the throttle body connector.

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(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B3-5 (VC) - B30-88 (VCTA)	Always	Below 1 Ω
B3-6 (VTA) - B30-90 (VTA1)	Always	Below 1 Ω
B3-4 (VTA2) - B30-89 (VTA2)	Always	Below 1 Ω
B3-3 (E2) - B30-111 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B3-5 (VC) or B30-88 (VCTA) - Body ground	Always	10 kΩ or higher
B3-6 (VTA) or B30-90 (VTA1) - Body ground	Always	10 kΩ or higher
B3-4 (VTA2) or B30-89 (VTA2) - Body ground	Always	10 kΩ or higher

(d) Reconnect the throttle body connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

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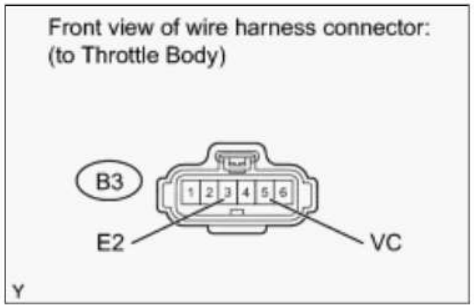
3.	INSPECT ECM (VC VOLTAGE)

(a) Disconnect the throttle body connector.

(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B3-5 (VC) - B3-3 (E2)	Ignition switch ON	4.5 to 5.5 V

(d) Reconnect the throttle body connector.

NG ▶ REPLACE ECM

OK ▼

4.	REPLACE THROTTLE BODY

(a) Replace the throttle body INFO .

NEXT ▼

5.	CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

(a) Connect the Techstream to the DLC3.

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(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine.

(f) Allow the engine to idle for 15 seconds or more.

(g) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(h) Read DTCs.

Result

RESULT	PROCEED TO
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B ▶ **END**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000T9P07XX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0125: Insufficient Coolant Temperature for Closed Loop Fuel Control (2011 RAV4)		

DTC	**P0125**	**Insufficient Coolant Temperature for Closed Loop Fuel Control**

DESCRIPTION

Refer to DTC P0115 INFO .

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0125	The Engine Coolant Temperature (ECT) does not reach the closed loop enabling temperature for 20 minutes (this period varies with the ECT at engine start) (2 trip detection logic).	• Cooling system • Engine coolant temperature sensor • Thermostat

MONITOR DESCRIPTION

The resistance of the Engine Coolant Temperature (ECT) sensor varies in proportion to the actual ECT. The ECM supplies a constant voltage to the sensor and monitors the signal output voltage of the sensor. The signal output voltage varies according to the changing resistance of the sensor. After the engine is started, the ECT is monitored by this signal. If the ECT sensor indicates that the engine is not yet warm enough for closed loop fuel control, despite a specified period of time having elapsed since the engine was started, the ECM interprets this as a malfunction in the sensor or cooling system and stores the DTC.

Example:

The ECT is 10°C (50°F) at engine start. After approximately 1 minute of running time, the ECT sensor still indicates that the engine is not warm enough to begin closed loop fuel (air-fuel ratio feedback) control. The ECM interprets this as a malfunction in the sensor or cooling system and stores the DTC.

MONITOR STRATEGY

Related DTCs	P0125: Insufficient engine coolant temperature for closed loop fuel control
Required Sensors/Components (Main)	Engine coolant temperature sensor Thermostat Cooling system
Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle

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Duration	55 seconds: Engine coolant temperature at engine start 1.67°C (35.00°F) or higher 108 seconds: Engine coolant temperature at engine start -9.44 to 1.67°C (15.00 to 35.00°F) 1200 seconds: Engine coolant temperature at engine start below -9.44°C (15.00°F)
MIL Operation	2 driving cycles
Sequence of Operation	None

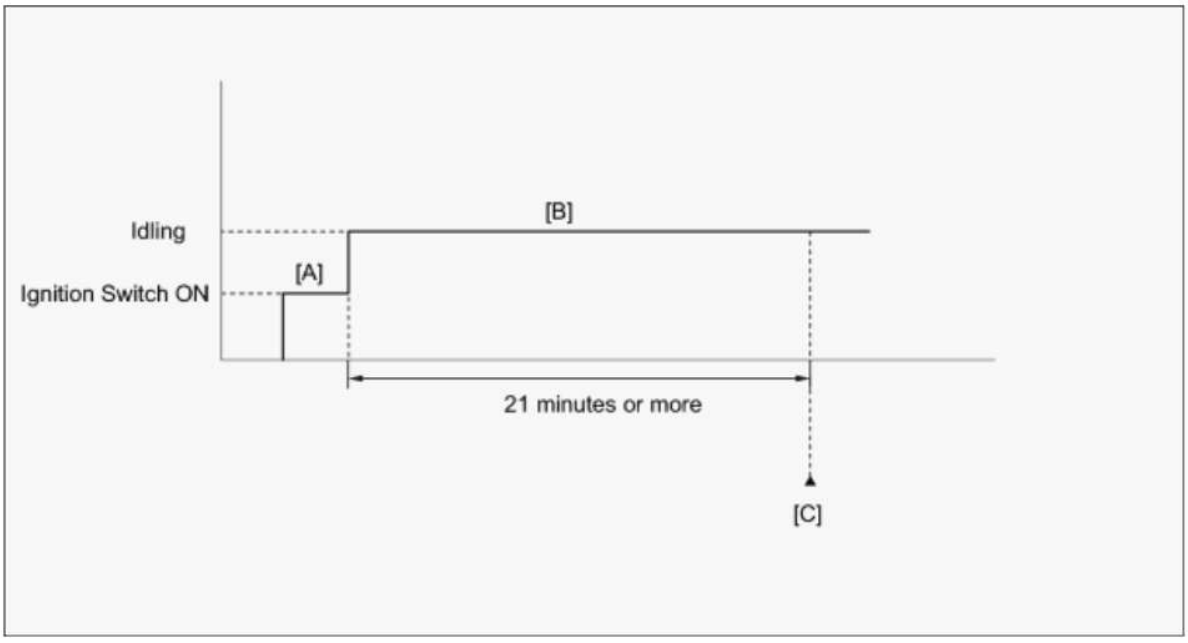
TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0101, P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0128 (Thermostat)

TYPICAL MALFUNCTION THRESHOLDS

Engine coolant temperature	Below 10°C (50°F)

CONFIRMATION DRIVING PATTERN



1. Leave the vehicle outside overnight.
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch to ON and turn the Techstream on.

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4. Enter the following menu items: Powertrain / Engine and ECT / Data List / Coolant Temp.
5. Check that the engine coolant temperature is 10°C (50°F) or less.
6. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
7. Start the engine.
8. After starting the engine, wait 21 minutes or more [B].
9. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
10. Input the DTC: P0125.
11. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

12. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
13. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- ○ If a permanent DTC is output, the system is malfunctioning.
- ○ If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0115 INFO .

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0116, P0117 or P0118 are output simultaneously with DTC P0125, the Engine Coolant Temperature (ECT) sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was

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moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0125)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0125	A
P0125 and other DTCs	B

HINT:

If any DTCs other than P0125 are output, troubleshoot those DTCs first.

B ▶ GO TO DTC CHART

A ▼

2.	**INSPECT THERMOSTAT**

(a) Remove the thermostat INFO .

(b) Check the valve opening temperature of the thermostat.

Standard value:
80 to 84°C (176 to 183°F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

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(c) Reinstall the thermostat INFO .

NG ▶ **REPLACE THERMOSTAT**

OK ▼

3.	**CHECK COOLING SYSTEM**

(a) Check for defects in the cooling system that might cause the system to be too cold, such as abnormal radiator fan operation or any modifications.

NG ▶ **REPAIR OR REPLACE COOLING SYSTEM**

OK ▶ **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000TB3060X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0128: Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature) (2011 RAV4)		

DTC	**P0128**	**Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)**

DESCRIPTION

HINT:

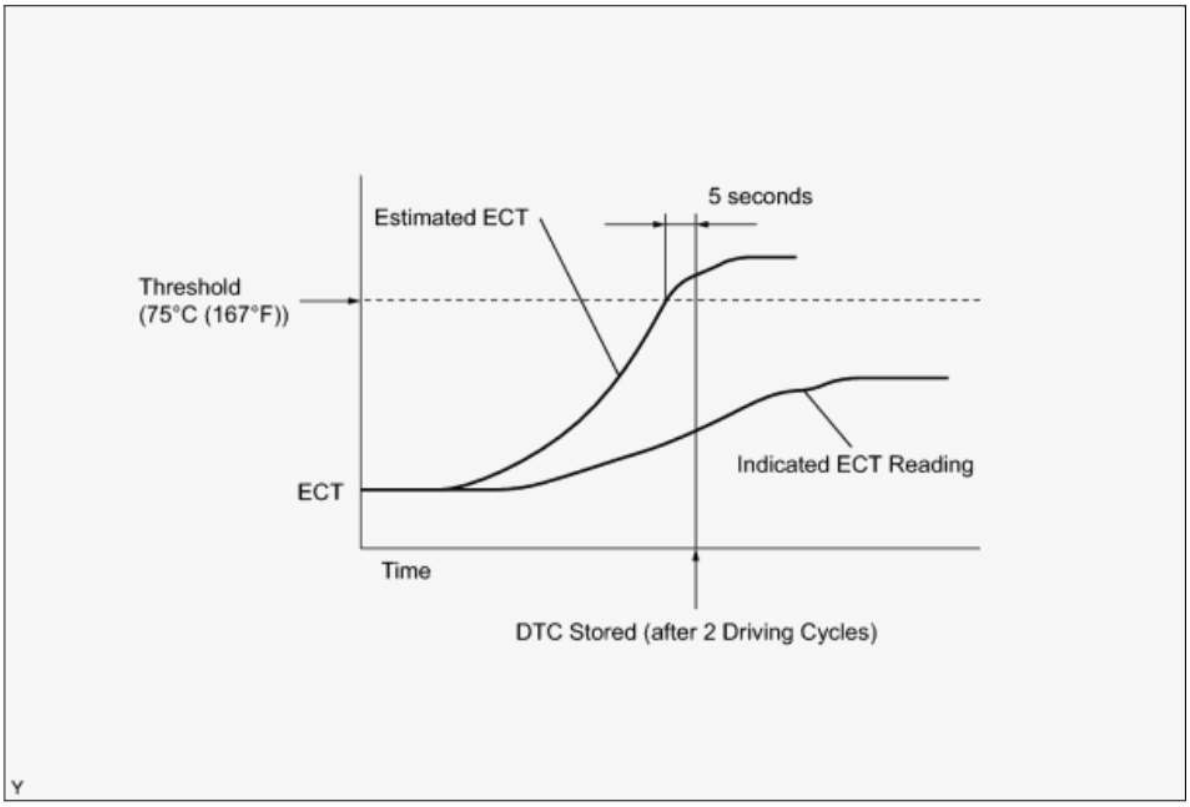
- This DTC relates to the thermostat.

This DTC is stored when the Engine Coolant Temperature (ECT) does not reach 75°C (167°F) despite sufficient engine warm-up time having elapsed.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0128	• All of the following conditions are met for 5 seconds (2 trip detection logic): • (a) Cold start. • (b) The engine is warmed up. • (c) The engine coolant temperature is below 75°C (167°F).	• Thermostat • Cooling system • Engine coolant temperature sensor • ECM

MONITOR DESCRIPTION

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The ECM estimates the Engine Coolant Temperature (ECT) based on the starting temperature, engine loads, and engine speeds. The ECM then compares the estimated temperature with the actual ECT. When the estimated ECT reaches 75°C (167°F), the ECM checks the actual ECT. If the actual ECT is less than 75°C (167°F), the ECM interprets this as a malfunction in the thermostat or the engine cooling system and stores the DTC.

MONITOR STRATEGY

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat Engine Coolant Temperature (ECT) sensor
Required Sensors/Components (Related)	Intake Air Temperature (IAT) sensor Vehicle speed sensor
Frequency of Operation	Once per driving cycle
Duration	500 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0010 (VVT Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard)

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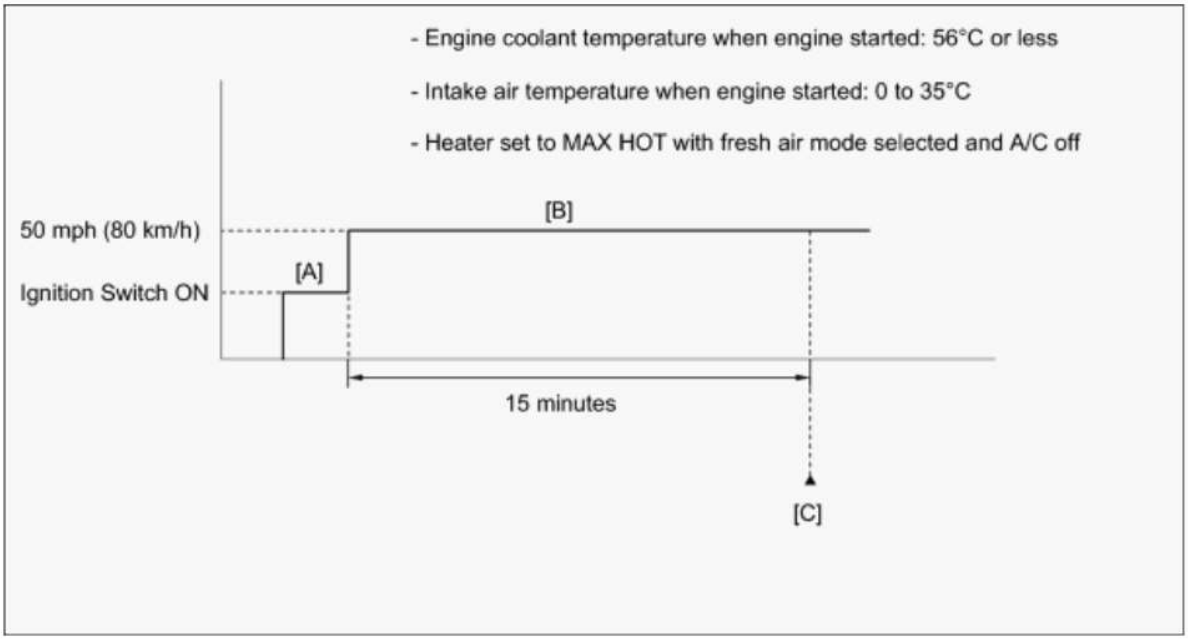
	P0016 (VVT System - Misalignment) P0013 (Exhaust VVT Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P0101D (Air Fuel Ratio Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust VVT Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor)
Battery voltage	11 V or higher
Either of following conditions met:	-
1. All of following conditions met:	-
• ECT at engine start - IAT at engine start	-15 to 7°C (-27 to 12.6°F)
• ECT at engine start	-10 to 56°C (14 to 133°F)
• IAT at engine start	-10 to 56°C (14 to 133°F)
2. All of following conditions met:	-
• ECT at engine start - IAT at engine start	Higher than 7°C (12.6°F)
• ECT at engine start	56°C (133°F) or less
• IAT at engine start	-10°C (14°F) or higher
Accumulated time at vehicle speed of 128 km/h (80 mph) or more	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

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Duration that both of following conditions met	5 seconds or more
(a) Estimated ECT	75°C (167°F) or higher
(b) ECT sensor output	Below 75°C (167°F)

CONFIRMATION DRIVING PATTERN



1. Stop the engine and allow it to soak.
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch to ON and turn the Techstream on [A].
4. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation).
5. Enter the following menu items: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp and Intake Air.
6. Check if "Coolant Temp" is 56°C (133°F) or less and "Intake Air" is between 0 and 35°C (0 and 95°F).
7. Set the heater to MAX HOT with fresh air mode selected and turn the A/C off.
8. Start the engine and drive the vehicle at 50 mph (80 km/h) for 15 minutes [B].

HINT:

- Data can be captured relatively easily by using the snapshot function in the Data List.
- Enter the following menu: Data List / Function / Snap-shot configuration / Record time / 5 min.
- Data capture can be started by using the target point. For example, setting the target point to an engine speed of 4000 rpm and then racing the engine, etc. to raise the engine speed to a speed of 4000 rpm or more will cause data capture to start.

9. After driving the vehicle at 50 mph (80 km/h) and "Coolant Temp" stabilizes, check that "Coolant Temp" is 75°C (167°F) or higher.

HINT:

IF "Coolant Temp" is below 75°C (167°F) while driving the vehicle at 50 mph (80 km/h), inspect the cooling system and thermostat.

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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0128)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0128	A
P0128 and other DTCs	B

HINT:

If any DTCs other than P0128 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**CHECK COOLING SYSTEM**

(a) Check for defects in the cooling system that might cause the system to be too cold, such as abnormal radiator fan operation or any modifications.

NG ▶ **REPAIR OR REPLACE COOLING SYSTEM**

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OK

3.	**INSPECT THERMOSTAT**

(a) Remove the thermostat INFO .

(b) Measure the valve opening temperature of the thermostat.

Standard value:
80 to 84°C (176 to 183°F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

(c) Reinstall the thermostat INFO .

NG ▶ **REPLACE THERMOSTAT**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WBY0ANX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0136-P0139: Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2) (2011 RAV4)		

DTC	**P0136**	**Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)**

DTC	**P0137**	**Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)**

DTC	**P0138**	**Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)**

DTC	**P0139**	**Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)**

DESCRIPTION

HINT:

Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC (Three-Way Catalytic Converter) is used. For the most efficient use of the TWC, the air-fuel ratio is precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

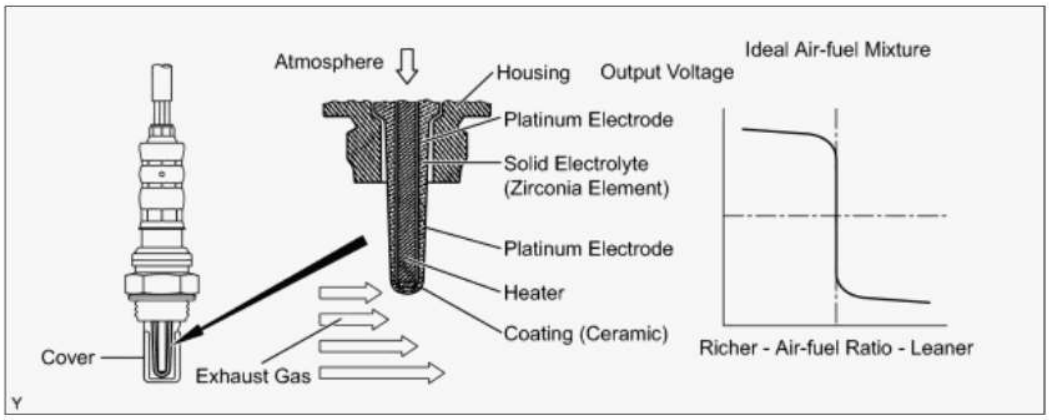
The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. less than 0.45 V).

Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. more than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0136	• Abnormal voltage output: During active air-fuel ratio control, both of the following conditions are met for a certain period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage does not decrease to below 0.21 V. (b) The HO2 sensor voltage does not increase to higher than 0.69 V. • Low impedance: The sensor impedance is below 5 Ω for more than 30 seconds when the ECM presumes the sensor is warmed up and operating normally (2 trip detection logic).	• HO2 sensor (sensor 2) • Air-Fuel Ratio (A/F) sensor (sensor 1) • Gas leak from exhaust system • Fuel pressure • Fuel injector • PCV valve and hose • Air induction system
P0137	• Low voltage (open): During active air-fuel ratio control, both of the following conditions are met for certain a period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage output is below 0.21 V. (b) The target air-fuel ratio is rich. • High impedance: The sensor impedance is 15 kΩ or higher for more than 90 seconds when the ECM presumes the sensor to be warmed up and operating normally (2 trip detection logic).	• Open or short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • HO2 sensor heater (sensor 2) • Air-Fuel Ratio (A/F) sensor (sensor 1) • Gas leak from exhaust system
P0138	• High voltage (short): During active air-fuel ratio control, both of the following conditions are met for certain a period of time (2 trip detection logic): (a) The Heated Oxygen (HO2) sensor voltage output is 0.69 V or higher. (b) The target air-fuel ratio is lean. • Extremely high voltage (short): The HO2 sensor voltage output exceeds 1.2 V for more than 10 seconds (2 trip detection logic).	• Short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • ECM • Air-Fuel Ratio (A/F) sensor (sensor 1)

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0139	• The heated oxygen sensor (sensor 2) voltage does not drop to below 0.2 V immediately after fuel cut starts. • The heated oxygen sensor (sensor 2) voltage does not drop from 0.35 V to 0.2 V immediately after fuel cut starts.	• Short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • ECM

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DTC NO.	DTC DETECTION CONDITIONS	TROUBLE AREAS
P0136	Not applicable	None
P0137	• Low voltage (open): During active air-fuel ratio control, both of the following conditions are met for a certain period of time (2 trip detection logic): (a) The HO2 sensor voltage output is below 0.21 V. (b) The target air-fuel ratio is rich.	• Open in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • HO2 sensor heater (sensor 2) • EFI relay • Gas leak from exhaust system
P0138	Not applicable	None
P0139	Not applicable	None

MONITOR DESCRIPTION

1. Active Air-Fuel Ratio Control

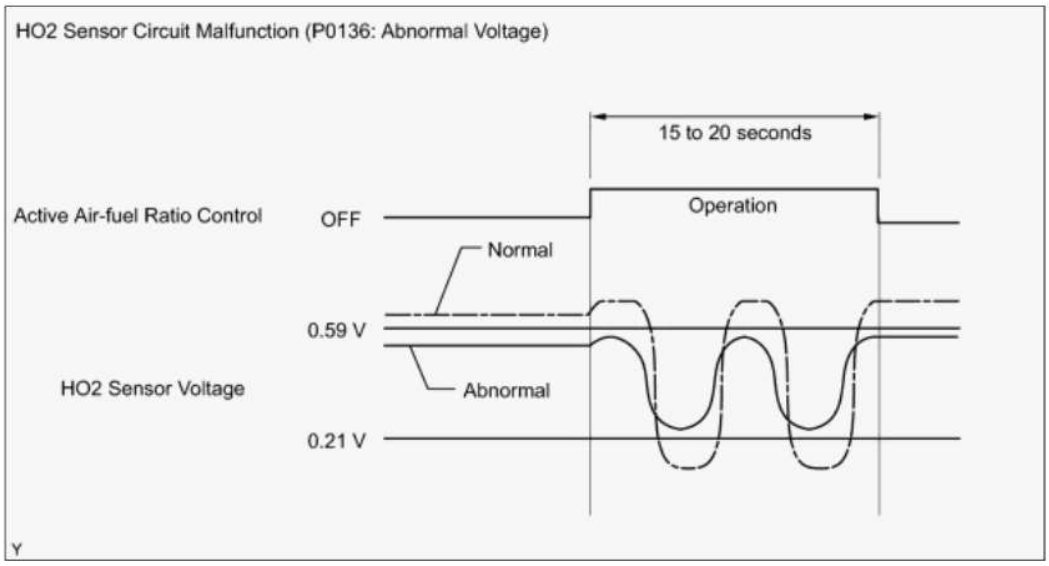
The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

2. Abnormal Voltage Output of Heated Oxygen (HO2) Sensor (DTC P0136)

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to below 0.21 V and does not increase to higher than 0.69 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and stores DTCs P0136.

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3. Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTCs P0137 or P0138)

During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean.

If the HO2 sensor has an open or short, or the voltage output of the sensor noticeably decreases, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

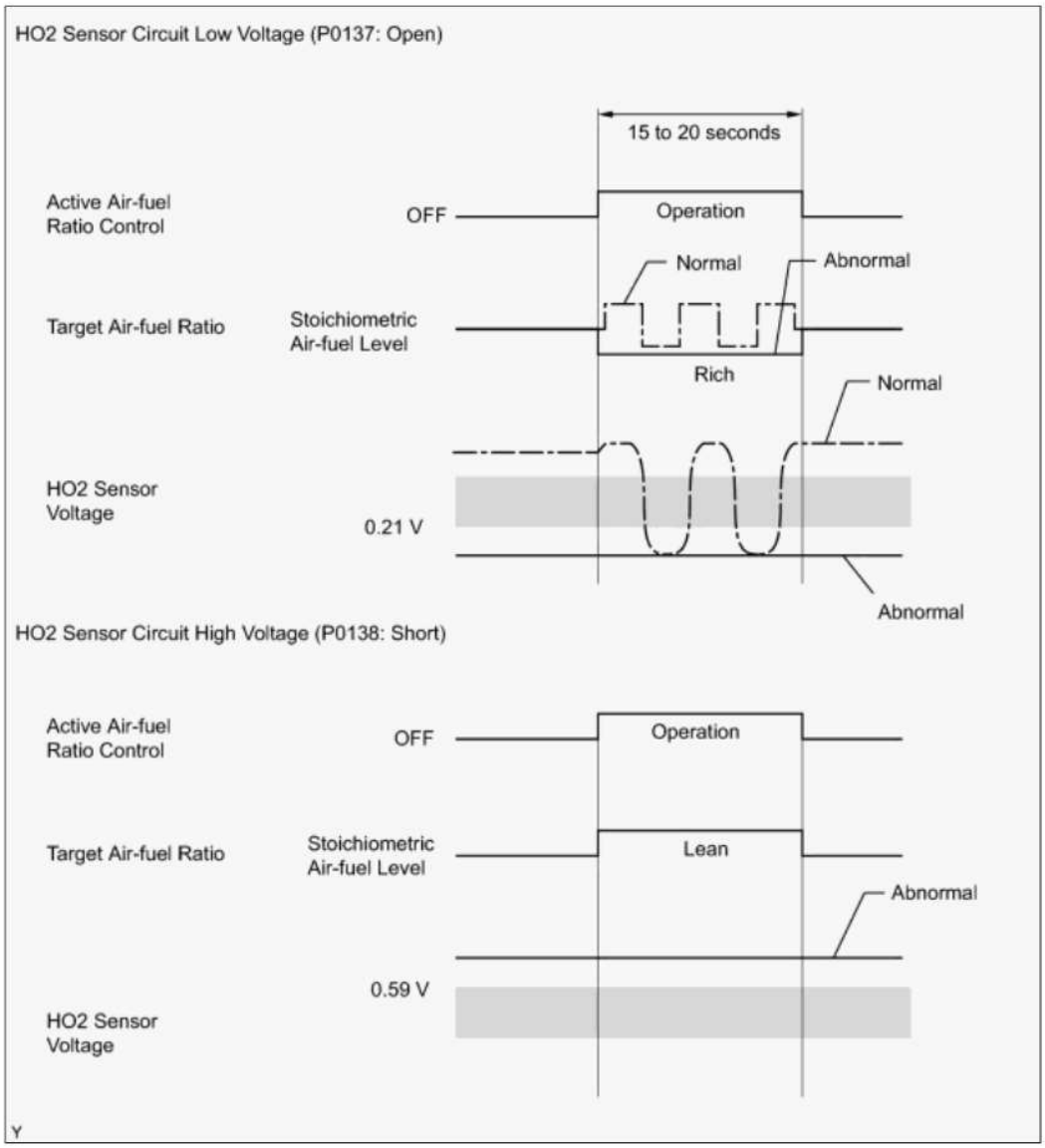
While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137. When the target air-fuel ratio is lean and the voltage output is 0.69 V or higher (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and stores DTC P0138.

HINT:

DTC P0138 is also set if the HO2 sensor voltage output is higher than 1.2 V for 10 seconds or more.

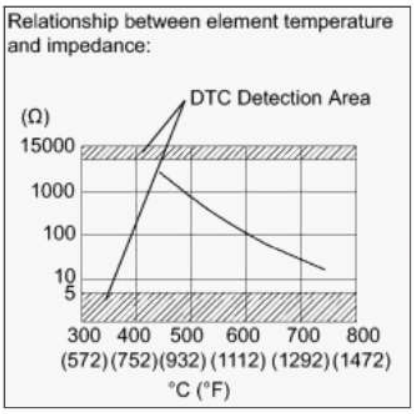
***: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated, based on the calculated OSC value** INFO **.**

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4. High or Low Impedance of Heated Oxygen (HO2) Sensor (DTCs P0136 or P0137)



During normal air-fuel ratio feedback control, there are small variations in the exhaust gas oxygen concentration. In order to continuously monitor the slight variation of the HO2 sensor signal while the engine is running, the impedance* of the sensor is measured by the ECM. The ECM determines that there is a malfunction in the sensor when the measured impedance deviates from the standard range.

*: The effective resistance in an alternating current electrical circuit.

HINT:

- The impedance cannot be measured using an ohmmeter.
- DTC P0136 indicates the deterioration of the HO2 sensor. The ECM stores the DTC by calculating the impedance of the sensor when the typical enabling conditions are satisfied (2 driving cycles).
- DTC P0137 indicates an open or short circuit in the HO2 sensor (2 driving cycles). The ECM stores the DTC when the impedance of the sensor exceeds the threshold of 15 kΩ.

5. Abnormal Voltage Output of Heated Oxygen (HO2) Sensor During Fuel-cut (DTC P0139)

The sensor output voltage drops to below 0.2 V (extremely lean status) immediately when the vehicle decelerates and fuel cut is operating. If the voltage does not drop to below 0.2 V for 7 seconds or more, or voltage does not drop from 0.35 V to 0.2 V for 1 second, the ECM determines that the sensor response has deteriorated, illuminates the MIL and stores a DTC.

MONITOR STRATEGY

Related DTCs	P0136: Heated oxygen sensor output voltage (Output voltage) P0136: Heated oxygen sensor impedance (Low) P0137: Heated oxygen sensor output voltage (Low voltage) P0137: Heated oxygen sensor impedance (High) P0138: Heated oxygen sensor output voltage (High voltage) P0138: Heated oxygen sensor output voltage (Extremely high) P0139: Heated oxygen sensor output voltage during fuel cut
Required Sensors/Components (Main)	Heated oxygen sensor (sensor 2)
Required Sensors/Components (Related)	Crankshaft position sensor Engine coolant temperature sensor Mass air flow meter Throttle position sensor
Frequency of Operation	Once per driving cycle: Active air-fuel ratio control detection, Heated oxygen sensor voltage during fuel-cut Continuous: Other
Duration	20 seconds: Heated oxygen sensor output (Output voltage, High voltage, Low voltage) 30 seconds: Heated oxygen sensor impedance (Low) 90 seconds: Heated oxygen sensor impedance (High) 10 seconds: Heated oxygen sensor voltage (Extremely high) 7 seconds: Heated oxygen sensor voltage during fuel cut
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Heated Oxygen Sensor Output Voltage (Output Voltage, High Voltage and Low Voltage):

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0037, P0038, P102D (Rear Oxygen Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor)

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	P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor)
Active air-fuel ratio control	Executing
Active air-fuel ratio control begins when all of following conditions met:	-
Battery voltage	11 V or higher
Engine coolant temperature	75°C (167°F) or higher
Idling	OFF
Engine speed	Less than 4000 rpm
A/F sensor status	Activated
Fuel system status	Closed loop
Fuel cut	OFF
Engine load	10 to 80%
Shift position	4th or more

Heated Oxygen Sensor Impedance (Low):

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0037, P0038, P102D (Rear Oxygen Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0607 (Rear Oxygen Sensor)
Battery voltage	11 V or higher
Estimated heated oxygen sensor temperature	Below 700°C (1292°F)
ECM monitor	Completed

Heated Oxygen Sensor Impedance (High):

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0037, P0038, P102D (Rear Oxygen Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio

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	Sensor) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0607 (Rear Oxygen Sensor)
Battery voltage	11 V or higher
Estimated heated oxygen sensor temperature	450 to 750°C (842 to 1382°F)

Heated Oxygen Sensor Output Voltage (Extremely High):

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0037, P0038, P102D (Rear Oxygen Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor)
Battery voltage	11 V or higher
Time after engine start	2 seconds or more

Heated Oxygen Sensor Voltage During Fuel Cut:

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0037, P0038, P102D (Rear Oxygen Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor)

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	P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor)
Engine coolant temperature	75°C (167°F) or higher
Estimated catalyst temperature	400°C (752°F) or higher
Fuel cut	Executing

TYPICAL MALFUNCTION THRESHOLDS

Heated Oxygen Sensor Output Voltage (Output voltage):

Either of following conditions met:	1 or 2
1. All of following conditions met	-
(a) Commanded air-fuel ratio	14.4 or less
(b) Rear HO2 sensor voltage	0.21 to 0.69 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.0 g or more
2. All of following conditions met	-
(d) Commanded air-fuel ratio	14.8 or more
(e) Rear HO2 sensor voltage	0.21 to 0.69 V
(f) OSC	2.0 g or more

Heated Oxygen Sensor Output Voltage (Low output voltage):

All of following conditions met	-
(a) Commanded air-fuel ratio	14.4 or less
(b) Rear HO2 sensor voltage	Below 0.21 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.0 g or more

Heated Oxygen Sensor Output Voltage (High output voltage):

All of following conditions met	-
(a) Commanded air-fuel ratio	14.8 or more
(b) Rear HO2 sensor voltage	Higher than 0.69 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.0 g or more

Heated Oxygen Sensor Impedance (Low):

Duration of following condition	30 seconds or more
Heated oxygen sensor impedance	Below 5 Ω

Heated Oxygen Sensor Impedance (High):

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Duration of following condition	90 seconds or more
Heated oxygen sensor impedance	15 kΩ or higher

Heated Oxygen Sensor Output Voltage (Extremely High):

Duration of following condition	10 seconds or more
Heated oxygen sensor voltage	1.2 V or higher

Heated Oxygen Sensor Voltage During Fuel-cut:

Either condition is met	-
Duration until rear heated oxygen sensor voltage drops to 0.2 V after fuel cut	7 seconds or more
Duration that rear heated oxygen sensor voltage drops from 0.35 V to 0.2 V during fuel cut	1 second or more

COMPONENT OPERATING RANGE

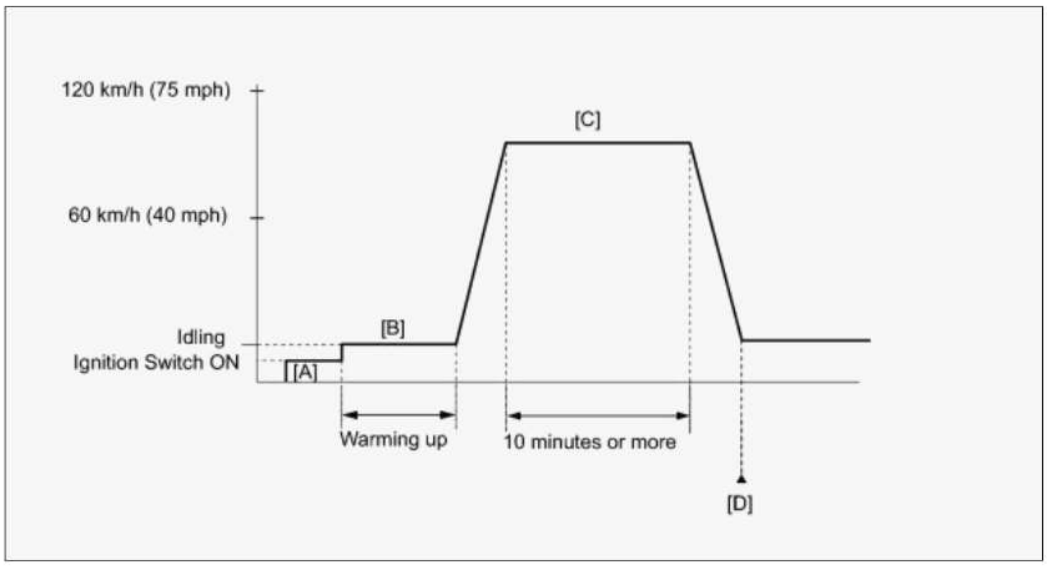
Duration of following condition	30 seconds or more
Heated oxygen sensor voltage	Varies between 0.1 V and 0.9 V

MONITOR RESULT

Refer to Checking Monitor Status INFO .

CONFIRMATION DRIVING PATTERN

P0136, P0137 and P0138



1. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
2. Start the engine and warm it up until the ECT reaches 75°C (167°F) or higher [B].
3. With the transmission in 4th gear or higher, drive the vehicle at 60 to 120 km/h (40 to 75 mph) for 10 minutes or more [C].
4. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
5. Input the DTC: P0136, P0137 or P0138.

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6. Check the DTC judgment result [D].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [C] and [D].

7. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
8. Read Pending DTCs.

HINT:

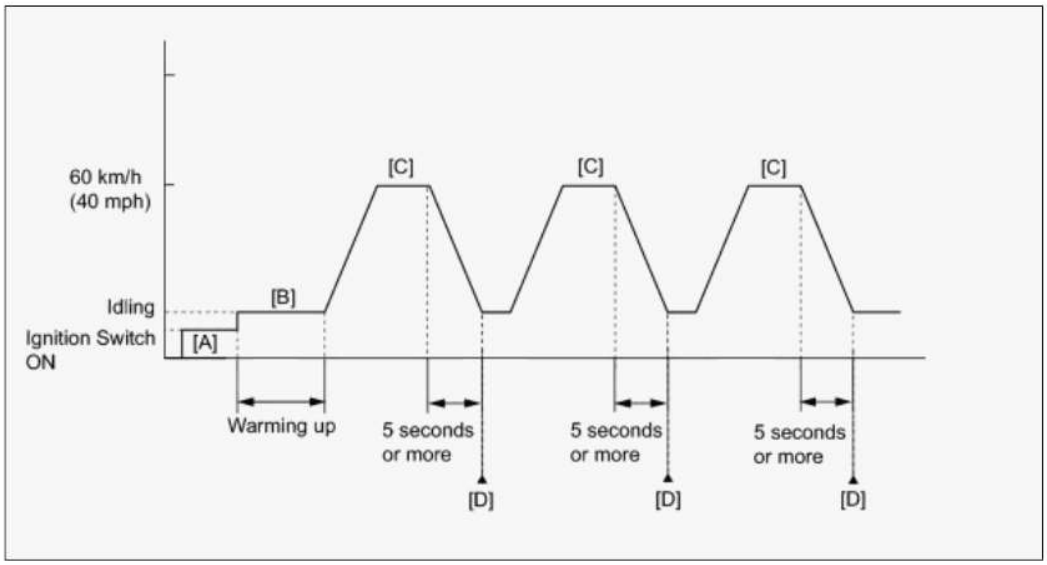
If a pending DTC is output, the system is malfunctioning.

9. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

P0139



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1. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
2. Start the engine and warm it up until the ECT reaches 75°C (167°F) or higher [B].
3. Drive the vehicle at 60 km/h (40 mph), and then decelerate the vehicle by releasing the accelerator pedal for 5 seconds or more to perform the fuel-cut [C].
4. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
5. Input the DTC: P0139.
6. Check the DTC judgment result [D].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, move the shift lever to 2 and then perform steps [C] through [D] again.

7. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
8. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

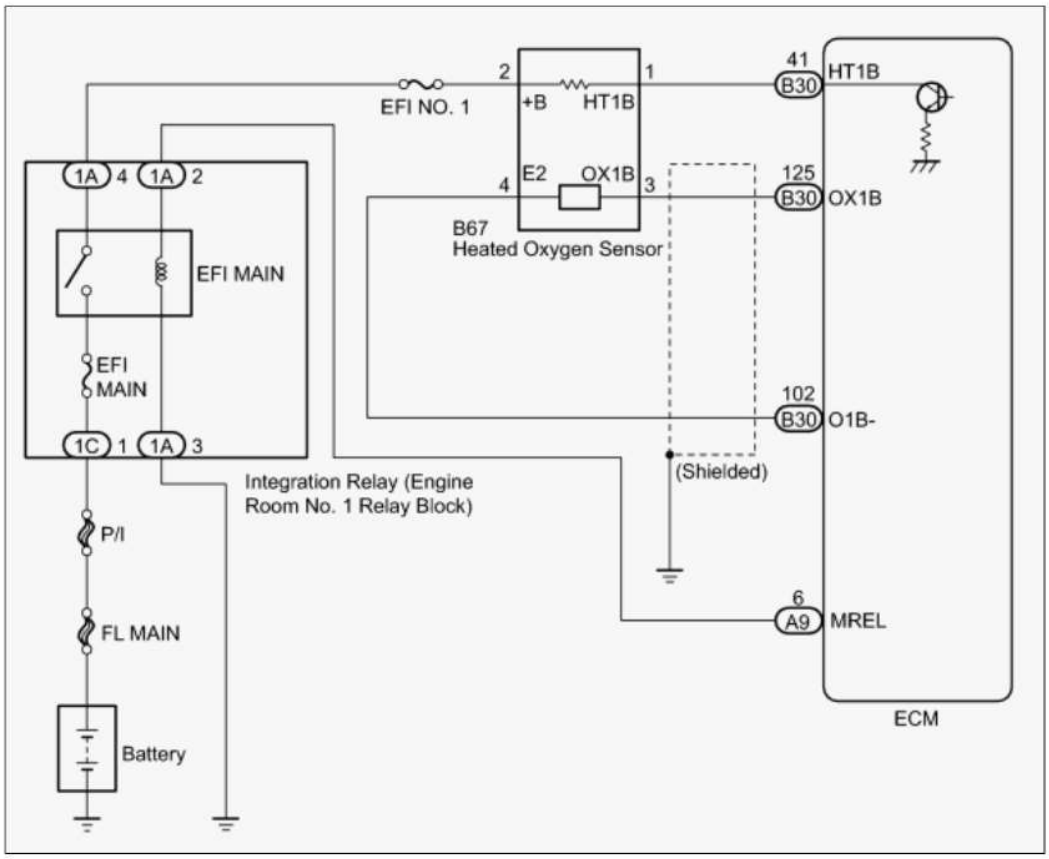
9. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)
7. Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

HINT:

- The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

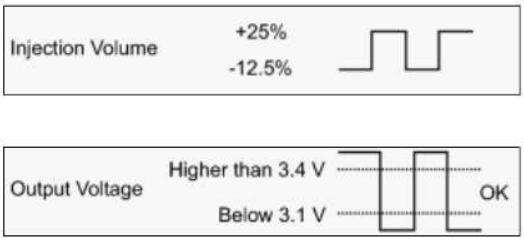
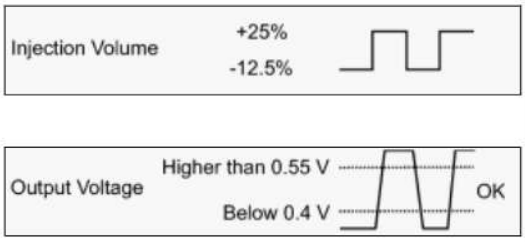
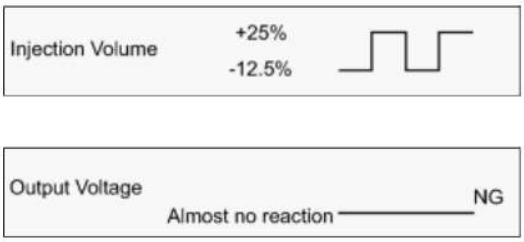
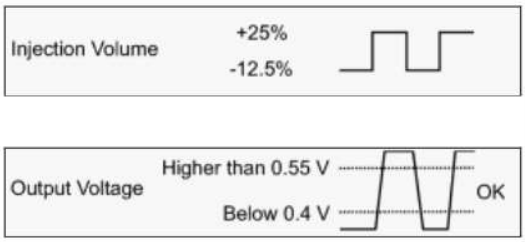
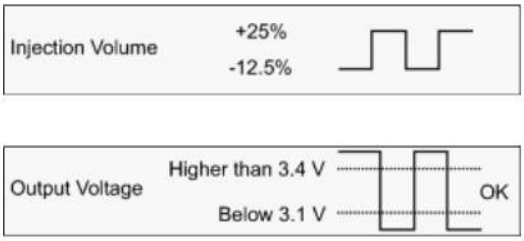
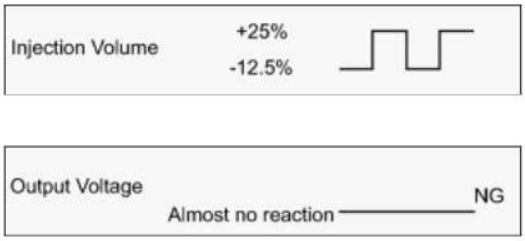
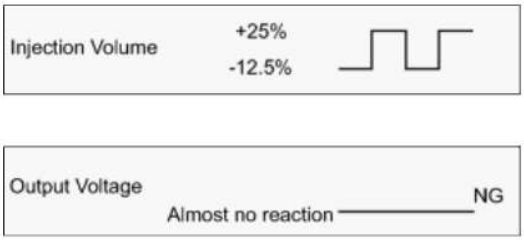
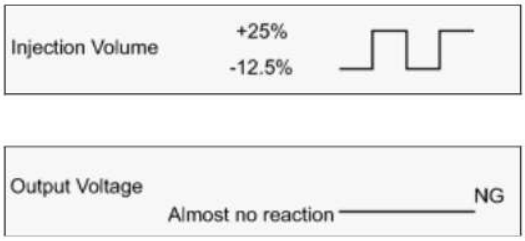
TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1 S1 (A/F)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2	+25%	Rich	Higher than 0.55 V

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TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
(HO2)	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

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NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

1.	**READ OUTPUT DTC (DTC P0136, P0137, P0138 OR P0139)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0138	A
P0137	B
P0136	C
P0139	D
P0136, P0137 or P0138 and other DTCs are output	E

B ▶ **CHECK FOR EXHAUST GAS LEAK**

C ▶ **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**

D ▶ **CHECK FOR EXHAUST GAS LEAK**

E ▶ **GO TO DTC CHART**

A ▼

2.	**READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**

(a) Connect the Techstream to the DLC3.

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(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / O2S B1 S2.

(e) Allow the engine to idle.

(f) Read the Heated Oxygen (HO2) sensor output voltage while idling.

Result

RESULT	PROCEED TO
1.0 V or higher	A
Below 1.0 V	B

B ▶ **PERFORM ACTIVE TEST USING TECHSTREAM (INJECTION VOLUME)**

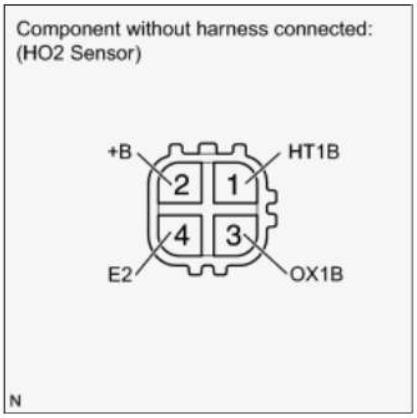
A ▼

3.	**INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)**

(a) Disconnect the heated oxygen sensor connector.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
2 (+B) - 4 (E2)	Always	10 kΩ or higher
2 (+B) - 3 (OX1B)		

(c) Reconnect the heated oxygen sensor connector.

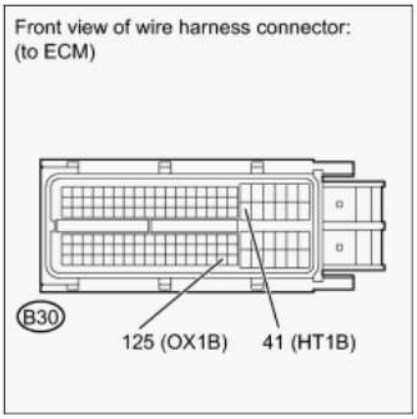
NG ▶ **REPLACE HEATED OXYGEN SENSOR**

OK ▼

4.	**CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)**

(a) Turn the ignition switch off and wait for 5 minutes or more.

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(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-41 (HT1B) - B30-125 (OX1B)	Always	10 kΩ or higher

(d) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

5.	PERFORM ACTIVE TEST USING TECHSTREAM (INJECTION VOLUME)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Start the engine and warm it up.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

(f) Change the fuel injection volume using the Techstream, and monitor the voltage output of the Air Fuel Ratio (A/F) and Heated Oxygen (HO2) sensors displayed on the Techstream.

HINT:

- Change the fuel injection volume within the range of -12% to +12%. The injection volume can be changed in 1% graduations within the range.
- The A/F sensor is displayed as AFS Voltage B1 S1, and the HO2 sensor is displayed as O2S B1 S2 on the Techstream.

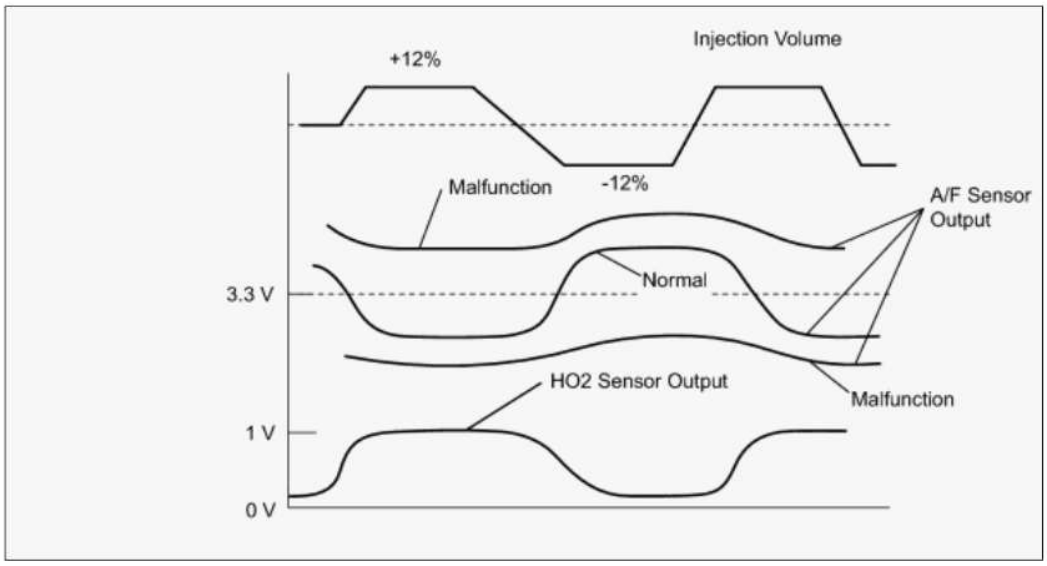
Result

TESTER DISPLAY (SENSOR)	VOLTAGE VARIATION	PROCEED TO
AFS Voltage B1 S1 (A/F)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal HO2 sensor voltage (O2S B1 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either below or higher than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

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NG ▶ **REPLACE AIR FUEL RATIO SENSOR**

OK ▼

6.	**INSPECT AIR FUEL RATIO SENSOR**

HINT:

This A/F sensor test is to check the A/F sensor current during fuel-cut. When the sensor is normal, the sensor current indicates below 3.0 mA in this test.

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

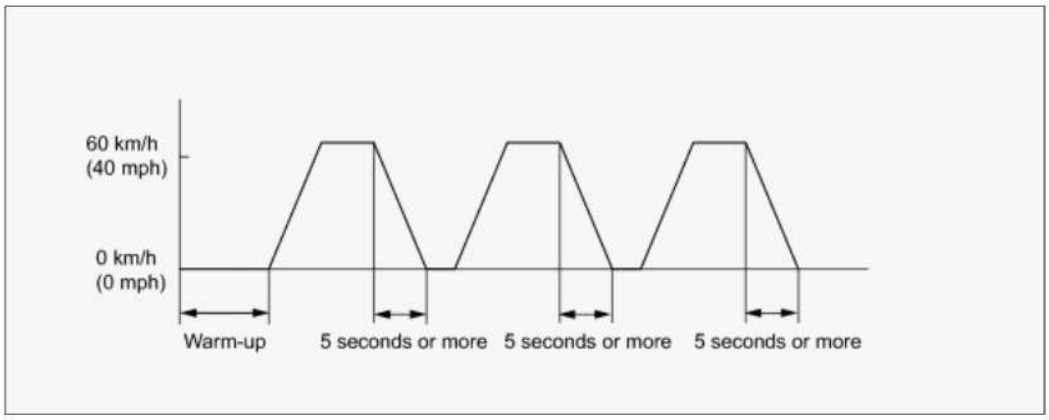
(d) Drive the vehicle according to the drive pattern listed below:

(1) Warm up the engine until the engine coolant temperature reaches 75°C (167°F) or higher.

(2) Drive the vehicle at 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more.

(3) Repeat the step above at least 3 times.

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(e) Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details.

(f) Confirm that RANGE B1S1 is either PASS or FAIL. If the Techstream shows incomplete, recheck RANGE B1S1 after performing the drive pattern.

(g) Select the RANGE B1S1.

(h) Read the test value.

Standard current:
Below 3.0 mA

HINT:

If the Techstream shows incomplete again, accelerate the vehicle and use second gear to decelerate the vehicle. Refer to the Confirmation Driving Pattern.

OK ▶ **REPLACE HEATED OXYGEN SENSOR**

NG ▶ **REPLACE AIR FUEL RATIO SENSOR**

7.	**READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine and turn the Techstream ON.

(c) Warm up the engine.

(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Injection Volume.

(e) Change the fuel injection volume using the Techstream, monitoring the voltage output of HO2 sensors displayed on the Techstream.

HINT:

Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within the range.

Standard:
Fluctuates between 0.4 V or less and 0.5 V or higher.

NG ▶ **CHECK FOR EXHAUST GAS LEAK**

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OK

8.	PERFORM ACTIVE TEST USING TECHSTREAM (INJECTION VOLUME)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Start the engine and warm it up.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

(f) Change the fuel injection volume using the Techstream, and monitor the voltage output of the Air Fuel Ratio (A/F) and Heated Oxygen (HO2) sensors displayed on the Techstream.

HINT:

- Change the fuel injection volume within the range of -12% to +12%. The injection volume can be changed in 1% graduations within the range.
- The A/F sensor is displayed as AFS Voltage B1 S1, and the HO2 sensor is displayed as O2S B1 S2 on the Techstream.

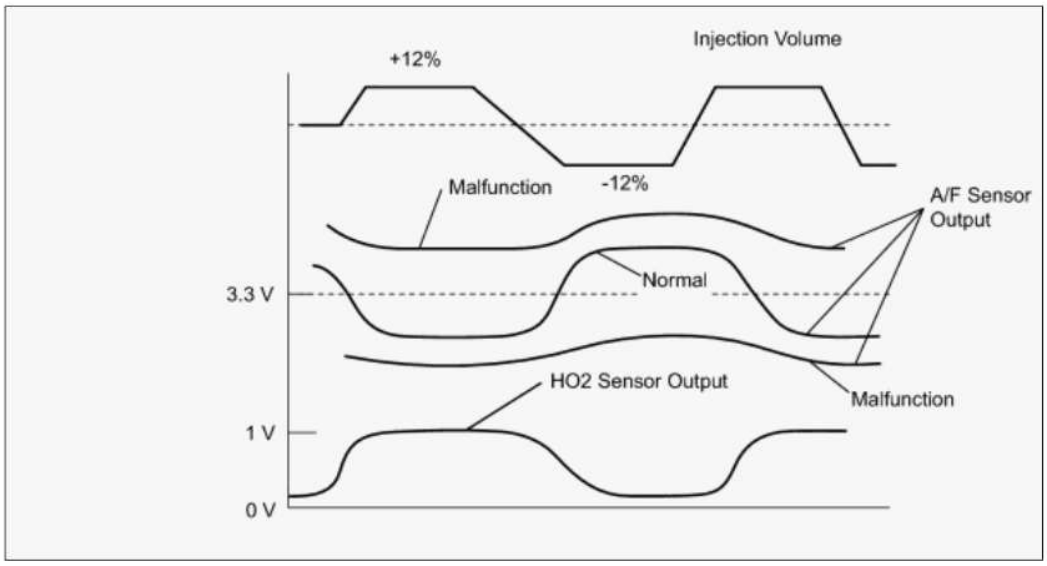
Result

TESTER DISPLAY (SENSOR)	VOLTAGE VARIATION	PROCEED TO
AFS Voltage B1 S1 (A/F)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal HO2 sensor voltage (O2S B1 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either below or higher than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

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NG ▶ **REPLACE AIR FUEL RATIO SENSOR**

OK ▶ **CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO AND REPAIR CAUSE (FUEL INJECTOR, FUEL PRESSURE, GAS LEAK FROM SYSTEM, ETC.)**

9.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leak.

OK:

No gas leakage.

NG ▶ **REPAIR OR REPLACE EXHAUST GAS LEAK POINT**

OK ▼

10.	**INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)** INFO

NG ▶ **REPLACE HEATED OXYGEN SENSOR**

OK ▼

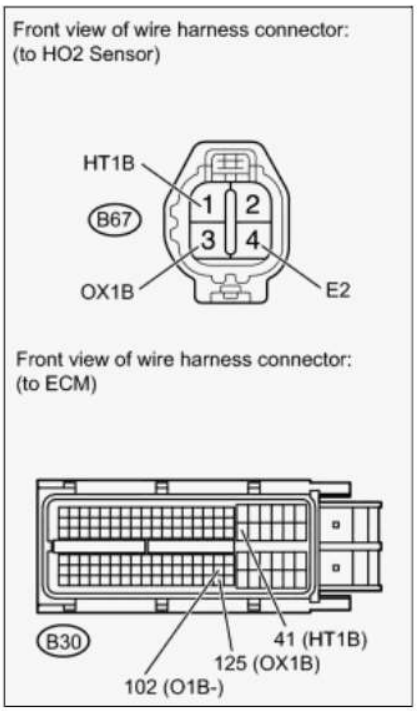
11.	**CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)**

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(a) Disconnect the heated oxygen sensor connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.



Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B67-1 (HT1B) - B30-41 (HT1B)	Always	Below 1 Ω
B67-3 (OX1B) - B30-125 (OX1B)		
B67-4 (E2) - B30-102 (O1B-)		

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B67-1 (HT1B) or B30-41 (HT1B) - Body ground	Always	10 kΩ or higher
B67-3 (OX1B) or B30-125 (OX1B) - Body ground		

(d) Reconnect the heated oxygen sensor connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

12.	**REPLACE HEATED OXYGEN SENSOR**

(a) Replace the heated oxygen sensor INFO .

NEXT ▼

13.	**PERFORM CONFIRMATION DRIVING PATTERN**

HINT:

Refer to the Confirmation Driving Pattern.

NEXT

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14.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137 OR P0138)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

(e) Input DTCs: P0136, P0137 and P0138.

Check that the DTC MONITOR is NORMAL. If the DTC MONITOR is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.

Result

RESULT	PROCEED TO
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137 or P0138 detected)	B

B ▶ **REPLACE AIR FUEL RATIO SENSOR**

A ▶ **END**

15.	REPLACE AIR FUEL RATIO SENSOR

(a) Replace the air fuel ratio sensor INFO .

NEXT

16.	PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the Confirmation Driving Pattern.

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NEXT

17.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137 OR P0138)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

(e) Input DTCs: P0136, P0137 and P0138.

Check that the DTC MONITOR is NORMAL. If the DTC MONITOR is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.

Result

RESULT	PROCEED TO
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137 or P0138 detected)	B

B ▶ **REPLACE HEATED OXYGEN SENSOR**

A ▶ **END**

18.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leak.

OK:
No gas leakage.

NG ▶ **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT**

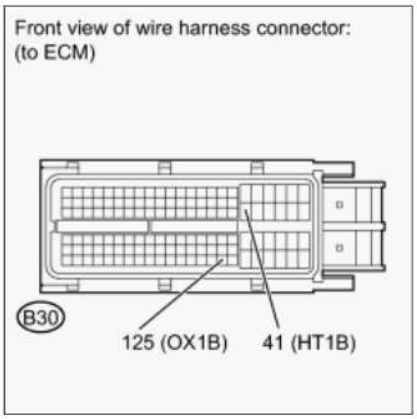
OK

19.	**CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)**

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(a) Turn the ignition switch off and wait for 5 minutes or more.

(b) Disconnect the ECM connector.



(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-41 (HT1B) - B30-125 (OX1B)	Always	10 kΩ or higher

(d) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

20.	PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Refer to the Confirmation Driving Pattern (P0139).

NEXT ▼

21.	READ DTC OUTPUT (DTC P0139 IS OUTPUT AGAIN)

(a) Read the DTCs INFO .

Result

Result	Proceed to
P0139 is output	A
No DTC is output	B

B ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A ▶ **REPLACE HEATED OXYGEN SENSOR**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WC30DBX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0171,P0172: System Too Lean (Bank 1) (2011 RAV4)		

DTC	**P0171**	**System Too Lean (Bank 1)**

DTC	**P0172**	**System Too Rich (Bank 1)**

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and long-term fuel trims.

The short-term fuel trim is fuel compensation that is used to constantly maintain the air-fuel ratio at stoichiometric levels. The signal from the Air Fuel Ratio (A/F) sensor indicates whether the air-fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air-fuel ratio is rich and an increase in the fuel injection volume if lean.

Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

If both the short-term and long-term fuel trims are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and stores a DTC.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0171	With a warm engine and stable air-fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Air induction system • Injector blockage • Mass air flow meter • Engine coolant temperature sensor • Fuel pressure • Gas leak from exhaust system • Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • EFI NO. 2 fuse • PCV valve and hose • PCV hose connections • ECM • Wire harness or connector
P0172	With a warm engine and stable air fuel-ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leak or blockage • Mass air flow meter • Engine coolant temperature sensor • Ignition system • Fuel pressure • Gas leak from exhaust system • Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1)

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
		• EFI NO. 2 fuse • ECM • Wire harness or connector

HINT:

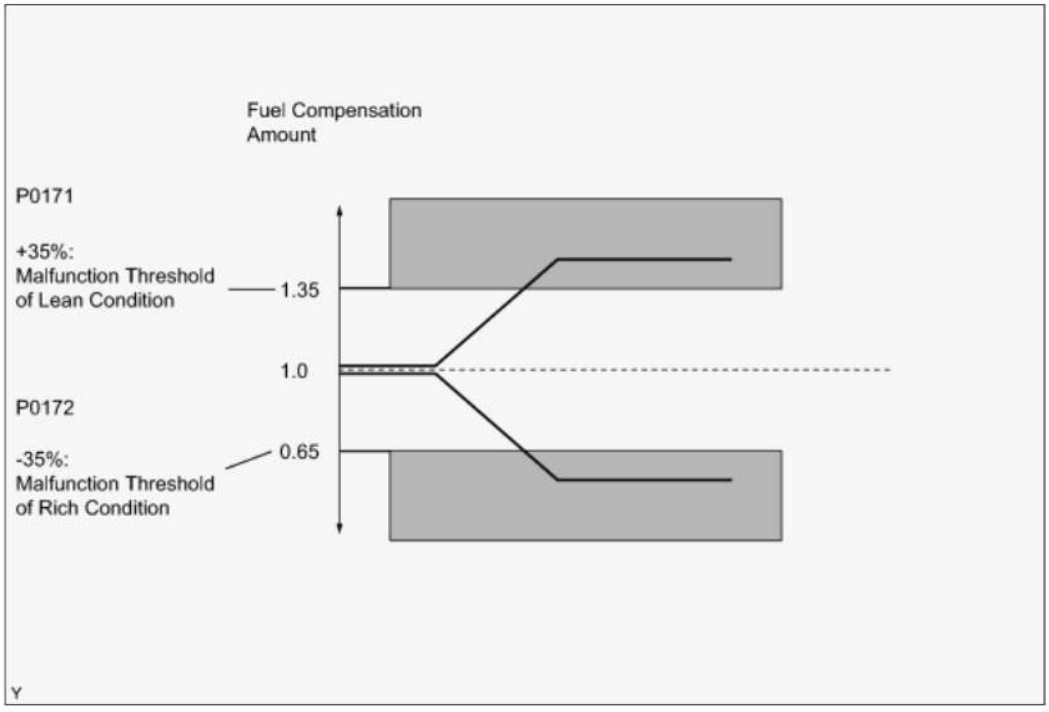
- When DTC P0171 is stored, the actual air-fuel ratio is on the lean side. When DTC P0172 is stored, the actual air-fuel ratio is on the rich side.
- If the vehicle runs out of fuel, the air-fuel ratio is lean and DTC P0171 may be stored. The MIL is then illuminated.
- When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is higher than 75°C [167°F]), the system is functioning normally.

MONITOR DESCRIPTION

Under closed loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the fuel injection volumes estimated by the ECM also affect the average fuel trim learned value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learned value of the air-fuel ratio). If the average fuel trim learned value exceeds the malfunction thresholds, the ECM interprets this as a fault in the fuel system and stores a DTC.

Example:

The average fuel trim learned value is more than +35% or less than -35%, the ECM interprets this as a fuel system malfunction.



MONITOR STRATEGY

Related DTCs	P0171: Fuel trim Lean (bank 1) P0172: Fuel trim Rich (bank 1)

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Required Sensors/Components (Main)	Fuel system
Required Sensors/Components (Related)	Air Fuel Ratio (A/F) sensor Mass air flow meter Crankshaft position sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Fuel-trim:

Monitor runs whenever following DTCs not stored	P0010 (VVT Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust VVT Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust VVT Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor)
Fuel system status	Closed loop
Battery voltage	11 V or higher
Either of following conditions met	-
1. Engine speed	Less than 1100 rpm
2. Intake air amount per revolution	0.173 g/rev or more
Catalyst monitor	Not executed

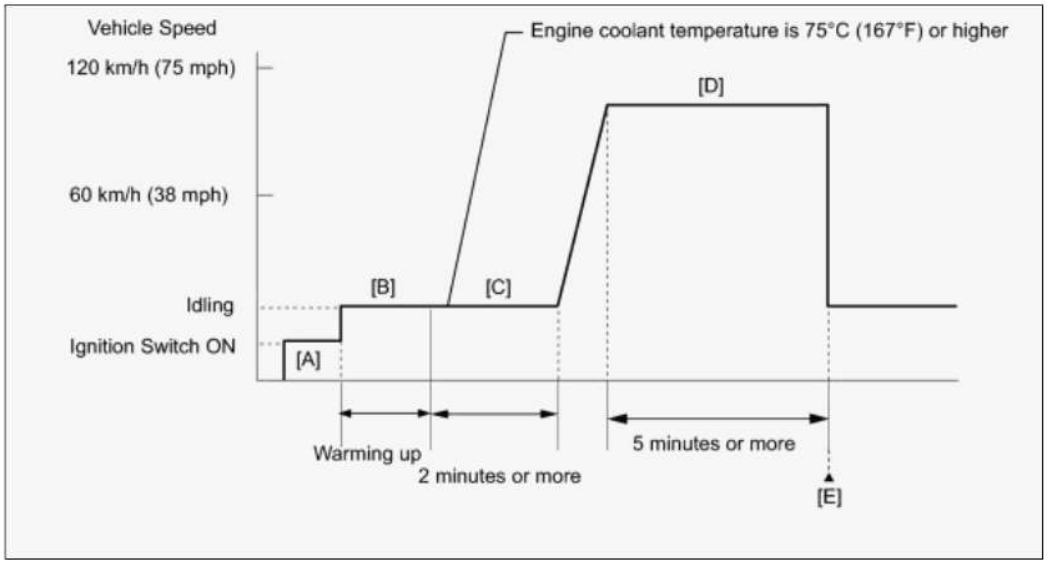
TYPICAL MALFUNCTION THRESHOLDS

Fuel-trim:

Purge-cut	Executing
Either of following conditions met	-
1. Average between short-term fuel trim and long-term fuel trim	35% or more (varies with ECT)
2. Average between short-term fuel trim and long-term fuel trim	-35% or less (varies with ECT)

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CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or higher) with all the accessories switched off [B].
5. With the engine warmed up, idle the engine for 2 minutes or more [C].
6. Drive the vehicle at between 60 and 120 km/h (38 and 75 mph) and at an engine speed of between 1400 and 3200 rpm for 5 minutes or more [D].
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P0171 or P0172.
9. Check the DTC judgment result [E].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [C] through [E] again.

10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
11. Read Pending DTCs.

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HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0136 INFO .

Refer to DTC P2195 INFO .

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)
7. Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

HINT:

- The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

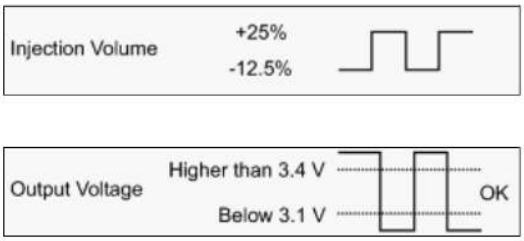
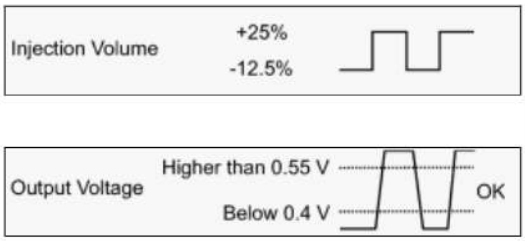
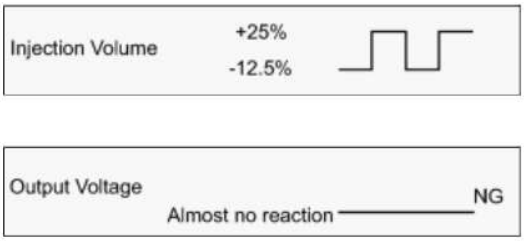
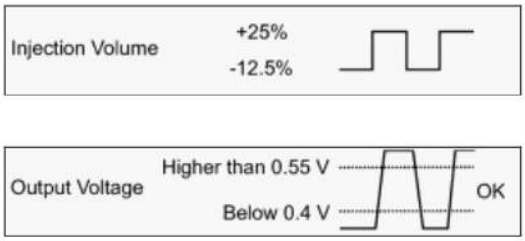
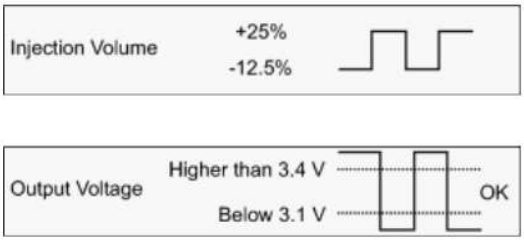
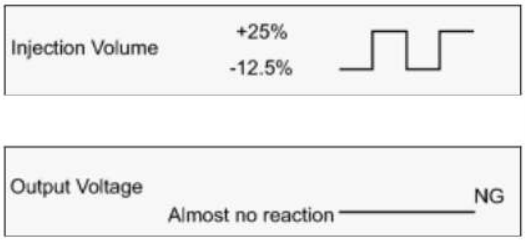
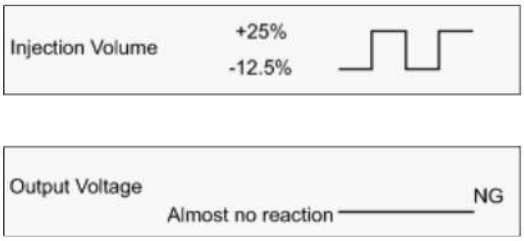
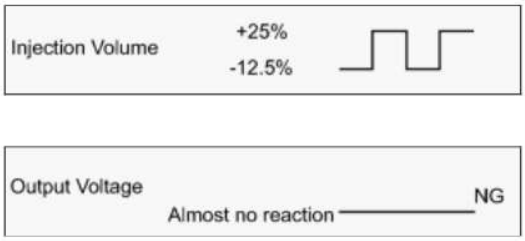
TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1 S1 (A/F)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
1			-

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CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
			
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1 S1 and O2S B1 S2; then press the graph button on the Data List view.

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.

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- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171 OR P0172)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0171 or P0172	A
P0171 or P0172 and other DTCs	B

HINT:

If any DTCs other than P0171 or P0172 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**CHECK PCV HOSE CONNECTIONS**

(a) Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG ▶ **REPAIR OR REPLACE PCV HOSE**

OK ▼

3.	**CHECK AIR INDUCTION SYSTEM**

(a) Check the air induction system for vacuum leakage INFO .

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OK:
No leakage from air induction system.

NG ▶ **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK ▼

4.	**PERFORM ACTIVE TEST USING TECHSTREAM (A/F CONTROL)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine.

(c) Turn the Techstream on.

(d) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.

(f) Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

(g) Monitor the voltage outputs of the Air Fuel Ratio (A/F) sensor and the Heated Oxygen (HO2) sensor (AFS Voltage B1S1 and O2S B1S2) displayed on the Techstream.

HINT:

- The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard:

TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1S1 (A/F)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1S2 (HO2)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

Result

STATUS AFS B1S1	STATUS O2S B1S2	A/F CONDITION AND A/F SENSOR CONDITION	MISFIRE	SUSPECTED TROUBLE AREA	PROCEED TO
Lean/Rich	Lean/Rich	Normal	-	-	A
Lean	Lean	Actual air-fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leak from exhaust system • Air induction system • Fuel pressure	A

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STATUS AFS B1S1	STATUS O2S B1S2	A/F CONDITION AND A/F SENSOR CONDITION	MISFIRE	SUSPECTED TROUBLE AREA	PROCEED TO
				• Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	
Rich	Rich	Actual air-fuel ratio rich	-	• Injector leak or blockage • Gas leak from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	

Lean: During Control the Injection Volume for A/F Sensor, the A/F sensor output voltage (AFS) is consistently higher than 3.4 V, and the HO2 sensor output voltage (O2S) is consistently below 0.4 V.

Rich: During Control the Injection Volume for A/F Sensor, the AFS is consistently below 3.1 V, and the O2S is consistently higher than 0.55 V.

Lean/Rich: During Control the Injection Volume for A/F Sensor of the Active Test, the output voltage of the heated oxygen sensor alternates correctly.

B ▶ **INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)**

A ▼

5.	**READ VALUE USING TECHSTREAM (COOLANT TEMP)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

(e) Read the Data List twice, when the engine is both cold and warmed up.

Standard value:
With cold engine: Same as ambient air temperature.
With warm engine: 75 to 100°C (167 to 212°F).

NG ▶ **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

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6.	**READ VALUE USING TECHSTREAM (MAF)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / MAF and Coolant Temp.

(e) Allow the engine to idle until Coolant Temp reaches 75°C (167°F) or higher.

(f) Read MAF with the engine speed at 3000 rpm.

Standard:
Between 9.38 g/sec. and 14.08 g/sec. (shift lever: N; A/C: Off).

NG ▶ **CHECK HARNESS AND CONNECTOR**

OK

7.	**CHECK FUEL PRESSURE**

(a) Check the fuel pressure INFO .

NG ▶ **REPAIR OR REPLACE FUEL SYSTEM**

OK

8.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leaks.

OK:
No gas leak.

NG ▶ **REPAIR OR REPLACE EXHAUST SYSTEM**

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OK

9.	**CHECK SPARK AND IGNITION**

HINT:

- Refer to the ignition system inspection procedure INFO .
- If the spark plugs or ignition system malfunctions, engine misfire may occur. The misfire count can be read using the Techstream. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Count (to Cylinder #4 Misfire Count).

NG ▶ **REPAIR OR REPLACE IGNITION SYSTEM**

OK

10.	**INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)**

HINT:

- Refer to the fuel injector inspection procedure INFO .
- If the injectors malfunction, engine misfire may occur. The misfire count can be read using the Techstream. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Count (to Cylinder #4 Misfire Count).

OK ▶ **PERFORM CONFIRMATION DRIVING PATTERN**

NG ▶ **REPLACE FUEL INJECTOR ASSEMBLY**

11.	**INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)** INFO

NG ▶ **REPLACE AIR FUEL RATIO SENSOR**

OK

12.	**CHECK TERMINAL VOLTAGE (POWER SOURCE OF AIR FUEL RATIO SENSOR)** INFO

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NG ▶ CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - INTEGRATION RELAY)

OK ▼

13.	CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM) INFO

NG ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ▼

14.	REPLACE AIR FUEL RATIO SENSOR

(a) Replace the air fuel ratio sensor INFO .

NEXT ▼

15.	PERFORM CONFIRMATION DRIVING PATTERN

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTCs INFO .

(e) Turn the ignition switch off.

(f) Turn the ignition switch to ON and turn the Techstream on.

(g) Start the engine and warm it up.

(h) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(i) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(j) Read DTCs.

Result

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RESULT	PROCEED TO
DTC P0171 or P0172 is output	A
DTC is not output	B

B ▶ **END**

A ▼

16.	**CHECK HARNESS AND CONNECTOR**

(a) Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter and ECM INFO .

HINT:

Repair any problems.

NEXT ▼

17.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P0171 OR P0172)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTCs INFO .

(e) Turn the ignition switch off.

(f) Turn the ignition switch to ON and turn the Techstream on.

(g) Start the engine and warm it up.

(h) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(i) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(j) Read DTCs.

Result

RESULT	PROCEED TO
DTC P0171 or P0172 is output	A

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RESULT	PROCEED TO
DTC is not output	B

B ▶ **END**

A ▼

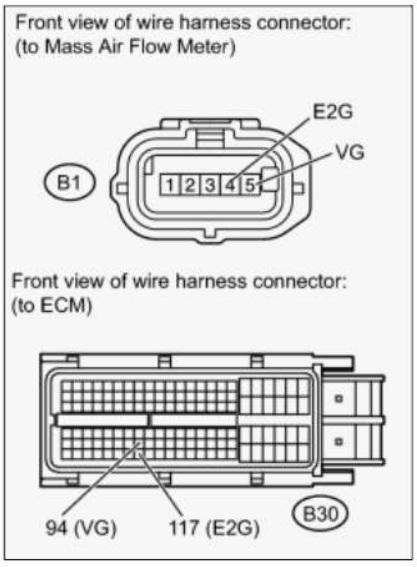
18.	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)

(a) Disconnect the mass air flow meter connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B1-5 (VG) - B30-94 (VG)	Always	Below 1 Ω
B1-4 (E2G) - B30-117 (E2G)	Always	Below 1 Ω
B1-5 (VG) or B30-94 (VG) - Body ground	Always	10 kΩ or higher

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

19.	REPLACE MASS AIR FLOW METER

(a) Replace the mass air flow meter assembly INFO .

HINT:

If the result of the inspection performed in step 6 indicated no problem, proceed to the next step without replacing the mass air flow meter assembly.

NEXT ▼

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20.	**CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTCs INFO .

(e) Turn the ignition switch off.

(f) Turn the ignition switch to ON and turn the Techstream on.

(g) Start the engine and warm it up.

(h) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(i) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(j) Read DTCs.

Result

RESULT	PROCEED TO
DTC is not output	A
DTC P0171 or P0172 is output	B

B ▶ **REPLACE ECM**

A ▶ **END**

21.	**CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - INTEGRATION RELAY)** INFO

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

22.	**INSPECT INTEGRATION NO.1 RELAY (A/F)**

(a) Inspect the No. 1 integration relay (A/F) INFO .

NG ▶ **REPLACE INTEGRATION NO.1 RELAY**

OK ▶ **GO TO ECM POWER SOURCE CIRCUIT**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000XH30FUX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0300-P0304: Random / Multiple Cylinder Misfire Detected (2011 RAV4)		

DTC	**P0300**	**Random / Multiple Cylinder Misfire Detected**

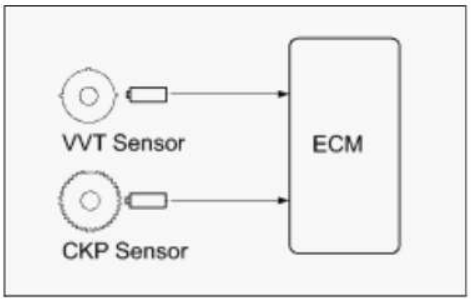
DTC	**P0301**	**Cylinder 1 Misfire Detected**

DTC	**P0302**	**Cylinder 2 Misfire Detected**

DTC	**P0303**	**Cylinder 3 Misfire Detected**

DTC	**P0304**	**Cylinder 4 Misfire Detected**

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, and could cause emission deterioration, the ECM illuminates the MIL and stores a DTC.

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0300	One of the following conditions is met (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates). • Simultaneous misfiring of several cylinders occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM • Tumble Control Valve (TCV)
P0301 P0302 P0303 P0304	One of the following conditions is met (2 trip detection logic): • A misfire occurs that may damage the Three-Way Catalytic Converter (TWC) (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates). • Misfiring of a specific cylinder occurs.	

When DTCs for misfiring cylinders are randomly stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions after the engine starts, an excessive number of misfires (approximately 20 to 50 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive number of misfires (approximately 20 to 50 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the Three-Way Catalytic Converter (TWC), is detected (2 trip detection logic).

HINT:

If a catalyst-damaging misfire occurs, the monitor informs the driver by blinking the MIL (1 trip).

- In every 200 crankshaft revolutions at a high engine speed, the threshold misfiring percentage is recorded once.
- In every 200 crankshaft revolutions at a normal engine speed, the threshold misfiring percentage is recorded 3 times.

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

Misfire Monitor for Mexico Models

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- Within the first 1000 crankshaft revolutions after the engine starts, an excessive number of misfires (approximately 1000 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive number of misfires (approximately 500 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

The ECM flashes the MIL and stores a DTC when the following condition, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- A catalyst-damaging misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

MONITOR STRATEGY

Related DTCs	P0300: Multiple cylinder misfire P0301: Cylinder 1 misfire P0302: Cylinder 2 misfire P0303: Cylinder 3 misfire P0304: Cylinder 4 misfire
Required Sensors/Components (Main)	Crankshaft position sensor Camshaft position sensor
Required Sensors/Components (Related)	Engine coolant temperature Intake air temperature sensor Mass air flow meter
Frequency of Operation	Continuous
Duration	1000 to 4000 crankshaft revolutions: Emission-related misfire 200 to 600 crankshaft revolutions: Catalyst-damaging misfire
MIL Operation	2 driving cycles: Emission-related misfire MIL flashes immediately: Catalyst-damaging misfire
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Misfire:

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0327, P0328 (Knock Sensor) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0351 - P0354 (Igniter)

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	P0500 (Vehicle Speed Sensor) P0705 (Shift Lever Position Switch)
Battery voltage	8 V or higher
VVT system	Not operated by scan tool
Engine speed	400 to 6300 rpm
Either of following conditions (a) or (b) met	-
(a) ECT at engine start	Higher than -7°C (19°F)
(b) ECT	Higher than 20°C (68°F)
Fuel cut	OFF

Monitor period of emission-related misfire:

First 1000 revolutions after engine start, or during check mode	Crankshaft 1000 revolutions
Except above	Crankshaft 1000 revolutions x 4

Monitor period of catalyst-damaging misfire (MIL blinks):

All of following conditions 1, 2 and 3 met	Crankshaft 200 revolutions x 3
1. Driving cycles	1st
2. Check mode	OFF
3. Engine speed	Less than 2260 rpm
Except above	Crankshaft 200 revolutions

TYPICAL MALFUNCTION THRESHOLDS

Monitor period of emission-related misfire:

Misfire rate	0.99% or more

Monitor period of catalyst-damaging misfire (MIL blinks):

Number of misfires per 200 revolutions	130 or more (varies with intake air amount and RPM)

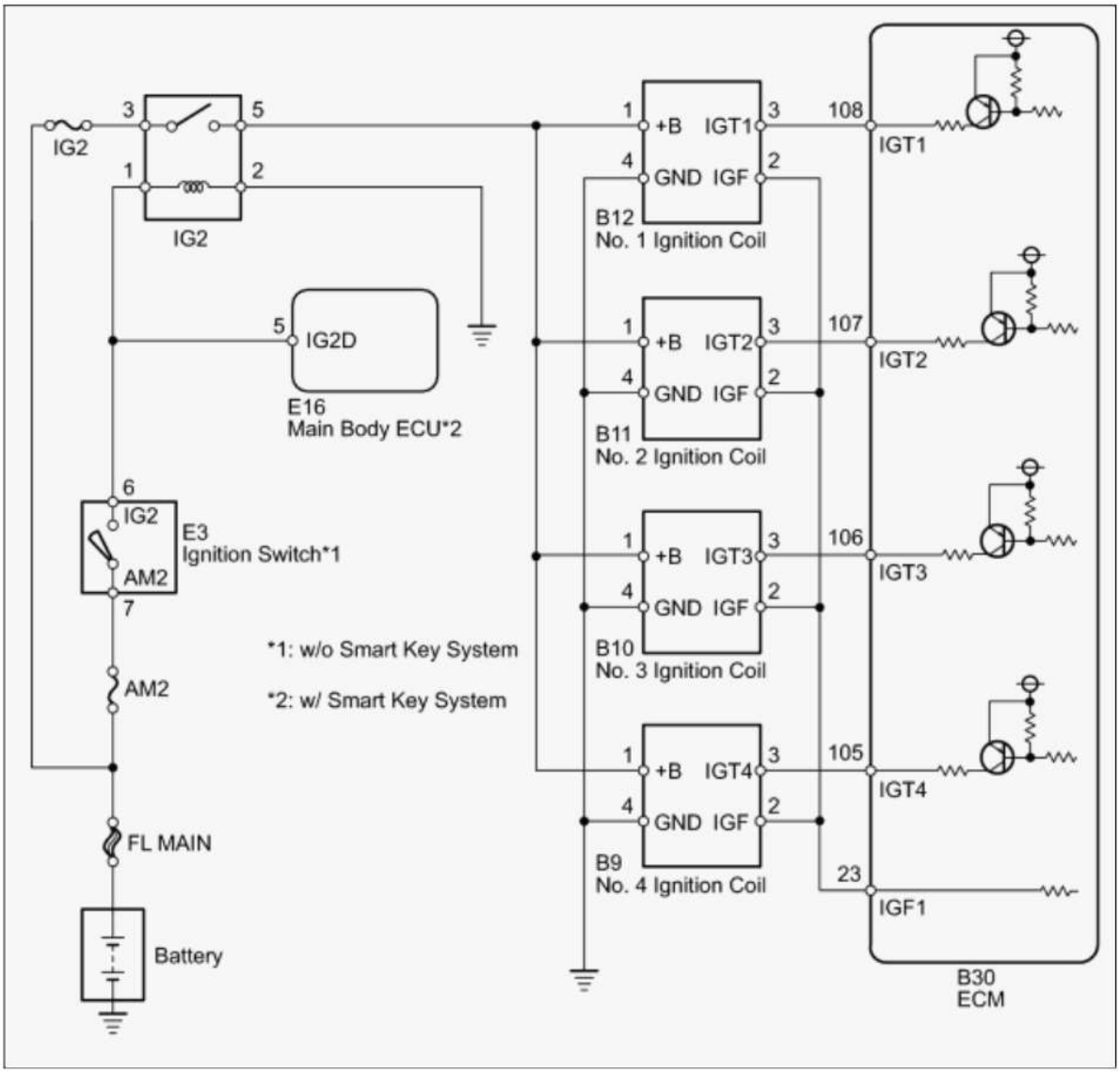
MONITOR RESULT

Refer to Checking Monitor Status INFO .

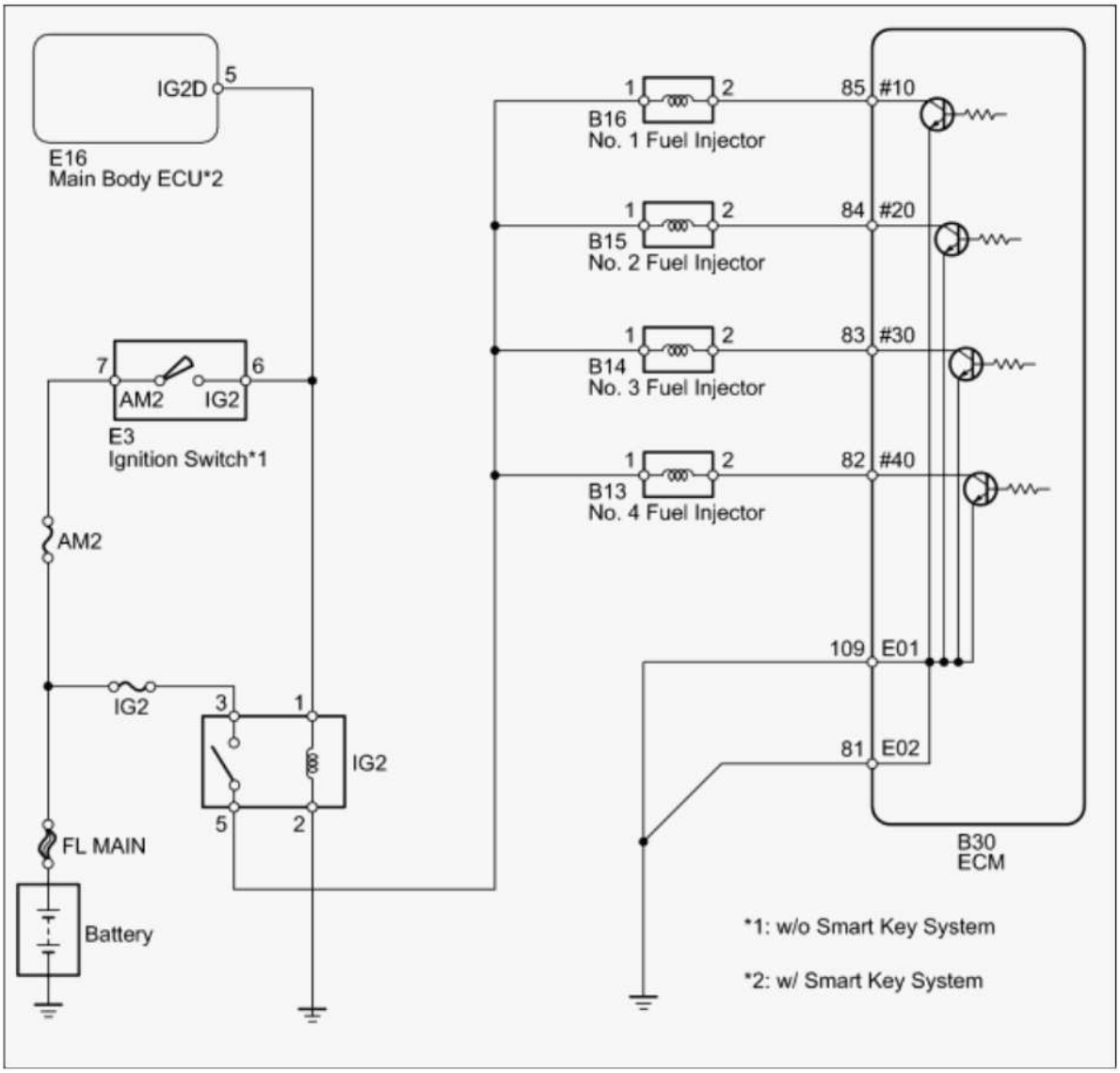
WIRING DIAGRAM

Wiring diagram of the ignition system.

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CONFIRMATION DRIVING PATTERN

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Record the DTC(s) and freeze frame data.
5. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).
6. Using the Techstream, switch the ECM from normal mode to check mode INFO .
7. Read the misfire counts of each cylinder, Cylinder #1 Misfire Count to Cylinder #4 Misfire Count, with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
8. Drive the vehicle so that the vehicle conditions displayed in Misfire RPM and Misfire Load of the Data List are the same as the freeze frame data. Perform this step several times.

HINT:

In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, confirm the Misfire RPM and Misfire Load in the Data List.

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ENGINE SPEED	DURATION
Idling	7 minutes or more
1000	4 minutes or more
2000	2 minutes or more
3000	1.5 minutes or more

9. Check whether misfires have occurred by checking DTCs and freeze frame data.

HINT:

Do not turn the ignition switch off until the output DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data are cleared.

10. Record the DTC(s), freeze frame data and misfire counts.
11. Turn the ignition switch off and wait for at least 15 seconds.
12. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).

INSPECTION PROCEDURE

HINT:

- If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.
- If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors is considered to be a possible cause of the problem:
    a. There was insufficient fuel in the tank.
    b. Improper fuel was used.
    c. The spark plugs have been contaminated.
    d. The problem requires further diagnosis.
- After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #4 Misfire Count).
- Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.
- When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 in the freeze frame data is outside the range of +/-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).
- When Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires have occurred only while warming up the engine.
- An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be stored.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE DTCS)**

(a) Connect the Techstream to the DLC3.

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(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

HINT:

Write down the output DTCs.

Result

RESULT	PROCEED TO
P0300, P0301, P0302, P0303 and/or P0304	A
P0300, P0301, P0302, P0303 and/or P0304 and other DTCs	B

HINT:

If any DTCs other than P0300, P0301, P0302, P0303 and P0304 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A

▼

2.	**CHECK PCV HOSE CONNECTIONS**

(a) Check the PCV hose connections.

OK:
PCV hose is correctly connected and is not damaged.

NG ▶ **REPAIR OR REPLACE PCV HOSE**

OK

▼

3.	**READ VALUE USING TECHSTREAM (MISFIRE RPM AND MISFIRE LOAD)**

(a) Connect the Techstream to the DLC3.

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(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Misfire RPM and Misfire Load.

(e) Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

NEXT

4.	**READ VALUE USING TECHSTREAM (CATALYST OT MF F/C)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / Catalyst OT MF F/C.

(e) Read the value displayed on the Techstream.

Result

DATA LIST	TESTER DISPLAY	PROCEED TO
Catalyst OT MF F/C	Avail	A
	Not Avl	B

B ▶ **READ VALUE USING TECHSTREAM (CYLINDER MISFIRE COUNT)**

A

5.	**PERFORM ACTIVE TEST USING TECHSTREAM (PROHIBIT CAT OT F/C)**

(a) Connect the Techstream to the DLC3.

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(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Prohibit the Catalyst OT Misfire prevent F/C.

(e) Perform the Active Test.

NOTICE:

When performing the Active Test, make sure the vehicle is stopped and the engine is either idling or being revved within 3000 rpm.

NEXT

6.	**READ VALUE USING TECHSTREAM (CYLINDER MISFIRE COUNT)**

(a) Enter the following menus: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Count, Cylinder #2 Misfire Count, Cylinder #3 Misfire Count and Cylinder #4 Misfire Count.
(b) Start the engine and allow the engine to idle.
(c) Read each value for Cylinder #1 Misfire Count to Cylinder #4 Misfire Count displayed on the Techstream. If no misfire counts occur in any cylinders, perform steps (d) and (e) and then check the misfire counts again.

(d) Drive the vehicle with the Misfire RPM and Misfire Load noted in the "READ VALUE USING TECHSTREAM (MISFIRE RPM AND MISFIRE LOAD)" procedures above.
(e) Read the Cylinder #1 Misfire Count to Cylinder #4 Misfire Count or DTCs displayed on the Techstream.

Result

RESULT (MISFIRE COUNT)	PROCEED TO
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.
- If the freeze frame data records of the ECT is below 75°C (167°F), the misfire may be detected only when the engine is cold.
- If the freeze frame data records of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.

B ▶ CHECK AIR INDUCTION SYSTEM

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A

7.	**INSPECT SPARK PLUG**

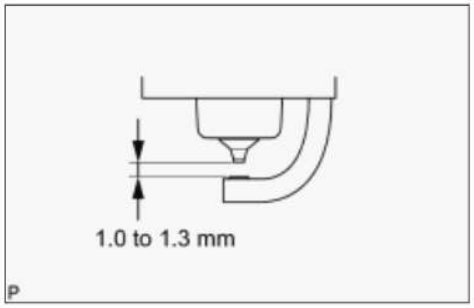
(a) Remove the ignition coil and spark plug from the misfiring cylinder.

(b) Measure the spark plug electrode gap.

Electrode gap for a new spark plug:
1.0 to 1.1 mm (0.039 to 0.043 in.)
Maximum electrode gap for a used spark plug:
1.3 mm (0.051 in.)

NOTICE:

If the electrode gap is more than 1.3 mm (0.051 in.), replace the spark plug. Do not adjust the electrode gap.



Recommended Spark Plug

MANUFACTURER	PRODUCT
DENSO made	SK16HR11

(c) Check the electrode for carbon deposits.

NOTICE:

If necessary, clean the spark plug.

(d) Reinstall the ignition coil and spark plug.

NG ▶ **REPLACE SPARK PLUG**

OK

8.	**CHECK FOR SPARKS AND IGNITION**

(a) Disconnect the injector connectors to prevent the engine from

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starting.

CAUTION:

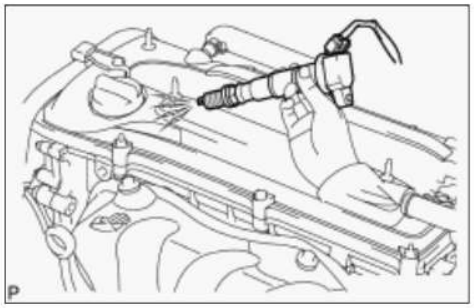
Always disconnect all the injector connectors.

(b) Remove the ignition coil from the cylinder head.

(c) Install the spark plug onto the ignition coil.

(d) Attach the spark plug assembly to the cylinder head.

(e) Crank the engine for less than 2 seconds and check the spark.



NOTICE:

Do not crank the engine for more than 2 seconds.

OK:

Sparks jump across electrode gap.

(f) Install the ignition coil.

(g) Reconnect the injector connectors.

NG ▶ **CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER**

OK ▼

9.	**CHECK CYLINDER COMPRESSION PRESSURE**

(a) Measure the cylinder compression pressure of the misfiring cylinder INFO .

NG ▶ **CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION**

OK ▼

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10.	CHECK FUEL INJECTOR (POWER SOURCE) INFO

NG ▶ GO TO FUEL INJECTOR CIRCUIT

OK ▼

11.	CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM) INFO

NG ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ▼

12.	CHECK FUEL INJECTOR OF MISFIRING CYLINDER

(a) Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) INFO .

NG ▶ REPLACE FUEL INJECTOR

OK ▼

13.	CHECK AIR INDUCTION SYSTEM

(a) Check the air induction system for vacuum leakage INFO .

OK:

No leakage from air induction system.

NG ▶ REPAIR OR REPLACE AIR INDUCTION SYSTEM

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OK



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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000SVT0E0X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0327,P0328: Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor) (2011 RAV4)		

DTC	**P0327**	**Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)**

DTC	**P0328**	**Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)**

DESCRIPTION

Flat-type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6 kHz and 15 kHz.

Knock sensors are fitted onto the engine block to detect engine knocking.

The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed.

The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

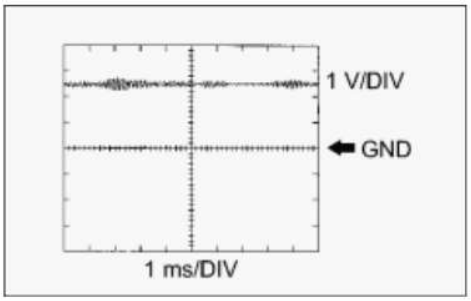
DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0327	The output voltage of the knock sensor is below 0.5 V for 1 second or more (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328	The output voltage of the knock sensor is higher than 4.5 V for 1 second or more (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When DTC P0327 or P0328 is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the ignition switch is turned off.

Reference: Inspection using an oscilloscope

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The correct waveform is as shown.

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-87 (KNK1) - B30-110 (EKNK)	1 V/DIV, 1 ms/DIV	Engine speed maintained at 4000 rpm after warming up engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.

The monitor for DTCs P0327 and P0328 begins to run when 5 seconds have elapsed since the engine was started.

If the malfunction is not repaired successfully, DTC P0327 or P0328 is stored 5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0327: Knock sensor (bank 1) range check (Low voltage) P0328: Knock sensor (bank 1) range check (High voltage)
Required Sensors/Components (Main)	Knock sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Time after engine start	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

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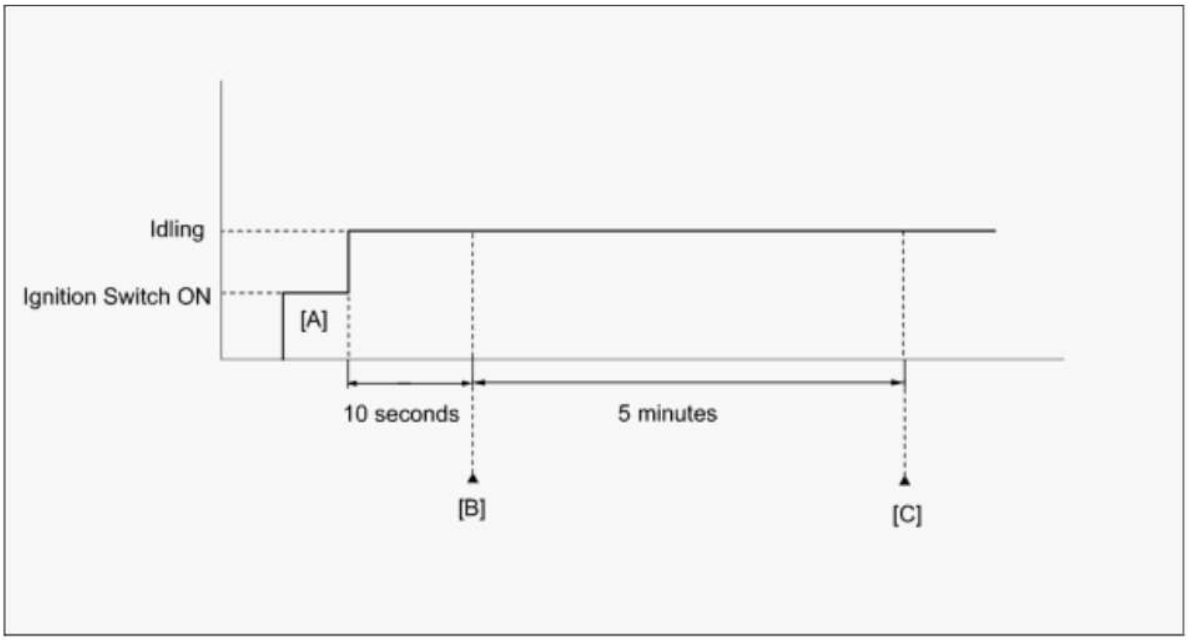
Knock Sensor Range Check (Low voltage) P0327:

Knock sensor voltage	Below 0.5 V

Knock Sensor Range Check (High voltage) P0328:

Knock sensor voltage	Higher than 4.5 V

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and wait 10 seconds.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0327 or P0328.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions

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TESTER DISPLAY	DESCRIPTION
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, idle the engine for 5 minutes and check the DTC judgment result again [C].

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

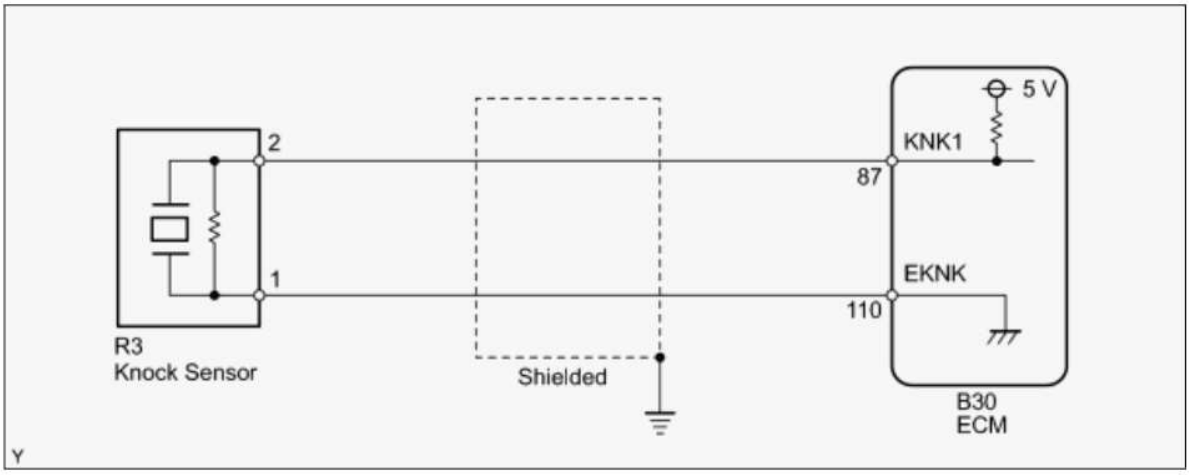
If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data

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from the time the malfunction occurred.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (KNOCK FEEDBACK VALUE)**

(a) Connect the Techstream to the DLC3.

(b) Start the engine.

(c) Turn the Techstream on.

(d) Warm up the engine.

(e) Enter the following menus: Powertrain / Engine and ECT / All Data / Knock Feedback Value.

(f) Read the value while driving the vehicle.

OK:
The value changes.

Malfunction does not occur	Knock Feedback Value changes
Malfunctions occur	Knock Feedback Value does not change

HINT:

The knock feedback value change can be confirmed by running the engine with a high load, for example, by activating the air conditioning system and racing the engine.

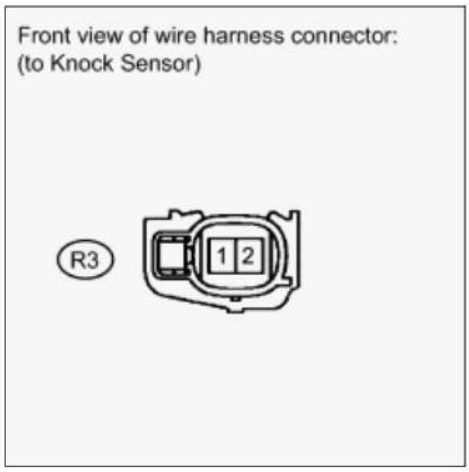
NG ▶ **INSPECT ECM (KNK1 VOLTAGE)**

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

2.	**INSPECT ECM (KNK1 VOLTAGE)**

(a) Disconnect the knock sensor connector.

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(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
R3-2 - R3-1	Ignition switch ON	4.5 to 5.5 V

(d) Reconnect the knock sensor connector.

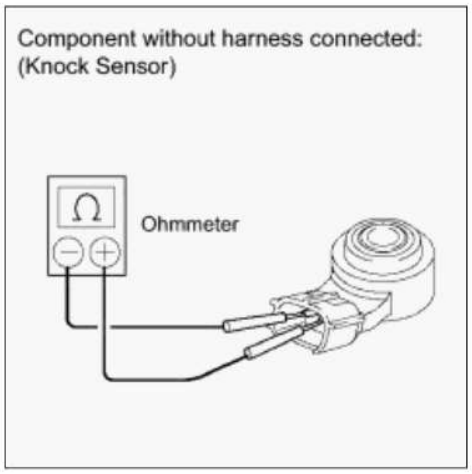
NG ▶ **CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)**

OK ▼

3.	**INSPECT KNOCK SENSOR**

(a) Remove the knock sensor.

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(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 - 2	20°C (68°F)	120 to 280 kΩ

(c) Reinstall the knock sensor.

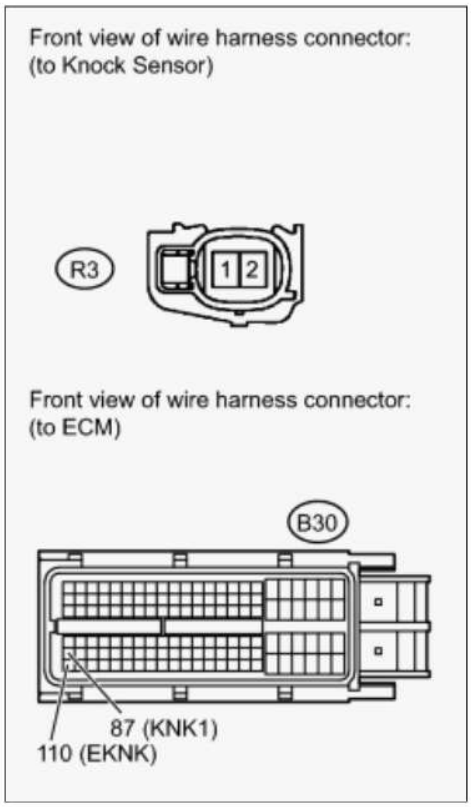
NG ▶ **REPLACE KNOCK SENSOR**

OK ▶ **REPLACE ECM**

4.	**CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)**

(a) Disconnect the knock sensor connector.

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(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
R3-2 - B30-87 (KNK1)	Always	Below 1 Ω
R3-1 - B30-110 (EKNK)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
R3-2 or B30-87 (KNK1) - Body ground	Always	10 kΩ or higher
R3-1 or B30-110 (EKNK) - Body ground	Always	10 kΩ or higher

(d) Reconnect the knock sensor connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000TCW0GSX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0335,P0339: Crankshaft Position Sensor "A" Circuit (2011 RAV4)		

DTC	**P0335**	**Crankshaft Position Sensor "A" Circuit**

DTC	**P0339**	**Crankshaft Position Sensor "A" Circuit Intermittent**

DESCRIPTION

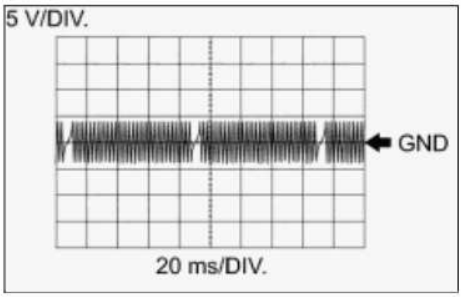
The Crankshaft Position (CKP) sensor system consists of a CKP sensor plate and a pickup coil.

The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of wound copper wire, an iron core and magnet. The sensor plate rotates and, as each tooth passes by the pickup coil, a pulse signal is created. The pickup coil generates 34 signals per crankshaft revolution. Based on these signals, the ECM calculates the crankshaft position and engine speed. Using these calculations, the fuel injection time and ignition timing are controlled.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0335	When either of the following conditions is met (1 trip detection logic): • A missing Crankshaft Position (CKP) sensor signal despite the camshaft position sensor signal inputs being normal after the engine is cranked. • No CKP sensor signal to the ECM at an engine speed of 600 rpm or less.	• Open or short in CKP sensor circuit • CKP sensor • Crankshaft position sensor plate • ECM
P0339	All of the following conditions are met (1 trip detection logic): (a) The engine speed is 1000 rpm or more. (b) No Crankshaft Position (CKP) sensor signal for 0.05 seconds or more. (c) 3 seconds or more have elapsed since the starter signal switched from ON to OFF.	• Open or short in CKP sensor circuit • CKP sensor • Crankshaft position sensor plate • ECM

Reference: Inspection using an oscilloscope.

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HINT:

- The correct waveform is as shown.
- NE stands for the CKP sensor signal.
- Grounding failure of the shielded wire may cause noise in waveforms.

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-74 (NE+) - B30-120 (NE-)	5 V/DIV, 20 ms/DIV	Idling

MONITOR DESCRIPTION

If there is no signal from the Crankshaft Position (CKP) sensor despite the crankshaft revolving, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0335: Crankshaft Position (CKP) sensor range check or rationality
Required Sensors/Components (Main)	CKP sensor
Required Sensors/Components (Related)	Camshaft Position (CMP) sensor
Frequency of Operation	Continuous
Duration	4.7 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Case 1:

Monitor runs whenever following DTCs not stored	P0340, P0342, P0343 (VVT Sensor)
Time after starter OFF to ON	3 seconds or more
Number of CMP sensor signal pulses	6
Battery voltage	7 V or higher

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Minimum battery voltage while starter ON	Below 11 V

Case 2:

Monitor runs whenever following DTCs not stored	None
Starter	OFF
Engine speed	600 rpm or less
Time after starter from ON to OFF	3 seconds or more

Case 3:

Monitor runs whenever following DTCs not stored	None
Starter	ON
Minimum battery voltage while starter ON	Below 11 V

TYPICAL MALFUNCTION THRESHOLDS

Case 1:

Number of CKP sensor signal pulses	132 or less, and 174 or more

Case 2, Case 3:

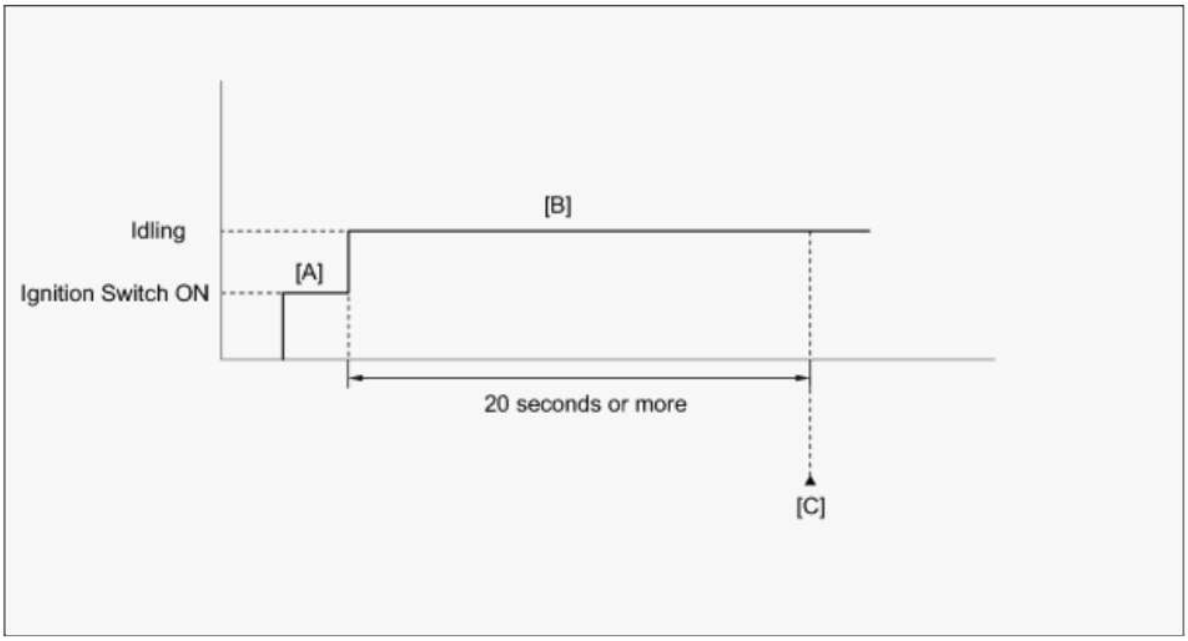
Engine speed signal	No signal

COMPONENT OPERATING RANGE

CKP sensor	• CKP sensor output voltage fluctuates while crankshaft revolving • 34 CKP sensor signals per crankshaft revolution

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. Idle the engine for 20 seconds or more [B].
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P0335 or P0339.
8. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
10. Read Pending DTCs.

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HINT:

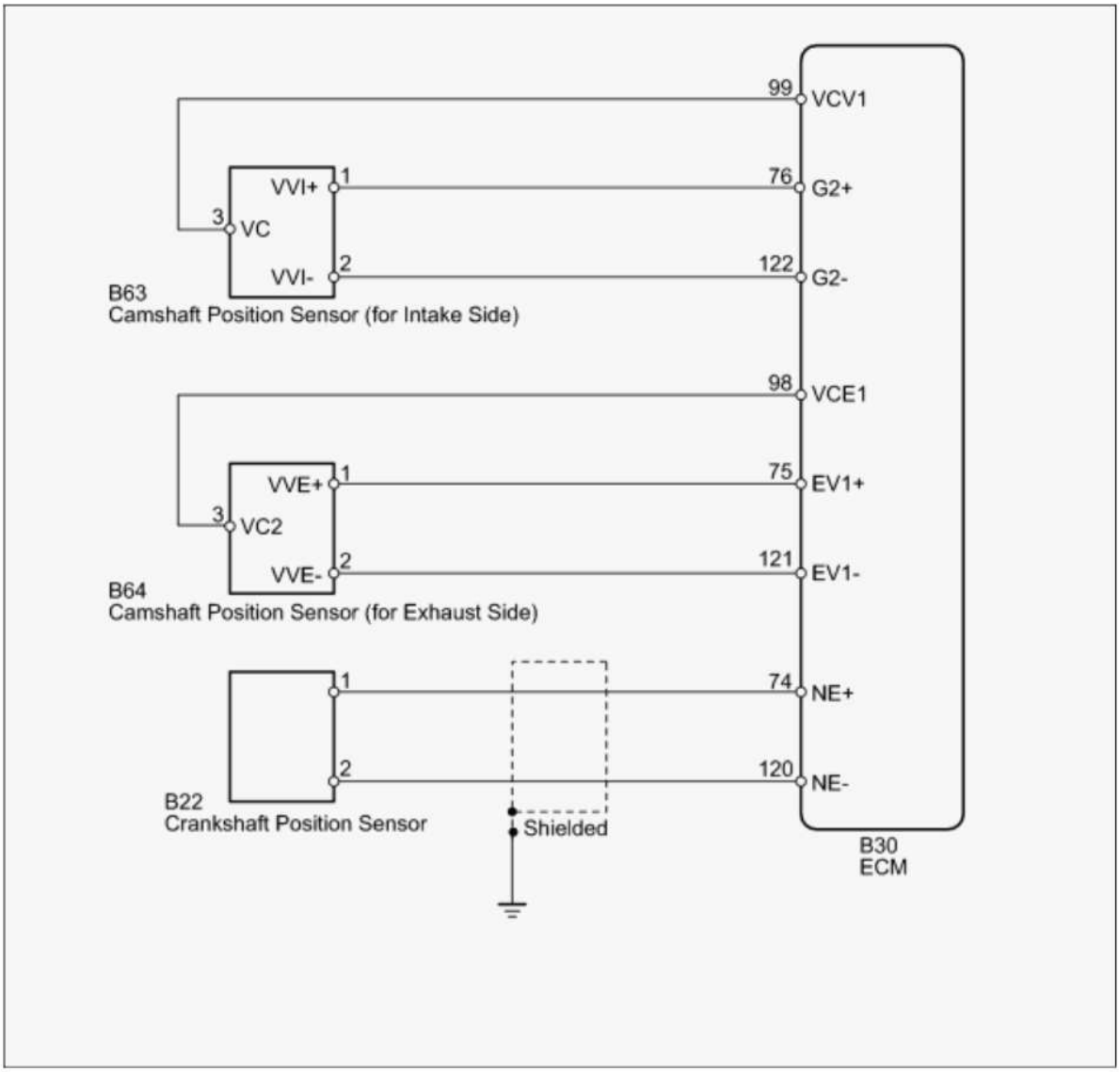
If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



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INSPECTION PROCEDURE

HINT:

- If no problem is found through this diagnostic troubleshooting procedure, there may be a mechanical problem with the engine.

- Check the engine speed. The engine speed can be checked by using the Techstream. To check, follow the operation below:

  a. Connect the Techstream to the DLC3.
  b. Start the engine.
  c. Turn the Techstream on.
  d. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

  The engine speed may be indicated as zero despite the crankshaft revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as less than the actual engine speed if the CKP sensor output voltage is insufficient.

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (ENGINE SPEED)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

(e) Start the engine.

(f) Read the values displayed on the Techstream while the engine is running.

OK:
Correct values are displayed.

HINT:

- To check the engine speed change, display the graph on the Techstream.
- If the engine does not start, check the engine speed while cranking.
- If the engine speed indicated on the Techstream remains at zero (0), there may be an open or short in the crankshaft position sensor circuit.

NG ▶ **INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)**

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

2.	**INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)**

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(a) Inspect the crankshaft position sensor INFO .

NG ▶ **REPLACE CRANKSHAFT POSITION SENSOR**

OK ▼

3.	CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

(a) Disconnect the crankshaft position sensor connector.

(b) Disconnect the ECM connector.

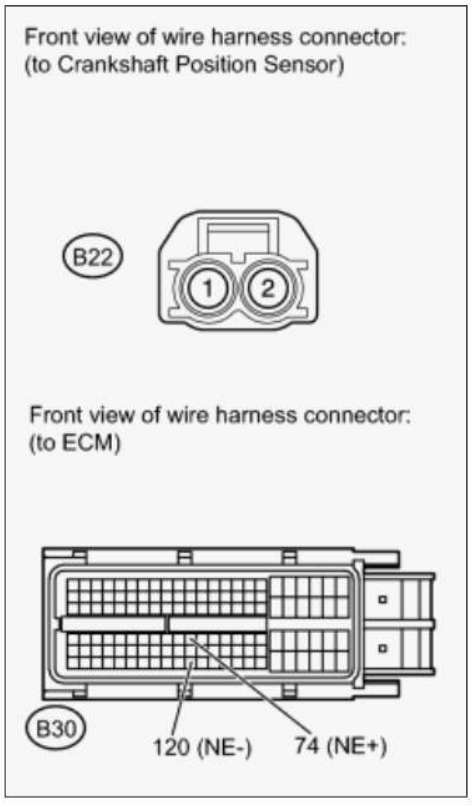
(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B22-1 - B30-74 (NE+)	Always	Below 1 Ω
B22-2 - B30-120 (NE-)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B22-1 or B30-74 (NE+) - Body ground	Always	10 kΩ or higher
B22-2 or B30-120 (NE-) - Body ground	Always	10 kΩ or higher



(d) Reconnect the crankshaft position sensor connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

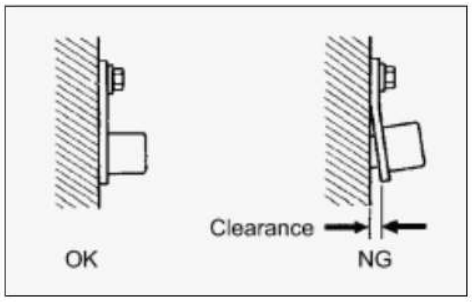
OK

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4.	CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)

(a) Check the crankshaft position sensor installation.

OK:
Sensor is installed correctly.



NG ▶ SECURELY REINSTALL SENSOR

OK ▼

5.	INSPECT CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE)

(a) Check the teeth of the sensor plate.

OK:
Sensor plate does not have any cracks or deformation.

NG ▶ REPLACE CRANKSHAFT

OK ▼

6.	REPLACE CRANKSHAFT POSITION SENSOR

(a) Replace the crankshaft position sensor INFO .

NEXT

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7.	CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine.

(f) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(g) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P0335 or P0339	B

HINT:

If the engine does not start, replace the ECM.

B ▶ **REPLACE ECM**

A ▶ **END**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WBZ0AGX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0340,P0342,P0343: Camshaft Position Sensor Circuit Malfunction (2011 RAV4)		

DTC	**P0340**	**Camshaft Position Sensor Circuit Malfunction**

DTC	**P0342**	**Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)**

DTC	**P0343**	**Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)**

DESCRIPTION

The camshaft position sensor for the intake camshaft (G signal sensor) consists of a magnet and MRE element.

The camshaft has a timing rotor for the camshaft position sensor. When the camshaft rotates, changes occur in the air gaps between the timing rotor and MRE element, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The camshaft position sensor converts the camshaft rotation data to pulse signals, and uses the pulse signals to determine the camshaft angle, which it sends to the ECM. Then the ECM uses this data to control fuel injection time and injection timing.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0340	When one of the following conditions is met: • No camshaft position sensor signal to the ECM while cranking (2 trip detection logic). • A missing camshaft position sensor signal despite the crankshaft position sensor inputs being normal at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in camshaft position sensor circuit for intake camshaft • Camshaft position sensor for intake camshaft • Camshaft timing gear for intake camshaft • Timing chain jumped tooth for intake camshaft • ECM
P0342	The output voltage of the camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in camshaft position sensor circuit for intake camshaft • Camshaft position sensor for intake camshaft • Camshaft timing gear for intake camshaft • Timing chain jumped

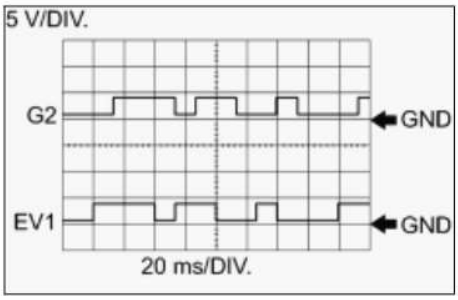
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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
		tooth for intake camshaft • ECM
P0343	An output voltage of 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in camshaft position sensor circuit for intake camshaft • Camshaft position sensor for intake camshaft • Camshaft timing gear for intake camshaft • Timing chain jumped tooth for intake camshaft • ECM

HINT:

DTC P0340 indicates a malfunction relating to the camshaft position sensor circuit (the wire harness between the ECM and camshaft position sensor, and the camshaft position sensor itself).

Reference: Inspection using an oscilloscope.



- The correct waveform is as shown.
- G2 stands for the Camshaft Position (CMP) sensor (for intake side) signal and EV1 stands for the CMP sensor (for exhaust side) signal.

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-76 (G2+) - B30-122 (G2-)	5 V/DIV, 20 ms/DIV	Idling
B30-75 (EV1+) - B30-121 (EV1-)	5 V/DIV, 20 ms/DIV	Idling

MONITOR DESCRIPTION

If no signal is transmitted by the camshaft position sensor despite the camshaft revolving, or the rotation of the camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, the DTC is stored 10 seconds after the engine is next started.

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MONITOR STRATEGY

Related DTCs	P0340: Camshaft position sensor range check (cranking) P0340: Camshaft position/crankshaft position misalignment P0342: Camshaft position sensor range check (Low voltage) P0343: Camshaft position sensor range check (High voltage)
Required Sensors/Components (Main)	Camshaft position sensor
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	4 seconds: Camshaft position sensor range check (cranking) (P0340) 5 seconds: Camshaft position/crankshaft position misalignment (P0340) 4 seconds: Camshaft position sensor range check (P0342, P0343)
MIL Operation	2 driving cycles: Camshaft position sensor range check (cranking) (P0340) Immediate: Camshaft position/crankshaft position misalignment (P0340) Camshaft position sensor range check (P0342, P0343)
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0340 Camshaft Position Sensor Range Check (Cranking)

Monitor runs whenever following DTCs not stored	None
Starter	ON
Minimum battery voltage while starter ON	Below 11 V

P0340 Camshaft Position/Crankshaft Position Misalignment

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0342, P0343 (VVT Sensor)
Engine speed	600 rpm or more
Starter	OFF
Camshaft position sensor voltage	0.3 to 4.7 V

P0342, P0343 Camshaft Position Sensor Range Check

Monitor runs whenever following DTCs not stored	P0340 (VVT Sensor)
Starter	OFF

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Ignition switch	ON
Time after ignition switch turned from off to ON	2 seconds or more
Battery voltage	8 V or higher

TYPICAL MALFUNCTION THRESHOLDS

P0340 Camshaft Position Sensor Range Check (Cranking)

Camshaft position sensor signal	No signal

P0340 Camshaft Position/Crankshaft Position Misalignment

Camshaft position and crankshaft position phase	Misaligned

P0342 Camshaft Position Sensor Range Check

Camshaft position sensor voltage	Below 0.3 V

P0343 Camshaft Position Sensor Range Check

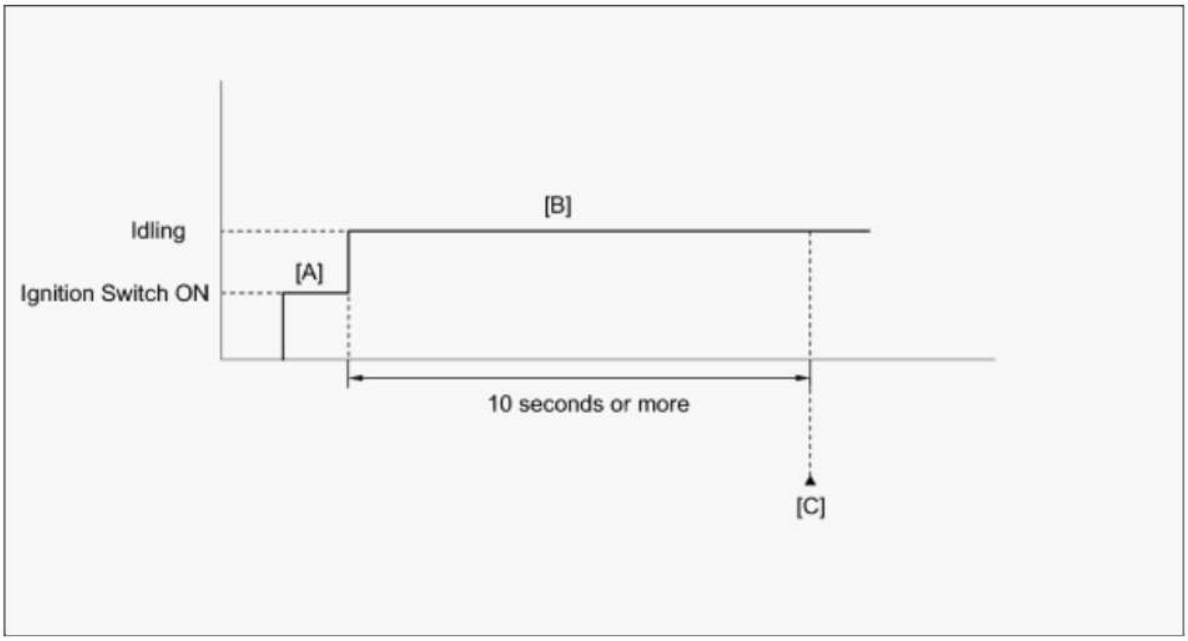
Camshaft position sensor voltage	Higher than 4.7 V

COMPONENT OPERATING RANGE

Camshaft position sensor	Camshaft position sensor output voltage fluctuates while camshaft revolving 3 camshaft position sensor signals per 2 crankshaft revolutions
Camshaft position sensor voltage	0.3 to 4.7 V

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. Idle the engine for 10 seconds or more [B].
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P0340, P0342 or P0343.
8. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
10. Read Pending DTCs.

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HINT:

If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0335 INFO .

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.
- If no problem is found through this diagnostic troubleshooting procedure, there may be a mechanical problem with the engine.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0340, P0342 OR P0343)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read the DTCs.

Result:

RESULT	PROCEED TO
DTC P0340, P0342 or P0343 is output	A
DTC P0340, P0342 or P0343 and other DTCs are output	B

HINT:

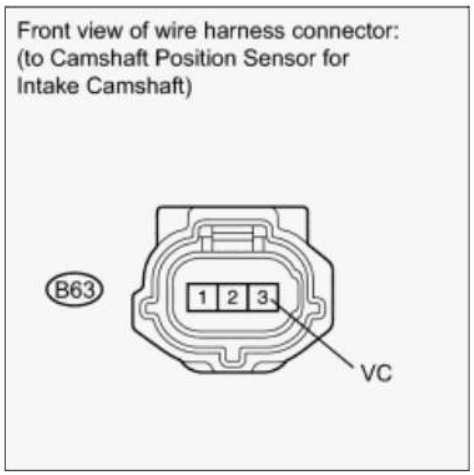
If any DTCs other than P0340, P0342 or P0343 are output, troubleshoot those DTCs first.

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B ▶ GO TO DTC CHART

A ▼

2.	**INSPECT CAMSHAFT POSITION SENSOR (FOR INTAKE CAMSHAFT) (POWER SOURCE)**



(a) Disconnect the camshaft position sensor (for intake camshaft) connector.

(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
B63-3 (VC) - Body ground	Ignition switch ON	4.5 to 5.0 V

(d) Reconnect the camshaft position sensor (for intake camshaft) connector.

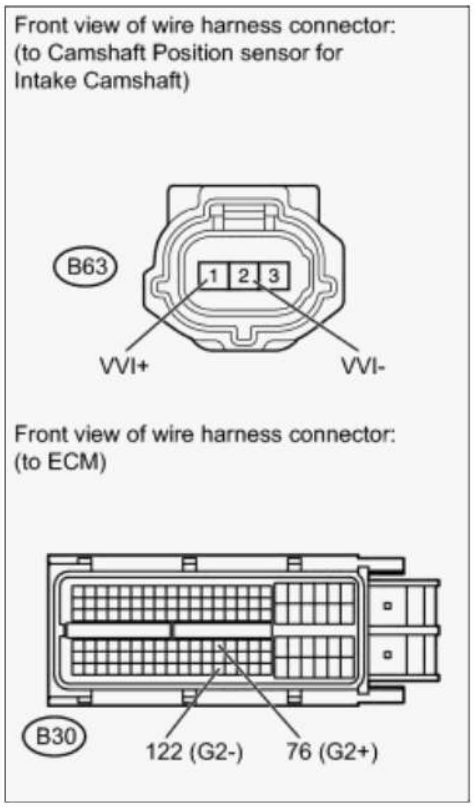
NG ▶ CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)

OK ▼

3.	**CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**

(a) Disconnect the camshaft position sensor (for intake camshaft)

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connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B63-1 (VVI+) - B30-76 (G2+)	Always	Below 1 Ω
B63-2 (VVI-) - B30-122 (G2-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B63-1 (VVI+) or B30-76 (G2+) - Body ground	Always	10 kΩ or higher
B63-2 (VVI-) or B30-122 (G2-) - Body ground	Always	10 kΩ or higher

(d) Reconnect the camshaft position sensor (for intake camshaft) connector.

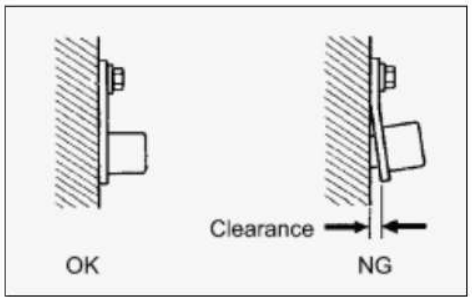
(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

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4.	**CHECK SENSOR INSTALLATION (CAMSHAFT POSITION SENSOR FOR INTAKE CAMSHAFT)**



(a) Check the camshaft position sensor (for intake camshaft) installation.

OK:

Sensor is installed correctly.

NG ▶ **SECURELY REINSTALL SENSOR**

OK

5.	**INSPECT INTAKE CAMSHAFT (TIMING ROTOR)**

(a) Check the timing rotor of the intake camshaft.

OK:

Camshaft timing rotor does not have any cracks or deformation.

NG ▶ **REPLACE INTAKE CAMSHAFT**

OK

6.	**REPLACE CAMSHAFT POSITION SENSOR (FOR INTAKE CAMSHAFT)**

(a) Replace the camshaft position sensor INFO .

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000XH40FMX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0351-P0354: Ignition Coil "A" Primary / Secondary Circuit (2011 RAV4)		

DTC	**P0351**	**Ignition Coil "A" Primary / Secondary Circuit**

DTC	**P0352**	**Ignition Coil "B" Primary / Secondary Circuit**

DTC	**P0353**	**Ignition Coil "C" Primary / Secondary Circuit**

DTC	**P0354**	**Ignition Coil "D" Primary / Secondary Circuit**

DESCRIPTION

HINT:

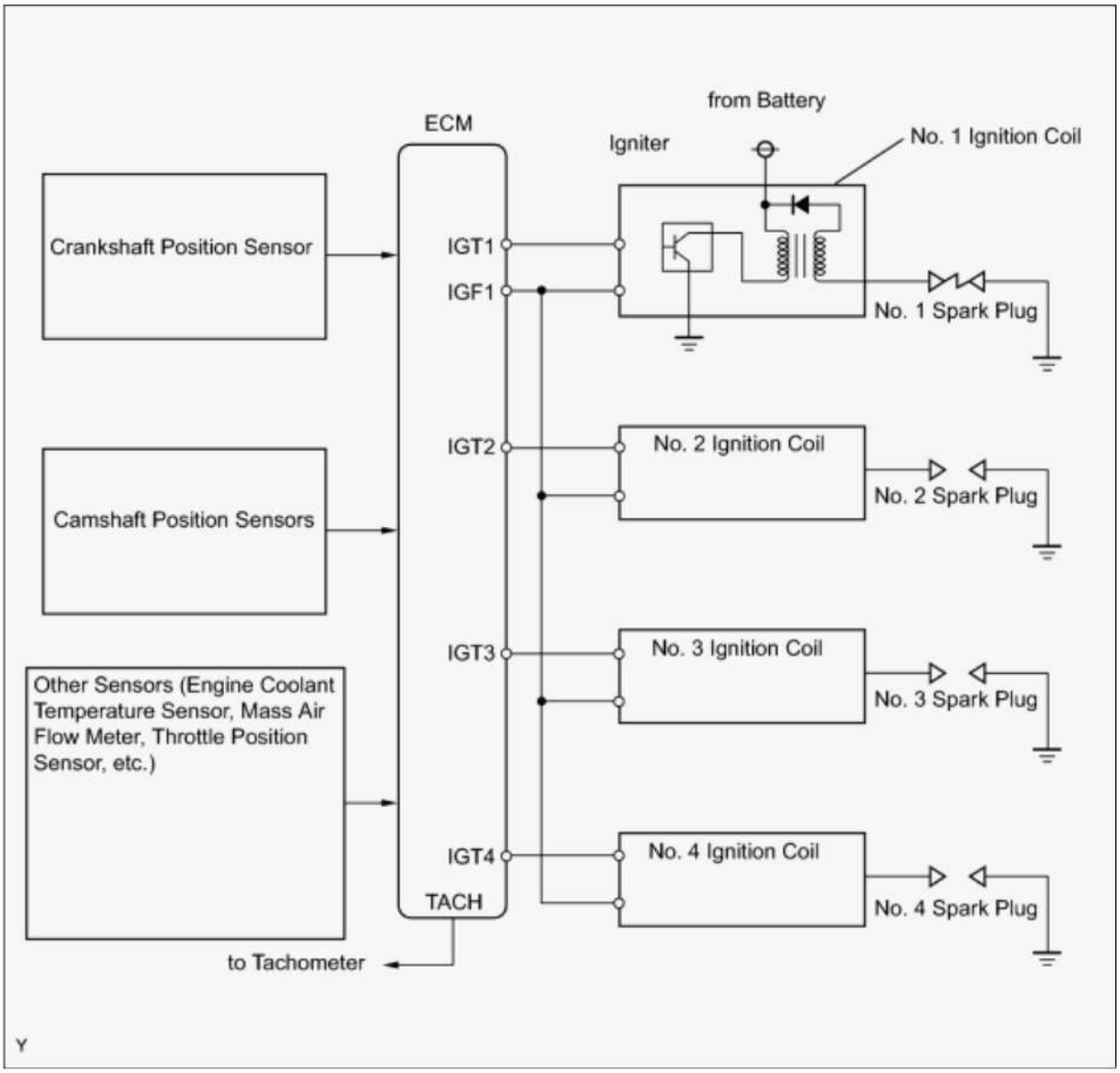
- These DTCs indicate malfunctions relating to the primary circuit.
- If DTC P0351 is output, check the No. 1 ignition coil circuit.
- If DTC P0352 is output, check the No. 2 ignition coil circuit.
- If DTC P0353 is output, check the No. 3 ignition coil circuit.
- If DTC P0354 is output, check the No. 4 ignition coil circuit.

A Direct Ignition System (DIS) is used on this vehicle.

The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.

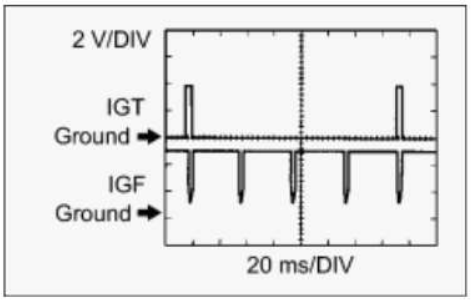
The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0351 P0352 P0353 P0354	No IGF signal to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 4) between ignition coil and ECM • No. 1 to No. 4 ignition coils • ECM

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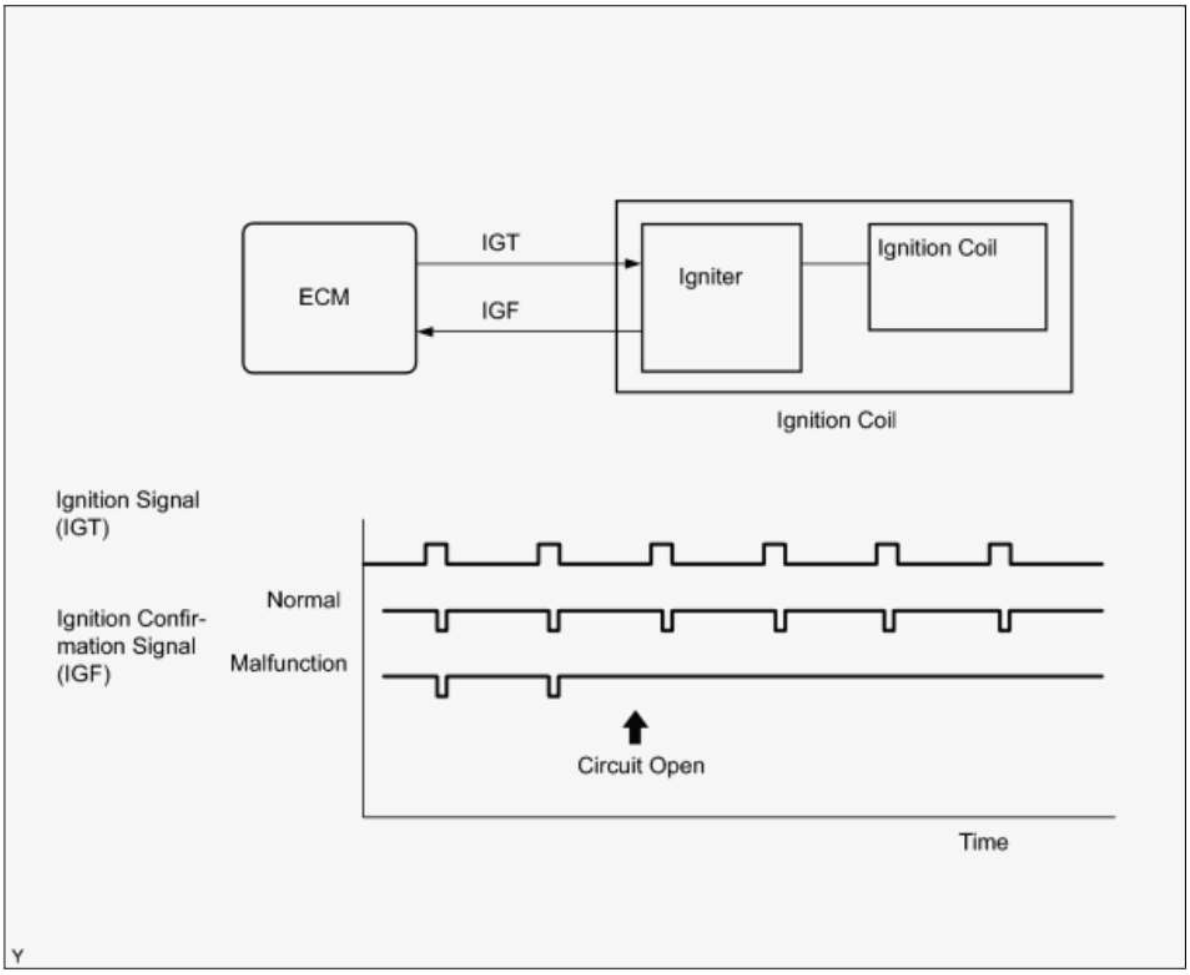


Reference: Inspection using an oscilloscope.
While cranking or idling the engine, check the waveform between terminals IGT (1 to 4) and E1, and IGF1 and E1 of the ECM connector.

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-108 (IGT1) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling
B30-107 (IGT2) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling
B30-106 (IGT3) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling
B30-105 (IGT4) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling
B30-23 (IGF1) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling

MONITOR DESCRIPTION

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If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0351: Igniter (cylinder 1) malfunction P0352: Igniter (cylinder 2) malfunction P0353: Igniter (cylinder 3) malfunction P0354: Igniter (cylinder 4) malfunction
Required Sensors/Components (Main)	Igniter
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	0.512 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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Monitor runs whenever following DTCs not stored	None
Spark cut	Not operating
Either of following conditions met	-
A. Engine speed	1500 rpm or less
B. Starter	OFF
Either of following conditions met	-
C. Both of following conditions met	-
(a) Engine speed	500 rpm or less
(b) Battery voltage	6 V or higher
D. All of following conditions met	-
(a) Engine speed	More than 500 rpm
(b) Battery voltage	10 V or higher
(c) Number of sparks after CPU reset	5 sparks or more

TYPICAL MALFUNCTION THRESHOLDS

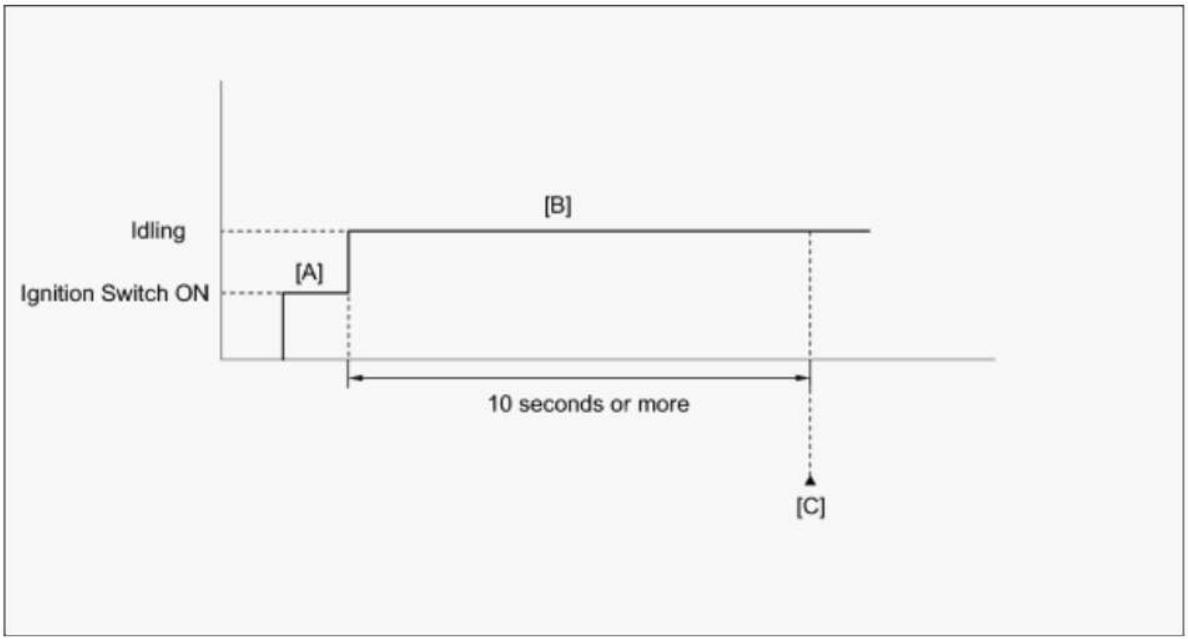
IGF signal	ECM does not receive any IGF signal despite ECM sending IGT signal to igniter

COMPONENT OPERATING RANGE

IGF signal	Igniter transmits IGF signal when it receives IGT signal from ECM

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. Idle the engine for 10 seconds or more [B].
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P0351, P0352, P0353 or P0354.
8. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.

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10. Read Pending DTCs.

HINT:

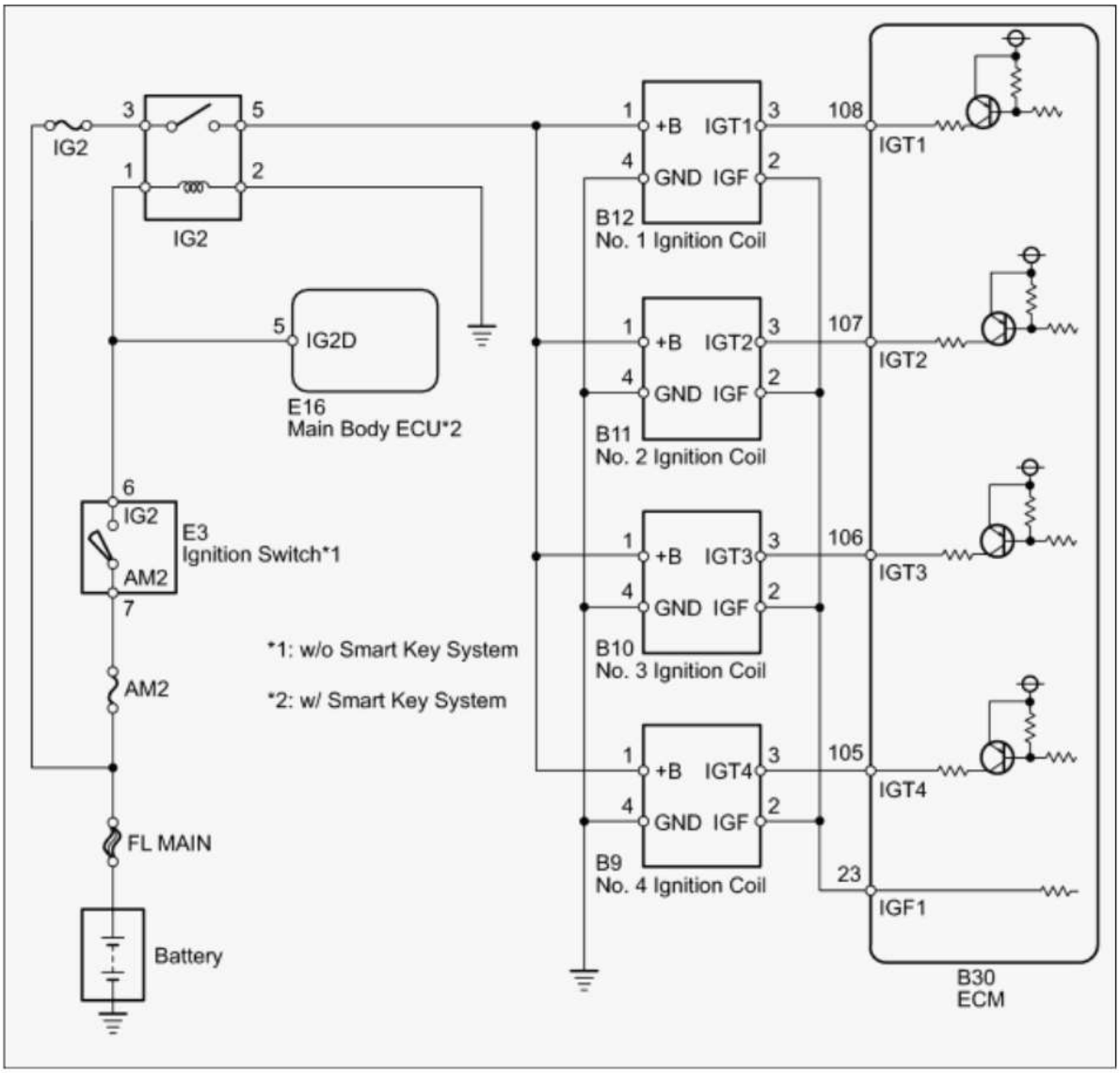
If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

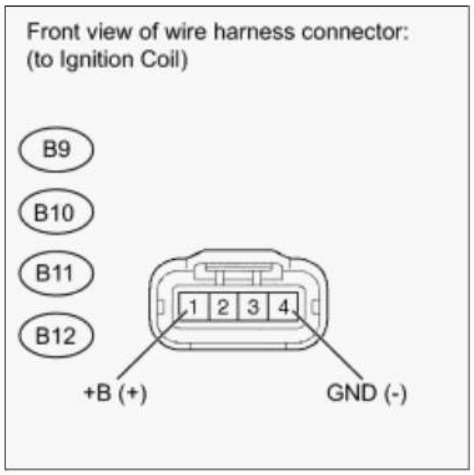
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HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)**



(a) Disconnect the ignition coil connectors.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B12-4 (GND) - Body ground	Always	Below 1 Ω
B11-4 (GND) - Body ground	Always	Below 1 Ω
B10-4 (GND) - Body ground	Always	Below 1 Ω
B9-4 (GND) - Body ground	Always	Below 1 Ω

(c) Turn the ignition switch to ON.

(d) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B12-1 (+B) - B12-4 (GND)	Ignition switch ON	11 to 14 V
B11-1 (+B) - B11-4 (GND)	Ignition switch ON	11 to 14 V
B10-1 (+B) - B10-4 (GND)	Ignition switch ON	11 to 14 V
B9-1 (+B) - B9-4 (GND)	Ignition switch ON	11 to 14 V

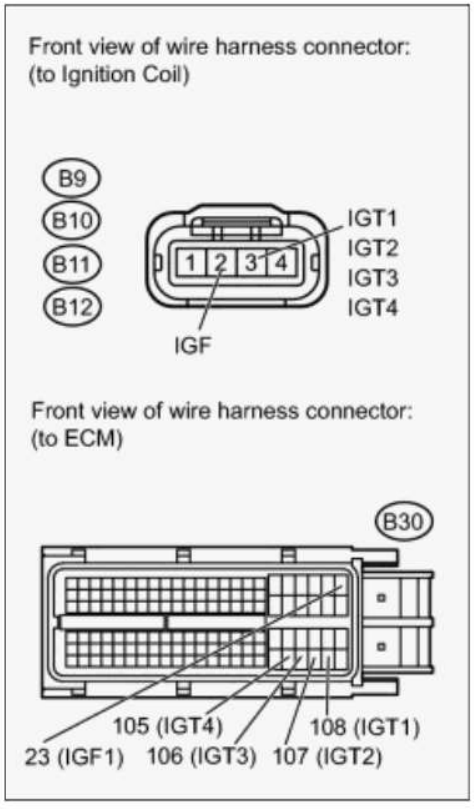
(e) Reconnect the ignition coil connectors.

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NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

2.	**CHECK HARNESS AND CONNECTOR (IGNITION COIL - ECM)**



(a) Disconnect the ignition coil connectors.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B12-2 (IGF) - B30-23 (IGF1)	Always	Below 1 Ω
B11-2 (IGF) - B30-23 (IGF1)	Always	Below 1 Ω
B10-2 (IGF) - B30-23 (IGF1)	Always	Below 1 Ω
B9-2 (IGF) - B30-23 (IGF1)	Always	Below 1 Ω

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B12-3 (IGT1) - B30-108 (IGT1)	Always	Below 1 Ω
B11-3 (IGT2) - B30-107 (IGT2)	Always	Below 1 Ω
B10-3 (IGT3) - B30-106 (IGT3)	Always	Below 1 Ω
B9-3 (IGT4) - B30-105 (IGT4)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B12-2 (IGF) or B30-23 (IGF1) -	Always	10 kΩ or higher

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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
Body ground		
B11-2 (IGF) or B30-23 (IGF1) - Body ground	Always	10 kΩ or higher
B10-2 (IGF) or B30-23 (IGF1) - Body ground	Always	10 kΩ or higher
B9-2 (IGF) or B30-23 (IGF1) - Body ground	Always	10 kΩ or higher

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B12-3 (IGT1) or B30-108 (IGT1) - Body ground	Always	10 kΩ or higher
B11-3 (IGT2) or B30-107 (IGT2) - Body ground	Always	10 kΩ or higher
B10-3 (IGT3) or B30-106 (IGT3) - Body ground	Always	10 kΩ or higher
B9-3 (IGT4) or B30-105 (IGT4) - Body ground	Always	10 kΩ or higher

(d) Reconnect the ECM connector.

(e) Reconnect the ignition coil connectors.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

3.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353 OR P0354)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

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(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Shuffle the arrangement of the ignition coils with igniters (among No. 1 to No. 4 cylinders).

NOTICE:

Do not shuffle the connectors.

(f) Perform a simulation test.

(g) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(h) Read DTCs.

Result

RESULT	PROCEED TO
Same DTC output	A
Different ignition coil DTC output	B

B ▶ **REPLACE IGNITION COIL**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000YTB08PX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0365,P0367,P0368: Camshaft Position Sensor "B" Circuit (Bank 1) (2011 RAV4)		

DTC	**P0365**	**Camshaft Position Sensor "B" Circuit (Bank 1)**

DTC	**P0367**	**Camshaft Position Sensor "B" Circuit Low Input (Bank 1)**

DTC	**P0368**	**Camshaft Position Sensor "B" Circuit High Input (Bank 1)**

DESCRIPTION

The camshaft position sensor for the exhaust camshaft (EV signal sensor) consists of a magnet and MRE element.

The exhaust camshaft has a timing rotor for the camshaft position sensor. When the camshaft rotates, changes occur in the air gaps between the timing rotor and MRE element, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The camshaft position sensor converts the camshaft rotation data to pulse signals, and uses the pulse signals to determine the camshaft angle, which it sends to the ECM. Then the ECM uses this data to control fuel injection duration, injection timing and the Variable Valve Timing (VVT) system.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0365	No exhaust camshaft position sensor signal for 5 seconds at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Camshaft timing gear for exhaust camshaft • Timing chain jumped tooth for exhaust camshaft • ECM
P0367	The output voltage of the exhaust camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Camshaft timing gear for exhaust camshaft • Timing chain jumped tooth for

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
		exhaust camshaft • ECM
P0368	The output voltage of the exhaust camshaft position sensor is 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Camshaft timing gear for exhaust camshaft • Timing chain jumped tooth for exhaust camshaft • ECM

HINT:

DTC P0365, P0367 and P0368 indicate a malfunction relating to the exhaust camshaft position sensor circuit (the wire harness between the ECM and exhaust camshaft position sensor, and the exhaust camshaft position sensor itself).

Reference: Inspection using an oscilloscope INFO

MONITOR DESCRIPTION

If no signal is transmitted by the exhaust camshaft position sensor despite the camshaft revolving, or the rotation of the exhaust camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, the DTC is stored 10 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0365: Exhaust camshaft position sensor range check (running) P0367: Exhaust camshaft position sensor range check (Low voltage) P0368: Exhaust camshaft position sensor range check (High voltage)
Required Sensors/Components (Main)	Exhaust camshaft position sensor
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	5 seconds: Exhaust camshaft position sensor range check (running) (P0365) 4 seconds: Exhaust camshaft position sensor range check (P0367, P0368)
MIL Operation	Immediate

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Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0365 Exhaust Camshaft Position Sensor Range Check (Running)

Monitor runs whenever following DTCs not stored	P0367, P0368 (Exhaust VVT Sensor)
Engine speed	600 rpm or more
Ignition switch	ON
Starter	OFF
Battery voltage	8 V or higher
Exhaust camshaft position sensor voltage	0.3 to 4.7 V

P0367, P0368 Exhaust Camshaft Position Sensor Range Check

Monitor runs whenever following DTCs not stored	P0365 (Exhaust VVT Sensor)
Starter	OFF
Ignition switch	ON
Time after ignition switch turned from off to ON	2 seconds or more
Battery voltage	8 V or higher

TYPICAL MALFUNCTION THRESHOLDS

P0365 Exhaust Camshaft Position Sensor Range Check (Running)

Exhaust camshaft position signal	No signal

P0367 Exhaust Camshaft Position Sensor Range Check (Low Voltage)

Exhaust camshaft position sensor voltage	Below 0.3 V

P0368 Exhaust Camshaft Position Sensor Range Check (High Voltage)

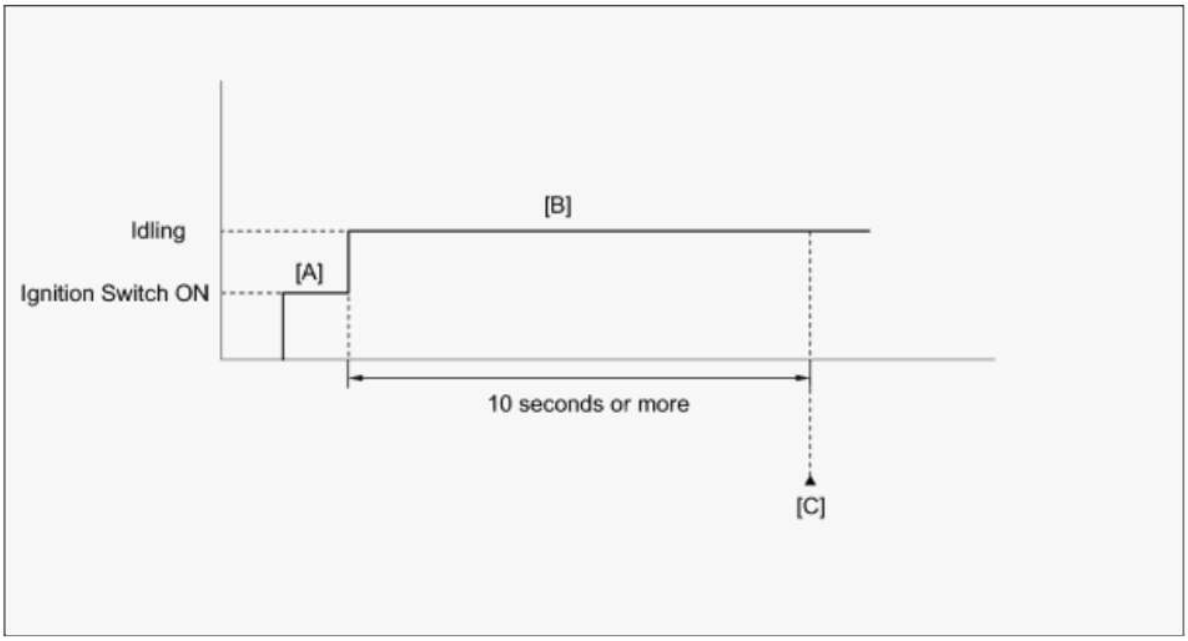
Exhaust camshaft position sensor voltage	Higher than 4.7 V

COMPONENT OPERATING RANGE

Exhaust camshaft position sensor	• Exhaust camshaft position sensor output voltage fluctuates while camshaft is revolving • 3 exhaust camshaft position sensor signals per 2 crankshaft revolutions

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. Idle the engine for 10 seconds or more [B].
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P0365, P0367 or P0368.
8. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.

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10. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0335 INFO .

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.
- If no problem is found through this diagnostic troubleshooting procedure, there may be a mechanical problem with the engine.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0365, P0367 OR P0368)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read the DTCs.

Result:

RESULT	PROCEED TO
DTC P0365, P0367 or P0368 is output	A
DTC P0365, P0367 or P0368 and other DTCs are output	B

HINT:

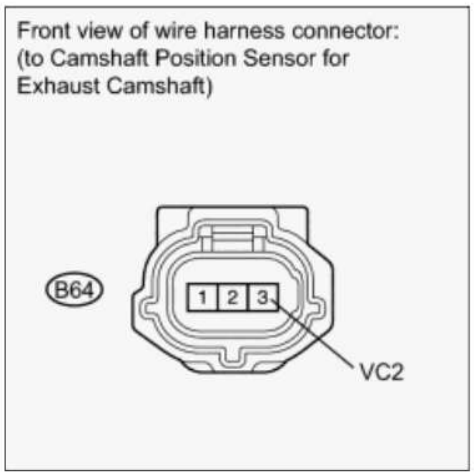
If any DTCs other than P0365, P0367 or P0368 are output, troubleshoot those DTCs first.

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B ▶ GO TO DTC CHART

A ▼

2.	INSPECT CAMSHAFT POSITION SENSOR (FOR EXHAUST CAMSHAFT) (POWER SOURCE)



(a) Disconnect the camshaft position sensor (for exhaust camshaft) connector.

(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
B64-3 (VC2) - Body ground	Ignition switch ON	4.5 to 5.5 V

(d) Reconnect the camshaft position sensor (for exhaust camshaft) connector.

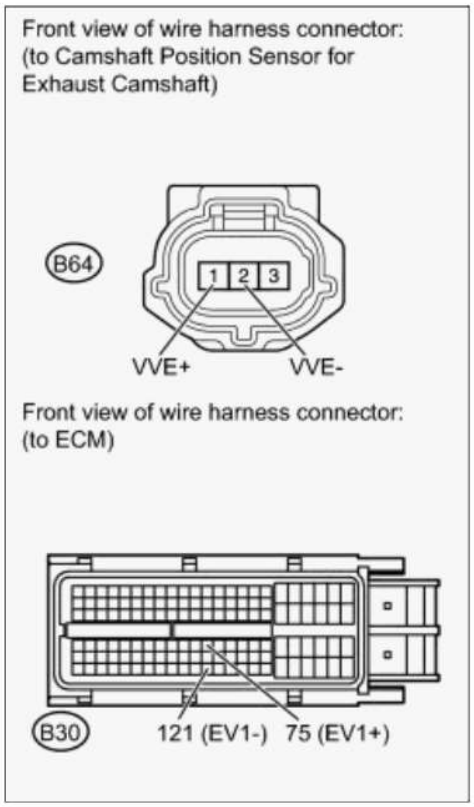
NG ▶ CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)

OK ▼

3.	CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)

(a) Disconnect the camshaft position sensor (for exhaust

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camshaft) connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B64-1 (VVE+) - B30-75 (EV1+)	Always	Below 1 Ω
B64-2 (VVE-) - B30-121 (EV1-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B64-1 (VVE+) or B30-75 (EV1+) - Body ground	Always	10 kΩ or higher
B64-2 (VVE-) or B30-121 (EV1-) - Body ground	Always	10 kΩ or higher

(d) Reconnect the camshaft position sensor (for exhaust camshaft) connector.

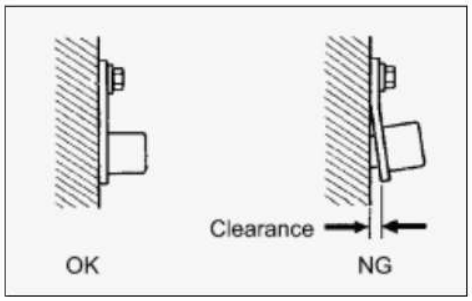
(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

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4.	**CHECK SENSOR INSTALLATION (CAMSHAFT POSITION SENSOR FOR EXHAUST CAMSHAFT)**



(a) Check the camshaft position sensor (for exhaust camshaft) installation.

OK:

Sensor is installed correctly.

NG ▶ **SECURELY REINSTALL SENSOR**

OK

5.	**INSPECT EXHAUST CAMSHAFT (TIMING ROTOR)**

(a) Check the timing rotor of the exhaust camshaft.

OK:

Camshaft timing rotor does not have any cracks or deformation.

NG ▶ **REPLACE EXHAUST CAMSHAFT**

OK

6.	**REPLACE CAMSHAFT POSITION SENSOR (FOR EXHAUST CAMSHAFT)**

(a) Replace the camshaft position sensor INFO .

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WC008AX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0420: Catalyst System Efficiency Below Threshold (Bank 1) (2011 RAV4)		

DTC	**P0420**	**Catalyst System Efficiency Below Threshold (Bank 1)**

MONITOR DESCRIPTION

The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.

The first sensor, the Air Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM.

In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air-fuel ratio control.

The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air-fuel ratio control is performed for approximately 15 to 20 seconds. When active air-fuel ratio control is performed, the ECM deliberately sets the air-fuel ratio to lean or rich levels. If a rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.

The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, the ECM illuminates the MIL and stores the DTC.

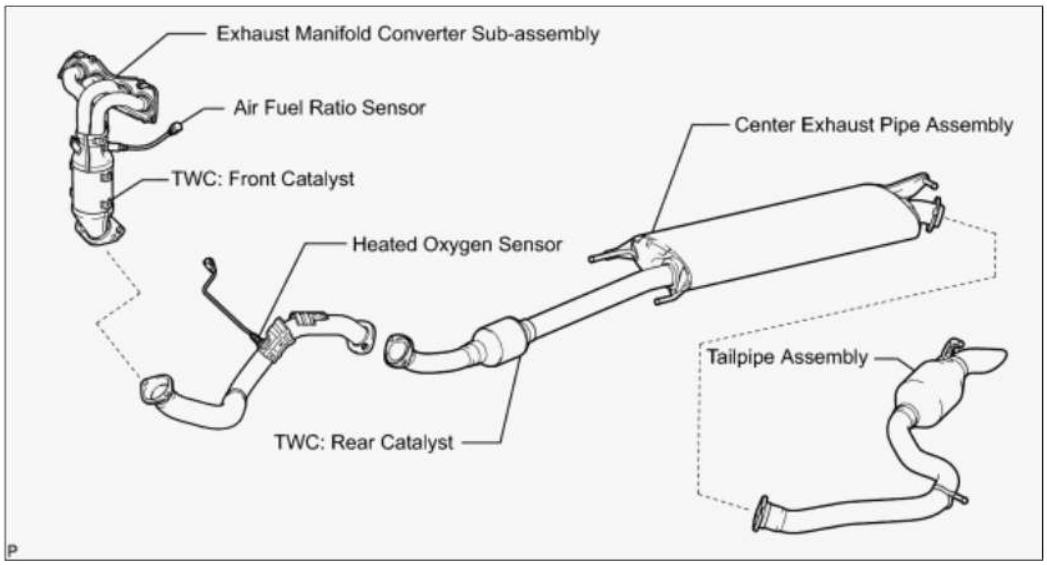
DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0420	The Oxygen Storage Capacity (OSC) value is less than the standard value under active air-fuel ratio control (2 trip detection logic).	• Gas leak from exhaust system • Air fuel ratio sensor (sensor 1) • Heated oxygen sensor (sensor 2) • Exhaust manifold converter sub-assembly (TWC: Front Catalyst) • Center exhaust pipe assembly (TWC: Rear Catalyst)

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

CATALYST LOCATION

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MONITOR STRATEGY

Related DTCs	P0420: Catalyst Deterioration
Required Sensors/Components (Main)	Air fuel ratio sensor Heated oxygen sensor
Required Sensors/Components (Related)	Intake air temperature sensor Mass air flow meter Crankshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Approximately 30 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0010 (VVT Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust VVT Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0037, P0038, P102D (Rear Oxygen Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0136, P0137, P0138, P0139, P0607 (Rear Oxygen Sensor) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control)

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	P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust VVT Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor)
Battery voltage	11 V or higher
Intake air temperature	-10°C (14°F) or higher
Engine coolant temperature	75°C (167°F) or higher
Atmospheric pressure	76 kPa (570 mmHg) or higher
Idling	OFF
Engine speed	Less than 4000 rpm
Air fuel ratio sensor status	Activated
Fuel system status	Closed loop
Engine load	10 to 80%
All of the following conditions are met	Condition 1, 2 and 3
1. Mass air flow rate	2.5 to 60 g/sec
2. Front catalyst temperature (estimated)	620 to 865°C (1148 to 1589°F)
3. Rear catalyst temperature (estimated)	400 to 770°C (752 to 1418°F)
Shift position	4th or higher

TYPICAL MALFUNCTION THRESHOLDS

Oxygen Storage Capacity (OSC) of Three-Way Catalytic Converter (TWC)	Less than 0.14 g

MONITOR RESULT

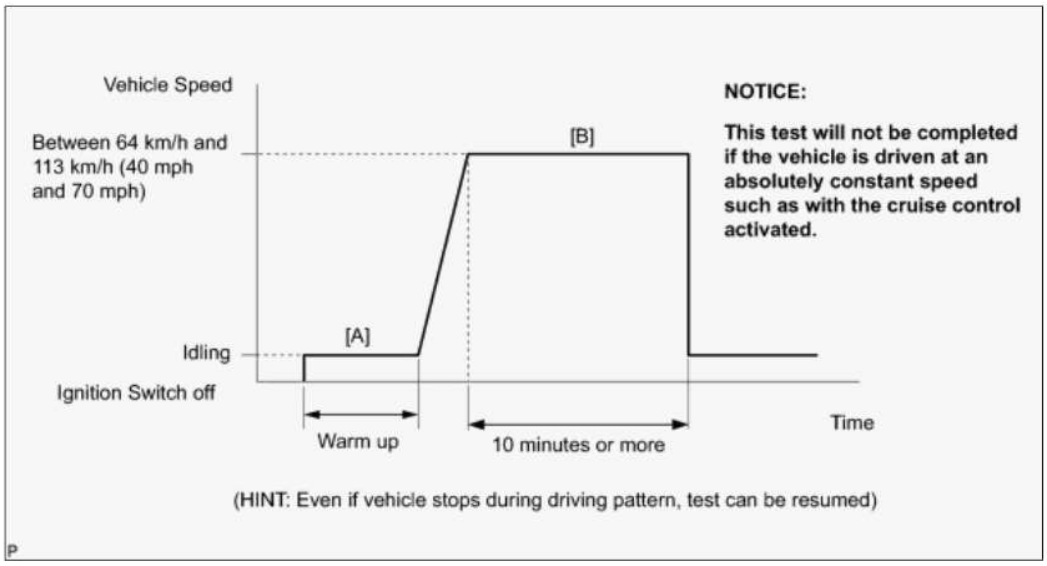
Refer to Checking Monitor Status INFO .

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the catalyst monitor. This is very useful for verifying the completion of a repair.

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
5. Enter the following menus: Powertrain / Engine and ECT / Monitor.
6. Check that Catalyst / Status2 is Incomplete.
7. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or higher) [A].
8. Drive the vehicle at between 64 and 113 km/h (40 and 70 mph) for at least 10 minutes or more [B].
9. The monitor items will change to Complete as Catalyst monitor operates.
10. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
11. Check if any DTCs (pending DTCs) are set.

HINT:

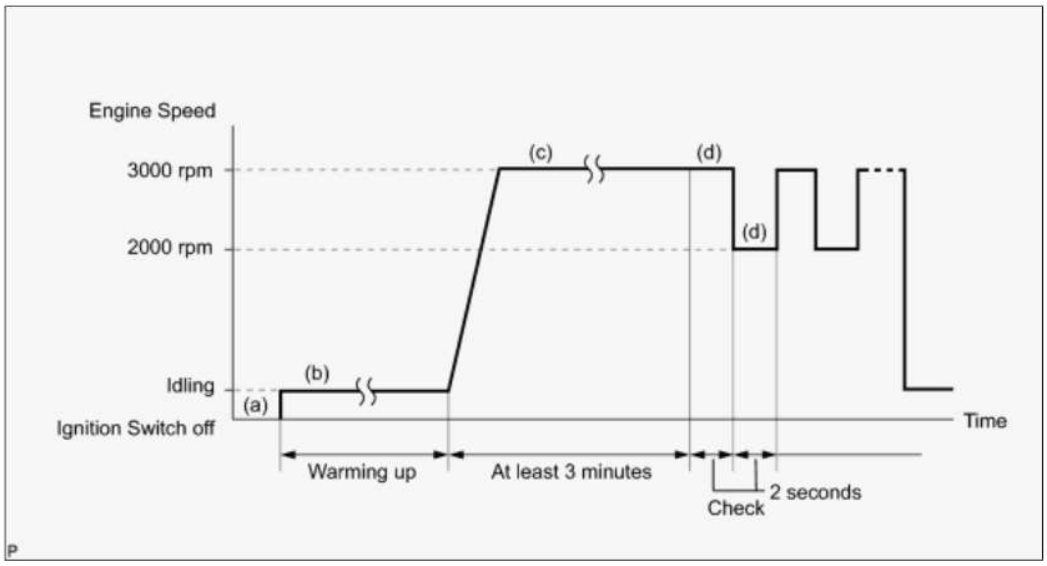
If Catalyst does not change to Complete, and no pending DTCs are stored, extend the driving time.

CONDITIONING FOR SENSOR TESTING

HINT:

Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the Air Fuel Ratio (A/F) sensor and Heated Oxygen (HO2) sensor. This is to activate the sensors sufficiently to obtain the appropriate inspection results.

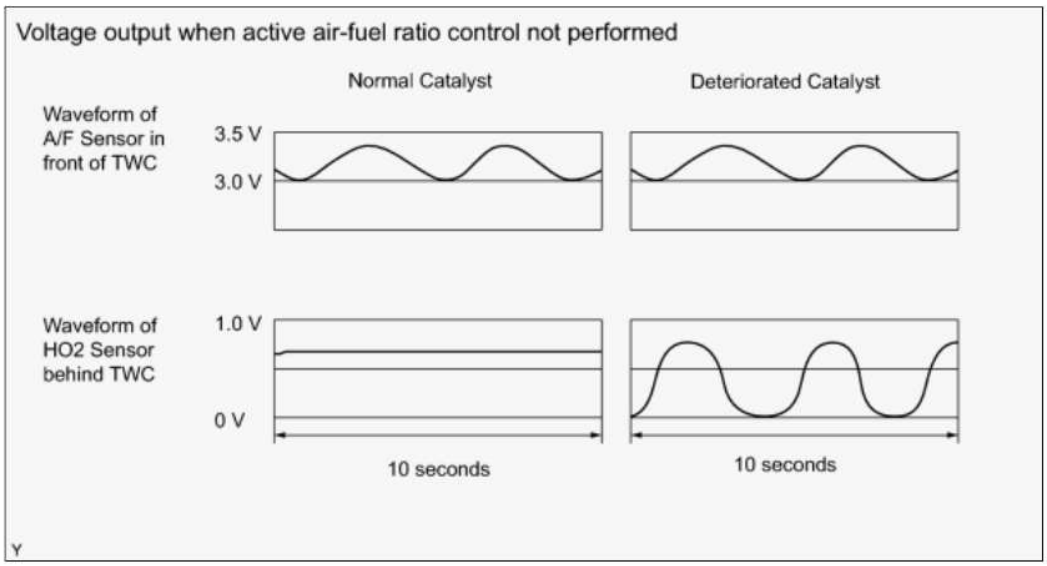
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(a) Connect the Techstream to the DLC3.
(b) Start the engine and warm it up with all the accessories switched OFF until the engine coolant temperature stabilizes.
(c) Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes.
(d) While running the engine at 3000 rpm for 2 seconds and 2000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the Techstream.

HINT:

- If either voltage output of the Air Fuel Ratio (A/F) or Heated Oxygen (HO2) sensor does not fluctuate, or there is noise in the waveform of either sensor, the sensor may be malfunctioning.
- If the voltage outputs of both the sensors remain lean or rich, the air-fuel ratio may be extremely lean or rich. In such cases, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
- If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air-fuel ratio control is not performed).



INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

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The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)
7. Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

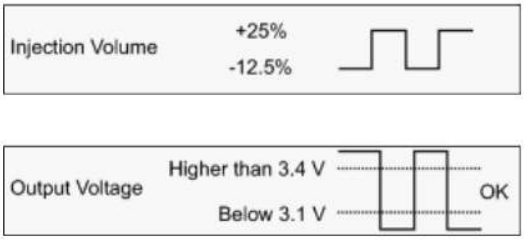
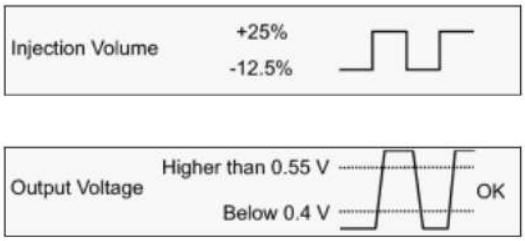
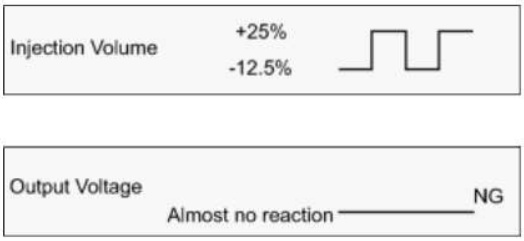
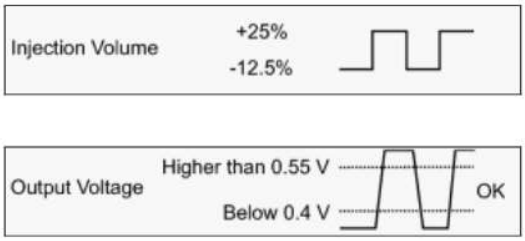
HINT:

- The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

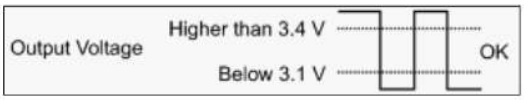
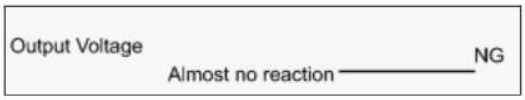
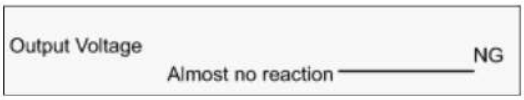
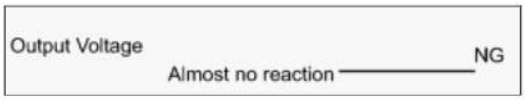
TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1 S1 (A/F)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor

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CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
			circuit
4	 	 	• Injector • Fuel pressure • Gas leak from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0420	A
P0420 and other DTCs	B

HINT:

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If any DTCs other than P0420 are output, troubleshoot those DTCs first.

B ▶ GO TO DTC CHART

A ▼

2.	PERFORM ACTIVE TEST USING TECHSTREAM (CONTROL THE INJECTION VOLUME FOR A/F SENSOR)

(a) Connect the Techstream to the DLC3.

(b) Start the engine and warm it up.

(c) Turn the Techstream on.

(d) Run the engine at an engine speed of 2500 rpm for approximately 90 seconds.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.

(f) Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

(g) Monitor the voltage outputs of the air fuel ratio sensor and heated oxygen sensor (AFS Voltage B1S1 and O2S B1S2) displayed on the Techstream.

HINT:

- The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard:

TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1 S1 (A/F)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

Result

STATUS AFS VOLTAGE B1 S1	STATUS O2S B1 S2	A/F CONDITION AND A/F AND HO2 SENSORS CONDITION	MISFIRE	MAIN SUSPECTED TROUBLE AREA	PROCEED TO
Lean/Rich	Lean/Rich	Normal	-	○ Three-Way Catalytic Converter (TWC) ○ Gas leak from exhaust system	A
Lean	Lean/Rich	A/F sensor malfunction	-	○ A/F sensor	B

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STATUS AFS VOLTAGE B1 S1	STATUS O2S B1 S2	A/F CONDITION AND A/F AND HO2 SENSORS CONDITION	MISFIRE	MAIN SUSPECTED TROUBLE AREA	PROCEED TO
Rich	Lean/Rich	A/F sensor malfunction	-	○ A/F sensor	
Lean/Rich	Lean	HO2 sensor malfunction	-	○ HO2 sensor ○ Gas leak from exhaust system	C
Lean/Rich	Rich	HO2 sensor malfunction	-	○ HO2 sensor ○ Gas leak from exhaust system	
Lean	Lean	Actual air-fuel ratio lean	May occur	○ Extremely rich or lean actual air-fuel ratio ○ Gas leak from exhaust system	D
Rich	Rich	Actual air-fuel ratio rich	-	○ Extremely rich or lean actual air-fuel ratio ○ Gas leak from exhaust system	

Lean: During Control the Injection Volume for A/F sensor, the A/F sensor output voltage (AFS Voltage) is consistently higher than 3.4 V, and the HO2 sensor output voltage (O2S) is consistently below 0.4 V.

Rich: During Control the Injection Volume for A/F sensor, the AFS Voltage is consistently below 3.1 V, and the O2S is consistently higher than 0.55 V.

Lean/Rich: During Control the Injection Volume for A/F sensor of the Active Test, the output voltage of the HO2 sensor alternates correctly.

B ▶ **REPLACE AIR FUEL RATIO SENSOR (SENSOR 1)**

C ▶ **CHECK FOR EXHAUST GAS LEAK**

D ▶ **GO TO NEXT STEP AFTER CHECKING ENGINE TO DETERMINE CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO**

A ▼

3.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leaks.

OK:
No gas leak.

NG ▶ **REPAIR OR REPLACE EXHAUST GAS LEAK POINT**

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OK

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000SWF075X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0441: Evaporative Emission Control System Incorrect Purge Flow (2011 RAV4)		

DTC	**P0441**	**Evaporative Emission Control System Incorrect Purge Flow**

DTC SUMMARY

DTC NO.	MONITORING ITEM	MALFUNCTION DETECTION CONDITION	TROUBLE AREA	DETECTION TIMING	DETECTION LOGIC
P0441	Purge VSV (Vacuum Switching Valve) stuck open	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check. If stabilized pressure higher than [second reference pressure x 0.2], ECM determines that purge VSV stuck open.	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leak from EVAP system	While ignition switch off	2 trip
	Purge VSV stuck closed	After EVAP leak check performed, purge VSV turned ON (open), and atmospheric air introduced into EVAP system. Reference pressure measured at start and at end of check. If pressure does not return to near atmospheric pressure, ECM determines that purge VSV stuck closed.	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leak from EVAP system	While ignition switch off	2 trip
	Purge flow	While engine running, following conditions successively met: • Negative pressure not created in EVAP system when purge VSV turned ON (open) • EVAP system pressure change less than 0.4 kPa-g (3.0 mmHg-g) when vent valve turned ON (closed) • Atmospheric pressure change before and after purge flow monitor less than 0.1 kPa-g (0.75 mmHg-g)	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • Leak from EVAP line (Purge VSV - Intake manifold) • ECM	While engine running	2 trip

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DESCRIPTION

The description can be found in EVAP (Evaporative Emission) System INFO .

INSPECTION PROCEDURE

Refer to EVAP System INFO .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] is the absolute pressure.
- [kPa-g (mmHg-g)] is the gauge pressure (relative pressure).
- On the Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

The two monitors, Key-Off and Purge Flow, are used to detect malfunctions relating to DTC P0441. The Key-Off monitor is initiated by the ECM internal timer, known as the soak timer, 5 hours* after the ignition switch is turned off. The purge flow monitor runs while the engine is running.

1. KEY-OFF MONITOR

   5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

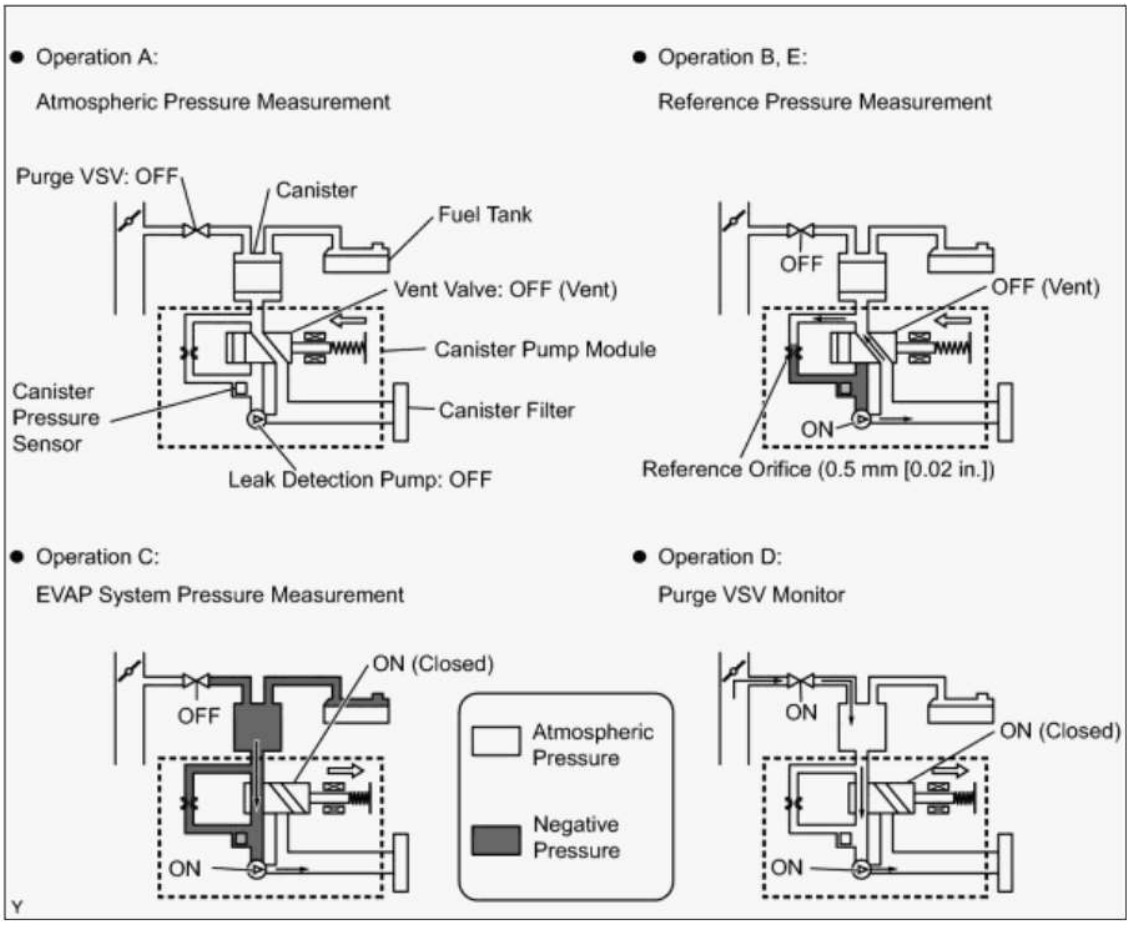
***: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.**

SEQUENCE	OPERATION	DESCRIPTION	DURATION
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	60 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*

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SEQUENCE	OPERATION	DESCRIPTION	DURATION
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

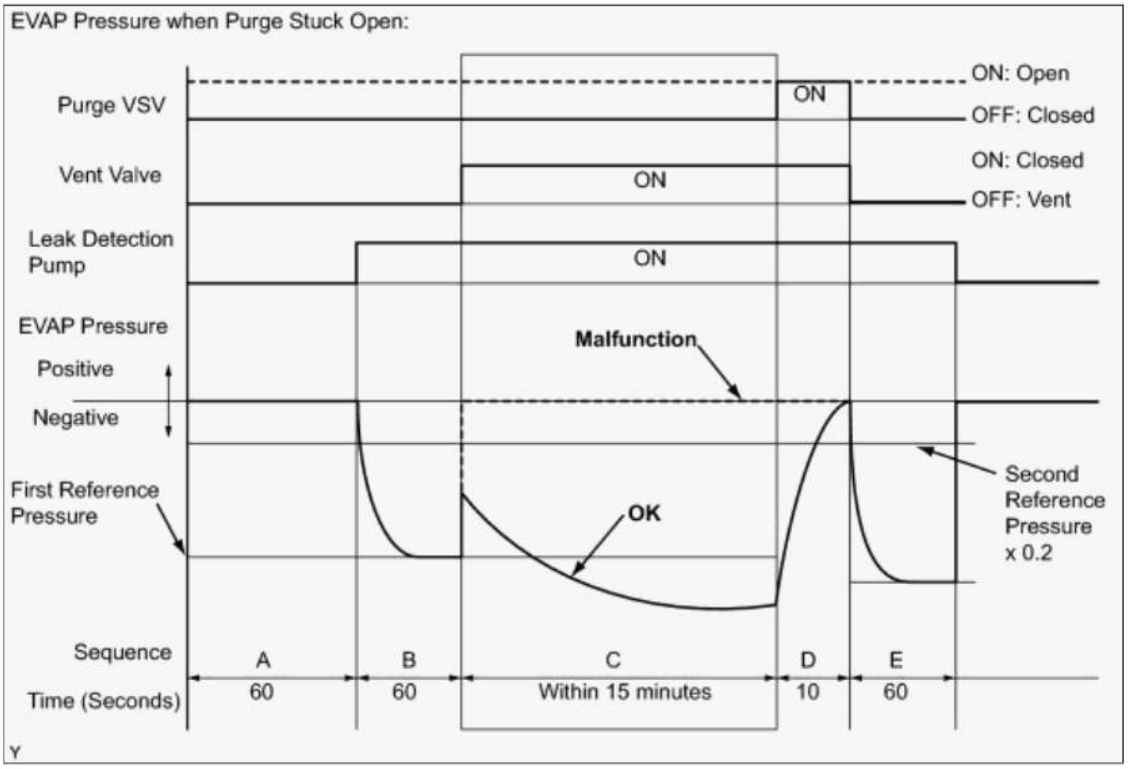
*: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.



a. Purge VSV stuck open

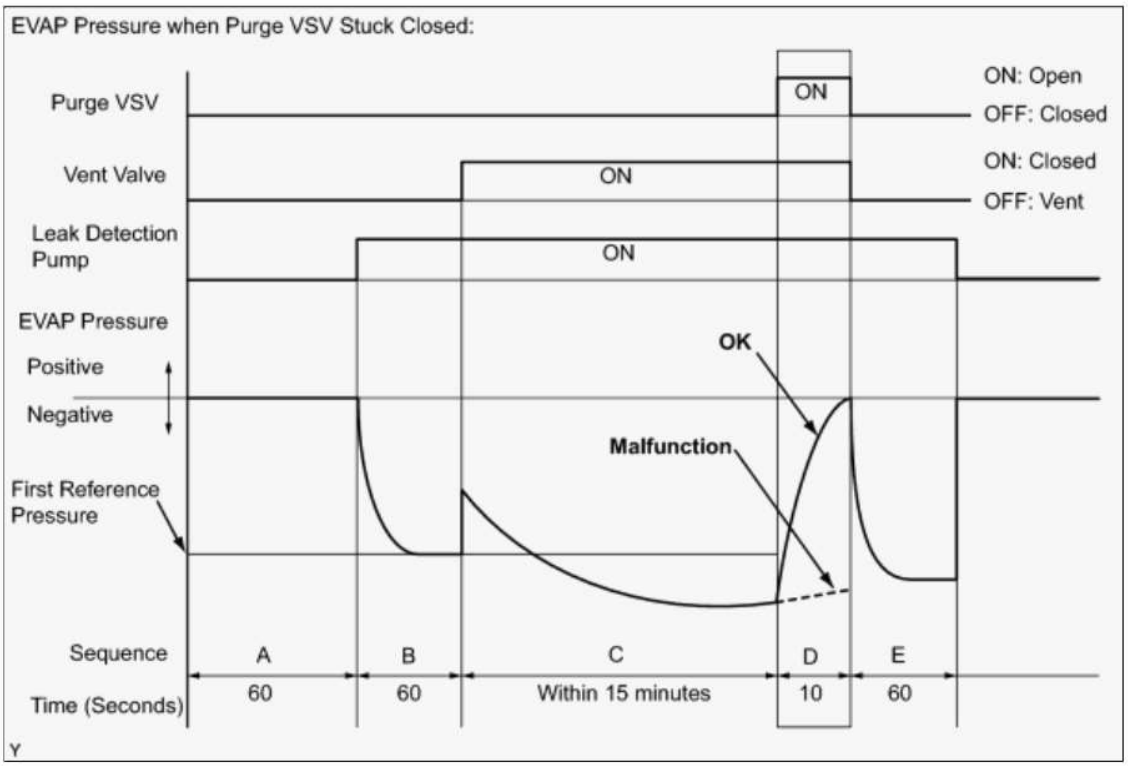
In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The EVAP system pressure is then measured by the ECM using the canister pressure sensor. If the stabilized system pressure is higher than [second reference pressure x 0.2], the ECM interprets this as the purge VSV (Vacuum Switching Valve) being stuck open. The ECM illuminates the MIL and stores the DTC (2 trip detection logic).

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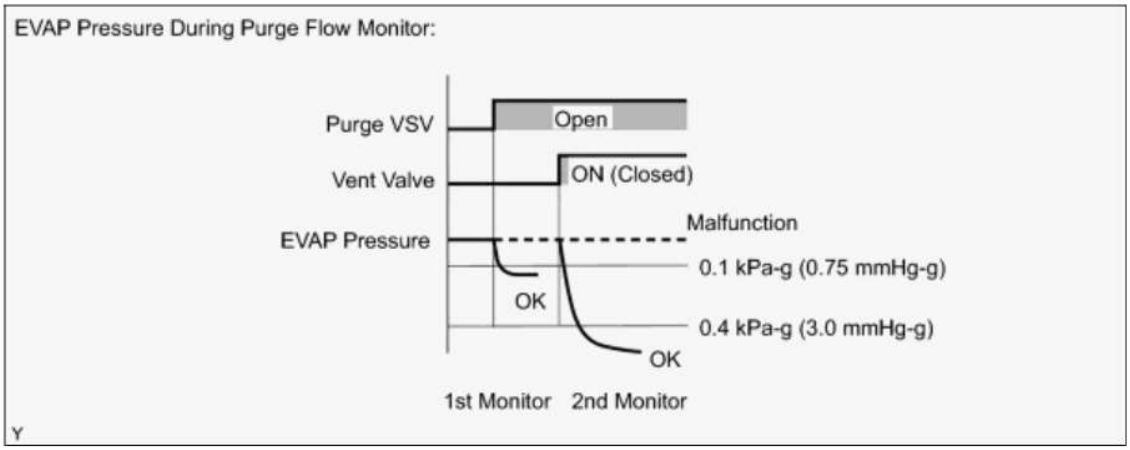
b. Purge VSV stuck closed

In operation D, the canister pressure sensor measures the EVAP system pressure. The pressure measurement for the purge VSV monitor is begun when the purge VSV is turned ON (open) after the EVAP leak check. When the measured pressure indicates an increase of 0.3 kPa-g (2.25 mmHg-g) or more, the purge VSV is functioning normally. If the pressure does not increase, the ECM interprets this as the purge VSV being stuck closed. The ECM illuminates the MIL and stores the DTC (2 trip detection logic).



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2. PURGE FLOW MONITOR



The purge flow monitor consists of two monitors. The 1st monitor is conducted every time and the 2nd monitor is activated if necessary.

- The 1st monitor

  While the engine is running and the purge VSV is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.

- The 2nd monitor

  The vent valve is turned ON (closed) and the EVAP pressure is then measured. If the variation in the pressure is less than 0.4 kPa-g (3.0 mmHg-g), the ECM interprets this as the purge VSV being stuck closed, illuminates the MIL and stores DTC P0441 (2 trip detection logic).

Atmospheric pressure check:

In order to ensure reliable malfunction detection, the variation between the atmospheric pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

OBD II MONITOR SPECIFICATIONS

1. Key-off Monitor

Monitor Strategy

Required Sensors/Components	Purge VSV Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions

Monitor runs whenever following DTCs not stored	P0451, P0452, P0453 (EVAP System)
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)

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Battery voltage	10.5 V or higher
Vehicle speed	Less than 4 km/h (2.5 mph)
Ignition switch	off
Time after key-off	5, 7 or 9.5 hours
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key-off	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

Typical Malfunction Thresholds

Purge VSV stuck open:	-
EVAP pressure when vacuum introduction complete	Higher than reference pressure x 0.2

Purge VSV stuck closed:	-
EVAP pressure change after purge VSV open	Below 0.3 kPa-g (2.25 mmHg-g)

OBD II MONITOR SPECIFICATIONS

1. Purge Flow Monitor

Monitor Strategy

Required Sensors/Components	Purge VSV Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions

Monitor runs whenever following DTCs not stored	P0451, P0452, P0453 (EVAP System)
Engine	Running
ECT	4.4°C (40°F) or higher
IAT	4.4°C (40°F) or higher
Purge VSV	Not operated by scan tool

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EVAP system check	Not operated by scan tool
Battery voltage	10 V or higher
Purge duty-cycle	8% or more

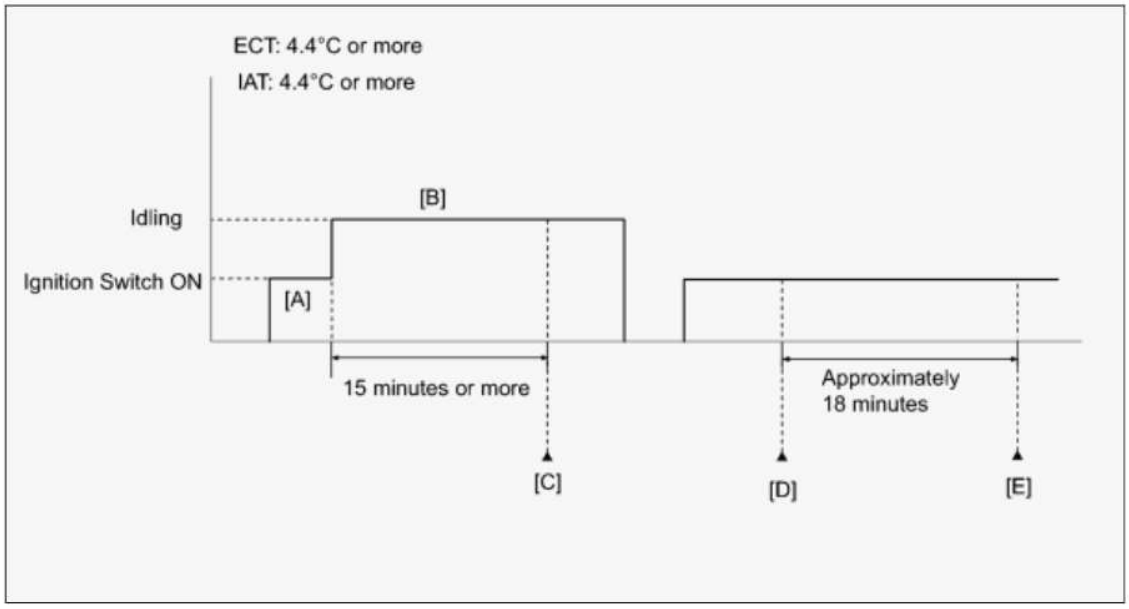
Typical Malfunction Thresholds

Both of following conditions met	Conditions 1 and 2
1. EVAP pressure change when purge operation started	Below 0.1 kPa-g (0.75 mmHg-g)
2. EVAP pressure change during purge operation when vent valve closed	Below 0.4 kPa-g (3.0 mmHg-g)

MONITOR RESULT

Refer to Checking Monitor Status INFO .

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and wait 15 minutes or more [B].
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All readiness.
6. Input the DTC: P0441.
7. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal

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TESTER DISPLAY	DESCRIPTION
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ You should perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

NOTICE:

- The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by Techstream. It takes a maximum of approximately 18 minutes.
- Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.
- Do not run the engine during this operation.
- When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the fuel temperature below 35°C (95°F).

8. Turn the ignition switch to ON and turn the Techstream on.
9. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [D].
10. Enter the following menus: Powertrain / Engine and ECT / Utility / Evaporative System Check / Automatic Mode.
11. After the "Evaporative System Check" is completed, check for All Readiness by entering the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
12. Input the DTC: P0441.
13. Check the DTC judgment result [E].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

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If the judgment result shows ABNORMAL, the system has a malfunction.

14. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
15. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

16. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

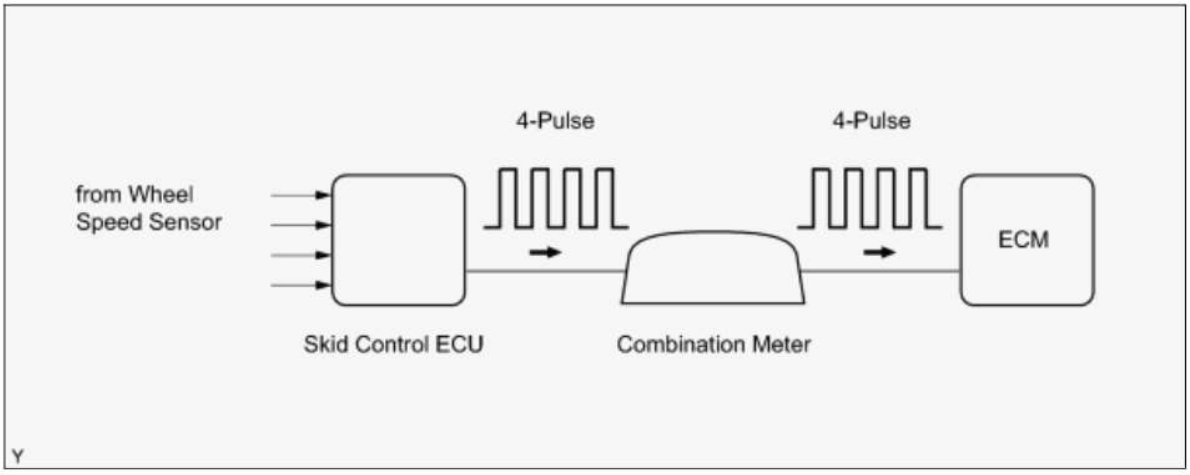
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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000012ME071X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0500: Vehicle Speed Sensor "A" (2011 RAV4)		

DTC	**P0500**	**Vehicle Speed Sensor "A"**

DESCRIPTION

The speed sensor detects the wheel speed and sends the appropriate signals to the skid control ECU. The skid control ECU converts these wheel speed signals into a 4-pulse signal and outputs it to the ECM via the combination meter. The ECM determines the vehicle speed based on the frequency of these pulse signals.



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0500	While the vehicle is being driven, no vehicle speed sensor signal is transmitted to the ECM (1 trip detection logic).	• Open or short in speed signal circuit • Speedometer circuit (wheel speed sensor, skid control ECU) • Combination meter • ECM

MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven when the vehicle speed sensor signal is being transmitted by the combination meter. If there is no signal from the combination meter, despite the ECM detecting the speed signal from the speed sensor NC, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and stores the DTC.

MONITOR STRATEGY

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Related DTCs	P0500: Vehicle speed sensor "A" pulse input error
Required Sensors/Components (Main)	Vehicle Speed Sensor (VSS) Combination meter Skid control ECU
Required Sensors/Components (Related)	Park/Neutral Position (PNP) switch Engine Coolant Temperature (ECT) sensor Crankshaft Position (CKP) sensor Throttle Position (TP) sensor Mass Air Flow (MAF) meter
Frequency of Operation	Continuous
Duration	2 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

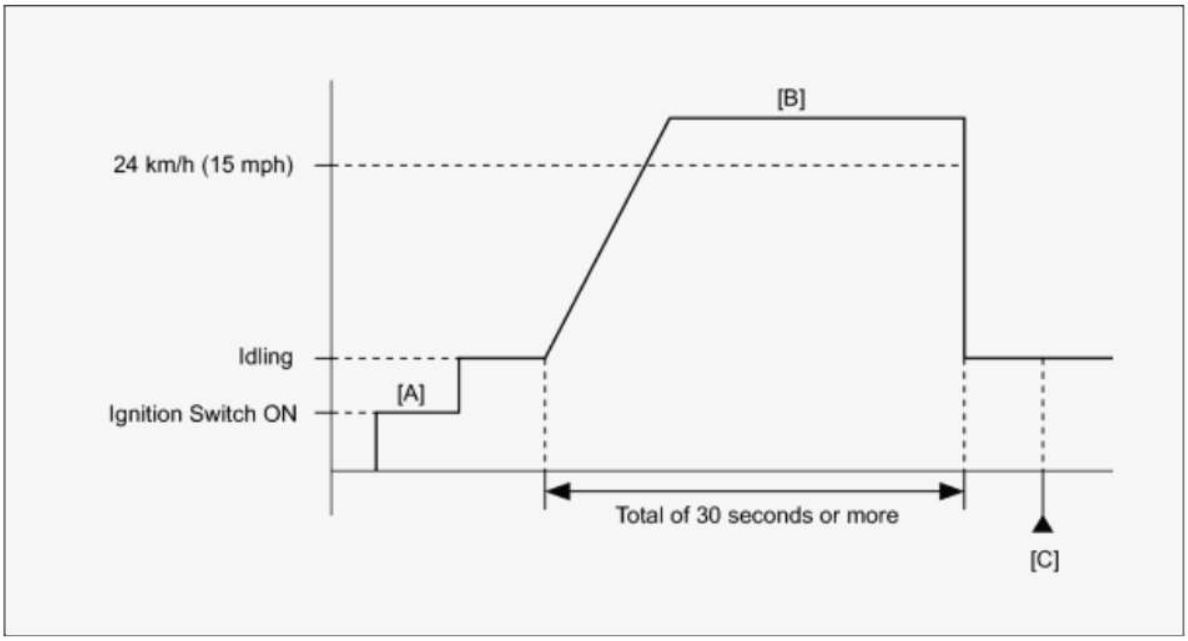
Monitor runs whenever following DTCs not stored	None
Time after ignition switch turned from off to ON	3 seconds or more
Battery voltage	8 V or higher
Ignition switch	ON
Starter	OFF
Engine	Running
Transmission counter gear revolution	300 rpm or more
When either condition below is met	Condition A or B
A. When both conditions below are met	-
Engine coolant temperature	20°C (68°F) or higher
Time after park/neutral position switch turned from on to off	2 seconds or more
B. When both conditions below are met	-
Engine coolant temperature	Below 20°C (68°F)
Time after park/neutral position switch turned from on to off	30 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Vehicle speed sensor signal	No pulse input

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. Drive the vehicle at 24 km/h (15 mph) or more for a total of 30 seconds or more [B].
6. Stop the vehicle.
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P0500.
9. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.

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11. Read Pending DTCs.

HINT:

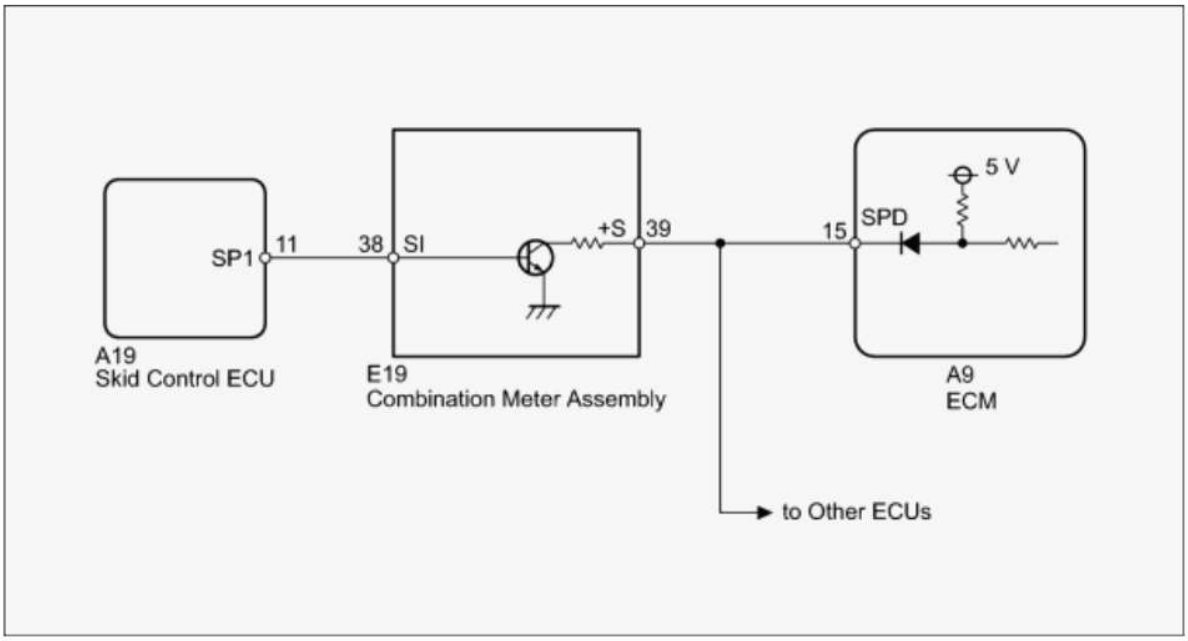
If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- Various systems uses the vehicle speed signal distributed from the combination meter. Check all the components possibly related to speed signal.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK OPERATION OF SPEEDOMETER**

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(a) Drive the vehicle and check whether the operation of the speedometer in the combination meter is normal.

HINT:

- The vehicle speed sensor is operating normally if the speedometer reading is normal.
- If the speedometer does not operate, check it by following the procedure described in Speedometer Malfunction.

NG ▶ **GO TO MALFUNCTION IN SPEEDOMETER**

OK ▼

2.	READ VALUE USING TECHSTREAM (VEHICLE SPEED)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / Vehicle Speed.

(e) Drive the vehicle.

(f) Read the value displayed on the Techstream.

OK:
Vehicle speeds displayed on Techstream and speedometer display are equal.

NG ▶ **CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)**

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

3.	CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)

(a) Disconnect the combination meter connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according the value(s) in the table below.

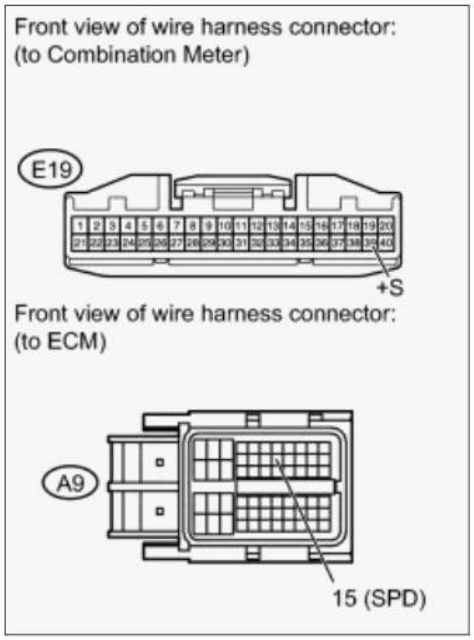
Standard Resistance (Check for open):

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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
E19-39 (+S) - A9-15 (SPD)	Always	Below 1 Ω

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
E19-39 (+S) or A9-15 (SPD) - Body ground	Always	10 kΩ or higher



HINT:

If the wire has a short, check the speed signal circuit in other systems related to the vehicle speed signal (e.g. tire pressure warning system, audio system, etc.).

(d) Reconnect the combination meter connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR (OTHER SYSTEMS RELATED TO SPEED SIGNAL)**

OK ▼

4.	CHECK COMBINATION METER (+S VOLTAGE)

(a) Disconnect the combination meter connector.

HINT:

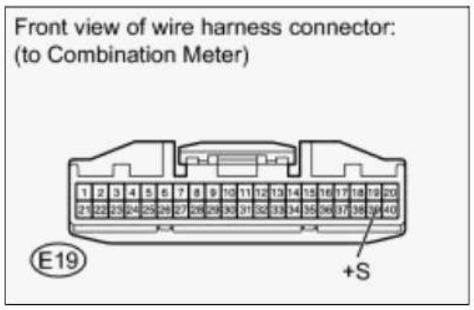
Disconnect the ECU connectors on the other systems related to the speed signal (but the ECM connectors must be connected).

(b) Turn the ignition switch to ON.

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(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:



TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
E19-39 (+S) - Body ground	Ignition switch ON	4.5 to 5.5 V

(d) Reconnect the combination meter connector.

NG ▶ **REPLACE ECM**

OK ▼

5.	**CHECK COMBINATION METER (SPD SIGNAL OUTPUT WAVEFORM)**

(a) Remove the combination meter.

(b) Connect the combination meter connector.

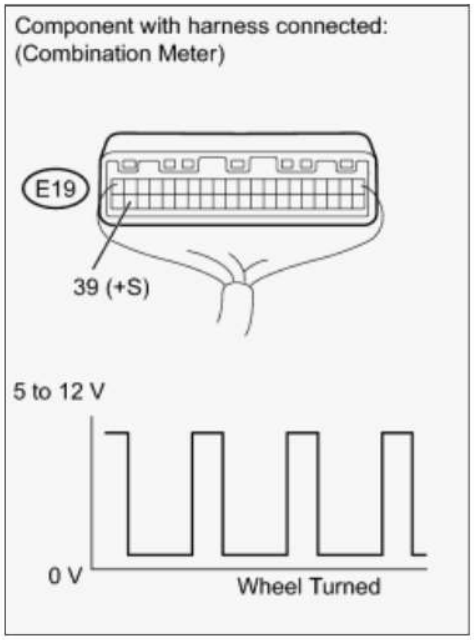
(c) Move the shift lever to N.

(d) Jack up the vehicle.

(e) Turn the ignition switch to ON.

(f) Check the voltage between the terminal of the combination meter and the body ground while the wheel is turned slowly.

Standard Voltage:



TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
E19-39 (+S) - Body ground	Ignition switch ON (Wheel turned slowly)	Voltage generated intermittently

HINT:

- The output voltage fluctuates up and down, similarly to the diagram, when the wheel is turned slowly.
- A voltage of 12 V or 5 V is output from each ECU and then input to

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the combination meter assembly.

(g) Reinstall the combination meter.

NG ▶ **CHECK COMBINATION METER (SPD SIGNAL INPUT WAVEFORM)**

OK ▶ **REPLACE ECM**

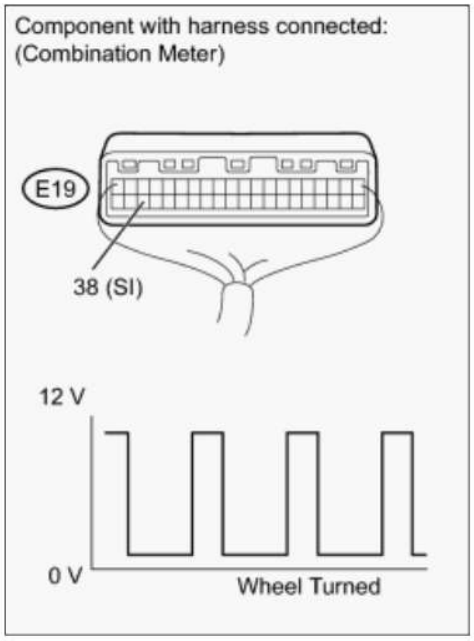
6.	CHECK COMBINATION METER (SPD SIGNAL INPUT WAVEFORM)

(a) Remove the combination meter.

(b) Connect the combination meter connector.

(c) Move the shift lever to N.

(d) Jack up the vehicle.



(e) Turn the ignition switch to ON.

(f) Check the voltage between the terminal of the combination meter and the body ground while the wheel is turned slowly.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
E19-38 (SI) - Body ground	Ignition switch ON (Wheel turned slowly)	Voltage generated intermittently

HINT:

The output voltage fluctuates up and down, similarly to the diagram, when the wheel is turned slowly.

(g) Reinstall the combination meter.

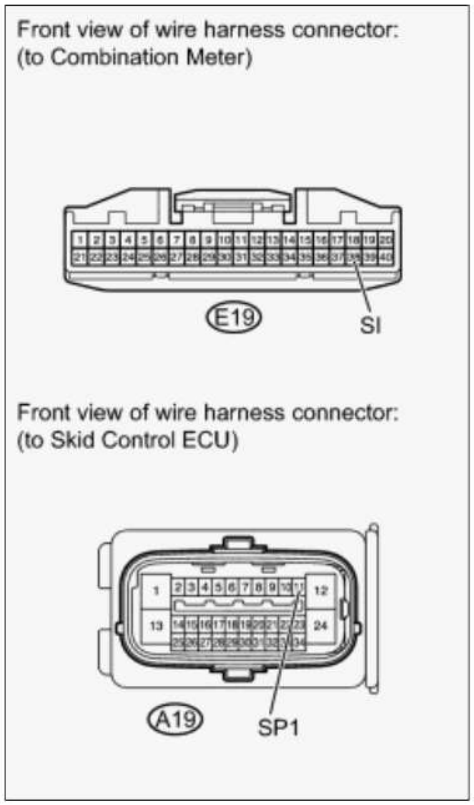
NG ▶ **CHECK HARNESS AND CONNECTOR (COMBINATION METER - SKID**

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CONTROL ECU)

OK ▶ REPLACE COMBINATION METER

7.	CHECK HARNESS AND CONNECTOR (COMBINATION METER - SKID CONTROL ECU)



(a) Disconnect the combination meter connector.

(b) Disconnect the skid control ECU connector.

(c) Measure the resistance according the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
E19-38 (SI) - A19-11 (SP1)	Always	Below 1 Ω

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
E19-38 (SI) or A19-11 (SP1) - Body ground	Always	10 kΩ or higher

(d) Reconnect the combination meter connector.

(e) Reconnect the skid control ECU connector.

NG ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ▶ REPLACE SKID CONTROL ECU

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000XCT0EAX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0504: Brake Switch "A" / "B" Correlation (2011 RAV4)		

DTC	**P0504**	**Brake Switch "A" / "B" Correlation**

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If signals which indicate the brake pedal is being depressed and released are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and stores the DTC.

HINT:

The normal signal conditions are as shown in the table below.

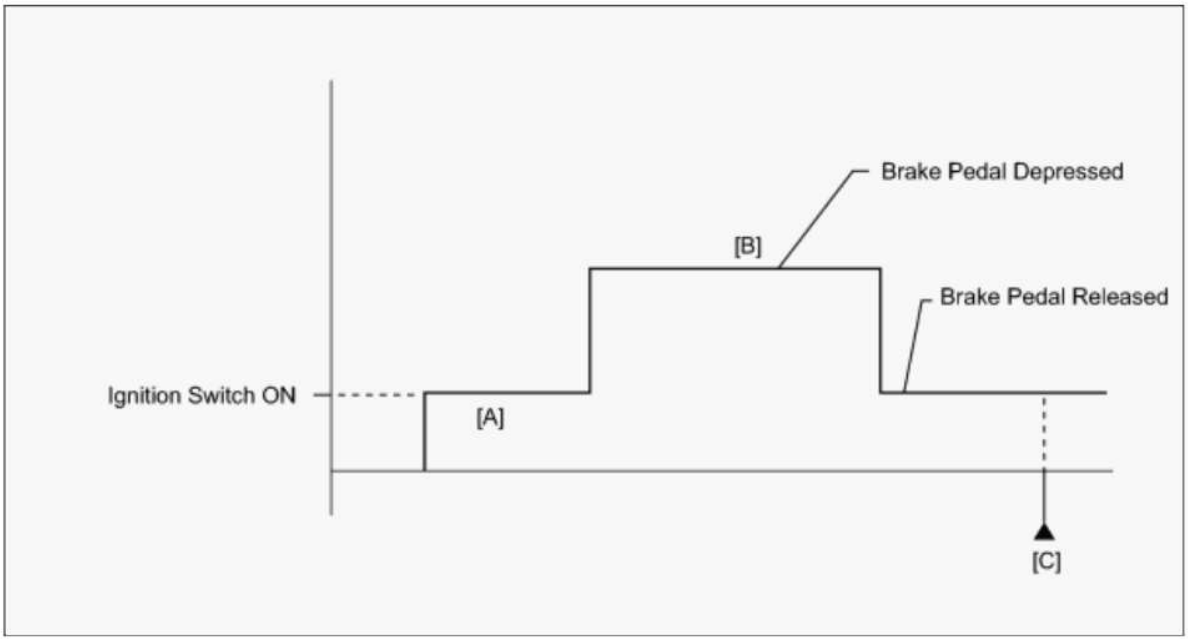
SIGNAL (ECM TERMINAL)	BRAKE PEDAL RELEASED	IN TRANSITION	BRAKE PEDAL DEPRESSED
STP	OFF	ON	ON
ST1-	ON	ON	OFF

- [OFF] denotes ground potential.
- [ON] denotes battery potential (+B).
- On the Techstream, both the Data List items Stop Light Switch and ST1 are ON when the brake pedal is depressed because the ST1 indication characteristic is opposite to the Stop Light Switch indication.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0504	All of the following conditions continue for 0.5 seconds or more (1 trip detection logic): (a) The ignition switch is ON. (b) The brake pedal is released. (c) The STP signal is OFF when the ST1- signal is OFF.	• Short in stop light switch signal circuit • STOP fuse • IGN fuse • Stop light switch • ECM

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Depress and release the brake pedal [B].
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0504.
7. Check the DTC judgment result[C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

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HINT:

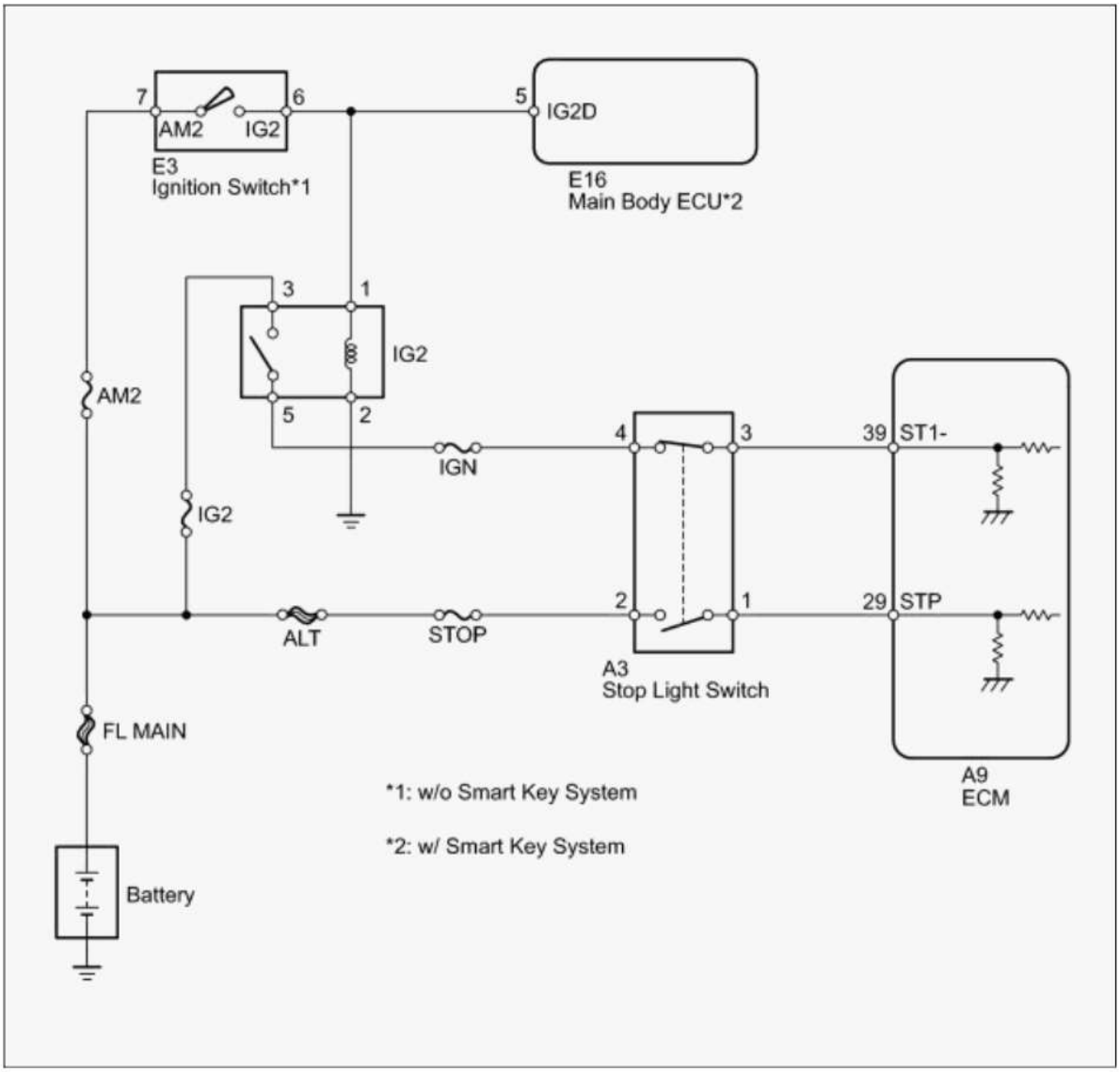
If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was

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moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

- STP signal conditions can be checked using the Techstream.

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Enter the following menus: Powertrain / Engine and ECT / All Data / Stop Light Switch and ST1.
e. Check the Data List indication when the brake pedal is depressed and released.

BRAKE PEDAL OPERATION	STOP LIGHT SWITCH	ST1
Depressed	ON	ON
Released	OFF	OFF

NOTICE:

Inspect the fuses for circuits related to this system before performing the following inspection procedure.

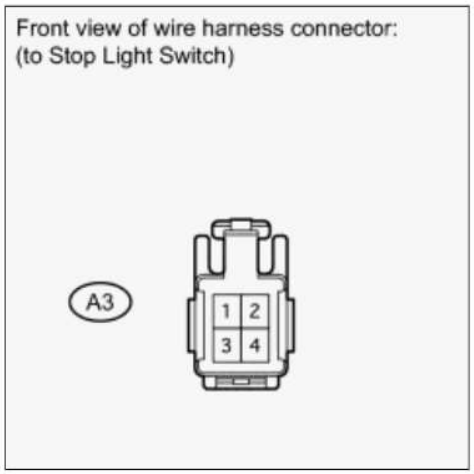
PROCEDURE

1.	**INSPECT STOP LIGHT SWITCH (TERMINAL VOLTAGE)**

(a) Disconnect the stop light switch connector.

(b) Measure the voltage according to the value(s) in the table below.

Standard Voltage:



TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
A3-2 - Body ground	Always	11 to 14 V
A3-4 - Body ground	Ignition switch ON	11 to 14 V

(c) Reconnect the stop light switch connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - STOP LIGHT SWITCH)**

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OK

2.	**INSPECT STOP LIGHT SWITCH**

(a) Inspect the stop light switch INFO .

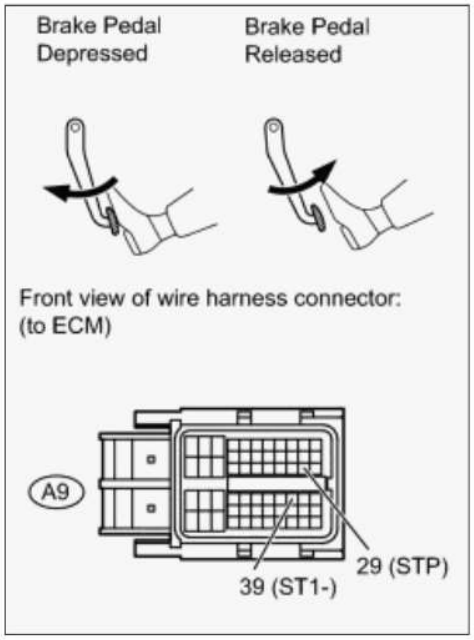
NG **REPLACE STOP LIGHT SWITCH**

OK

3.	**INSPECT ECM (STP AND ST1- VOLTAGE)**

(a) Disconnect the ECM connector.

(b) Turn the ignition switch to ON.



(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A9-39 (ST1-) - Body ground	Brake pedal released	11 to 14 V
	Brake pedal depressed	0 to 3 V
A9-29 (STP) - Body ground	Brake pedal released	0 to 3 V
	Brake pedal depressed	11 to 14 V

(d) Reconnect the ECM connector.

NG **REPAIR OR**

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REPLACE HARNESS OR CONNECTOR

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000T8M0EAX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0505: Idle Control System Malfunction (2011 RAV4)		

DTC	**P0505**	**Idle Control System Malfunction**

DESCRIPTION

The idling speed is controlled by the ETCS (Electronic Throttle Control System). The ETCS is comprised of: 1) the one-valve-type throttle body; 2) the throttle actuator, which operates the throttle valve; 3) the Throttle Position (TP) sensor, which detects the opening angle of the throttle valve; 4) the Accelerator Pedal Position (APP) sensor, which detects the accelerator pedal position; and 5) the ECM, which controls the ETCS. Based on the target idling speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

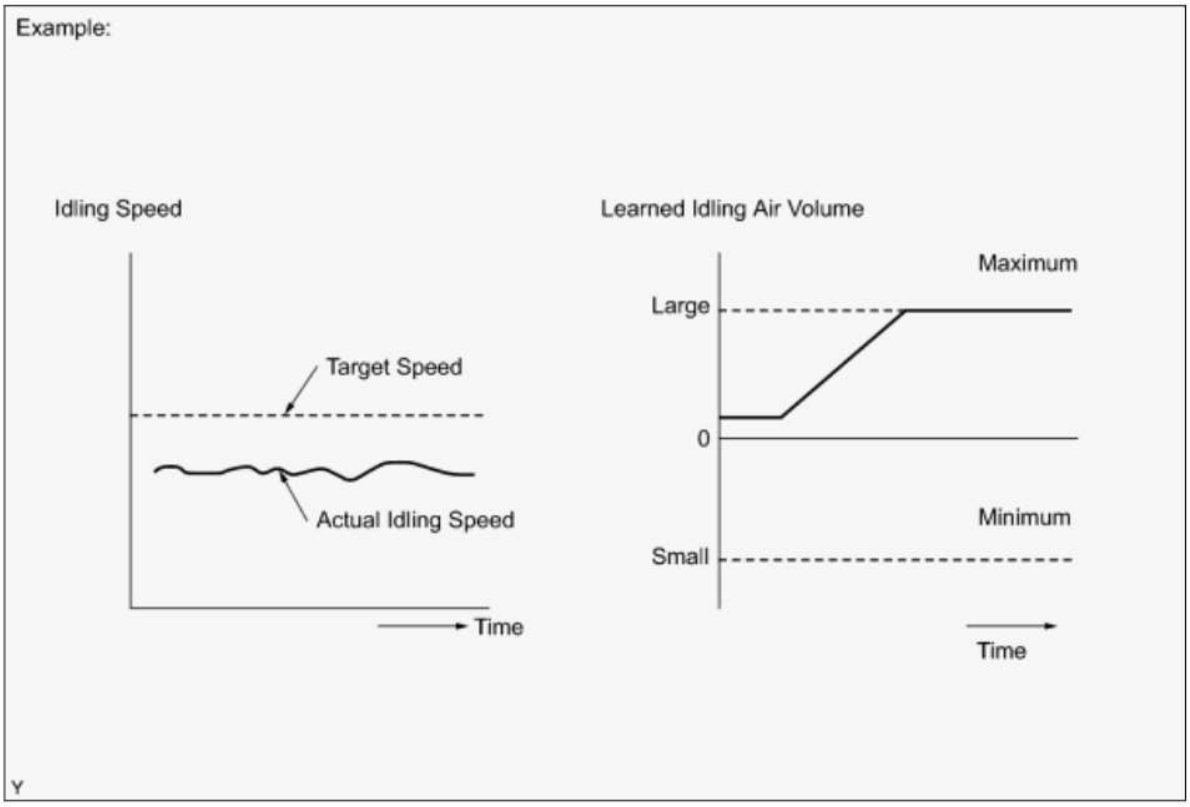
DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0505	The idling speed continues to vary greatly from the target idling speed (2 trip detection logic).	• ETCS (Electronic Throttle Control System) • Air induction system • PCV hose connections • ECM

MONITOR DESCRIPTION

The ECM monitors the idling speed and idling air flow volume to conduct Idle Speed Control (ISC). The ECM determines that the ISC system is malfunctioning if either of the following conditions is met:

- The difference between the target engine idling speed and actual engine idling speed exceeds the threshold and the IAC flow rate learned value is stuck at the upper or lower limit for 5 seconds or more.
- After driving at a vehicle speed of 10 km/h (6.25 mph) or more, the difference between the target and actual engine idling speed exceeds the threshold 5 times or more during a driving cycle, and then the system determines that the IAC flow rate learned value is stuck at the upper or lower limit, or that the IAC flow rate learned value has been changed by an amount that exceeds the threshold.

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MONITOR STRATEGY

Related DTCs	P0505: ISC function
Required Sensors/Components (Main)	ETCS (Electronic Throttle Control System)
Required Sensors/Components (Related)	Crankshaft position sensor Engine coolant temperature sensor Vehicle speed sensor
Frequency of Operation	Once per driving cycle
Duration	10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0010 (VVT Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust VVT Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard)

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	P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust VVT Sensor) P0351 - P0354 (Igniter) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0705 (Shift Lever Position Switch) P0748, P0778 (Pressure Control Solenoid) P0982, P0983 (Shift Solenoid)
Engine	Running

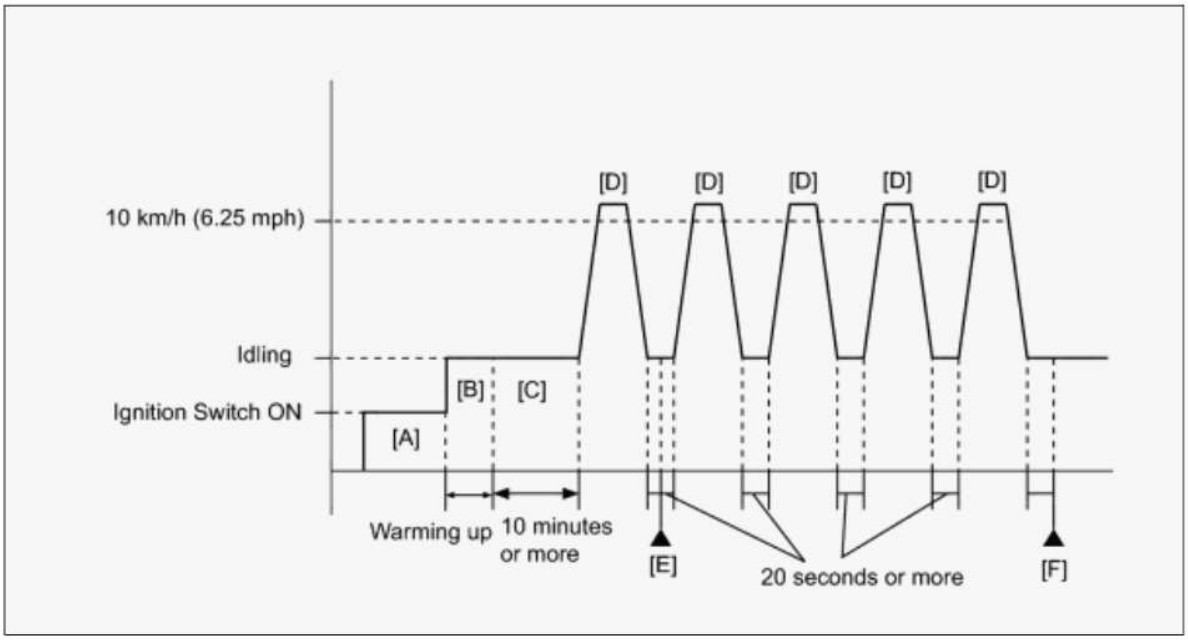
TYPICAL MALFUNCTION THRESHOLDS

Either condition is met	1 or 2
1. Both of following conditions A and B met	-
A. Engine speed - Target engine speed	Less than -100 rpm, or more than 150 rpm (A/C off and NSW off) Less than -100 rpm, or more than 200 rpm (A/C on or NSW on)
B. IAC flow rate learned value	0.9 L/sec. or less, or 6 L/sec. or more for 5 seconds or more
2. Both of following conditions C and D met	-
C. Frequency that both of following conditions (a) and (b) met	5 times or more
(a) Engine speed - Target engine speed	Less than -100 rpm, or more than 150 rpm (A/C off and NSW off) Less than -100 rpm, or more than 200 rpm (A/C on or NSW on)
(b) Vehicle condition	Stopped after being driven at 10 km/h (6.25 mph) or more
D. Either condition is met	(c) or (d)

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(c) IAC flow rate learned value	0.9 L/sec. or less, or 6 L/sec. or more
(d) Amount of change of IAC flow rate learned value	+2.56 L/sec. or more, or -2.56 L/sec. or less

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or more) with all the accessories switched off [B].
5. Idle the engine for 10 minute or more [C].
6. Accelerate the vehicle to 10 km/h (6.25 mph) or more, and then idle the engine [D].
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P0505.
9. Check the DTC judgment result [E].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions

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TESTER DISPLAY	DESCRIPTION
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, repeat step [D] 4 times, allowing 20 seconds or more between each repetition, and then check the DTC judgment result [F].

10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

- The following conditions may also cause DTC P0505 to be stored:
  a. The floor carpet overlapping slightly onto the accelerator pedal, causing the accelerator pedal to be slightly depressed and therefore the throttle valve position to be slightly open.
  b. The accelerator pedal being not fully released.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

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(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0505	A
P0505 and other DTCs	B

HINT:

If any DTCs other than P0505 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**CHECK PCV HOSE CONNECTIONS**

(a) Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG ▶ **REPAIR OR REPLACE PCV HOSE**

OK ▼

3.	**CHECK AIR INDUCTION SYSTEM**

(a) Check the air induction system for vacuum leakage INFO .

OK:

No leakage from air induction system.

NG ▶ **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

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OK

4.	**INSPECT THROTTLE BODY (THROTTLE VALVE)**

(a) Check the throttle valve condition.

OK:

Throttle valve is not contaminated with foreign objects and moves smoothly.

NG ▶ **REPLACE THROTTLE BODY**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000T8P0KKX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0560: System Voltage (2011 RAV4)		

DTC	**P0560**	**System Voltage**

MONITOR DESCRIPTION

The battery supplies electricity to the ECM even when the ignition switch off. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, the memory is cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and stores the DTC.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0560	An open in the ECM back up power source circuit (1 trip detection logic).	• Open in back up power source circuit • Battery • Battery terminals • EFI MAIN fuse • ECM

HINT:

If DTC P0560 is stored, the ECM does not store other DTCs or the data stored in the ECM is partly cleared.

MONITOR STRATEGY

Related DTCs	P0560: ECM system voltage
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	3 seconds
MIL Operation	Immediate (MIL illuminated after next engine start)
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

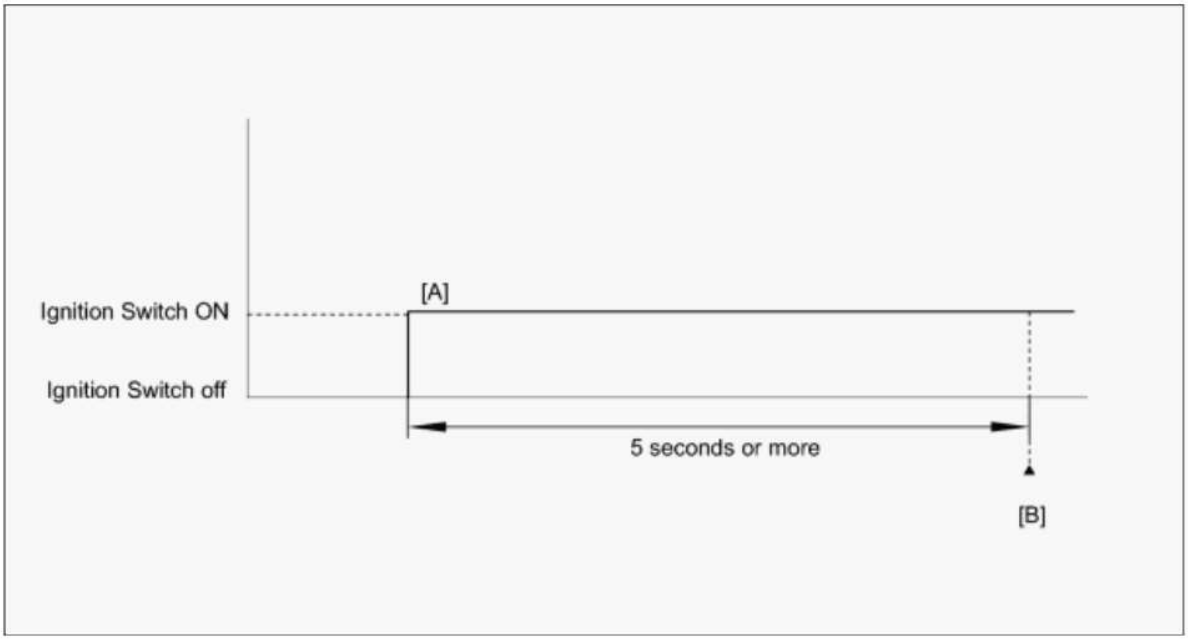
Monitor runs whenever following DTCs not stored	None

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TYPICAL MALFUNCTION THRESHOLDS

ECM power source	Below 3.5 V

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 5 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0560.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions

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TESTER DISPLAY	DESCRIPTION
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

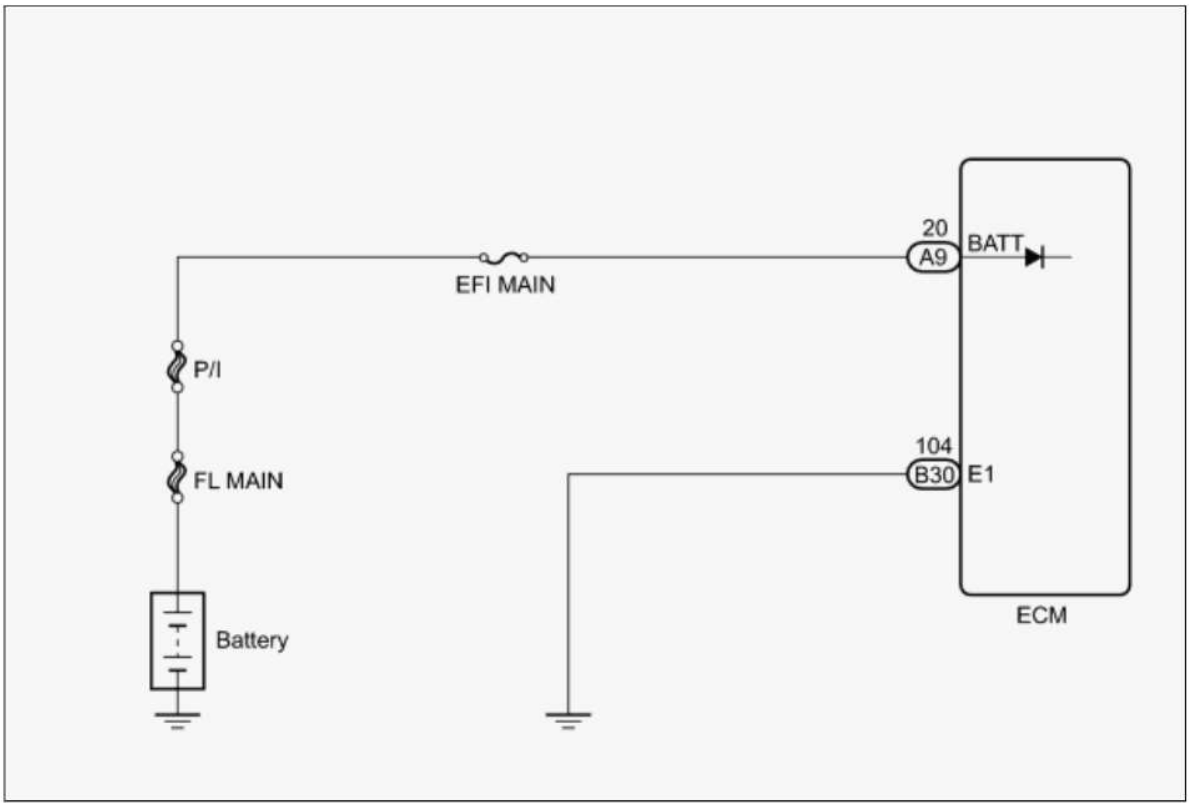
If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

NOTICE:

Inspect the fuses for circuits related to this system before performing the following inspection procedure.

PROCEDURE

1.	**CHECK HARNESS AND CONNECTOR (ECM - BATTERY)**

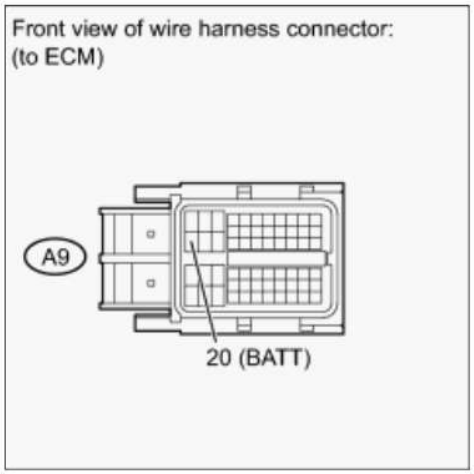
(a) Disconnect the cable from the negative (-) battery terminal.

(b) Disconnect the positive battery terminal.

(c) Disconnect the ECM connector.

(d) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
Battery positive terminal (+) - A9-20 (BATT)	Always	Below 1 Ω

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
Battery positive terminal (+) or A9-20 (BATT) - Body ground	Always	10 kΩ or higher

(e) Reconnect the ECM connector.

(f) Reconnect the positive battery terminal.

(g) Reconnect the negative battery terminal.

NG ▶ **REPAIR OR REPLACE HARNESS**

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OR
CONNECTOR

OK

2.	**INSPECT BATTERY**

(a) Check that the battery is not depleted.

OK:
Battery is not depleted

NG ▶ **REPLACE BATTERY**

OK

3.	**CHECK BATTERY TERMINAL**

(a) Check that the battery terminals are not loose or corroded.

OK:
Battery terminals are not loose or corroded

NG ▶ **REPAIR OR REPLACE BATTERY TERMINAL**

OK

4.	**CHECK WHETHER DTC OUTPUT RECURS**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

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(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Start the engine and turn the Techstream on.

(g) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(h) Read DTCs.

Result

RESULT	PROCEED TO
P0560	A
No output	B

B ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002KQO04MX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0604: Random Access Memory (RAM) (2011 RAV4)		

DTC	**P0604**	**Random Access Memory (RAM)**

MONITOR DESCRIPTION

The ECM continuously monitors its internal memory status. This self-check ensures that the ECM is functioning properly. It is diagnosed by internal "mirroring" of the main CPU and sub CPU to detect Random Access Memory (RAM) errors. If outputs from these CPUs are different and deviate from the standard, the ECM illuminates the MIL and stores the DTC immediately.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0604	ECM RAM errors.	ECM

MONITOR STRATEGY

Related DTCs	P0606: ECM RAM error
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	None
Frequency of operation	Continuous
Duration	16 seconds
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

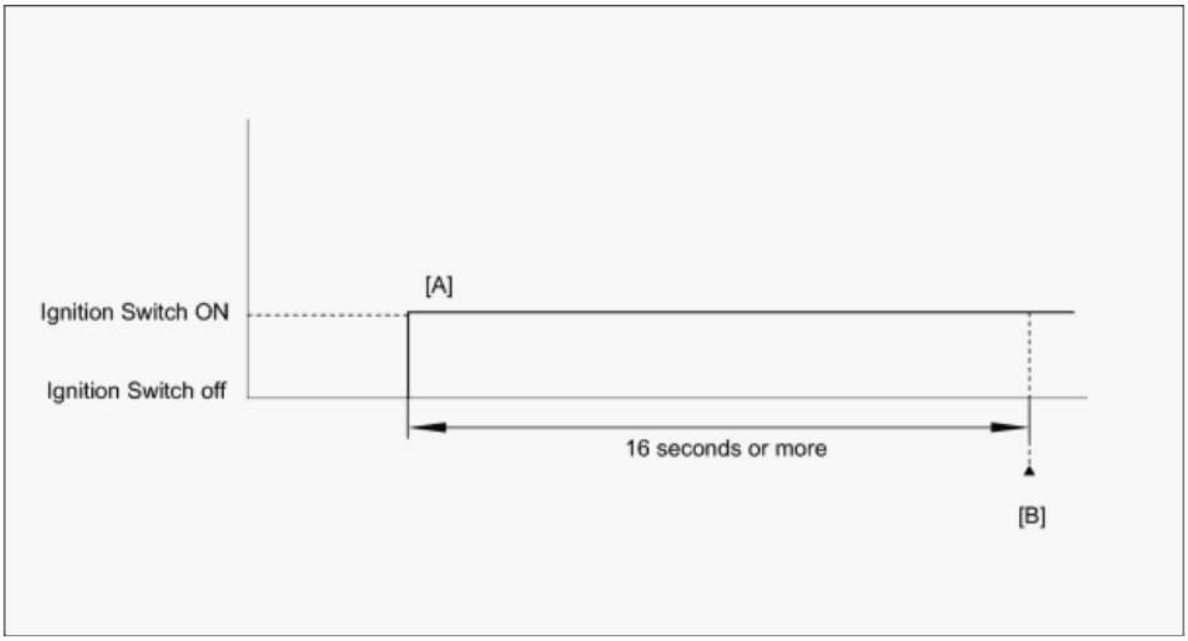
Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

Main CPU and sub CPU mirroring	Fail

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 16 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0604.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

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HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ OUTPUT DTC (DTC P0604)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTC INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Disconnect the Techstream.

(g) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(h) Connect the cable to the negative (-) battery terminal.

(i) Connect the Techstream to the DLC3.

(j) Turn the ignition switch to ON.

(k) Turn the Techstream on.

(l) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(m) Read DTCs.

Result

RESULT	PROCEED TO

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RESULT	PROCEED TO
No output	A
P0604	B

B ▶ **REPLACE ECM**

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM00000324203ZX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0606: ECM / PCM Processor (2011 RAV4)		

DTC	**P0606**	**ECM / PCM Processor**

MONITOR DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM illuminates the MIL and stores the DTC immediately.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0606	An ECM main CPU error.	ECM

MONITOR STRATEGY

Related DTC	P0606: ECM range check
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	16 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

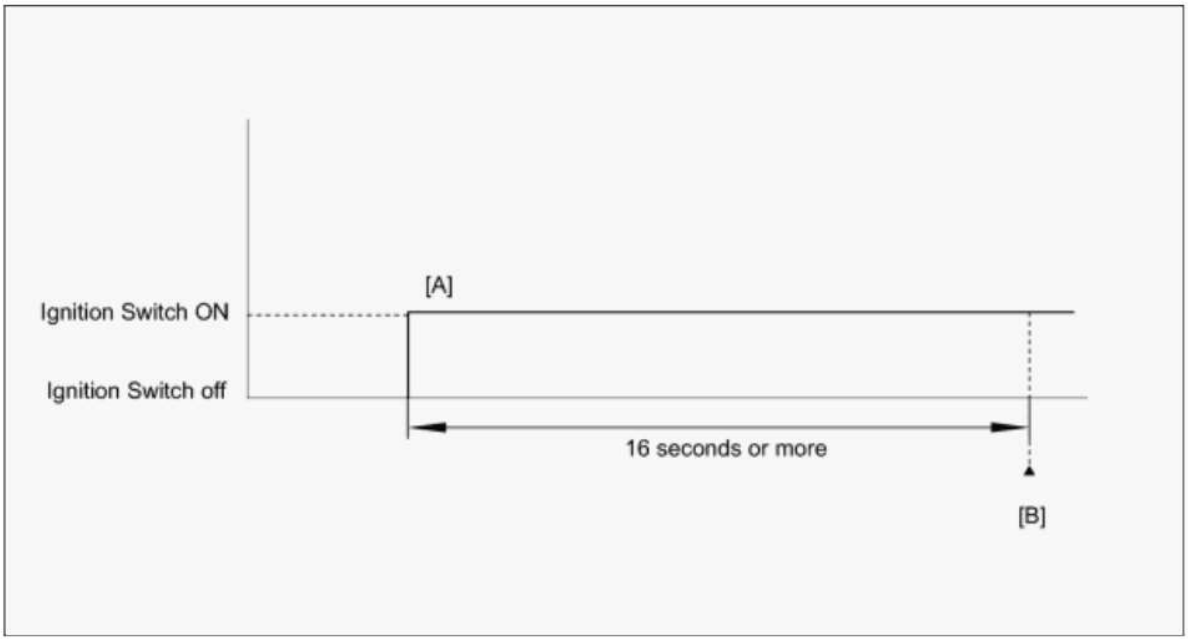
Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

DMA communication	No response

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 16 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0606.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

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HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**READ OUTPUT DTC (DTC P0606)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Disconnect the Techstream.

(g) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(h) Connect the cable to the negative (-) battery terminal.

(i) Connect the Techstream to the DLC3.

(j) Turn the ignition switch to ON.

(k) Turn the Techstream on.

(l) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(m) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P0606	B

B ▶ REPLACE ECM

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A CHECK FOR INTERMITTENT PROBLEMS

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002I3S061X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0607: Control Module Performance (2011 RAV4)		

DTC	**P0607**	**Control Module Performance**

MONITOR DESCRIPTION

The ECM continuously monitors its internal processors (CPUs) and Heated Oxygen (HO2) sensor transistors. This self-check ensures that the ECM is functioning properly.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0607	• The ECM CPUs malfunction. • The heated oxygen sensor transistor (built into the ECM) malfunctions.	• ECM • Heated oxygen sensor • Exhaust gas leak

MONITOR STRATEGY

Related DTCs	P0607: Control module performance
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	Heated oxygen sensor
Frequency of operation	Continuous
Duration	60 seconds
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

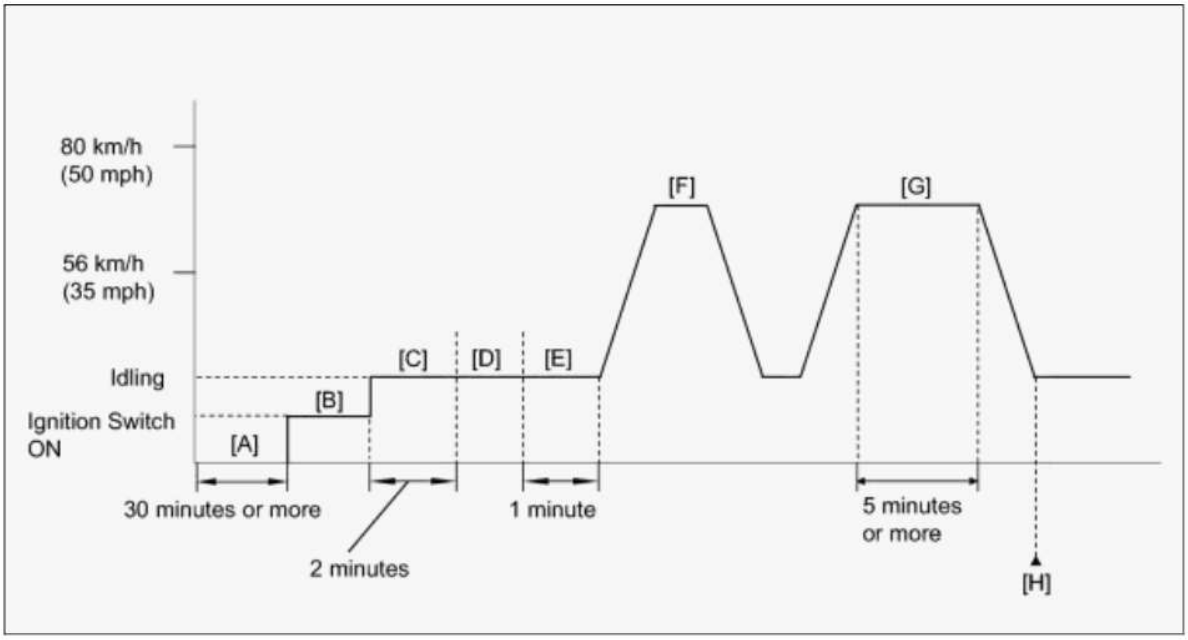
Monitor runs whenever the following DTCs are not stored	None
Engine	Running
Estimated HO2 sensor temperature	450 to 800°C (842 to 1472°F)

TYPICAL MALFUNCTION THRESHOLDS

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Heated oxygen sensor transistors	Fail

CONFIRMATION DRIVING PATTERN



1. Stop the engine for 30 minutes or more [A].
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch to ON and turn the Techstream on.
4. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [B].
5. Start the engine, and wait 2 minutes [C].
6. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [D].
7. Idle the engine for 1 minute [E].
8. Accelerate the vehicle to 80 km/h (50 mph) and stop the vehicle [F].
9. Drive the vehicle at 56 to 80 km/h (35 to 50 mph) for 5 minutes or more [G].
10. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
11. Input the DTC: P0607, P0136, P0137 or P0138.
12. Check the DTC judgment result [H].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions

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TESTER DISPLAY	DESCRIPTION
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] through [H].

13. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
14. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read the DTCs INFO .

Result

RESULT	PROCEED TO

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RESULT	PROCEED TO
P0607 and P0136, P0137 or P0138 are output	A
P0607 is output	B

B ▶ **CHECK FOR EXHAUST GAS LEAK**

A ▼

2.	**INSPECT DTC (P0136, P0137 OR P0138)**

(a) Refer to the P0136, P0137 or P0138 flowchart.

HINT:

- If P0136 is output, troubleshoot for that DTC first INFO . Then proceed to "INSPECT ECM".
- If P0137 is output, troubleshoot for that DTC first INFO . Then proceed to "INSPECT ECM".
- If P0138 is output, troubleshoot for that DTC first INFO . Then proceed to "INSPECT ECM".
- If DTC P0607 and P0136, P0137 or P0138 are output, the output voltage of the heated oxygen sensor may remain close to 0 V or become high (around 1 V or higher).

NEXT ▶ **INSPECT ECM**

3.	**CHECK FOR EXHAUST GAS LEAK**

(a) Allow the engine to idle and rev the engine.

(b) Check for exhaust gas leaks around the heated oxygen sensor.

If any exhaust gas leaks are present, repair them and proceed to "PERFORM CONFIRMATION DRIVING PATTERN".
If no exhaust gas leaks are present proceed to "PERFORM CONFIRMATION DRIVING PATTERN".

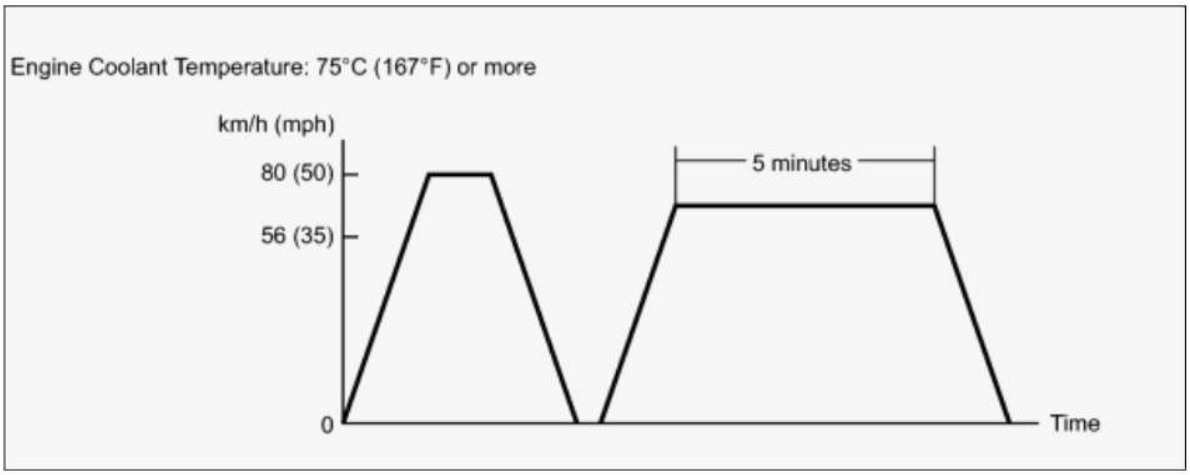
HINT:

- If no exhaust gas leaks are present, a malfunction in the heated oxygen sensor circuit is suspected.
- If any exhaust gas leaks are present around the heated oxygen sensor, noise appears in the output voltage of the heated oxygen sensor.

NEXT

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4.	**PERFORM CONFIRMATION DRIVING PATTERN**



(a) Clear DTC INFO .

(b) Connect the Techstream to the DLC3.

(c) Start the engine.

(d) Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher.

(e) Perform the driving pattern.

(1) Accelerate the vehicle to 80 km/h (50 mph) and stop the vehicle.

(2) Drive the vehicle between 56 and 80 km/h (35 and 50 mph) for 5 minutes.

(f) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(g) Read the DTCs.

Result

RESULT	PROCEED TO
P0136, P0137, P0138 and/or P0607	A
Only P0607	B
No DTC output	C

B ▶ **REPLACE ECM**

C ▶ **INSPECT ECM**

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A

5.	**INSPECT DTC (P0136, P0137 OR P0138)**

(a) Refer to the P0136, P0137 or P0138 flowchart.

HINT:

- If P0136 is output, troubleshoot for that DTC first INFO . Then proceed to "INSPECT ECM".
- If P0137 is output, troubleshoot for that DTC first INFO . Then proceed to "INSPECT ECM".
- If P0138 is output, troubleshoot for that DTC first INFO . Then proceed to "INSPECT ECM".
- If DTC P0607 and P0136, P0137 or P0138 are output, the output voltage of the heated oxygen sensor may remain close to 0 V or become high (around 1 V or higher).

NEXT

6.	**INSPECT ECM**

(a) Clear DTC INFO .

(b) Stop the engine and wait for 30 minutes.

(c) Connect the Techstream to the DLC3.

(d) Start the engine and allow it to idle for 2 minutes.

(e) Turn the Techstream on.

(f) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(g) Check the DTCs.

Result

RESULT	PROCEED TO
DTC is not output	A
P0607 is output	B

B REPLACE ECM

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000TA00LZX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0617: Starter Relay Circuit High (2011 RAV4)		

DTC	**P0617**	**Starter Relay Circuit High**

MONITOR DESCRIPTION

While the engine is being cranked, battery voltage is applied to terminal STA of the ECM. If the ECM detects the Starter Control (STA) signal while the vehicle is being driven, it determines that there is a malfunction in the STA circuit. The ECM then illuminates the MIL and stores the DTC.

This monitor runs when the vehicle is driven at 20 km/h (12.4 mph) for over 20 seconds.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0617	When all of the following conditions are met, and a positive (+B) battery voltage of 10.5 V or higher is applied to the ECM for 20 seconds (1 trip detection logic): • (a) The vehicle speed is 20 km/h (12.4 mph) or more. • (b) The engine speed is 1000 rpm or more. • (c) The STA signal is ON.	• Park/Neutral Position (PNP) switch or clutch start switch • ST relay circuit • Ignition switch • ECM

MONITOR STRATEGY

Related DTCs	P0617: Starter signal
Required Sensors/Components (Main)	ST relay Park/Neutral Position (PNP) switch Ignition switch
Required Sensors/Components (Related)	Vehicle Speed Sensor (VSS) Crankshaft Position (CKP) sensor
Frequency of Operation	Continuous
Duration	20 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None

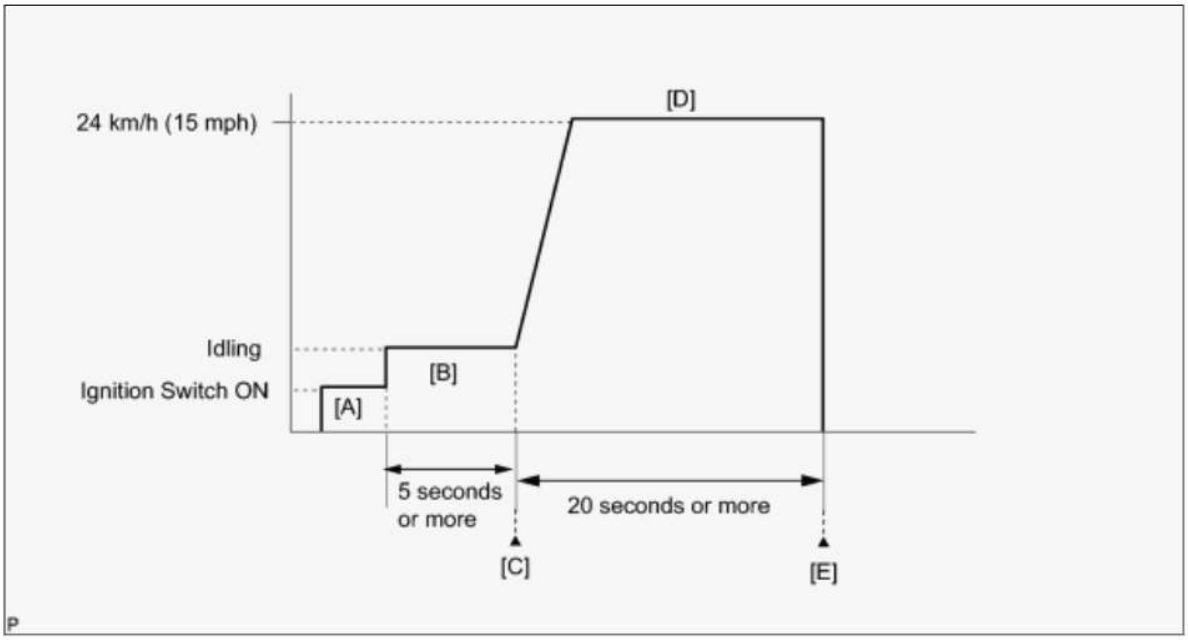
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Battery voltage	10.5 V or higher
Vehicle speed	20 km/h (12.4 mph) or more
Engine speed	1000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

Starter signal	ON

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Idle the engine for 5 minutes or more [B].
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0617.
7. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal

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TESTER DISPLAY	DESCRIPTION
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] and [E].

8. Drive the vehicle at 24 km/h (15 mph) or more for 20 seconds or more [D].
9. Check the DTC judgment result [E].
10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

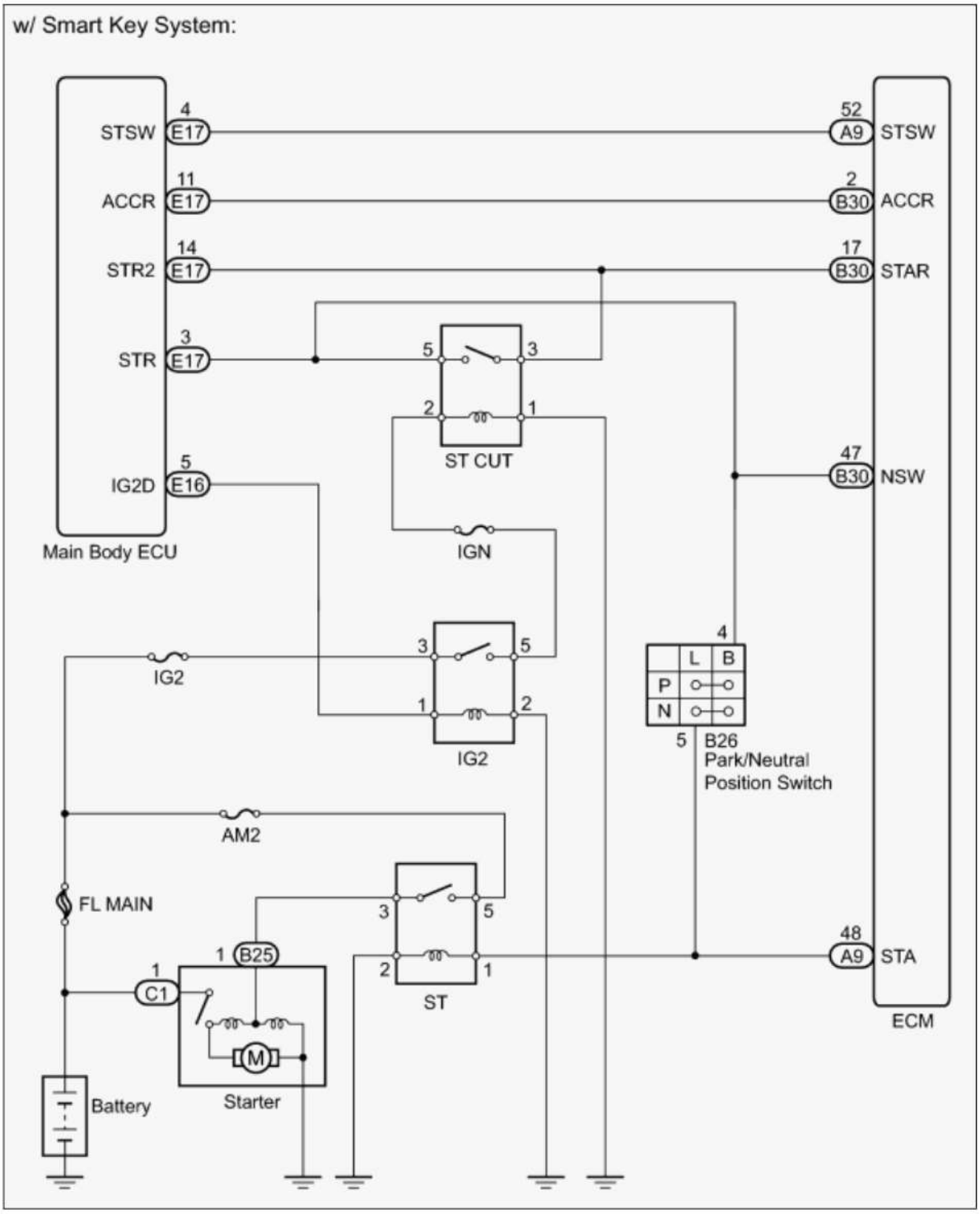
- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

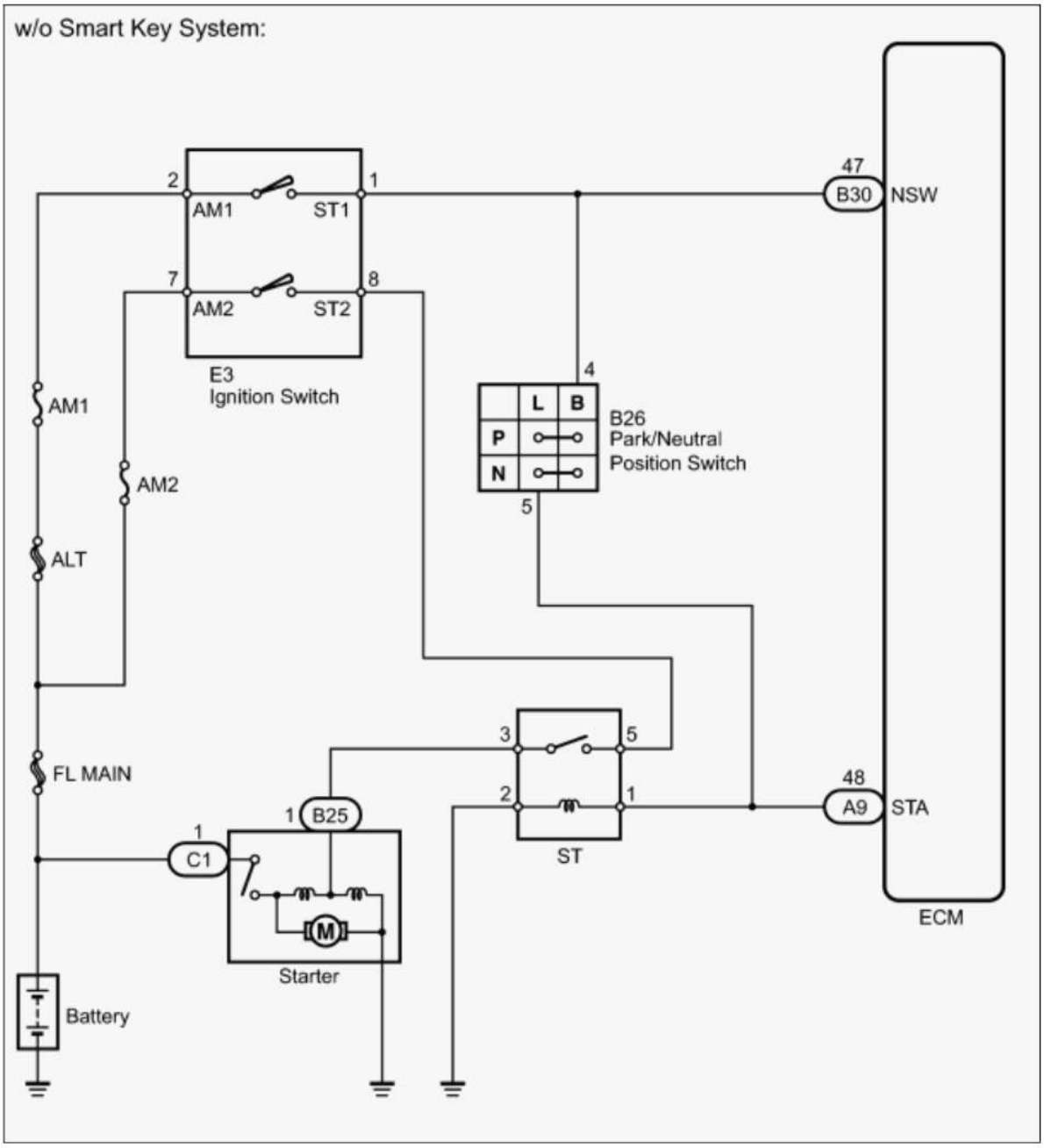
For the details of the park/neutral position switch circuit for 2WD, refer to DTC P0705 INFO .

For the details of the park/neutral position switch circuit for 4WD, refer to DTC P0705 INFO .

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INSPECTION PROCEDURE

HINT:

- The following troubleshooting flowchart is based on the premise that the engine cranks normally.

  If the engine does not crank, proceed to the Problem Symptoms Table INFO .
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

NOTICE:

Inspect the fuses for circuits related to this system before performing the following inspection procedure.

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PROCEDURE

1.	**READ VALUE USING TECHSTREAM (STARTER SIGNAL)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Starter Signal.

(e) Check the value displayed on the Techstream when the ignition switch is turned to ON and START.

OK:

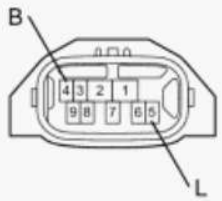
IGNITION SWITCH POSITION	STARTER SIGNAL
ON	OFF
START	ON

NG ▶ **INSPECT PARK/NEUTRAL POSITION SWITCH**

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

2.	**INSPECT PARK/NEUTRAL POSITION SWITCH**

Component without harness connected:
(Park / Neutral Position Switch)



(a) Disconnect the Park/Neutral Position (PNP) switch connector.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
4 (B) - 5 (L)	Shift lever not in P or N	10 kΩ or higher

Result

RESULT	PROCEED TO
OK	A

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RESULT	PROCEED TO
NG for 2WD	B
NG for 4WD	C

(c) Reconnect the PNP switch connector.

B ▶ **REPLACE PARK/NEUTRAL POSITION SWITCH**

C ▶ **REPLACE PARK/NEUTRAL POSITION SWITCH**

A ▼

3.	REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - ST RELAY, PNP SWITCH)

(a) Repair or replace the harness or connector between the ECM and ST relay or PNP switch.

NEXT ▼

4.	CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Drive the vehicle at more than 20 km/h (12.43 mph) for more than 20 seconds.

(f) Enter the following menus: Powertrain / Engine and ECT / Trouble Code.

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(g) Read DTCs.

Result

RESULT	PROCEED TO
DTC P0617 is output	A
DTC is not output	B

B ▶ **END**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PGD05DX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0630: VIN not Programmed or Mismatch - ECM / PCM (2011 RAV4)		

DTC	**P0630**	**VIN not Programmed or Mismatch - ECM / PCM**

MONITOR DESCRIPTION

DTC P0630 is stored when the Vehicle Identification Number (VIN) is not stored in the Engine Control Module (ECM) or the input VIN is not accurate. Input the VIN with the Techstream.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0630	When either of the following conditions is met: • The VIN is not stored in the ECM. • The VIN input into the ECM is not accurate.	ECM

MONITOR STRATEGY

Related DTCs	P0630: VIN not programmed
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.325 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Battery voltage	8 V or higher
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

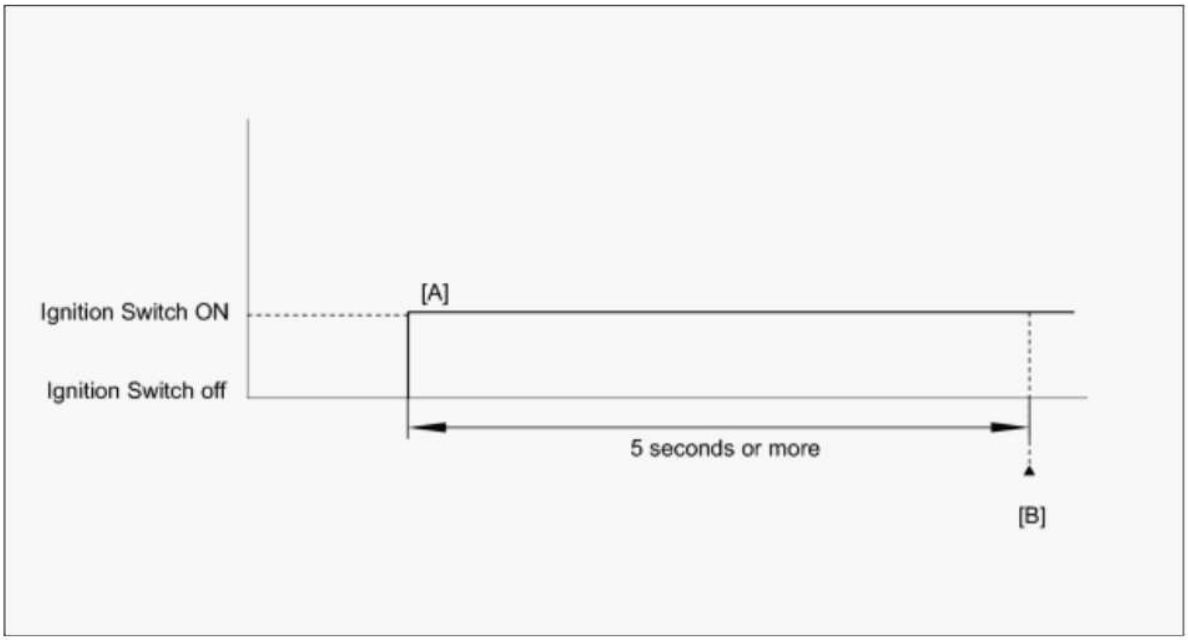
VIN code	Not programmed

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COMPONENT OPERATING RANGE

VIN code	Programmed

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 5 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0630.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU

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TESTER DISPLAY	DESCRIPTION
	memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0630)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P0630	A
P0630 and other DTCs	B

If any DTCs other than P0630 are output, troubleshoot those DTCs first.

NOTICE:

If P0630 is output, the VIN must be input into the ECM using the Techstream. However, all DTCs are

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cleared automatically by the Techstream when inputting the VIN. If DTCs other than P0630 are output, check them first.

B ▶ GO TO DTC CHART

A

2.	**INPUT VIN**

(a) Input the VIN INFO .

NEXT ▶ END

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002I3U068X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0657: Actuator Supply Voltage Circuit / Open (2011 RAV4)		

DTC	**P0657**	**Actuator Supply Voltage Circuit / Open**

MONITOR DESCRIPTION

The ECM monitors the output voltage to the throttle actuator. This self-check ensures that the ECM is functioning properly. The output voltage is usually 0 V when the ignition switch is turned off. If the output voltage is higher than 7 volts when the ignition switch is turned off, the ECM illuminates the MIL and stores the DTC when the ignition switch is turned to ON.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0657	A throttle actuator power supply error.	ECM

MONITOR STRATEGY

Related DTCs	P0657: ETCS power supply
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	Throttle actuator
Frequency of operation	Once per driving cycle
Duration	Within 1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

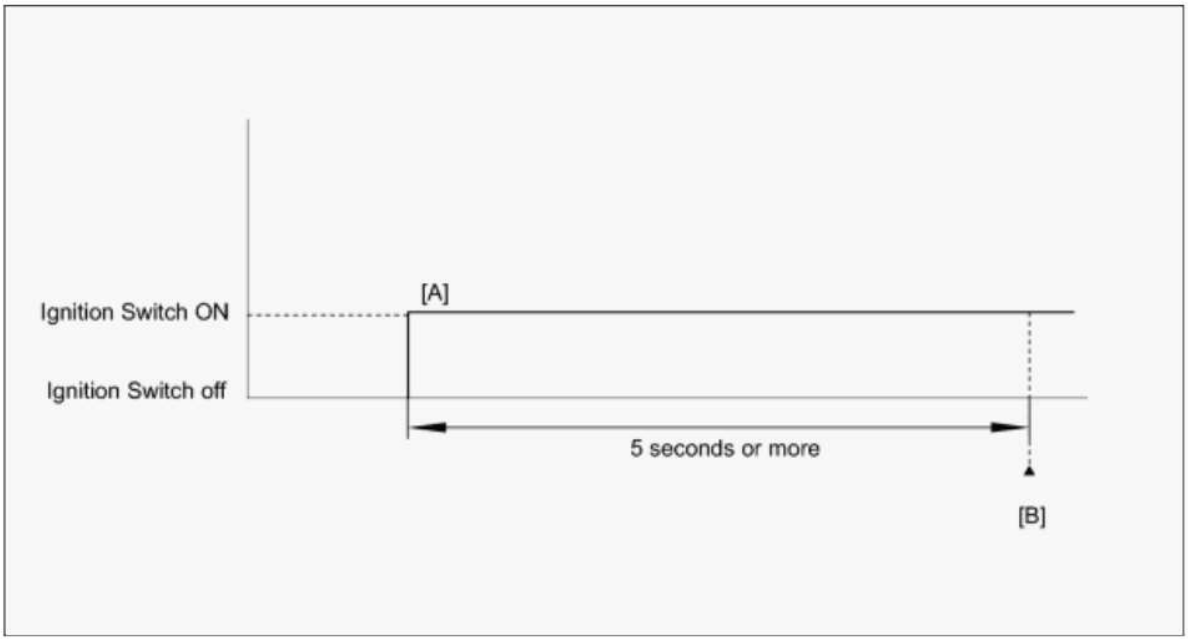
Throttle actuator power supply voltage	7 V or higher

TYPICAL MALFUNCTION THRESHOLDS

Electronic throttle actuator power supply	ON

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).
4. Turn the ignition switch off and wait for at least 30 seconds.
5. Turn the ignition switch to ON and turn the Techstream on.
6. Wait 5 seconds or more [A].
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P0657.
9. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.

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11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ OUTPUT DTC (DTC P0657)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTC INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Disconnect the Techstream.

(g) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(h) Connect the cable to the negative (-) battery terminal.

(i) Turn the ignition switch to ON for 10 seconds.

(j) Turn the ignition switch off.

(k) Turn the ignition switch to ON.

(l) Connect the Techstream to the DLC3.

(m) Turn the Techstream on.

(n) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

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(o) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P0657	B

B ▶ **REPLACE ECM**

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001DN904ZX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0724: Brake Switch "B" Circuit High (2011 RAV4)		

DTC	**P0724**	**Brake Switch "B" Circuit High**

DESCRIPTION

The purpose of this circuit is to prevent the engine from stalling when brakes are suddenly applied while driving in lock-up condition.

When the brake pedal is depressed, this switch sends a signal to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0724	The stop light switch remains on even when the vehicle repeats 5 cycles of STOP (less than 3 km/h [1.86 mph]) and GO (30 km/h [18.65 mph] or more) (2 trip detection logic).	• Short in stop light switch signal circuit • Stop light switch • ECM

MONITOR DESCRIPTION

This DTC indicates that the stop light switch remains on. When the stop light switch remains on during "stop and go" driving, the ECM interprets this as a fault in the stop light switch, the MIL turns on and the ECM stores the DTC. The vehicle must stop (less than 3 km/h [1.86 mph]) and go (30 km/h [18.65 mph] or more) 5 times during 2 driving cycles, in order to detect a malfunction.

MONITOR STRATEGY

Related DTCs	P0724: Stop light switch/Range check/Rationality
Required sensors/Components (Main)	Stop light switch
Required sensors/Components (Related)	Speed sensor
Frequency of Operation	Continuous
Duration	5 times
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

The stop light switch remains ON during STOP and GO 5 times.

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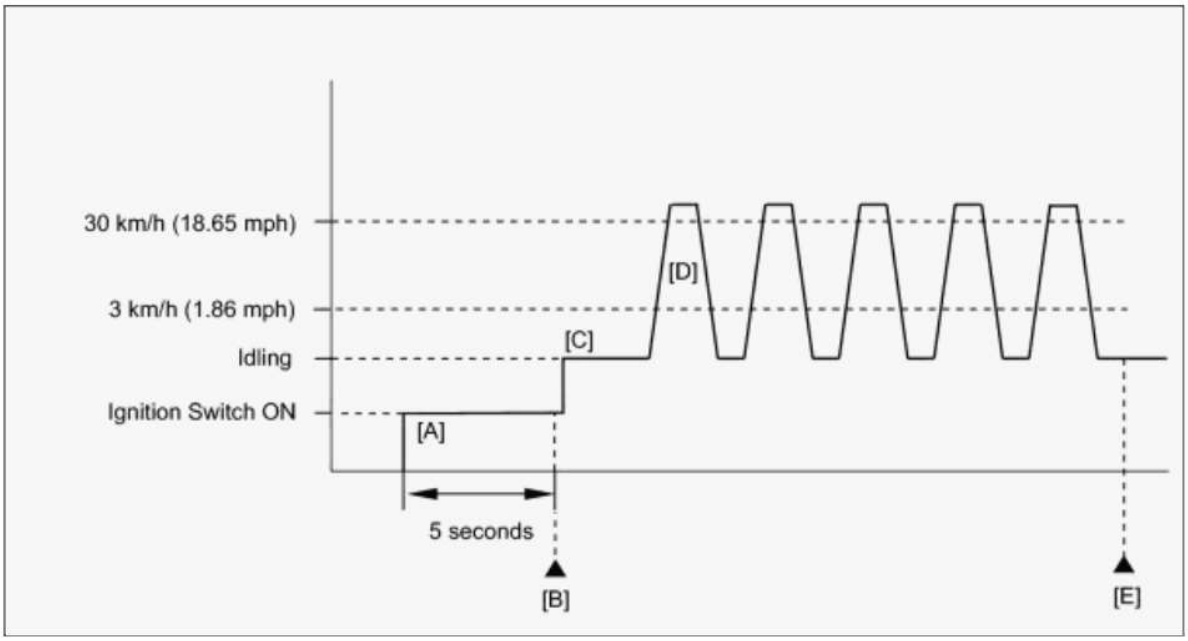
GO and STOP are defined as follows:

Monitor runs whenever following DTCs not stored	None
GO: Vehicle speed	30 km/h (18.65 mph) or more
STOP: Vehicle speed	Less than 3 km/h (1.86 mph)

TYPICAL MALFUNCTION THRESHOLDS

Stop light switch status	Stuck on

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 5 seconds after clear DTCs.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P0724.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal

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TESTER DISPLAY	DESCRIPTION
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [C] through [E].

8. Start the engine [C].
9. Accelerate the vehicle to 30 km/h (19 mph) or more, depress the brake pedal and decelerate the vehicle to 3 km/h (1.8 mph) or less [D]. Repeat step [D] 5 times.
10. Check the DTC judgment result [E].
11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0504 INFO .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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NOTICE:

Inspect the fuses for circuits related to this system before performing the following inspection procedure.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (STOP LIGHT SWITCH)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Stop Light Switch.

(e) Read the values displayed on the Techstream.

OK:

ITEM	MEASUREMENT ITEM: RANGE (DISPLAY)	NORMAL CONDITION
Stop Light Switch	Stop light switch status: ON or OFF	• ON: Brake pedal is depressed • OFF: Brake pedal is released

NG ▶ **INSPECT STOP LIGHT SWITCH**

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

2.	**INSPECT STOP LIGHT SWITCH** INFO

NG ▶ **REPLACE STOP LIGHT SWITCH**

OK ▼

3.	**CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)**

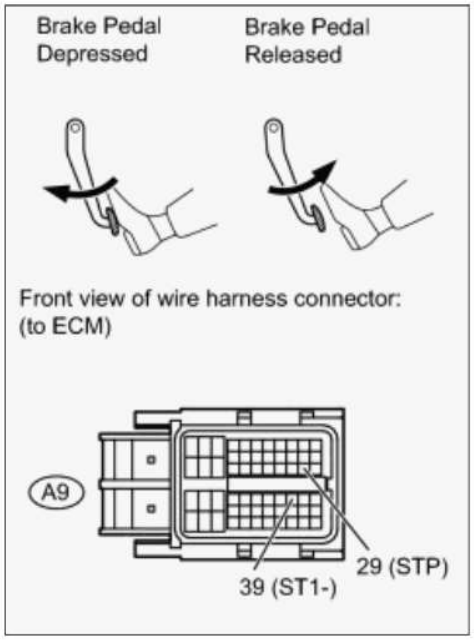
(a) Disconnect the ECM connector.

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(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:



TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A9-39 (ST1-) - Body ground	Brake pedal released	11 to 14 V
	Brake pedal depressed	0 to 3 V
A9-29 (STP) - Body ground	Brake pedal released	0 to 3 V
	Brake pedal depressed	11 to 14 V

(d) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000324403KX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P1607: Cruise Control Input Processor (2011 RAV4)		

DTC	**P1607**	**Cruise Control Input Processor**

MONITOR DESCRIPTION

The ECM continuously monitors its main and sub CPUs while cruise control is operating. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM illuminates the MIL and stores the DTC immediately.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P1607	An ECM internal error.	ECM

MONITOR STRATEGY

Related DTC	P1607: Internal control module range check
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	Cruise control
Frequency of Operation	Continuous
Duration	0.3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

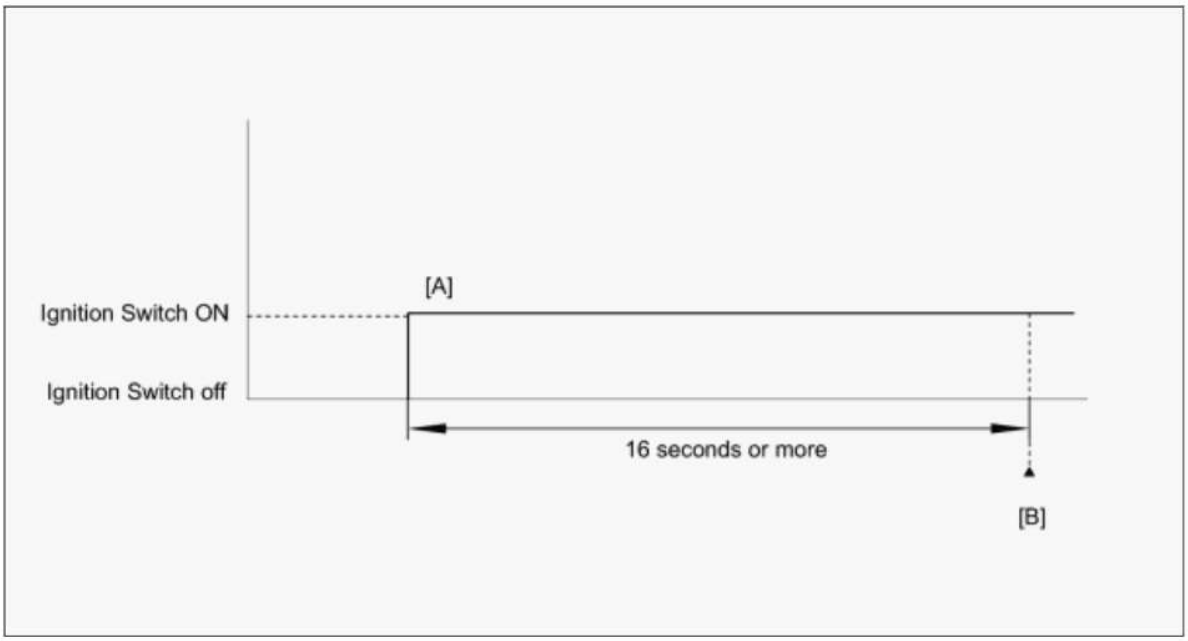
Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

Cruise control	Prohibited
When either condition below is met:	-
• Cruise control	Operating
• Low speed control	Operating

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CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Wait 16 seconds or more.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P1607.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble

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Code / Pending.

9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

PROCEDURE

1.	**READ OUTPUT DTC (DTC P1607)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTC INFO .

(e) Turn the ignition switch off and turn the Techstream off.

(f) Disconnect the Techstream.

(g) Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.

(h) Connect the cable to the negative (-) battery terminal.

(i) Connect the Techstream to the DLC3.

(j) Turn the ignition switch to ON.

(k) Turn the Techstream on.

(l) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(m) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P1607	B

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B ▶ REPLACE ECM

A ▶ CHECK FOR INTERMITTENT PROBLEMS

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WZ4011X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2004,P2006: Intake Manifold Runner Control Stuck Open (Bank 1) (2011 RAV4)		

DTC	**P2004**	**Intake Manifold Runner Control Stuck Open (Bank 1)**

DTC	**P2006**	**Intake Manifold Runner Control Stuck Closed (Bank 1)**

DESCRIPTION

The Tumble Control Valve (TCV) is built into the intake manifold. The TCV is composed of a position sensor and a DC motor. The DC motor opens and closes the TCV in response to signals from the ECM. The position sensor detects the opening angle of the TCV.

When the TCV is closed, the intake air tumble flow intensifies and negative pressure is generated between the tumble control valve and intake valve which atomizes the fuel. Combustion is enhanced and exhaust gas emissions are reduced at low temperatures.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2004 (Stuck open)	When the TCV opening angle is 17° or more after requesting the TCV to fully close (2 trip detection logic).	• DC Motor for TCV circuit • DC Motor for TCV • TCV position sensor • TCV • ECM
P2006 (Stuck closed)	When the TCV opening angle is less than 35° after requesting the TCV to fully open (2 trip detection logic).	• Same as DTC No. P2004

HINT:

After confirming DTCs P2004 and/or P2006, use the Techstream to confirm the Intake Air Control Position while performing Control the IAC Duty Ratio of the Active Test.

Reference (Normal condition):

CONTROL THE IAC DUTY RATIO OPERATION	INTAKE AIR CONTROL POSITION
100%	70°
0%	70°
-100%	2°

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Reference (Normal condition):

COOLANT TEMPERATURE AND INTAKE AIR TEMPERATURE AT ENGINE START	INTAKE AIR CONTROL POSITION
-10°C or less	70°
60°C or higher	70°
-10 to 60°C	2°

MONITOR DESCRIPTION

When the ECM has requested a TCV close operation but the actual TCV opening angle is 17° or more for 10 seconds, DTC P2004 is output. When the ECM has requested a TCV open operation but the actual TCV opening angle is less than 35° for 10 seconds, DTC P2006 is output.

MONITOR STRATEGY

Related DTCs	P2004: Tumble Control Valve (TCV) Stuck Open P2006: TCV Stuck Closed
Required sensors/components (Main)	TCV
Required sensors/components (Related)	IAT sensor, ECT sensor
Frequency of operation	Once per driving cycle
Duration	Approximately 10 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not stored	None
ECT	-10°C (14°F) or higher
IAT	-10°C (14°F) or higher
Control valve half-open operation	Not operated
Ignition switch	ON
Control valve	Not operated by scan tool
Battery voltage during close operation	8 V or higher
When either condition below is met	Condition A or B
A. When both conditions below are met	-
ECT at engine start	5°C (41°F) or higher
IAT at engine start	5°C (41°F) or higher

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B. When both conditions below are met	-
ECT	70°C (158°F) or higher
Vehicle speed	Less than 75 km/h (46 mph)

P2004:

Command to control valve	Closed

P2006:

Command to control valve	Open

TYPICAL MALFUNCTION THRESHOLDS

P2004:

Control valve angle	17° or more

P2006:

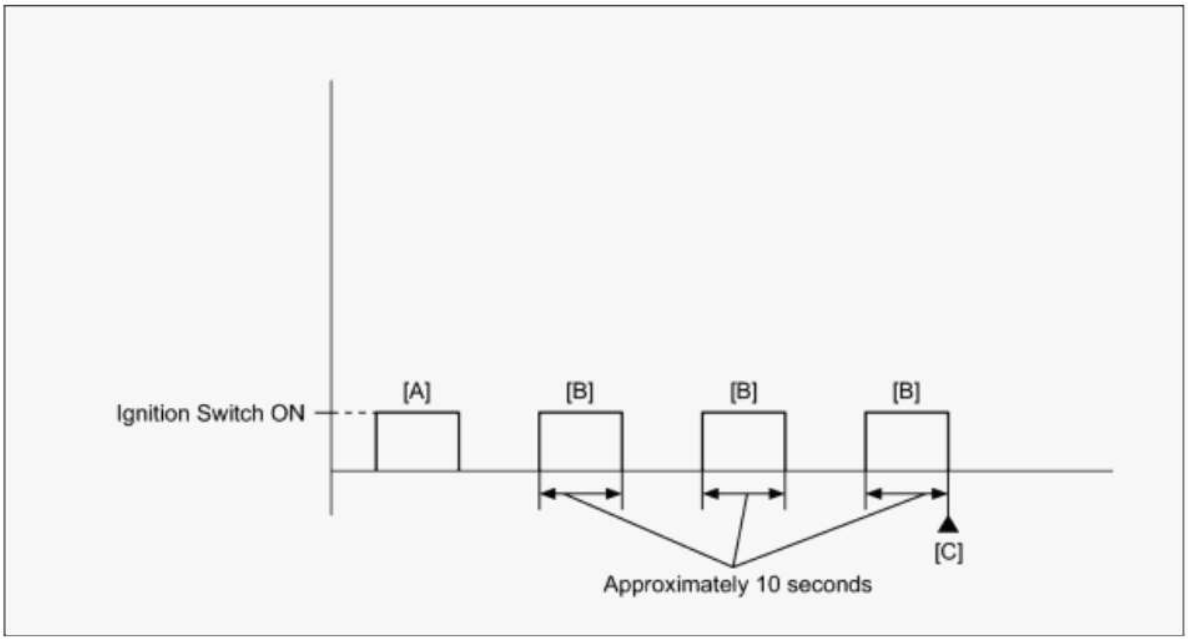
Control valve angle	Less than 35°

COMPONENT OPERATING RANGE

Control valve angle	0 to 70°

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON [A].
3. Turn the Techstream on.
4. Clear the DTCs.
5. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.

HINT:

- Check DTC P2004 at a coolant temperature of 30°C or less.
- Check DTC P2006 at a coolant temperature of 80°C or higher.

6. Turn the ignition switch off.
7. Turn the ignition switch to ON, wait approximately 10 seconds, and then turn the ignition switch off. Repeat this procedure 3 times [B].
8. Enter the following menus: Powertrain / Engine and ECT / Utility / All readiness.
9. Input the DTC: P2004 or P2006.
10. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU's

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TESTER DISPLAY	DESCRIPTION
	memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

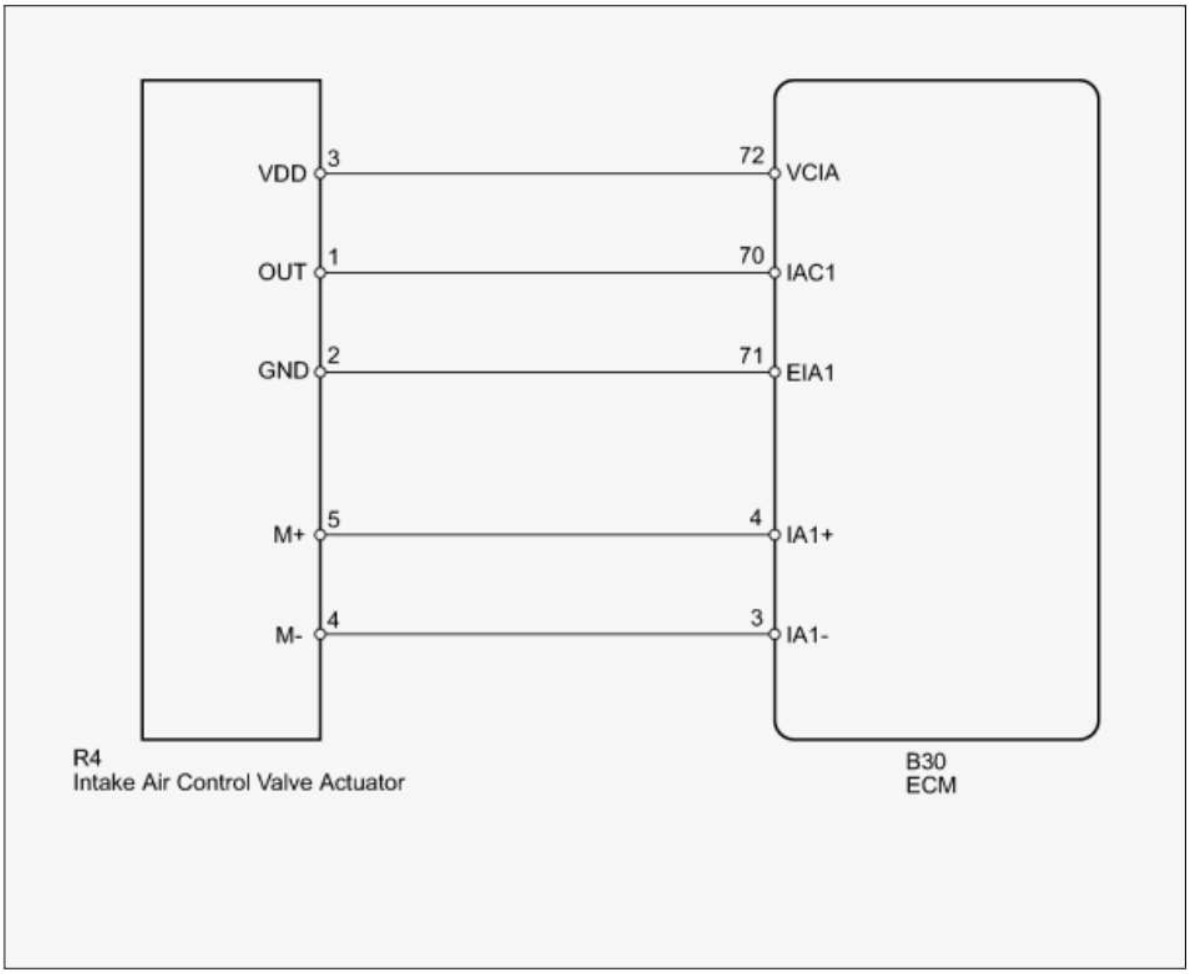
13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2004 OR P2006)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

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Result

DISPLAY (DTC OUTPUT)	PROCEED TO
P2004 or P2006	A
P2004 or P2006 and other DTCs	B

HINT:

If any DTCs other than P2004 or P2006 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A

▼

2.	**INSPECT INTAKE MANIFOLD (DC MOTOR FOR TCV OPERATION)**

(a) Inspect the intake manifold INFO .

NG ▶ **REPLACE INTAKE MANIFOLD**

OK

▼

3.	**CHECK HARNESS AND CONNECTOR (ECM - DC MOTOR FOR TCV)**

(a) Disconnect the ECM connector.

(b) Disconnect the intake air control valve actuator connector.

(c) Measure the resistance according to the value(s) in the table below.

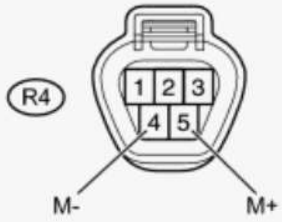
Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-3 (IA1-) - R4-4 (M-)	Always	Below 1 Ω

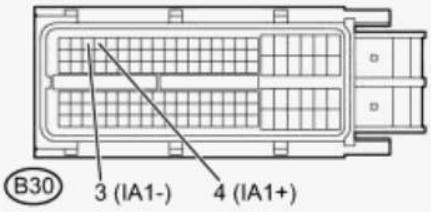
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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-4 (IA1+) - R4-5 (M+)	Always	Below 1 Ω

Front view of wire harness connector:
(to Intake Air Control Valve Actuator)



Front view of wire harness connector:
(to ECM)



Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-3 (IA1-) or R4-4 (M-) - Body ground	Always	10 kΩ or higher
B30-4 (IA1+) or R4-5 (M+) - body ground	Always	10 kΩ or higher

(d) Reconnect the ECM connector.

(e) Reconnect the intake air control valve actuator connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

4.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P2004 OR P2006)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs.

(e) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(f) Read DTCs.

Result

DISPLAY (DTC OUTPUT)	PROCEED TO
P2004 or P2006	A

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DISPLAY (DTC OUTPUT)	PROCEED TO
No DTC	B

B ▶ **SYSTEM OK**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WZ5011X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2009,P2010: Intake Manifold Runner Control Circuit Low (Bank 1) (2011 RAV4)		

DTC	**P2009**	**Intake Manifold Runner Control Circuit Low (Bank 1)**

DTC	**P2010**	**Intake Manifold Runner Control Circuit High (Bank 1)**

DESCRIPTION

The ECM activates the DC motor for the Tumble Control Valve (TCV), which opens and closes the TCV. The ECM activates the DC motor based on engine speed, coolant temperature, intake air temperature and other conditions.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2009	Both of the following conditions continue for 1 second (1 trip detection logic): (a) The output duty of the DC motor for the TCV is 100%. (b) The current of the DC motor for the TCV is below 0.35 A.	• Open or short in DC motor for TCV circuit • Intake manifold (DC motor for TCV) • ECM
P2010	Either of the following conditions continues for 0.2 seconds or more (1 trip detection logic): (a) The motor drive IC is overcurrent. (b) The motor drive IC overheats.	• Open or short in DC motor for TCV circuit • Intake manifold (DC motor for TCV) • ECM

MONITOR DESCRIPTION

When the voltage of the DC motor deviates from the standard range, the ECM determines that a malfunction has occurred and outputs a DTC.

MONITOR STRATEGY

Related DTCs	P2009: DC motor for TCV Range Check (Low Current) P2010: DC motor for TCV Range Check (High Current)
Required sensors/components (Main)	Tumble Control Valve (Actuator)
Required sensors/components (Related)	None
Frequency of operation	Continuous

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Duration	DC motor for TCV Range Check (Low Current): 1 second DC motor for TCV Range Check (High Current): 10 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

P2009:

The monitor will run whenever these DTCs are not stored	None
Battery voltage	8 V or higher
Starter	OFF
Output signal duty	100%
Difference between motor current and previous motor current	Below 0.2 A

P2010:

The monitor will run whenever these DTCs are not stored	None
Battery voltage	8 V or higher
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

P2009:

DC motor for TCV current	Below 0.35 A

P2010:

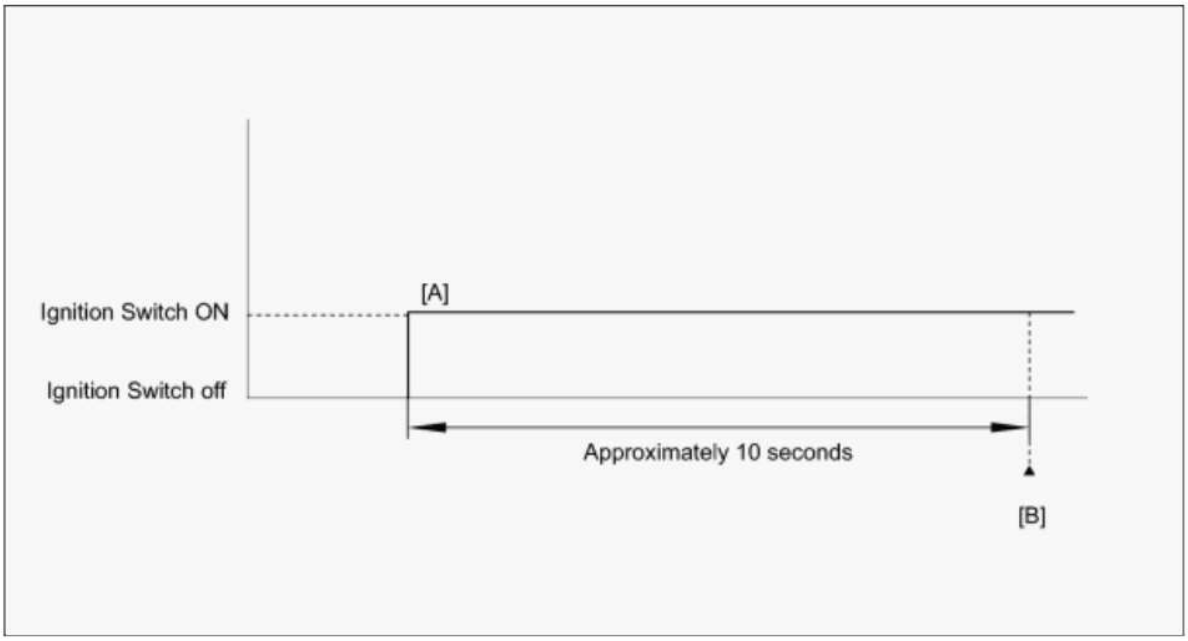
Motor drive IC high current limiter port	Fail

COMPONENT OPERATING RANGE

DC motor for TCV current	0.4 to 3 A

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear the DTCs.
5. Enter the following menus: Powertrain / Engine and ECT / Data List / Coolant Temp.
6. Check that the coolant temperature is 60°C (140°F) or higher.
7. Wait approximately 10 seconds [A].
8. Enter the following menus: Powertrain / Engine and ECT / Utility / All readiness.
9. Input the DTC: P2009 or P2010.
10. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

11. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble

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Code / Pending.

12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P2004 INFO .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**INSPECT INTAKE MANIFOLD (DC MOTOR FOR TCV OPERATION)**

(a) Inspect the intake manifold INFO .

NG ▶ **REPLACE INTAKE MANIFOLD**

OK ▼

2.	**CHECK HARNESS AND CONNECTOR (ECM - DC MOTOR FOR TCV)**

(a) Disconnect the ECM connector.

(b) Disconnect the intake air control valve actuator connector.

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(c) Measure the resistance according to the value(s) in the table below.

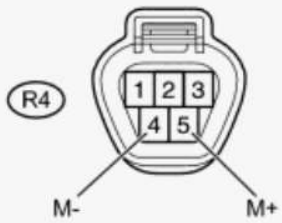
Standard Resistance (Check for open)::

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-3 (IA1-) - R4-4 (M-)	Always	Below 1 Ω
B30-4 (IA1+) - R4-5 (M+)	Always	Below 1 Ω

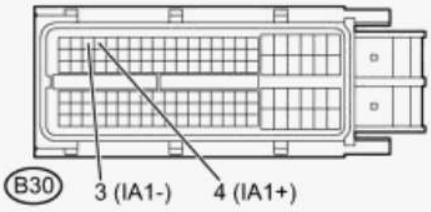
Standard Resistance (Check for short)::

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-3 (IA1-) or R4-4 (M-) - Body ground	Always	10 kΩ or higher
B30-4 (IA1+) or R4-5 (M+) - body ground	Always	10 kΩ or higher

Front view of wire harness connector:
(to Intake Air Control Valve Actuator)



Front view of wire harness connector:
(to ECM)



(d) Reconnect the ECM connector.

(e) Reconnect the intake air control valve actuator connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

3.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P2009 OR P2010)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(f) Read DTCs.

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Result

DISPLAY (DTC OUTPUT)	PROCEED TO
P2009 or P2010	A
No DTC	B

B ▶ **CHECK FOR INTERMITTENT PROBLEMS**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WZ6012X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2014,P2016,P2017: Intake Manifold Runner Position Sensor / Switch Circuit (Bank 1) (2011 RAV4)		

DTC	**P2014**	**Intake Manifold Runner Position Sensor / Switch Circuit (Bank 1)**

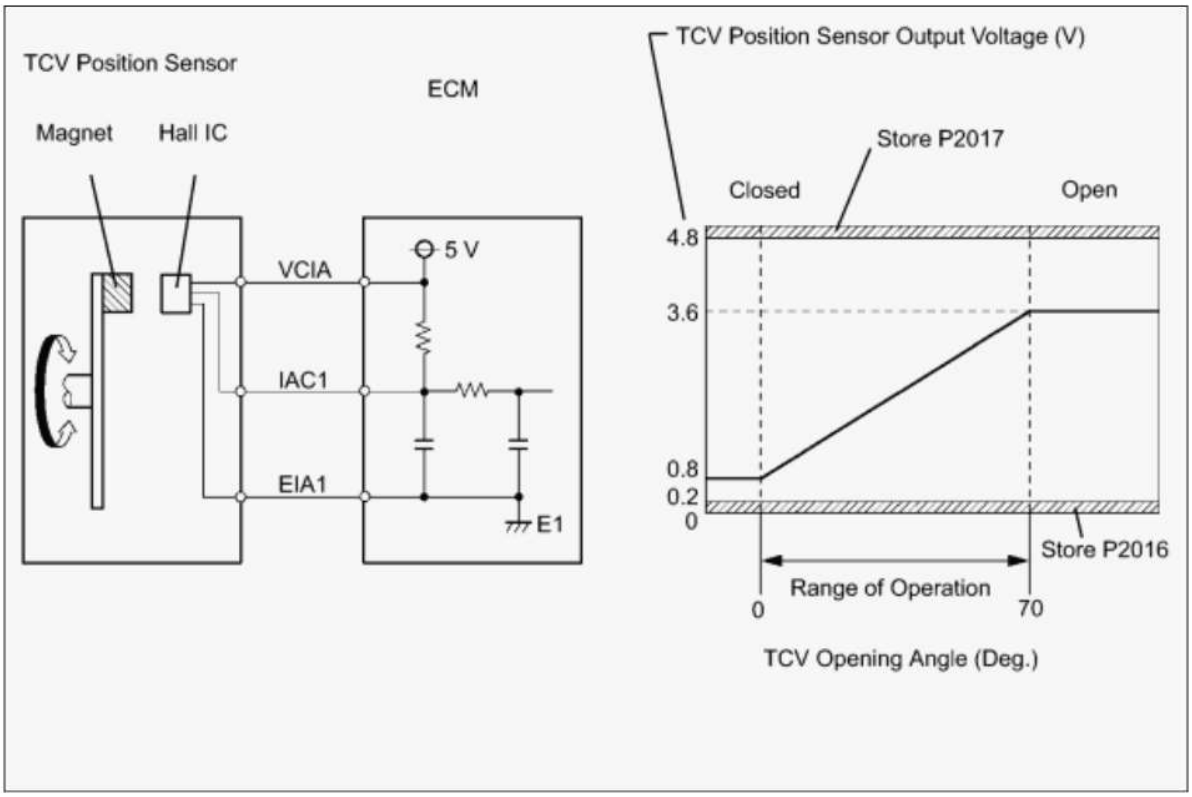
DTC	**P2016**	**Intake Manifold Runner Position Sensor / Switch Circuit Low (Bank 1)**

DTC	**P2017**	**Intake Manifold Runner Position Sensor / Switch Circuit High (Bank 1)**

DESCRIPTION

The Tumble Control Valve (TCV) position sensor is a non-contact type sensor.

The position sensor measures the opening angle of the TCV. The sensor is reliable and accurate, as it is electrically controlled by Hall elements.



DTC	DTC DETECTION CONNECTION	TROUBLE AREA

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NO.		
P2014	The TCV position sensor output voltage flutters up and down beyond the normal operating range (below 0.2 V or higher than 4.8 V) for more than 0.5 seconds (open or short) (1 trip detection logic).	• Open or short in TCV position sensor circuit • TCV position sensor • ECM
P2016	The TCV position sensor output voltage is below 0.2 V for more than 0.5 seconds (short) (1 trip detection logic).	• Same as DTC No. P2014
P2017	The TCV position sensor output voltage is higher than 4.8 V for more than 0.5 seconds (open) (1 trip detection logic).	• Same as DTC No. P2014

HINT:

After confirming DTC P2014, P2016 or P2017, use the Techstream to confirm the IAC Sensor Voltage (TCV position sensor output voltage). Enter the following menus: Powertrain / Engine and ECT / Data List / All Data.

IAC SENSOR VOLTAGE	MALFUNCTION
0.2 V or less	• IAC1 circuit shorted • VCIA circuit open
4.8 V or higher	• VCIA and IAC1 circuit short-circuited • IAC1 circuit open • EIA1 circuit open

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MONITOR DESCRIPTION

The ECM IAC1 terminal voltage increases in correlation with the opening angle of the TCV. When the TCV is fully closed, approximately 0.8 V is applied to the IAC1 terminal. When the TCV is fully open, approximately 3.6 V is applied to the IAC1 terminal.

When the output voltage of the IAC1 terminal deviates from the standard range, the ECM determines that a malfunction has occurred in the position sensor and stores a DTC. Refer to ECM Power Source Circuit INFO .

MONITOR STRATEGY

Related DTCs	P2014: TCV Position Sensor Range Check (Chattering) P2016: TCV Position Sensor Range Check (Low Voltage) P2017: TCV Position Sensor Range Check (High Voltage)
Required sensors/components (Main)	TCV Position Sensor
Required sensors/components (Related)	None

Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not stored	None

TYPICAL MALFUNCTION THRESHOLDS

P2014:

TCV position sensor voltage	Below 0.2 V or higher than 4.8 V

P2016:

TCV position sensor voltage	Below 0.2 V

P2017:

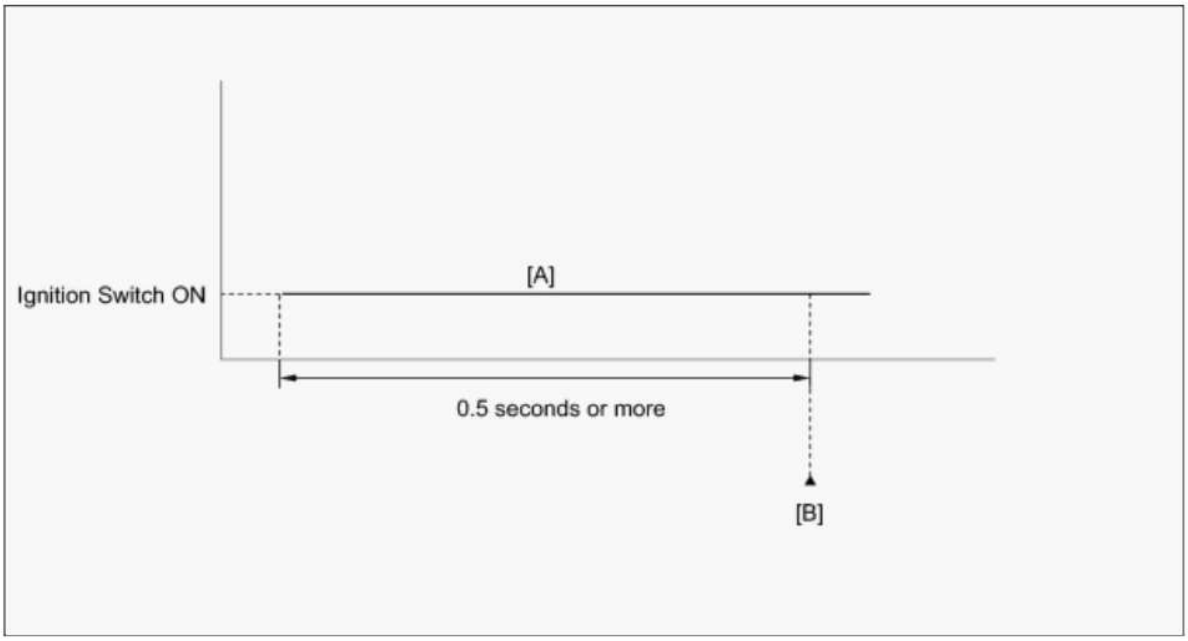
TCV position sensor voltage	Higher than 4.8 V

COMPONENT OPERATING RANGE

TCV position sensor voltage	0.2 to 4.8 V

CONFIRMATION DRIVING PATTERN

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs.
4. Allow 0.5 seconds or more to elapse [A].
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All readiness.
6. Input the DTC: P2014, P2016 or P2017.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

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HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P2004 INFO .

INSPECTION PROCEDURE

HINT:

- If different DTCs that are related to a different system are output simultaneously while terminal EIA1 is used as a ground terminal, terminal EIA1 may be open.
- Read freeze frame data using the Techstream. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE TCV)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the IAC Duty Ratio / All Data / IAC Sensor Voltage.

(d) Check the output voltage of IAC Sensor Voltage while changing Control the IAC Duty Ratio from -100 to 100% (or from 100 to -100%) using the Techstream.

OK:

The voltage output of IAC Sensor Voltage remains between 0.2 and 4.8 V while Control the IAC Duty Ratio is changed from -100 to 100% (or from 100 to -100%).

HINT:

		Suspected Failure Area		
Control the IAC Duty Ratio operation	IAC Sensor Voltage (Normal)	• IAC1 circuit shorted • VCIA	• VCIA and IAC1 circuit short-circuited • IAC1 circuit open	• Sensor malfunction

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		circuit open	• EIA1 circuit open	
-100%	0.2 to 1.0 V	Remain below 0.2 V	Remain higher than 4.8 V	Other than the voltage in the 2 columns on the left
100%	3.2 to 4.8 V	Remain below 0.2 V	Remain higher than 4.8 V	

NG ▶ **CHECK HARNESS AND CONNECTOR (TCV POSITION SENSOR - ECM)**

OK ▼

2.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P2014, P2016 AND/OR P2017 ARE OUTPUT AGAIN)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Clear DTCs INFO .

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

DISPLAY (DTC OUTPUT)	PROCEED TO
P2014, P2016 and/or P2017 are output again	A
No output	B

B ▶ **SYSTEM OK**

A ▶ **REPLACE ECM**

3.	**CHECK HARNESS AND CONNECTOR (TCV POSITION SENSOR - ECM)**

(a) Disconnect the ECM connector.

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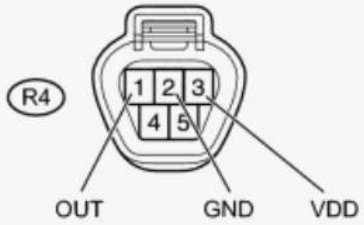
(b) Disconnect the intake air control valve actuator connector.

(c) Measure the resistance according to the value(s) in the table below.

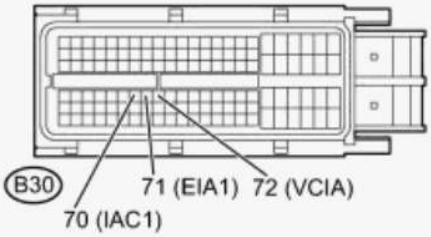
Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-72 (VCIA) - R4-3 (VDD)	Always	Below 1 Ω
B30-70 (IAC1) - R4-1 (OUT)	Always	Below 1 Ω
B30-71 (EIA1) - R4-2 (GND)	Always	Below 1 Ω

Front view of wire harness connector:
(to Intake Air Control Valve Actuator)



Front view of wire harness connector:
(to ECM)



Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-72 (VCIA) or R4-3 (VDD) - Body ground	Always	10 kΩ or higher
B30-70 (IAC1) or R4-1 (OUT) - Body ground	Always	10 kΩ or higher
B30-71 (EIA1) or R4-2 (GND) - Body ground	Always	10 kΩ or higher

(d) Reconnect the intake air control valve actuator connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

4.	**INSPECT ECM (VCIA VOLTAGE)**

(a) Disconnect the intake air control valve actuator connector.

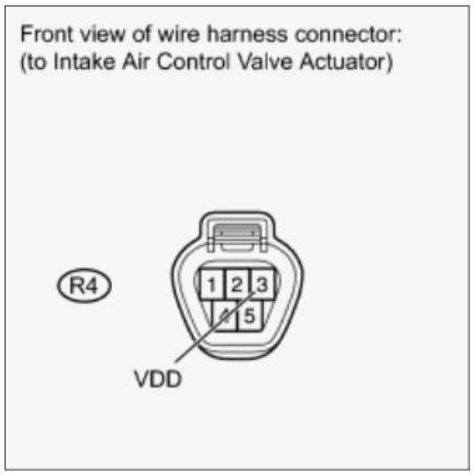
(b) Turn the ignition switch to ON.

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(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
R4-3 (VDD) - Body ground	Ignition switch ON	4.5 to 5.0 V



(d) Reconnect the intake air control valve actuator connector.

NG ▶ **REPLACE ECM**

OK ▼

5.	**REPLACE INTAKE MANIFOLD**

(a) Replace the intake manifold INFO .

NEXT ▼

6.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P2014, P2016 AND/OR P2017 ARE OUTPUT AGAIN)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON and turn the Techstream on.

(c) Clear DTCs INFO .

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

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DISPLAY (DTC OUTPUT)	PROCEED TO
P2014, P2016 and/or P2017 are output again	A
No output	B

B ▶ **END**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PFU0FFX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2102,P2103: Throttle Actuator Control Motor Circuit Low (2011 RAV4)		

DTC	**P2102**	**Throttle Actuator Control Motor Circuit Low**

DTC	**P2103**	**Throttle Actuator Control Motor Circuit High**

DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.

The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2102	Both of the following conditions continue for 2.0 seconds (1 trip detection logic): (a) The throttle actuator duty ratio is 80% or more. (b) The throttle actuator current is below 0.5 A.	• Open in throttle actuator circuit • Throttle actuator • ECM
P2103	Either of the following conditions is met (1 trip detection logic): • A hybrid IC diagnosis signal failure. • A hybrid IC current limiter port failure.	• Short in throttle actuator circuit • Throttle actuator • Throttle valve • Throttle body • ECM

MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the

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MIL and stores a DTC.

Example:

When the electrical current is below 0.5 A and the throttle actuator duty ratio exceeds 80%, the ECM interprets this as the current being outside the standard range, illuminates the MIL and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored when the engine is quickly revved to a high rpm several times after the engine has idled for 5 seconds after engine start.

MONITOR STRATEGY

Related DTCs	P2102: Throttle actuator current (low current) P2103: Throttle actuator current (high current)
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	P2102: 2 seconds P2103: 0.6 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None

P2102:

Throttle actuator	ON
Duty-cycle ratio to throttle actuator	80% or more
Throttle actuator power supply	8 V or higher
Motor current change during last 0.016 seconds	Below 0.2 A

P2103:

Throttle actuator	ON
Either of the following conditions 1 or 2 is met:	-
1. Throttle actuator power supply	8 V or higher
2. Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

P2102:

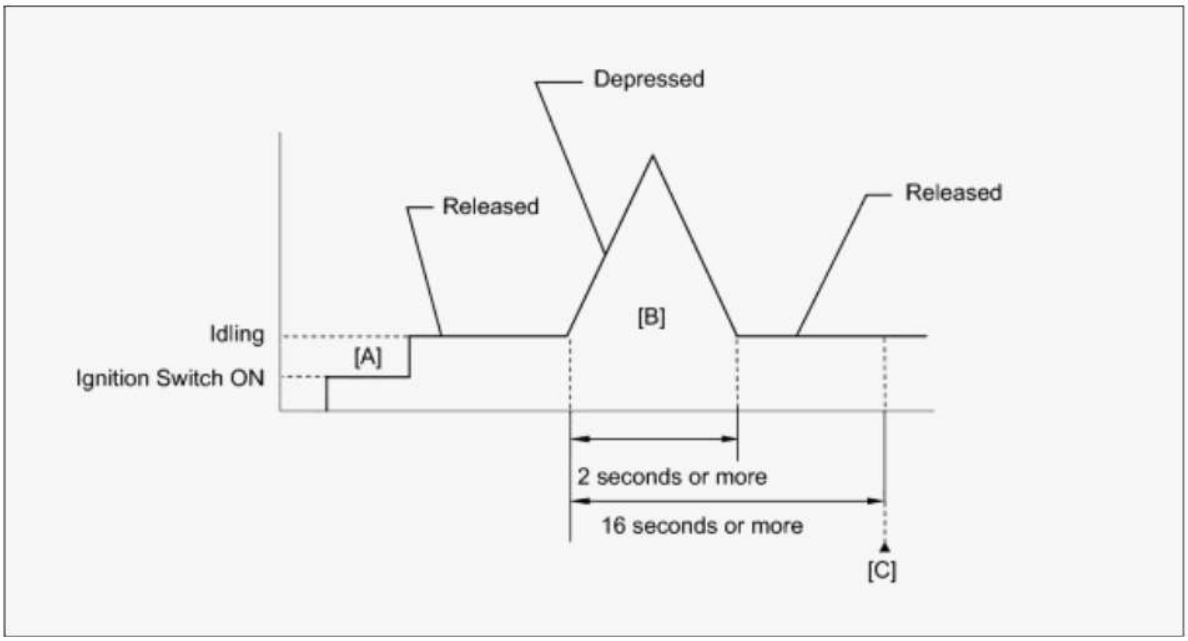
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Throttle actuator current	Below 0.5 A

P2103:

Either of following conditions is met:	A or B
A. Hybrid IC diagnosis signal	Fail
B. Hybrid IC current limiter port	Fail

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. With the vehicle stationary, fully depress the accelerator pedal and quickly release it [B].
6. Check that 16 seconds or more have elapsed from the instant when the accelerator pedal is first depressed.
7. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
8. Input the DTC: P2102 or P2103.
9. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal

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TESTER DISPLAY	DESCRIPTION
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [C] again.

10. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

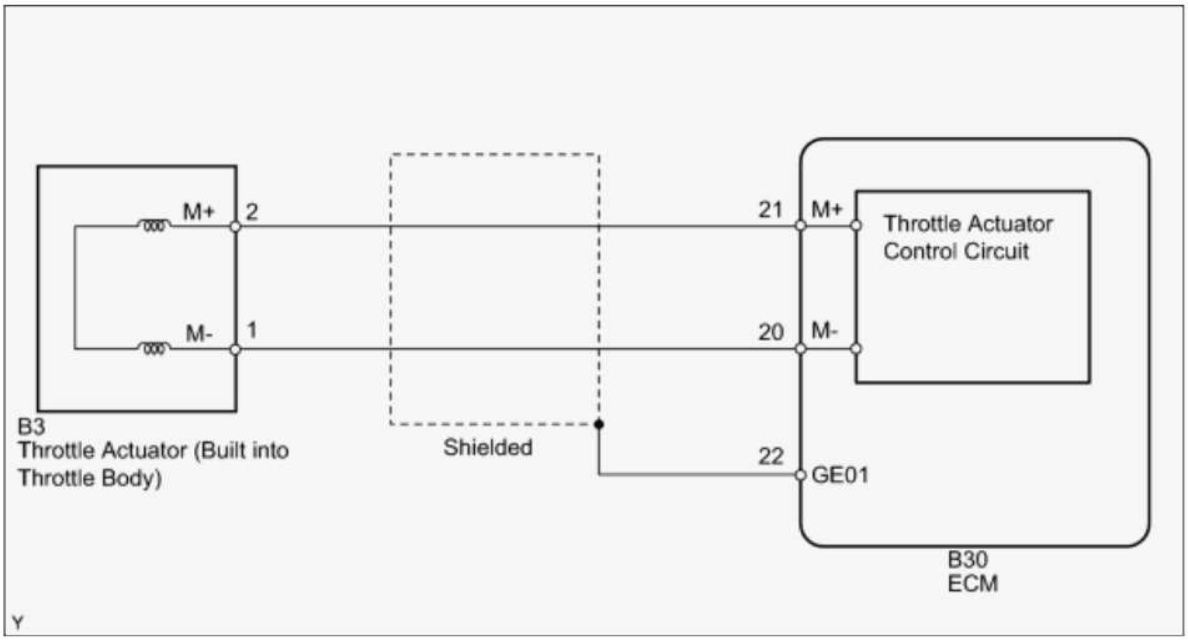
FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

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INSPECTION PROCEDURE

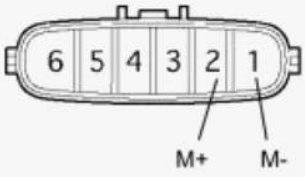
HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- The throttle actuator current (Throttle Motor Current) and the throttle actuator duty ratio (Throttle Motor Duty (Open) / Throttle Motor Duty (Close)) can be read using the Techstream. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.

PROCEDURE

1.	**INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE ACTUATOR)**

Component without harness connected:
(Throttle Body)



(a) Disconnect the throttle body connector.

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(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

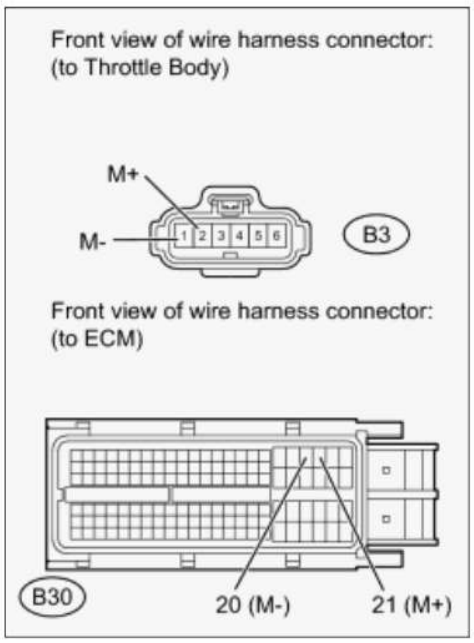
TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω

(c) Reconnect the throttle body connector.

NG ▶ **REPLACE THROTTLE BODY**

OK ▼

2.	**CHECK HARNESS AND CONNECTOR (THROTTLE BODY - ECM)**



(a) Disconnect the throttle body connector.

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B3-2 (M+) - B30-21 (M+)	Always	Below 1 Ω
B3-1 (M-) - B30-20 (M-)	Always	Below 1 Ω

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Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B3-2 (M+) or B30-21 (M+) - Body ground	Always	10 kΩ or higher
B3-1 (M-) or B30-20 (M-) - Body ground	Always	10 kΩ or higher

(d) Reconnect the ECM connector.

(e) Reconnect the throttle body connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

3.	**INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)**

(a) Check for foreign objects between the throttle valve and the housing.

OK:

No foreign objects between throttle valve and housing.

NG ▶ **REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY**

OK ▼

4.	**INSPECT THROTTLE BODY (THROTTLE VALVE)**

(a) Check if the throttle valve opens and closes smoothly.

OK:

Throttle valve opens and closes smoothly.

NG ▶ **REPLACE THROTTLE BODY**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PFV0H3X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2111,P2112: Throttle Actuator Control System - Stuck Open (2011 RAV4)		

DTC	**P2111**	**Throttle Actuator Control System - Stuck Open**

DTC	**P2112**	**Throttle Actuator Control System - Stuck Closed**

DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2111	The ECM signals the throttle actuator to close, but the actuator is stuck (1 trip detection logic).	• Throttle actuator • Throttle body • Throttle valve • ECM
P2112	The ECM signals the throttle actuator to open, but the actuator is stuck (1 trip detection logic).	• Throttle actuator • Throttle body • Throttle valve • ECM

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

MONITOR STRATEGY

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Related DTCs	P2111: Throttle actuator stuck open P2112: Throttle actuator stuck closed
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not stored	None
System guard* judge condition	ON
*System guard is ON when the following conditions set	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor fail	Not detected
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or higher
Throttle actuator fail	Not detected

P2111 (Throttle actuator stuck open):

All of following conditions met	-
Throttle actuator current	2 A or more
Duty cycle to close throttle	80% or more

P2112 (Throttle actuator stuck closed):

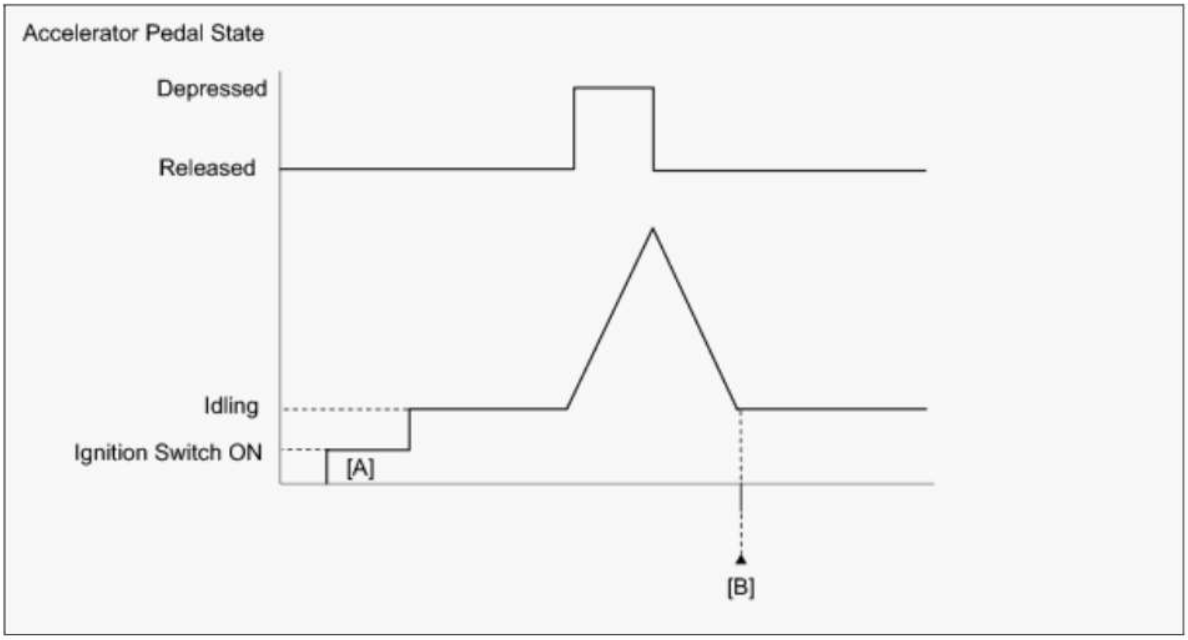
All of following conditions met	-
Throttle actuator current	2 A or more
Duty cycle to open throttle	80% or more

TYPICAL MALFUNCTION THRESHOLDS

TP sensor voltage change	No change

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CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P2111 or P2112.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU's memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

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8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 INFO .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2111 OR P2112)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

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Result

RESULT	PROCEED TO
P2111 or P2112 is output	A
P2111 or P2112 and other DTCs are output	B

HINT:

If any DTCs other than P2111 or P2112 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)**

(a) Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

OK:

Throttle valve is not contaminated with foreign objects and moves smoothly.

NG ▶ **REPLACE THROTTLE BODY ASSEMBLY**

OK ▼

3.	**READ VALUE USING TECHSTREAM (THROTTLE POSITION)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Turn the ignition switch off and wait for at least 30 seconds.

(f) Turn the ignition switch to ON.

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(g) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Position No. 1, Throttle Position No. 2 and Throttle Position Command.

(h) Check the values displayed on the Techstream while wiggling the ECM wire harness.

(i) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(j) Check for DTCs.

Result

RESULT	PROCEED TO
Value in Data List changes when wire harness is wiggled, or DTC is output*	A
Other than above	B

*: As the DTC was stored due to a change in the contact resistance of the connector, repair or replace the wire harness or connector INFO .

B ▶ **CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)**

A ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

4.	REPLACE THROTTLE BODY ASSEMBLY

(a) Replace the throttle body assembly INFO .

NEXT

5.	CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).

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(f) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(g) Read DTCs.

Result

RESULT	PROCEED TO
No output	A
P2111 or P2112	B

B ▶ **REPLACE ECM**

A ▶ **END**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PFW0FLX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2118: Throttle Actuator Control Motor Current Range / Performance (2011 RAV4)		

DTC	**P2118**	**Throttle Actuator Control Motor Current Range / Performance**

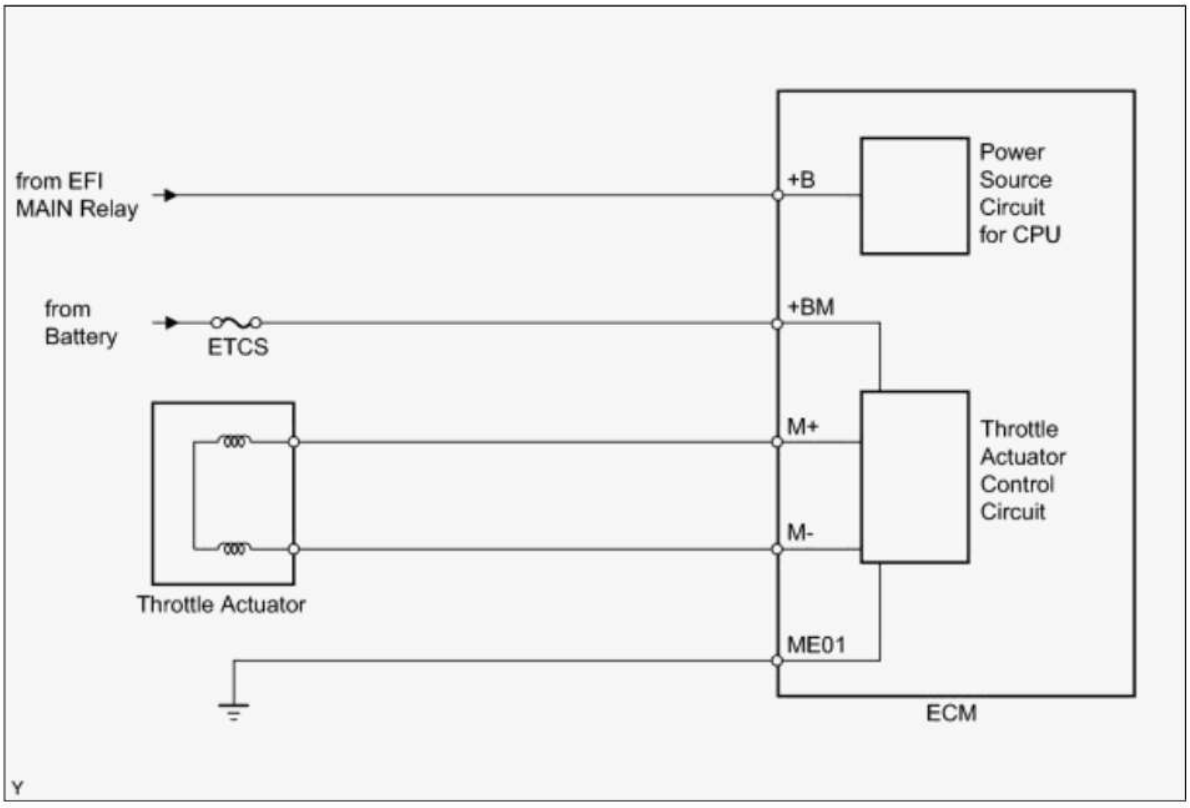
DESCRIPTION

The ETCS (Electronic Throttle Control System) has a dedicated power supply circuit. The voltage (+BM) is monitored and when it is low (below 4 V), the ECM determines that there is a malfunction in the ETCS and cuts off the current to the throttle actuator.

When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the ignition switch off. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.

HINT:

The ETCS does not use a throttle cable.



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2118	An open in the ETCS power source (+BM) circuit (1 trip detection logic).	• Open in ETCS power source circuit • Battery • Battery terminals • ETCS fuse • ECM

MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the throttle actuator.

When the power supply voltage (+BM) drops below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and stores the DTC.

If the malfunction is not repaired successfully, the DTC is stored 5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P2118: Throttle actuator power supply
Required Sensors/Components (Main)	Throttle actuator, throttle valve (throttle body) ETCS fuse
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	0.8 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None
Battery voltage	8 V or higher
Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

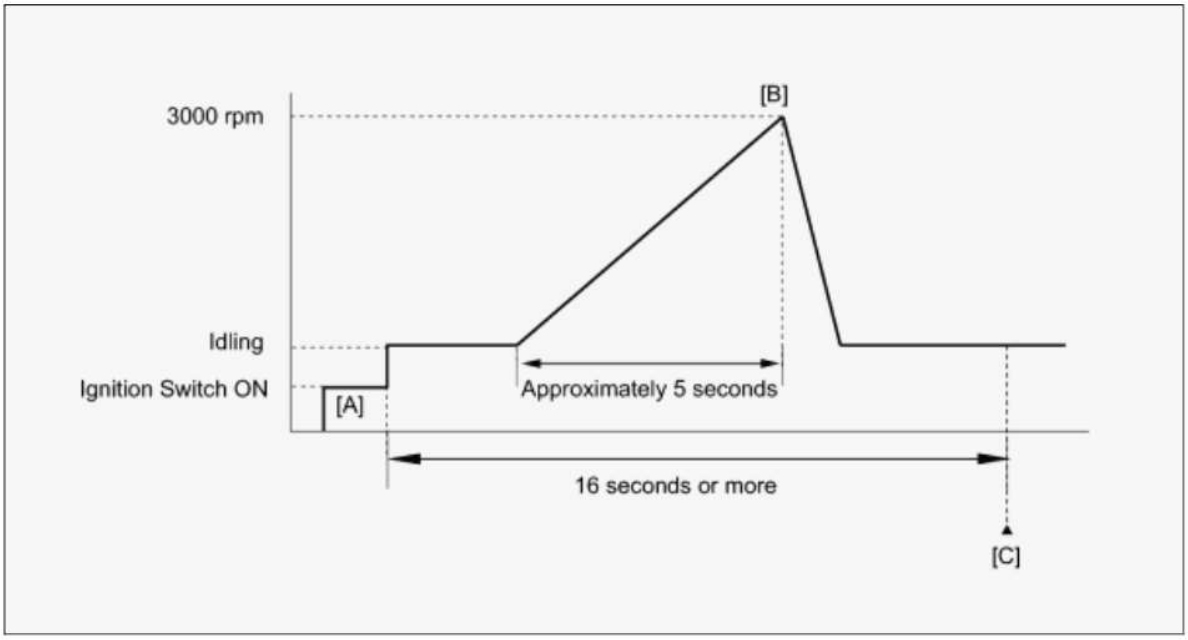
Throttle actuator power supply voltage (+BM)	Below 4 V

COMPONENT OPERATING RANGE

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Throttle actuator power supply voltage (+BM)	11 to 14 V

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. Slowly depress the accelerator pedal, raise the engine speed to approximately 3000 rpm for approximately 5 seconds, and then idle the engine [B].
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P2118.
8. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU

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TESTER DISPLAY	DESCRIPTION
	memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
10. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

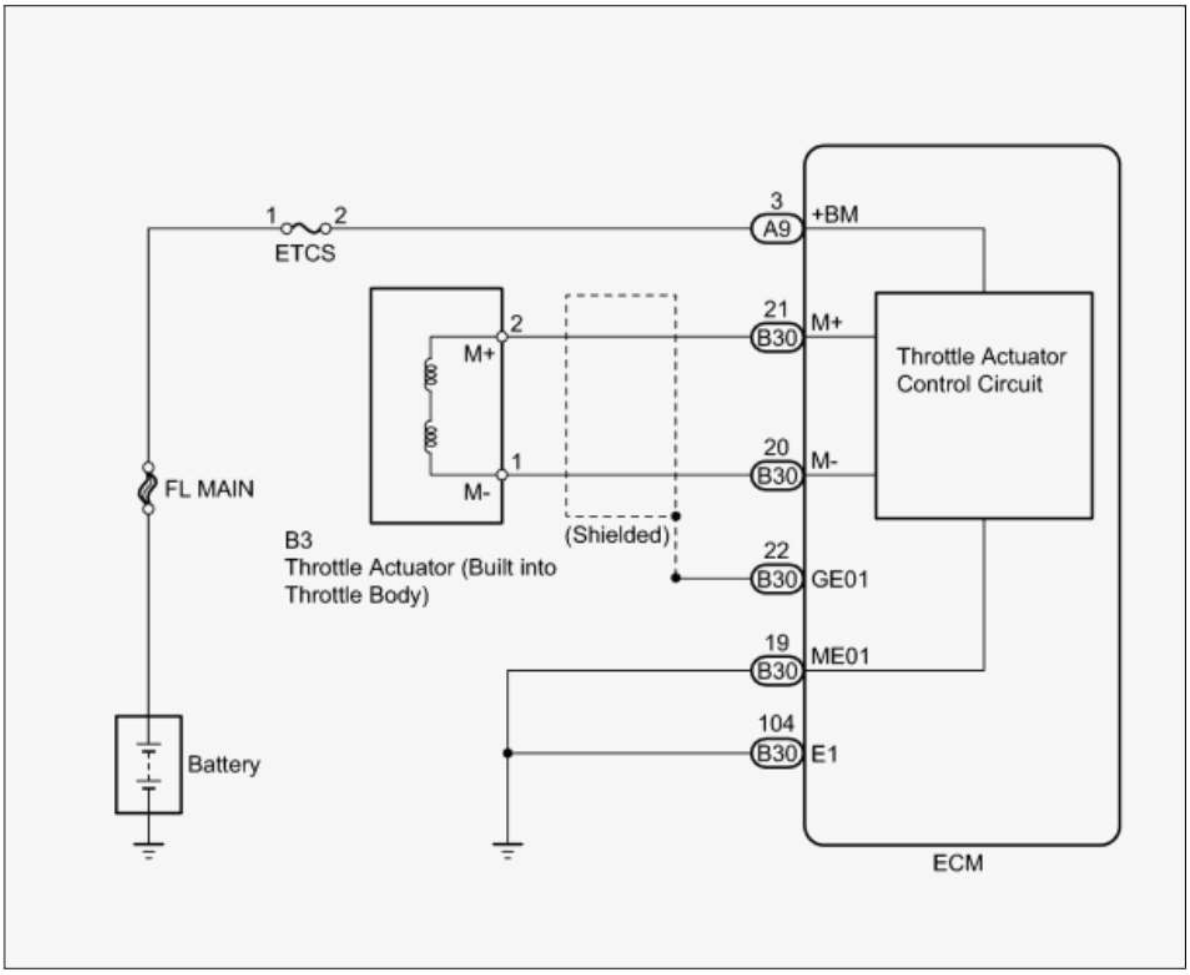
FAIL-SAFE

When this DTC or other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

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INSPECTION PROCEDURE

NOTICE:

Inspect the fuses of circuits related to this system before performing the following inspection procedure.

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (+BM VOLTAGE)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

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(d) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / +BM Voltage.

(e) Read the value displayed on the Techstream.

Standard voltage:
11 to 14 V

NG ▶ **CHECK FOR INTERMITTENT PROBLEMS**

OK ▼

2.	CHECK HARNESS AND CONNECTOR (ECM - BATTERY, BODY GROUND)

(a) Disconnect the ECM connectors.

(b) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

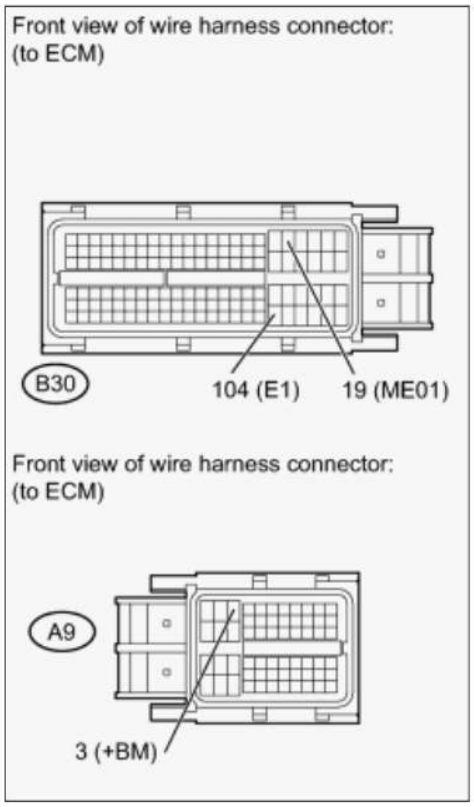
TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A9-3 (+BM) - Body ground	Always	11 to 14 V

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B30-19 (ME01) - Body ground	Always	Below 1 Ω
B30-104 (E1) - Body ground		

(d) Reconnect the ECM connectors.



NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PFX0H3X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2119: Throttle Actuator Control Throttle Body Range / Performance (2011 RAV4)		

DTC	**P2119**	**Throttle Actuator Control Throttle Body Range / Performance**

DESCRIPTION

The Electronic Throttle Control System (ETCS) is composed of the throttle actuator, Throttle Position (TP) sensor, Accelerator Pedal Position (APP) sensor, and ECM. The ECM operates the throttle actuator to regulate the throttle valve in response to driver inputs. The TP sensor detects the opening angle of the throttle valve, and provides the ECM with feedback so that the throttle valve can be appropriately controlled by the ECM.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2119	The throttle valve opening angle continues to vary greatly from the target opening angle (1 trip detection logic).	• Electronic Throttle Control System (ETCS) • ECM

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the ETCS. The ECM then illuminates the MIL and stores the DTC.

If the malfunction is not repaired successfully, the DTC is stored when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5000 rpm by fully depressing the accelerator pedal (fully open the throttle valve).

MONITOR STRATEGY

Related DTCs	P2119: ETCS malfunction
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

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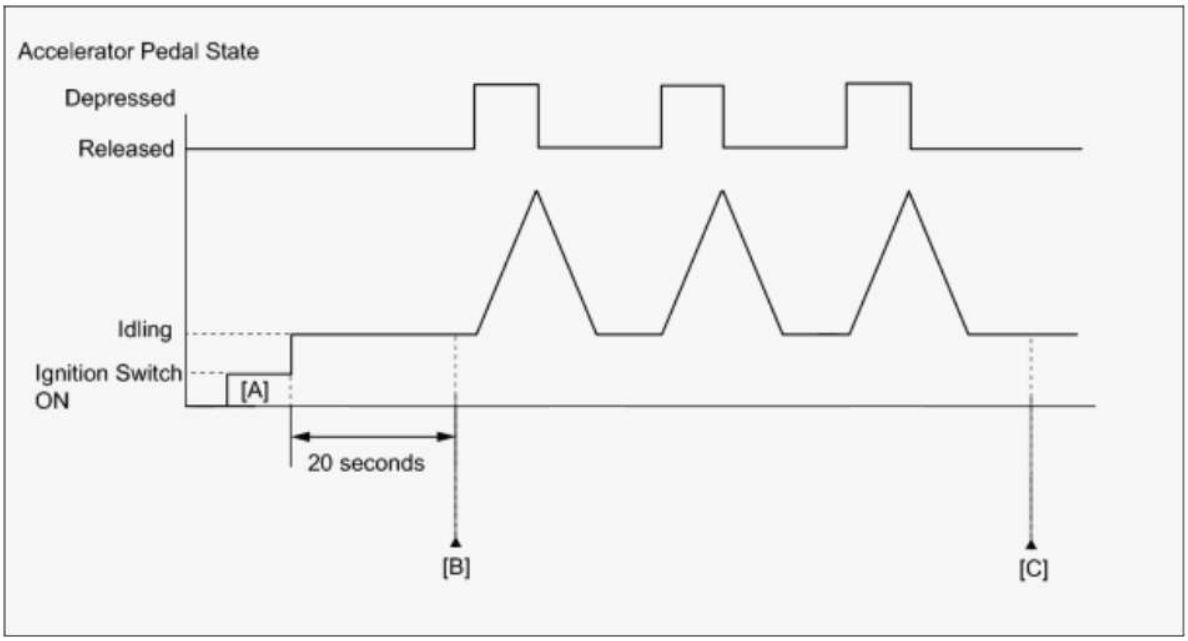
TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
System guard* judge condition	ON
*: System guard is ON when the following conditions set	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor fail	Not detected
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or higher
Throttle actuator fail	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions A or B is met	-
A. Difference between commanded closed throttle position and current closed throttle position	0.3 V or higher for 1 second
B. Difference between commanded open throttle position and current open throttle position	0.3 V or higher for 0.6 seconds

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.

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2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. Idle the engine for 20 seconds.
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P2119.
8. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, fully depress and release the accelerator pedal 3 times, and then check the DTC judgment result at step [C].

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
10. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator

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pedal is depressed firmly and gently, the vehicle can be driven slowly.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 INFO .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2119)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P2119	A
P2119 and other DTCs	B

HINT:

If any DTCs other than P2119 are output, troubleshoot those DTCs first.

B ▶ GO TO DTC CHART

A ▼

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2.	READ VALUE USING TECHSTREAM (THROTTLE POSITION)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Turn the ignition switch off and wait for at least 30 seconds.

(f) Turn the ignition switch to ON.

(g) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Position No. 1 and Throttle Position Command.

(h) Check the values displayed on the Techstream while fully depressing and releasing the accelerator pedal quickly.

Result

RESULT	PROCEED TO
Throttle Position No. 1 does not change	A
Throttle Position No. 1 changes even a little	B

HINT:

When a DTC is output, the system changes to fail-safe mode. Therefore, only use the data up until the time the DTC is stored for confirmation.

B ▶ **INSPECT THROTTLE BODY ASSEMBLY (VISUALLY CHECK THROTTLE VALVE)**

A ▼

3.	INSPECT THROTTLE BODY ASSEMBLY (RESISTANCE OF THROTTLE ACTUATOR)

(a) Inspect the throttle body assembly INFO .

NG ▶ **REPLACE THROTTLE BODY**

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OK

4.	**INSPECT THROTTLE BODY ASSEMBLY (VISUALLY CHECK THROTTLE VALVE)**

(a) Check for contamination between the throttle valve and housing. If necessary, clean the throttle body. Also, check that the throttle valve moves smoothly.

OK:

Throttle valve is not contaminated with foreign objects and moves smoothly.

NG ▶ **REPLACE THROTTLE BODY**

OK

5.	**READ VALUE USING TECHSTREAM (THROTTLE POSITION)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Turn the ignition switch off and wait for at least 30 seconds.

(f) Turn the ignition switch to ON.

(g) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Position No. 1, Throttle Position No. 2 and Throttle Position Command.

(h) Check the values displayed on the Techstream while wiggling the ECM wire harness.

(i) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(j) Check for DTCs.

Result

RESULT	PROCEED TO
Value in Data List changes when wire harness is wiggled, or DTC is output*	A

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RESULT	PROCEED TO
Other than above	B

As the DTC was stored due to a change in the contact resistance of the connector, repair or replace the wire harness or connector INFO .

B ▶ CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)

A ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR

6.	**REPLACE THROTTLE BODY**

(a) Replace the throttle body assembly INFO .

NEXT

7.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Allow the engine to idle for 15 seconds or more.

(f) Fully depress and release the accelerator pedal several times quickly.

(g) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(h) Read DTCs.

Result

RESULT	PROCEED TO
No DTC is output	A
P2119 is output	B

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B ▶ REPLACE ECM

A ▶ END

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PFY0FBX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2120,P2122,P2123,P2125,P2127,P2128,P2138: Throttle / Pedal Position Sensor / Switch "D" Circuit (2011 RAV4)		

DTC	**P2120**	**Throttle / Pedal Position Sensor / Switch "D" Circuit**

DTC	**P2122**	**Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input**

DTC	**P2123**	**Throttle / Pedal Position Sensor / Switch "D" Circuit High Input**

DTC	**P2125**	**Throttle / Pedal Position Sensor / Switch "E" Circuit**

DTC	**P2127**	**Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input**

DTC	**P2128**	**Throttle / Pedal Position Sensor / Switch "E" Circuit High Input**

DTC	**P2138**	**Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation**

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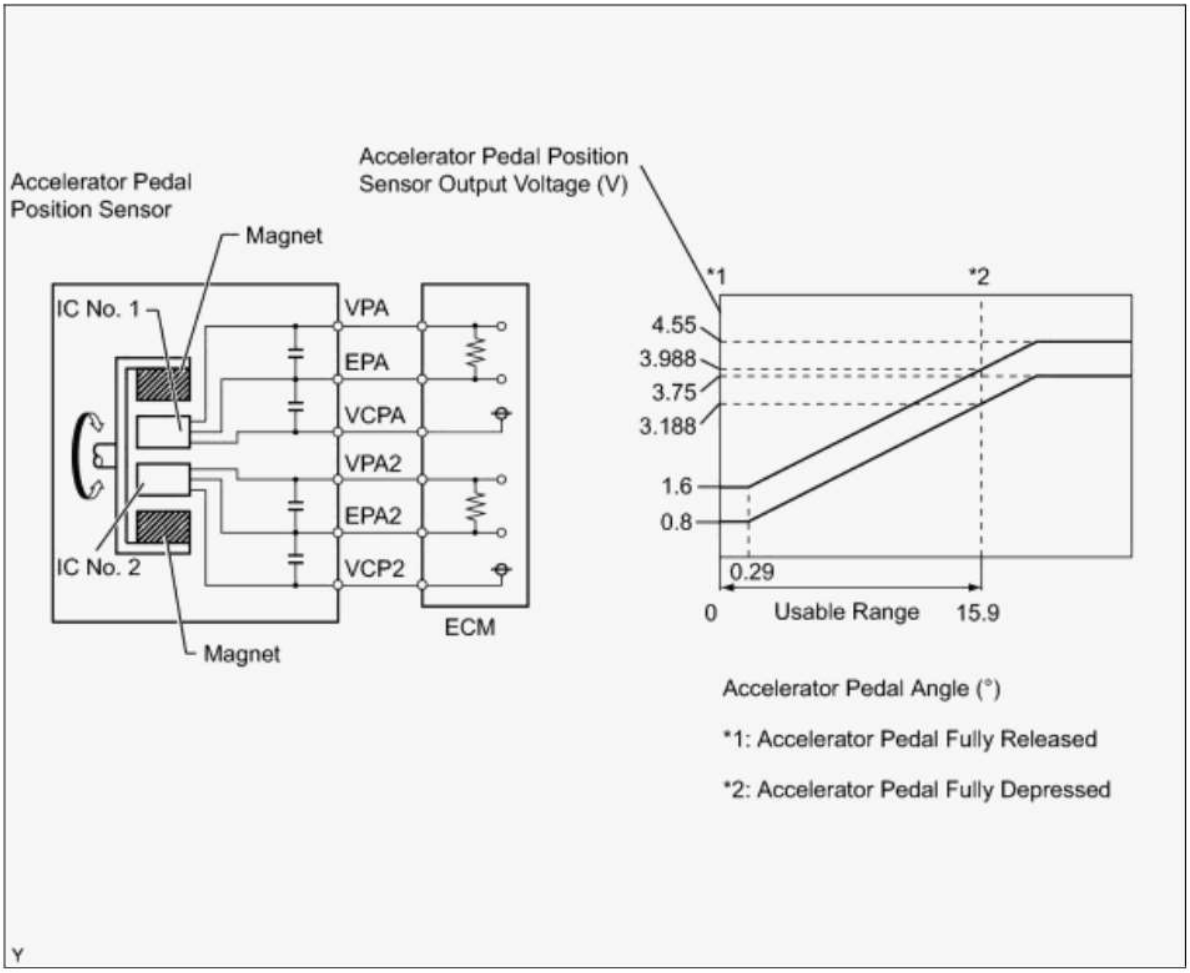
DESCRIPTION

HINT:

- This ETCS (Electronic Throttle Control System) does not use a throttle cable.
- These DTCs relate to the Accelerator Pedal Position (APP) sensor.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type sensor and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM
P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is depressed (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • Open in EPA circuit

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
		• ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is depressed (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Both of the following conditions continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher. (b) VPA is between 0.4 V and 3.45 V.	• Accelerator Pedal Position (APP) sensor • Open in EPA2 circuit • ECM
P2138	Either of the following conditions continues for 2.0 seconds or more (1 trip detection logic): (a) The difference between VPA and VPA2 is 0.02 V or less. (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • Accelerator Pedal Position (APP) sensor • ECM

HINT:

When any of these DTCs are output, check the APP sensor voltage using the Techstream. Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accel Sensor Out No. 1 and Accel Sensor Out No. 2.

TROUBLE AREA	ACCEL SENSOR OUT NO. 1 WHEN ACCELERATOR PEDAL RELEASED	ACCEL SENSOR OUT NO. 2 WHEN ACCELERATOR PEDAL RELEASED	ACCEL SENSOR OUT NO. 1 WHEN ACCELERATOR PEDAL DEPRESSED	ACCEL SENSOR OUT NO. 2 WHEN ACCELERATOR PEDAL DEPRESSED
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.98 V

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TROUBLE AREA	ACCEL SENSOR OUT NO. 1 WHEN ACCELERATOR PEDAL RELEASED	ACCEL SENSOR OUT NO. 2 WHEN ACCELERATOR PEDAL RELEASED	ACCEL SENSOR OUT NO. 1 WHEN ACCELERATOR PEDAL DEPRESSED	ACCEL SENSOR OUT NO. 2 WHEN ACCELERATOR PEDAL DEPRESSED
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 4.98 V	4.5 to 4.98 V	4.5 to 4.98 V	4.5 to 4.98 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.98 V

HINT:

Accelerator pedal positions are expressed as voltages.

MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and stores a DTC.

Example:

When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.

If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P2120: Accelerator Pedal Position (APP) sensor 1 range check (fluctuating) P2122: APP sensor 1 range check (low voltage) P2123: APP sensor 1 range check (high voltage) P2125: APP sensor 2 range check (fluctuating) P2127: APP sensor 2 range check (low voltage) P2128: APP sensor 2 range check (high voltage) P2138: APP sensor range check (correlation)
Required Sensors/Components (Main)	APP sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds: P2120, P2122, P2125 and P2127 2.0 seconds: P2123, P2128 and P2138
MIL Operation	Immediate
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	None
Either of following conditions met:	-
1. Ignition switch	ON
2. Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

P2120:

Either of following conditions met:	-
1. VPA voltage when VPA2 voltage 0.04 V or higher	0.4 V or less
2. VPA voltage	4.8 V or higher

P2122:

VPA voltage when VPA2 voltage 0.04 V or higher	0.4 V or less

P2123:

VPA voltage	4.8 V or higher

P2125:

Either of following conditions met:	-
1. VPA2 voltage when VPA voltage 0.04 V or higher	1.2 V or less
2. VPA2 voltage when VPA voltage 0.4 to 3.45 V	4.8 V or higher

P2127:

VPA2 voltage when VPA voltage 0.04 V or higher	1.2 V or less

P2128:

VPA2 voltage when VPA voltage 0.4 to 3.45 V	4.8 V or higher

P2138:

Either of following conditions met:	-
Condition A	-
Difference between VPA and VPA 2 voltages	0.02 V or less

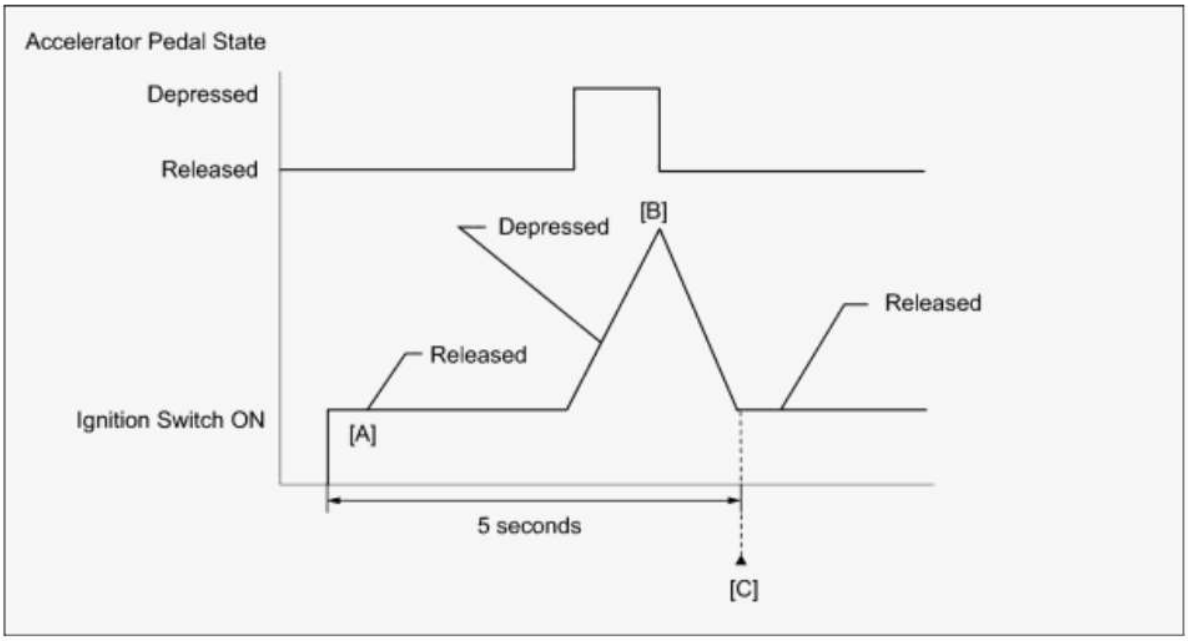
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Condition B	-
VPA voltage	0.4 V or less
VPA2 voltage	1.2 V or less

COMPONENT OPERATING RANGE

VPA voltage	0.4 to 4.8 V
VPA2 voltage	1.2 to 4.8 V
Difference between VPA and VPA2 voltages	Higher than 0.02 V

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Fully depress and release the accelerator pedal [B].
5. Check that 5 seconds or more have elapsed since the DTCs were cleared.
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P2120, P2122, P2123, P2125, P2127, P2128 or P2138.
8. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL **HINT:**	○ DTC judgment completed ○ System normal

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- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
10. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

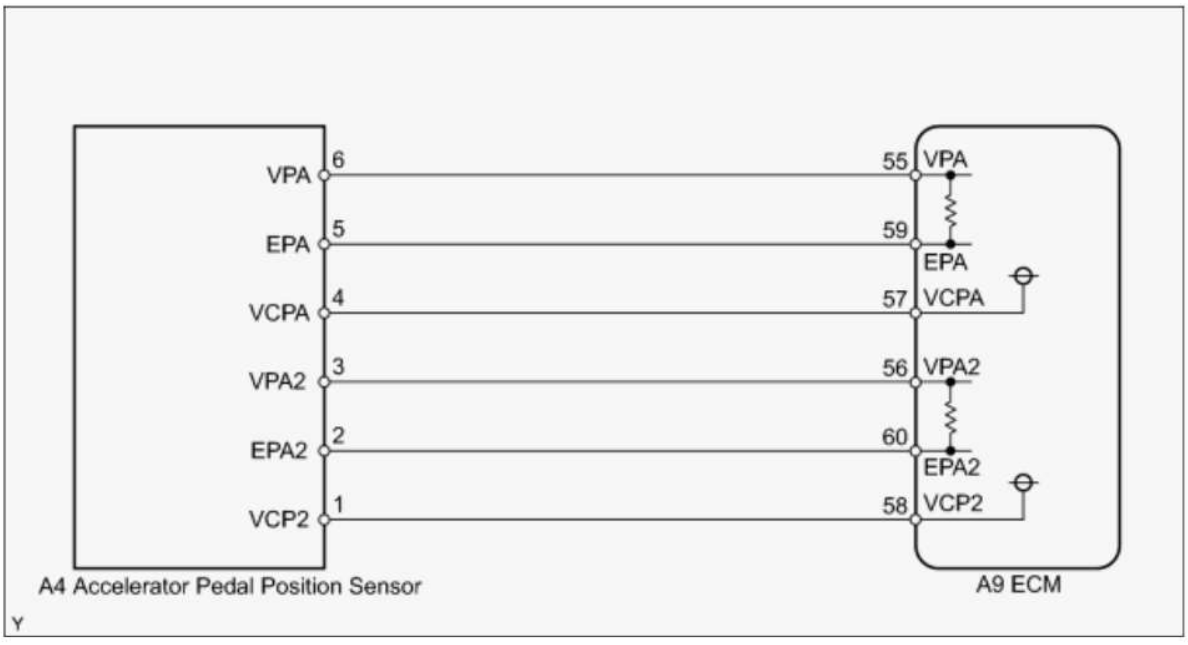
- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions

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are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**READ VALUE USING TECHSTREAM (ACCELERATOR PEDAL POSITION SENSOR)**

(a) Connect the Techstream to the DLC3.

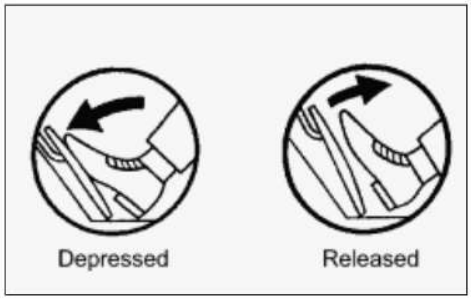
(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / ETCS / Accel Sensor Out No. 1 and Accel Sensor Out No. 2.

(e) Read the value displayed on the Techstream.

Standard Voltage:



ACCELERATOR PEDAL OPERATION	ACCEL SENSOR OUT NO. 1	ACCEL SENSOR OUT NO. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 4.98 V

NG ▶ **CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)**

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

2.	**CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)**

(a) Disconnect the accelerator pedal position sensor connector.

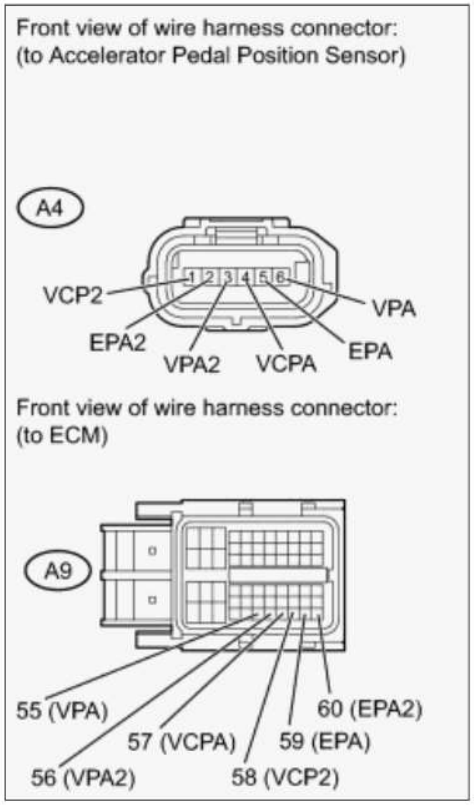
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(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A4-6 (VPA) - A9-55 (VPA)	Always	Below 1 Ω
A4-5 (EPA) - A9-59 (EPA)	Always	Below 1 Ω
A4-4 (VCPA) - A9-57 (VCPA)	Always	Below 1 Ω
A4-3 (VPA2) - A9-56 (VPA2)	Always	Below 1 Ω
A4-2 (EPA2) - A9-60 (EPA2)	Always	Below 1 Ω
A4-1 (VCP2) - A9-58 (VCP2)	Always	Below 1 Ω



Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A4-6 (VPA) or A9-55 (VPA) - Body ground	Always	10 kΩ or higher
A4-5 (EPA) or A9-59 (EPA) - Body ground	Always	10 kΩ or higher
A4-4 (VCPA) or A9-57 (VCPA) - Body ground	Always	10 kΩ or higher
A4-3 (VPA2) or A9-56 (VPA2) - Body ground	Always	10 kΩ or higher
A4-2 (EPA2) or A9-60 (EPA2) - Body ground	Always	10 kΩ or higher
A4-1 (VCP2) or A9-58 (VCP2) - Body ground	Always	10 kΩ or higher

(d) Reconnect the accelerator pedal position sensor connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

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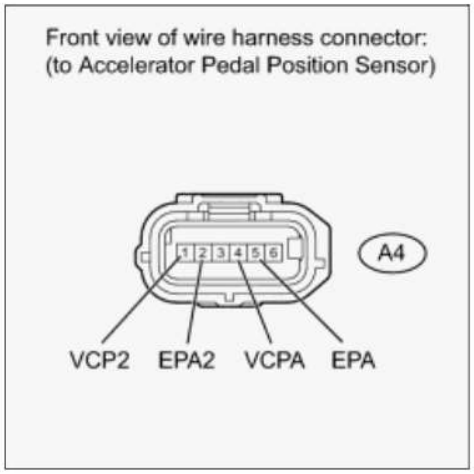
3.	**CHECK ECM (VCPA AND VCP2 VOLTAGE)**

(a) Disconnect the accelerator pedal position sensor connector.

(b) Turn the ignition switch to ON.

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:



TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
A4-4 (VCPA) - A4-5 (EPA)	Ignition switch ON	4.5 to 5.5 V
A4-1 (VCP2) - A4-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

(d) Reconnect the accelerator pedal position sensor connector.

NG ▶ **REPLACE ECM**

OK

4.	**REPLACE ACCELERATOR PEDAL ROD ASSEMBLY**

(a) Replace the accelerator pedal rod assembly INFO .

NEXT

5.	**CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

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(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine.

(f) Allow the engine to idle for 15 seconds or more.

(g) Fully depress and release the accelerator pedal several times quickly.

(h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(i) Read DTCs.

Result

RESULT	PROCEED TO
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B ▶ **END**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PFZ0FMX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2121: Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance (2011 RAV4)		

DTC	**P2121**	**Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance**

DESCRIPTION

HINT:

- This DTC relates to the Accelerator Pedal Position (APP) sensor.

Refer to DTC P2120 INFO .

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2121	The difference between VPA and VPA2 is below 0.4 V, or higher than 1.2 V for 0.5 seconds (1 trip detection logic).	• Accelerator Pedal Position (APP) sensor • ECM

MONITOR DESCRIPTION

The accelerator pedal position sensor is mounted on the accelerator pedal bracket. The accelerator pedal position sensor has 2 sensor elements and 2 signal outputs: VPA and VPA2. VPA is used to detect the actual accelerator pedal angle (used for engine control) and VPA2 is used to detect malfunctions in VPA. When the difference between the output voltages of VPA and VPA2 deviates from the standard, the ECM determines that the accelerator pedal position sensor is malfunctioning. The ECM turns on the MIL and the DTC is stored.

MONITOR STRATEGY

Related DTCs	P2121: Accelerator pedal position (APP) sensor rationality
Required Sensors/Components (Main)	APP sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

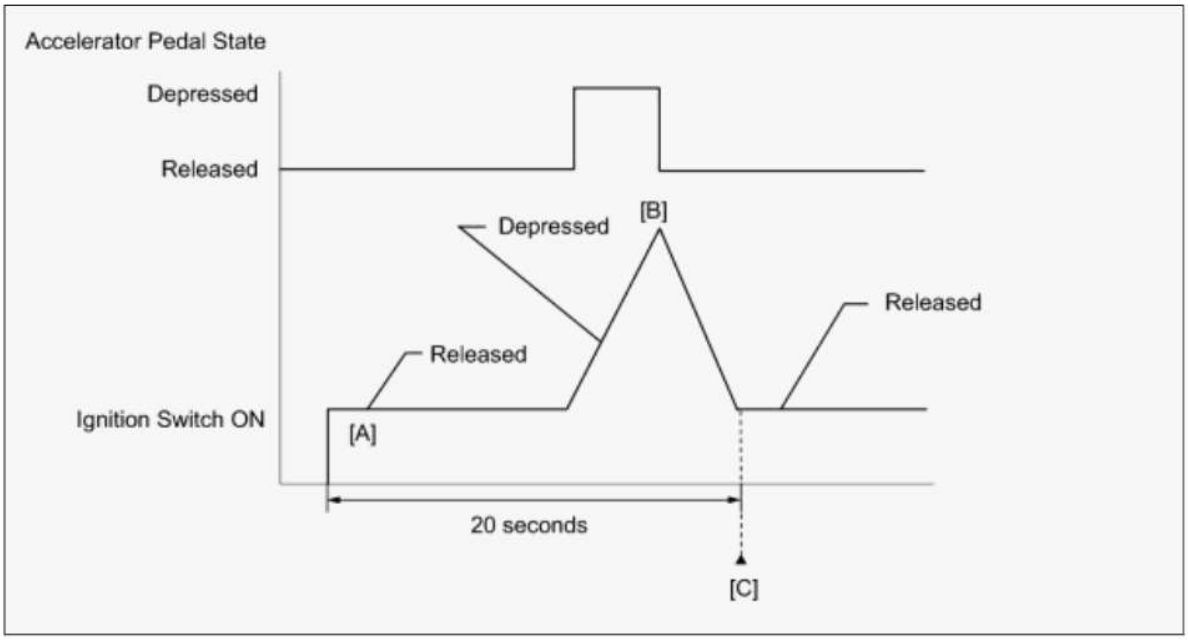
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Monitor runs whenever following DTCs not stored	P2120, P2122, P2123, P2125, P2127, P2128, P2138 (Accelerator pedal position sensor)
Either of following conditions met:	-
1. Ignition switch	ON
2. Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

Difference between VPA voltage (learned value) and VPA2 voltage (learned value)	Below 0.4 V, or higher than 1.2 V

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream ON.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Fully depress and release the accelerator pedal [B].
5. Check that 20 seconds or more have elapsed since the DTCs were cleared.
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P2121.
8. Check the DTC judgment result [C].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed

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TESTER DISPLAY	DESCRIPTION
	○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
10. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.

If a pass condition is detected and then the ignition switch is turned off, the fail-safe operation stops and the system returns to normal.

WIRING DIAGRAM

Refer to DTC P2120 INFO .

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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2121)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P2121	A
P2121 and other DTCs	B

HINT:

If any DTCs other than P2121 are output, troubleshoot those DTCs first.

B ▶ **GO TO DTC CHART**

A ▼

2.	**READ VALUE USING TECHSTREAM (ACCELERATOR PEDAL POSITION SENSOR)** INFO

NG ▶ **REPLACE ACCELERATOR PEDAL ROD ASSEMBLY**

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

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3.	**REPLACE ACCELERATOR PEDAL ROD ASSEMBLY**

(a) Replace the accelerator pedal rod assembly INFO .

NEXT

4.	**CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine.

(f) Allow the engine to idle for 15 seconds.

(g) Fully depress and release the accelerator pedal several times quickly.

(h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(i) Read DTCs.

Result

RESULT	PROCEED TO
P2121	A
No output	B

B ▶ **END**

A ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000WC40EIX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2195,P2196: Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1) (2011 RAV4)		

DTC	**P2195**	**Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)**

DTC	**P2196**	**Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)**

DESCRIPTION

HINT:

- Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

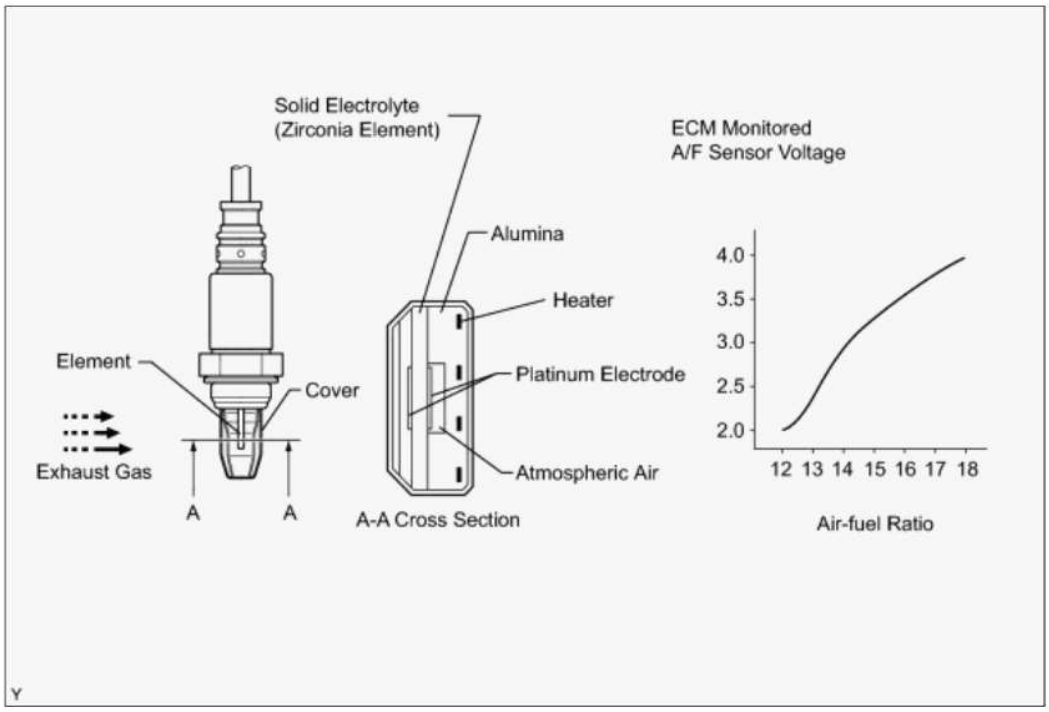
The A/F sensor generates a voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is planar-type sensor and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor, in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are a narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, and therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio is precisely controlled so that it is always close to the stoichiometric level.

*: The value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors show a constant voltage.

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
• P2195 •	Both of the following conditions continue for 5 seconds or more (2 trip detection logic): (a) The Air Fuel Ratio (A/F) sensor voltage is higher than 3.8 V. (b) The Heated Oxygen (HO2) sensor voltage is 0.21 V or higher.	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • A/F sensor heater circuit • Air induction system • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the Air Fuel Ratio (A/F) sensor current is 3.6 mA or higher for 3 seconds (2 trip detection logic).	• A/F sensor • ECM
• P2196 •	Both of the following conditions continue for 5 seconds or more (2 trip detection logic): (a) The Air Fuel Ratio (A/F) sensor voltage is below 2.8 V. (b) The Heated Oxygen (HO2) sensor voltage is below 0.59 V.	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • A/F sensor heater circuit • Air induction system • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation is performed (during vehicle deceleration), the Air Fuel Ratio (A/F) sensor current is below 1.0 mA for 3 seconds (2 trip detection logic).	• A/F sensor • ECM

HINT:

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- When any of these DTCs are output, check the A/F sensor voltage output using the Techstream. Enter the following menus: Powertrain / Engine and ECT / Data List / A/F Control System / AFS Voltage B1 S1.
- Short-term fuel trim values can also be read using the Techstream.
- The ECM regulates the voltages at the A1A+ and A1A- terminals of the ECM to a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using the Techstream.
- If an A/F sensor malfunction is detected, the ECM stores a DTC.

MONITOR DESCRIPTION

Sensor voltage detection monitor

Under the air-fuel ratio feedback control, if the Air Fuel Ratio (A/F) sensor voltage output indicates rich or lean for a certain period of time, the ECM determines that there is a malfunction in the A/F sensor. The ECM illuminates the MIL and stores a DTC.

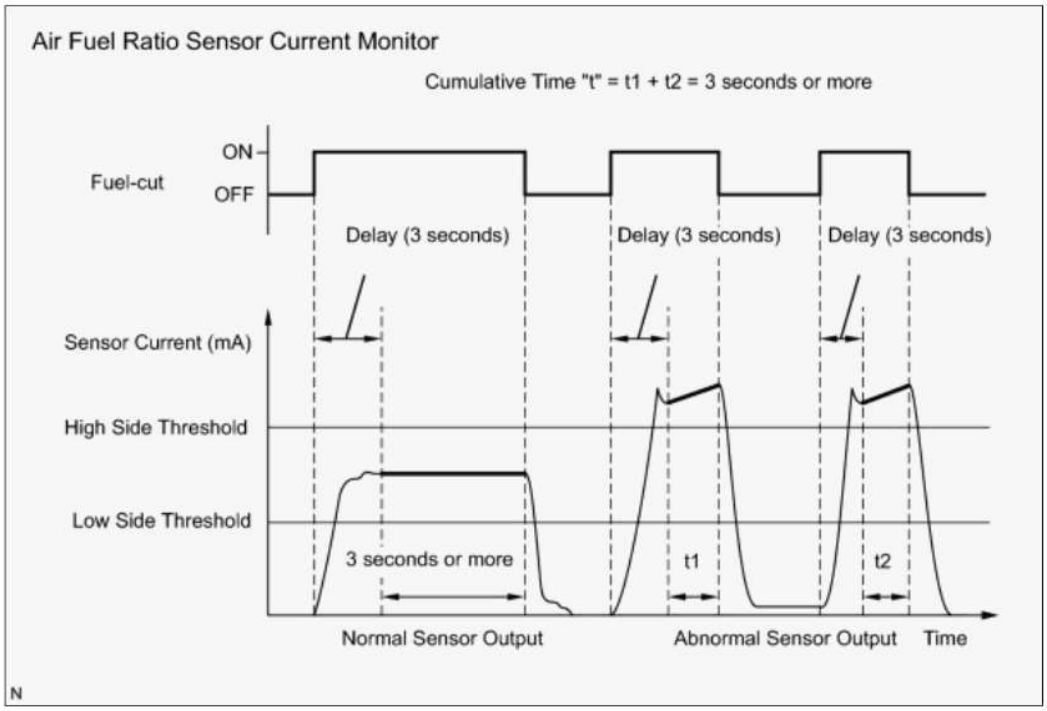
Example:

If the A/F sensor voltage output is below 2.8 V (very rich condition) for 5 seconds, despite the HO2 sensor voltage output being below 0.59 V, the ECM stores DTC P2196. Alternatively, if the A/F sensor voltage output is higher than 3.8 V (very lean condition) for 5 seconds, despite the HO2 sensor voltage output being 0.21 V or higher, DTC P2195 is stored.

Sensor current detection monitor

A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.

If the A/F sensor output is 3.6 mA or higher for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and stores DTC P2195 (stuck on high side). If the A/F sensor output is below 1.0 mA for more than 3 seconds of cumulative time, the ECM stores DTC P2196 (stuck on low side).



MONITOR STRATEGY

Related DTCs	P2195: Air Fuel Ratio (A/F) sensor (Bank 1) signal stuck lean P2196: A/F sensor (Bank 1) signal stuck rich

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Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Heated Oxygen (HO2) sensor
Frequency of Operation	Continuous: Sensor voltage detection monitor Once per driving cycle: Sensor current detection monitor
Duration	5 seconds: Sensor voltage detection monitor 3 seconds: Sensor current detection monitor
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

ALL

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0505 (IAC Valve)

Sensor voltage detection monitor (P2195, P2196):

Time after engine start	30 seconds or more
Air Fuel ratio sensor status	Activated
Fuel system status	Closed loop

Sensor current detection monitor (P2195, P2196):

Battery voltage	11 V or higher
Atmospheric pressure	76 kPa (570 mmHg) or higher
Air fuel ratio sensor status	Activated
Engine coolant temperature	75°C (167°F) or higher
Continuous time of fuel cut	3 to 10 seconds

TYPICAL MALFUNCTION THRESHOLDS

Sensor voltage detection monitor (Lean side malfunction P2195):

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Rear heated oxygen sensor voltage	0.21 V or higher
A/F sensor voltage	Higher than 3.8 V

Sensor voltage detection monitor (Rich side malfunction P2196):

Rear heated oxygen sensor voltage	Below 0.59 V
A/F sensor voltage	Below 2.8 V

Sensor current detection monitor (High side malfunction P2195):

Air fuel ratio sensor current	3.6 mA or higher

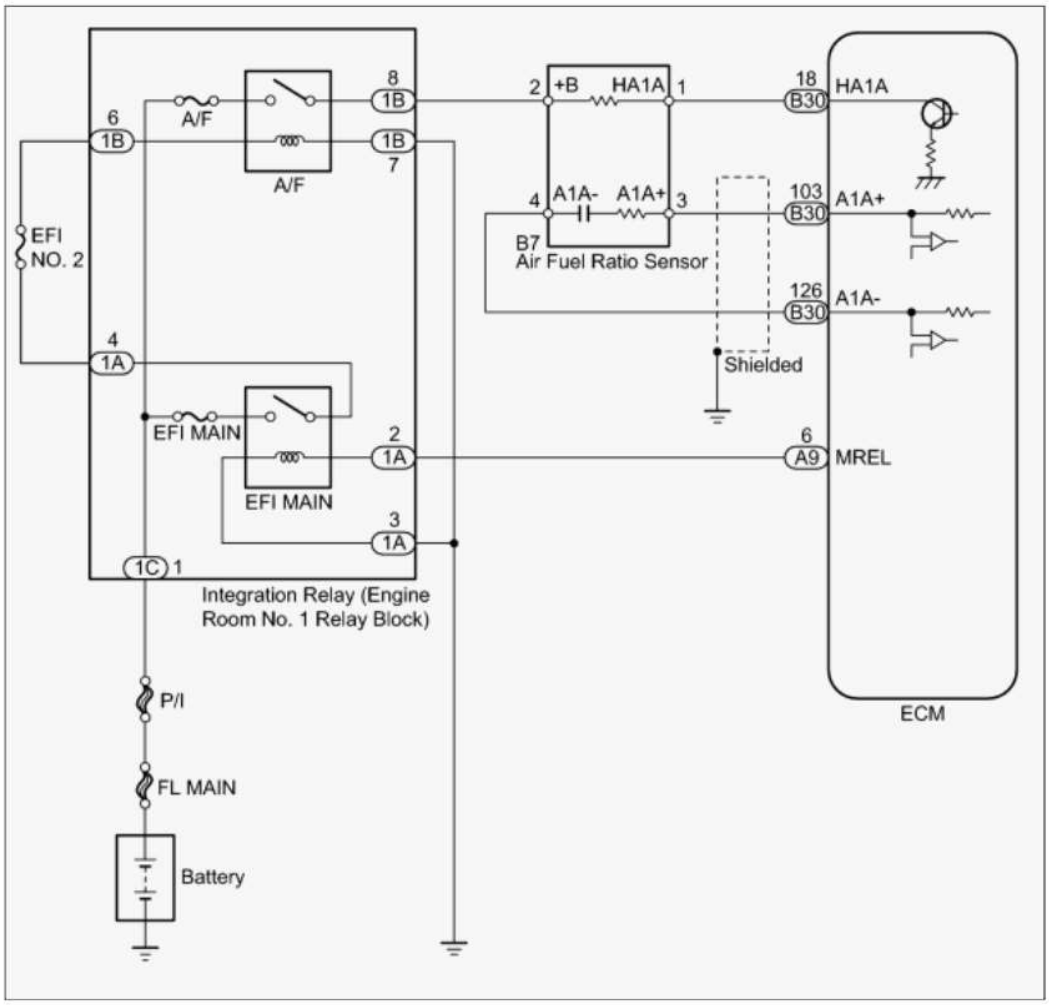
Sensor current detection monitor (Low side malfunction P2196):

Air fuel ratio sensor current	Below 1.0 mA

MONITOR RESULT

Refer to Checking Monitor Status INFO .

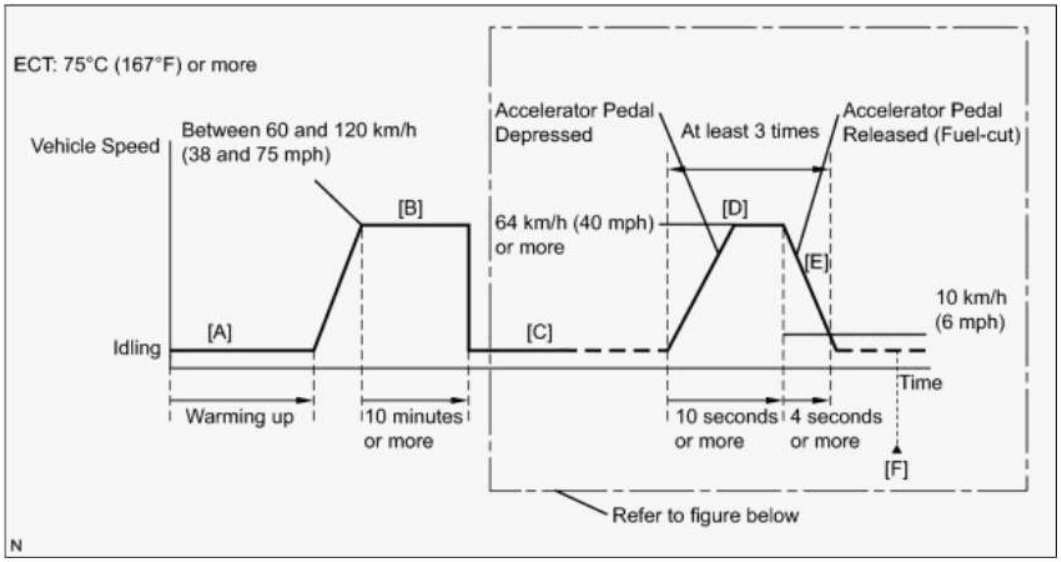
WIRING DIAGRAM

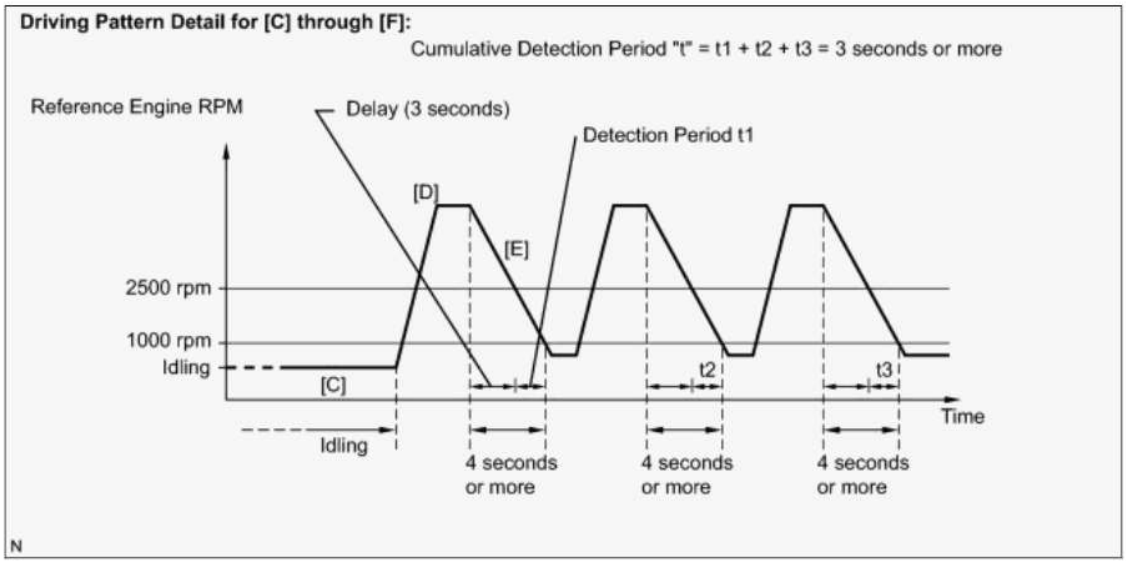


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CONFIRMATION DRIVING PATTERN

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.





1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).
5. Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher [A].
6. On Techstream, enter the following menus to check the fuel-cut status: Powertrain / Engine and ECT / Data List / Idle Fuel Cut.
7. Drive the vehicle at between 60 and 120 km/h (38 and 75 mph) for at least 10 minutes [B].

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

8. Shift the transmission to 2nd gear [C].
9. Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds [D].
10. Soon after performing step [D] above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal in order to execute fuel-cut control [E].

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HINT:

Fuel-cut is performed when the following conditions are met:

- Accelerator pedal is fully released.
- Engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).

11. Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).
12. Repeat steps [C] through [E] above at least 3 times in one driving cycle.
13. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
14. Input the DTC: P2195 or P2196.
15. Check the DTC judgment result [F].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [F].

16. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
17. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

18. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.

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5. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)
7. Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

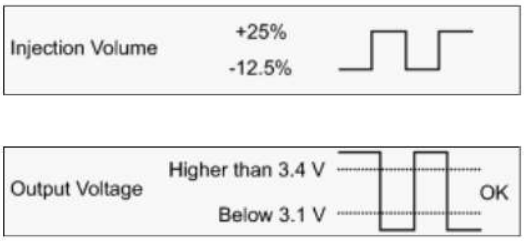
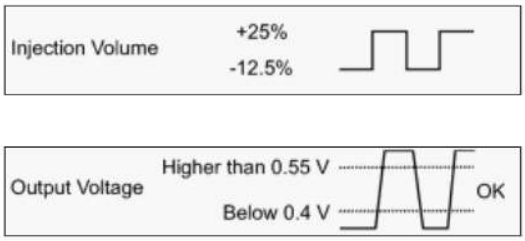
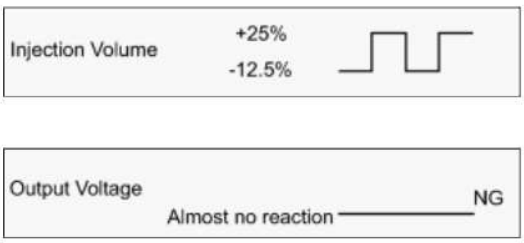
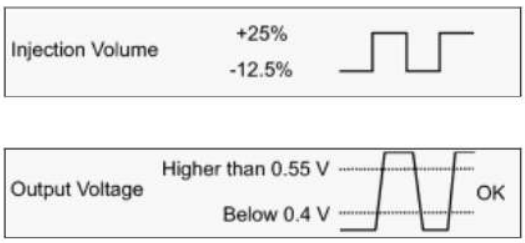
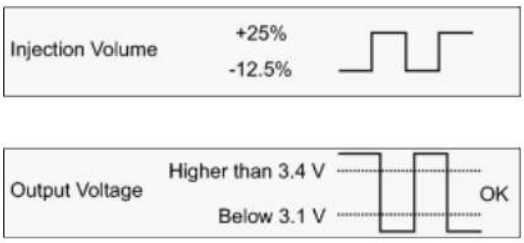
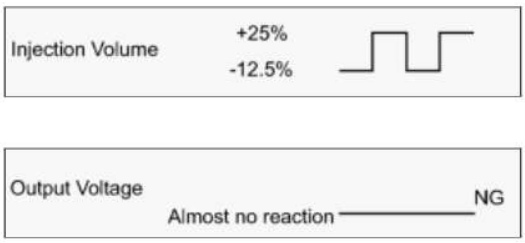
HINT:

- The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1 S1 (A/F)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak

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CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
	Output Voltage — Almost no reaction — NG	Output Voltage — Almost no reaction — NG	from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

1.	**CHECK FOR ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195 OR P2196)**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

(e) Read DTCs.

Result

RESULT	PROCEED TO
P2195 or P2196 is output	A
"P2195 or P2196" and "P0136, P0137 or P0138" are output	A
P2195 or P2196 and other DTCs are output	B

HINT:

If any DTCs relating to the air fuel ratio sensor (DTCs for the air fuel ratio sensor heater or air fuel ratio sensor admittance) are output, troubleshoot those DTCs first.

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B ▶ GO TO DTC CHART

A ▼

2.	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

(a) Has the vehicle run out of fuel in the past?

NO ▶ READ VALUE USING TECHSTREAM (TEST VALUE OF AIR FUEL RATIO SENSOR)

YES ▼

3.	PERFORM CONFIRMATION DRIVING PATTERN

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTCs INFO .

(e) Turn the ignition switch off.

(f) Turn the ignition switch to ON and turn the Techstream on.

(g) Start the engine and warm it up.

(h) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(i) Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

(j) Input the DTC: P2195 or P2196.

(k) Check the DTC judgment result.

Result

RESULT	PROCEED TO
NORMAL (DTC is not output)	A
ABNORMAL (DTC P2195 or P2196 is output)	B

B ▶ READ VALUE USING TECHSTREAM (TEST VALUE OF AIR FUEL RATIO SENSOR)

A ▶ DTC CAUSED BY RUNNING OUT OF FUEL

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4.	READ VALUE USING TECHSTREAM (TEST VALUE OF AIR FUEL RATIO SENSOR)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(f) Enter the following menus: Powertrain / Engine and ECT / Monitor / O2 Sensor / Current.

(g) Check that the status of O2 Sensor is Complete.

If the status is still Incomplete, drive the vehicle according to the driving pattern again.

(h) Enter the following menus: Powertrain / Engine and ECT / Monitor / Current Monitor / O2 Sensor / Details / RANGE B1 S1.

(i) Check the test value of the A/F sensor output current during fuel-cut.

Result

RESULT	PROCEED TO
Within normal range (1.0 mA or higher, and below 3.6 mA)	A
Outside normal range (Below 1.0 mA, or 3.6 mA or higher)	B

B ▶ **REPLACE AIR FUEL RATIO SENSOR**

A ▼

5.	READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF AIR FUEL RATIO SENSOR)

(a) Connect the Techstream to the DLC3.

(b) Start the engine.

(c) Turn the Techstream on.

(d) Warm up the air fuel ratio sensor at an engine speed of 2500 rpm for 90 seconds.

(e) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

(f) Perform the Control the Injection Volume operation with the engine idling.

(g) Monitor the output voltages of the air fuel ratio and heated oxygen sensors (AFS Voltage B1S1 and O2S B1S2) displayed on the Techstream.

HINT:

- Change the fuel injection volume within the range of -12.0% to +12.0%. The injection volume can be changed in fine

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gradations.

- The air fuel ratio sensor has an output delay of a few seconds and the heated oxygen sensor has a maximum output delay of approximately 20 seconds.

TECHSTREAM DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1S1 (Air fuel ratio)	+12.0%	Rich	Below 3.1 V
AFS Voltage B1S1 (Air fuel ratio)	-12.0%	Lean	Higher than 3.4 V
O2S B1S2 (Heated oxygen)	+12.0%	Rich	Higher than 0.55 V
O2S B1S2 (Heated oxygen)	-12.0%	Lean	Below 0.4 V

Result

STATUS OF AFS VOLTAGE B1S1	STATUS OF O2S B1S2	AIR FUEL RATIO CONDITION AND AIR FUEL RATIO SENSOR CONDITION	MISFIRE	SUSPECTED TROUBLE AREA	PROCEED TO
Lean	Lean	Actual air fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Fuel injector blockage • Gas leaks from exhaust system • Intake system • Fuel pressure • Mass air flow meter assembly • Engine coolant temperature sensor	A
Rich	Rich	Actual air fuel ratio rich	-	• Fuel injector leakage or blockage • Gas leaks from exhaust system • Ignition system • Fuel pressure • Mass air flow meter assembly • Engine coolant temperature sensor	A
Lean	Lean/Rich	Air fuel ratio sensor malfunction	-	Air fuel ratio sensor	B
Rich	Lean/Rich	Air fuel ratio sensor malfunction	-	Air fuel ratio sensor	B
Lean/Rich	Lean/Rich	Normal	-	-	B

Lean: During the Control the Injection Volume Active Test, the air fuel ratio sensor output voltage (AFS Voltage) is consistently higher than 3.4 V, and the heated oxygen sensor output voltage (O2S) is consistently below 0.4 V.

Rich: During the Control the Injection Volume Active Test, the AFS Voltage is consistently below 3.1 V, and the O2S is consistently higher than 0.55 V.

Lean/Rich: During the Control the Injection Volume Active Test, the output voltage of the heated oxygen sensor alternates correctly.

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B ▶ REPLACE AIR FUEL RATIO SENSOR

A ▼

6.	CHECK AIR INDUCTION SYSTEM

(a) Check the air induction system for vacuum leaks INFO .

OK:

No leaks in air induction system.

NG ▶ REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK ▼

7.	CHECK FOR EXHAUST GAS LEAK

(a) Check for exhaust gas leaks.

OK:

No gas leaks.

NG ▶ REPAIR OR REPLACE EXHAUST SYSTEM

OK ▼

8.	CHECK FUEL PRESSURE

(a) Check the fuel pressure INFO .

NG ▶ CHECK FUEL LINE

OK ▼

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9.	**INSPECT FUEL INJECTOR**

(a) Check the fuel injector (whether fuel volume is high or low, and whether injector pattern is poor) INFO .

NG ▶ **REPLACE FUEL INJECTOR**

OK ▼

10.	**REPLACE AIR FUEL RATIO SENSOR**

(a) Replace the air fuel ratio sensor INFO .

NEXT ▼

11.	**PERFORM CONFIRMATION DRIVING PATTERN**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTCs INFO .

(e) Turn the ignition switch off.

(f) Turn the ignition switch to ON and turn the Techstream on.

(g) Start the engine and warm it up.

(h) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(i) Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

(j) Input the DTC: P2195 or P2196.

(k) Check the DTC judgment result.

Result

RESULT	PROCEED TO
ABNORMAL (DTC P2195 or P2196 is output)	A
NORMAL (DTC is not output)	B

B ▶ **END**

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A

12.	REPLACE ECM

(a) Replace the ECM INFO .

NEXT

13.	CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTC INFO .

(e) Turn the ignition switch off.

(f) Turn the ignition switch to ON and turn the Techstream on.

(g) Start the engine and warm it up.

(h) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(i) Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

(j) Input the DTC: P2195 or P2196.

(k) Check the DTC judgment result.

Result

TECHSTREAM DISPLAY	DESCRIPTION
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions

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TECHSTREAM DISPLAY	DESCRIPTION
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

NEXT ▶ END

14.	REPLACE AIR FUEL RATIO SENSOR

(a) Replace the air fuel ratio sensor INFO .

NEXT ▼

15.	PERFORM CONFIRMATION DRIVING PATTERN

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear the DTCs INFO .

(e) Turn the ignition switch off.

(f) Turn the ignition switch to ON and turn the Techstream on.

(g) Start the engine and warm it up.

(h) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

(i) Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

(j) Input the DTC: P2195 or P2196.

(k) Check the DTC judgment result.

Result

RESULT	PROCEED TO
NORMAL (DTC is not output)	A
ABNORMAL (DTC P2195 or P2196 is output)	B

B ▶ REPLACE ECM

A ▶ END

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16.	**CHECK FUEL LINE**

(a) Check the fuel lines for leaks or blockage.

NG ▶ **REPAIR OR REPLACE FUEL LINE**

OK ▶ **REPLACE FUEL PUMP**

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000028K607QX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2237-P2239,P2252,P2253: Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1) (2011 RAV4)		

DTC	**P2237**	**Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)**

DTC	**P2238**	**Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)**

DTC	**P2239**	**Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)**

DTC	**P2252**	**Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)**

DTC	**P2253**	**Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)**

DESCRIPTION

HINT:

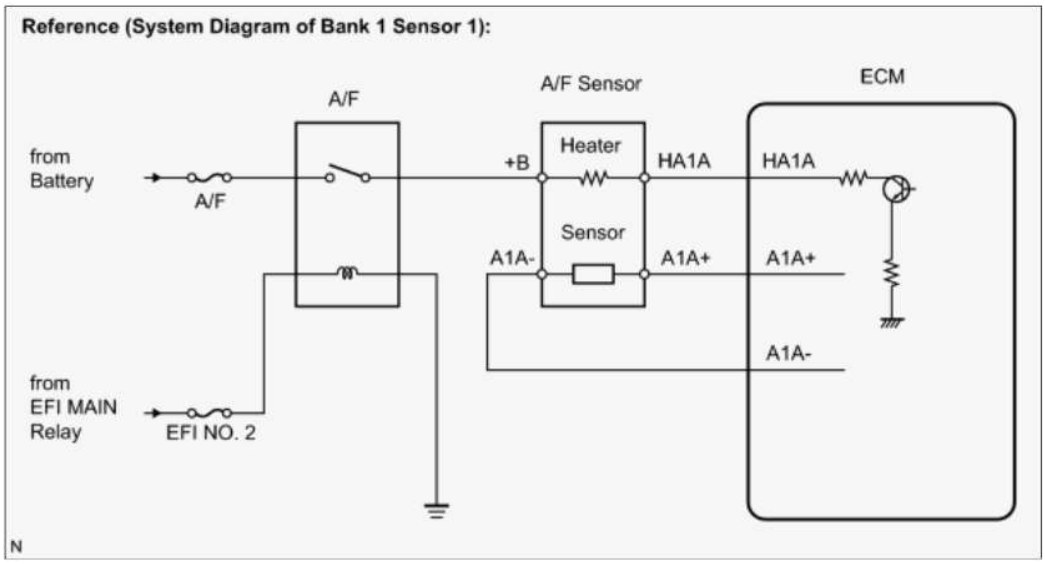
- Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

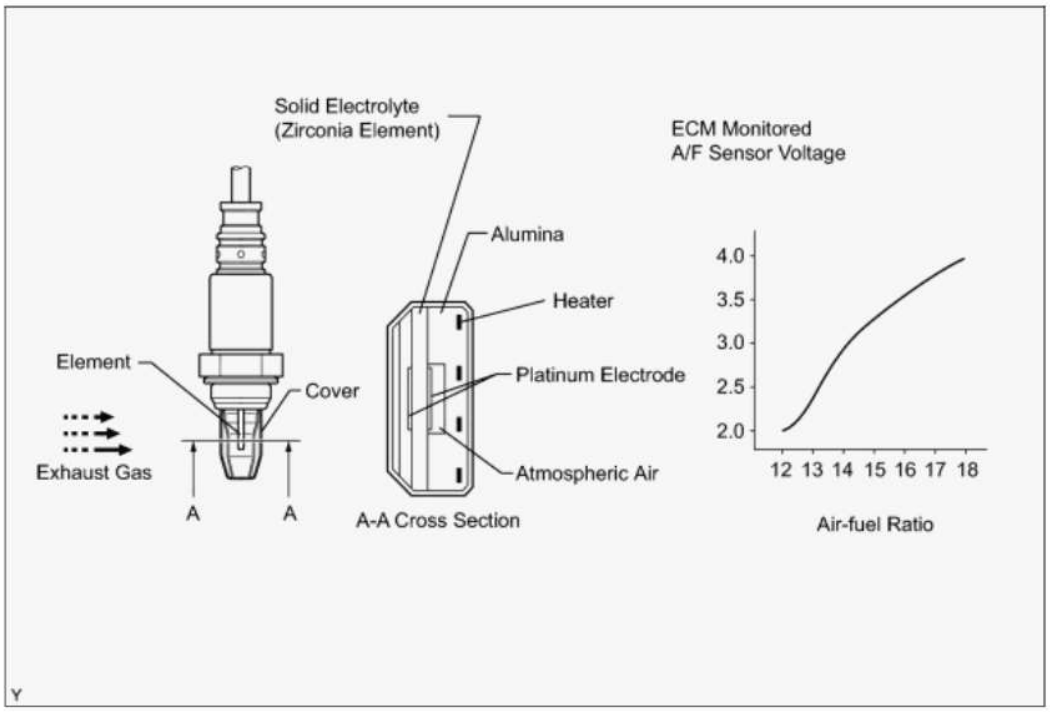
The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.

Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio.

The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air-fuel ratio and regulates the fuel injection volume depending on the air-fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air-fuel ratio is lean, which means that the oxygen concentration in the exhaust gas is high, the voltage is high. If the air-fuel ratio is rich, which means that the oxygen concentration in the exhaust gas is low, the voltage is low.

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2237	An open in the circuit between terminals A1A+ and A1A- of the Air Fuel Ratio (A/F) sensor while the engine is running (2 trip detection logic).	• Open in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2238	One of the following conditions is met (2 trip detection logic): • The Air Fuel Ratio (A/F) sensor output drops while the engine is running. • The voltage at terminal A1A+ is 0.5 V or less. • The voltage difference between terminals A1A+ and A1A- is 0.1 V	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM

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DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
	or less.	
P2239	The A1A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2252	The A1A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2253	The A1A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the Air Fuel Ratio (A/F) sensor circuit, or if the A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM determines that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL is illuminated and a DTC is stored.

MONITOR STRATEGY

Related DTCs	P2237: Air Fuel Ratio (A/F) sensor open circuit between A1A+ and A1A- P2238: A/F sensor short circuit between A1A+ and A1A- P2238: A/F sensor short circuit between A1A+ and GND P2238: A/F sensor low impedance P2239: A/F sensor short circuit between A1A+ and +B P2252: A/F sensor short circuit between A1A- and GND P2253: A/F sensor short circuit between A1A- and +B
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor Crankshaft position sensor
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P2237 (A/F sensor open circuit between A1A+ and A1A-):

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Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0505 (IAC Valve)
Estimated sensor temperature	450 to 550°C (842 to 1022°F)
Engine	Running
Battery voltage	11 V or higher

P2238 (A/F sensor low impedance):

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0505 (IAC Valve)
Estimated sensor temperature	700 to 800°C (1292 to 1472°F)
Engine coolant temperature	10°C (50°F) or higher
Fuel cut	Not executed

P2238 (A/F Sensor Short Circuit Between AF+ and AF-, GND):

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor)

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	P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0505 (IAC Valve)
Battery voltage	11 V or higher
Ignition switch	ON
Time after ignition switch is turned from off to ON	5 seconds or more

Other:

Battery voltage	11 V or higher
Ignition switch	ON
Time after ignition switch is turned from off to ON	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P2237 (A/F sensor open circuit between A1A+ and A1A-):

A/F sensor admittance	Below 0.002 1/Ω

P2238 (A/F sensor low impedance):

A/F sensor admittance	Below 0.022 1/Ω

P2238 (A/F sensor short circuit between A1A+ and GND):

A/F+ terminal voltage	0.5 V or less

P2239 (A/F sensor short circuit between A1A+ and +B):

A/F+ terminal voltage	Higher than 4.5 V

P2252 (A/F sensor short circuit between A1A- and GND):

A/F- terminal voltage	0.5 V or less

P2253 (A/F sensor short circuit between A1A- and +B):

A/F- terminal voltage	Higher than 4.5 V

P2238 (A/F sensor short circuit between A1A+ and A1A-):

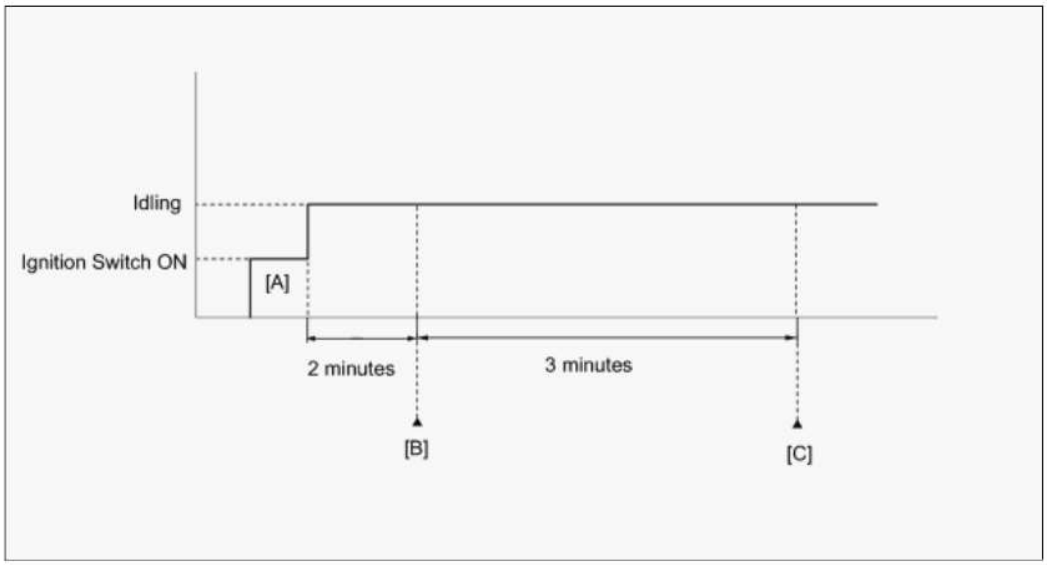
Difference between A/F+ terminal and A/F- terminal voltage	0.1 V or less

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COMPONENT OPERATING RANGE

A/F sensor admittance	0.022 1/Ω or higher
A1A+ terminal voltage	0.6 to 4.5 V
A1A- terminal voltage	0.6 to 4.5 V
Difference between A1A+ and A1A- terminal voltages	0.1 to 0.8 V

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine and wait 2 minutes.
5. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P2237, P2238, P2239, P2252 or P2253.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.

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- If the judgment result shows INCOMPLETE or UNKNOWN, idle the engine for 3 minutes and check the DTC judgment result again [C].

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P2195 INFO .

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume.)
7. Monitor the output voltages of the A/F and HO2 sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

HINT:

- The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

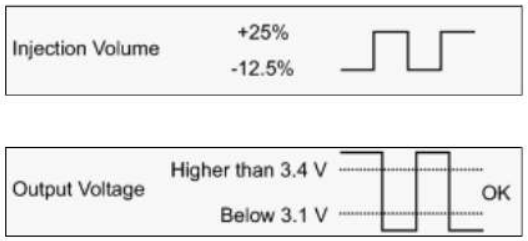
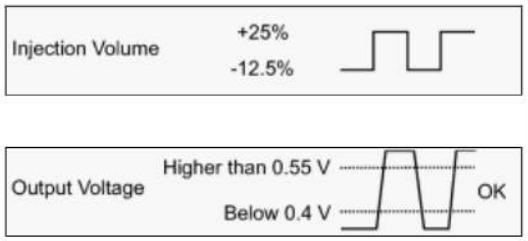
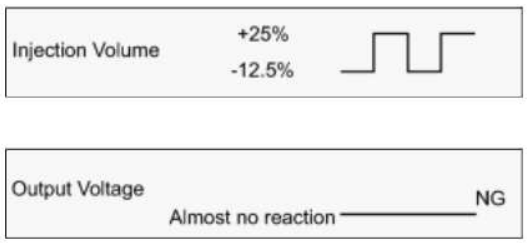
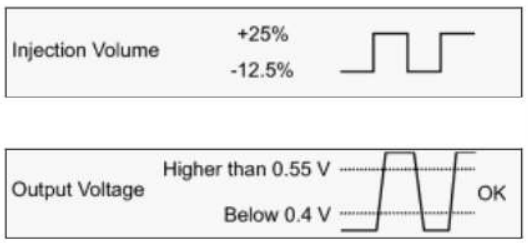
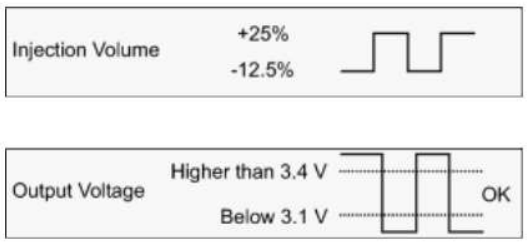
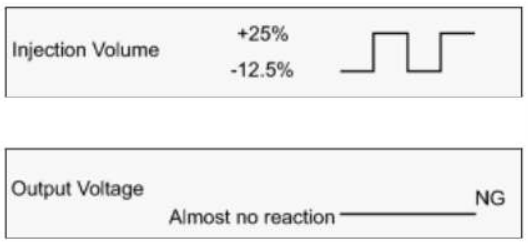
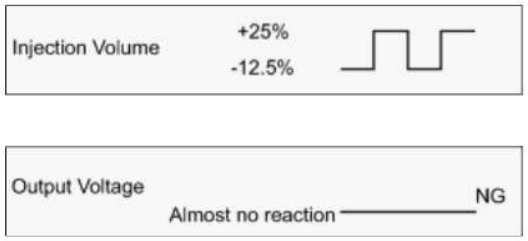
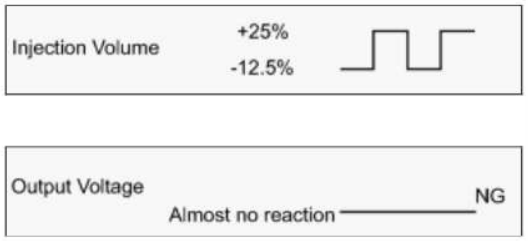
TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS Voltage B1 S1 (A/F)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (HO2)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTICE:

The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
1			

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CASE	A/F SENSOR (SENSOR 1) OUTPUT VOLTAGE	HO2 SENSOR (SENSOR 2) OUTPUT VOLTAGE	MAIN SUSPECTED TROUBLE AREA
			
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air-fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

HINT:

- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

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1.	CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)

(a) Disconnect the air fuel ratio sensor connector.

(b) Disconnect the ECM connector.

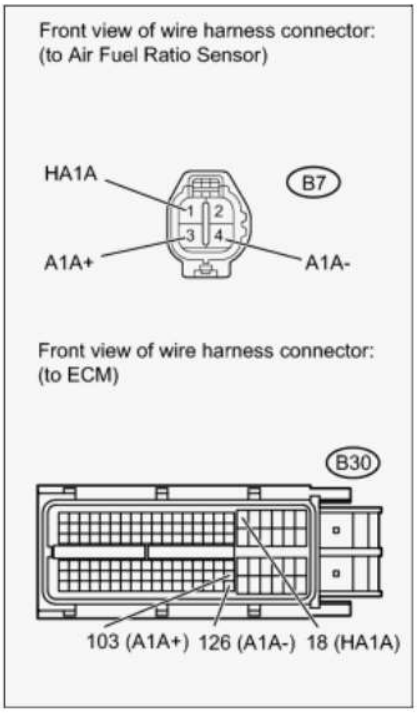
(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B7-1 (HA1A) - B30-18 (HA1A)	Always	Below 1 Ω
B7-3 (A1A+) - B30-103 (A1A+)		
B7-4 (A1A-) - B30-126 (A1A-)		

Standard Resistance (Check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B7-1 (HA1A) or B30-18 (HA1A) - Body ground	Always	10 kΩ or higher
B7-3 (A1A+) or B30-103 (A1A+) - Body ground		
B7-4 (A1A-) or B30-126 (A1A-) - Body ground		



(d) Reconnect the air fuel ratio sensor connector.

(e) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

2.	REPLACE AIR FUEL RATIO SENSOR

(a) Replace the air fuel ratio sensor INFO .

NEXT ▼

3.	PERFORM CONFIRMATION DRIVING PATTERN

(a) Drive the vehicle according to the Confirmation Driving Pattern.

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NEXT

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000002BHC039X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2420: Evaporative Emission System Switching Valve Control Circuit High (2011 RAV4)		

DTC	**P2420**	**Evaporative Emission System Switching Valve Control Circuit High**

DTC SUMMARY

DTC NO.	MONITORING ITEM	MALFUNCTION DETECTION CONDITION	TROUBLE AREA	DETECTION TIMING	DETECTION LOGIC
P2420	Vent valve stuck open (vent)	Following condition met during key-off EVAP monitor: • EVAP pressure change when vent valve closed (ON) below 0.3 kPa-g (2.25 mmHg-g)	• Canister pump module (Reference orifice, leak detection pump, vent valve) • Connector/wire harness (Canister pump module - ECM) • ECM	While ignition switch off	2 trip

HINT:

The vent valve is built into the canister pump module.

DESCRIPTION

The description can be found in EVAP (Evaporative Emission) System INFO .

INSPECTION PROCEDURE

Refer to EVAP System INFO .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] is the absolute pressure.
- [kPa-g (mmHg-g)] is the gauge pressure (relative pressure).
- On the Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

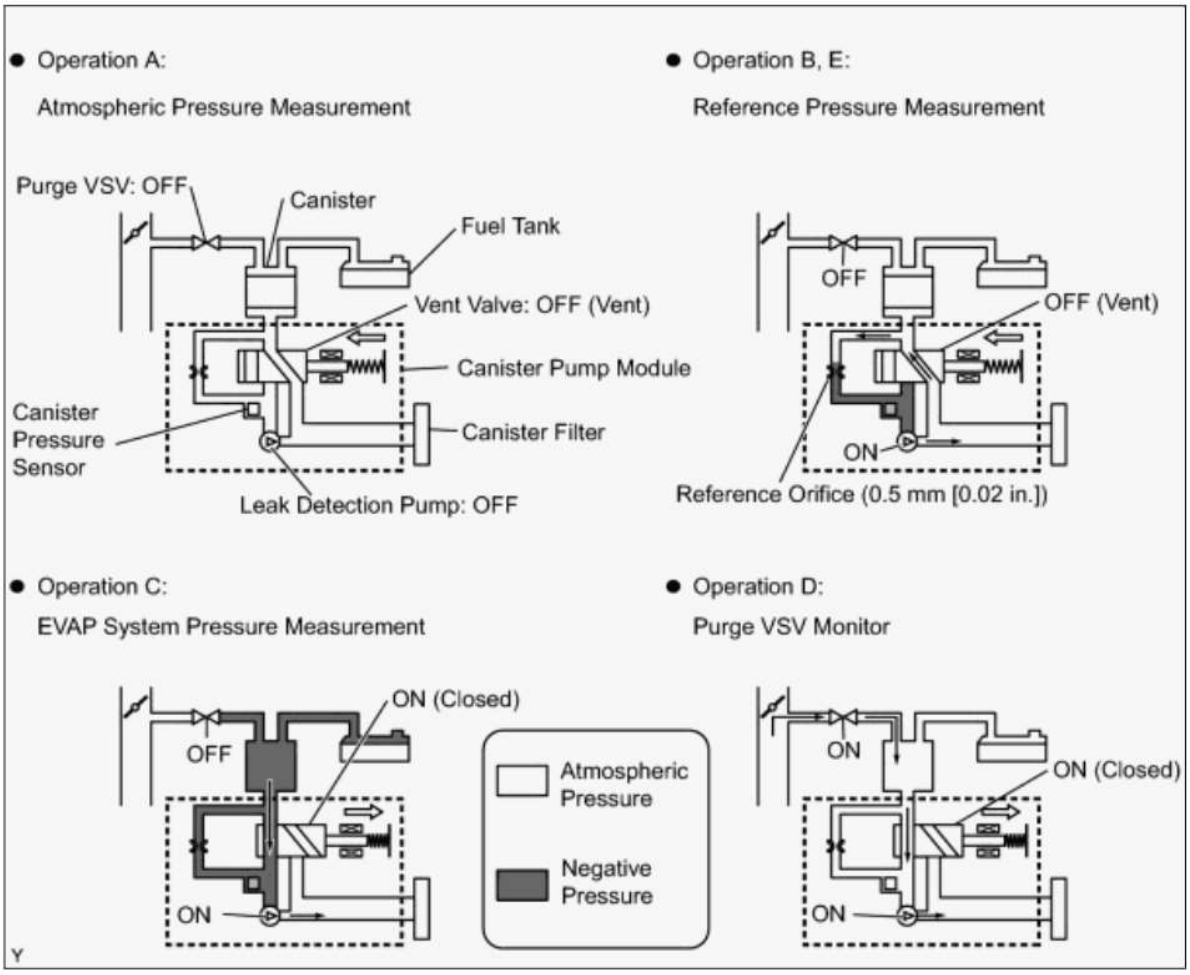
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***: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.**

SEQUENCE	OPERATION	DESCRIPTION	DURATION
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	60 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

*: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

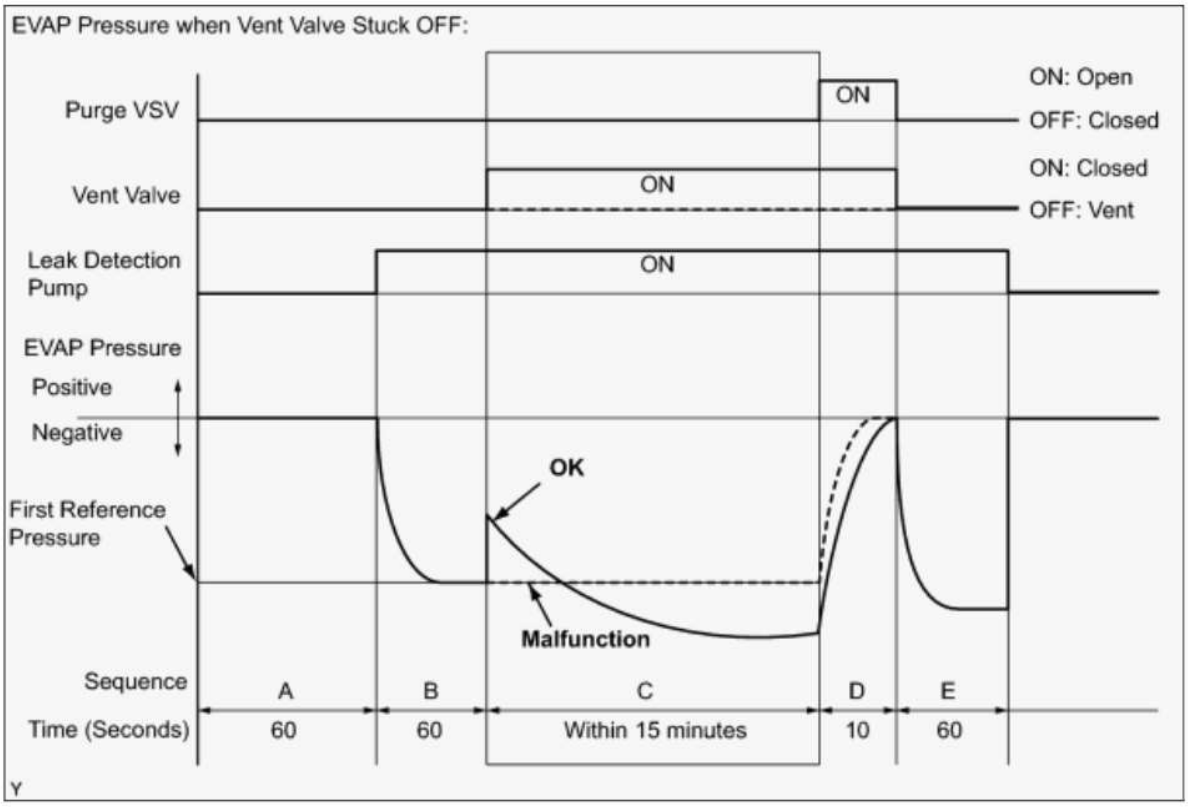
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P2420: Vent valve stuck open (vent)

In operation C, the vent valve turns ON (closes) and the EVAP system pressure is then measured by the ECM using the canister pressure sensor to conduct an EVAP leak check. If the pressure does not increase when the vent valve is open, the ECM interprets this as the vent valve being stuck open. The ECM illuminates the MIL and stores the DTC.

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MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 2 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0451, P0452, P0453 (EVAP System)
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or higher
Vehicle speed	Less than 4 km/h (2.5 mph)
Ignition switch	off
Time after key-off	5, 7 or 9.5 hours
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool

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Leak detection pump	Not operated by scan tool
Both of following conditions met before key-off	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

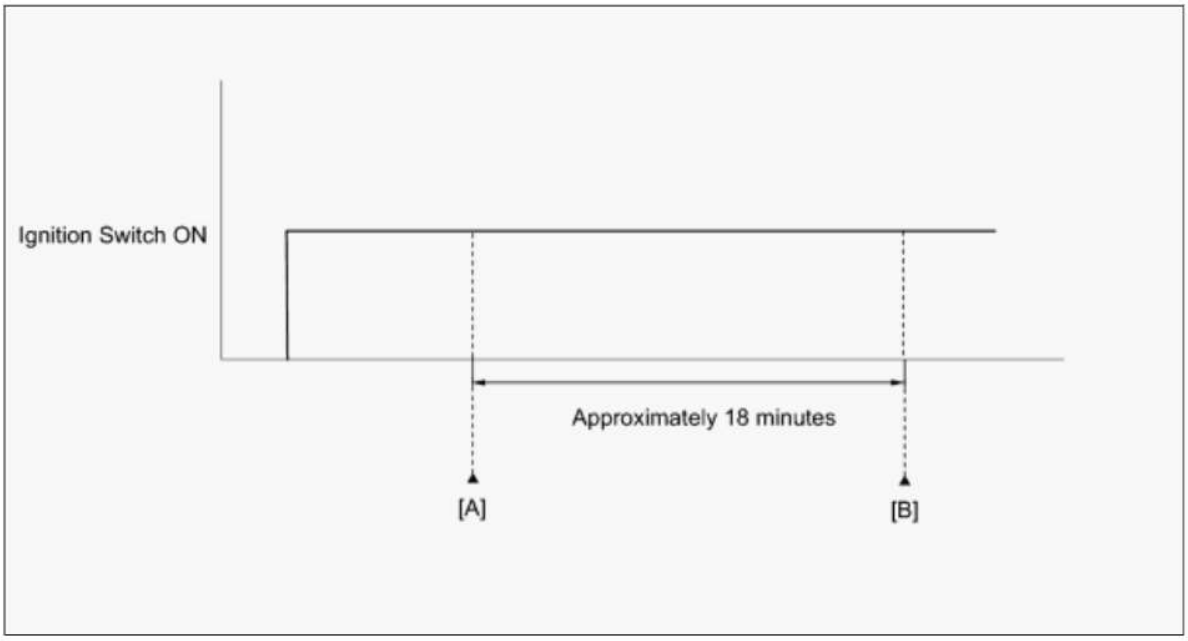
TYPICAL MALFUNCTION THRESHOLDS

EVAP pressure change after EVAP canister vent valve ON	Less than 0.3 kPa-g (2.25 mmHg-g)

MONITOR RESULT

Refer to Checking Monitor Status INFO .

CONFIRMATION DRIVING PATTERN



NOTICE:

- The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by Techstream. It takes a maximum of approximately 18 minutes.
- Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.
- Do not run the engine during this operation.
- When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the fuel temperature below 35°C (95°F).

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Enter the following menu items: Powertrain / Engine and ECT / Utility / Evaporative System Check / Automatic Mode.
5. After the "Evaporative System Check" is completed, check for All Readiness by entering the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
6. Input the DTC: P2420.
7. Check the DTC judgment result [B].

TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

8. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
9. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

10. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

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Last Modified: 9-7-2011	6.4 C	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000T6X070X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2610: ECM / PCM Internal Engine Off Timer Performance (2011 RAV4)		

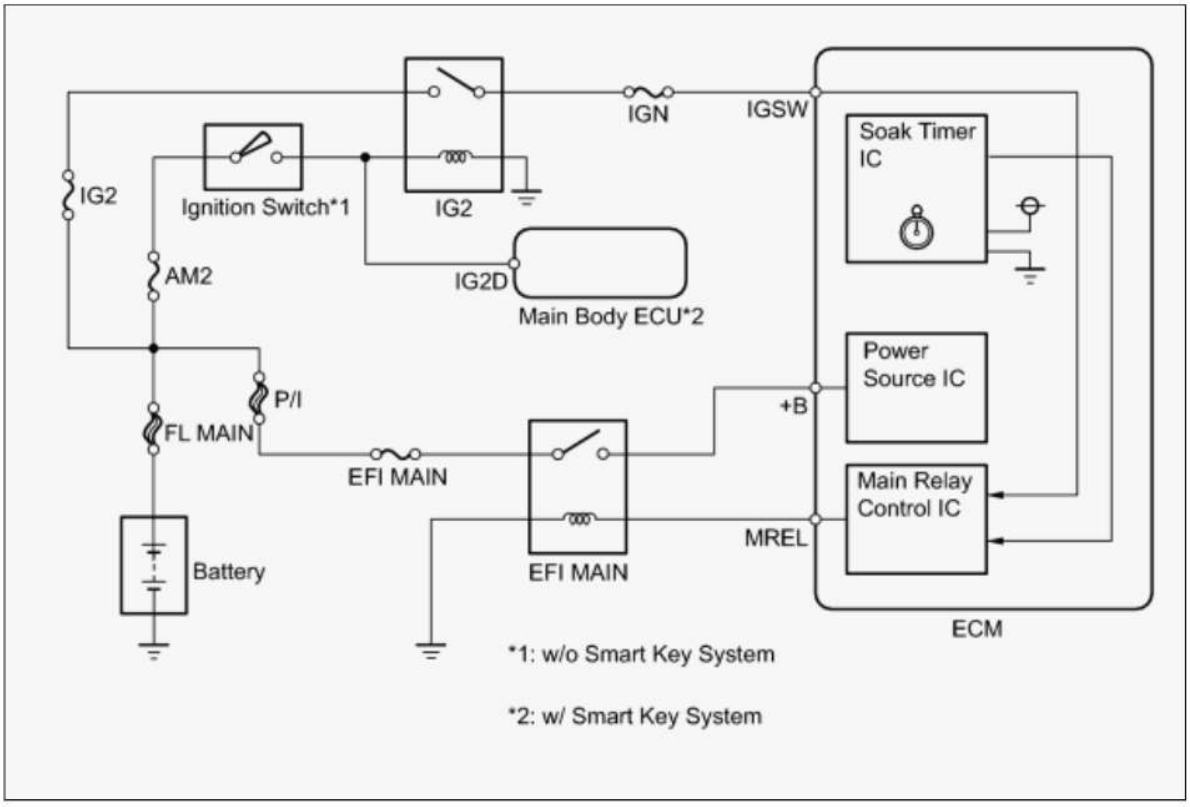
DTC	**P2610**	**ECM / PCM Internal Engine Off Timer Performance**

DTC SUMMARY

DTC NO.	MONITORING ITEM	MALFUNCTION DETECTION CONDITION	TROUBLE AREA	DETECTION TIMING	DETECTION LOGIC
P2610	Soak timer (built into ECM)	An ECM internal malfunction.	ECM	Engine running	2 trip

DESCRIPTION

The soak timer operates after the ignition switch is turned off. When a certain amount of time has elapsed after turning the ignition switch off the soak timer activates the ECM to perform malfunction checks which can only be performed after the engine is stopped. The soak timer is built into the ECM.



MONITOR DESCRIPTION

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1. While the engine is running, the ECM monitors the synchronization of the soak timer and the CPU clock. If these two are not synchronized, the ECM interprets this as a malfunction, illuminates the MIL and stores the DTC.
2. If the soak timer activates the ECM even though only a short amount of time has elapsed since the ignition switch was turned off, or if the soak timer does not activate the ECM even though a considerable amount of time has elapsed since the ignition switch was turned off, the ECM determines that the soak timer is malfunctioning, illuminates the MIL and stores a DTC the next time the ignition switch is turned ON.

MONITOR STRATEGY

Required Sensors/Components	ECM
Frequency of Operation	Once per driving cycle
Duration	10 minutes: Timer malfunction Within 9.5 hours: Timer start-up malfunction
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Timer Malfunction

Monitor runs whenever following DTC not present	None
Ignition switch	ON
Engine	Running
Battery voltage	8 V or higher
Starter	OFF

Timer Start-up Malfunction (Case 1)

Monitor runs whenever following DTC not present	None
Elapsed time from engine stop	Less than 1800 seconds
Ignition switch	ON
Battery voltage	8 V or higher
Starter	OFF

Timer Start-up Malfunction (Case 2)

Monitor runs whenever following DTC not present	None
Elapsed time from engine stop	2400 seconds or more
Ignition switch	ON
Battery voltage	8 V or higher

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Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Timer Malfunction

Soak timer measurement when ECM CPU clock counts 10 minutes	Less than 7 minutes, or more than 13 minutes

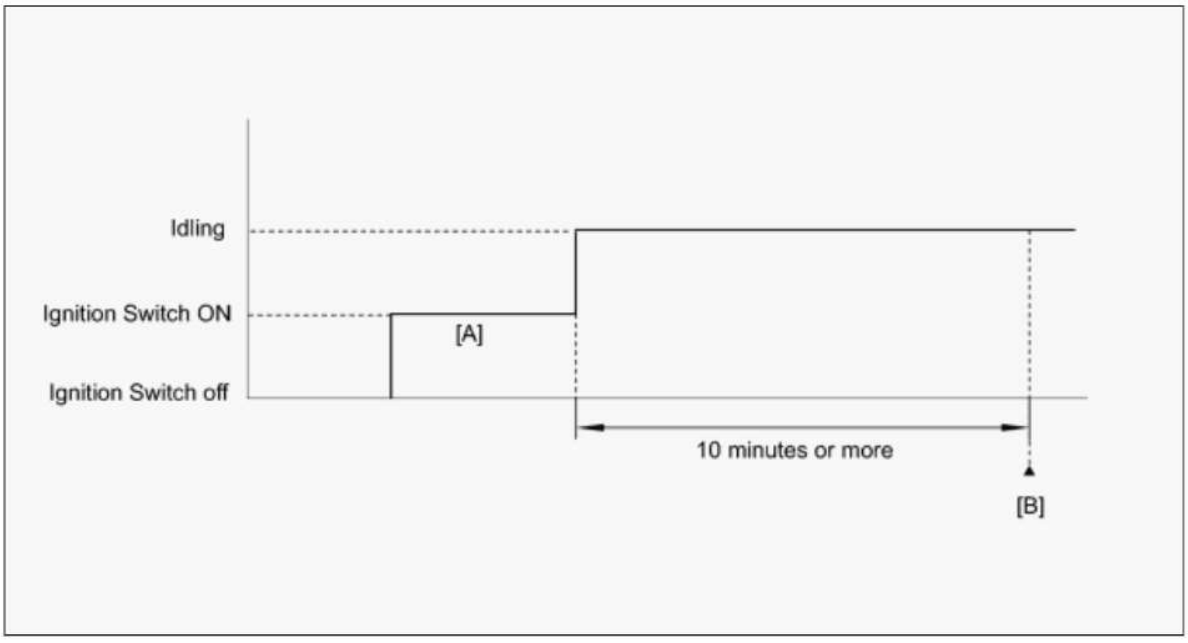
Timer Start-up Malfunction (Case 1)

ECM has a record of being started by soak timer	Yes

Timer Start-up Malfunction (Case 2)

ECM has a record of being started by soak timer	No

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation) [A].
4. Start the engine.
5. Idle the engine for 10 minutes or more.
6. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
7. Input the DTC: P2610.
8. Check the DTC judgment result [B].

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TESTER DISPLAY	DESCRIPTION
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

9. If the test result is UNKNOWN, enter the following menus: Powertrain / Engine and ECT / Trouble Code / Pending.
10. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

11. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

- DTC P2610 is stored if an internal ECM problem is detected. Diagnostic procedures are not required. ECM replacement is necessary.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

PROCEDURE

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1.	REPLACE ECM

(a) Replace the ECM INFO .

NEXT

2.	CHECK WHETHER DTC OUTPUT RECURS (DTC P2610)

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine and wait for 10 minutes or more.

(f) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

(g) If no pending DTC is output, the repair has been successfully completed.

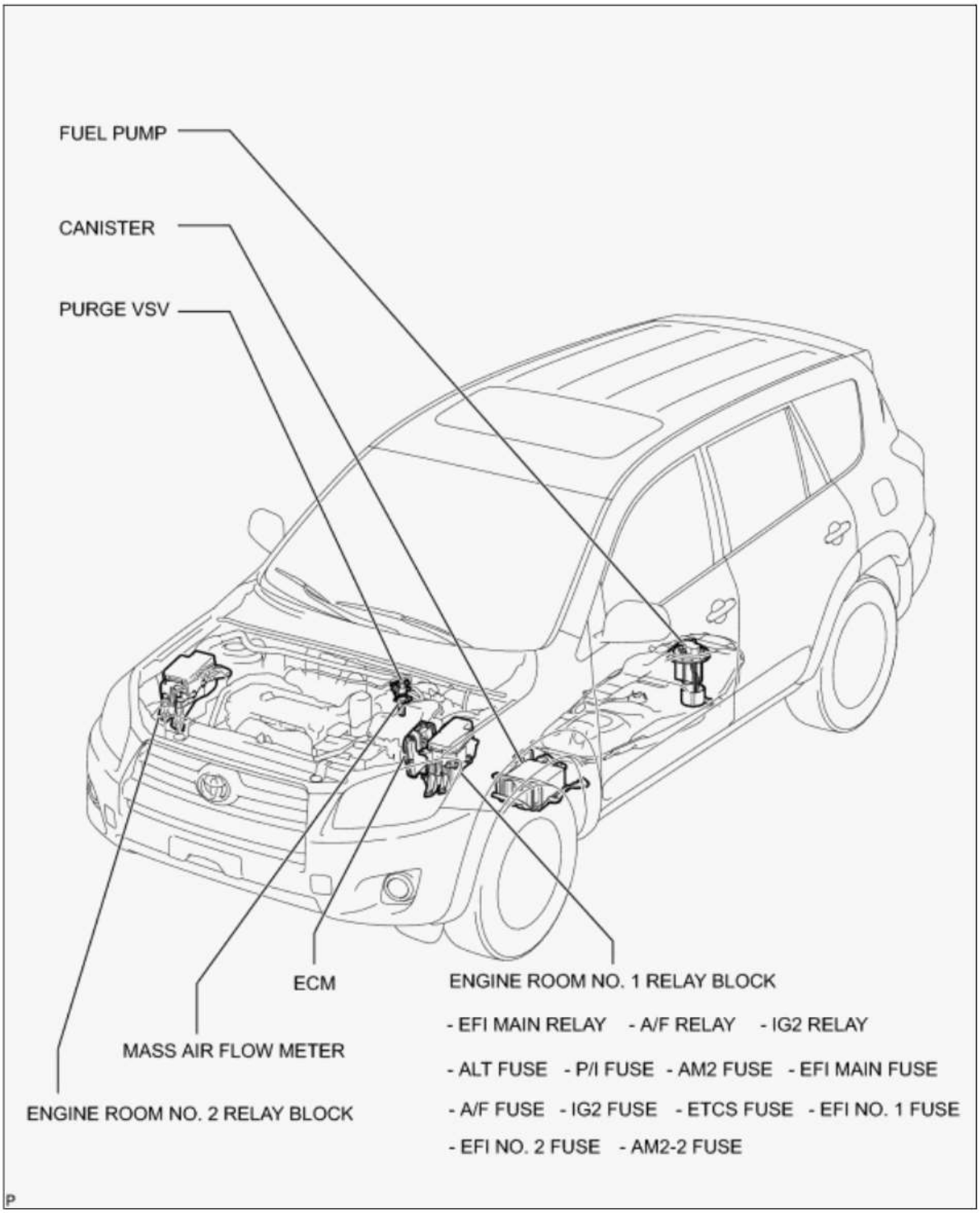
NEXT END

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Last Modified: 9-7-2011	6.4 R	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDA069X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: PARTS LOCATION (2011 RAV4)		

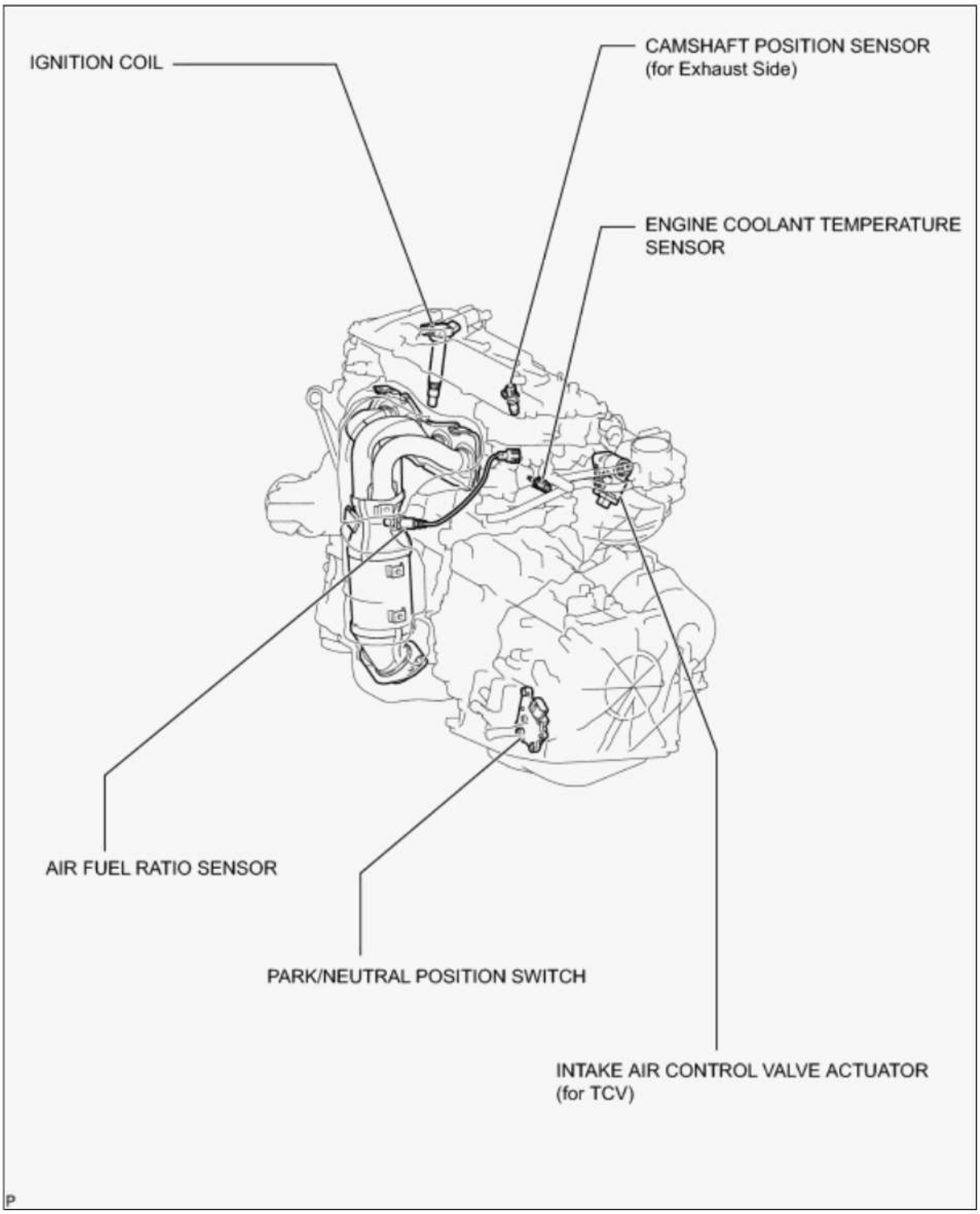
PARTS LOCATION

ILLUSTRATION



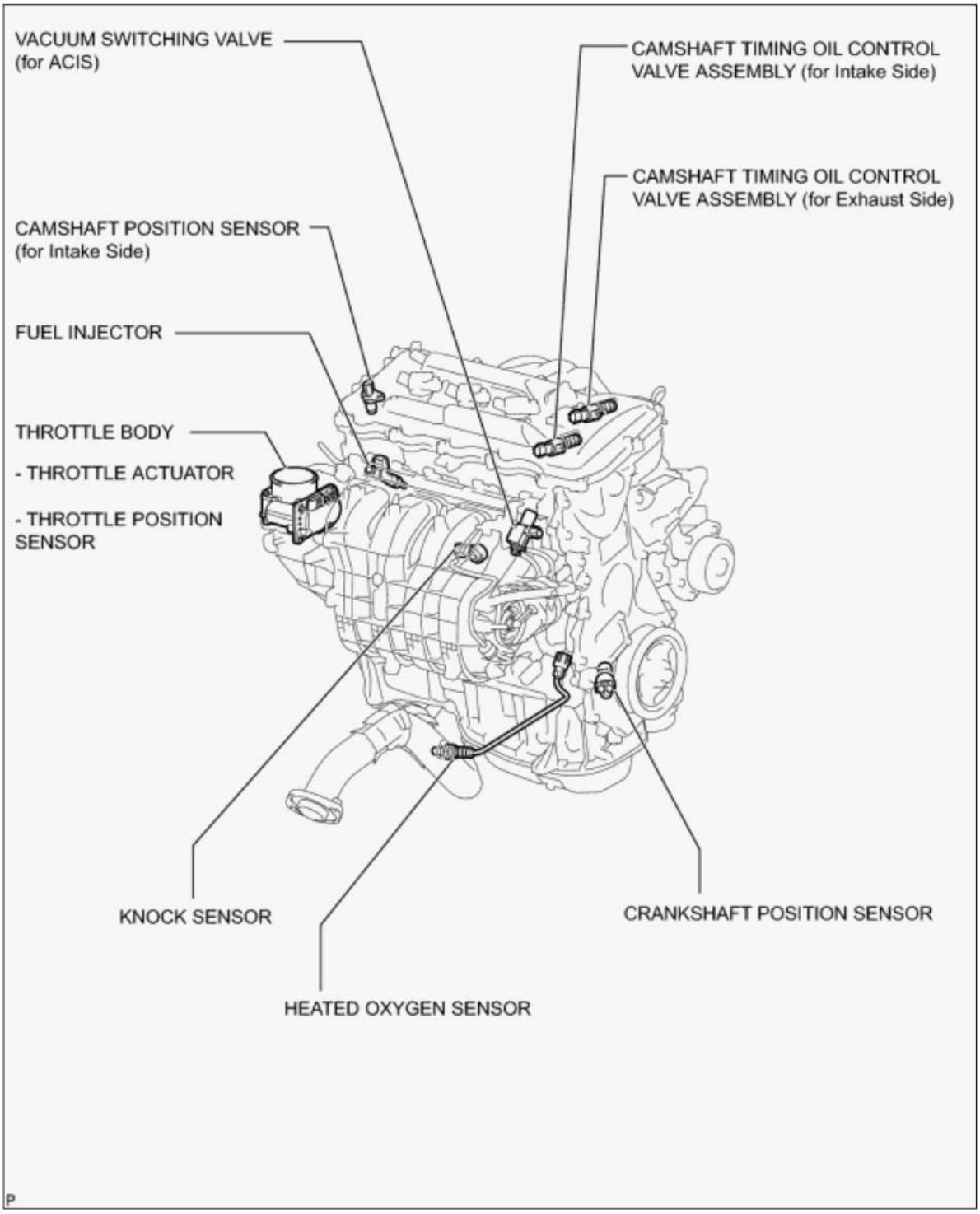
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ILLUSTRATION



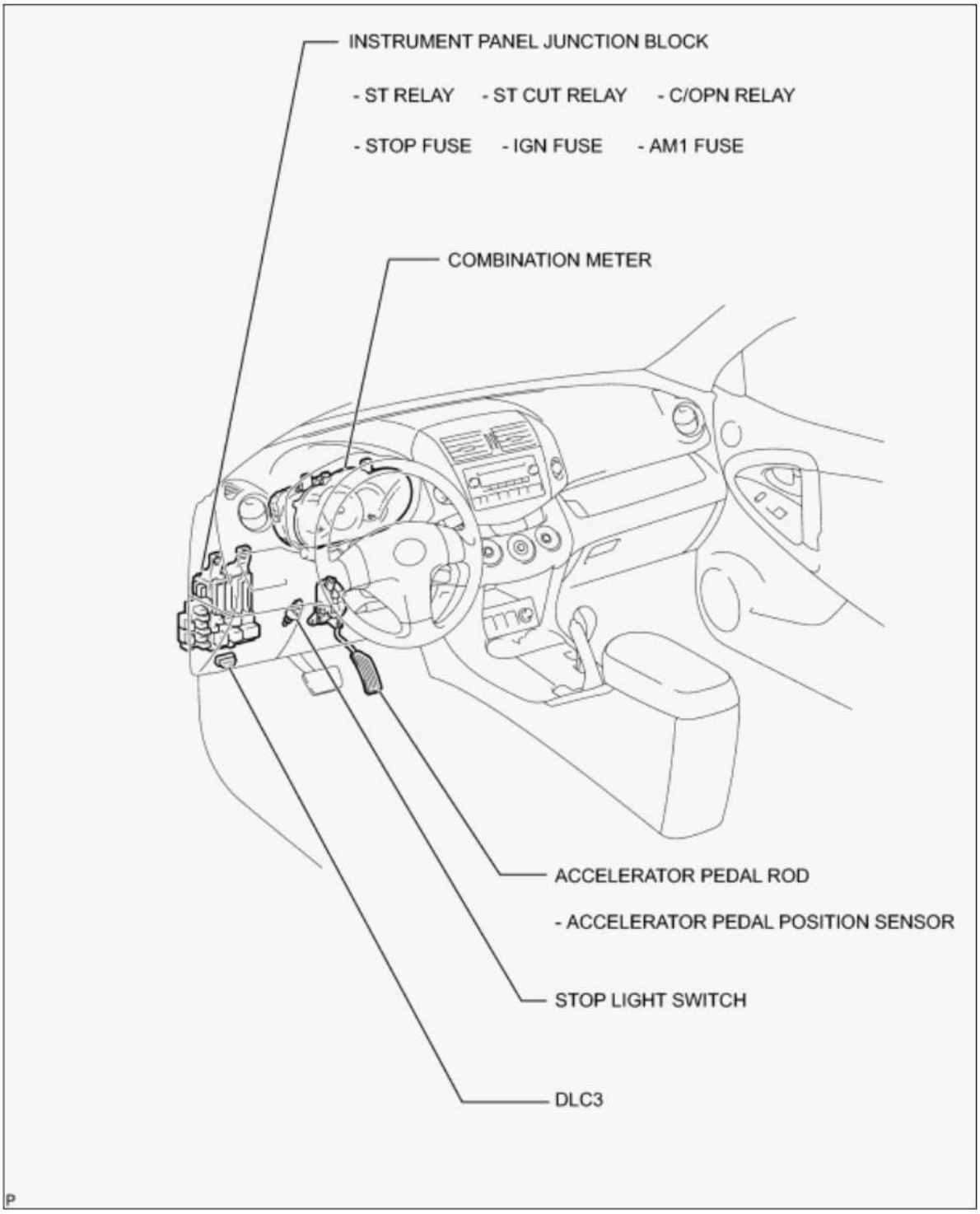
ILLUSTRATION

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ILLUSTRATION

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Last Modified: 9-7-2011	6.4 L	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PD8077X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: PRECAUTION (2011 RAV4)		

PRECAUTION

1. IGNITION SWITCH EXPRESSION

HINT:

The type of ignition switch used on this model differs according to the specifications of the vehicle. The expressions listed in the table below are used in this section.

EXPRESSION	IGNITION SWITCH (POSITION)	ENGINE SWITCH (CONDITION)
Ignition Switch off	Off	Off
Ignition Switch ON	ON	On (IG)
Ignition Switch ACC	ACC	On (ACC)
Engine Start	START	Start

2. INITIALIZATION

NOTICE:

- Perform initialization (throttle position) after replacing the throttle body assembly or cleaning any throttle body components INFO .
- Perform initialization (throttle position) after reconnecting the battery cable or replacing the ECM INFO .
- Perform Reset Memory (AT initialization) for 2WD when replacing the automatic transaxle assembly, engine assembly or ECM INFO .
- Perform Reset Memory (AT initialization) for 4WD when replacing the automatic transaxle assembly, engine assembly or ECM INFO .
- Perform Registration (VIN registration) when replacing the ECM INFO .

HINT:

Initialization cannot be completed only by disconnecting and reconnecting the battery cable.

3. WHEN USING TECHSTREAM

CAUTION:

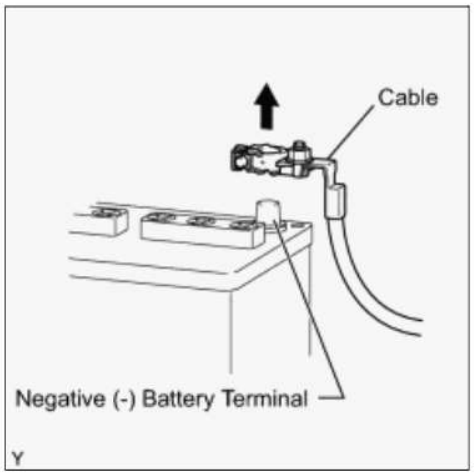
Observe the following items for safety reasons:

- Read the Techstream instruction books before using the Techstream.
- Prevent the Techstream cable from being caught on the pedals, shift lever and steering wheel when driving with the Techstream connected to the vehicle.
- When driving the vehicle for testing purposes while using the Techstream, two persons are required. One person drives the vehicle, and the other operates the Techstream.

4. DISCONNECT AND RECONNECT CABLE OF NEGATIVE BATTERY TERMINAL

(a) Before performing electronic work, disconnect the cable from

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the negative (-) battery terminal in order to prevent short circuit and burn outs.

(b) Before disconnecting and reconnecting the battery cable, turn the ignition switch off and the headlight dimmer switch off. Then loosen the terminal nut completely. Do not damage the cable or terminal.

(c) When the battery cable is disconnected, the clock and radio settings and stored DTCs are cleared. Therefore, before disconnecting the cable from the negative (-) battery terminal, make a note of the settings.

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Last Modified: 9-7-2011	6.4 T	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDG0EOX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: PROBLEM SYMPTOMS TABLE (2011 RAV4)		

PROBLEM SYMPTOMS TABLE

HINT:

- Use the table below to help determine the cause of problem symptoms. If multiple suspected areas are listed, the potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.
- Inspect the fuses and relays related to this system before inspecting the suspected areas below.

SFI system

SYMPTOM	SUSPECTED AREA	SEE PAGE
Engine does not crank (Does not start)	Battery	INFO
	Starter	INFO
	Starter relay	INFO
	Park/neutral position switch for 2WD	INFO
	Park/neutral position switch for 4WD	INFO
	Smart key system	INFO
	Cranking holding function circuit	INFO
No initial combustion (Does not start)	ECM power source circuit	INFO
	Crankshaft position sensor	INFO
	Camshaft position sensor	INFO
	Ignition system	INFO
	Fuel pump control circuit	INFO
	Fuel injector circuit	INFO
	Valve timing	INFO
	VC output circuit	INFO
	ECM	INFO
Engine cranks normally but difficult to start	Fuel pump control circuit	INFO
	Fuel pump	INFO
	Fuel injector circuit	INFO
	ECM power source circuit	INFO
	Engine coolant temperature sensor	INFO
	Air induction system	INFO

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SYMPTOM	SUSPECTED AREA	SEE PAGE
	Ignition system	INFO
	Spark plug	INFO
	Throttle body	INFO
	Compression	INFO
Incomplete intermittent combustion occurs (Does not start)	Fuel pump control circuit	INFO
	Fuel pump	INFO
	Ignition circuit	INFO
	Ignition system	INFO
	Fuel injector circuit	INFO
	ECM power source circuit	INFO
	Crankshaft position sensor	INFO
	Camshaft position sensor	INFO
	Valve timing	INFO
High engine idle speed	Throttle body	INFO
	Air induction system	INFO
	A/C signal circuit for Automatic Air Conditioning System	INFO
	A/C signal circuit for Manual Air Conditioning System	INFO
	ECM power source circuit	INFO
	Engine coolant temperature sensor	INFO
	PCV valve and hose	INFO
	Acoustic Control Induction System (ACIS)	INFO
Low engine idle speed (Poor idling)	Throttle body	INFO
	A/C signal circuit for Automatic Air Conditioning System	INFO
	A/C signal circuit for Manual Air Conditioning System	INFO
	Fuel pump control circuit	INFO
	Fuel pump	INFO
	Air induction system	INFO
	PCV valve and hose	INFO
	Acoustic Control Induction System (ACIS)	INFO
Rough idling	Compression	INFO

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SYMPTOM	SUSPECTED AREA	SEE PAGE
	Ignition system	INFO
	Spark plug	INFO
	Fuel injector circuit	INFO
	ECM power source circuit	INFO
	Fuel pump control circuit	INFO
	Fuel pump	INFO
	Throttle body	INFO
	Air induction system	INFO
	PCV valve and hose	INFO
	Air fuel ratio sensor	INFO
	Heated oxygen sensor	INFO
	Mass air flow meter	INFO
	Acoustic Control Induction System (ACIS)	INFO
	Tumble Control Valve (TCV)	INFO
Idle hunting	Throttle body	INFO
	Air induction system	INFO
	PCV valve and hose	INFO
	Air fuel ratio sensor	INFO
	Mass air flow meter	INFO
	Acoustic Control Induction System (ACIS)	INFO
	Tumble Control Valve (TCV)	INFO
Hesitation/poor acceleration	Fuel pump control circuit	INFO
	Fuel pump	INFO
	Spark plug	INFO
	Ignition system	INFO
	Fuel injector circuit	INFO
	ECM power source circuit	INFO
	Mass air flow meter	INFO
	Throttle body	INFO
	Air induction system	INFO
	Valve timing	INFO
	Compression	INFO

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SYMPTOM	SUSPECTED AREA	SEE PAGE
	Brake override system	INFO
Surging (Poor driveability)	Spark plug	INFO
	Fuel pump control circuit	INFO
	Fuel pump	INFO
	Ignition system	INFO
	Fuel injector circuit	INFO
	ECM power source circuit	INFO
	Mass air flow meter	INFO
	Variable valve timing (VVT) system	INFO
	Compression	INFO
Engine stalls soon after starting	Fuel pump control circuit	INFO
	Fuel pump	INFO
	Spark plug	INFO
	Ignition system	INFO
	Fuel injector circuit	INFO
	ECM power source circuit	INFO
	Mass air flow meter	INFO
	Variable valve timing (VVT) system	INFO
	Throttle body	INFO
	Air induction system	INFO
	PCV valve and hose	INFO
	Compression	INFO
Engine stalls only during A/C operation	A/C signal circuit for Automatic Air Conditioning System	INFO
	A/C signal circuit for Manual Air Conditioning System	INFO
	ECM	INFO
Unable/difficult to refuel	Refueling valve (canister)	-

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Last Modified: 9-7-2011	6.4 D	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000SXQ04QX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: READINESS MONITOR DRIVE PATTERN (2011 RAV4)		

READINESS MONITOR DRIVE PATTERN

1. PURPOSE OF READINESS TESTS

- The On-Board Diagnostic (OBD II) system is designed to monitor the performance of emission-related components, and indicate any detected abnormalities with DTCs (Diagnostic Trouble Codes). Since various components need to be monitored during different driving conditions, the OBD II system is designed to run separate monitoring programs called Readiness Monitors.
- To view the monitor status, enter the following menus: Powertrain / Engine and ECT / Monitor / Current Monitor / Current.
- When the Readiness Monitor status displays Complete, the necessary conditions have been met for running the performance tests for that Readiness Monitor.
- A generic OBD II scan tool can also be used to view the Readiness Monitor status.

HINT:

Many state Inspection and Maintenance (I/M) programs require the vehicle Readiness Monitor status to show Complete before beginning emission tests.

The Readiness Monitor is reset to Incomplete if:

- The ECM has lost battery power or blown a fuse.
- DTCs have been cleared.
- The conditions for running the Readiness Monitor have not been met.

If the Readiness Monitor status shows Incomplete, follow the appropriate Readiness Monitor Drive Pattern to change the status to Complete.

CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

NOTICE:

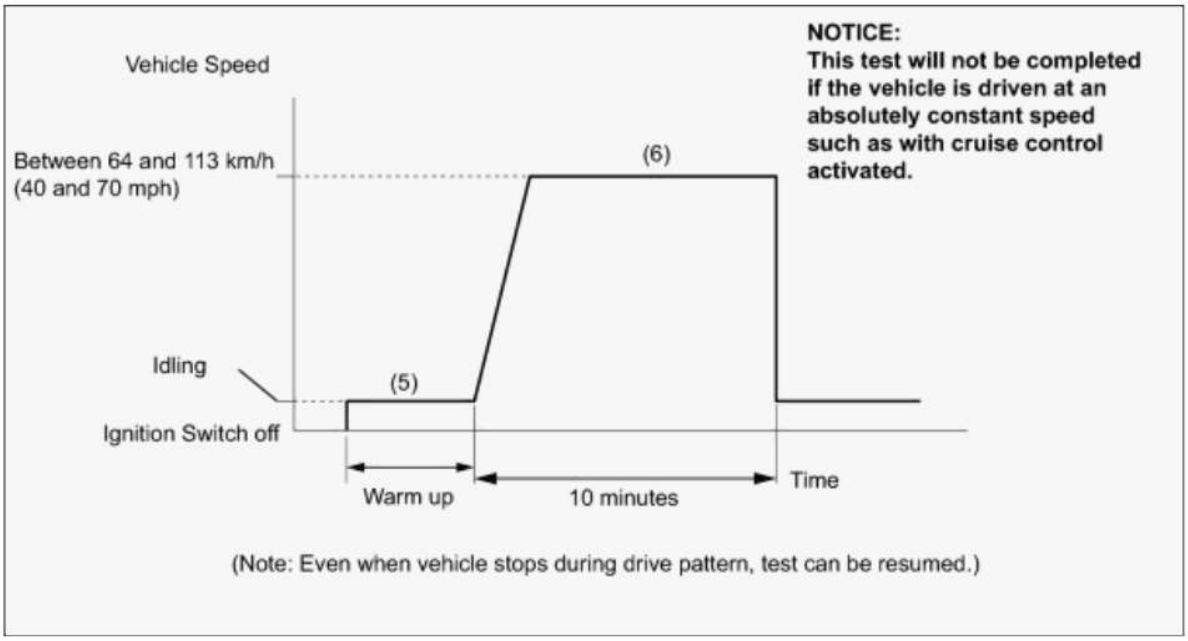
These drive patterns represent the fastest method of satisfying all conditions necessary to achieve complete status for each specific Readiness Monitor.

In the event of a drive pattern being interrupted (possibly due to factors such as traffic conditions), the drive pattern can be resumed. In most cases, the Readiness Monitor will still achieve complete status upon completion of the drive pattern.

To ensure completion of the Readiness Monitors, avoid sudden changes in vehicle load and speed (driving up and down hills and/or sudden acceleration).

2. CATALYST MONITOR (ACTIVE AIR-FUEL RATIO CONTROL TYPE)

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(a) Preconditions

- The monitor will not run unless:
  - The MIL is off.

(b) Drive Pattern

(1) Connect the Techstream to the DLC3.

(2) Turn the ignition switch to ON.

(3) Turn the Techstream on.

(4) Clear DTCs (if output) INFO .

(5) Start the engine and warm it up.

(6) Drive the vehicle at between 64 and 113 km/h (40 and 70 mph) for at least 10 minutes.

(c) Monitor Status

Check the Readiness Monitor status displayed on the Techstream.

If the status does not switch to Complete, extend the driving time.

3. EVAP SYSTEM MONITOR (KEY-OFF TYPE)

(a) Preconditions

- The monitor will not run unless:
  - The fuel tank is less than 90% full.
  - The altitude is less than 8000 ft. (2438 m).
  - The vehicle is stationary.
  - The engine coolant temperature is between 4.4 and 35°C (40 and 95°F).
  - The intake air temperature is between 4.4 and 35°C (40 and 95°F).
  - The vehicle was driven in a city area (or on a freeway) for 10 minutes or more.

(b) Monitor Conditions

(1) Turn the ignition switch off and wait for 6, 8 or 10.5 hours depending on certain vehicle conditions.

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HINT:

Do not start the engine until after checking Readiness Monitor status. If the engine is started, the step described above must be repeated.

(c) Monitor Status

(1) Connect the Techstream to the DLC3.

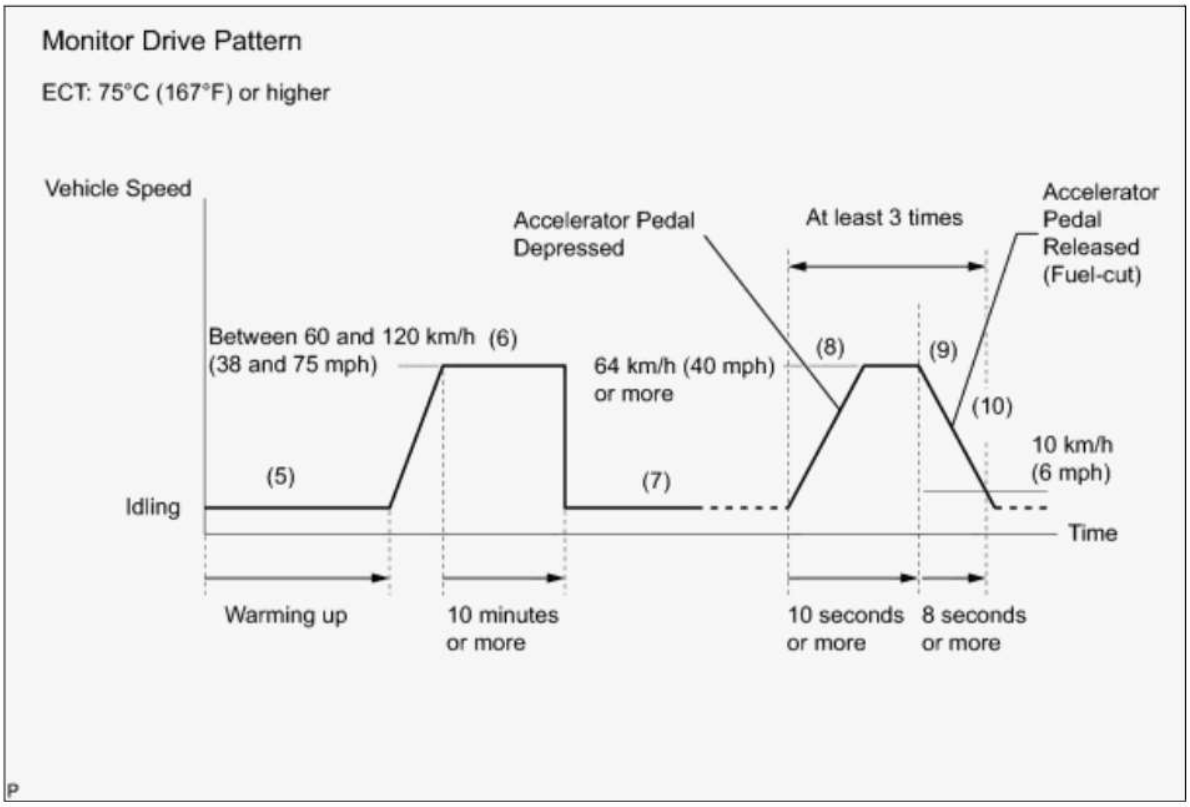
(2) Turn the ignition switch to ON.

(3) Turn the Techstream on.

(4) Check the Readiness Monitor status displayed on the Techstream.

If the status does not switch to Complete, restart the engine, make sure that the preconditions have been met, and then perform the Monitor Conditions procedure again.

4. AIR-FUEL RATIO (A/F) AND HEATED OXYGEN (HO2) SENSOR MONITORS (ACTIVE AIR-FUEL RATIO CONTROL TYPE)



(a) Preconditions

- The monitor will not run unless:
  - 2 minutes or more have elapsed since the engine was started.
  - The Engine Coolant Temperature (ECT) is 75°C (167°F) or higher.
  - Cumulative driving time at a vehicle speed of 48 km/h (30 mph) or more exceeds 6 minutes.
  - Air-fuel ratio feedback control is performed.

(b) Drive Pattern for Front A/F Sensor and HO2 Sensor

(1) Connect the Techstream to the DLC3.

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(2) Turn the ignition switch to ON.

(3) Turn the Techstream on.

(4) Clear DTCs INFO .

(5) Start the engine and warm it up until the ECT reaches 75°C (167°F) or higher.

(6) Drive the vehicle at a speed between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.

(7) Change the transmission to 2nd gear.

(8) Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.

(9) Release the accelerator pedal for at least 8 seconds without depressing the brake pedal in order to execute fuel-cut control.

(10) Allow the vehicle to decelerate until the vehicle speed decreases to less than 10 km/h (6 mph).

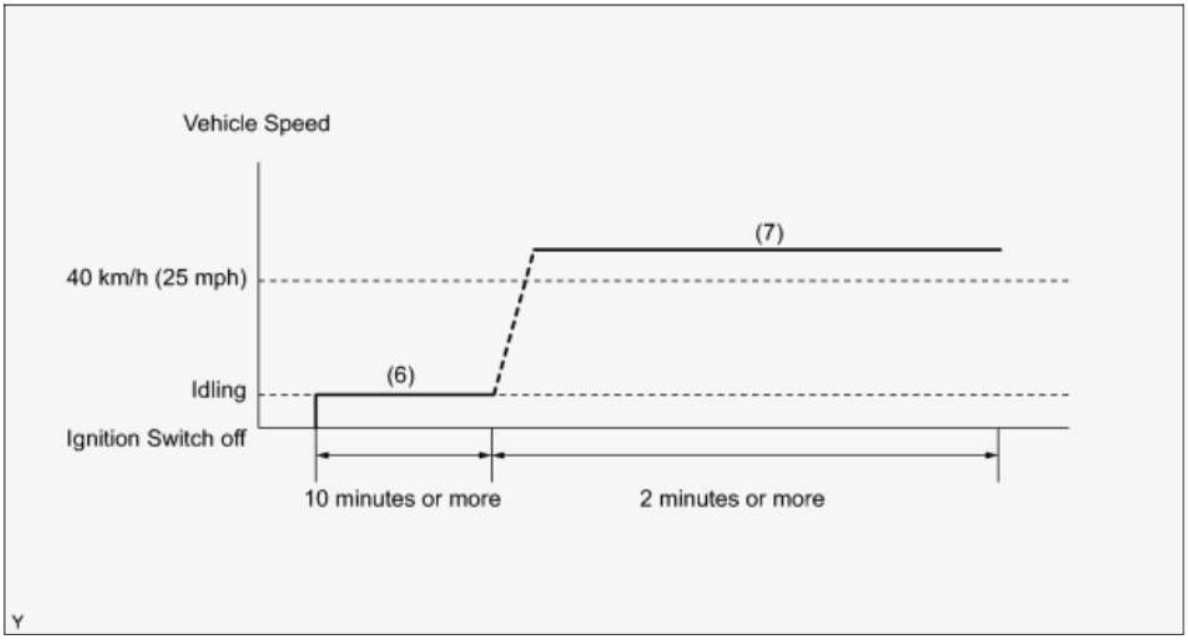
(11) Repeat steps (8) through (10) above at least 3 times in one driving cycle.

(c) Monitor Status

(1) Check the Readiness Monitor status displayed on the Techstream.

(2) If the status does not switch to Complete, make sure that the preconditions have been met, and then perform steps (5) through (11) in the Drive Pattern above.

5. AIR-FUEL RATIO (A/F) AND HEATED OXYGEN (HO2) SENSOR HEATER MONITORS (FRONT A/F AND REAR HO2 SENSOR TYPE)



(a) Preconditions

- The monitor will not run unless:
  - The MIL is off.

(b) Drive Pattern

(1) Connect the Techstream to the DLC3.

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(2) Turn the ignition switch to ON.

(3) Turn the Techstream on.

(4) Clear DTCs (if output) INFO .

(5) Start the engine.

(6) Allow the engine to idle for 10 minutes or more.

(7) Drive the vehicle at 40 km/h (25 mph) or more for at least 2 minutes.

(c) Monitor Status

(1) Check the Readiness Monitor status displayed on the Techstream.

If the status does not switch to Complete, make sure that the preconditions have been met, and repeat steps (5) to (7) described in the Drive Pattern above.

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Last Modified: 9-7-2011	6.4 M	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDT06UX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: REGISTRATION (2011 RAV4)		

REGISTRATION

NOTICE:

The Vehicle Identification Number (VIN) must be input into the replacement ECM.

HINT:

The VIN is in the form of a 17-digit alphanumeric vehicle identification number. The Techstream is required to register the VIN.

1. DESCRIPTION (Using the Techstream)

HINT:

This registration section consists of two parts: Read VIN and Write VIN.

(a) Read VIN: Explains the VIN reading process in a flowchart. This process allows the VIN stored in the ECM to be read in order to confirm that the two VINs, provided with the vehicle and stored in the vehicle ECM, are the same.

(b) Write VIN: Explains the VIN writing process in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is replaced, or the ECM VIN and vehicle VIN do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.

2. READ VIN

(a) Confirm the vehicle VIN.

(b) Connect the Techstream to the DLC3.

(c) Turn the ignition switch to ON.

(d) Turn the Techstream on.

(e) Enter the following menus: Powertrain / Engine and ECT / Utility / VIN / VIN Read.

3. WRITE VIN

(a) Confirm the vehicle VIN.

(b) Connect the Techstream to the DLC3.

(c) Turn the ignition switch to ON.

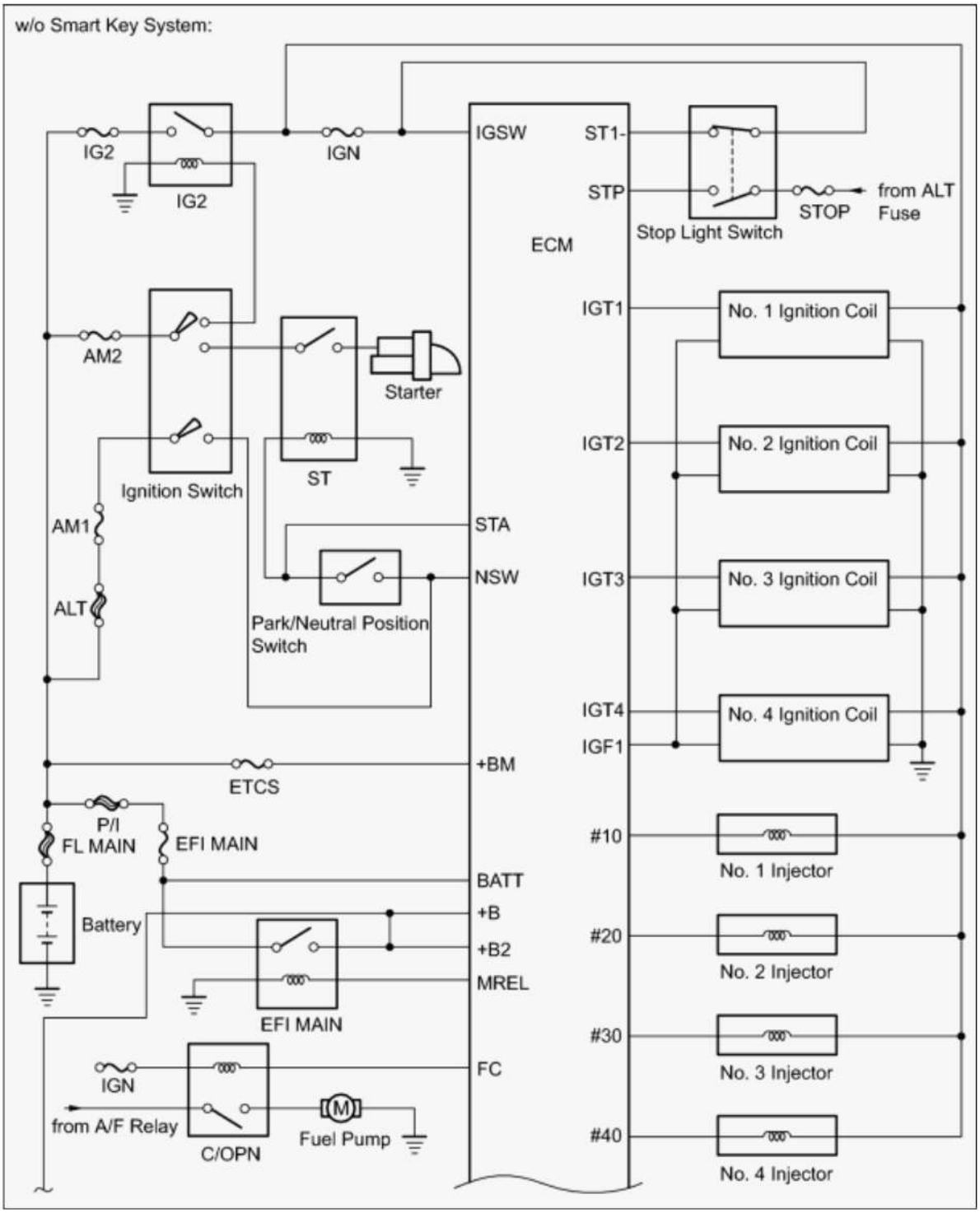
(d) Turn the Techstream on.

(e) Enter the following menus: Powertrain / Engine and ECT / Utility / VIN / VIN Write.

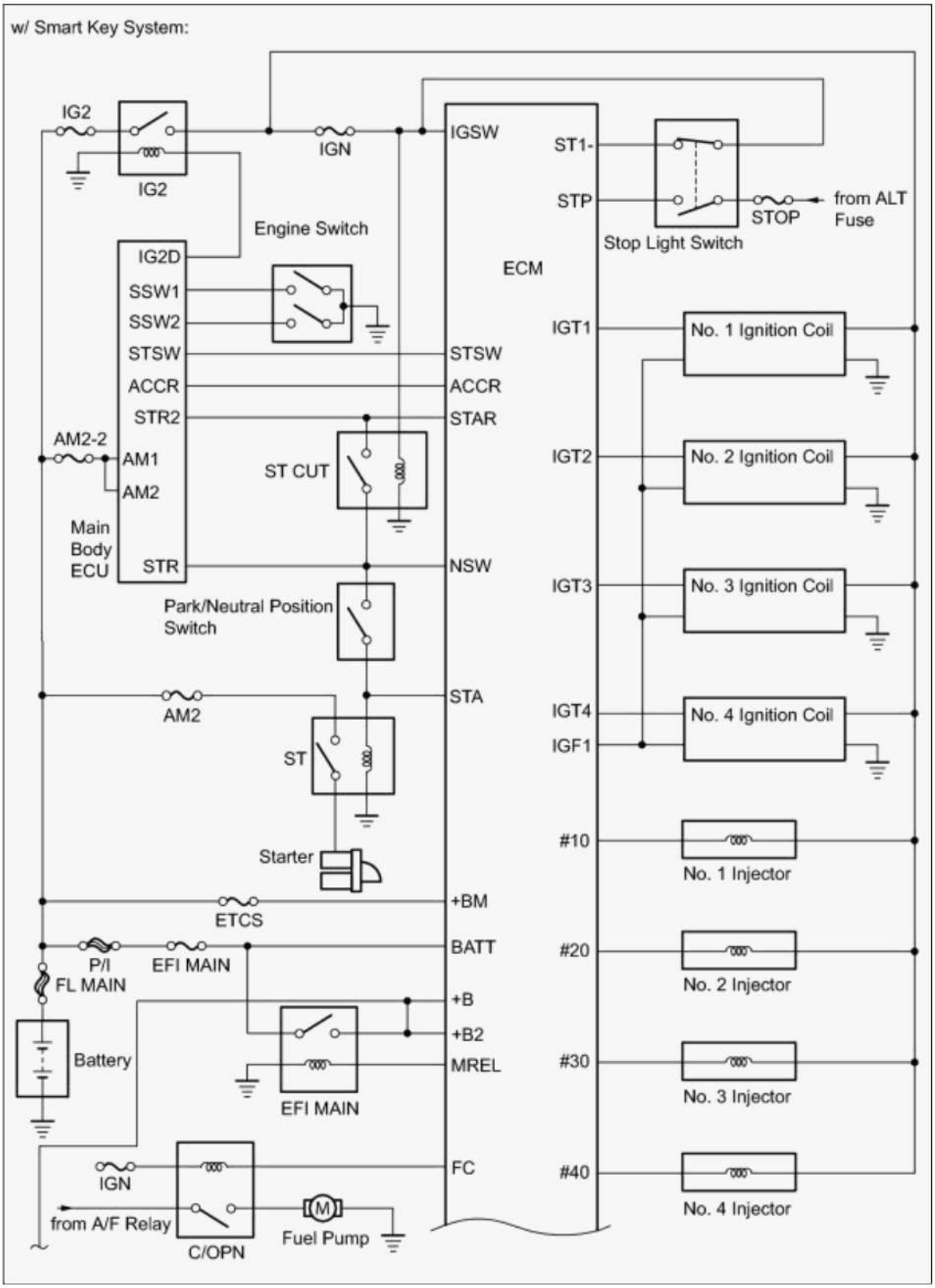
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Last Modified: 9-7-2011	6.4 U	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDB07QX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: SYSTEM DIAGRAM (2011 RAV4)		

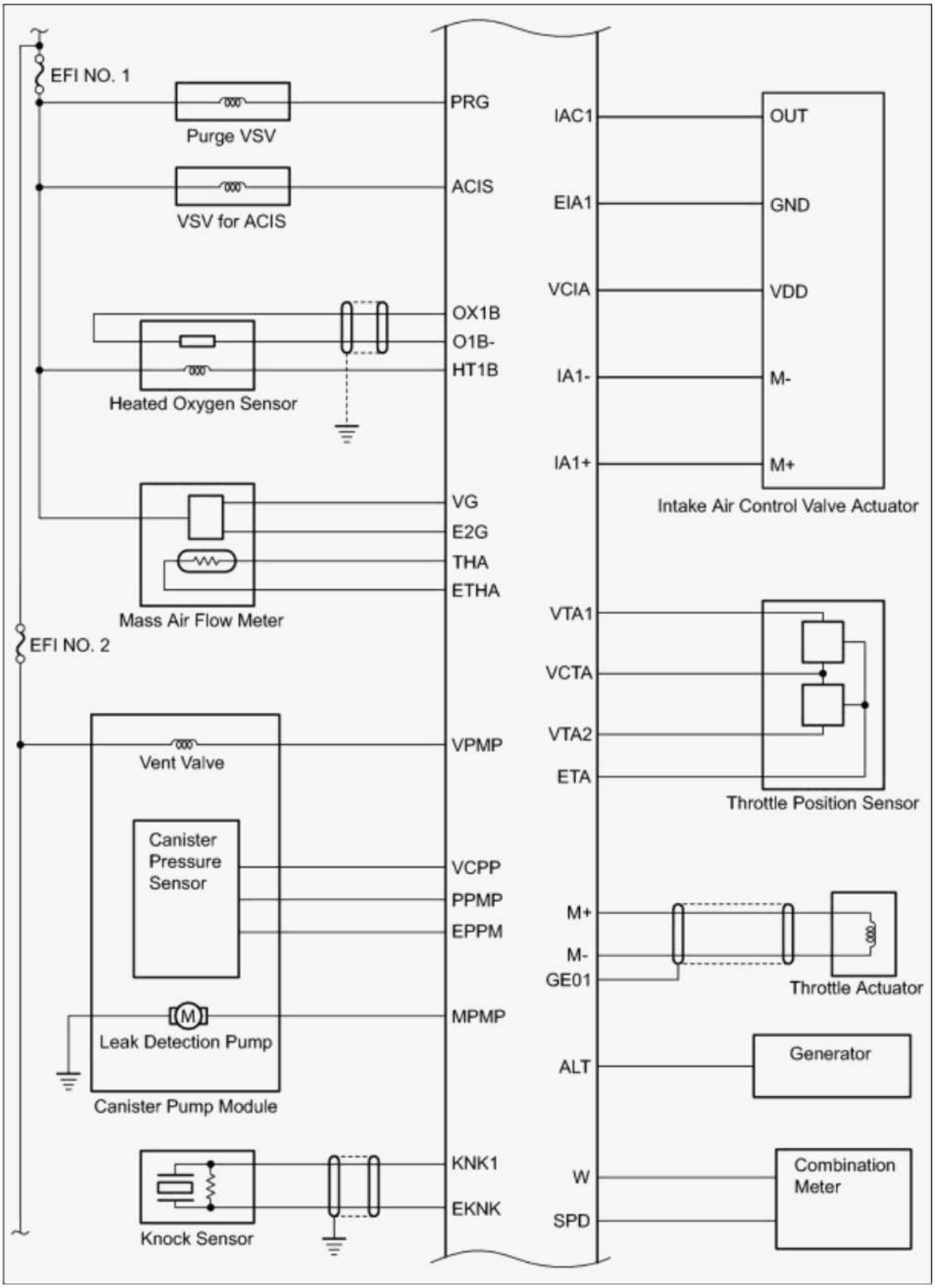
SYSTEM DIAGRAM



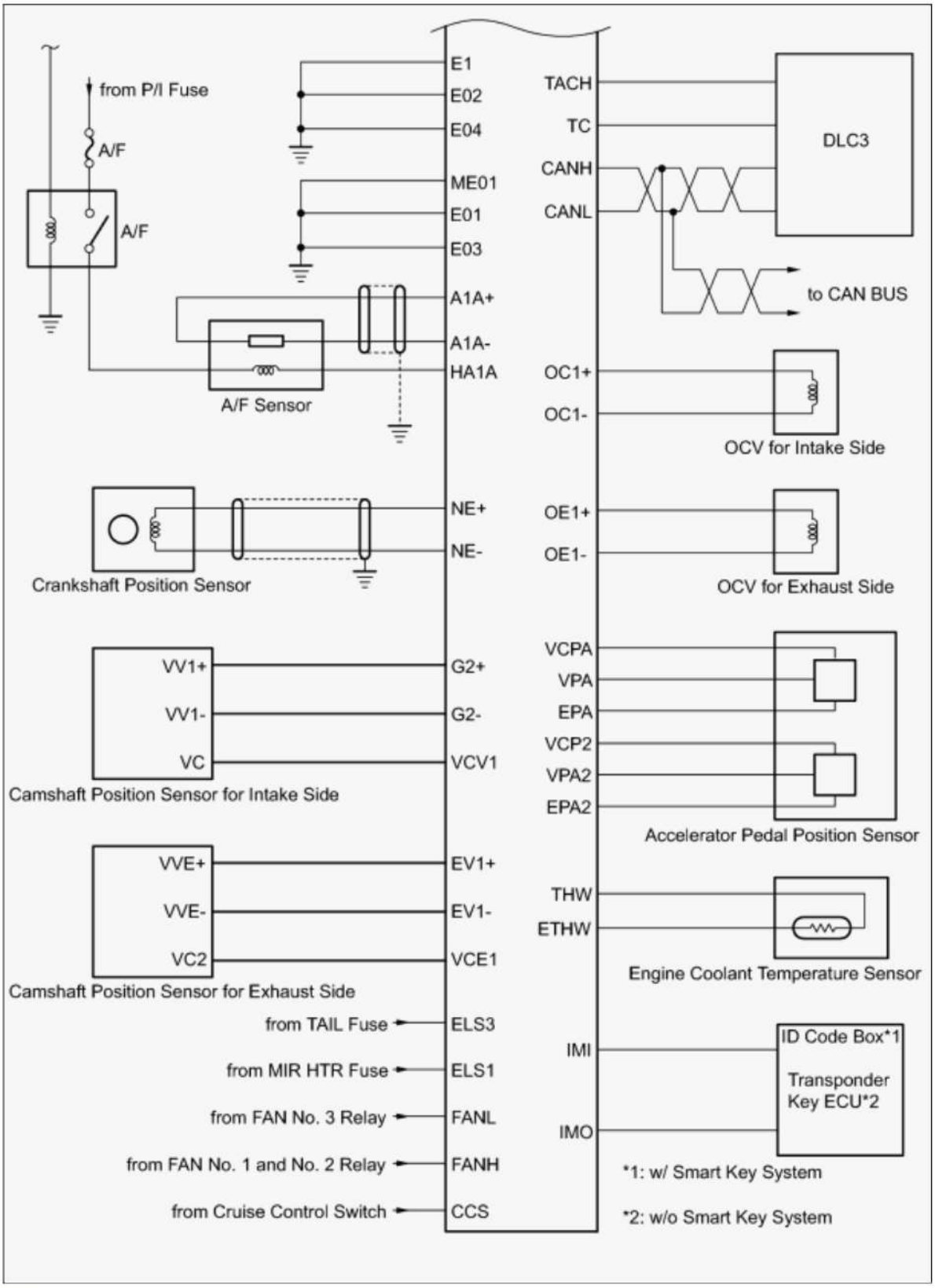
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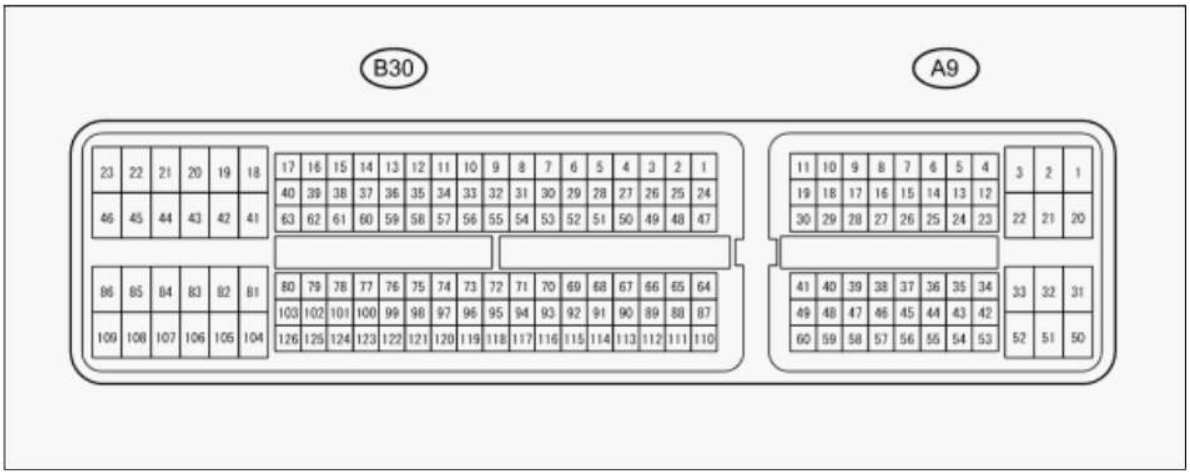
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Last Modified: 9-7-2011	6.4 U	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000000PDH0C9X
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: TERMINALS OF ECM (2011 RAV4)		

TERMINALS OF ECM



HINT:

The standard voltage between each pair of ECM terminals is shown in the table below. The appropriate conditions for checking each pair of terminals are also indicated. The result of checks should be compared with the standard voltage for that pair of terminals, displayed in the Specified Condition column. The illustration above can be used as a reference to identify the ECM terminal locations.

TERMINAL NO. (SYMBOL)	WIRING COLOR	TERMINAL DESCRIPTION	CONDITION	SPECIFIED CONDITION
A9-20 (BATT) - B30-104 (E1)	W - BR	Battery (for measuring battery voltage and for ECM memory)	Always	11 to 14 V
A9-3 (+BM) - B30-104 (E1)	LG - BR	Power source of throttle actuator	Always	11 to 14 V
A9-28 (IGSW) - B30-104 (E1)	B - BR	Ignition switch	Ignition switch ON	11 to 14 V
A9-2 (+B) - B30-104 (E1)	B - BR	Power source of ECM	Ignition switch ON	11 to 14 V
A9-1 (+B2) - B30-104 (E1)	B - BR	Power source of ECM	Ignition switch ON	11 to 14 V
B30-36 (OC1+) - B30-59 (OC1-)	W - B	Camshaft timing Oil Control Valve (OCV) for intake side	Idling	Pulse generation (see waveform 1)
A9-6 (MREL) - B30-104 (E1)	P - BR	EFI relay	Ignition switch ON	11 to 14 V
B30-94 (VG) - B30-117 (E2G)	R - LG	Mass air flow meter	Idling, shift lever in P or N, A/C switch off	0.5 to 3.0 V

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TERMINAL NO. (SYMBOL)	WIRING COLOR	TERMINAL DESCRIPTION	CONDITION	SPECIFIED CONDITION
B30-116 (THA) - B30-93 (ETHA)	W - BR	Intake air temperature sensor (built into mass air flow meter)	Idling, intake air temperature 20°C (68°F)	0.5 to 3.4 V
B30-64 (THW) - B30-65 (ETHW)	GR - BR	Engine coolant temperature sensor	Idling, engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
B30-88 (VCTA) - B30-111 (ETA)	Y - BR	Power source of throttle position sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B30-90 (VTA1) - B30-111 (ETA)	G - BR	Throttle position sensor (for engine control)	Ignition switch ON, throttle valve fully closed	0.5 to 1.1 V
			Ignition switch ON, throttle valve fully open	3.2 to 4.8 V
B30-89 (VTA2) - B30-111 (ETA)	L - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, throttle valve fully closed	2.1 to 3.1 V
			Ignition switch ON, throttle valve fully open	4.5 to 5.5 V
A9-55 (VPA) - A9-59 (EPA)	W - Y	Accelerator pedal position sensor (for engine control)	Ignition switch ON, accelerator pedal released	0.5 to 1.1 V
			Ignition switch ON, accelerator pedal fully depressed	2.5 to 4.5 V
A9-56 (VPA2) - A9-60 (EPA2)	R - P	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, accelerator pedal released	1.2 to 2.0 V
			Ignition switch ON, accelerator pedal fully depressed	3.4 to 5.5 V
A9-57 (VCPA) - A9-59 (EPA)	B - Y	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.5 V
A9-58 (VCP2) - A9-60 (EPA2)	L - P	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.5 V
B30-18 (HA1A) - B30-46 (E04)	L - W-B	Air fuel ratio sensor heater	Idling with warm engine	Pulse generation (see waveform 2)
			Ignition switch ON	11 to 14 V
B30-103 (A1A+) - B30-104 (E1)	G -BR	Air fuel ratio sensor	Ignition switch ON	3.3 V*
B30-126 (A1A-) - B30-104 (E1)	R - BR	Air fuel ratio sensor	Ignition switch ON	3.0 V*
B30-41 (HT1B) - B30-86 (E03)	R - W-B	Heated oxygen sensor heater	Ignition switch ON	11 to 14 V

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TERMINAL NO. (SYMBOL)	WIRING COLOR	TERMINAL DESCRIPTION	CONDITION	SPECIFIED CONDITION
B30-125 (OX1B) - B30-102 (O1B-)	W - B	Heated oxygen sensor	Engine speed maintained at 2500 rpm for 2 minutes after warming up sensor	Pulse generation (see waveform 3)
B30-85 (#10) - B30-109 (E01) B30-84 (#20) - B30-109 (E01) B30-83 (#30) - B30-109 (E01) B30-82 (#40) - B30-109 (E01)	L - W-B G - W-B B - W-B W - W-B	Fuel injector	Ignition switch ON	11 to 14 V
			Idling	Pulse generation (see waveform 4)
B30-87 (KNK1) - B30-110 (EKNK)	B - W	Knock sensor	Engine speed maintained at 4000 rpm after warming up engine	Pulse generation (see waveform 5)
B30-76 (G2+) - B30-122 (G2-)	B - R	Camshaft position sensor for intake side	Idling	Pulse generation (see waveform 6)
B30-74 (NE+) - B30-120 (NE-)	W - B	Crankshaft position sensor	Idling	Pulse generation (see waveform 7)
B30-108 (IGT1) - B30-104 (E1) B30-107 (IGT2) - B30-104 (E1) B30-106 (IGT3) - B30-104 (E1) B30-105 (IGT4) - B30-104 (E1)	R - BR P - BR G - BR L - BR	Ignition coil (ignition signal)	Idling	Pulse generation (see waveform 8)
B30-23 (IGF1) - B30-104 (E1)	W - BR	Ignition coil (ignition confirmation signal)	Ignition switch ON	4.5 to 5.5 V
			Idling	Pulse generation (see waveform 8)
B30-28 (PRG) - B30-104 (E1)	G - BR	Purge VSV	Ignition switch ON	11 to 14 V
			Idling	Pulse generation (see waveform 9)
A9-15 (SPD) - B30-104 (E1)	V - BR	Speed signal from combination meter	Vehicle driven at 20 km/h (12 mph)	Pulse generation (see waveform 10)
A9-48 (STA) - B30-104 (E1)	LG - BR	Starter signal	Cranking	5.5 V or higher
B30-47 (NSW) - B30-104 (E1)	W - BR	Park/neutral position switch signal	Ignition switch ON, transmission gear position in P or N	Below 1.5 V

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TERMINAL NO. (SYMBOL)	WIRING COLOR	TERMINAL DESCRIPTION	CONDITION	SPECIFIED CONDITION
			Ignition switch ON, transmission gear position not in P or N	6.0 V or higher
A9-29 (STP) - B30-104 (E1)	L - BR	Stop light switch	Brake pedal depressed	7.5 to 14 V
			Brake pedal released	Below 1.5 V
A9-39 (ST1-) - B30-104 (E1)	GR - BR	Stop light switch (opposite to voltage at STP terminal)	Ignition switch ON, brake pedal depressed	Below 1.5 V
			Ignition switch ON, brake pedal released	7.5 to 14 V
B30-21 (M+) - B30-19 (ME01)	B - W-B	Throttle actuator	Idling with warm engine	Pulse generation (see waveform 11)
B30-20 (M-) - B30-19 (ME01)	W - W-B	Throttle actuator	Idling with warm engine	Pulse generation (see waveform 12)
A9-8 (FC) - B30-104 (E1)	W - BR	Fuel pump control	Ignition switch ON	11 to 14 V
			Idling	Below 1.5 V
A9-36 (W) - B30-104 (E1)	R - BR	MIL	Ignition switch ON (MIL turns on)	Below 1.5 V
			Idling	11 to 14 V
A9-7 (TC) - B30-104 (E1)	G - BR	Terminal TC of DLC3	Ignition switch ON	11 to 14 V
A9-26 (TACH) - B30-104 (E1)	GR - BR	Engine speed	Idling	Pulse generation (see waveform 13)
A9-42 (VPMP) - B30-104 (E1)	W - BR	Vent valve (built into canister pump module)	Ignition switch ON	11 to 14 V
A9-34 (MPMP) - B30-104 (E1)	B - BR	Leak detection pump (built into canister pump module)	Leak detection pump OFF	Below 3 V
			Leak detection pump ON	11 to 14 V
B30-113 (VCPP) - B30-112 (EPPM)	Y - BR	Power source for canister pressure sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B30-114 (PPMP) - B30-112 (EPPM)	V - BR	Canister pressure sensor (built into canister pump module)	Ignition switch ON	3 to 3.6 V
A9-31 (ELS1) - B30-104 (E1)	P - BR	Electric load	Taillight switch on	7.5 to 14 V
			Taillight switch off	Below 1.5 V
A9-41 (ELS3) - B30-104 (E1)	G - BR	Electric load	Defogger switch on	7.5 to 14 V
			Defogger switch off	Below 1.5 V

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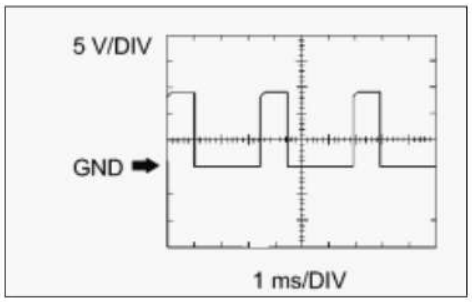
TERMINAL NO. (SYMBOL)	WIRING COLOR	TERMINAL DESCRIPTION	CONDITION	SPECIFIED CONDITION
A9-21 (FANL) - B30-104 (E1)	R - BR	No. 3 fan relay	Ignition switch ON	11 to 14 V
			Idling with A/C ON, or high engine coolant temperature	Below 1.5 V
A9-22 (FANH) - B30-104 (E1)	W - BR	No. 1 and No. 2 fan relay	Idling with high engine coolant temperature	Below 1.5 V
B30-39 (ALT) - B30-104 (E1)	B - BR	Generator	Ignition switch ON	11 to 14 V
A9-13 (CANH) - B30-104 (E1)	Y - BR	CAN communication line	Ignition switch ON	Pulse generation (see waveform 14)
A9-5 (CANL) - B30-104 (E1)	W - BR	CAN communication line	Ignition switch ON	Pulse generation (see waveform 15)
B30-27 (ACIS) - B30-104 (E1)	R - BR	Intake air control valve actuator	Ignition switch ON	11 to 14 V
B30-35 (OE1+) - B30-58 (OE1-)	R - LG	Camshaft timing Oil Control Valve (OCV) for exhaust side	Idling	Pulse generation (see waveform 1)
B30-99 (VCV1) - B30-104 (E1)	W - BR	Power source of camshaft position sensor for intake side (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B30-98 (VCE1) - B30-104 (E1)	W - BR	Power source of camshaft position sensor for exhaust side (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B30-75 (EV1+) - B30-121 (EV1-)	B - R	Camshaft position sensor for exhaust side	Idling	Pulse generation (see waveform 6)
B30-4 (IA1+) - B30-109 (E01)	W - W-B	DC motor for TCV	Idling with cold engine	Pulse generation (see waveform 16)
B30-3 (IA1-) - B30-109 (E01)	B - W-B	DC motor for TCV	Idling with cold engine	Pulse generation (see waveform 17)
B30-70 (IAC1) - B30-71 (EIA1)	GR - BR	TCV position sensor	Ignition switch off to ON	3.0 to 4.0 V
B30-72 (VCIA) - B30-104 (E1)	V - BR	Power source of TCV position sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
A9-52 (STSW) - B30-104 (E1)	R - BR	Starter switch	Shift lever in P or N, cranking	6.0 V or higher
B30-2 (ACCR) - B30-104 (E1)	LG - BR	ACC relay control signal	Ignition switch ON → Cranking	11 to 14 V → Below 1 V

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TERMINAL NO. (SYMBOL)	WIRING COLOR	TERMINAL DESCRIPTION	CONDITION	SPECIFIED CONDITION
B30-17 (STAR) - B30-104 (E1)	W - BR	Starter relay control	Ignition switch ON	Below 1.5 V
B30-17 (STAR) - B30-104 (E1)	W - BR	Starter relay control	Cranking	5.5 V or higher

HINT:

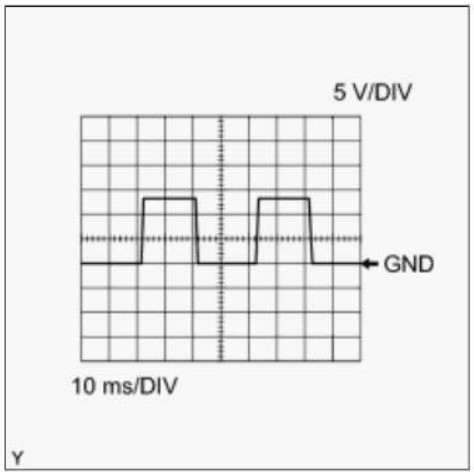
***: The ECM terminal voltage is constant regardless of the output voltage from the sensor.**



1. WAVEFORM 1

Camshaft Timing Oil Control Valve (OCV)

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-36 (OC1+) - B30-59 (OC1-)	5 V/DIV, 1 ms/DIV	Idling
B30-35 (OE1+) - B30-58 (OE1-)	5 V/DIV, 1 ms/DIV	Idling



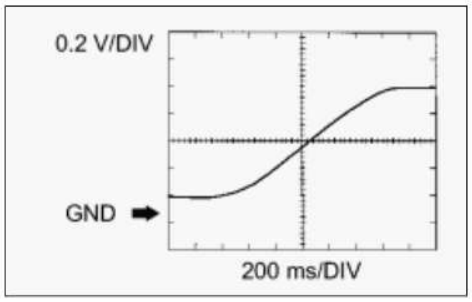
2. WAVEFORM 2

Air Fuel Ratio Sensor (Sensor 1) Heater

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-18 (HA1A) - B30-46 (E04)	5 V/DIV, 10 ms/DIV	Idling with warm engine

HINT:

The wavelength varies in accordance with the engine operating condition.



3. WAVEFORM 3

Heated Oxygen Sensor (Sensor 2)

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-125 (OX1B) - B30-102 (O1B-)	0.2 V/DIV, 200 ms/DIV	Engine speed maintained at 2500 rpm for 2 minutes after warming

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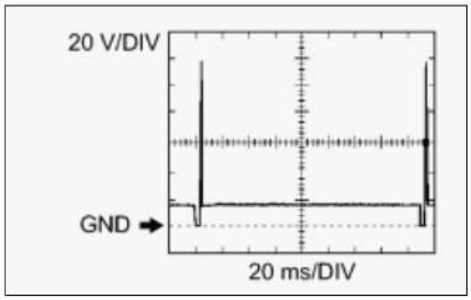
		up sensor

HINT:

In the Data List, item O2S B1 S2 shows the ECM input values from the heated oxygen sensor.

4. WAVEFORM 4

Injector No. 1 (to No. 4) Injection Signal



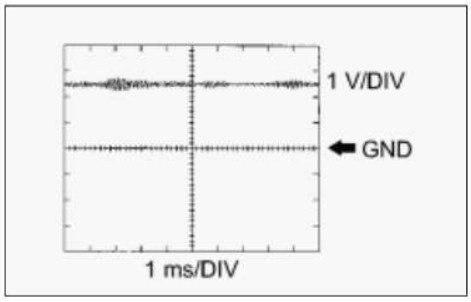
TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-85 (#10) - B30-109 (E01)	20 V/DIV, 20 ms/DIV	Idling
B30-84 (#20) - B30-109 (E01)	20 V/DIV, 20 ms/DIV	Idling
B30-83 (#30) - B30-109 (E01)	20 V/DIV, 20 ms/DIV	Idling
B30-82 (#40) - B30-109 (E01)	20 V/DIV, 20 ms/DIV	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

5. WAVEFORM 5

Knock Sensor



TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-87 (KNK1) - B30-110 (EKNK)	1 V/DIV, 1 ms/DIV	Engine speed maintained at 4000 rpm after warming up engine

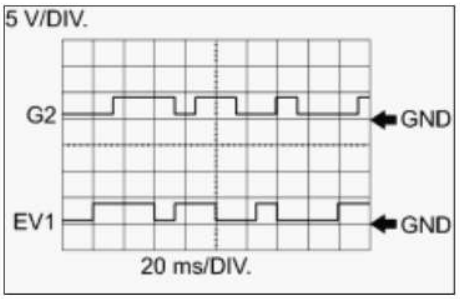
HINT:

- The wavelength becomes shorter as the engine speed increases.
- The waveforms and amplitudes displayed differ slightly depending on the vehicle.

6. WAVEFORM 6

Camshaft Position Sensor

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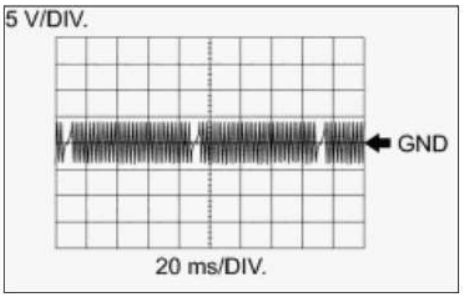


TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-76 (G2+) - B30-122 (G2-)	5 V/DIV, 20 ms/DIV	Idling
B30-75 (EV1+) - B30-121 (EV1-)	5 V/DIV, 20 ms/DIV	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

7. WAVEFORM 7



Crankshaft Position Sensor

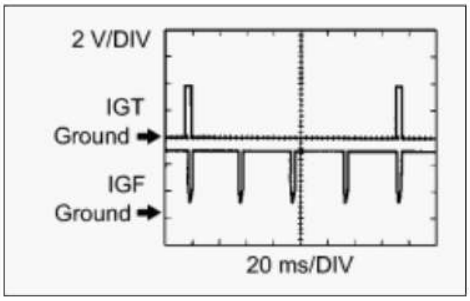
TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-74 (NE+) - B30-120 (NE-)	5 V/DIV, 20 ms/DIV	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

8. WAVEFORM 8

Igniter IGT Signal (from ECM to Igniter) and Igniter IGF Signal (from Igniter to ECM)



TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-108 (IGT1) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling
B30-107 (IGT2) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling
B30-106 (IGT3) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling
B30-105 (IGT4) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling
B30-23 (IGF1) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Idling

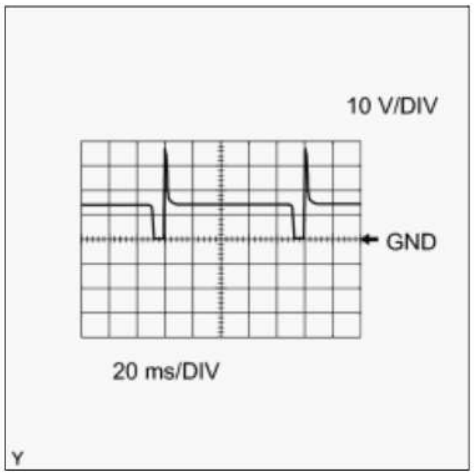
HINT:

The wavelength becomes shorter as the engine speed increases.

9. WAVEFORM 9

Purge VSV

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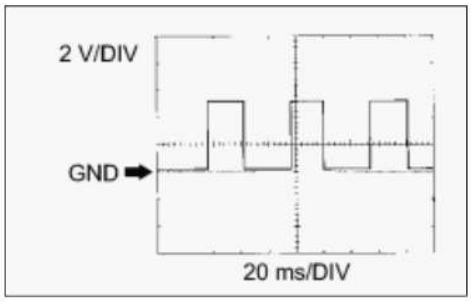
TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-28 (PRG) - B30-104 (E1)	10 V/DIV, 20 ms/DIV	Idling

HINT:

If the waveform is not similar to the illustration, check the waveform again after idling for 10 minutes or more.

10. WAVEFORM 10

Vehicle Speed Signal



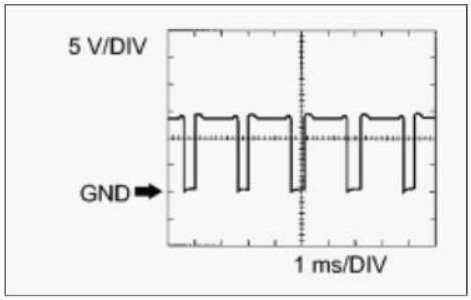
TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
A9-15 (SPD) - B30-104 (E1)	2 V/DIV, 20 ms/DIV	Vehicle driven at 20 km/h (12 mph)

HINT:

- The wavelength becomes shorter as the vehicle speed increases.
- Depending on the systems installed to the vehicle, the output voltage may rise to 12 V.

11. WAVEFORM 11

Throttle Actuator Positive Terminal



TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-21 (M+) - B30-19 (ME01)	5 V/DIV, 1 ms/DIV	Idling with warm engine

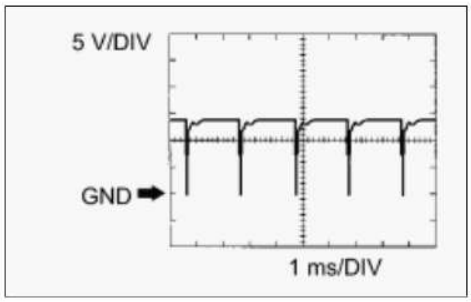
HINT:

The duty ratio varies depending on the throttle actuator operation.

12. WAVEFORM 12

Throttle Actuator Negative Terminal

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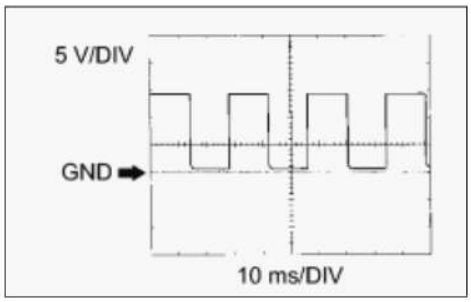
TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-20 (M-) - B30-19 (ME01)	5 V/DIV, 1 ms/DIV	Idling with warm engine

HINT:

The duty ratio varies depending on the throttle actuator operation.

13. WAVEFORM 13

Engine Speed Signal



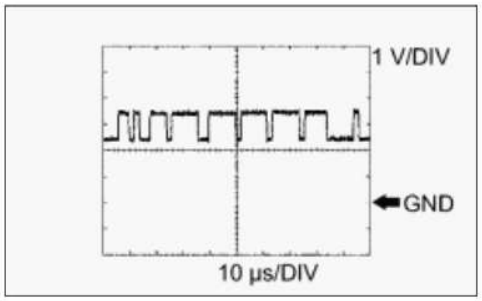
TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
A9-26 (TACH) - B30-104 (E1)	5 V/DIV, 10 ms/DIV	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

14. WAVEFORM 14

CAN Communication Signal (Reference)



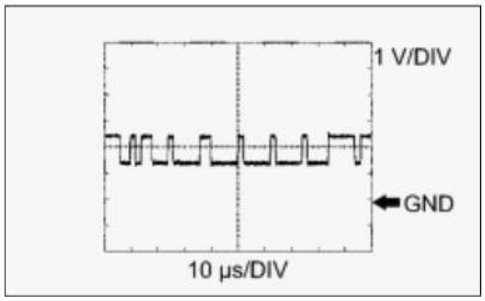
TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
A9-13 (CANH) - B30-104 (E1)	1 V/DIV, 10 µs/DIV	Engine stopped and ignition switch ON

HINT:

The waveform varies depending on the CAN communication signal.

15. WAVEFORM 15

CAN Communication Signal (Reference)

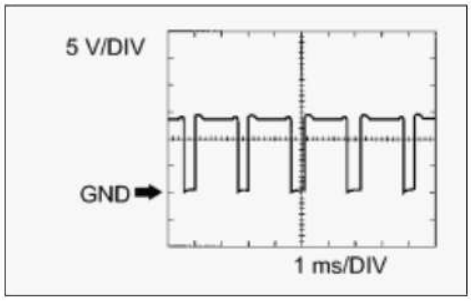


TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
A9-5 (CANL) - B30-104 (E1)	1 V/DIV, 10 µs/DIV	Engine stopped and ignition switch ON

HINT:

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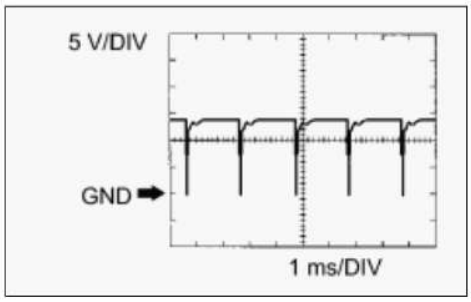
The waveform varies depending on the CAN communication signal.



16. WAVEFORM 16

DC Motor for TCV Positive Terminal

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-4 (IA1+) - B30-109 (E01)	5 V/DIV, 1 ms/DIV	Idling with cold engine



17. WAVEFORM 17

DC Motor for TCV Negative Terminal

TERMINAL NO. (SYMBOL)	TOOL SETTING	CONDITION
B30-3 (IA1-) - B30-109 (E01)	5 V/DIV, 1 ms/DIV	Idling with cold engine

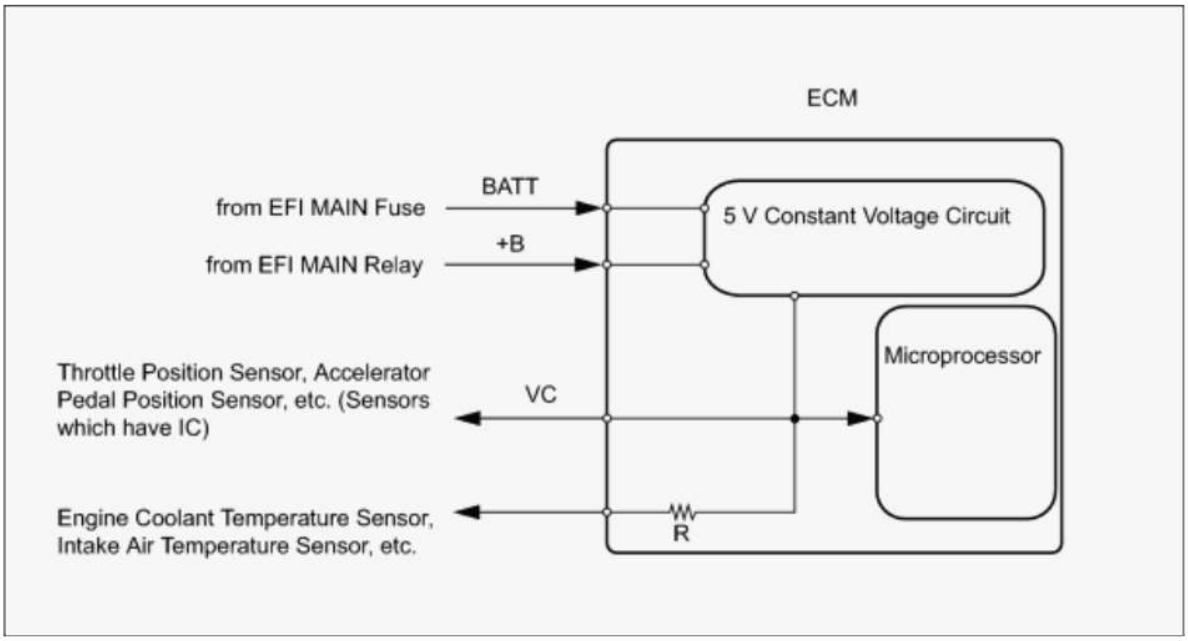
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Last Modified: 9-7-2011	6.4 J	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001D6V0CJX
Title: 2AR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: VC Output Circuit (2011 RAV4)		

VC Output Circuit

DESCRIPTION

The ECM constantly generates 5 V of power from battery voltage supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.



When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied with power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

HINT:

Under normal conditions, the MIL is illuminated for several seconds when the ignition switch is first turned to ON. The MIL turns off when the engine is started.

WIRING DIAGRAM

Refer to DTC P0120 INFO .

Refer to DTC P0335 INFO .

Refer to DTC P0451 INFO .

Refer to DTC P2004 INFO .

Refer to DTC P2120 INFO .

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INSPECTION PROCEDURE

PROCEDURE

1.	**CHECK MIL**

(a) Check that the Malfunction Indicator Lamp (MIL) turns on when turning the ignition switch to ON.

OK:
MIL turns on.

NG ▶ **CHECK COMMUNICATION BETWEEN TECHSTREAM AND ECM**

OK ▶ **END**

2.	**CHECK COMMUNICATION BETWEEN TECHSTREAM AND ECM**

(a) Connect the Techstream to the DLC3.

(b) Turn the ignition switch to ON.

(c) Turn the Techstream on.

(d) Check the communication between the Techstream and ECM.

Result

RESULT	PROCEED TO
Communication is possible	A
Communication is not possible	B

A ▶ **GO TO MIL CIRCUIT**

B ▼

3.	**CHECK MIL (THROTTLE POSITION SENSOR)**

(a) Disconnect the throttle body connector.

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(b) Turn the ignition switch to ON.

(c) Check the MIL.

Result

RESULT	PROCEED TO
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the throttle body connector.

A ▶ **REPLACE THROTTLE BODY**

B ▼

4.	**CHECK MIL (ACCELERATOR PEDAL POSITION SENSOR)**

(a) Disconnect the accelerator pedal position sensor connector.

(b) Turn the ignition switch to ON.

(c) Check the MIL.

Result

RESULT	PROCEED TO
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the accelerator pedal position sensor connector.

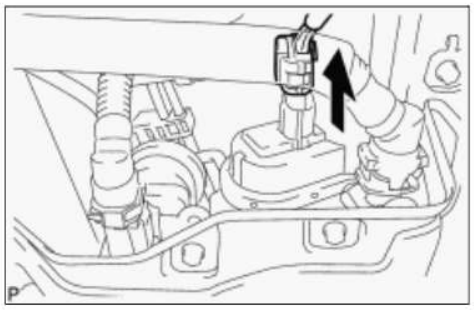
A ▶ **REPLACE ACCELERATOR PEDAL ROD ASSEMBLY**

B ▼

5.	**CHECK MIL (CANISTER PUMP MODULE)**

(a) Disconnect the canister pump module connector.

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(b) Turn the ignition switch to ON.

(c) Check the MIL.

Result

RESULT	PROCEED TO
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the canister pump module connector.

A ▶ **REPLACE CANISTER**

B ▼

6.	**CHECK MIL (CAMSHAFT POSITION SENSOR FOR INTAKE SIDE)**

(a) Disconnect the camshaft position sensor for intake side connector.

(b) Turn the ignition switch to ON.

(c) Check the MIL.

Result

RESULT	PROCEED TO
MIL illuminates	A
MIL does not illuminate	B

A ▶ **REPLACE CAMSHAFT POSITION SENSOR**

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B

7.	**CHECK MIL (CAMSHAFT POSITION SENSOR FOR EXHAUST SIDE)**

(a) Disconnect the camshaft position sensor for exhaust side connector.

(b) Turn the ignition switch to ON.

(c) Check the MIL.

Result

RESULT	PROCEED TO
MIL illuminates	A
MIL does not illuminate	B

A ▶ **REPLACE CAMSHAFT POSITION SENSOR**

B

8.	**CHECK MIL (INTAKE AIR CONTROL VALVE ACTUATOR)**

(a) Disconnect the intake air control valve actuator connector.

(b) Turn the ignition switch to ON.

(c) Check the MIL.

Result

RESULT	PROCEED TO
MIL illuminates	A
MIL does not illuminate	B

A ▶ **REPLACE INTAKE AIR CONTROL VALVE ACTUATOR**

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B

9.	CHECK HARNESS AND CONNECTOR (VC CIRCUIT)

(a) Disconnect the throttle body connector.

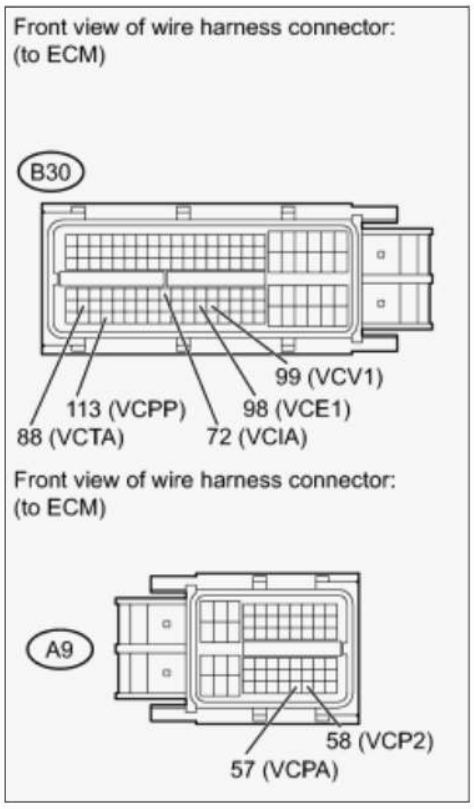
(b) Disconnect the accelerator pedal position sensor connector.

(c) Disconnect the canister pump module connector.

(d) Disconnect the camshaft position sensor for intake side connector.

(e) Disconnect the camshaft position sensor for exhaust side connector.

(f) Disconnect the intake air control valve actuator connector.



(g) Disconnect the ECM connectors.

(h) Measure the resistance according to the value(s) in the table below.

Standard Resistance (check for short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION

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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A9-57 (VCPA) - Body ground	Always	10 kΩ or higher
A9-58 (VCP2) - Body ground	Always	10 kΩ or higher
B30-72 (VCIA) - Body ground	Always	10 kΩ or higher
B30-88 (VCTA) - Body ground	Always	10 kΩ or higher
B30-98 (VCE1) - Body ground	Always	10 kΩ or higher
B30-99 (VCV1) - Body ground	Always	10 kΩ or higher
B30-113 (VCPP) - Body ground	Always	10 kΩ or higher

(i) Reconnect the throttle body connector.

(j) Reconnect the accelerator pedal position sensor connector.

(k) Reconnect the canister pump module connector.

(l) Reconnect the camshaft position sensor for intake side connector.

(m) Reconnect the camshaft position sensor for exhaust side connector.

(n) Reconnect the intake air control valve actuator connector.

(o) Reconnect the ECM connectors.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

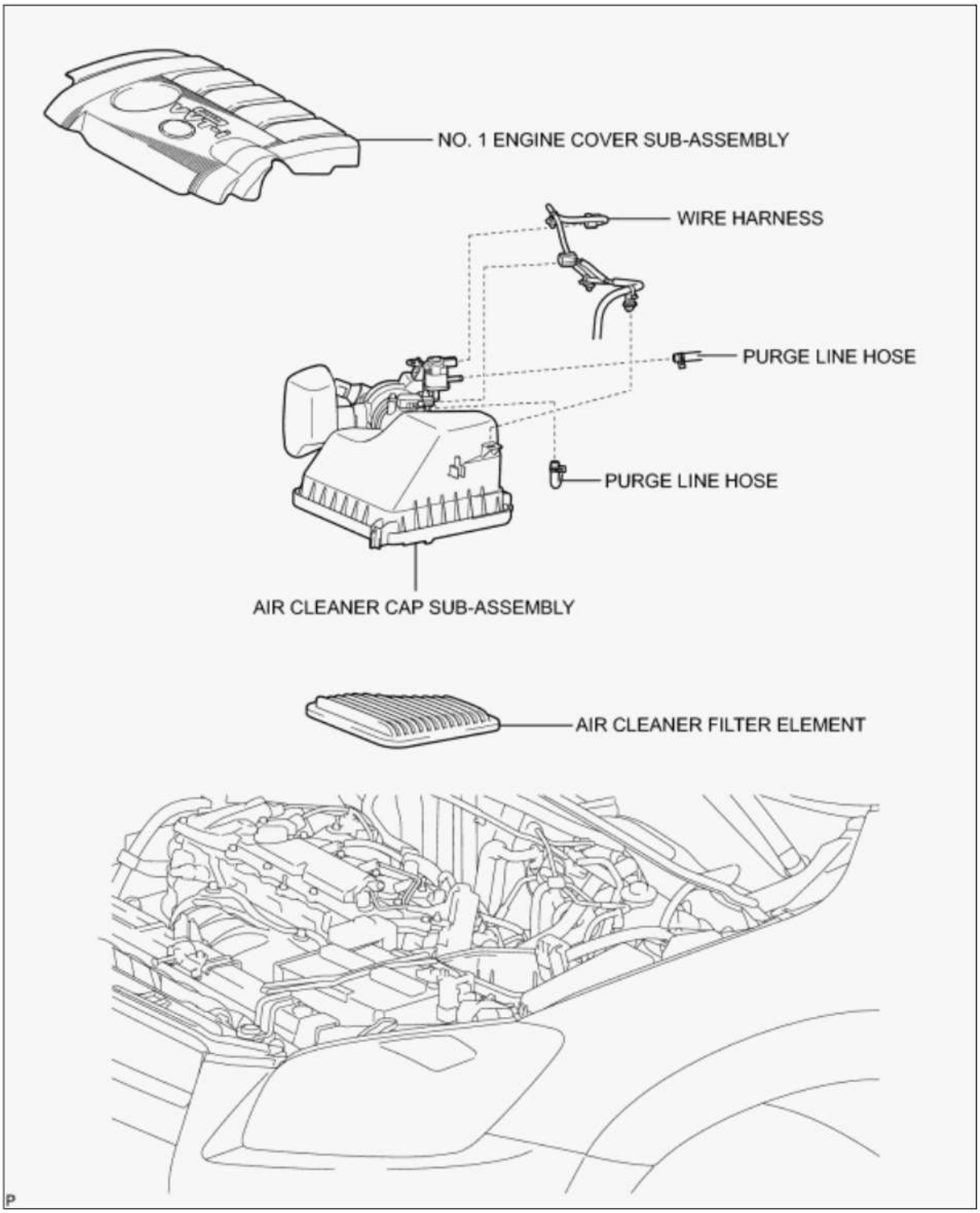
OK ▶ **REPLACE ECM**

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Last Modified: 9-7-2011	6.4 K	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UC01QX
Title: 2AR-FE ENGINE CONTROL SYSTEM: THROTTLE BODY: COMPONENTS (2011 RAV4)		

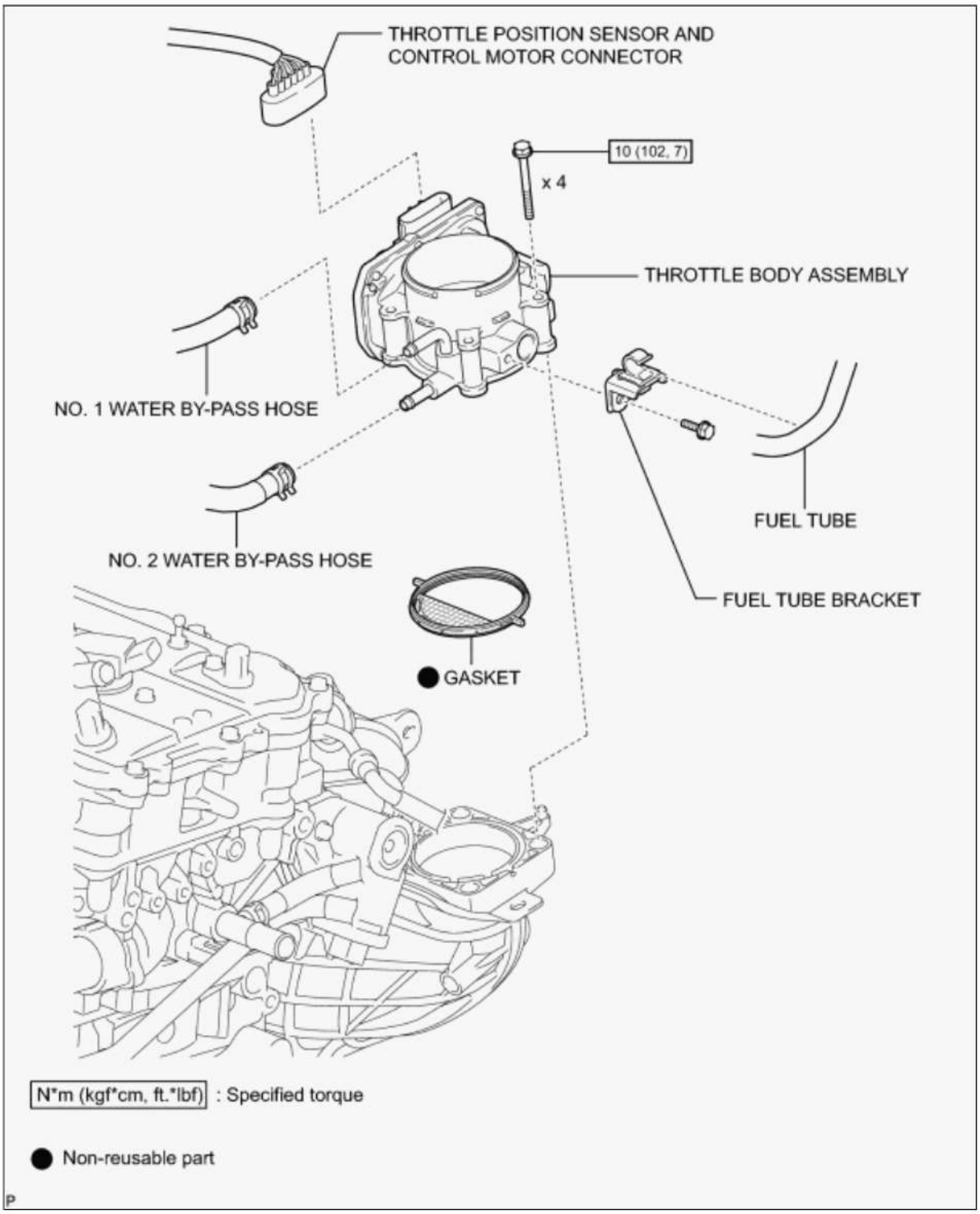
COMPONENTS

ILLUSTRATION



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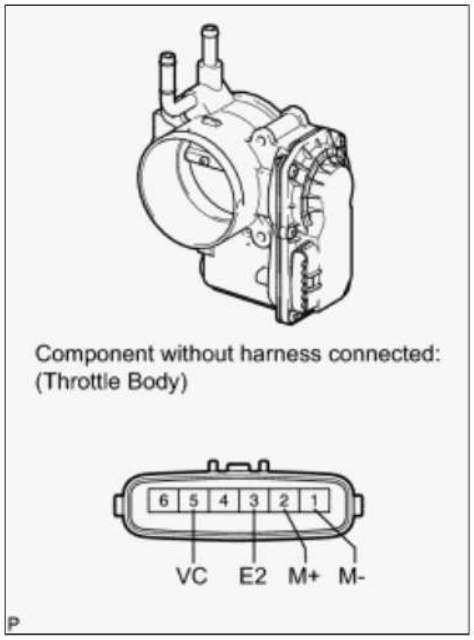
ILLUSTRATION



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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UB01SX
Title: 2AR-FE ENGINE CONTROL SYSTEM: THROTTLE BODY: INSPECTION (2011 RAV4)		

INSPECTION



1. INSPECT THROTTLE BODY ASSEMBLY

(a) Check that the throttle valve opens and closes smoothly.

(b) Check that the there is no sludge accumulating around the throttle body.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 (M-) - 2 (M+)	20°C (68°F)	0.3 to 100 Ω

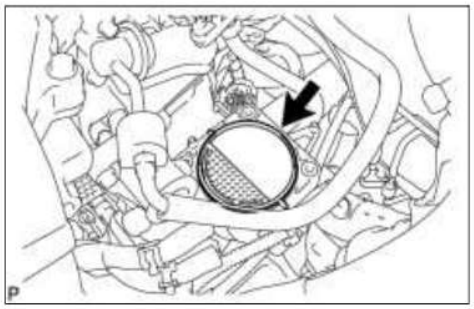
If the result is not as specified, replace the throttle body assembly.

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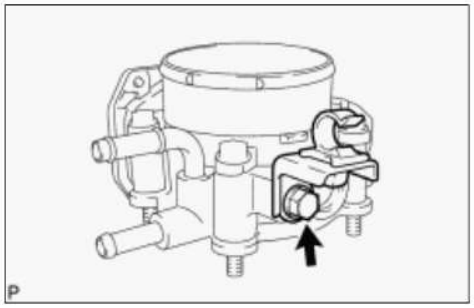
Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UA03MX
Title: 2AR-FE ENGINE CONTROL SYSTEM: THROTTLE BODY: INSTALLATION (2011 RAV4)		

INSTALLATION

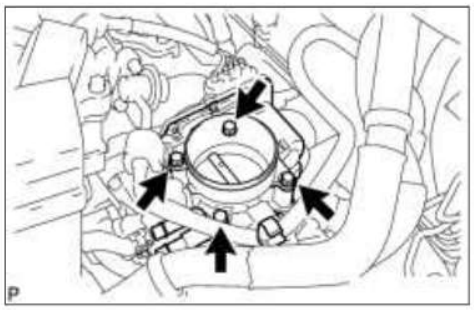
1. INSTALL THROTTLE BODY ASSEMBLY



(a) Install a new gasket to the intake manifold.



(b) Install the fuel tube bracket with the bolt.

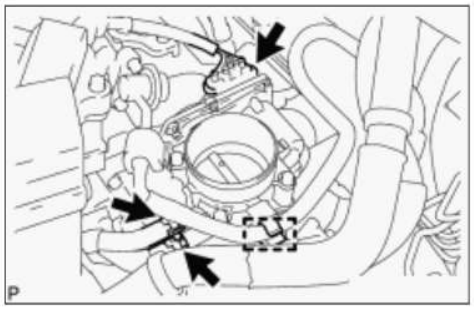


(c) Install the throttle body (with the fuel tube bracket) with the 4 bolts.

Torque: 10 N·m (102 kgf·cm, 7ft·lbf)

(d) Connect the throttle position sensor and control motor connector.

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(e) Connect the fuel tube to the clamp.

(f) Connect the No. 2 water by-pass hose to the throttle body.

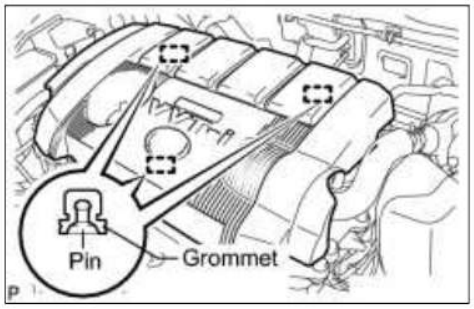
(g) Connect the water by-pass hose to the throttle body.

2. INSTALL AIR CLEANER CAP SUB-ASSEMBLY INFO

3. ADD ENGINE COOLANT INFO

4. INSPECT FOR COOLANT OIL LEAK

5. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY



(a) Align the 3 engine cover grommets with the 3 pins, and press down on the engine cover to install it.

6. PERFORM INITIALIZATION

NOTICE:

- Be sure to perform this procedure after reassembling the throttle body assembly or removing and reinstalling any throttle body component.
- Perform the following procedure after replacing the ECM, throttle body assembly or any throttle body components. The following procedure should also be performed if the throttle body is cleaned.
- Be sure to perform this procedure after reconnecting the battery cable or replacing the ECM.

(a) Disconnect the EFI fuse and ETCS fuse at the same time. Wait at least 60 seconds and reconnect the fuses.

(b) Turn the ignition switch to ON without operating the accelerator pedal.

NOTICE:

If the accelerator pedal is operated, perform the above steps again.

(c) Connect the Techstream to the DLC3 and clear the DTCs INFO .

(d) Start the engine and check that the MIL is not illuminated. After the engine is warmed up, check that the

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idle speed is within the specified range when the A/C is switched off.

Standard:

CONDITION	ENGINE IDLE SPEED
A/C switched off	600 to 700 rpm

NOTICE:

- Be sure to perform this step with all accessories off.
- Make sure that the shift lever is in N or P.

(e) Enter the following menus: Powertrain / Engine and ETC / Data List / All Data / Throttle Sensor Position. Sensor Output. Fully depress the accelerator pedal and check that the value is 60% or more.

(f) Perform a road test and confirm that there are no abnormalities.

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UE01WX
Title: 2AR-FE ENGINE CONTROL SYSTEM: THROTTLE BODY: ON-VEHICLE INSPECTION (2011 RAV4)		

ON-VEHICLE INSPECTION

1. CHECK THROTTLE BODY ASSEMBLY

(a) Check the throttle control motor operating sounds.

(1) Turn the ignition switch to ON.

(2) When pressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises are emitted from the motor.

If friction noise exists, replace the throttle body.

(b) Check the throttle position sensor.

(1) Connect the Techstream to the DLC3.

(2) Turn the ignition switch to ON.

(3) Turn the Techstream on.

(4) Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Sensor Position.

(5) Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of "Throttle Sensor Position" is within the specification.

Standard throttle valve opening percentage:

60% or more

NOTICE:

When checking the standard throttle valve opening percentage, make sure the shift lever is in N.

If the percentage is less than 60%, replace the throttle body assembly.

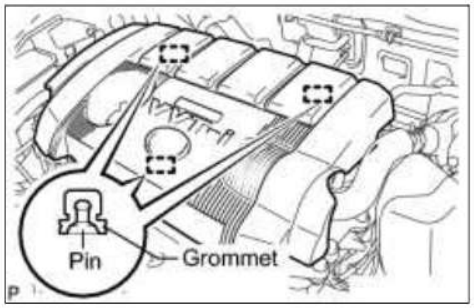
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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM0000017UD03KX
Title: 2AR-FE ENGINE CONTROL SYSTEM: THROTTLE BODY: REMOVAL (2011 RAV4)		

REMOVAL

1. DRAIN ENGINE COOLANT INFO

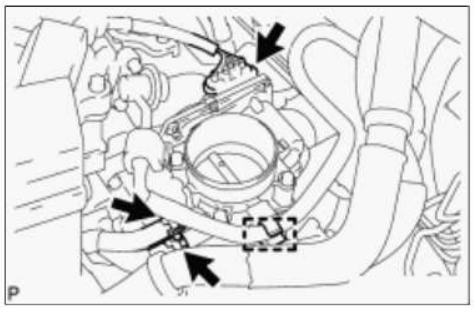
2. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY



(a) Lift the rear of the engine cover to detach the cover from the 2 pins, and then lift the front of the engine cover to detach the cover from the pin and remove the engine cover.

3. REMOVE AIR CLEANER CAP SUB-ASSEMBLY INFO

4. REMOVE THROTTLE BODY ASSEMBLY



(a) Disconnect the water by-pass hose from the throttle body.

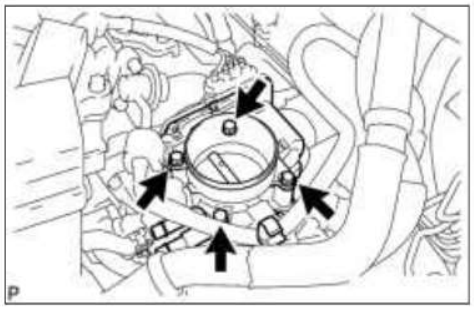
(b) Disconnect the No. 2 water by-pass hose from the throttle body.

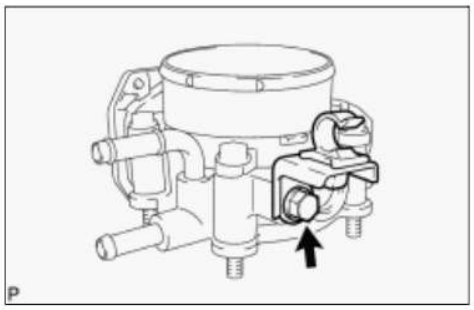
(c) Disconnect the fuel tube from the clamp.

(d) Disconnect the throttle position sensor and control motor connector.

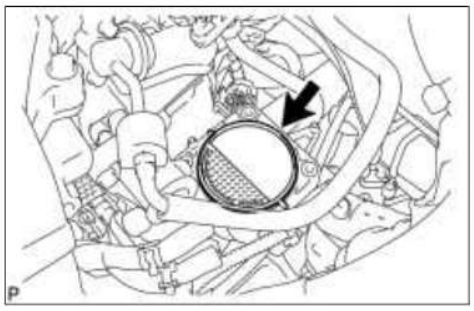
(e) Remove the 4 bolts and the throttle body with fuel tube bracket.

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(f) Remove the bolt and fuel tube bracket.



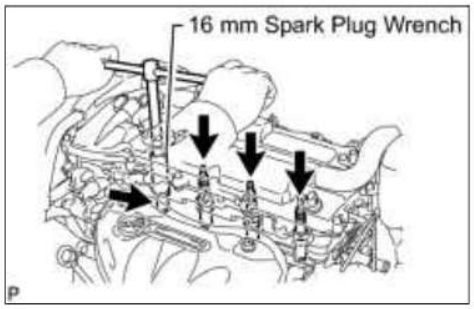
(g) Remove the gasket from the intake manifold.

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001QVK02FX
Title: 2AR-FE IGNITION: IGNITION COIL AND SPARK PLUG: INSTALLATION (2011 RAV4)		

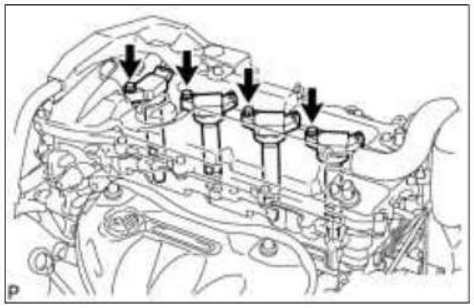
INSTALLATION

1. INSTALL SPARK PLUG



(a) Using a 16 mm spark plug wrench, install the 4 spark plugs.

Torque: 25 N·m (254 kgf·cm, 18ft·lbf)



2. INSTALL IGNITION COIL ASSEMBLY

(a) Install the 4 ignition coils with the 4 bolts.

Torque: 10 N·m (102 kgf·cm, 7ft·lbf)

(b) Connect the 4 ignition coil connectors.

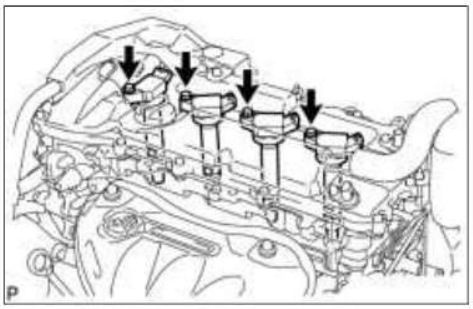
3. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY INFO

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Last Modified: 9-7-2011	6.4 A	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001QVM02CX
Title: 2AR-FE IGNITION: IGNITION COIL AND SPARK PLUG: REMOVAL (2011 RAV4)		

REMOVAL

1. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY

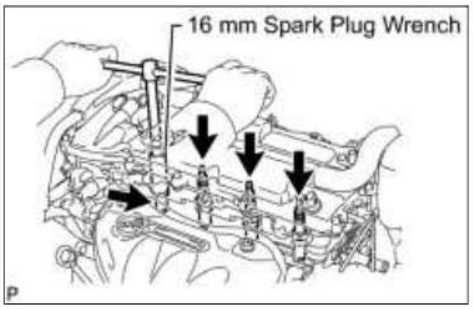


2. REMOVE IGNITION COIL ASSEMBLY

(a) Disconnect the 4 ignition coil connectors.

(b) Remove the 4 bolts and 4 ignition coils.

3. REMOVE SPARK PLUG



(a) Using a 16 mm spark plug wrench, remove the 4 spark plugs.

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Last Modified: 9-7-2011	6.4 G	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001QVP03EX
Title: 2AR-FE IGNITION: IGNITION SYSTEM: ON-VEHICLE INSPECTION (2011 RAV4)		

ON-VEHICLE INSPECTION

1. PERFORM SPARK TEST

(a) Check for DTCs INFO .

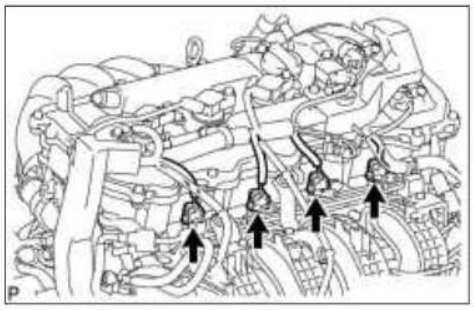
NOTICE:

If any DTC is output, perform troubleshooting procedures for that DTC.

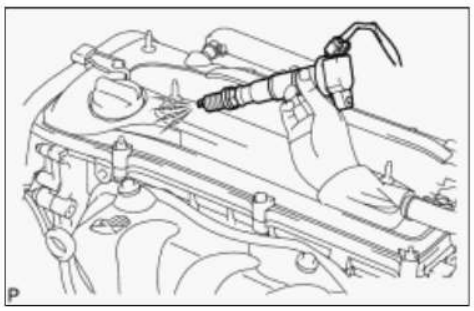
(b) Check if sparks occur.

(1) Remove the ignition coils and spark plugs INFO .

(2) Install the spark plug to the ignition coil and connect the ignition coil connector.



(3) Disconnect the 4 injector connectors.



(4) Ground the spark plug.

(5) Visually check that sparks occur while the engine is being cranked.

NOTICE:

- Be sure to ground the spark plug when checking.
- If the ignition coil has been struck or dropped, replace it.
- Do not crank the engine for more than 2 seconds.

(c) Spark test flowchart.

(1) Check that the wire harness side connector of the ignition coil with igniter is securely connected.

Result

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RESULT	PROCEED TO
NG	Connect securely
OK	Go to next step

(2) Perform a spark test on a malfunctioning ignition coil with igniter.

1. Replace the ignition coil with a normal one.
2. Perform the spark test again.

Result

RESULT	PROCEED TO
OK	Replace ignition coil with igniter
NG	Go to next step

(3) Check the power supply to the ignition coil with igniter.

1. Turn the ignition switch to ON.
2. Check that there is battery voltage at the ignition coil positive (+) terminal.

Result

RESULT	PROCEED TO
NG	Check wiring between ignition switch and ignition coil with igniter
OK	Go to next step

(4) Check the camshaft position sensor INFO .

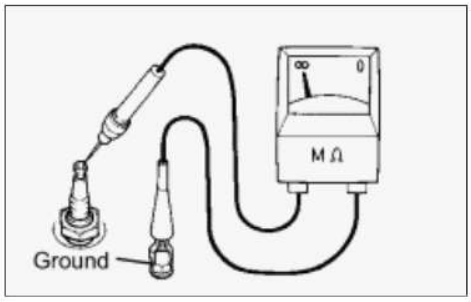
(5) Check the crankshaft position sensor INFO .

(6) Check the IGT signal from the ECM INFO .

(7) Connect the 4 injector connectors.

(8) Install the ignition coils and spark plugs INFO .

2. CHECK SPARK PLUG



(a) Check the electrode.

(1) Using a megohmmeter, measure the insulation resistance.

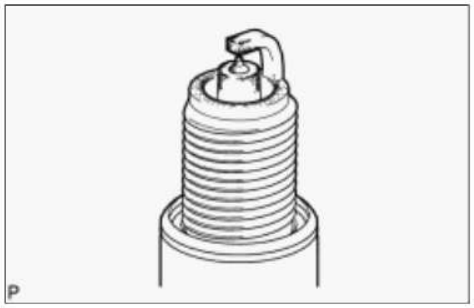
Standard Insulation Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
Spark plug (terminal part) - Body ground	Always	10 MΩ or higher

HINT:

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If a megohmmeter is not available, perform the following simple inspection instead.



(b) Alternative inspection method:

(1) Quickly accelerate the engine to 4000 rpm 5 times.

(2) Remove the spark plug.

(3) Visually check the spark plug.

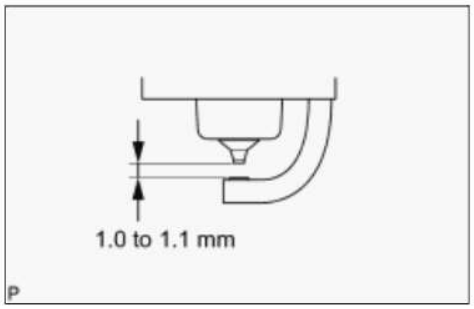
If the electrode is dry, the spark plug is functioning properly.
If the electrode is damp, proceed to the next step.

(c) Check the spark plug for any damage on its threads and insulator.

If there is damage, replace the spark plug.

Recommended Spark Plug:

MANUFACTURER	SPARK PLUG TYPE
DENSO	SK16HR11

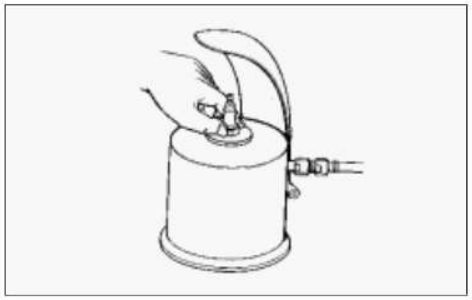


(d) Check the spark plug electrode gap.

Maximum electrode gap for used spark plug:
1.3 mm (0.051 in.)

If the gap is more than the maximum, replace the spark plug.

Electrode gap for new spark plug:
1.0 to 1.1 mm (0.039 to 0.043 in.)



(e) Clean the spark plugs.

If the electrode has traces of wet carbon, clean the electrode with a spark plug cleaner, and then dry it.

Standard air pressure:
588 kPa (6 kgf/cm^2, 85 psi)
Standard duration:
20 seconds or less

HINT:

Only use a spark plug cleaner when the electrode is free of oil. If the electrode has traces of oil, use gasoline to clean off the oil before

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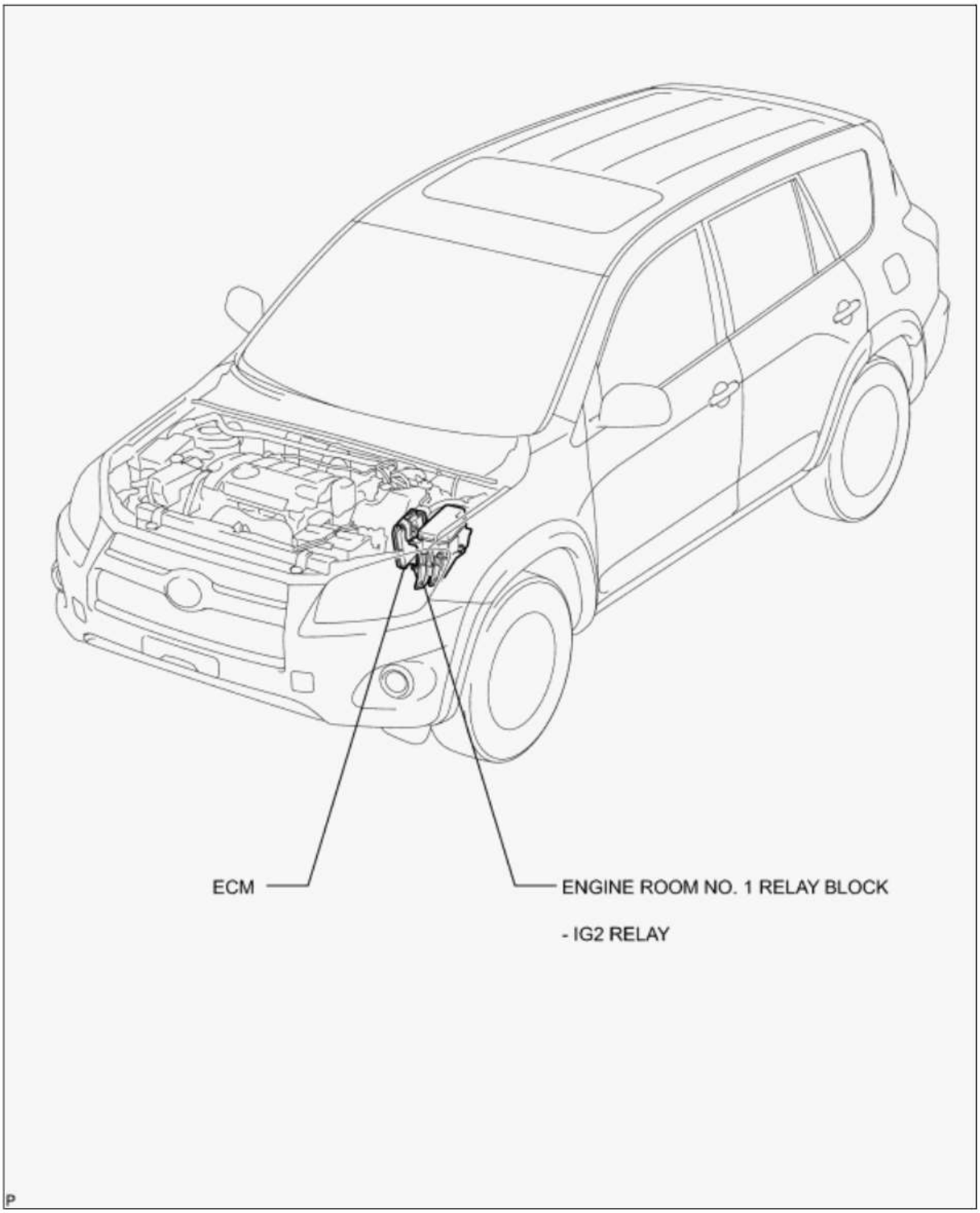
using the spark plug cleaner.

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Last Modified: 9-7-2011	6.4 R	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001QVN01EX
Title: 2AR-FE IGNITION: IGNITION SYSTEM: PARTS LOCATION (2011 RAV4)		

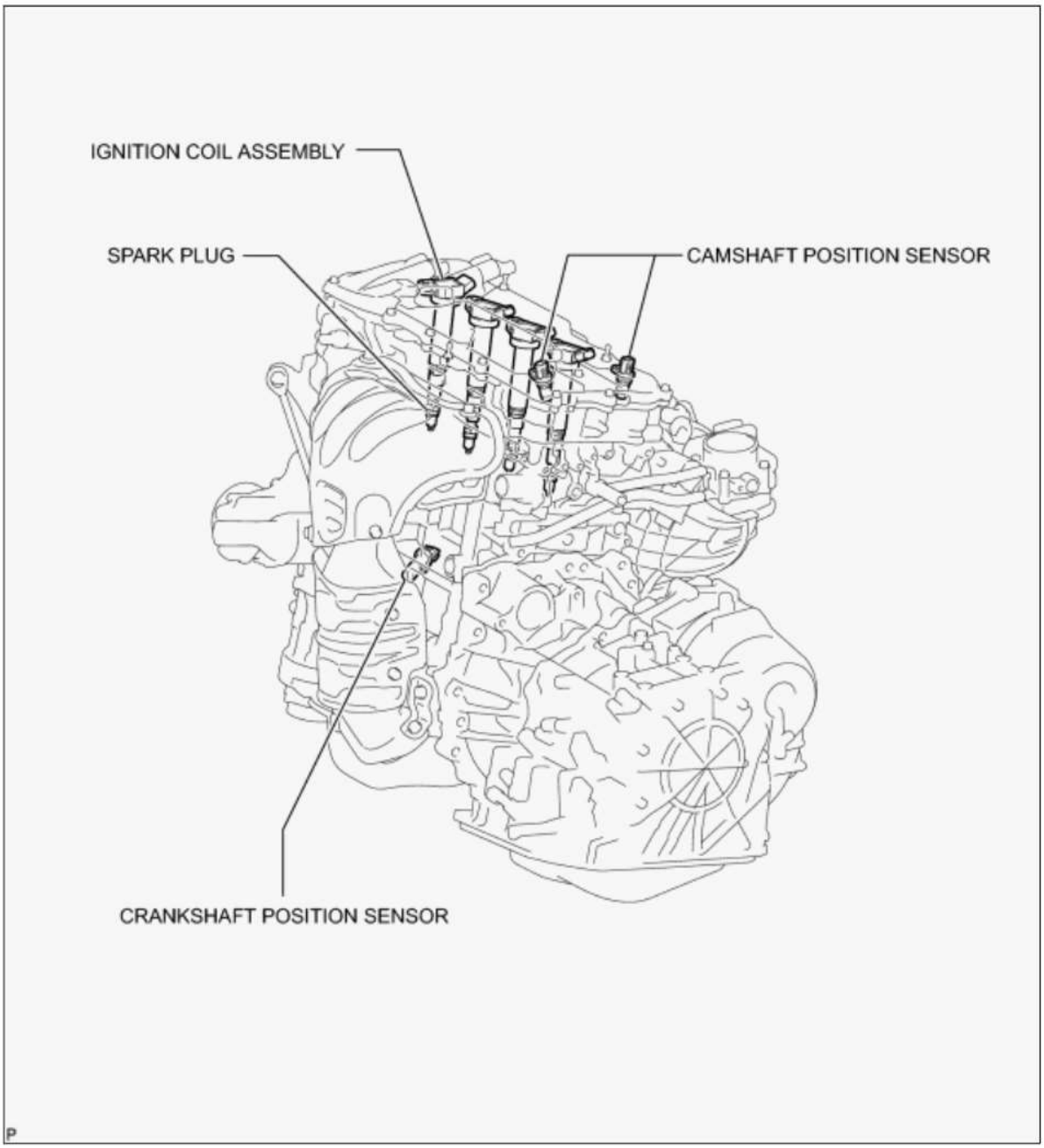
PARTS LOCATION

ILLUSTRATION



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ILLUSTRATION



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Last Modified: 9-7-2011	6.4 L	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000003SKD004X
Title: 2AR-FE IGNITION: IGNITION SYSTEM: PRECAUTION (2011 RAV4)		

PRECAUTION

1. IGNITION SWITCH EXPRESSION

HINT:

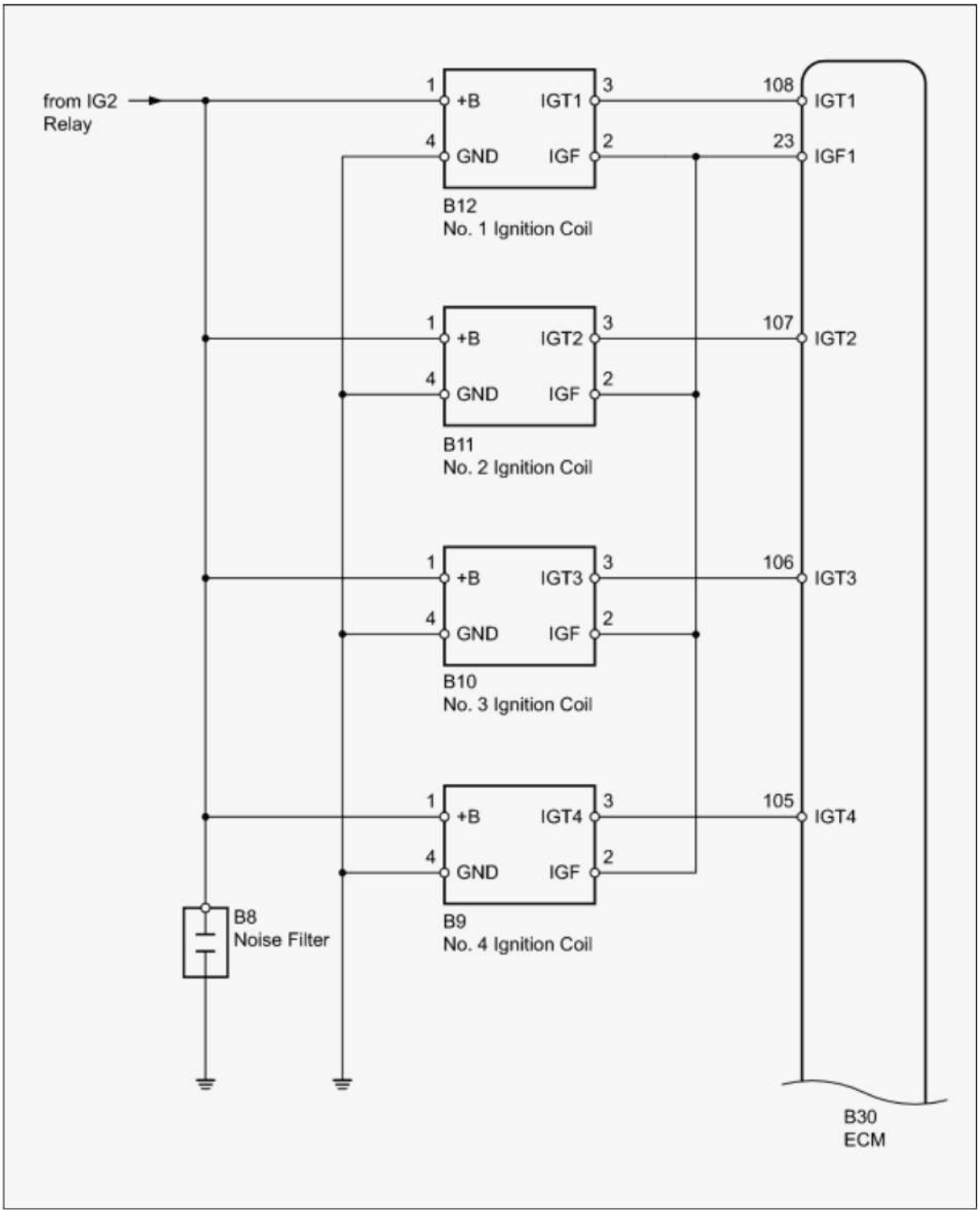
The type of ignition switch used on this model differs according to the specifications of the vehicle. The expressions listed in the table below are used in this section.

EXPRESSION	IGNITION SWITCH (POSITION)	ENGINE SWITCH (CONDITION)
Ignition Switch off	Off	Off
Ignition Switch ON	ON	On (IG)
Ignition Switch ACC	ACC	On (ACC)
Engine Start	START	Start

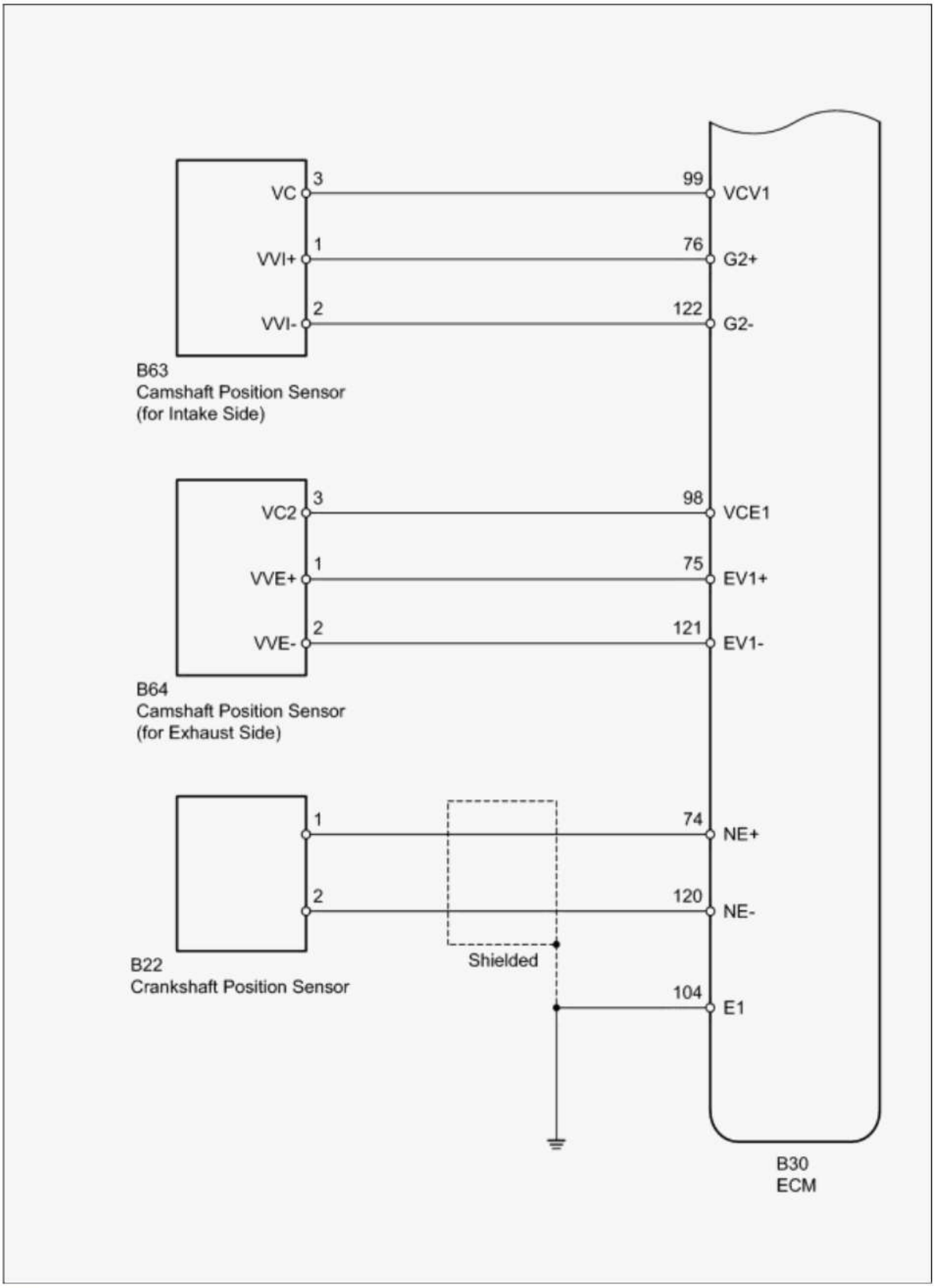
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Last Modified: 9-7-2011	6.4 U	**From:** 201008
Model Year: 2011	**Model:** RAV4	**Doc ID:** RM000001QVO01IX
Title: 2AR-FE IGNITION: IGNITION SYSTEM: SYSTEM DIAGRAM (2011 RAV4)		

SYSTEM DIAGRAM



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