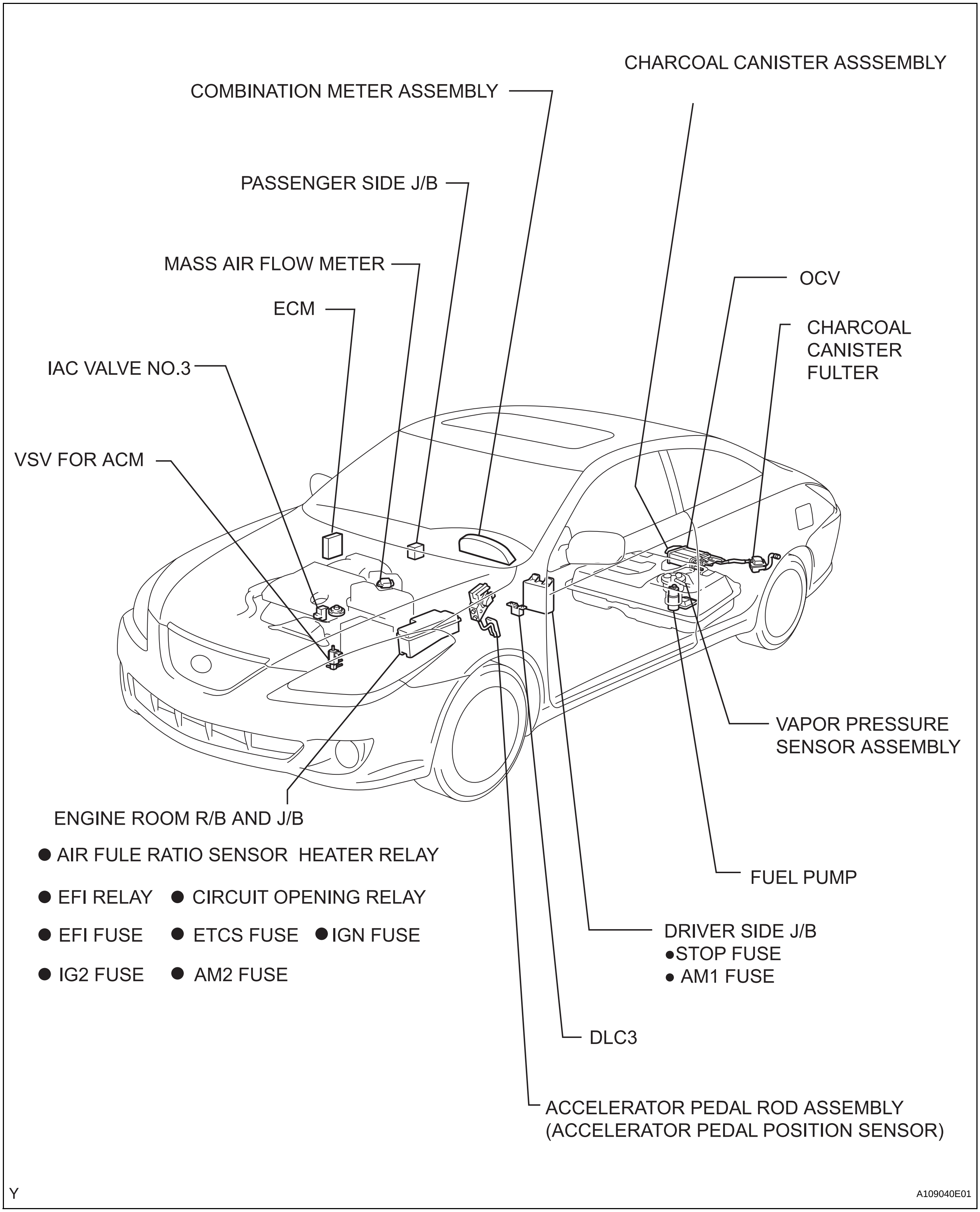
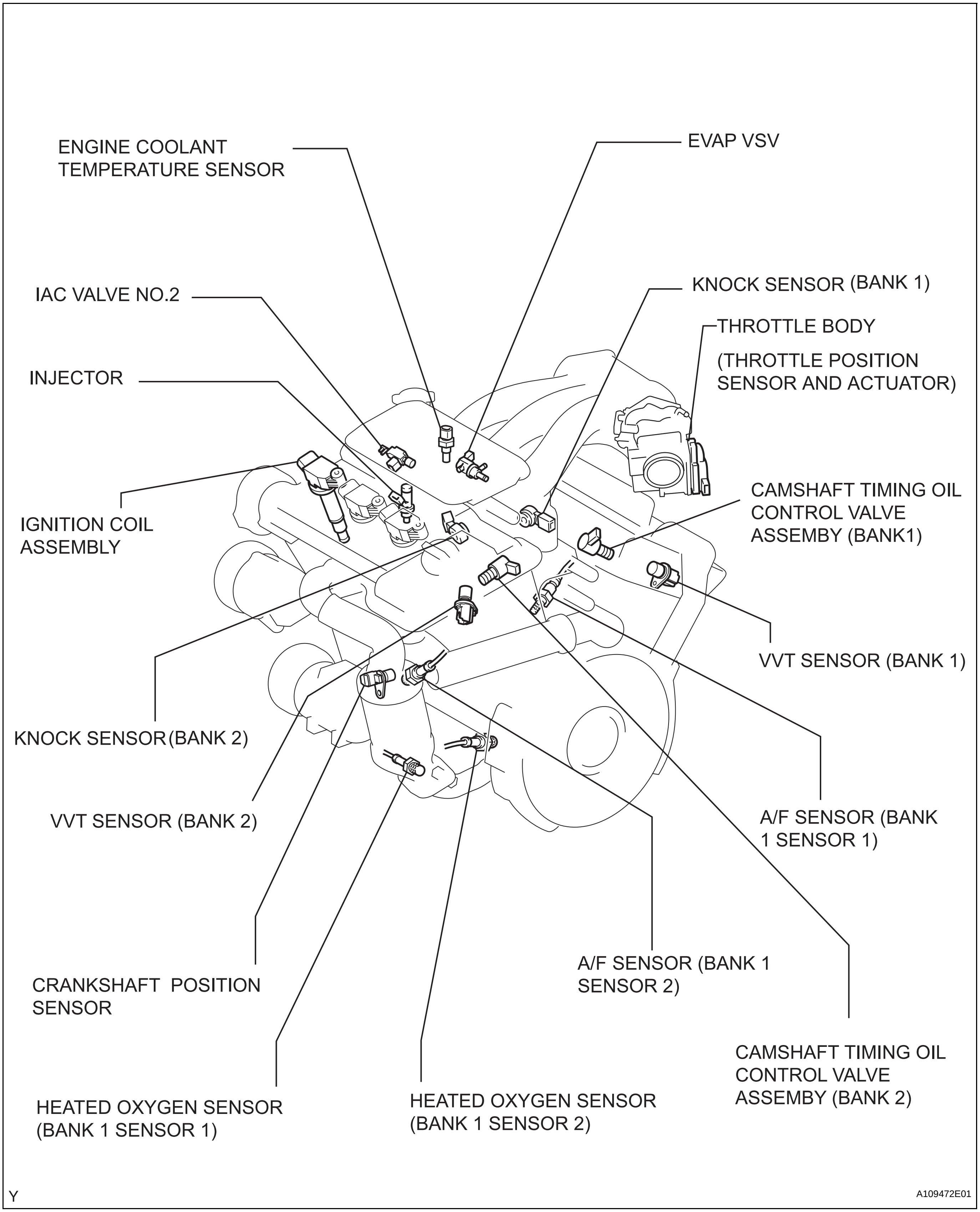
ES

PARTS LOCATION




ENGINE COOLANT
TEMPERATURE SENSOR
EVAP VSV
KNOCK SENSOR (BANK 1)
IAC VALVE NO.2
THROTTLE BODY
(THROTTLE POSITION
SENSOR AND ACTUATOR)
INJECTOR
CAMSHAFT TIMING OIL
CONTROL VALVE
ASSEMBY (BANK1)
IGNITION COIL
ASSEMBLY
VVT SENSOR (BANK 1)
KNOCK SENSOR (BANK 2)
VVT SENSOR (BANK 2)
A/F SENSOR (BANK
1 SENSOR 1)
A/F SENSOR (BANK 1
SENSOR 2)
CRANKSHAFT POSITION
SENSOR
CAMSHAFT TIMING OIL
CONTROL VALVE
ASSEMBY (BANK 2)
HEATED OXYGEN SENSOR
(BANK 1 SENSOR 1)
HEATED OXYGEN SENSOR
(BANK 1 SENSOR 2)
Y
A109472E01

HOW TO PROCEED WITH TROUBLESHOOTING

HINT:
The intelligent tester should be used in steps 3, 4, 5, 7 and 10.

1	**VEHICLE BROUGHT TO WORKSHOP**

NEXT

2	**CUSTOMER PROBLEM ANALYSIS**

NEXT

3	**CONNECT INTELLIGENT TESTER TO THE DLC3**

HINT:
If the display indicates a communication fault in the tester, inspect the DLC3.

NEXT

4	**CHECK DTC AND FREEZE FRAME DATA**

HINT:
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, perform steps 10 and 12 first.

Result

Result	Proceed to
Malfunction does not occur	A
Malfunction occur	B

B → **GO TO STEP 10**

A

9 SIMULATE SYMPTOMS

NEXT

10 CHECK DTC

HINT:
See page ES-29.

Result

Result	Proceed to
Malfunction code	A
No code	B

B → **GO TO STEP 12**

A

11 REFER TO DTC CHART

HINT:
See page ES-38.

NEXT

GO TO STEP 14

12 CONDUCT BASIC INSPECTION

HINT:
See page ES-8.

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

HINT:
See page ES-23.

Result

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B → GO TO STEP 17

A

14	CHECK ECM POWER SOURCE CIRCUIT

HINT:
See page ES-327.

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

HINT:
See page ES-8.

NEXT

GO TO STEP 18

17	CONDUCT PARTS INSPECTION

NEXT

18	IDENTIFY PROBLEM

NEXT

19	ADJUST AND/OR REPAIR

NEXT

20	CONDUCT CONFIRMATION TEST

NEXT

END

CHECK FOR INTERMITTENT PROBLEMS

HINT:
Inspect the vehicle's ECM using check mode. Intermittent problems are easier to detect with an intelligent tester 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 the DTCs (See page ES-29).
2. Switch the ECM from normal mode to check mode using an intelligent tester (See page ES-31).
3. Perform a simulation test (See page IN-34).
4. Check and wiggle the harness(es), connector(s) and terminal(s).

BASIC INSPECTION

When the malfunction is not confirmed by the DTC check, troubleshooting should be carried out in 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 engine switch OFF.
Result

Result	Proceed to
11 V or more	OK
Below 11 V	NG

NG → **CHARGE OR REPLACE BATTERY**

OK

2	CHECK WHETHER ENGINE WILL CRANK

HINT:
See page ES-23.

NG → **PROCEED TO PROBLEM SYMPTOMS TABLE**

OK

3	CHECK WHETHER ENGINE STARTS

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 → **REPLACE AIR FILTER**

OK

5	CHECK IDLING SPEED

HINT:
See page ES-23.

NG → PROCEED TO PROBLEM SYMPTOMS TABLE

OK

6	CHECK FUEL PRESSURE

ES

HINT:
See page FU-1 (for Fuel system).

NG → PROCEED TO FUEL SYSTEM AND CONTINUE TO TROUBLESHOOT

OK

7	CHECK FOR SPARK

HINT:
See page IG-1 (for Ignition system).

NG → PROCEED TO IGNITION SYSTEM AND CONTINUE TO TROUBLESHOOT

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

DIAGNOSTIC TROUBLE CODE CHART

HINT:
Parameters listed in the chart may be different from your readings depending on the type of instruments and other factors.
If any DTCs are displayed during a check mode, check the circuit for the DTCs listed in the below. For details of each DTC, refer to the page indicated.

SFI SYSTEM

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	1. Open or short in OCV (bank 1) circuit 2. OCV (bank 1) 3. ECM	Come on	DTC Stored	ES-50
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. OCV (bank 1) 3. Camshaft timing gear assembly 4. ECM	Come on	DTC Stored	ES-57
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	1. Valve timing 2. OCV (bank 1) 3. Camshaft timing gear assembly 4. ECM	Come on	DTC Stored	ES-57
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	1. Mechanical system (Timing belt has jumped tooth, belt is stretched) 2. ECM	Come on	DTC Stored	ES-65
P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	1. Mechanical system (Timing belt has jumped tooth, belt is stretched) 2. ECM	Come on	DTC Stored	ES-65
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	1. Open or short in OVC (bank 2) circuit 2. OCV (bank 2) 3. ECM	Come on	DTC Stored	ES-50
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	1. Valve timing 2. OCV (bank 2) 3. Camshaft timing gear assembly 4. ECM	Come on	DTC Stored	ES-57
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	1. Valve timing 2. OCV (bank 2) 3. Camshaft timing gear assembly 4. ECM	Come on	DTC Stored	ES-57
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 1 sensor 1) 3. A/F sensor heater relay 4. ECM	Come on	DTC Stored	ES-67
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	1. Short in heater circuit of A/F sensor 2. A/F sensor heater (bank 1 sensor 1) 3. A/F sensor heater relay 4. ECM	Come on	DTC Stored	ES-67
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	1. Open or short in heater circuit of heated oxygen sensor 2. Heated oxygen sensor heater (bank 1 sensor 2) 3. EFI relay 4. ECM	Come on	DTC Stored	ES-71
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	1. Short in heater circuit of heated oxygen sensor 2. Heated oxygen sensor heater (bank 1 sensor 2) 3. EFI relay 4. ECM	Come on	DTC Stored	ES-71
P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 2 sensor 1) 3. A/F sensor heater relay 4. ECM	Come on	DTC Stored	ES-67

ES

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)	1. Short in heater circuit of A/F sensor 2. A/F sensor heater (bank 2 sensor 1) 3. A/F sensor heater relay 4. ECM	Come on	DTC Stored	ES-67
P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 2 sensor 2) 3. A/F sensor heater relay 4. ECM	Come on	DTC Stored	ES-71
P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	1. Short in heater circuit of A/F sensor 2. A/F sensor heater (bank 2 sensor 2) 3. A/F sensor heater relay 4. ECM	Come on	DTC Stored	ES-71
P0100	Mass or Volume Air Flow Circuit	1. Open or short in MAF meter circuit 2. MAF meter 3. ECM	Come on	DTC Stored	ES-76
P0101	Mass Air Flow Circuit Range / Performance Problem	1. MAF meter	Come on	DTC Stored	ES-83
P0102	Mass or Volume Air Flow Circuit Low Input	1. Open in MAF meter circuit 2. Short in ground circuit 3. MAF meter 4. ECM	Come on	DTC Stored	ES-76
P0103	Mass or Volume Air Flow Circuit High Input	1. Short in MAF meter circuit (to +B circuit) 2. MAF meter 3. ECM	Come on	DTC Stored	ES-76
P0110	Intake Air Temperature Circuit Malfunction	1. Open or short in IAT sensor circuit 2. IAT sensor (built in MAF meter) 3. ECM	Come on	DTC Stored	ES-86
P0112	Intake Air Temperature Circuit Low Input	1. Short in IAT sensor circuit 2. IAT sensor (built in MAF meter) 3. ECM	Come on	DTC Stored	ES-86
P0113	Intake Air Temperature Circuit High Input	1. Open in IAT sensor circuit 2. IAT sensor (built in MAF meter) 3. ECM	Come on	DTC Stored	ES-86
P0115	Engine Coolant Temperature Circuit Malfunction	1. Open or short in ECT sensor circuit 2. ECT sensor 3. ECM	Come on	DTC Stored	ES-92
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	1. ECT sensor	Come on	DTC Stored	ES-97
P0117	Engine Coolant Temperature Circuit Low Input	1. Short in ECT sensor circuit 2. ECT sensor 3. ECM	Come on	DTC Stored	ES-92
P0118	Engine Coolant Temperature Circuit High Input	1. Open in ECT sensor circuit 2. ECT sensor 3. ECM	Come on	DTC Stored	ES-92
P0120	Throttle Pedal Position Sensor / Switch "A" Circuit Malfunction	1. Throttle position sensor (built in throttle body) 2. ECM	Come on	DTC Stored	ES-99
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	1. Throttle position sensor (built in throttle body)	Come on	DTC Stored	ES-108
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	1. Throttle position sensor (built in throttle body) 2. Short in VTA1 circuit 3. Open in VC circuit 4. ECM	Come on	DTC Stored	ES-99

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	1. Throttle position sensor (built in throttle body) 2. Open in VTA1 circuit 3. Open in E2 circuit 4. VC and VTA1 circuits are short-circuited 5. ECM	Come on	DTC Stored	ES-99
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	1. Cooling system 2. ECT sensor 3. Thermostat	Come on	DTC Stored	ES-111
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	1. Thermostat (water inlet) 2. Cooling system 3. ECT sensor 4. ECM	Come on	DTC Stored	ES-114
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	1. Open or short in heated oxygen sensor circuit 2. Heated oxygen sensor 3. Heated oxygen sensor heater 4. A/F sensor 5. A/F sensor heater 6. EFI relay	Come on	DTC Stored	ES-117
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	1. Open or short in heated oxygen sensor circuit (sensor to ECM) 2. Open or short in heated oxygen sensor internal circuit	Come on	DTC Stored	ES-117
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	1. Short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Short in heated oxygen sensor (bank 1 sensor 2) 3. ECM internal circuit malfunction	Come on	DTC Stored	ES-117
P0139	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)	1. Short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Short in heated oxygen sensor (bank 1 sensor 2) 3. ECM internal circuit malfunction	Come on	DTC Stored	ES-117
P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)	1. Open or short in heated oxygen sensor circuit 2. Heated oxygen sensor 3. Heated oxygen sensor heater 4. A/F sensor 5. A/F sensor heater 6. EFI relay	Come on	DTC Stored	ES-117
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	1. Open or short in heated oxygen sensor circuit (sensor to ECM) 2. Open or short in heated oxygen sensor internal circuit	Come on	DTC Stored	ES-117
P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)	1. Short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Short in heated oxygen sensor (bank 1 sensor 2) 3. ECM internal circuit malfunction	Come on	DTC Stored	ES-117
P0159	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 2)	1. Short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Short in heated oxygen sensor (bank 1 sensor 2) 3. ECM internal circuit malfunction	Come on	DTC Stored	ES-117
P0171	System Too Lean (Bank 1)	1. Air induction system 2. Injector blockage 3. MAF meter 4. ECT sensor 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor (bank 1 sensor 1) circuit 8. A/F sensor (bank 1 sensor 1) 9. A/F sensor heater (bank 1 sensor 1) 10. A/F HTR relay 11. PCV valve and hose 12. PCV hose connection	Come on	DTC Stored	ES-132

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0172	System Too Rich (Bank 1)	1. Injector lead, blockage 2. MAF meter 3. ECT sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor (bank 1 sensor 1) circuit 8. A/F sensor (bank 1 sensor1) 9. A/F sensor heater (bank 1 sensor 1) 10. A/F HTR relay	Come on	DTC Stored	ES-132
P0174	System Too Lean (Bank 2)	1. Air induction system 2. Injector blockage 3. MAF meter 4. ECT sensor 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor (bank 2 sensor 1) circuit 8. A/F sensor (bank 2 sensor 1) 9. A/F sensor heater (bank 2 sensor 1) 10. A/F HTR relay 11. PCV valve and hose 12. PCV hose connection	Come on	DTC Stored	ES-132
P0175	System Too Rich (Bank 2)	1. Injector leak, blockage 2. MAF meter 3. ECT sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor (bank 2 sensor 1) circuit 8. A/F sensor (bank1 sensor 1) 9. A/F sensor heater (bank 2 sensor 1) 10. A/F HTR relay	Come on	DTC Stored	ES-132
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	1. Throttle position sensor (built in throttle body) 2. ECM	Come on	DTC Stored	ES-99
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	1. Throttle position sensor (built in throttle body) 2. Short in VTA2 circuit 3. Open in VC circuit 4. ECM	Come on	DTC Stored	ES-99
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	1. Throttle position sensor (built in throttle body) 2. Open in VTA2 circuit 3. Open in E2 circuit 4. VC and VTA2 circuits are short-circuited 5. ECM	Come on	DTC Stored	ES-99
P0300	Random / Multiple Cylinder Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-144

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0301	Cylinder 1 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-144
P0302	Cylinder 2 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-144
P0303	Cylinder 3 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-144
P0304	Cylinder 4 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-144

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0305	Cylinder 5 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-144
P0306	Cylinder 6 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-144
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	1. Short in knock sensor 1 circuit 2. Knock sensor 3. ECM	Come on	DTC Stored	ES-156
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	1. Open in knock sensor 1 circuit 2. Knock sensor 1 3. ECM	Come on	DTC Stored	ES-156
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	1. Short in knock sensor 2 circuit 2. Knock sensor 2 3. ECM	Come on	DTC Stored	ES-156
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	1. Short in knock sensor 2 circuit 2. Knock sensor 2 3. ECM	Come on	DTC Stored	ES-156
P0335	Crankshaft Position Sensor "A" Circuit	1. Open or short in crankshaft position sensor circuit 2. Crankshaft position sensor 3. Crankshaft timing pulley 4. ECM	Come on	DTC Stored	ES-161
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	1. Open or short in crankshaft position sensor circuit 2. Crankshaft position sensor 3. Crankshaft timing pulley 4. ECM	Does not come on	DTC Stored	ES-161
P0340	Camshaft Position Sensor Circuit Malfunction	1. Open or short in VVT sensor circuit 2. VVT sensor 3. Camshaft timing pulley 4. Timing belt has jumped tooth 5. ECM	Come on	DTC Stored	ES-166
P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)	1. Open or short in VVT sensor circuit 2. VVT sensor 3. Camshaft timing pulley 4. Timing belt has jumped tooth 5. ECM	Come on	DTC Stored	ES-166
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	1. Open or short in VVT sensor circuit 2. VVT sensor 3. Camshaft timing pulley 4. Timing belt has jumped tooth 5. ECM	Come on	DTC Stored	ES-166

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0346	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 2)	1. Open or short in VVT sensor circuit 2. VVT sensor 3. Camshaft timing pulley 4. Timing belt has jumped tooth 5. ECM	Come on	DTC Stored	ES-166
P0351	Ignition Coil "A" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT1 circuit from ignition coil with igniter to ECM (ignition coil circuit 1) 3. Ignition coil with igniter (ignition coil 1) 4. ECM	Come on	DTC Stored	ES-171
P0352	Ignition Coil "B" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT2 circuit from ignition coil with igniter to ECM (ignition coil circuit 2) 3. Ignition coil with igniter (ignition coil 2) 4. ECM	Come on	DTC Stored	ES-171
P0353	Ignition Coil "C" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT3 circuit from ignition coil with igniter to ECM (ignition coil circuit 3) 3. Ignition coil with igniter (ignition coil 3) 4. ECM	Come on	DTC Stored	ES-171
P0354	Ignition Coil "D" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT4 circuit from ignition coil with igniter to ECM (ignition coil circuit 4) 3. Ignition coil with igniter (ignition coil 4) 4. ECM	Come on	DTC Stored	ES-171
P0355	Ignition Coil "E" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT5 circuit from ignition coil with igniter to ECM (ignition coil circuit 5) 3. Ignition coil with igniter (ignition coil 5) 4. ECM	Come on	DTC Stored	ES-171
P0356	Ignition Coil "F" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT6 circuit from ignition coil with igniter to ECM (ignition coil circuit 6) 3. Ignition coil with igniter (ignition coil 6) 4. ECM	Come on	DTC Stored	ES-171
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	1. Gas leakage in exhaust system 2. A/F sensor (bank 1 sensor 1) 3. Heated oxygen sensor (bank 1 sensor 2) 4. Three-way catalytic converter (inside exhaust manifold)	Come on	DTC Stored	ES-180
P0430	Catalyst System Efficiency Below Threshold (Bank 2)	1. Gas leakage in exhaust system 2. A/F sensor (bank 2 sensor 1) 3. Heated oxygen sensor (bank 2 sensor 2) 4. Three-way catalytic converter (inside exhaust manifold)	Come on	DTC Stored	ES-180
P0441	Evaporative Emission Control System Incorrect Purge Flow	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-187

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0442	Evaporative Emission Control System Leak Detected (Small Leak)	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-193
P0446	Evaporative Emission Control System Vent Control Circuit	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-199
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	1. Open or short in vapor pressure sensor circuit 2. Vapor pressure sensor 3. ECM	Come on	DTC Stored	ES-202
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	1. Open in vapor pressure sensor circuit 2. Vapor pressure sensor 3. ECM	Come on	DTC Stored	ES-202
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	1. Short in vapor pressure sensor circuit 2. Vapor pressure sensor 3. ECM	Come on	DTC Stored	ES-202
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-193

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-193
P0500	Vehicle Speed Sensor "A"	1. Open or short in speed sensor circuit 2. Speed sensor 3. Combination meter 4. ECM 5. Skid control ECU	Come on	DTC Stored	ES-208
P0503	Vehicle Speed Sensor "A" Intermittent / Erratic / High	1. Open or short in speed sensor circuit 2. Speed sensor 3. Combination meter 4. ECM 5. Skid control ECU	Does not come on	DTC Stored	ES-208
P0504	Brake Switch "A" / "B" Correlation	1. Short in stop light switch signal circuit 2. Stop light switch 3. ECM	Does not come on	DTC Stored	ES-211
P0505	Idle Control System Malfunction	1. Electric throttle control system 2. Air induction system 3. PCV hose connection	Come on	DTC Stored	ES-217
P0560	System Voltage	1. Open in back-up power source circuit 2. ECM	Come on	DTC Stored	ES-220
P0604	Internal Control Module Random Access Memory (RAM) Error	1. ECM	Come on	DTC Stored	ES-223
P0606	ECM / PCM Processor	1. ECM	Come on	DTC Stored	ES-223
P0607	Control Module Performance	1. ECM	Come on	DTC Stored	ES-223
P0617	Starter Relay Circuit High	1. Short in park/neutral position switch circuit 2. PNP switch 3. Ignition switch 4. ECM	Come on	DTC Stored	ES-225
P0630	Vin not Programmed or Mismatch - ECM / PCM	1. ECM	Come on	DTC Stored	ES-231
P0657	Actuator Supply Voltage Circuit / Open	1. ECM	Come on	DTC Stored	ES-223
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	1. Short in park/neutral position switch circuit 2. PNP switch 3. ECM	Come on	DTC Stored	ES-233
P2102	Throttle Actuator Control Motor Circuit Low	1. Open in throttle actuator circuit 2. Throttle actuator 3. ECM	Come on	DTC Stored	ES-234
P2103	Throttle Actuator Control Motor Circuit High	1. Short in throttle actuator circuit 2. Throttle actuator 3. Throttle body 4. Throttle valve 5. ECM	Come on	DTC Stored	ES-234
P2111	Throttle Actuator Control System - Stuck Open	1. Open or short in throttle actuator circuit 2. Throttle actuator 3. Throttle body 4. Throttle valve	Come on	DTC Stored	ES-238

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2112	Throttle Actuator Control System - Stuck Closed	1. Open or short in throttle actuator circuit 2. Throttle actuator 3. Throttle body 4. Throttle valve	Come on	DTC Stored	ES-238
P2118	Throttle Actuator Control Motor Current Range / Performance	1. Open in ETCS power source circuit 2. ECM	Come on	DTC Stored	ES-241
P2119	Throttle Actuator Control Throttle Body Range / Performance	1. Electronic throttle control system 2. ECM	Come on	DTC Stored	ES-246
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	1. Accelerator pedal position sensor 2. ECM	Come on	DTC Stored	ES-249
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-258
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	1. Accelerator pedal position sensor 2. Open in VCP1 circuit 3. Open or short to ground in VPA1 circuit 4. ECM	Come on	DTC Stored	ES-249
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	1. Accelerator pedal position sensor 2. Open in EPA circuit 3. ECM	Come on	DTC Stored	ES-249
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	1. Accelerator pedal position sensor 2. ECM	Come on	DTC Stored	ES-249
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	1. Accelerator pedal position sensor 2. Open in VCP2 circuit 3. Open or short to ground in VPA2 circuit 4. ECM	Come on	DTC Stored	ES-249
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	1. Accelerator pedal position sensor 2. Open in EPA2 circuit 3. ECM	Come on	DTC Stored	ES-249
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	1. VTA1 and VTA2 circuits are short-circuited 2. Throttle position sensor (built in throttle body) 3. ECM	Come on	DTC Stored	ES-99
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	1. VPA1 and VPA2 circuits are short-circuited 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-249
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-262
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-262

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2197	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. AiF sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-262
P2198	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. AiF sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-262
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-275
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-275
P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-275
P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-275
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-275
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-275
P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-275

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-275
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-281
P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor heater 4. A/F HTR relay 5. Open or short in A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-281

SFI SYSTEM

DEFINITION OF TERMS

Terms	Definition
Monitor Description	Description of what ECM monitors and how detects malfunctions (monitoring purpose and its details).
Related DTCs	A 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 sets 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 and not monitored until 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 set DTC. Timing begins when Typical Enabling Conditions met.
Malfunction Thresholds	Value, beyond which, ECM determines malfunctions exist and sets DTCs.
MIL Operation	Timing of MIL illumination after defected. "Immediate" means ECM illuminates MIL as soon as malfunction detected. "2 driving cycle" means ECM illuminates MIL if same malfunction detected second time during next sequential driving cycle.

PART AND SYSTEM NAME LIST

This reference list indicates the part names used in this manual along with their definitions.

TOYOTA/LEXUS name	Definition
Toyota HCAC system, Hydro-carbon Adsorptive Catalyst (HCAC) system, HC adsorptive three-way catalyst	HC adsorptive three-way catalytic converter
Variable valve timing sensor, VVT sensor	Camshaft position sensor
Variable valve timing system, VVT system	Camshaft timing control system
Camshaft timing oil control valve, Oil control valve, OCV, VVT, VSV	Camshaft timing oil control valve
Variable timing and lift	Camshaft timing and lift control
Crankshaft position sensor "A"	Crankshaft position sensor
Engine speed sensor	Crankshaft position sensor
THA	Intake air temperature
Knock control module	Engine knock control module
Knock sensor	Engine knock sensor
Mass or volume air flow circuit	Mass air flow sensor circuit
Vacuum sensor	Manifold air pressure sensor
Internal control module, Control module, Engine control ECU, PCM	Power train control module
FC idle	Deceleration fuel cut
Idle air control valve	Idle speed control valve
VSV for CCV, Canister close valve VSV for canister control	Evaporative emissions canister vent valve
VSV for EVAP, Vacuum switching valve assembly No. 1, EVAP VSV, Purge VSV	Evaporative emissions canister purge valve
VSV for pressure switching valve, Bypass VSV	Evaporative emission pressure switching valve
Vapor pressure sensor, EVAP pressure sensor, Evaporative emission control system pressure sensor	Fuel tank pressure sensor
Charcoal canister	Evaporative emissions canister
ORVR system	On-board refueling vapor recovery system
Intake manifold runner control	Intake manifold tuning system
Intake manifold runner valve, IMRV, IACV (runner valve)	Intake manifold tuning valve
Intake control VSV	Intake manifold tuning solenoid valve
AFS	Air fuel ratio sensor
HO2 sensor	Heater oxygen sensor
Oxygen sensor pumping current circuit	Oxygen sensor output signal
Oxygen sensor reference ground circuit	Oxygen sensor signal ground
Accel position sensor	Accelerator pedal position sensor
Throttle actuator control motor, Actuator control motor, Electronic throttle motor, Throttle control motor	Electronic throttle actuator
Electronic throttle control system, Throttle actuator control system	Electronic throttle control system
Throttle/pedal position sensor, Throttle/pedal position switch, Throttle position sensor/switch	Throttle position sensor
Turbo pressure sensor	Turbocharger pressure sensor
Turbo VSV	Turbocharger pressure control solenoid valve
P/S pressure switch	Power-steering pressure switch
VSV for ACM	Active control engine mount
Speed sensor, Vehicle speed sensor "A", Speed sensor for stability control ECU	Vehicle speed sensor
ATF temperature sensor, Trans. fluid temp. sensor, ATF temperature sensor "A"	Transmission fluid temperature sensor
Electronic controlled automatic transmission, ECT	Electronically controlled automatic
Intermediate shaft speed sensor "A"	Counter gear speed sensor
Output speed sensor	Output shaft speed sensor

ES

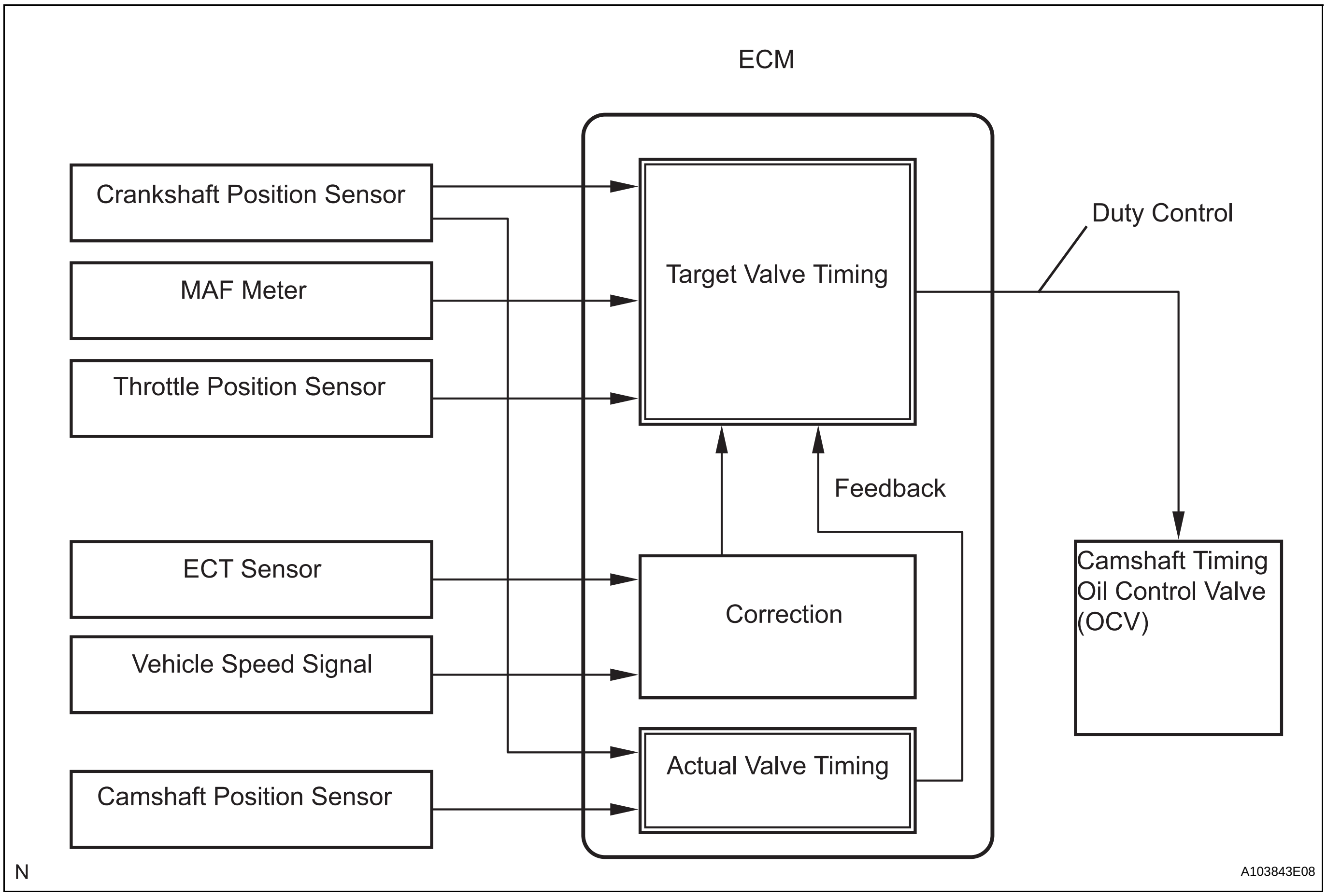
TOYOTA/LEXUS name	Definition
Input speed sensor, Input turbine speed sensor "A", Speed sensor (NT), Turbine speed sensor	Input turbine speed sensor
PNP switch, NSW	Park/Neutral position switch
Pressure control solenoid	Transmission pressure control solenoid
Shift solenoid	Transmission shift solenoid valve
Transmission control switch, Shift lock control unit	Shift lock control module
Engine immobilizer system, Immobilizer system	Vehicle anti-theft system

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

DTC	P0020	Camshaft Position "A" Actuator Circuit (Bank 2)

DESCRIPTION

The Variable Valve Timing (VVT) system includes the ECM, the Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal, sent to the OCV, regulates the oil pressure applied to the VVT controller. Camshaft timing control is performed based on engine operation conditions such as intake air volume, throttle position and engine coolant temperature. The ECM controls the OCV based on the signals output from several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative position between the camshaft and the crankshaft is optimized. Also, the engine torque and fuel economy improve, and exhaust emissions decrease. The ECM detects the actual valve timing using signals from the camshaft position sensor and the crankshaft position sensor. The ECM performs feedback control and verifies target valve timing.



DTC No.	DTC Detection Condition	Trouble Area
P0010 P0020	Open or short OCV circuit (1 trip detection logic)	• Open or short OCV circuit • OCV • ECM

MONITOR DESCRIPTION

After the ECM sends the "target" duty-cycle signal to the OCV, the ECM monitors the OCV current to establish an "actual" duty-cycle. The ECM detects a malfunction and sets a DTC when the actual duty-cycle ratio varies from the target duty-cycle ratio.

MONITOR STRATEGY

Related DTCs	P0010: VVT OCV (bank 1) open/short P0020: VVT OCV (bank 2) open/short
Required sensors / components (Main)	VVT OCV (Variable Valve Timing oil control valve)
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	11 to 13 V
Target duty ratio for the OCV	Less than 70 %
Starter	OFF
Current cut status for the OCV	Not cut

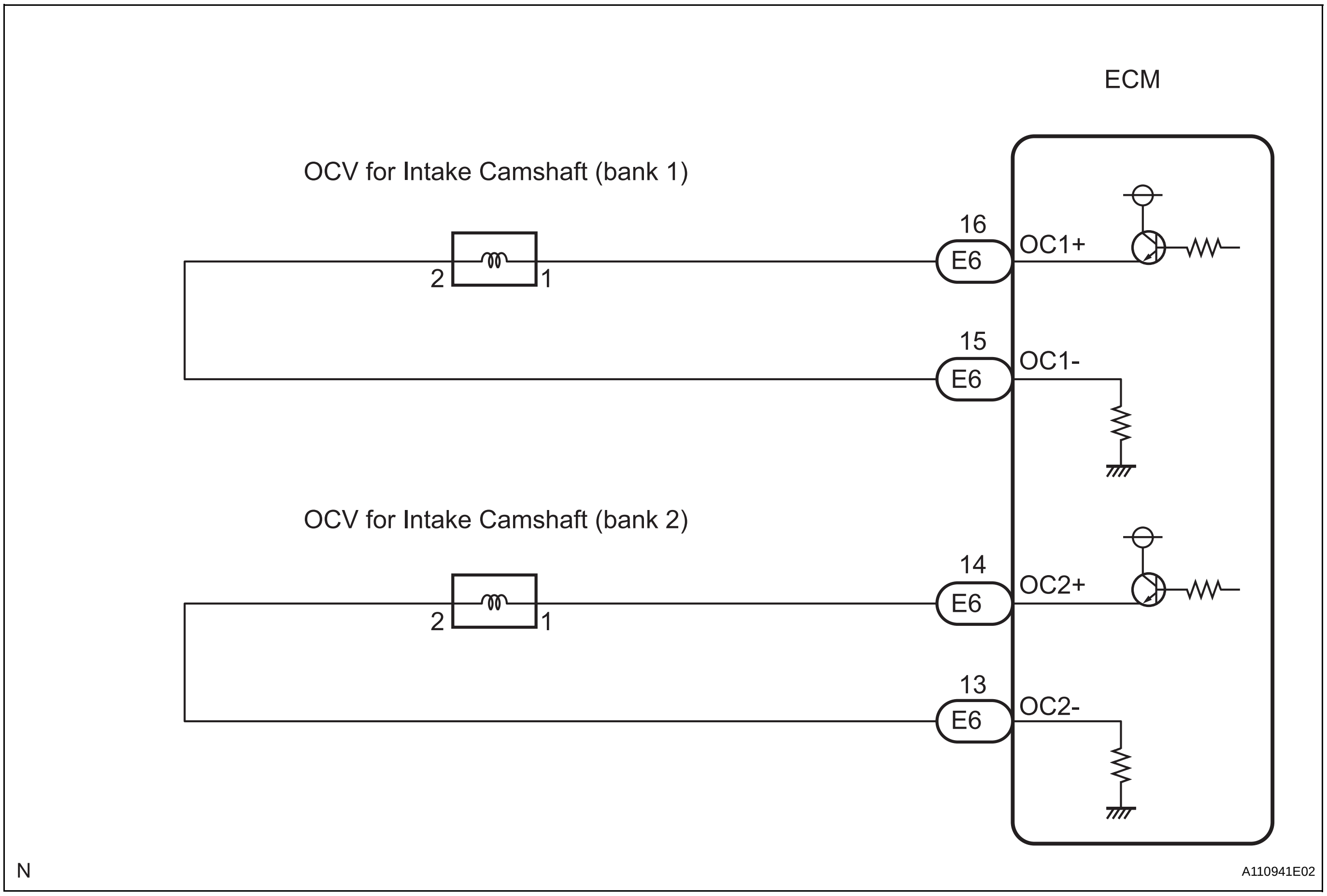
TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	Condition 1 or 2
Either of the following conditions is met: Condition 1 or 2 1. OCV duty ratio	100 % (always ON) even though the target duty ratio is less than 70 %
2. OCV duty ratio when ECM supplies current to OCV	3 % or less despite the ECM supplying the current to the OCV

COMPONENT OPERATING RANGE

VVT OCV duty ratio	More than 3 %, and Less than 100 %

WIRING DIAGRAM



HINT:
- If DTC P0010 is displayed, check the right bank VVT system.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. 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.

1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OCV OPERATION)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Warm up the engine.
(d) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
(e) Using the hand-held tester, operate the OCV and check the engine speed.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Rough idle or engine stall

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

2 INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

OK:

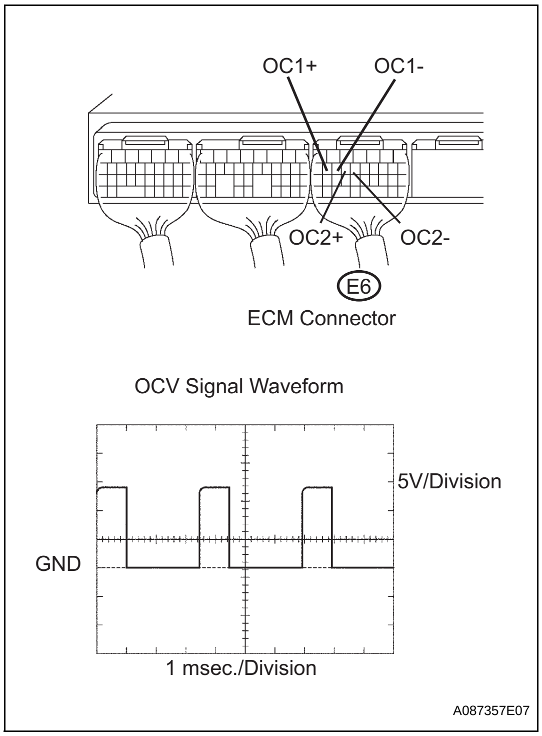
OCV has no contamination and moves smoothly.

(a) Reconnect the OCV connector.

NG → **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

OK

3 INSPECT ECM (OCV SIGNAL)



(a) During idling, check the waveform of the ECM connector using an oscilloscope.

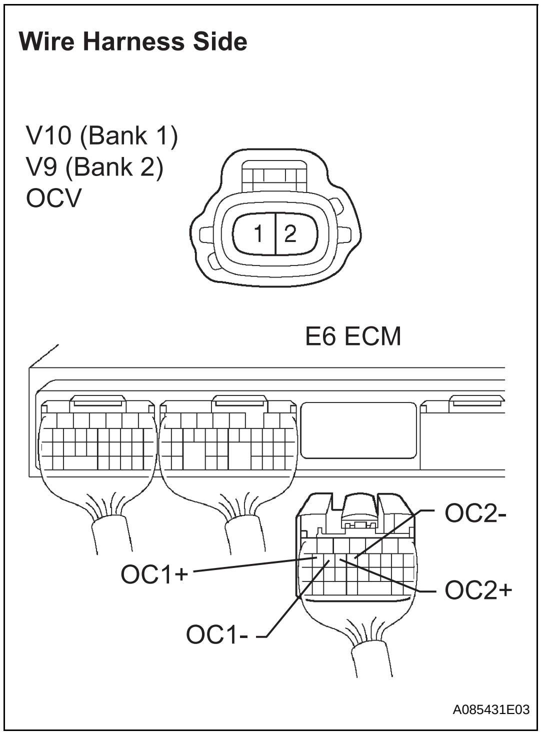
Signal waveform

Tester Connection	Specified Condition
E6-16 (OC1+) - E6-15 (OC1-) E6-14 (OC2+) - E6-13 (OC2-)	Correct waveform is as shown

NG → **REPLACE ECM**

OK

4	INSPECT HARNESS AND CONNECTOR (OCV - ECM)



(a) Disconnect the V9 or V10 OCV connector.
(b) Disconnect the E6 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
V10-1 (OCV) - E6-16 (OC1+) V10-2 (OCV) - E6-15 (OC1-) V9-1 (OCV) - E6-14 (OC2+) V9-2 (OCV) - E6-13 (OC2-)	Below 1 Ω
V10-1 (OCV) or E6-16 (OC1+) - Body ground V10-2 (OCV) or E6-15 (OC1-) - Body ground V9-1 (OCV) or E6-14 (OC2+) - Body ground V9-2 (OCV) or E6-13 (OC2-) - Body ground	10 kΩor higher

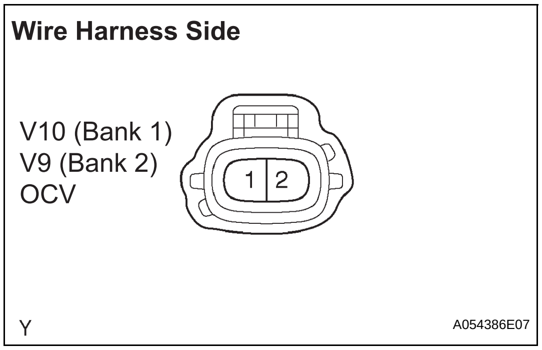
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

ES

OK

CHECK FOR INTERMITTENT PROBLEMS

1	CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV OPERATION)

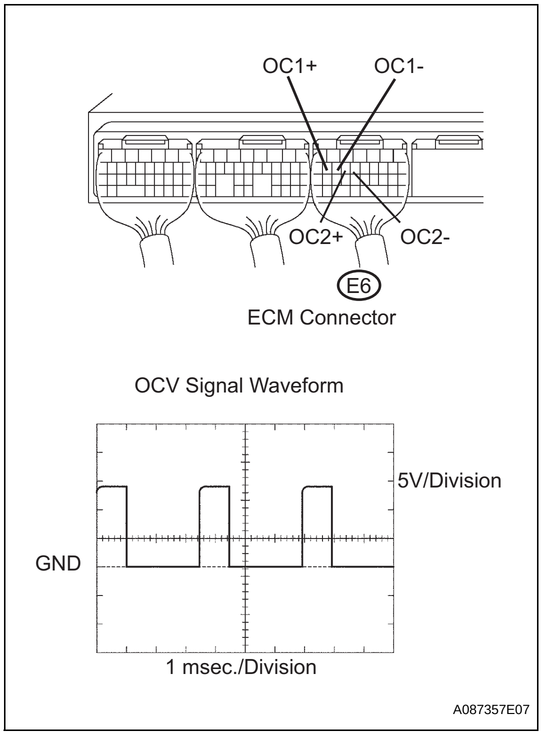


(a) Disconnect the V9 or V10 OCV connector.
(b) Apply positive battery voltage between the terminals of the OCV.
(c) Check the engine speed.
OK:
Engine speed is rough idle or engine is stalled.

NG → **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

OK

2	CHECK ECM (OCV SIGNAL)



(a) During idling, check the waveform of the E6 ECM connector using an oscilloscope.

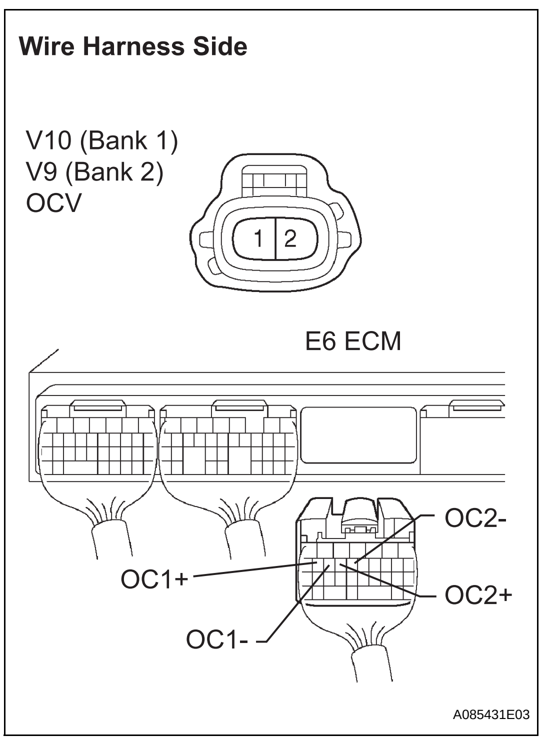
Signal waveform

Tester Connection	Specified Condition
E6-16 (OC1+) - E6-15 (OC1-) E6-14 (OC2+) - E6-13 (OC2-)	Correct waveform is as shown

NG → **REPLACE ECM**

OK

3	CHECK WIRE HARNESS (OCV - ECM)



(a) Disconnect the V9 or V10 OCV connector.
(b) Disconnect the E6 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
V10-1 (OCV) - E6-16 (OC1+) V10-2 (OCV) - E6-15 (OC1-) V9-1 (OCV) - E6-14 (OC2+) V9-2 (OCV) - E6-13 (OC2-)	Below 1 Ω
V10-1 (OCV) or E6-16 (OC1+) - Body ground V10-2 (OCV) or E6-15 (OC1-) - Body ground V9-1 (OCV) or E6-14 (OC2+) - Body ground V9-2 (OCV) or E6-13 (OC2-) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

CHECK FOR INTERMITTENT PROBLEMS

DTC	P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC	P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)

DTC	P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC	P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)

DESCRIPTION

Refer to DTC P0010 (See page ES-50).

DTC No.	DTC Detection Condition	Trouble Area
P0011 P0021	After engine is warmed up and engine speed is at 500 to 4,000 rpm, condition (a) continues (1 trip detection logic) (b) Valve timing does not change from current valve timing (Problem of advanced valve timing)	• Valve timing • OCV • Camshaft timing gear assembly • ECM
P0012 P0022	After engine is warmed up and engine speed is at 500 to 4,000 rpm, condition (a) continues (2 trip detection logic) (b) Valve timing does not change from current valve timing (Problem of retarded valve timing)	• Valve timing • OCV • Camshaft timing gear assembly • ECM

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the Variable Valve Timing (VVT) system to control the intake valve camshaft. The VVT system includes the ECM, the Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal, sent to the OCV, regulates the oil pressure applied to the VVT controller. The VVT controller can advance or retard the intake valve camshaft.

Example:

A DTC will be set if: 1) the difference between the target and actual valve timing is more than 5 degrees of the camshaft angle (CA) and the condition continues for more than 4.5 seconds; or 2) the OCV is forcibly activated 63 times or more.

Advanced cam DTCs are subject to "1 trip" detection logic.

Retarded cam DTCs are subject to "2 trip" detection logic.

MONITOR STRATEGY

Related DTCs	P0011: Advanced camshaft timing (bank 1) P0012: Retard camshaft timing (bank 1) P0021: Advanced camshaft timing (bank 2) P0022: Retard camshaft timing (bank 2)
Required sensors / components (Main)	VVT OCV and Camshaft timing gear
Required sensors / components (Related)	Crankshaft position sensor, camshaft position sensor and Engine coolant temperature sensor
Frequency of operation	Once per drive cycle
Duration	Within 10 seconds
MIL operation	P0011 and P0021: Immediate P0012 and P0022: 2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present.	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0100 - P0103 (MAF Sensor) P0105 - P0108 (MAF Sensor) P0115 - P0118 (ECT Sensor) P0125 (Insufficient ECT for Closed Loop) P0335 (CKP Sensor) P0340, P0341 (CMP Sensor) P0351 - P0358 (Ignitor)
Battery voltage	11 V or more
Engine RPM	500 to 4,000 rpm
ECT	75°C (167°F) to 100°C (212°F)
Throttle position learning	Completed

TYPICAL MALFUNCTION THRESHOLDS

Deviation of valve timing	More than 5°CA (Crankshaft Angle)
OCV activation	63 times or more
Response of valve timing	1 sec./°CA or more (Valve timing does not change)

If the difference between "target" and "actual"camshaft timing is larger than the specified value, the ECM operates the VVT actuator. Then, the ECM monitors the camshaft timing change for 5 seconds.

WIRING DIAGRAM

Refer to DTC P0010 (See page ES-52).

HINT:

Abnormal bank	Problem of advanced OCV	Problem of retarded OCV
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- If DTC P0011 or P0012 is displayed, check the right bank VVT system.
- If DTC P0021 or P0022 is displayed, check the left bank VVT system.

Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM recoeds vehicle and driving conditoin information as freeze data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING BELT)

OK:
The matchmarks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING**

OK

2	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OCV OPERATION)

(a) Connect the intelligent tester to the DLC3.

(b) Start the engine and warm it up.
(c) Turn the ignition switch ON and push the intelligent tester main switch ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
(e) Using the intelligent tester, operate the OCV and check the engine speed.
Standard

Tester Operation	Specified Condition
OCV is OFF	Normal engine speed
OCV is ON	Rough idle or engine stall

NG → **Go to step 4**

OK

3 CHECK WHETHER DTC OUTPUT RECURS

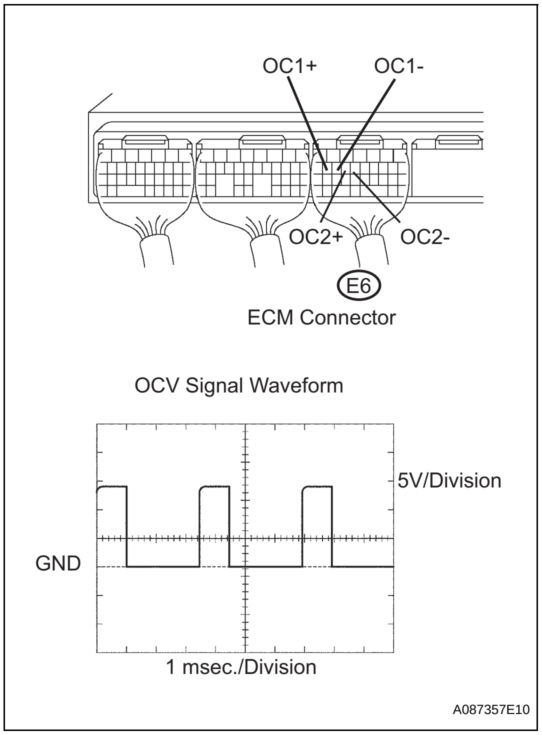
(a) Clear the DTCs.
(1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.
HINT:
After disconnecting the battery cable, perform the "INITIALIZE" procedure (See page IN-24).
(b) Start and warm up the engine.
(c) Drive the vehicle for 10 minutes or more.
(d) Read output DTC using the intelligent tester.
OK:
No DTC output.

HINT:
*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object in the engine oil enters the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

OK → **VVT SYSTEM OK**

NG

4	CHECK ECM (OCV SIGNAL)



(a) During idling, check the waveform of the ECM connector using an oscilloscope.
Standard

Tester Connection	Specified Condition
E6-16 (OC1+) - E6-15 (OC1-) E6-14 (OC2+) - E6-13 (OC2-)	Correct waveform is as shown

NG → **REPLACE ECM**

OK

5	CHECK OIL CONTROL VALVE FILTER

OK:
The filter is not clogged.

NG → **REPLACE OIL CONTROL VALVE FILTER**

OK

6	CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

OK:
OCV has no contamination and moves smoothly.

OK → **Go to step 8**

NG

7	REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

GO

8	CHECK CAMSHAFT TIMING GEAR ASSEMBLY

OK:
Camshaft timing gear rotate smoothly when apply pressure.

OK → **Go to step 10**

NG

9	REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

ES

GO

10	CHECK FOR BLOCKAGE (OCV, OIL CHECK VALVE AND OIL HOLE)

OK:
No blockage.

NG → **REPAIR OR REPLACE MALFUNCTION PARTS**

OK

11	CHECK ANY OTHER DTCS OUTPUT

(a) Clear the DTCs.
  (1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.
  HINT:
  After disconnecting the battery cable, perform the "INITIALIZE" procedure (See page IN-24).
(b) Start and warm up the engine.
(c) Drive the vehicle around for 10 minutes or more.
(d) Read output DTC using the intelligent tester.
  OK:
  No DTC output.

HINT:
*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object in the engine oil enters the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

OK → **VVT SYSTEM OK**

NG

REPLACE ECM

1	CHECK VALVE TIMING (CHECK FOR LOOSE OR JUMPED TOOTH OF TIMING BELT)

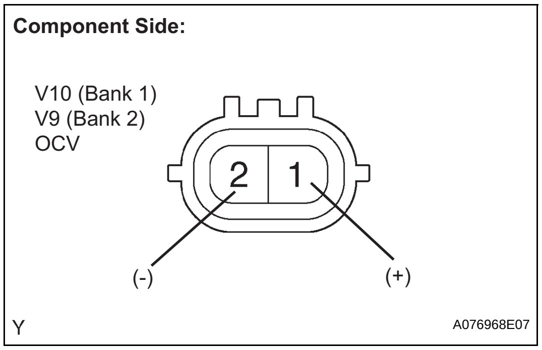
OK:

The matchmarks of crankshaft pulley and camshaft pulley are aligned.

NG → ADJUST VALVE TIMING

OK

2	CHECK OPERATION OF OCV



(a) Start the engine.

(b) Check the engine speed with (*1) and (*2).

(1) Disconnect the V9 or V10 OCV connector (*1).

(2) Apply battery positive voltage between the terminals of the OCV (*2).

Result

Proceed to	Check (1)	Check (2)
A	Normal engine speed	Rough idle or engine stall
B	Conditions other than A	Conditions other than A

B → Go to step 4

A

3	CHECK IF DTC OUTPUT REOCCUR

(a) Clear the DTCs.

(1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:

After disconnecting the battery cable, perform the "INITIALIZE" procedure (see page IN-24).

(b) Start and warm up the engine.

(c) Drive the vehicle around for 10 minutes or more.

(d) Read output DTC using the OBD II scan tool.

OK:

No DTC output.

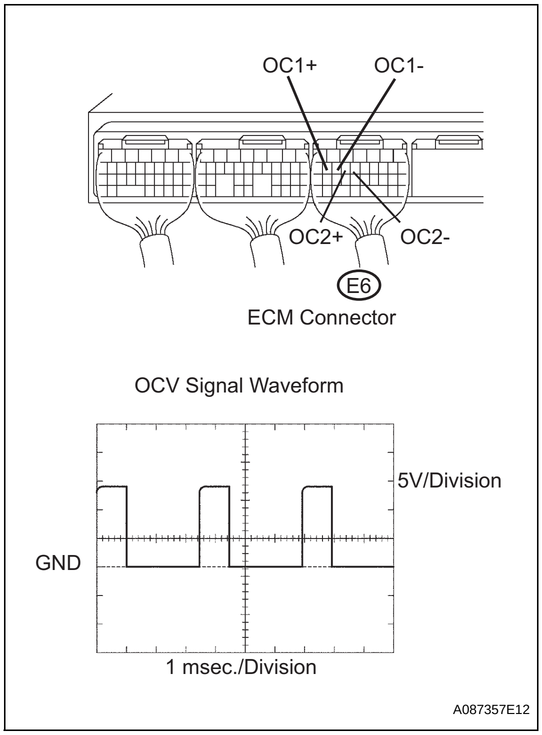
HINT:

*: DTCs P0011, P0012, P0021 or P0022 is output when a foreign object in the engine oil enters the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

OK → VVT SYSTEM OK

NG

4	CHECK ECM (OCV SIGNAL)



(a) During idling, check the waveform of the ECM connector using an oscilloscope.

Standard

Tester Connection	Specified Condition
E6-16 (OC1+) - E6-15 (OC1-) E6-14 (OC2+) - E6-13 (OC2-)	Correct waveform is as shown

NG → **REPLACE ECM**

OK

5	CHECK OIL CONTROL VALVE FILTER

OK:
The filter is not clogged.

NG → **REPLACE OIL CONTROL VALVE FILTER**

OK

6	CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

OK:
OCV has no contamination and moves smoothly.

OK → **Go to step 8**

NG

7	REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

GO

ES

8	CHECK CAMSHAFT TIMING GEAR ASSEMBLY

OK:
Camshaft timing gear rotates smoothly when pressure is applied.

OK → **Go to step 10**

NG

9	REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

GO

ES

10	CHECK FOR BLOCKAGE (OCV, OIL CHECK VALVE AND OIL HOLE)

OK:
No blockage.

NG → **REPAIR OR REPLACE MALFUNCTION PARTS**

OK

11	CHECK IF DTC OUTPUT REOCCUR

(a) Clear the DTCs.
(1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.
HINT:
After disconnecting the battery cable, perform the "INITIALIZE" procedure (see page IN-24).
(b) Start and warm up the engine.
(c) Drive the vehicle around for 10 minutes or more.
(d) Read output DTC using the OBD II scan tool.
OK:
No DTC output.

HINT:
*: DTCs P0011, P0012, P0021 or P0022 is output when a foreign object in the engine oil enters the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

NG → **VVT SYSTEM OK**

OK

REPLACE ECM

DTC	P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DTC	P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)

DESCRIPTION

Refer to DTCs P0335 and P0339 (See page ES-161).

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and VVT sensor 1 signal (2 trip detection logic)	• Mechanical system (timing belt has jumped tooth, belt is stretched) • ECM
P0018	Deviation in crankshaft position sensor signal and VVT sensor 2 signal (2 trip detection logic)	• Mechanical system (timing belt has jumped tooth, belt is stretched) • ECM

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the Variable Valve Timing (VVT) system to control the intake valve camshaft. The VVT system includes the ECM, the Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal, sent to the OCV, regulates the oil pressure applied to the VVT controller. The VVT controller can advance or retard the intake valve camshaft. The ECM calibrates the valve timing of the VVT system by setting the camshaft to the maximum retard angle when the engine is idling. The ECM closes the OCV to retard the cam. The ECM stores this value as a VVT learning value. When the difference between the target valve timing and the actual valve timing is 5 degrees or less, the ECM stores this in its memory.
If the learning value meets both of the following conditions ("a" and "b"), the ECM interprets this as a defect in the VVT system and sets a DTC.

1. The VVT learning value is less than 26°CA (bank 1)/23.2°CA (bank 2) or more than 45 °CA (bank 1)/ 39.1°CA (bank 2).
   The above condition continues for more than 18 seconds.

MONITOR STRATEGY

Related DTCs	P0016: Camshaft timing misalignment at idle (bank 1) P0018: Camshaft timing misalignment at idle (bank 2)
Required sensors/components	VVT actuator
Required sensors/components	Camshaft position sensor, Crankshaft position sensor
Frequency of operation	Once per drive cycle
Duration	Within 1 minute
MIL operation	2 drive cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0011 (VVT system 1 - advance) P0012 (VVT system 1 - retard) P0021 (VVT system 2 - advance) P0022 (VVT system 2 - retard) P0115 - P0118 (ECT sensor)
Engine RPM	500 to 1,000 rpm

TYPICAL MALFUNCTION THRESHOLDS

Duration that either of the following conditions 1 or 2 is met:	18 seconds or more
1. VVT angle when camshaft is retarded maximum	Less than 26°CA (Bank 1) Less than 23.2°CA (Bank 2)
2. VVT angle when camshaft is retarded maximum	More than 45°CA (Bank 1)More than 44.5°CA (bank 1) More than 39.1°CA (Bank 2)

WIRING DIAGRAM

Refer to DTC P0335 (See page ES-163).

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK VALVE TIMING (CHECK FOR LOOSE AND A JUMPED TOOTH OF TIMING BELT)

OK:
The matchmarks of the crankshaft pulley and camshaft pulley are aligned.

NG → **ADJUST VALVE TIMING**

OK

REPLACE ECM

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	P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

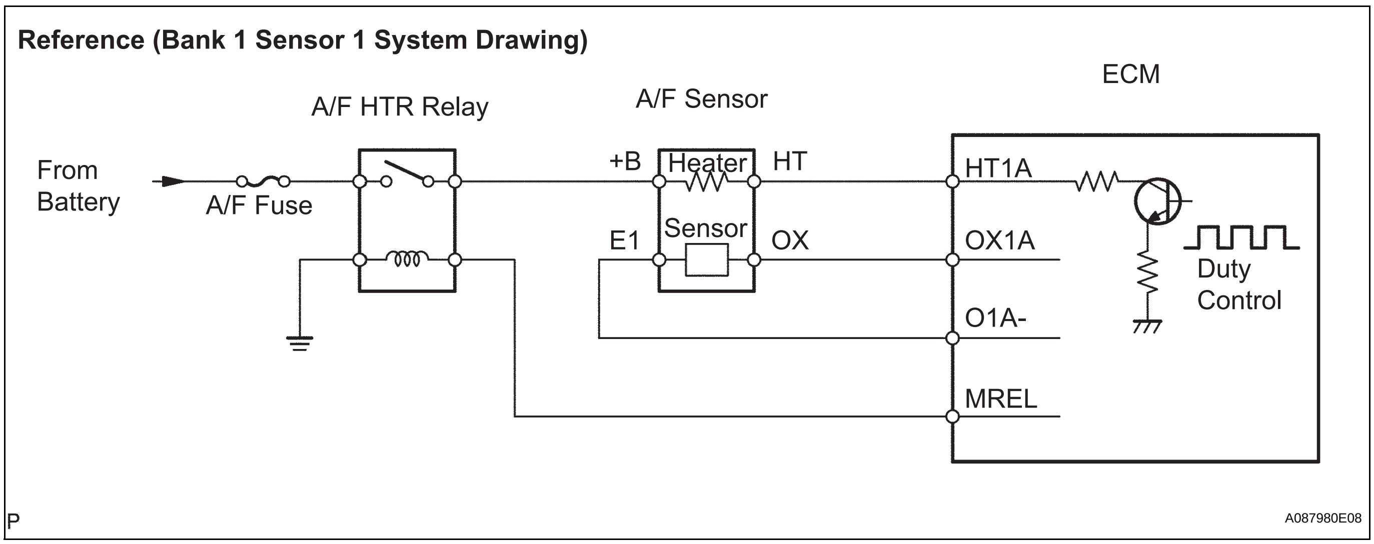
DTC	P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

DESCRIPTION

HINT:

- Although the caption of each detection item (DTC description) says "oxygen sensor", this DTC is related to the "air fuel ratio sensor (A/F sensor)".
- The ECM provides a pulse width modulated control circuit to adjust current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.

Refer to DTC P2195 (See page ES-262)



DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Heater current is 0.8 A or less when heater operates (1 trip detection logic)	• Open or short in heater circuit of A/F sensor • A/F sensor heater • A/F sensor heater relay • ECM
P0032 P0052	Heater current exceeds 19.7 A when heater operates (1 trip detection logic)	• Open or short in heater circuit of A/F sensor • A/F sensor heater • A/F sensor heater relay • ECM

HINT:

- Bank 1 is the bank that includes cylinder No. 1.
- Bank 2 is the bank that does not include cylinder No. 1.
- Sensor 1 is the sensor closest to the engine assembly.
- Sensor 2 is the sensor farthest away from the engine assembly.

MONITOR DESCRIPTION

The ECM uses the Air-Fuel Ratio sensor (A/F sensor) information to regulate the air-fuel ratio close to the stoichiometric ratio. This maximizes the catalytic converter's ability to purify exhaust gas. The sensor detects oxygen levels in the exhaust gas and sends this signal to the ECM.
The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The zirconia element generates small voltage when there is a large difference in the oxygen concentrations of the exhaust and the outside air. The platinum coating amplifies the voltage generation. When heated, the sensor becomes very efficient. If the temperature of the exhaust is low, the sensor will not generate useful voltage signals without supplemental heating. The ECM regulates the supplemental heating using a duty-cycle approach to regulate the average current in the heater element. If the heater current is out of the normal range, the sensor's output signals will be inaccurate and the ECM cannot regulate the air-fuel ratio properly.
When the heater current is out of the normal operating range, the ECM interprets this as a malfunction and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0031: A/F Sensor Heater (Bank 1) Range Check (Low current) P0032: A/F Sensor Heater (Bank 1) Range Check (High current) P0051: A/F Sensor Heater (Bank 2) Range Check (Low current) P0052: A/F Sensor Heater (Bank 2) Range Check (High current)
Required sensors / components (Main)	A/F sensor heater
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	P0300 - P0304 (Misfire)
Time after engine start	10 seconds

P0031:

A/F sensor heater duty ratio	50 % or more
Battery voltage	10.5 V or more

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0051:

A/F sensor heater current	Less than 0.8 A

P0032 and P0052:

Hybirid IC high current limiter port	Fail

COMPONENT OPERATING RANGE

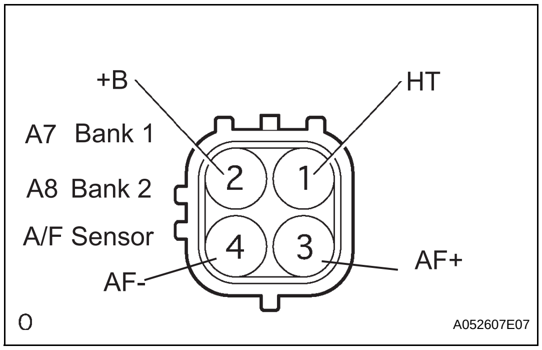
A/F sensor heater current	1.8 to 3.4 A at 20°C (68°F)

WIRING DIAGRAM

Refer to DTC P2195 (See pageES-265).

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A7 or A8 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.
Resistance

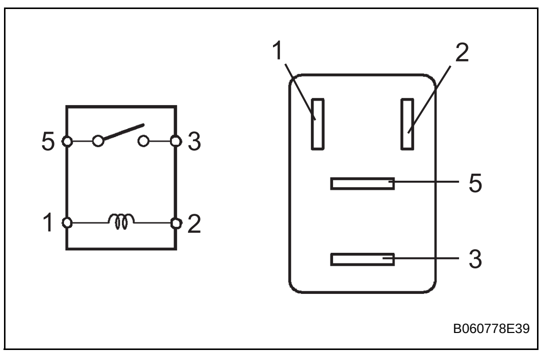
Tester Connection	Condition	Specified Condition
1 (HT) - 2 (+B)	20°C (68°F)	1.8 to 3.2 Ω

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2	INSPECT RELAY (Marking: A/F HTR)



(a) Remove the A/F HTR relay from the engine room R/B.
(b) Measure the resistance of the A/F HTR relay.
Resistance

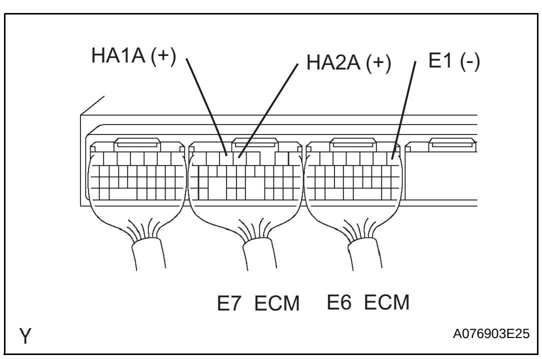
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Continuity (when battery voltage is applied to terminals 1 and 2)

(c) Reinstall the A/F HTR relay.

NG → **REPLACE RELAY**

OK

3	INSPECT ECM (HA1A AND HA2A VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Specified Condition
E7-5 (HA1A) - E6-1 (E1) E7-4 (HA2A) - E6-1 (E1)	9 to 14 V

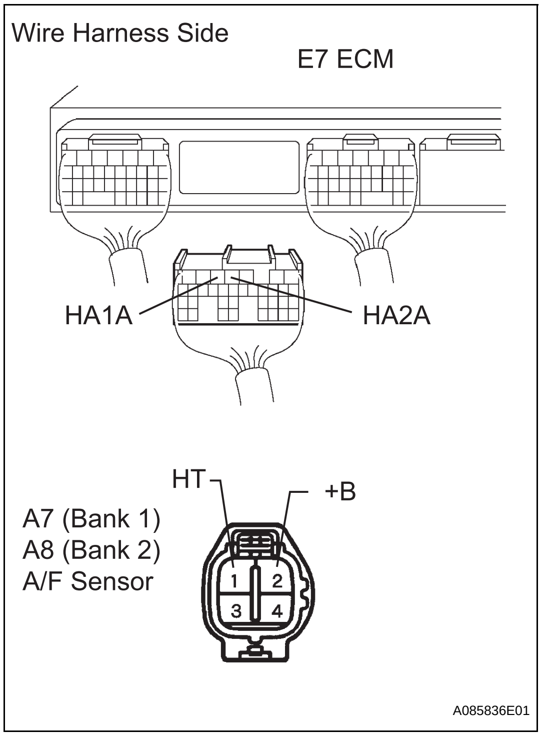
HINT:
- The HA1A stands for the A/F sensor bank 1 sensor 1.
- The HA2A stands for the A/F sensor bank 2 sensor 1.

OK → **REPLACE ECM**

NG

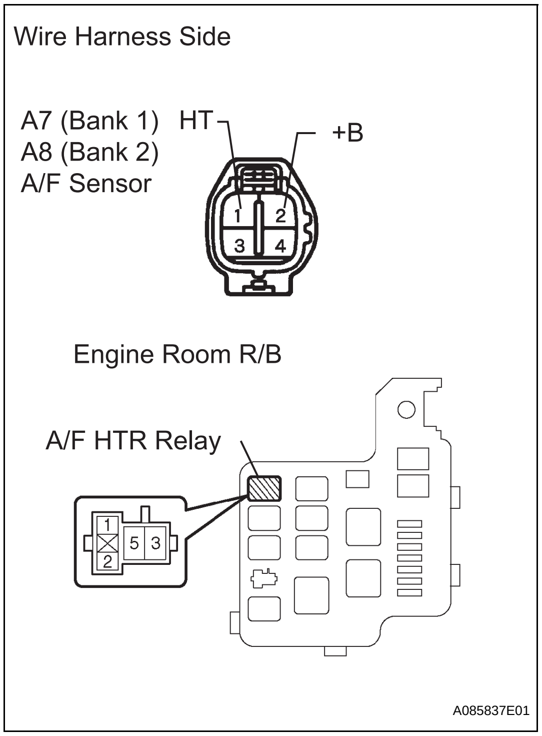
ES

4	CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM, A/F SENSOR - A/F HTR RELAY)



(a) Check the wire harness between the ECM and A/F sensors.
(1) Disconnect the E7 ECM connector.
(2) Disconnect the A7 or A8 A/F sensor connector.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
A7-1 (HT) - E7-5 (HA1A) A8-1 (HT) - E7-4 (HA2A)	Below 1 Ω
A7-1 (HT) or E7-5 (HA1A) - Body ground A8-1 (HT) or E7-4 (HA2A) - Body ground	10 kΩ or higher



(b) Check the wire harness between the A/F sensor and A/F HTR relay.
(1) Disconnect the A7 or A8 A/F sensor connector.
(2) Remove the A/F HTR relay from the engine room R/B.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
A7-2 (+B) - J/B A/F HTR relay terminal 3 A8-2 (+B) - J/B A/F HTR relay terminal 3	Below 1 Ω
A7-2 (+B) or J/B A/F HTR relay terminal 3 - Body ground A8-2 (+B) or J/B A/F HTR relay terminal 3 - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

DTC	P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

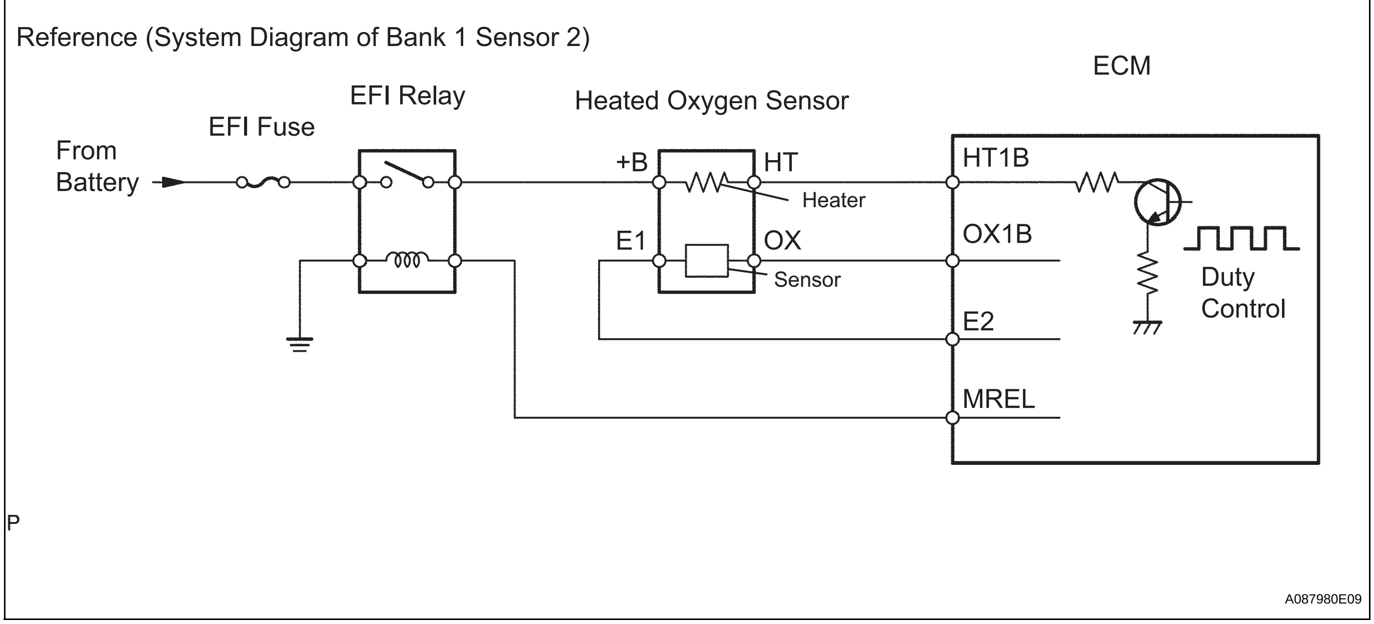
DTC	P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC	P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC	P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

DESCRIPTION

Refer to DTC P0136 (See page ES-117).
HINT:
The ECM provides a pulse width modulated control circuit to adjust current through the heater. The heated oxygen sensor heater circuit uses a relay on the +B side of the circuit.



DTC No.	DTC Detection Condition	Trouble Area
P0037 P0057	Heater current is 0.3 A or less when the heater operates with +B greater than 10.5 V (1 trip detection logic)	• Open or short in heater circuit of the heated oxygen sensor • Heated oxygen sensor heater • EFI relay • ECM
P0038 P0058	Heated current exceeds 2 A when the heater operates (1 trip detection logic)	• Open or short in heater circuit of the heated oxygen sensor • Heated oxygen sensor heater • EFI relay • ECM

HINT:
- Bank 1 is the bank that includes cylinder No.1.
- Bank 2 is the bank that does not include cylinder No.1.
- Sensor 1 is the sensor closest to the engine assembly.
- Sensor 2 is the sensor farthest away from the engine assembly.

MONITOR DESCRIPTION

The sensing portion of the heated oxygen sensor has a zirconia element that is used to detect oxygen concentration in the exhaust. If the zirconia element is at the proper temperature and the difference in the oxygen concentration between the inside and outside surfaces of the sensor is large, the zirconia element will generate voltage signals. In order to increase the oxygen concentration detecting capacity in the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor. When the current in the sensor is out of the standard operating range, the ECM interprets this as a fault in the heated oxygen sensor and sets a DTC.
Example:
The ECM will set a high current DTC if the current in the sensor is more than 2 A when the heater is OFF. Similarly, the ECM will set a low current DTC if the current is less than 0.3 A when the heater is ON.

MONITOR STRATEGY

Related DTCs	P0037: HO2S Heater (Bank 1) Range Check (Low current) P0038: HO2S Heater (Bank 1) Range Check (High current) P0057: HO2S Heater (Bank 2) Range Check (Low current) P0058: HO2S Heater (Bank 2) Range Check (High current)
Required sensors / components (Main)	HO2S heater
Required sensors / components (Related)	Vehicle Speed Sensor (VSS)
Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None

P0038, P0058 (Low current):

Battery voltage	More than 10.5 V
All heater is turned OFF and intrusive heating is operated when the following conditions are met	Condition (a) and (b)
(a) Heater	ON
(b) Heater current	Less than 0.3 A

P0037, P0057 (High current):

Case 1:	
Battery voltage	More than 10.5 V
Engine	Running
Starter	OFF
Intrusive heating	Not operating

Case 2:	
Battery voltage	More than 10.5 V
All heater is turned OFF and intrusive heating is operated when the following conditions are met	Condition (a) and (b)
(a) Heater	ON

(b) Heater current	2 A or morer

TYPICAL MALFUNCTION THRESHOLDS

P0037 and P0057 (Low current):

HO2S heater current when HO2S heater OFF	Less than 0.3 A

P0038 and P0058 (High current):

Case 1:	
Hybrid IC high current limiter port	Fail

HO2S heater current during intrusive heating	More than 2 A

COMPONENT OPERATING RANGE

ES

HO2S heater current	0.4 to 1 A (at idle, warmed-up engine and +B: 11 to 14 V)

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See pageES-15).
The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page ES-17).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID $04: HO2S heater

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	$02	Multiply by 0.000076 (A)	Maximum HO2S heater current (Bank 1 Sensor 2)	Malfunction threshold for HO2S heater
1	$20	Multiply by 0.000076 (A)	Maximum HO2S heater current (Bank 2 Sensor 2)	Malfunction threshold for HO2S heater

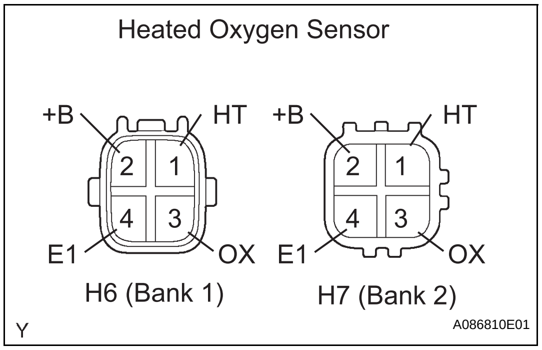
WIRING DIAGRAM

Refer to DTC P0136 (See page ES-122).

HINT:

- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H6 or H7 heated oxygen sensor connector.

(b) Measure the resistance of the heated oxygen sensor terminals.

Resistance (bank 1, 2 sensor 2)

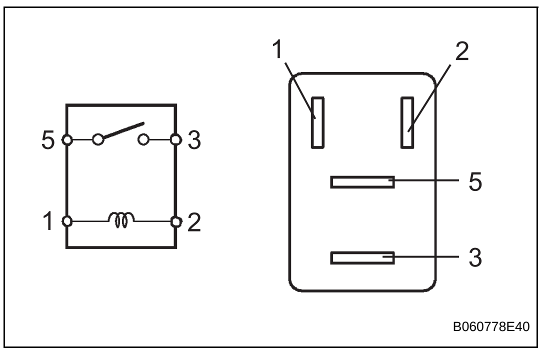
Tester Connection	Condition	Specified Condition
H6-1 (HT) - H6-2 (+B) H7-1 (HT) - H7-2 (+B)	20°C (68°F)	11 to 16 Ω

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

ES

2 INSPECT RELAY (Marking: EFI)



(a) Remove the EFI relay from the engine room J/B.

(b) Measure the resistance of the EFI relay.

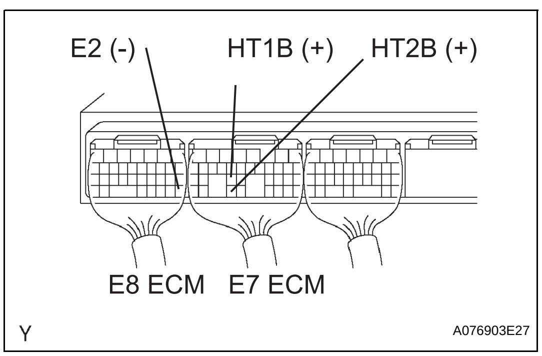
Resistance

Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Continuity (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE RELAY**

OK

3 INSPECT ECM (HT1B OR HT2B VOLTAGE)



(a) Turn the ignition switch ON.

(b) Measure the voltage of the ECM connectors.

Voltage

Tester Connection	Specified Condition
E7-25 (HT1B) - E8-28 (E2) E7-33 (HT2B) - E8-28 (E2)	9 to 14 V

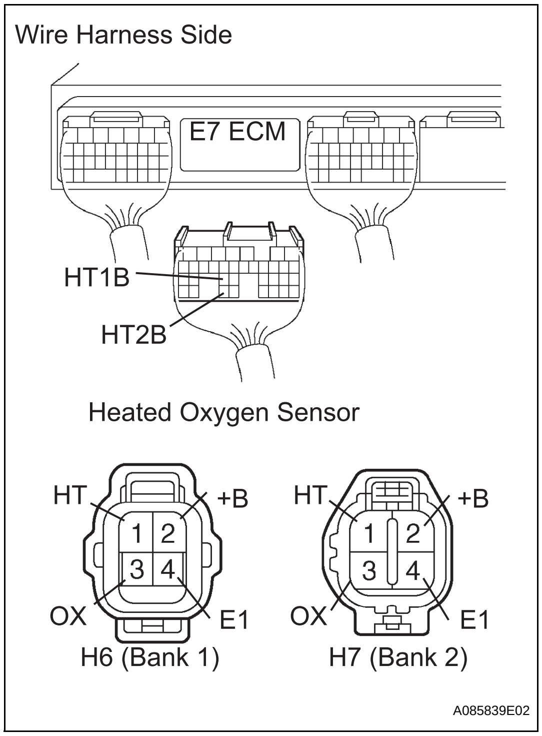
HINT:
- The HT1B stands for the heated oxygen sensor bank 1 sensor 2.
- The HT2B stands for the heated oxygen sensor bank 2 sensor 2.

OK → **REPLACE ECM**

NG

ES

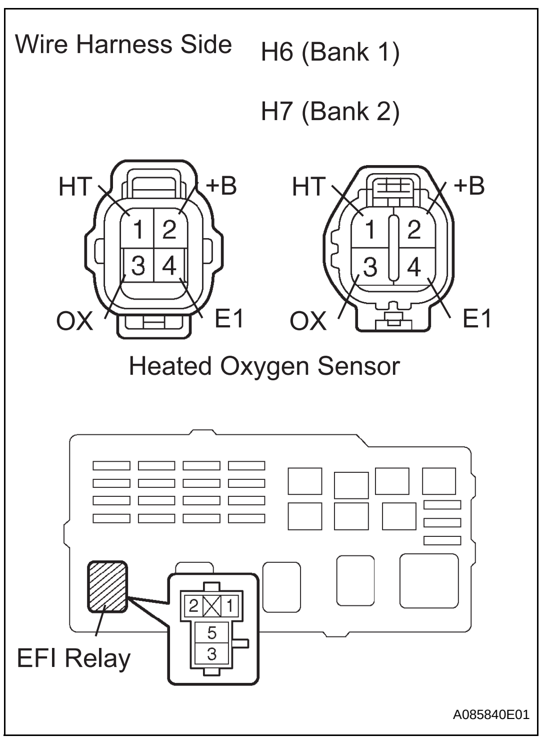
4	CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM, HEATED OXYGEN SENSOR - EFI RELAY)



(a) Check the wire harness between the ECM and heated oxygen sensor.
(1) Disconnect the E7 ECM connector.
(2) Disconnect the H6 or H7 heated oxygen sensor connector.
(3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
H6-1 (HT) - E7-25 (HT1B) H7-1 (HT) - E7-33 (HT2B)	Below 1 Ω
H6-1 (HT) or E7-25 (HT1B) - Body ground H7-1 (HT) or E7-33 (HT2B) - Body ground	10 kΩ or higher



(b) Check the wire harness between the heated oxygen sensor and EFI relay.
(1) Disconnect the H6 or H7 heated oxygen sensor connector.
(2) Remove the EFI relay from the engine room J/B.
(3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
H6-2 (+B) - J/B EFI relay terminal 3 H7-2 (+B) - J/B EFI relay terminal 3	Below 1 Ω
H6-2 (+B) or J/B EFI relay terminal 3 - Body ground H7-2 (+B) or J/B EFI relay terminal 3 - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM

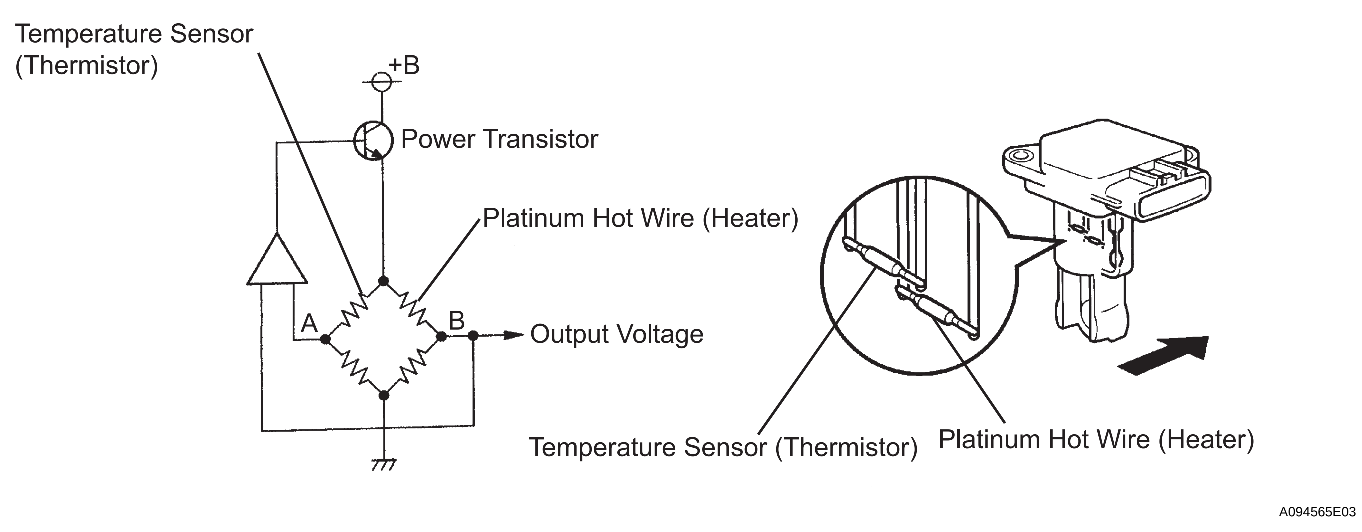
DTC	P0100	Mass or Volume Air Flow Circuit

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 measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and provide a proper air fuel ratio. Inside the MAF meter, there is a heated platinum wire exposed to the flow of intake air.
By applying a specific current to the wire, the ECM heats this wire to a given temperature. The flow of incoming air cools the wire and an internal thermistor, changing their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter. The voltage level is proportional to the air flow through the sensor. The ECM interprets this voltage as the intake air amount.
The circuit is constructed so that the platinum hot wire and temperature sensor provide a bridge circuit, with the power transistor controlled so that the potential of A and B remains equal to maintain the set temperature.



DTC No.	DTC Detection Condition	Trouble Area
P0100	When MAF meter circuit has an open or a short for more than 3 seconds under 4,000 rpm engine speed	• Open or short in MAF meter circuit • MAF meter • ECM
P0102	When MAF meter circuit has an open for more than 3 seconds under 4,000 rpm engine speed	• Open or short in MAF meter circuit • MAF meter • ECM
P0103	When MAF meter circuit has a short for more than 3 seconds under 4,000 rpm engine speed	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:
After confirming DTC P0100, P0102 or P0103, use the intelligent tester or the OBD II scan tool to confirm the MAF ratio from the ALL menu (to reach the ALL menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL).

Air Flow Value (gm/s)	Malfunction
Approx. 0.0	• Open in MAF meter power source circuit • Open or short in VG circuit
271.0 or more	• Open in E2G circuit

MONITOR DESCRIPTION

If there is a defect in the sensor, or an open or short circuit, the voltage level will deviate from the normal operating range. The ECM interprets this deviation as a defect in the MAF meter and sets a DTC.
Example:
The sensor voltage output is less than 0.2 V or more than 4.9 V and either condition continues for more than 3 seconds.

MONITOR STRATEGY

Related DTCs	P0100: MAF Meter Range Check (Chattering) P0102: 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
MIL operation	Immediate: Engine RPM is less than 4,000 rpm 2 driving cycles: Engine RPM is 4,000 rpm or more
Sequence operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0100:

MAF meter voltage	Less than 0.2 V, or more than 4.9 V

P0102:

MAF meter voltage	Less than 0.2 V

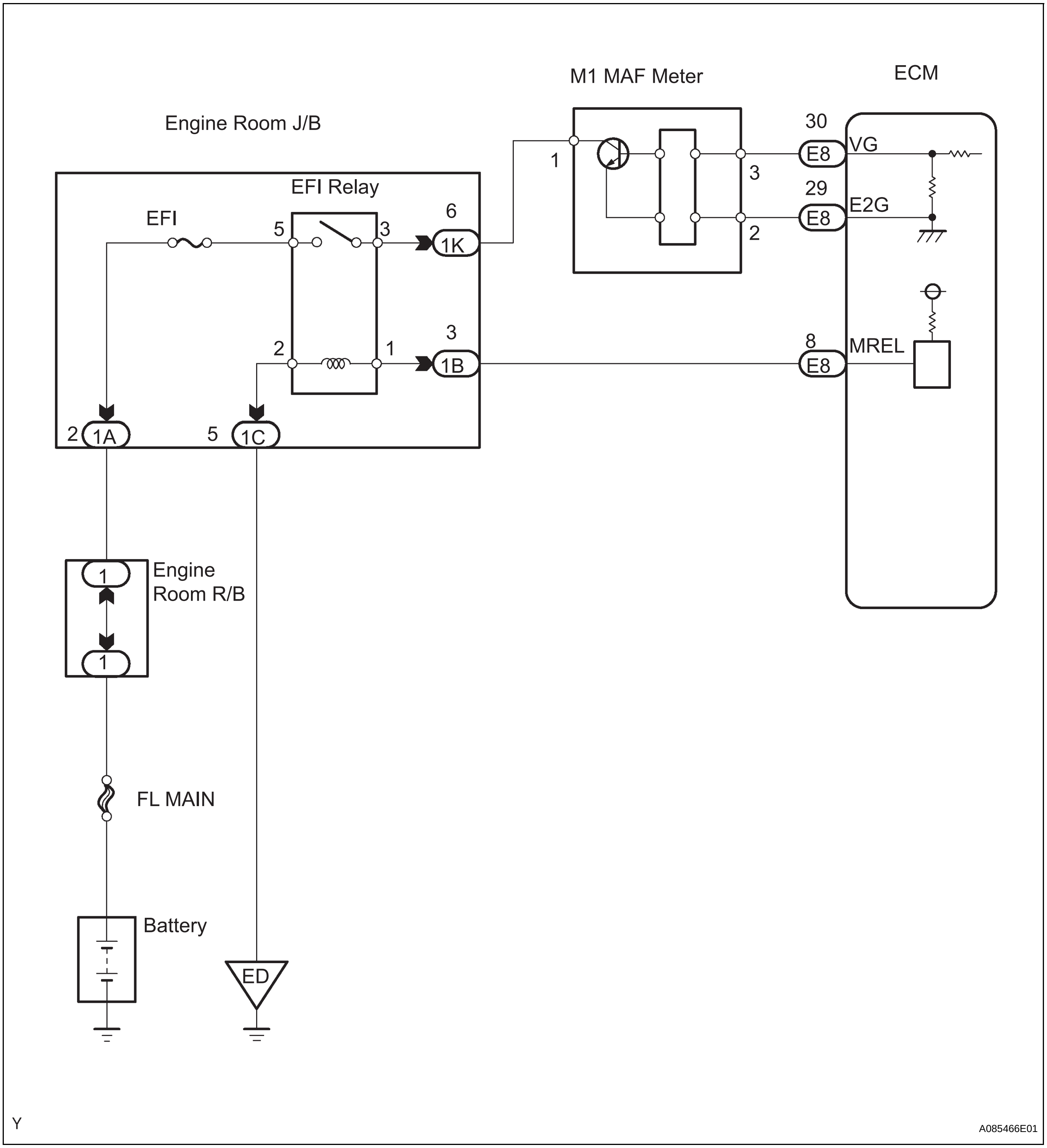
P0103:

MAF meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

Mass air flow meter voltage	Between 0.4 V and 2.2 V

WIRING DIAGRAM



HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1 READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (MASS RATE)

(a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
(b) Start the engine.
(c) Push the intelligent tester or the OBD II scan tool main switch ON.
(d) On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / MAF. Read the values.

Result

Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
MAF rate greater than 1 but less than 270.0*	C

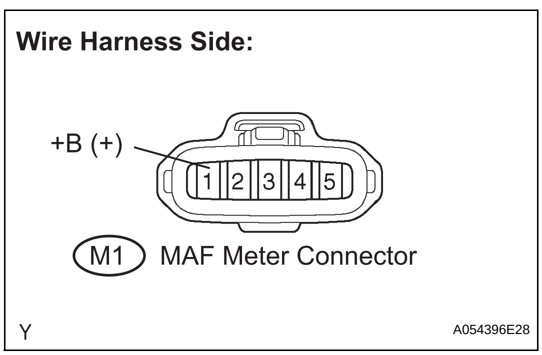
HINT:
*: The value must change when the throttle valve is opened or closed.

B → **Go to step 6**

C → **CHECK FOR INTERMITTENT PROBLEMS**

A

2 INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)



(a) Turn the ignition switch ON.
(b) Disconnect the M1 MAF meter connector.
(c) Measure the voltage of the wire harness side connector.

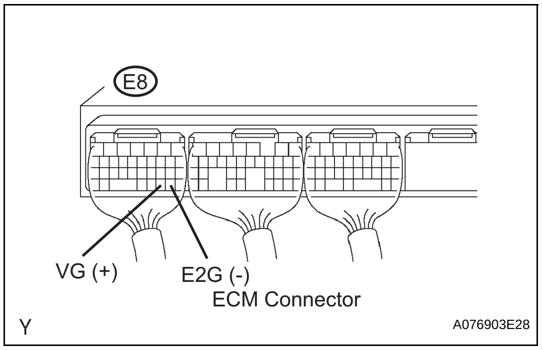
Voltage

Tester Connection	Specified Condition
M1-1 (+B) - Body ground	9 to 14 V

NG → **Go to step 5**

OK

3	INSPECT ECM (VG VOLTAGE)



(a) Start the engine.
(b) Measure the voltage of the ECM connector.
HINT:
The shift position should be P or N and the A/C switch should be turned OFF.
Voltage

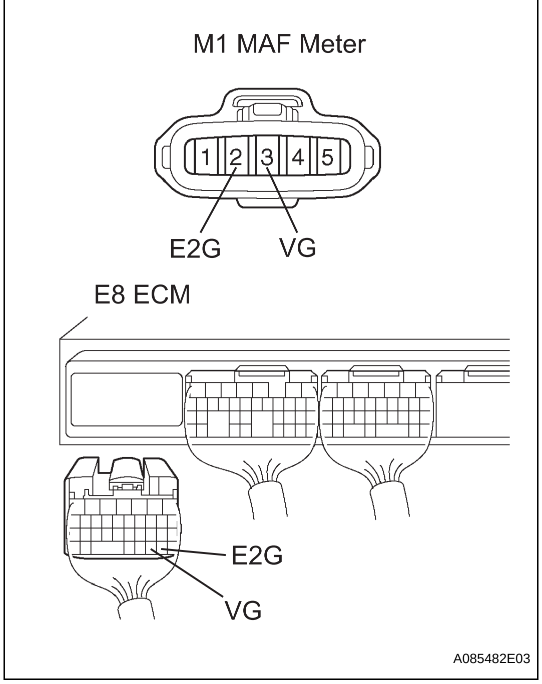
Tester Connection	Condition	Specified Condition
E8-30 (VG) - E8-29 (E2G)	Engine is idling	0.5 to 3.0 V

OK → **REPLACE ECM**

ES

NG

4	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)



(a) Disconnect the M1 MAF meter connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Resistance

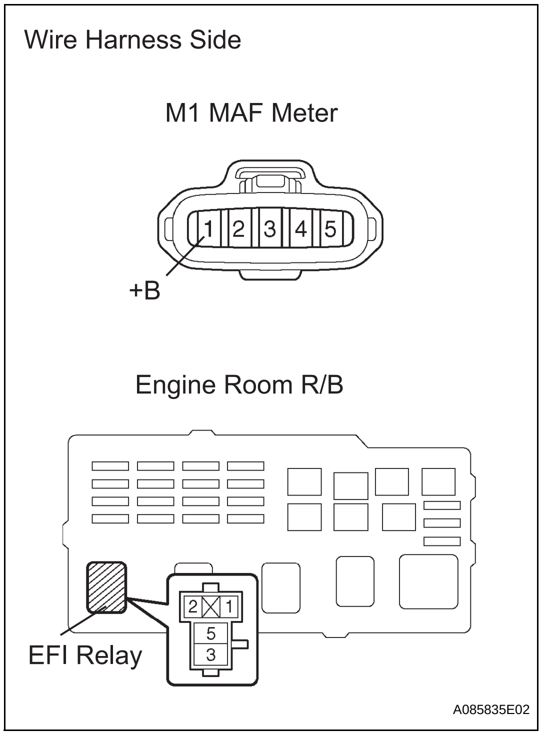
Tester Connection	Specified Condition
M1-3 (VG) - E8-30 (VG) M1-2 (E2G) - E8-29 (E2G)	Below 1 Ω
M1-3 (VG) or E8-30 (VG) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE MASS AIR FLOW METER

5	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - EFI RELAY)



(a) Disconnect the M1 MAF meter connector.
(b) Remove the EFI relay from the engine room J/B.
(c) Measure the resistance of the wire harness side connectors.
Resistance

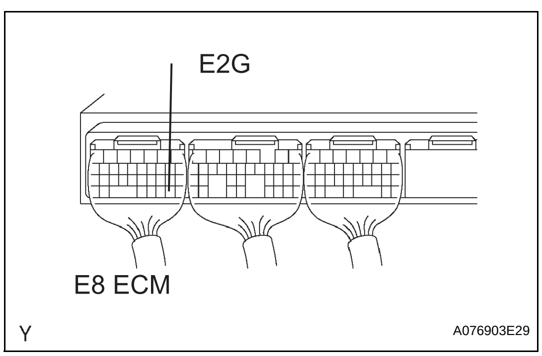
Tester Connection	Specified Condition
M1-1 (+B) - J/B EFI relay terminal 3	Below 1 Ω
M1-1 (+B) or J/B EFI relay terminal 3 - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

CHECK ECM POWER SOURCE CIRCUIT

6	INSPECT ECM (SENSOR GROUND)



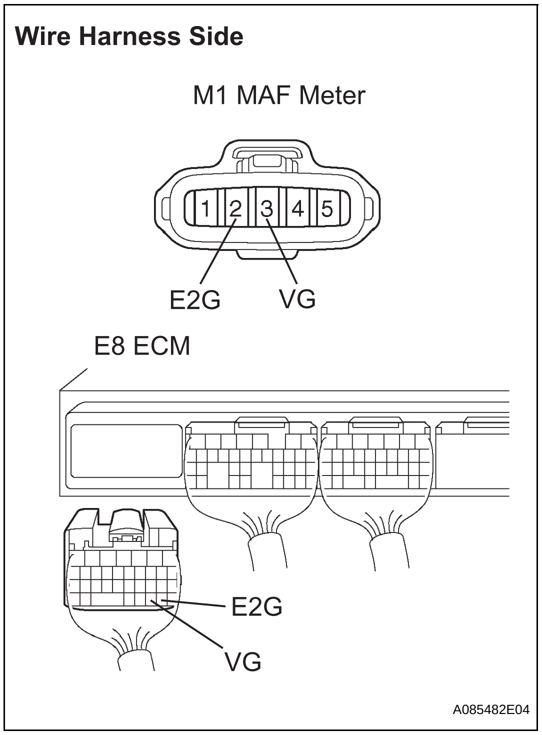
(a) Measure the resistance of the ECM connector.
Resistance

Tester Connection	Specified Condition
E8-29 (E2G) - Body ground	Below 1 Ω

NG → **REPLACE ECM**

OK

7	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)



(a) Disconnect the M1 MAF meter connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance of between the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
M1-3 (VG) - E8-30 (VG) M1-2 (E2G) - E8-29 (E2G)	Below 1 Ω
M1-3 (VG) or E8-30 (VG) - Body ground	10 kΩor higher

NG → **HARNESS OR CONNECTOR**

ES

OK

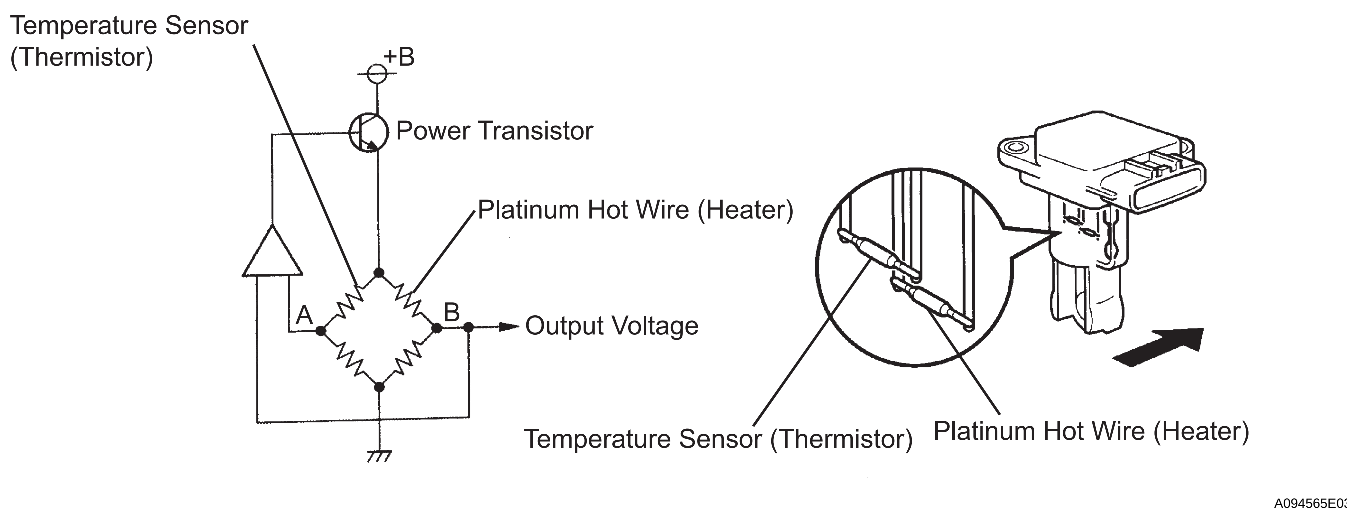
REPLACE MASS AIR FLOW METER

DTC	P0101	Mass Air Flow Circuit Range / Performance Problem

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the valve. The ECM uses this information to determine the fuel injection time and to prove 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 these components in 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 circuit is constructed so that the platinum hot wire and the temperature sensor provide 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 are set, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine RPM and throttle valve position. Fail-safe mode continues until a pass condition is detected.



DTC No.	DTC Detection Condition	Trouble Area
P0101	• High voltage: Conditions (a), (b) and (c) continue for more than 5 seconds (2 trip detection logic): (a) Engine speed less than 2,000 rpm (b) Engine coolant temperature 70°C (158°F) or higher (c) Output voltage of Mass Air Flow (MAF) meter more than 2.2 V (varies with Throttle Position sensor voltage) • Low voltage: Conditions (a) and (b) continue for more than 5 seconds (2 trip detection logic): (a) Engine speed more than 300 rpm (b) Output voltage of MAF meter less than 0.57 V (varies with throttle position sensor voltage)	MAF meter

MONITOR DESCRIPTION

The 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-furl 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 these components of 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 .If there is a defect in the sensor, or an open or short in the circuit, the voltage level deviates from the normal operating range. The ECM interprets this deviation as a malfunction in the MAF meter and sets the DTC.
Example:
If the voltage is more than 2.2 V, or less than 0.57 V while idling, the ECM determines that there is a malfunction in the MAF meter and sets the DTC.

MONITOR STRATEGY

Related DTCs	P0101: Mass air flow meter rationality
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Crankshaft position sensor, engine coolant temperature sensor and throttle position sensor
Frequency of Operation	Continuous
Duration	High voltage: 10 seconds Low voltage: 5 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor)

Mass Air Flow Meter Rationality (High Voltage):

Engine speed	Less than 2,000 rpm
Engine coolant temperature	70°C (158°F) or more

Mass Air Flow Meter Rationality (Low Voltage):

Engine speed	More than 300 rpm
Fuel cut	OFF

TYPICAL MALFUNCTION THRESHOLDS

Mass Air Flow Meter Rationality (High Voltage):

Mass air flow meter voltage	More than 2.2 V (varies with throttle position sensor voltage)

Mass Air Flow Meter Rationality (Low Voltage):

Mass air flow meter voltage	Less than 0.7 V (varies with throttle position sensor voltage)

WIRING DIAGRAM

Refer to DTC P0100 (See page ES-78).

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. 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.

1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0101)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result

Display (DTC Output)	Proceed to
P0101 and other DTCs	A
P0101	B

HINT:
If any DTCs other than P0101 are output, troubleshoot those DTCs first.

B → **REPLACE MASS AIR FLOW METER**

A

GO TO RELEVANT DTC CHART

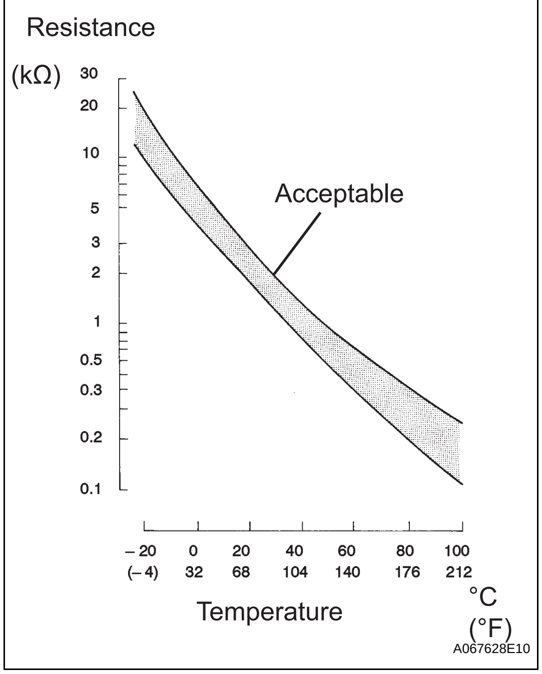
DTC	P0110	Intake Air Temperature Circuit Malfunction

DTC	P0112	Intake Air Temperature Circuit Low Input

DTC	P0113	Intake Air Temperature Circuit High Input

DESCRIPTION

Fig. 1



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 (Included in 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 drivability.
HINT:
When any of DTCs P0110, P0112 and P0113 are set, 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 No.	Proceed to	DTC Detection Condition	Trouble Area
P0110	Step 1	Open or short in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Open or short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0112	Step 4	Short in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	Step 2	Open in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

HINT:
When any of these DTCs are set, check the IAT by entering the following menus on the intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / 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 sets a DTC.
Example:
If the sensor output voltage is -40°C (-40°F) for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and sets DTC P0113. Conversely, if the output voltage is more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0112.
If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0110: Intake air temperature sensor open/short (Fluctuating) P0112: Intake air temperature sensor short (Low electrical resistance) P0113: Intake air temperature sensor open (High electrical resistance)
Required Sensors/Components (Main)	Intake Air Temperature (IAT) 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 present	None

TYPICAL MALFUNCTION THRESHOLDS

P0110:

Intake air temperature sensor resistance	Less than 98.5 Ω or more than 156 kΩ

P0112:

Intake air temperature sensor resistance	Less than 98.5 Ω

P0113:

Intake air temperature sensor resistance	More than 156 kΩ

COMPONENT OPERATING RANGE

Intake air temperature sensor resistance	98.5 Ω to 156 kΩ [-40 to 140°C (-40 to 284°F)]

WIRING DIAGRAM

ES

HINT:
- If other DTCs relating to different systems that have terminal E8 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. 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.

1	READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (INTAKE AIR TEMPERATURE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(e) Read the value displayed on the tester.

Standard:

Same as actual Intake Air Temperature (IAT).

Result

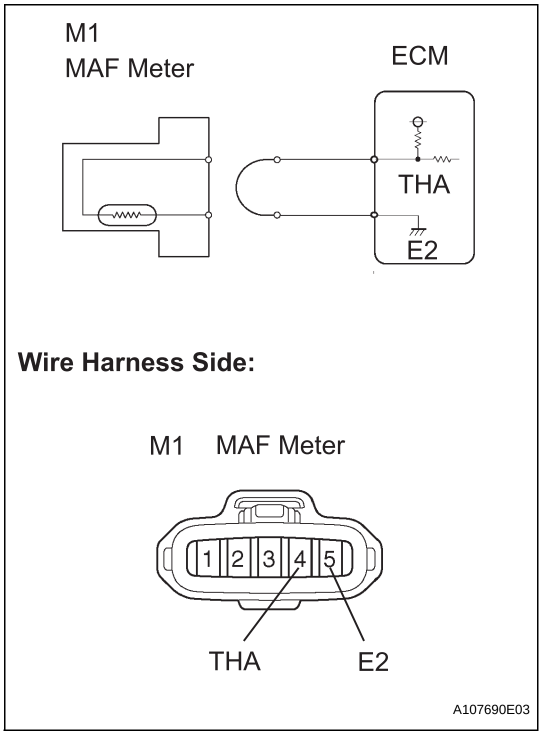
Temperature Displayed	Proceed to
-40 °C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

HINT:
- If there is an open circuit, the intelligent tester indicates -40°C (-40°F).
- If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS

A

2	READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN WIRE HARNESS)

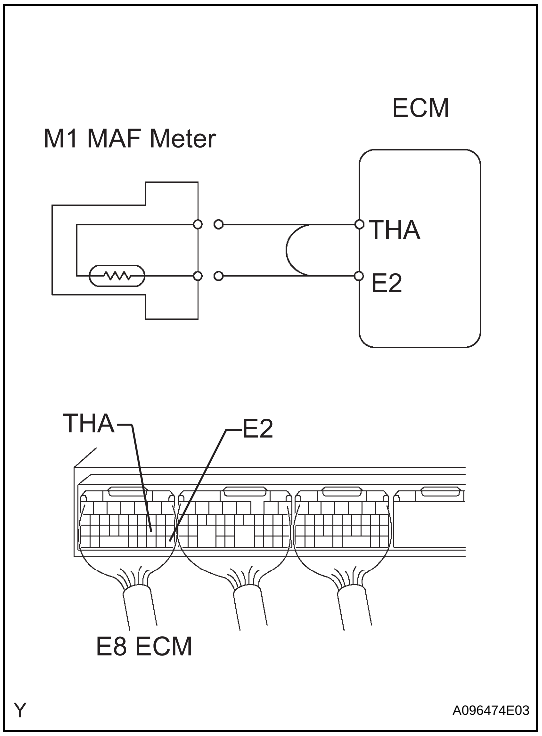


(a) Disconnect the M1 Mass Air Flow (MAF) meter connector.
(b) Connect terminals THA and E2 of the MAF meter wire harness side connector.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn the tester ON.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(g) Read the value displayed on the tester.
Standard:
140°C (284°F) or higher
(h) Reconnect the MAF meter connector.

OK → **CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER**

NG

3	READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN ECM)



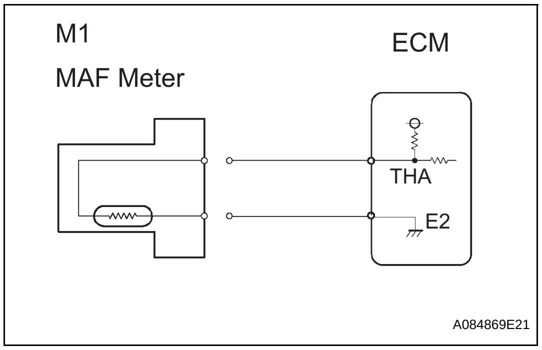
(a) Disconnect the M1 MAF meter connector.
(b) Connect terminals THA and E2 of the E8 ECM connector.
HINT:
Before checking, do visual and contact pressure checks on the ECM connector.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn the tester ON.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(g) Read the value displayed on the tester.
Standard:
140°C (284°F) or higher
(h) Reconnect the MAF meter connector.

OK → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

NG ↓

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

4	READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR SHORT IN WIRE HARNESS)



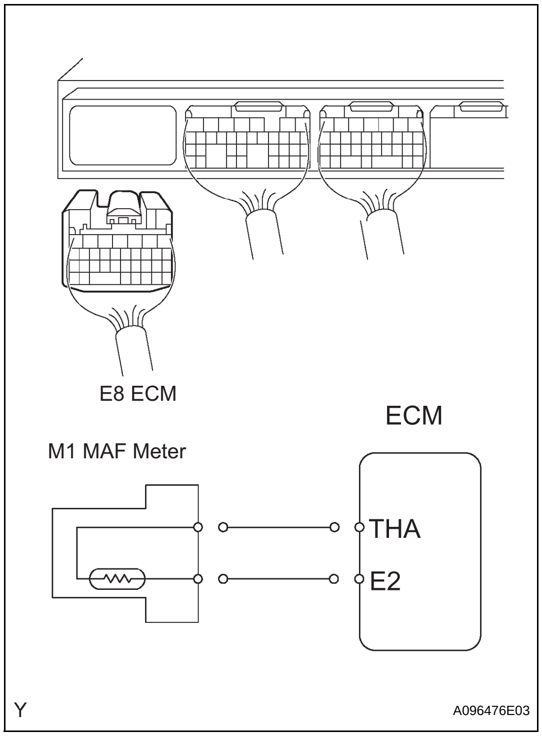
(a) Disconnect the M1 MAF meter connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch ON.
(d) Turn the tester ON.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(f) Read the value displayed on the tester.
Standard:
-40°C (-40°F) or higher
(g) Reconnect the MAF meter connector.

OK → **REPLACE MASS AIR FLOW METER**

NG ↓

ES

5	READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR SHORT IN ECM)



(a) Disconnect the E8 ECM connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch ON.
(d) Turn the tester ON.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(f) Read the value displayed on the tester.
Standard:
-40°C (-40°F) or higher
(g) Reconnect the ECM connector.

OK → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

NG

REPLACE ECM

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 is built into the Engine Coolant Temperature (ECT) sensor, of which the resistance value varies according to the ECT.

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 are set, 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.	Proceed to	DTC Detection Condition	Trouble Area
P0115	Step 1	Open or short in 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	Step 4	Short in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in ECT sensor • ECT sensor • ECM
P0118	Step 2	Open in 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 set, check the ECT by entering the following menus on the intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / 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 and sets a DTC.

Example:

If the sensor output voltage is -40°C (-40°F) for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and sets DTC P0118. Conversely, if the voltage output is more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0117.

If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0115: Engine coolant temperature sensor open/short (Fluctuating) P0117: Engine coolant temperature sensor short (Low electrical resistance) P0118: Engine coolant temperature sensor open (High electrical resistance)
Required Sensors/Components (Main)	Engine coolant temperature 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 present	None

TYPICAL MALFUNCTION THRESHOLDS

P0115:

Engine coolant temperature sensor resistance	Less than 79 Ω or more than 156 kΩ

P0117:

Engine coolant temperature sensor resistance	Less than 79 Ω

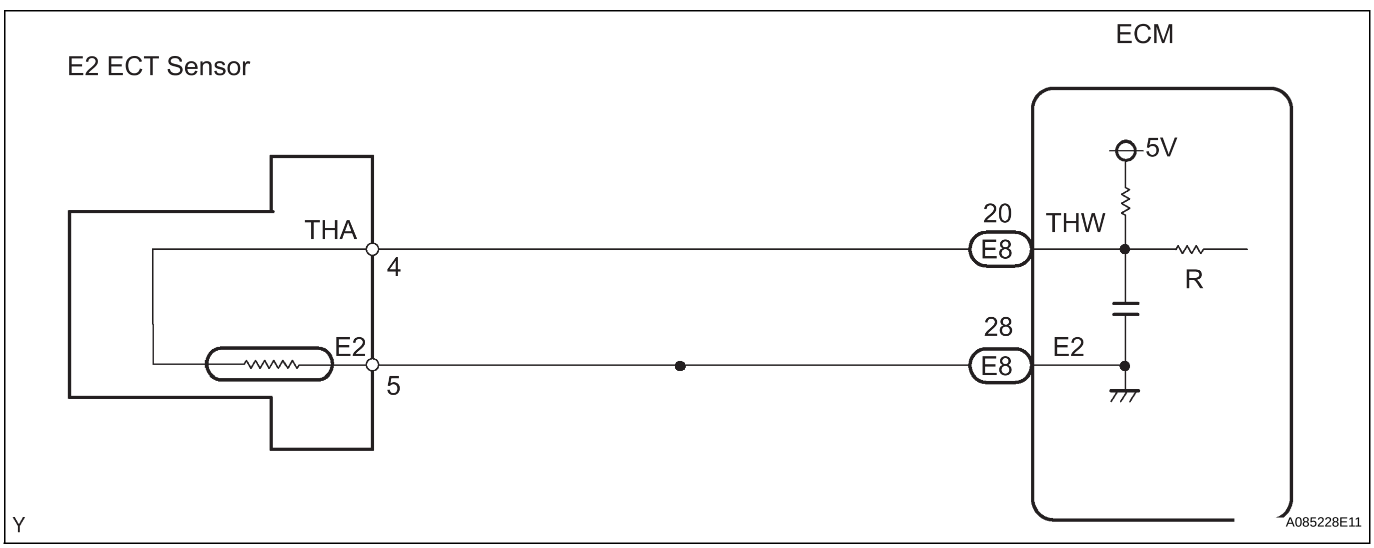
P0118:

Engine coolant temperature sensor resistance	More than 156 kΩ

COMPONENT OPERATING RANGE

Engine coolant temperature sensor resistance	79 Ω to 156 kΩ [-40 to 140°C (-40 to 284°F)]

WIRING DIAGRAM



HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. 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.

1	READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (ENGINE COOLANT TEMPERATURE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) Read the value displayed on the tester.
Standard:
Between 80°C and 97°C (176°F and 207°F) with warm engine.

ES

Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80°C and 97°C (176°F and 207°F)	C

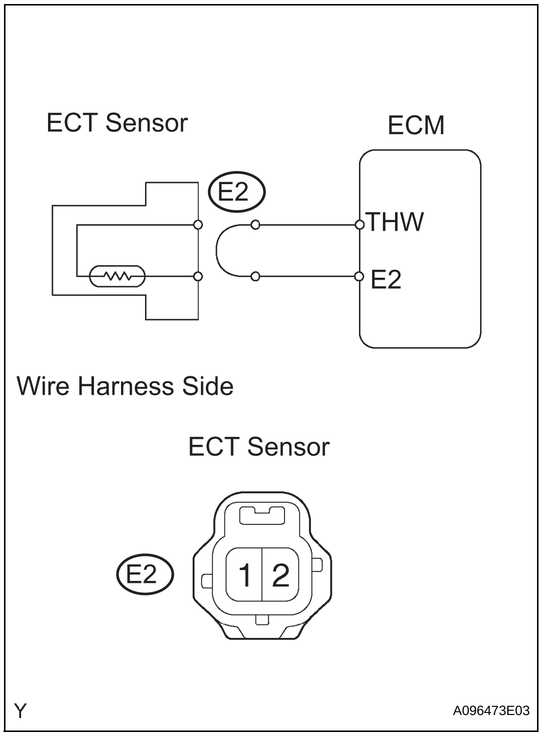
HINT:
- If there is an open circuit, the intelligent tester indicates -40°C (-40°F).
- If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.

B → **Go to step 4**

C → **CHECK FOR INTERMITTENT PROBLEMS**

A

2	READ VALUE USING INTELLIGENT TESTER OR ODB II SCAN TOOL (CHECK FOR OPEN IN WIRE HARNESS)

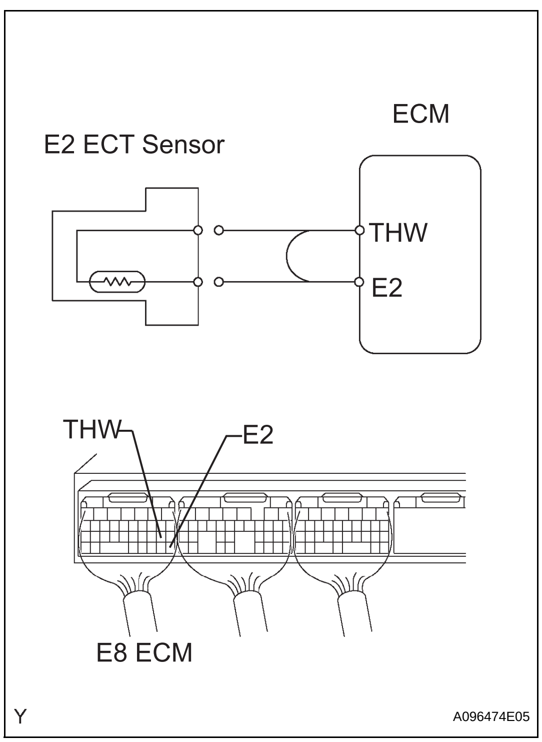


(a) Disconnect the E2 ECT sensor connector.
(b) Connect terminals 1 and 2 of the E2 ECT sensor wire harness side connector.
(c) Turn the ignition switch ON.
(d) On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP. Read the values.
OK:
Temperature value: 140°C (284°F) or more

OK → **CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

NG

3	READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN ECM)



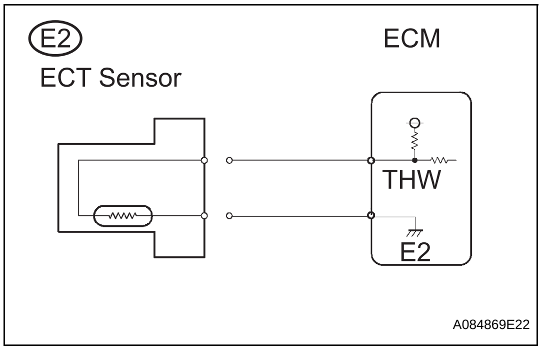
(a) Disconnect the E2 ECT sensor connector.
(b) Connect terminals THW and E2 of the E8 ECM connector.
HINT:
Before checking, do a visual and contact pressure check for the ECM connector.
(c) Turn the ignition switch ON.
(d) On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP. Read the values.
OK:
Temperature value: 140°C (284°F) or more

OK → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

NG

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

4	READ VALUE USING INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)



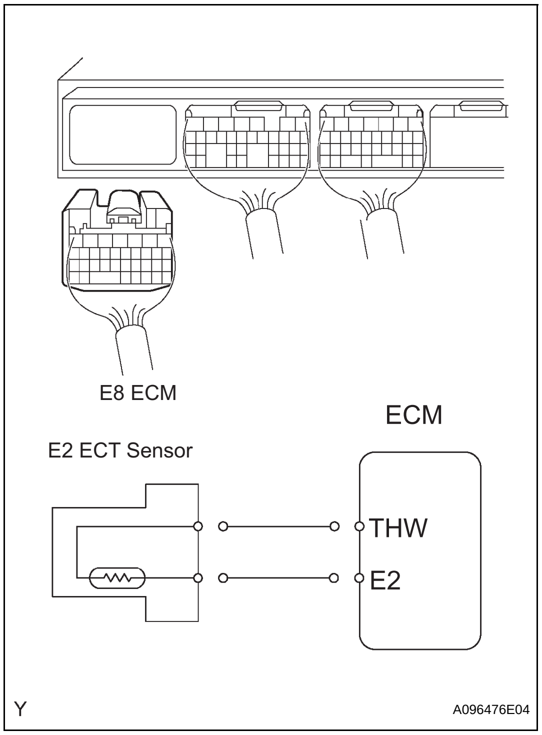
(a) Disconnect the E2 ECT sensor connector.
(b) Turn the ignition switch ON.
(c) On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP. Read the values.
OK:
Temperature value: -40°C (-40°F)

OK → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

ES

NG

5	READ VALUE USING INTELLIGENT TESTER OR ODB II SCAN TOOL (CHECK FOR SHORT IN ECM)



(a) Disconnect the E8 ECM connector.
(b) Turn the ignition switch ON.
(c) On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP. Read the values.
OK:
Temperature value: -40°C (-40°F)

OK → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

NG

REPLACE ECM

REGISTRATION

NOTICE:
The Vehicle Identification Number (VIN) must be input into the replacement ECM.

HINT:
The VIN is a 17-digit alphanumeric vehicle identification number. The intelligent tester is required to register the VIN.

1. INPUT INSTRUCTIONS

(a) Explains the general VIN input instructions using the intelligent tester.

(b) intelligent tester
The arrow buttons (UP, DOWN, RIGHT and LEFT) and numerical buttons (0 to 9) are used to input the VIN.

(c) Cursor Operation
To move the cursor around the tester screen, press the RIGHT and LEFT buttons.

(d) Alphabetical Character Input
(1) Press the UP and DOWN buttons to select the desired alphabetical character.
(2) After selection, the cursor should move.

(e) Numeric Character Input
(1) Press the numerical button corresponding to the number that you want to input.
(2) Select or input the correct character using the UP/DOWN buttons, or the numerical buttons.
HINT:
Numerical characters can be selected by using the UP and DOWN buttons.

(f) Correction
(1) After input, the cursor should move.
(2) When correcting the input character(s), put the cursor onto the character using the RIGHT or LEFT buttons.

(g) Finishing Input Operation
(1) Make sure that the input VIN matches the vehicle VIN after input.
(2) Press the ENTER button on the tester.

2. READ VIN (Vehicle Identification Number)

(a) Explains the VIN reading process in a flowchart. Reading the VIN stored in the ECM is necessary when comparing it to the VIN provided with the vehicle.

(b) Read VIN using the intelligent tester.

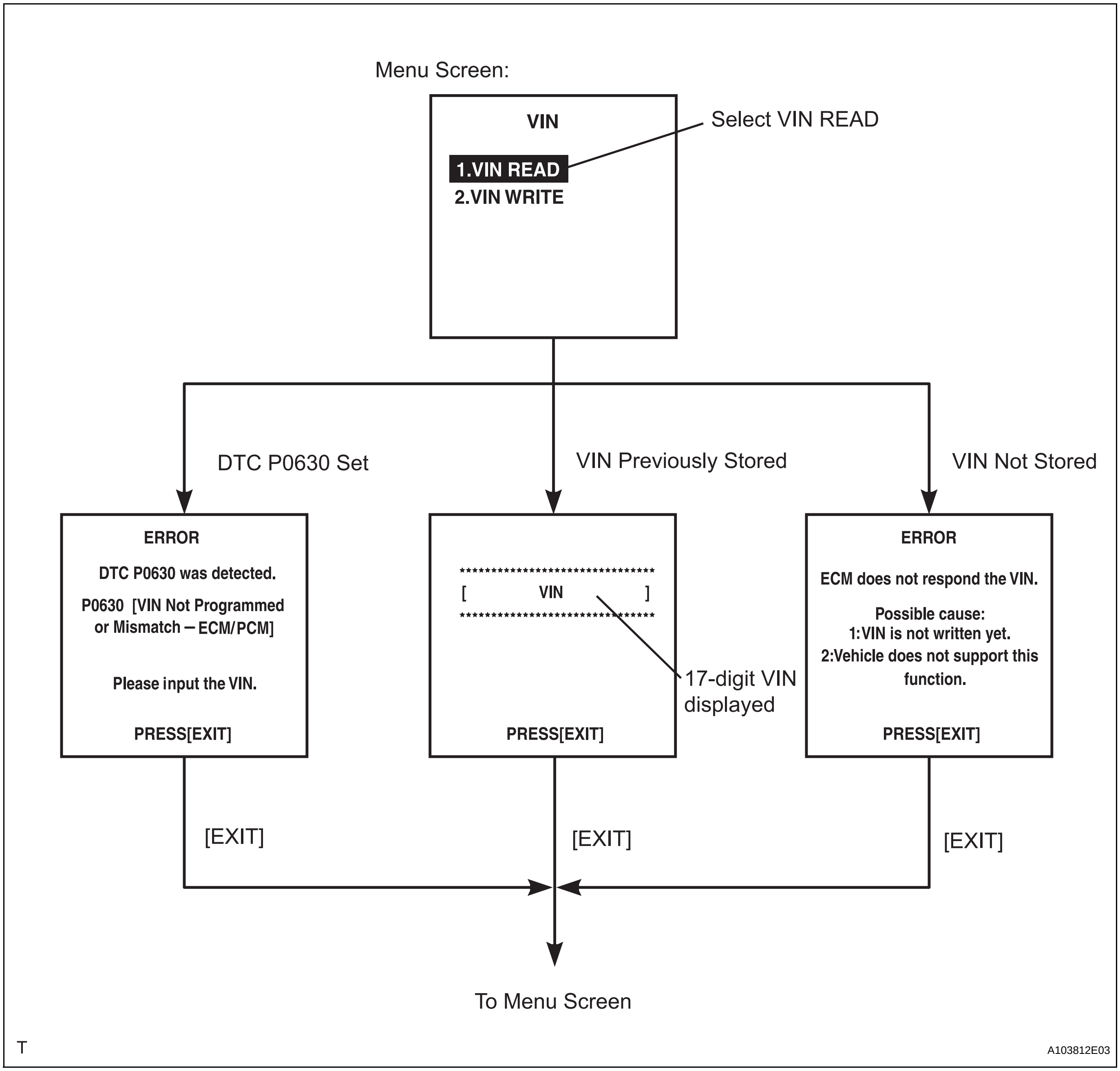
(c) Check the vehicle's VIN.

(d) Connect the intelligent tester to the DLC3.

(e) Turn the ignition switch to ON.

(f) Turn the tester ON.

(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / VIN.



3. WRITE VIN

(a) Explains the VIN writing process in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is changed, or the ECM VIN and Vehicle VIN do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.

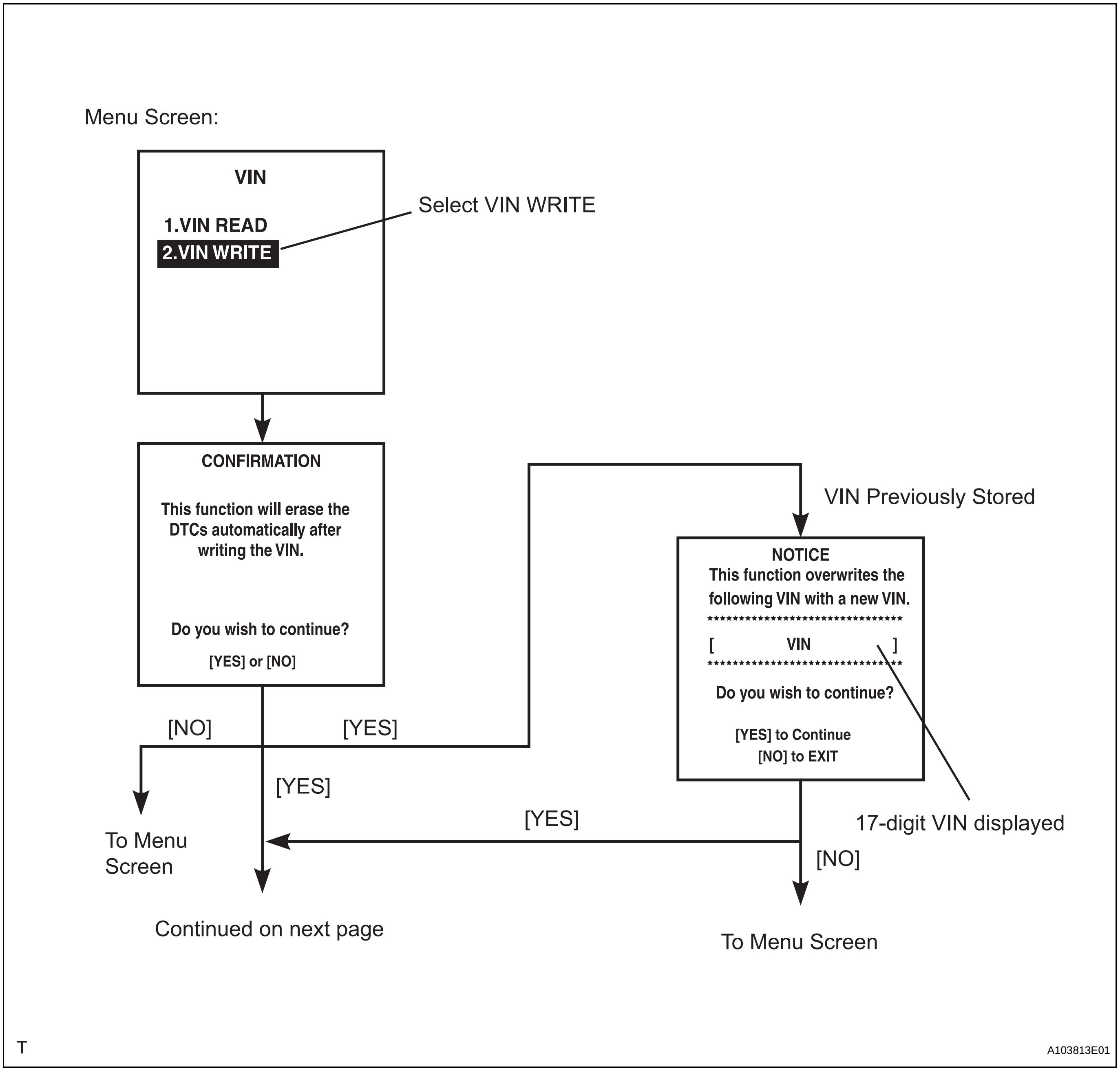
(b) Write VIN using the intelligent tester.

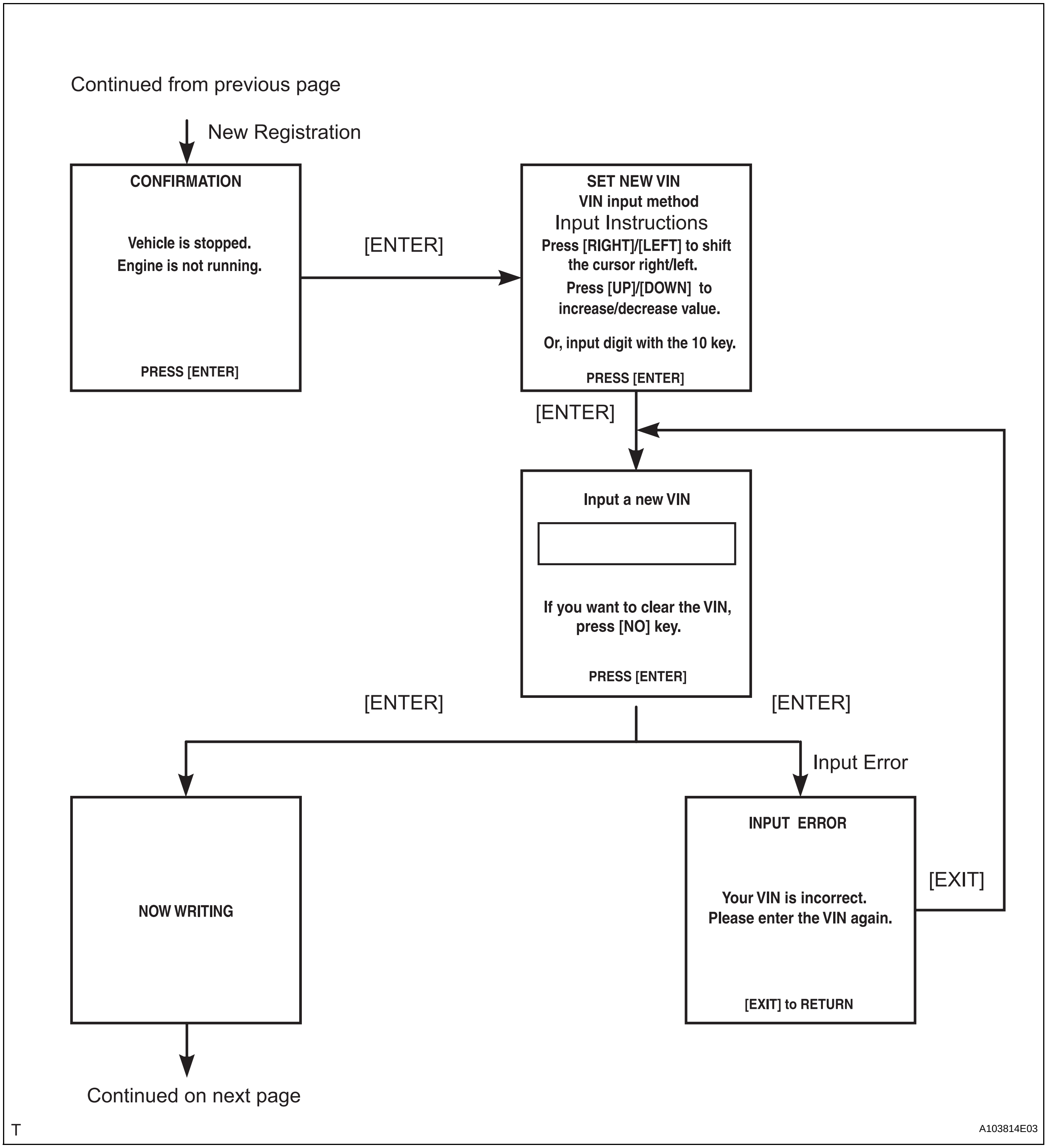
(c) Connect the intelligent tester to the DLC3.

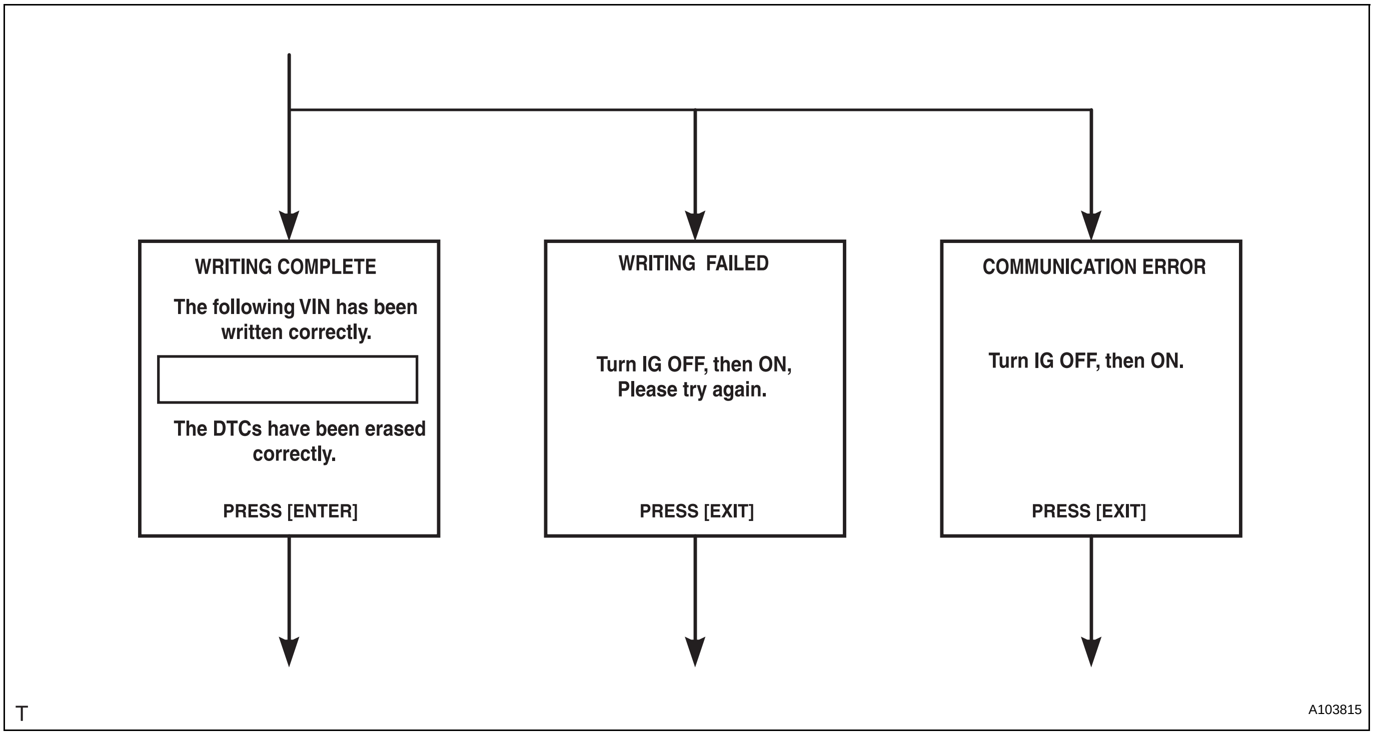
(d) Turn the ignition switch to ON.

(e) Turn the tester ON.

(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / VIN.




Continued from previous page
New Registration
CONFIRMATION
Vehicle is stopped.
Engine is not running.
PRESS [ENTER]
[ENTER]
SET NEW VIN
VIN input method
Input Instructions
Press [RIGHT]/[LEFT] to shift the cursor right/left.
Press [UP]/[DOWN] to increase/decrease value.
Or, input digit with the 10 key.
PRESS [ENTER]
[ENTER]
Input a new VIN
If you want to clear the VIN, press [NO] key.
PRESS [ENTER]
[ENTER]
[ENTER]
Input Error
NOW WRITING
INPUT ERROR
Your VIN is incorrect.
Please enter the VIN again.
[EXIT] to RETURN
[EXIT]
Continued on next page
T
A103814E03


WRITING COMPLETE
The following VIN has been written correctly.
The DTCs have been erased correctly.
PRESS [ENTER]
WRITING FAILED
Turn IG OFF, then ON, Please try again.
PRESS [EXIT]
COMMUNICATION ERROR
Turn IG OFF, then ON.
PRESS [EXIT]
T
A103815

DTC	P0116	Engine Coolant Temperature Circuit Range / Performance Problem

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor, of which the resistance value varies according to the ECT.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

DTC No.	DTC Detection Condition	Trouble Area
P0116	Case1: Engine Coolant Temperature (ECT) between 35°C and 60°C (95°F and 140°F) when engine started, and conditions (a) and (b) met (2 trip detection logic): (a) Vehicle driven at varying speeds (accelerated and decelerated) (b) ECT remains within 3°C (5.4°F) of initial ECT Case2: ECT more than 60°C (140°F) when engine started, and conditions (a) and (b) met (6 trip detection logic): (a) Vehicle driven at varying speeds (accelerated and decelerated) (b) ECT measurements remain within 1°C (1.8°F) of initial ECT on 6 successive occasions	• Thermostat • ECT sensor

ES

MONITOR DESCRIPTION

The ECT sensor is used to monitor the ECT. The ECT sensor has a built-in thermistor with a resistance that varies according to the temperature of the engine coolant. When the ECT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in the resistance are reflected in the output voltage from the ECT sensor.
The ECM monitors the sensor voltage and uses this value to calculate the ECT. If the sensor output voltage deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the ECT sensor and sets the DTC.
Examples:

- Upon starting the engine, the ECT is between 35°C and 60°C (95°F 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 set (2 trip detection logic).
- Upon starting the engine, the ECT is over 60°C (140°F). If after driving for 250 seconds, the ECM remains within 1°C (1.8°F) of the starting temperature, the DTC is set (6 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0116: Engine coolant temperature sensor output stuck at low engine coolant temperature P0116: Engine coolant temperature sensor output stuck at high engine coolant temperature
Required Sensors/Components (Main)	Engine coolant temperature (ECT) sensor
Required Sensors/Components (Related)	Crankshaft position sensor, intake air temperature sensor and mass air flow meter
Frequency of Operation	Continuous
Duration	250 seconds
MIL Operation	2 driving cycles: ECT sensor output stuck at low engine coolant temperature 6 driving cycles: ECT sensor output stuck at high engine coolant temperature
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Engine Coolant Temperature Sensor Output Stuck at Low Engine Coolant Temperature:

Monitor runs whenever following DTCs not present	P0100 to P0103: Mass air flow meter
Cumulative idle off period	250 seconds or more
Speed increase by 18.6 mph (30km/h) or more	10 times or more
Engine coolant temperature at engine start	35 to 60°C (95 to 140°F)
Intake air temperature after engine start	-6.7°C (20°F) or more

Engine Coolant Temperature Sensor Output Stuck at High Engine Coolant Temperature:

Monitor runs whenever following DTCs not present	P0100 to P0103: Mass air flow meter
Engine coolant temperature at engine start	60°C (140°F) or more
Intake air temperature after engine start	-6.7°C (20°F) or more
Stop and go*1	Once or more
Steady driving and stop*2	Once or more
Engine running time after engine start	0.3 seconds or more

*1: The vehicle is stopped for 20 seconds or more and accelerated to more than 43.5 mph (70 km/h) within 40 seconds.
*2: Following these steps: 1) the vehicle is driven at 40.4 mph (65 km/h) or more for 30 seconds or more and the vehicle speed reaches 43.5 mph (70 km/h); 2) the vehicle is decelerated from 40.4 mph (65 km/h) to 1.86 mph (3 km/h) or less within 35 seconds; and 3) the vehicle is stopped for 10 seconds.

TYPICAL MALFUNCTION THRESHOLDS

Engine Coolant Temperature Sensor Output Stuck at Low Engine Coolant Temperature:

Variation of engine coolant temperature	Less than 3°C (5.4°F)

Engine Coolant Temperature Sensor Output Stuck at High Engine Coolant Temperature

Variation of engine coolant temperature	1°C (1.8°F) or less

COMPONENT OPERATING RANGE

Engine coolant temperature	Varies with actual engine coolant temperature

HINT:
- If any of DTCs P0115, P0117, P0118 or P0125 are set 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 intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. 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.

1	**REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

NEXT

END

DTC	P0120	Throttle Pedal Position Sensor / Switch "A" Circuit Malfunction

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

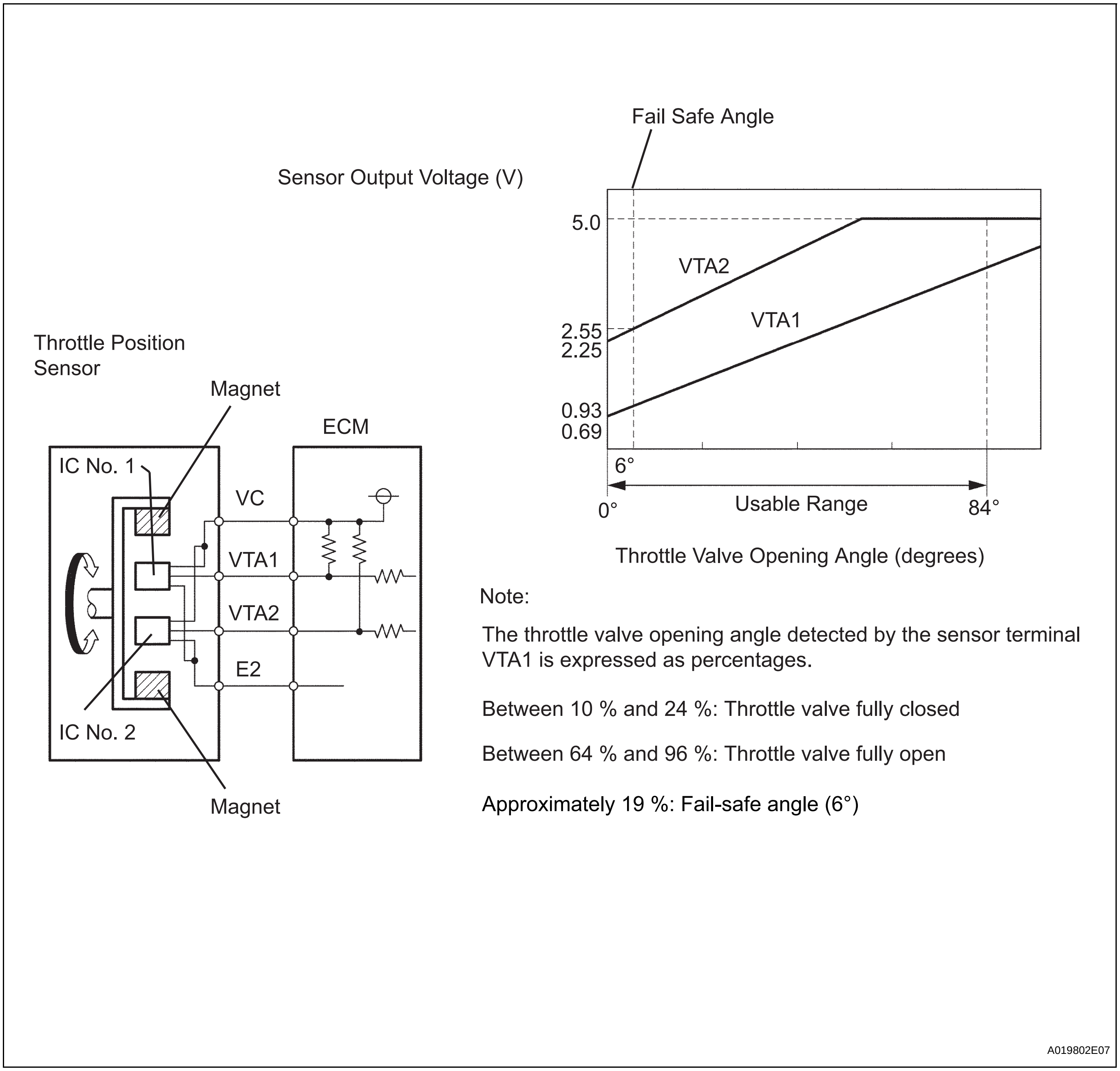
DESCRIPTION

HINT:
This ETC (Electrical Throttle Control System) does not use a throttle cable.

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, 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 TP sensor has two sensor circuits which each transmits a signal, VTA1 and VTA2. VTA1 is used to detect the 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 VTA 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	Output voltage of VTA1 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds (1 trip detection logic)	• Throttle Position (TP) sensor (built into throttle body) • ECM
P0122	Output voltage of VTA1 0.2 V or less for 2 seconds (1 trip detection logic)	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	Output voltage of VTA1 4.535 V or more for 2 seconds (1 trip detection logic)	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	Output voltage of VTA2 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds (1 trip detection logic)	• TP sensor (built into throttle body) • ECM

DTC No.	DTC Detection Condition	Trouble Area
P0222	Output voltage of VTA2 1.75 V or less for 2 seconds (1 trip detection logic)	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	Output voltage of VTA2 4.535 V or more, and VTA1 between 0.2 V and 2.02 V, for 2 seconds (1 trip detection logic)	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) met (1 trip detection logic): (a) Difference between output voltages of VTA1 and VTA2 0.02 V or less for 0.5 seconds or more (b) Output voltage of VTA1 0.2 V or less, and VTA2 1.75 V or less, for 0.4 seconds or more	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:
- When any of these DTCs are set, check the throttle valve opening angle by entering the following menus on an intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS AND THROTTLE POS #2.
- THROTTLE POS denotes the VTA1 signal (expressed in percentages), and THROTTLE POS #2 denotes the VTA2 signal (expressed in voltages).

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
THROTTLE POS	**10 to 24 %**	**64 to 96 %**
THROTTLE POS #2	**2.1 to 3.1 V**	**4.5 to 5.0 V**

MONITOR DESCRIPTION

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, and sets 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, and sets 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, and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0120: Throttle position sensor 1 range check (Fluctuating) 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	Throttle position sensor 1 range check (Fluctuating): 2 seconds (Accelerator pedal ON) Throttle position sensor 1 range check (Low voltage): 2 seconds (Accelerator pedal ON) Throttle position sensor 1 range check (High voltage): 2 seconds (Accelerator pedal ON) Throttle position sensor 2 range check (Fluctuating): 2 seconds (Accelerator pedal ON) Throttle position sensor 2 range check (Low voltage): 2 seconds (Accelerator pedal ON) Throttle position sensor 2 range check (High voltage): 2 seconds (Accelerator pedal ON) Throttle position sensor 1 range check (Fluctuating): 10 seconds (Accelerator pedal OFF Throttle position sensor 1 range check (Low voltage): 10 seconds (Accelerator pedal OFF) Throttle position sensor 1 range check (High voltage): 10 seconds (Accelerator pedal OFF) Throttle position sensor 2 range check (Fluctuating): 10 seconds (Accelerator pedal OFF) Throttle position sensor 2 range check (Low voltage): 10 seconds (Accelerator pedal OFF) Throttle position sensor 2 range check (High voltage): 10 seconds (Accelerator pedal OFF) Throttle position sensor range check (Correlation): Within 0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

ES

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0120:

VTA1 voltage	0.2 V or less, or 4.535 V or more

P0122:

VTA1 voltage	0.2 V or less

P0123:

VTA1 voltage	4.535 V or more

P0220:

VTA2 voltage	1.75 V or less, or 4.8 V or more

P0222:

VTA2 voltage	1.75 V or less

P0223:

VTA2 voltage when VTA1 0.2 V or more, and 2.02 V or less	4.8 V or more

P2135:

Either of following conditions A or B met:	-
Condition A	-
Difference between VTA1 and VTA2 voltages	0.02 V or less
Condition B	-
VTA1 voltage	0.2 V or less
VTA2 voltage	1.75 V or less

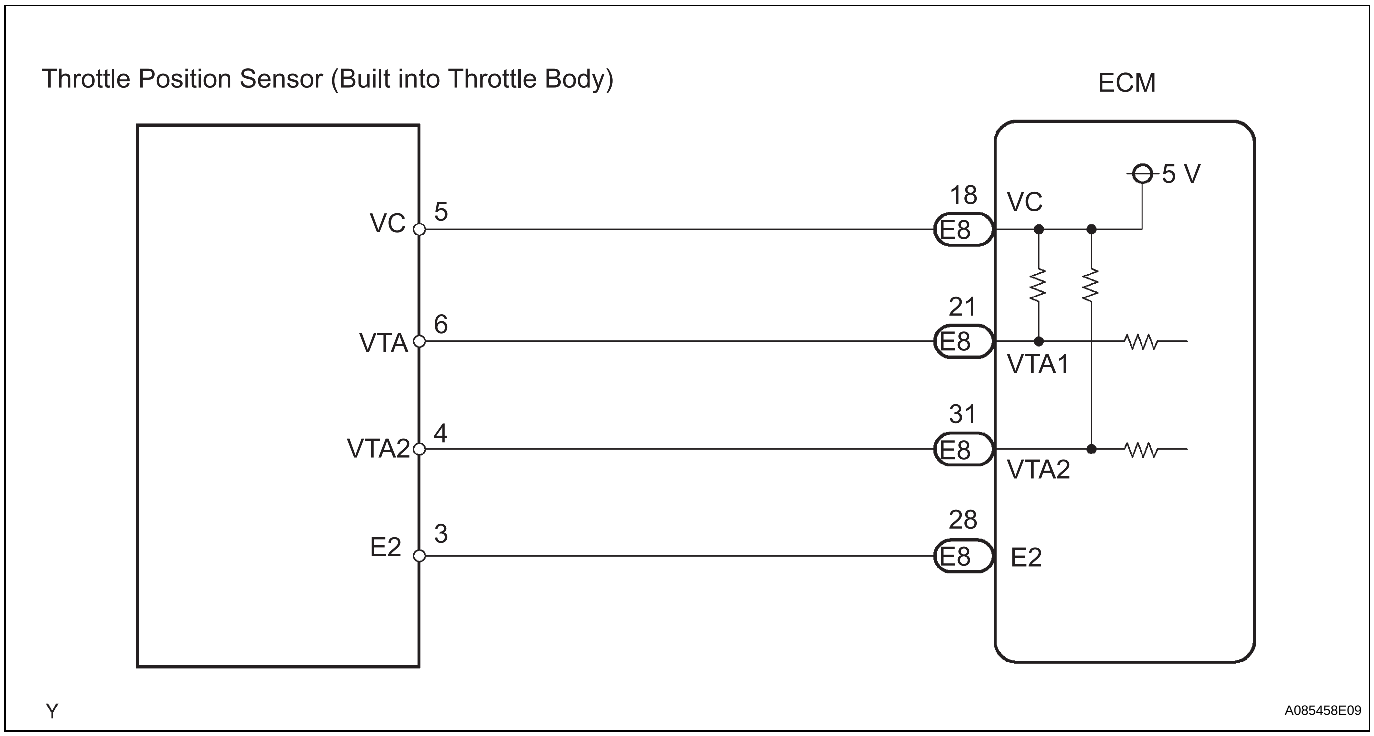
COMPONENT OPERATING RANGE

VTA1 voltage	0.6 to 3.96 V
VTA2 voltage	2.25 to 5.0 V

FAIL-SAFE

If the Electronic Throttle Control System (ETCS) has a malfunction, the ECM cuts off current to the throttle actuator. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of 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 enable the vehicle to continue at a minimal speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail-safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM



HINT:
- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. 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.
- These DTCs relate to the Throttle Position (TP) sensor.

1	READ VALUE USING INTELLIGENT TESTER (THROTTLE POS AND THROTTLE POS #2)

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch ON and turn the intelligent tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS and THROTTLE POS #2.
(d) Check the values displayed on the tester.

Result

TP#1 (VTA1) When AP Released	TP#2 (VTA2) When AP Released	TP#1 (VTA1) When AP Depressed	TP#2 (VTA2) When AP Depressed	Trouble Area	Proceed to
0 %	Between 0 V and 0.2 V	0 %	Between 0 V and 0.2 V	VC circuit open	A
100 %	Between 4.5 V and 5.0 V	100 %	Between 4.5 V and 5.0 V	E2 circuit open	A
0 % or 100 %	Between 2.1 V and 3.1 V (Fail-safe)	0 % or 100 %	Between 2.1 V and 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A
About 16% (Fail-safe)	Between 0 V and 0.2 V, or 4.5 V and 5.0 V	About 16% (Fail-safe)	Between 0 V and 0.2 V, or 4.5 V and 5.0 V	VTA2 circuit open or ground short	A
Between 10 % and 24 %	Between 2.1 V and 3.1 V	Between 64 % and 96 % (Not fail-safe)	Between 4.5 V and 5.0 V (Not fail-safe)	TP sensor circuit normal	B

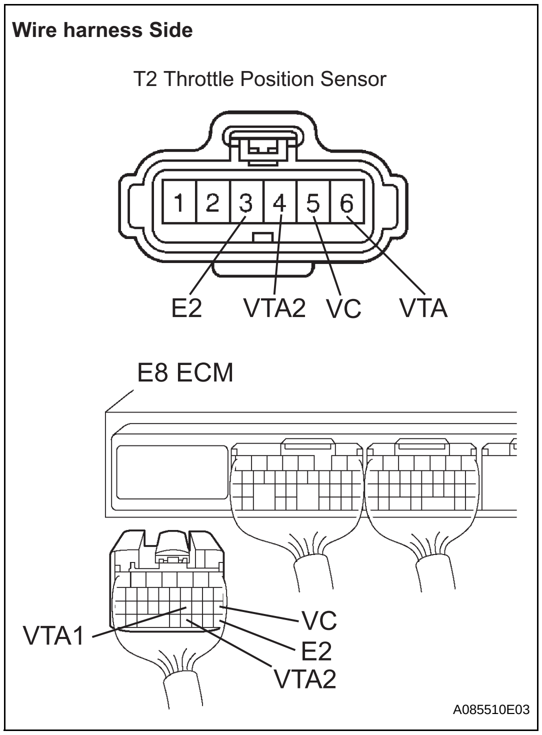
HINT:
- TP#1 denotes THROTTLE POS, and TP#2 denotes THROTTLE POS#2.
- AP denotes Accelerator Pedal.
- VTA1 is expressed as percentages, and VTA2 is expressed as voltages.

B → **Go to step 5**

A

ES

2	CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)



(a) Disconnect the T2 throttle body connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance between the terminals of the throttle body and ECM.

Standard resistance (Check for open)

Tester Connection	Specified Condition
VC (T2-5) - VC (E8-18)	Below 1 Ω
VTA (T2-6) - VTA (E8-21)	Below 1 Ω
VTA2 (T2-4) - VTA2 (E8-31)	Below 1 Ω
E2 (T2-3) - E2 (E8-28)	Below 1 Ω

Standard resistance (Check for short)

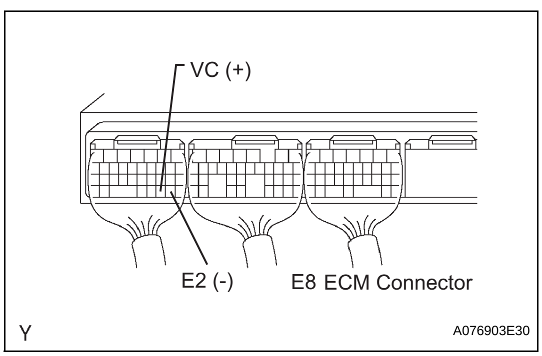
Tester Connection	Specified Condition
VC (T2-5) or VC (E8-18) - Body ground	10 kΩ or higher
VTA (T2-6) or VTA (E8-21) - Body ground	10 kΩ or higher
VTA2 (T2-4) or VTA2 (E8-31) - Body ground	10 kΩ or higher

(d) Reconnect the throttle body connector.
(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3	INSPECT ECM (VC VOLTAGE)



(a) Disconnect the T2 throttle body connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the terminals VC and E2 of the E8 ECM connector.

Standard voltage

Tester Connection	Specified Condition
VC (E8-18) - E2 (E8-28)	4.5 to 5.5 V

(d) Reconnect the throttle body connector.

NG → **REPLACE ECM**

OK

4	REPLACE THROTTLE BODY ASSEMBLY

NEXT

ES

5	CHECK WHETHER READ OUTPUT DTC (THROTTLE POSITION SENSOR DTCS ARE OUTPUT AGAIN)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-29).
(d) Start the engine.
(e) Allow the engine to idle for 15 seconds or more.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read DTCs.

Result

Display (DTC Output)	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223, and/or P2135	A
No output	B

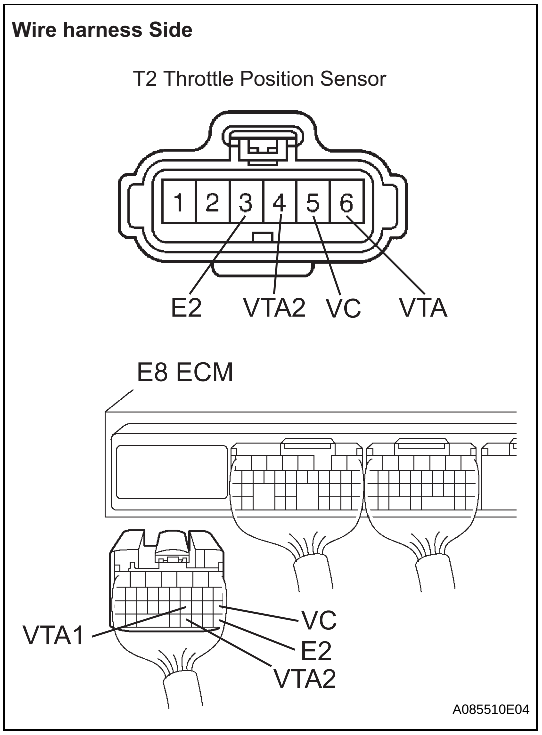
ES

B → **SYSTEM OK**

A

REPLACE ECM

1	CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)



(a) Disconnect the T2 throttle position sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

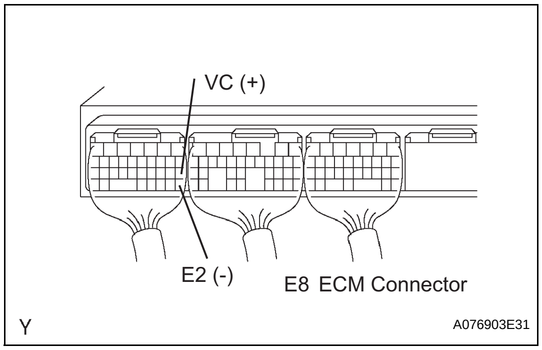
Standard resistance

Tester Connection	Specified Condition
T2-5 (VC) - E8-18 (VC) T2-6 (VTA1) - E8-21 (VTA1) T2-4 (VTA2) - E8-31 (VTA2) T2-3 (E2) - E8-28 (E2)	Below 1 Ω
T2-5 (VC) or E8-18 (VC) - Body ground T2-6 (VTA1) or E8-21 (VTA1) - Body ground T2-4 (VTA2) or E8-31 (VTA2) - Body ground	10 kΩor higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

2 CHECK ECM (VC VOLTAGE)



(a) Disconnect the T2 throttle position sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage of the ECM connector.

Standard voltage

Tester Connection	Specified Condition
E8-18 (VC) - E8-28 (E2)	4.5 to 5.5 V

NG → **REPLACE ECM**

OK

3 REPLACE THROTTLE BODY ASSEMBLY

GO

4 READ OUTPUT DTC (THROTTLE POSITION SENSOR DTCS ARE OUTPUT AGAIN)

(a) Clear the DTC (See page ES-29).
(b) Start the engine.
(c) Run the engine at idle for 15 seconds or more.
(d) Read the DTC.

Result

Display (DTC Output)	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135 are output again	A
No DTC output	B

B → **SYSTEM OK**

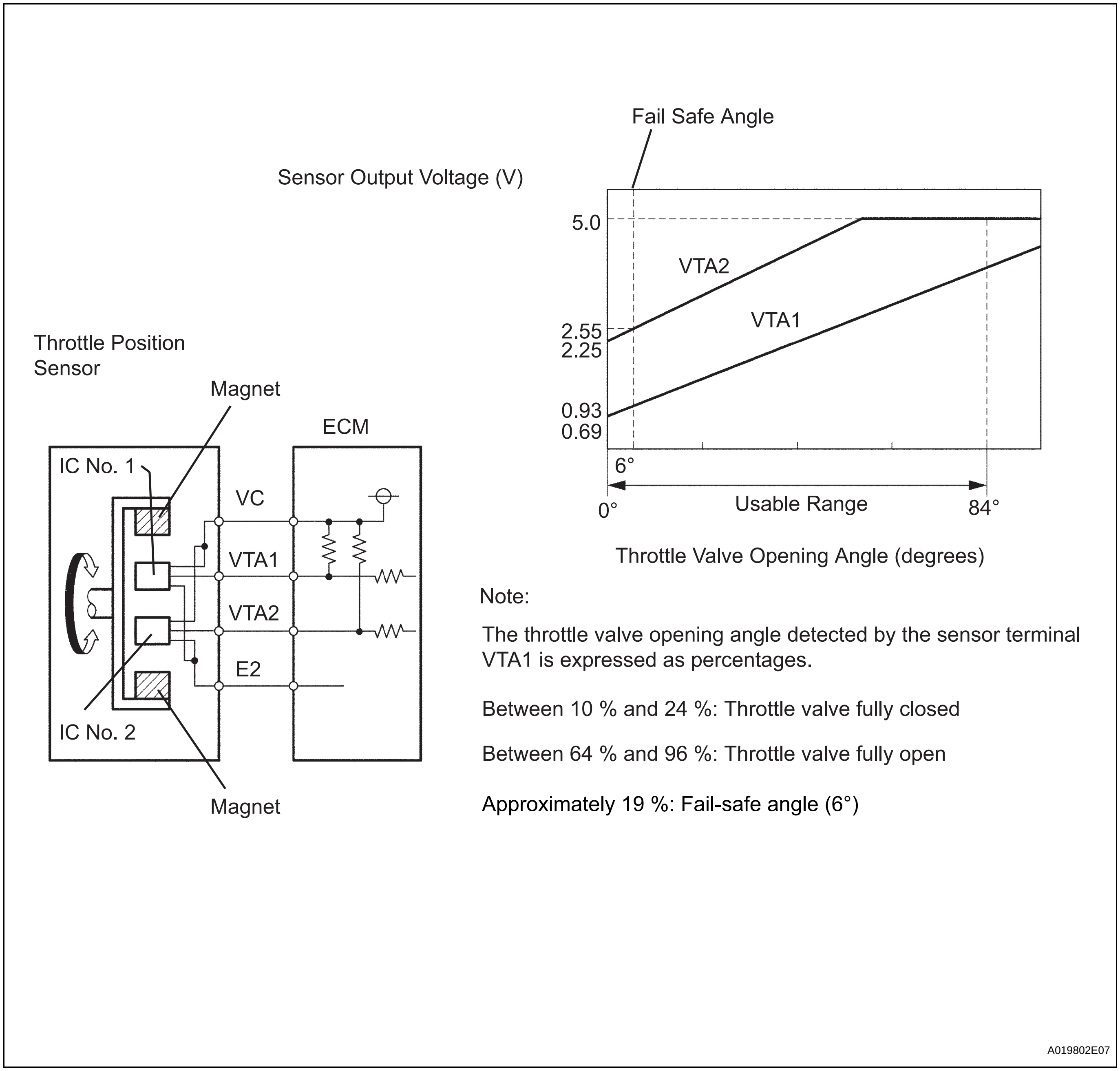
A

REPLACE ECM

DTC	P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem

DESCRIPTION

HINT:
This DTC relates to the Throttle Position (TP) sensor.
This ETC (Electrical Throttle Control System) does not use a throttle cable.
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, 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 TP sensor has two sensor circuits which each transmits a signal, VTA1 and VTA2. VTA1 is used to detect the 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 VTA 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
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)	TP sensor (built into throttle body)

MONITOR DESCRIPTION

The ECM uses the TP sensor to monitor the throttle valve opening angle.
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 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 sets the DTC.
If the malfunction is not repaired successfully, the DTC is set 2 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0121: TP sensor rationality
Required Sensors/Components (Main)	TP sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Within 2 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0120 - P0223, P2135 (TP sensor)
Either of following conditions A or B set	-
A. Engine switch	ON
B. Electric throttle motor power	ON

TYPICAL MALFUNCTION THRESHOLDS

Difference in voltage between VAT1 and VTA2 TP sensor 1 - [TP sensor 2 x 0.8 (corrected by learning value)]	Less than 0.8 V or more than 1.6 V

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, 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 engine switch is then turned to off.

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. 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.

1	REPLACE THROTTLE BODY ASSEMBLY

NEXT

END

DTC	P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control

ES

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor, of which the resistance value varies according to the ECT.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

DTC No.	DTC Detection Condition	Trouble Area
P0125	**Case 1:** Engine coolant temperature (ECT) is less than -19.45°C (-3°F) at engine and following conditions are met (2 trip detection logic): (a) 20 minutes elapsed since engine starts (b) ECT sensor value remains below closed-loop fuel control enabling temperature **Case 2:** ECT is between -19.45°C and -8.34°C (-3°F and 17°F) at engine start and following conditions are met (2 trip detection logic): (a) 5 minutes elapsed since engine starts (b) ECT sensor value remains below closed-loop fuel control enabling temperature **Case 3:** ECT is between -8.34°C (17°F) at engine start and following conditions are met (2 trip detection logic): (a) 2 minutes elapsed since engine starts (b) ECT sensor value remains below closed-loop fuel control enabling temperature	• Engine coolant temperature sensor • Cooling system • Thermostat

MONITOR DESCRIPTION

The resistance of the ECT varies in proportion to the actual ECT. The ECT supplies a constant voltage to the sensor and monitors the signal output voltage of the sensor. The signal voltage output varies according to the changing resistance of the sensor. After the engine is started, the ECT is monitored through 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 sets the DTC.
Example:
The ECT is 0°C (32°F) at engine start. After 5 minutes 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 sets the DTC.

MONITOR STRATEGY

Related DTCs	P0125: Insufficient engine coolant temperature for closed-loop fuel control
Required Sensors/Components (Main)	Thermostat, cooling system
Required Sensors/Components (Related)	Engine coolant temperature sensor and mass air flow meter
Frequency of Operation	Once per driving cycle
Duration	2 minutes: Closed-loop enable temperature - 8.34°C (15°F) or more 5 minutes: Closed-loop enable temperature - 19.45 to 8.34°C (35 to 15°F) 20 minutes: Less than closed-loop enable temperature - 19.45°C (35°F)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor)
Fuel cut	OFF
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Time until actual engine coolant temperature reaches closed-loop fuel control enabling temperature	2 minutes or more: Engine coolant temperature at engine start - 8.34°C (15°F) or more 5 minutes or more: Engine coolant temperature at engine start - 19.45 to 8.35°C (15 to 35°F) 20 minutes or more: Engine coolant temperature at engine start less than - 19.4°C (35°F)

WIRING DIAGRAM

Refer to DTC P0115 (See page ES-93).

HINT:
- If any of DTCs P0115, P0116, P0117 or P0118 are set 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 intelligent tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0125)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result

Display (DTC Output)	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 RELEVANT DTC CHART**

A

2	INSPECT THERMOSTAT

(a) Remove the thermostat (See page CO-11).
(b) Check the valve opening temperature of the thermostat.
Standard:
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 (See page CO-12).

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.

OK:

There is no modification of cooling system.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

ES

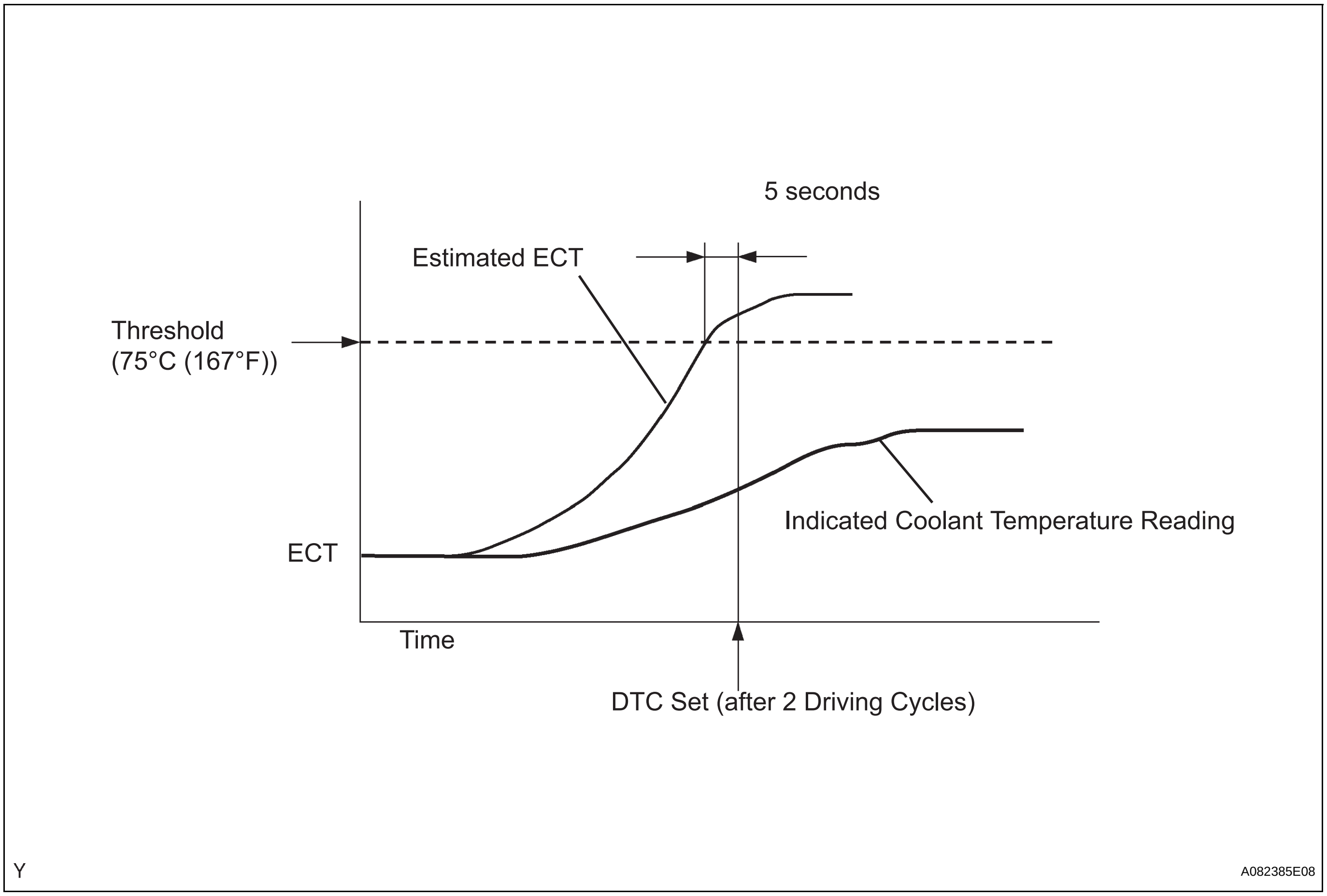
DTC	P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)

DESCRIPTION

This DTC is set when the Engine Coolant Temperature (ECT) does not reach 75°C (167°F) despite sufficient engine warm-up time.

DTC No.	DTC Detection Condition	Trouble Area
P0128	Conditions (a), (b) and (c) are met for 5 seconds (2 rip detection logic): (a) Cold start (b) Engine warmed up (c) ECT less than 75°C (167°F)	• Thermostat • Cooling system • ECT sensor • ECM

MONITOR DESCRIPTION



The ECM estimates the 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 sets the DTC.

MONITOR STRATEGY

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Intake Air Temperature (IAT) sensor, Vehicle speed sensor
Frequency of Operation	Once per drive cycle

Duration	900 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor will run whenever this DTC is not present	P0010, P0020 (VVT OCV Bank 1, 2) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0356 (Ignitor) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	11 V or more
Either of following conditions 1 or 2 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	More than 7°C (12.6 °F)
• ECT at engine start	56°C (132.8°F) or less
• IAT at engine start	-10°C (14°F) or more
Accumulated time with 128 km/h (80 mph) or more of vehicle speed	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

Duration that all following conditions (a) and (b) set	5 seconds or more
(a) Simulated ECT	75°C (167°F) or more
(b) ECT sensor output	Below 75°C (167°F)

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-15).

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (refer to "Confirmation Monitor").

- MID (Monitor Identification Date) is assigned to each emission-related component.
- TID (Test Identification Date) is assigned to each emission-related component.
- Scaling is used to calculate the test value indicated on generic OBD II scan tools.

Thermostat

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$E1	$E8	Multiply by 01 [°C]	ECT sensor output when estimated ECT reached to malfunction criteria	Malfunction criteria	Maximum test limit

If the Test Value is less than Test Limit when the engine is warmed up, the ECM interprets this as a malfunction.

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK COOLING SYSTEM

(a) Check the cooling system for excessive cooling, such as abnormal radiator fan operation, modified cooling system and other defects.
OK:
There is no modification of cooling system.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK ↓

2	INSPECT THERMOSTAT

(a) Check the valve opening temperature of the thermostat.
OK:
Valve opening temperature: 80 to 84°C (176 to 183°F).
HINT:
Also check that the valve is completely closed under opening temperature as above.

NG → **REPLACE THERMOSTAT**

OK ↓

REPLACE ECM

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)

DTC	P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

DTC	P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)

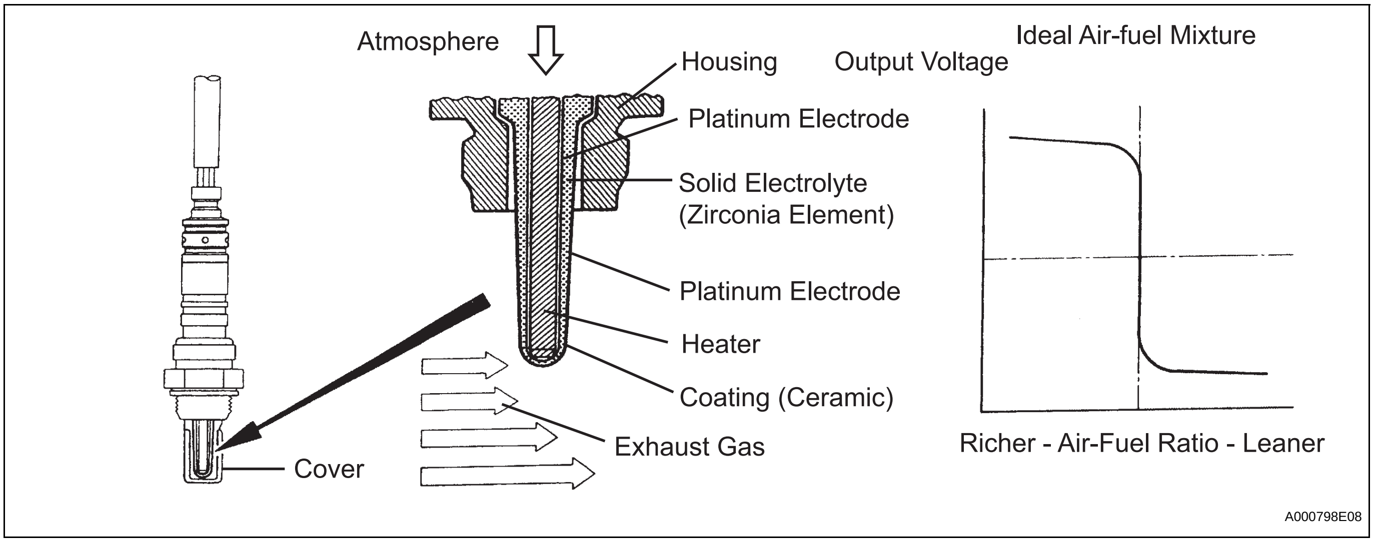
DTC	P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

DTC	P0159	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 2)

DESCRIPTION

The heated oxygen sensor (HO2S) is used to monitor oxygen in the exhaust gas. For optimum catalyst operation, the air fuel mixture (air-fuel ratio) must be maintained near the ideal "stoichiometric" ratio. The HO2S output voltage changes suddenly in the vicinity of the stoichiometric ratio. The ECM adjusts the fuel injection time so that the air-fuel ratio is nearly stoichiometirc.

The HO2S generates a voltage between 0.1 and 0.9 volts in response to oxygen in the exhaust gas. If the oxygen in the exhaust gas increases, the air-fuel ratio becomes "Lean". The ECM interprets Lean when the HO2S voltage is below 0.45 volts. If the oxygen in the exhaust gas decreases, the air-fuel ratio becomes "Rich". The ECM interprets Rich when the HO2S voltage is above 0.45 volts.



DTC No.	DTC Detection Condition	Trouble Area
P0136 P0156	• Either of the following conditions is met (2 trip detection logic): (a) Heated Oxygen (HO2) sensor voltage was lower than 0.05 V for a certain period (b) HO2 sensor did not switch for a certain period	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air-Fuel Ratio (A/F) sensor (bank 1, 2 sensor 1)
P0137 P0157	HO2 sensor voltage was lower than 0.03 V for 90 seconds	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2)
P0138 P0158	HO2 sensor voltage was 1.2 V or higher for 10 seconds	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2)
P0139 P0159	HO2 sensor voltage did not drop during fuel-cut	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2)

MONITOR DESCRIPTION

The ECM monitors the rear Heated Oxygen (HO2) sensor to check for the following malfunctions. If any of the malfunctions are detected, the ECM illuminates the MIL and sets a DTC.

- The HO2 sensor output voltage remains above 0.45 V (rich) or below 0.45 V (lean) while the vehicle is accelerated and decelerated for 8 minutes.
- The HO2 sensor output voltage remains at below 0.05 V, for a long period of time while the vehicle is driven.
- The HO2 sensor output voltage does not decrease below 0.2 V (extremely lean condition) within 7 seconds after fuel-cut is performed while the vehicle is decelerated. The ECM interprets this as the sensor response having deteriorated.

MONITOR STRATEGY

Voltage:

Related DTCs	P0136 (bank 1 sensor 2), P0156 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	ECT sensor, MAF meter, VSS, CKP sensor, Throttle position sensor
Frequency of Operation	Once per driving cycle
Duration	160 seconds
MIL Operation	2 driving cycle
Sequence of Operation	None

Switching:

Related DTCs	P0136 (bank 1 sensor 2), P0156 (bank 2 sensor 2)

Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	CKP sensor
Frequency of Operation	Once per driving cycle
Duration	480 seconds
MIL Operation	2 driving cycle
Sequence of Operation	None

Low voltage:

Related DTCs	P0137(bank 1 sensor 2), P0157 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	MAF meter, HO2 sensor heater
Frequency of Operation	Continuous
Duration	90 seconds
MIL Operation	Immediate
Sequence of Operation	None

High voltage:

Related DTCs	P0138(bank 1 sensor 2), P0158 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	Immediate
Sequence of Operation	None

Voltage during fuel-cut:

Related DTCs	P0139(bank 1 sensor 2), P0159 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	ECT sensor, MAF meter, HO2 sensor heater
Frequency of Operation	Once per driving cycle
Duration	6 seconds
MIL Operation	2 driving cycle
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (O2 Sensor Heater - Sensor 2) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2A00, P2A03 (A/F sensor - slow response)

Voltage:

Engine	Running
Vehicle speed	1.85 mph (3 dm/h) or more
Idle	OFF

Fuel cut	OFF
Intake air amount	6g/sec or more

Switching:

All of the following condition are met	Condition 1, 2 and 3
1. Engine	Running
2. Cumulative time when oxygen sensor heater is operating	22 seconds or more
3. Time after engine start	0 second or more

Low voltage:

Battery voltage	11 V or more
Estimated heated oxygen sensor temperature	450°C (842°F) or more
Time after fuel-cut ended	30 seconds or more

High voltage:

Engine	Running
Battery voltage	11 V or more

Voltage during fuel-cut:

Engine coolant temperature	70°C (158°F) or more
Estimated catalyst temperature	500°C (932°F) or more
Fuel-cut	ON

TYPICAL MALFUNCTION THRESHOLDS

Voltage:

All of the following conditions are met	Conditions 1, 2, 3, 4 and 5
1. Cumulative monitor time of HO2S	160 seconds or more
2. Duration while HO2S voltage is below 0.05 V	96 seconds or more
3. Duration while HO2S voltage is higher than 0.7 V	Less then 32 seconds
4. Duration while HO2S voltage is 0.45 V to 0.7 V	Less than 48 seconds
5. Duration while HO2S voltage is 0.45 V or more	Less than 20 seconds

Switching:

Both of the following conditions are met:	Conditions 1 and 2
1. Frequency in cumulative monitor time that HO2S voltage changes between (a) and (b)	0 time
(a) Maximum voltage	0.6 V or more
(b) Minimum voltage	Less than 0.45 V
2. Cumulative monitor time* of rear HO2S	480 seconds or more
*: Monitor time is counted when all of following conditions are met	Conditions (a) and (b)
(a) Fuel system status	Closed-loop
Idle	OFF

Low voltage:

Engine voltage	Lower than 0.03 V

High voltage:

Sensor voltage	1.2 V or more

Voltage during fuel-cut:

One of the following conditions is met:	Conditions 1 or 2
1. Duration until rear HO2S voltage drops to 0.2 V during fuel-cut start	6 seconds or more
2. Duration that rear HO2S voltage drops from 0.35 to 0.2 V during fuel-cut	1 second or more

COMPONENT OPERATING RANGE

Heated Oxygen sensor voltage	Varies between 0.1 and 0.9 V

MONITOR RESULT

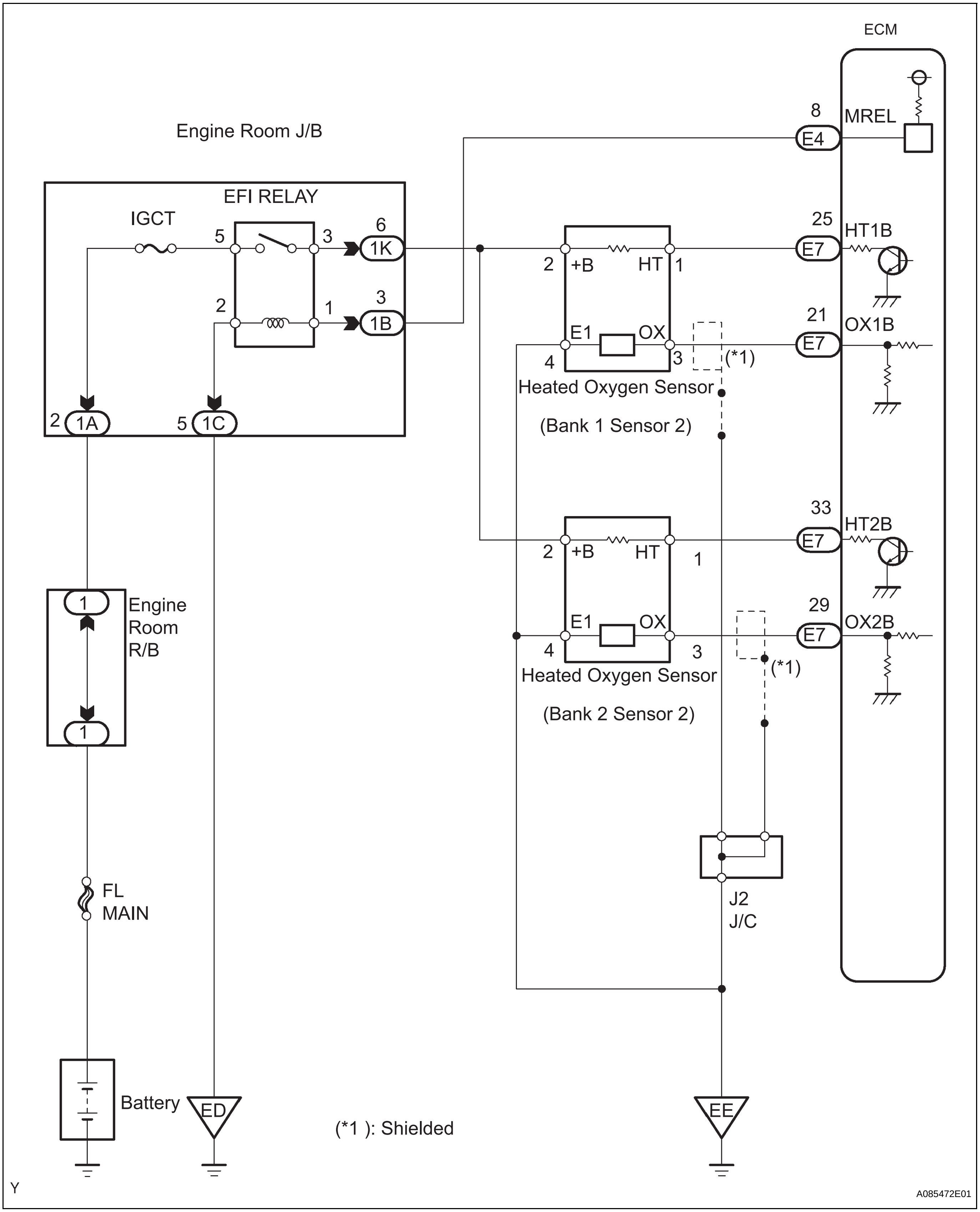
Refer to CHECKING MONITOR STATUS (See page ES-15).

HO2S bank 1 sensor 2

Test ID	Test Item	Description	Unit Conversion	Unit	Standard Value
$07	MIN HO2S V	Minimum HO2 voltage	Multiply by 0.005	V	Less than malfunction threshold
$08	MAX HO2S V	Maximum HO2 voltage	Multiply by 0.005	V	More than malfunction threshold
$31	Time $31	HO2S switch time form Lean to Rich	Multiply by 0.04096	Second	Less than malfunction threshold
$32	Time $32	HO2S switch time form Rich to Lean	Multiply by 0.04096	Second	Less than malfunction threshold
$37	Time $37	Time that HO2S voltage drops to 0.2 V after fuel-cut begins	Multiply by 0.04096	Second	Less than malfunction threshold
$81	Time $81	Percentage in monitor time when HO2S voltage is lower than 0.05 V	Multiply by 0.04096	%	Less than malfunction threshold
$84	Time $84	Percentage in monitor time when HO2S voltage is 0.7 V or higher	Multiply by 0.04096	%	More than malfunction threshold
$85	Time $85	Maximum time while HO2S voltage exceeded 0.45 V continuously	Multiply by 0.04096	Second	More than malfunction threshold
$87	Time $87	Maximum time while HO2S voltage exceeded 0.45 V or higher	Multiply by 0.04096	%	More than malfunction threshold

If the sensor voltage is outside the standard values, the ECM interprets this as a malfunction and sets a DTC.

WIRING DIAGRAM



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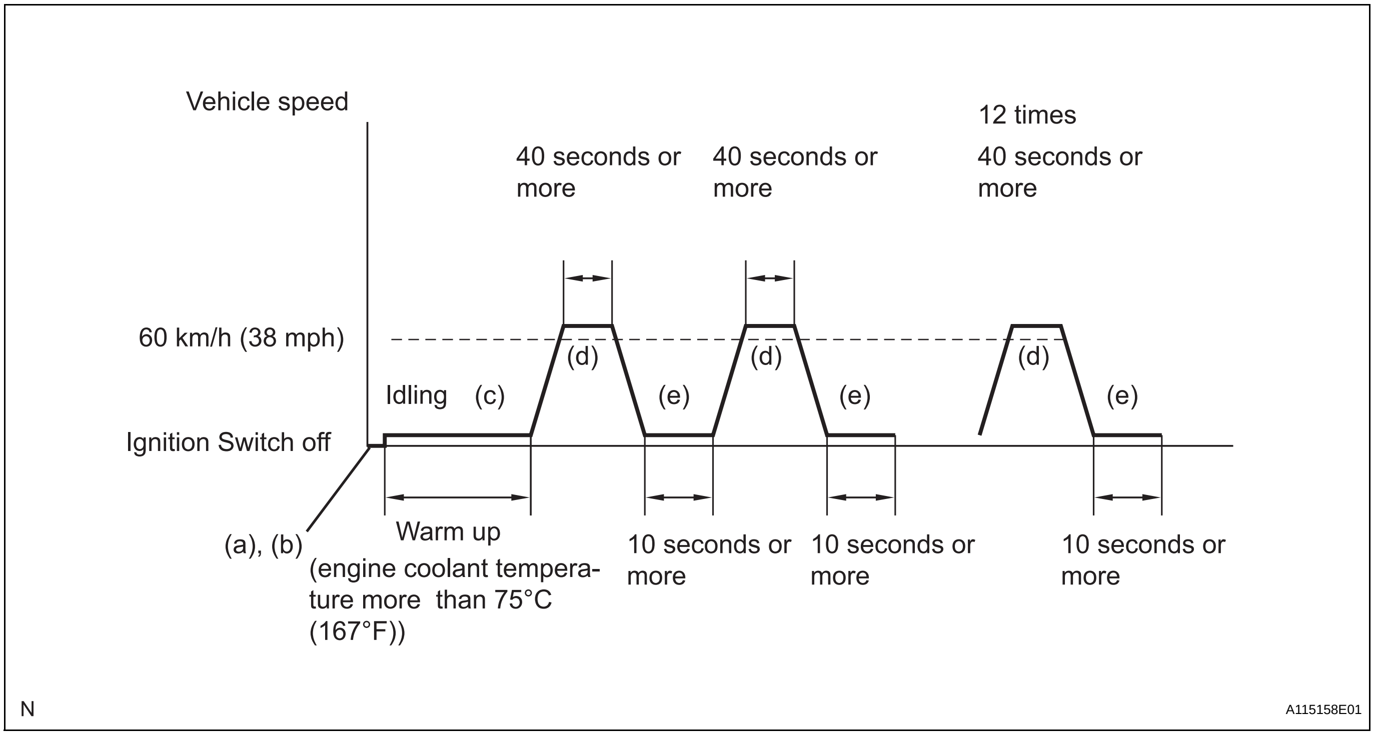
CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Switch the ECM From normal mode to check mode using the tester (See page ES-31).
(c) Start the engine and warm it up until the engine coolant temperature reaches more than 75°C (167°F).
(d) Drive the vehicle at 38 mph (60 km/h) or more for 40 seconds or more.
(e) Let the engine idle for 10 seconds or more.
(f) Perform steps (d) and (e) 12 times.
HINT:
If a malfunction exists, the MIL illuminates during step (f).
NOTICE:
If the conditions in this test are not strictly followed, malfunctions may not be detected. If you do not have the intelligent tester, turn the engine switch off after performing steps from (c) to (f), then perform steps (c) to (f) again.

CONFIRMATION DRIVING PATTERN

Warm up the engine and run the engine at 38 mph (60 km/h) for 7 minutes.

CONFIRMATION DRIVING PATTERN

Warm up the engine and run the engine at idle for 30 seconds.

HINT:
Intelligent tester only:
Malfunctioning ares can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL 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 A/F CONTROL operation using an intelligent tester.

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at engine speed of 2,500 rpm for approximately 90 seconds.
4. On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.

5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:
- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases in the fuel injection volume.

Standard

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 or O2S B2S2 (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5 %	Lean	Less than 0.4

ES

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	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage More than 0.55 V Less than 0.4 V	OK	
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction	NG	Output Voltage More than 0.55 V Less than 0.4 V	OK	
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage Almost no reaction	NG	
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

- Following the A/F CONTROL 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: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:
- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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 OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be set.
- If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be set.

1 READ OTHER DTC OUTPUT

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display (DTC Output)	Proceed to
P0138 and/or P0158 are output	A
P0137 and/or P0157 are output	B
P0136 and/or P0156 are output	C

HINT:
If any other codes besides P0136, P0137, P0138, P0156, P0157 and/or P0158 are output, perform the troubleshooting for those codes first.

B → **Go to step 9**

C → **Go to step 6**

A

2 READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

(a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
(b) Turn the ignition switch ON. Push the intelligent tester or the OBD II scan tool main switch ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1S2.
(d) Run the engine at idle.
(e) Read the output voltage of the heated oxygen sensor during idling.

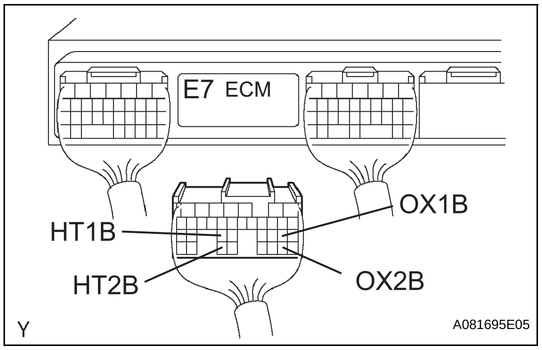
Result

Heated oxygen sensor output voltage	Proceed to
More than 1.2 V	A
Less than 1.0 V	B

B → **Go to step 5**

A

3	CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)



(a) Turn the ignition switch OFF and wait for 5 minutes.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Resistance

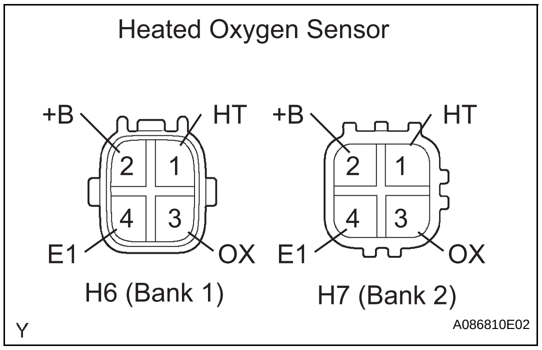
Tester Connection	Specified Condition
E7-25 (HT1B) - E7-21 (OX1B)	10 kΩ or higher
E7-33 (HT2B) - E7-29 (OX2B)	10 kΩor higher
E7-25 (HT1B) - Body ground	10 kΩ or higher
E7-33 (HT2B) - Body ground	10 kΩor higher

ES

OK → **REPLACE ECM**

NG

4	INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)



(a) Disconnect the H6 or H7 heated oxygen sensor connector.
(b) Measure the resistance of the sensor side connectors.
Resistance

Tester Connection	Specified Condition
H6-2 (+B) - H6-4 (E1)	10 kΩ or higher
H6-2 (+B) - H6-3 (OX)	10 kΩ or higher
H7-2 (+B) - H7-4 (E1)	10 kΩ or higher
H7-2 (+B) - H7-3 (OX)	10 kΩor higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

NG

REPLACE HEATED OXYGEN SENSOR

5	READ OUTPUT DTC (CHECK MODE)

(a) Change the ECM to check mode with the intelligent tester.
Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(b) Warm up the engine and drive the vehicle at over 25 mph (40 km/h) for 10 minutes.

HINT:
Driving should be continued for 10 minutes consecutively, but it is not necessary to maintain a speed of 25 mph (40 km/h) during this time.

(c) Read the DTC.

Result

Display (DTC output)	Proceed to
P0138 and/or P0158 are output	A
No DTC	B

B → **CHECK FOR INTERMITTENT PROBLEMS**

A ↓

ES

REPLACE HEATED OXYGEN SENSOR

6 READ VALUE OF INTELLIGENT TESTER OR ODB II SCAN TOOL (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

(a) After warming up the engine, run the engine at 2,500 rpm for 3 minutes.

(b) Read the output voltage of the heated oxygen sensor when the engine rpm is suddenly increased.

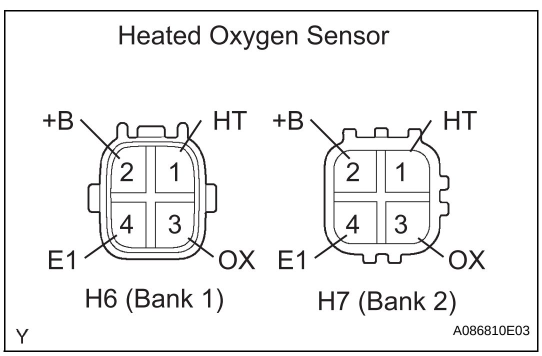
HINT:
Quickly accelerate the engine to 4,000 rpm 3 times by using the accelerator pedal.

Heated oxygen sensor output voltage:
Alternates 0.4 V or less and 0.5 V or more.

OK → **Go to step 10**

NG ↓

7 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H6 or H7 heated oxygen sensor connector.

(b) Measure the resistance of the heated oxygen sensor terminals.

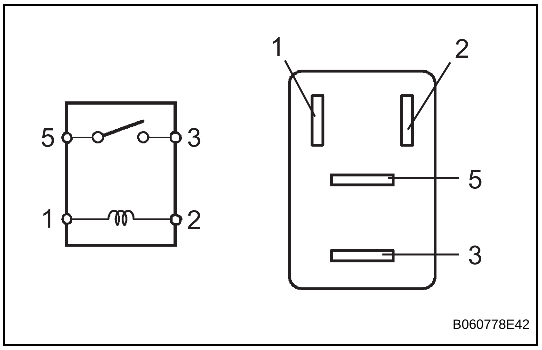
Resistance

Tester Connection	Condition	Specified Condition
H6-1 (HT) - H6-2 (+B)	20°C (68°F)	11 to 16 Ω
H7-1 (HT) - H7-2 (+B)	20°C (68°F)	11 to 16 Ω
H6-1 (HT) - H6-2 (+B)	800°C (1,472°F)	11 to 16 Ω
H7-1 (HT) - H7-2 (+B)	800°C (1,472°F)	11 to 16 Ω

NG → **REPLACE HEATED OXYGEN SENSOR**

OK ↓

8 INSPECT RELAY (EFI)



(a) Remove the EFI relay from the engine room J/B.
(b) Measure the resistance of the EFI relay.
Resistance

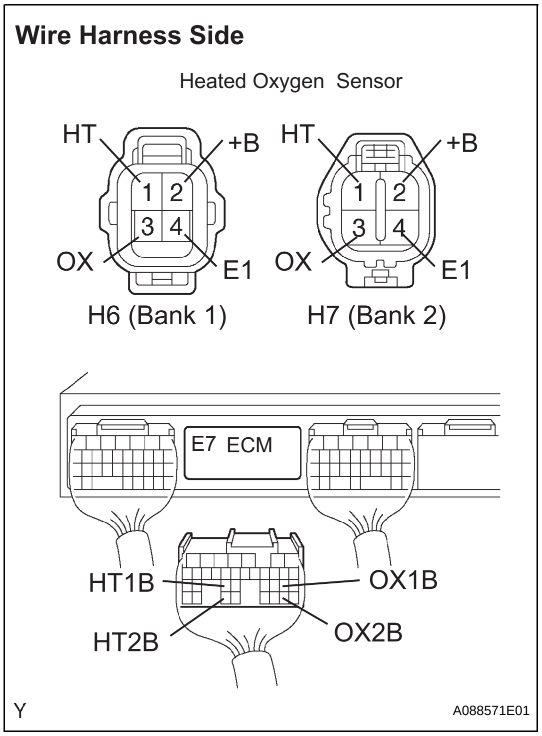
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE RELAY**

OK

ES

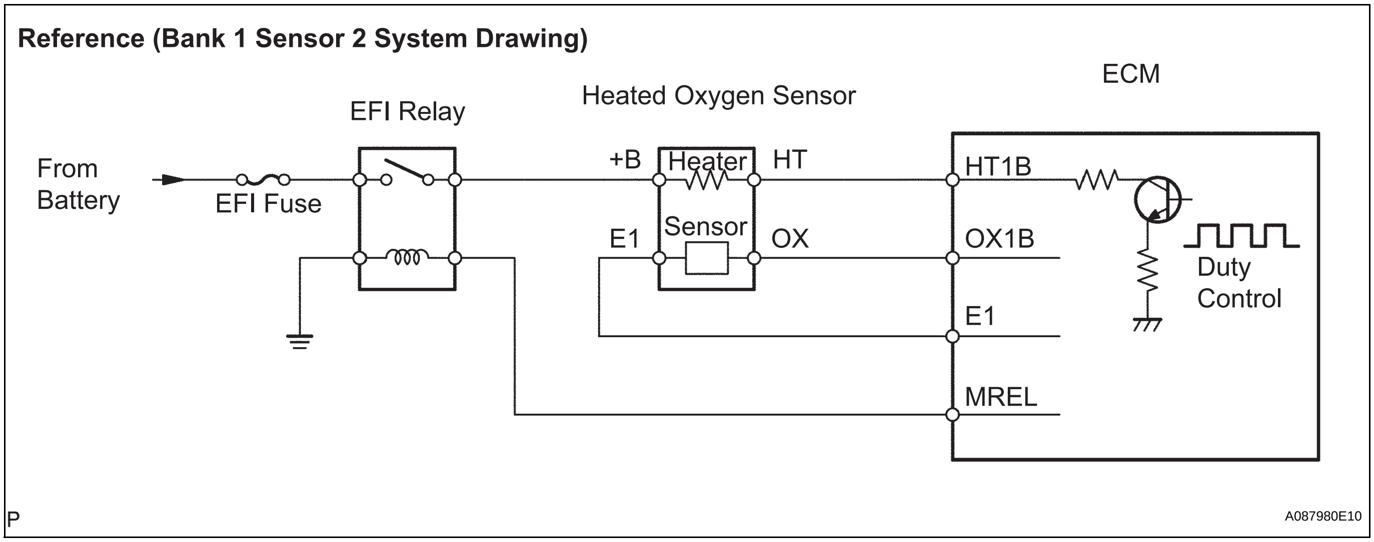
9 CHECK HARNESS AND CONNECTOR



(a) Check the wire harness between the ECM and heated oxygen sensor.
(1) Disconnect the H6 or H7 heated oxygen sensor connector.
(2) Disconnect the E7 ECM connector.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
H6-3 (OX) - E7-21 (OX1B)	Below 1 Ω
H6-1 (HT) - E7-25 (HT1B)	Below 1 Ω
H7-3 (OX) - E7-29 (OX2B)	Below 1 Ω
H7-1 (HT) - E7-33 (HT2B)	Below 1 Ω
H6-3 (OX) or E7-21 (OX1B) - Body ground	10 kΩ higher
H6-1 (HT) or E7-25 (HT1B) - Body ground	10 kΩ higher
H7-3 (OX) or E7-29 (OX2B) - Body ground	10 kΩ higher
H7-1 (HT) or E7-33 (HT2B) - Body ground	10 kΩ higher

(4) Reconnect the H6 or H7 heated oxygen sensor connector.
(5) Reconnect the E7 ECM connector.



ES

NG — REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR

10 PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

GO

11 READ OUTPUT DTC (DTC P0136 AND/OR P0156 ARE OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display (DTC Output)	Proceed to
P0136 and/or P0156 are not output again	A
P0136 and/or P0156 are output again	B

A — CHECK FOR INTERMITTENT PROBLEMS

B

12 REPLACE HEATED OXYGEN SENSOR

GO

13 PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

GO

14 CHECK READ OUTPUT DTC (DTC P0136 AND/OR P0156 ARE OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

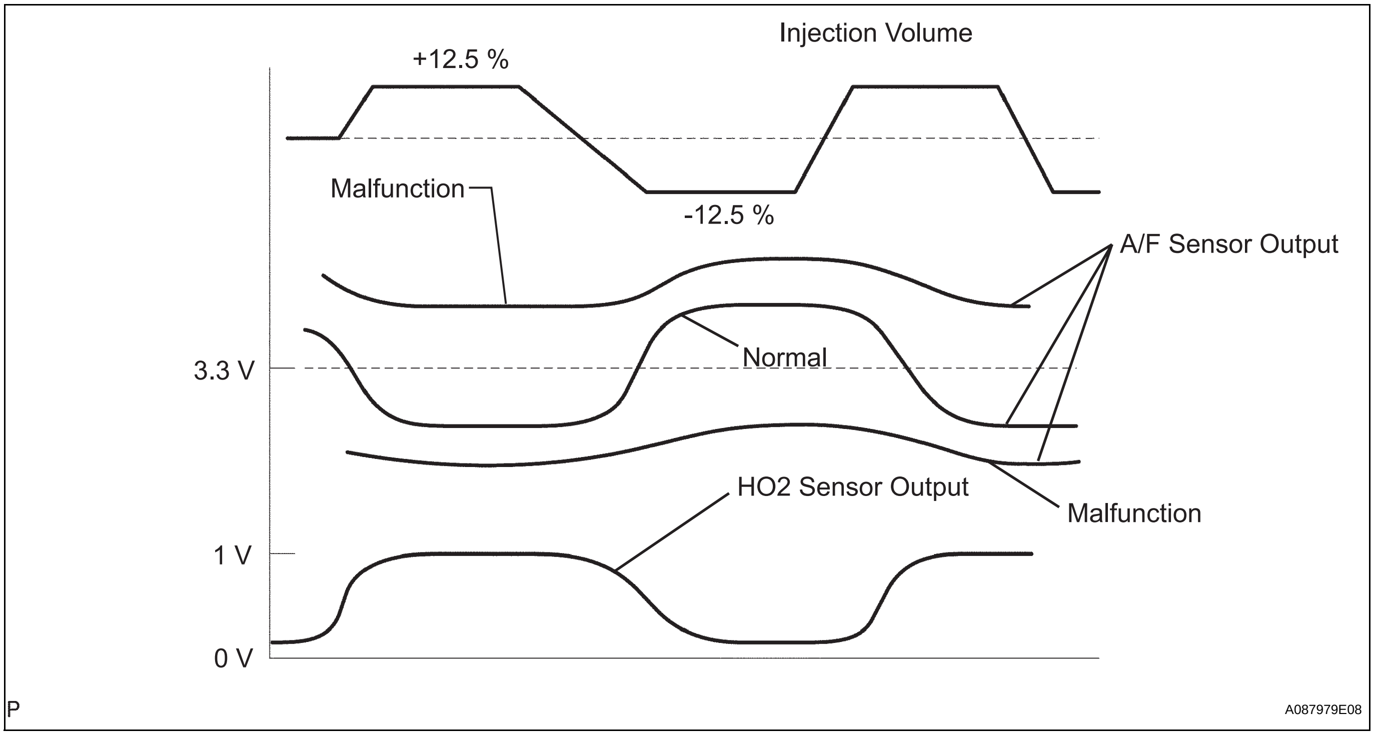
Display (DTC Output)	Proceed to
P0136 and/or P0156 are not output again	A
P0136 and/or P0156 are output again	B

A → **REPAIR COMPLETED**

B

15 PERFORM ACTIVE TEST USING INTELLIGENT TESTER

(a) Start the engine and warm it up.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch ON. Push the intelligent tester main switch ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INJ VOL.
(e) Using the intelligent tester, change the injection volume to check the A/F sensor output and heated oxygen sensor output values below.



HINT:
Change the injection volume from -12.5 % to +12.5 %.

Result:

A/F sensor output remains more than 3.3 V or A/F sensor output remains less than 3.3 V
(Heated oxygen sensor reacts in accordance with increase and decrease of injection volume)

OK → **REPLACE AIR FUEL RATIO SENSOR**

NG

CHECK AND REPAIR EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

DTC	P0171	System Too Lean (Bank 1)

DTC	P0172	System Too Rich (Bank 1)

DTC	P0174	System Too Lean (Bank 2)

DTC	P0175	System Too Rich (Bank 2)

DESCRIPTION

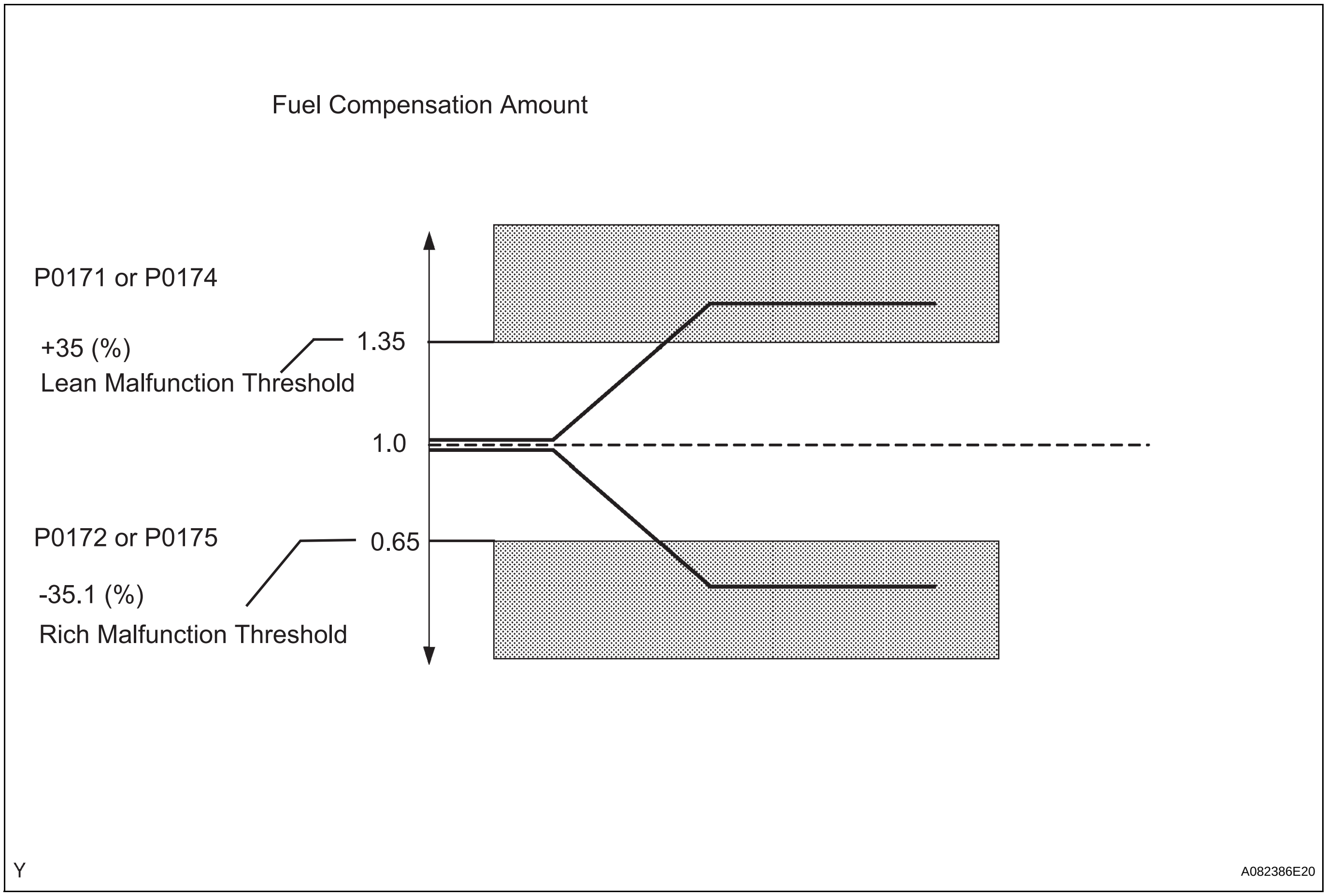
The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and the long-term fuel trims.
The short-term fuel trim is fuel compensation that is used to constantly maintain the air-fuel ratio at stoichiometric levels. The 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 it is 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 sets a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0171 P0174	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to lean side (2 trip detection logic)	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • A/F HTR relay • A/F sensor heater and A/F HTR relay circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to rich side (2 trip detection logic)	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • A/F HTR relay • A/F sensor heater and A/F HTR relay circuits • ECM

HINT:
- When DTC P0171 or P0174 is set, the actual air-fuel ratio is on the lean side. When DTC P0172 or P0175 is set, 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 or P0174 may be set. 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 more 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 ECM's estimated fuel injection volumes also affects the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air-fuel ratio). If the average fuel trim learning value exceeds the malfunction threshold, the ECM interprets this a fault in the fuel system and sets a DTC.
Example:
The average fuel trim learning 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) P0174: Fuel trim Lean (bank 2) P0175: Fuel trim Rich (bank 2)
Required Sensors/Components (Main)	Fuel system
Required Sensors/Components (Related)	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

Monitor runs whenever following DTCs not present	P0010, P0020 (VVT OCV Bank 1, 2) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
Fuel system status	Closed loop for more than 13 seconds
Battery voltage	11 V or more
Either of following conditions 1 or 2 set	-
1. Engine RPM	Below 1,100 rpm
2. Intake air amount per revolution	0.22 g/rev or more

TYPICAL MALFUNCTION THRESHOLDS

Purge-cut	Executing
Either of following conditions 1 or 2 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)

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-265).

HINT:
Intelligent tester only:
Malfunctioning ares can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL 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 A/F CONTROL operation using an intelligent tester.

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at engine speed of 2,500 rpm for approximately 90 seconds.
4. On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume.)
6. Monitor the output voltages of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:

- The A/F CONTROL 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 B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 or AFS B2S1 (A/F)	**-12.5 %**	**Lean**	**More than 3.35**
O2S B1S2 or O2S B2S2 (HO2)	**+25 %**	**Rich**	**More than 0.55**
O2S B1S2 or O2S B2S2 (HO2)	**-12.5 %**	**Lean**	**Less than 0.4**

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	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V	 OK	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction	NG	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V	 OK	Output Voltage Almost no reaction	NG	
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

- Following the A/F CONTROL 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: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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 rich air-fuel mixture. Check for conditions that would cause the engine to run lean.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read DTCs.

Result

Display (DTC output)	Proceed to
P0171, P0172, P0174 or P0175	A
P0171, P0172, P0174 or P0175 and other DTCs	B

HINT:
If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

ES

B → **GO TO DTC CHART**

A

2	CHECK PCV HOSE

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.
OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

4	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester ON.
(c) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
(d) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(e) Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

(f) Monitor the outputs voltages of A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:
- The A/F CONTROL 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 B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 or O2S B2S2 (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5 %	Lean	Less than 0.4

Result

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	-	C
Lean	Lean	Actual air-fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leakage from exhaust system • Air induction system • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	A
Rich	Rich	Actual air-fuel ratio rich	-	• Injector blockage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	A
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B

Lean: During A/F CONTROL, the A/F sensor output voltage (AFS) is consistently more than 3.35 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.

Rich: During A/F CONTROL, the AFS is consistently less than 3.0 V, and the O2S is consistently more than 0.55 V.

B → **Go to step 10**

C → **Go to step 14**

A

5 READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(d) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.

Standard:

With cold engine:

Same as ambient air temperature.

With warm engine:

Between 75 and 95°C (167 and 203°F)

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

6 READ VALUE USING INTELLIGENT TESTER (MAF)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF and COOLANT TEMP.
(d) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
(e) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.

Standard:

MAF while engine idling:

Between 2.1 g/s and 3.1 g/s (shift position: N, A/C: OFF).

MAF at an engine speed of 2,500 rpm:

Between 7.8 g/s and 11.4 g/s (shift position: N, A/C: OFF).

NG → **REPLACE MASS AIR FLOW METER**

OK

7 CHECK FUEL PRESSURE

(a) Check the fuel pressure (See page FU-8).

Standard:
304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44.1 to 49.7 psi)

NG → **CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER**

OK

8	CHECK FOR EXHAUST GAS LEAKAGE

OK:
No gas leakage.

NG → **REPAIR OR REPLACE EXHAUST SYSTEM**

OK

9	CHECK FOR SPARKS AND IGNITION

HINT:
If the spark plugs or ignition system malfunctions, engine misfire may occur. The misfire count can be read using an intelligent tester. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1 (to CYL #6).

NG → **REPAIR OR REPLACE IGNITION SYSTEM**

OK

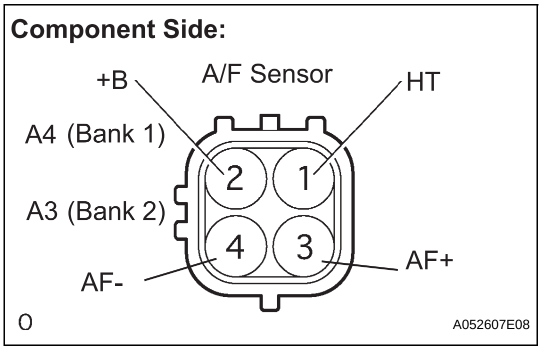
10	INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

HINT:
If the injectors malfunction, engine misfire may occur. The misfire count can be read using the intelligent tester. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / CYL #1 (to CYL #6).

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

11 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A3 or A4 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.
Standard resistance

Tester Connection	Specified Condition
HT - +B	1.8 Ω to 3.4 Ω at 20°C (68°F)
HT - AF+, AF-	10 kΩ or higher

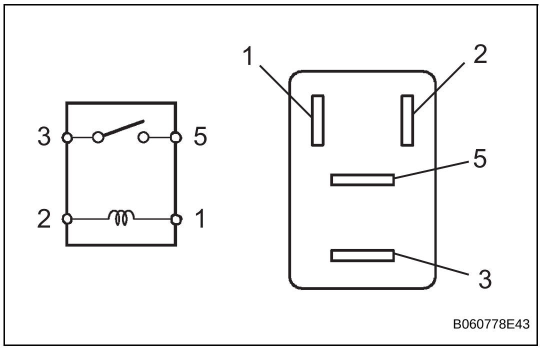
(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

ES

OK

12 INSPECT A/F RELAY



(a) Remove the A/F relay from the engine room No. 2 relay block.
(b) Measure the A/F relay resistance.
Standard resistance

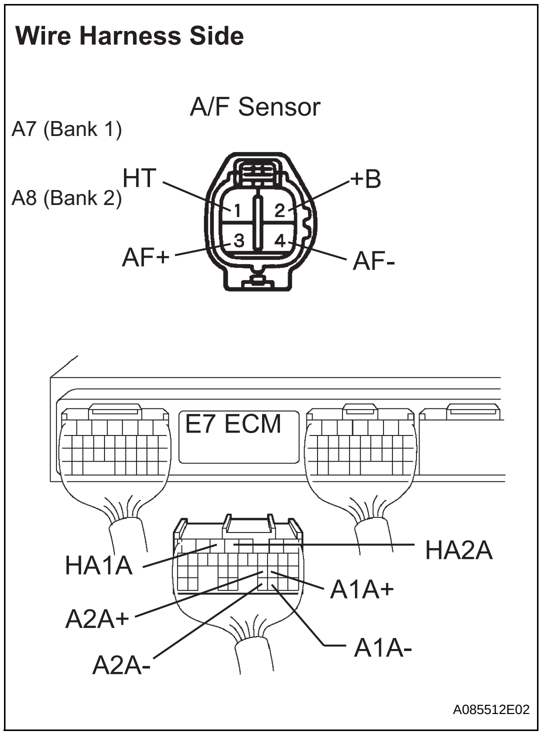
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F relay.

NG → **REPLACE A/F RELAY**

OK

13 CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

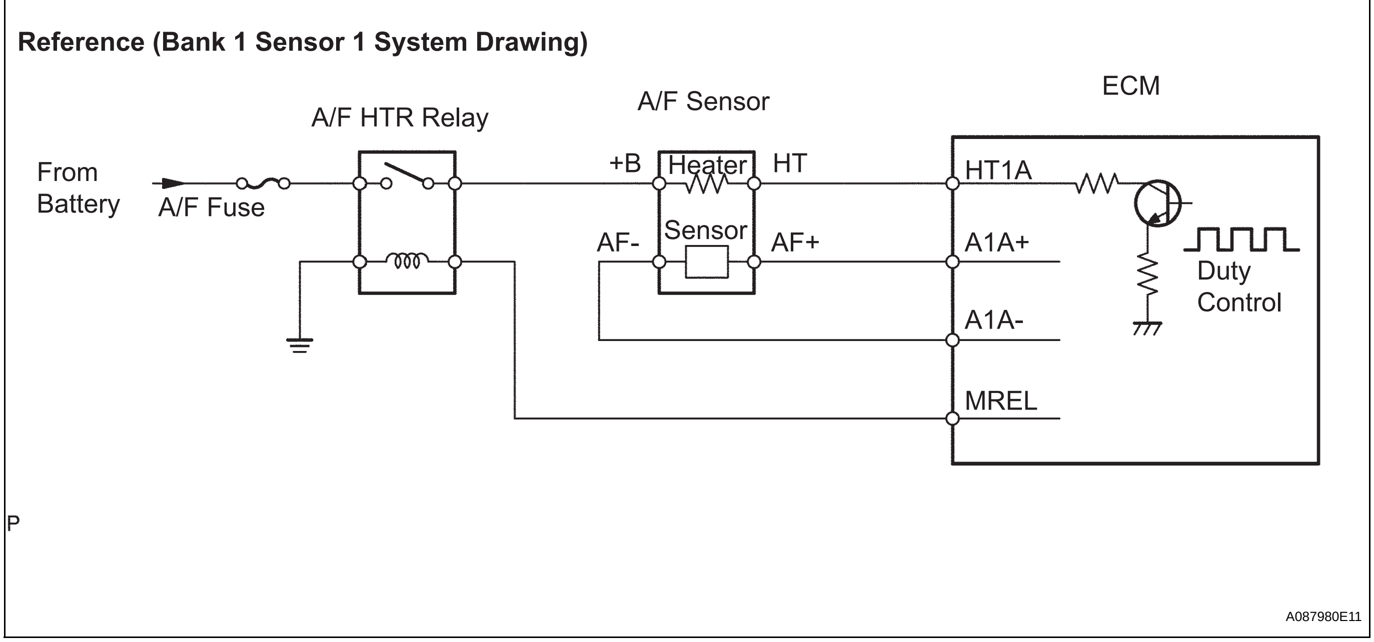


(a) Disconnect the A7 or A8 A/F sensor connector.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Standard

Tester Connection	Specified Condition
A7-3 (AF+) - E7-22 (A1A+) A7-4 (AF-) - E7-30 (A1A-) A7-1 (HT) - E7-5 (HA1A) A8-3 (AF+) - E7-23 (A2A+) A8-4 (AF-) - E7-31 (A2A-) A8-1 (HT) - E7-4 (HA2A)	Below 1 Ω
A7-3 (AF+) or E7-22 (A1A+) - Body ground A7-4 (AF-) or E7-30 (A1A-) - Body ground A7-1 (HT) or E7-5 (HA1A) - Body ground A8-3 (AF+) or E7-23 (A2A+) - Body ground A8-4 (AF-) or E7-31 (A2A-) - Body ground A8-1 (HT) or E7-4 (HA2A) - Body ground	10 kΩ or higher

(d) Reconnect the E7 ECM connector.
(e) Reconnect the A7 or A8 A/F sensor connector.

Reference (Bank 1 Sensor 1 System Drawing)



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

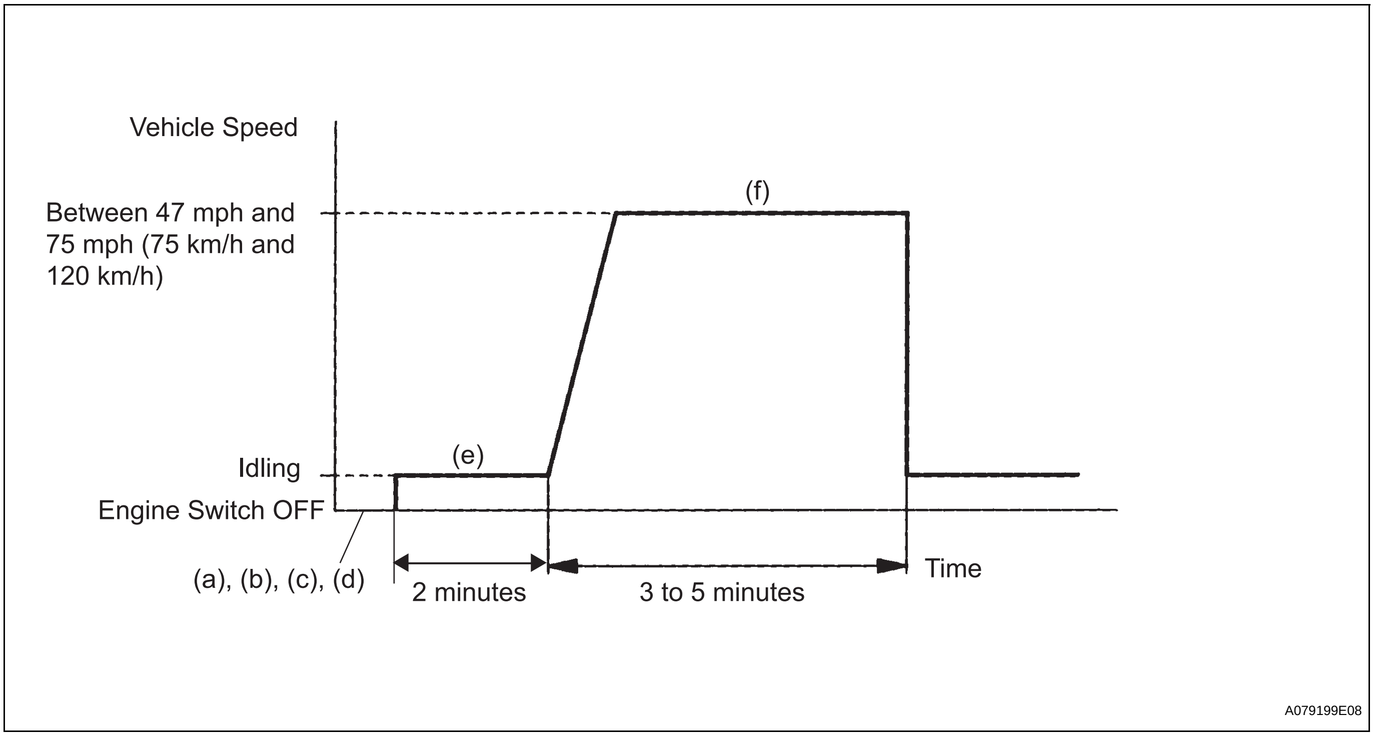
OK

14	REPLACE AIR FUEL RATIO SENSOR

NEXT

15	PERFORM CONFIRMATION DRIVING PATTERN

(a) Connect the intelligent tester to the DLC3.



(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-29).
(d) Switch the ECM from normal mode to check mode using the tester (See page ES-31).
(e) Start the engine and warm it up with all the accessories switched OFF.
(f) Drive the vehicle at between 47 mph and 75 mph (75 km/h and 120 km/h) and at an engine speed of between 1,400 rpm and 3,200 rpm for 3 to 5 minutes.
HINT:
If the system is still malfunctioning, the MIL will be illuminated during step (f).
NOTICE:
If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16 CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

(a) On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(b) Read DTCS.

Result

Display (DTC output)	Proceed to
No output	A
P0171, P0172, P0174 or P0175	B

B → **Go to step 5**

A ↓

END

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

DTC	P0305	Cylinder 5 Misfire Detected

DTC	P0306	Cylinder 6 Misfire Detected

DESCRIPTION

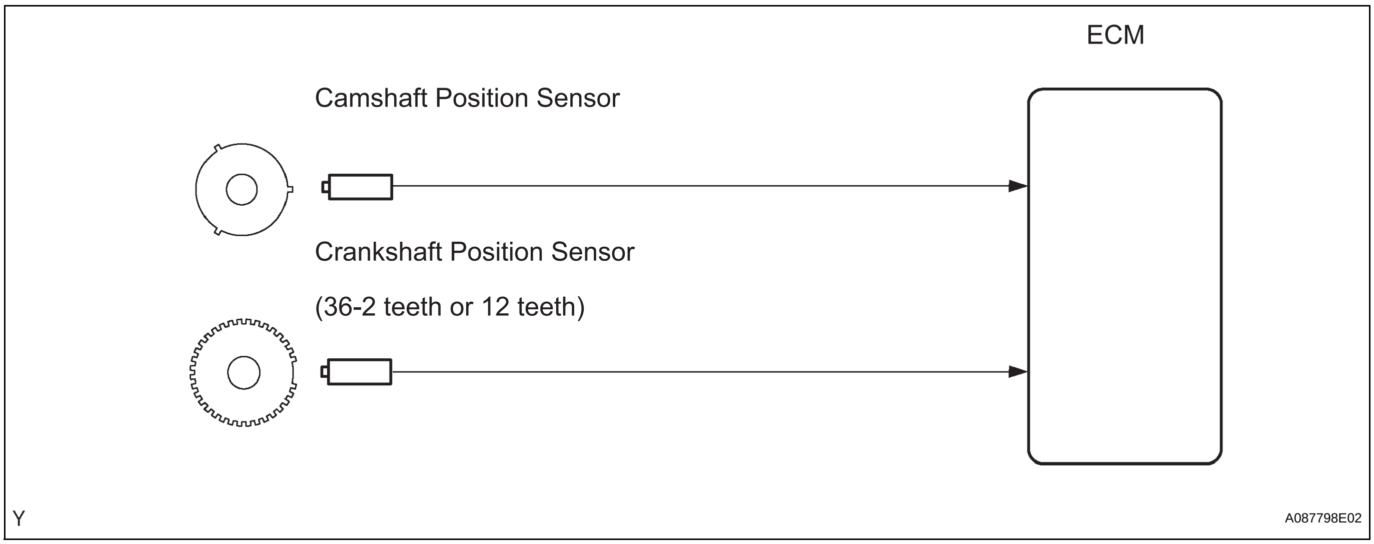
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increase in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage 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 exceeds the threshold levels, and could cause emission deterioration, the ECM illuminates the MIL and set a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinder detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • 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

DTC No.	DTC Detection Condition	Trouble Area
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • 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

When DTCs for misfiring cylinders are randomly set, but DTC P0300 is not set, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only set when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION



The ECM illuminates the MIL and sets a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1,000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 20 to 50 misfires per 1, 000 crankshaft revolutions) occurs once.
- After the first 1,000 crankshaft revolutions, an excessive misfiring rate (approximately 20 to 60 misfires per 1, 000 crankshaft revolutions) occurs 4 times in sequential crankshaft revolutions.

The ECM flashes the MIL and sets a DTC when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

- In every 200 crankshaft revolutions at a high engine rpm, the threshold misfiring percentage is recorded once.
- In every 200 crankshaft revolutions at a normal engine rpm, the threshold misfiring percentage is recorded 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 P0305: Cylinder 5 misfire P0306: Cylinder 6 misfire
Required Sensors/Components (Main)	Injector, Ignition coil, Spark plug
Required Sensors/Components (Related)	Crankshaft, Camshaft, Engine coolant temperature and intake air temperature sensors and Mass air flow meter
Frequency of Operation	Continuous
Duration	1,000 to 4,000 crankshaft revolutions: Emission related misfire 200 to 600 crankshaft revolutions: Catalyst damaged misfire
MIL Operation	2 driving cycles: Emission related misfire MIL flashes immediately: Catalyst damaged misfire
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Misfire:

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0327 - P0333 (Knock sensor) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
Battery voltage	8 V or more
Throttle position learning	Completed
VVT system	No operate by scan tool
Engine RPM	750 to 5,800 rpm
Both of following conditions 1 and 2 met	-
All of the following conditions are met	Condition 1, 2 and 3
1. Engine Coolant Temperature (ECT)	-10°C (14°F) or more
2. Either of the following conditions is met	Condition (a) or (b)
(a) IAT	-10°C (14°F) or more
(b) ECT	75°C (167°F) or more
3. Either of following condition is met	Condition (a) or (b)
(a) ECT at engine start	More than -7°C (19°F)
(b) ECT	More than 20°C (68°F)
Fuel cut	OFF

Monitor period of emission-related-misfire:

First 1,000 revolutions after engine start, or Check Mode	Crankshaft 1,000 revolutions
Except above	Crankshaft 1,000 revolutions x 4

Monitor period of catalyst-damaged-misfire (MIL blinks):

All of following conditions 1, 2 and 3 met	Crankshaft 200 revolutions x 3
1. Driving cycles	1 set
2. Check mode	OFF
3. Engine RPM	Less than 3,000 rpm
Except above	Crankshaft 200 revolutions

TYPICAL MALFUNCTION THRESHOLDS

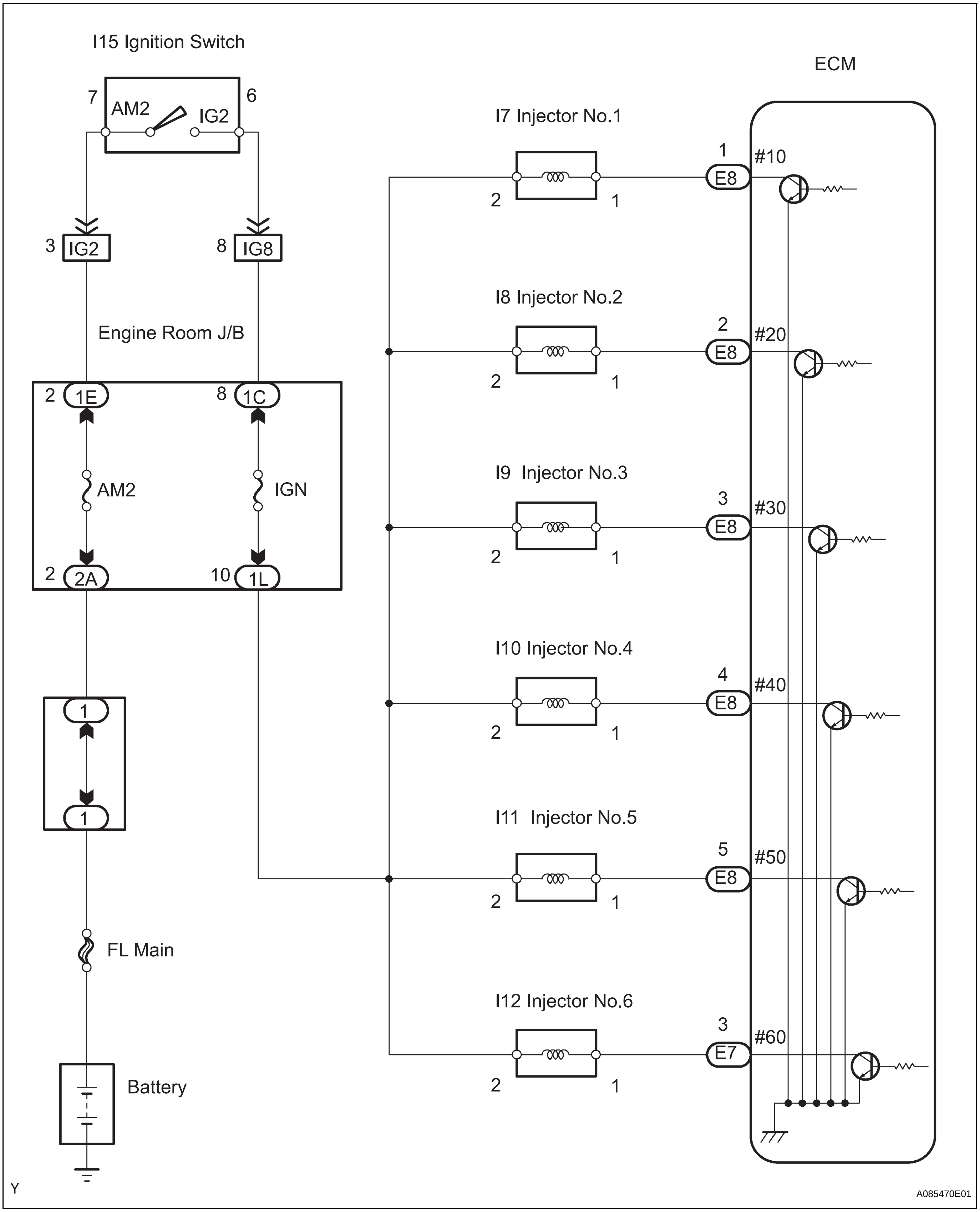
Monitor period of emission-related-misfire:

Misfire rate	1.2 % or more

Monitor period of catalyst-damage-misfire (MIL blinks):

Number of misfire per 200 revolutions	180 or more (varies with intake air amount and RPM)
Paired cylinders misfire	Detected

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch ON.

3. Turn the tester ON.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM (Included in ECM) from normal mode to check mode (See page ES-17).
6. Read the misfire counts of each cylinder (CYL #10 to #60 with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine rpm and engine load, shown in MISFIRE RPM and MISFIRE LOAD in the DATA LIST.
   HINT:
   In order to store misfire DTCs, it is necessary to drive the vehicle for the period of time shown in the table below, with the MISFIRE RPM and MISFIRE LOAD in the DATA LIST.

Engine RPM	Duration
Idling	3.5 minutes or more
1,000	3 minutes or more
2,000	1.5 minutes or more
3,000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.
   HINT:
   Do not turn the engine switch off until the stored DTC(s) and freeze data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be erased.
9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch OFF and wait for at least 5 seconds.

HINT:
- If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When trouble shooting, freeze frame data can help determine if the vehicle was running or stopped, 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 freeze frame data.
- The misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:
  (a) The fuel tank is low full.
  (b) Improper fuel is used.
  (c) The spark plugs have been contaminated.
  (d) The problem is complex.
- After finishing repairs, check the misfire counts of the cylinders (CYL #10, #20, #30, #40, #50 and #60).
- Be sure to confirm that no misfiring cylinder DTCs are set again by conducting the confirmation driving pattern, after repairs.
- For 6 and 8 cylinder engines, the ECM (Included in ECM) intentionally does not set the specific misfiring cylinder DTCs at high engine RPM. If misfires occur only in high engine RPM areas, only DTC P0300 is set.
  In the event of DTC P0300 being present, perform the following operations:
  (a) Clear the DTC (See page ES-29).
  (b) Start the engine and conduct the confirmation driving pattern.
  (c) Read the misfiring rates of each cylinder or DTC(s) using the tester.
  (d) Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.
  (e) After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not set.
- 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 the COOLANT TEMP in the freeze frame data is less than 75°C (167°F), the misfire have occurred only while warming up the engine.

1	CHECK ANY OTHER DTC OUTPUT (IN ADDITION TO MISFIRE DTCS)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result

Display (DTC output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

ES

HINT:
If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART**

A

2	READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / MISFIRE RPM and MISFIRE LOAD.
(d) Read and note the MISFIRE RPM and MISFIRE LOAD (engine load) values.
HINT:
The MISFIRE RPM and MISFIRE LOAD indicate the vehicle conditions under which the misfire occurred.

NEXT

3	CHECK PCV HOSE CONNECTIONS

OK:
PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

4	CHECK MISFIRE COUNT (CYL #1, #2, #3, #4, #5 AND #6)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the tester ON.
(c) Clear DTCs.

(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1, #2, #3, #4, #5 and #6.
(e) Start the engine.
(f) Read each value of CYL #1 to #6 displayed on the tester. If no misfire counts occur in any cylinders, perform the following conditions:
 (1) Shift the gear selector lever to the D position.
 (2) Repeat steps (e) to (g) above.
 (3) Check the CYL #1 to #6.
 (4) If misfire counts are still not displayed, perform steps (h) and (i) and then check the misfire counts again.
(g) Drive the vehicle with MISFIRE RPM and MISFIRE LOAD noted in step 2.
(h) Read the CYL #1 to #6 or DTCs displayed on the tester.

ES

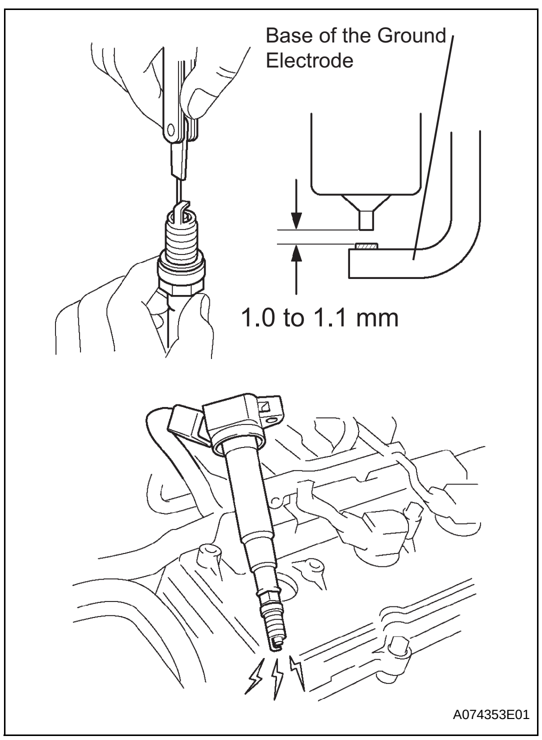
Result

Misfire count	Proceed to
1 or 2 cylinders have misfire counts	A
3 cylinders or more have misfire counts	B

B → **Go to step 11**

A

5 CHECK SPARK PLUG



(a) Remove the ignition coil and the spark plug of the misfiring cylinder.
(b) Measure the spark plug electrode gap.
Standard:
Between 1.0 mm and 1.1 mm (0.039 in. and 0.043 in.) Maximum: 1.3 mm (0.051 in.)
(c) Check the electrode for carbon deposits.
Recommended spark plug:

Manufacture	Product
DENSO made	SK20R11
NGK made	IFR6A11

NOTICE:
If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → **REPLACE SPARK PLUG**

OK

6	CHECK FOR SPARKS AND IGNITION

(a) Disconnect the injector connectors, in order to prevent the engine from starting.
(b) Install the spark plug to the ignition coil.
(c) Attach the spark plug assembly to the cylinder head cover.
(d) Crank the engine for less than 2 seconds and check the spark.
OK:
Sparks jump across electrode gap.
(e) Reconnect the injector connectors.

NG → **Go to step 8**

OK

7	CHECK CYLINDER COMPRESSION PRESSURE OF MISFIRING CYLINDER

(a) Measure the cylinder compression pressure of the misfiring cylinder (See page EM-3).
Minimum pressure:
0.74 MPa (7.5 kgf/cm^2, 107 psi)
Difference between each cylinder:
100 kPa (1.0 kgf/cm^2, 15 psi)

OK → **Go to step 9**

NG

CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

8	CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

(a) Change the installed spark plug to a spark plug that functions normally.
(b) Perform a spark test.
CAUTION:
Always disconnect all injector connectors.
NOTICE:
Do not crank the engine for more than 2 seconds.
(1) Install the spark plug to the ignition coil and connect the ignition coil connector.
(2) Disconnect the injector connector.
(3) Ground the spark plug.
(4) Check if sparks occur while the engine is being cranked.
OK:
Sparks jump across electrode gap.

NG → **REPLACE IGNITION COIL ASSEMBLY THEN CONFIRM THAT THERE IS NO MISFIRE**

OK

REPLACE SPARK PLUG

9 CHECK FUEL INJECTOR OF MISFIRING CYLINDER

(a) Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor).
Standard:
13 cm^3 (0.8 cu in.) or less

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

10 CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

NG → **ADJUST VALVE CLEARANCE**

OK

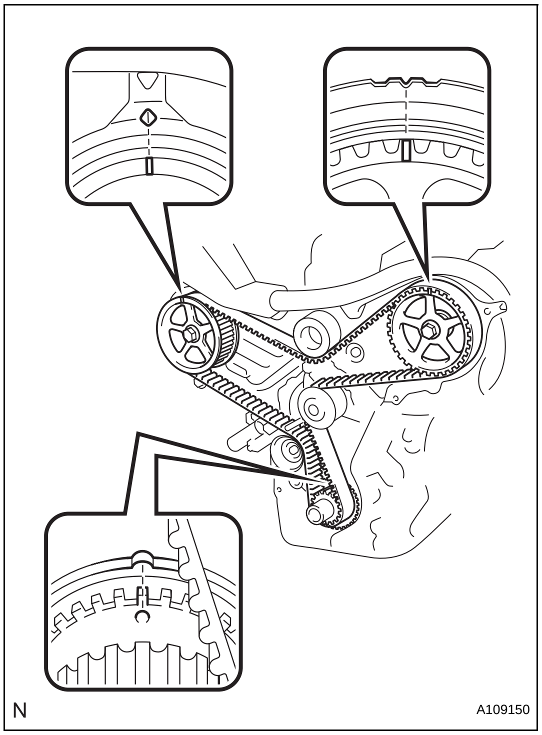
11 CHECK AIR INDUCTION SYSTEM

(a) Check the air induction system for vacuum leakage.
OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

12	CHECK VALVE TIMING



(a) Remove the cylinder head cover.
(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 aligned with the timing marks of the No.3 timing belt cover as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°) and align the marks as above.
OK:
Point marks on camshaft timing gears are aligned as shown in illustration.
(d) Reinstall the cylinder head cover.

ES

NG → **ADJUST VALVE TIMING**

OK

13	CHECK FUEL PRESSURE

(a) Check the fuel pressure (See page FU-8).
Standard:
304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44.1 to 49.7 psi)

NG → **CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER**

OK

14	READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.
Standard:
With cold engine:
Same as ambient air temperature.
With warm engine:
Between 75°C and 95°C (167°F and 203°F).

NG → **REPLACE E.F.I. ENGINE COOLANT TEMPERATURE SENSOR**

OK

15	READ VALUE USING INTELLIGENT TESTER (MAF)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF and COOLANT TEMP.
(e) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
(f) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.

Standard:

MAF while engine idling:

Between 2.1 g/s and 3.1 g/s (shift position: N).

MAF at engine speed of 2,500 rpm:

Between 7.8 g/s and 11.4 g/s (shift position: N).

NG → **REPLACE MASS AIR FLOW METER**

OK

CHECK FOR INTERMITTENT PROBLEMS

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)

DTC	P0332	Knock Sensor 2 Circuit Low Input (Bank 2)

DTC	P0333	Knock Sensor 2 Circuit High Input (Bank 2)

DESCRIPTION

A flat type knock sensor (non-resonant type) can detect vibrations in a wide band of frequency (about 6 kHz to 15 kHz) and has the following features:

- Knock sensors are fitted on the cylinder block to detect the engine knocking.
- The sensor contains a piezoelectric element which generates a voltage when the cylinder block vibrates due to knocking. If engine knocking occurs, the ignition timing is retarded to suppress it.

DTC No.	DTC Detection Condition	Trouble Area
P0327 P0332	Output voltage of the knock sensor 1 or 2 is 0.5 V or less	• Short in knock sensor 1 or 2 circuit • Knock sensor 1 or 2 • ECM
P0328 P0333	Output voltage of the knock sensor 1 or 2 is 4.5 V or more	• Open in knock sensor 1 or 2 circuit • Knock sensor 1 or 2 • ECM

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the sensor picks up vibrations in a specific frequency range. When the ECM detects the voltage in this frequency range, it retards the ignition timing to suppress the spark knock.

The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, and if the knock sensor output voltage is out of normal range, the ECM interprets this as a fault in the knock sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0327: Knock Sensor (Bank 1) Range Check (Low voltage) P0328: Knock Sensor (Bank 1) Range Check (High voltage) P0332: Knock Sensor (Bank 2) Range Check (Low voltage) P0333: Knock Sensor (Bank 2) Range Check (High voltage)
Required sensors / components (Main)	Knock Sensor
Required sensors / components (Related)	MAF meter, Crankshaft position sensor, ECT sensor
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	10.5 V or more
Time after engine start	5 seconds or more

Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

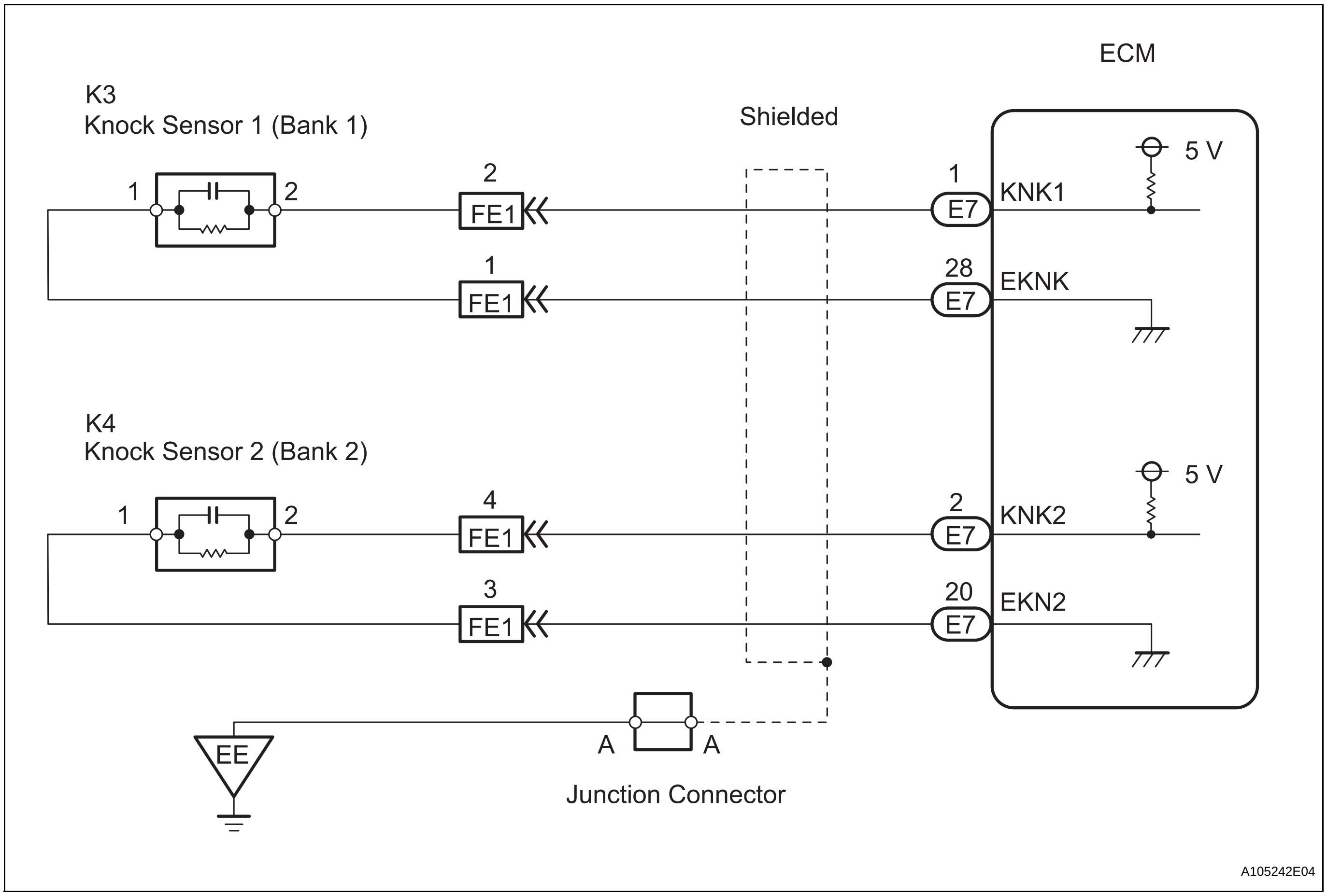
Knock Sensor Range Check (Low voltage):

Knock sensor Voltage	Less than 0.5 V

Knock Sensor Range Check (High voltage):

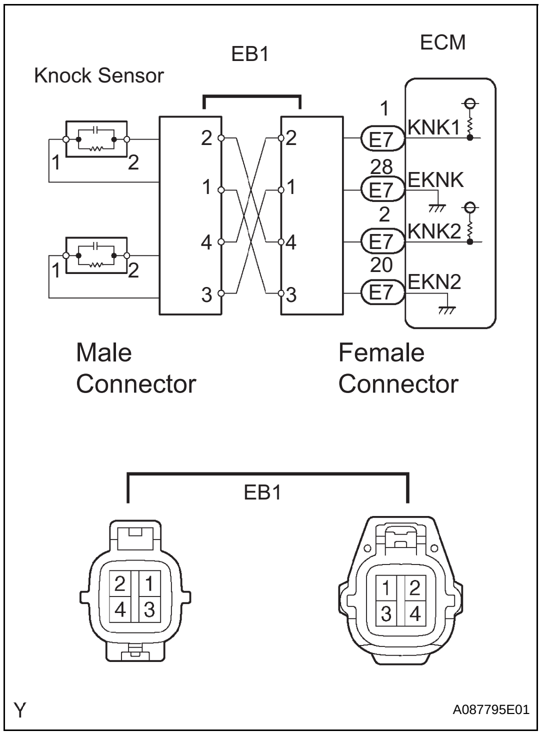
Knock sensor voltage	More than 4.5 V

WIRING DIAGRAM



HINT:
- DTC P0327 and P0328 are for the bank 1 knock sensor circuit.
- DTC P0332 and P0333 are for the bank 2 knock sensor circuit.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	READ OUTPUT DTC (CHECK KNOCK SENSOR CIRCUIT)



(a) Disconnect the EB1 connector.
(b) Using lead wires, connect the EB1 terminals as follows.

Male Connector - Female Connector
Terminal 2 - Terminal 4
Terminal 1 - Terminal 3
Terminal 4 - Terminal 2
Terminal 3 - Terminal 1

(c) Warm up the engine.
(d) Run the engine at 3,000 rpm for 10 seconds or more.
(e) Check the DTC (See page ES-29).

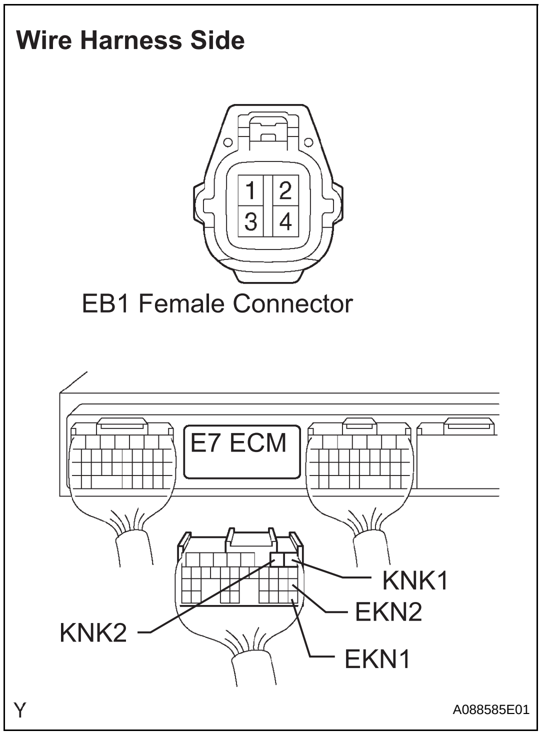
Result

Display	Proceed to
DTC same as when vehicle brought in P0327, P0328 → P0327, P0328 or P0332, P0333 → P0332, P0333	**A**
DTC different from when vehicle brought in P0327, P0328 → P0332, P0333 or P0332, P0333 → P0327, P0328	**B**

B → **Go to step 4**

A

2	CHECK WIRE HARNESS (FE1 FEMALE CONNECTOR - ECM)



(a) Disconnect the EB1 connector.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connector.

Resistance

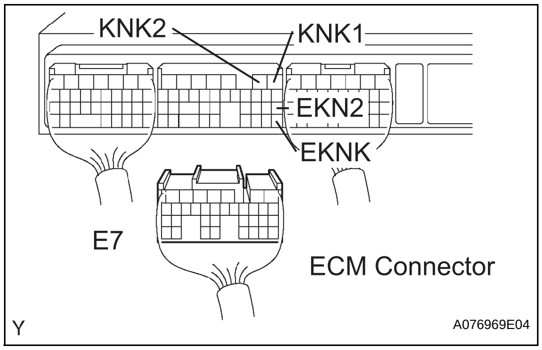
Tester Connection	Specified Condition
2 of EB1 female connector - E7-1 (KNK1) 1 of EB1 female connector - E7-28 (EKNK) 4 of EB1 female connector 4 - E7-2 (KNK2) 3 of EB1 female connector - E7-20 (EKN2)	**Below 1 Ω**
2 of EB1 female connector or E7-1 (KNK1) - Body ground 1 of EB1 female connector or E7-28 (EKNK) - Body ground 4 of EB1 female connector or E7-2 (KNK2) - Body ground 3 of EB1 female connector or E7-20 (EKN2) - Body ground	**10 kΩ or higher**

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

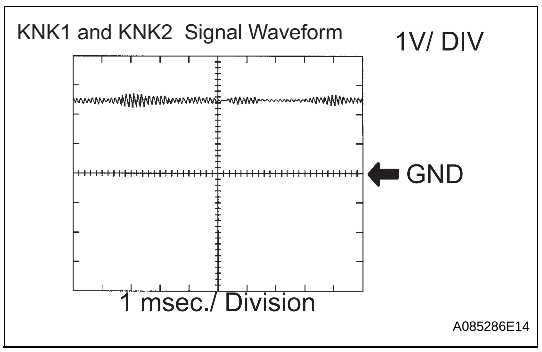
ES

OK

3	CHECK ECM (KNK1, KNK2 VOLTAGE)



(a) Disconnect the E7 ECM connector.
(b) Turn the ignition switch ON.



(c) Measure the voltage of ECM terminals.
Voltage

Tester Connection	Specified Condition
E7-1 (KNK1) - E7-28 (EKNK) E7-2 (KNK2) - E7-20 (EKN2)	4.5 to 5.5 V

Reconnect the E7 ECM connector.
HINT:
Reference: Inspection using an oscilloscope.
After warming up, run the engine at 4,000 rpm and check the waveform between terminal KNK1 and EKNK of the ECM connector.
Voltage

Tester Connection	Specified Condition
E7-1 (KNK1) - E7-28 (EKNK) E7-2 (KNK2) - E7-20 (EKN2)	Correct waveform is as shown

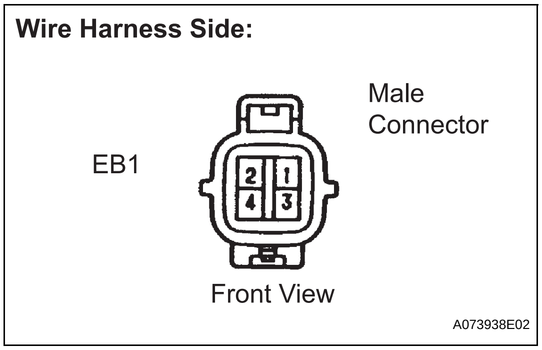
NOTICE:
Fault may be intermittent. Check harness and connectors carefully and retest.

NG → **REPLACE ECM**

OK

CHECK FOR INTERMITTENT PROBLEMS

4	INSPECT KNOCK SENSOR (RESISTANCE)



(a) Disconnect the EB1 connector.
(b) Measure the resistance between the terminals of the EB1 male connector.
Restance

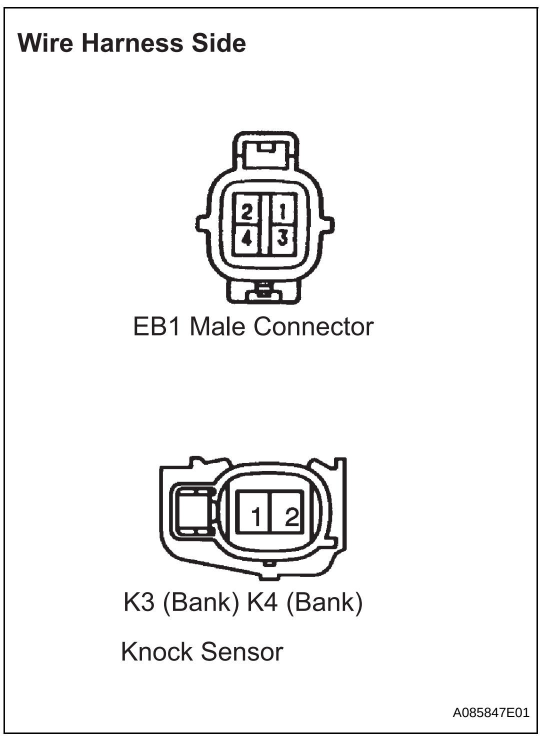
Tester Connection	Specified Condition
2 - 1 of EB1 male connector 4 - 3 of EB1 male connector	120 to 280 kΩ

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG ↓

5	CHECK WIRE HARNESS (FE1 MALE CONNECTOR - KNOCK SENSOR)

HINT:
- If DTC P0327 has changed to P0328, or if DTC P0332 has changed to P0333, check the knock sensor circuit on the bank 1 side.
- If DTC P0332 has changed to P0327, or if DTC P0333 has changed to P0338, check the knock sensor circuit on the bank 2 side.



(a) Disconnect the EB1 connector.
(b) Disconnect the K3 or K4 knock sensor connector.
(c) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
2 of EB1 male connector - K3-2 1 of EB1 male connector - K3-1 4 of EB1 male connector - K4-2 3 of EB1 male connector - K4-1	Below 1 Ω
2 of EB1 male connector or K3-2 - Body ground 1 of EB1 male connector or K3-1 - Body ground 4 of EB1 male connector or K4-2 - Body ground 3 of EB1 male connector or K4-1 - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK ↓

REPLACE KNOCK SENSOR

DTC	P0335	Crankshaft Position Sensor "A" Circuit

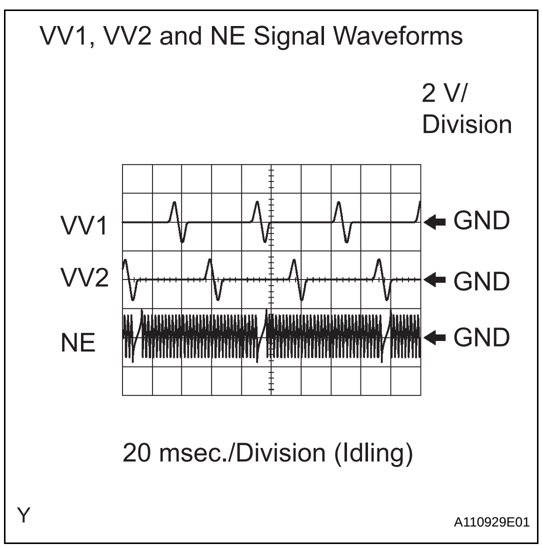
DTC	P0339	Crankshaft Position Sensor "A" Circuit Intermittent

DESCRIPTION

The crankshaft position sensor (NE signal) consists of a magnet, iron core and pickup coil.
The NE signal plate (crankshaft position sensor plate) has 34 teeth and is installed on the crankshaft. The NE signal sensor generates 34 signals for each engine revolution. This sensor monitors a plate (timing rotor) located on the crankshaft timing pulley and is used by the ECM to detect crankshaft angle and engine speed (RPM/NE). As the crankshaft timing pulley rotates through an engine revolution, this sensor communicates the rotation of the NE signal plate as a pulse signal to the ECM. Based on the signal, the ECM controls fuel injection time and ignition timing.

DTC No.	DTC Detection Condition	Trouble Area
P0335	• No CKP sensor signal to ECM while engine running (Engine rotating signal from ECM) (1 trip detection logic)	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0335	No crankshaft position sensor signal to ECM with engine speed 600 rpm or more (2 trip detection logic)	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Crankshaft timing pulley • ECM
P0339	No crankshaft position sensor signal is input to ECM for 0.05 seconds. or more, and conditions (a), (b) and (c) are met: (a) Engine is at 1,000 rpm or more (b) STA signal is OFF (c) 3 seconds or more have elapsed after STA signal is switched from ON to OFF	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Crankshaft timing pulley • ECM

Reference: Inspection using an oscilloscope.



HINT:
- The correct waveform is as shown.
- VV1+ and VV2+ stands for the VVT sensor signal, and NE+ stands for the CKP sensor signal.

Item	Content
Terminals	VV1+ - NE- VV2+ - NE- NE+ - NE-
Equipment Settings	5 V/Division, 20ms/Division

Item	Content
Conditions	Cranking or idling

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the engine revolving, the ECM interprets this as a malfunction of the sensor.
If the malfunction is not repaired successfully, these DTCs are set 10 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0335/P0339: CKP sensor range check or rationality
Required Sensors/Components (Main)	Crankshaft Position (CKP) sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	4.7 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None

Crankshaft Position Sensor Range Check During Cranking:

Starter	ON
Minimal battery voltage while starter is ON	Less than 11 V

Crankshaft Position Sensor Range Check During Engine Running:

Engine RPM	600 rpm or more
Starter	OFF
Time after starter turns from ON to OFF	3 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Crankshaft Position Sensor Range Check During Cranking:

Sensor signal	No signal for 4.7 seconds

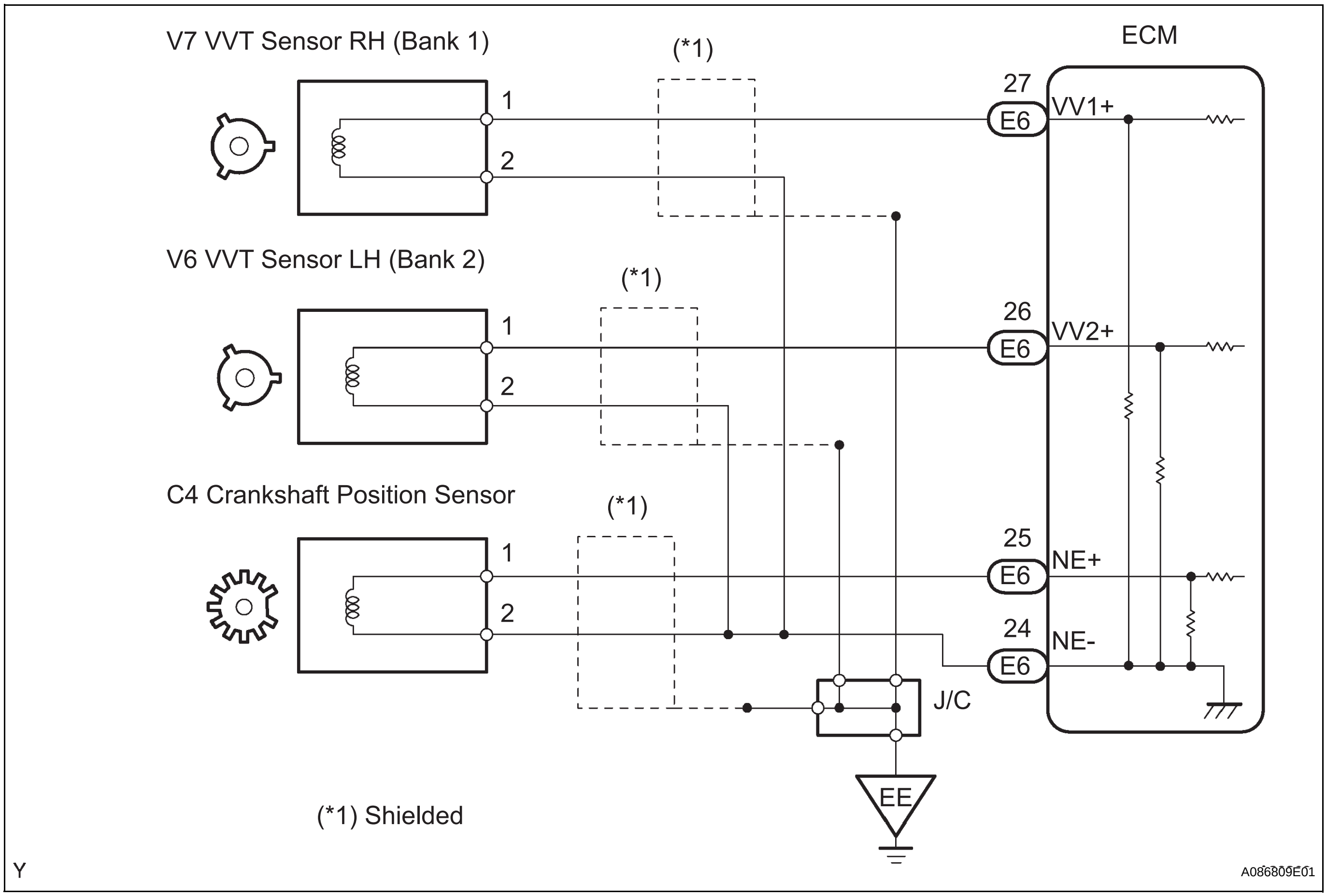
Crankshaft Position Sensor Range Check During Engine Running:

Crankshaft position signal during engine running	No signal for 0.016 seconds

COMPONENT OPERATING RANGE

Crankshaft position sensor signal	Crankshaft position sensor voltage fluctuates when the crankshaft rotates 34 crankshaft position sensor signals per 1 revolution of crankshaft

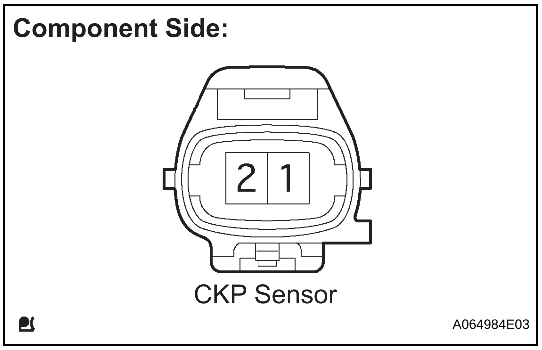
WIRING DIAGRAM



HINT:

- If no problem is found by this diagnostic troubleshooting procedure, troubleshooting the engine mechanical system.
- Check the engine speed. The engine speed can be checked by using the intelligent tester. To check, follow the operation below:
  (a) Connect the intelligent tester to the DLC3.
  (b) Start the engine.
  (c) Turn the tester ON
  (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ENGINE SPD.
  The engine speed may be indicated as zero despite the engine 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 lower than the actual engine speed, if the CKP sensor output voltage is insufficient.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	INSPECT CRANKSHAFT POSITION SENSOR



(a) Disconnect the C4 crankshaft position (CKP) sensor connector.
(b) Measure the resistance of the between terminal 1 and 2.
Standard resistance

Tester Connection	Condition	Specified Condition
1 - 2	Cold	1,630 to 2,740 Ω
1 - 2	Hot	2,065 to 3,225 Ω

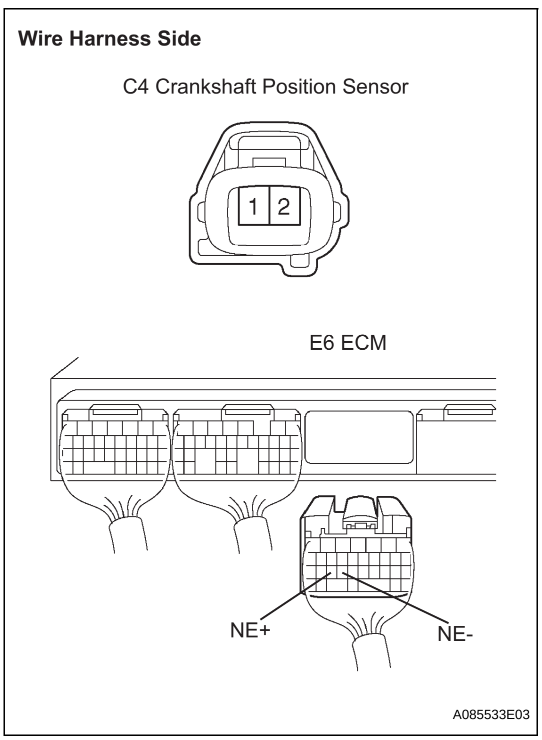
HINT:
Terms cold and hot refer to the temperature of the coils.
"Cold" means approximately -10 to 50°C (14 to 122°F).
"Hot" means approximately 50 to 100°C (122 to 212°F).
(c) Reconnect the CKP sensor connector.

NG → **REPLACE CRANKSHAFT POSITION SENSOR**

ES

OK

2	CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - HV CONTROL ECU)



(a) Disconnect the C4 CKP sensor connector.
(b) Disconnect the E6 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
C4-1 - E6-25 (NE+)	Below 1 Ω
C4-2 - E6-24 (NE-)	Below 1 Ω

Standard resistance (Check for short)

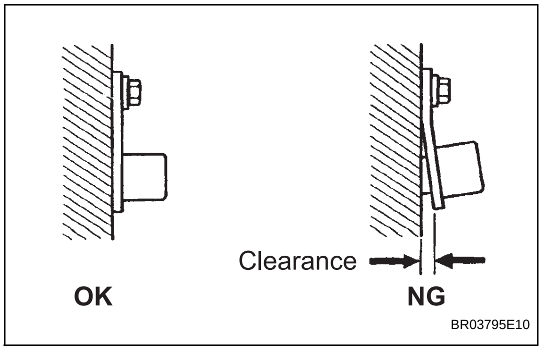
Tester Connection	Specified Condition
C4-1 or E6-25 (NE+) - Body ground	10 kΩ or higher
C4-2 or E6-24 (NE-) - Body ground	10 kΩ or higher

(d) Reconnect the ECM connector.
(e) Reconnect the CKP sensor connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3	CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)



(a) Check the CKP sensor installation.
OK:
Sensor is installed correctly.

NG → **TIGHTEN SENSOR**

ES

OK

4	CHECK CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE)

(a) Check the teeth of the sensor plate.
OK:
Sensor plate does not have any crack or deformation.

NG → **REPLACE CRANKSHAFT POSITION SENSOR PLATE**

OK

REPLACE HV CONTROL ECU

O2S TEST RESULT

1. INTRODUCTION

The O2S TEST RESULT refers to the results of the engine control module (ECM) when it monitors the oxygen sensor (O2S), and it can be read using the intelligent tester or the generic OBD II scan tool. Based on this, you can find the O2S's conditions.

The ECM monitors the O2S for various data. You can read the monitor result (TEST DATA) of each monitor item using the O2S TEST RESULT. However, the output value of the TEST DATA is the latest "snapshot" value that is taken after monitoring and therefore it is not dynamic.

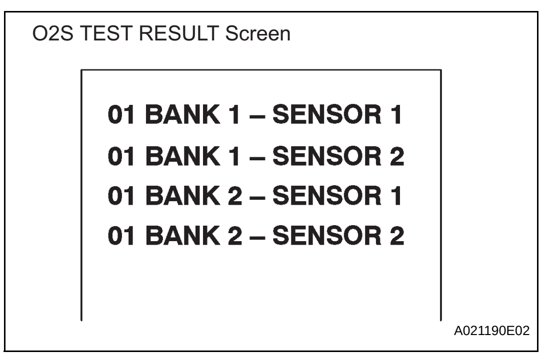
In this repair manual, the description of the O2S TEST RESULT (for O2S related DTCs) are written in a table. This table consists of 5 items:

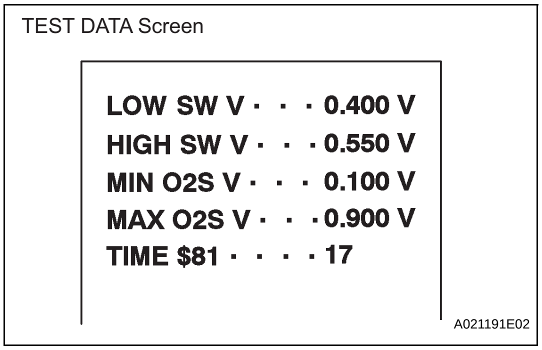
1. TEST ID (a code applied to each TEST DATA)
2. Description of TEST DATA
3. Conversion Factor (When conversion factor has a value written in the table, multiply the TEST DATA value appearing on the scan tool by the conversion factor value. The result will be the required value.)
4. Unit
5. Standard Value
   If the TEST DATA value appearing on the scan tool is out of the standard value, the O2S is malfunctioning. If it is within the standard value, the O2S is functioning normally. However, if the value is on the borderline of the standard value, the O2S may malfunction very soon.

2. HOW TO READ O2S TEST RESULT USING INTELLIGENT TESTER

(a) Connect the intelligent tester to the DLC3.

(b) On the tester screen, select the following menus: DIAGNOSIS / CARB OBDII / O2S TEST RESULT. A list of the O2S equipped on the vehicle will be displayed.





(c) Select the desired O2S and press ENTER. The following screen will appear.

(d) Press HELP and * simultaneously. More information will appear.

(e) Example:

(1) The intelligent tester displays "17" as a value of the "TIME $81" (see the illustration on the left).

(2) Find the conversion factor value of "TIME $81" in the O2S TEST RESULT chart below. 0.3906 is specified for $81 in this chart.

(3) Multiply "17" in step (1) by 0.3906 (conversion factor) in the step (2).
17 x 0.3906 = 6.6 %

(4) If the answer is within the standard value, the "TIME $81" can be confirmed to be normal.

O2S TEST RESULT Chart

TEST ID	Description of TEST DATA	Conversion Factor	Unit	Standard Value
$81	Percentage of monitoring time when the O2S voltage is less than 0.05 V	Multiply 0.3906	%	Within 60 %

DTC	P0340	Camshaft Position Sensor Circuit Malfunction

DTC	P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)

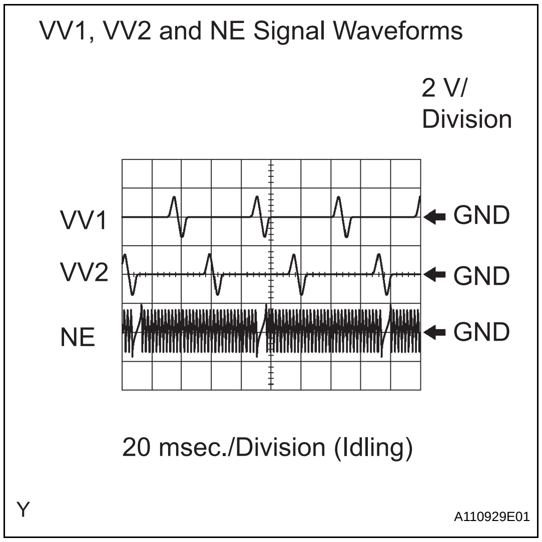
DTC	P0345	Camshaft Position Sensor "A" Circuit (Bank 2)

DTC	P0346	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 2)

DESCRIPTION

The intake camshaft's Variable Valve Timing (VVT) sensor (G signal) consists of a magnet and MRE element.
The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and pickup coil, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear 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.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each engine revolution. Based the G signal and actual crankshaft angle, the ECM detects the normal crankshaft angle. Also, based on the NE signal, the ECM detects the engine speed.

DTC No.	DTC Detection Condition	Trouble Area
P0340 P0345	• No VVT sensor signal to ECM during cranking. (1 trip detection logic) • No VVT sensor signal to ECM with engine speed 600 rpm or more (1 trip detection logic)	• Open or short in VVT sensor • VVT sensor • Camshaft timing gear • Jumped tooth of timing belt • ECM
P0341	While crankshaft rotates twice, VVT sensor signal is input to ECM 12 times or more. (1 trip detection logic)	• Open or short in VVT sensor • VVT sensort • Camshaft timing gear • Jumped tooth of timing belt • ECM
P0346	While crankshaft rotates twice, VVT sensor signal is input to ECM 5 times or more. (1 trip detection logic)	• Open or short in VVT sensor • VVT sensort • Camshaft timing gear • Jumped tooth of timing belt • ECM



Reference: Inspection using an oscilloscope
HINT:
- The correct waveform is shown.
- VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.

Item	Content
Terminals	NE+ - NE- VV1+ - NE- VV2+ - NE-
Equipment Settings	5 V/Division, 20 ms/Division
Conditions	Cranking or idling

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

MONITOR STRATEGY

Related DTCs	P0340: VVT position/Crankshaft position misalignment (Bank 1) P0341: Camshaft position sensor (Bank 1) Malfunction P0345: VVT sensor (Bank 2) range check P0346: VVT sensor (Bank 2) Malfunction
Required Sensors/Components (Main)	VVT position sensor (Bank 1 and 2)
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	5 seconds
MIL Operation	2 driving cycles: Camshaft position sensor range check, VVT sensor range check (case 1) Immediate: Others

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	None

P0340:

Engine speed	600 rpm or more
Starter	OFF

P0341 :

Starter	After OFF to ON timing

P0345:

Engine RPM	600 rpm or more
Battery voltage	8 V or more
Ignition switch	ON

P0346:

Starter	After OFF to ON timing

TYPICAL MALFUNCTION THRESHOLDS

P0340, P345:

Camshaft position and crankshaft position alignment	Miss-aligned

P0340, P0345:

VVT sensor signal	No signal

P0341:

Camshaft position and crankshaft position alignment	Miss-aligned
Camshaft position signal count	12 signals or more

P0346:

VVT sensor signal count	12 signals or more

COMPONENT OPERATING RANGE

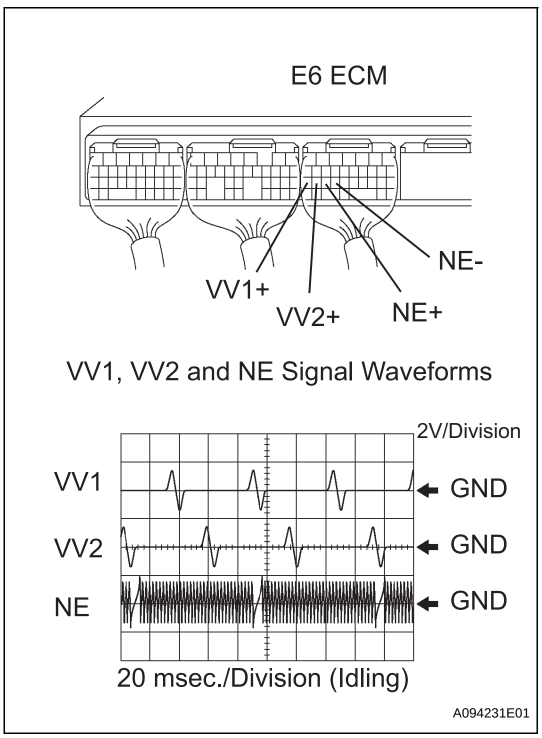
VVT sensor voltage	Camshaft position sensor voltage fluctuates when the crankshaft rotates 3 camshaft position signals per 1 revolution camshaft 3 camshaft position signals per 2 revolutions camshaft

WIRING DIAGRAM

Refer to DTC P0335 (See page ES-163).

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK ECU TERMINAL VOLTAGE (VV1+, VV2+, NE+ AND NE- TERMINALS)



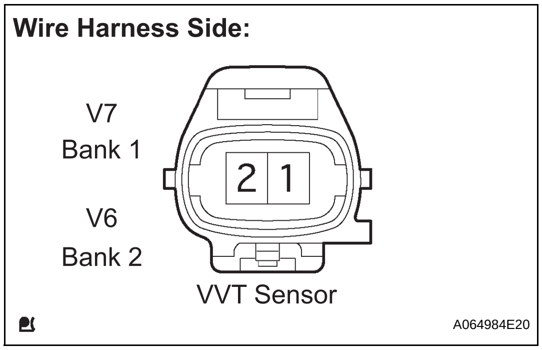
(a) Inspect the ECM using an oscilloscope.
(1) While the engine is idling, check the waveform between the terminals of the ECM connector.
Standard

Tester Connection	Specified Condition
E6-27 (VV1+) - E6-24 (NE-)	Correct waveform shown
E6-26 (VV2+) - E6-24 (NE-)	Correct waveform shown
E6-25 (NE+) - E6-24 (NE-)	Correct waveform shown

NG → **REPLACE VVT SENSOR**

OK

2 CHECK VVT SENSOR (SENSOR RESISTANCE)



(a) Disconnect the V4 or V5 VVT sensor connector.
(b) Measure the resistance between the terminals of the sensor.

Standard resistance

Tester Connection	Specified Condition
1 - 2	835 to 1,400 Ω at cold
1 - 2	1,060 to 1,645 Ω at hot

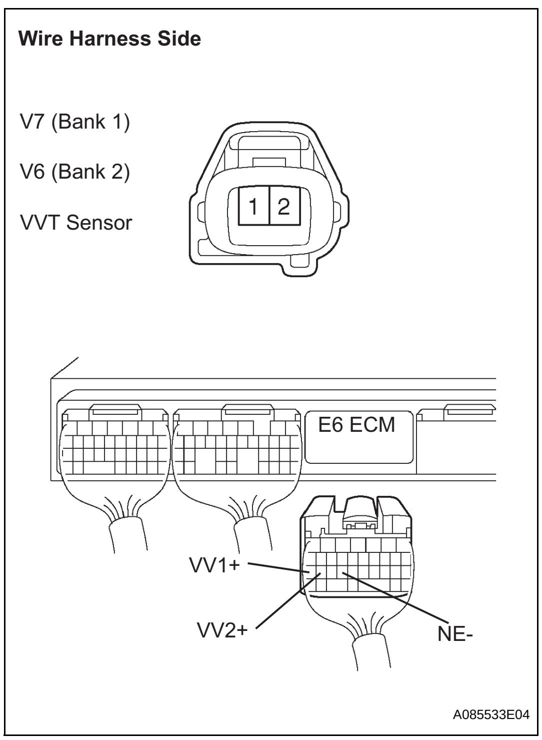
(c) Reconnect the VVT sensor connector.

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

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3 CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)



(a) Disconnect the V4 or V5 VVT sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance between the terminals of the VVT sensor and ECM.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-1 - E6-27 (VV1+)	Below 1 Ω
V6-1 - E6-26 (VV2+)	Below 1 Ω
V6 or V7-2 - E6-24 (NE-)	Below 1 Ω

Standard resistance (Check for short)

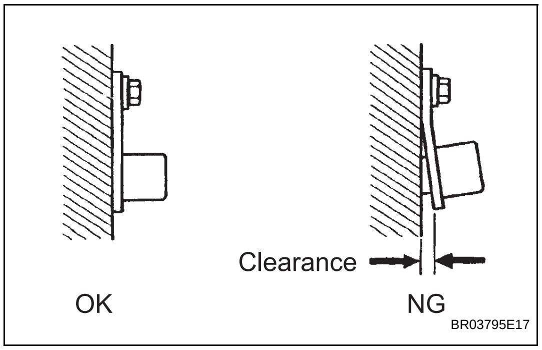
Tester Connection	Specified Condition
V7-1 or E6-27 (VV1+) - Body ground	10 kΩ or higher
V6 -1 or E6-26 (VV2+) - Body ground	10 kΩ or higher
2 of V6 or V7 or E6-24 (NE-) - Body ground	10 kΩ or higher

(d) Reconnect the VVT sensor connector.
(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

4	CHECK SENSOR INSTALLATION (VVT SENSOR)



(a) Check the CKP sensor installation.
OK:
Sensor is installed correctly.

NG → **TIGHTEN SENSOR**

OK ↓

5	CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF PLATE)

(a) Check the teeth of the signal plate.
OK:
Sensor plate teeth do not have any cracks or deformation.

NG → **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**

OK ↓

REPLACE ECM

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**

DTC	**P0355**	**Ignition Coil "E" Primary / Secondary Circuit**

DTC	**P0356**	**Ignition Coil "F" Primary / Secondary Circuit**

DESCRIPTION

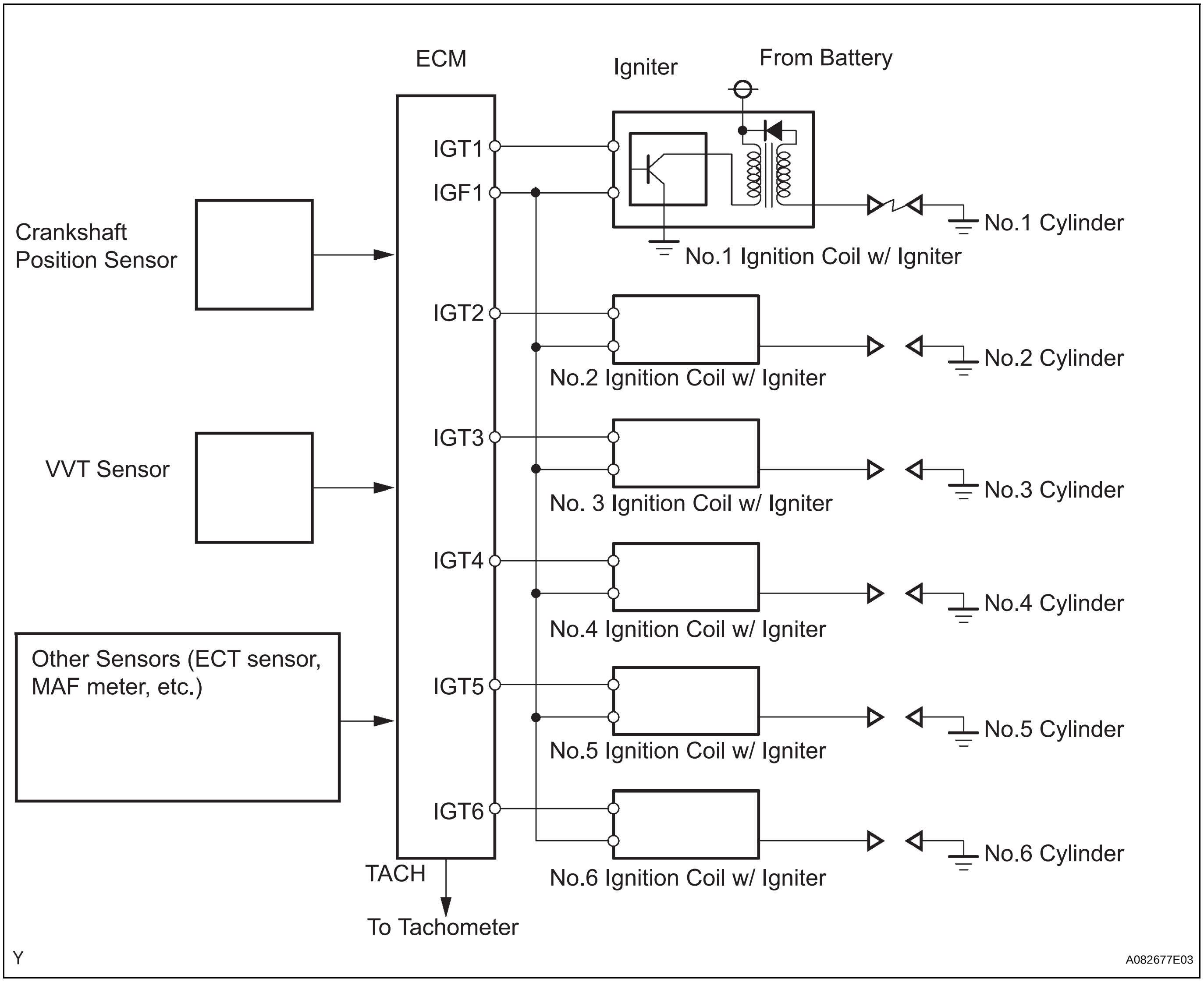
HINT:

- These DTCs indicate malfunctions relating to the primary circuit.
- IF DTC P0351 is set, check No. 1 ignition coil circuit.
- IF DTC P0352 is set, check No. 2 ignition coil circuit.
- IF DTC P0353 is set, check No. 3 ignition coil circuit.
- IF DTC P0354 is set, check No. 4 ignition coil circuit.
- IF DTC P0355 is set, check No. 5 ignition coil circuit.
- IF DTC P0356 is set, check No. 6 ignition coil circuit.

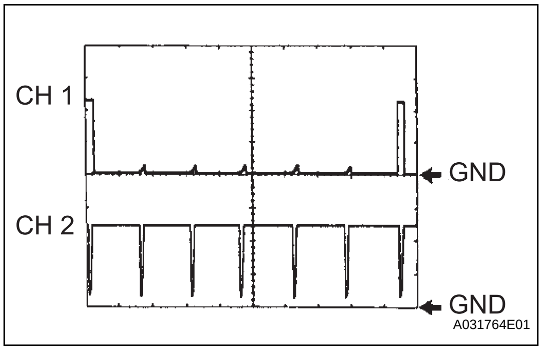
A Direct Ignition System (DIS) is used on this vehicle.

The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and 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 (Included in ECM) determines the ignition timing and transmits the ignition signals (IGT) 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 signal (IGF) to the ECM, for each cylinder ignition.



DTC No.	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal to ECM while engine running (1 trip detection logic)	• Ignition system • Open or short in IGF1 and IGT circuit (1 to 6) between ignition coil and ECM • No. 1 to No. 6 ignition coils • ECM

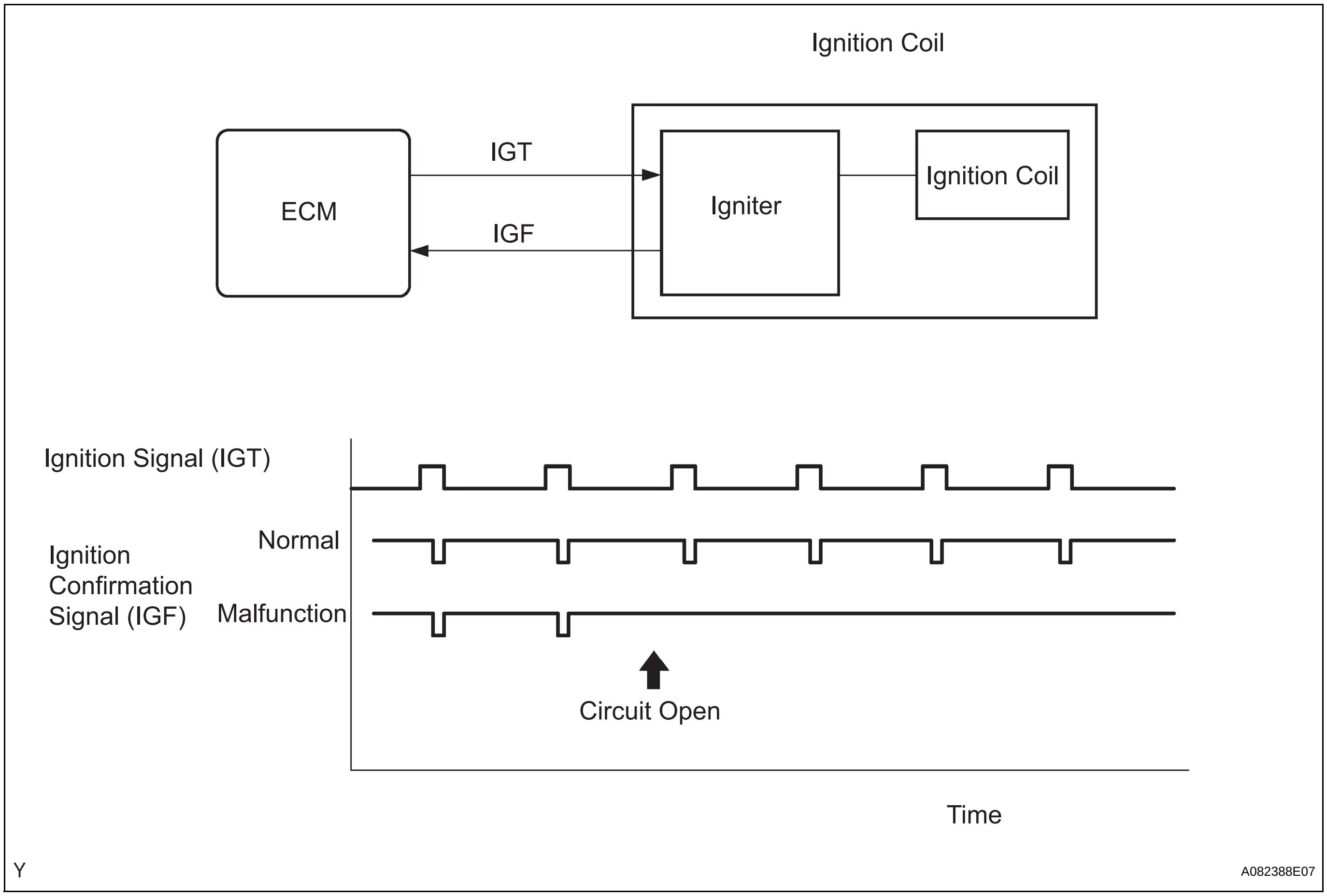


Reference: Inspection using an oscilloscope.

While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

Item	Content
Terminals	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Settings	2 V/Division, 20 ms/DIvision
Conditions	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and sets a DTC.
If the malfunction is not repaired successfully, a DTC is set 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 P0355: Igniter (cylinder 5) malfunction P0356: Igniter (cylinder 6) malfunction
Required Sensors/Components (Main)	Igniter (Cylinder 1 to 6)
Frequency of Operation	Continuous
Duration	0.256 seconds and 4 sparks
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Either of following conditions 1 or 2 met	-
1. Following conditions (a) and (b) met:	-
(a) Engine RPM	500 rpm or less
(b) Battery voltage	6 V or more
2. Following conditions (a) and (b) met:	-
(a) Engine RPM	More than 500 rpm
(b) Battery voltage	10 V or more

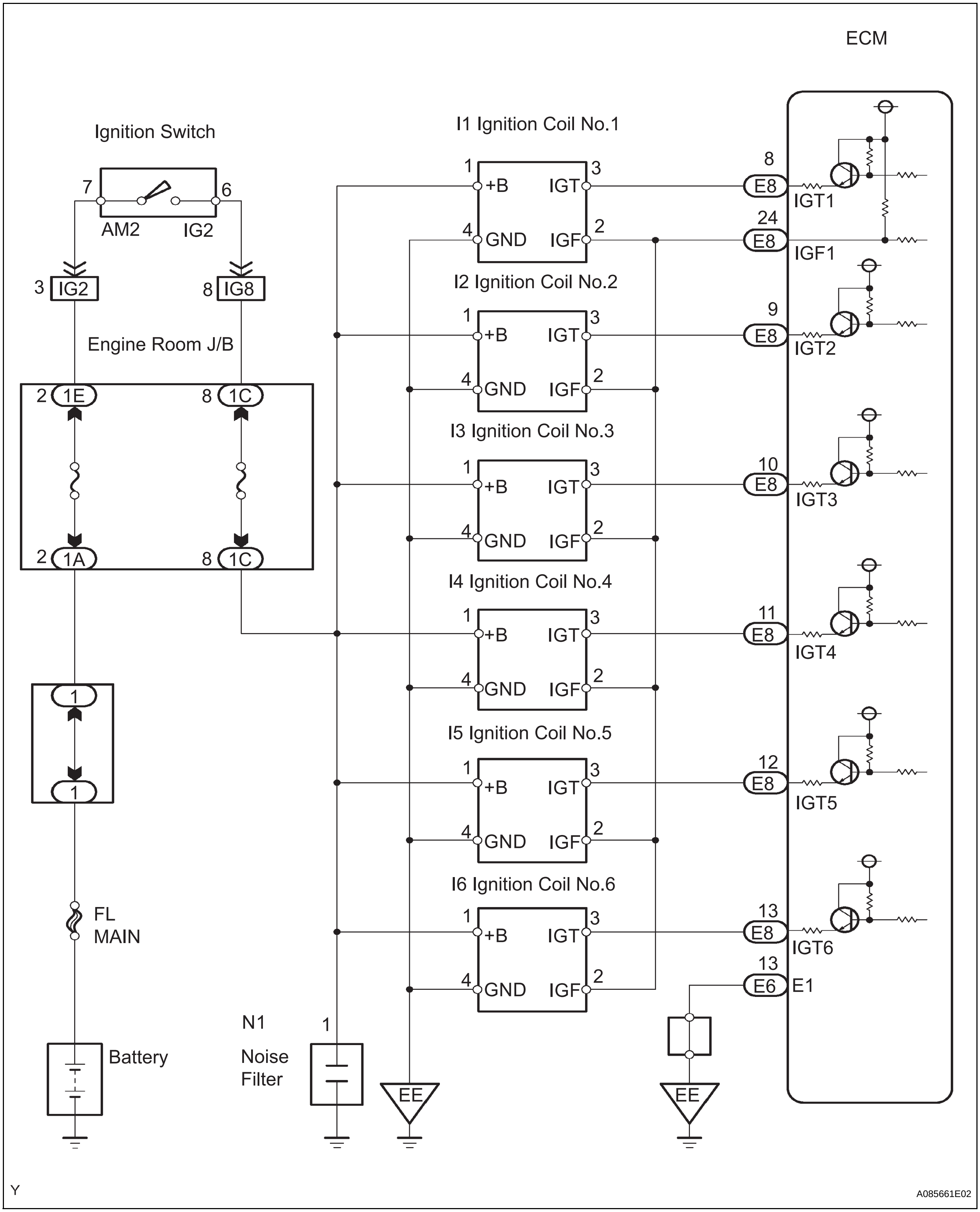
TYPICAL MALFUNCTION THRESHOLDS

Ignition signal fail count	More than 2 times
Ignition signal fail count is on the right:	No ignition confirmation signal from ignitor

COMPONENT OPERATING RANGE

IGF signal	Igniter transmits IGF signal when it receives IGT signal from ECM

WIRING DIAGRAM



ES

HINT:

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1 PERFORM SIMULATION TEST

(a) Clear the DTC(s) (See page ES-29).

(b) Change the arrangement of the ignition coils (with igniters).

NOTICE:

Do not change the location of the connectors.

(c) Reform a simulation test.

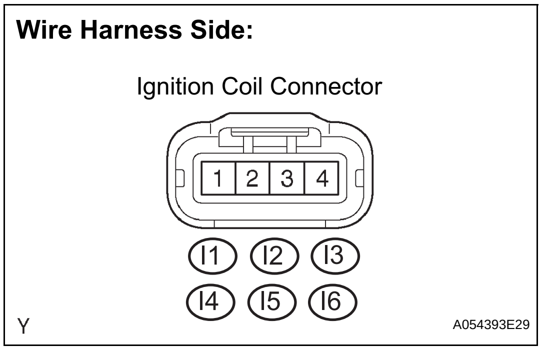
Result

Display (DTC Output)	Proceed to
Same DTCs (that have been erased)	A
Other DTCs	B

B → **REPLACE IGNITION COIL ASSEMBLY**

A

2 INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)



(a) Disconnect the I1, I2, I3, I4, I5 or I6 ignition coil connector.

(b) Turn the ignition switch ON.

(c) Measure the voltage between the terminal of the wire harness side connector and body ground.

Standard voltage

Tester Connection	Specified Condition
I1-1 (+B) - Body ground	9 to 14 V
I2-1 (+B) - Body ground	9 to 14 V
I3-1 (+B) - Body ground	9 to 14 V
I4-1 (+B) - Body ground	9 to 14 V
I5-1 (+B) - Body ground	9 to 14 V
I6-1 (+B) - Body ground	9 to 14 V

(d) Measure the resistance between the wire harness side connectors.

Standard resistance

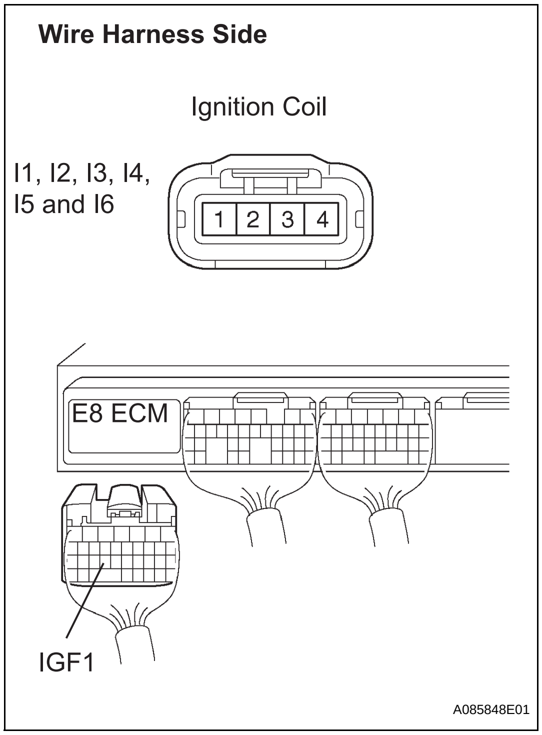
Tester Connection	Specified Condition
I1-4 (GND) - Body ground	Below 1 Ω
I2-4 (GND) - Body ground	Below 1 Ω
I3-4 (GND) - Body ground	Below 1 Ω
I4-2 or E8-24 (IGF1) - Body ground	Below 1 Ω
I5-4 (GND) - Body ground	Below 1 Ω
I6-4 (GND) - Body ground	Below 1 Ω

ES

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3 CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - HV CONTROL ECU)



(a) Disconnect the I1, I2, I3, I4, I5 or I6 ignition coil connector.
(b) Disconnect the ECM E8connectors.
(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
I1-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I2-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I3-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I4-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I5-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I6-2 (IGF) - E8-24 (IGF1)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
I1-2 (IGF) - E8-24 (IGF1) - Body ground	10 kΩ or higher
I2-2 (IGF) - E8-24 (IGF1) - Body ground	10 kΩ or higher
I3-2 (IGF) - E8-24 (IGF1) - Body ground	10 kΩ or higher
I4-2 (IGF) - E8-24 (IGF1) - Body ground	10 kΩ or higher
I5-2 (IGF) - E8-24 (IGF1) - Body ground	10 kΩ or higher
I6-2 (IGF) - E8-24 (IGF1) - Body ground	10 kΩ or higher

Standard resistance (Check for open)

Tester Connection	Specified Condition
I1-3 (IGT) - E8-8 (IGT1)	Below 1 Ω
I2-3 (IGT) - E8-9 (IGT2)	Below 1 Ω
I3-3 (IGT) - E8-10 (IGT3)	Below 1 Ω
I4-3 (IGT) - E8-11 (IGT4)	Below 1 Ω
I5-3 (IGT) - E8-12 (IGT5)	Below 1 Ω
I6-3 (IGT) - E8-13 (IGT6)	Below 1 Ω

Standard resistance (Check for short)

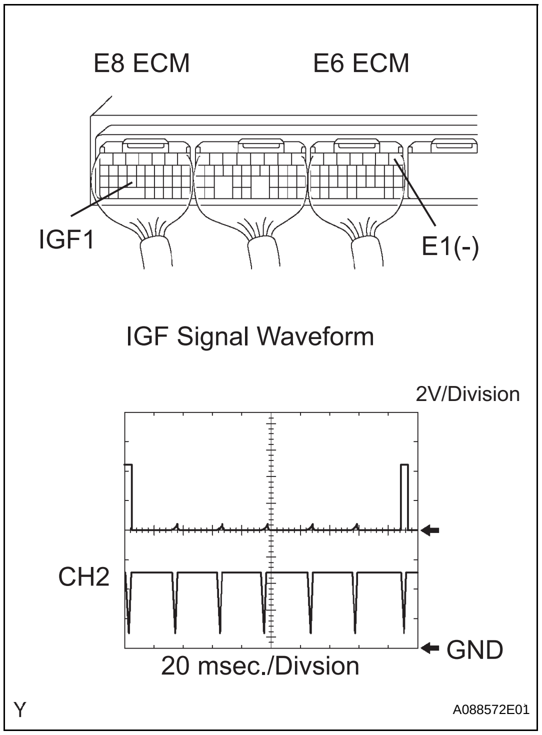
Tester Connection	Specified Condition
I1-3 (IGT) - E8-8 (IGT1) - Body ground	10 kΩ or higher
I2-3 (IGT) - E8-9 (IGT2) - Body ground	10 kΩ or higher
I3-3 (IGT) - E8-10 (IGT3)- Body ground	10 kΩ or higher
I4-3 (IGT) - E8-11 (IGT4) - Body ground	10 kΩ or higher

Tester Connection	Specified Condition
I5-3 (IGT) - E8-12 (IGT5) - Body ground	10 kΩ or higher
I6-3 (IGT) - E8-13 (IGT6) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

4 CHECK ECM (IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGF1 SIGNAL)



(a) Inspect using an oscilloscope.
(b) Start the engine.
(c) Check the waveform of the ECM connectors.
Standard

Tester Connection	Specified Condition
E8-24 (IGF1) - E6-1 (E1) E8-8 (IGT1) - E6-1 (E1) E8-9 (IGT2) - E6-1 (E1) E8-10 (IGT3) - E6-1 (E1) E8-11 (IGT4) - E6-1 (E1) E8-12 (IGT5) - E6-1 (E1) E8-13 (IGT6) - E6-1 (E1)	Correct waveform is shown

NG → **REPLACE ECM**

ES

OK

5 CHECK IF DTC OUTPUT RECURS

(a) Clear the DTC (See page ES-29).
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch ON and turn the intelligent tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTC.

Result

Display (DTC Output)	Proceed to
P0351, P0352, P0353, P0354, P0355 and/or P0356 are output	A
No output	B

B → **REPAIR OR REPLACE SYSTEM OK**

A

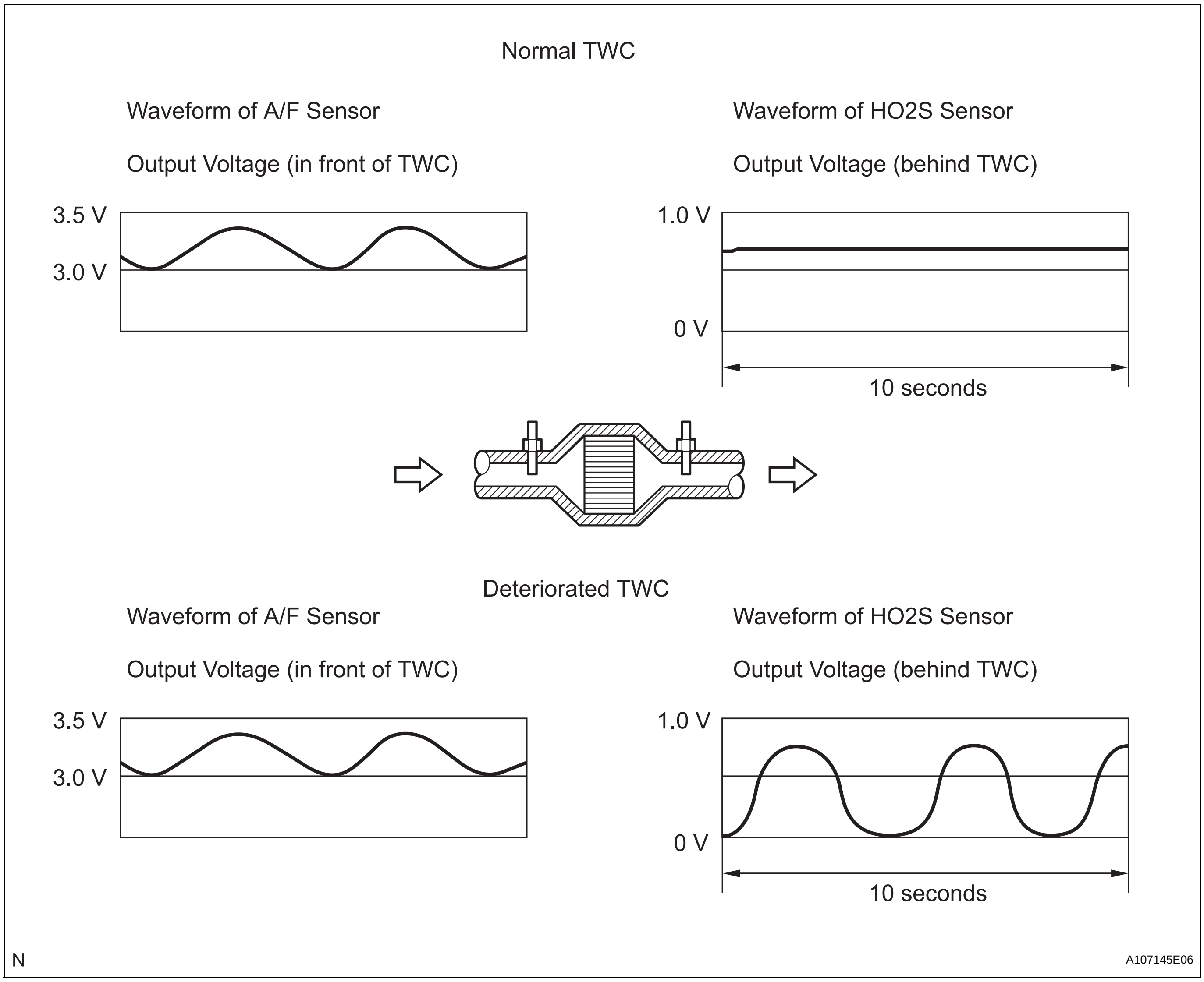
REPLACE ECM

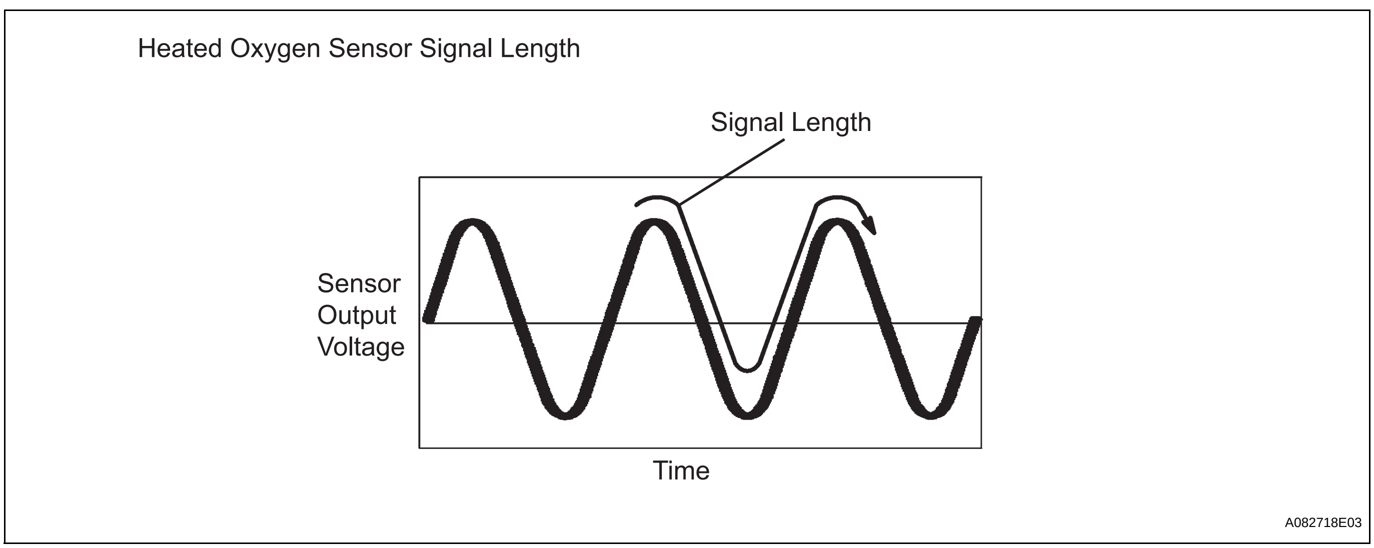
DTC	**P0420**	**Catalyst System Efficiency Below Threshold (Bank 1)**

DTC	**P0430**	**Catalyst System Efficiency Below Threshold (Bank 2)**

MONITOR DESCRIPTION

The ECM uses the two sensors, mounted in front of and behind the Three-way Catalytic Converter (TWC), to monitor its efficiency.
The first sensor, the Air-Fuel Ration (A/F) sensor (sensor 1), sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor (sensor 2), sends post-catalyst information to the ECM. The ECM compares the information transmitted by these two sensors to determine the efficiency of the TWC performance and its ability to store oxygen.
When the TWC is functioning properly, the variation in the oxygen concentration in the exhaust gas, after it has passed through the TWC, is small. As a result, the voltage output of sensor 2 slowly alternates between the rich and lean signal voltages (shown in the illustration below). As the TWC performance efficiency deteriorates, its oxygen storage capacity decreases, and the variation in the oxygen concentration in the exhaust gas increases. As a result, the sensor voltage output fluctuates frequently.
While the catalyst monitor is running, the ECM measures the signal length of both sensors 1 and 2, and calculate the ratio of the signal lengths to determine the extent of the TWC deterioration. If the deterioration level exceeds the preset threshold, the ECM interprets this as the TWC malfunction. The ECM then illuminates the MIL and sets the DTC.





DTC No.	DTC Detection Condition	Trouble Area
P0420	After engine and TWC warmed up, and while vehicle driven within set vehicle and engine speeds, waveform of Heated Oxygen (HO2) sensor (bank 1 sensor 2) alternates frequently between rich and lean (2 trip detection logic)	• Gas leakage from exhaust system • A/F sensor (bank 1 sensor 1) • HO2 sensor (bank 1 sensor 2) • Three-Way Catalytic Converter (TWC) (Exhaust manifold)

DTC No.	DTC Detection Condition	Trouble Area
P0430	After engine and catalyst are warmed up, and while vehicle is driven within set vehicle and engine speed ranges: Waveform of heated oxygen sensor (bank 2 sensor 2) alternates frequently between rich and lean (2 trip detection logic)	• Gas leakage from exhaust system • A/F sensor (bank 2 sensor 1) • HO2 sensor (bank 2 sensor 2) • Three-Way Catalytic Converter (TWC) (Exhaust manifold)

HINT:
- Bank 1 refers to the bank that includes cylinder No. 1
- Bank 2 refers to the bank that does not include cylinder No. 1
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR STRATEGY

Related DTCs	P0420: Catalyst (Bank 1) detection P0430: Catalyst (Bank 2) detection
Required Sensors/Components (Main)	TWC
Required Sensors/Components (Related)	A/F sensor, heated oxygen sensor, intake air temperature sensor, mass air flow meter, crankshaft position sensor and engine coolant temperature sensor
Frequency of Operation	Once par driving cycle
Duration	150 seconds or more
MIL Operation	2 driving cycles
Sequence of Operation	None

ES

TYPICAL ENABLING CONDITIONS

Monitor will run whenever this DTC is not present	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (O2 Sensor Heater - Sensor 2) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136, P0156 (O2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0356 (Ignitor) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2A00, P2A03 (A/F sensor - slow response)
Accumulated time that all of following conditions are met	30 seconds
Battery voltage	11 V or more
Intake air temperature	-10°C (14°F) or more
Idle	OFF
Mass air flow rate	10 to 50 g/sec.
Engine RPM	Less than 3,200 rpm
Engine coolant temperature sensor	75°C (167°F) or more
Fuel system status	Closed loop
A/F sensor	Activated
Estimated catalyst temperature	Both of following conditions 1 and 2 met
1. Up stream catalyst temperature	530 to 800°C (932 to 1472°F) or more
2. Down stream catalyst temperature	430 to 670°C (932 to 1472°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Oxygen storage capacity of catalyst	15 V or more (varies with A/F sensor locus length)

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-15).
The monitor result (mode 6) allows the OBD scan tool to display the monitor status, test value and test limit. A problem in this component can be found by comparing the test value and test limit. The procedure is described in "CHECKING MONITOR STATUS".

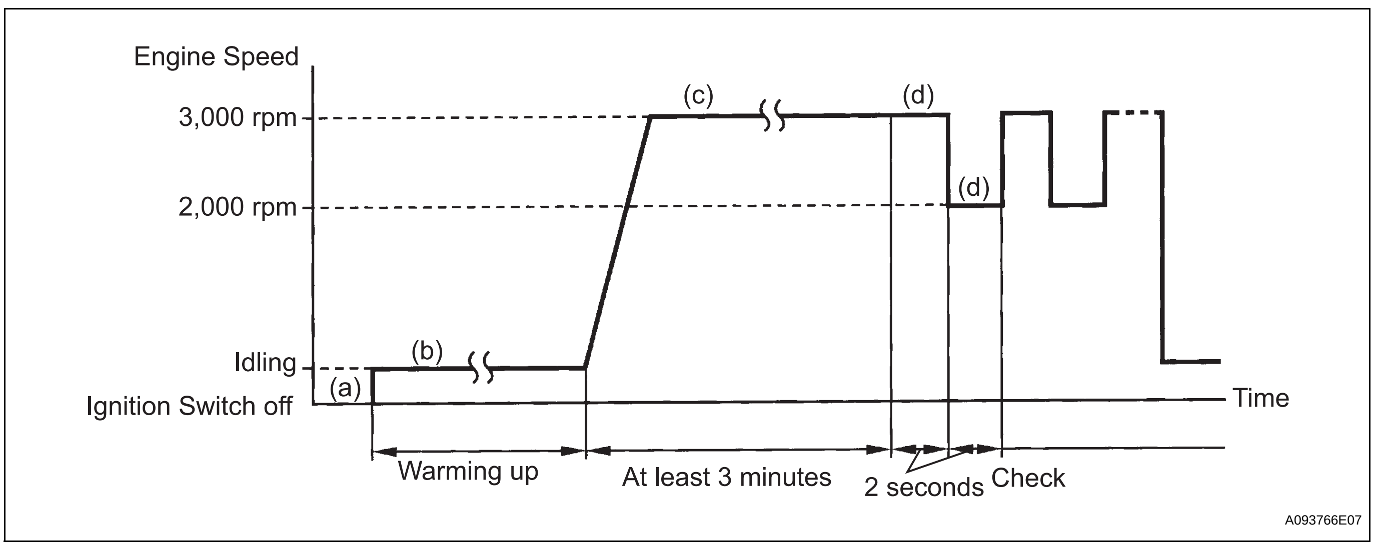
- TID (Test Identification Data) is assigned to each emission-related component.
- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification) is assigned to each test value.
- Unit Conversation is used to calculate the test value indicated on generic OBD scan tools.

TID $01: Catalyst - Using A/F Sensor and HO2

TLT	CID	Unit Conversion	Description of Test Value	Description of Test Limit
0	$01	Multiply by 0.0078 (no dimension)	Catalyst deterioration level (bank 1): Determined by waveform of A/F sensor and HO2S	Malfunction criterion
0	$01	Multiply by 0.0078 (no dimension)	Catalyst deterioration level (bank 1): Determined by waveform of A/F sensor and HO2S	Malfunction criterion for catalyst deterioration

CONDITIONING FOR SENSOR TESTING

HINT:
Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.



1. Connect the intelligent tester to the DLC3.
2. Start the engine and warm it up with all the accessories switched OFF, until the engine coolant temperature stabilizes.
3. Run the engine at engine speed of between 2,500 rpm and 3,000 rpm for at least 3 minutes.

4. While running the engine at 3,000 rpm for 2 seconds and 2,000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the tester or scan tool.

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	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V	 OK	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction	NG	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V	 OK	Output Voltage Almost no reaction	NG	
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

- Following the A/F CONTROL procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.
- To display the graph, enter the following menus on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 AND/OR P0430)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read DTCs.

ES

Result

Display (DTC output)	Proceed to
P0420 and/or P0430	A
P0420 and/or P0430 and other DTCs	B

HINT:
If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART**

A

2 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at engine speed of 2,500 rpm for approximately 90 seconds.
4. On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume.).
6. Monitor the output voltages of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:
- The A/F CONTROL 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 B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 or O2S B2S2 (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5 %	Lean	Less than 0.4

Result

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensor Conditions	Misfire	Main Suspected Trouble Areas	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• Three-Way Catalytic Converter (TWC) • Gas leakage from exhaust system	A

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensor Conditions	Misfire	Main Suspected Trouble Areas	Proceed to
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	May occur	• A/F sensor	B
Lean/Rich	Lean	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean/Rich	Rich	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean	Lean	Actual air-fuel ratio lean	May occur	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A
Rich	Rich	Actual air-fuel ratio lean	-	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A

Lean: During A/F CONTROL, the A/F sensor output voltage (AFS) is consistently more than 3.35 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During A/F CONTROL, the AFS is consistently less than 3.0 V, and the O2S is consistently more than 0.55 V.
Lean/Rich: During A/F CONTROL of the ACTIVE TEST, the output voltage of the HO2 sensor alternates correctly.

B → **CHECK AND REPLACE AIR FUEL RATIO SENSOR**

C → **CHECK AND REPLACE HEATED OXYGEN SENSOR, AND CHECK AND REPAIR EXHAUST GAS LEAKAGE**

A

3	CHECK FOR EXHAUST GAS LEAKAGE

OK:
No gas leakage.

NG → **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT**

OK

REPLACE THREE-WAY CATALYTIC CONVERTER

ES

DTC	P0441	Evaporative Emission Control System Incorrect Purge Flow

DESCRIPTION

The circuit description can be found in the EVAP INSPECTION PROCEDURE (See page ES-299).

Refer to the EVAP INSPECTION PROCEDURE (See page ES-304).

MONITOR DESCRIPTION

The ECM tests the Evaporative Emissions (EVAP) system using the fuel tank pressure sensor, Canister Close Valve (CCV), and EVAP VSV. The ECM closes the EVAP system and creates negative pressure (vacuum) into it. The ECM then monitors the internal pressure using the fuel tank pressure sensor (refer to the Leak Check graphic).

P0441

The EVAP VSV has the following features:

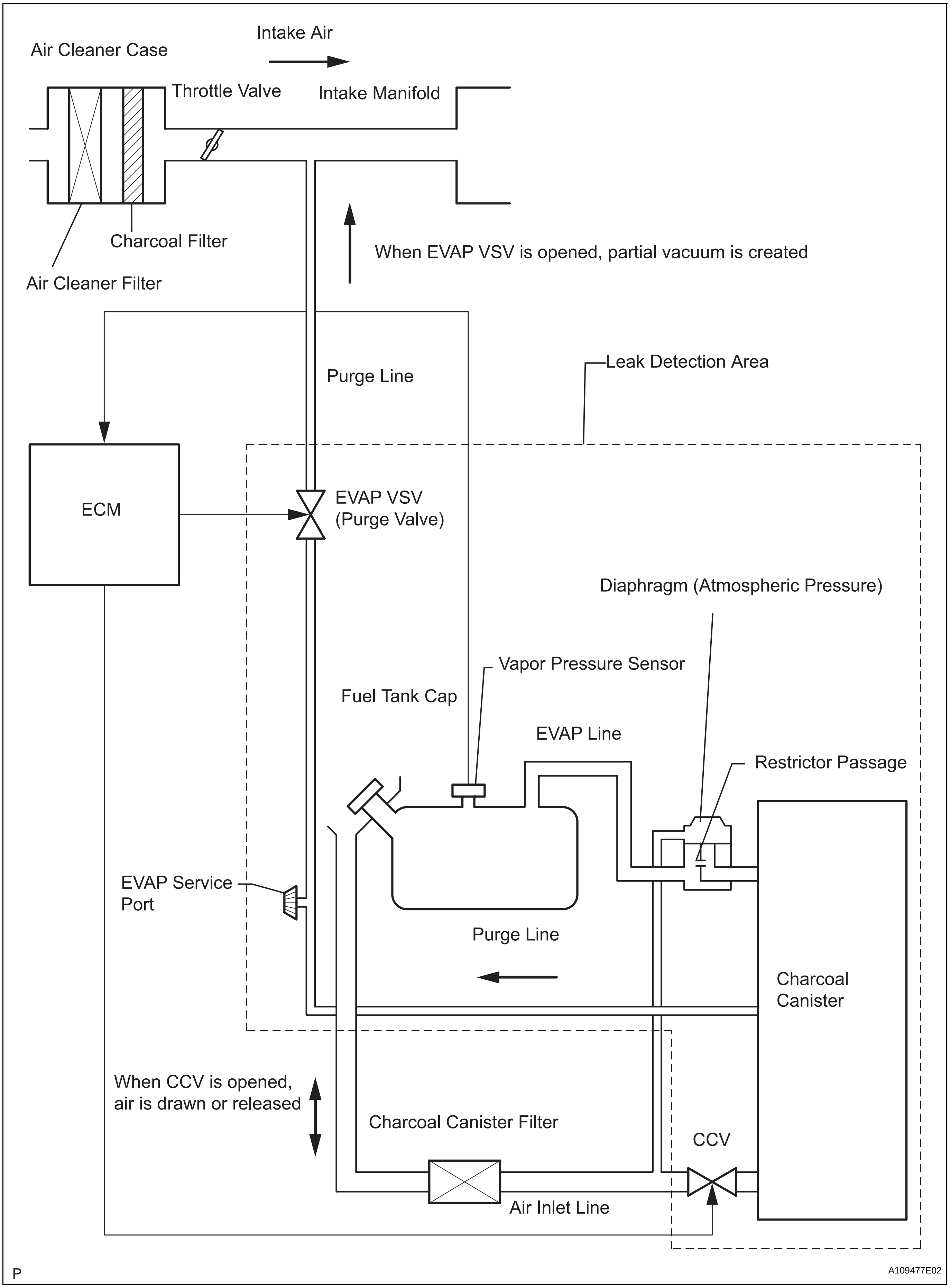
1. Purges the evaporative emissions from the fuel tank to the intake manifold.
2. Works with the CCV to create negative pressure (vacuum) inside the fuel tank and performs leak tests.

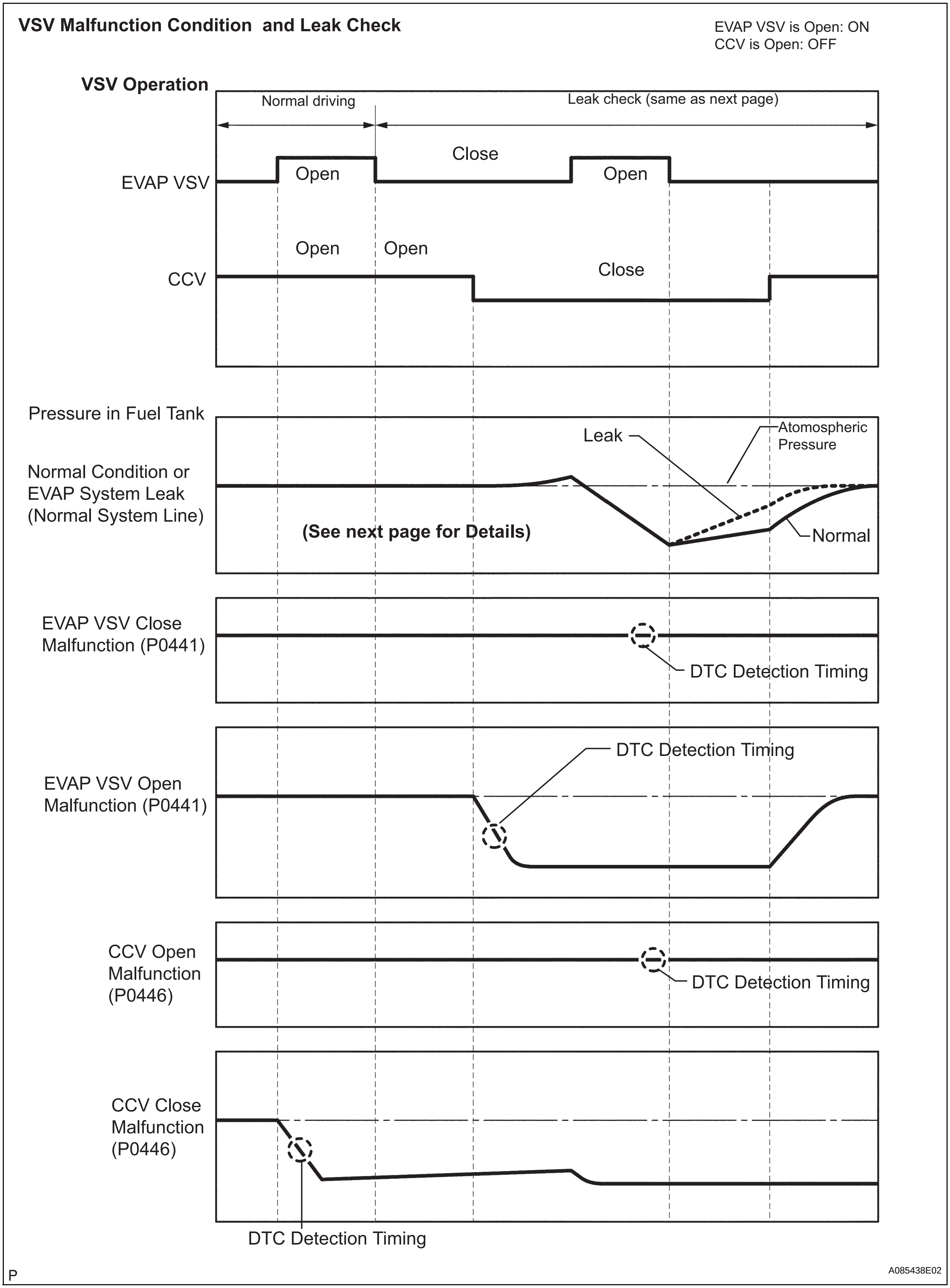
When the EVAP VSV remains open or closed, the ECM sets DTC P0441.

The ECM checks if the EVAP VSV is "stuck closed". The ECM commands the EVAP VSV to open while the CCV is closed. Under these circumstances, a high negative pressure (vacuum) should develop in the fuel tank. If no negative pressure develops, the ECM determines that the EVAP VSV remains closed despite the open command. The ECM will turn on the MIL and set a DTC.

The ECM also checks if the EVAP VSV is "stuck open". The ECM commands the EVAP VSV to close while the CCV is closed and the pressure in the fuel tank is the same as ambient pressure. Under these circumstances, the pressure in the fuel tank should remain at ambient pressure. If negative pressure develops in the fuel tank, the ECM determines that the EVAP VSV remains open despite the close command. The ECM will turn on the MIL and set a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0441	• Pressure in charcoal canister and fuel tank does not drop during purge control (2 trip detection logic) • During purge cut-off, negative pressure enters charcoal canister and fuel tank (2 trip detection logic)	• Vacuum hose has cracks, holes, or is blocked, damaged or disconnected • Fuel tank cap is incorrectly installed • Fuel tank cap has cracks or is damaged • Open or short in vapor pressure sensor circuit • Vapor pressure sensor • Open or short in EVAP VSV circuit • EVAP VSV • Open or short in CCV circuit • CCV • Fuel tank has cracks, holes, or is damaged • Charcoal canister has cracks, holes, or is damaged • Fuel tank over fill check valve has cracks, or is damaged • ECM

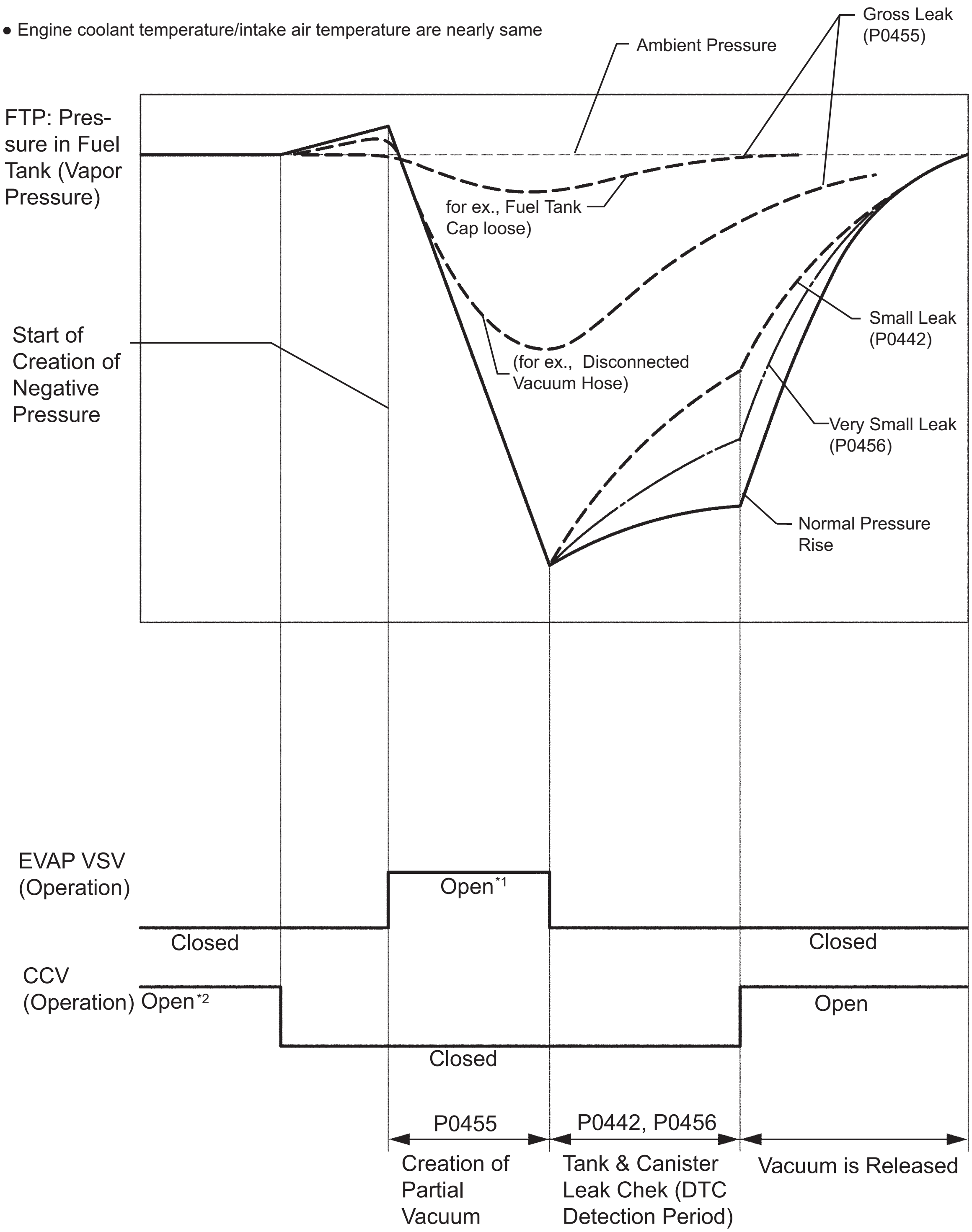

Intake Air
Air Cleaner Case
Throttle Valve
Intake Manifold
Charcoal Filter
Air Cleaner Filter
When EVAP VSV is opened, partial vacuum is created
Purge Line
Leak Detection Area
ECM
EVAP VSV
(Purge Valve)
Diaphragm (Atmospheric Pressure)
Vapor Pressure Sensor
Fuel Tank Cap
EVAP Line
Restrictor Passage
EVAP Service
Port
Purge Line
Charcoal
Canister
When CCV is opened,
air is drawn or released
Charcoal Canister Filter
CCV
Air Inlet Line
P
A109477E02


VSV Malfunction Condition and Leak Check
EVAP VSV is Open: ON
CCV is Open: OFF
VSV Operation
Normal driving
Leak check (same as next page)
EVAP VSV
Open
Close
Open
CCV
Open
Open
Close
Pressure in Fuel Tank
Normal Condition or
EVAP System Leak
(Normal System Line)
Leak
Atomospheric
Pressure
(See next page for Details)
Normal
EVAP VSV Close
Malfunction (P0441)
DTC Detection Timing
EVAP VSV Open
Malfunction (P0441)
DTC Detection Timing
CCV Open
Malfunction
(P0446)
DTC Detection Timing
CCV Close
Malfunction
(P0446)
DTC Detection Timing
P
A085438E02

Leak check

Initial Condition:

- Cold Start
- Engine coolant temperature/intake air temperature are nearly same



*1 : EVAP VSV is Open: ON
*2 : CCV is Open : OFF

P

A085439E02

MONITOR STRATEGY

Related DTCs	P0441: Purge VSV stuck open P0441: purge VSV stuck close
Required sensors / components (Main)	CCV, EVAP canister, EVAP hose, Fuel cap, Fuel tank and Purge VSV
Required sensors / components (Related)	ECT sensor, FTP sensor, IAT sensor, MAF meter, Vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	Within 60 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0011 (VVT system 1 - Advance) P0012 (VVT system 1 - Retard) P0021 (VVT system 2 - Advance) P0022 (VVT system 2- Retard) P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for close loop) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0358 (Ignitor) P0450 - P0453 (EVAP press sensor) P0500 (VSS) P2196, P2198 (A/F sensor (rationality)) P2237, P2240 (A/F sensor (open)) P2A00, P2A03 (A/F sensor (slow response))
Battery voltage	11 V or more
Altitude	Less than 7,870 ft. (2,400 m)
Throttle position learning	Completed
FTP sensor malfunction	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV and CCV	Not operated by scan tool
Either of the following conditions is met	Conditions 1 or 2
1. Purge duty cycle	6 % or more (vary with MAF)
2. Purge concentration for 30 seconds	-5 %/% or more when vehicle speed is less than 6.25 mph (10 km/h)
Refuel	Not refueled with engine running
FTP before EVAP monitor	-12.75 mmHg (-1.7 kPa) or more
ECT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT	4.4°C (39.9°F) or more
Vehicle speed change	Vehicle is driven by steady speed
Fuel slosh	No sloshing (i.e. fairly smooth road)
Time after engine start	Within 50 minutes
FTP change before vacuum introduction	Minimum change
Fuel level	Less than 90 %

TYPICAL MALFUNCTION THRESHOLDS

Purge VSV stuck close P0441:

FTP change during vacuum introduction	Less than 5.25 mmHg (0.7 kPa)

Purge VSV stuck open P0441:

Duration that the following condition is met:	4 seconds or more
FTP before vacuum introduction	Less than -10 mmHg (-1.333 kPa)

MONITOR RESULT

Refer to "CHECKING MONITOR STATUS" for detailed information (See page ES-15).
The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page ES-17).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID $02: EVAP system - LEV II Vacuum monitor

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	$01	Multiply by 0.183 (mmHg)	Test value of EVAP VSV stuck close: Determined by fuel tank pressure change during vacuum introduction	Malfunction criteria for EVAP VSV stuck closed
0	$02	Multiply by 0.0655 (seconds)	Test value of EVAP VSV stuck open: Determined by duration that fuel tank pressure is higher than criteria	Malfunction criteria for EVAP VSV stuck open
0	$03	Multiply by 0.0655 (seconds)	Test value of canister closed valve (CCV): Determined by duration that fuel tank pressure is lower than criteria	Malfunction criteria for Canister Closed Valve (CCV)
0	$04	Multiply by 0.0458 (mmHg)	Test value 0.04 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.04 inch leak
0	$05	Multiply by 0.0458 (mmHg)	Test value 0.02 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.02 inch leak

DTC	P0442	Evaporative Emission Control System Leak Detected (Small Leak)

DTC	P0455	Evaporative Emission Control System Leak Detected (Gross Leak)

DTC	P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)

DESCRIPTION

The circuit description can be found in the EVAP INSPECTION PROCEDURE (See page ES-299).

ES

Refer to the EVAP INSPECTION PROCEDURE (See page ES-304).

MONITOR DESCRIPTION

The ECM tests the Evaporative Emissions (EVAP) system using the fuel tank pressure sensor, Canister Close Valve (CCV), and EVAP VSV. The ECM closes the EVAP system and creates negative pressure (vacuum) into it. The ECM then monitors the internal pressure using the fuel tank pressure sensor (refer to the Leak Check graphic).

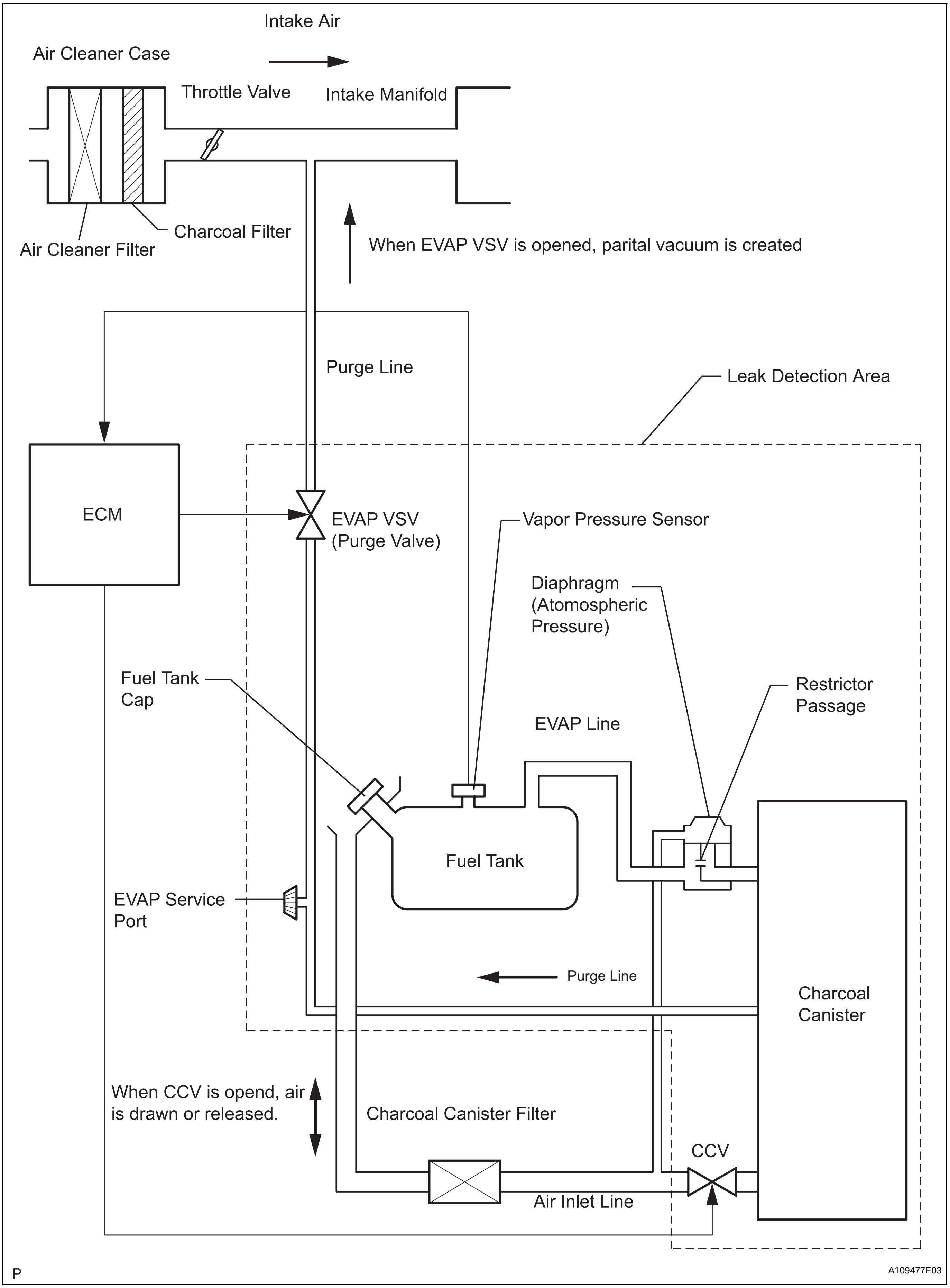
P0442, P0455 and P0456

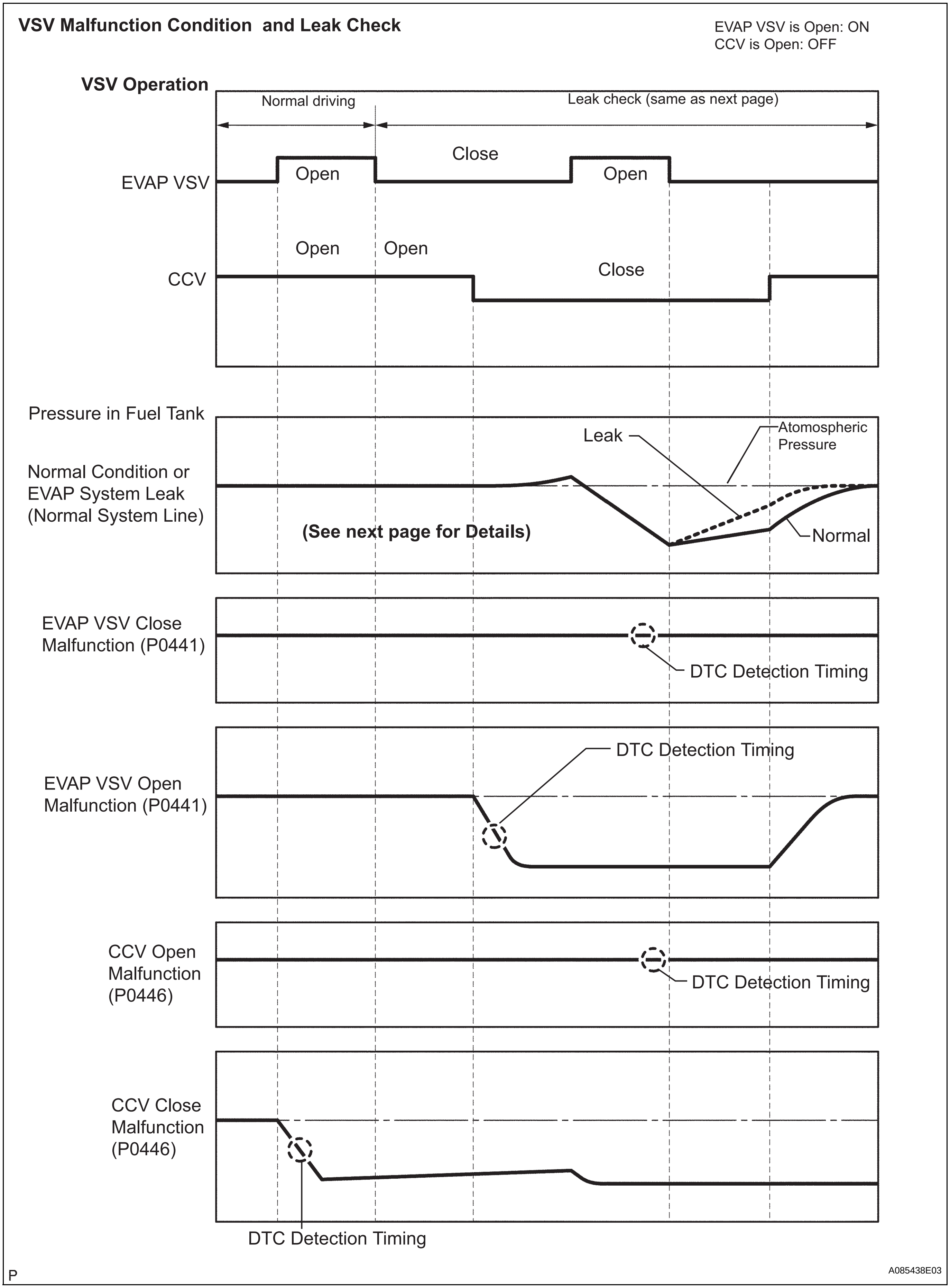
When there is a leak in the evaporative emission system, the ECM sets DTC P0442, P0445 or P0456. The ECM checks if the EVAP has leaks. First, the ECM opens the EVAP VSV while the CCV is closed. After a sufficient amount of time has passed, a high negative pressure (vacuum) will develop in the fuel tank as air is drawn into the intake manifold. The EVAP VSV is then closed. The ECM then monitors the pressure increase (loss of vacuum) in the fuel tank. If the pressure rises beyond a specified amount, the ECM determines that the system has a leak, turns on the MIL and sets a DTC.

The ECM has DTCs for small and large leaks:

1. DTC P0442 is set when the internal fuel tank pressure has a large increase and the EVAP system has a small leak.
2. DTC P0455 is set when the EVAP system has a very large leak. The ECM tries to create negative pressure (vacuum) in the fuel tank by opening the EVAP VSV while the CCV is closed. However, the fuel tank pressure does not decrease beyond a specified threshold.
3. DTC P0456 is set when the internal fuel tank pressure increases slightly and the EVAP system has a very small leak.

DTC No.	DTC Detection Condition	Trouble Area
P0442 P0455 P0456	• Cold engine start. • EVAP VSV has been operated and turned OFF, sealing negative pressure (vacuum) in system. • ECM begins to monitor fuel tank pressure increase and one of the following occurs (2 trip detection logic): (a) Rapid, sharp increase in pressure occurs, indicating small leak in EVAP system. DTC P0442 is set. (b) Negative pressure (vacuum) is not strong enough, indicating large hole in EVAP system. DTC P0455 is set. (c) Increase in pressure above expected amount occurs, indicating small leak in EVAP system. DTC P0456 is set.	• Vacuum hose has cracks, holes, or is blocked, damaged or disconnected • Fuel tank cap is incorrectly installed • Fuel tank cap has cracks or is damaged • Open or short in vapor pressure sensor circuit • Vapor pressure sensor • Open or short in EVAP VSV circuit • EVAP VSV • Open or short in CCV circuit • CCV • Fuel tank has cracks, holes, or is damaged • Charcoal canister has cracks, holes, or is damaged • Fuel tank over fill check valve has cracks, or is damaged • ECM

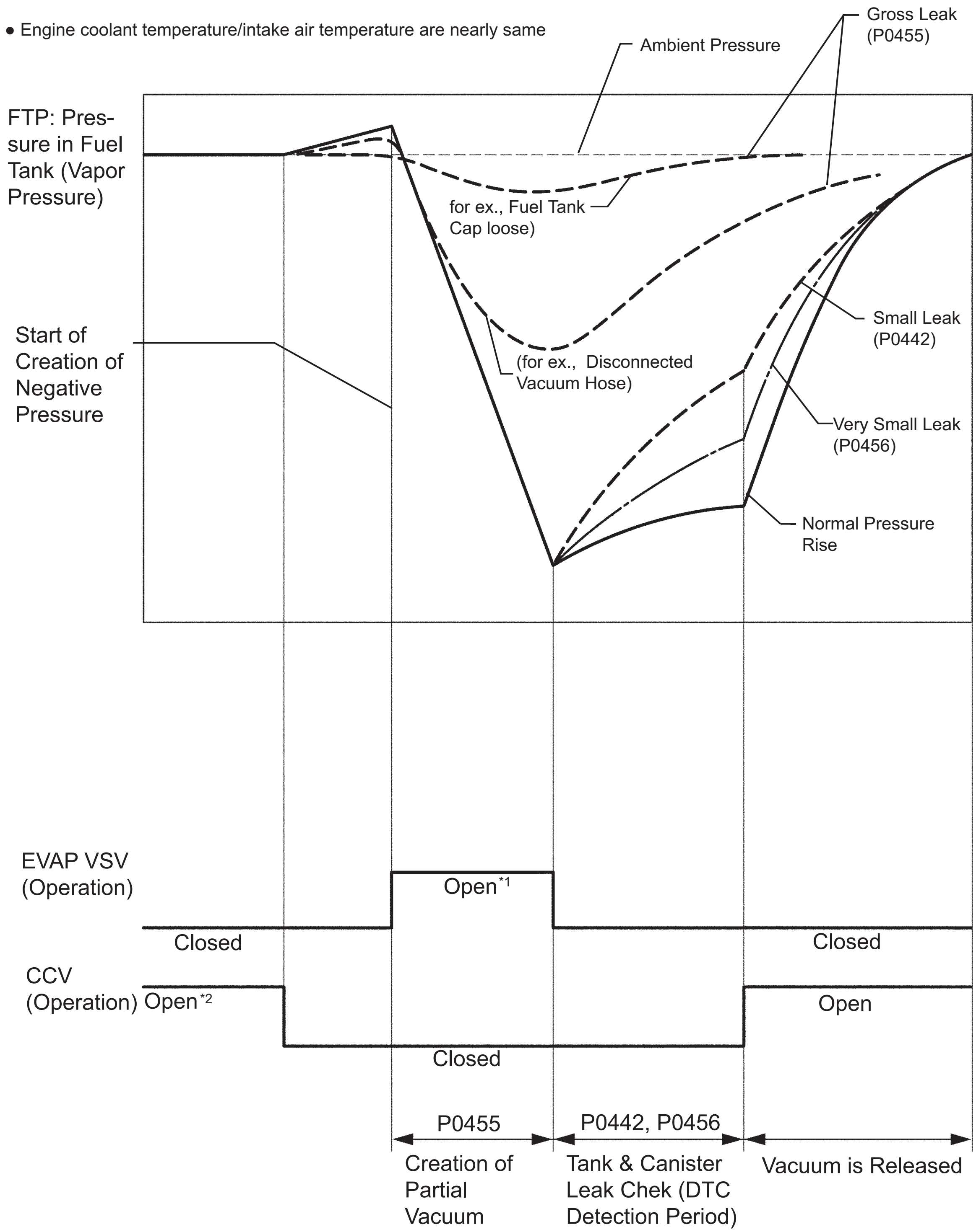

Intake Air
Air Cleaner Case
Throttle Valve
Intake Manifold
Charcoal Filter
Air Cleaner Filter
When EVAP VSV is opened, parital vacuum is created
Purge Line
Leak Detection Area
ECM
EVAP VSV
(Purge Valve)
Vapor Pressure Sensor
Diaphragm
(Atomospheric
Pressure)
Fuel Tank
Cap
Restrictor
Passage
EVAP Line
Fuel Tank
EVAP Service
Port
Purge Line
Charcoal
Canister
When CCV is opend, air
is drawn or released.
Charcoal Canister Filter
CCV
Air Inlet Line
P
A109477E03


VSV Malfunction Condition and Leak Check
EVAP VSV is Open: ON
CCV is Open: OFF
VSV Operation
Normal driving
Leak check (same as next page)
EVAP VSV
Open
Close
Open
CCV
Open
Open
Close
Pressure in Fuel Tank
Normal Condition or
EVAP System Leak
(Normal System Line)
Leak
Atomospheric
Pressure
(See next page for Details)
Normal
EVAP VSV Close
Malfunction (P0441)
DTC Detection Timing
EVAP VSV Open
Malfunction (P0441)
DTC Detection Timing
CCV Open
Malfunction
(P0446)
DTC Detection Timing
CCV Close
Malfunction
(P0446)
DTC Detection Timing
P
A085438E03

Leak check

Initial Condition:

- Cold Start
- Engine coolant temperature/intake air temperature are nearly same



*1 : EVAP VSV is Open: ON

*2 : CCV is Open : OFF

P

A085439E03

ES

MONITOR STRATEGY

Related DTCs	P0442: EVAP 0.04 inch leak P0455: EVAP gross leak P0456: EVAP 0.02 inch leak
Required sensors / components (Main)	CCV, EVAP canister, EVAP hose, Fuel cap, Fuel tank and Purge VSV
Required sensors / components (Related)	ECT sensor, FTP sensor, IAT sensor, MAF meter, Vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	Within 90 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	P0011 (VVT system 1 - Advance) P0012 (VVT system 1 - Retard) P0021 (VVT system 2 - Advance) P0022 (VVT system 2 - Retard) P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0358 (Ignitor) P0450 - P0453 (EVAP press sensor) P0500 (VSS)
Battery voltage	11 V or more
Altitude	Less than 7,870 ft. (2,400 m)
Throttle position learning	Completed
FTP sensor malfunction	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV and CCV	Not operated by scan tool
Either of the following conditions is met:	Conditions 1 or 2
1. Purge duty cycle	6 % or more (vary with MAF)
2. Purge concentration for 30 seconds	-5 %/% or more when vehicle speed is less than 6.25 mph (10 km/h)
Refuel	Not refueled with engine running
FTP before EVAP monitor	-12.75 mmHg (-1.7 kPa) or more

EVAP 0.02 inch leak P0456:

ECT at engine start	4.4 to 32°C (39.9 to 89.6°F)
IAT at engine start	4.4 to 32°C (39.9 to 89.6°F)
IAT	4.4°C (39.9°F) or more
Vehicle speed change	Vehicle is driven by steady speed
Fuel slosh	No sloshing (i.e. fairly smooth road)
Time after engine start	Within 50 minutes
FTP change before vacuum introduction	Minimum change
Fuel level	Less than 90 %
0.04 inch leak	Not detected
CCV malfunction	Not detected
Vehicle speed	Less than 81.25 mph (130 km/h)
Purge VSV malfunction	Not detected

Others:

ECT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT	4.4°C (39.9°F) or more
Vehicle speed change	Vehicle is driven by steady speed
Fuel slosh	No sloshing (i.e. fairly smooth road)
Time after engine start	Within 50 minutes
FTP change before vacuum introduction	Minimum change
Fuel level	Less than 90 %

TYPICAL MALFUNCTION THRESHOLDS

EVAP 0.04 inch leak P0442:

Both of the following conditions are met:	Condition 1 and 2
1. FTP change for 5 seconds from -20 mmHg (-2.67 kPa)	1.2 mmHg (0.16 kPa) or more
2. FTP change for 5 seconds from -17 mmHg (-2.27 kPa)	1.2 mmHg (0.16 kPa) or more

EVAP 0.02 inch leak P0456:

Both of the following conditions are met:	Condition 1 and 2
1. FTP change for 5 seconds when FTP is -17 mmHg (-2.27 kPa)	0.5 mmHg (0.07 kPa) or more
2. FTP change for 5 seconds when FTP is -20 mmHg (-2.67 kPa)	0.5 mmHg (0.07 kPa) or more

EVAP gross leak P0455:

FTP when vacuum introduction compleated	-7 mmHg (-0.933 kPa) or more

MONITOR RESULT

Refer to "CHECKING MONITOR STATUS" for detailed information (See pageES-15).
The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page ES-17).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID $02: EVAP system - LEV II Vacuum monitor

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	$01	Multiply by 0.183 (mmHg)	Test value of EVAP VSV stuck close: Determined by fuel tank pressure change during vacuum introduction	Malfunction criteria for EVAP VSV stuck closed
0	$02	Multiply by 0.0655 (seconds)	Test value of EVAP VSV stuck open: Determined by duration that fuel tank pressure is higher than criteria	Malfunction criteria for EVAP VSV stuck open
0	$03	Multiply by 0.0655 (seconds)	Test value of canister closed valve (CCV): Determined by duration that fuel tank pressure is lower than criteria	Malfunction criteria for Canister Closed Valve (CCV)
0	$04	Multiply by 0.0458 (mmHg)	Test value 0.04 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.04 inch leak
0	$05	Multiply by 0.0458 (mmHg)	Test value 0.02 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.02 inch leak

DTC	P0446	Evaporative Emission Control System Vent Control Circuit

DESCRIPTION

The circuit description can be found in the EVAP INSPECTION PROCEDURE (See page ES-299).

Refer to the EVAP INSPECTION PROCEDURE (See page ES-304).

MONITOR DESCRIPTION

The ECM tests the Evaporative Emissions (EVAP) system using the fuel tank pressure sensor, Canister Close Valve (CCV), and EVAP VSV. The ECM closes the EVAP system and creates negative pressure (vacuum) into it. The ECM then monitors the internal pressure using the fuel tank pressure sensor (See page ES-300).
P0446 (FOR SYSTEM DIAGRAM AND DTC DETECTION TIMING CHART, REFER TO DTC P0441)(See page ES-300).
The CCV is open under normal conditions. The CCV has the following features:

1. Draws fumes from the fuel tank into the charcoal canister after the EVAP VSV purges the EVAP from the fuel tank into the intake manifold,.
2. Relieves pressure inside the fuel tank when the pressure has suddenly risen.
3. Works with the EVAP VSV to create negative pressure (vacuum) inside the fuel tank and performs leak tests.

The ECM checks if the CCV is "stuck closed". The ECM commands the CCV to open while the EVAP VSV is open. If high negative pressure (vacuum) develops in the fuel tank and stays for more than 4 seconds, the ECM determines that the CCV remains closed despite the open command. The ECM will turn on the MIL and set a DTC. The engine coolant temperature is not related to the output of this DTC.
The ECM also has a method for checking if the CCV is "stuck open". The ECM commands the CCV to close while the EVAP VSV is open. If a sufficient amount of negative pressure dose not develop in the fuel tank, the ECM determines that the CCV remains open despite the close command. The ECM will turn on the MIL and set a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0446	Open or close malfunction in CCV (2 trip detection logic)	• Vacuum hose has cracks, holes, or is blocked, damaged or disconnected • Fuel tank cap is incorrectly installed • Fuel tank cap has cracks or is damaged • Open or short in vapor pressure sensor circuit • Vapor pressure sensor • Open or short in EVAP VSV circuit • EVAP VSV • Open or short in CCV circuit • CCV • Fuel tank has cracks, holes, or is damaged • Charcoal canister has cracks, holes, or is damaged • Fuel tank over fill check valve has cracks, or is damaged • ECM

MONITOR STRATEGY

Related DTCs	P0446: CCV stuck open P0446: CCV stuck closed
Required sensors / components (Main)	CCV, EVAP canister, EVAP hose, Fuel cap, Fuel tank and Purge VSV
Required sensors / components (Related)	ECT sensor, FTP sensor, IAT sensor, MAF meter, Vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	Within 60 seconds
MIL operation	2 driving cycles

Sequence operation	None

TYPICAL ENABLING CONDITIONS

Monitor will run whenever this DTC is not present	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0358 (Ignitor) P0450 - P0453 (EVAP press sensor) P0500 (VSS)
Battery voltage	11 V or more
Altitude	Less than 7,870 ft. (2,400 m)
Throttle position learning	Completed
FTP sensor malfunction	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV and CCV	Not operated by scan tool
Either of the following conditions is met:	Conditions 1 or 2
1. Purge duty cycle	6 % or more (vary with MAF)
2. Purge concentration for 30 seconds	-5 %/% or more when vehicle speed is less than 6.25 mph (10 km/h)
Refuel	Not refueled with engine running
FTP before EVAP monitor	-12.75 mmHg (-1.7 kPa) or more
ECT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT	4.4°C (39.9°F) or more
Vehicle speed change	Vehicle is driven by steady speed
Fuel slosh	No sloshing (i.e. fairly smooth road)
Time after engine start	Within 50 minutes
FTP change before vacuum introduction	Minimum change
Fuel level	Less than 90 %

TYPICAL MALFUNCTION THRESHOLDS

CCV stuck close P0446:

Duration that the following conditions are met:	4 seconds or more
1. Accumulated purge volume	0.5 g or more
2. FTP	Less than -12.75 mmHg (-1.7 kPa)

CCV stuck open P0446:

Purge VSV stuck closed	Detected

MONITOR RESULT

Refer to "checking monitor status" for detailed information (See page ES-15).
The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page ES-17).

- TID (Test Identification Data) is assigned to each emissions-related component.

ES

- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID $02: EVAP system - LEV II Vacuum monitor

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	$01	Multiply by 0.183 (mmHg)	Test value of EVAP VSV stuck close: Determined by fuel tank pressure change during vacuum introduction	Malfunction criteria for EVAP VSV stuck closed
0	$02	Multiply by 0.0655 (seconds)	Test value of EVAP VSV stuck open: Determined by duration that fuel tank pressure is higher than criteria	Malfunction criteria for EVAP VSV stuck open
0	$03	Multiply by 0.0655 (seconds)	Test value of canister closed valve (CCV): Determined by duration that fuel tank pressure is lower than criteria	Malfunction criteria for Canister Closed Valve (CCV)
0	$04	Multiply by 0.0458 (mmHg)	Test value 0.04 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.04 inch leak
0	$05	Multiply by 0.0458 (mmHg)	Test value 0.02 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.02 inch leak

DTC	P0451	Evaporative Emission Control System Pressure Sensor Range / Performance

DTC	P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input

DTC	P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input

MONITOR DESCRIPTION

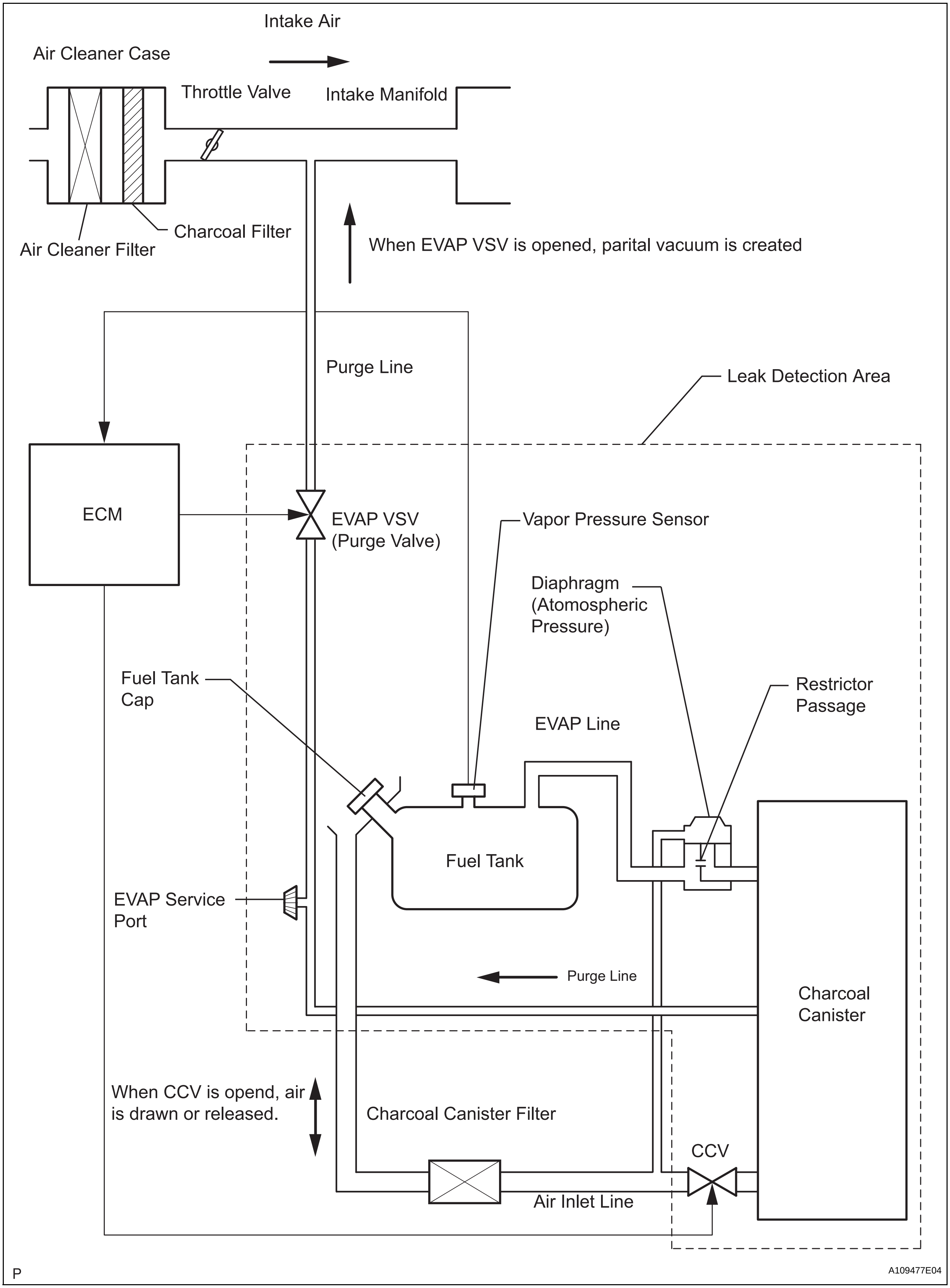
DTC "P0451, P0452 or P0453" is recorded by the ECM when the vapor pressure sensor malfunctions.

P0451

The ECM monitors the vapor pressure sensor in 2 ways. One method examines the fluctuation of the electrical signal while the engine is idling. If the pressure signal varies beyond the specified range more than 7 times, the ECM interprets this as a fault in the vapor pressure sensor. The ECM also verifies that the pressure signal changes within the specified range. If the output of the sensor does not vary for 5 minutes while the intake air amount is changing, the ECM interprets this as a fault in the vapor pressure sensor. DTC P0451 will be set when either of the faults occurs and the ECM will turn on the MIL.

P0452 and P0453

When pressure indicated by the vapor pressure sensor deviates below -3.999 kPa (-30 mmHg) or above 1.999 kPa (15 mmHg), the ECM interprets this as a malfunction in the vapor pressure sensor. The ECM will turn on the MIL and a DTC will be set.


Intake Air
Air Cleaner Case
Throttle Valve
Intake Manifold
Charcoal Filter
Air Cleaner Filter
When EVAP VSV is opened, parital vacuum is created
Purge Line
Leak Detection Area
ECM
EVAP VSV
(Purge Valve)
Vapor Pressure Sensor
Diaphragm
(Atomospheric
Pressure)
Fuel Tank
Cap
Restrictor
Passage
EVAP Line
Fuel Tank
EVAP Service
Port
Purge Line
Charcoal
Canister
When CCV is opend, air
is drawn or released.
Charcoal Canister Filter
CCV
Air Inlet Line
P
A109477E04

DTC No.	DTC Detection Condition	Trouble Area
P0451	Vapor pressure sensor output changes extremely under the following conditions: • Vapor pressure sensor output changes often while vehicle speed is 0 mph (0 km/h) and the engine is idling 5 sec. to 10 sec. (2 trip detection logic) • Vapor pressure sensor output is stuck 5 minutes (2 trip detection logic)	• Open or short in vapor pressure sensor circuit • Vapor pressure sensor • ECM
P0452	Vapor pressure sensor output remains less than -30 mmHg: (2 trip detection logic)	• Open or short in vapor pressure sensor circuit • Vapor pressure sensor • ECM
P0453	Vapor pressure sensor output remains more than 15 mmHg: (2 trip detection logic)	• Open or short in vapor pressure sensor circuit • Vapor pressure sensor • ECM

MONITOR STRATEGY

Related DTCs	P0451: FTP Sensor Noise P0451: FTP Sensor Stuck P0452: FTP Sensor Range Check (Low voltage) P0453: FTP Sensor Range Check (High voltage)
Required sensors / components (Main)	FTP sensor
Required sensors / components (Related)	ECT sensor, IAT sensor
Frequency of operation	Once per driving cycle
Duration	7 seconds: FTP Sensor Range Check 45 seconds: FTP Sensor Noise 5 minutes: FTP Sensor Stuck
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None

FTP Sensor Noise P0451:

Altitude	Less than 7,870 ft. (2,400 m)
Battery voltage	11 V or more
Throttle position learning	Completed
FTP sensor malfunction (P0452, P0453)	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV, CCV	Not operated by scan tool
ECT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT at engine start	4.4 to 35°C (39.9 to 95°F)

FTP Sensor Stuck P0451:

Altitude	Less than 7,870 ft. (2,400 m)
Battery voltage	11 V or more
Throttle position learning	Completed
FTP sensor malfunction (P0452, P0453)	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV, CCV	Not operated by scan tool
ECT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT at engine start	4.4 to 35°C (39.9 to 95°F)
Time after engine start	5 seconds or more
0.04 inch leak	Not detected

0.02 inch leak	Not detected
CCV malfunction	Not detected

FTP Sensor Range Check P0452, P0453:

ECT at engine start	10 to 35°C (50 to 95°F)
IAT at engine start	10 to 35°C (50 to 95°F)
Difference between engine start ECT and engine start IAT	12°C (21.6°F) or less
Engine condition	Running

TYPICAL MALFUNCTION THRESHOLDS

FTP Sensor Noise P0451:

FTP change after the vehicle stop	A lot of change for a short time

FTP Sensor Stuck P0451:

FTP change	No change for 5 minutes

FTP Sensor Range Check (Low voltage) P0452:

FTP	Less than -30 mmHg (-3.999 kPa)

FTP Sensor Range Check (High voltage) P0453:

FTP	15 mmHg (1.999 kPa) or more

COMPONENT OPERATING RANGE

FTP	-26 to 11 mmHg (-3.5 to 1.5 kPa) or more [734 to 771 mmHg]

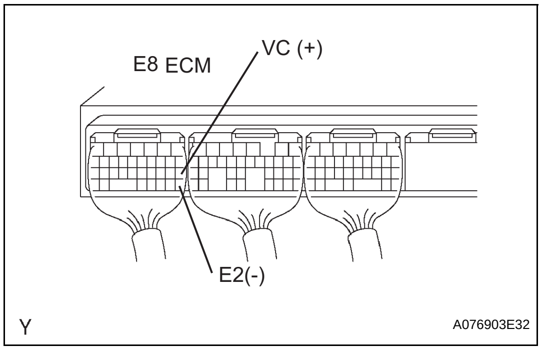
WIRING DIAGRAM

Refer to the EVAP INSPECTION PROCEDURE (See page ES-303).

HINT:

- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Always troubleshoot DTCs P0441 (purge flow), P0446 (VSV for CCV), P0451, P0452 and P0453 (evaporative pressure sensor) before troubleshooting DTCs P0442, P0455 and P0456.
- Read freeze frame data using the hand-held tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was lean or rich, etc. at the time of the malfunction.
- When the ENGINE RUN TIME in the freeze frame data is less than 200 seconds, carefully check the vapor pressure sensor.

1	CHECK ECM (VC VOLTAGE)



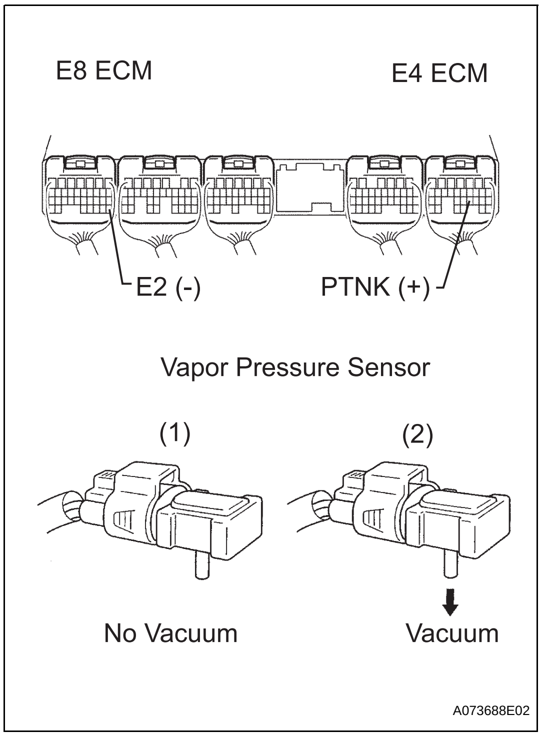
(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connector.
Voltage

Tester Connection	Specified Condition
E8-18 (VC) - E8-28 (E2)	4.5 to 5.5 V

NG → **REPLACE ECM**

OK

2	CHECK ECM (PTNK VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
(1) Disconnect the vacuum hose from the vapor pressure sensor.
Voltage (1)

Tester Connection	Specified Condition
E4-21 (PTNK) - E8-28 (E2)	2.9 to 3.7 V

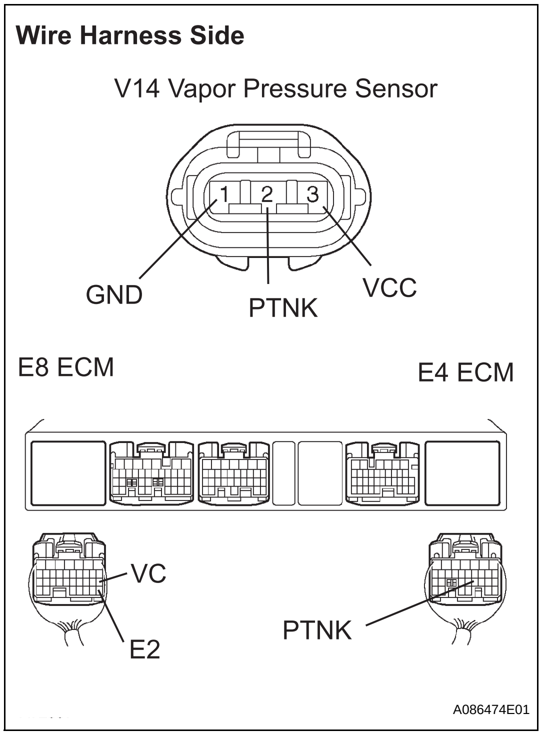
(2) Using a MITYVAC (Hand-held Vacuum Pump), apply a vacuum of 4.0 kPa (30 mmHg, 1.18 in.Hg) to the vapor pressure sensor.
NOTICE:
The vacuum applied to the vapor pressure sensor must be less than 66.7 kPa (500 mmHg, 19.7 in.Hg).
Voltage (2)

Tester Connection	Specified Condition
E4-21 (PTNK) - E8-28 (E2)	0.5 V or less

OK → **REPLACE ECM**

NG

3	CHECK WIRE HARNESS (VAPOR PRESSURE SENSOR - ECM)



(a) Disconnect the V14 vapor pressure sensor connector.
(b) Disconnect the E4 and E8 ECM connectors.
(c) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
V14-2 (PTNK) - E4-21 (PTNK) V14-1 (GND) - E8-28 (E2) V14-3 (VCC) - E8-18 (VC)	Below 1 Ω
V14-2 (PTNK) or E4-21 (PTNK) - Body ground V14-3 (VCC) or E8-18 (VC) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

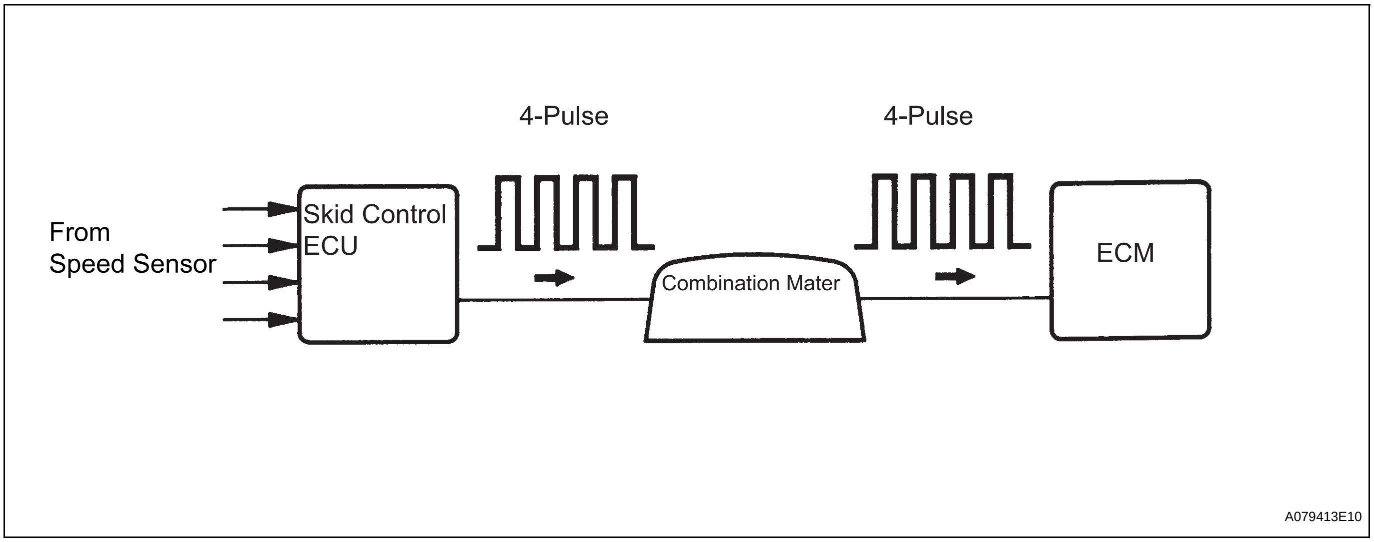
REPLACE VAPOR PRESSURE SENSOR ASSEMBLY

DTC	P0500	Vehicle Speed Sensor "A"

DTC	P0503	Vehicle Speed Sensor "A" Intermittent / Erratic / High

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 P0503	The ECM detects the following conditions simultaneously for 2 second (1 trip detection logic): • No SPD (speed sensor) signal while ECM detects NC (transmission counter gear) signal is more than 300 RPM. • Park/Neutral position switch is OFF (When shift lever is in other than P and N positions)	• Open or short in speed sensor circuit • Speed sensor • Combination meter • ECM • Skid control ECU

MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven when the transmission counter gear indicates more than 300 rpm and over 30 seconds have passed since the park/neutral position switch was turned OFF. If there is no signal from the vehicle speed sensor with these conditions satisfied, the ECM concludes that the vehicle speed sensor is malfunctioning. The ECM will turn on the MIL and a DTC will be set.

MONITOR STRATEGY

Related DTCs	P0500: Vehicle Speed Sensor Circuit
Required sensors / components (Main)	Vehicle speed sensor, Combination meter, ABS ECU
Required sensors / components (Related)	Countergear Speed (CS) sensor, PNP switch, ECT sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediate
Sequence operation	None

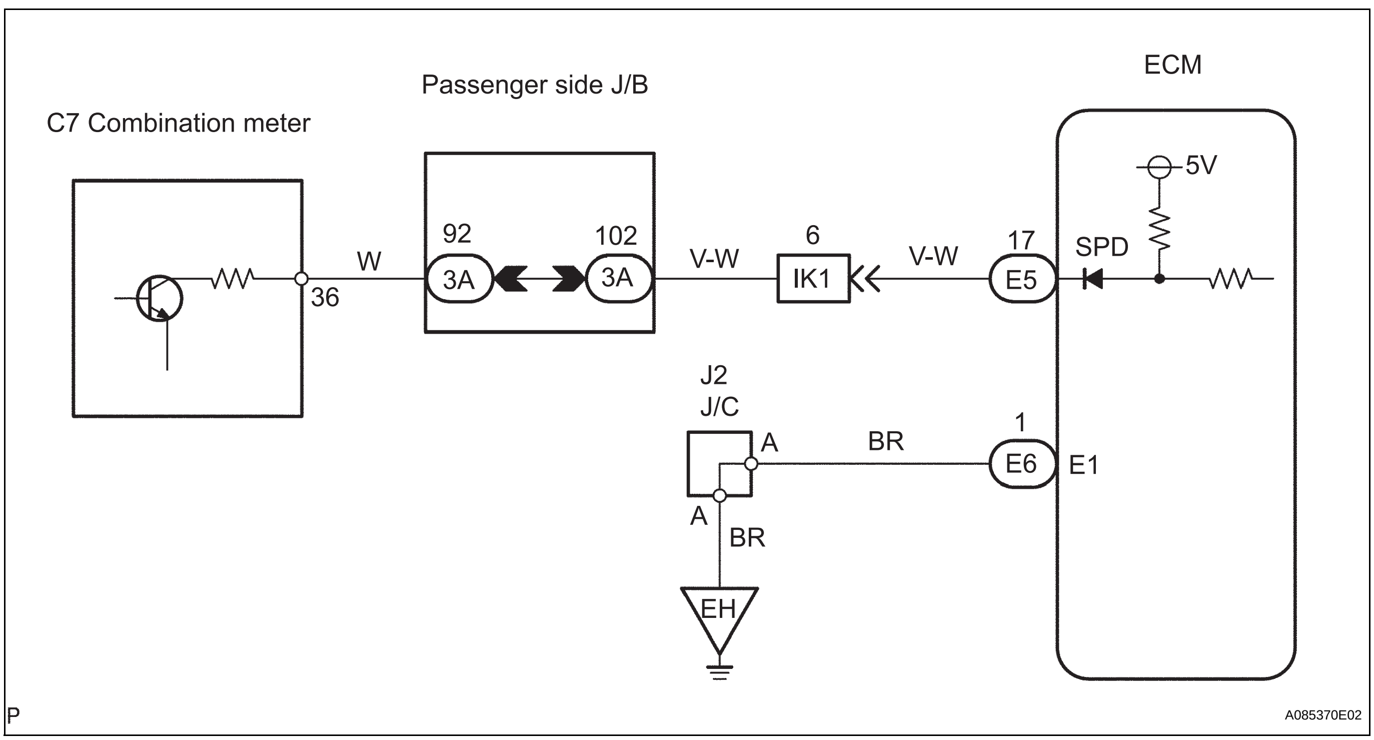
TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0100 - P0103 (MAF sensor) P0105 - P0108 (MAP sensor) P0115 - P0118 (ECT sensor) P0120 - P02238 (TP sensor) P0125 (VSS/ECT1 sensor, non-ECT)
Transmission counter gear speed	300 rpm or more
Engine condition	Running
Time after ignition switch ON	3 secnonds or more
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF
Either of the following conditions is met:	Condition 1 or 2
Condition 1	-
Time after PNP switch turns from ON to OFF	2 seconds or more
ECT and ECT sensor	ECT is 20°C (68°F) or more and ECT sensor does not malfunction (P0115 or P0116)
Condition 2	-
Time after PNP switch turns from ON to OFF	30 seconds or more
ECT and ECT sensor	ECT is less than 20°C (68°F) or ECT sensor malfunctions (P0115 or P0116)

TYPICAL MALFUNCTION THRESHOLDS

Vehicle speed sensor signal	No pulse input

WIRING DIAGRAM



HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

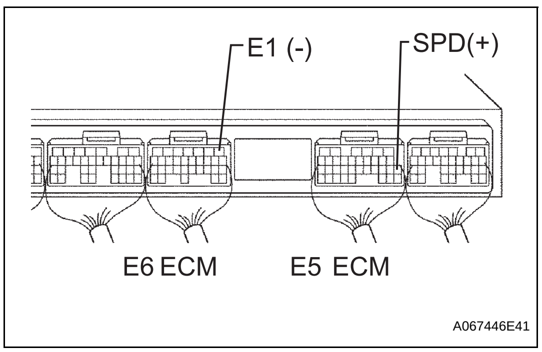
1 INSPECT OPERATION OF SPEEDOMETER

(a) Drive the vehicle and check if operation of the speedometer in the combination meter is normal.
HINT:
The vehicle speed sensor is operating normally if the speedometer display is normal.

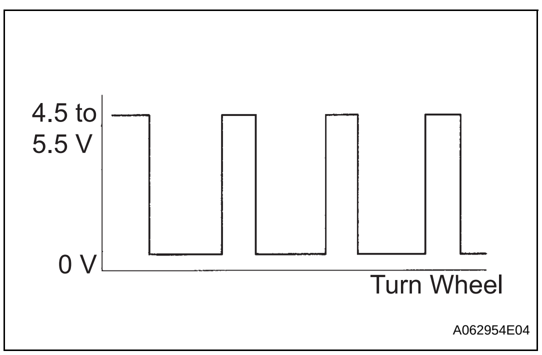
NG → **CHECK SPEEDOMETER CIRCUIT**

OK ↓

2 INSPECT ECM



(a) Shift the lever to the neutral position.
(b) Jack up the vehicle.
(c) Turn the ignition switch ON.



(d) Measure the voltage of the ECM connectors as the wheel is turned slowly.
Standard

Tester Connection	Specified Condition
E5-17 (SPD) - E6-1 (E1)	Generated intermittently

HINT:
The output voltage should fluctuate up and down similarly to the diagram on the left when the wheel is turned slowly.

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ↓

REPLACE ECM

DTC	P0504	Brake Switch "A" / "B" Correlation

DESCRIPTION

In addition to turning on the stop lights, the stop light switch signals are used for a variety of engine, transmission, and suspension functions as well as being an input for diagnostic checks. It is important that the switch operates properly, therefore this switch is designed with 2 complementary signal outputs: STP and ST1-. The ECM analyzes these signal outputs to detect malfunctions in the stop light switch.

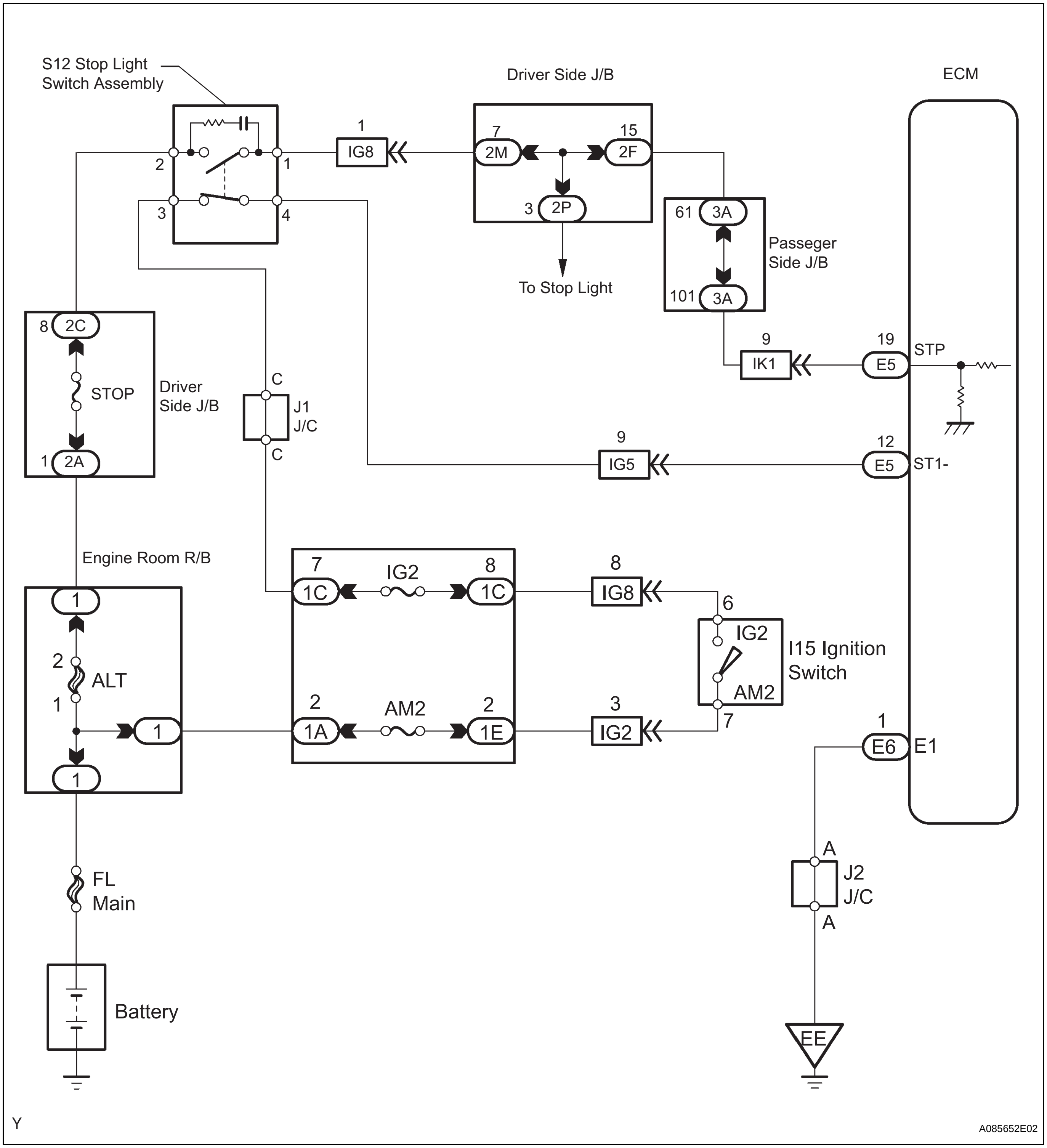
HINT:

Normal condition is as shown in the table.

Signal	Brake pedal released	In transition	Brake pedal depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

DTC No.	DTC Detection Condition	Trouble Area
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more: (a) Ignition switch ON (b) Brake pedal released (c) STP signal is OFF when the ST1- signal is OFF	• Short in stop light switch signal circuit • STOP light fuse • Stop light switch • ECM

WIRING DIAGRAM



HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK STOP LIGHT SWITCH

(a) Check if the stop lights turn on and off normally when the brake pedal is depressed and released.

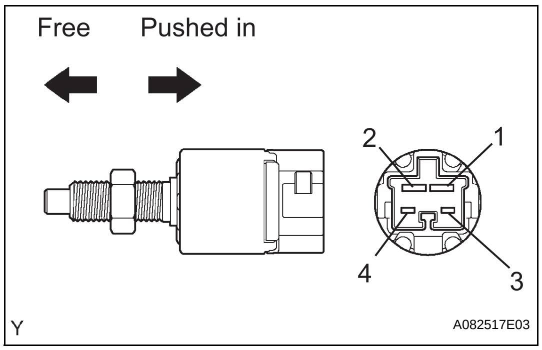
OK:

The stop lights turn on when you depress the brake pedal.

NG → **REPAIR OR REPLACE STOP LIGHT SWITCH**

OK

2	INSPECT STOP LIGHT SWITCH



(a) Measure the resistance of the switch terminals.

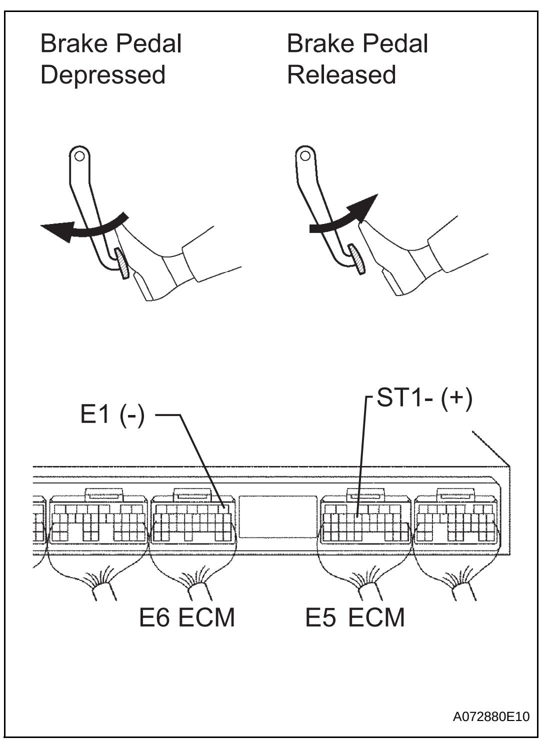
Resistance

Switch condition	Tester Connection	Specified Condition
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 kΩ or higher
Switch pin pushed in	1 - 2	10 kΩ or higher
Switch pin pushed in	3 - 4	Below 1 Ω

NG → **REPLACE STOP LIGHT SWITCH**

OK

3	READ VALUE OF INTELLIGENT TESTER (STP SIGNAL, ST1 - VOLTAGE)



(a) Turn the ignition switch ON.

(b) On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STOP LIGHT SW. Read the values.

Standard

Brake Pedal Condition	Specified Condition
Depressed	STP Signal ON
Released	STP Signal OFF

(c) Measure the voltage of the ECM connectors.

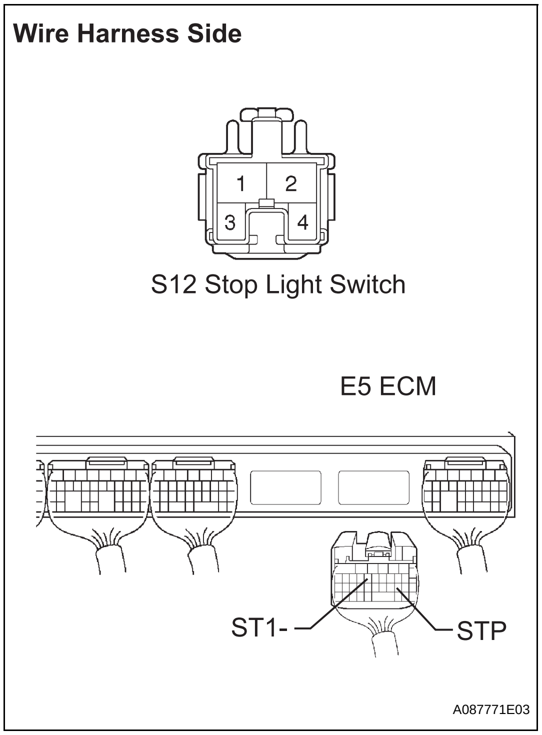
Voltage

Tester Connection	Brake Pedal Condition	Specified Condition
E5-12 (ST1-) - E6-1 (E1)	Depressed	Below 1.5 V
E5-12 (ST1-) - E6-1 (E1)	Released	7.5 to 14 V

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

4	CHECK WIRE HARNESS (STOP LIGHT SWITCH - ECM)



(a) Disconnect the S12 stop light switch connector.
(b) Disconnect the E5 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
S12-1 - E5-19 (STP) S12-4 - E5-12 (ST1-)	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

ES

OK

REPLACE ECM

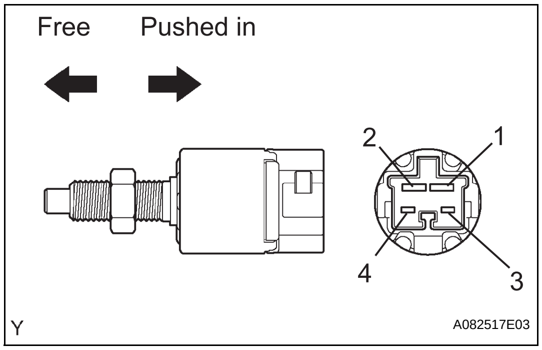
1	CHECK STOP LIGHT (OPERATION)

(a) Check if the stop lights turn on and off normally when the brake pedal is depressed and released.
OK:
The stop lights turn on when you depress the brake pedal.

NG → **REPAIR OR REPLACE STOP LIGHT SWITCH CIRCUIT**

OK

2	INSPECT STOP LIGHT SWITCH ASSEMBLY



(a) Measure the resistance of the switch terminals.

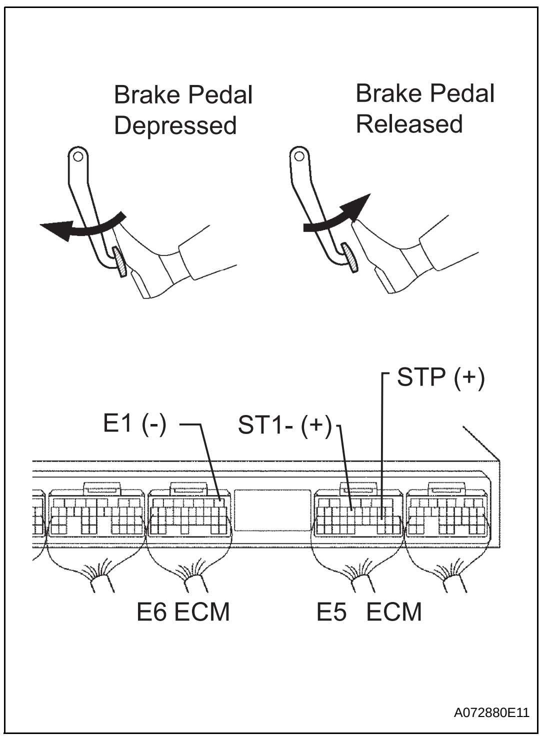
Resistance

Switch condition	Tester Connection	Specified Condition
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 kΩ or higher
Switch pin pushed in	1 - 2	10 kΩ or higher
Switch pin pushed in	3 - 4	Below 1 Ω

NG → **REPLACE STOP LIGHT SWITCH ASSEMBLY**

OK

3	CHECK ECM (STP, ST1 - VOLTAGE)



(a) Turn the ignition switch ON.

(b) Measure the voltage of the ECM connectors.

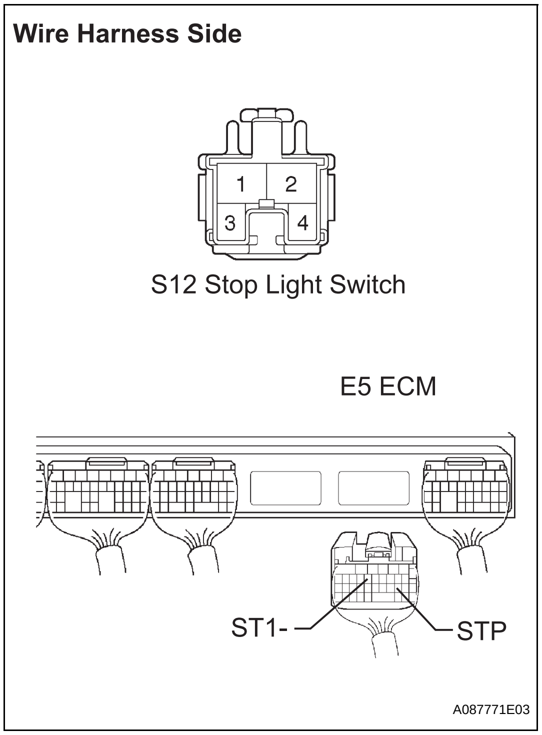
Voltage

Tester Connection	Brake Pedal Condition	Specified Condition
E5-19 (STP) - E6-1 (E1)	Depressed	7.5 to 14 V
E5-19 (STP) - E6-1 (E1)	Released	Below 1.5 V
E5-12 (ST1-) - E6-1 (E1)	Depressed	Below 1.5 V
E5-12 (ST1-) - E6-1 (E1)	Released	7.5 to 14 V

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

4	CHECK WIRE HARNESS (STOP LIGHT SWITCH - ECM)



(a) Disconnect the S12 stop light switch connector.
(b) Disconnect the E5 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
S12-1 - E5-19 (STP) S12-4 - E5-12 (ST1-)	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

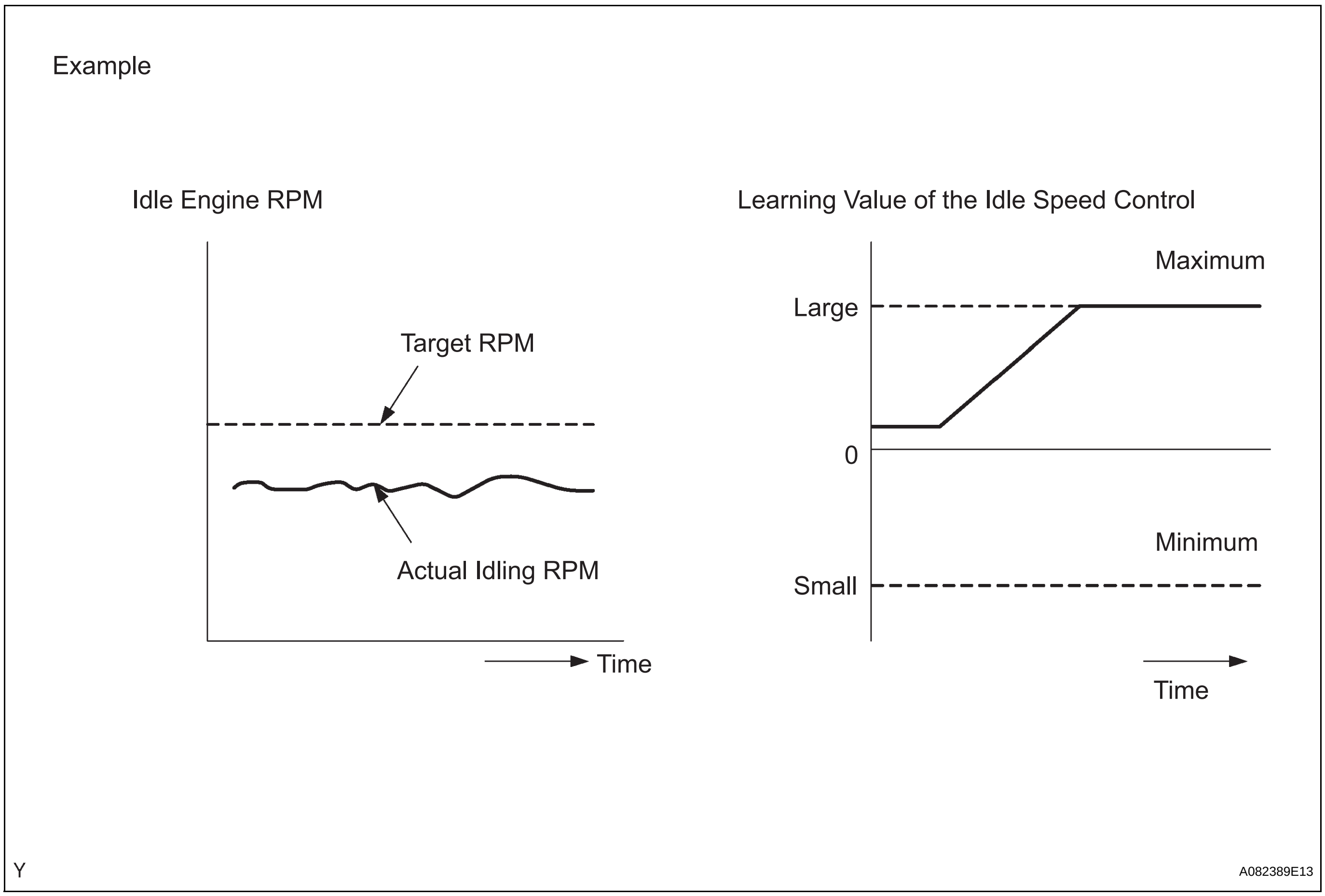
OK

REPLACE ECM

DTC	P0505	Idle Control System Malfunction

MONITOR DESCRIPTION

The idle speed is controlled by the Electronic Throttle Control System (ETCS).
The ETCS is composed of the throttle motor, which operates the throttle valve, and the throttle position sensor, which detects the opening angle of the throttle valve.
The ECM controls the throttle motor to provide the proper throttle valve opening angle to obtain the target idle speed.
The ECM regulates the idle speed by opening and closing the throttle valve using the ETCS. The ECM concludes that the idle speed control ECM function is malfunctioning if: 1) the actual idle RPM varies more than the specified amount 5 times or more during a drive cycle, or 2) a learning value of the idle speed control remains at the maximum or minimum 5 times or more during a drive cycle. The ECM will turn on the MIL and set a DTC.
Example:
If the actual idle RPM varies from the target idle RPM by more than 200 (*1) rpm 5 times during a drive cycle, the ECM will turn on the MIL and a DTC will be set.
*1: RPM threshold varies with engine load.



DTC No.	DTC Detection Condition	Trouble Area
P0505	Idle speed continues to vary greatly from target speed (1 trip detection logic)	• Electronic throttle control system • Air induction system • PCV hose connection

MONITOR STRATEGY

Related DTCs	P0505: IAC Functional Check P0505: IAC Range Check

Required sensors / components (Main)	ETCS
Required sensors / components (Related)	Crankshaft position sensor, ECT sensor, Vehicle speed sensor
Frequency of operation	Continuous
Duration	10 minutes
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present	None
Engine condition	Running

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	Condition 1 or 2
1. Frequency that both of the following conditions (a) and (b) are met:	5 times
(a) Engine RPM - Target engine RPM	Less than -100 rpm, or more than 150 rpm
(b) Vehicle condition	Stop after vehicle was driven at 6.25 mph (10 km/h) or more
2. Frequency that both of the following conditions (a) and (b) are met:	Once
(a) Engine RPM - Target engine RPM	Less than -100 rpm, or more than 150 rpm
(b) IAC flow rate learning value	1.3 L/sec. or less, or 9.03 L/sec. or more

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Enter the following the menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result

Display (DTC output)	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

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.
OK:
No leakage from air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

4	CHECK THROTTLE VALVE

(a) Check the throttle valve condition.
OK:
No foreign objects between the throttle valve and housing.

NG → **REPLACE THROTTLE BODY ASSEMBLY**

OK

REPLACE ECM

DTC P0560 System Voltage

MONITOR DESCRIPTION

The battery supplies electricity to the ECM even when the ignition switch is OFF. This electricity allows the ECM to store data such as DTC history, freeze frame data, fuel trim values, and other data. If the battery voltage falls below a minimum level, the ECM will conclude that there is a fault in the power supply circuit. The next time the engine starts, the ECM will turn on the MIL and a DTC will be set.

DTC No.	DTC Detection Condition	Trouble Area
P0560	Open in back-up power source circuit	• Open in back-up power source circuit • ECM

HINT:
If DTC P0560 is present, the ECM will not store other DTCs.

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 will illuminate after the next engine start)
Sequence operation	None

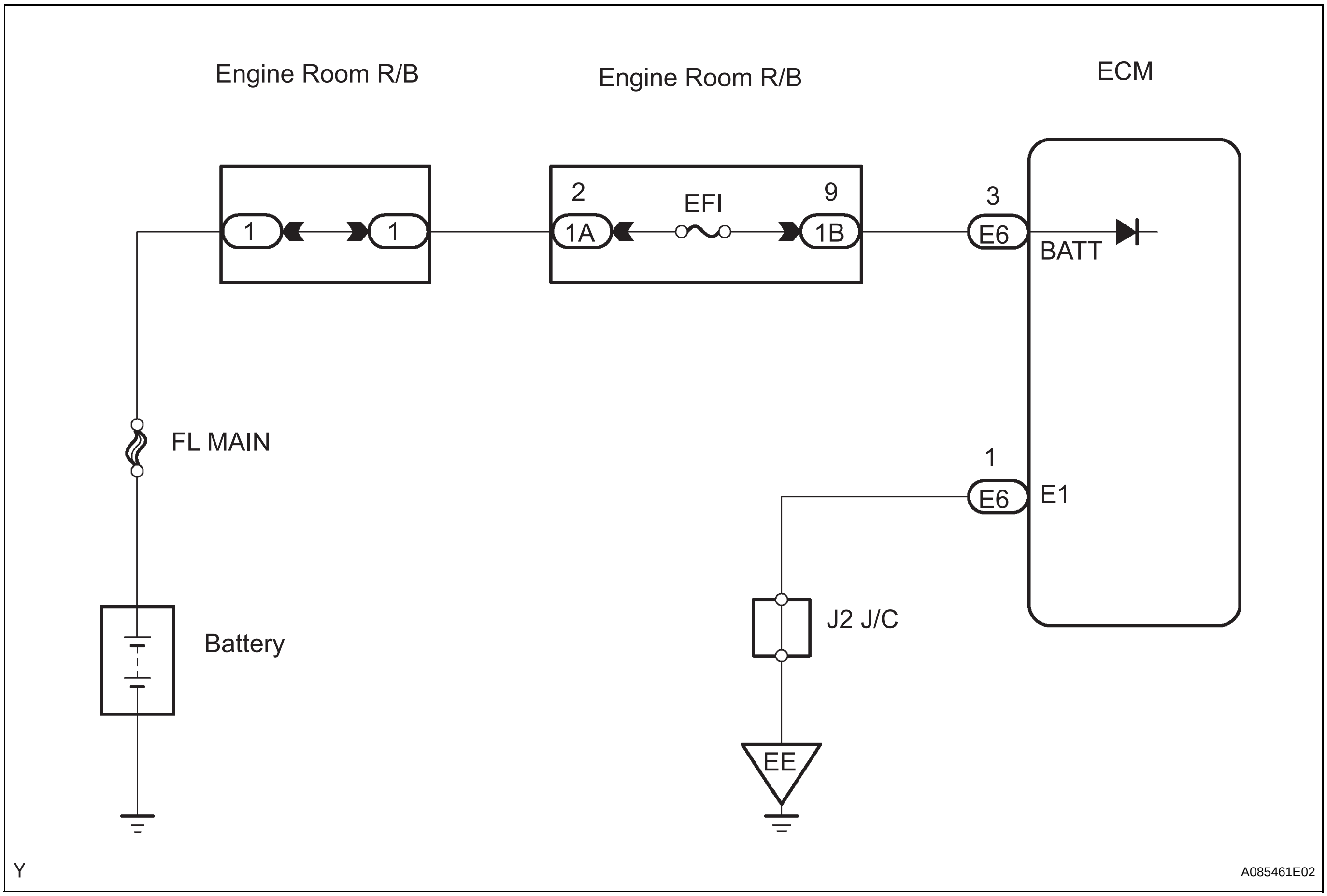
TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

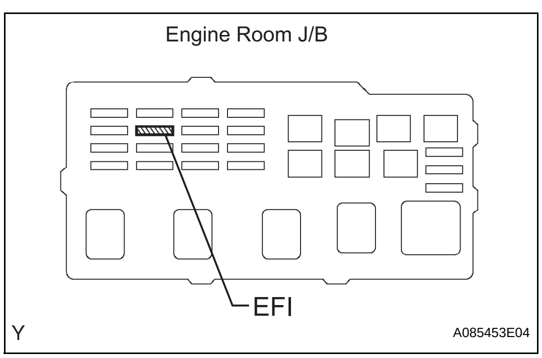
ECM power source	Less than 3.5 V

WIRING DIAGRAM



HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK FUSE (EFI)

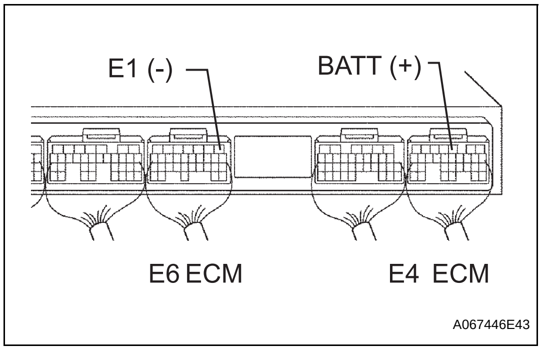


(a) Remove the EFI fuse from the engine room J/B.
(b) Measure the resistance of the EFI fuse.
Resistance:
Below 1 Ω

NG → **REPLACE FUSE**

OK

2	INSPECT ECM (BATT VOLTAGE)



(a) Measure the voltage of the ECM connectors.

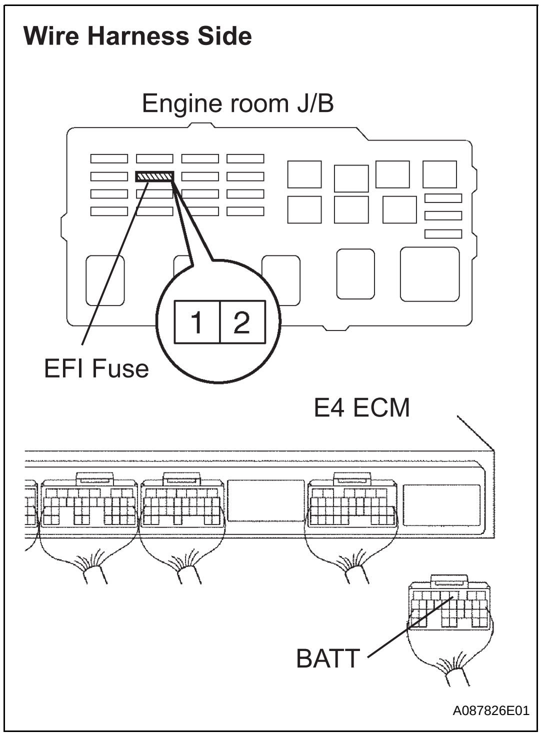
Voltage

Tester Connection	Specified Condition
E4-3 (BATT) - E6-1 (E1)	9 to 14 V

NG → **REPLACE ECM**

OK

3	CHECK HARNESS AND CONNECTOR (ECM - EFI FUSE, EFI FUSE - BATTERY)



(a) Check the wire harness between the EFI fuse and ECM.

(1) Remove the EFI fuse from the engine room J/B.

(2) Disconnect the E4 ECM connector.

(3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
J/B EFI fuse terminal 2 - E4-3 (BATT)	Below 1 Ω
J/B EFI fuse terminal 2 or E4-3 (BATT) - Body ground	10 kΩ or higher

(b) Check the wire harness between the EFI fuse and battery.

(1) Remove the EFI fuse from the engine room J/B.

(2) Disconnect the battery positive cable.

(3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
Battery positive cable - J/B EFI fuse terminal 1	Below 1 Ω
Battery positive cable or J/B EFI fuse terminal 1 - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

CHECK AND REPLACE FUSIBLE LINK BLOCK

CHECKING MONITOR STATUS

NOTICE:
The monitor status (mode 6) is not applicable to the heated oxygen sensor (HO2S). However, HO2S test values can be checked by O2S TEST RESULT (mode 5). (See page)

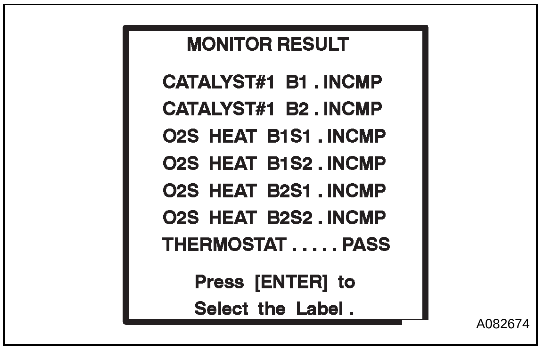
1. **Outline**
   The monitor results and the test values can be checked with the OBDII scan tool.
   The engine control module (ECM) monitors the emissions-related components as the thermostat, catalyst converter and evaporative emissions (EVAP), and determines whether they are functioning normally or not. When finished monitoring, the ECM stores the monitor results and the test values.
   The monitor result indicates whether the component is functioning normally or not. The test value is the value that was used to determine the monitor result. If the test value is outside the test limit (malfunction criterion), the ECM determines the component is malfunctioning.
   Some emissions-related components have multiple test values to determine monitor result. If one of these test values is outside test limit, the ECM determines the component is malfunctioning.
2. **Description**
   The test value and test limit information are described as shown in the following table. This information is included under "MONITOR RESULT" in the emissions-related DTC sections:

TID $08: Thermostat

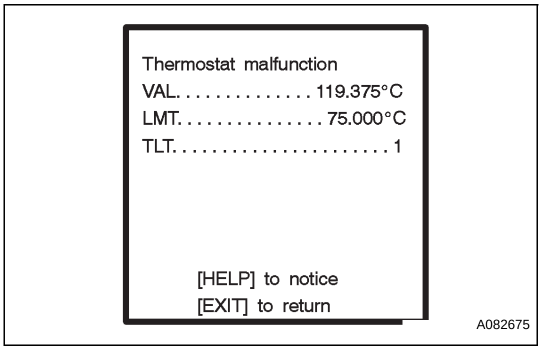
TLT	CID	Unit Conversion	Description of Test Value	Description of Test Limit
1	$01	Multiply by 0.625 and subtract 40 (°C)	ECT sensor output when estimated ECT has reached to malfunction criterion	Malfunction criterion for thermostat

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBDII scan tools.

3. **Procedure (using intelligent tester)**
   (a) Connect the intelligent tester to the DLC3.
   (b) Turn the ignition switch and intelligent tester ON.
   (c) Clear DTCs.
   (d) Allow the vehicle to drive, in accordance with the applicable drive pattern described in the READINESS MONITOR DRIVE PATTERN section (See page ES-17).



(e) Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBDII, MONITOR INFO and MONITOR RESULT. The monitor result appears after the component name.
- INCMP indicates the component has not been monitored yet.
- PASS indicates the component is functioning normally.
- FAIL indicates the component is malfunctioning.



(f) Select the component and press ENTER. If the monitor result has been PASS or FAIL, the accuracy test value appears.
- VAL indicates the test value.
- LMT indicates the test limit (malfunction criterion).
- TLT indicates the test limit type.

(g) Compare the test value with the test limit.
- If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
- If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- If the test value is on the borderline of the test limit, a malfunction is concealed in the component.

  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.

ES

DTC	**P0604**	**Internal Control Module Random Access Memory (RAM) Error**

DTC	**P0606**	**ECM / PCM Processor**

DTC	**P0607**	**Control Module Performance**

DTC	**P0657**	**Actuator Supply Voltage Circuit / Open**

MONITOR DESCRIPTION

The ECM continuously monitors its internal memory status, internal circuits, and output signals to the throttle actuator. This self-check ensures that the ECM is functioning properly. If any malfunction is detected, the ECM will set the appropriate DTC and illuminate the MIL.

The ECM memory status is diagnosed by internal "mirroring" of the main CPU and the sub CPU to detect random access memory (RAM) errors. The 2 CPUs also perform continuous mutual monitoring. The ECM sets a DTC if: 1) outputs from the 2 CPUs are different and deviate from the standards, 2) the signals to the throttle actuator deviate from the standards, 3) a malfunction is found in the throttle actuator supply voltage, and 4) any other ECM malfunction is found.

DTC No.	DTC Detection Condition	Trouble Area
P0604 P0606 P0607 P0657	ECM internal error	ECM

MONITOR STRATEGY

Related DTCs	P0604: RAM Error P0606: CPU Malfunction P0607: ECM CPU Malfunction P0657: ETCS Power Supply
Required sensors / components (Main)	ECM
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	Within 1 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

RAM Error:

RAM	RAM check failure

CPU Malfunction:

Either of the following conditions is met:	Condition 1 or 2
1. Difference between TP of main CPU and TP of sub CPU	0.3 V or more
2. Difference between APP of main CPU and APP of sub CPU	0.3 V or more

CPU Malfunction:

Either of the following conditions is met:	Condition 1 or 2
1. All of the following conditions are met:	Condition (a), (b) and (c)
(a) CPU reset	1 time or more
(b) Difference between TP and APP learning values	0.4 V or more
(c) Electronic throttle actuator	OFF
2. CPU reset	2 times or more

ETCS Power Supply:

ETCS power supply when ignition switch is turned from OFF to ON	7 V or more

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0604/P0606/P0607/P0657)

(a) Check for DTCs.

OK:

DTC P0604, P0606, P0607 or P0657 is not output.

B → **GO TO DTC CHART**

A

REPLACE ECM

DTC	P0617	Starter Relay Circuit High

MONITOR DESCRIPTION

While the engine is being cranked, the battery positive voltage is applied to terminal STA of the ECM.
If the vehicle is being driven and the ECM detects the starter control signal (STA), the ECM concludes that the starter control circuit is malfunctioning. The ECM will turn on the MIL and a DTC will be set.

DTC No.	DTC Detecting Condition	Trouble Area
P0617	When conditions (a), (b) and (c) are met and the battery (+B) voltage 10.5 V or more is applied for 20 seconds: (a) Vehicle speed greater than 12 mph (20 km/h) (b) Engine revolution greater than 1,000 rpm (c) STA signal ON	• Short in PNP switch assembly circuit • PNP switch assembly • Ignition switch • ECM

MONITOR STRATEGY

Related DTCs	P0617: Starter Signal
Required sensors / components (Main)	Starter Relay, PNP Switch
Required sensors / components (Related)	Crankshaft Position Sensor, Vehicle Speed Sensor
Frequency of operation	Continuous
Duration	20 seconds
MIL operation	Immediate
Sequence operation	None

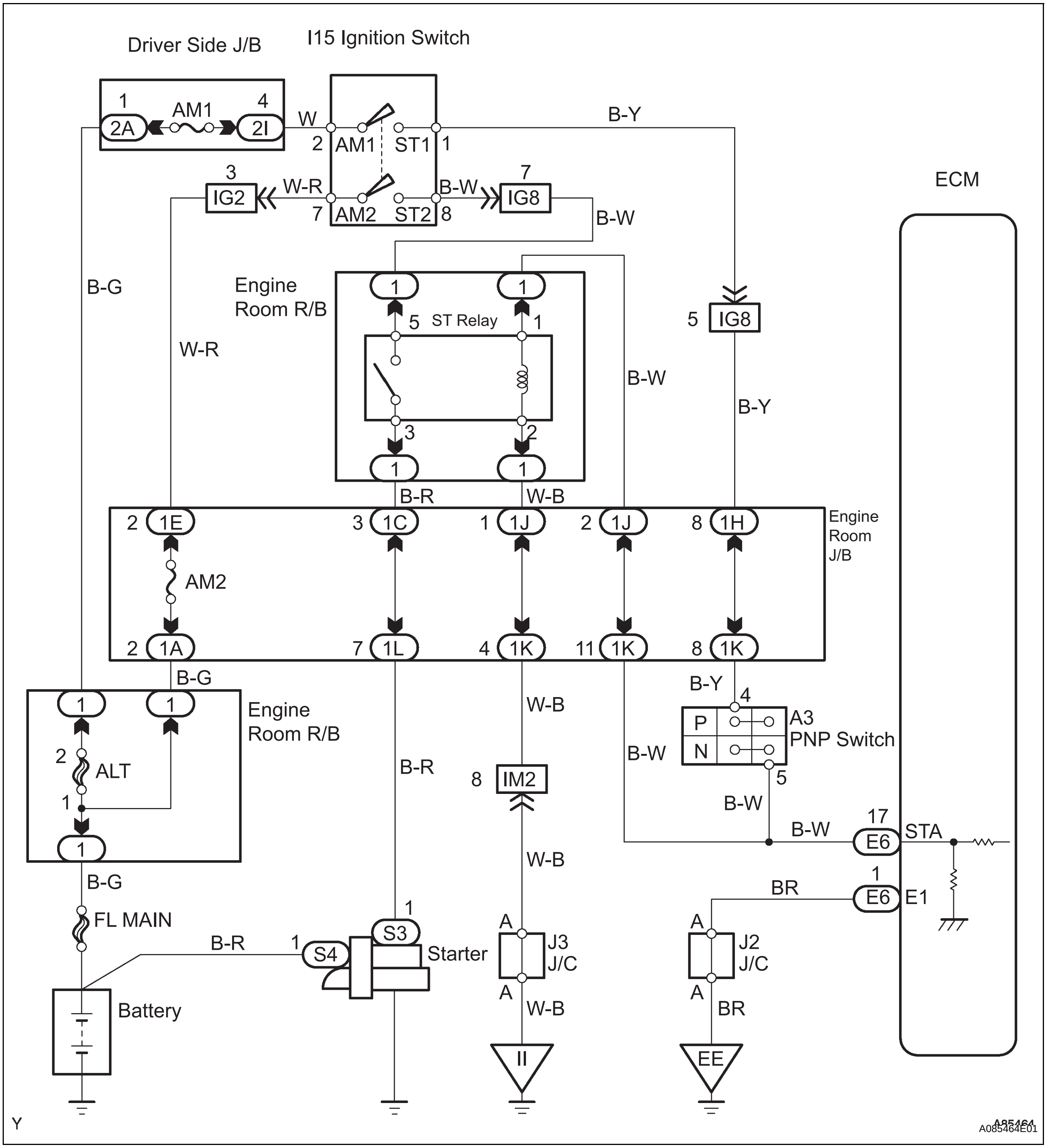
TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	10.5 V or more
Vehicle speed	12.4 mph (20 km/h) or more
Engine RPM	1,000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

Starter signal	ON

WIRING DIAGRAM



HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	READ INTELLIGENT TESTER (STARTER SIGNAL)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and push the intelligent tester main switch ON.
(c) On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG. Read the values.

Result

Ignition Switch Condition	ON	START
STA Signal	OFF	ON

OK → **REPLACE ECM**

NG ↓

2	INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY

OK:
When shift lever is the N position, the PNP switch is ON.
When shift lever is the D position, the PNP switch is OFF.

NG → **REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (GO TO NEXT STEP 3 AFTER REPLACEMENT)**

OK ↓

3	READ VALUE OF INTELLIGENT TESTER (STA SIGNAL)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and push the intelligent tester main switch ON.
(c) On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG. Read the values.

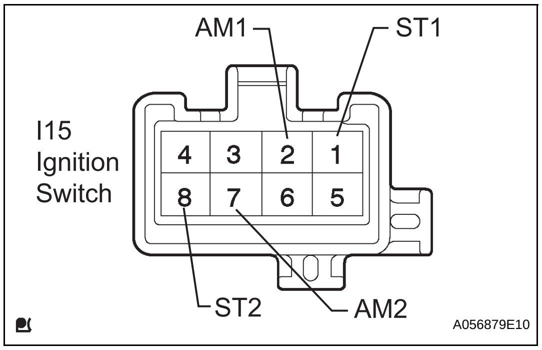
Result

Ignition Switch Condition	ON	START
STA Signal	OFF	ON

OK → **CHECK SYSTEM OK**

NG ↓

4	INSPECT IGNITION OR STARTER SWITCH ASSEMBLY



(a) Measure the resistance of the ignition switch terminals.
Resistance

Switch Condition	Tester Connection	Specified Condition
LOCK	1 - 2 7 - 8	10 kΩ or higher
START	1 - 2 7 - 8	Below 1 Ω

NG → **REPLACE IGNITIOIN OR STARTER SWITCH ASSEMBLY (GO TO NEXT STEP 5 AFTER REPLACEMENT)**

ES

OK

5	READ VALUE OF INTELLIGENT TESTER (STA SIGNAL)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and push the intelligent tester main switch ON.
(c) On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG. Read the values.
Result

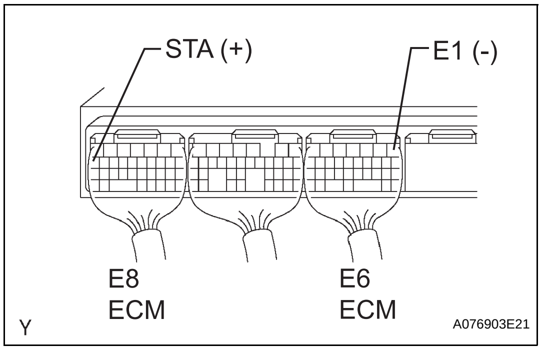
Ignition Switch Condition	ON	START
STA Signal	OFF	ON

OK → **CHECK SYSTEM OK**

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

1	CHECK ECM (STA VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Condition	Specified Condition
E8-17 (STA) - E6-1 (E1)	Ignition switch ON	0 V
E8-17 (STA) - E6-1 (E1)	Engine cranking	6 V or more

OK → **REPLACE ECM**

NG

2	INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY

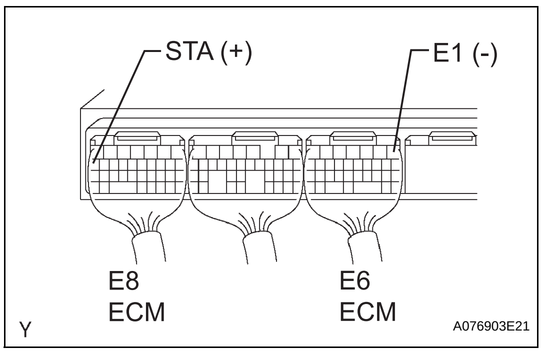
OK:
When shift lever is the N position, the PNP switch is ON.
When shift lever is the D position, the PNP switch is OFF.

NG → **REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (GO TO NEXT STEP 3 AFTER REPLACEMENT)**

OK

ES

3	CHECK ECM (STA VOLTAGE)



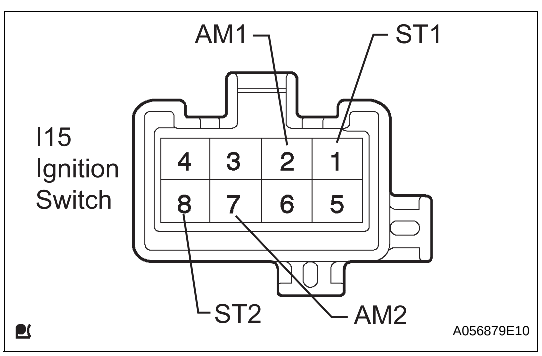
(a) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Condition	Specified Condition
E8-17 (STA) - E6-1 (E1)	Ignition switch ON	0 V
E8-17 (STA) - E6-1 (E1)	Engine cranking	6 V or more

OK → **SYSTEM OK**

NG

4	INSPECT IGNITION OR STARTER SWITCH ASSEMBLY



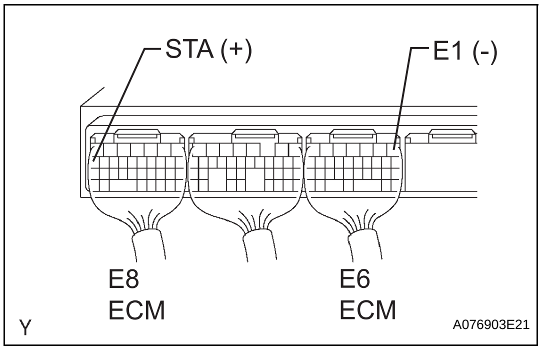
(a) Measure the resistance of the ignition switch terminals.
Resistance

Switch Condition	Tester Connection	Specified Condition
LOCK	1 - 2 7 - 8	10 kΩ or higher
START	1 - 2 7 - 8	Below 1 Ω

NG → **REPLACE IGNITION OR STARTER SWITCH ASSEMBLY**

OK

5	CHECK ECM (STA VOLTAGE)



(a) Measure the voltage of the ECM connectors.

Voltage

Tester Connection	Condition	Specified Condition
E8-17 (STA) - E6-1 (E1)	Ignition switch ON	0 V
E8-17 (STA) - E6-1 (E1)	Engine cranking	6 V or more

OK → **SYSTEM OK**

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

DTC P0630 Vin not Programmed or Mismatch - ECM / PCM

DESCRIPTION

DTC P0630 is set when the Vehicle Indication Number (VIN) is not stored the ECM or the input VIN is not accurate. Input the VIN with the intelligent tester (See page ES-10).

DTC No.	DTC Detection Conditions	Trouble Areas
P0630	• VIN is not stored in ECM • Input VIN in ECM is not accurate	• ECM

MONITOR STRATEGY

Related DTCs	P0630: VIN not programed
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

VIN code	Not programmed

COMPONENT OPERATING RANGE

VIN code	Programmed

1 READ CURRENT DTC

NOTICE:
If P0630 is present, the VIN must be input to the ECM using the intelligent tester. However, all DTCs are cleared automatically by the tester when inputting the VIN. If DTCs other than P0630 are present, check them first.

NEXT

2	INPUT VIN WITH INTELLIGENT TESTER

NEXT

END

DTC	P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)

DESCRIPTION

When the shift lever is in the N or P position: 1) the Park/Neutral Position (PNP) switch turns ON, and 2) ECM terminal NSW is grounded to the body ground via the starter relay and voltage becomes 0V. When the shift lever is in the D, 2, L or R position: 1) the PNP switch turns OFF, and 2) ECM terminal NSW receives current and becomes the voltage of the ECM internal power source.
If the shift lever is moved from the N position to the D position, this signal is used for air-fuel ratio correction and for idle speed control (estimated control).

DTC No.	DTC Detection Condition	Trouble Area
P0705	2 or more switches are ON simultaneously at P R, N, D, 2 and L positions (2 trip detection logic)	• Short in PNP switch circuit • PNP switch • ECM

HINT:
After confirming DTC P0705, use the intelligent tester to confirm the PNP switch signal in the ALL menu (to reach the ALL menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL).

WIRING DIAGRAM

Refer to DTC P0705 (See page AX-39).

Refer to DTC P0705 (See page AX-39).
HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

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 it opens and closes the throttle valve.
The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. The throttle position sensor provides feedback to the ECM. This feedback allows the ECM to control the throttle actuator and monitor the throttle opening angle in response to driver inputs.
HINT:
This Electronic Throttle Control System (ETCS) does not use a throttle cable.

DTC No.	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds: (a) Throttle actuator output duty 80 % or more (b) Throttle actuator current less than 0.5 A	• Open in throttle actuator circuit • Throttle actuator • ECM
P2103	Either of following conditions is met: • Throttle actuator current 10 A or more (0.1 seconds) • Throttle actuator current 7 A or more (0.6 seconds)	• Short in throttle actuator circuit • Throttle actuator • Throttle valve • Throttle body assembly • ECM

MONITOR DESCRIPTION

The ECM monitors the flow of electrical current through the electronic throttle actuator, and detects malfunctions or open circuits in the throttle actuator based on the value of the electrical current. When the current deviates from the standard values, the ECM concludes that there is a fault in the throttle actuator. Or, if the throttle valve is not functioning properly (for example, stuck ON), the ECM concludes that there is a fault and turns on the MIL and a DTC is set.
Example:
When the current is more than 10 A, or the current is less than 0.5 A when the actuator driving duty ratio is exceeding 80%, the ECM concludes that the current is deviated from the standard values, turns on the MIL and a DTC is set.

MONITOR STRATEGY

The ECM monitors the flow of electrical current through the electronic throttle actuator, and detects malfunctions or open circuits in the throttle actuator based on the value of the electrical current. When the current deviates from the standard values, the ECM concludes that there is a fault in the throttle actuator. Or, if the throttle valve is not functioning properly (for example, stuck ON), the ECM concludes that there is a fault and turns on the MIL and a DTC is set.
Example:
When the current is more than 10 A, or the current is less than 0.5 A when the actuator driving duty ratio is exceeding 80%, the ECM concludes that the current is deviated from the standard values, turns on the MIL and a DTC is set.

FAIL-SAFE

If the ETCS has a malfunction, the ECM cuts off current to the throttle actuator. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of 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 enable the vehicle to continue at a minimal speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail-safe operation will stop and the system will return to normal condition.

MONITOR STRATEGY

Related DTCs	P2102: Throttle Actuator Current (Low current) P2103: Throttle Actuator Current (High current)
Required sensors / components (Main)	Throttle actuator
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	P2102: 2 seconds P2103: 0.6 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None

P2102:

Throttle actuator duty ratio	80 % or more
Throttle actuator power supply	8 V or more

P2103:

Throttle actuator power supply	8 V or more

TYPICAL MALFUNCTION THRESHOLDS

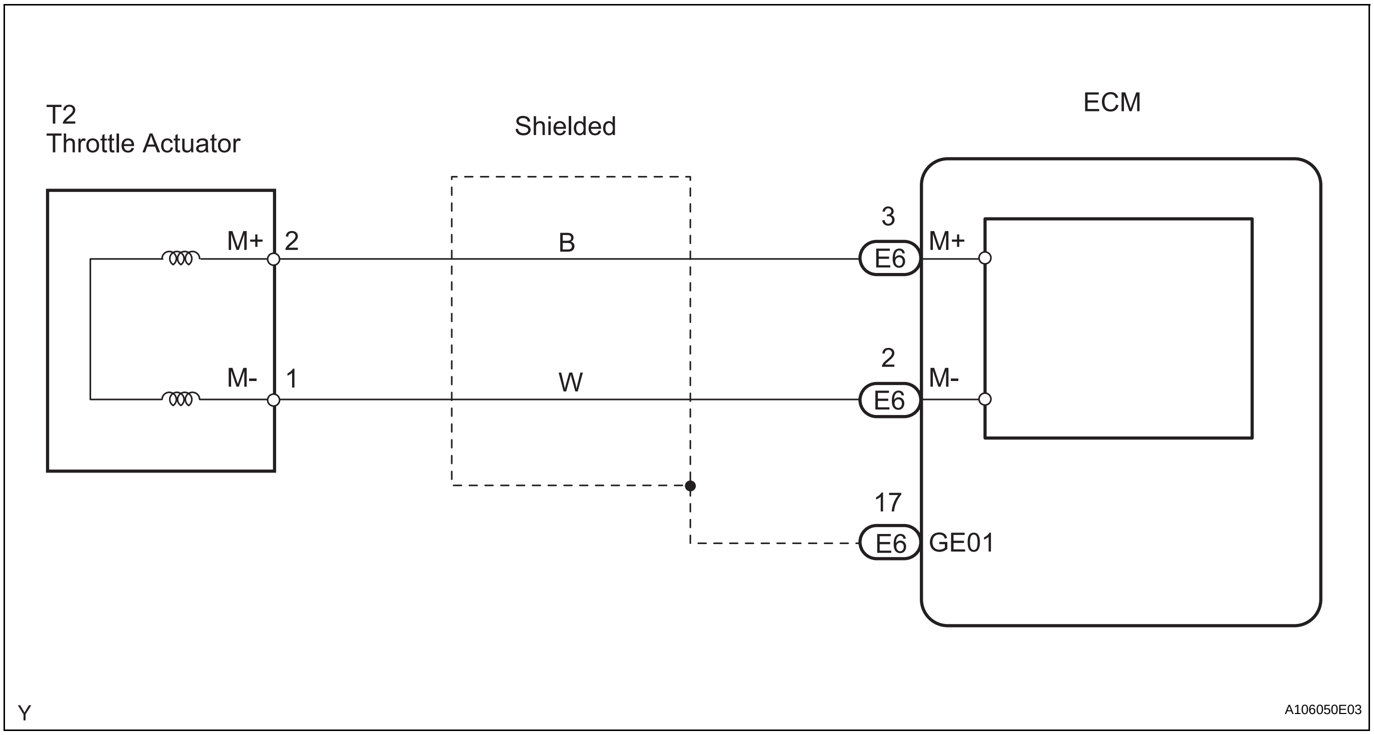
P2102:

Throttle actuator current	Less than 0.5 A

P2103:

Either of the following conditions is met:	Condition 1 or 2
1. Hybrid IC diagnosis signal	Fail (for 0.1 seconds)
2. Hybrid IC current limiter port	Fail (for 0.6 seconds)

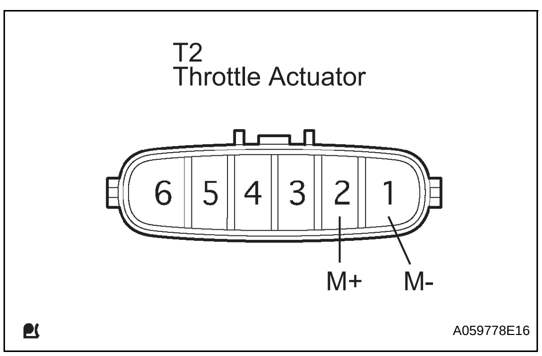
WIRING DIAGRAM



ES

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	INSPECT THROTTLE BODY ASSEMBLY (RESISTANCE OF THROTTLE ACTUATOR)



(a) Disconnect the T2 throttle actuator connector.

(b) Measure the resistance of the throttle actuator terminals.

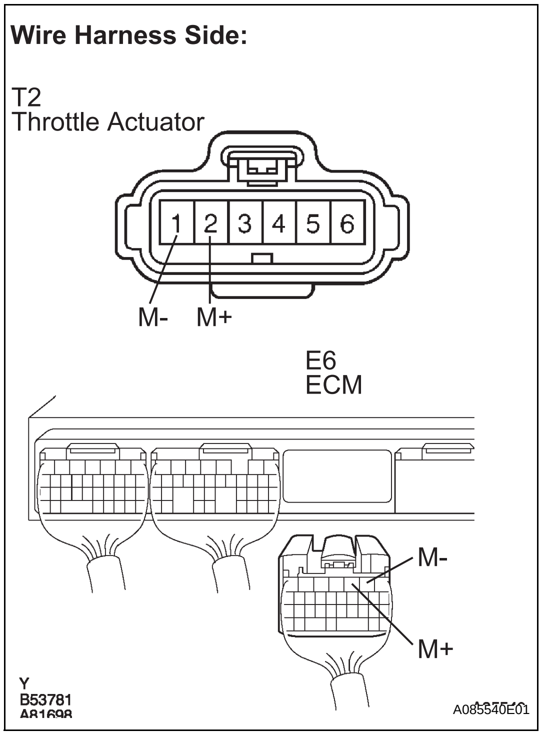
Resistance

Tester Connection	Specified Condition
T2-2 (M+) - T2-1 (M-)	0.3 to 100 Ω (20°C (68°F))

NG → **REPLACE THROTTLE BODY ASSEMBLY**

OK

2	CHECK WIRE HARNESS (THROTTLE ACTUATOR - ECM)



(a) Disconnect the T2 throttle actuator connector.
(b) Disconnect the E6 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
T2-2 (M+) - E6-3 (M+) T2-1 (M-) - E6-2 (M-)	Below 1 Ω
T2-2 (M+) or E6-3 (M+) - Body ground T2-1 (M-) or E6-2 (M-) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3	INSPECT THROTTLE BODY ASSEMBLY

(a) Visually check between the throttle valve and the housing for foreign objects.
Also, check if the valve can open and close smoothly.
OK:
The throttle valve is not contaminated by foreign objects and can move smoothly.

NG → **REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY**

OK

REPLACE ECM

ES

DTC	P2111	Throttle Actuator Control System - Stuck Open

DTC	P2112	Throttle Actuator Control System - Stuck Closed

SYSTEM DESCRIPTION

The throttle actuator is operated by the ECM and it opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the throttle position sensor, which is mounted on the throttle body. The throttle position sensor provides feedback to the ECM to control the throttle actuator and set the throttle valve angle in response to driver inputs.
HINT:
This Electronic Throttle Control System (ETCS) does not use a throttle cable.

DTC No.	DTC Detection Condition	Trouble Area
P2111	Throttle actuator locked during ECM order to close	• Throttle actuator circuit • Throttle actuator • Throttle body • Throttle valve
P2112	Throttle actuator locked during ECM order to open	• Throttle actuator circuit • Throttle actuator • Throttle body • Throttle valve

MONITOR DESCRIPTION

The ECM concludes that there is a malfunction of the ETCS when the throttle valve remains at a fixed angle despite high drive current from the ECM. The ECM will turn on the MIL and a DTC will be set.

FAIL-SAFE

If the ETCS has a malfunction, the ECM cuts off current to the throttle actuator. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of 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 enable the vehicle to continue at a minimal speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail-safe operation will stop and the system will return to normal.

MONITOR STRATEGY

Related DTCs	P2111: Throttle actuator stuck open P2112: Throttle actuator stuck closed
Required sensors / components (Main)	Throttle actuator
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None

P2111:

System guard*	ON
Throttle actuator current	2 A or more
Duty cycle to close throttle	80% or more
*: System guard is ON when the following conditions are met	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor	Fail determined
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or more
Throttle actuator	Fail determined

P2112:

System guard*	ON
Throttle actuator current	2 A or more
Duty cycle to open throttle	80% or more
*: System guard is ON when the following conditions are met	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor	Fail determined
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or more
Throttle actuator	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

TP sensor voltage change	Less than 0.1 V

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-234).

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK OTHER DTC OUTPUT

Display (DTC output)	Proceed to
P2111 or P2112	A
P2111 or P2112 and other DTCs	B

B → **GO TO RELEVANT DTC CHART**

A

2 INSPECT THROTTLE BODY ASSEMBLY (VISUALLY CHECK THROTTLE VALVE)

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:

The throttle valve is not contaminated by foreign objects and can move smoothly.

NG → **REPLACE THROTTLE BODY ASSEMBLY**

OK

3 CHECK DTC OUTPUT

(a) Clear the DTC.
(b) Start the engine, and depress and release the accelerator pedal quickly (fully open and fully close).
(c) Read DTC.

Result

Display (DTC output)	Proceed to
No DTC	A
P2111 and/or P2112	B

B → **REPLACE ECM**

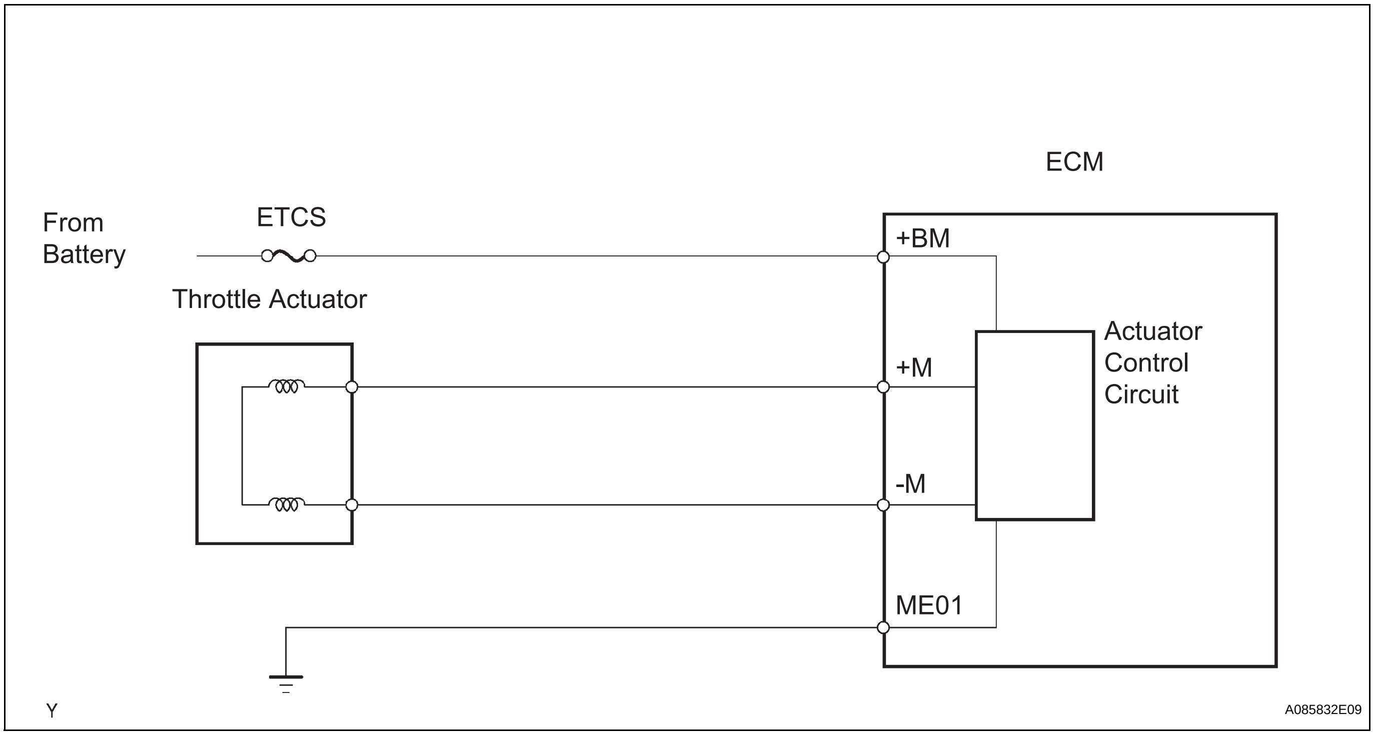
A

CHECK FOR INTERMITTENT PROBLEM

DTC	P2118	Throttle Actuator Control Motor Current Range / Performance

DESCRIPTION

The Electronic Throttle Control System (ETCS) has a dedicated power supply circuit. The voltage (+BM) is monitored and when the voltage is low (less than 4V), the ECM concludes that the ETCS has a fault and current to the throttle actuator is cut.
When the voltage becomes unstable, the ETCS condition itself becomes unstable. For this reason, when the voltage is low, the current to the actuator is cut. If repairs are made and the system has returned to normal, turn the ignition switch OFF. The ECM then allows current to flow to the actuator and the actuator can be restarted.



HINT:
This ETCS does not use a throttle cable.

DTC No.	DTC Detection Condition	Trouble Area
P2118	Open in ETCS power source circuit	• Open in ETCS power source circuit • ETCS fuse • ECM

MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the electronic throttle actuator. When the power supply voltage drops below the threshold, the ECM concludes that the power supply circuit has an open circuit. A DTC is set and the MIL is turned on.

FAIL-SAFE

If the ETCS has a malfunction, the ECM cuts off current to the throttle actuator. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of 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 enable the vehicle to continue at a minimal speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

If a "pass" condition is detected and then the ignition switch is turned OFF, the fail-safe operation will stop and the system will return to normal.

MONITOR STRATEGY

Related DTCs	P2118: Throttle Actuator Power Supply
Required sensors / components (Main)	Throttle actuator, Throttle valve, ETCS fuse
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	0.8 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	More than 8 V

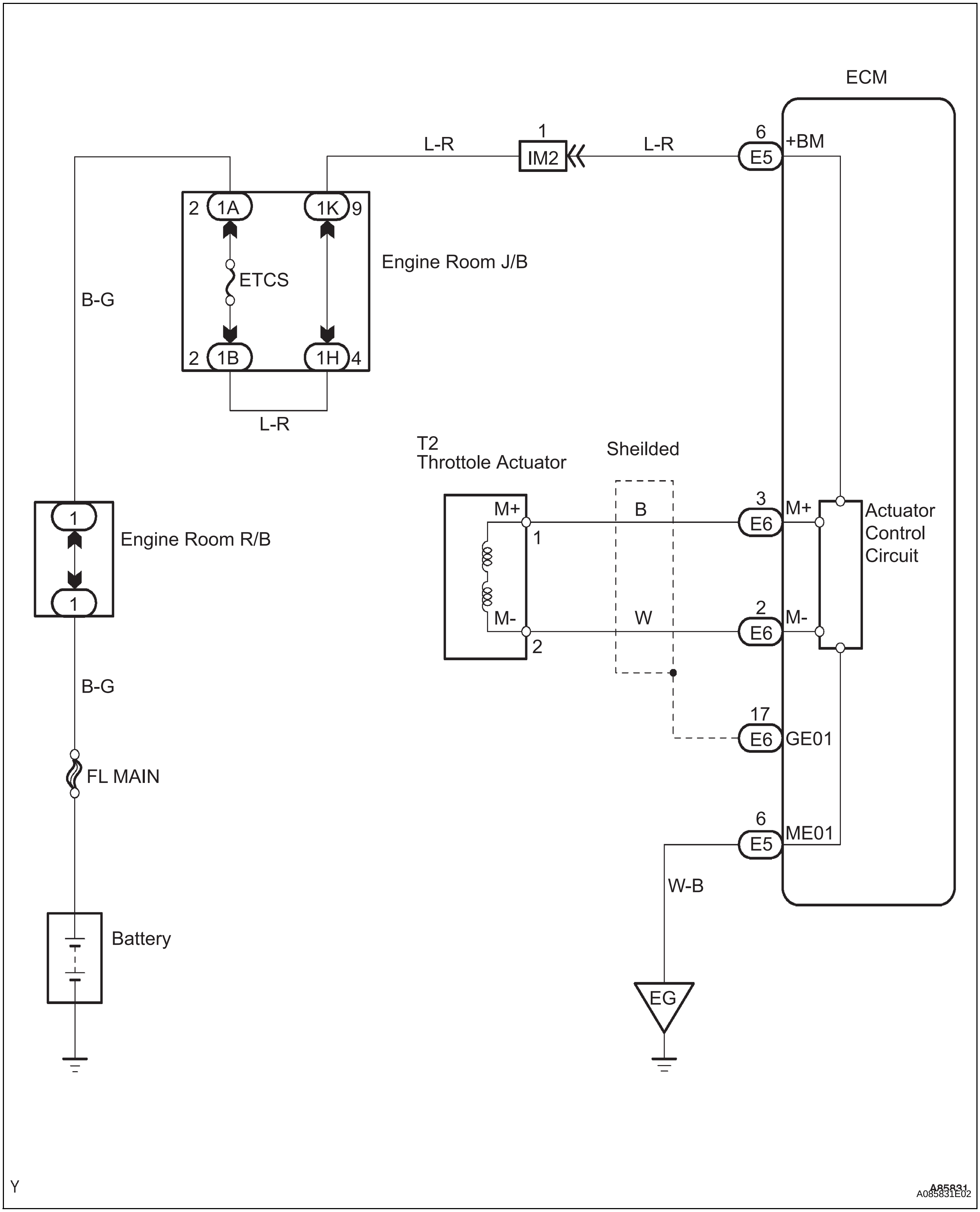
TYPICAL MALFUNCTION THRESHOLDS

Throttle actuator power supply voltage	Less than 4 V

COMPONENT OPERATING RANGE

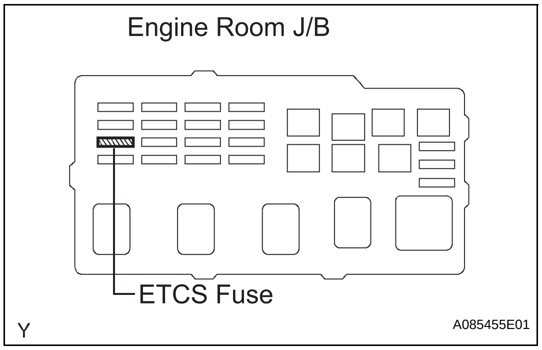
Throttle actuator power supply voltage	9 to 14 V

WIRING DIAGRAM



HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1 CHECK FUSE (ETCS)

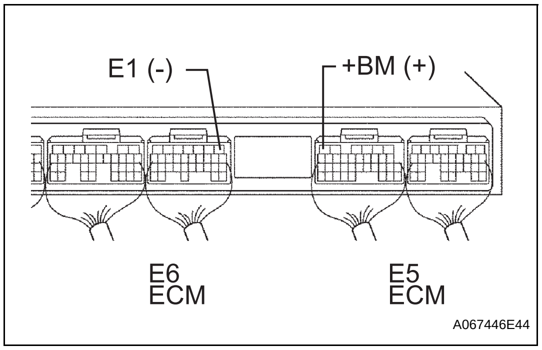


(a) Remove the ETCS fuse from the engine room J/B.
(b) Measure the resistance of the ETCS fuse.
Resistance:
Below 1 Ω

NG → **REPLACE FUSE**

OK

2 INSPECT ECM (+BM VOLTAGE)



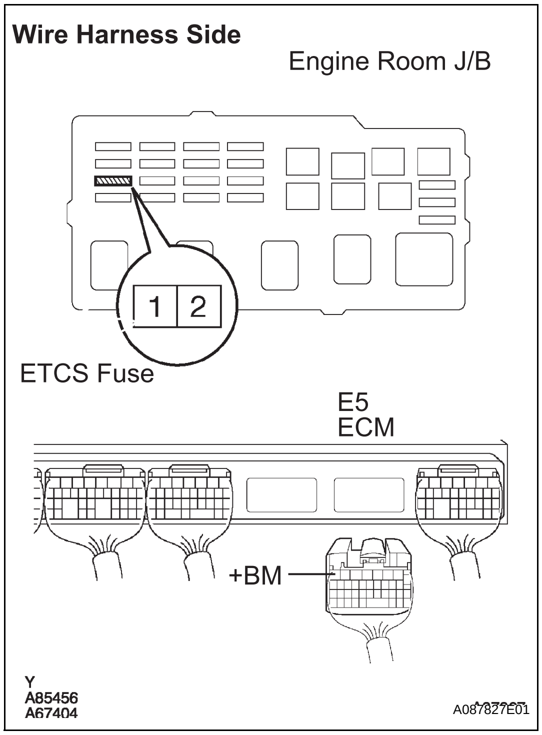
(a) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Specified Condition
E5-6 (+BM) - E6-1 (E1)	9 to 14 V

OK → **REPLACE ECM**

NG

3	CHECK WIRE HARNESS (ECM - ETCS FUSE, ETCS FUSE - BATTERY)



(a) Check the wire harness between the ETCS fuse and ECM.
(1) Remove the ETCS fuse from the engine room J/B.
(2) Disconnect the E5 ECM connector.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
J/B ETCS fuse terminal 2 - E5-6 (+BM)	Below 1 Ω
J/B ETCS fuse terminal 2 or E5-6 (+BM) - Body ground	10 kΩ or higher

(b) Check the wire harness between the ETCS fuse and battery.
(1) Remove the ETCS fuse from the engine room J/B.
(2) Disconnect the battery's positive cable.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
Battery positive cable - J/B ETCS fuse terminal 1	Below 1 Ω
Battery positive cable or J/B ETCS fuse terminal 1 - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ENGINE ROOM JUNCTION BLOCK

DTC P2119 Throttle Actuator Control Throttle Body Range / Performance

DESCRIPTION

The Electronic Throttle Control System (ETCS) is composed of a throttle actuator that operates the throttle valve, a throttle position sensor that detects the opening angle of the throttle valve, an accelerator pedal position sensor that detects the accelerator pedal position, and the ECM that controls the ETCS system.
The ECM operates the throttle motor to position the throttle valve for proper response to driver inputs. The throttle position sensor, which is mounted on the throttle body, detects the opening angle of the throttle valve and provides this signal to the ECM so that the ECM can regulate the throttle motor.

DTC No.	DTC Detection Condition	Trouble Area
P2119	Throttle opening angle continues to vary greatly from target throttle opening angle	• Electronic throttle control system • ECM

MONITOR DESCRIPTION

The ECM determines the "actual" throttle angle based on the throttle position sensor signal. The "actual" throttle position is compared to the "target" throttle position commanded by the ECM. If the difference between these 2 values exceeds a specified limit, the ECM interprets this as a fault in the ETCS system. The ECM turns on the MIL and a DTC is set.

FAIL-SAFE

If the ETCS has a malfunction, the ECM cuts off current to the throttle actuator. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of 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 enable the vehicle to continue at a minimal speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail-safe operation will stop and the system will return to normal.

MONITOR STRATEGY

Related DTCs	P2119: ETCS malfunction
Required sensors / components (Main)	Throttle actuator
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	1 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
System guard*	ON
*: System guard is ON when the following conditions are met	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor	Fail determined
Throttle actuator current-cut operation	Not executing

Throttle actuator power supply	4 V or more
Throttle actuator	Gail determined

The monitor will run whenever these DTCs are not present	See page

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions are met	Condition 1 and 2
Commanded closed throttle position - current closed throttle position	0.3 V or more
Commanded open throttle position - current open throttle position	0.3 V or more

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-234).

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P2119)

Display (DTC output)	Proceed to
Only P2119 is output	A
P2119 and other codes are output	B

B → **GO TO RELEVANT DTC CHART**

A

2	CHECK IF DTC OUTPUT RECURS (DTC P2119)

(a) Clear the DTC (See page ES-29).
(b) Allow the engine to idle for 15 seconds.
(c) Pull the hand brake and shift the gear to D.
(d) Depress the brake pedal securely and the accelerator pedal fully for 5 seconds.
(e) Read the DTC.
HINT:
Actual throttle position (TP) sensor voltage can be confirmed using the intelligent tester [DATA LIST/ALL/ THROTTLE POS #1].
OK:
No DTC output.

NG → **REPLACE THROTTLE BODY ASSEMBLY**

OK

NORMAL

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

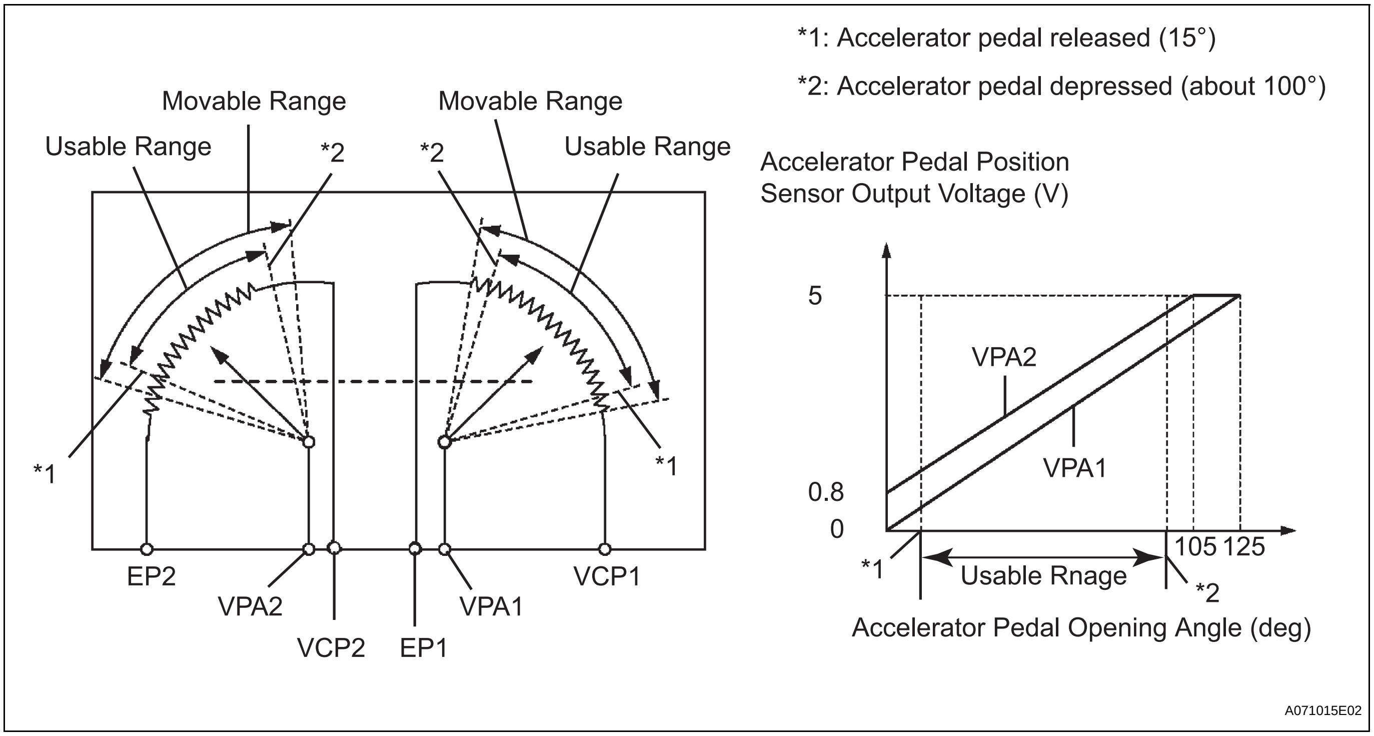
DESCRIPTION

HINT:

- This Electronic Throttle Control System (ETCS) does not use a throttle cable.
- This accelerator pedal position sensor is a non-contact type.

The accelerator pedal position sensor is mounted on the accelerator pedal bracket. The accelerator pedal position sensor has 2 sensor elements / signal outputs: VPA1 and VPA2. VPA1 is used to detect the actual accelerator pedal angle (used for engine control) and VPA2 is used to detect malfunctions in VPA1. Voltage applied to VPA1 and VPA2 changes between 0V and 5V in proportion to the accelerator pedal angle.

The ECM monitors the accelerator pedal angle from VPA1 and VPA2 signal outputs, and controls the throttle motor based on these signals.



DTC No.	DTC Detection Condition	Trouble Area
P2120	Condition (a) continues for 0.5 seconds or more: 1. VPA is 0.4 V or less and VPA2 is 0.97 degrees or more; or VPA is 4.8 V or more	• Accelerator pedal position sensor • ECM
P2122	Condition (a) continues for 0.5 seconds or more when accelerator pedal is released: 1. VPA is 0.4 V or less	• Accelerator pedal position sensor • Open in VCP1 circuit • Open or short to ground in VPA circuit • ECM
P2123	Condition (a) continues for 2.0 seconds or more: 1. VPA is 4.8 V or more	• Accelerator pedal position sensor • Open in EPA circuit • ECM
P2125	Condition (a) continues for 0.5 seconds or more: 1. VPA2 is 1.2 V or less and VPA is 0.97 degrees or more; or VPA2 is 4.8 V or more and VPA is between 0.4 V and 3.45 V	• Accelerator pedal position sensor • ECM
P2127	Condition (a) continues for 0.5 seconds or more when accelerator pedal is released: 1. VPA2 is 1.2 V or less	• Accelerator pedal position sensor • Open in VCP2 circuit • Open or short to ground in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more: 1. VPA2 is 4.8 V or more 2. VPA is 0.4 V or more and VPA is 3.45 V or less	• Accelerator pedal position sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more: 1. Difference between VPA and VPA2 is 0.02 V or less 2. VPA is 0.4 V or less and VPA2 is 1.2 V or less	• VPA and VPA2 circuits are short circuited • Accelerator pedal position sensor • ECM

HINT:
After confirming DTCs P2120, P2122, P2123, P2125, P2127, P2128 and P2138, use the intelligent tester or the OBD II scan tool to confirm the accelerator pedal position sensor output voltage.

Trouble Area	Accelerator pedal position expressed as voltage output	Accelerator pedal position expressed as voltage output	Accelerator pedal position expressed as voltage output	Accelerator pedal position expressed as voltage output
	Accelerator pedal released	Accelerator pedal released	Accelerator pedal depressed	Accelerator pedal depressed
	ACCEL POS #1	ACCEL POS #2	ACCEL POS #1	ACCEL POS #2
VCP circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.3 V

VPA2 circuit open or ground short	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 5.5 V	4.5 to 5.5 V	4.5 to 5.5 V	4.5 to 5.5 V

A071015

MONITOR DESCRIPTION

When VPA or VPA2 deviates from the standard, or the difference between the voltage outputs of the two sensors is less than the threshold, the ECM concludes that there is a defect in the accelerator pedal position sensor. The ECM turns on the MIL and a DTC is set.
Example:
The voltage output of the VPA is below 0.4 V or exceeds 4.8 V.

FAIL-SAFE

The accelerator pedal position sensor has 2 (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 fail-safe mode. In fail-safe 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 to be fully closed. In this case, the throttle valve will remain 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 will stop and the system will return to normal condition.

MONITOR STRATEGY

Related DTCs	P2120: APP Sensor 1 Range Check (Chattering) P2122: APP Sensor 1 Range Check (Low voltage) P2123: APP Sensor 1 Range Check (High voltage) P2125: APP Sensor 2 Range Check (Chattering) 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	2 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P2120:

Either of the following conditions is met:	Condition 1 or 2
1. VPA1 voltage when VPA2 is 0.97° or more	0.4 V or less
2. VPA1 voltage	4.8 V or more

P2122:

VPA1 voltage when VPA2 is 0.97° or more	0.4 V or less

P2123:

VPA1 voltage	4.8 V or more

P2125:

Either of the following conditions is met:	Condition 1 or 2
1. VPA2 voltage when VPA1 is 0.97° or more	1.2 V or less
2. VPA2 voltage when VPA1 is 0.4 to 3.45 V	4.8 V or more

P2127:

VPA2 voltage when VPA1 is 0.97° or more	1.2 V or less

P2128:

VPA2 voltage when VPA1 is 0.4 to 3.45 V	4.8 V or more

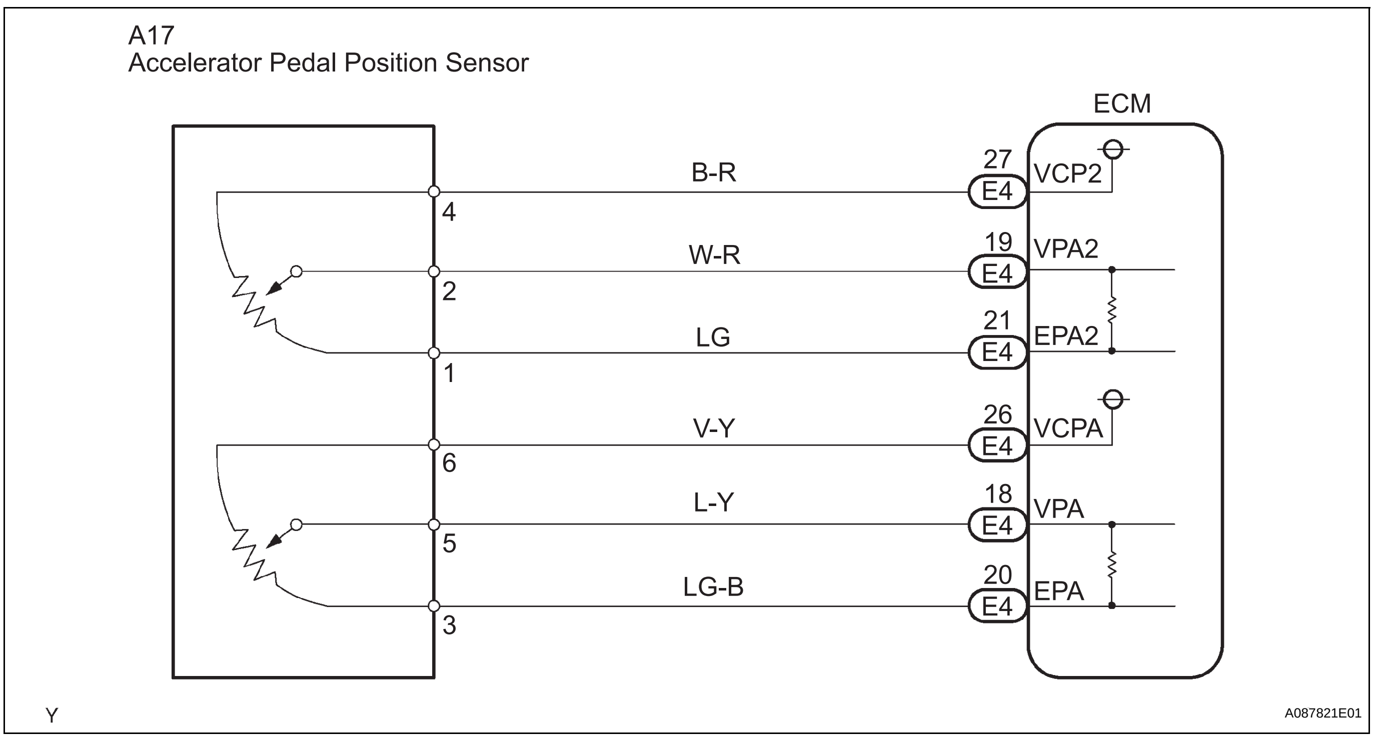
P2138:

Either of the following conditions is met:	Condition 1 or 2
Condition 1	-
Difference between VPA 1 and VPA2 voltages	0.02 V or less
Condition 2	-
VPA1 voltage	0.4 V or less
VPA2 voltage	1.2 V or less

COMPONENT OPERATING RANGE

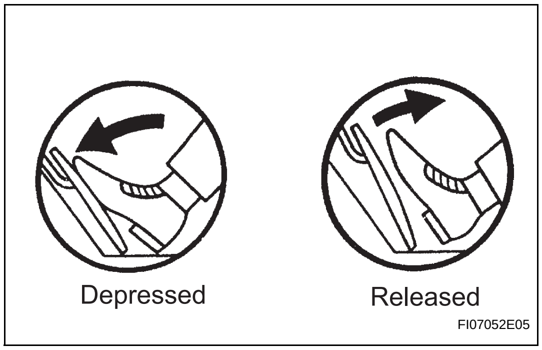
VPA1 voltage	0.5 to 4.5 V
VPA2 voltage	1.2 to 4.8 V

WIRING DIAGRAM



HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1 READ VALUE OF INTELLIGENT TESTER (ACCEL POS #1 AND ACCEL POS #2)



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1 and ACCEL POS #2. Read the values.

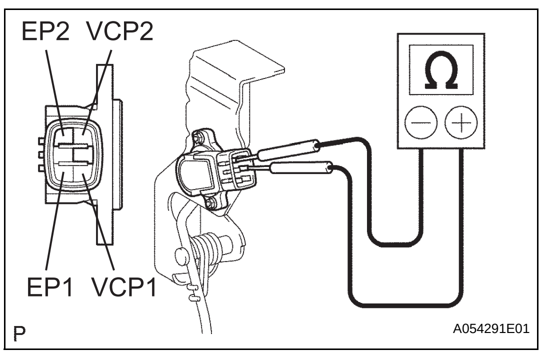
Voltage

Accelerator Pedal	ACCEL POS #1	ACCEL POS #2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.3 V

OK → **Go to step 6**

NG

2 INSPECT ACCELERATOR PEDAL ASSEMBLY (ACCELERATOR PEDAL POSITION SENSOR)



(a) Disconnect the A17 sensor connector.
(b) Measure the resistance of the sensor terminals.

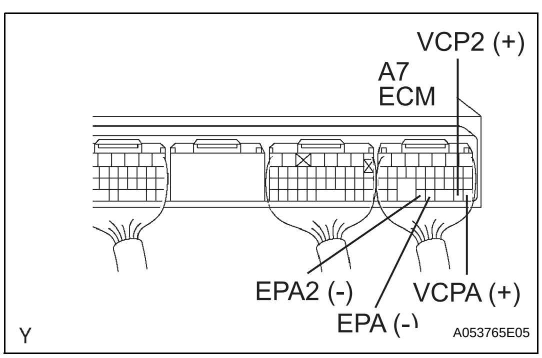
Resistance

Tester Condition	Condition	Specified Condition
3 (EP1) - 6 (VCP1) 1 (EP2) - 4 (VCP2)	20°C (68°F)	2.25 to 4.75 kΩ

NG → **REPLACE ACCELERATOR PEDAL ASSEMBLY**

OK

3 CHECK ECM (VCPA AND VCP2 VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the E4 ECM connector.

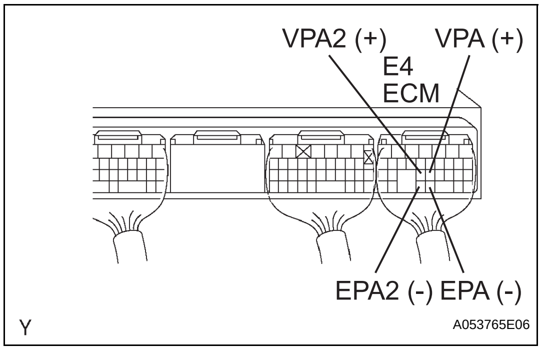
Voltage

Tester Connection	Specified Condition
E4-26 (VCPA) - E4-28 (EPA) E4-27 (VCP2) - E4-29 (EPA2)	4.5 to 5.5 V

NG → **REPLACE ECM**

OK

4	CHECK ECM (VPA AND VPA2 VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connector.

Voltage

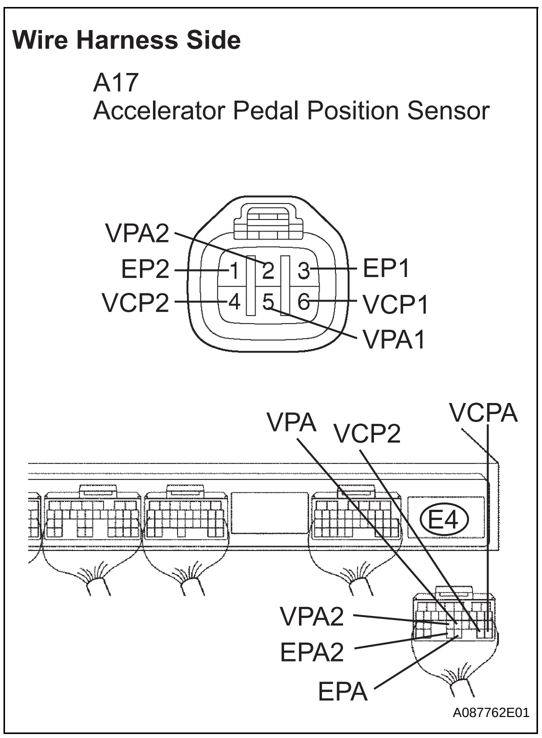
Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-22 (VPA) - E4-28 (EPA)	Released	0.5 to 1.1 V
E4-22 (VPA) - E4-28 (EPA)	Depressed	2.6 to 4.5 V
E4-23 (VPA2) - E4-29 (EPA2)	Released	1.2 to 2.9 V
E4-23 (VPA2) - E4-29 (EPA2)	Depressed	3.4 to 5.5 V

ES

OK → **REPLACE ECM**

NG

5	CHECK WIRE HARNESS (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A17 sensor connector.
(b) Disconnect the E4 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A17-6 (VCP1) - E4-26 (VCPA) A17-5 (VPA1) - E4-22 (VPA) A17-4 (VCP2) - E4-27 (VCP2) A17-3 (EP1) - E4-28 (EPA) A17-2 (VPA2) - E4-23 (VPA2) A17-1 (EP2) - E4-29 (EPA2)	Below 1 Ω
A17-6 (VCP1) or E4-26 (VCPA) - Body ground A17-5 (VPA1) or E4-22 (VPA) - Body ground A17-4 (VCP2) or E4-27 (VCP2) - Body ground A17-3 (EP1) or E4-28 (EPA) - Body ground A17-2 (VPA2) or E4-23 (VPA2) - Body ground A17-1 (EP2) or E4-29 (EPA2) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

6	READ OUTPUT DTC (ACCELERATOR PEDAL POSITION SENSOR DTCS ARE OUTPUT AGAIN)

(a) Clear the DTC (See page ES-29).
(b) Start the engine.
(c) Run the engine at idle for 15 seconds or more.

(d) Read the DTC.

Result:

Display (DTC Output)	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No DTC output	B

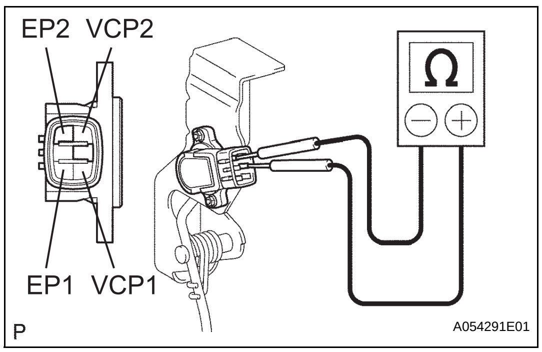
B → **SYSTEM OK**

A

REPLACE ECM

ES

1 INSPECT ACCELERATOR PEDAL ASSEMBLY (ACCELERATOR PEDAL POSITION SENSOR)



(a) Disconnect the A17 sensor connector.

(b) Measure the resistance of the sensor terminals.

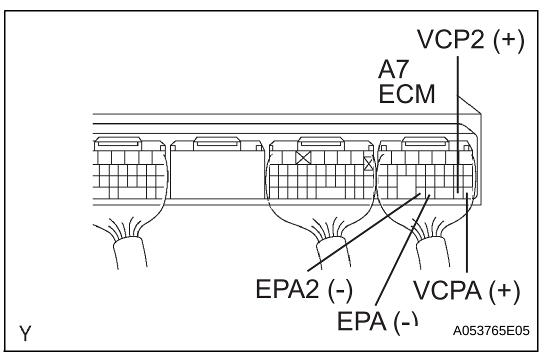
Resistance

Tester Connection	Specified Condition
3 of EP1 - 6 of VCP1 1 of EP2 - 4 of VCP2	2.25 to 4.75 kΩ at 20°C (68°F)

NG → **REPLACE ACCELERATOR PEDAL ASSEMBLY**

OK

2 CHECK ECM



(a) Turn the ignition switch ON.

(b) Measure the voltage of the ECM connector.

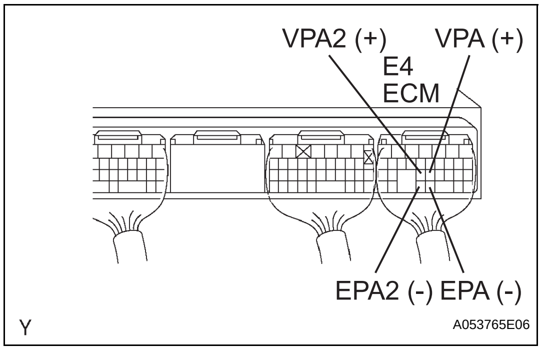
Voltage

Tester Connection	Specified Condition
E4-26 (VCPA) - E4-28 (EPA) E4-27 (VCP2) - E4-29 (EPA2)	4.5 to 5.5 V

NG → **REPLACE ECM**

OK

3 CHECK ECM (VPA VPA2 VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connector.

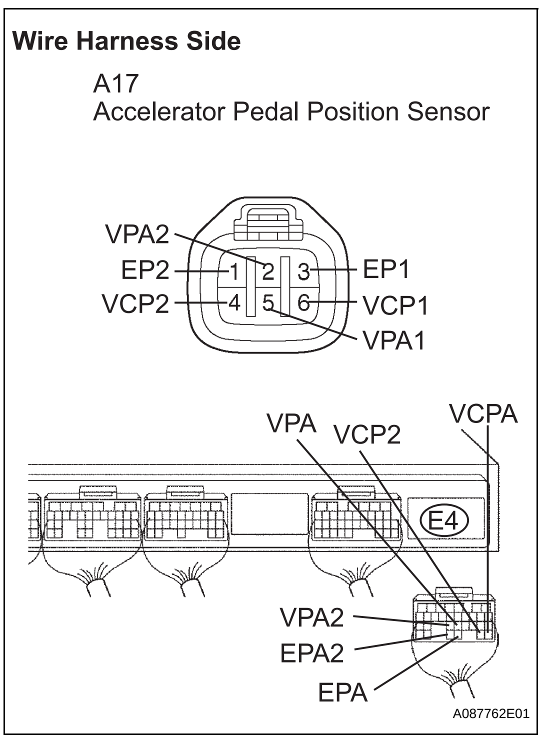
Voltage

Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-22 (VPA) - E4-28 (EPA)	Released	0.5 to 1.1 V
E4-22 (VPA) - E4-28 (EPA)	Depressed	2.6 to 4.5 V
E4-23 (VPA2) - E4-29 (EPA2)	Released	1.2 to 2.9 V
E4-23 (VPA2) - E4-29 (EPA2)	Depressed	3.4 to 5.5 V

OK → **REPLACE ECM**

NG

4 CHECK WIRE HARNESS (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A17 sensor connector.
(b) Disconnect the E4 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Condition	Specified Condition
A17-6 (VCP1) - E4-26 (VCPA) A17-5 (VPA1) - E4-22 (VPA) A17-4 (VCP2) - E4-27 (VCP2) A17-3 (EP1) - E4-28 (EPA) A17-2 (VPA2) - E4-23 (VPA2) A17-1 (EP2) - E4-29 (EPA2)	Below 1 Ω
A17-6 (VCP1) or E4-26 (VCPA) - Body ground A17-5 (VPA1) or E4-22 (VPA) - Body ground A17-4 (VCP2) or E4-27 (VCP2) - Body ground A17-3 (EP1) or E4-28 (EPA) - Body ground A17-2 (VPA2) or E4-23 (VPA2) - Body ground A17-1 (EP2) or E4-29 (EPA2) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

5 READ OUTPUT DTC (ACCELERATOR PEDAL POSITION SENSOR DTCS ARE OUTPUT AGAIN)

(a) Clear the DTC (See page ES-29).
(b) Start the engine.
(c) Run the engine at idle for 15 seconds or more.

(d) Read the DTC.

Result:

Display (DTC Output)	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138 are output again	A
No DTC output	B

B → **SYSTEM OK**

A ↓

REPLACE ECM

DTC P2121 Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance

HINT:
This is the repair procedure for the "accelerator pedal position sensor".

DESCRIPTION

Refer to DTC P2120 (See page ES-249).

DTC No.	DTC Detection Condition	Trouble Area
P2121	Conditions (a) and (b) continue for 0.5 sec.: (a) Difference between VPA and VPA2 deviates from standard (b) IDL is OFF	• Open or short in accelerator pedal position sensor circuit • Accelerator pedal position sensor • ECM

FAIL-SAFE

The accelerator pedal position sensor has 2 (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 2 sensor circuits and switches to fail-safe mode. In fail-safe 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 to be fully closed. In this case, the throttle valve will remain 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 will stop and the system will return to normal condition.

MONITOR DESCRIPTION

The accelerator pedal position sensor is mounted on the accelerator pedal bracket. The accelerator pedal position sensor has 2 sensor elements / signal outputs: VPA1 and VPA2. VPA1 is used to detect the actual accelerator pedal angle (used for engine control) and VPA2 is used to detect malfunctions in VPA1. When the difference between the voltage outputs of VPA1 and VPA2 deviates from the standard, the ECM concludes that the accelerator pedal position sensor has a malfunction. The ECM turns on the MIL and a DTC is set.

MONITOR STRATEGY

Related DTCs	P2121: APP sensor malfunction
Required sensors / components (Main)	APP sensor
Required sensors / components (Related)	-
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 present	None

TYPICAL MALFUNCTION THRESHOLDS

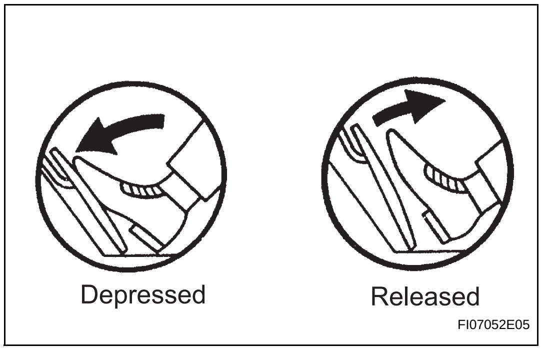
Difference between VPA1 and VPA2 voltages	Less than 0.4 V, or more than 1.2 V

WIRING DIAGRAM

Refer to DTC P2120 (See page ES-252).

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	READ VALUE USING INTELLIGENT TESTER (ACCEL POS #1 AND ACCEL POS #2)



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1 and ACCEL POS #2. Read the values.

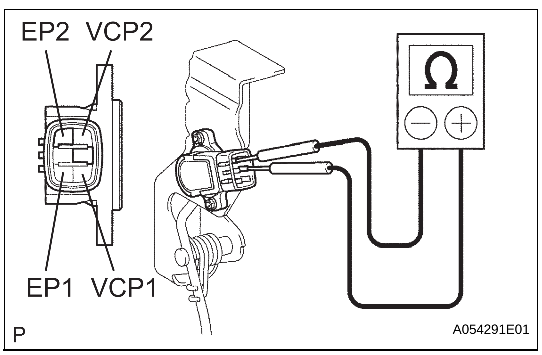
Voltage

Accelerator Pedal	ACCEL POS #1	ACCEL POS #2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.3 V

OK → **REPLACE ECM**

NG

2	INSPECT ACCELERATOR PEADL ASSEMBLY (ACCELERATOR PEDAL POSITION SENSOR)



(a) Disconnect the A17 sensor connector.
(b) Measure the resistance of the sensor terminals.

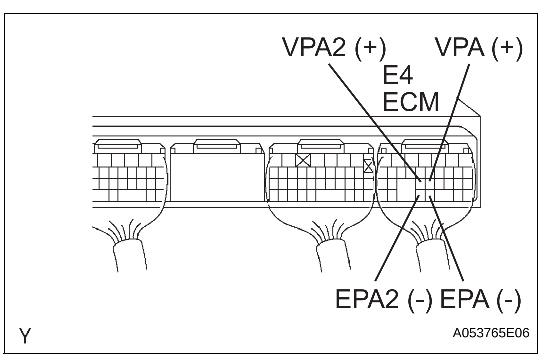
Resistance

Tester Connection	Specified Condition
3 of EP1 - 6 of VCP1 1 of EP2 - 4 of VCP2	2.25 to 4.75 kΩ at 20°C (68°F)

NG → **REPLACE ACCELERATOR PEDAL ASSEMBLY**

OK

3	CHECK ECM (VPA, VPA2 VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connector.

Voltage

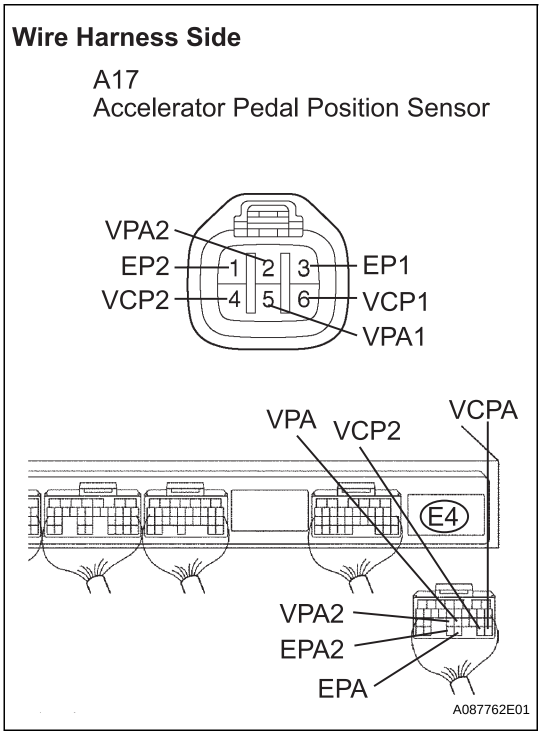
Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-22 (VPA) - E4-28 (EPA)	Released	0.5 to 1.1 V
E4-22 (VPA) - E4-28 (EPA)	Depressed	2.6 to 4.5 V

Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-23 (VPA2) - E4-29 (EPA2)	Released	1.2 to 2.9 V
E4-23 (VPA2) - E4-29 (EPA2)	Depressed	3.4 to 5.5 V

OK → **REPLACE ECM**

NG ↓

4 CHECK WIRE HARNESS (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A17 accelerator pedal position sensor connector.
(b) Disconnect the E4 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A17-6 (VCP1) - E4-26 (VCPA) A17-5 (VPA1) - E4-22 (VPA) A17-4 (VCP2) - E4-27 (VCP2) A17-3 (EP1) - E4-28 (EPA) A17-2 (VPA2) - E4-23 (VPA2) A17-1 (EP2) - E4-29 (EPA2)	Below 1 Ω
A17-6 (VCP1) or E4-26 (VCPA) - Body ground A17-5 (VPA1) or E4-22 (VPA) - Body ground A17-4 (VCP2) or E4-27 (VCP2) - Body ground A17-3 (EP1) or E4-28 (EPA) - Body ground A17-2 (VPA2) or E4-23 (VPA2) - Body ground A17-1 (EP2) or E4-29 (EPA2) - Body ground	10 kΩ or higher

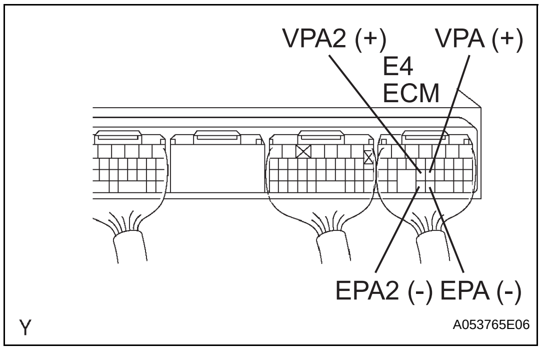
NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

ES

OK ↓

REPLACE ACCELERATOR PEDAL ASSEMBLY

1 CHECK ECM (VPA, VPA2 VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connector.

Voltage

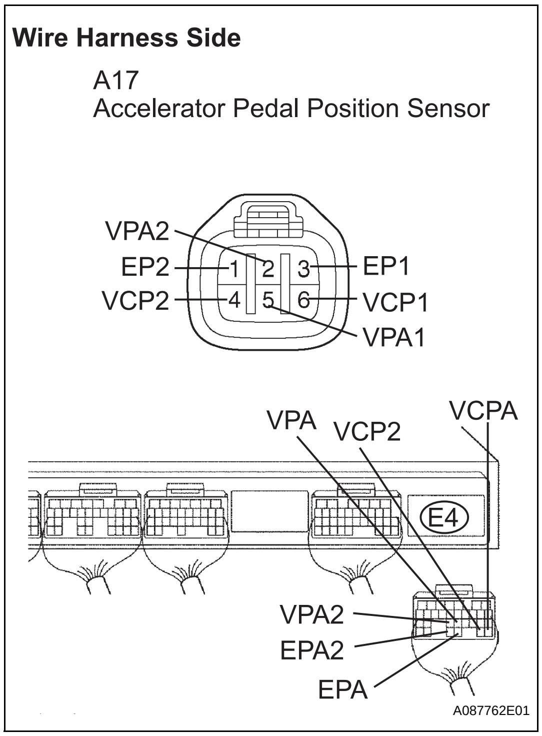
Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-22 (VPA) - E4-28 (EPA)	Released	0.5 to 1.1 V
E4-22 (VPA) - E4-28 (EPA)	Depressed	2.6 to 4.5 V
E4-23 (VPA2) - E4-29 (EPA2)	Released	1.2 to 2.9 V

Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-23 (VPA2) - E4-29 (EPA2)	Depressed	3.4 to 5.5 V

OK → **REPLACE ECM**

NG

2 CHECK WIRE HARNESS (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A17 accelerator pedal position sensor connector.
(b) Disconnect the E4 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

A17-6 (VCP1) - E4-26 (VCPA) A17-5 (VPA1) - E4-22 (VPA) A17-4 (VCP2) - E4-27 (VCP2) A17-3 (EP1) - E4-28 (EPA) A17-2 (VPA2) - E4-23 (VPA2) A17-1 (EP2) - E4-29 (EPA2)	Below 1 Ω
A17-6 (VCP1) or E4-26 (VCPA) - Body ground A17-5 (VPA1) or E4-22 (VPA) - Body ground A17-4 (VCP2) or E4-27 (VCP2) - Body ground A17-3 (EP1) or E4-28 (EPA) - Body ground A17-2 (VPA2) or E4-23 (VPA2) - Body ground A17-1 (EP2) or E4-29 (EPA2) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ACCELERATOR PEDAL ASSEMBLY

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)

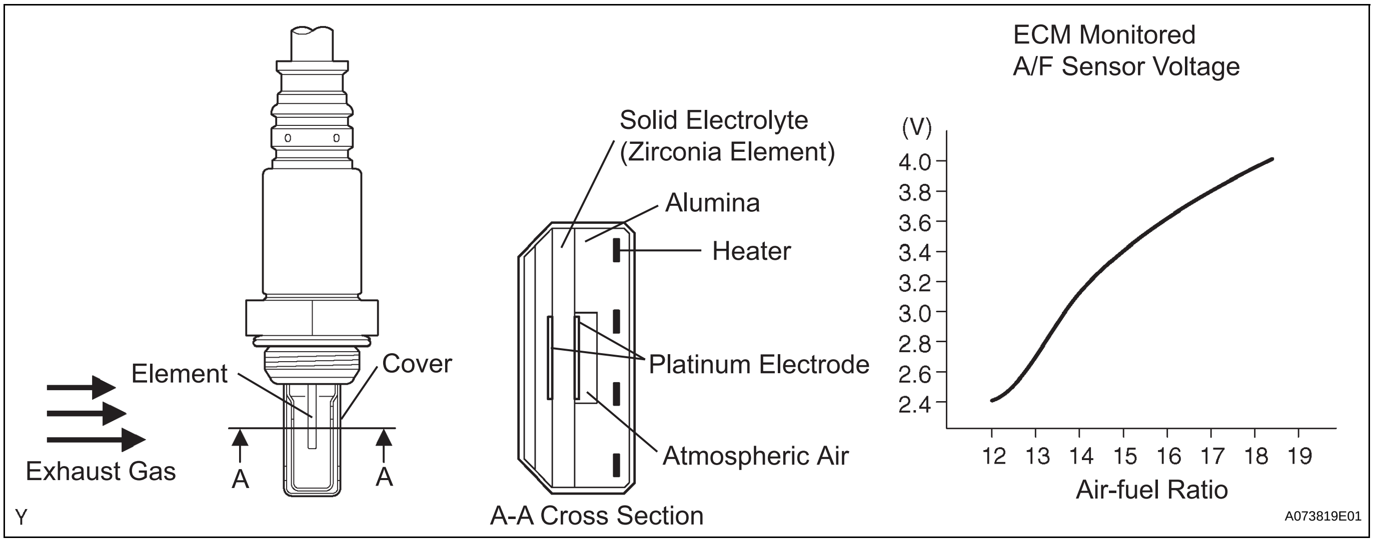
DTC	P2197	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC	P2198	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

HINT:
Although the title (DTC description) says "oxygen sensor", this DTC is related to the "A/F sensor".

DESCRIPTION

The Air-Fuel ratio sensor provides output voltage* approximately equal to the existing air-fuel ratio. The A/F sensor output voltage is used to provide feedback for the ECM to control the air-fuel ratio.
With the A/F sensor output, the ECM can determine deviation from the stoichiometric air-fuel ratio and control proper injection time. If the A/F sensor is malfunctioning, the ECM is unable to accurately control air-fuel ratio.
The A/F sensor is equipped with a heater which heats the zirconia element. The heater is also controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor to facilitate detection of accurate oxygen concentration.
The A/F sensor is a planar type. Compared to a conventional type, the sensor and heater portions are narrower. Because the heat of the heater is conducted through the alumina to zirconia (of the sensor portion), sensor activation is accelerated.
To obtain a high purification rate of the CO, HC and NOx components of the exhaust gas, a three-way catalytic converter is used. The converter is most efficient when the air-fuel ratio is maintained near the stoichiometric air-fuel ratio.
*: The voltage value changes on the inside of the ECM only.



DTC No.	DTC Detection Condition	Trouble Area
P2195 P2197	• Conditions (a) and (b) continue for 2 sec. or more (a) A/F sensor voltage is more than 3.8 V (b) Rear oxygen sensor voltage is 0.15 V or more • A/F sensor currnet 3.6 mA or more	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater • A/F sensor heater relay • Open or short in A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM
P2196 P2198	• Conditions (a) and (b) continue for 2 sec. or more: (a) A/F sensor voltage is less than 2.8 V (b) Rear oxygen sensor voltage is less than 0.85 V • A/F sensor current less than 1.57 mA	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater • A/F sensor heater relay • Open or short in A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM

HINT:
- DTCs P2195 and P2196 indicate a malfunction related to bank 1 of the A/F sensor circuit.
- DTCs P2197 and P2198 indicate a malfunction related to bank 2 of the A/F sensor circuit.
- Bank 1 is the bank that includes cylinder No. 1.
- Bank 2 is the bank that includes cylinder No. 2.
- Sensor 1 is the sensor closest to the engine assembly.
- After confirming DTCs P2195, P2196, P2197 or P2198, use the intelligent tester or the OBD II scan tool to confirm A/F sensor output voltage (AFS B1S1 / AFS B2S1) from the ALL menu (to reach the ALL menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL).
- The A/F sensor's output voltage and the short-term fuel trim value can be read using the OBD II scan tool or the intelligent tester.
- The ECM controls the voltage of the A1A+, A2A+, A1A- and A2A- terminals of the ECM to a fixed voltage. Therefore, it is impossible to confirm the A/F sensor output voltage without the OBD II scan tool or the intelligent tester.
- The OBD II scan tool (excluding intelligent tester) displays one fifth of the A/F sensor output voltage which is displayed on the intelligent tester.

MONITOR DESCRIPTION

Under the air-fuel ratio feedback control, if the voltage output of the A/F sensor indicates RICH or LEAN for more than a certain period of time, the ECM concludes that there is a fault in the A/F sensor system. The ECM will turn on the MIL and a DTC will be set.
Example:
If the A/F sensor voltage output is less than 2.8 V (very RICH) for 10 seconds even though voltage output of the heated oxygen sensor output voltage is less than 0.6 V, the ECM sets DTC P2196 or DTC P2198. If the heated oxygen sensor output voltage is 0.15 V or more but the A/F sensor voltage output is more than 3.8 V (very LEAN) for 10 seconds, DTC P2195 or DTC P2197 is set.

MONITOR STRATEGY

Related DTCs	P2195: A/F Sensor (Bank 1) voltage detection monitor (lean side malfunction) P2195: A/F Sensor (Bank 1) high current P2196: A/F Sensor (Bank 1) voltage detection monitor (rich side malfunction) P2196: A/F Sensor (Bank 1) low current P2197: A/F Sensor (Bank 2) voltage detection monitor (lean side malfunction) P2197: A/F Sensor (Bank 2) high current P2198: A/F Sensor (Bank 2) voltage detection monitor (rich side malfunction) P2198: A/F Sensor (Bank 2) low current
Required sensors / components (Main)	A/F sensor

Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	10 seconds: A/F sensor voltage detection monitor (Lean/Rich side malfunction) 3 seconds: A/F sensor high/low current
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater) P0037. P0038, P0057, P0058 (O2 sensor heater) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171 - P0175 (Fuel system) P0300 - P0306 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS)

ES

Sensor voltage detection monitor (Lean side malfunction P2195, P2197):

Duration while all of the following conditions are met	2 seconds or more
Rear HO2S voltage	0.15 V or more
Time after engine start	30 seconds or more
A.F sensor status	Activated
Fuel system status	Closed-loop
Engine condition	Running

Sensor voltage detection monitor (Rich side malfunction P2196, P2198):

Duration while all of the following conditions are met	2 seconds or more
Rear HO2S voltage	Below 0.6 V
Time after engine start	30 seconds or more
A.F sensor status	Activated
Fuel system status	Closed-loop
Engine condition	Running

Sensor current high/low current (P2195, P2196, P2197 and P2198):

Battery voltage	11 V or more
Atmospheric pressure	22.5 kPa (570 mmHg) or more
A.F sensor status	Activated
Continuous time of fuel cut	3 to 10 seconds
ETC	75°C (167°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Sensor voltage detection monitor (Lean side malfunction P2195, P2197):

A/F sensor voltage	More than 3.8 V

Sensor voltage detection monitor (Rich side malfunction P2196, P2198):

A/F sensor voltage	Less than 2.8 V

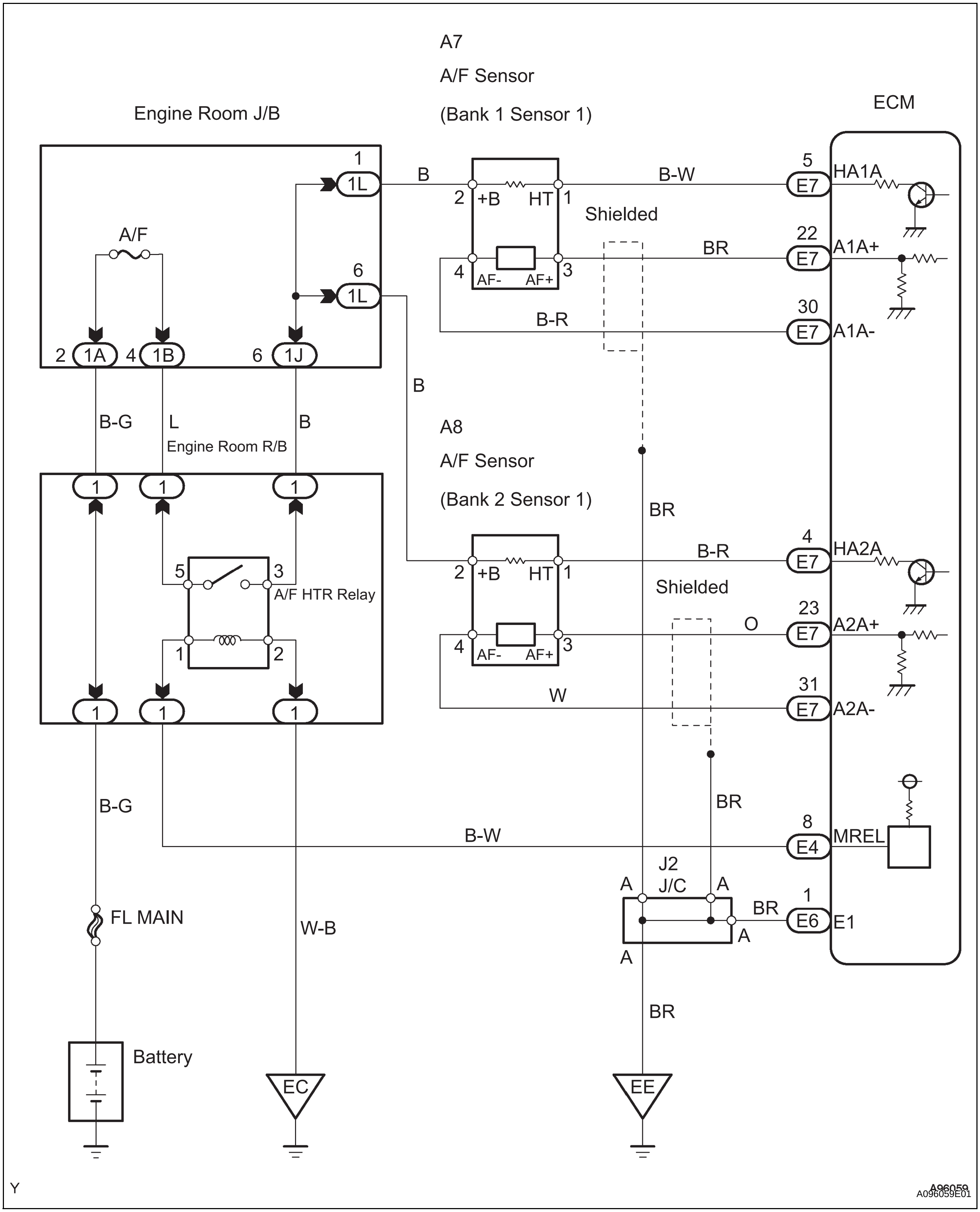
Sensor high current (P2195, P2197):

A/F sensor current	3.6 mA or more

Sensor low current (P2196, P2198):

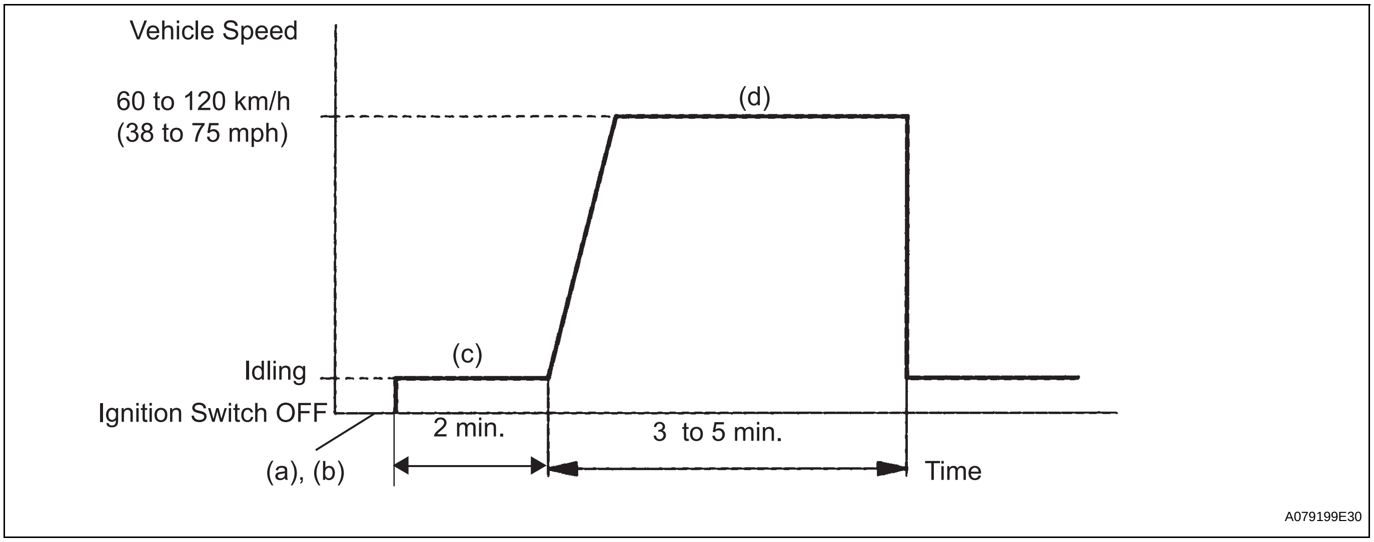
A/F sensor current	Less than 1.57 mA

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN

(a) Connect the intelligent tester to the DLC3.



(b) Switch the intelligent tester from the normal mode to the check mode (See page ES-31).
(c) Start the engine and warm it up with all the accessory switches OFF.
(d) Drive the vehicle at 60 to 120 km/h (38 to 75 mph) and engine speed at 1,400 to 3,200 rpm for 3 to 5 minutes.

HINT:
If a malfunction exists, the MIL will be illuminated during step (d).

NOTICE:
If the conditions in this test are not strictly followed, detection of a malfunction will not occur. If you do not have a intelligent tester, turn the ignition switch OFF after performing steps (c) and (d), then perform steps (c) and (d) again.

HINT:
Intelligent tester only:
It is possible the malfunctioning area can be found using the ACTIVE TEST A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble areas are malfunctioning or not.

1. **Perform the ACTIVE TEST A/F CONTROL operation.**
   HINT:
   The A/F CONTROL operation lowers the injection volume 12.5 % or increases the injection volume 25%.
   (a) Connect the intelligent tester to the DLC3 on the vehicle.
   (b) Turn the ignition switch ON.
   (c) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
   (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
   (e) Perform the A/F CONTROL operation with the engine idle (press the right or left button).
   Result:
   A/F sensor reacts in accordance with increase and decrease of injection volume:
   +25 % → RICH output: Less than 3.0 V
   -12.5 % → LEAN output: More than 3.35 V
   Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
   +25 % → RICH output: More than 0.55 V
   -12.5 % → LEAN output: Less than 0.4 V

NOTICE:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage More than 0.55 V Less than 0.4 V	OK	
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction	NG	Output Voltage More than 0.55 V Less than 0.4 V	OK	
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage Almost no reaction	NG	
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

The following A/F CONTROL procedure enables the technician to check and graph the voltage outputs of both the A/F sensor and the heated oxygen sensor.
For displaying the graph, enter "ACTIVE TEST / A/F CONTROL / USER DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES" and push "ENTER". Then press "F4".
HINT:

- If DTC P2195 or P2196 is displayed, check bank 1 sensor 1 circuit.
- If DTC P2197 or P2198 is displayed, check bank 2 sensor 1 circuit.
- 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 with a RICH air-fuel mixture.
- 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 with a LEAN air-fuel mixture.
- Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO A/F SENSOR DTC)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result :

Display	Proceed to
A/F sensor circuit DTC are output	A
A/F sensor circuit DTC and other codes are output	B

HINT:
If any other DTCs besides A/F sensor DTC are output, perform the troubleshooting for those DTCs first.

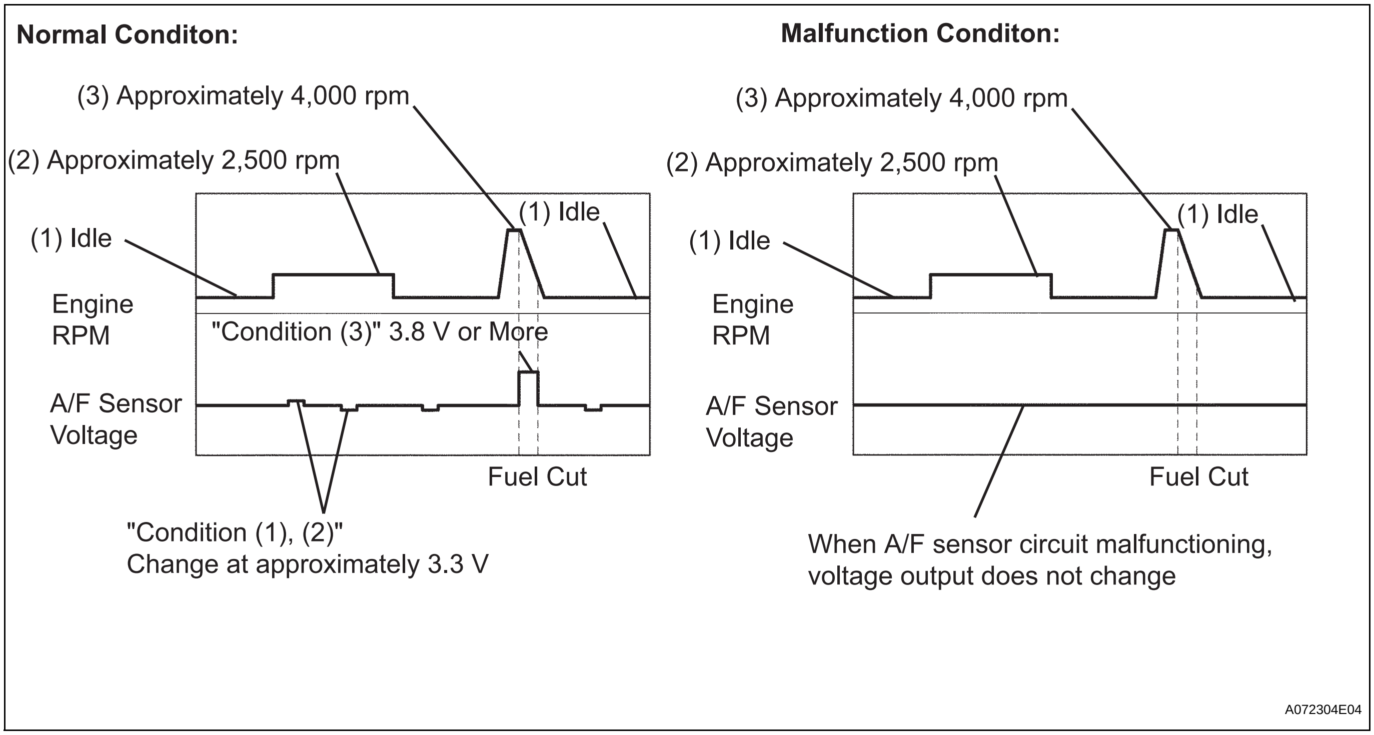
B → **GO TO RELEVANT DTC CHART**

ES

A

2 READ VALUE USING INTELLIGENT TESTER OR OBD II SCAN TOOL (OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the intelligent tester or the OBD II scan tool to the DLC 3.
(b) Warm up the A/F sensor (bank 1, 2 sensor 1) by running the engine at 2,500 rpm for approximately 90 seconds.
(c) Read A/F sensor voltage output on the intelligent tester or the OBD II scan tool.
(d) Hand-held tester only:
On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA. Read the values.
(e) Select "AFS B1 S1 or AFS B2 S1 / ENGINE SPD" and press YES.
(f) Monitor the A/F sensor voltage carefully.
(g) Check the A/F sensor voltage output under the following conditions:
   (1) Allow the engine to idle for 30 seconds.
   (2) Run the engine at approximately 2,500 rpm. Do not suddenly change the rpm.
   (3) Raise the engine to 4,000 rpm and quickly release the accelerator pedal so that the throttle is fully closed.



Standard:

Condition (1) and (2)

Voltage change of 3.3 V (0.66 V)* (between approximately 3.1 to 3.5 V) as shown in the illustration.

Condition (3)

A/F sensor voltage increases to 3.8 V (0.76 V)* or more during engine deceleration when fuel is cut as shown in the illustration.

*: Voltage when using the OBD II scan tool.

HINT:

- Whenever the A/F sensor output voltage remains at approximately 3.3 V (0.660 V)* (see "Malfunction Condition" graphic) under any condition as well as the above conditions, the A/F sensor may have an open circuit. This will happen also when the A/F sensor heater has an open circuit.
- Whenever the A/F sensor output voltage remains at a certain value of approximately 3.8 V (0.76 V)* or more, or 2.8 V (0.56 V)* or less (see "Malfunction Condition" graphic) under any condition as well as the above conditions, the A/F sensor may have a short circuit.
- The ECM will stop fuel injection (fuel is cut) during engine deceleration. This will cause a LEAN condition and should result in a momentary increase in A/F sensor output voltage.

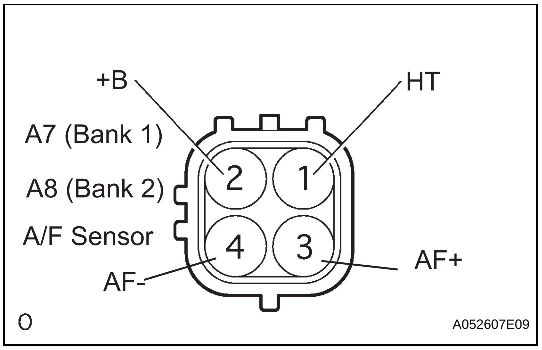
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal has been disconnected, the vehicle must be driven over 10 mph to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V (0.76 V)* during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F sensor or ECM, you will observe a constant voltage.

*: Voltage when using the OBD II scan tool.

OK → **Go to step 13**

NG

3 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



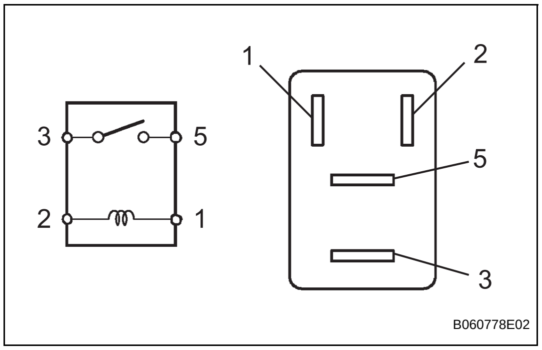
(a) Disconnect the A7 or A8 A/F sensor connector.
(b) Measure the resistance of the A/F sensor terminals.
Resistance

Tester Connection	Condition	Specified Condition
1 (HT) - 2 (+B)	20°C (68°F)	1.8 to 3.2 Ω

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

4 INSPECT A/F RELAY



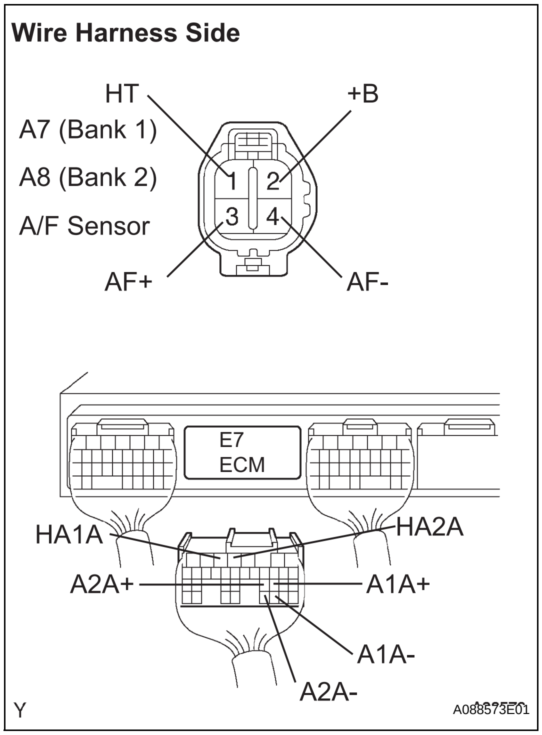
(a) Remove the A/F sensor heater relay from the engine room R/B.
(b) Measure the resistance of the A/F sensor heater relay.
Resistance

Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE A/F RELAY**

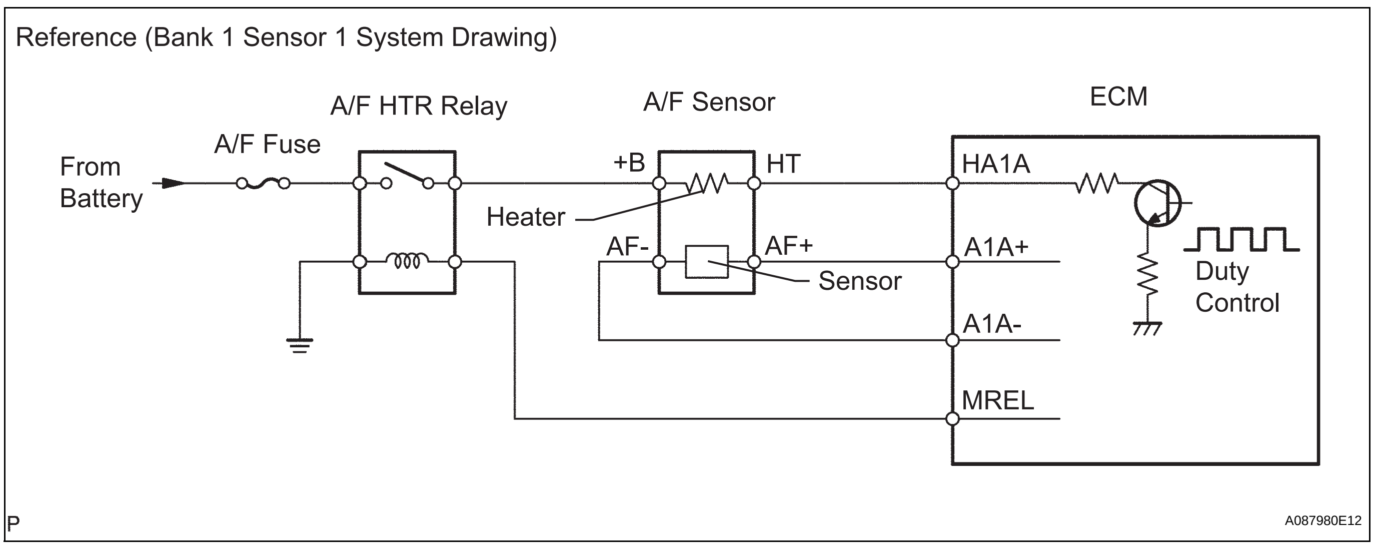
OK

5	CHECK WIRE HARNESS (A/F SENSOR - ECM)



(a) Disconnect the A7 or A8 A/F sensor connector.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
A7-3 (AF+) - E7-22 (A1A+) A7-4 (AF-) - E7-30 (A1A-) A7-1 (HT) - E7-5 (HA1A) A8-3 (AF+) - E7-23 (A2A+) A8-4 (AF-) - E7-31 (A2A-) A8-1 (HT) - E7-4 (HA2A)	Below 1 Ω
A7-3 (AF+) or E7-22 (A1A+) - Body ground A7-4 (AF-) or E7-30 (A1A-) - Body ground A7-1 (HT) or E7-5 (HA1A) - Body ground A8-3 (AF+) or E7-23 (A2A+) - Body ground A8-4 (AF-) or E7-31 (A2A-) - Body ground A8-1 (HT) or E7-4 (HA2A) - Body ground	10 kΩ or higher



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK ↓

6	CHECK AIR INDUCTION SYSTEM

(a) Check for vacuum leaks in air induction system.
OK:
No leak in air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

7 CHECK FUEL PRESSURE

(a) Check fuel pressure (See page FU-8).
Standard:
Fuel pressure:
304 to 343 kPa (3.1 to 3.5 kgf/cm ^{2}, 44 to 50 psi).

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8 INSPECT FUEL INJECTOR ASSEMBLY

(a) Check injector injection (See page FU-16).
Standard

Injection Volume	Difference between Each Injector
60 to 73 cm^3(3.7 to 4.5 cu in.) per 15 seconds	13 cm^3(0.8 cu in.) or less

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

9 REPLACE AIR FUEL RATIO SENSOR

NEXT

10 PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

NEXT

11 READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.
Result :

Display	Proceed to
A/F sensor circuit DTC are not output	A
A/F sensor circuit DTC are output	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

A

12 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK:
Vehicle has run out of fuel in past.

NG → **CHECK FOR INTERMITTENT PROBLEMS**

OK

ES

DTC CAUSED BY RUNNING OUT OF FUEL

13 PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

NEXT

14 READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.
Result :

Display	Proceed to
A/F sensor circuit DTC are output	A
A/F sensor circuit DTC are not output	B

B → **Go to step 18**

A

15 REPLACE AIR FUEL RATIO SENSOR

NEXT

16 PERFORM CONFIRMATION FRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

NEXT

17 READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result :

Display	Proceed to
A/F sensor circuit DTC are not output	A
A/F sensor circuit DTC are output	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

A

18 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK:

Vehicle has run out of fuel in past.

NG → **CHECK FOR INTERMITTENT PROBLEMS**

OK

DTC CAUSED BY RUNNING OUT OF FUEL

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 DTC (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.
- The intelligent tester's software must be version 9.0 or newer to view the Readiness Monitor Status. To view the status, enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR STATUS.
- When the Readiness Monitor status reads COMPL (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 a vehicle's Readiness Monitor status to show COMPL before beginning emissions tests.

  The Readiness Monitor will be reset to INCMPL (incomplete) if:
  - The ECM (Included in HV Control ECU) 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 INCMPL, follow the appropriate Readiness Monitor Drive Pattern to change the status to COMPL.

  CAUTION:

  Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

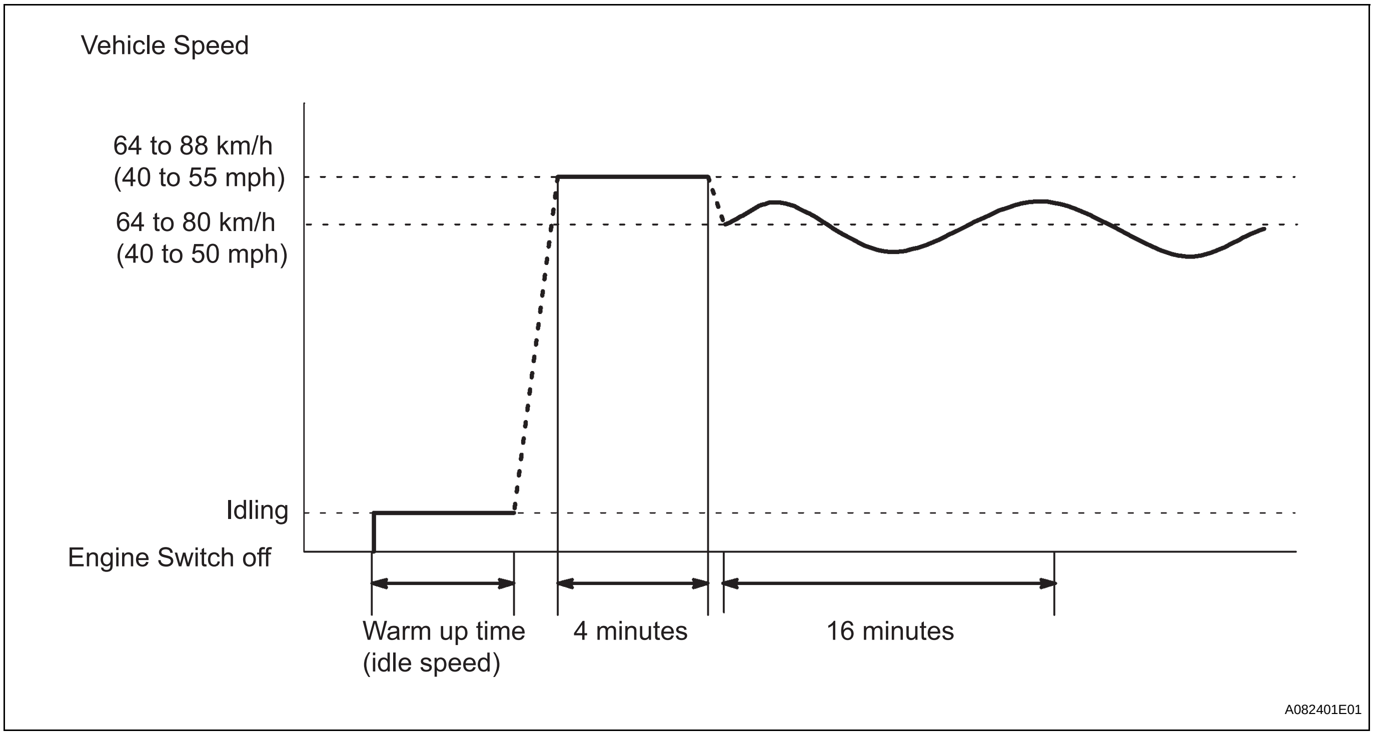
  NOTICE:

  The drive patterns represent the fastest method of satisfying all conditions necessary to achieve complete status for each specific Readiness Monitor.

  If a drive pattern is 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 (A/F SENSOR TYPE)



(a) Preconditions
The monitor will not run unless:
Step A
- The MIL is OFF.
- Engine Coolant Temperature (ECT) is 75°C (167°F) or higher.
- Intake Air Temperature (IAT) is -10°C (14°F) or higher.

NOTICE:
To complete the readiness test in cold ambient conditions (less than -10°C / 14°F), turn the ignition switch OFF and then back to ON. Perform the drive pattern a second time.

(b) Drive Pattern
Step 1
Connect the intelligent tester to the DLC3 to check Readiness Monitor status and preconditions (refer to step (A)).
Step 2
Drive the vehicle at 47 to 55 mph (75 to 88 km/h) for approximately 4 minutes.

NOTICE:
Drive with smooth throttle operation and avoid sudden acceleration. If IAT was less than 10°C (50°F) when the engine was started, drive the vehicle at 47 to 55 mph (75 to 88 km/h) for an additional 4 minutes.

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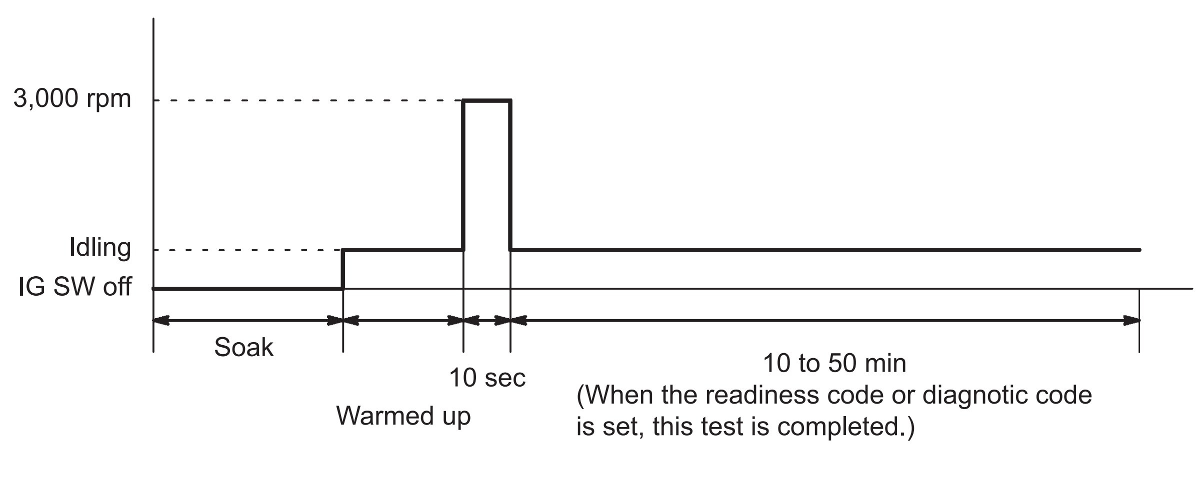
Step 3
Drive the vehicle allowing speed to fluctuate between 47 to 55 mph (75 to 88 km/h) for approximately 7 minutes.
NOTICE:
Drive with smooth throttle operation and avoid sudden closure of the throttle.
Step 4
Check the status of the readiness monitor on the scan tool display. If the readiness monitor status did not switch to complete, ensure preconditions are met, turn the engine switch off, and then repeat steps 2 and 3.

3. EVAP MONITOR (VACUUM PRESSURE MONITOR)
NOTICE:
A cold soak must be performed prior to conducting the drive pattern to complete the internal pressure readiness monitor.

(a) Cold Soak Preconditions
Step B
The monitor will not run unless:
- The MIL is OFF.
- Fuel level is approximately 1/2 to 3/4 full.
- ?Altitude is 2,450 m (8,000 feet) or less.

(b) Cold Soak Procedure



Let vehicle cold soak for 8 hours or until "IAT - ECT" must be -7°C (-13°F) to 11.1°C (20°F)
- Example 1 ECT = 24°C (75°F) IAT = 16°C (60°F)
  Difference between ECT and IAT is 8°C (15°F).
  → The monitor will not run because difference between ECT and IAT is greater than 7°C (13°F).

- Example 2 ECT = 21°C (70°F) IAT = 20°C (68°F) Difference between ECT and IAT is 1°C (2°F). → The monitor will run because difference between ECT and IAT is less than 7°C (13°F).

(c) Preconditions

The monitor will not run unless:

- The MIL is OFF.
- Fuel level is approximately 1/2 to 3/4 full.
- The altitude is 7800 feet (2400 m) or less.
- ECT is between 4.4°C and 35°C (40°F and 95°F).
- IAT is between 4.4°C and 35°C (40°F and 95°F).
- The cold soak procedure has been completed.
- Before starting the engine, the difference between ECT and IAT must be less than 7°C (13°F).

HINT:

- Example 1 ECT = 24°C (75°F) IAT = 16°C (60°F) Difference between ECT and IAT is 8°C (15°F). → The monitor will not run because difference between ECT and IAT is greater than 7°C (13°F).
- ?Example 2 ECT = 21°C (70°F) IAT = 20°C (68°F) Difference between ECT and IAT is 1°C (2°F). → The monitor will run because difference between ECT and IAT is less than 7°C (13°F).

NOTICE:

The readiness test can be completed in cold ambient conditions (less than 4.4°C / 40°F) and / or high altitudes (more than 7,800 ft / 2,400 m). Finish the drive pattern, turn the ignition switch OFF and then ON again, and repeat the drive pattern a second time.

(d) Drive Pattern

(1) Connect the OBD II scan tool to DLC3 to check monitor status and preconditions (refer to Step B).

(2) Release pressure in fuel tank by removing the fuel tank cap and then reinstalling it.

(3) Start the engine and allow it to idle until ECT is 75°C (167°F) or more.

(4) Run the engine at 3,000 rpm for about 10 seconds.

(5) With the engine idling, turn the A/C ON to create a slight electrical load. Wait 15 to 50 minutes.

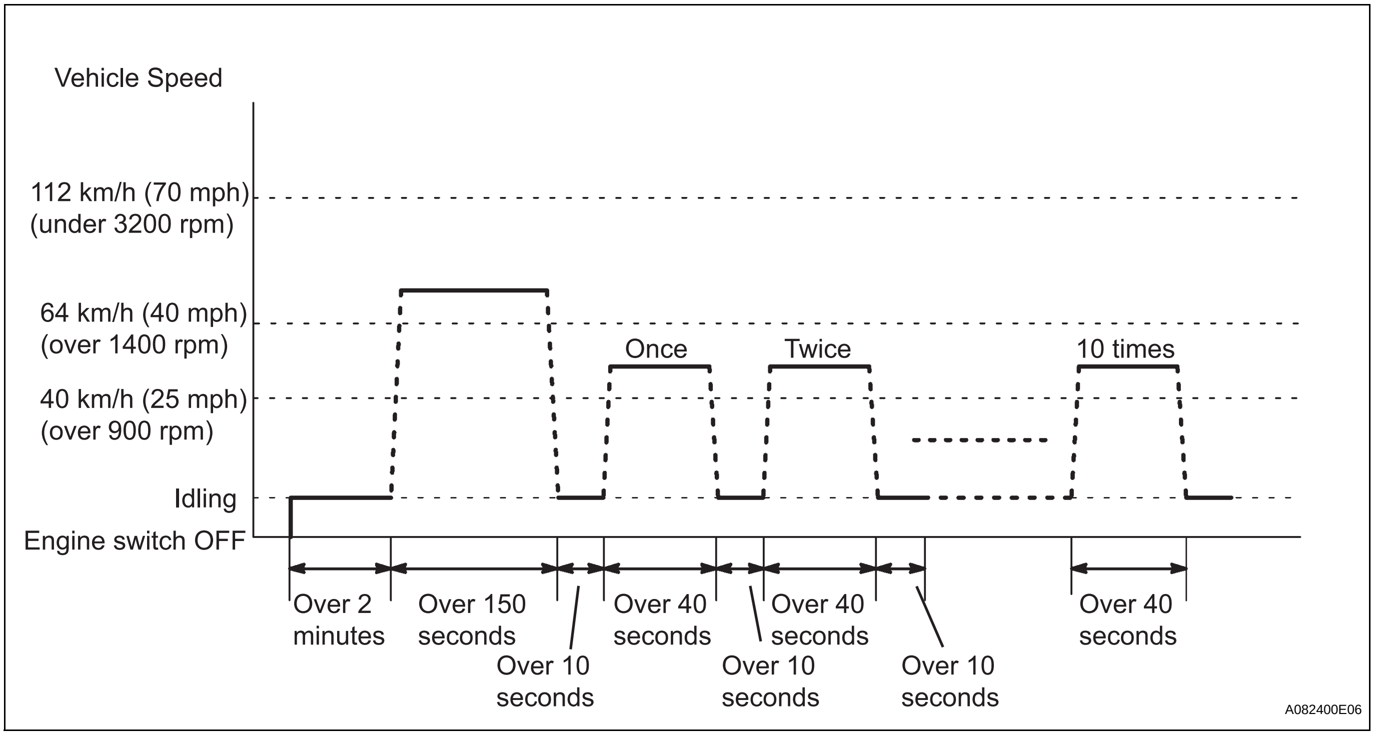
NOTICE:

If the vehicle does not have A/C, put a slight electrical load on the engine by following the steps below:

- **Set the parking brake securely.**
- **Use wheel chocks to secure the tires.**
- **Move the shift lever to drive (position D) and allow engine to idle for 15 to 50 minutes. Check the readiness monitor status.**

4. OXYGEN / A/F SENSOR MONITOR (FRONT A/F SENSOR AND REAR O2S SYSTEM)

(a) Preconditions
Step C



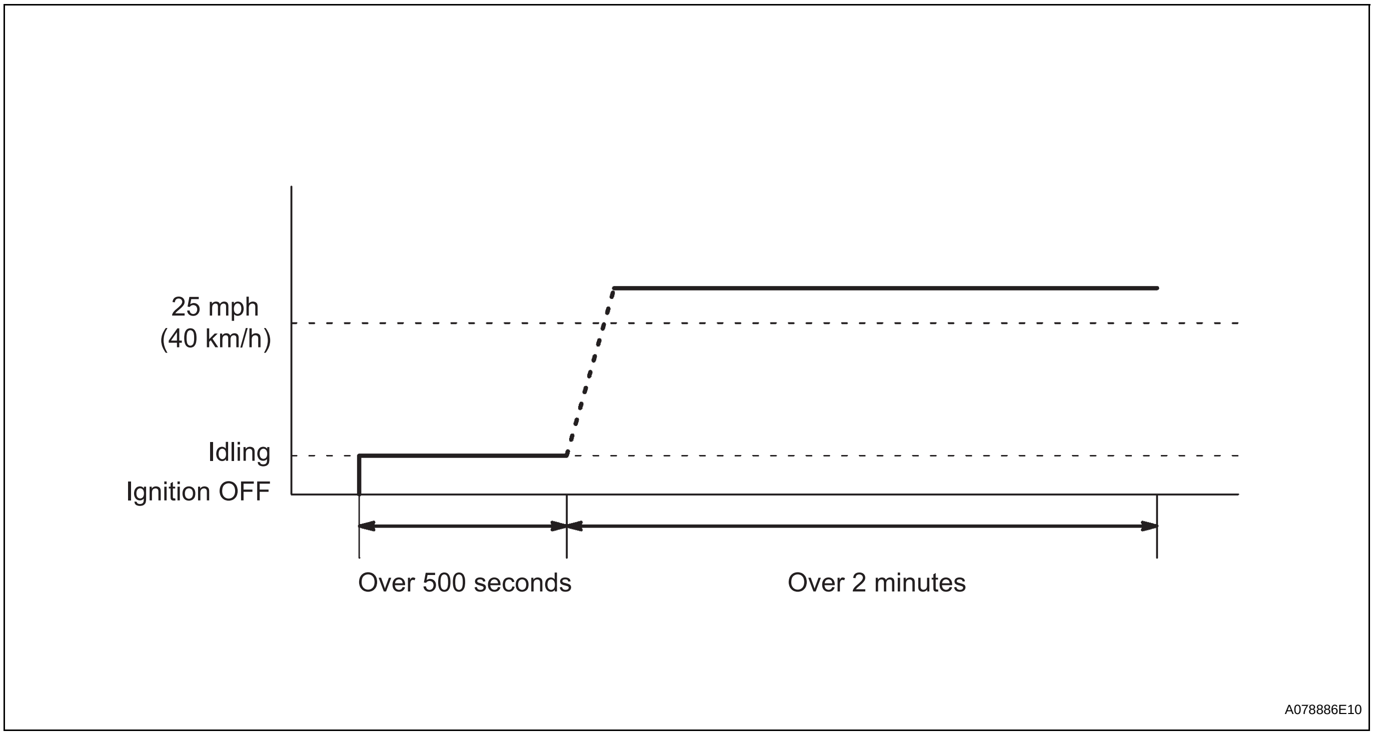
The monitor will not run unless:
(1) The MIL is OFF.

(b) Drive Pattern
(1) Connect the OBD II scan tool to the DLC3 to check monitor status and preconditions (refer to step C).
Step 1
(2) Start the engine and allow it to idle for 2 minutes or more.
Step 2
(3) Drive the vehicle at 64 to 112 km/h (40 to 70 mph) for at least 150 seconds.
Step 3
(4) Stop the vehicle and allow the engine to idle for 10 seconds or more.
Step 4
(5) Drive the vehicle at 40 to 64 km/h (25 to 40 mph) for at least 40 seconds.
Step 5
(6) Stop the vehicle and allow the engine to idle for 10 seconds or more.
Step 6
(7) Perform steps (1) and (6) 10 times.
(8) Check the readiness monitor status. If the readiness monitor status did not change to "complete", check the preconditions, turn the ignition switch OFF, and repeat steps (1) to (6).

5. OXYGEN / A/F SENSOR HEATER MONITOR

(a) Preconditions

Step D



The monitor will not run unless:

(1) The MIL is OFF.

(b) Drive Pattern

(1) Connect the OBD II scan tool to the DLC3 to check monitor status and preconditions (refer to step "D").

Step 1

(2) Start the engine and allow it to idle for 500 seconds or more.

Step 2

(3) Drive the vehicle at 40 km/h (25 mph) or more for at least 2 minutes.

Step 3

(4) Check the readiness monitor status. If the readiness monitor status did not change to "complete", check the preconditions, turn the ignition switch OFF, and repeat steps (2) to (3).

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	P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)

DTC	P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 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)

DTC	P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)

DTC	P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

HINT:
- Although the title (DTC description) says "oxygen sensor", this DTC is related to the "A/F sensor".
- DTCs P2237, P2238, P2239, P2251, P2252 and P2253 indicate the malfunction related to the bank 1 A/F sensor circuit.
- DTCs P2240, P2241, P2242, P2254, P2255 and P2256 indicate the malfunction related to the bank 2 A/F sensor circuit.

DESCRIPTION

Refer to DTC P2195 (See page ES-262).

DTC No.	DTC Detection Conditions	Trouble Areas
P2238 P2241	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) AF+ voltage 0.5 V or less (b) Difference between AF+ and AF- terminal voltage: 0.1 V or less • Case 2: A/F sensor admittance: Less than 0.022 1/Ω (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • EFI relay • Open or short in A/F sensor heater and relay circuits • ECM
P2239 P2242	AF+ voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • EFI relay • Open or short in A/F sensor heater and relay circuits • ECM

DTC No.	DTC Detection Conditions	Trouble Areas
P2252 P2255	AF- voltage 0.5 V or less for 5.0 seconds or more (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • EFI relay • Open or short in A/F sensor heater and relay circuits • ECM
P2253 P2256	AF- voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • EFI relay • Open or short in A/F sensor heater and relay circuits • ECM

HINT:
- Bank 1 is the bank that includes cylinder No. 1.
- Bank 2 is the bank that includes cylinder No. 2.

MONITOR DESCRIPTION

The air-fuel ratio (A/F) sensor varies its voltage output in proportion to the air-fuel ratio. If impedance (alternating current resistance) or voltage output of the sensor deviates greatly from the standard, the ECM determines that an open or short is in the A/F sensor circuit.

MONITOR STRATEGY

Related DTCs	P2238: A/F sensor (Bank 1) open circuit between AF+ and AF- P2238: A/F sensor (Bank 1) short circuit between AF+ and AF- P2238: A/F sensor (Bank 1) short circuit between AF+ and GND P2239: A/F sensor (Bank 1) short circuit between AF+ and+B P2241: A/F sensor (Bank 2) open circuit betrween AF+ and AF- P2241: A/F sensor (Bank 2) short circuit between AF+ and AF- P2241: A/F sensor (Bank 2) short circuit between AF+ and GND P2242: A/F sensor (Bank 2) short circuit between AF+ and +B P2252: A/F sensor (Bank 1) short circuit between AF- and GND P2253: A/F sensor (Bank 1) short circuit between AF- and +B P2253: A/F sensor (Bank 2) short circuit between AF- and GND P2256: A/F sensor (Bank 2) short circuit between AF- and +B
Required sensors / components (Main)	A/F sensor
Required sensors / components (Related)	ECT sensor, Crankshaft position sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None

P2238, P2241 (open circuit between AF+ and AF-):

Duration while all of the following conditions are met:	10 seconds or more
AF+ terminal voltage	0.5 to 4.5 V
AF- terminal voltage	0.5 to 4.5 V
Difference between AF+ terminal and AF- terminal voltages	0.1 to 0.8 V
ECT	20°C (68°F) or more
Engine condition	Running
Time after engine start	20 seconds or more
Fuel-cut	OFF (for 5 seconds or more)
A/F sensor heater duty ratio	0 % or more

Time after A/F sensor heating	20 seconds or more
Battery voltage	10.5 V or more
Ignition switch	ON (5 seconds or more)

Others:

Battery voltage	10.5 V or more
Ignition switch	ON (5 seconds or more)

TYPICAL MALFUNCTION THRESHOLDS

P2238, P2241 (Open circuit between AF+ and AF-):

A/F sensor admittance	Below 0.022 1/ohm

P2238, P2241 (Short circuit between AF+ and GND):

AF+ terminal voltage	0.5 V or less

ES

P2238, P2241 (Short circuit between AF+ and AF-):

Difference between AF+ and AF- terminal voltages	0.1 V or less

P2239, P2242 (Short circuit between AF+ and +B):

AF+ terminal voltage	More than 4.5 V

P2252, P2255 (Short circuit between AF- and GND):

AF- terminal voltage	0.5 V or less

P2253, P2256 (Short circuit between AF- and +B):

AF- terminal voltage	More than 4.5 V

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-265).

HINT:
Intelligent tester only:
The malfunctioning area can be found by the ACTIVE TEST A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other suspected areas are malfunctioning or not.

1. **Perform the ACTIVE TEST A/F CONTROL operation.**
   HINT:
   The A/F CONTROL operation lowers the injection volume by 12.5% or increases the injection volume by 25%.
   (a) Connect the intelligent tester to the DLC3 on the vehicle.
   (b) Turn the ignition switch ON.
   (c) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
   (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
   (e) Perform the A/F CONTROL operation with the engine idling (press the right or left button).
   Result:
   A/F sensor reacts in accordance with increase and decrease of injection volume:
   +25 % → RICH output: Less than 3.0 V
   -12.5 % → LEAN output: More than 3.35 V
   Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
   +25 % → RICH output: More than 0.55 V
   -12.5 % → LEAN output: Less than 0.4 V

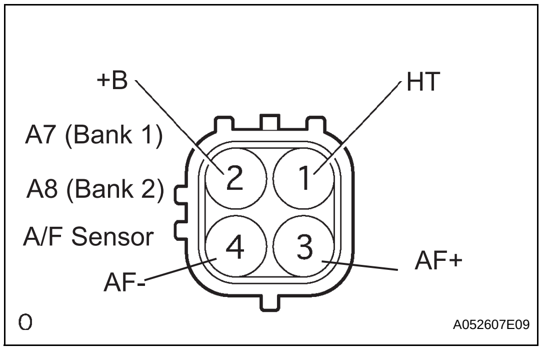
NOTICE:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage More than 0.55 V Less than 0.4 V	OK	
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction	NG	Output Voltage More than 0.55 V Less than 0.4 V	OK	
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage Almost no reaction	NG		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

The following A/F CONTROL procedure enables the technician to check and graph the voltage outputs of both the A/F sensor and the heated oxygen sensor.
For displaying the graph, enter "ACTIVE TEST / A/F CONTROL / USER DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES" and push "ENTER". Then press "F4".
HINT:
- If DTC P2237, P2238, P2239, P2251, P2252 or P2253 is displayed, check the bank 1 sensor1 circuit.
- If DTC P2240, P2241, P2242, P2254, P2255 or P2256 is displayed, check the bank 2 sensor 1 circuit.
- Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

ES

1	INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



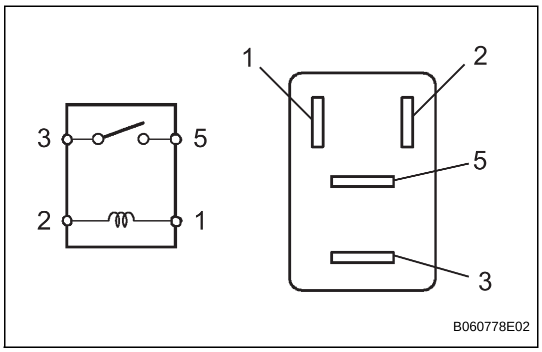
(a) Disconnect the A7 or A8 A/F sensor connector.
(b) Measure the resistance of the A/F sensor terminals.
Resistance

Tester Connection	Condition	Specified Condition
1 (HT) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2	INSPECT A/F RELAY



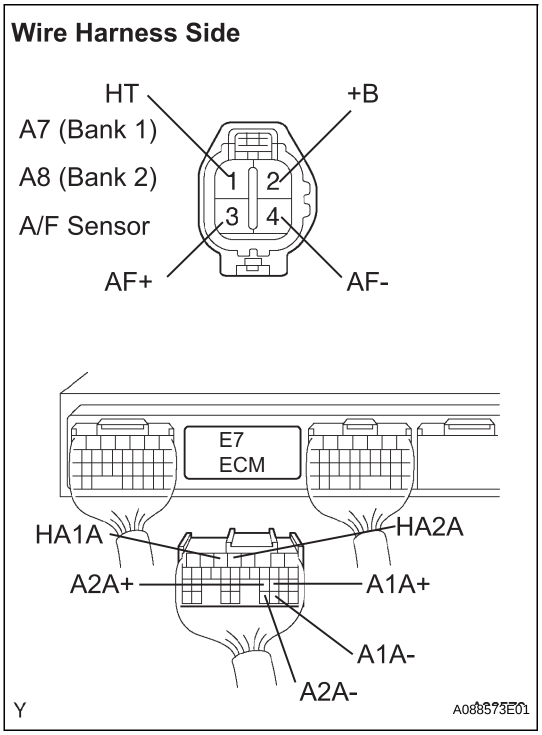
(a) Remove the A/F sensor heater relay from the engine room R/B.
(b) Measure the resistance of the A/F sensor heater relay.
Resistance

Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE A/F RELAY**

OK

3 CHECK WIRE HARNESS (HEATER RESISTANCE)



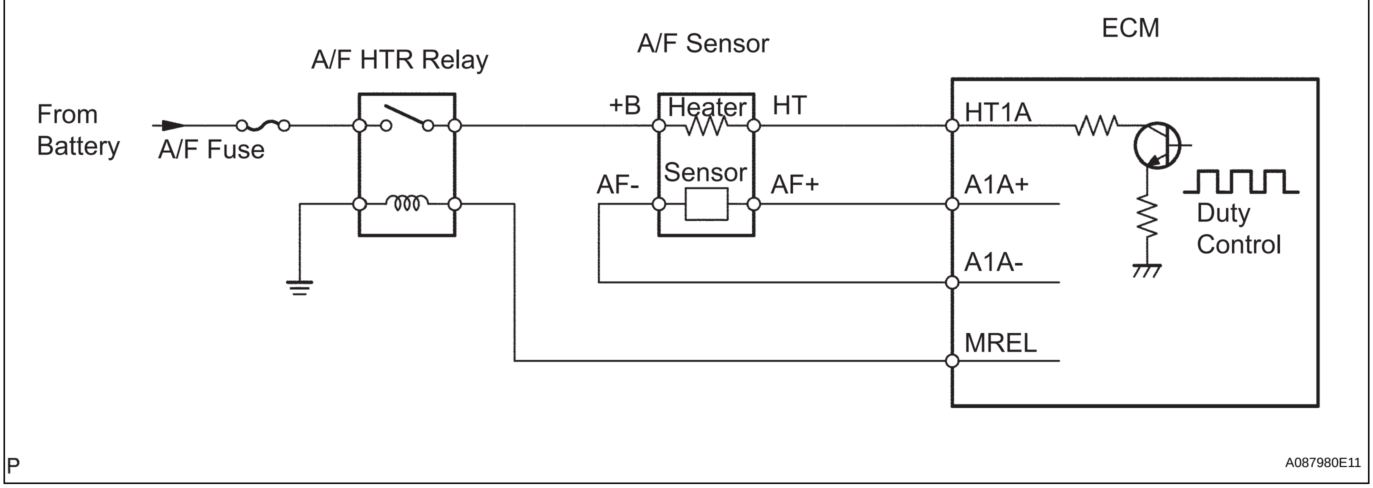
(a) Disconnect the A7 or A8 A/F sensor connector.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A7-3 (AF+) - E7-22 (A1A+) A7-4 (AF-) - E7-30 (A1A-) A7-1 (HT) - E7-5 (HA1A) A8-3 (AF+) - E7-23 (A2A+) A8-4 (AF-) - E7-31 (A2A-) A8-1 (HT) - E7-4 (HA2A)	Below 1 Ω
A7-3 (AF+) or E7-22 (A1A+) - Body ground A7-4 (AF-) or E7-30 (A1A-) - Body ground A7-1 (HT) or E7-5 (HA1A) - Body ground A8-3 (AF+) or E7-23 (A2A+) - Body ground A8-4 (AF-) or E7-31 (A2A-) - Body ground A8-1 (HT) or E7-4 (HA2A) - Body ground	10 kΩ or higher

ES

Reference (Bank 1 Sensor 1 System Drawing)



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

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

DTC	P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)

HINT:
- DTC P2A00 is a malfunction related to the bank 1 A/F sensor.
- DTC P2A03 is a malfunction related to the bank 2 A/F sensor.

DESCRIPTION

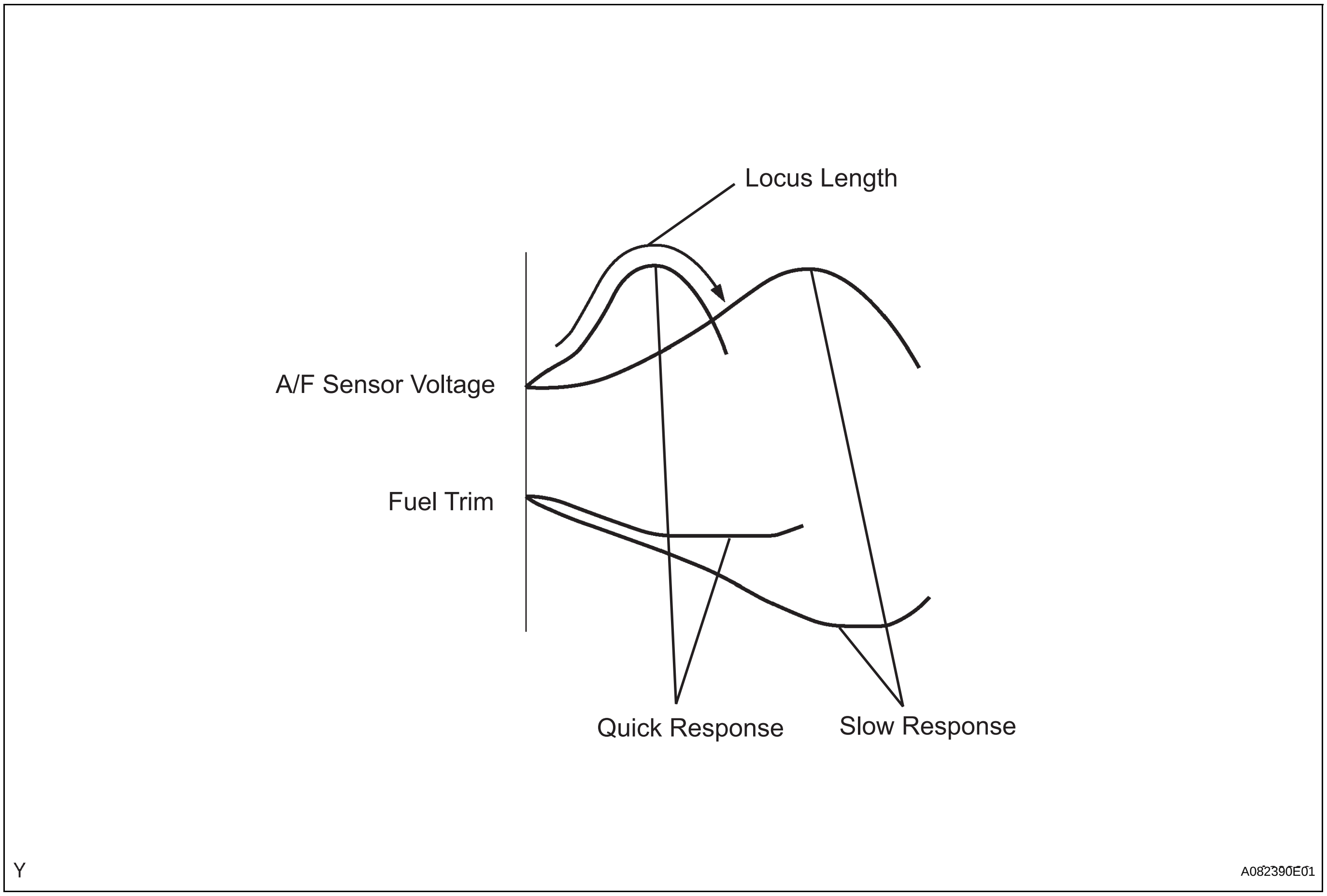
Refer to DTC P2195 (See page ES-262).

DTC No.	DTC Detecting Condition	Trouble Area
P2A00 P2A03	In conditions (a), (b), and (c), when A/F sensor output voltage change is below expected level compared to fuel trim change, ECM judges that A/F sensor circuit has slow response: (2 trip detection logic) (a) After engine is warmed up (b) During vehicle driving with engine speed 1,400 to 3,200 rpm (c) Vehicle speed 25 mph (40 km/h) or more	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater • A/F sensor heater relay • Open or short in A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM

HINT:
- Bank 1 is the bank that includes cylinder No. 1.
- Bank 2 is the bank that includes cylinder No. 2.
- Sensor 1 is the sensor closest to the engine assembly.

MONITOR DESCRIPTION

The air fuel ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. Based on the output voltage, the ECM determines if the air-fuel ratio is RICH or LEAN and adjusts the stoichiometric air-fuel ratio. The ECM also checks the fuel injection volume compensation value to check if the A/F sensor is deteriorating or not. The output voltage variation, known as locus length, should be high when the air-fuel ratio fluctuates. When the A/F sensor response rate has deteriorated, the locus length should be short. The ECM concludes that there is a malfunction in the ratio of the A/F sensor when the locus length is short and the response rate has deteriorated.



MONITOR STRATEGY

Related DTCs	P2A00: A/F sensor (Bank 1) Slow Response P2A03: A/F sensor (Bank 2) 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	60 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel system) P0300 - P0306 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2237, P2240 (A/F sensor - open)
Engine condition	Running
Time after engine start	120 seconds or more

Fuel system status	Closed Loop
A/F sensor status	Activated
Idle	OFF
Time after idle OFF	2 seconds or more
Engine RPM	1,400 to 3,200 rpm
Vehicle speed	37.5 to 75 mph (60 to 120 km/h)
Time after fuel cut is OFF	2 seconds or more
Driving for 20 seconds or more	25 mph (40 km/h) or more and 900 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	6.0 or more

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page ES-15).
The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page ES-17).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID $06: A/F sensor

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
0	$01	Multiply by 0.000244 (no dimension)	Parameter for identify A/F sensor response rate (Bank 1)	Malfunction threshold for A/F sensor deterioration
0	$11	Multiply by 0.000244 (no dimension)	Parameter for identify A/F sensor response rate (Bank 2)	Malfunction threshold for A/F sensor deterioration

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-265).

HINT:
Intelligent tester only:
The malfunctioning area can be found by the ACTIVE TEST A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other suspected areas are malfunctioning or not.

1. Perform the ACTIVE TEST A/F CONTROL operation.

HINT:
The A/F CONTROL operation lowers the injection volume by 12.5 % or increases the injection volume by 25 %.

(a) Connect the intelligent tester to the DLC3 on the vehicle.
(b) Turn the ignition switch ON.
(c) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(e) Perform the A/F CONTROL operation with the engine idling (press the right or left button).

Result:

A/F sensor reacts in accordance with increase and decrease of injection volume:
+25 % → RICH output: Less than 3.0 V
-12.5 % → LEAN output: More than 3.35 V

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

+25 % → RICH output: More than 0.55 V

-12.5 % → LEAN output: Less than 0.4 V

NOTICE:

The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage More than 0.55 V Less than 0.4 V	OK	
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction	NG	Output Voltage More than 0.55 V Less than 0.4 V	OK	
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage Almost no reaction	NG		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

The following A/F CONTROL procedure enables the technician to check and graph the voltage outputs of both the A/F sensor and the heated oxygen sensor.

For displaying the graph, enter "ACTIVE TEST / A/F CONTROL / USER DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES" and push "ENTER". Then press "F4".

HINT:

- DTC P2A00 or P2A03 may be also detected, when the air fuel ratio is stuck 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 with a RICH air-fuel mixture.
- 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 with a LEAN air-fuel mixture.
- Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO A/F SENSOR DTC)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result :

Display	Proceed to
DTC P2A00 and/or P2A03 are output.	A
DTC P2A00 and/or P2A03 and other DTCs are output.	B

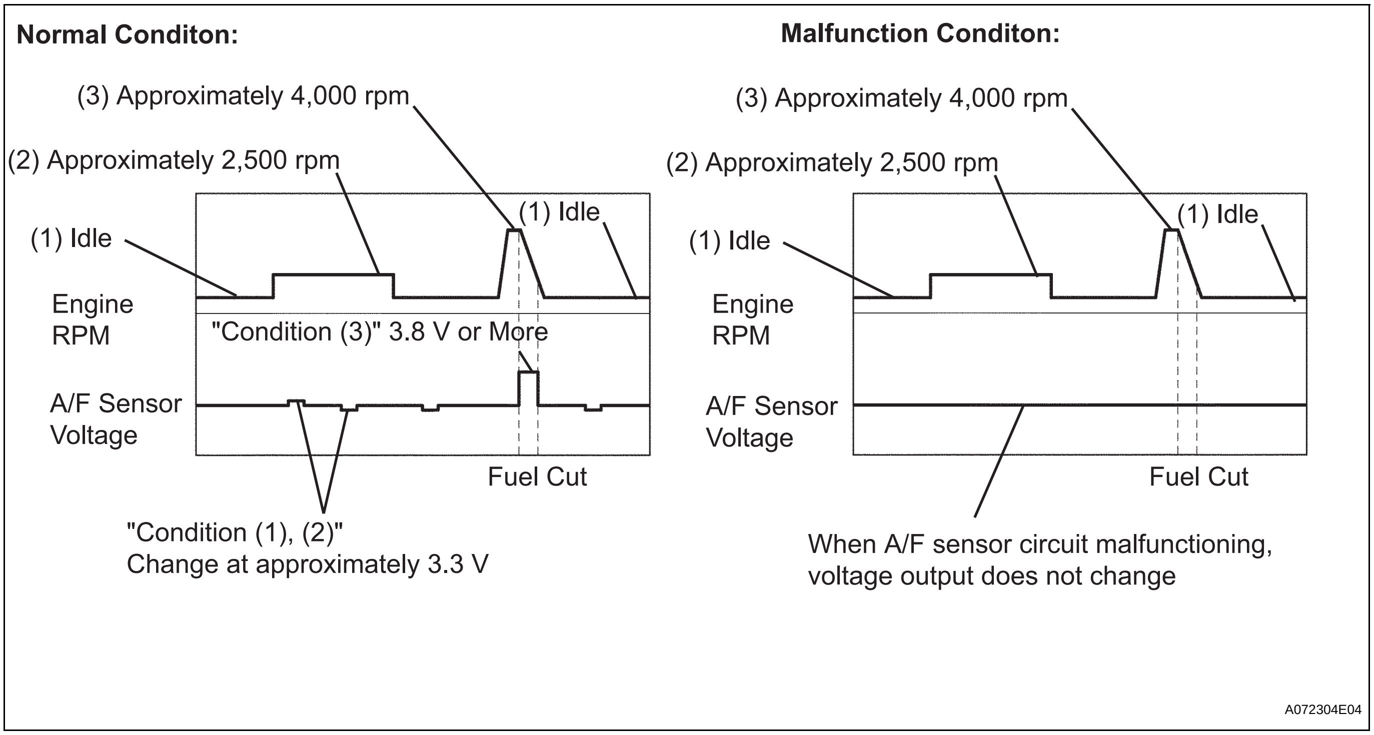
HINT:
If any other DTCs besides P2A00 and/or P2A03 are output, perform the troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A ↓

2	READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
(b) Warm up the A/F sensor (bank 1 sensor 1 and bank 2 sensor 1) by running the engine at 2,500 rpm for approximately 90 seconds.
(c) Read A/F sensor voltage output on the intelligent tester or the OBD II scan tool.
(d) Intelligent tester only:
On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA. Read the values.
(e) Select "AFS B1 S1 or AFS B2 S1 / ENGINE SPD" and press YES.
(f) Monitor the A/F sensor voltage carefully.
(g) Check the A/F sensor voltage output under the following conditions:
  (1) Allow the engine to idle for 30 seconds.
  (2) Run the engine at approximately 2,500 rpm. Do not suddenly change the rpm.
  (3) Raise the engine speed to 4,000 rpm and quickly release the accelerator pedal so that the throttle is fully closed.



Standard:

Conditions (1) and (2)
Voltage change of 3.3 V (0.66 V)* (between approximately 3.1 to 3.5 V) as shown in the illustration.
Condition (3)
A/F sensor voltage increases to 3.8 V (0.76 V)* or more when fuel is cut during engine deceleration as shown in the illustration.

*: Voltage when using the OBD II scan tool.

HINT:

- Whenever the A/F sensor output voltage remains at approximately 3.3 V (0.660 V)* (see "Malfunction Condition" graphic) under any condition as well as the above conditions, the A/F sensor may have an open circuit. This will happen also when the A/F sensor heater has an open circuit.
- Whenever the A/F sensor output voltage remains at a certain value of approximately 3.8 V (0.76 V)* or more, or 2.8 V (0.56 V)* or less (see "Malfunction Condition" graphic) under any condition as well as the above conditions, the A/F sensor may have a short circuit.
- The ECM will stop fuel injection (fuel is cut) during engine deceleration. This will cause a LEAN condition and should result in a momentary increase in A/F sensor output voltage.

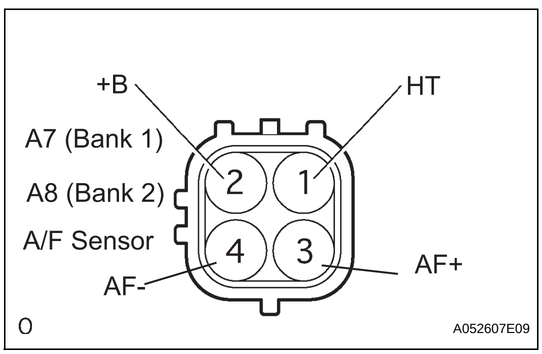
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal has been disconnected, the vehicle must be driven over 16 km/h (10 mph) to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V (0.76 V)* during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F sensor or ECM, you will observe a constant voltage.

*: Voltage when using the OBD II scan tool.

OK → **Go to step 14**

NG

3 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A7 or A8 A/F sensor connector.
(b) Measure the resistance of the A/F sensor terminals.
Resistance

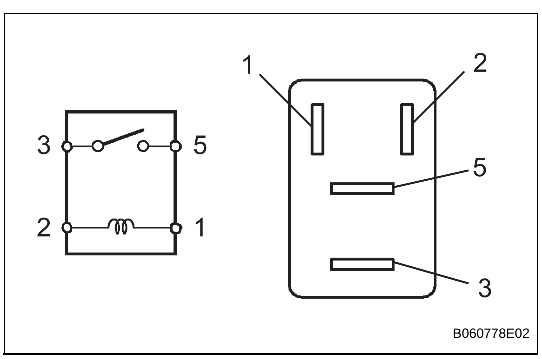
Tester Connection	Condition	Specified Condition
1 (HT) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

4 INSPECT A/F RELAY



(a) Remove the A/F HTR relay from the engine room R/B.
(b) Measure the resistance of the A/F HTR relay.
Resistance

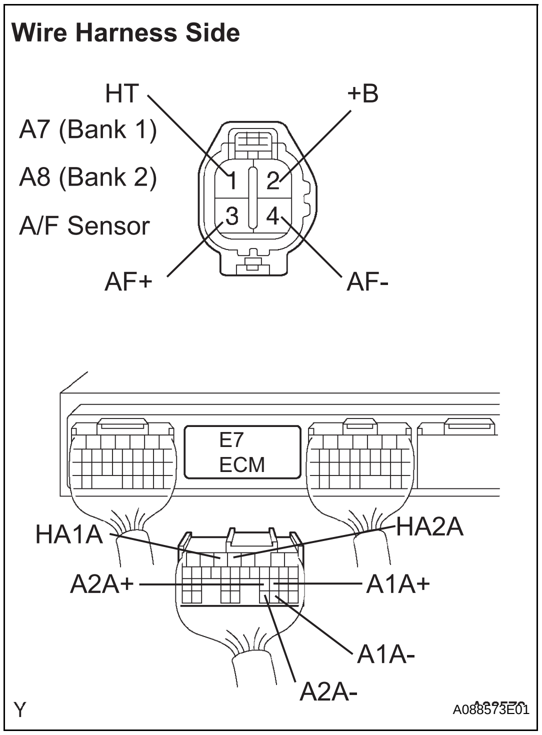
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

(c) Reinstall the A/F HTR relay.

NG → **REPLACE A/F RELAY**

OK

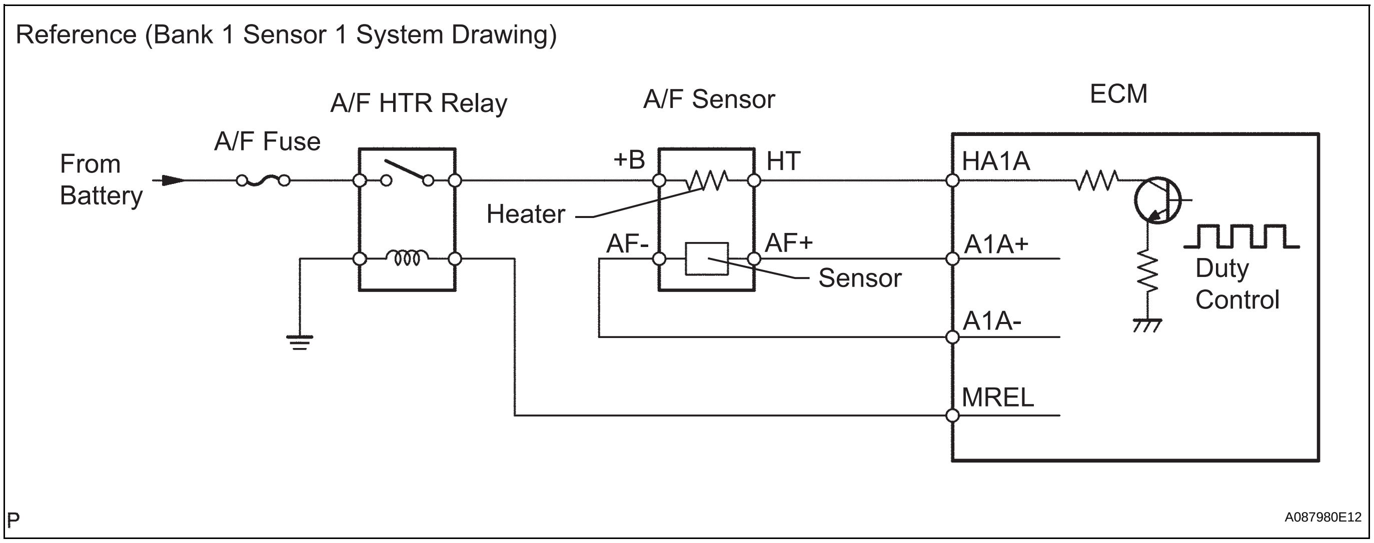
5	CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)



(a) Disconnect the A7 or A8 A/F sensor connector.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A7-3 (AF+) - E7-22 (A1A+) A7-4 (AF-) - E7-30 (A1A-) A7-1 (HT) - E7-5 (HA1A) A8-3 (AF+) - E7-23 (A2A+) A8-4 (AF-) - E7-31 (A2A-) A8-1 (HT) - E7-4 (HA2A)	Below 1 Ω
A7-3 (AF+) or E7-22 (A1A+) - Body ground A7-4 (AF-) or E7-30 (A1A-) - Body ground A7-1 (HT) or E7-5 (HA1A) - Body ground A8-3 (AF+) or E7-23 (A2A+) - Body ground A8-4 (AF-) or E7-31 (A2A-) - Body ground A8-1 (HT) or E7-4 (HA2A) - Body ground	10 kΩ or higher



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

6	CHECK AIR INDUCTION SYSTEM

(a) Check for vacuum leaks in the air induction system.

OK:

There is no leak in air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

7 CHECK CONNECTION OF PCV HOSE

OK:
PCV hose is connected correctly. And PCV hose has no damage.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

8 CHECK FUEL PRESSURE

(a) Check fuel pressure (See page FU-8).
Standard:
Fuel pressure: 304 to 343 kPA (3.1 to 3.5 kgf/cm^2, 44 to 55 psi).

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

9 INSPECT FUEL INJECTOR ASSEMBLY

(a) Check injector injection (See page FU-16).
Standard

Injection Volume	Difference between Each Injector
60 to 73 cm^3(3.7 to 4.5 cu in.) per 15 seconds	13 cm^3(0.8 cu in.) or less

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

10 REPLACE AIR FUEL RATIO SENSOR

NEXT

11 PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (See page ES-17).

NEXT

12 READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display	Proceed to
DTC P2A00 and/or P2A03 are not output	A
DTC P2A00 and/or P2A03 are output again	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

A

13 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTC CAUSED BY RUNNING OUT OF FUEL

14 PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (See page ES-17).

NEXT

15 READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display	Proceed to
DTC P2A00 and/or P2A03 are not output	A
DTC P2A00 and/or P2A03 are output	B

B → **Go to step 19**

A

16 REPLACE AIR FUEL RATIO SENSOR

17	PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (See page ES-17).

18	READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display	Proceed to
DTC P2A00 and/or P2A03 are output	A
DTC P2A00 and/or P2A03 are not output	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

A

19	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK:
Vehicle has run out of fuel in past.

NG → **CHECK FOR INTERMITTENT PROBLEMS**

OK

DTC CAUSED BY RUNNING OUT OF FUEL

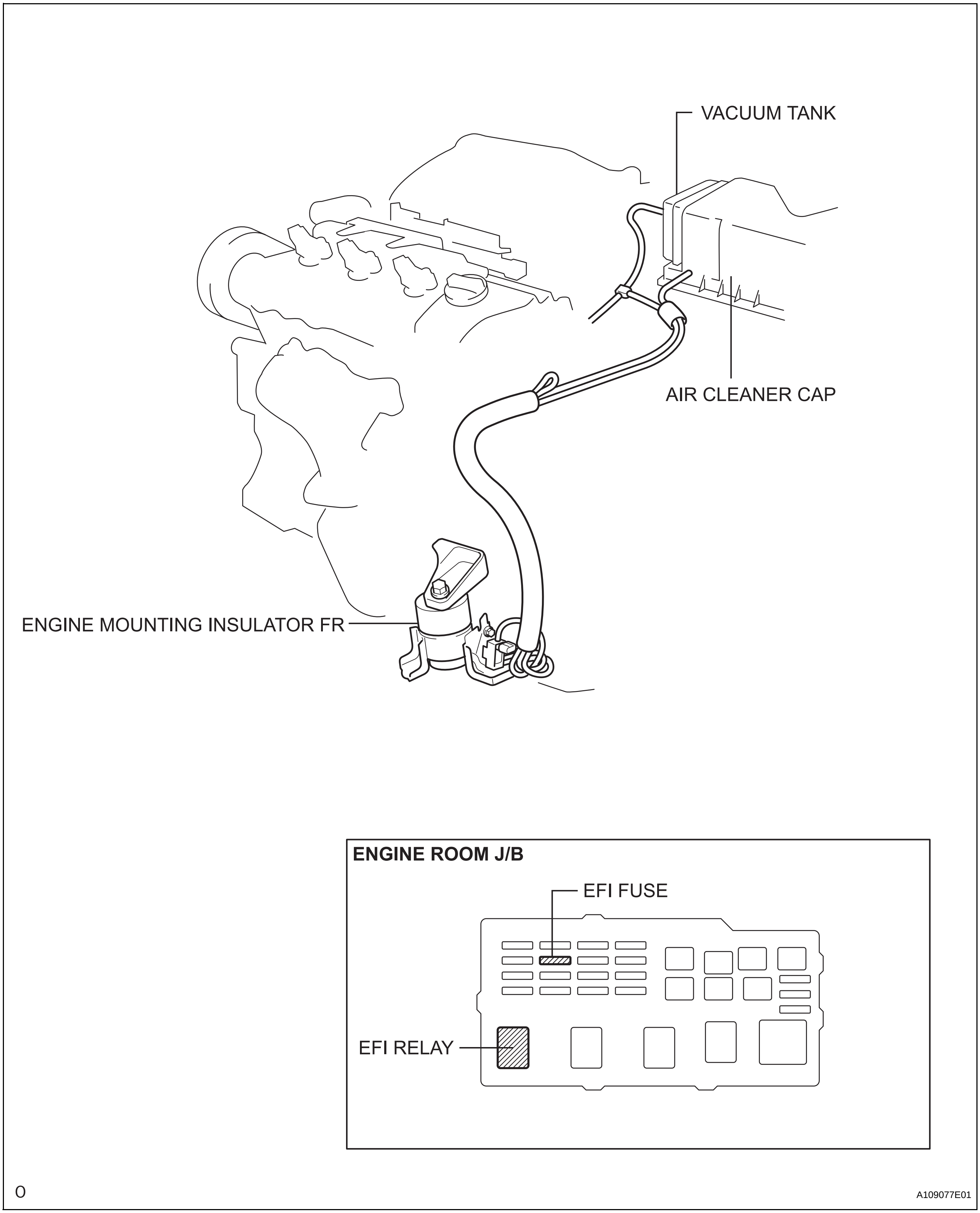
ES

Active Control Engine Mount System

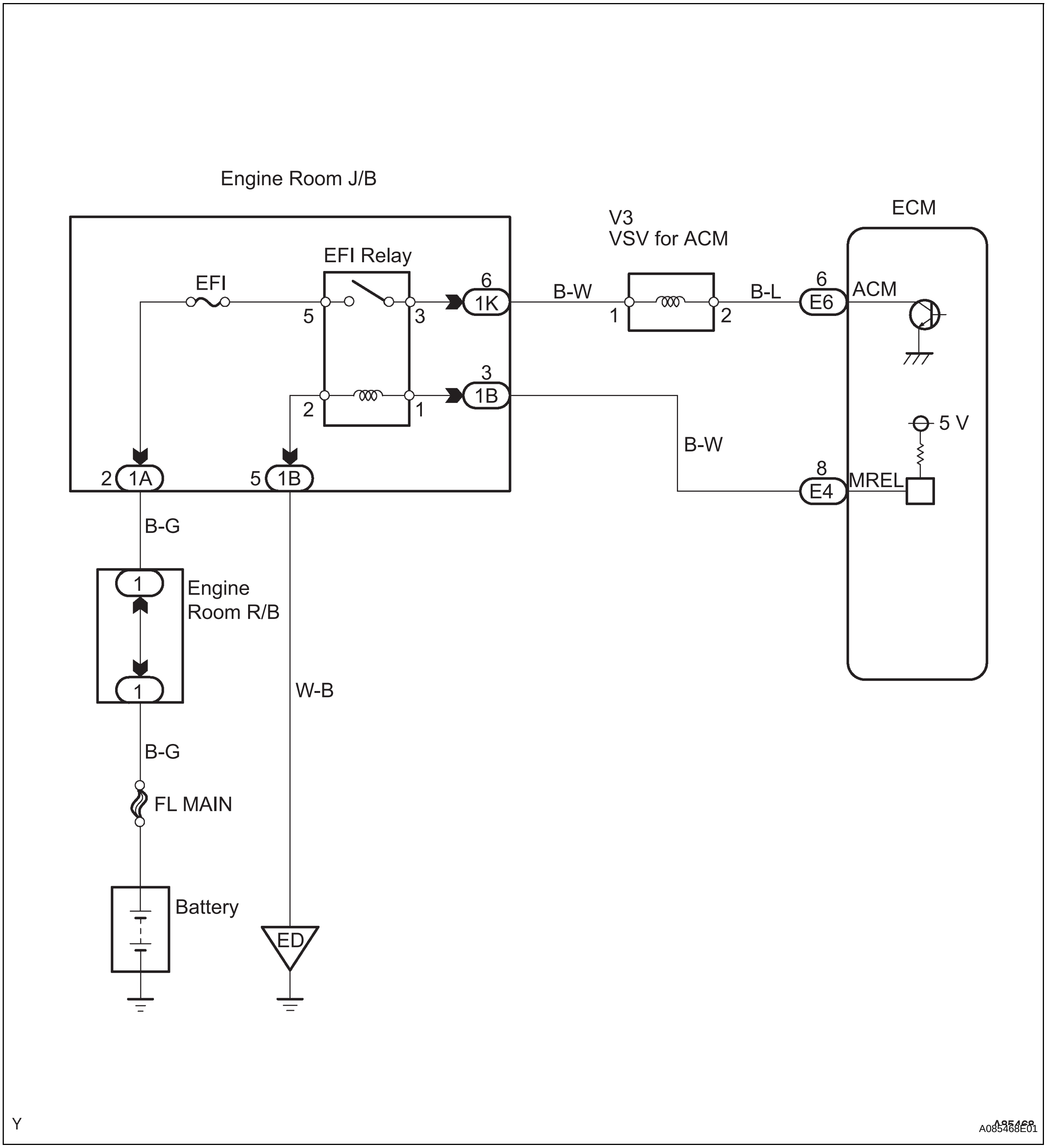
DESCRIPTION

The Active Control Engine Mount (ACM) system decreases engine vibration at low engine speed using the VSV for ACM. The VSV is controlled by a pulse signal transmitted to the VSV from the ECM. The frequency of this pulse signal is matched to the engine speed to decrease engine vibration.

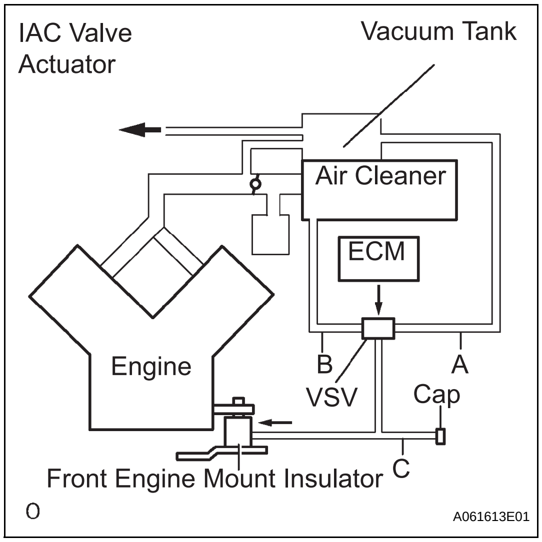
LOCATION


VACUUM TANK
AIR CLEANER CAP
ENGINE MOUNTING INSULATOR FR
ENGINE ROOM J/B
EFI FUSE
EFI RELAY
O
A109077E01

WIRING DIAGRAM



1	CHECK VACUUM HOSES

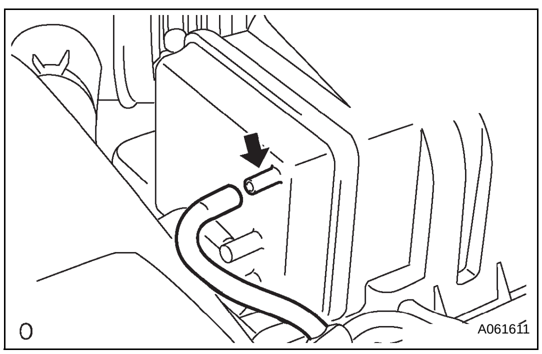


(a) Check if the vacuum hose cap is missing.
(b) If the hose is damaged, replace the vacuum hose assembly.
(c) Check the air and vacuum hoses for looseness, disconnection and blockage.

NG → **REPAIR OR REPLACE VACUUM HOSES**

OK

2	CHECK VACUUM

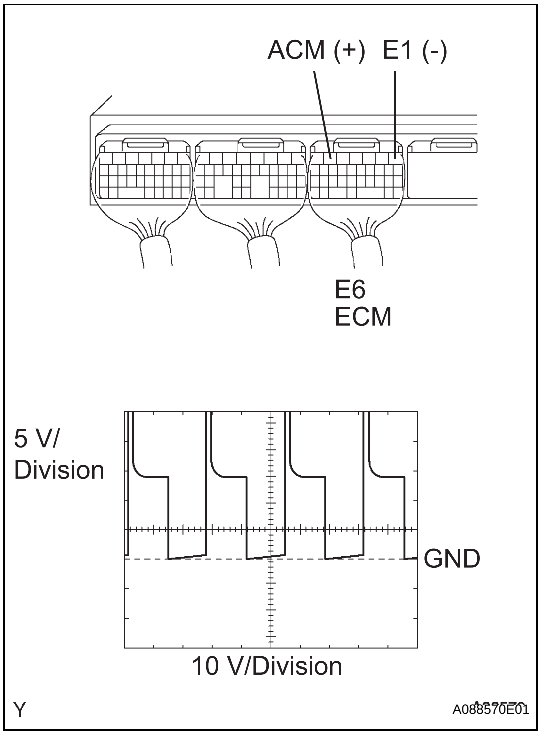


(a) Start the engine.
(b) Disconnect the vacuum hose from the vacuum tank.
(c) Check that the unconnected port located on the vacuum tank applies suction to your finger.
(d) Reconnect the vacuum hose.

NG → **CHECK AND REPLACE VACUUM SOURCE AND HOSES**

OK

3	CHECK ECM (ACM VOLTAGE)



(a) Connect the oscilloscope between terminals ACM and E1 of the E6 ECM connector.
(b) Warm up engine to normal operating temperature.
(c) Turn the A/C switch on.
(d) Measure the voltage between terminals ACM and E1 of the E6 ECM connector.

Voltage

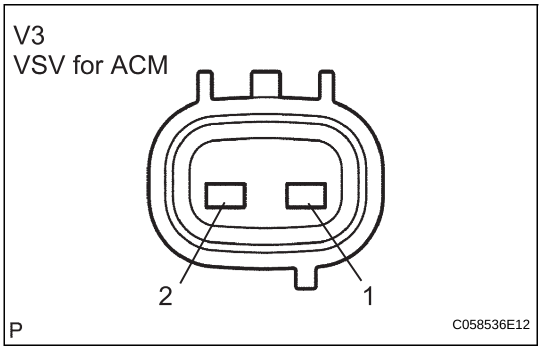
Condition	Voltage
Shift position is D range, and engine speed is 850 rpm or less	Pulse generation
Shift position is D range, and engine speed is 950 rpm or more	9 to 14 V
Shift position is P range	9 to 14 V

ES

OK → **Go to step 6**

NG

4	INSPECT VSV FOR ACM (RESISTANCE)



(a) Disconnect the V3 VSV connector.
(b) Measure the resistance between the terminals 1 and 2.

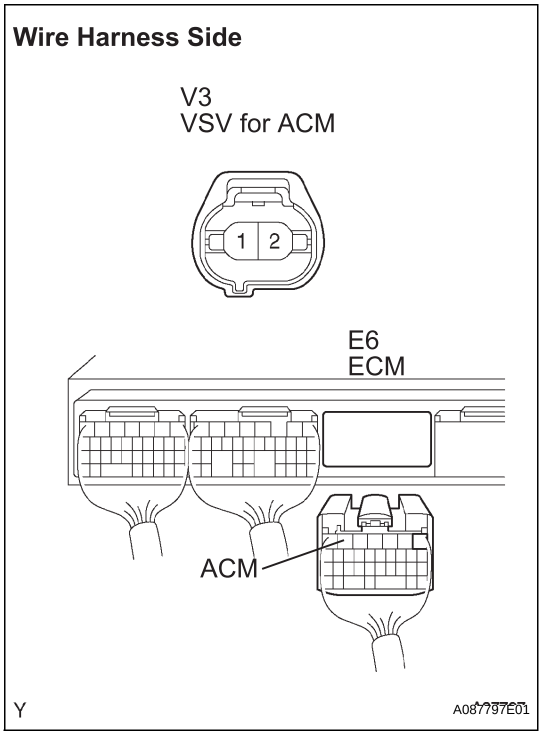
Resistance

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	19 to 20 Ω

NG → **REPLACE VSV**

OK

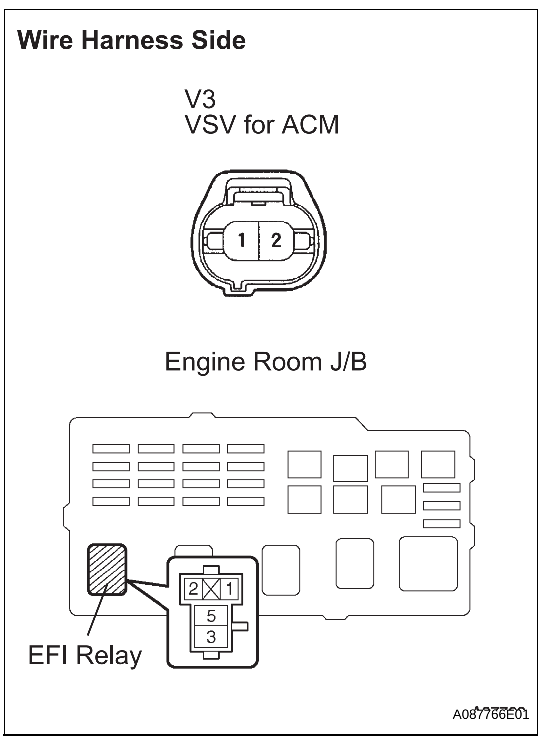
5	CHECK WIRE HARNESS (VSV FOR ACM - ECM, VSV FOR ACM - EFI RELAY)



(a) Check the wire harness between the VSV and ECM.
(1) Disconnect the V3 VSV connector for ACM.
(2) Disconnect the E6 ECM connector.
(3) Measure the resistance of the wire harness side connectors.

Resistancse

Tester Connection	Specified Condition
V3-2 - E6-6 (ACM)	Below 1 Ω
V3-2 or E6-6 (ACM) - Body ground	10 kΩ or higher



(b) Check the wire harness between the VSV and EFI relay.
(1) Disconnect the V3 VSV connector.
(2) Remove the EFI relay from the engine room J/B.
(3) Measure the resistance of the wire harness side connectors.

Resistance

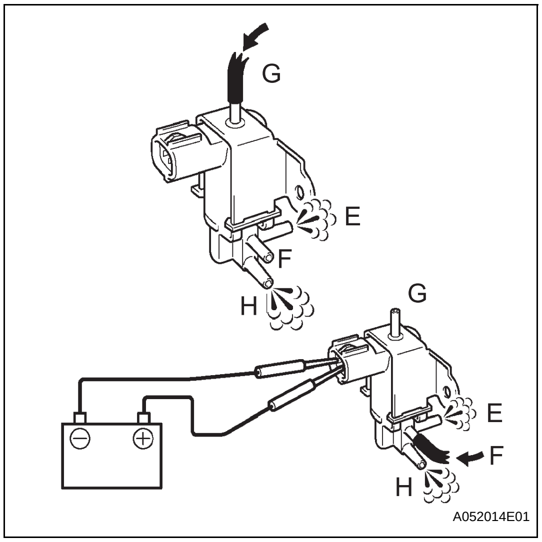
Tester Connection	Specified Condition
V3-1 (VSV for ACM) - J/B EFI relay terminal 3	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

6	INSPECT VSV FOR ACM (OPERATION)



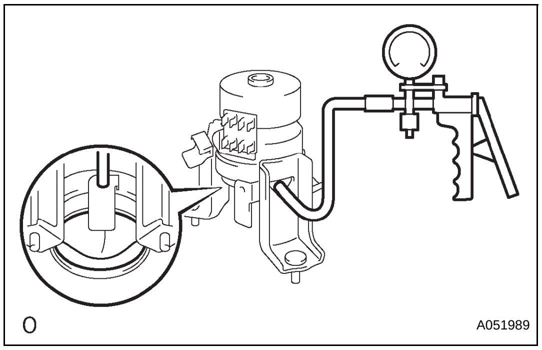
(a) Remove the VSV.
(b) Check operation of the VSV when battery positive voltage is applied to the terminals of the VSV connector.
Battery positive voltage is not applied:
The air from pipe G is flowing out through pipes E and H.
Battery positive voltage is applied:
The air from pipe F is flowing out through pipes E and H.

NG → **REPLACE VSV FOR ACM**

ES

OK

7	INSPECT TRANSVERSE ENGINE ENGINE MOUNTING INSULATOR



(a) Disconnect the vacuum hose from the front engine mount insulator.
(b) Using MITYVAC (Hand-held Vacuum Pump), apply a vacuum of 80 kPa (600 mmHg, 25 in.Hg) and wait for 1 minute.
(c) Make sure there is no needle movement on the MITYVAC.
(d) Check that there is no fluid leakage caused by a broken lower diaphragm.

NG → **REPLACE TRANSVERSE ENGINE ENGINE MOUNTING INSULATOR**

OK

SYSTEM OK

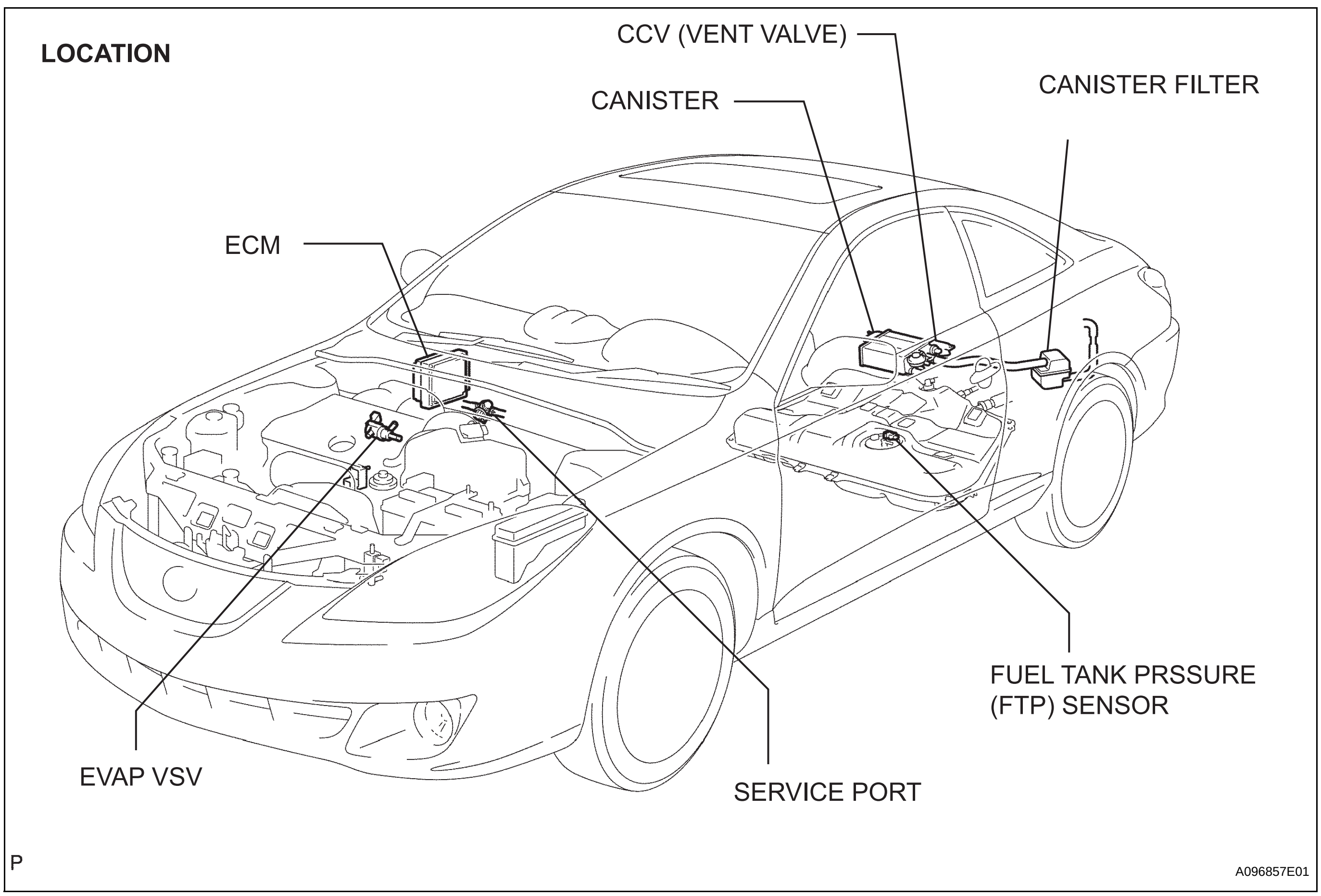
EVAP System

DESCRIPTION

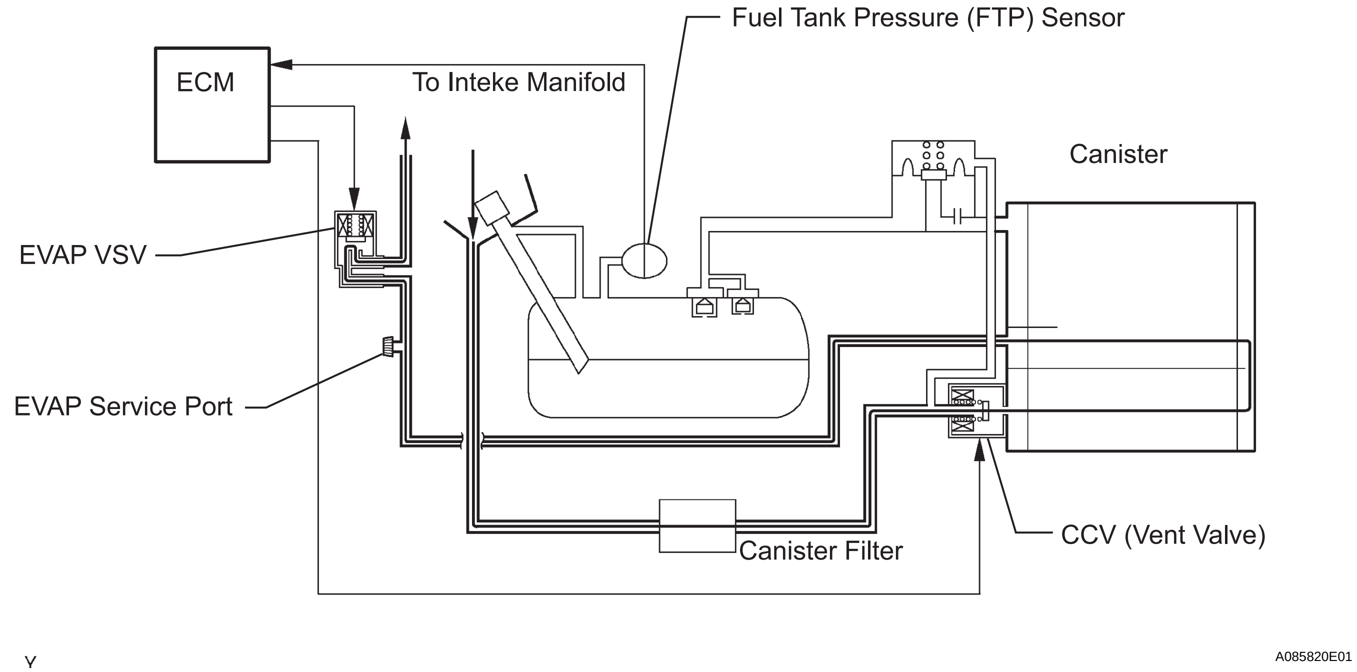
When predetermined conditions (closed loop, etc.) are met, the EVAP VSV is opened and stored fuel vapor in the canister is purged to the intake manifold. The ECM changes duty-cycle to the EVAP VSV to control purge flow volume. Purge flow volume is determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve (CCV) to ensure that purge flow is maintained when negative pressure (vacuum) is applied to the canister. This EVAP system contains following components:

Components

Components	Operation
Canister	Contains activated charcoal to absorb EVAP that is created in fuel tank.
EVAP VSV	Opens or closes line between canister and intake manifold to control EVAP purge flow. EVAP VSV is opened and purges fuel vapor absorbed by canister to intake manifold. ECM changes duty-cycle of purge VSV to control purge volume (ON is open, OFF is closed).
Refueling Valve	Controls EVAP pressure from fuel tank to canister. Valve has diaphragm, spring and restrictor. When fuel tank pressure increase, valve opens. When EVAP is purging, valve closes and restrictor prevents strong of vacuum from affecting pressure in fuel tank. When valve opens, refueling is possible.
Service Port	Used for connecting vacuum gauge for inspecting EVAP system.
Vent Valve (CCV)	Vents and seals EVAP system. When CCV is turned ON, EVAP system is closed. When CCV is turned OFF, EVAP system is vented. When vacuum introduction, EVAP VSV is opened and CCV is closed.
Fuel Tank Pressure (FTP) Sensor	Indicates pressure as voltage. 5 V is supplied by ECM. ECM detects EVAP system pressure using this voltage.



DIAGRAM

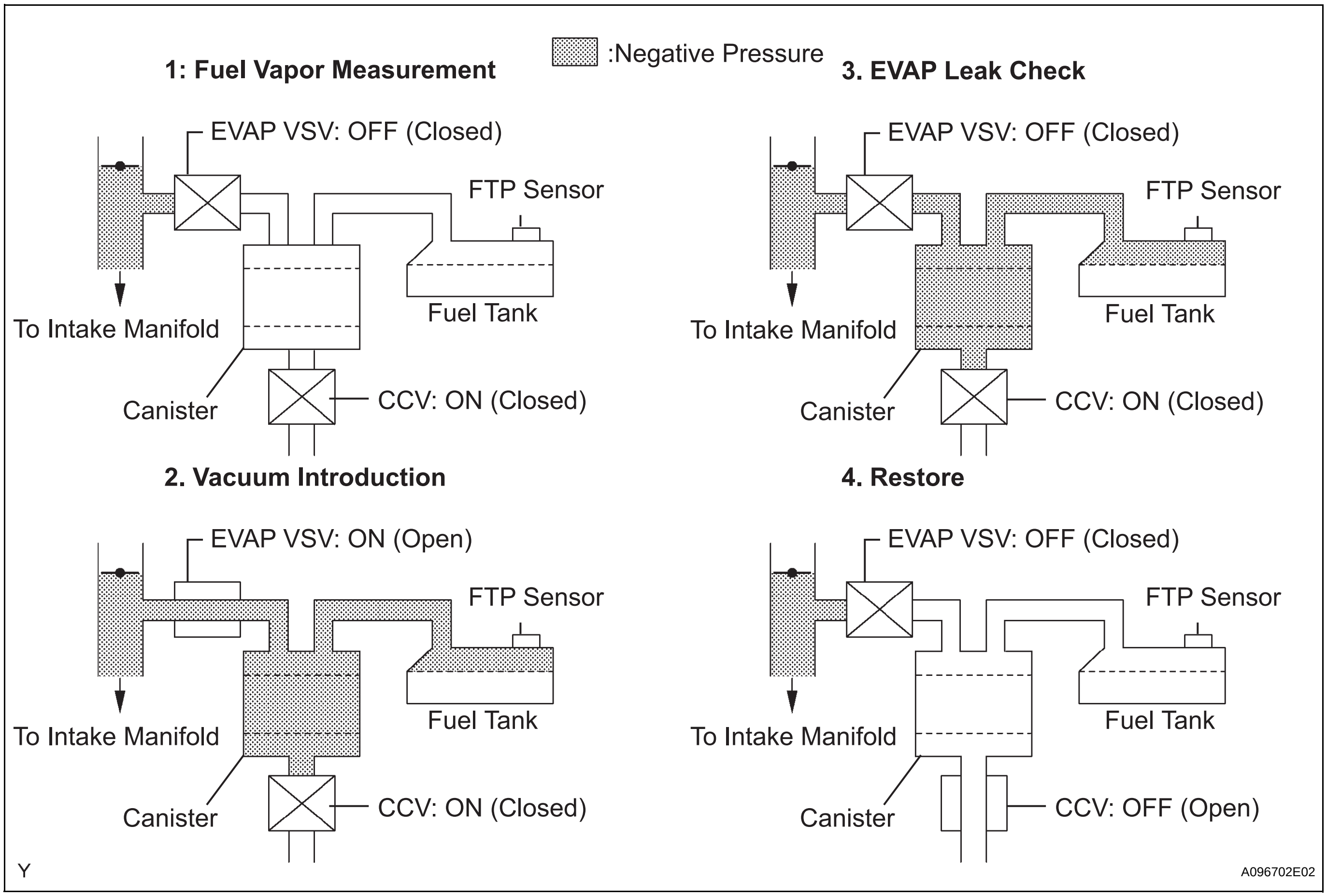


MONITOR DESCRIPTION

The EVAP monitor's purpose is to check for EVAP leaks and EVAP VSV and CCV malfunctions. The monitor performs the check by first introducing the intake manifold's negative pressure (vacuum) to the EVAP system. Then, the monitor records change in the EVAP system's pressure levels. The monitor runs when the following conditions are met:

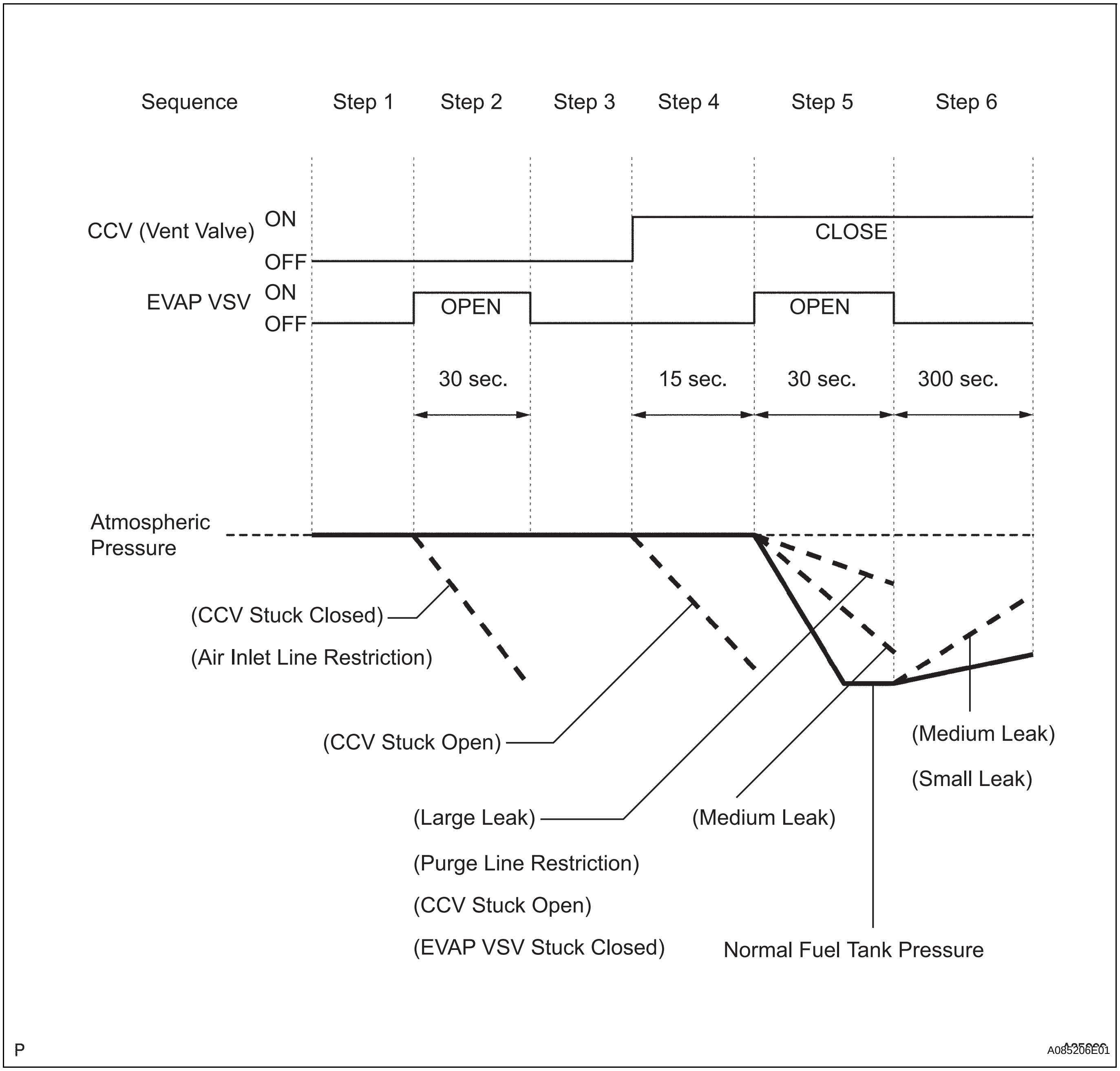
- The engine coolant and intake air temperatures are 4 to 35°C (40 to 90°F).
- The engine is idling or the vehicle is being driven at a steady speed.
- The fuel tank pressure is stabilized.

LEV II EVAP Monitor Process



Sequence	Operation	Description
1	Fuel vapor measurement	EVAP VSV is turned OFF (closed) and EVAP pressure is measured. If EVAP pressure is not stable, EVAP monitor is canceled to prevent inaccurate monitor.
2	Vacuum introduction	EVAP VSV is turned ON (open) and CCV is turned ON (closed). As a result, intake manifold pressure (vacuum) is introduced to EVAP system.
3	EVAP leak check	EVAP VSV is turned OFF (closed) to seal EVAP system. EVAP pressure increase is measured for 5 seconds when EVAP pressure is -20 mmHg and -17 mmHg. If increase is large, ECM concludes EVAP system has leak.
4	Restore	CCV is turned OFF (open) to finish EVAP monitor.

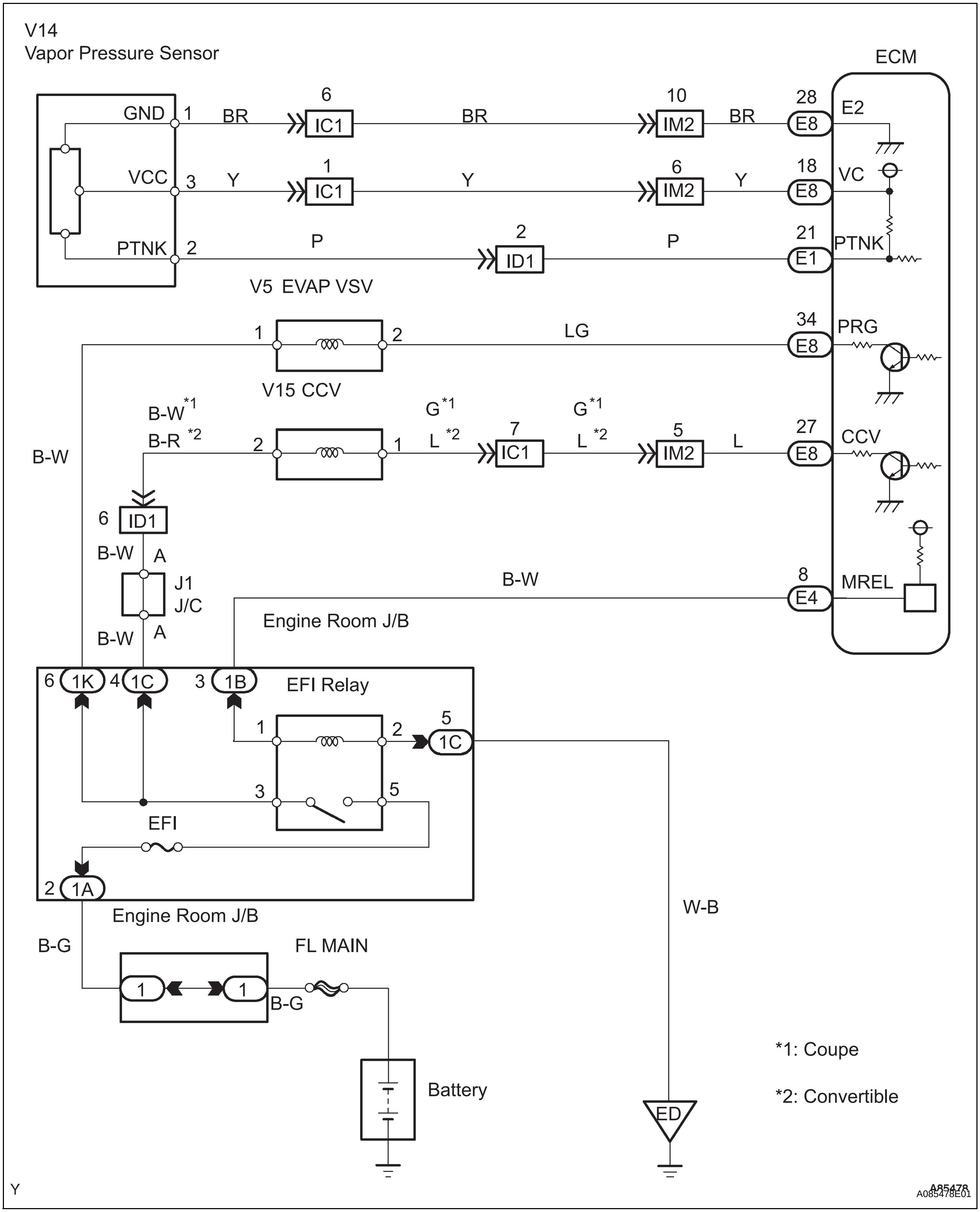
LEV II EVAP Monitor Sequence



Related DTCs

DTCs	Monitoring Item
P0441	EVAP VSV stuck closed EVAP VSV stuck open
P0442	EVAP small leak (0.04 inch)
P0446	Vent valve (CCV) stuck closed CCV stuck open
P0451	Fuel tank pressure (FTP) sensor malfunction
P0452	FTP sensor low output
P0453	FTP sensor high output
P0455	EVAP gross leak
P0456	EVAP small leak (0.02 inch)

WIRING DIAGRAM



HINT:
Read 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 help determine if the vehicle was running or stopped, 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.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P041, P0442, P0446 AND/OR P0456)

Result

Display (DTC output)	Proceed to
Only P0441, P0442, P0446 and /or P0456 are output	A
P0451, P0452 and P453 are output	B

HINT:
If any other DTCs besides P0441, P0442, P0446 and/or P0456 are output, perform the troubleshooting for those DTCs first (reference: P0451, P0452, P0453 are vapor pressure sensor malfunctions).

B → **GO TO RELEVANT DTC CHART**

A

2 CHECK CURRENT AND PENDING DTC

(a) Check current DTCs. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBDII, DTC INFO and CURRENT DTCS.
(b) Check pending DTCs. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBDII, DTC INFO and PENDING DTCS.

Result

Current DTC	Pending DTC	Conclusion
Set	Set	System has been malfunctioning. Problem can be specified.
Set	-	System was malfunctioning in previous driving cycle. Problem may be specified.
-	Set	System is malfunctioning. This is intermittent problem and caused by fuel tank cap loosening. Otherwise, this problem may be difficult to eliminate.

HINT:
- The ECM stores the current DTC and illuminates the MIL when an emission-related component is malfunctioning in 2 consecutive driving cycles (2 trips). The MIL is turned OFF, if the component is functioning normally in 3 consecutive driving cycles. The ECM erases the current DTC, if the component is functioning normally in 40 consecutive driving cycles.
- The ECM stores the pending DTC when If the component is malfunctioning in present driving cycle (1 trip).
- The ECM erases the pending DTC, if the component is functioning normally in the next driving cycle.

NEXT

3	PREDICT POSSIBLE MALFUNCTION AREA (MANUAL OPERATION)

(a) Predict possible malfunction area using the matrix below.

EVAP DTC Matrix

Malfunction Area	DTCs
EVAP VSV stuck closed	P0441, P0466, P0455
EVAP VSV stuck open	P0441
EVAP small leak (0.04 inch)	P0442
CCV stuck closed	P0446
CCV stuck open	P0441, P0446, P0455
FTP sensor malfunction	P0451
FTP sensor low output	P0452
FTP sensor high output	P0453
Gross leak	P0441, P0455
EVAP small leak (0.02 inch)	P0442, P0456

DTCs	Suspected Malfunction Area
P0441 only	EVAP VSV stuck open
P0446 only	CCV (vent valve) stuck open
P0442 and/or P0456	Small leak

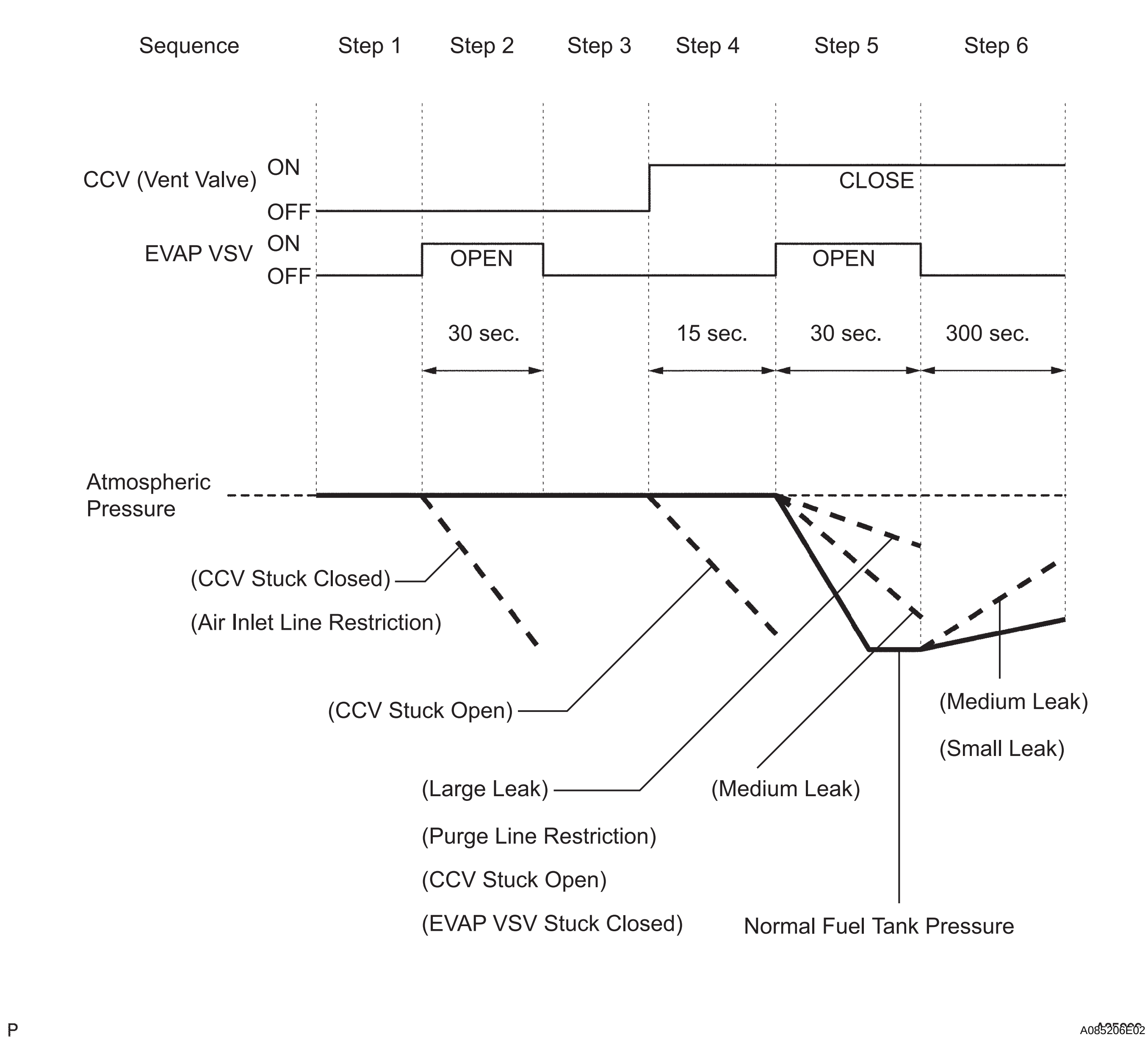
NEXT

4	PERFORM EVAP SYSTEM CHECK

NOTICE:
The EVAP system check can be used for confirmation after the EVAP system repair. Check DTCs after performing the EVAP system check. If no pending DTC is set, the EVAP system is functioning normally and the repair is complete.

(a) Select the "mmHg" unit. Select the intelligent tester menus: DIAGNOSIS, SETUP, UNIT CONVERSION and VAPOR PRESS.
(b) Allow the engine to idle.
(c) Perform the EVAP system check to find a malfunction area. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, SYSTEM CHECK and LEV II SYS CHECK.
(d) Read NOTICE and press ENTER.

Diagram of LEV II EVAP System Check



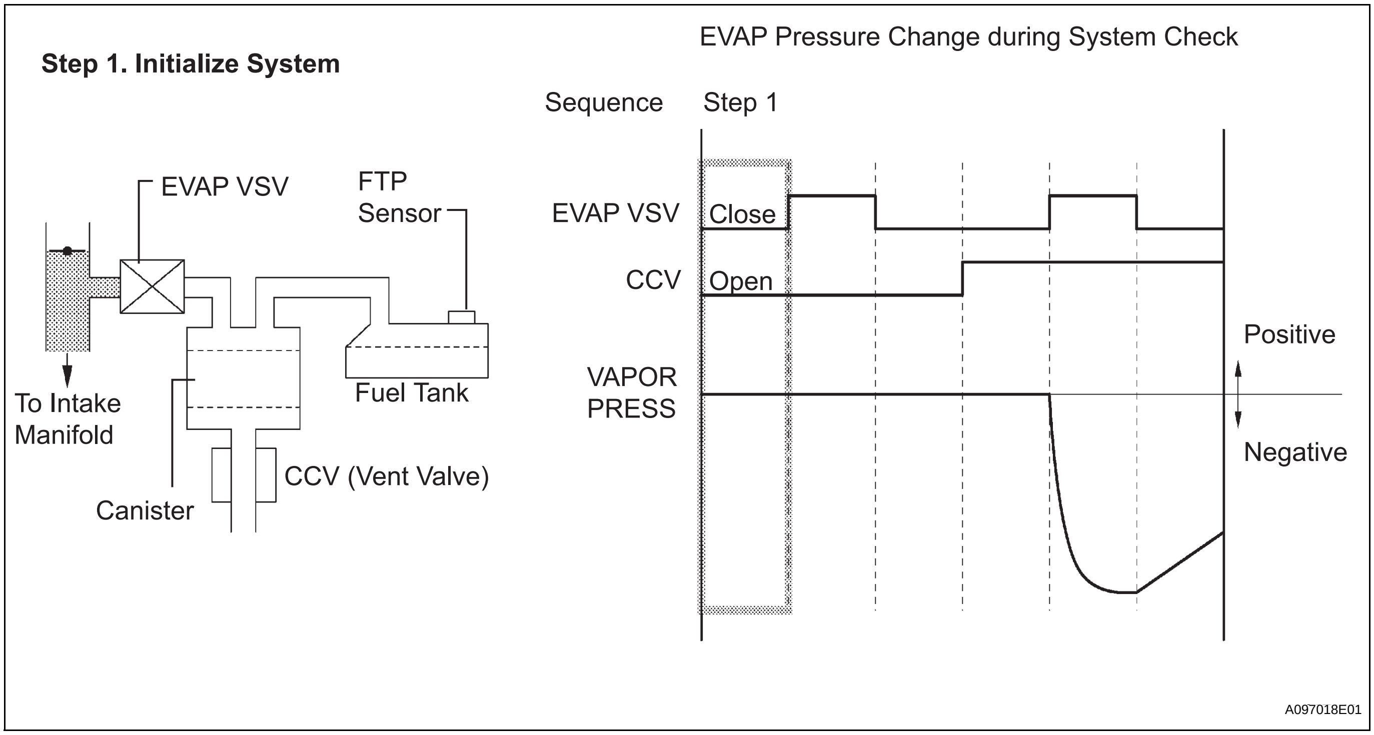
HINT:
The EVAP system check is most accurate when the following conditions are being set:

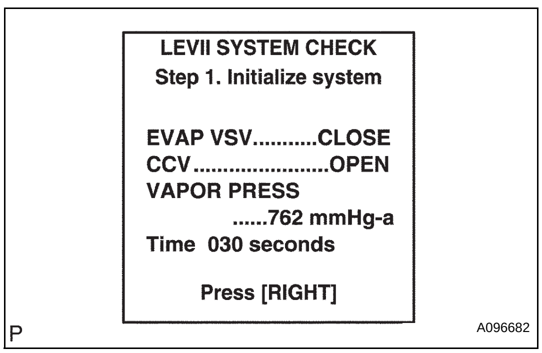
- Atmospheric pressure is 762 mmHg (sea level).
- The engine coolant and intake air temperatures are 4 to 35°C (40 to 90°F).
- The fuel tank level is 1/4 to 3/4.

NEXT

5	PERFORM EVAP SYSTEM CHECK STEP 1 (INITIALIZE SYSTEM)

(a) Perform step 1.



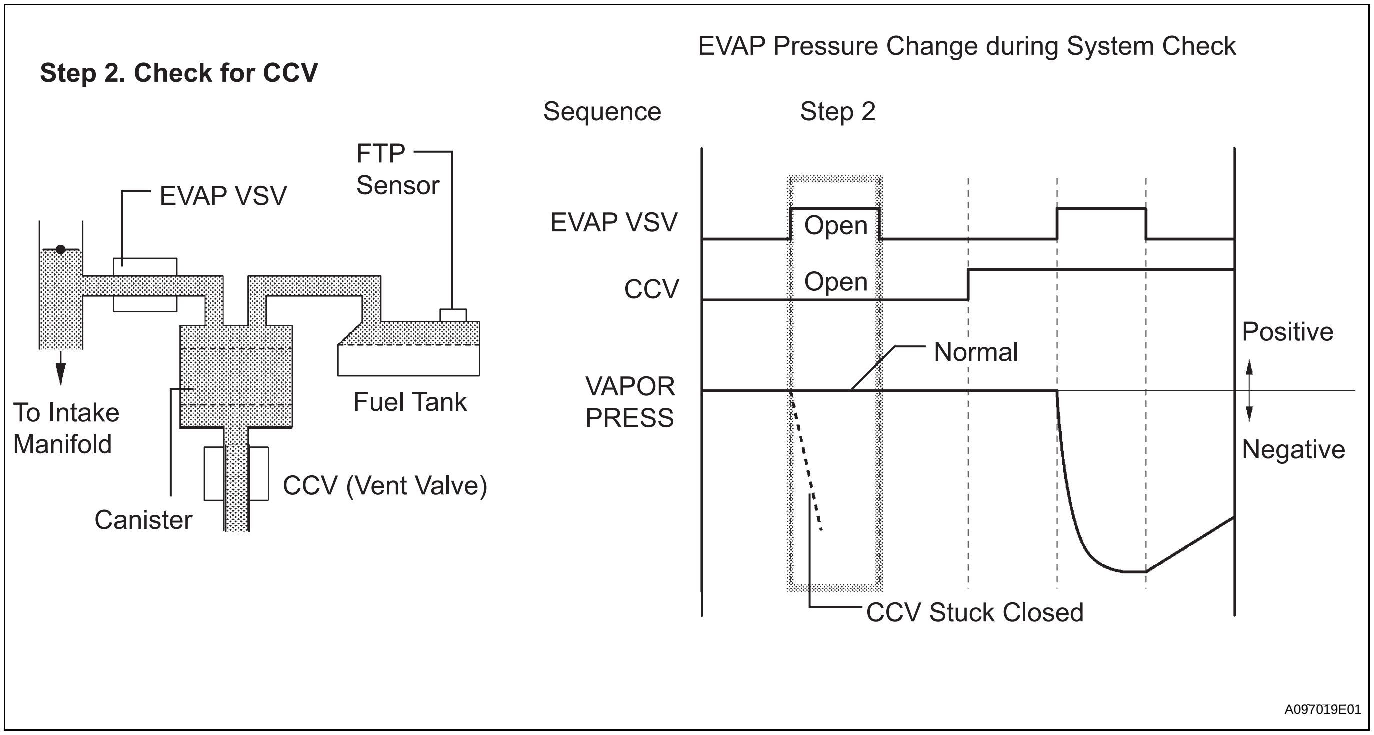


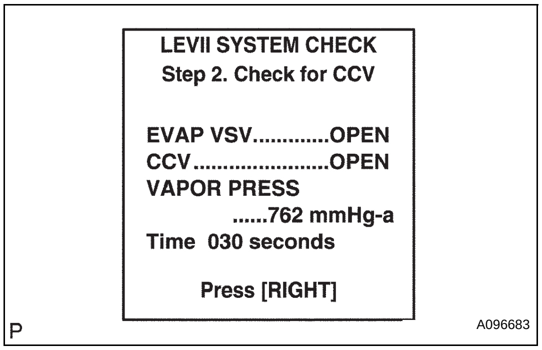
(b) Wait for 30 seconds.

NEXT

6	PERFORM EVAP SYSTEM CHECK STEP 2 (CHECK FOR CCV)

(a) Press RIGHT to go to step 2.





(b) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).

Result

VAPOR PRESS	Conclusion	Proceed to
Higher than 752 mmHg-a (-10 mmHg-g)	Trouble area has not been found yet.	OK
Lower than 752 mmHg-a (-10 mmHg-g)	Following problems are suspected: • Air inlet line restriction • Canister filter restriction • CCV (vent valve) stuck closed	NG

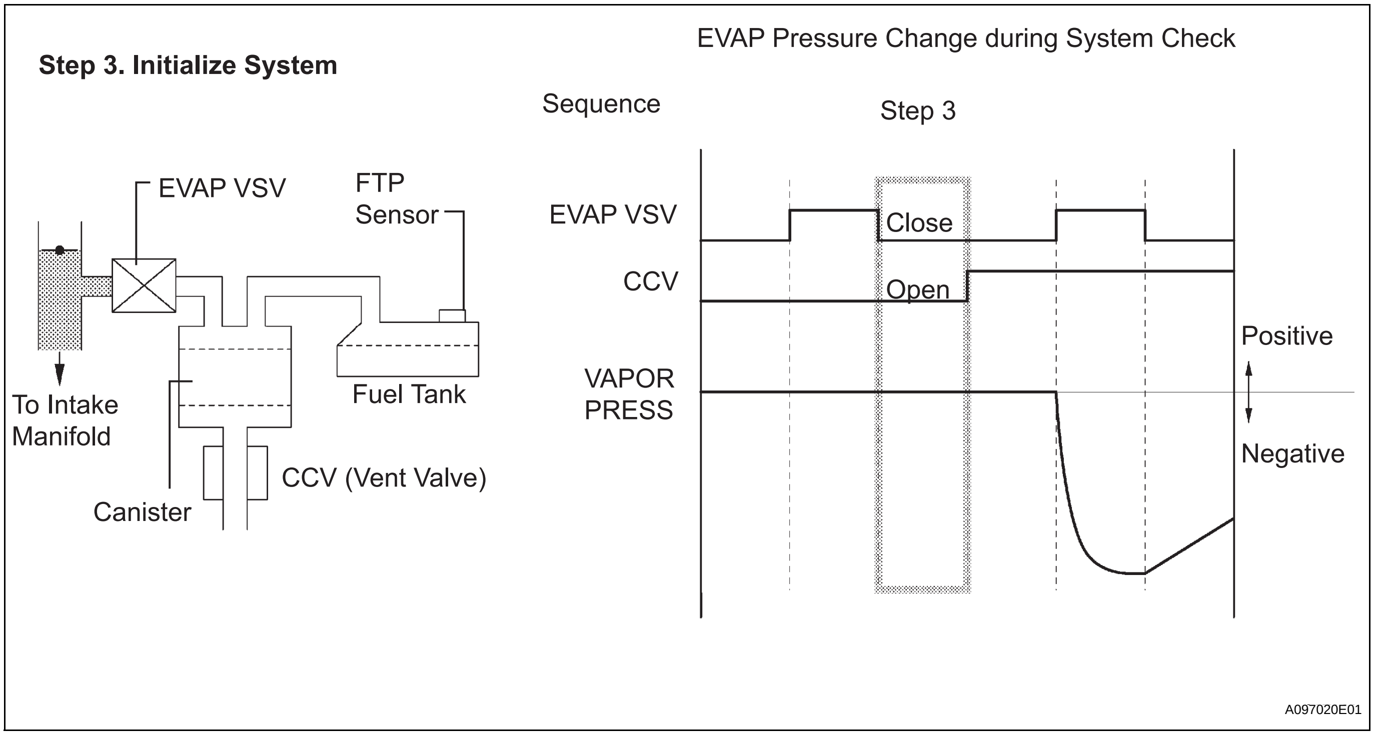
HINT:
In this step, the intake manifold pressure (vacuum) is applied to the EVAP system. However, the fuel tank pressure does not drop due to the CCV (vent valve) open.

NG → **Go to step 11**

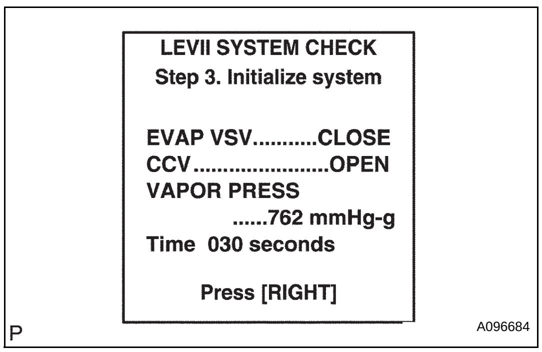
OK

7 PERFORM EVAP SYSTEM CHECK STEP 3 (INITIALIZE SYSTEM)

(a) Press RIGHT to go to step 3.



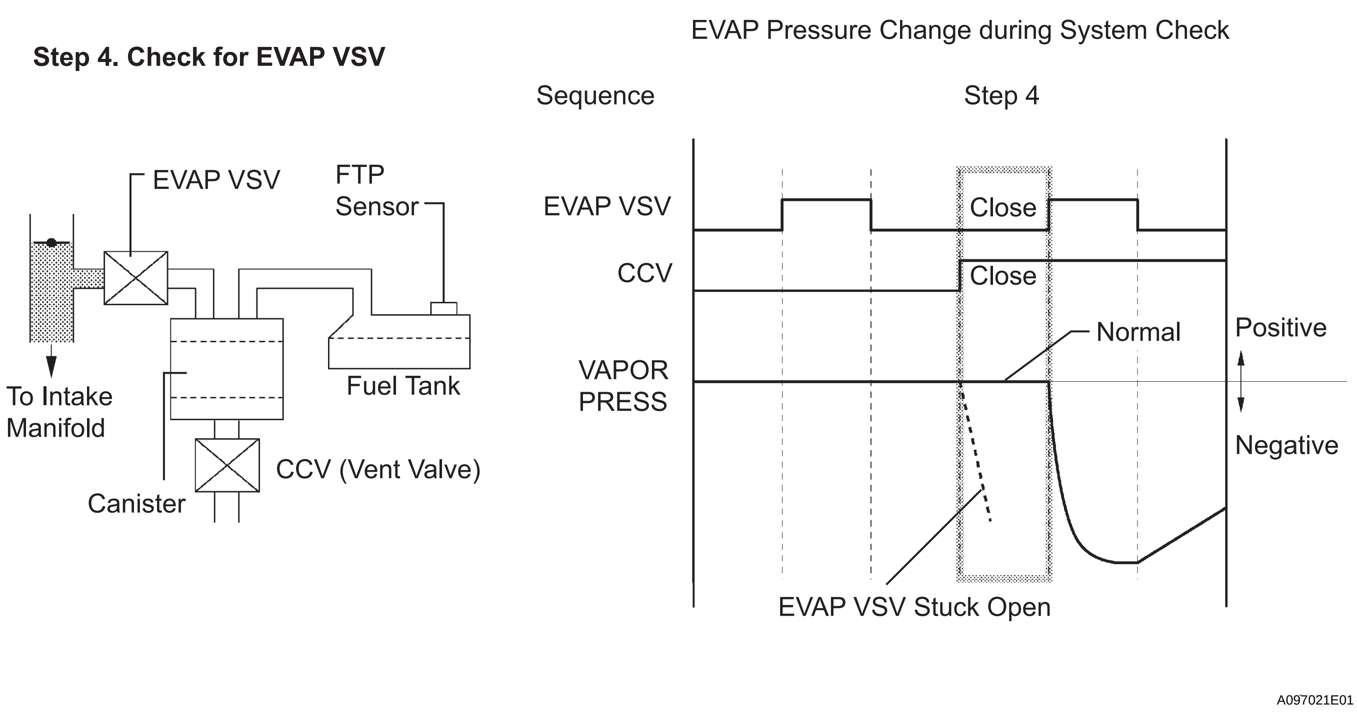
(b) Wait for 30 seconds.

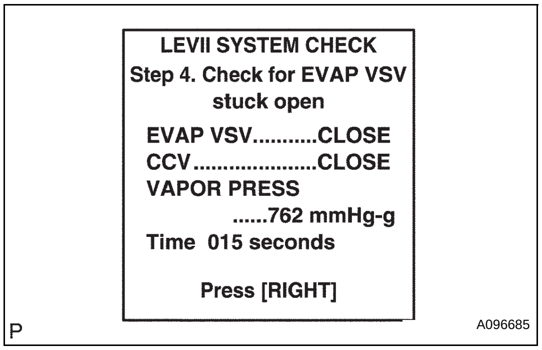


NEXT

8	PERFORM EVAP SYSTEM CHECK STEP 4 (CHECK FOR EVAP VSV STUCK OPEN)

(a) Press RIGHT to go to step 4.





(b) Wait for 15 seconds and check VAPOR PRESS (EVAP pressure).

Result

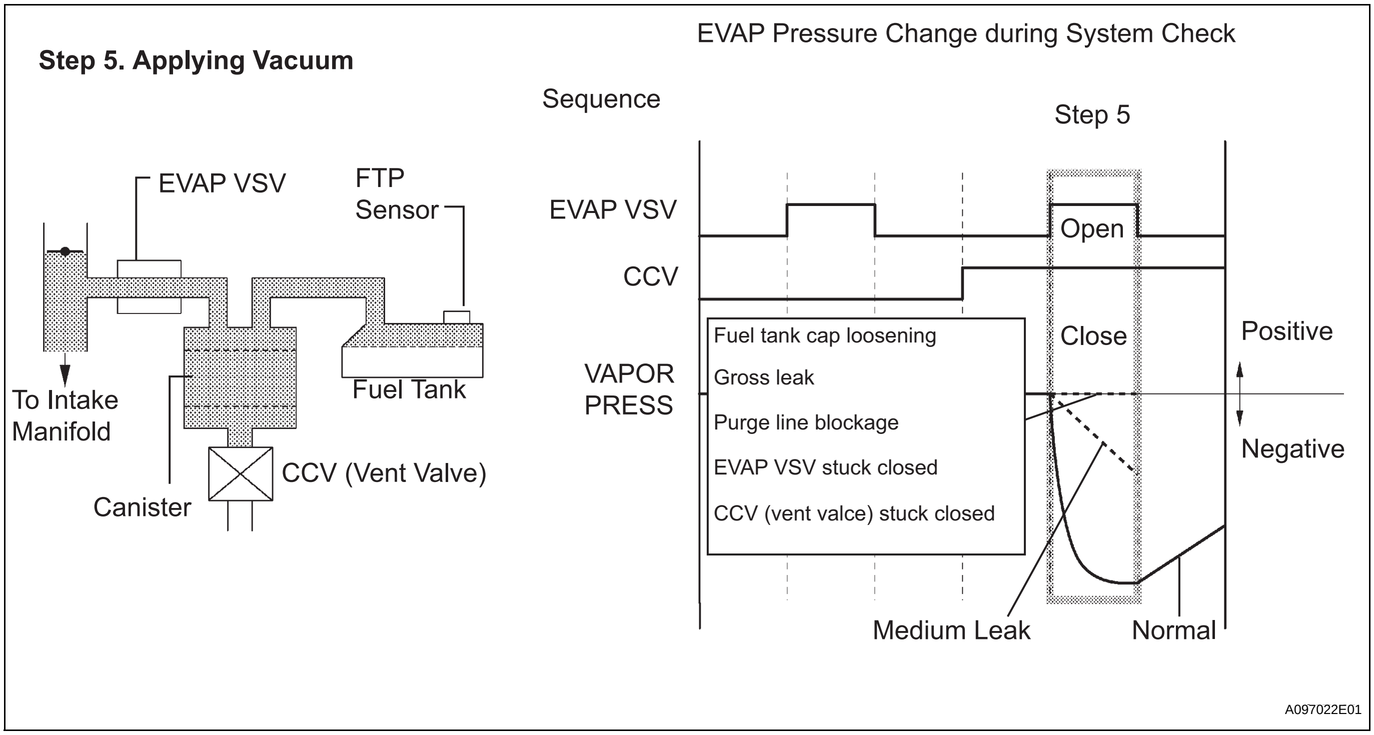
VAPOR PRESS	Conclusion	Proceed to
Higher than 758 mmHg-a (-4 mmHg-g)	Trouble area has not been found yet	OK
Lower than 758 mmHg-a (-4 mmHg-g)	EVAP VSV stuck open	NG

NG → **Go to step 14**

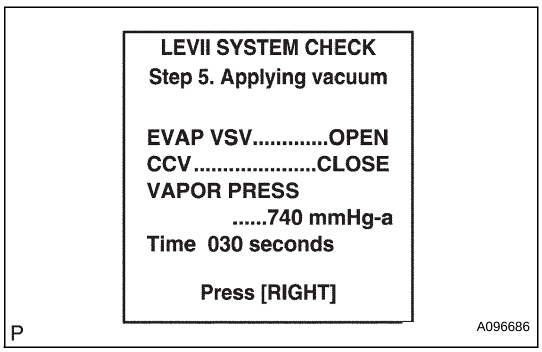
OK

9 PERFORM EVAP SYSTEM CHECK STEP 5 (APPLYING VACUUM)

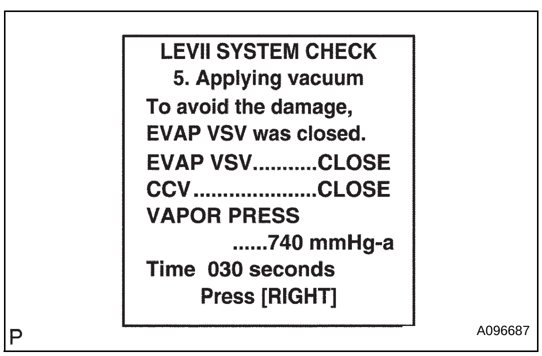
(a) Press RIGHT to go to step 5.



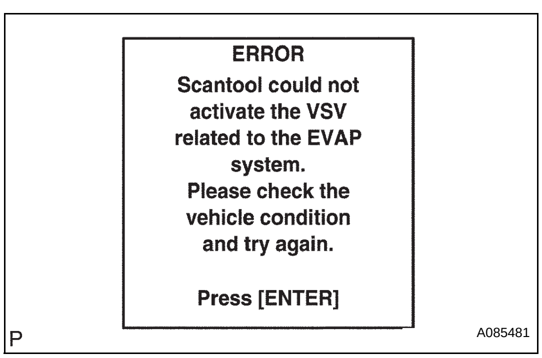
(b) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).



- If the pressure is lower than 740 mmHg-a (-22 mmHg-g), the intelligent tester closes the EVAP VSV.



- If the pressure is lower than 735 mmHg-a (-27 mmHg-g), the intelligent tester cancels the EVAP system check.



Result

VAPOR PRESS	Conclusion	Proceed to
Lower than 748 mmHg-a (-14 mmHg-g)	Trouble area has not been found yet.	A

VAPOR PRESS	Conclusion	Proceed to
756 to 768 mmHg-a (-6 to 6 mmHg-g)	Following problems are suspected: • Fuel tank cap loosening • Gross leak • ?EVAP VSV stuck closed • CCV (vent valve) stuck open • Purge line blockage between fuel tank and canister	B
748 to 755 mmHg-a (-14 to -7 mmHg-g)	Medium leak	C

B → **Go to step 15**

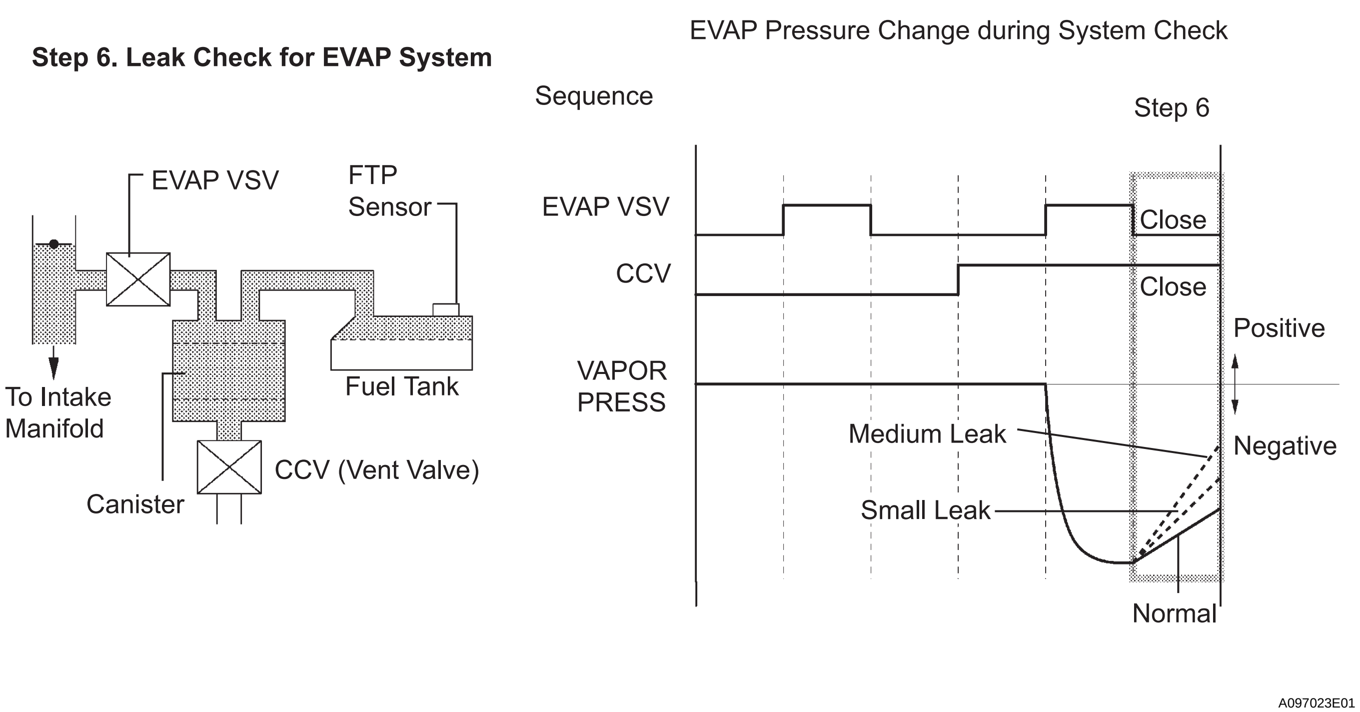
C → **Go to step 18**

A

ES

10 PERFORM EVAP SYSTEM CHECK STEP 6 (LEAK CHECK FOR EVAP SYSTEM)

(a) Press RIGHT to go to step 6 when the VAPOR PRESS (EVAP pressure) is lower than 742 mmHg-a (-20 mmHg-g).



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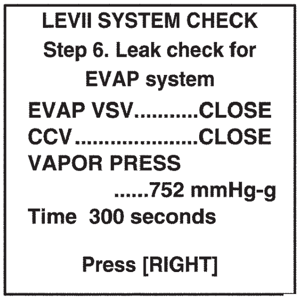

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(b) Wait for 300 seconds and check VAPOR PRESS (EVAP pressure).

Result

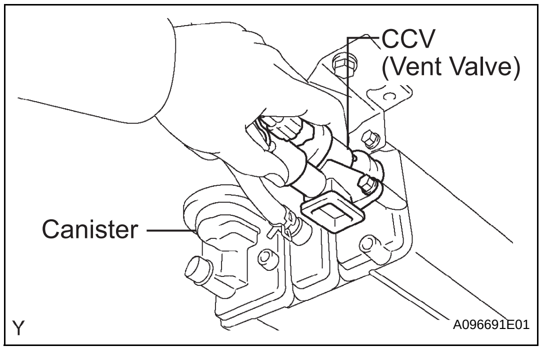
VAPOR PRESS	Conclusion	Proceed to
Less than 758 mmHg-a (-4 mmHg-g)	EVAP system is functioning normally	OK
Higher than 758 mmHg-a (-4 mmHg-g)	Leakage	NG

NG → **Go to step 18**

OK

GO TO STEP 40

11	CHECK CCV



(a) Turn the ignition switch OFF.
(b) Turn the ignition switch ON.
(c) Switch the CCV (vent valve) using the intelligent tester. Select the intelligentd tester menus: DIAGNOSIS, ENHANCED OBD Ⅱ, ACTIVE TEST and CAN CTRL VSV.
(d) Touch the CCV and check the operation during switching the CCV.

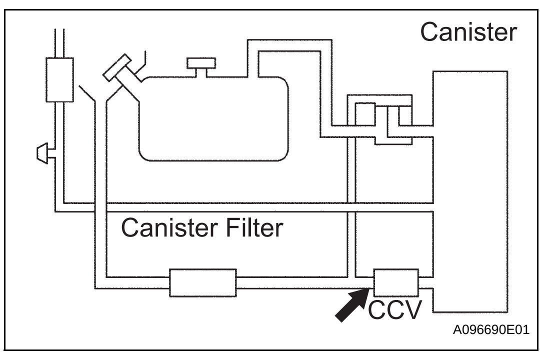
Result

CCV (Vent Valve)	Conclusion	Proceed to
CCV is operated	CCV is functioning normally.	OK
CCV is not operated	CCV is malfunctioning.	NG

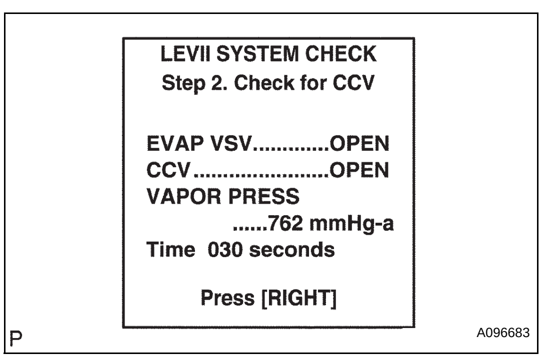
NG → **Go to step 25**

OK

12	CHECK AIR INLET LINE RESTRICTION



(a) Disconnect the air inlet line from the CCV.
(b) Remove and reinstall the fuel tank cap to release the fuel tank pressure.
(c) Allow the engine to idle.



(d) Perform step 2 of the EVAP system check.
(e) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).

Result

VAPOR PRESS	Conclusion	Proceed to
Higher than 752 mmHg-a (-10 mmHg-g)	Blockage in canister filter	A
Lower than 752 mmHg-a (-10 mmHg-g)	Blockage in CCV (vent valve) or canister	B

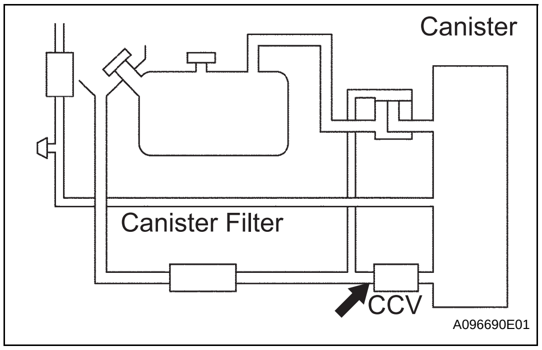
(f) Reconnect the air inlet line to the CCV.

B → **Go to step 13**

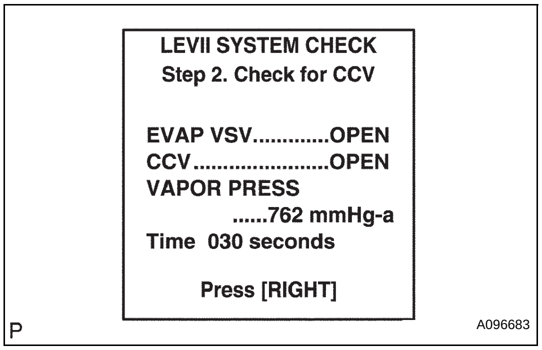
A

REPLACE CANISTER FILTER

13 CHECK CANISTER BLOCKAGE



(a) Turn the ignition switch OFF.
(b) Remove the CCV from the canister.
(c) Remove and reinstall the fuel tank cap to release the fuel tank pressure.
(d) Allow the engine to idle.



(e) Perform step 2 of the EVAP system check.
(f) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).

Result

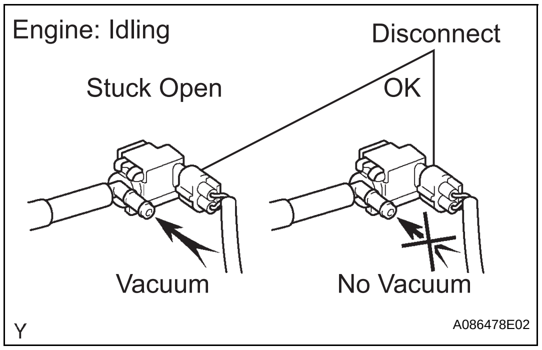
VAPOR PRESS	Conclusion	Proceed to
Higher than 752 mmHg-a (-10 mmHg-g)	CCV (vent valve) stuck closed	A
Lower than 752 mmHg-a (-10 mmHg-g)	Blockage in canister	B

B → **CHECK AND REPLACE CHARCOAL CANISTER ASSEMBLY**

A

REPLACE CCV (VENT VALVE)

14 CHECK EVAP VSV (FOR EVAP VSV STUCK OPEN)



(a) Turn the ignition switch OFF.
(b) Disconnect the purge hose of the canister from the EVAP VSV.
(c) Disconnect the EVAP VSV connector.
(d) Allow the engine to idle.
(e) Touch the EVAP VSV port to check the vacuum.

Result

EVAP VSV	Conclusion	Proceed to
Vacuum is applied.	EVAP VSV is malfunctioning.	A
No vacuum is applied.	Electrical circuit of EVAP VSV is malfunctioning.	B

B → Go to step 29

A

REPLACE EVAP VSV

15 CHECK FUEL TANK CAP ASSEMBLY

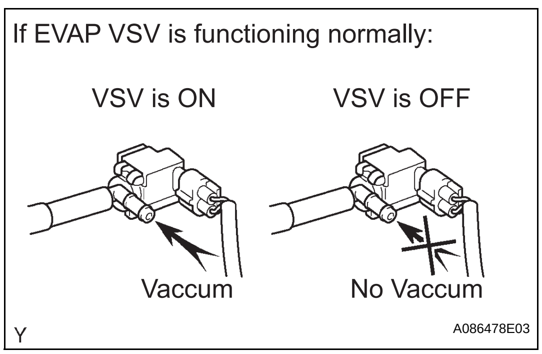
(a) Remove the fuel tank cap and reinstall it until a few click sound is heard.
(b) Clear the DTCs.
(c) Check pending DTCs after the EVAP system check If no pending DTC is set, the DTC(s) was set due to the fuel cap loosening.
If necessary, replace the fuel cap.

NG → Go to step 16

OK

REPAIR IS COMPLETE

16 CHECK EVAP VSV (FOR EVAP VSV STUCK CLOSED)



(a) Disconnect the purge hose of the canister from the EVAP VSV.
(b) Allow the engine to idle.
(c) Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV.
(d) Touch the EVAP VSV port to check the vacuum.
Result

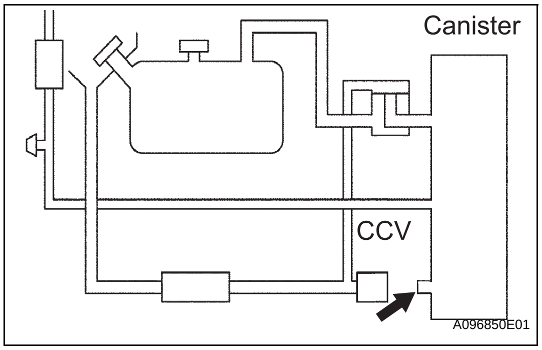
EVAP VSV	Conclusion	Proceed to
Vacuum is applied when EVAP VSV is ON. No vacuum is applied when EVAP VSV is OFF.	EVAP VSV is functioning normally.	OK
No vacuum is applied when EVAP VSV is ON.	Electrical circuit of EVAP VSV is malfunctioning.	NG

HINT:
The EVAP VSV can be tested with the EVAP Test Equipment (go to step 39).

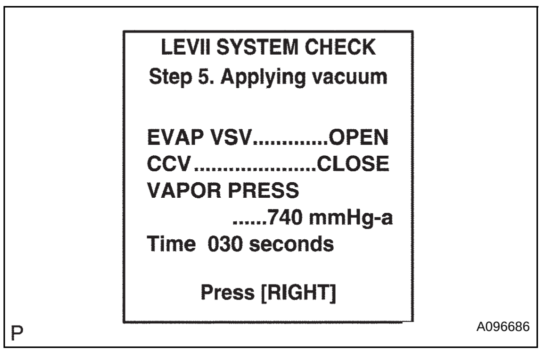
NG → Go to step 31

OK

17	CHECK CCV (FOR CCV STUCK OPEN)



(a) Turn the ignition switch OFF.
(b) Remove the CCV (vent valve) and plug the canister.
(c) Allow the engine to idle.



(d) Apply vacuum to the EVAP system with the EVAP system check. Perform step 5 "Applying Vacuum".
(e) Wait for 30 seconds and check the VAPOR PRESS (EVAP pressure).

Result

VAPOR PRESS	Conclusion	Proceed to
Lower than 747 mmHg-a (-15 mmHg-g)	CCV (vent valve) stuck open	A
Higher than 747 mmHg-a (-15 mmHg-g)	Blockage in canister Blockage in purge line (Fuel tank - Canister) Blockage in purge line (Fuel tank - EVAP VSV)	B

ES

B → Go to step 20

A

GO TO STEP 24

18	CHECK FUEL TANK CAP ASSEMBLY

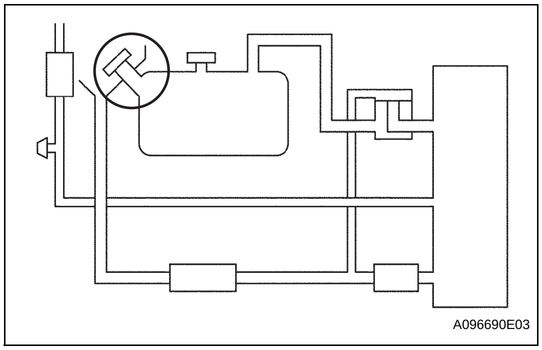
(a) Remove the fuel tank cap and reinstall it until a few click sound is heard.
(b) Clear the DTCs.
(c) Check pending DTCs after the EVAP system check If no pending DTC is set, the DTC(s) was set due to the fuel cap loosening.
If necessary, replace the fuel cap.

NG → Go to step 19

OK

REPAIR IS COMPLETE

19	CHECK FILLER NECK DAMAGE

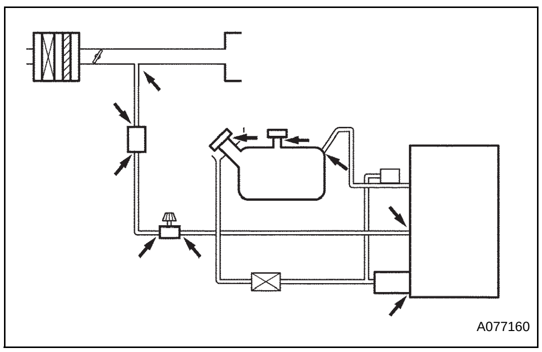


(a) Remove the fuel tank cap.
(b) Visually inspect the filler neck for damage.
(c) Reinstall the fuel tank cap.
HINT:
A leak point may be found with the EVAP Test Equipment (go to step 36).

NG → **REPLACE FUEL TANK INLET PIPE SUB-ASSEMBLY**

OK

20	CHECK PURGE LINE (CANISTER - FUEL TANK)



(a) Check that the pipes and hoses are connected correctly.
(b) Check that the pipes and hoses are not loose or disconnected.
(c) Check the pipes and hoses have no damage or blockage.

NG → **REPLACE PURGE HOSE**

OK

21	CHECK PURGE LINE (CANISTER - EVAP VSV)

(a) Check that the pipes and hoses are connected correctly.
(b) Check that the pipes and hoses are not loose or disconnected.
(c) Check the pipes and hoses have no damage or blockage.

B → **REPLACE PURGE HOSE**

OK

22	INSPECT CANISTER

NG → **REPLACE CANISTER**

OK

23	INSPECT FUEL TANK ASSEMBLY

(a) Check that the fuel tank has no damage.
(b) Check the fuel inlet pipe has no damage.
(c) Check leakage from the fuel pump unit

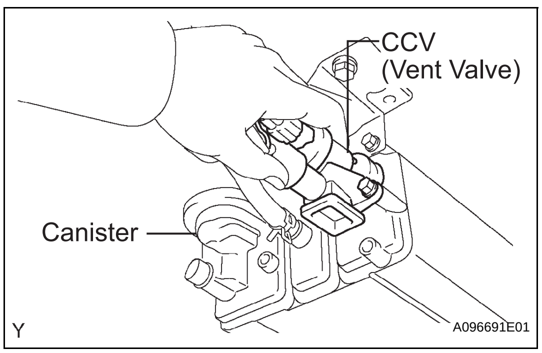
NG → **REPAIR OR REPLACE DEFFECTIVE OR DAMAGED PARTS**

OK

GO TO STEP 40

ES

24	CHECK CCV



(a) Stop the engine and turn the ignition switch ON.
(b) Switch the CCV (vent valve) using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD Ⅱ, ACTIVE TEST and CAN CTRL VSV.
(c) Touch the CCV and check the operation during switching the CCV.

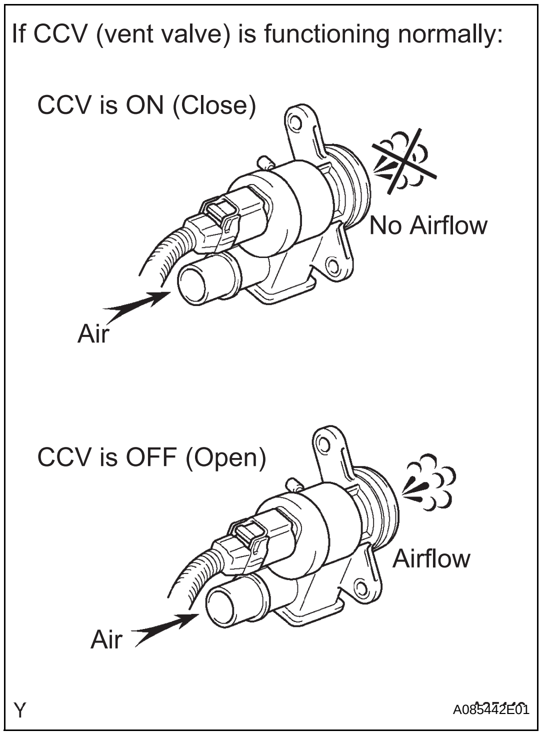
Result

CCV (Vent Valve)	Conclusion	Proceed to
CCV is operated	Electrical circuit of CCV is functioning normally.	A
CCV is not operated	Electrical circuit of CCV is malfunctioning.	B

B → **Go to step 26**

A

25 CHECK CCV



(a) Turn the ignition switch OFF.
(b) Remove the CCV (vent valve).
(c) Connect the CCV connector.
(d) Turn the ignition switch ON.
(e) Switch the CCV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
(f) Apply air to the CCV port using an air gun and check the airflow.

Result

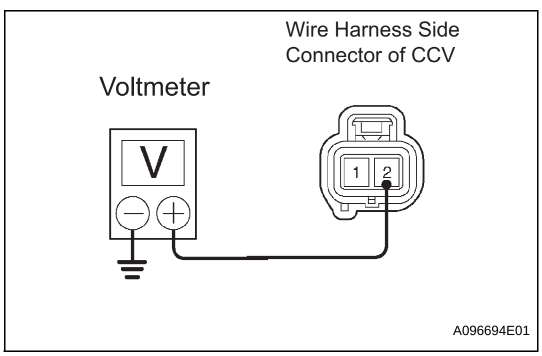
CCV (Vent Valve)	Conclusion	Proceed to
Air flows when CCV is OFF (open). Air does not flows when CCV is ON (close).	**CCV is functioning normally. Electrical circuit of CCV is malfunctioning.**	**A**
Air flows when CCV is ON (close). Air does not flows when CCV is OFF (open).	**CCV is malfunctioning.**	**B**

B → **REPLACE CCV**

A

ES

26 CHECK WIRE HARNESS (CCV - POWER SOURCE)



(a) Turn the ignition switch OFF.
(b) Disconnect the CCV connector.
(c) Turn the ignition switch ON.
(d) Measure the voltage between terminal 2 of the wire harness side connector and body ground.

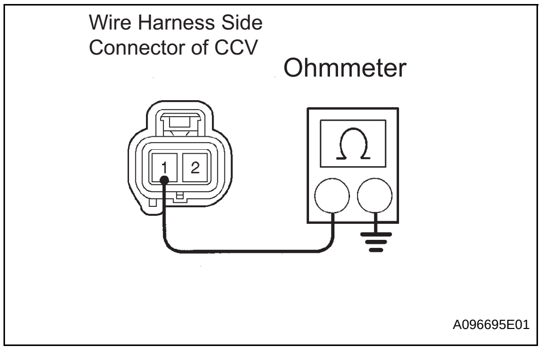
Result

Voltage	Conclusion	Proceed to
Battery voltage	**Wire harness (CCV - Power source) is OK.**	**OK**
0 to 3 V	**Wire harness (CCV - Power source) is short circuit.**	**NG**

B → **REPAIR OR REPLACE WIRE HARNESS**

OK

27	CORRECTLY REINSTALL OR REPLACE WIRE HARNESS (CCV - ECM)



(a) Switch the CCV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
(b) Measure the resistance between terminal 1 of the wire harness side connector and body ground.

Result

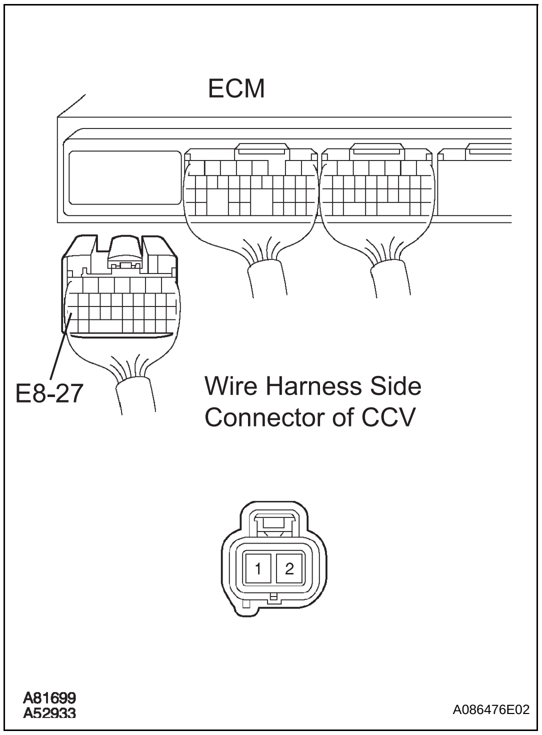
Resistance	Conclusion	Proceed to
More than 10 kΩ when CCV is OFF. Less than 10 Ω when CCV is ON.	ECM and wire harness (CCV - ECM) are OK. CCV is malfunctioning.	OK
No change	Either of wire harness (CCV - ECM) or ECM is malfunctioning.	NG

NG → Go to step 28

OK

REPLACE CCV

28	CHECK WIRE HARNESS (CCV - ECM)



(a) Check the wire harness between the ECM and CCV.
(b) Turn the ignition switch OFF.
(c) Disconnect the E8 ECM connector.
(d) Measure the resistance between the CCV and ECM wire harness side connectors.

Resistance

Tester Connection	Specified Condition
1 (CCV) - E8-27 (ECM)	Less than 10 Ω
1 (CCV) - Body ground	More than 10 kΩ

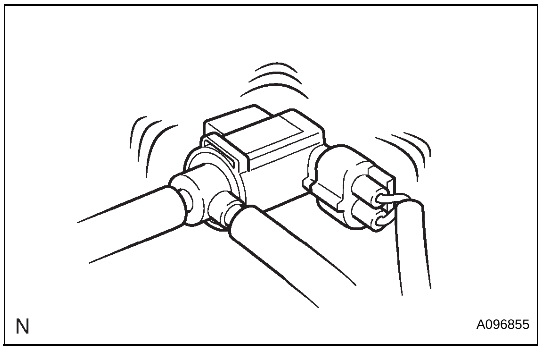
NG → REPAIR OR REPLACE WIRE HARNESS

OK

CHECK AND REPLACE ECM

ES

29	CHECK EVAP VSV



(a) Turn the ignition switch ON.
(b) Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV (Alone).
(c) Listen to click sounds to check the EVAP VSV operation.

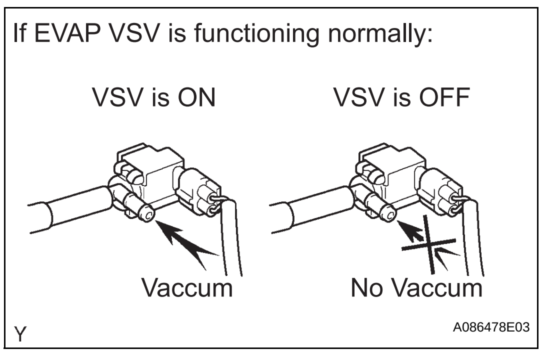
Result

EVAP VSV	Conclusion	Proceed to
Operated	Electrical circuit of EVAP VSV is functioning normally.	OK
Not operated	Electrical circuit of EVAP VSV is malfunctioning.	NG

NG → Go to step 32

OK

30	CHECK EVAP VSV



(a) Disconnect the purge hose of the canister from the EVAP VSV.
(b) Start the engine.
(c) Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV.
(d) Touch the EVAP VSV port to check the vacuum.

Result

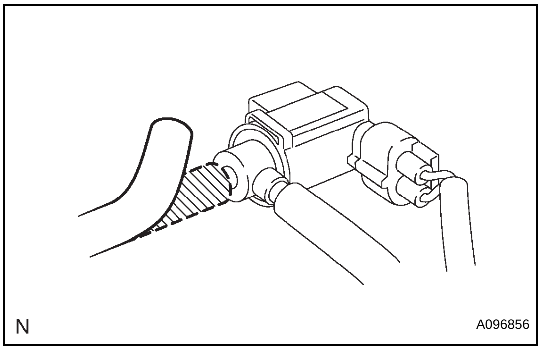
EVAP VSV	Conclusion	Proceed to
Vacuum is applied when EVAP VSV is ON. No vacuum is applied when EVAP VSV is OFF.	EVAP VSV is functioning normally.	OK
No vacuum is applied when EVAP VSV is ON.	Electrical circuit of EVAP VSV is malfunctioning.	NG

HINT:
The EVAP VSV can be tested with the EVAP Test Equipment (go to step 39).

NG → Go to step 32

OK

31 CHECK HARNESS AND CONNECTOR (EVAP VSV - THROTTLE BODY)



(a) Check that the vacuum hoses are connected correctly.
(b) Check that the vacuum hoses are not loose or disconnected.
(c) Check the vacuum hoses and tubes for cracks, holes, damage, or blockage.

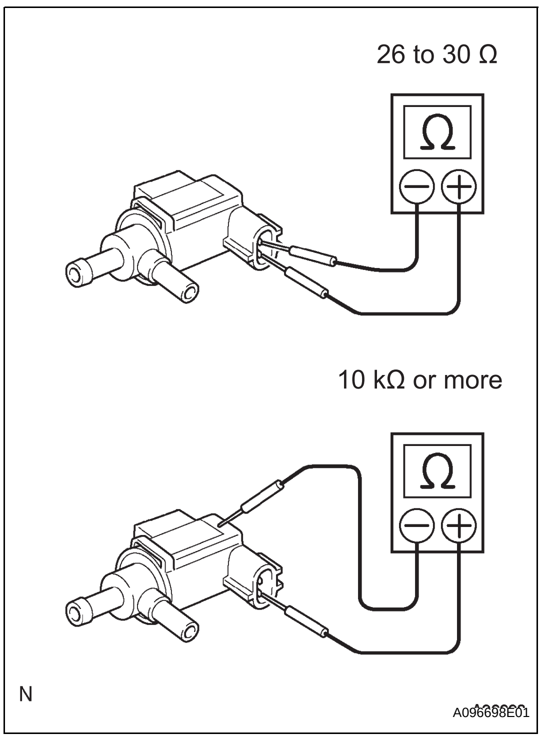
NG → **REPLACE PURGE HOSE**

OK

REPLACE EVAP VSV

ES

32 INSPECT EVAP VSV



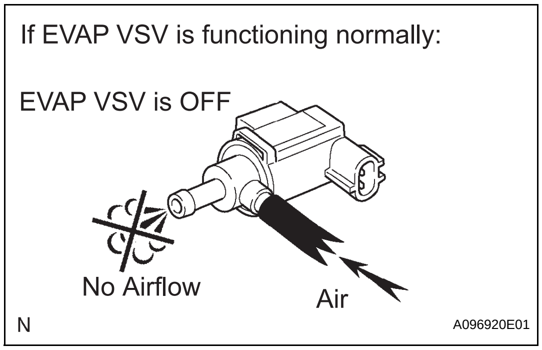
(a) Turn the ignition switch OFF.
(b) Disconnect the EVAP VSV connector.
(c) Measure the resistance of the EVAP VSV.
Resistance

Tester Connection	Specified Condition
Between terminals	26 to 30 Ω at 20°C (68°F)
Each terminal - Body ground	10 kΩ or more

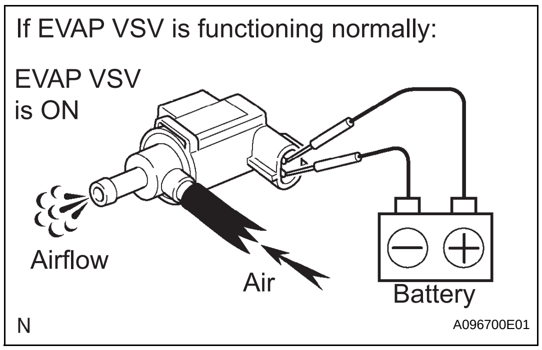
NG → **REPLACE EVAP VSV**

OK

33 INSPECT EVAP VSV



(a) Remove the EVAP VSV.
(b) Apply air to the EVAP VSV using an air gun, check the airflow.



(c) Apply battery positive voltage across the terminals.
(d) Apply air to the EVAP VSV using an air gun, check the airflow.

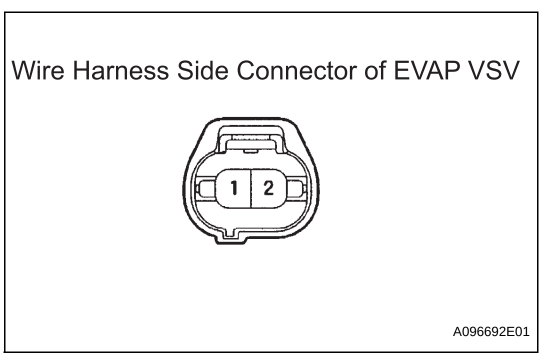
Result

EVAP VSV	Conclusion	Proceed to
Air does not flow when EVAP VSV is OFF. Air flows when EVAP VSV is ON.	EVAP VSV is functioning normally.	OK
Air flows when EVAP VSV is OFF. Air does not flow when EVAP VSV is ON.	Electrical circuit of EVAP VSV is malfunctioning.	NG

NG → **REPLACE EVAP VSV**

OK

34 CHECK WIRE HARNESS (EVAP VSV - POWER SOURCE)



(a) Turn the ignition switch ON.
(b) Measure the voltage between the terminal 1 of the wire harness side and body ground.

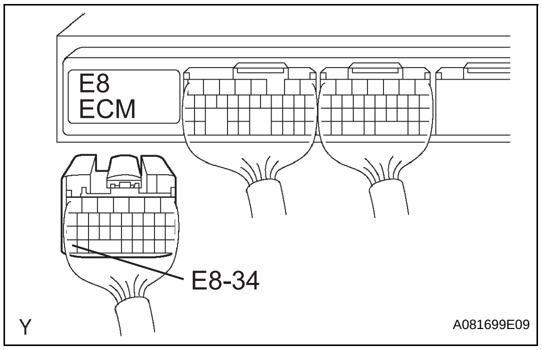
Result

Voltage	Conclusion	Proceed to
Battery voltage	Wire harness (EVAP VSV - Power source) is OK.	OK
0 to 3 V	Wire harness (EVAP VSV - Power source) is short circuit.	NG

NG → **REPAIR OR REPLACE WIRE HARNESS**

OK

35 CHECK WIRE HARNESS (EVAP VSV - ECM)



(a) Turn the ignition switch OFF.
(b) Disconnect the E8 ECM connector.
(c) Turn the ignition switch ON.
(d) Measure the voltage between the terminal 34 of the wire harness side and body ground.

Result

Voltage	Conclusion	Proceed to
Battery voltage	Wire harness (EVAP VSV - ECM) is OK.	OK
0 to 3 V	Wire harness (EVAP VSV - ECM) is short circuit.	NG

NG → **REPAIR OR REPLACE WIRE HARNESS**

ES

OK

CHECK AND REPLACE ECM

36 CHECK FUEL TANK CAP ASSEMBLY

(a) Connect the fuel tank cap to the gas cap adaptor.
(b) Connect the pressure hose from the pump to the gas cap adaptor.
(c) Plug the gas cap adaptor port.
(d) Turn the pump ON and pressurize the gas cap adaptor by 24 - 28 mmHg. If the pressure does not reach to 24 mmHg within 45 seconds, stop the pump. The fuel tank cap is malfunctioning.
(e) Turn the pump OFF and seal the pressure line to maintain the pressure.
(f) Measure the pressure change for 2 minutes. If the pressure drops to lower than 15 mmHg, the fuel tank cap is malfunctioning.

Standard:
The fuel tank cap keeps the pressure that is 15 mmHg or higher.

NG → **REPLACE FUEL TANK CAP ASSEMBLY**

OK

37 CHECK LEAK

NOTICE:
DO NOT apply the EVAP system to the pressure that is higher than 35 mmHg. The EVAP system will be damaged.

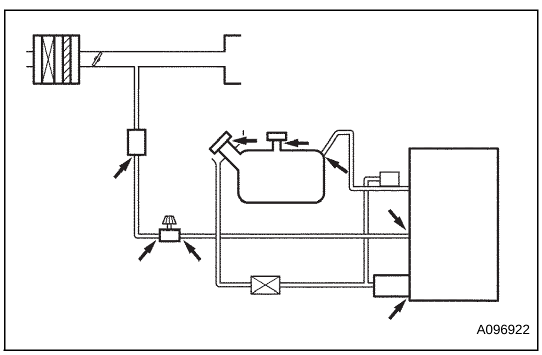
(a) Connect the pressure line from the pump to the EVAP service port.
(b) Turn the ignition switch ON but the engine is not running.
(c) Turn the CCV (vent valve) is ON (close) using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD Ⅱ, ACTIVE TEST and CAN CTRL VSV.
(d) Turn the pump ON and pressurize the EVAP system by 24 - 28 mmHg.
(e) Turn the pump OFF and seal the pressure line to maintain the pressure. If the pressure does not reach to 24 mmHg within 45 seconds, stop the pump. A leakage is in the EVAP system. If the system has a small leak, a whistling sound may be heard.
(f) Measure the pressure change for 2 minutes. If the pressure drops to lower than 15 mmHg, a leakage is in the EVAP system.
Standard:
The EVAP system keeps the pressure that is 15 mmHg or higher.

NG → **Go to step 38**

OK

NO LEAKAGE IN EVAP SYSTEM

38	LOOK FOR LEAK POINT



(a) Apply the soapy water on suspected components.
(b) Turn the CCV (vent valve) is ON (close) using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD Ⅱ, ACTIVE TEST and CAN CTRL VSV.
(c) Turn the pump ON and pressurize the EVAP system by 24 - 28 mmHg.
(d) Turn the pump OFF and seal the pressure line to maintain the pressure. If the pressure does not reach to 24 mmHg within 45 seconds, stop the pump.
(e) Check bubbles to find the leak point:
- EVAP service port
- Canister
- Hose connections/Lines
- Fuel cap
- Fuel filler neck
- Purge line
- EVAP VSV
- CCV (vent valve)
- Fuel pump sending unit

(f) Repair or replace the leak component.
(g) Perform the EVAP system check to confirm no leak.

NEXT

GO TO STEP 4

39 CHECK EVAP VSV

(a) Connect the vacuum gauge to the EVAP service port.
  (1) Start the engine.
  (2) Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV.
  (3) Check the vacuum when switching the EVAP VSV. If the vacuum gauge indicates negative value when the EVAP VSV is ON, the EVAP VSV is functioning normally.
  OK:
  The vacuum gauge indicates negative value when the EVAP VSV is ON.

NG → **Go to step 31**

OK

GO TO STEP 17

40 CHECK MONITOR STATUS AND DTC

(a) Clear DTCs.
(b) Perform a drive pattern test (See page ES-17)
(c) Check that the monitor result is PASS.
(d) Confirm no pending DTC.

NEXT

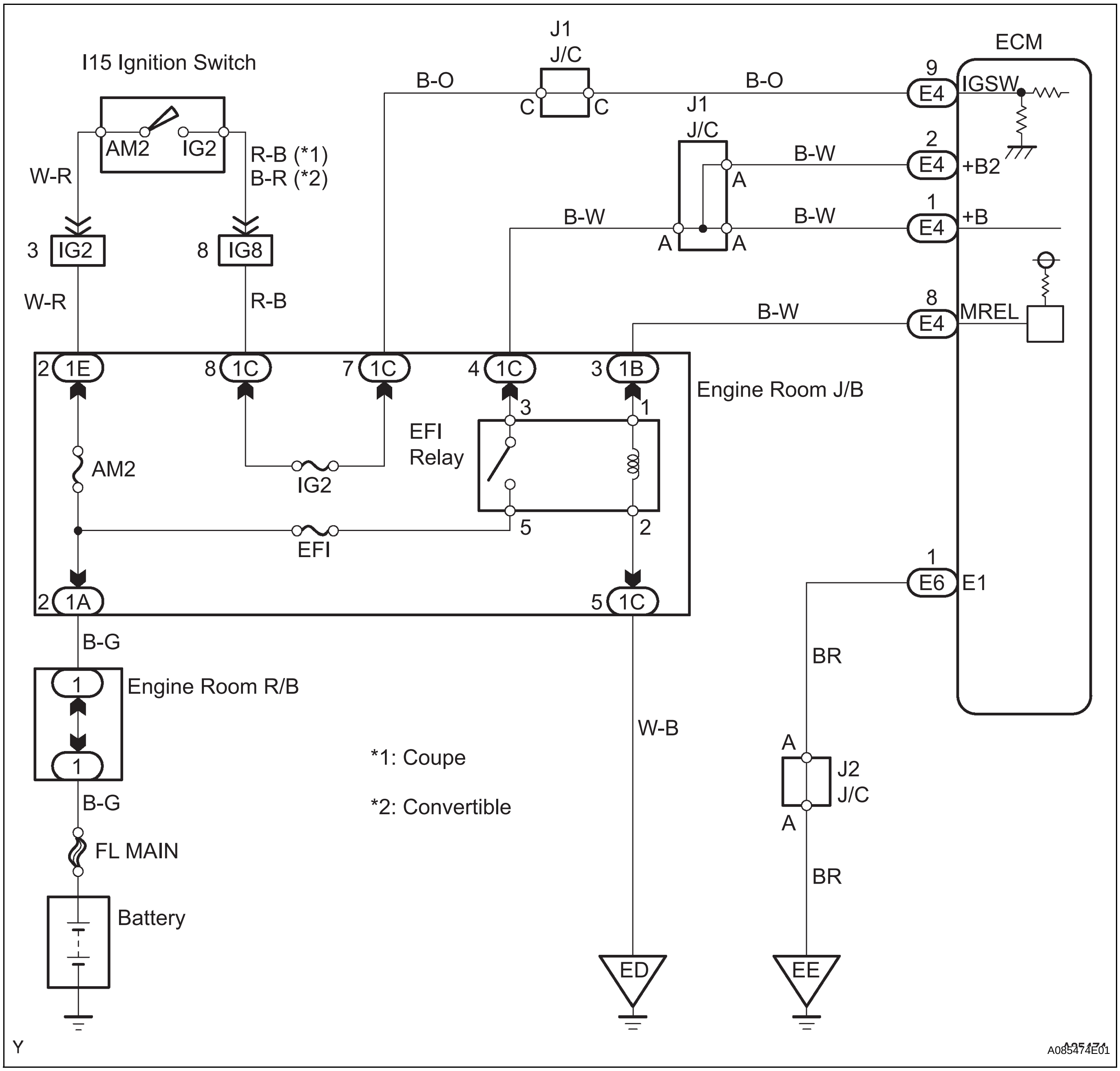
REPAIR IS COMPLETE

ECM Power Source Circuit

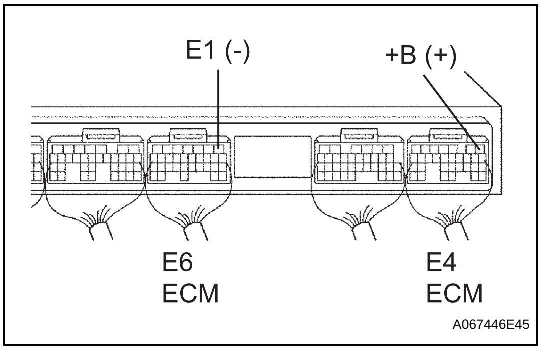
DESCRIPTION

When the ignition switch is turned ON, battery voltage is applied to terminal IGSW of the ECM. The ECM "MREL" output signal causes current to flow to the coil, closing the contacts of the EFI relay (marked: EFI) and supplying power to terminal +B of the ECM.
If the ignition switch is turned OFF, the ECM holds the EFI relay ON for a maximum of 2 seconds to allow the initial setting of the throttle valve.

WIRING DIAGRAM



1	INSPECT ECM (+B VOLTAGE)



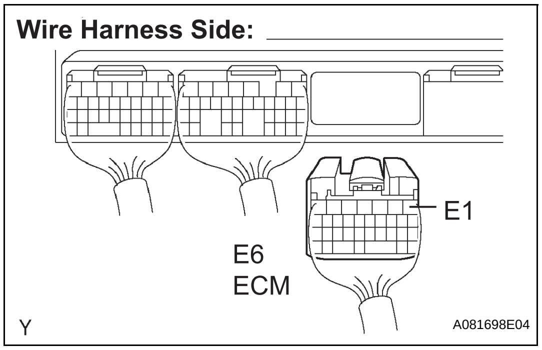
(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Specified Condition
E4-1 (+B) - E6-1 (E1)	9 to 14 V

OK → **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN ON PROBLEM SYMPTOMS TABLE**

NG

2	CHECK WIRE HARNESS (ECM - BODY GROUND)



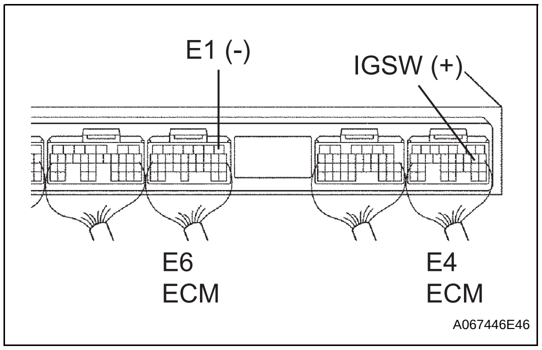
(a) Disconnect the E6 ECM connector.
(b) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
E6-1 (E1) - Body ground	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3	INSPECT ECM (IGSW VOLTAGE)



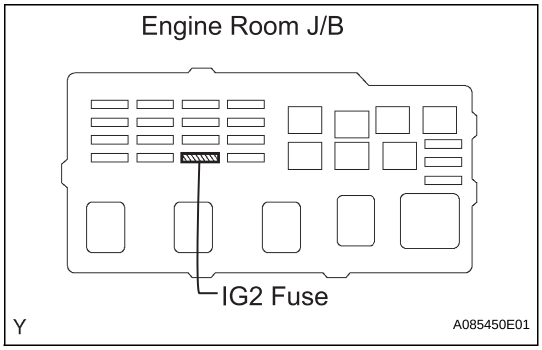
(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Specified Condition
E4-9 (IGSW) - E6-1 (E1)	9 to 14 V

OK → **Go to step 6**

NG

4	CHECK IG2 FUSE



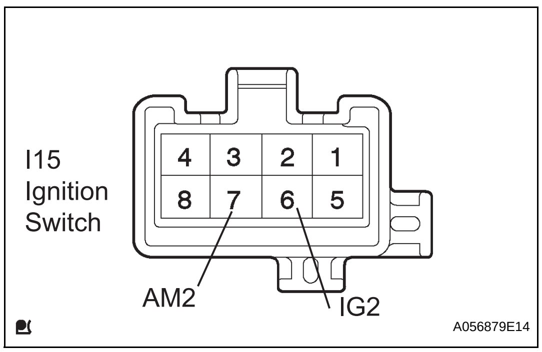
(a) Remove the IG2 fuse from the engine room J/B.
(b) Measure the resistance of the IG2 fuse.
Resistance:
Below 1 Ω

NG → **REPLACE FUSE**

ES

OK

5	INSPECT IGNITION OR STARTER SWITCH ASSEMBLY



(a) Measure the resistance of the switch terminals shown in the chart below.
Resistance

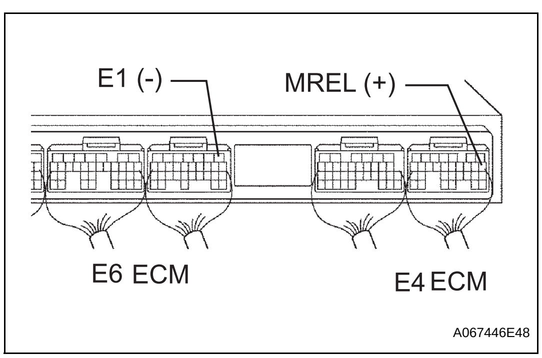
Tester Connection	Switch Condition	Specified Condition
6 (IG2) - 7 (AM2)	LOCK	10 kΩor higher
6 (IG2) - 7 (AM2)	ON	Below 1 Ω

NG → **REPLACE IGNITION OR STARTER SWITCH ASSEMBLY**

OK

CHECK AND REPLACE HARNESS AND CONNECTOR (IGNITION SWITCH ASSEMBLY - ECM)

6	INSPECT ECM (MREL VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Specified Condition
E4-8 (MREL) - E6-1 (E1)	9 to 14 V

NG → **REPLACE ECM**

OK

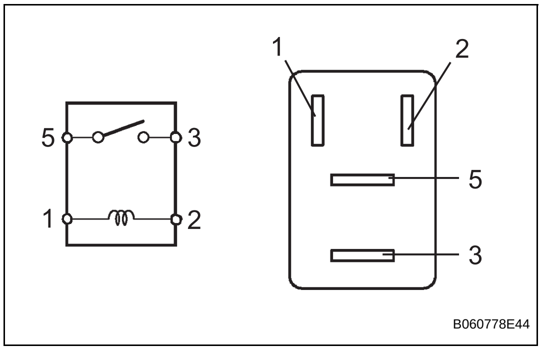
7	CHECK EFI FUSE

(a) Remove the EFI fuse from the engine room J/B.
(b) Measure the resistance of the EFI fuse.
Resistance:
Below 1 Ω

NG → **REPLACE FUSE**

OK

8	INSPECT EFI RELAY



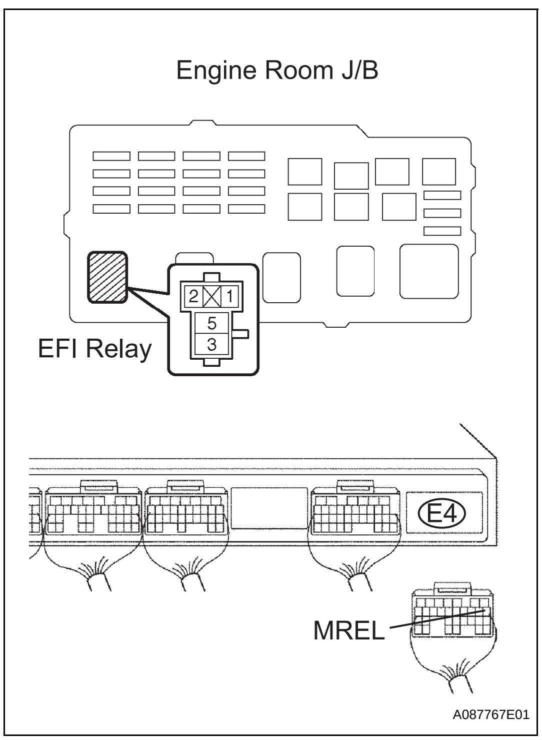
(a) Remove the EFI relay from the engine room J/B.
(b) Measure the resistance of the EFI relay.
Resistance

Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE RELAY**

OK

9	CHECK WIRE HARNESS (EFI RELAY- ECM, EFI RELAY - BODY GROUND)



(a) Check the wire harness between the EFI relay and ECM.
(1) Remove the EFI relay from the engine room J/B.
(2) Disconnect the E4 ECM connector.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
J/B EFI relay terminal 1 - E4-8 (MREL)	Below 1 Ω
J/B EFI relay terminal 1 or E4-8 (MREL) - Body ground	10 kΩ or higher

(b) Check the wire harness between the EFI relay and body ground.
(1) Remove the EFI relay from the engine room J/B.
(2) Measure the resistance between the wire harness side connector.
Resistance

Tester Connection	Specified Condition
J/B EFI relay terminal 2 - Body ground	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

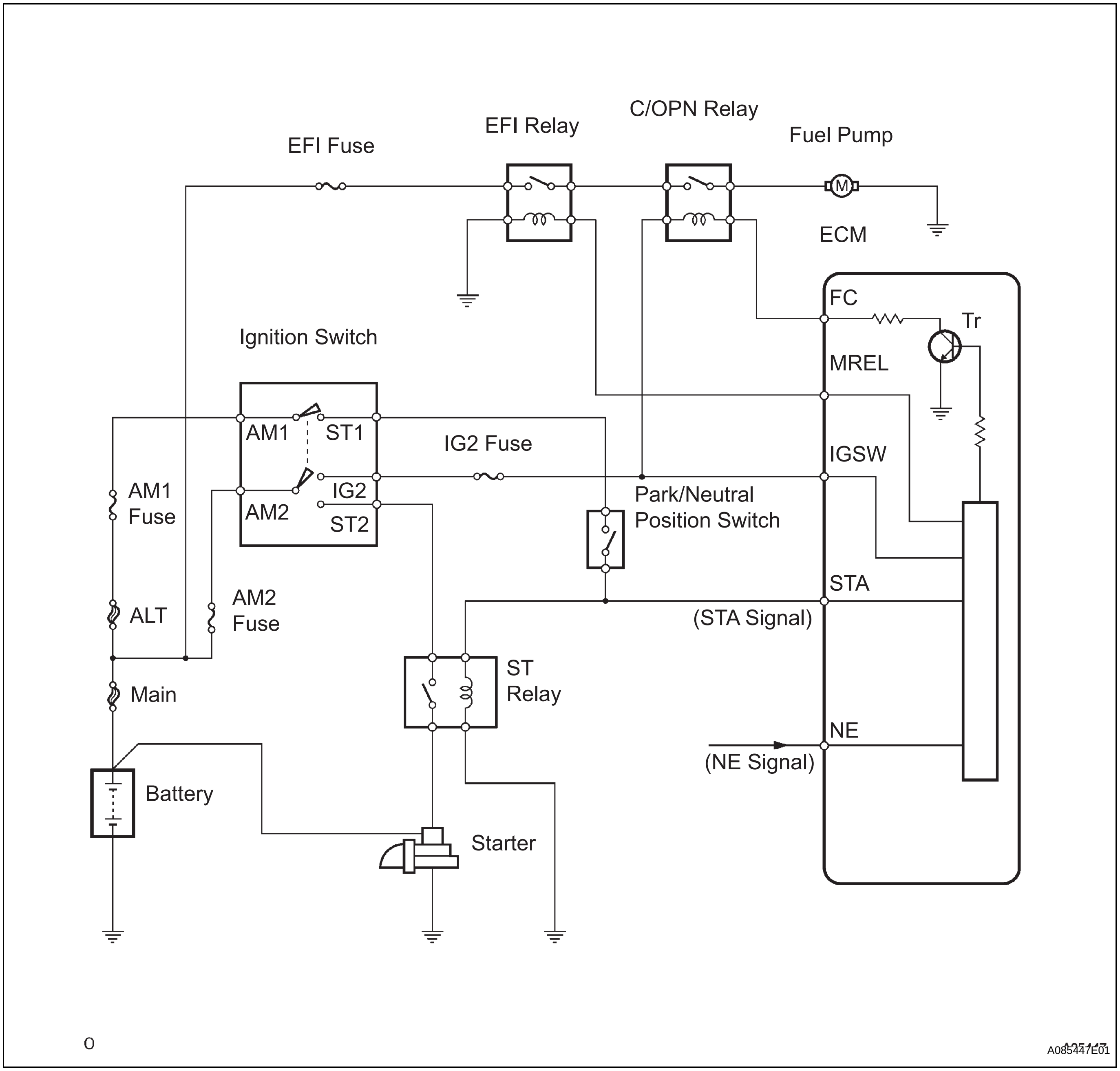
OK

CHECK AND REPAIR HARNESS AND CONNECTOR (TERMINAL +B OF ECM - BATTERY POSITIVE TERMINAL)

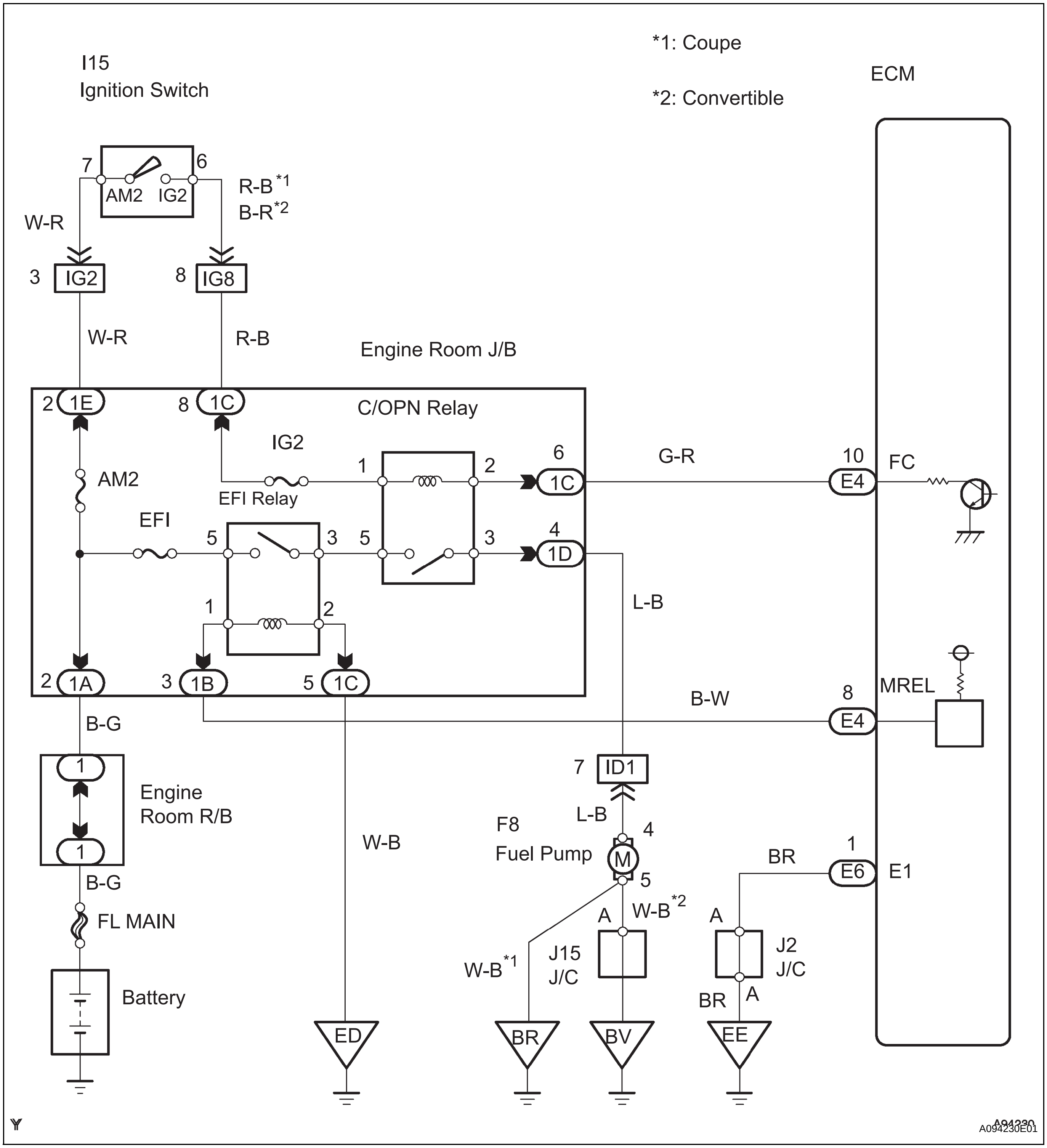
Fuel Pump Control Circuit

DESCRIPTION

When the engine is cranked, current flows from the IG2ition switch terminal ST1 to the starter relay coil (marking: ST), and current flows to terminal STA of ECM (STA signal).
When the STA signal and NE signal are input to the ECM, Tr is turned ON, current flows to coil of the circuit opening relay (marking: C/OPN), the relay switches ON, power is supplied to the fuel pump and the fuel pump operates.
While the NE signal is generated and the engine is running, the ECM keeps Tr ON (C/OPN relay ON) and the fuel pump also keeps operating.



WIRING DIAGRAM



1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE C/OPN RELAY)

(a) Connect the intelligent tester to the DLC3.
(b) Turn ON the ignition switch, push the intelligent tester or the OBD II scan tool main switch ON.

(c) (c)Enter the following menus :DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / FUEL PUMP / SPD.

(d) Check the relay operation while operating it using the intelligent tester.

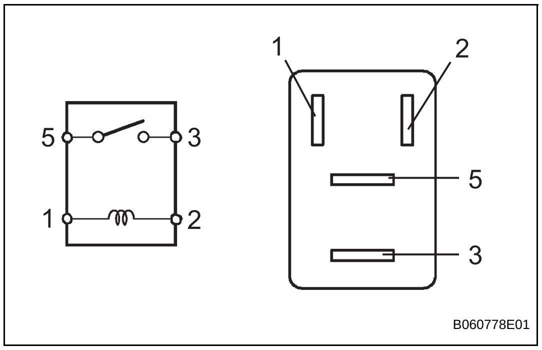
Standard:

Operating noise can be heard from the relay.

OK → **Go to step 5**

NG

2 INSPECT C/OPN RELAY



(a) Remove the C/OPN relay from the engine room J/B.

(b) Measure the resistance of the C/OPN relay.

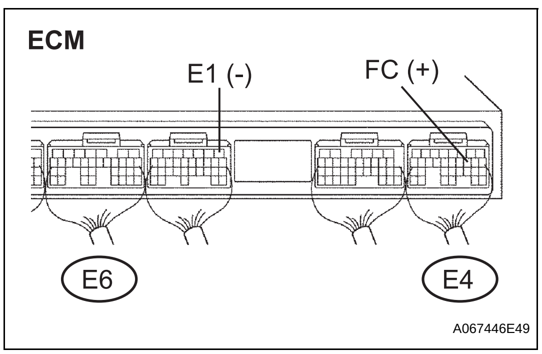
Resistance

Tester Connection	Specified Condition
3-5	10 kΩ or higher
3-5	Below 1 Ω (When battery voltage is applied to terminals 1 and 2)

NG → **REPLACE RELAY**

OK

3 CHECK ECM (FC VOLTAGE)



(a) Turn the ignition switch ON.

(b) Measure the voltage of the ECM connectors.

Voltage

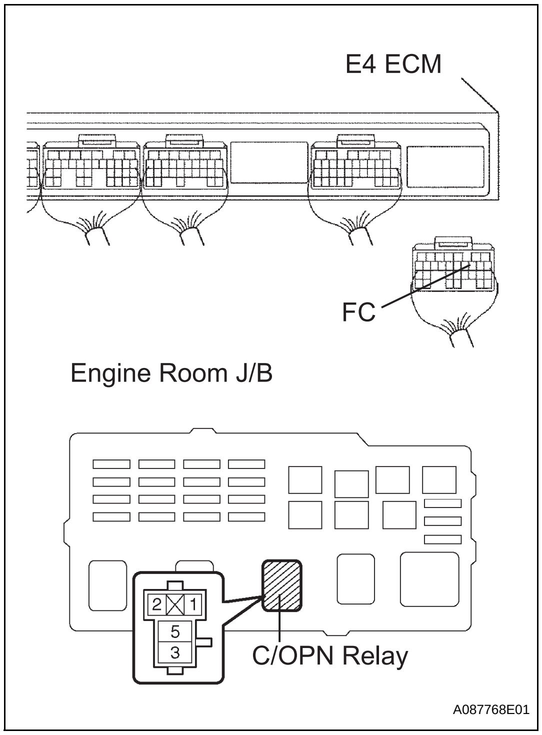
Tester Connection	Specified Condition
E4-10 (FC) - E6-1 (E1)	9 to 14 V

OK → **REPLACE ECM**

NG

ES

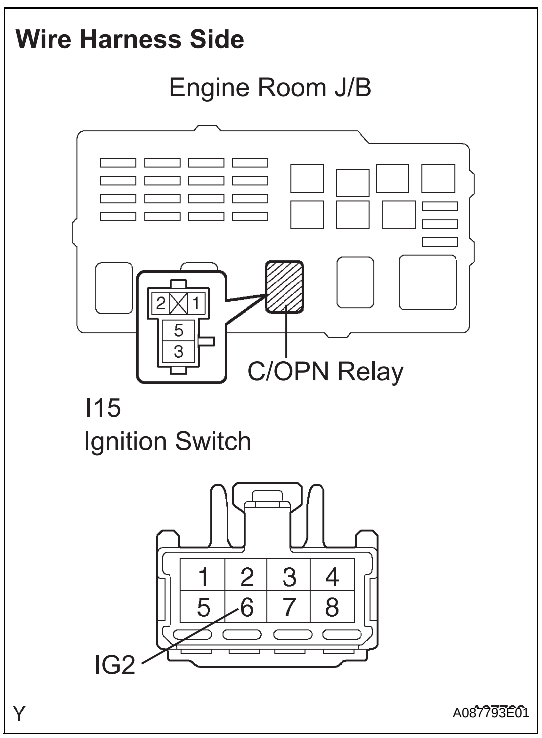
4	CHECK WIRE HARNESS (ECM - C/OPN RELAY, C/OPN RELAY - IGNITION)



(a) Check the wire harness between the ECM and C/OPN relay.
(1) Disconnect the E4 ECM connector.
(2) Remove the C/OPN relay from the engine room J/B.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Terminal Connections	Specified Condition
E4-10 (FC) - 2 of C/OPM relay	Below 1 Ω
E4-10 (FC) or 2 of C/OPM relay - Body ground	10 kΩ or higher

ES



(b) Check the wire harness between the C/OPN relay and ignition switch.
(1) Check the IG2 fuse.
- Remove the IG2 fuse from the engine room J/B.
- Check the resistance of the IG2 fuse.
Resistance:
Below 1 Ω
- Reinstall the IG2 fuse.

(2) Remove the C/OPN relay from the engine room J/B.
(3) Disconnect the I15 ignition switch connector.
(4) Measure the resistance of the wire harness side connectors.
Resistance

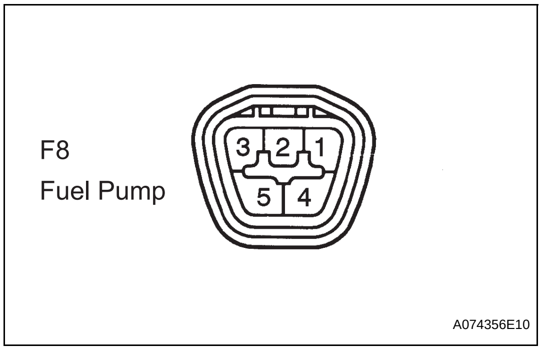
Terminal Connections	Specified Condition
J/B C/OPN relay terminal 1 - I15-6	Below 1 Ω
J/B C/OPN relay terminal 1 or I15-6 - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

5	INSPECT FUEL PUMP



(a) Measure the resistance of the fuel pump.

(1) Measure the resistance between terminals 4 and 5.

Resistance

Terminal Connections	Condition	Specified Condition
4-5	20°C (68°F)	0.2 to 0.3 Ω

(b) Check operation of the fuel pump.

(1) Apply battery voltage to both terminals. Check that the pump operates.

NOTICE:

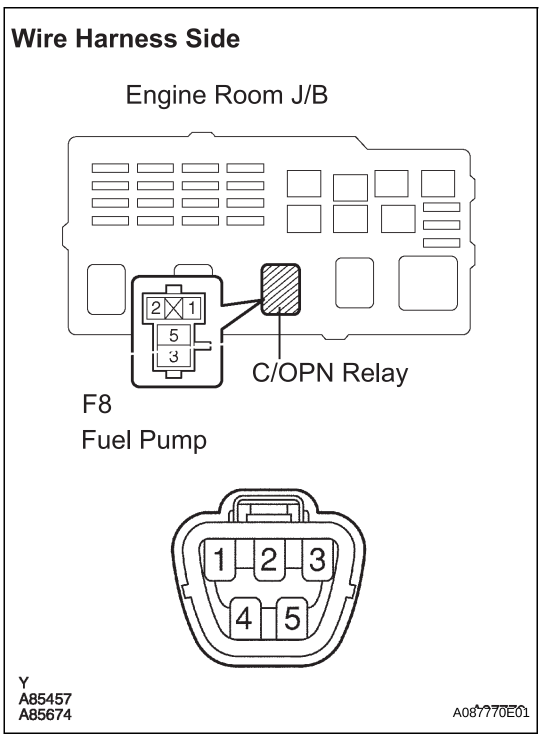
- **These tests must be done quickly (within 10 seconds) to prevent the coil from burning out.**
- **Keep the fuel pump as far away from the battery as possible.**
- **Always turn ON and OFF the voltage on the battery side, not the fuel pump side.**

NG → **REPLACE FUEL PUMP**

ES

OK

6	CHECK WIRE HARNESS (C/OPN RELAY - FUEL PUMP, FUEL PUMP - BODY GROUND)



(a) Check the wire harness between the C/OPN relay and fuel pump.

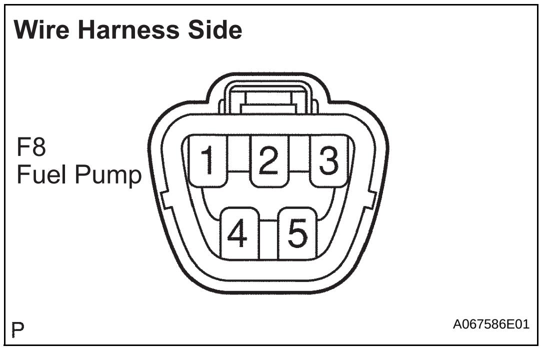
(1) Remove the C/OPN relay from the engine room J/B.

(2) Disconnect the F8 fuel pump connector.

(3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
J/B C/OPN relay terminal 3 - F8-4	Below 1 Ω
J/B C/OPN relay terminal 3 or F8-4 - Body ground	10 kΩ or higher



(b) Check the wire harness between the fuel pump and body ground.
(1) Disconnect the F8 fuel pump connector.
(2) Measure the resistance of the wire harness side connector and body ground.
Resistance

Tester Connection	Specified Condition
F8-5 (Fuel pump) - Body ground	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

ES

CHECK ECM

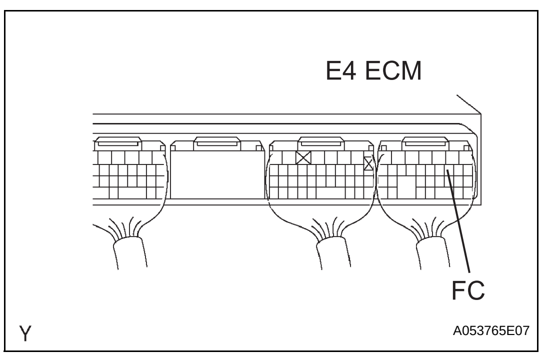
1 CHECK FUEL PUMP OPERATION

(a) Check if there is pressure in the fuel inlet hose.
HINT:
The pump has fuel pressure if the sound of fuel flowing can be heard.

OK → **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN ON PROBLEM SYMPTOMS TABLE**

NG

2 CHECK RELAY OPERATION (C/OPN)

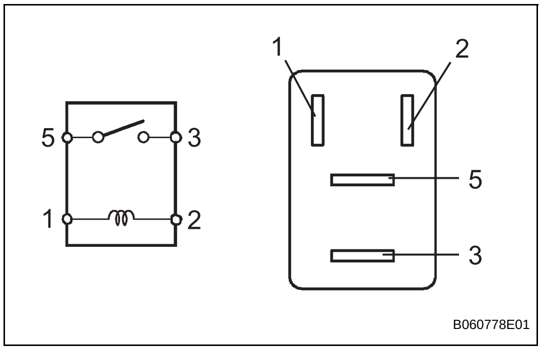


(a) Connect terminal FC of the E4 ECM connector and body ground, and check relay operation.
Standard:
Noise can be heard from the C/OPN relay.

OK → **Go to step 6**

NG

3	INSPECT C/OPN RELAY



(a) Remove the C/OPN relay from the engine room J/B.
(b) Measure the resistance of the C/OPN relay.

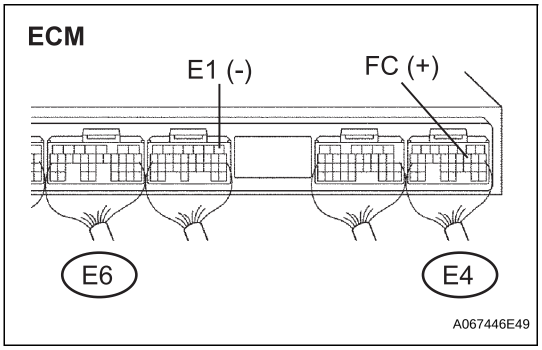
Resistance

Tester Connection	Specified Condition
3-5	10 kΩ or higher
3-5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE RELAY**

OK

4	CHECK ECM (FC VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.

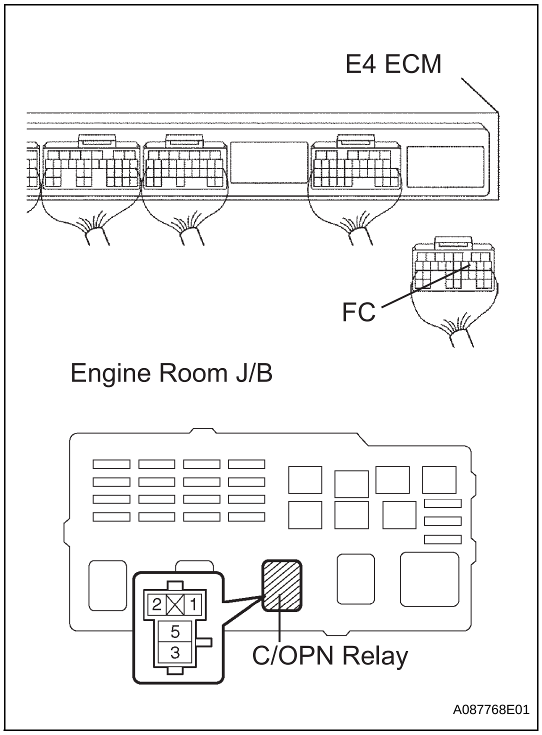
Voltage

Tester Connection	Specified Condition
E4-10 (FC) - E6-1 (E1)	9 to 14 V

NG → **REPLACE ECM**

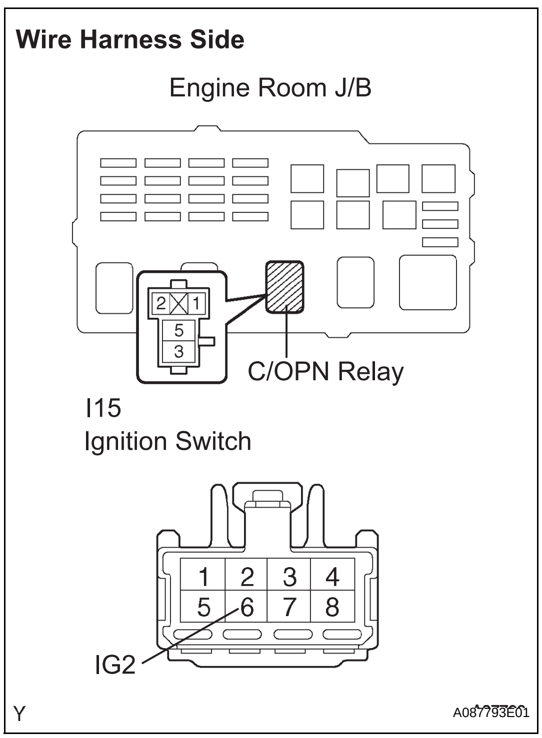
OK

5	CHECK WIRE HARNESS (ECM - C/PN RELAY , C/OPN RELAY IGNITION)



(a) Check the wire harness between the ECM and C/OPN relay.
  (1) Disconnect the E4 ECM connector.
  (2) Remove the C/OPN relay from the engine room J/B.
  (3) Measure the resistance of the wire harness side connectors.
  Resistance

Tester Connection	Specified Condition
E4-10 (FC) - J/B C/OPN relay terminal 2	Below 1 Ω
E4-10 (FC) or J/B C/OPN relay terminal 2 - Body ground	10 kΩ or higher



(b) Check the wire harness between the C/OPN relay and ignition switch.
  (1) Check the IG2 fuse.
  - Remove the IG2 fuse from the engine room J/B.
  - Measure the resistance of the IG2 fuse.
    Resistance:
    Below 1 Ω
  - Reinstall the IG2 fuse.
  (2) Remove the C/OPN relay from the engine room J/B.
  (3) Disconnect the I15 ignition switch connector.
  (4) Measure the resistance of the wire harness side connectors.
  Resistance

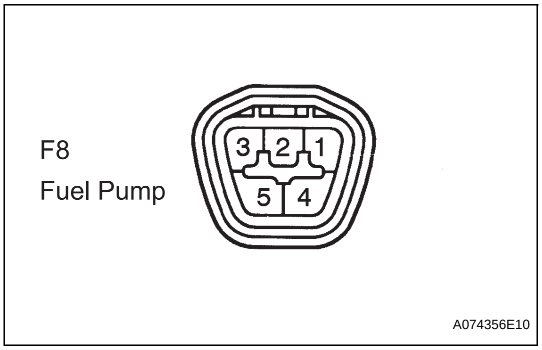
Tester Connection	Specified Condition
J/B C/OPN relay terminal 1 - I15-6 (Ignition switch)	Below 1 Ω
J/B C/OPN relay terminal 1 or I15-6 (Ignition switch) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

6	INSPECT FUEL PUMP



(a) Measure the resistance of the fuel pump.
(1) Measure the resistance between terminals 4 and 5.
Resistance

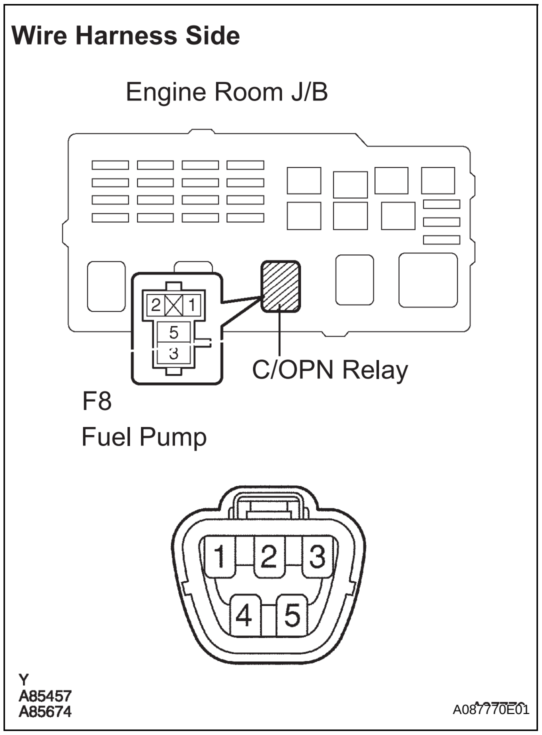
Tester Connection	Condition	Specified Condition
4-5	20°C (68°F)	0.2 to 0.3 Ω

(b) Check operation of the fuel pump.
(1) Apply battery voltage to both the terminals. Check that the pump operates.
NOTICE:
- **These tests must be done quickly (within 10 seconds) to prevent the coil from burning out.**
- **Keep the fuel pump as far away from the battery as possible.**
- **Always turns ON and OFF the voltage on the battery side, not the fuel pump side.**

NG → **REPLACE FUEL PUMP**

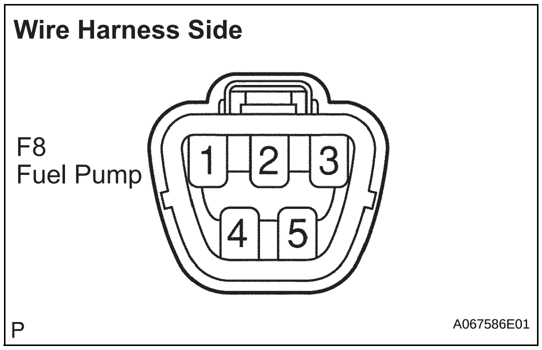
OK

7	CHECK WIRE HARNESS (C/OPN RELAY - FUEL PUMP, FUEL PUMP - BODY GROUND)



(a) Check the wire harness between the C/OPN relay and fuel pump.
(1) Remove the C/OPN relay from the engine room J/B.
(2) Disconnect the F8 fuel pump connector.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
J/B C/OPN relay terminal 3 - F8-4	Below 1 Ω
J/B C/OPN relay terminal 3 or F8-4 - Body ground	10 kΩ or higher



(b) Check the wire harness between the fuel pump and body ground.
(1) Disconnect the F8 fuel pump connector.
(2) Measure the resistance of the wire harness side connector.
Resistance

Tester Connection	Specified Condition
F8-5 - Body ground	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

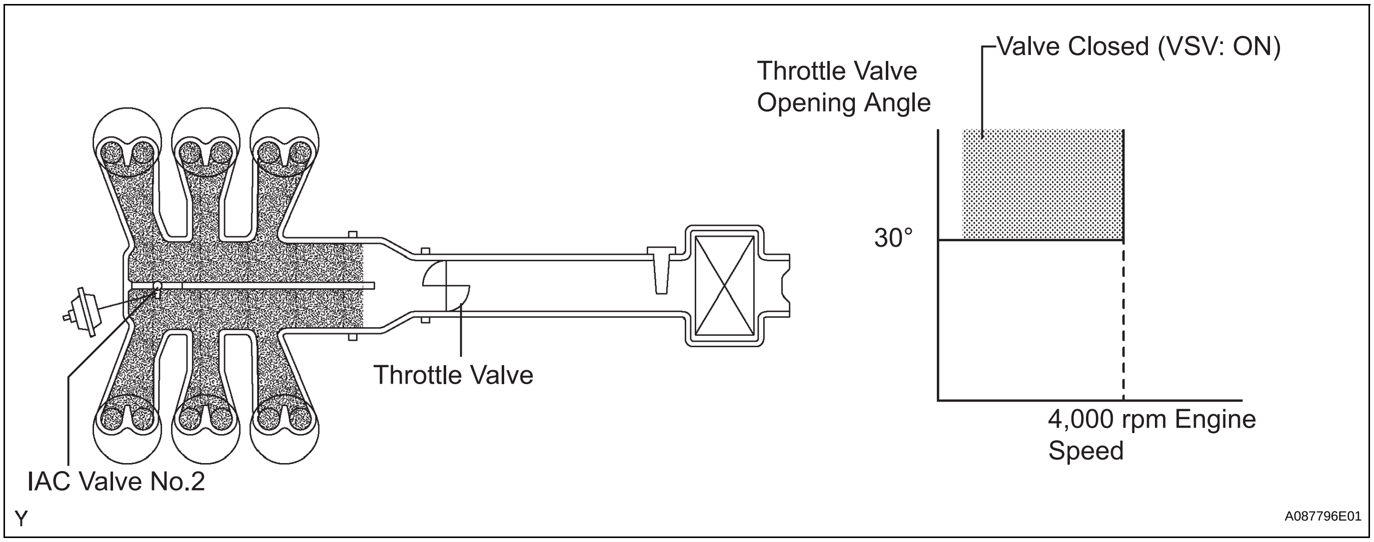
ES

REPLACE ECM

ACIS Control Circuit

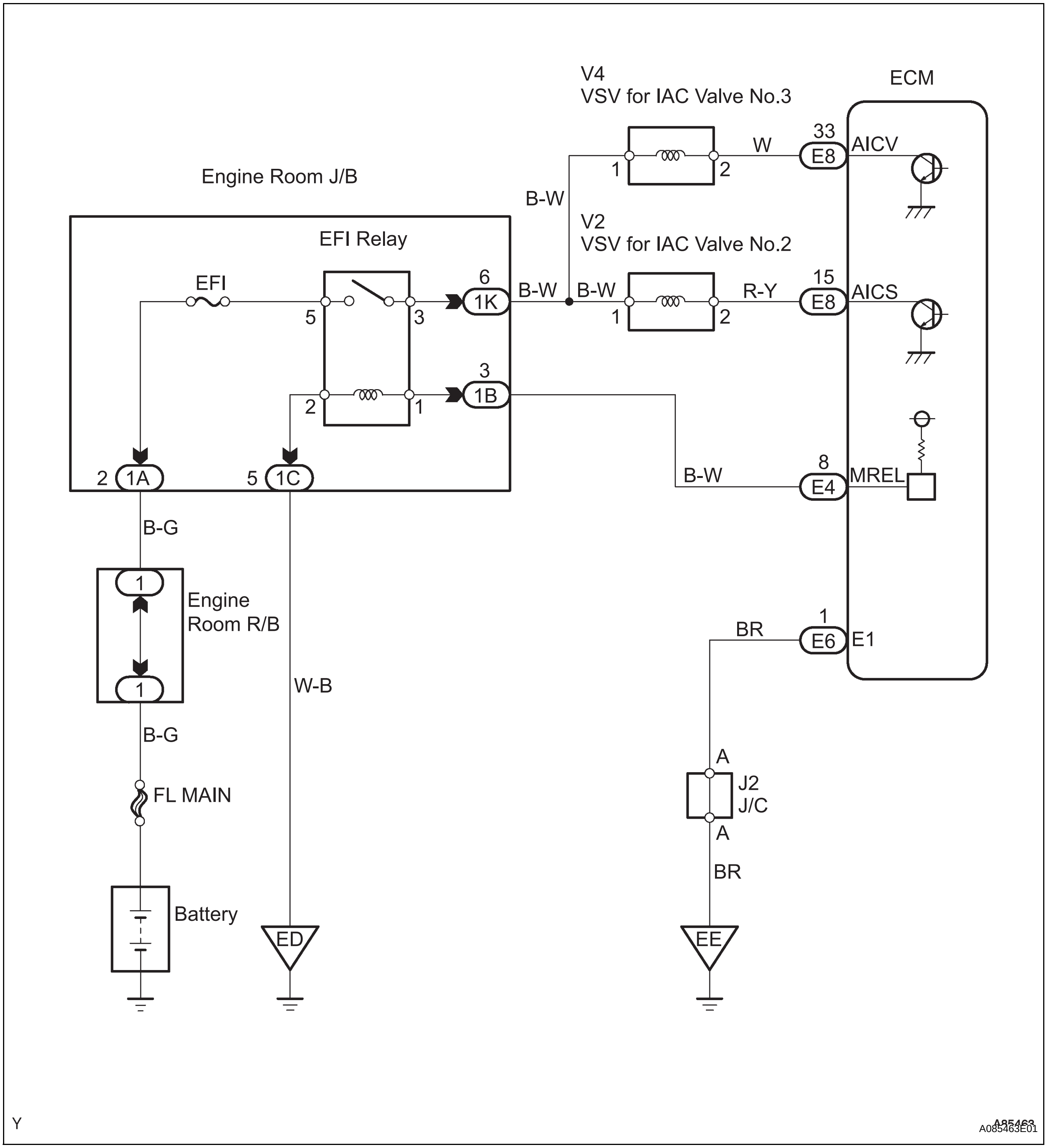
DESCRIPTION

HINT:
ACIS stands for "Acoustic Control Induction System".
The ECM opens and closes the Intake Air Control (IAC) valve No.2 in response to engine speed (RPM/NE). This system improves intake manifold tuning for better efficiency at low and high engine rpm. When the engine speed is 4,000 rpm or less and the throttle valve opening angle is 30° or more, the ECM turns the VSV ON to operate the IAC valve.

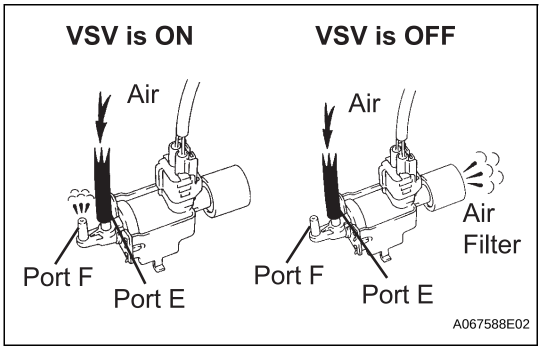


ES

WIRING DIAGRAM



1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE VSV FOR IAC VALVE NO.2)



(a) Disconnect the vacuum hose.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch ON and push the intelligent tester main switch ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INTAKE CTL VSV1. Operate the VSV.
(e) Check the VSV operation when it is operated by the intelligent tester.

Standard

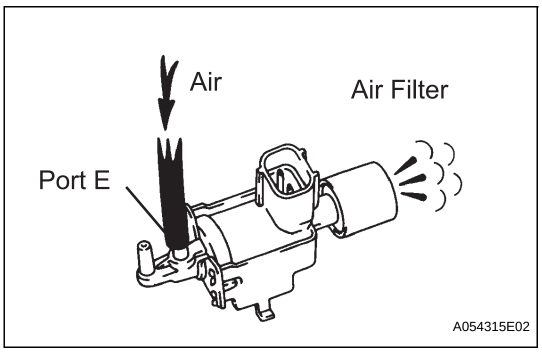
Tester Operation	Specified Condition
VSV is ON	Air from port E flows out through port F
VSV is OFF	Air from port E flows out through the air filter

ES

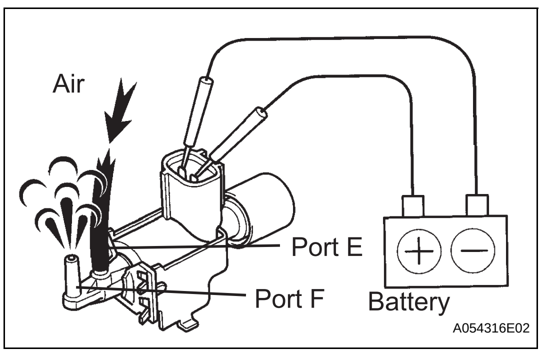
OK → **Go to step 4**

NG

2	CHECK VSV FOR IAC VALVE NO.2 (OPERATION)



(a) Check that air flows from port E to the air filter.



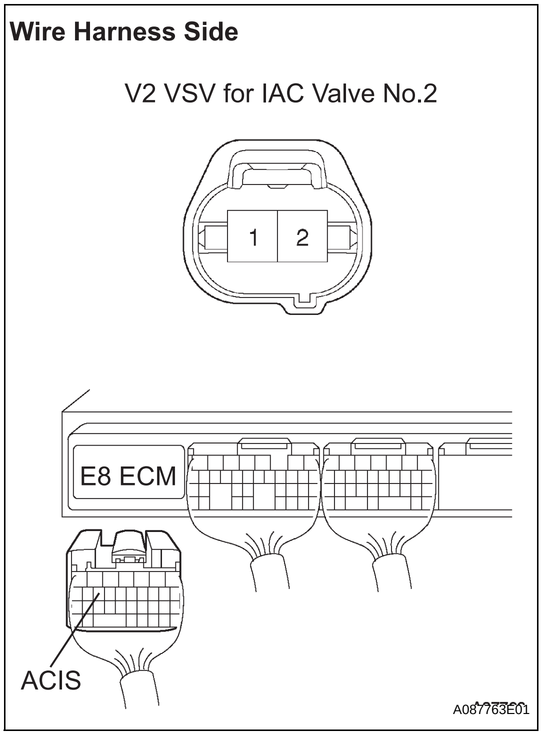
(b) Apply battery positive voltage across the terminals.
(c) Check that air flows from port E to port F.

NG → **REPLACE VSV**

OK

ES

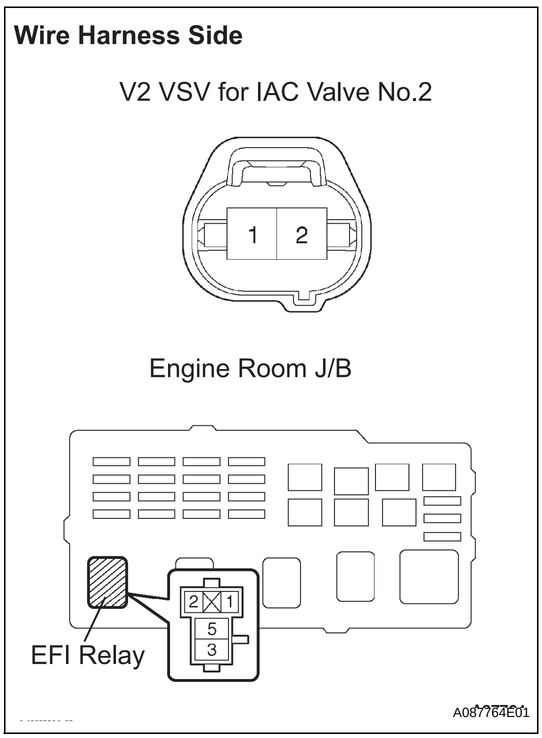
3 CHECK WIRE HARNESS (VSV FOR IAC VALVE NO.2 - ECM, EFI RELAY)



(a) Check the wire harness between the VSV and the ECM.
(1) Disconnect the V2 VSV connector.
(2) Disconnect the E8 ECM connector.
(3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
V2-2 - E8-15 (ACIS)	Below 1 Ω
V2-2 or E8-15 (ACIS) - Body ground	10 kΩ or higher



(b) Check the wire harness between the VSV and EFI relay.
(1) Disconnect the V2 VSV connector.
(2) Remove the EFI relay from the engine room J/B.
(3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
V2-1 - J/B EFI relay terminal 3	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

4 CHECK VACUUM HOSES (INTAKE MANIFOLD - IAC VALVE, INTAKE AIR CONTROL)

Check that the vacuum hoses are:
- Connected correctly.

- Are not loose or disconnected.
- Do not have cracks, holes or damage.

NG → **REPAIR OR REPLACE VACUUM HOSES**

OK

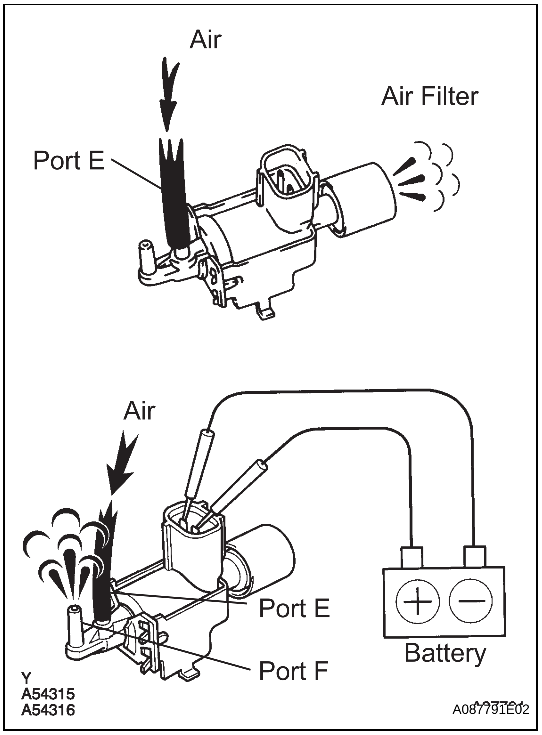
5 INSPECT INTAKE AIR CONTROL VALVE

NG → **REPLACE INTAKE AIR CONTROL VALVE**

OK

REPLACE ECM

1 INSPECT VSV FOR IAC VALVE NO.2 (OPERATION)

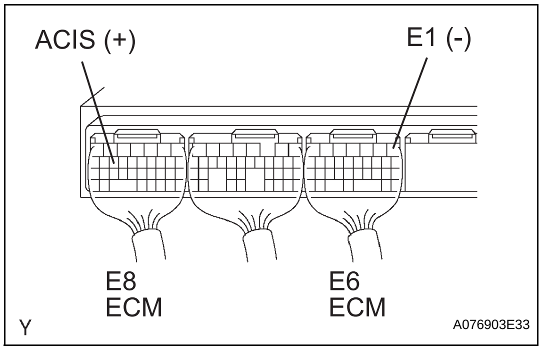


(a) Disconnect the VSV connector.
(b) Check operation of the VSV when battery positive voltage is applied to the terminals of the VSV.
Standard:
Battery positive voltage is not applied:
Air from port E flows out through the air filter.
Battery positive voltage is applied:
Air from port E flows out through port F.

NG → **REPLACE VSV**

OK

2	CHECK ECM (ACIS VOLTAGE)



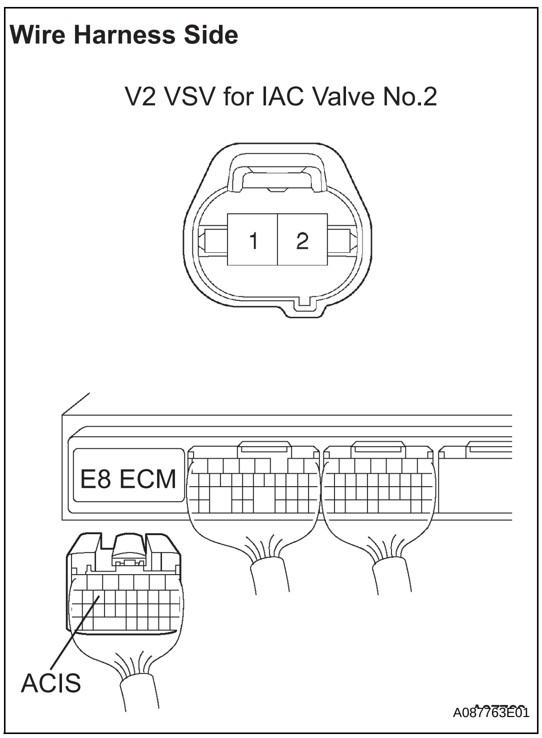
(a) Start the engine.
(b) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Condition	Specified Condition
E8-15 (ACIS) - E6-1 (E1)	• Engine speed is 4,000 rpm or less • Throttle valve opening angle is 30° or more	9 to 14 V

OK → Go to step 4

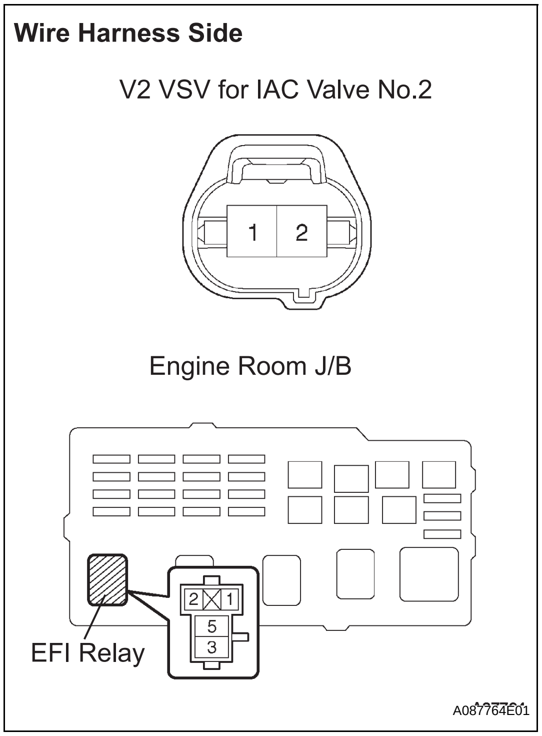
NG

3	CHECK WIRE HARNESS (VSV FOR IAC VALVE NO.2 ECM, EFI RELAY)



(a) Check the wire harness between the VSV and the ECM.
(1) Disconnect the V2 VSV connector.
(2) Disconnect the E8 ECM connector.
(3) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
V2-2 - E8-15 (ACIS)	Below 1 Ω
V2-2 or E8-15 (ACIS) - Body ground	10 kΩ or higher



(b) Check the wire harness between the VSV and EFI relay.
(1) Disconnect the V2 VSV connector.
(2) Remove the EFI relay from the engine room J/B.
(3) Measure the resistance OF the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
V2-1 (VSV for ACIS) - J/B EFI relay terminal 3	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

4 CHECK VACUUM HOSES (INTAKE MANIFOLD - IAC VALVE, INTAKE AIR CONTROL)

Check that the vacuum hoses are:

- Connected correctly.
- Are not loose or disconnected.
- Do not have cracks, holes or damage.

NG → **REPAIR OR REPLACE VACUUM HOSES**

OK

5 INSPECT INTAKE AIR CONTROL VALVE

NG → **REPLACE INTAKE AIR CONTROL VALVE**

OK

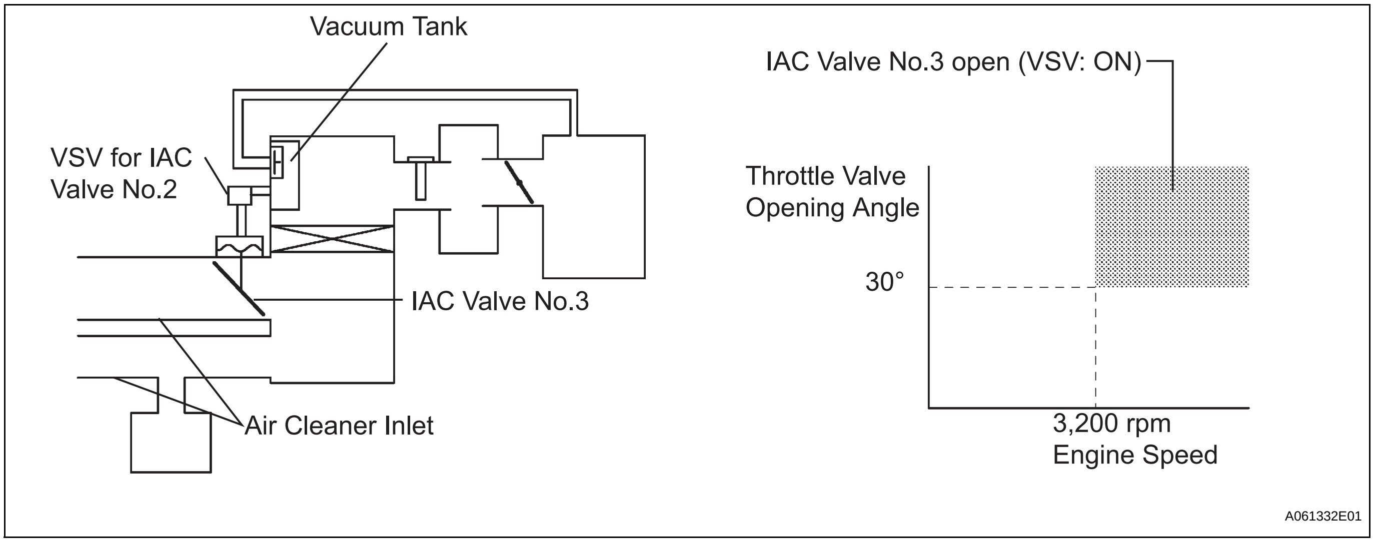
REPLACE ECM

Air Intake Control Circuit

DESCRIPTION

The air cleaner is equipped with two inlets, one of which is opened or closed by the Intake Air Control (IAC) valve No. 3. This system reduces intake noise and increases engine power at low to high speed engine speeds.

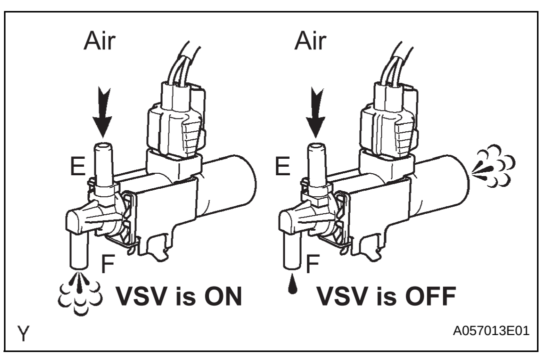
When the engine is operating at low to mid speeds, this system operates the IAC valve to close one of the air cleaner inlets. When the engine speed is more than 3,200 rpm and the opening angle of the throttle valve is more than 30°, the ECM activates the VSV and opens the IAC valve No. 3.



WIRING DIAGRAM

Refer to ACIS CONTROL CIRCUIT (See page ES-343).

1	READ VALUE OF INTELLIGENT TESTER (VSV FOR IAC VALVE NO.3)



(a) Turn the ignition switch ON and push the intelligent tester main switch ON.

(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INTAKE CTL VSV1. Operate the VSV.

(c) Check the operation of the VSV when the VSV is operated by the intelligent tester.

Standard

Tester Operation	Specified Condition
VSV is ON	Air from port E flows out through port F
VSV is OFF	Air from port E flows out through the air filter

OK → Go to step 4

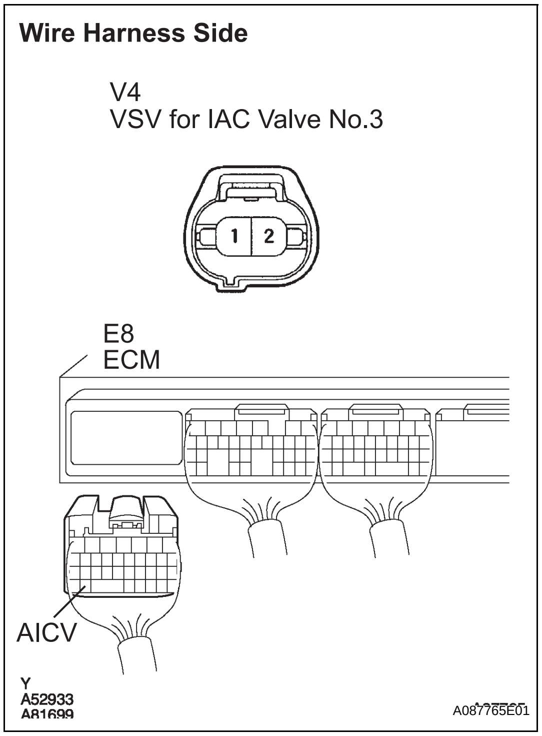
NG

2	CHECK VSV

NG → **REPLACE INTAKE AIR CONTROL VALVE ASSEMBLY NO.3**

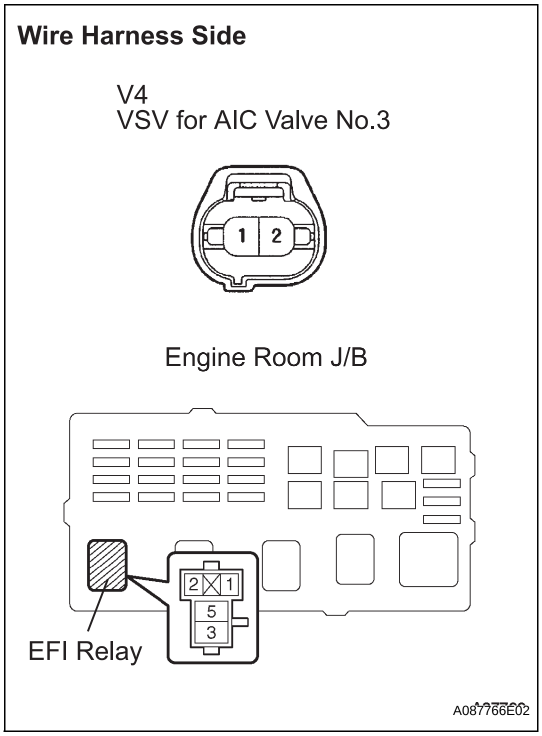
OK ↓

3	CHECK WIRE HARNESS (VSV FOR IAC VALVE NO.3 - ECM, EFI RELAY)



(a) Check the wire harness between the VSV and ECM.
  (1) Disconnect the V4 VSV connector for AICV.
  (2) Disconnect the E8 ECM connector.
  (3) Measure the resistance of the wire harness side connectors.
  Resistance

Tester Connection	Specified Condition
V4-1 - E8-33 (AICV)	Below 1 Ω
V4-1 or E8-33 (AICV) - Body ground	10 kΩ or higher



(b) Check the wire harness between the VSV and the EFI relay.
  (1) Disconnect the V4 VSV connector for AICV.
  (2) Remove the EFI relay from the engine room J/B.
  (3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
V4-2 (VSV for AICV) - J/B EFI relay terminal 3	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

4	INSPECT VACUUM TANK

NG → **REPLACE VACUUM TANK**

OK

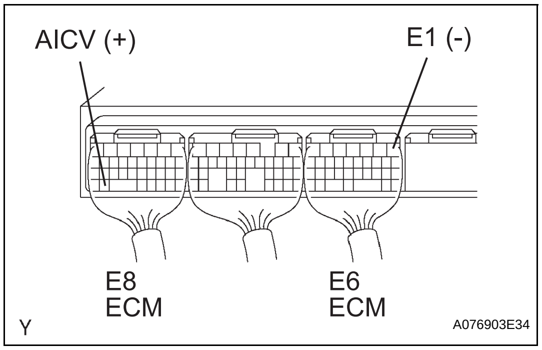
REPLACE ECM

1	CHECK VSV FOR AICV

NG → **REPLACE INTAKE AIR CONTROL VALVE ASSEMBLY NO.3**

OK

2	CHECK ECM (AICV VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Specified Condition
E8-33 (AICV) - E6-1 (E1)	9 to 14 V

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

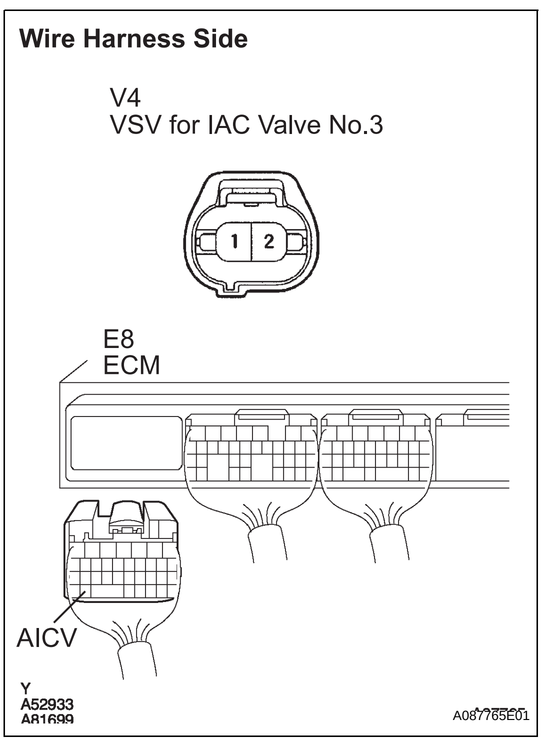
ES

3	INSPECT VACUUM TANK

NG → **REPLACE VACUUM TANK**

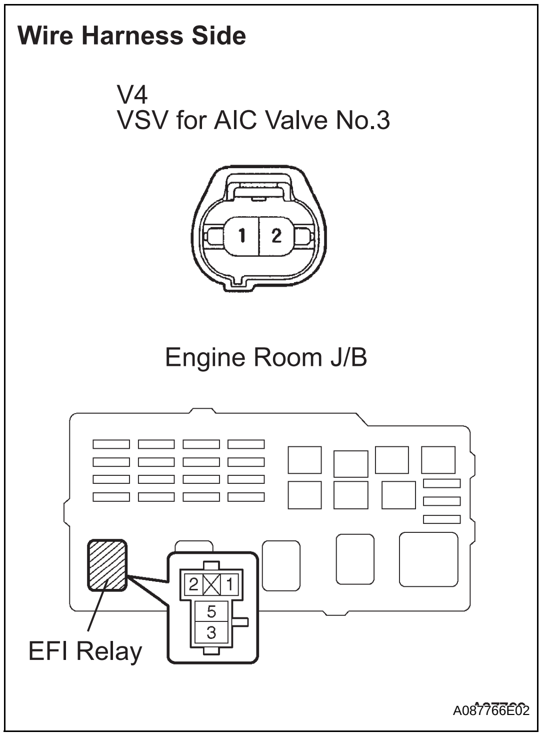
OK

4	CHECK WIRE HARNESS (VSV FOR IAC VALVE NO.3 - ECM, EFI RELAY)



(a) Check the wire harness between the VSV and ECM.
 (1) Disconnect the V4 VSV connector.
 (2) Disconnect the E8 ECM connector.
 (3) Measure the resistance of the wire harness side connectors.
 Resistance

Tester Connection	Specified Condition
V4-1 - E8-33 (AICV)	Below 1 Ω
V4-1 or E8-33 (AICV) - Body ground	10 kΩ or higher



(b) Check the wire harness between the VSV and EFI relay.
 (1) Disconnect the V4 VSV connector.
 (2) Remove the EFI relay from the engine room J/B.
 (3) Measure the resistance of the wire harness side connectors.
 Resistance

Tester Connection	Specified Condition
V4-2 (VSV for AICV) - J/B EFI relay terminal 3	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

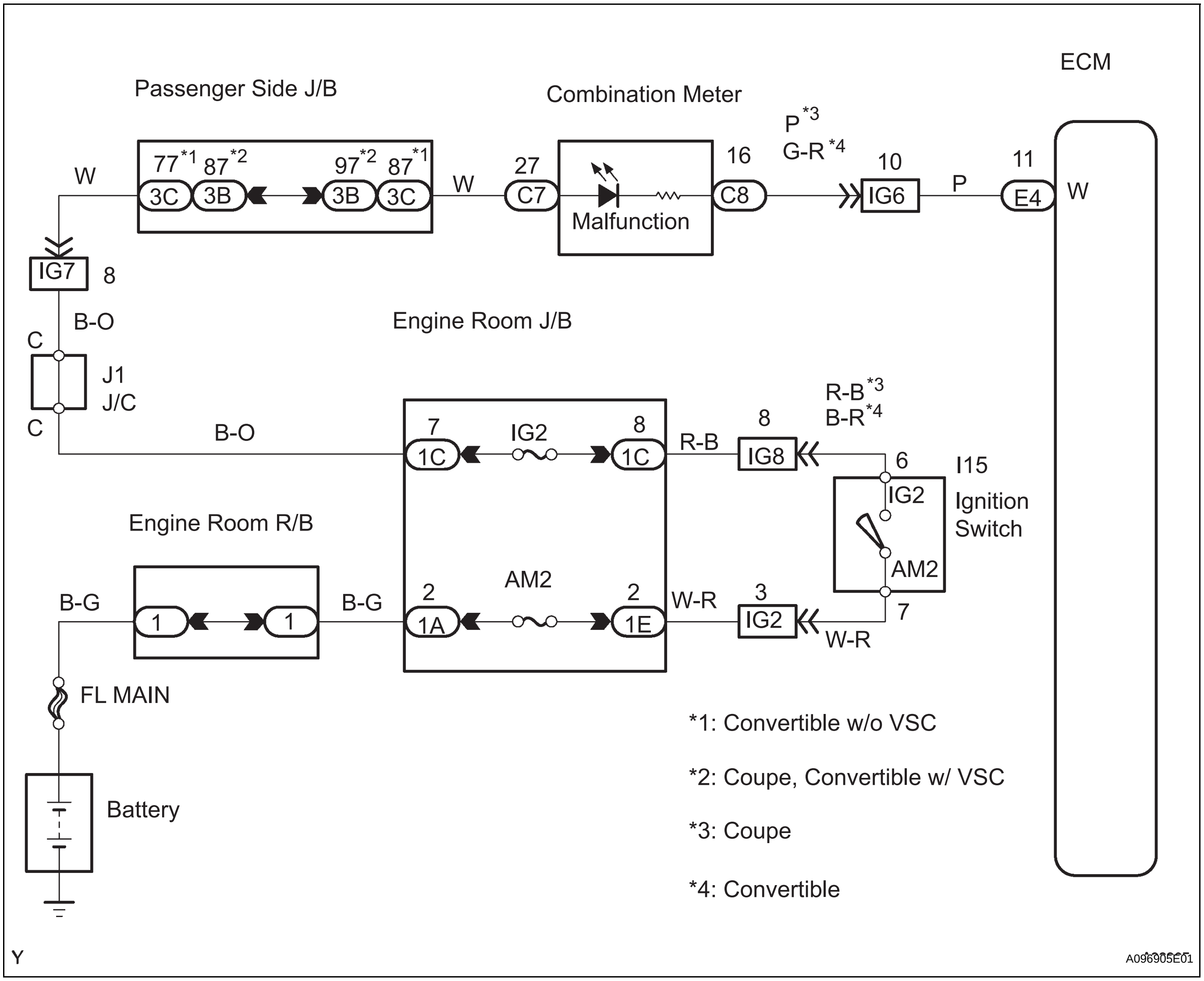
REPLACE ECM

MIL Circuit

DESCRIPTION

The MIL is used to indicate the ECM's detection of a vehicle malfunction.
The instrument panel GAUGE fuse provides the circuit power and the ECM provides the circuit ground that illuminates the MIL.
MIL operations should be checked visually:
The MIL should be illuminated when the ignition switch is first turned ON. If the MIL is always ON or OFF, use the intelligent tester or OBD II scan tool and follow the procedures below to determine the cause of the problem.

WIRING DIAGRAM



HINT:
Troubleshoot each problem symptom in accordance with the chart below.

MIL remains on	Start inspection from step 1
MIL is not illuminated	Start inspection from step 3

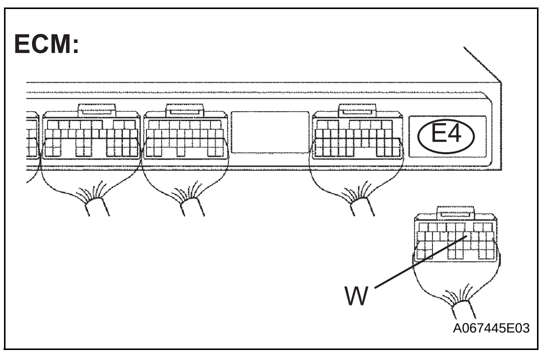
1	CLEAR DTC

(a) Connect the intelligent tester or OBD II scan tool to the DLC3.
(b) Turn the ignition switch ON and push the intelligent tester or the OBD II scan tool main switch ON.
(c) Read the DTC.
(d) Clear the DTC (See page ES-29).
(e) Check that the MIL is not illuminated.
OK:
MIL is not illuminated.

OK → **REPAIR CIRCUIT INDICATED BY OUTPUT DTC**

NG

2	CHECK WIRE HARNESS (CHECK FOR SHORT IN WIRE HARNESS)



(a) Disconnect the E4 ECM connector.
(b) Turn the ignition switch ON.
(c) Check that the MIL is not illuminated.
OK:
MIL is not illuminated.

OK → **REPLACE ECM**

NG

CHECK AND REPAIR HARNESS AND CONNECTOR

3	CHECK THAT MIL IS ILLUMINATED

(a) Check that the MIL is illuminated when turning the engine switch ON.
Standard:
MIL is illuminated.

OK → **SYSTEM OK**

NG

4	INSPECT COMBINATION METER (MIL CIRCUIT)

(a) See the combination meter troubleshooting (See page ME-11).

NG

REPAIR OR REPLACE BULB OR COMBINATION METER

OK

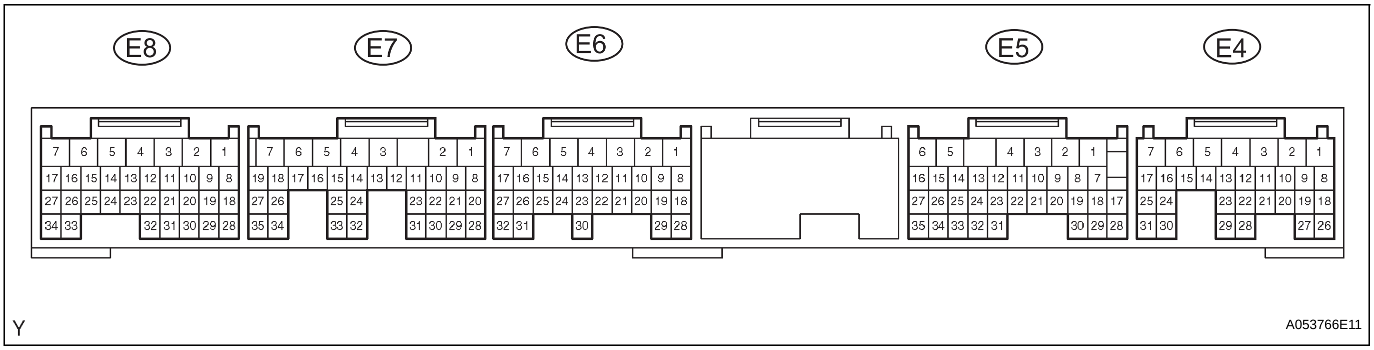
CHECK AND REPLACE HARNESS AND CONNECTOR (COMBINATION METER - ECM)

PROBLEM SYMPTOMS TABLE

SFI SYSTEM

Symptom	Suspected area	See page
Engine does not crank (Does not start)	1.Starter	ST-8
	2.ST Relay	ST-3
	3.Park/neutral position switch	AX-39
No initial combustion (does not start)	1.ECM power source circuit	ES-327
	2.Fuel pump control circuit	ES-332
	3.ECM	-
No complete combustion (does not start)	1.Fuel pump control circuit	ES-332
Difficult to start (engine cranks normally)	1.Starter signal circuit	ES-225
	2.Fuel pump control circuit	ES-332
	3.Compression	EM-3
Difficult to start with cold engine	1.Starter signal circuit	ES-225
	2.Fuel pump control circuit	ES-332
Difficult to start with hot engine	1.Starter signal circuit	ES-225
	2.Fuel pump control circuit	ES-332
High engine idle speed (poor idling)	1.A/C signal circuit (Compressor circuit)	AC-88
	2.ECM power source circuit	ES-327
Low engine idle speed (poor idling)	1.A/C signal circuit (Compressor circuit)	AC-88
	2.Fuel pump control circuit	ES-332
Rough idling (poor idling)	1.Compression	EM-3
	2.Fuel pump control circuit	ES-332
Hunting (poor idling)	1.ECM power source circuit	ES-327
	2.Fuel pump control circuit	ES-332
Hesitation/Poor acceleration (poor driveability)	1.Fuel pump control circuit	ES-332
	2.A/T faulty	AX-8
Surging (poor driveability)	1.Fuel pump control circuit	ES-332
Engine stalls soon after starting	1.Fuel pump control circuit	ES-332
Engine stalls during A/C operation	1.A/C signal circuit (Compressor circuit)	AC-88
	2.ECM	-
Unable to refuel/Difficult to refuel	1.ORVR system	-

TERMINALS OF ECM



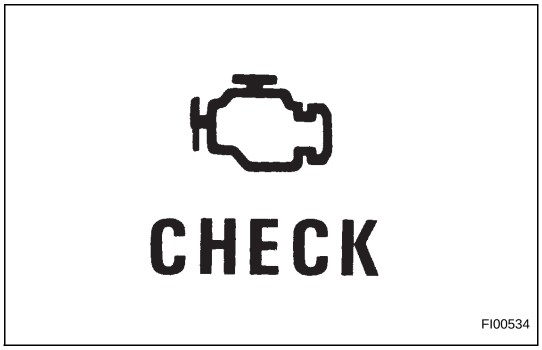
HINT:
Each ECM terminal's standard voltage is shown in the table below. In the table, first follow the information under "Condition". Next look under "Symbols (Terminal No.)" for the terminals to be inspected. The standard voltage between the terminals is shown under "Specific Condition". Use the illustration above as a reference for the ECM terminals.

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	Specified Condition
BATT (E4-3) - E1 (E6-1)	B-Y - BR	Battery (for measuring battery voltage and for ECM memory)	Always	9 to 14 V
+BM (E5-6) - E1 (E6-1)	L-R - BR	Power source of throttle motor	Always	9 to 14 V
IGSW (E4-9) - E1 (E6-1)	B-O - BR	Ignition switch	Ignition switch ON	9 to 14 V
+B1 (E4-1) - E1 (E6-1)	B-W - BR	Power source of ECM	Ignition switch ON	9 to 14 V
+B2 (E4-2) - E1 (E6-1)	B-W - BR	Power source of ECM	Ignition switch ON	9 to 14 V
OC1+ (E6-16) - OC1- (E6-15)	G-B - G-R	Camshaft timing oil control valve (OCV) (Intake side (bank 1))	Ignition switch ON	Pulse generation
OC2+ (E6-14) - OC2- (E6-13)	L-R - L-W	Camshaft timing oil control valve (OCV) (Intake side (bank 2))	Ignition switch ON	Pulse generation
MREL (E4-8) - E1 (E6-1)	B-W - BR	EFI relay	Ignition switch ON	9 to 14 V
VC (E8-18) - E2 (E8-28)	Y - BR	Power source for sensors (specific voltage)	Ignition switch ON	4.5 to 5.0 V
VG (E8-30) - EVG (E8-29)	R - L-W	Mass air flow meter	Idling, Shift lever position P or N, A/C switch OFF	0.5 to 3.0 V
THA (E8-20) - E2 (E8-28)	L-B - BR	Intake air temperature sensor	Idling, Intake air temperature 20°C (68°F)	0.5 to 3.4 V
THW (E8-19) - E2 (E8-28)	G-B - BR	Engine coolant temperature sensor	Idling, Engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
VTA1 (E8-21) - E2 (E8-28)	LG - BR	Throttle position sensor (for engine control)	Ignition switch ON, Throttle valve fully closed	0.5 to 1.2 V
VTA1 (E8-21) - E2 (E8-28)	LG - BR	Throttle position sensor (for engine control)	Ignition switch ON, Throttle valve fully open	3.2 to 4.8 V
VTA2 (E8-31) - E2 (E8-28)	B-R - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal released	2.1 to 3.1 V
VTA2 (E8-31) - E2 (E8-28)	B-R - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal depressed	4.5 to 5.0 V
VPA (E4-22) - EPA (E4-28)	L-Y - LG-B	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal released	0.5 to 1.1 V

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	Specified Condition
VPA (E4-22) - EPA (E4-28)	L-Y - LG-B	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal depressed	2.6 to 4.5 V
VPA2 (E4-23) - EPA2 (E4-29)	W-R - LG	Accelerator pedal position sensor (for sensor malfunctioning detection)	Ignition switch ON, Accelerator pedal released	1.2 to 2.0 V
VPA2 (E4-23) - EPA2 (E4-29)	W-R - LG	Accelerator pedal position sensor (for sensor malfunctioning detection)	Ignition switch ON, Accelerator pedal depressed	3.4 to 5.0 V
VCPA (E4-26) - EPA (4-28)	V-Y - LG-B	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.0 V
VCP2 (E4-27) - EPA2 (E4-29)	B-R - LG	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.0 V
HA1A (E7-3) - E04 (E7-7) HA2A (E7-4) - E05 (E7-6)	B-W - W-B B-R - W-B	A/F sensor heater	Idling	Below 3.0 V
HA1A (E7-5) - E04 (E7-7) HA2A (E7-4) - E05 (E7-6)	B-W - W-B R-W - BR	A/F sensor heater	Ignition switch ON	9 to 14 V
A1A+ (E7-22) - E1 (E6-1)	BR - BR	A/F sensor	Ignition switch ON	3.0 to 3.6 V
A2A+ (E7-23) - E1 (E6-1)	O - BR	A/F sensor	Ignition switch ON	3.0 to 3.6 V
A1A- (E7-30) - E1 (E6-1)	B-R - BR	A/F sensor	Ignition switch ON	2.7 to 3.3 V
A2A- (E7-31) - E1 (E6-1)	W - BR	A/F sensor	Ignition switch ON	2.7 to 3.3 V
HT1B (E7-25) - E2 (E8-28) HT2B (E7-33) - E2 (E8-28)	L - BR Y - BR	Heated oxygen sensor heater	Idling	Below 3.0 V
HT1B (E7-25) - E2 (8-28) HT2B (E7-33) - E1 (E8-28)	L - BR Y - BR	Heated oxygen sensor heater	Ignition switch ON	9 to 14 V
OX1B (E7-21) - E2 (E8-28) OX2B (E7-29) - E2 (E8-28)	W - BR B - BR	Heated oxygen sensor	Maintain engine speed at 2,500 rpm for 2 minutes after warming up sensor	Pulse generation
#10 (E8-1) - E01 (E8-7) #20 (E8-2) - E01 (E8-7) #30 (E8-3) - E01 (E8-7) #40 (E8-4) - E01 (E8-7) #50 (E8-5) - E01 (E8-7) #60 (E7-7) - E01 (E8-7)	L - W-B R - BR Y - BR W - BR R-L - BR G - BR	Injector	Ignition switch ON	9 to 14 V
#10 (E8-1) - E01 (E8-7) #20 (E8-2) - E01 (E8-7) #30 (E8-3) - E01 (E8-7) #40 (E8-4) - E01 (E8-7) #50 (E8-5) - E01 (E8-7) #60 (E7-7) - E01 (E8-7)	L - W-B R - BR Y - BR W - BR R-L - BR G - BR	Injector	Idling	Pulse generation
KNK1 (E7-1) - EKNK (E7-28)	B - W	Knock sensor	Maintain engine speed at 4,000 after warming up	Pulse generation
KNK2 (E7-2) - EKN2 (E7-20)	R - G	Knock sensor	Maintain engine speed at 4,000 after warming up	Pulse generation
VV1+ (E6-27) - NE- (E6-24)	Y - G	Variable valve timing (VVT) sensor	Idling	Pulse generation
VV2+ (E6-26) - NE- (E6-24)	BW - G	Variable valve timing (VVT) sensor	Idling	Pulse generation
NE+ (E6-25) - NE- (E6-24)	R - G	Crankshaft position sensor	Idling	Pulse generation

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	Specified Condition
IGT1 (E8-8) - E1 (E6-1) IGT2 (E8-9) - E1 (E6-1) IGT3 (E8-10) - E1 (E6-1) IGT4 (E8-11) - E1 (E6-1) IGT5 (E8-12) - E1 (E6-1) IGT6 (E8-13) - E1 (E6-1)	R-W - BR P - BR KG-B - BR L-Y - BR G-R - BR L - BR	Ignition coil (ignition signal)	Idling	Pulse generation
IGF1 (E8-24) - E1 (E6-1)	W-R - BR	Ignition coil (ignition confirmation signal)	Ignition switch ON	4.5 to 5.0 V
IGF1 (E8-24) - E1 (E6-5)	W-R - BR	Ignition coil (ignition confirmation signal)	Idling	Pulse generation
PRG (E8-34) - E1 (E6-1)	LG - BR	EVAP VSV	Ignition switch ON	9 to 14 V
PTNK (E4-21) - E1 (E6-1)	P - BR	Vapor pressure sensor	Ignition switch ON	2.9 to 3.7 V
PTNK (E4-214) - E1 (E6-1)	P - BR	Vapor pressure sensor	Ignition switch ON, apply vacuum 4.0 kPa (30 mmHg, 1.18 in.Hg)	Below 0.5 V
SPD (E5-17) - E1 (E6-1)	V-W - BR	Speed signal from combination meter	Ignition switch ON, Rotate driving wheel slowly	Pulse generation
STA (E8-17) - E1 (E6-1)	B-W - BR	Starter signal	Cranking	6 V or higher
STP (E5-19) - E1 (E6-1)	G-W - BR	Stop light switch	Ignition switch ON, Brake pedal depressed	7.5 to 14 V
STP (E5-19) - E1 (E6-1)	G-W - BR	Stop light switch	Ignition switch ON, Brake pedal released	Below 1.5 V
ST1- (E5-12) - E1 (E6-1)	R-B - BR	Stop light switch (opposite to STP terminal)	Ignition switch ON, Brake pedal depressed	Below 1.5 V
ST1- (E5-12) - E1 (E6-1)	R-B - BR	Stop light switch (opposite and STP terminal)	Ignition switch ON, Brake pedal released	7.5 to 14 V
NSW (E8-16) - E1 (E6-1)	B-Y - BR	Park/neutral position switch	Ignition switch ON, Shift lever position in P or N	Below 3.0 V
NSW (E8-16) - E1 (E6-1)	B-Y - BR	Park/neutral position switch	Ignition switch ON, Shift except lever position in P or N	9 to 14 V
M+ (E6-3) - ME01 (E6-4)	B - W-B	Throttle actuator	Idling	Pulse generation
M- (E6-2) - ME01 (E6-4)	W - BR	Throttle actuator	Idling	Pulse generation
FC (E4-10) - E1 (E6-1)	G-R - BR	Fuel pump control	Ignition switch ON	9 to 14 V
FC (E4-10) - E1 (E6-1)	G-R - BR	Fuel pump control	Idling	0 to 3 V
W (E4-11) - E1 (E6-1)	P - BR	MIL	Ignition switch ON	Below 3.0 V
W (E4-11) - E1 (E6-1)	P - BR	MIL	Idling	9 to 14 V
TC (E4-3) - E1 (E6-5)	BR - BR	Terminal TC of DLC 3	Ignition switch ON	9 to 14 V
ELS (E4-12) - E1 (E6-1)	G - BR	Electric load	Light control switch OFF	0 to 1.5 V
ELS (E4-12) - E1 (E6-1)	G - BR	Electric load	Light control switch is in TAIL position	9 to 14 V
ELS2 (E4-13) - E1 (E6-1)	B-Y - BR	Electric load	Rear defogger switch OFF (Rear defogger system is not operating)	0 to 1.5 V
ELS2 (E4-13) - E1 (E6-1)	B-Y - BR	Electric load	Rear defogger switch OFF (Rear defogger system is operating)	9 to 14V
TC (E4-20) - E1 (E6-1)	P-B - BR	Terminal TC of DLC 3	Ignition switch ON	9 to 14 V
SIL (E4-18) - E1 (E6-1)	W - BR	Terminal SIL of DLC 3	During transmission	Pulse generation
TACH (E44-5) - E1 (E6-1)	B-O - BR	Engine speed	Idling	Pulse generation
AICV (E8-33) - E1 (E6-1)	W - BR	VSV for AICV	Ignition switch ON	9 to 14 V
AICS (E8-15) - E1 (E6-1)	R-Y - BR	VSV for AICV	Ignition switch ON	9 to 14 V
AICM (E6-6) - E1 (E6-1)	B-L - BR	VSV for AICV	Ignition switch ON	9 to 14 V
ENG+ (E4-24) - ENG- (E4-30)	P - V	Electric load (from skid control ECU)	Idling	Pulse generation

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	Specified Condition
TRC+ (E4-25) - TRC- (E4-31)	G - L	Electric load (from skid control ECU)	Idling	Pulse generation
PSW (E6-10) - E1 (E6-1)	R-W - BR	P/S pressure switch	Ignition switch ON	9 to 14 V



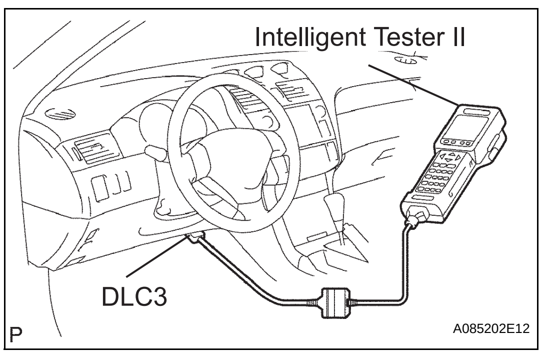
ES

DIAGNOSIS SYSTEM

1. DESCRIPTION

- When troubleshooting On-Board Diagnostic (OBD II) vehicles, the vehicle must be connected to the OBD II scan tool (in compliance with SAE J1978) or the intelligent tester. Various data output from the vehicle's ECM can then be read.
- OBD II regulations require that the vehicle's on-board computer illuminates the Malfunction Indicator Lamp (MIL) on the instrument panel when the computer detects a malfunction in: 1) the emission control system/components, or 2) the powertrain control components (which affect vehicle emissions), or 3) the computer. In addition, the applicable Diagnostic Trouble Codes (DTCs) prescribed by SAE J2012 are recorded in the ECM memory (See page ES-38).

If the malfunction does not reoccur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECM memory.

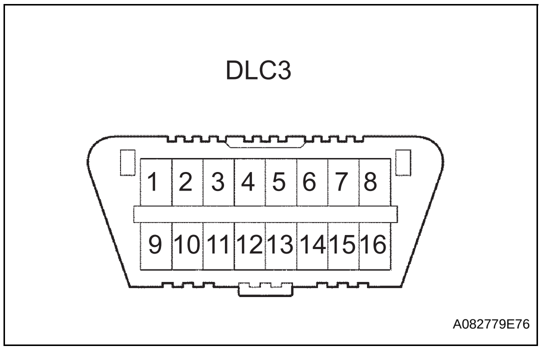


- To check DTCs, connect the intelligent tester or OBD II scan tool to the Data Link Connector 3 (DLC3) of the vehicle. The intelligent tester or OBD II scan tool also enables you to erase the DTC and check freeze frame data and various forms of engine data (see the instruction manual for the OBD II scan tool or the intelligent tester). The DTC includes SAE controlled codes and manufacturer controlled codes. SAE controlled codes must be set according to the SAE, while manufacturer controlled codes can be set by a manufacturer with certain restrictions (See page ES-29).
- 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. A "check mode" is also available to technicians as an option. In "check mode", 1 trip detection logic is used for simulating malfunction symptoms and increasing the system's ability to detect malfunctions, including intermittent malfunctions (intelligent tester only) (see page ES-31).
- *2 trip detection logic: When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the ignition switch is turned OFF and then ON again, and the same malfunction is detected again, the MIL will illuminate (2nd trip).

- 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 running or stopped, 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.

Priorities for troubleshooting: When multiple DTCs occur, find out the order in which the DTCs should be inspected by checking the component's DTC chart. If no instructions are written in the DTC chart, check DTCs in following order of priority:

(a) DTCs other than fuel trim malfunction DTCs (P0171, P0172, P0174 and P0175) and misfire DTCs (P0300 to P0306).
(b) Fuel trim malfunction DTCs (P0171, P0172, P0174 and P0175).
(c) Misfire DTCs (P0300 to P0306).



2. CHECK DLC3

The vehicle's ECM uses the ISO 9141-2 communication protocol. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 9141-2 format.

Symbols	Terminal No.	Names	Reference terminal	Results	Condition
SIL	7	Bus "+" line	5 - Signal ground	Pulse generation	During transmission
CG	4	Chassis ground	Body ground	1 Ω or less	Always
SG	5	Signal ground	Body ground	1 Ω or less	Always
BAT	16	Battery ground	Body ground	9 to 14 V	Always

HINT:
Connect the cable of the OBD II scan tool or the intelligent tester to the DLC3, turn the ignition switch ON and attempt to use the OBD II scan tool or the intelligent tester. If the screen displays UNABLE TO CONNECT TO VEHICLE, a problem exists in the vehicle side or the tester side.

- If the communication is normal when the tool is connected to another vehicle, inspect the DLC3 on the original vehicle.
- If the communication is still impossible when the tool is connected to another vehicle, the problem is probably in the tool itself. Consult the Service Department listed in the tool's instruction manual.

3. CHECK BATTERY VOLTAGE

Battery Voltage:
11 to 14 V

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

4. CHECK THE MIL

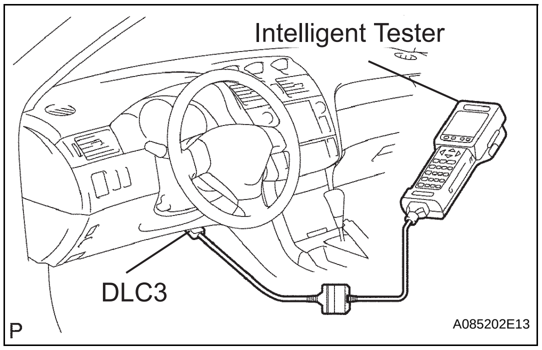
(a) The MIL turns ON when the ignition switch is turned ON and the engine is not running. HINT:
HINT:
If the MIL does not turn ON, troubleshoot the MIL circuit (See page ES-354).

(b) When the engine is started, the MIL should turn OFF. If the lamp remains ON, the diagnosis system has detected a malfunction or abnormality in the system.

DTC CHECK / CLEAR

NOTICE:

- **If no DTC appears in normal mode:**
  On the OBD II scan tool or the intelligent tester, check the pending fault code using the Continuous Test Results function (Mode 7 for SAE J1979).
- **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 will be erased. Before changing modes, always check and make a note of DTCs and freeze frame data.**



1. CHECK DTC (Using the OBD II scan tool or intelligent tester)

(a) Connect the OBD II scan tool or intelligent tester to the DLC3.

(b) Turn the ignition switch ON.

(c) Use the OBD II scan tool or the intelligent tester to check the DTCs and freeze frame data and then make a note of them.
For the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES. For the OBD II scan tool, see its instruction manual.

(d) See page ES-38 to confirm the details of the DTCs.
NOTICE:
When simulating a symptom with the OBD II scan tool (excluding intelligent tester) to check for DTCs, use the normal mode. For DTCs subject to "2 trip detection logic", perform either of the following actions.

- **Turn the ignition switch OFF after the symptom is simulated once. Then repeat the simulation process again. When the problem has been simulated twice, the MIL illuminates and the DTCs are recorded in the ECM.**
- **Check the pending fault code using the Continuous Test Results function (Mode 7 for SAE J1979) on the OBD II scan tool.**

2. CLEAR DTC (Using the OBD II scan tool or intelligent tester)

(a) Connect the OBD II scan tool or the intelligent tester to the DLC3.

(b) Turn the ignition switch ON.

(c) Erase DTCs and freeze frame data with the OBD II scan tool (complying with SAE J1978) or the intelligent tester.
For the intelligent tester: 1) enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CLEAR CODES; and 2) press YES. For the OBD II scan tool, see its instruction manual.

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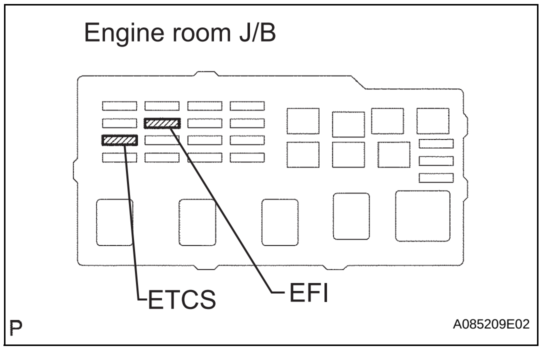
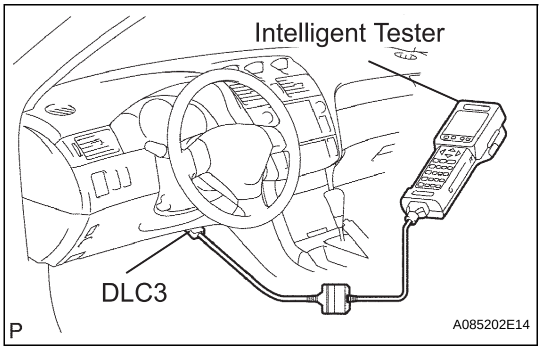


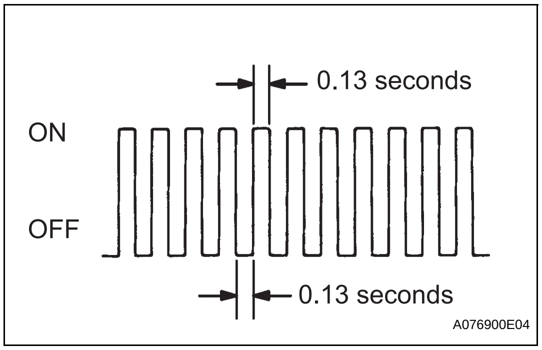
3. **CLEAR DTC (Not using the OBD II scan tool or intelligent tester)**
   (a) Remove the EFI and ETCS fuses from the engine room J/B for more than 60 seconds. Or, disconnect the battery terminal for more than 60 seconds. After disconnecting the battery cable, perform the "INITIALIZE" procedure (See page IN-24).

CHECK MODE PROCEDURE

HINT:
Intelligent tester only:
Check mode has a higher sensitivity to detect malfunctions and can detect malfunctions that normal mode cannot detect. Check mode can also detect all the malfunctions that normal mode can detect.



1. **CHECK MODE PROCEDURE (Using the intelligent tester)**
   (a) Make sure that the items below are true:
      (1) Battery positive voltage 11 V or more
      (2) Throttle valve fully closed
      (3) Transmission in the P or N position
      (4) A/C switched OFF
   (b) Turn the ignition switch OFF.
   (c) Connect the intelligent tester to the DLC3.
   (d) Turn the ignition switch ON.



   (e) Change the ECM to check mode with the intelligent tester. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE. Make sure the MIL flashes as shown in the illustration.
   NOTICE:
   All DTCs and freeze frame data recorded will be erased if: 1) the intelligent tester is used to change the ECM from normal mode to check mode or vice-versa; or 2) during check mode, the ignition switch is turned from ON to ACC or OFF.
   (f) Start the engine. The MIL should turn OFF after the engine starts.
   (g) Simulate the conditions of the malfunction described by the customer.
   (h) After simulating the malfunction conditions, use the intelligent tester diagnosis selector to check the DTC, freeze frame data and other data.
      (1) After checking the DTC, inspect the applicable circuit.
2. **CLEAR DTC (Using the OBD II scan tool or intelligent tester)**
   (a) Connect the OBD II scan tool or the intelligent tester to the DLC3.
   (b) Turn the ignition switch ON.
   (c) Erase DTCs and freeze frame data with the OBD II scan tool (complying with SAE J1978) or the intelligent tester.
   For the intelligent tester: 1) enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CLEAR CODES; and 2) press YES. For the OBD II scan tool, see its instruction manual.

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3. **CLEAR DTC (Not using the OBD II scan tool or intelligent tester)**

(a) Remove the EFI and ETCS fuses from the engine room J/B for more then 60 seconds.
Or, disconnect the battery cable for more than 60 seconds. After disconnecting the battery terminal, perform the "INITIALIZE" procedure (See page IN-24).

FAIL-SAFE CHART

If any of the following codes are recorded, the ECM enters fail-safe mode.

DTC No.	Fail-Safe Operation	Fail Safe Deactivation Condition
P0031 P0032 P0037 P0038 P0051 P0052 P0057 P0058	Turn off heater	Ignition switch OFF
P0100 P0102 P0103	Ignition timing is calculated from engine RPM and TP (Throttle Position)	"Pass" condition detected
P0110 P0112 P0113	IAT (Intake Air Temperature) is fixed at 20°C (68°F)	"Pass" condition detected
P0115 P0117 P0118	ECT (Engine Coolant Temperature) is fixed at 80°C (176°F)	"Pass" condition detected
P0120 P0121 P0122 P0123 P0220 P0222 P0223 P0604 P0606 P0607 P0657 P2102 P2103 P2111 P2112 P2118 P2119 P2135	If the Electronic Throttle Control System (ETCS) has a malfunction, the ECM cuts off current to the throttle actuator. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of 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 enable the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly. If the accelerator pedal is depressed quickly, the vehicle may speed up and slow down erratically.	"Pass" condition is detected and then the ignition switch is turned OFF.
P0325 P0327 P0328 P0330 P0332 P0333	Maximum timing retardation	Ignition switch OFF
P0351 P0352 P0353 P0354 P0355 P0356	Fuel is cut	"Pass" condition detected
P2120 P2121 P2122 P2123 P2125 P2127 P2128 P2138	The accelerator pedal position sensor has 2 (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 2 sensor circuits and switches to fail-safe mode. In fail-safe 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 to be fully closed. In this case, the throttle valve will remain closed as if the engine is idling.	"Pass" condition is detected and the ignition switch is turned OFF.

DATA LIST / ACTIVE TEST

1. DATA LIST

HINT:

Using the intelligent tester's DATA LIST allows switch, sensor, actuator and other item values to be read without removing any parts. Reading the DATA LIST early in troubleshooting is one way to save 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 intelligent tester or the OBD II scan tool to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn ON the intelligent tester.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST.
(g) According to the display on tester, read the "DATA LIST".

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
INJECTOR	Injection period of No.1 cylinder: Min.:0 ms, Max.:32.64 ms	1.5 to 2.8 ms: Idling (Inspection mode)	-
IGN ADVANCE	Ignition timing advance for No. 1 cylinder/ Min.: -64 deg., Max.: 63.5 deg.	BTDC 5 to 25° : Idling (Inspection mode)	-
CALC LOAD	Calculated load by ECM: Min.: 0 %, Max.: 100 %	• 10.4 to 15.6 %: Idling • Running without load (2,500 rpm): 12.1 to 18.2 %	-
MAF	Air flow rate from MAF meter: Min.: 0 g/s , Max.: 655 g/s	2.0 to 3.7 g/s : Idling 2.4 to 4.3 g/s: 2,500 rpm	If value approximately 0.0 g/s: • Mass air flow meter power source circuit open • VG circuit open or short • E2G circuit open
ENGINE SPD	Engine speed: Min.: 0 rpm, Max.: 16,383 rpm	Idling: 580 to 750 rpm	-
COOLANT TEMP	Engine coolant temperature: Min.: -40°C, Max.: 140°C	After warming up: 80 to 97°C (176 to 207°F)	• If value -40°C (-40°F): sensor circuit open • If value 140°C (284°F): sensor circuit shorted
INTAKE AIR	Intake air temperature: Min.: -40°C, Max.: 140°C	Equivalent to ambient temp. (after cold soak)	
THROTTLE POS	Absolute throttle position sensor/ Minimum: 0 %, Maximum: 100 %	• Throttle fully closed: 10 to 24 % • Throttle fully open: 64 to 96 %	Read value with ignition switch ON (do not start engine)
CTP SW	Closed throttle position switch/ ON or OFF	• Throttle fully closed: ON • Throttle open: OFF	-
VEHICLE SPD	Vehicle speed/ Minimum: 0 km/h, Maximum: 255 km/h	Actual vehicle speed	Speed indicated on speedometer
ACCEL POS #1	Accelerator pedal position sensor No.1 output voltage/ Minimum: 0 V, Maximum: 5 V	• Accelerator pedal released: 0.5 to 1.1 V • Accelerator pedal depressed: 1.2 to 2.0 V	Read value with ignition switch ON (do not start engine)
ACCEL POS #2	Accelerator pedal position sensor No. 2 output voltage/ Minimum: 0 V, Maximum: 5 V	• Accelerator pedal released: 0.5 to 1.1 V • Accelerator pedal depressed: 3.4 to 5.3 V	Read value with ignition switch ON (do not start engine)

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
THROTTLE POS #2	Throttle position No. 2: Min.: 0 V, Max.: 5 V	• 2.1 to 3.1 V: Throttle fully closed • 4.5 to 5.5 V: Throttle fully open	Read value with intrusive operation (active test)
THROTTLE TARGT	Target position of throttle valve/ Minimum: 0 V, Maximum: 5 V	Idling: 0.4 to 1.1 V	-
THROTTLE OPN DUTY	Throttle motor opening duty ratio/ Minimum: 0 %, Maximum: 100 %	Throttle fully closed: 0 %	• When accelerator pedal is depressed, duty ratio is increased • Read value with ignition switch ON (do not start engine)
THROTTLE CLS DUTY	Throttle motor closed duty ratio/ Minimum: 0 %, Maximum: 100 %	Throttle fully open: 0 %	• When accelerator pedal is released quickly, duty ratio is increased • ?Read the value with ignition switch ON (do not start engine)
THROTTLE MOT	Whether or not throttle actuator control is permitted/ ON or OFF	Idling: ON	Read value with ignition switch ON (do not start engine)
+BM	Whether or not accelerator pedal position sensor is detecting idle/ ON or OFF	Idling: ON	-
ACCEL IDL POS	Whether or not accelerator pedal position sensor is detecting idle/ ON or OFF	Idling: ON	-
THROTTLE IDL POS	Whether or not throttle position sensor is detecting idle/ ON or OFF	Idling: ON	-
FAIL #1	Whether or not fail safe function is executed/ ON or OFF	ETCS has failed: ON	-
FAIL #2	Whether or not fail safe function is executed/ ON or OFF	ETCS has failed: ON	-
THROTTLE INITIAL	Throttle fully closed (learned value) Minimum: 0 V, Maximum: 5 V	0.5 to 0.9 V	-
ACCEL LEARN VAL	Accelerator fully closed (learned value) Minimum: 0 V, Maximum: 5 V	0.4 to 0.8 V	-
THROTTLE MOT	Throttle actuator current Minimum: 0 A, Maximum: 20 A	Idling: 0 to 3.0 A	-
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2/ Minimum: 0 V, Maximum: 1.0 V	Driving (50 km/h, 31 mph): 0.1 to 0.9 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check voltage output of each sensor
O2S B2 S2	Heated oxygen sensor output voltage for bank 2 sensor 2/ Minimum: 0 V, Maximum: 1.0 V	Driving (50 km/h, 31 mph): 0.1 to 0.9 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check voltage output of each sensor
AFS B1 S1	A/F sensor output voltage for bank 1 sensor 1/ Minimum: 0 V, Maximum: 7.999 V	Idling 2.8 to 3.8 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check voltage output of each sensor
AFS B2 S1	A/F sensor output voltage for bank 2 sensor 1/ Minimum: 0 V, Maximum: 7.999 V	Idling 2.8 to 3.8 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check voltage output of each sensor
VAPOR PRESS	Vapor Pressure/ Minimum: -4.125 kPa, Maximum: 2.125 kPa	Fuel tank cap removed: 0 kPa	Pressure inside of fuel tank as read by the vapor pressure sensor

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
SHORT FT #1	Short term fuel trim of bank 1/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	This item is short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #1	Long term fuel trim of bank 1/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	This item is overall, long-term fuel compensation that helps to maintain air-fuel ratio at stoichiometric air-fuel ratio (steadies long term deviations of short-term fuel trim from central value)
TOTAL FT #1	Total fuel trim of bank 1: Average value for fuel trim system of bank 1/ Minimum: 0.5, Maximum: 1.496	Idling: 0.5 to 1.4	-
SHORT FT #2	Short term fuel trim of bank 2/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	This item is short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #2	Long term fuel trim of bank 2/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	This item is overall, long-term fuel compensation that helps to maintain air-fuel ratio at stoichiometric air-fuel ratio (steadies long term deviation of short-term fuel trim from central value)
TOTAL FT #2	Total fuel trim of bank 2: Average value for fuel trim system of bank 2/ Minimum: 0.5, Maximum: 1.496	Idling: 0.5 to 1.4	-
O2FT B1 S2	Short term fuel trim associated with the bank 1 sensor 2/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	Same as SHORT FT #1
O2FT B2 S2	Short term fuel trim associated with the bank 2 sensor 2/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	Same as SHORT FT #2
AF FT B1 S1	Short term fuel trim associated with bank 1 sensor 1/ Minimum: 0, Maximum: 1.999	• Value less than 1 (0.000 to 0.999) = Lean • Stoichiometric air-fuel ratio = 1 • Value greater than 1 (1.001 to 1.999) = Rich	-
AF FT B2 S1	Short term fuel trim associated with bank 2 sensor 1/ Minimum: 0, Maximum: 1.999	• Lean: 0 more than AF FT B2 S1 less than 1 • Stoichiometric air-fuel ratio = 1 • Rich: 1 more than AF FT B2 S1less than 1.999	-
FUEL SYS #1	Fuel system status (Bank 1) / OL or CL or OL DRIVE or OL FAULT or CL FAULT	Idling after warming up: CL	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor(s) as feed back for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but one of heated oxygen sensors, which is used for fuel control, is malfunctioning

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
FUEL SYS #2	Fuel system status (Bank 2) / OL or CL or OL DRIVE or OL FAULT or CL FAULT	Idling after warming up: CL	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor(s) as feed back for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but one of heated oxygen sensors, which is used for fuel control, is malfunctioning
FC IDL	Fuel cut idle/ ON or OFF	Fuel cut operation: ON	FC IDL = ON when throttle valve is fully closed and engine speed is over 1,500 rpm
MIL	MIL status/ ON or OFF	MIL ON: ON	-
STARTER SIG	Starter signal/ ON or OFF	Cranking: ON	-
A/C SIG	A/C signal/ ON or OFF	A/C ON: ON	-
PNP SW [NSW]	PNP switch signal/ ON or OFF	P or N position: ON	-
ELECT LOAD SIG	Electrical load signal/ ON or OFF	• Taillight switch ON: ON • Defogger switch ON: ON	-
STOP LIGHT SW	Stop light switch/ ON or OFF	• Brake pedal depressed: ON • Brake pedal released: OFF	-
PS OIL PRESS SW	Power steering oil pressure switch signal/ ON or OFF	• While turning the steering wheel: ON • While not turning the steering wheel: OFF	Idle-up control is performed when PS is ON
PS SIGNAL	Power steering signal/ ON or OFF	When steering wheel is turned	This signal is usually ON until the Ignition switch is turned OFF
INTAKE CTL VSV1	VSV status for intake control (bank 1)/ ON or OFF	VSV operation: ON	-
INTAKE CTL VSV 2	VSV status for intake control (bank 2)/ ON or OFF	VSV operation: ON	-
FUEL PUMP / SPD	Fuel pump/speed status/ ON/H or OFF/M,L	Idling: ON	-
A/C MAG CLUTCH	A/C magnet clutch status/ ON or OFF	A/C magnet clutch ON: ON	-
EVAP VSV	VSV status for EVAP control/ ON or OFF	VSV operating: ON	EVAP VSV is controlled by the ECM (ground side duty control)
BOOST PRESS VSV	VSV status for boost pressure control/ ON or OFF	VSV operating: ON	-
IGNITION	Ignition counter/ Minimum: 0, Maximum: 600	0 to 600	-
CYL #1, #2, #3, #4, #5, #6	Misfire ratio of cylinder 1 to 6/ Minimum: 0 %, Maximum: 50 %	0 %	This item is displayed in only idling
MISFIRE LOAD	Engine load for first misfire range/ Minimum: 0 g/rev, Maximum: 3.98 g/rev.	Misfire 0: 0 g/rev.	-
MISFIRE RPM	Engine RPM for first misfire range/ Minimum: 0 rpm, Maximum: 6,375 rpm	Misfire 0: 0 rpm	-
FC TAU	Fuel Cut TAU: Fuel cut during very light load/ ON or OFF	Fuel cut operating: ON	Fuel cut is being performed under very light load to prevent engine combustion from becoming incomplete
CHECK MODE	Check mode/ ON or OFF	Check mode ON: ON	-

HINT:
*1: If no idling conditions are specified, the transmission gear selector lever should be in the N or P position, and the A/C switch and all accessory switches should be OFF.

2. ACTIVE TEST

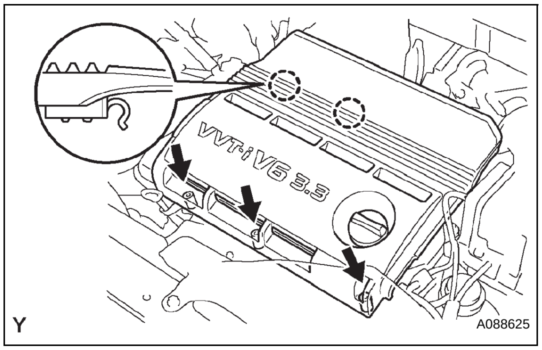
HINT:
Performing the intelligent tester's ACTIVE TEST allows relay, VSV, actuator and other items to be operated without removing any parts. Performing the ACTIVE TEST early in troubleshooting is one way to save time. The DATA LIST can be displayed during the ACTIVE TEST.

(a) Warm up the engine.
(b) Turn the ignition switch OFF.
(c) Connect the intelligent tester or the OBD II scan tool to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn ON the intelligent tester or the OBD II scan tool.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST.
(g) According to the display on tester, perform the "ACTIVE TEST".

Intelligent Tester Displays	Test Details	Diagnostic Note
INJ VOL	[Test Details] Control injection volume Minimum: -12.5 %, Maximum: 25 % [Vehicle Condition] Engine speed: 3,000 rpm or less	• All injectors are tested at once • Injection volume is gradually changed between -12.5 and 25 %
A/F CONTROL	[Test Details] Control injection volume -12.5 or 25 % (change injection volume -12.5 % or 25 %) [Vehicle Condition] Engine speed: 3,000 rpm or less	Following A/F CONTROL procedure enables technician to check and graph voltage outputs of both the A/F sensor and heated oxygen sensor For displaying graph, enter "ACTIVE TEST / A/F CONTROL / USER DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES" and push "ENTER". Then press "F4"
INTAKE CTL VSV1	[Test Details] Activate VSV for intake control ON or OFF	-
CAN CTRL VSV	[Test Details] Activate VSV for canister control ON or OFF	-
EVAP VSV (ALONE)	[Test Details] Activate VSV for canister control ON or OFF	-
A/C MAG CLUTCH	[Test Details] Activate VSV for canister control ON or OFF	-
FUEL PUMP / SPD	Test Details] Control A/C magnet clutch ON or OFF	-
VVT CTRL B1	[Test Details] Active VVT system (Bank 1) ON or OFF	• ON: Rough idle or engine stall • OFF: Normal engine speed
VVT CTRL B2	[Test Details] Active VVT system (Bank 2) ON or OFF	• ON: Rough idle or engine stall • OFF: Normal engine speed
ACM INHIBIT	[Test Details] Control ACM inhibit ON or OFF	-
TC/TE1	[Test Details] Connect TC and TE1 ON or OFF	-
FC IDL PROHBT	[Test Details] Control idle fuel cut prohibit ON or OFF	-

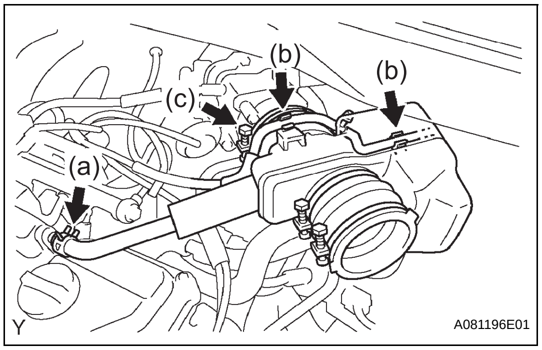
REMOVAL

1. **DRAIN ENGINE COOLANT (See page CO-7)**
2. **REMOVE FRONT SUSPENSION UPPER BRACE CENTER**
   (a) Remove the 2 nuts and upper brace.

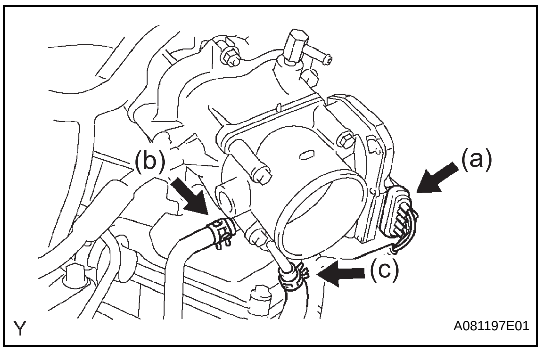


3. **REMOVE V-BANK COVER SUB-ASSEMBLY**
   (a) Using a 5 mm socket hexagon wrench, remove the 3 nuts.
   (b) Remove the V-bank cover.
4. **REMOVE AIR CLEANER INLET ASSEMBLY**
5. **REMOVE AIR CLEANER ASSEMBLY**

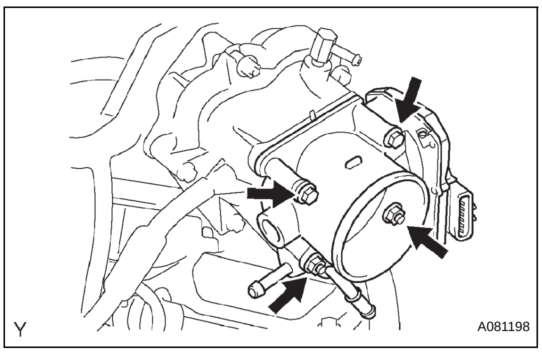
ES



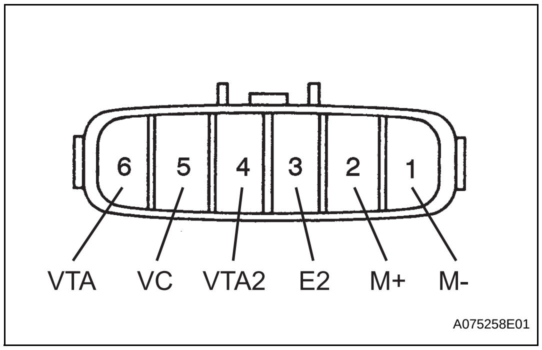
6. **REMOVE INTAKE AIR RESONATOR**
   (a) Remove the ventilation hose No. 2.
   (b) Remove the fuel vapor feed hose from the 2 hose clamps.
   (c) Loosen the air cleaner hose clamp bolt, and then remove the intake air resonator.



7. **REMOVE THROTTLE BODY ASSEMBLY**
   (a) Disconnect the throttle control motor & throttle position sensor connector.
   (b) Disconnect the water by-pass hose No. 2.
   (c) Disconnect the water by-pass hose No. 3.



   (d) Remove the 2 bolts, 2 nuts and throttle body.
   (e) Remove the gasket.



INSPECTION

1. INSPECT THROTTLE BODY ASSEMBLY

(a) Measure the resistance between the terminals.

Resistance

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω
5 (VC) - 3 (E2)	20°C (68°F)	1.2 to 3.2 Ω

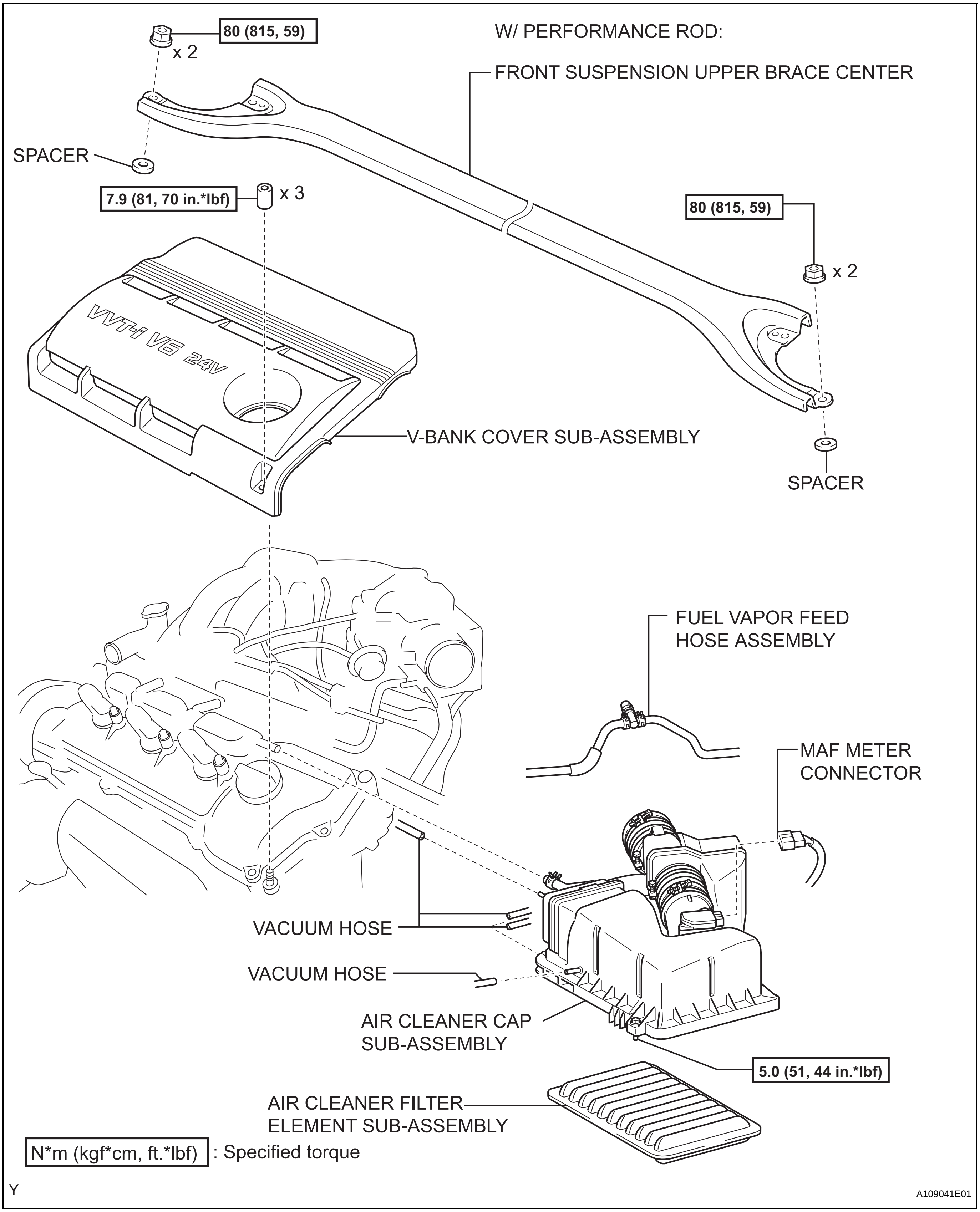
If the result is not as specified, replace the throttle body assembly.

INSTALLATION

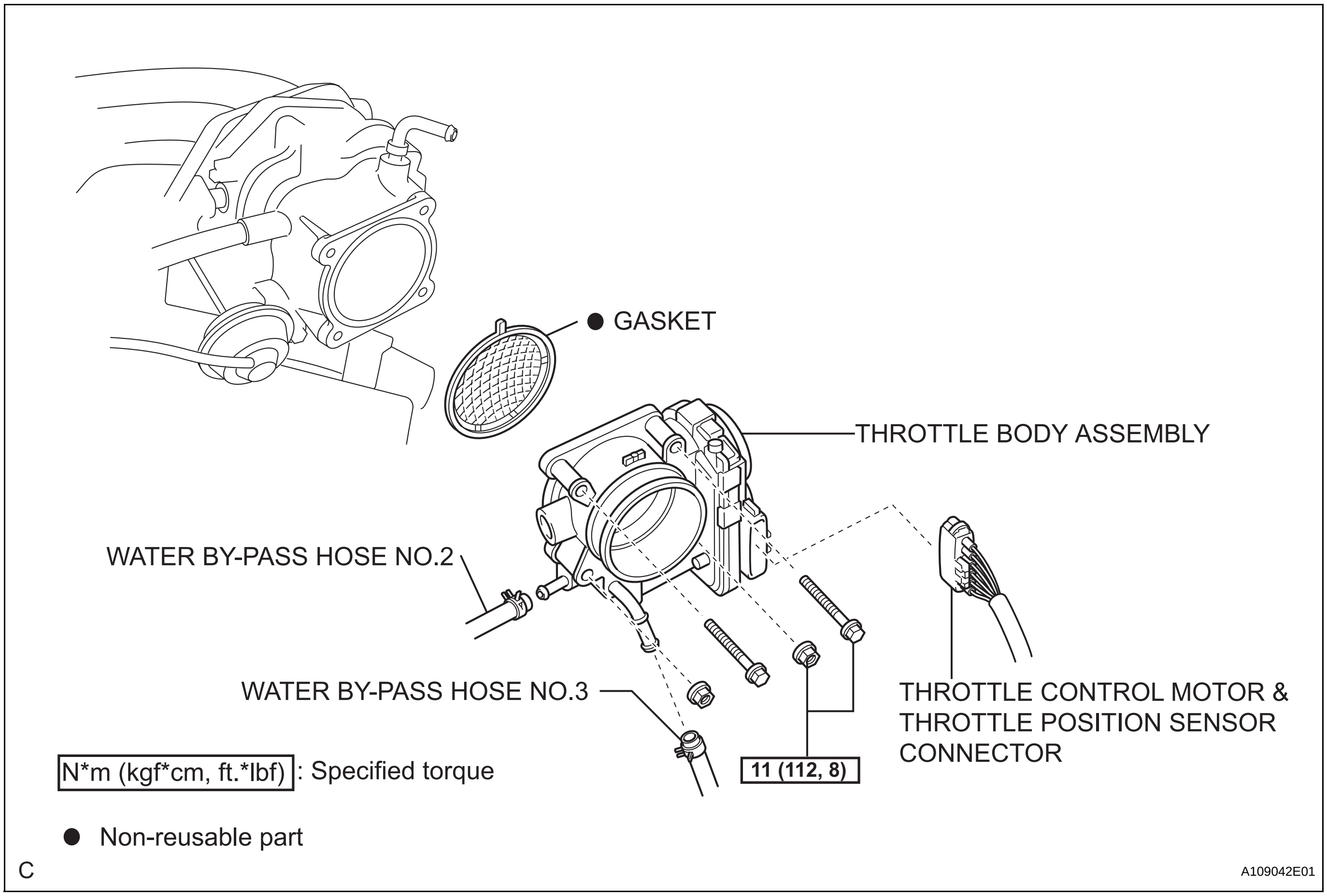
1. **INSTALL THROTTLE BODY ASSEMBLY**
   (a) Install a new gasket to the intake air connector.
   (b) Install the throttle body with the 2 bolts and 2 nuts.
   Torque: 11 N*m (112 kgf*cm, 8 ft.*lbf)
   (c) Connect the water by-pass hose No. 3.
   (d) Connect the water by-pass hose No. 2.
   (e) Connect the throttle control motor & throttle position sensor connector.
2. **INSTALL INTAKE AIR RESONATOR**
3. **INSTALL AIR CLEANER ASSEMBLY (See page IG-7)**
4. **INSTALL AIR CLEANER INLET ASSEMBLY**
5. **CHECK CONNECTION OF VACUUM HOSE**
6. **ADD ENGINE COOLANT (See page CO-7)**
7. **CHECK FOR ENGINE COOLANT LEAKS**
8. **INSTALL V-BANK COVER SUB-ASSEMBLY**
   (a) Fit the 2 retainers and install the V-bank cover.
   (b) Using a 5 mm socket hexagon wrench 5, tighten the 3 nuts.
   Torque: 7.9 N*m (81 kgf*cm, 70 in.*lbf)
9. **INSTALL FRONT SUSPENSION UPPER BRACE CENTER**
   (a) Install the upper brace with the 2 nuts.
   Torque: 80 N*m (815 kgf*cm, 59 ft.*lbf)

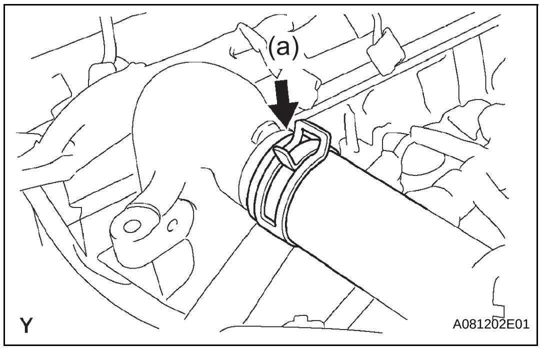
THROTTLE BODY

COMPONENTS

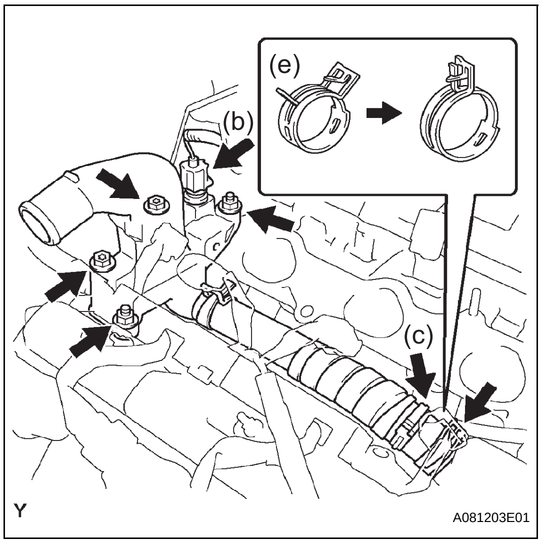


ES

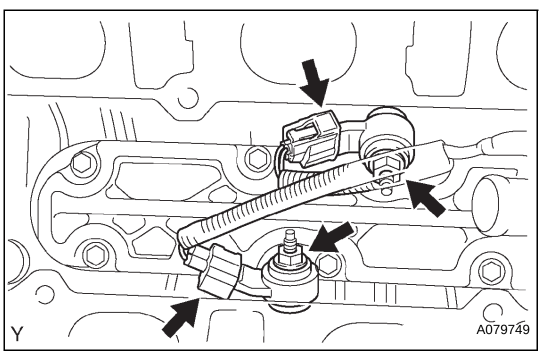

GASKET
THROTTLE BODY ASSEMBLY
WATER BY-PASS HOSE NO.2
WATER BY-PASS HOSE NO.3
THROTTLE CONTROL MOTOR & THROTTLE POSITION SENSOR CONNECTOR
11 (112, 8)
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
C
A109042E01



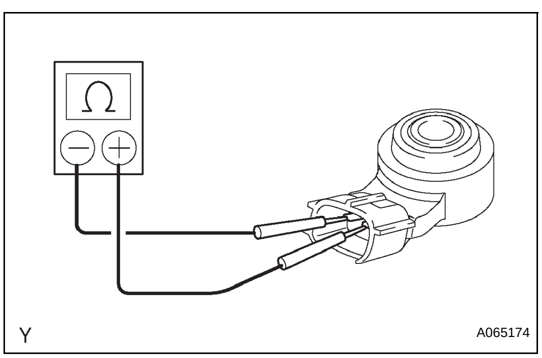
9. **REMOVE WATER OUTLET**
   (a) Disconnect the radiator hose inlet.



   (b) Disconnect the ECT sensor connector.
   (c) Remove the clamp.
   (d) Remove the 2 bolts, 2 nuts and 2 washers.
   (e) Lock the hose clamp as shown in the illustration. Then remove the water outlet together with the water by-pass hose No. 1.
   (f) Remove the 2 gaskets from the 2 cylinder heads.



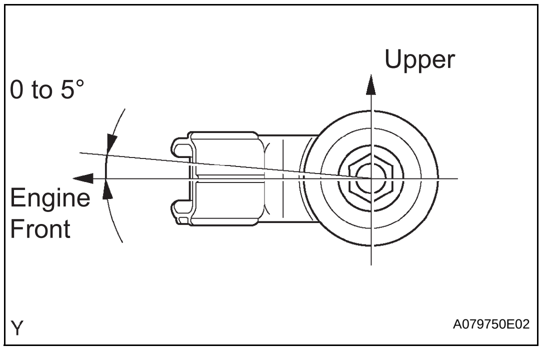
10. **REMOVE KNOCK SENSOR**
   (a) Disconnect the 2 knock sensor connectors.
   (b) Remove the 2 nuts and 2 knock sensors.



INSPECTION

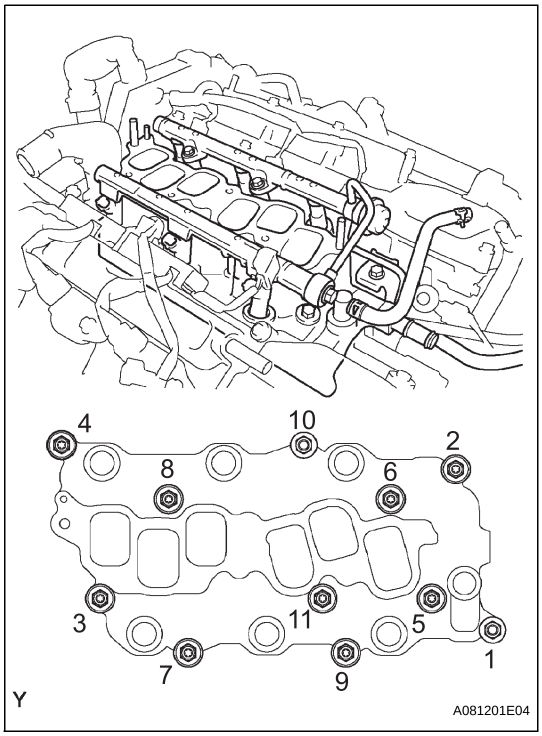
1. **INSPECT KNOCK SENSOR**
   (a) Using an ohmmeter, measure the resistance between the terminals.
   Resistance:
   120 to 280 kΩ at 20°C (68°F)
   If the result is not as specified, replace the sensor.

INSTALLATION

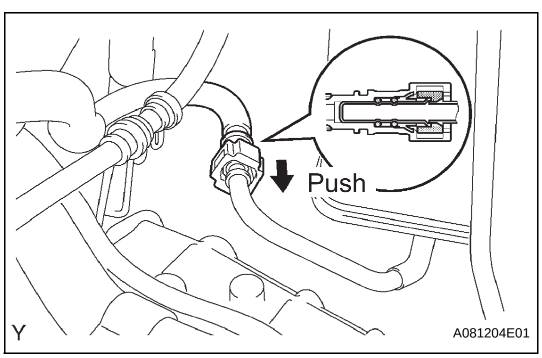


1. **INSTALL KNOCK SENSOR**
   (a) Install the 2 knock sensors with the 2 nuts, as shown in the illustration.
   Torque: 20 N*m (199 kgf*cm, 14 ft.*lbf)
   (b) Connect the 2 knock sensor connectors.

2. **INSTALL WATER OUTLET**
   (a) Install 2 new gaskets to the 2 cylinder heads.
   (b) Install the water outlet together with the water bypass hose No. 1 and unlock the hose clamp.
   (c) Tighten the 2 bolts, 2 nuts and 2 washers.
   Torque: 15 N*m (153 kgf*cm, 11 ft.*lbf)
   (d) Install the clamp.
   (e) Connect the ECT sensor connector.
   (f) Connect the radiator hose inlet.



3. **INSTALL INTAKE MANIFOLD**
   (a) Tighten the intake manifolds's 9 bolts and 2 nuts uniformly in the numerical order shown in the illustration.
   Torque: 15 N*m (153 kgf*cm, 11 ft.*lbf)
   NOTICE:
   Fully tightening one of these bolts or nuts without partially tightening the other bolts or nuts in the group may damage the intake manifold, bolts and nuts.
   (b) Retighten the water outlet mounting bolts and nuts.
   Torque: 15 N*m (153 kgf*cm, 11 ft.*lbf)
   (c) Install the ground cable with the nut.
   Torque: 8.4 N*m (86 kgf*cm, 74 in.*lbf)
   (d) Connect the heater inlet water hose.



   (e) Connect the fuel pipe No. 1.
      (1) Push the quick connector into the pipe until a "click" sound is heard.
      NOTICE:
      - **Check if there is any damage or contamination on the connected part.**
      - **After connecting, confirm that the connector and pipe are securely connected by trying to pull them apart.**
      (2) Install the fuel pipe clamp.

4. **INSTALL INTAKE AIR SURGE TANK**

5. **INSTALL EMISSION CONTROL VALVE SET**

6. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY**

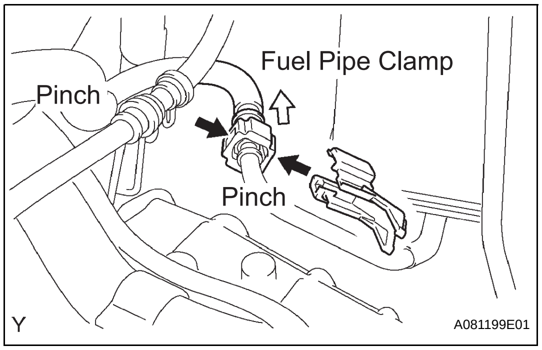
7. **CHECK CONNECTION OF VACUUM HOSE**

8. **ADD ENGINE COOLANT**
9. **CHECK FOR ENGINE COOLANT LEAKS (See page CO-7)**
10. **CHECK FOR FUEL LEAKS (See page FU-19)**
11. **INSTALL V-BANK COVER SUB-ASSEMBLY (See page ES-360)**

KNOCK SENSOR

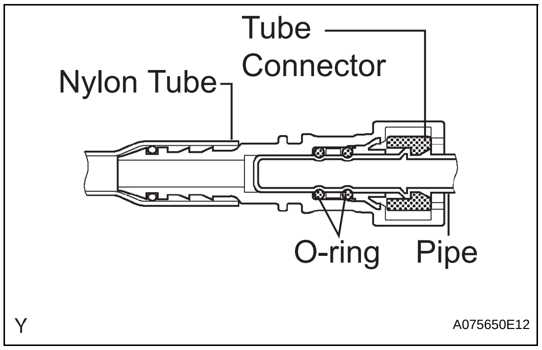
REMOVAL

1. **DISCHARGE FUEL SYSTEM PRESSURE (See page FU-8)**
2. **DRAIN ENGINE COOLANT (See page CO-7)**
3. **REMOVE V-BANK COVER SUB-ASSEMBLY (See page ES-358)**
4. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY**
5. **REMOVE EMISSION CONTROL VALVE SET**
6. **REMOVE INTAKE AIR SURGE TANK**
7. **REMOVE INTAKE MANIFOLD**



(a) Disconnect the fuel pipe No. 1.

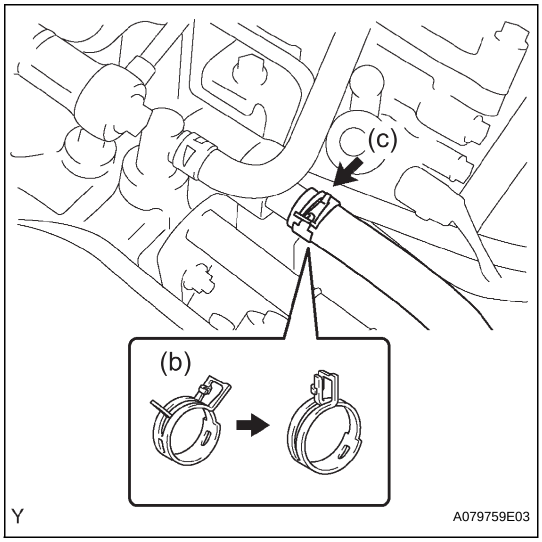
(1) Remove the fuel pipe clamp.



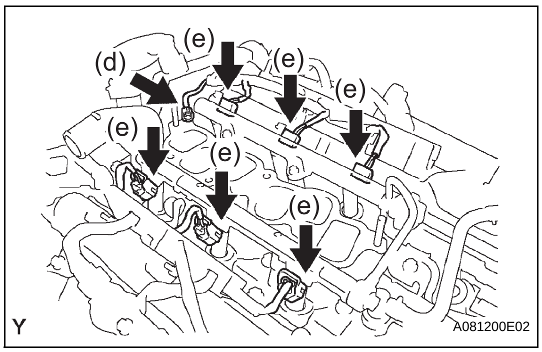
(2) Pinch the tube connector and then pull out the fuel pipe No. 1.

NOTICE:

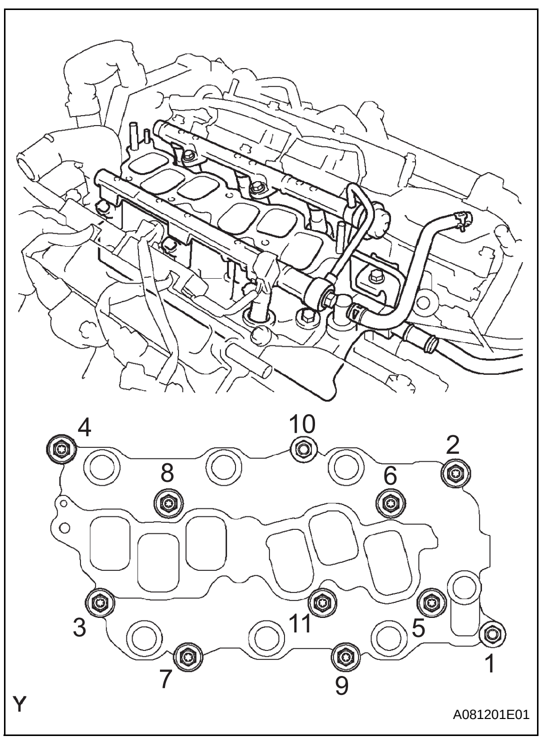
- **Check the connector for dirt, mud or other contamination. Clean if necessary.**
- **Be sure to keep the tube connector, pipe and O-ring clean. They can become contaminated easily.**
- **Do not use tools when disconnecting the fuel pipe.**
- **Do not bend or twist the nylon tube. Protect the connector by covering it with a vinyl or plastic bag.**
- **When the pipe and the connector are stuck, push and pull the connector to release it. Then pull the connector out carefully.**



(b) Lock the hose clamp, as shown in the illustration.
(c) Disconnect the heater inlet water hose.



(d) Remove the nut and disconnect the ground cable.
(e) Disconnect the 6 fuel injector connectors.



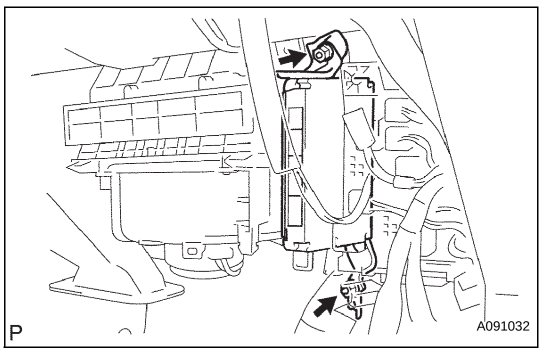
(f) Loosen and remove the intake manifold's 9 bolts and 2 nuts uniformly in the numerical order shown in the illustration.
(g) Remove the intake manifold.
NOTICE:
Fully removing each bolt and nut one by one may damage the intake manifold, bolts and nuts.

8. REMOVE ENGINE MOVING CONTROL ROD

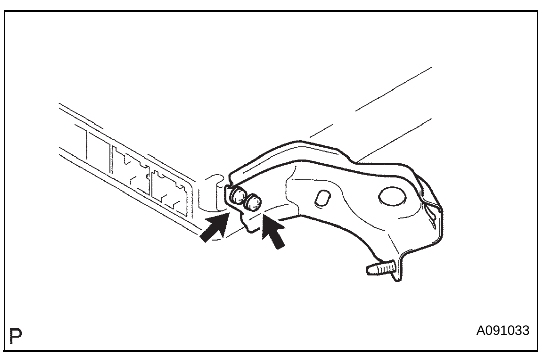
ECM

REMOVAL

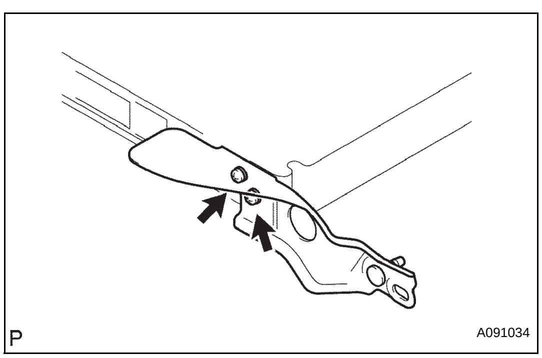
1. DISCONNECT BATTERY NEGATIVE TERMINAL
2. REMOVE FRONT DOOR SCUFF PLATE RH (for Coupe) (See page IR-4)
3. REMOVE FRONT DOOR SCUFF PLATE RH (See page IR-9)
4. REMOVE COWL SIDE TRIM SUB-ASSEMBLY RH (See page IR-4)
5. REMOVE COWL SIDE TRIM SUB-ASSEMBLY RH (See page IR-9)
6. REMOVE NO.1 INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY (See page IP-11)
7. REMOVE INSTRUMENT PANEL FINISH LOWER PANEL RH (See page IP-11)



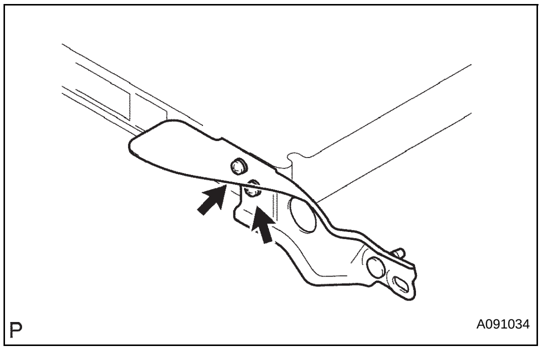
8. REMOVE ECM
   (a) Remove the 2 wire harness clamps.
   (b) Disconnect the 5 ECM connectors.
   (c) Remove the 2 nuts and ECM.



9. REMOVE ECM BRACKET
   (a) Remove the 2 screws and ECM bracket.



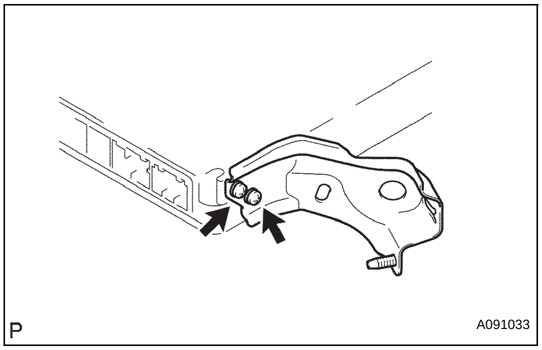
10. REMOVE ECM BRACKET NO.2
    (a) Remove the 2 screws and ECM bracket.



INSTALLATION

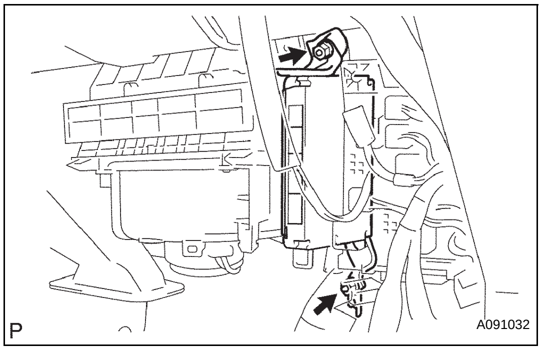
1. INSTALL ECM BRACKET NO.2

(a) Install the ECM bracket with the 2 screws.



2. INSTALL ECM BRACKET

(a) Install the ECM bracket with the 2 screws.



3. INSTALL ECM

(a) Install the 2 wire harness clamps.

(b) Connect the 5 ECM connectors.

(c) Install the ECM with the 2 nuts.

Torque: 5.5 N*m (56 kgf*cm, 49 in.*lbf)

4. INSTALL INSTRUMENT PANEL FINISH LOWER PANEL RH

5. INSTALL INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY NO.1

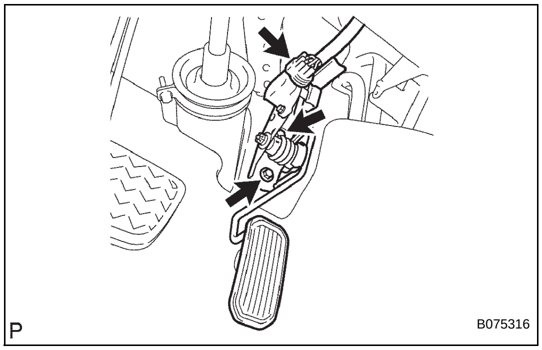
6. INSTALL COWL SIDE TRIM SUB-ASSEMBLY RH

7. INSTALL FRONT DOOR SCUFF PLATE RH

8. CONNECT BATTERY NEGATIVE TERMINAL

9. INITIALIZE SYSTEM

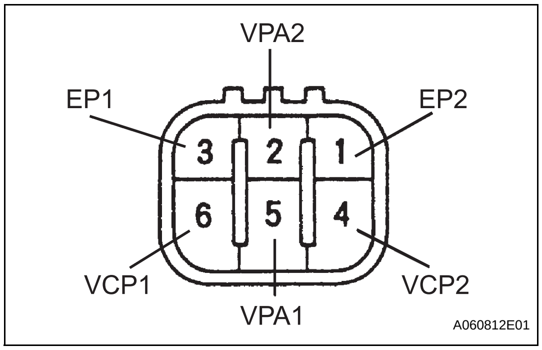
ES



ACCELERATOR PEDAL

REMOVAL

1. **REMOVE ACCELERATOR PEDAL ASSEMBLY**
   (a) Disconnect the accelerator position sensor connector.
   (b) Remove the 2 bolts and accelerator pedal.



INSPECTION

1. **INSPECT ACCELERATOR PEDAL ASSEMBLY**
   (a) Measure the resistance between the terminals.
   Standard

Tester Connection	Specified Condition
2 (VPA2) - 3 (EP1)	5.0 kΩ or less
5 (VPA1) - 1 (EP2)	5.0 kΩ or less
6 (VCP1) - 3 (EP1)	2.25 to 4.75 kΩ
4 (VCP2) - 1 (EP2)	2.25 to 4.75 kΩ

If the result is not as specified, replace the pedal assy.

INSTALLATION

1. INSTALL ACCELERATOR PEDAL ASSEMBLY

(a) Connect the accelerator position sensor connector.

(b) Install the accelerator pedal with the 2 bolts.

Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)