

DEFINITION OF TERMS

Term	Definition
Monitor description	Description of what the ECM monitors and how it detects malfunctions (monitoring purpose and its details).
Related DTCs	Diagnostic codes
Typical enabling condition	Preconditions that allow the ECM to detect malfunctions. With all preconditions satisfied, the ECM sets the DTC when the monitored value(s) exceeds the malfunction threshold(s).
Sequence of operation	The priority order that is applied to monitoring, if multiple sensors and components are used to detect the malfunction. When a sensor is being monitored, the next sensor or component will not be monitored until the current sensor monitoring is finished.
Required sensor/ components	The sensors and components that are used by the ECM to detect malfunctions.
Frequency of operation	The number of times that the ECM checks for malfunctions per driving cycle. "Once per driving cycle" means that the ECM detects the malfunction only once during a single driving cycle. "Continuous" means that the ECM detects the malfunction every time an enabling condition is met.
Duration	The minimum time that the ECM must sense a continuous deviation in the monitored value(s) before setting a DTC. This timing begins after the "typical enabling conditions" are met.
Malfunction thresholds	Beyond this value, the ECM will conclude that there is a malfunction and set a DTC.
MIL operation	MIL illumination timing after a defect is detected. "Immediately" means that the ECM illuminates the MIL the instant the ECM determines that there is a malfunction. "2 driving cycle" means that the ECM illuminates the MIL if the same malfunction is detected again in the 2nd driving cycle.

PART AND SYSTEM NAME LIST

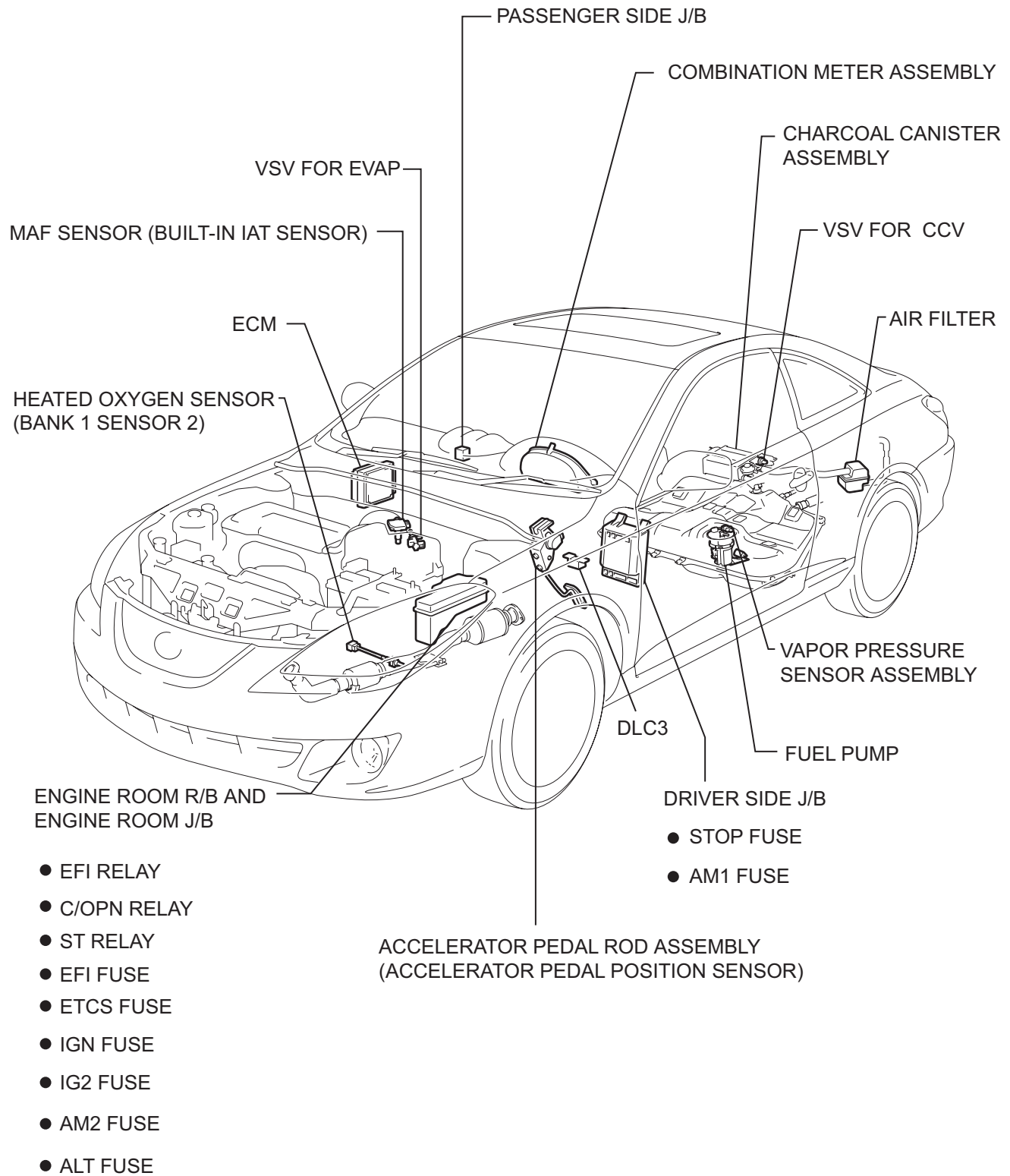
This reference list indicates the part names used in this manual along with their definitions.

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, VVTL	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 meter 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
CCV, Canister close valve VSV for canister control	Evaporative emissions canister vent valve
EVAP VSV, 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
O2 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 press 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 skid 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

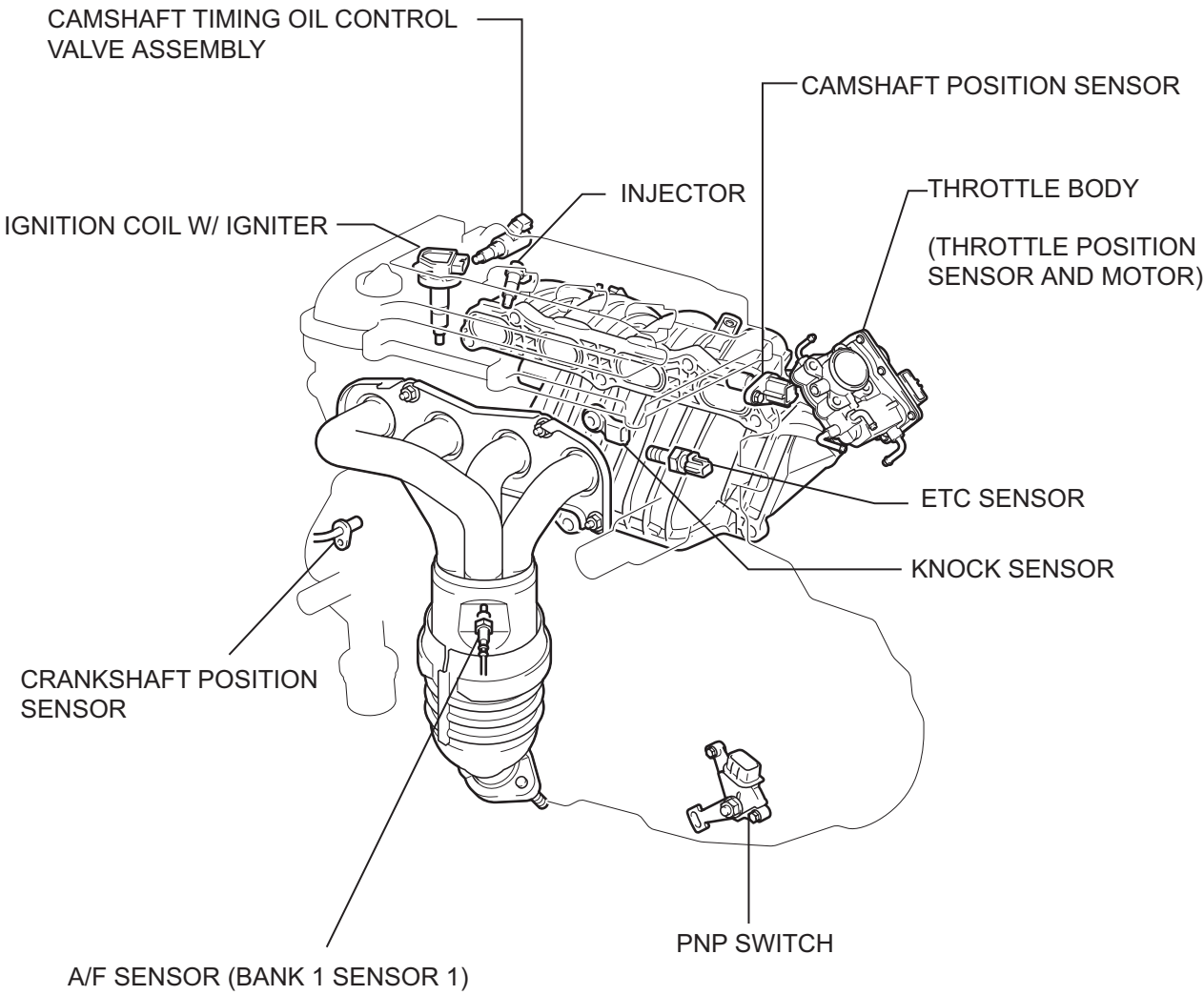
ES

TOYOTA/LEXUS name	Definition
Intermediate shaft speed sensor "A"	Counter gear speed sensor
Output speed sensor	Output shaft speed sensor
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

PARTS LOCATION

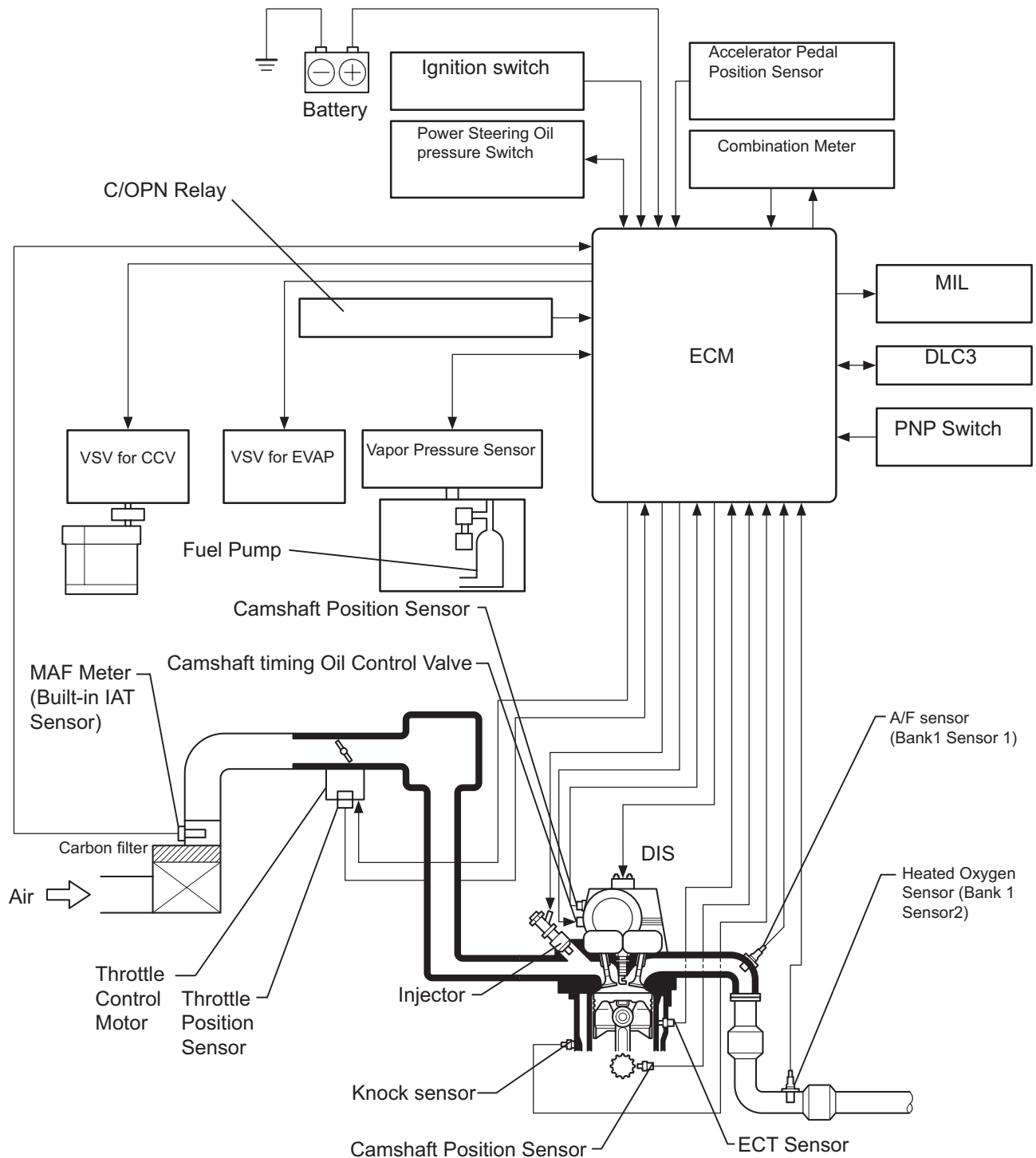


ES



SYSTEM DIAGRAM

The engine control system is controlled by the ECM based on signals from various sensors.



CHECK FOR INTERMITTENT PROBLEMS

Intelligent tester only:

Inspect the vehicle's ECM using check mode. Intermittent problems are easier to detect when the ECM is in check mode with the intelligent tester. In check mode, the ECM uses 1 trip detection logic, which has a higher sensitivity to malfunctions than normal mode (default), which uses 2 trip detection logic.

1. **Clear the DTCs (See page [ES-28](#)).**
2. **Set the check mode (See page [ES-29](#)).**
3. **Perform a simulation test (See page [IN-26](#)).**
4. **Check the connector and terminal (See page [IN-34](#)).**
5. **Wiggle the harness and the connector (See page [IN-34](#)).**

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 Conditions
P0031 P0032 P0037 P0038	Turn off heater	Ignition switch OFF
P0100 P0102 P0103	Ignition timing is calculated from engine speed and throttle angle	"Pass" condition detected
P0110 P0112 P0113	Intake air temperature is fixed at 20°C (68°F)	"Pass" condition detected
P0115 P0116 P0117 P0118	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	<p>If the Electronic Throttle Control System (ETCS) has a malfunction, the ECM cuts off current to the throttle control motor. 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.</p> <p>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.</p>	"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.
P0325 P0327 P0328	Maximum timing retardation	Ignition switch OFF
P0351 P0352 P0353 P0354	Fuel is cut	"Pass" condition detected
P2120 P2121 P2122 P2123 P2125 P2127 P2128 P2138	<p>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 remaining circuit is used to calculate the accelerator pedal opening to allow the vehicle to continue driving.</p> <p>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.</p>	"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.

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 shorten labor 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 or the OBD II scan tool.
- (f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST.
- (g) According to the display on tester, read the "DATA LIST".

ES

Intelligent Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
INJECTOR	Injection period/ Minimum: 0 ms, Maximum: 32.64 ms	Idling: 1.92 to 3.37 ms	-
IGN ADVANCE	Ignition timing advance/ Minimum: -64 deg., Maximum: 63.5 deg.	Idling: BTDC 5 to 15 deg.	-
CALC LOAD	Calculated load by ECM/ Minimum: 0%, Maximum: 100%	<ul style="list-style-type: none"> Idling: 3.3 to 26.7% Racing without load (2,500 rpm): 12.0 to 14.7% 	-
MAF	Air flow rate from MAF meter/ Minimum: 0 gm/s, Maximum: 655 gm/s	<ul style="list-style-type: none"> Idling: M/T 0.54 to 4.33 gm/second A/T 0.58 to 4.67 gm/second Racing without load (2,500 rpm): 3.33 to 9.17 gm/second. 	If the value is approximately 0.0 gm/s: <ul style="list-style-type: none"> Mass air flow meter power source circuit open VG circuit open or short If the value is 160.0 gm/s or more: <ul style="list-style-type: none"> EVG circuit open
ENGINE SPD	Engine Speed/ Minimum: 0 rpm, Maximum: 16,383 rpm	Idling: M/T 650 to 750 rpm A/T 550 to 750 rpm	-
COOLANT TEMP	Coolant temperature/ Minimum: -40 °C, Maximum: 140 °C	After warming up: 80 to 95°C (176 to 203°F)	<ul style="list-style-type: none"> If the value is -40°C (-40°F): sensor circuit is open If the value is 140°C (284°F) or more: sensor circuit is shorted
INTAKE AIR	Intake air temperature/ Minimum: -40 °C, Maximum: 140 °C	Equivalent to Ambient Temp. (after cold soak)	<ul style="list-style-type: none"> If the value is -40°C (-40°F): sensor circuit is open If the value is 140°C (284°F) or more: sensor circuit is shorted
THROTTLE POS	Absolute throttle position sensor/ Minimum: 0%, Maximum: 100%	<ul style="list-style-type: none"> Throttle fully closed: 6 to 16% Throttle fully open: 64 to 98% 	Read the value with the ignition switch ON (do not start engine)
CTP SW	Closed throttle position switch/ ON or OFF	<ul style="list-style-type: none"> Throttle fully closed: ON Throttle open: OFF 	-

Intelligent Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
VEHICLE SPD	Vehicle speed/ Minimum: 0 km/h, Maximum: 255 km/h	Vehicle stopped: 0 mph (0 km/h)	Speed indicated on speedometer
ACCEL POS #1	Accelerator pedal position sensor No.1 output voltage/ Minimum: 0 V, Maximum: 5 V	<ul style="list-style-type: none"> Accelerator pedal released 0.5 to 1.1 V Accelerator pedal depressed: 2.6 to 4.5 V 	Read the value when ignition switch ON (do not start engine)
ACCEL POS #2	Accelerator pedal position sensor No.2 output voltage/ Minimum: 0 V, Maximum: 5 V	<ul style="list-style-type: none"> Accelerator pedal released: 1.2 to 2.0 V Accelerator pedal depressed: 3.4 to 5.3 V 	Read the value when ignition switch ON (do not start engine)
THROTTLE POS #2	Throttle position sensor No.2 output voltage/ Minimum: 0 V, Maximum: 5 V	<ul style="list-style-type: none"> Throttle fully closed: 2.1 to 3.1 V Throttle fully open: 4.5 to 5.5 V 	Read the value when ignition switch ON (do not start engine)
THROTTLE TARGT	Target position of throttle valve/ Minimum: 0 V, Maximum: 5 V	Idling: 0.4 to 1.1 V	Read the value when ignition switch ON (do not start engine)
THROTTLE OPN DUTY	Throttle motor opening duty ratio/ Minimum: 0%, Maximum: 100%	Throttle fully closed: 0%	<ul style="list-style-type: none"> When accelerator pedal is depressed, duty ratio is increased Read the value when ignition switch ON (do not start engine)
THROTTLE CLS DUTY	Throttle motor closed duty ratio/ Minimum: 0%, Maximum: 100%	Throttle fully open: 0%	<ul style="list-style-type: none"> When accelerator pedal is quickly released, duty ratio is increased Read the value when ignition switch ON (do not start engine)
THROTTLE MOT	Whether or not throttle motor control is permitted/ ON or OFF	Idling: ON	Read the value when ignition switch ON (do not start engine)
+BM	Whether or not electric throttle control system power is input/ ON or OFF	Idling: ON	-
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
O2S B1 S2	Oxygen sensor output voltage of the bank 1 sensor 2/ Minimum: 0 V, Maximum: 1.275 V	Idling: 0.1 to 0.9 V	Performing INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of each sensor
AFS B1 S1	A/F sensor output voltage of the 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 the ACTIVE TEST enables the technician to check voltage output of each sensor
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	-

Intelligent Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
ACCEL LEARN VAL	Accelerator fully closed (learned value) Minimum: 0 V, Maximum: 5 V	0.4 to 0.8 V	-
THROTTLE MOT	Throttle motor current Minimum: 0 A, Maximum: 20 A	Idling: 0 to 3.0 A	-
SHORT FT #1	Short term fuel trim of bank 1/ Minimum: -100 %, Maximum: 100%	0 +- 20 %	This item is the 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 the 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 the central value).
TOTAL FT #1	Total fuel trim of bank 1/ Minimum: 0.5, Maximum: 1.496	Idling: 0.5 to 1.4	-
AF FT B1 S1	Short term fuel trim associated with the bank 1, sensor 1/ Minimum: 0, Maximum: 1.999	<ul style="list-style-type: none"> 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 	-
FUEL SYS #1	Fuel system status (Bank 1) / OL or CL or OLDRIVE or OLFAULT or CLFAULT	Idling after warming up: CL	<ul style="list-style-type: none"> 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	Idle fuel cut/ 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	Defogger switch ON: ON	-
STOP LIGHT SW	Stop light switch/ ON or OFF	<ul style="list-style-type: none"> Brake pedal depressed: ON Brake pedal released: OFF 	-
PS OIL PRESS SW	Power steering signal/ ON or OFF	<ul style="list-style-type: none"> While turning the steering wheel: ON While not turning the steering wheel: OFF 	The idle-up control is performed when PS is ON
PS SIGNAL	Power steering signal/ ON or OFF	When the steering wheel is turned	This signal is usually ON until the IG switch is turned OFF
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)

Intelligent Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
VVT CTRL B1	VVT control status (Bank 1) / ON or OFF	VVT system operation: ON	-
IGNITION	Ignition counter/ Minimum: 0, Maximum: 400	0 to 400	-
CYL #1, #2, #3, #4	Misfire ratio of the cylinder 1/ 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	(See page ES-29)

*: If no conditions are specifically stated for "Idling", the shift lever is in the N or P position, the A/C switch is OFF and all accessory switches are OFF.

2. ACTIVE TEST

HINT:

Performing the intelligent tester's ACTIVE LIST allows relay, VSV, actuator and other items to be operated without removing any parts. Performing the ACTIVE LIST early in troubleshooting is one way to shorten labor time. The DATA LIST can be displayed during the ACTIVE TEST.

- Warm up the engine.
- Turn the ignition switch OFF.
- Connect the intelligent tester or the OBD II scan tool to the DLC3.
- Turn the ignition switch ON.
- Turn ON the intelligent tester or the OBD II scan tool.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST.
- According to the display on tester, perform the "ACTIVE TEST."

Intelligent Tester Display	Test Details	Diagnostic Note
INJ VOL	[Test Details] Control the injection volume Minimum: -12.5%, Maximum: 25% [Vehicle Condition] Engine speed: 3,000 rpm or less	<ul style="list-style-type: none"> All injectors are tested at once Injection volume is gradually changed between -12.5 and 25%
A/F CONTROL	[Test Details] Control the injection volume -12.5 or 25% (change the injection volume -12.5% or 25%) [Vehicle Condition] Engine speed: 3,000 rpm or less	The following A/F CONTROL procedure enables the technician to check and graph voltage outputs of both the A/F sensor and 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".

Intelligent Tester Display	Test Details	Diagnostic Note
CAN CTRL VSV	[Test Details] Activate the VSV for canister control ON or OFF	-
EVAP VSV (ALONE)	[Test Details] Activate the EVAP VSV control ON or OFF	-
A/C MAG CLUTCH	[Test Details] Control the A/C magnet clutch ON or OFF	-
FUEL PUMP / SPD	[Test Details] Control the fuel pump ON or OFF	-
VVT CTRL B1	[Test Details] Activate the VVT system (Bank 1) ON or OFF	<ul style="list-style-type: none"> • ON: Rough idle or engine stall • OFF: Normal engine speed
TC/TE1	[Test Details] Connect the TC and TE1 ON or OFF	-
FC IDL PROHBT	[Test Details] Control the idle fuel cut prohibit ON or OFF	-

SFI SYSTEM

HOW TO PROCEED WITH TROUBLESHOOTING

The intelligent tester is 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 DLC3

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

NEXT

4 CHECK DTC AND FREEZE FRAME DATA

HINT:
Record or print DTC and freeze frame data, if needed.

NEXT

5 CLEAR DTC AND FREEZE FRAME DATA

NEXT

6 VISUAL INSPECTION

NEXT

7 SETTING CHECK (TEST) MODE DIAGNOSIS

NEXT

ES

8 PROBLEM SYMPTOM CONFIRMATION

HINT:

If the engine does not start, perform steps 10 and 12 first.

Malfunction does not occur	Malfunction occurs
A	B

B**GO TO STEP 10****A****ES****9 SYMPTOM SIMULATION****NEXT****10 DTC CHECK**

Malfunction code	No code
A	B

B**GO TO STEP 12****A****11 DTC CHART****NEXT****GO TO STEP 14****12 BASIC INSPECTION**

Wrong parts not confirmed	Wrong parts confirmed
A	B

B**GO TO STEP 17****A****13 PROBLEM SYMPTOMS TABLE**

Wrong circuit confirmed	Wrong parts confirmed
A	B

B**GO TO STEP 17****A****14****CHECK ECM POWER SOURCE CIRCUIT****NEXT****15****CIRCUIT INSPECTION**

Malfunction not confirmed

Malfunction confirmed

A

B

B**GO TO STEP 18****A****16****CHECK FOR INTERMITTENT PROBLEMS****NEXT****GO TO STEP 18****17****PARTS INSPECTION****NEXT****18****IDENTIFICATION OF PROBLEM****NEXT****19****ADJUSTMENT, REPAIR****NEXT****20****CONFIRMATION TEST****NEXT****END****ES**

DIAGNOSTIC TROUBLE CODE CHART

HINT:

Parameters listed in the chart may be different from your readings depending on the type of instrument used and other factors.

During the DTC check, refer to the table below if a malfunction code is displayed. For details about each code, refer to the page number in the DTC chart's left column.

ENGINE CONTROL 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 circuit 2. OCV valve 3. ECM	Come on	DTC Stored	ES-45
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. OCV 3. VVT controller assembly 4. ECM	Come on	DTC Stored	ES-51
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	1. Valve timing 2. OCV 3. VVT controller assembly 4. ECM	Come on	DTC Stored	ES-51
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	1. Mechanical system (jumped tooth of timing chain, chain stretched) 2. ECM	Come on	DTC Stored	ES-59
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	1. Open in heater circuit of A/F sensor 2. A/F sensor heater 3. EFI relay 4. ECM	Come on	DTC Stored	ES-61
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 3. EFI relay 4. ECM	Come on	DTC Stored	ES-61
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 3. EFI relay 4. ECM	Come on	DTC Stored	ES-66
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	1. Open or short in heater circuit of heated oxygen sensor 2. Heated oxygen sensor heater 3. EFI relay 4. ECM	Come on	DTC Stored	ES-66
P0100	Mass or Volume Air Flow Circuit	1. Open or short in mass air flow meter circuit 2. Mass air flow meter 3. ECM	Come on	DTC Stored	ES-70
P0101	Mass or Volume Air Flow Circuit Range / Performance Problem	1. Mass air flow meter	Come on	DTC Stored	ES-76
P0102	Mass or Volume Air Flow Circuit Low Input	1. Open in mass air flow meter circuit 2. Short in ground circuit 3. Mass air flow meter 4. ECM	Come on	DTC Stored	ES-70
P0103	Mass or Volume Air Flow Circuit High Input	1. Short in mass air flow meter circuit (to +B circuit) 2. Mass air flow meter 3. ECM	Come on	DTC Stored	ES-70
P0110	Intake Air Temperature Circuit	1. Open or short in intake air temp. sensor circuit 2. Intake air temperature sensor (built in mass air flow meter) 3. ECM	Come on	DTC Stored	ES-78

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0112	Intake Air Temperature Circuit Low Input	1. Open or short in intake air temp. sensor circuit 2. Intake air temperature sensor (built in mass air flow meter) 3. ECM	Come on	DTC Stored	ES-78
P0113	Intake Air Temperature Circuit High Input	1. Open or short in intake air temp. sensor circuit 2. Intake air temperature sensor (built in mass air flow meter) 3. ECM	Come on	DTC Stored	ES-78
P0115	Engine Coolant Temperature Circuit	1. Open or short in engine coolant temperature sensor circuit 2. Engine coolant temperature sensor 3. ECM	Come on	DTC Stored	ES-84
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	1. Cooling system 2. Engine coolant temperature sensor	Come on	DTC Stored	ES-89
P0117	Engine Coolant Temperature Circuit Low Input	1. Open or short in engine coolant temperature sensor circuit 2. Engine coolant temperature sensor 3. ECM	Come on	DTC Stored	ES-84
P0118	Engine Coolant Temperature Circuit High Input	1. Open or short in engine coolant temperature sensor circuit 2. Engine coolant temperature sensor 3. ECM	Come on	DTC Stored	ES-84
P0120	Throttle Pedal Position Sensor / Switch "A" Circuit Malfunction	1. Throttle position sensor (built in throttle body) 2. ECM	Come on	DTC Stored	ES-91
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	1. Throttle body assembly (Throttle position sensor)	Come on	DTC Stored	ES-99
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-91
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-91
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	1. Cooling system 2. Engine coolant temperature sensor 3. Thermostat	Come on	DTC Stored	ES-101
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	1. Thermostat 2. Cooling system 3. Engine coolant temperature sensor 4. ECM	Come on	DTC Stored	ES-104
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	1. Open or short in heated oxygen sensor (bank 1 sensor 2) 2. Heated oxygen sensor (bank 1 sensor 2) 3. Heated oxygen sensor heater (bank 1 sensor 2) 4. A/F sensor 5. A/F sensor heater 6. EFI relay	Come on	DTC Stored	ES-107
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	1. Open or short in heated oxygen sensor (bank 1 sensor 2) circuit (sensor to ECM) 2. Open or short in heated oxygen sensor (bank 1 sensor 2) inside	Come on	DTC Stored	ES-107
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 inside circuit malfunction	Come on	DTC Stored	ES-107

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
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 inside circuit malfunction	Come on	DTC Stored	ES-107
P0171	System Too Lean (Bank 1)	1. Air induction system 2. Injector blockage 3. Mass air flow meter 4. Engine coolant temperature sensor 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor circuit 8. A/F sensor 9. A/F sensor heater 10. EFI relay 11. A/F sensor heater and EFI relay circuit 12. PCV hose connection 13. PCV hose	Come on	DTC Stored	ES-121
P0172	System Too Rich (Bank 1)	1. Injector leak, blockage 2. Mass air flow meter 3. Engine coolant temperature sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor circuit 8. A/F sensor 9. A/F sensor heater 10. A/F sensor heater and EFI relay circuit 11. EFI relay	Come on	DTC Stored	ES-121
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	1. Throttle position sensor (built in throttle body) 2. ECM	Come on	DTC Stored	ES-91
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-91
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-91
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. Mass air flow meter 8. Engine coolant temp. sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flashes	DTC Stored	ES-135

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. Mass air flow meter 8. Engine coolant temp. sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flashes	DTC Stored	ES-135
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. Mass air flow meter 8. Engine coolant temp. sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flashes	DTC Stored	ES-135
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. Mass air flow meter 8. Engine coolant temp. sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flashes	DTC Stored	ES-135
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. Mass air flow meter 8. Engine coolant temp. sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flashes	DTC Stored	ES-135
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	1. Short in knock sensor circuit 2. Knock sensor 3. ECM	Come on	DTC Stored	ES-149
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	1. Open in knock sensor circuit 2. Knock sensor 3. ECM	Come on	DTC Stored	ES-149

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0335	Crankshaft Position Sensor "A" Circuit	1. Open or short in crankshaft position sensor circuit 2. Crankshaft position sensor 3. Signal plate (Crankshaft position sensor plate No.1) 4. ECM	Come on	DTC Stored	ES-153
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	1. Open or short in crankshaft position sensor circuit 2. Crankshaft position sensor 3. Signal plate (Crankshaft position sensor plate No.1) 4. ECM	Come on	DTC Stored	ES-153
P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	1. Open or short in camshaft position sensor circuit 2. Camshaft position sensor 3. Camshaft timing gear 4. Timing chain has a jumped tooth 5. ECM	Come on	DTC Stored	ES-157
P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)	1. Open or short in camshaft position sensor circuit 2. Camshaft position sensor 3. Camshaft timing gear 4. Timing chain has a jumped tooth 5. ECM	Come on	DTC Stored	ES-157
P0351	Ignition Coil "A" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IGF and IGT1 to 4 circuits from ignition coil with igniter assembly to ECM 3. No.1 - 4 ignition coil assembly 4. ECM	Come on	DTC Stored	ES-161
P0352	Ignition Coil "B" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IGF and IGT1 to 4 circuits from ignition coil with igniter assembly to ECM 3. No.1 - 4 ignition coil assembly 4. ECM	Come on	DTC Stored	ES-161
P0353	Ignition Coil "C" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IGF and IGT1 to 4 circuits from ignition coil with igniter assembly to ECM 3. No.1 - 4 ignition coil assembly 4. ECM	Come on	DTC Stored	ES-161
P0354	Ignition Coil "D" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IGF and IGT1 to 4 circuits from ignition coil with igniter assembly to ECM 3. No.1 - 4 ignition coil assembly 4. ECM	Come on	DTC Stored	ES-161
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	1. Gas leakage on exhaust system 2. A/F sensor 3. Heated oxygen sensor 4. Exhaust manifold converter (Three way catalytic converter)	Come on	DTC Stored	ES-170
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 EVAP VSV circuit 7. EVAP VSV 8. Open or short in CCV circuit 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-176

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 EVAP VSV circuit 7. EVAP VSV 8. Open or short in CCV circuit 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-182
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 EVAP VSV circuit 7. EVAP VSV 8. Open or short in CCV circuit 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-188
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-191
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	1. Open or short in vapor pressure sensor circuit 2. Vapor pressure sensor 3. ECM	Come on	DTC Stored	ES-191
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	1. Open or short in vapor pressure sensor circuit 2. Vapor pressure sensor 3. ECM	Come on	DTC Stored	ES-191
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 EVAP VSV circuit 7. EVAP VSV 8. Open or short in CCV circuit 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-182

ES

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 EVAP VSV circuit 7. EVAP VSV 8. Open or short in CCV circuit 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-182
P0500	Vehicle Speed Sensor "A"	1. Combination meter 2. Open or short in speed sensor circuit 3. Vehicle speed sensor 4. ECM 5. Skid control ECU	Come on	DTC Stored	ES-198
P0504	Brake Switch "A" / "B" Correlation	1. Short in stop light switch signal circuit 2. Stop light fuse 3. Stop light switch 4. ECM	Does not come on	DTC Stored	ES-201
P0505	Idle Control System Malfunction	1. Electric throttle control system 2. Air induction system 3. PCV hose connection 4. ECM	Come on	DTC Stored	ES-208
P0560	System Voltage	1. Open in back-up power source circuit 2. ECM	Come on	DTC Stored	ES-211
P0604	Internal Control Module Random Access Memory (RAM) Error	1. ECM	Come on	DTC Stored	ES-215
P0606	ECM / PCM Processor	1. ECM	Come on	DTC Stored	ES-215
P0607	Control Module Performance	1. ECM	Come on	DTC Stored	ES-215
P0617	Starter Relay Circuit High	1. Short in park/neutral position switch (A/T) or clutch start switch (M/T) circuit 2. Park/neutral position switch (A/T) 3. Clutch start switch (M/T) 4. Ignition switch 5. ECM	Come on	DTC Stored	ES-217
P0630	Vin not Programmed or Mismatch - ECM / PCM	1. ECM	Come on	DTC Stored	ES-223
P0657	Actuator Supply Voltage Circuit / Open	1. ECM	Come on	DTC Stored	ES-215
P2102	Throttle Actuator Control Motor Circuit Low	1. Open in throttle control motor circuit 2. Throttle control motor 3. ECM	Come on	DTC Stored	ES-225
P2103	Throttle Actuator Control Motor Circuit High	1. Short in throttle actuator circuit 2. Throttle actuator 3. Throttle valve 4. Throttle body assembly 5. ECM	Come on	DTC Stored	ES-225
P2111	Throttle Actuator Control System - Stuck Open	1. Throttle actuator circuit 2. Throttle actuator 3. Throttle body 4. Throttle valve	Come on	DTC Stored	ES-229
P2112	Throttle Actuator Control System - Stuck Closed	1. Throttle actuator circuit 2. Throttle actuator 3. Throttle body 4. Throttle valve	Come on	DTC Stored	ES-229
P2118	Throttle Actuator Control Motor Current Range / Performance	1. Open in ETCS power source circuit 2. ECM	Come on	DTC Stored	ES-232

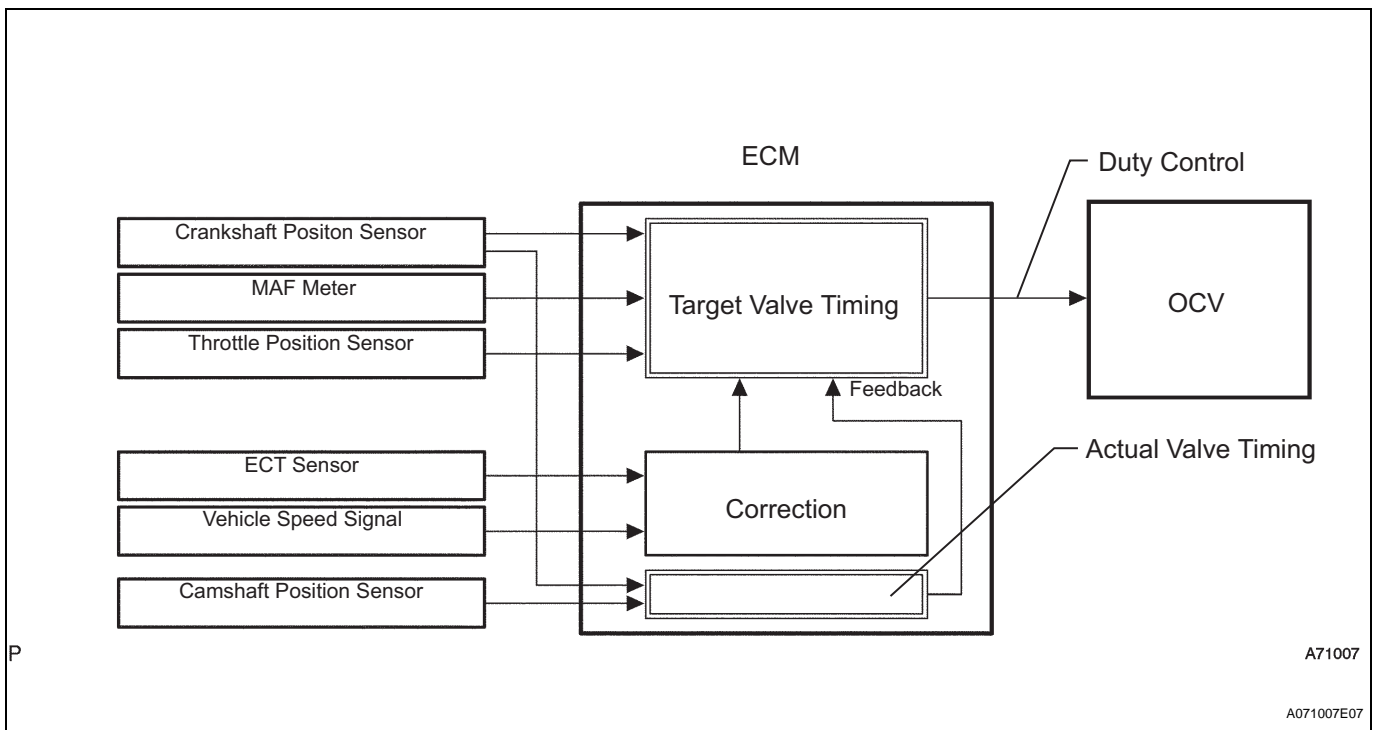
DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2119	Throttle Actuator Control Throttle Body Range / Performance	1. Electronic throttle control system 2. ECM	Come on	DTC Stored	ES-237
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-239
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-248
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-239
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-239
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-239
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-239
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-239
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-91
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	1. Open or short in accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-239
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	1. Open or short in A/F sensor circuit 2. A/F sensor 3. A/F sensor heater 4. EFI relay 5. A/F sensor heater and EFI relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. ECM	Come on	DTC Stored	ES-253
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	1. Open or short in A/F sensor circuit 2. A/F sensor 3. A/F sensor heater 4. EFI relay 5. Open or short in A/F sensor heater and EFI relay circuit 6. ECM	Come on	DTC Stored	ES-266
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	1. Open or short in A/F sensor circuit 2. A/F sensor 3. A/F sensor heater 4. EFI relay 5. Open or short in A/F sensor heater and EFI relay circuit 6. ECM	Come on	DTC Stored	ES-266

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	1. Open or short in A/F sensor circuit 2. A/F sensor 3. A/F sensor heater 4. EFI relay 5. Open or short in A/F sensor heater and EFI relay circuit 6. ECM	Come on	DTC Stored	ES-266
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	1. Open or short in A/F sensor circuit 2. A/F sensor 3. A/F sensor heater 4. EFI relay 5. Open or short in A/F sensor heater and EFI relay circuit 6. ECM	Come on	DTC Stored	ES-266
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	1. Open or short in A/F sensor circuit 2. A/F sensor 3. A/F sensor heater 4. EFI relay 5. Air induction system 6. Fuel pressure 7. Injector 8. ECM	Come on	DTC Stored	ES-271

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

ES

DTC No.	DTC Detection Condition	Trouble Area
P0010	Open or short in OCV circuit	<ul style="list-style-type: none"> • Open or short in 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. When the actual duty-cycle ratio varies from the target duty-cycle ratio, the ECM sets a DTC.

MONITOR STRATEGY

Related DTCs	P0010: VVT OCV Range Check
Required sensors/ components (Main)	VVT OCV
Required sensors / components (Related)	-
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	11 to 13 V
OCV target duty ratio	70% or less
Starter	OFF
OCV current cut status	Not cut

ES

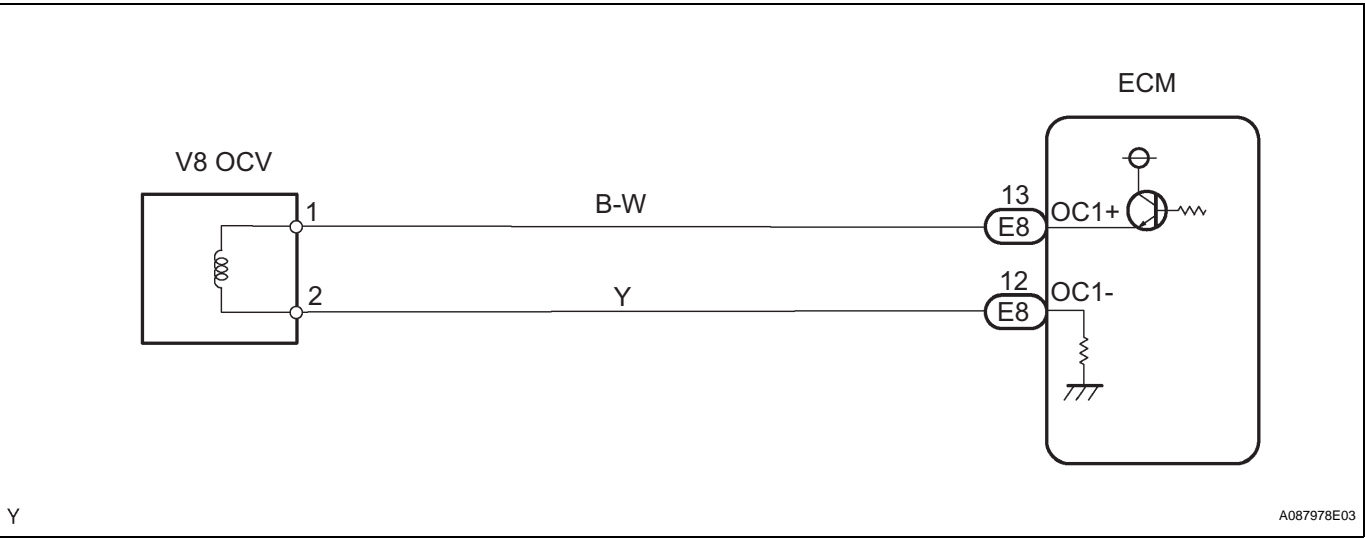
TYPICAL MALFUNCTION THRESHOLDS

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

COMPONENT OPERATING RANGE

OCV duty ratio	3 to 100%
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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	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OCV OPERATION)
---	---

- (a) Start the engine and warm it up.
- (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 / VVT CTRL B1.
- (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

OK

CHECK FOR INTERMITTENT PROBLEMS

NG

ES

2

INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

OK:

OCV has no contamination and moves smoothly.

NG

REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

OK

3

CHECK ECM (OCV SIGNAL)

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

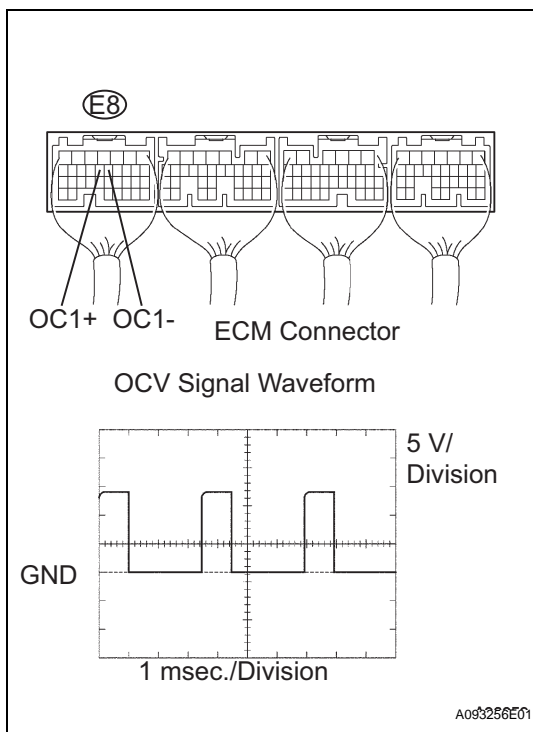
Standard

Tester Connection	Specified Condition
E8-3 (OC1+) - E8-12 (OC1-)	Correct waveform is as shown

NG

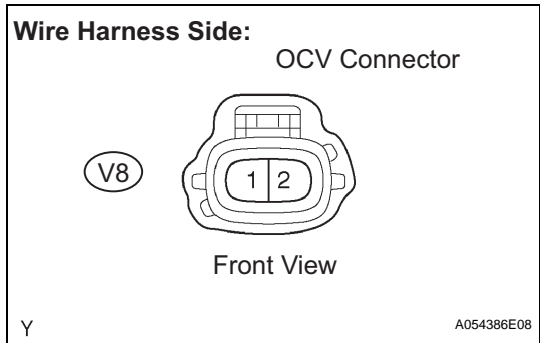
REPLACE ECM

OK

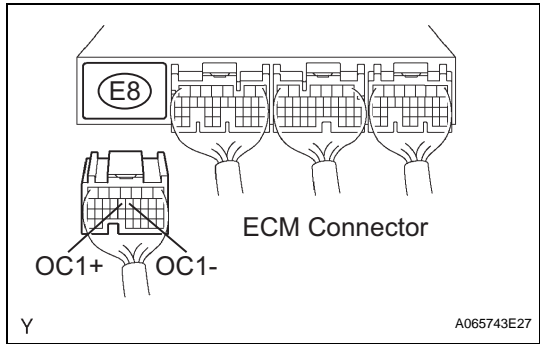


4

CHECK WIRE HARNESS (OCV - ECM)



(a) Disconnect the V8 OCV connector.



- (b) Disconnect the E8 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
V8-1 (OCV) - E8-13 (OC1+) V8-2 (OCV) - E8-12 (OC1-)	Below 1 Ω
V8-1 (OCV) or E8-13 (OC1+) - Body ground V8-2 (OCV) or E8-12 (OC1-) - Body ground	10 kΩ or higher

NG

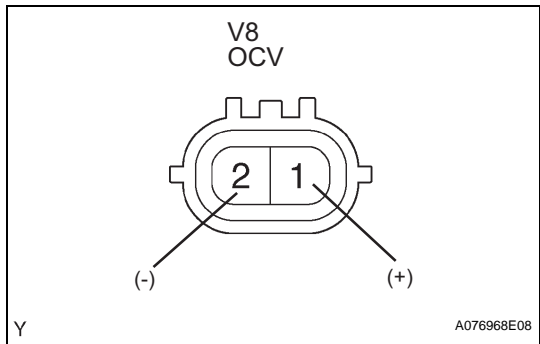
REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

CHECK FOR INTERMITTENT PROBLEMS

1

CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OPERATE OCV)



- (a) Start the engine and warm it up.
- (b) Disconnect the V8 OCV connector.
- (c) Apply battery positive voltage to the terminals of the OCV.
- (d) Check the engine speed.

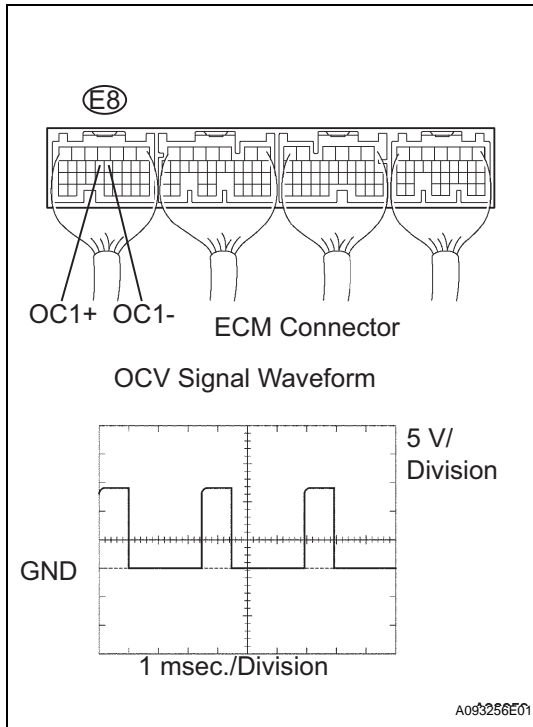
OK:

Rough idle or engine stalled

NG

REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

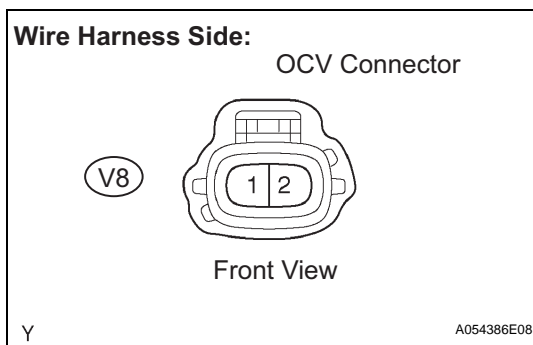
OK

2 CHECK ECM (OCV SIGNAL)

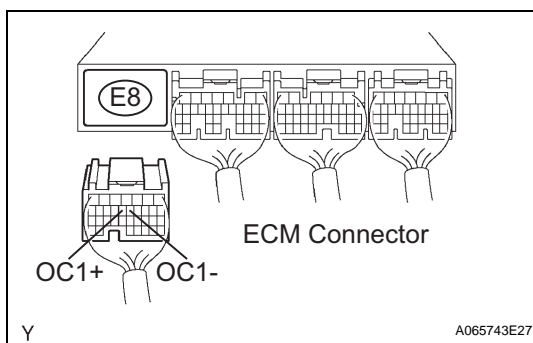
- (a) During idling, check the waveform of the ECM connector using an oscilloscope.

Standard

Tester Connection	Specified Condition
E8-13 (OC1+) - E8-12 (OC1-)	Correct waveform is as shown

NG**REPLACE ECM****OK****3 CHECK WIRE HARNESS (OCV - ECM)**

- (a) Disconnect the V8 OCV connector.



- (b) Disconnect the E8 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
V8-1 (OCV) - E8-13 (OC1+) V8-2 (OCV) - E8-12 (OC1-)	Below 1 Ω
V8-1 (OCV) or E8-13 (OC1+) - Body ground V8-2 (OCV) or E8-12 (OC1-) - Body ground	10 k Ω or higher

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

A button with a black border and a downward-pointing arrow shape at the bottom, containing the text "OK".

OK

CHECK FOR INTERMITTENT PROBLEMS

ES

DTC	P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)
DTC	P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)

DESCRIPTION

Refer to DTC P0010 (See page [ES-45](#)).

DTC No.	DTC Detection Condition	Trouble Area
P0011	After engine is warmed up and engine speed is at 550 to 4,000 rpm, condition (1) continues (1 trip detection logic) 1. Valve timing does not change from current valve timing (Problem of advanced valve timing)	<ul style="list-style-type: none"> Valve timing OCV VVT controller assembly ECM
P0012	After engine is warmed up and engine speed is at 550 to 4,000 rpm, condition (1) continues (2 trip detection logic) 1. Valve timing does not change from current valve timing (Problem of retarded valve timing)	<ul style="list-style-type: none"> Same as DTC No. P0011

ES

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 targeted 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 valve timing is no change.

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 P0012: Retarded Camshaft Timing
Required sensors/ components (Main)	VVT OCV, VVT Actuator
Required sensors/ components (Related)	ECT sensor, Crankshaft position sensor, Camshaft position sensor
Frequency of operation	Once per driving cycle
Duration	Within 10 seconds
MIL operation	P0011: Immediate P0012: 2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0100 - P0103 (MAF sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0354 (Igniter)
Battery voltage	11 V or more
Engine RPM	550 to 4,000 rpm

ECT	75 to 100°C (167 to 212°F)
Throttle position learning	Completed

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	Condition 1 or 2
Deviation of valve timing	More than 5 °CA (Crankshaft angle)
Valve timing	No change

If the difference between "target" and "actual" camshaft timing is larger than the specified value, the ECM operates the VVT actuator.

The ECM then monitors the camshaft timing change for 5 seconds.

ES WIRING DIAGRAM

Refer to DTC P0010 (See page [ES-46](#)).

HINT:

Abnormal bank	Problem of advanced OCV	Problem of retarded OCV
Bank 1	P0011	P0012

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 VALVE TIMING

- (a) Check for loose or a jumped tooth of the timing chain.

OK:

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

NG

ADJUST VALVE TIMING

OK

2 PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE OF OCV)

- Connect the intelligent tester to the DLC3.
- Start the engine and warm it up.
- Turn the ignition switch ON and push the intelligent tester main switch ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
- 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 IF DTC OUTPUTS REOCCUR

- (a) Erase the DTC(s) using one of the following methods: 1) use the intelligent tester, 2) disconnect the battery terminals for more than 60 seconds, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:

After disconnecting the battery terminals, perform the "INITIALIZE" procedure (See page [IN-24](#)).

- (b) Start the engine and warm it up.
 (c) Drive the vehicle for 10 minutes or more.
 (d) Read output DTC using the intelligent tester.

OK:

No DTC output.

HINT:

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

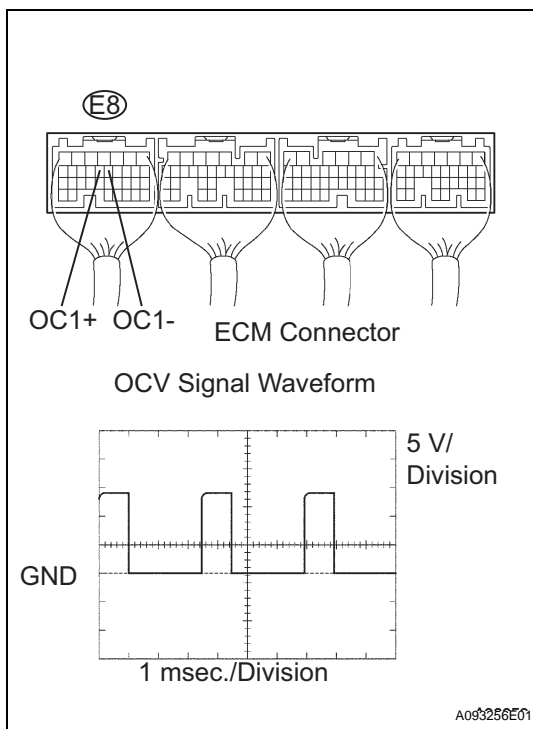
OK

VVT SYSTEM OK

NG

4

CHECK ECM (OCV SIGNAL)



- (a) During idling, check the waveform of the E8 ECM connector using an oscilloscope.

Standard

Tester Connection	Specified Condition
E8-13 (OC1+) - E8-12 (OC1-)	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

ES 6 CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

OK:
OCV has no contamination and moves smoothly.

OK Go to step 8

NG

7 REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

GO

8 CHECK CAMSHAFT TIMING GEAR ASSEMBLY (OCV)

OK Go to step 10

NG

9 REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

GO

10 INSPECT OIL CONTROL VALVE FILTER

OK:
No blockage.

NG REPAIR OR REPLACE OIL CONTROL VALVE FILTER

OK

11 CHECK IF DTC OUTPUTS REOCCUR

- (a) Erase the DTC(s) using one of the following methods: 1) use the intelligent tester, 2) disconnect the battery terminals for more than 60 seconds, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:

After disconnecting the battery terminals, 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:

*: DTCs P0011 and P0012 are output when a foreign object in the engine oil enters the system. These codes will stay 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

- (a) Check for loose or jumped tooth of timing chain.

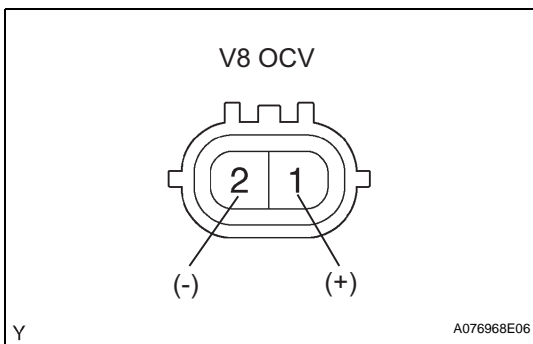
OK:

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 V8 OCV connector.
 (2) Apply battery positive voltage between the terminals of the OCV.

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 OUTPUTS REOCCUR

- (a) Erase the DTC(s) using one of the following methods: 1) use the intelligent tester, 2) disconnect the battery terminals for more than 60 seconds, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:

After disconnecting the battery terminals, 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:

*: DTCs P0011 and P0012 are output when a foreign object in the engine oil enters the system. These codes will stay 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)

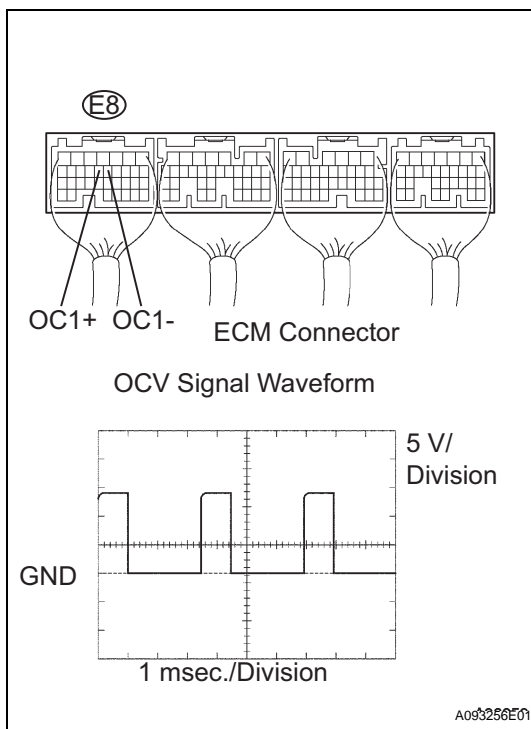
- (a) During idling, check the waveform of the ECM connector using an oscilloscope.

Standard

Tester Connection	Specified Condition
E8-13 (OC1+) - E8-12 (OC1-)	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 (OCV)

OK:
OCV has no contamination and moves smoothly.

OK

Go to step 8

NG

7 REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

GO

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

10 INSPECT OIL CONTROL VALVE FILTER

OK:
No blockage.

NG

REPAIR OR REPLACE OIL CONTROL VALVE FILTER

OK

ES

11 CHECK IF DTC OUTPUTS REOCCUR

- (a) Erase the DTC(s) using one of the following methods: 1) use the intelligent tester, 2) disconnect the battery terminals for more than 60 seconds, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:

After disconnecting the battery terminals, 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:

*: DTCs P0011 and P0012 are output when a foreign object in the engine oil enters the system. These codes will stay 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

ES

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

DESCRIPTION

Refer to DTC P0335 and P0339 (See page [ES-153](#)).

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and VVT sensor (bank 1) signal (2 trip detection logic)	<ul style="list-style-type: none"> Mechanical system (jumped tooth of timing chain, chain 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 speed 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 ("1" and "2"), the ECM interprets this as a defect in the VVT system and sets a DTC.

- The VVT learning value is less than 27.8°CA or more than 48°CA.**
- The above condition continues for more than 18 seconds.**

MONITOR STRATEGY

Related DTCs	P0016: Camshaft Timing Misalignment
Required sensors/ components (Main)	VVT actuator
Required sensors/ components (Related)	Camshaft position sensor, Crankshaft position 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 this DTC is not present	P0011, P0012 (VVT system - Advanced, Retard) P0115 - P0118 (ECT sensor)
Engine RPM	550 to 1,000 rpm

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met	Condition 1 or 2
1. VVT angle when camshaft is retarded maximum	Less than 27.8°
2. VVT angle when camshaft is retarded maximum	More than 48°

WIRING DIAGRAM

Refer to DTC P0335 and P0339 (See page [ES-154](#)).

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 VALVE TIMING**

- (a) Check for loose or jumped tooth of timing chain.

OK:

The matchmarks of crankshaft pulley and camshaft pulley are aligned.

ES**NG****ADJUST VALVE TIMING****OK****REPLACE ECM**

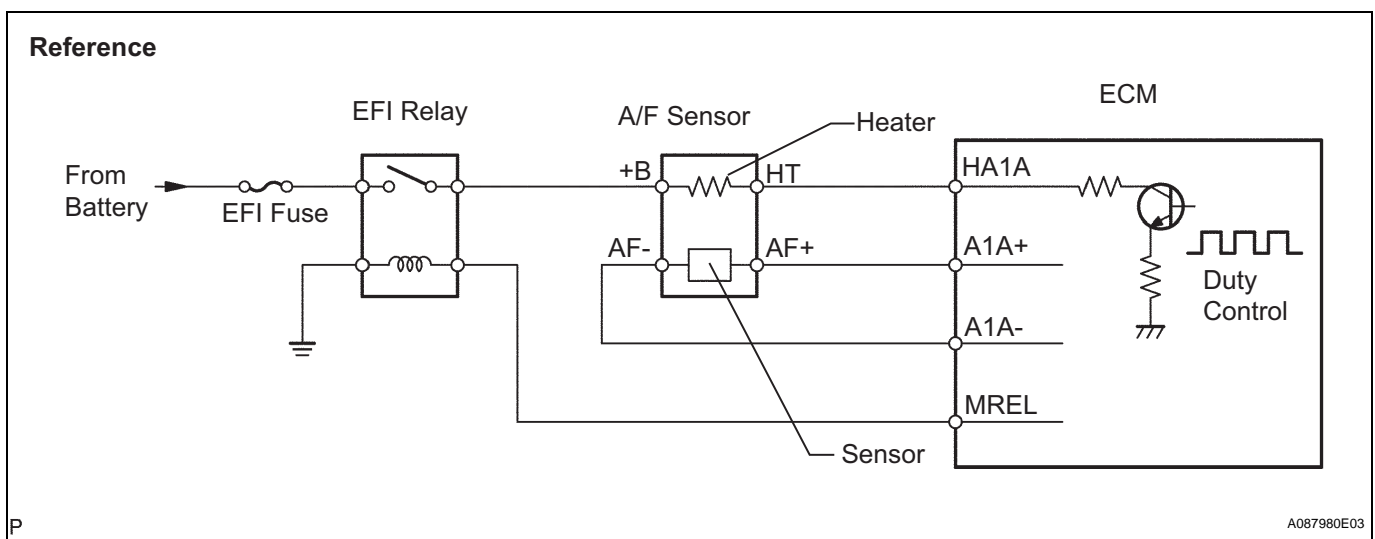
DTC	P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)
DTC	P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

HINT:

- Although the title (DTC description) says "oxygen sensor", this DTC is related to the "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.

DESCRIPTION

Refer to DTC P2195 (See page [ES-253](#)).



DTC No.	DTC Detection Condition	Trouble Area
P0031	Heater current of less than 0.8 A when heater operates (1 trip detection logic)	<ul style="list-style-type: none"> Open in heater circuit of A/F sensor A/F sensor heater EFI relay ECM
P0032	Heater current exceeds 10 A when heater operates (1 trip detection logic)	<ul style="list-style-type: none"> Short in heater circuit of A/F sensor A/F sensor heater EFI relay ECM

HINT:

Sensor 1 is the sensor closest to the engine assembly.

MONITOR DESCRIPTION

The ECM uses A/F sensor information to keep 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 A/F ratio properly.

When the heater current is out of the normal operating range, the ECM interprets this as a malfunction and sets a DTC.

ES

MONITOR STRATEGY

Related DTCs	P0031: A/F Sensor Heater Range Check (Low current) P0032: A/F Sensor Heater 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	Immediately
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:

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

TYPICAL MALFUNCTION THRESHOLDS

P0031:

A/F sensor heater current	Less than 0.8 A
---------------------------	-----------------

P0032:

A/F sensor heater current	More than 10 A
---------------------------	----------------

COMPONENT OPERATING RANGE

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

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page [ES-16](#)).

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 \$07: A/F sensor heater

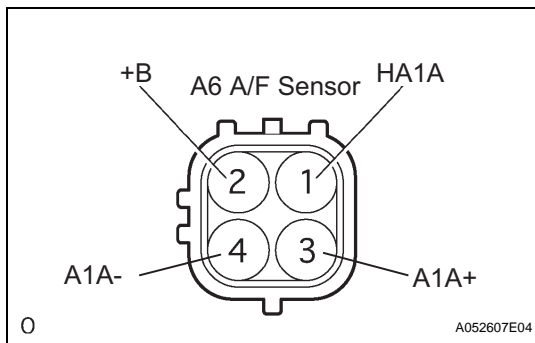
TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	\$01	Multiply by 0.00017 (A)	Maximum heater current (Bank 1)	Malfunction criterion for A/F sensor heater

WIRING DIAGRAM

Refer to DTC P2195 (See page [ES-256](#)).

HINT:

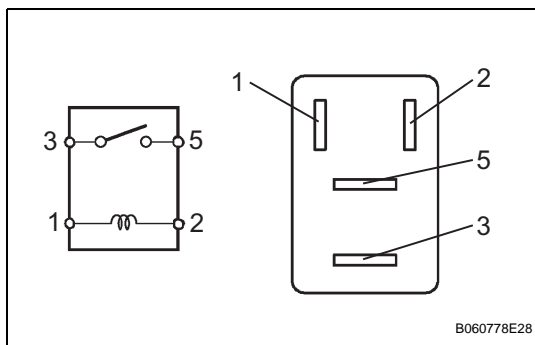
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES**1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)**

- Disconnect the A6 A/F sensor connector.
- Measure the resistance between the terminals of the A/F sensor.

Resistance

Tester Connection	Specified Condition
1 (HA1A) - 2 (+B)	1.8 to 3.4 Ω
1 (HA1A) - 4 (A1A-)	10 k Ω or higher

NG**REPLACE AIR FUEL RATIO SENSOR****OK****2 INSPECT EFI RELAY**

- Remove the EFI relay from the engine room J/B.
- Measure the resistance of the EFI relay.

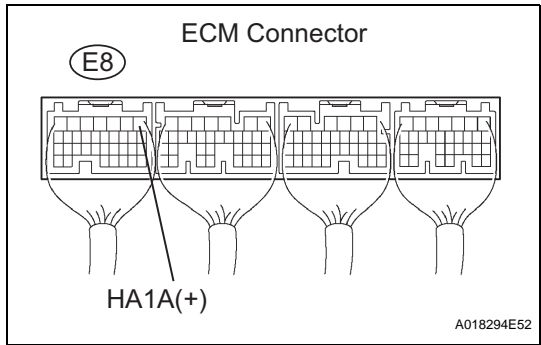
Resistance

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

NG**REPLACE EFI RELAY****OK**

3

CHECK ECM (HA1A VOLTAGE)



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

Voltage

Tester Connection	Specified Condition
E8-1 (HA1A) - E8-3 (E1)	9 to 14 V

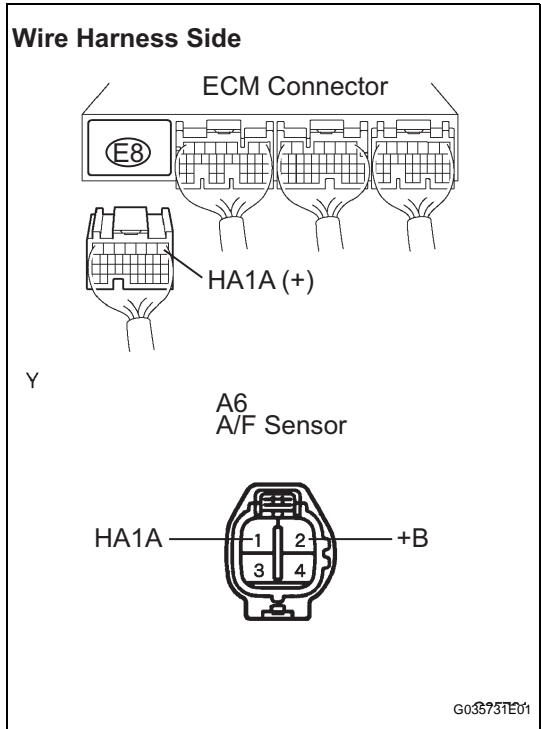
OK

REPLACE ECM

NG

4

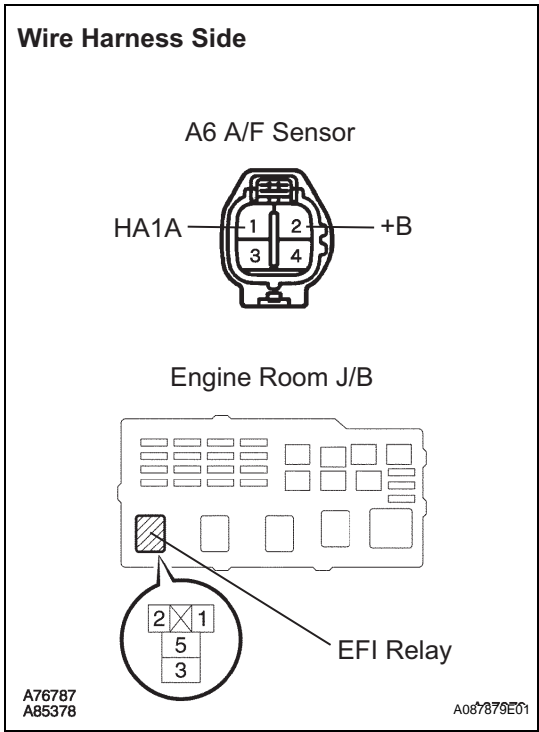
CHECK WIRE HARNESS (ECM - A/F SENSOR, A/F SENSOR - EFI RELAY)



- (a) Check the wire harness between the ECM and A/F sensor.
- (1) Disconnect the E8 ECM connector.
 - (2) Disconnect the A6 A/F sensor connector.
 - (3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A6-1 (HA1A) - E8-1 (HA1A)	Below 1 Ω
A6-1 (HA1A) or E8-1 (HA1A) - Body ground	10 k Ω or higher



- (b) Check the wire harness between the A/F sensor and EFI relay.
- (1) Disconnect the A6 A/F 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
A6-2 (+B) - J/B EFI relay terminal 3	Below 1 Ω
A6-2 (+B) or J/B EFI relay terminal 3 - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

ES

OK

REPLACE ECM

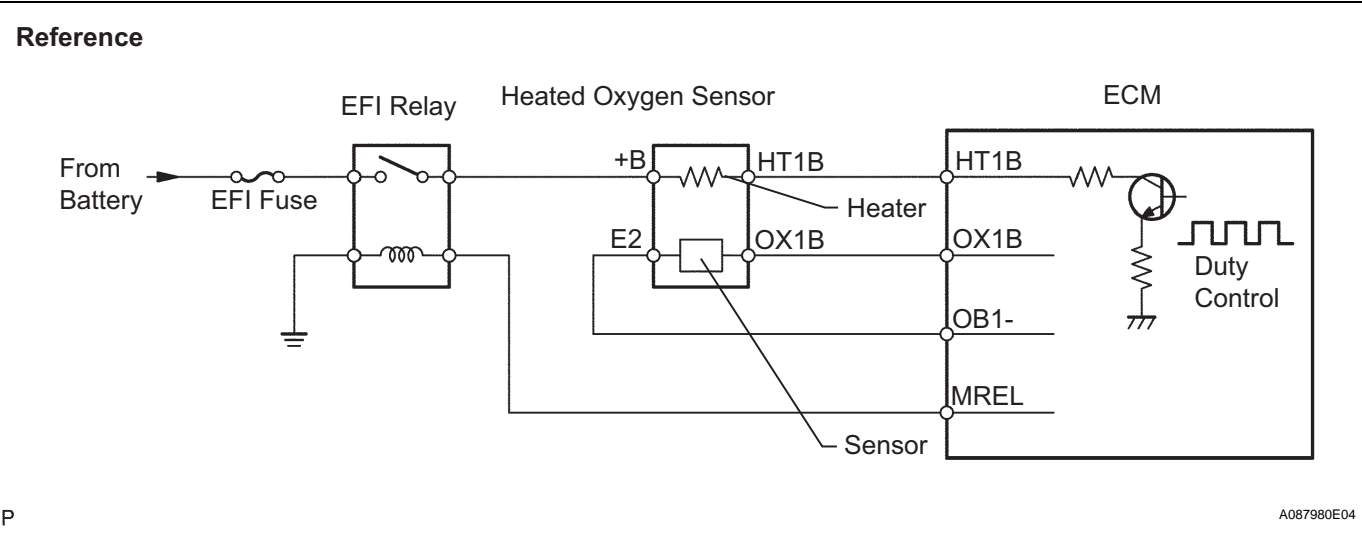
DTC	P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)
DTC	P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

HINT:
The ECM provides a pulse width modulated control circuit to adjust current through the heater. The oxygen sensor heater circuit uses a relay on the +B side of the circuit.

ES

DESCRIPTION

Refer to DTC P0136 (See page ES-107).



DTC No.	DTC Detection Condition	Trouble Area
P0037	Heater current of 0.3 A or less when the heater operates with +B greater than 10.5 V (1 trip detection logic)	<ul style="list-style-type: none">Open or short in heater circuit of heated oxygen sensorHeated oxygen sensor heaterEFI relayECM
P0038	Heater current exceeds 2 A when heater operates (1 trip detection logic)	<ul style="list-style-type: none">Same as DTC No. P0037

HINT:
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 of the oxygen concentration between the inside and outside surface 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 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 Range Check (Low current) P0038: HO2S Heater 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	Immediately
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	10.5 V or more
Engine	Running
Starter	OFF

ES

TYPICAL MALFUNCTION THRESHOLDS

P0037:

HO2S heater current when HO2S heater OFF	Less than 0.3 A
--	-----------------

P0038:

HO2S heater current when HO2S heater ON	More than 2 A
---	---------------

COMPONENT OPERATING RANGE

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

MONITOR RESULT

Refer to page "Checking Monitor Status" for detailed information (See page [ES-16](#)).

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

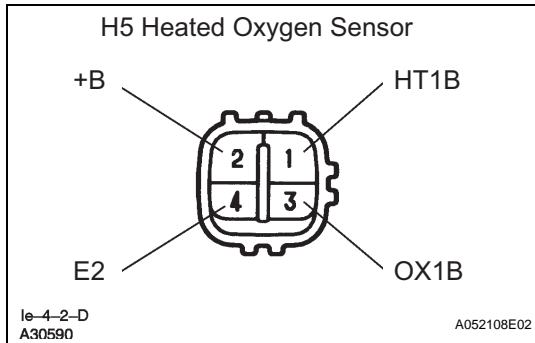
TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	\$02	Multiply by 0.000076 (A)	Maximum HO2S heater current (Bank 1 Sensor 2)	Malfunction threshold for HO2S heater

WIRING DIAGRAM

Refer to DTC P0136 (See page).

HINT:

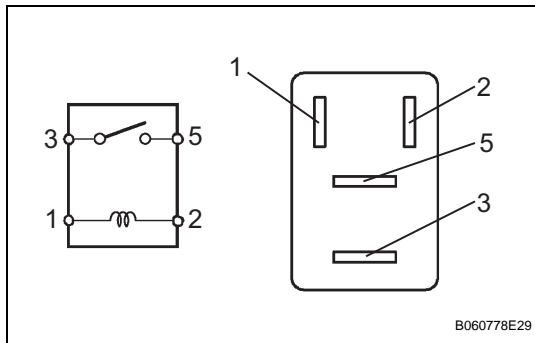
Read freeze frame data using the intelligent tester to the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

- (a) Disconnect the H5 heated oxygen sensor connector.
 (b) Measure the resistance of the heated oxygen sensor terminals.

Resistance

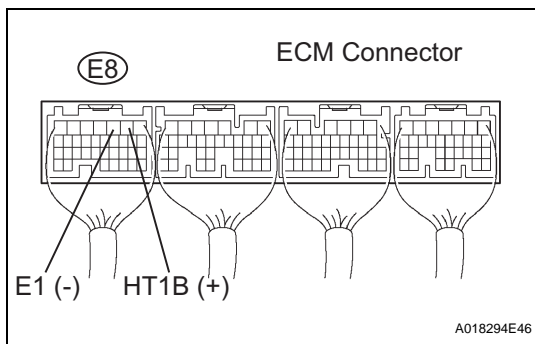
Tester Connection	Specified Condition
H5-1 (HT1B) - H5-2 (+B)	11 to 16 Ω
H5-1 (HT1B) - H5-4 (E2)	10 k Ω or higher

NG**REPLACE HEATED OXYGEN SENSOR****OK****2 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 k Ω or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

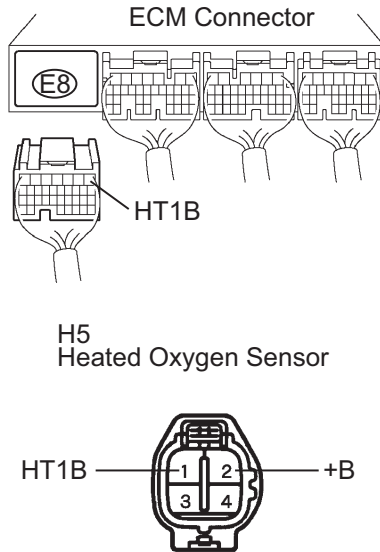
NG**REPLACE EFI RELAY****OK****3 INSPECT ECM (HT1B VOLTAGE)**

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

Voltage

Tester Connection	Specified Condition
E8-2 (HT1B) - E8-3 (E1)	9 to 14 V

OK**REPLACE ECM****NG**

4**CHECK WIRE HARNESS (ECM - HEATED OXYGEN SENSOR, HEATED OXYGEN SENSOR - EFI RELAY)****Wire Harness Side**

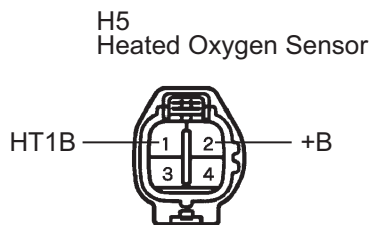
G035731E02

(a) Check the wire harness between the ECM and heated oxygen sensor.

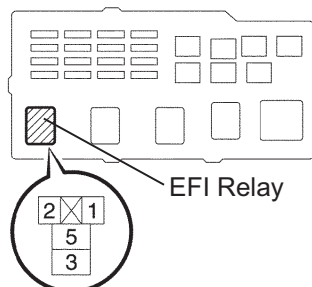
- (1) Disconnect the E8 ECM connector.
- (2) Disconnect the H5 heated oxygen sensor connector.
- (3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
H5-1 (HT1B) - E8-2 (HT1B)	Below 1 Ω
H5-1 (HT1B) or E8-2 (HT1B) - Body ground	10 k Ω or higher

ES**Wire Harness Side**

Engine Room J/B

A76787
A91834

A091574E01

(b) Check the wire harness between the heated oxygen sensor and EFI relay.

- (1) Disconnect the H5 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
H5-2 (+B) - J/B EFI relay terminal 3	Below 1 Ω
H5-2 (+B) or J/B EFI relay terminal 3 - Body ground	10 k Ω or higher

NG**REPAIR OR REPLACE HARNESS AND 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

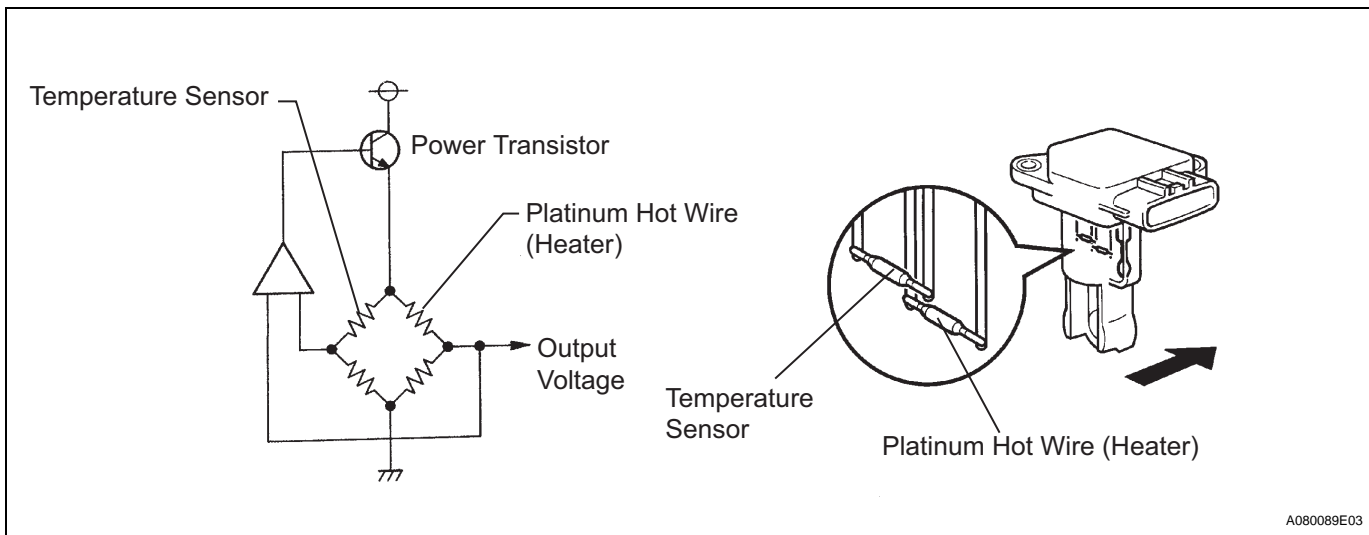
DESCRIPTION

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.

ES

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.



A080089E03

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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Same as DTC No. P0100
P0103	When MAF meter circuit has a short for more than 3 seconds under 4,000 rpm engine speed	<ul style="list-style-type: none"> Same as DTC No. P0100

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 (g/s)	Malfunction
Approximately 0.0	<ul style="list-style-type: none"> Open in MAF meter power source circuit Open or short in VG circuit
271.0 or more	<ul style="list-style-type: none"> 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

ES

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are 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
-------------------	-----------------

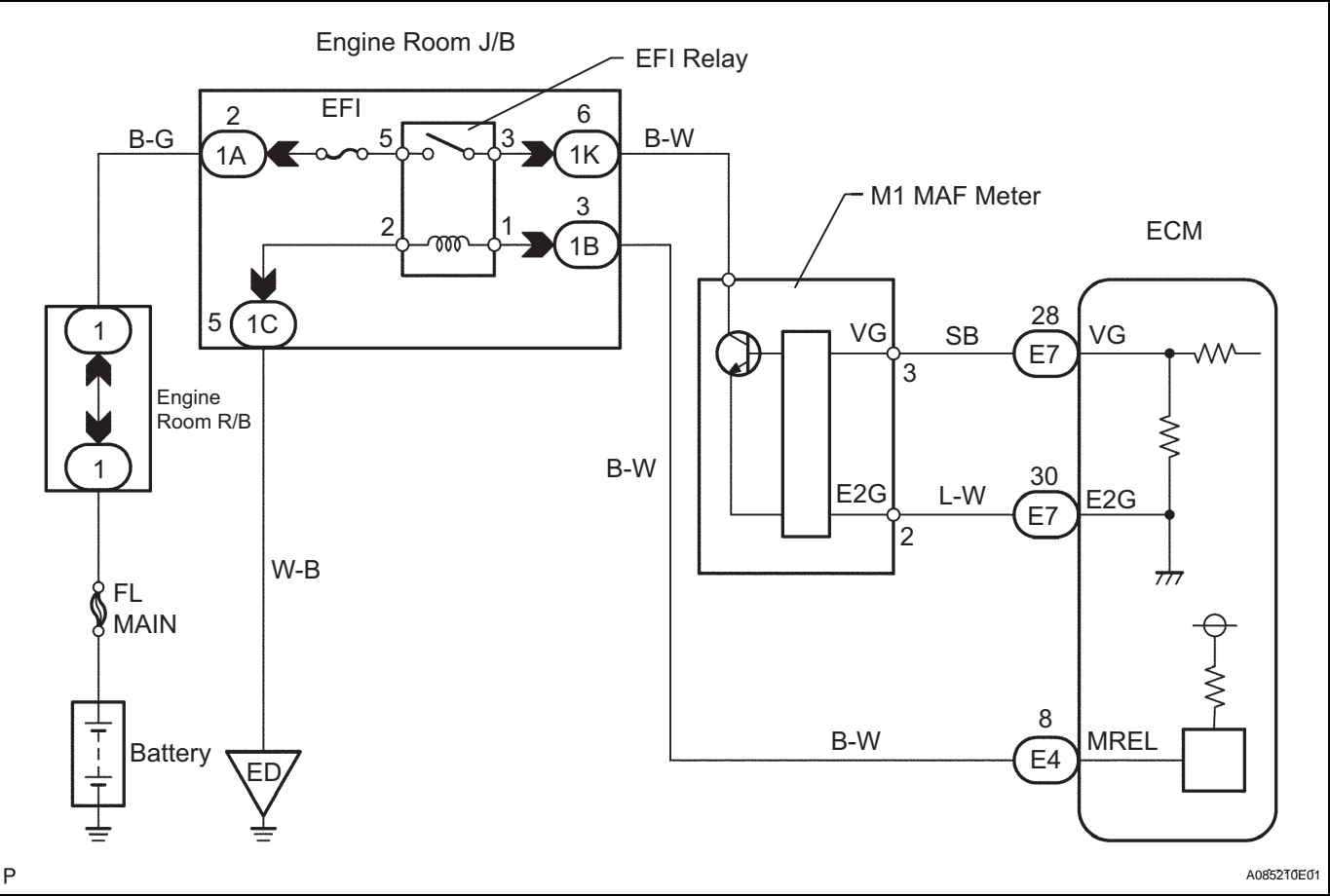
P0103:

MAF meter voltage	More than 4.9 V
-------------------	-----------------

COMPONENT OPERATING RANGE

MAF 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 OF INTELLIGENT TESTER OR OBD II SCAN TOOL (MAF 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/second)	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

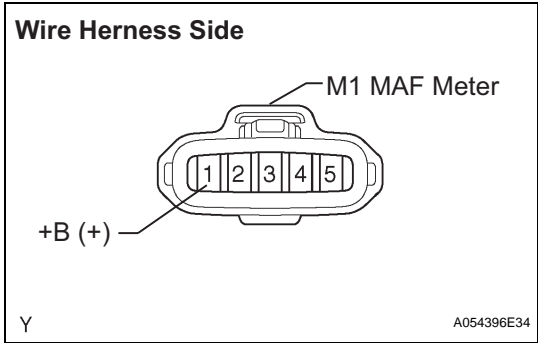
C

CHECK FOR INTERMITTENT PROBLEMS

A

2

CHECK 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

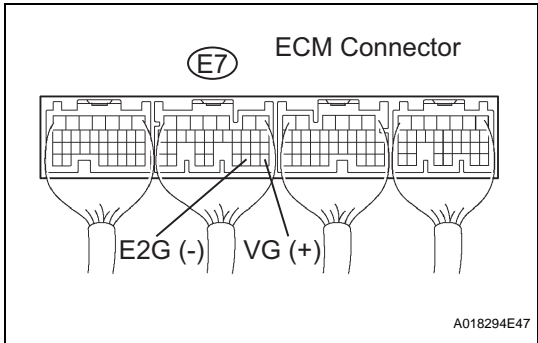
NG

Go to step 5

OK

3

CHECK 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
E7-28 (VG) - E7-30 (E2G)	Engine is idling	0.5 to 3.0 V

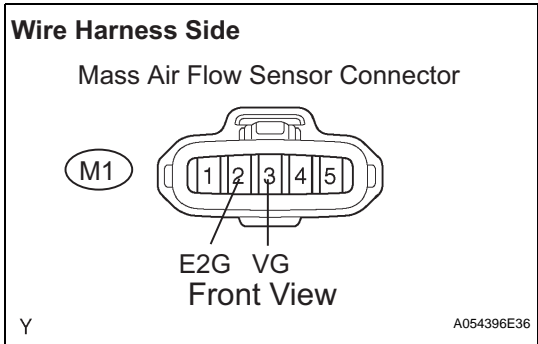
OK

REPLACE ECM

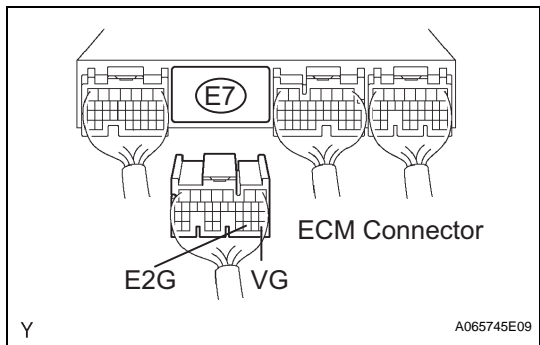
NG

4

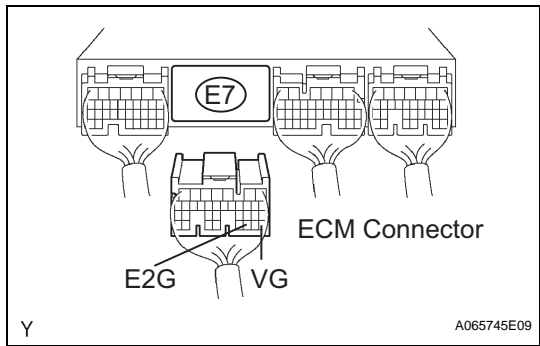
CHECK WIRE HARNESS (MAF METER - ECM)



- (a) Disconnect the M1 MAF meter connector.



(b) Disconnect the E7 ECM connector.



(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
M1-3 (VG) - E7-28 (VG) M1-2 (E2G) - E7-30 (E2G)	Below 1 Ω
M1-3 (VG) or E7-28 (VG) - Body ground	10 k Ω or higher

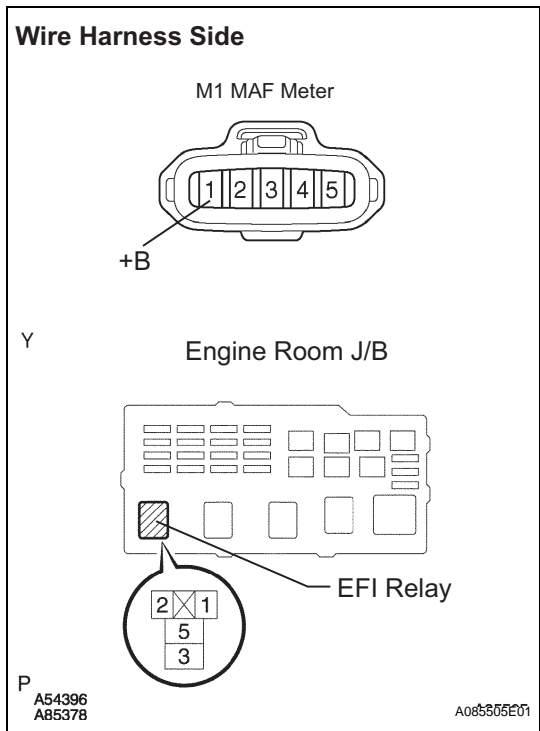
NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE MASS AIR FLOW METER

5 CHECK WIRE HARNESS (MAF 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 k Ω or higher

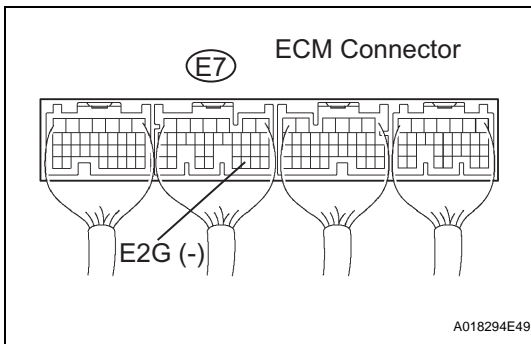
NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

INSPECT ECM POWER SOURCE CIRCUIT

6 CHECK ECM (SENSOR GROUND)



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

Tester Connection	Specified Condition
E7-30 (E2G) - Body ground	Below 1 Ω

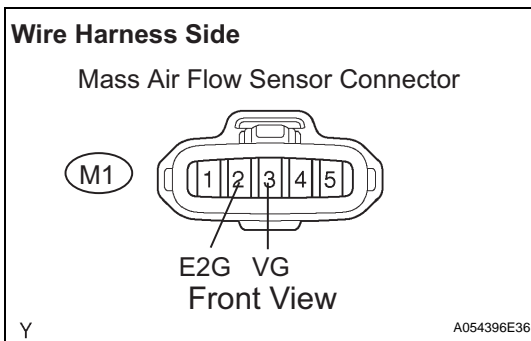
NG

REPLACE ECM

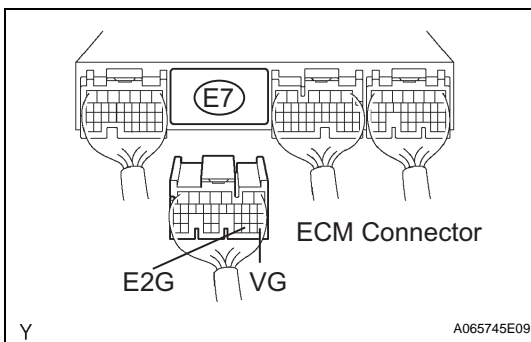
ES

OK

7 CHECK WIRE HARNESS (MAF METER - ECM)



- (a) Disconnect the M1 MAF meter connector.



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

Resistance

Tester Connection	Specified Condition
M1-3 (VG) - E7-28 (VG) M1-2 (E2G) - E7-30 (E2G)	Below 1 Ω
M1-3 (VG) or E7-28 (VG) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE MASS AIR FLOW METER

DTC	P0101	Mass or Volume Air Flow Circuit Range / Performance Problem
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DESCRIPTION

Refer to DTC P0100 (See page [ES-70](#)).

DTC No.	DTC Detection Condition	Trouble Area
P0101	<ul style="list-style-type: none"> High voltage: Conditions (a), (b) and (c) continue for more than 10 seconds (2 trip detection logic): (a) Engine speed less than 2,000 rpm (b) Engine coolant temperature 70°C (158°F) or higher (c) Voltage output of Mass Air Flow (MAF) meter more than 2.2 V (varies with Throttle Position [TP] sensor voltage) Low voltage: Conditions (a) and (b) continue for more than 10 seconds (2 trip detection logic): (a) Engine speed more than 300 rpm (b) Voltage output of MAF meter less than 0.65 V (varies with TP sensor voltage) 	<ul style="list-style-type: none"> 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-fuel ratio. Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air. By applying a specific electrical current to the wire, the ECM heats it to a specific temperature. The flow of incoming air cools both the wire and an internal thermistor, changing 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 air flow 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 0.65 V while idling, the ECM determines that there is a malfunction in the MAF meter and sets the DTC.

MONITOR STRATEGY

Related DTCs	P0101: MAF Meter Rationality (Low voltage) P0101: MAF Meter Rationality (High voltage)
Required sensors/ components (Main)	MAF meter
Required sensors/ components (Related)	Crankshaft position sensor, ECT sensor, Throttle position sensor
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever this DTC is not present	P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor)
---	---

MAF Meter Rationality (High Voltage):

Engine RPM	Less than 2,000 rpm
ECT	70°C (158°F) or more
MAF meter voltage	4.9 V or less

MAF Meter Rationality (Low Voltage):

Engine RPM	More than 300 rpm
MAF meter voltage	0.2 V or more
Fuel cut	OFF

TYPICAL MALFUNCTION THRESHOLDS**MAF Meter Rationality (High Voltage):**

MAF meter voltage	More than 2.2 V (varies with throttle position sensor voltage)
-------------------	--

ES**MAF Meter Rationality (Low Voltage):**

MAF meter voltage	Less than 0.65 V (varies with throttle position sensor voltage)
-------------------	---

WIRING DIAGRAM

Refer to DTC P0100 (See page [ES-72](#)).

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 P0101)**

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

Result

Display (DTC Output)	Proceed to
P0101 and other DTCs are output	A
Only P0101 is output	B

HINT:

If any other codes besides P0101 are output, perform the troubleshooting for those codes first.

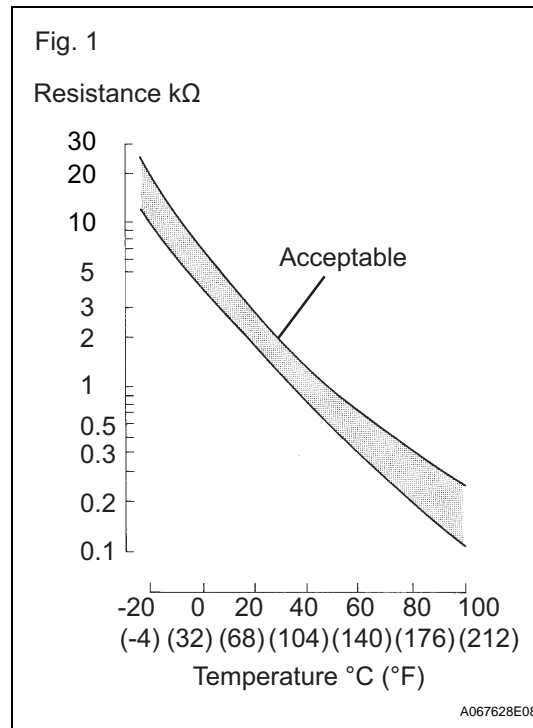
B**REPLACE MASS AIR FLOW METER****A****GO TO RELEVANT DTC CHART**

DTC	P0110	Intake Air Temperature Circuit
DTC	P0112	Intake Air Temperature Circuit Low Input
DTC	P0113	Intake Air Temperature Circuit High Input

DESCRIPTION

The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the intake air temperature. The IAT sensor has a thermistor that varies its resistance depending on the temperature of the intake air. When the air temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. The variations in resistance are reflected in the voltage output from the sensor (see Fig. 1).

ES



The IAT sensor is connected to the ECM (see below). The 5 V power source voltage in the ECM is applied to the IAT sensor from terminal THA via resistor R.

That is, the resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes in accordance with changes in the IAT, the voltage at terminal THA also changes. Based on this signal, the ECM increases the fuel injection volume to improve the driveability during cold engine operation.

DTC No.	Proceed to	DTC Detection Condition	Trouble Area
P0110	Step 1	Open or short in IAT sensor circuit for 0.5 seconds	<ul style="list-style-type: none"> Open or short in IAT sensor circuit IAT sensor (inside MAF meter) ECM
P0112	Step 4	Short in IAT sensor circuit for 0.5 seconds	<ul style="list-style-type: none"> Same as DTC No. P0110
P0113	Step 2	Open in IAT sensor circuit for 0.5 seconds	<ul style="list-style-type: none"> Same as DTC No. P0110

HINT:

After confirming DTC P0110, P0112 or P0113, use the intelligent tester or the OBD II scan tool to confirm the IAT from the ALL menu (to reach the ALL menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL).

Temp. Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or more	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the intake air temperature. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the IAT sensor and sets a DTC.

Example:

The sensor voltage output equals to -40°C (-40°F), or more than 140°C (284°F) and either condition continues for 0.5 second or more.

ES**MONITOR STRATEGY**

Related DTCs	P0110: IAT Sensor Range Check (Chattering) P0112: IAT Sensor Range Check (Low Resistance) P0113: IAT Sensor Range Check (High Resistance)
Required sensors/components (Main)	IAT 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**P0110:**

IAT sensor resistance	Less than 98.5 Ω , or more than 156 k Ω
-----------------------	---

P0112

IAT sensor resistance [IAT]	Less than 98.5 Ω [More than 140°C (284°F)]
-----------------------------	---

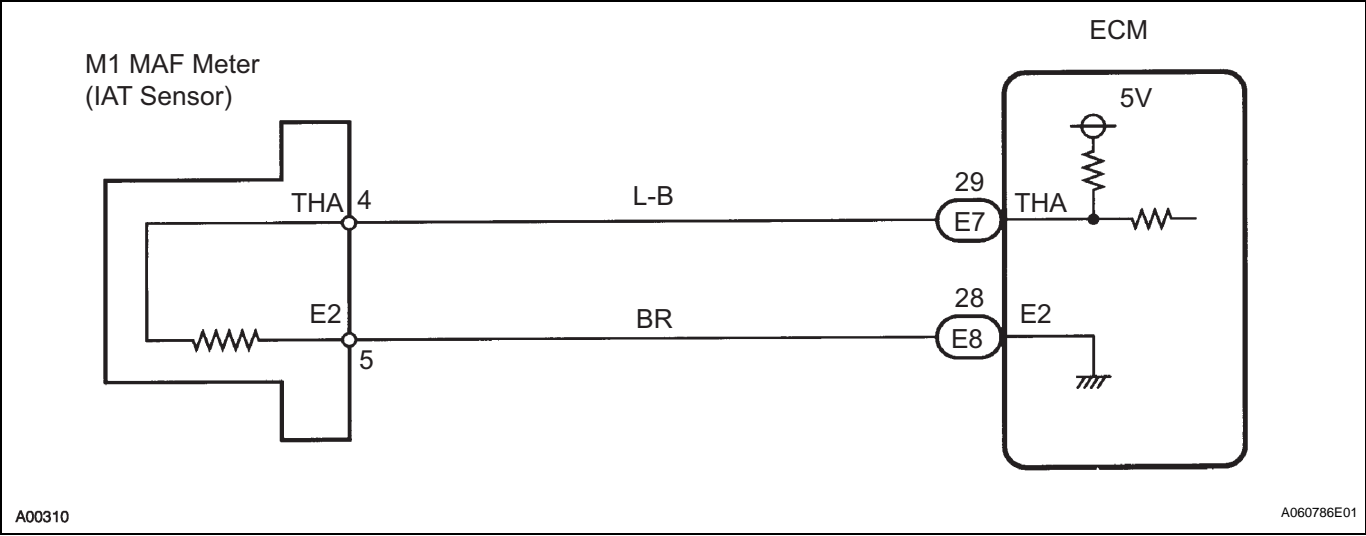
P0113

IAT sensor resistance [IAT]	More than 156 Ω [Less than -40°C (-40°F)]
-----------------------------	--

COMPONENT OPERATING RANGE

IAT sensor resistance [IAT]	98.5 Ω to 156 k Ω [-40 to 140°C (-40 to 284°F)]
-----------------------------	---

WIRING DIAGRAM



HINT:

- If DTCs that are related to different systems are output simultaneously while terminal E2 is used as a ground terminal, terminal E2 may have an open 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.

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

- (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 tester main switch ON.
- (c) On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR. Read the values.

Temperature:

The same as actual intake air temperature

Result:

Display	Proceed to
-40°C (-40°F)	A
140°C (284°F) or more	B
OK (same as present temperature)	C

HINT:

- If there is an open circuit, the intelligent tester or the OBD II scan tool indicates -40°C (-40°F).
- If there is a short circuit, the intelligent tester or the OBD II scan tool indicates 140°C (284°F) or more.

B

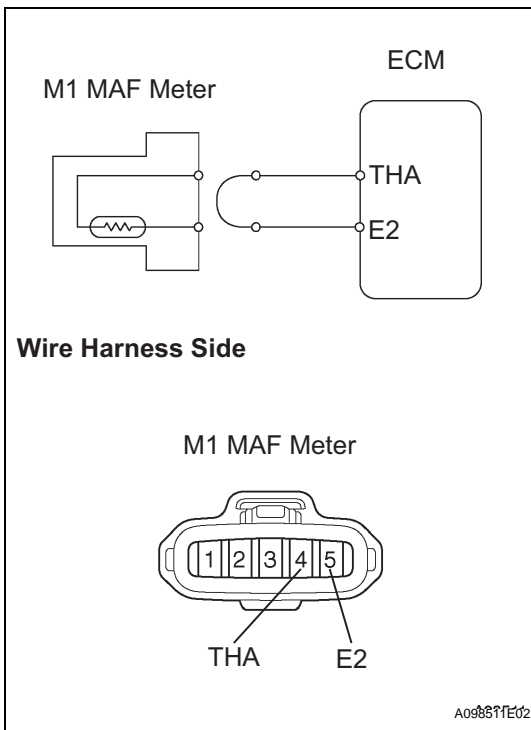
Go to step 4

C

CHECK FOR INTERMITTENT PROBLEMS

A

2

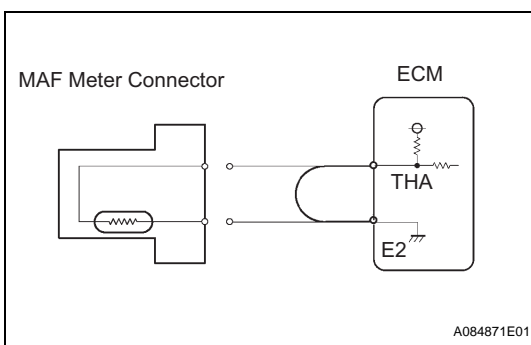
READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN HARNESS)

- Disconnect the M1 MAF meter connector.
- Connect terminals THA and E2 of the M1 MAF meter wire harness side connector.
- Turn the ignition switch ON.
- On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR. Read the values.

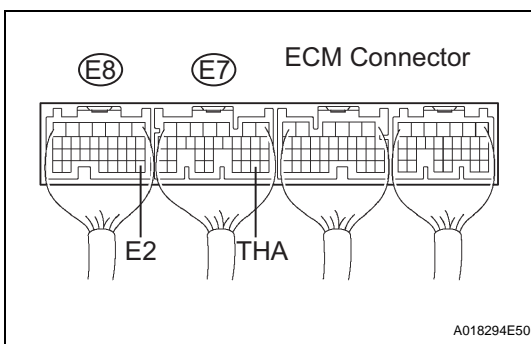
OK:**Temperature value: 140°C (284°F) or more****OK****REPLACE MASS AIR FLOW METER****ES**

NG

3

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

- Disconnect the M1 MAF meter connector.



- Connect terminals THA and E2 of the E8 and E7 ECM connector.
HINT:
Before checking, do a visual and contact pressure check for the ECM connector.
- Turn the ignition switch ON.
- On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS/ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR. Read the values.

OK:

Temperature value: 140°C (284°F) or more

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

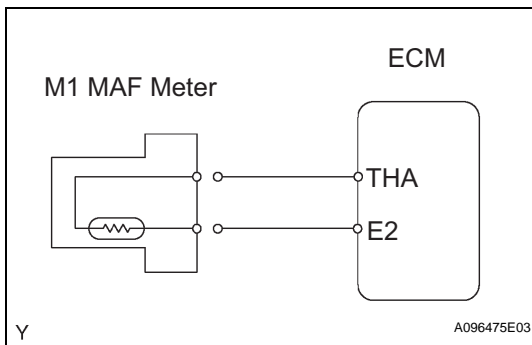
NG

CONFIRM GOOD CONNECTION AT ECM. IF OK, REPLACE ECM

ES

4

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



- (a) Disconnect the M1 MAF meter 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 / INTAKE AIR. Read the values.

OK:

Temperature value: -40°C (-40°F)

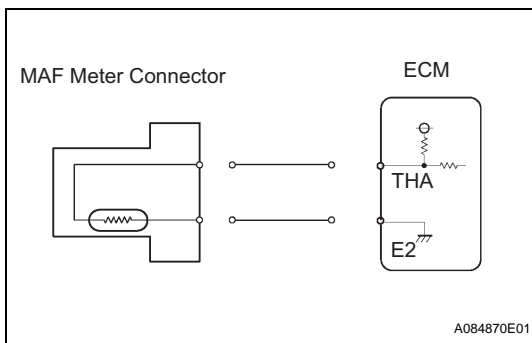
OK

REPLACE MASS AIR FLOW METER

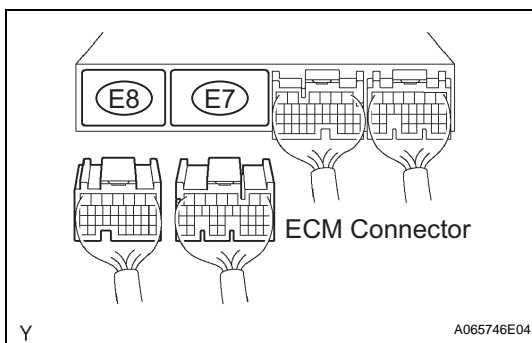
NG

5

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



- (a) Disconnect the E8 and E7 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 / INTAKE AIR. Read the values.

OK:

Temperature value: -40°C (-40°F)

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

REPLACE ECM

ES

BASIC INSPECTION

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

1 CHECK BATTERY VOLTAGE

NOTICE:

Carry out the battery voltage check with the engine stopped and ignition switch OFF.

	OK	NG
Voltage	11 V or more	Less than 11 V

NG**CHARGE OR REPLACE BATTERY****OK**

2 CHECK IF ENGINE WILL CRANK

NG**PROCEED TO PROBLEM SYMPTOMS TABLE****OK**

3 CHECK IF ENGINE STARTS

NG**GO TO STEP 7****OK**

4 CHECK AIR FILTER

Visually check if the air filter is contaminated or oily.

NG**CLEAN OR REPLACE****OK**

5 CHECK IDLE SPEED

NG**PROCEED TO PROBLEM SYMPTOMS TABLE****ES**

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

6 CHECK FUEL PRESSURE

NG

PROCEED TO PROBLEM SYMPTOMS
TABLE AND CONTINUE TO
TROUBLESHOOT

ES

OK

7 CHECK FOR SPARK

NG

PROCEED TO PROBLEM SYMPTOMS
TABLE AND CONTINUE TO
TROUBLESHOOT

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

DTC	P0115	Engine Coolant Temperature Circuit
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 and changes the resistance value according to the engine coolant temperature.

The structure of the sensor and connection to the ECM is the same as the Intake Air Temperature (IAT) sensor.

HINT:

If the ECM detects the DTC P0115, P0117 or P0118, it operates the fail-safe function in which the ECT is assumed to be 80°C (176°F).

DTC No.	Proceed to	DTC Detection Condition	Trouble Area
P0115	Step 1	Open or short in ECT sensor circuit for 0.5 seconds	<ul style="list-style-type: none"> Open or short in ECT sensor circuit ECT sensor ECM
P0117	Step 4	Short in ECT sensor circuit for 0.5 seconds	<ul style="list-style-type: none"> Same as DTC No. P0115
P0118	Step 2	Open in ECT sensor circuit for 0.5 seconds	<ul style="list-style-type: none"> Same as DTC No. P0115

HINT:

After confirming DTC P0115, P0117 or P0118, use the intelligent tester or the OBD II scan tool to confirm the ECT from the ALL menu (to reach the ALL menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL).

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or more	Short circuit

MONITOR DESCRIPTION

The ECT sensor is used to monitor the engine coolant temperature. The ECT sensor has a thermistor that varies its resistance depending on 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. The variations in resistance are reflected in the voltage output from the sensor.

The ECM monitors the sensor voltage and uses this value to calculate the engine coolant temperature. 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:

When the ECM calculates that the ECT is -40°C (-40°F) or more than 140°C (284°F) and if either condition continues for 0.5 seconds or more, the ECM will set a DTC.

MONITOR STRATEGY

Related DTCs	P0115: ECT Sensor Range Check (Chattering) P0117: ECT Sensor Range Check (Low resistance) P0118: ECT Sensor Range Check (High resistance)
Required sensors/components (Main)	ECT sensor
Required sensors/components (Related)	-
Frequency of operation	Continuous
Duration	0.5 seconds

MIL operation	Immediately
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
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TYPICAL MALFUNCTION THRESHOLDS

P0115:

ECT sensor resistance	Less than 79 Ω , or more than 156 k Ω
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P0117:

ECT sensor resistance [ECT]	Less than 79 Ω [More than 140°C (284°F)]
-----------------------------	---

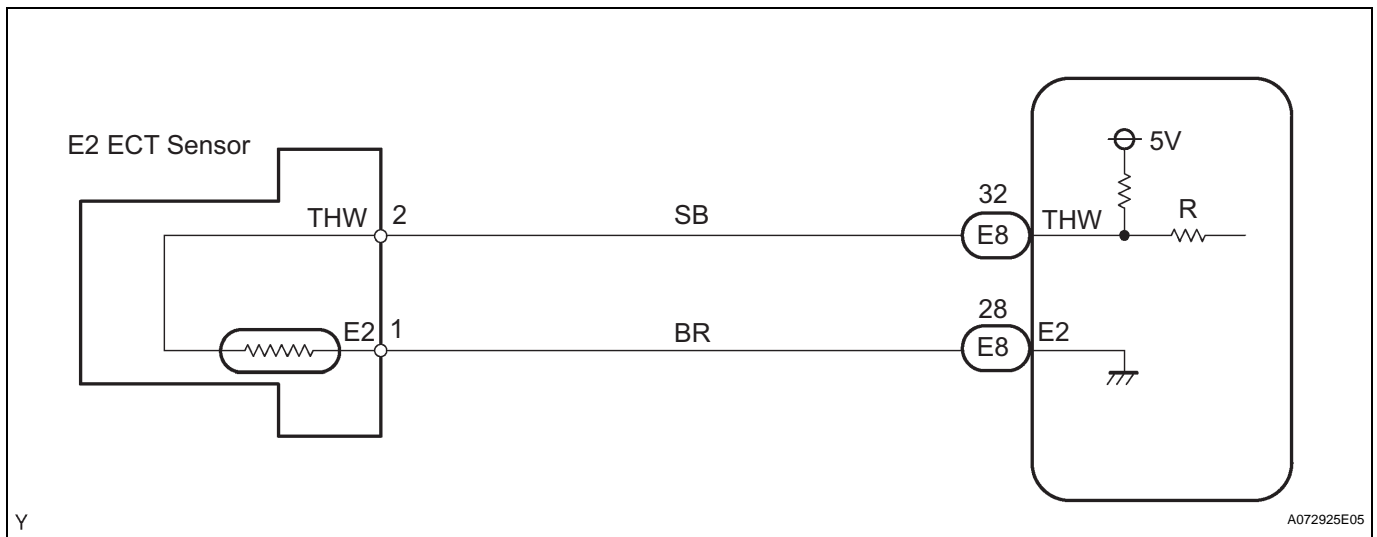
P0118:

ECT sensor resistance [ECT]	More than 156 k Ω [Less than -40°C (-40°F)]
-----------------------------	--

COMPONENT OPERATING RANGE

ECT sensor resistance [ECT]	79 Ω to 156 k Ω [-40 to 140°C (-40 to 284°F)]
-----------------------------	---

WIRING DIAGRAM



HINT:

- If DTCs that are related to different systems are output simultaneously while terminal E2 is used as a ground terminal, terminal E2 may have an open 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.

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

- (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 tester main 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.

Temperature:

Same value as the actual engine coolant temperature.

Result

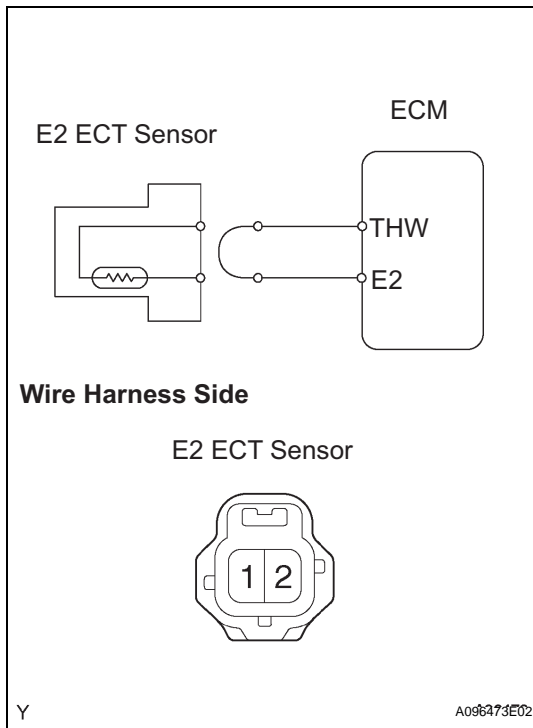
Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or more	B
OK (same as present temperature)	C

HINT:

- If there is an open circuit, the intelligent tester or the OBD II scan tool indicates -40°C (-40°F).
- If there is a short circuit, the intelligent tester or the OBD II scan tool indicates 140°C (284°F) or more.

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS

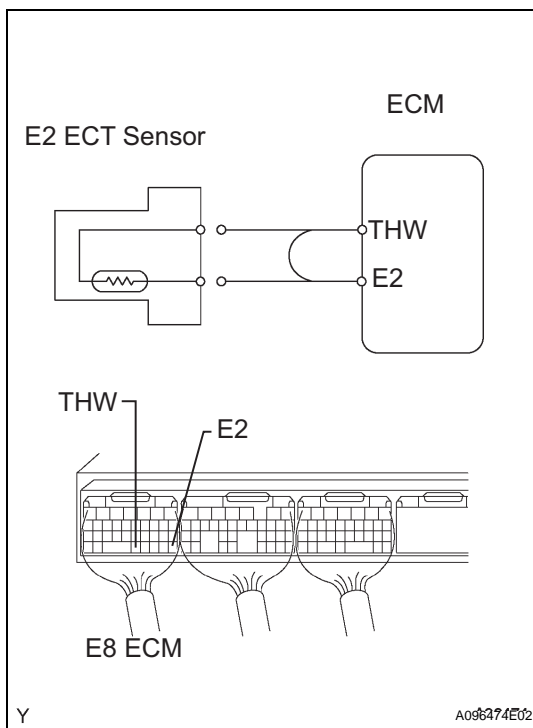


2**READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN WIRE HARNESS)**

- Disconnect the E2 ECT sensor connector.
- Connect terminals 1 and 2 of the E2 ECT sensor wire harness side connector.
- Turn the ignition switch ON.
- 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 SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR

ES**NG****3****READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN ECM)**

- Disconnect the E2 ECT sensor connector.
- Connect terminals THW and E2 of the E8 ECM connector.

HINT:

Before checking, do a visual and contact pressure check for the ECM connector.

- Turn the ignition switch ON.
- 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**

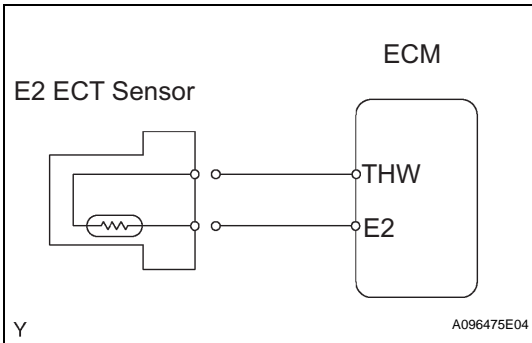
REPAIR OR REPLACE HARNESS AND CONNECTOR

NG

CONFIRM GOOD CONNECTION AT ECM. IF OK, REPLACE ECM

4

READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (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)

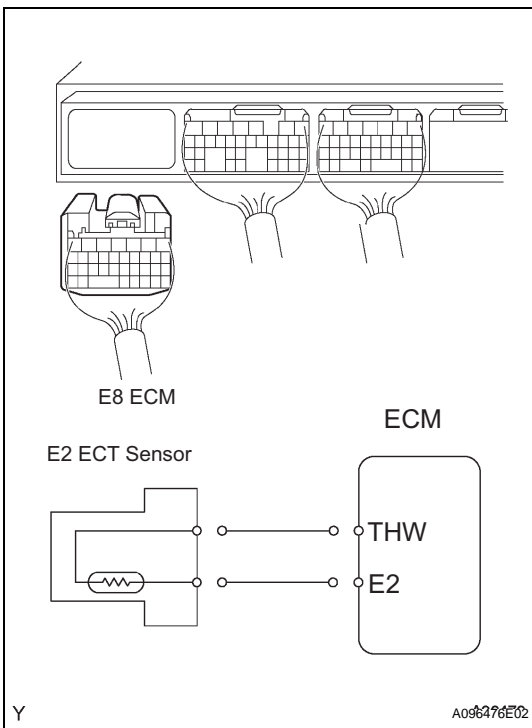
OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

NG

5

REAS VALUE OF INTELLIGENT TESTER OR OBD 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

DTC	P0116	Engine Coolant Temperature Circuit Range / Performance Problem
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DESCRIPTION

Refer to DTC P0115 (See page [ES-84](#)).

DTC No.	DTC Detection Condition	Trouble Area
P0116	ECT is between 35°C (95°F) and 60°C (140°F) when engine is started, and conditions (1) and (2) are met: 1. Vehicle has accelerated and decelerated 2. ECT remains within 3°C (5.4°F) of the initial engine coolant temperature (2 trip detection logic)	<ul style="list-style-type: none"> Cooling system ECT sensor
	<ul style="list-style-type: none"> ECT is more than 60°C (140°F) when engine is started and vehicle has accelerated and decelerated ECT sensor records a temperature variation is below 1°C (1.8°F) successively 6 times (6 trip detection logic) 	

ES**MONITOR DESCRIPTION**

The Engine Coolant Temperature (ECT) sensor is used to monitor the engine coolant temperature. The ECT sensor has a thermistor that varies its resistance depending on 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. The variations in resistance are reflected in the voltage output from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the engine coolant temperature. 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.

Examples:

- 1) Upon starting the engine, the ECT is between 35°C (95°F) and 60°C (140°F). If after driving for 250 seconds, the ECT still remains within 3°C (5.4°F) of the starting temperature, a DTC will be set (2 trip detection logic).
- 2) Upon starting the engine, the ECT is over 60°C (140°F). If after driving for 250 seconds, the ECT still remains within 1°C (1.8°F) of the starting temperature, a DTC will be set (6 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0116: ECT Sensor Stuck at Low ECT P0116: ECT Sensor Stuck at High ECT
Required sensors/ components (Main)	ECT sensor
Required sensors/ components (Related)	Crankshaft position sensor, IAT sensor, MAF meter
Frequency of operation	Continuous
Duration	4 minutes and 10 seconds or more
MIL operation	2 driving cycles: ECT Sensor Stuck at Low ECT 6 driving cycles: ECT Sensor Stuck at High ECT
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever this DTC is not present	P0100 - P0103 (MAF sensor)
---	----------------------------

ECT Sensor Stuck at Low ECT:

Cumulative idle off period	4 minutes and 10 seconds or more
Speed increase by 18.6 mph (30 km/h) or more	10 times or more
ECT	35 to 60°C (95 to 140°F)
IAT	-6.7°C (20°F) or more

ECT Sensor Stuck at High ECT:

ECT	60°C (140°F) or more
IAT	-6.7°C (20°F) or more
"Stop and go"* ¹	Once or more
"Steady driving and stop"* ²	Once or more Engine running and 0.3 seconds or more after engine start

* ¹Vehicle is stopped for 20 seconds or more and accelerated to more than 43.5 mph (70 km/h) within 40 seconds.

* ²Vehicle is driven by 40.4 mph (65 km/h) or more for 30 seconds or more and the vehicle speed reaches 43.5 mph (70 km/h). The vehicle is decelerated from 40.4 mph (65 km/h) to 1.86 mph (3 km/h) or less within 35 seconds and stopped for 10 seconds.

ES**TYPICAL MALFUNCTION THRESHOLDS****ECT Sensor Stuck at Low ECT:**

ECT change	Less than 3°C (5.4°F)
------------	-----------------------

ECT sensor Stuck at High ECT:

ECT change	1°C (1.8°F) or less
------------	---------------------

COMPONENT OPERATING RANGE

ECT	Varies with actual ECT
-----	------------------------

HINT:

- If DTCs P0115, P0116, P0117, P0118 and P0125 are output simultaneously, the ECT sensor circuit may be open or shorted. Perform the troubleshooting of DTC P0115, P0117 or P0118 first.
- 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**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

ES**DESCRIPTION****HINT:**

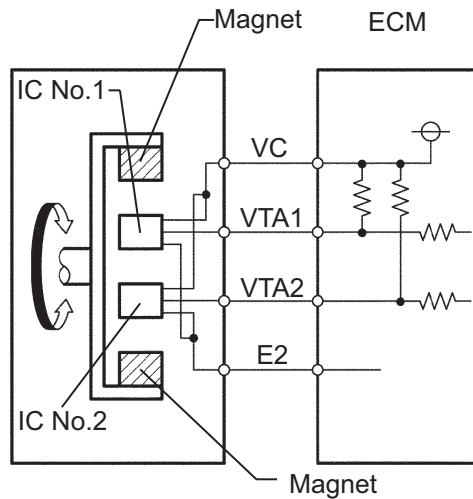
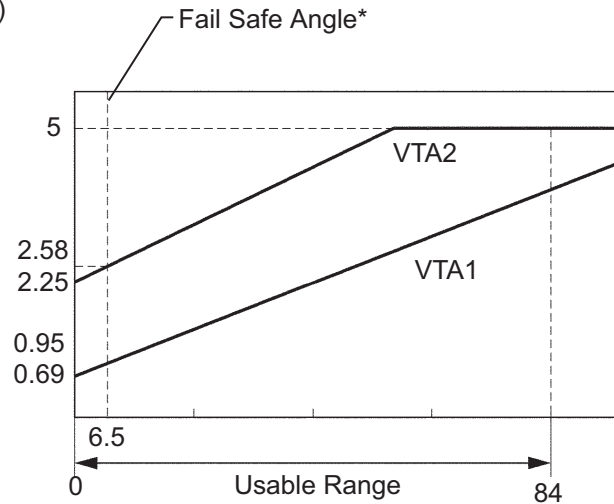
- This Electronic Throttle Control System (ETCS) does not use a throttle cable.
- This throttle position sensor is a non-contact type.

The throttle position sensor is mounted on the throttle body and it detects the opening angle of the throttle valve. This sensor is electronically controlled and uses Hall-effect elements, so that accurate control and reliability can be obtained. The throttle position sensor has 2 sensor elements/signal outputs: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. Voltage applied to VTA1 and VTA2 changes between 0 V and 5 V in proportion to the opening angle of the throttle valve. There are several checks that the ECM performs to confirm proper operation of the throttle position sensor and VTA1.

The ECM judges the current opening angle of the throttle valve from these signals input from terminals VTA1 and VTA2, and the ECM controls the throttle motor to make the throttle valve angle properly in response to driver inputs.

ES

Throttle position Sensor

Throttle Position
Sensor Output
Voltage (V)

Throttle Valve Opening Angle (deg.)

Throttle Valve Fully Closed (Throttle
Position expressed as percentage
(VTA 1) 10 to 24 %)

Throttle Valve Fully Opened (Throttle
Position expressed as percentage
(VTA 1) 64 to 96 %)

*: Fail Safe Angle 6.5° (Throttle
Position expressed as percentage
(VTA 1) about 16 %)

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DTC No.	DTC Detection Condition	Trouble Area
Condition (1) of DTC P0120, P0122, P0123, P0220, P0222 or P0223 continues for 2 seconds (open or short in the throttle position sensor circuit)		
P0120	Detection conditions for DTCs P0122 and P0123 are not satisfied but condition (1) is satisfied 1. VTA1 is 0.2 V or less or VTA1 is 4.535 V or more	<ul style="list-style-type: none">• Throttle position sensor• ECM
P0122	1. VTA1 is 0.2 V or less	<ul style="list-style-type: none">• Throttle position sensor• Short in VTA1 circuit• Open in VC circuit• ECM
P0123	1. VTA1 is 4.535 V or more	<ul style="list-style-type: none">• Throttle position sensor• Open in VTA1 circuit• Open in E2 circuit• Short in VC and VTA1 circuits• ECM

DTC No.	DTC Detection Condition	Trouble Area
Condition (1) of DTC P0120, P0122, P0123, P0220, P0222 or P0223 continues for 2 seconds (open or short in the throttle position sensor circuit)		
P0220	Detection conditions for DTCs P0222 and P0223 are not satisfied but condition (1) is satisfied 1. VTA2 is 1.75 V or less or VTA2 is 4.8 V or more	<ul style="list-style-type: none">• Throttle position sensor• ECM
P0222	1. VTA2 is 1.75 V or less	<ul style="list-style-type: none">• Throttle position sensor• Short in VTA2 circuit• Open in VC circuit• ECM
P0223	1. VTA2 is 4.8 V or more and VTA1 is 0.2 V or more and VTA1 is 2.02 V or less	<ul style="list-style-type: none">• Throttle position sensor• Open in VTA2 circuit• Open in E2 circuit• Short in VC and VTA2 circuits• ECM
P2135	Condition (1) continues for 0.5 seconds or more, or condition (2) continues for 0.4 seconds or more: 1. Difference between VTA1 and VTA2 is 0.02 V or less 2. VTA1 is 0.2 V or less and VTA2 is 1.75 V or less	<ul style="list-style-type: none">• Same as DTC No. P0120

HINT:

- After confirming DTCs, use the intelligent tester or the OBD II scan tool to confirm the throttle valve opening percentage and closed throttle position switch condition.
- "THROTTLE POS" is the VTA1 signal. "THROTTLE POS #2" is the VTA2 signal.

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 5.5 V

MONITOR DESCRIPTION

The ECM uses the throttle position sensor to monitor the throttle valve opening angle.

- There is a specific voltage difference between VTA1 and VTA2 for each throttle opening angle.**
 - If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a fault and will set a DTC.
- VTA1 and VTA2 each have a specific voltage operating range.**
 - If VTA1 or VTA2 is out of the normal operating range, the ECM interprets this as a fault and will set a DTC.
- VTA1 and VTA2 should never be close to the same voltage levels.**
 - If the difference between VTA1 and VTA2 is within 0.02 V, the ECM interprets this as a short circuit in the throttle position sensor system and will set a DTC.

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.

MONITOR STRATEGY

Related DTCs	P0120: TP Sensor (VTA1) Range Check (Chattering) P0122: TP Sensor (VTA1) Range Check (Low voltage) P0123: TP Sensor (VTA1) Range Check (High voltage) P0220: TP Sensor (VTA2) Range Check (Chattering) P0222: TP Sensor (VTA2) Range Check (Low voltage) P0223: TP Sensor (VTA2) Range Check (High voltage) P2135: TP Sensor Range Check (Correlation)
Required sensors/components (Main)	TP sensor
Required sensors/components (Related)	-
Frequency of operation	Continuous
Duration	Accelerator pedal ON: 2 seconds Accelerator pedal OFF: 10 seconds 0.5 seconds or 0.4 seconds (P2135)
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are 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 the VTA1 is 0.2 to 2.02 V	4.8 V or more
---	---------------

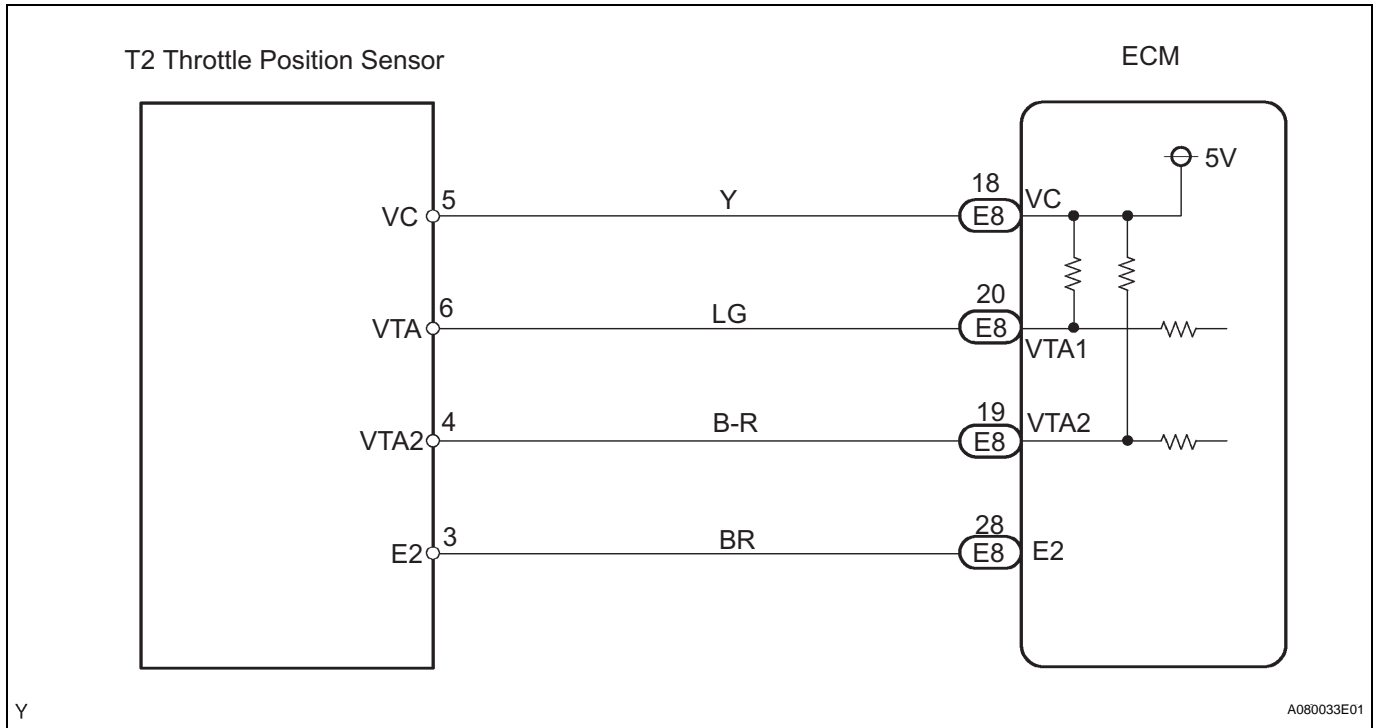
P2135:

Either of the following conditions is met:	Condition 1 or 2
Condition 1.	-
Difference between VTA1 and VTA2 voltage	0.02 V or less
Condition 2.	-
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 4.8 V

WIRING DIAGRAM



HINT:

- If DTCs that are related to different systems are output simultaneously while terminal E2 is used as a ground terminal, terminal E2 may have an open 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.

1

READ VALUE OF INTELLIGENT TESTER (THROTTLE POS AND THROTTLE POS #2)

- (a) On the intelligent tester, enter the following menus:
DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL /
THROTTLE POS and THROTTLE POS #2. Read the values.

Result

Throttle position expressed as percentage and voltage				Trouble Area	Proceed to
Accelerator pedal released		Accelerator pedal depressed			
THROTTLE POS (VTA1)	THROTTLE POS #2 (VTA2)	THROTTLE POS (VTA1)	THROTTLE POS #2 (VTA2)		
0 %	0 to 0.2 V	0 %	0 to 0.2 V	VC circuit open	A
100 %	4.5 to 5.5 V	100 %	4.5 to 5.5 V	E2 circuit open	A
0 % or 100 %	2.1 to 3.1 V (fail safe)	0 % or 100 %	2.1 to 3.1 V (fail safe)	VTA1 circuit open or ground short	A
about 16 % (fail safe)	0 to 0.2 or 4.5 to 5.5 V	about 16 % (fail safe)	0 to 0.2 or 4.5 to 5.5 V	VTA2 circuit open or ground short	A
10 to 24 %	2.1 to 3.1 V	64 to 96 % (does not fail safe)	4.5 to 5.5 V (does not fail safe)	Throttle position sensor circuit is normal	B

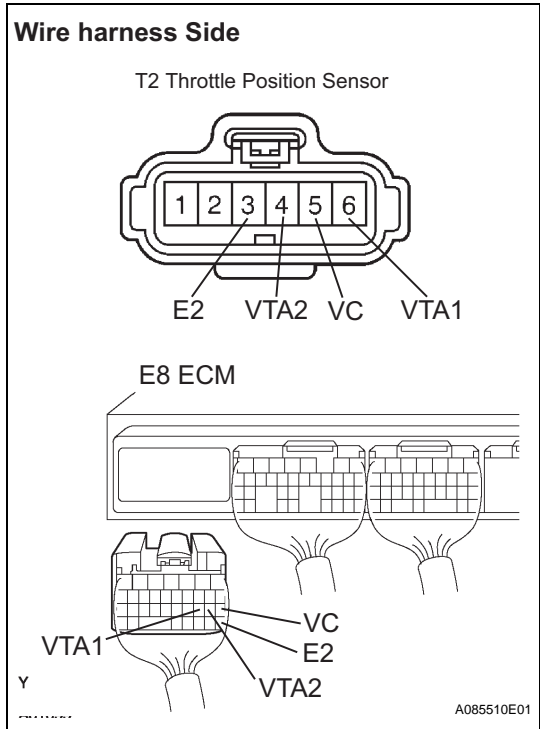
B

Go to step 5

A

2

CHECK WIRE HARNESS (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.

Resistance

Tester Connection	Specified Condition
T2-5 (VC) - E8-18 (VC) T2-6 (VTA) - E8-20 (VTA1) T2-4 (VTA2) - E8-19 (VTA2) T2-3 (E2) - E8-28 (E2)	Below 1 Ω
T2-5 (VC) or E8-18 (VC) - Body ground T2-6 (VTA) or E8-20 (VTA1) - Body ground T2-4 (VTA2) or E8-19 (VTA2) - Body ground	10 kΩ or higher

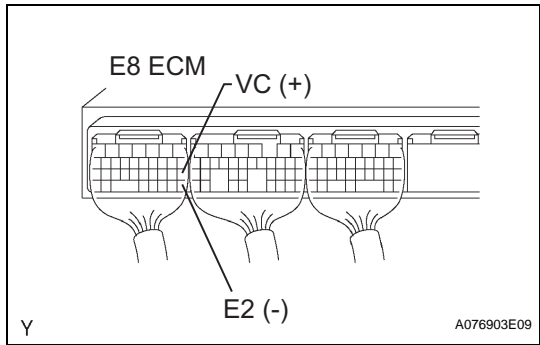
NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

3

CHECK ECM (VC VOLTAGE)



- (a) Turn the ignition switch ON.
- (b) Measure the voltage of the E8 ECM connector.

Voltage

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

NG

REPLACE ECM

OK

4

REPLACE THROTTLE BODY ASSEMBLY

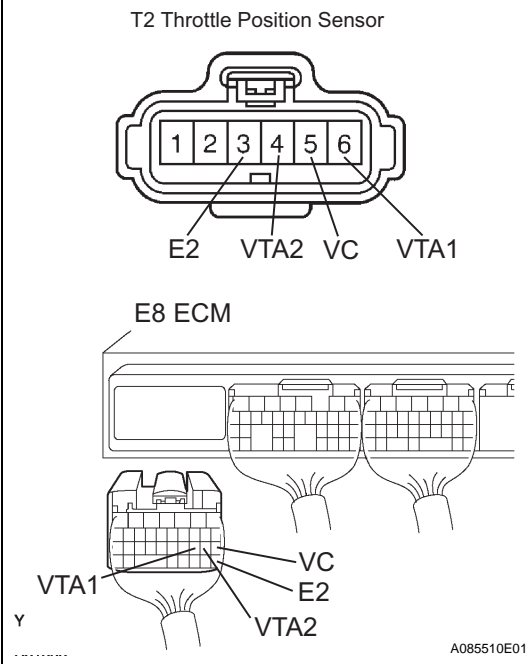
GO

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

- (a) Clear the DTC (See page ES-28).
- (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****ES****REPLACE ECM****1 CHECK WIRE HARNESS (THROTTLE POSITION SENSOR - ECM)****Wire harness Side**

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

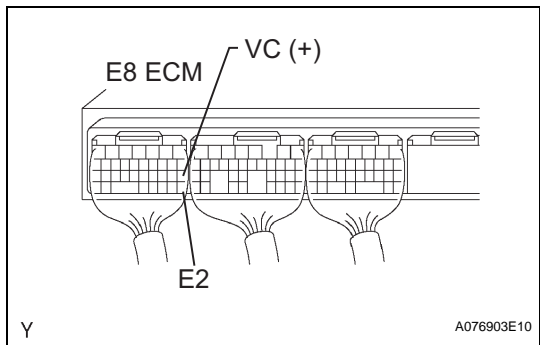
Resistance

Tester Connection	Specified Condition
T2-5 (VC) - E8-18 (VC) T2-6 (VTA) - E8-20 (VTA1) T2-4 (VTA2) - E8-19 (VTA2) T2-3 (E2) - E8-28 (E2)	Below 1 Ω
T2-5 (VC) or E8-18 (VC) - Body ground T2-6 (VTA) or E8-20 (VTA1) - Body ground T2-4 (VTA2) or E8-19 (VTA2) - Body ground	10 k Ω or higher

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

2

CHECK ECM (VC VOLTAGE)



- (a) Turn the ignition switch ON.
(b) Measure the voltage of the E8 ECM connector.
- 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-28](#)).
(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

Refer to DTC P0120 (See page [ES-91](#)).

DTC No.	DTC Detection Condition	Trouble Area
P0121	Condition (1) continues for 2.0 seconds: 1. Difference between VTA1 and VTA2 deviates from threshold	Throttle position sensor

MONITOR DESCRIPTION

The ECM uses the throttle position sensor to monitor the throttle valve opening angle.

This sensor includes 2 signals: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. There are several checks that the ECM performs to confirm proper operation of the throttle position sensor and VTA1.

There is a specific voltage difference between VTA1 and VTA2 for each throttle opening angle.

If the voltage output difference between the VTA1 and VTA2 deviates from the normal operating range, the ECM interprets this as a malfunction of the throttle position sensor. The ECM will turn on the MIL and a DTC will be set.

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.

MONITOR STRATEGY

Related DTCs	P0121: TP Sensor Rationality
Required sensors/components (Main)	TP 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
Either of the following condition is set	Condition 1 or 2
1. Ignition switch	ON
2. ETCS power	ON
TP sensor open/short malfunction (P0120, P0122, P0123, P0220, P0222, P0223, P2135)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met	Condition 1 or 2
---	------------------

1. Difference of TP sensor voltage between VTA1 and VTA2 x 0.8	More than 1.6 V
2. Difference of TP sensor voltage between VTA1 and VTA2 x 0.8	Less than 0.8 V

1

REPLACE THROTTLE POSITION SENSOR

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.

NEXT

END

DTC**P0125****Insufficient Coolant Temperature for Closed Loop Fuel Control****DESCRIPTION**

Refer to DTC P0115 (See page [ES-84](#)).

DTC No.	DTC Detection Condition	Trouble Area
P0125	<ul style="list-style-type: none"> Case 1: Engine Coolant Temperature (ECT) is less than -19.45°C (-3°F) at engine start 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 to -8.34°C (-3°F to 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 above -3°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 	<ul style="list-style-type: none"> Cooling system ECT sensor Thermostat

ES**MONITOR DESCRIPTION**

The resistance of the ECT sensor varies in proportion to the actual ECT. The ECM supplies a constant voltage to the sensor and monitors the signal output voltage of the sensor. The signal 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 2 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)	ECT sensor, MAF meter
Frequency of operation	Continuous
Duration	2 minutes: Engine coolant temperature at engine start is -8.34°C (17°F) or more 5 minutes: Engine coolant temperature at engine start is -19.45 to -8.34°C (-3 to 17°C) 20 minutes: Engine coolant temperature at engine start is less than -19.45°C (-3°F)
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is 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 is -8.34°C (17°F) or more 5 minutes or more: Engine coolant temperature at engine start is -19.45 to -8.34°C (-3 to 17°F) 20 minutes or more: Engine coolant temperature at engine start is less than -19.45°C (-3°F)
--	---

HINT:

- If DTCs P0115, P0116, P0117, P0118 and P0125 are output simultaneously, the engine coolant temperature sensor circuit may be open or shorted. Perform the troubleshooting of DTC P0115, P0117 or P0118 first.
- 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 P0125)

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

Result

Display (DTC Output)	Proceed to
Only P0125 is output	A
P0125 and other DTCs are output	B

HINT:

If any other DTCs besides P0125 are output, perform the troubleshooting for those DTCs first.

B**GO TO RELEVANT DTC CHART****A****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**3****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**ES****REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

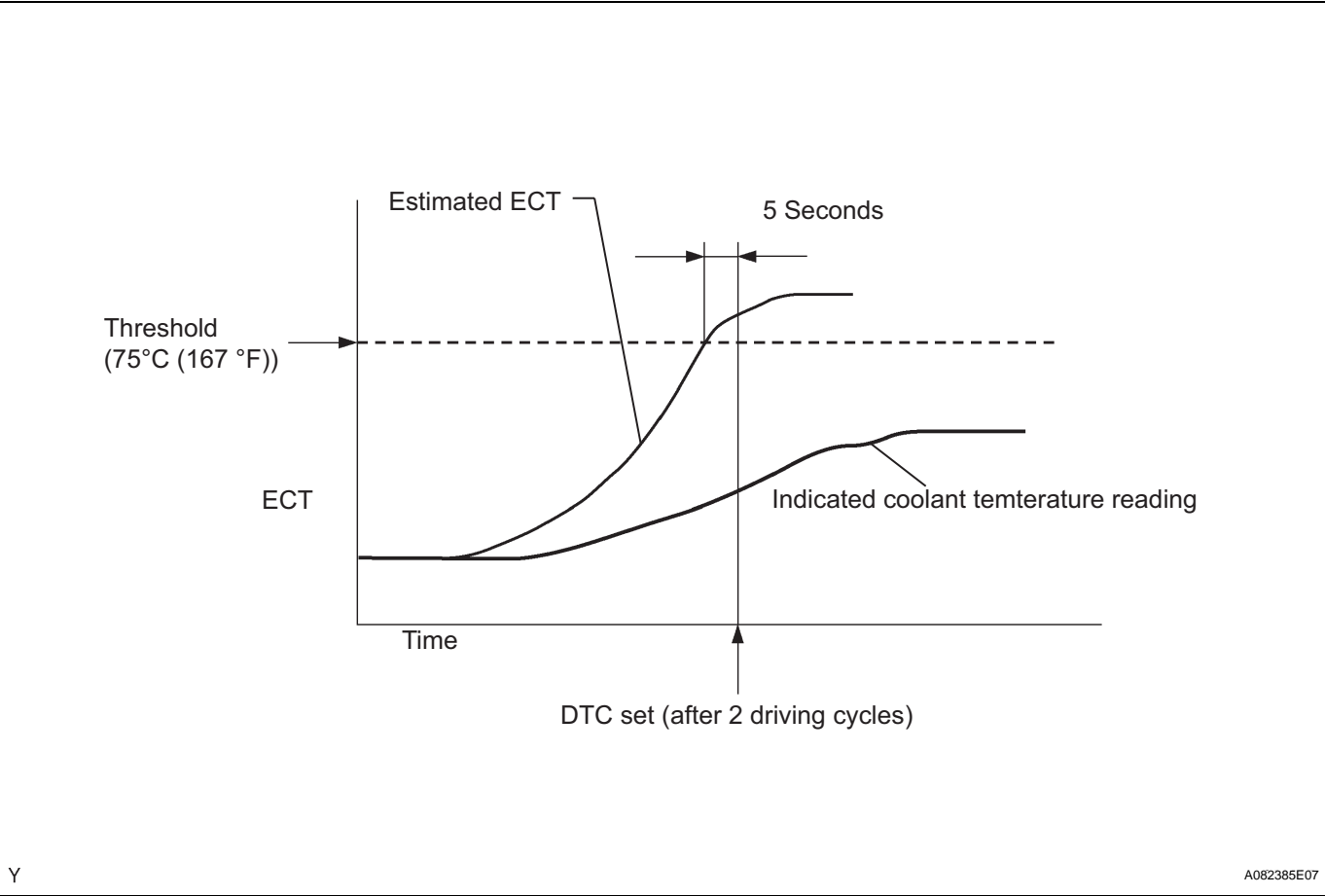
DTC	P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)
-----	-------	--

DESCRIPTION
This DTC is output 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 (1), (2) and (3) are met: 1. Cold start 2. Sufficient warm-up time has elapsed 3. ECT is less than 75°C (167°F)	<ul style="list-style-type: none">• Thermostat• Cooling system• ECT sensor• ECM

ES

MONITOR DESCRIPTION



The ECM estimates the coolant temperature based on starting temperature, engine loads, and engine speeds. The ECM then compares the estimated temperature with the actual ECT. When the estimated coolant temperature reaches 75°C (167°F), the ECM checks the actual ECT. If the actual ECT is less than 75°C (167°F), the ECM will interpret this as a fault in the thermostat or the engine cooling system and set a DTC.

MONITOR STRATEGY

Related DTCs	P0128: Coolant Thermostat
Required sensors/components (Main)	Thermostat
Required sensors/components (Related)	ECT sensor, IAT sensor, Vehicle speed sensor
Frequency of operation	Once per driving cycle

Duration	15 minutes
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present	P0010 (VVT VSV) P0011, P0012 (VVT system - Advance, Retard) P0031, P0032 (A/F sensor heater) P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0354 (Igniter) P0500 (VSS) P2196 (A/F sensor (Rationality)) P2237 (A/F sensor (Open)) P2A00 (A/F sensor (Slow response))
Battery voltage	11 V or more
Either of the following conditions is met	Condition 1 or 2
1. All of the following conditions are met	Condition (1), (2) and (3)
(1) ECT at engine start - IAT at engine start	-15 to 7°C (-27 to 12.6°F)
(2) ECT at engine start	-10 to 56°C (14 to 132.8°F)
(3) IAT at engine start	-10 to 56°C (14 to 132.8°F)
2. All of the following conditions are met	Condition (1), (2) and (3)
(1) ECT at engine start - IAT at engine start	7°C (12.6°F) or more
(2) ECT at engine start	56°C (132.8°F) or less
(3) IAT at engine start	-10°C (14°F) or more
Accumulated time that vehicle speed is 80 mph (128 km/h) or more	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

Duration that both of the following conditions 1 and 2 are met:	5 seconds or more
1. Estimated ECT	75°C (167°F) or more
2. ECT sensor output	Less than 75°C (167°F)

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page [ES-16](#)).

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 \$08: Thermostat

TLT	CID	Unit Conversion	Description of Test Data	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 criteria for thermostat

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.

ES**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)

ES**HINT:**

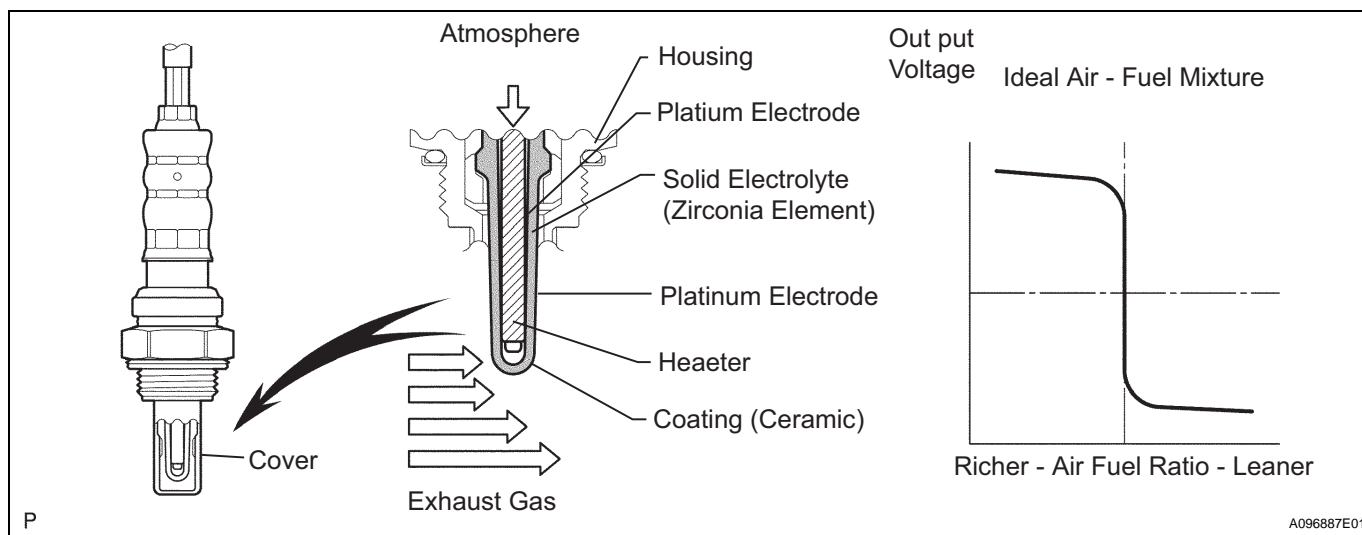
Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.

DESCRIPTION

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient sue of the TWC, the air-fuel ratio must be precisely controlled so that it is always closed to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low). When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. less than 0.45 V). Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. more than 0.45V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.



DTC No	DTC Detection Condition	Trouble Area
P0136	Abnormal voltage output: During active air-fuel ratio control, following conditions (1) and (2) met for certain period of time (1 trip detection logic): 1. Heated Oxygen (HO2) sensor voltage does not decrease to less than 0.45 V 2. HO2 sensor voltage does not increase to more than 0.6 V • Low impedance: Sensor impedance less than 5 Ω for more than 30 seconds when ECM presume sensor to being warmed up and operating normally (1 trip detection logic)	<ul style="list-style-type: none"> • Open or short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • HO2 sensor heater (sensor 2) • Air-Fuel Ratio (A/F) sensor (sensor 1) • EFI relay • Gas leakage from exhaust system
P0137	<ul style="list-style-type: none"> • High impedance: Sensor impedance 15 kΩ or more than 90 seconds when ECM presumes sensor to being warmed up and operating normally (1 trip detection logic) 	<ul style="list-style-type: none"> • Open in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • HO2 sensor heater (sensor 2) • EFI relay • Gas leakage from exhaust system
P0138	<ul style="list-style-type: none"> • Extremely high voltage (short): HO2 sensor voltage output exceeds 1.2 V for more than 10 seconds (1 trip detection logic) 	<ul style="list-style-type: none"> • Short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • ECM internal circuit malfunction
P0139	<ul style="list-style-type: none"> • Fuel-cut HO2 sensor voltage: Either of following conditions (1) or (2) met (1 trip detection logic): 1. Duration until HO2 sensor voltage drops to 0.2 V after fuel-cut start 7 seconds or more 2. Both following conditions (a) and (b) met: (a) Rear HO2 sensor voltage when fuel-cut start 0.5 V or more (b) Duration that HO2 sensor voltage to 0.35 to 0.2 V 1 second or more 	<ul style="list-style-type: none"> • Short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • ECM internal circuit malfunction

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

Related DTCs	P0136: Heated oxygen sensor output voltage (Output voltage) P0136: Heated oxygen sensor impedance (Low impedance) P0137: Heated oxygen sensor output voltage (Low voltage) P0137: Heated oxygen sensor impedance (High impedance) P0138: Heated oxygen sensor output voltage (High voltage) P0139: Heated oxygen sensor output voltage (Extremely high)
Required Sensors/Components (Main)	Heated oxygen sensor
Required Sensors/Components (Related)	Crankshaft position sensor, engine coolant temperature sensor, mass air flow meter and throttle position sensor
Frequency of Operation	Once per driving cycle: Active air-fuel ratio control detection Continuous: Others
Duration	Within 480 seconds
MIL Operation	2 driving cycles: P0136 (Rear HO2S output voltage - case 1) P0136 (Rear HO2S output voltage - case 2) P0139 (Rear HO2S voltage during fuel-cut) Immediate: Others
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None
--	------

P0316 (Rear HO2S output voltage - case 1):

All of the following conditions are met	Conditions 1, 2 and 3
1. Engine	Running
2. Time after engine start	0 second or more
3. Cumulative time while rear HO2S heater is operating	22 seconds or more

P0136 (HO2S output voltage - case 2)

Engine	Running
--------	---------

P0136 (Rear HO2S low impedance):

Battery voltage	11 V or more
Estimated rear HO2S temperature	Less than 700°C (1,292°F)
ECM monitor	Completed
P0606	No set

P0137 (Rear HO2S high impedance):

Battery voltage	11 V or more
Estimated rear HO2S temperature	450°C (842°F) or higher
ECM monitor	Completed
P0606	No set

P0138 (Rear HO2S output voltage - case 3):

Battery voltage	11 V or more
Time after engine start	2 seconds or more

P0139 (Rear HO2S output voltage during fuel-cut):

Engine coolant temperature	70°C (158°F) or more
Estimated catalyst temperature	400°C (752°F) or more
Fuel-cut	OK

TYPICAL MALFUNCTION THRESHOLDS

P0136 (Rear HO2S output voltage - case 1):

Both of the following conditions are met:	Conditions 1 and 2
1. Frequency of switch time between less than 0.45 V and 0.6 V or more.	0 time
2. Cumulative monitor time ^{*1} of rear HO2S	480 seconds or more
*1: Monitor time is counted when the following conditions are met	Conditions (a) and (b)
(a) Fuel system status	Closed-loop
(b) Idle	OFF

P0136 (Rear HO2S output voltage - case 2):

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Automatic transaxle models: All of the following conditions are met:	Conditions 1, 2, 3, 4 and 5
1. Cumulative monitor time * of rear HO2S	180 seconds or more
2. Cumulative time while rear HO2S voltage is below 0.05 V	108 seconds or more
3. Cumulative time while rear HO2S voltage is higher than 0.7 V	Less than 36 seconds
4. Cumulative time while rear HO2S voltage is 0.45 V to 0.7 V	Less than 72 seconds
5. Cumulative time while rear HO2S voltage is 0.45 V or more	Less than 20 seconds
Manual transaxle models: All of following conditions are met:	Conditions 1, 2, 3, 4 and 5
1. Cumulative monitor time * of rear HO2S	170 seconds or more
2. Cumulative time while rear HO2S voltage is below 0.05 V	102 seconds or more
3. Cumulative time while rear HO2S voltage is higher than 0.7 V	Less than 34 seconds
4. Cumulative time while rear HO2S voltage is 0.45 V to 0.7 V	Less than 68 seconds
5. Cumulative time while rear HO2S voltage is 0.45 V or more	Less than 20 seconds
*Monitor time is counted when all following conditions are met:	Conditions 1,2,3 and 4
Vehicle speed	1.875 mph (3 km/h or more)
Idle	OFF
Fuel-cut	OFF
Intake air amount per revolution	5 g/rev or more

P0136 (Rear HO2S low impedance):

Duration of the following condition	30 seconds or more
Rear HO2S impedance	Less than 5 Ω

P0137 (Rear HO2S high impedance):

Duration of the following condition	90 seconds or more
Rear HO2S impedance	15 kΩ or more

P0138 (Rear HO2S output voltage - case 3):

Duration of the following condition	10 seconds or more
Rear HO2S voltage	1.2 V or more

P0139 (Rear HO2S output voltage during fuel-cut):

Either of the following conditions is met:	Conditions 1 or 2
1. Duration until rear HO2S voltage drops to 0.2 V during fuel-cut	7 seconds or more
2. Both of the following conditions are met:	Conditions (a) and (b)

(a) Rear HO2S voltage when fuel-cut starts	0.5 V or more
(b) Duration that HO2S voltage drops from 0.35 to 0.2 V during fuel-cut.	1 second or more

COMPONENT OPERATING RANGE

Rear HO2S voltage	Varies between 0.1 and 0.9 V
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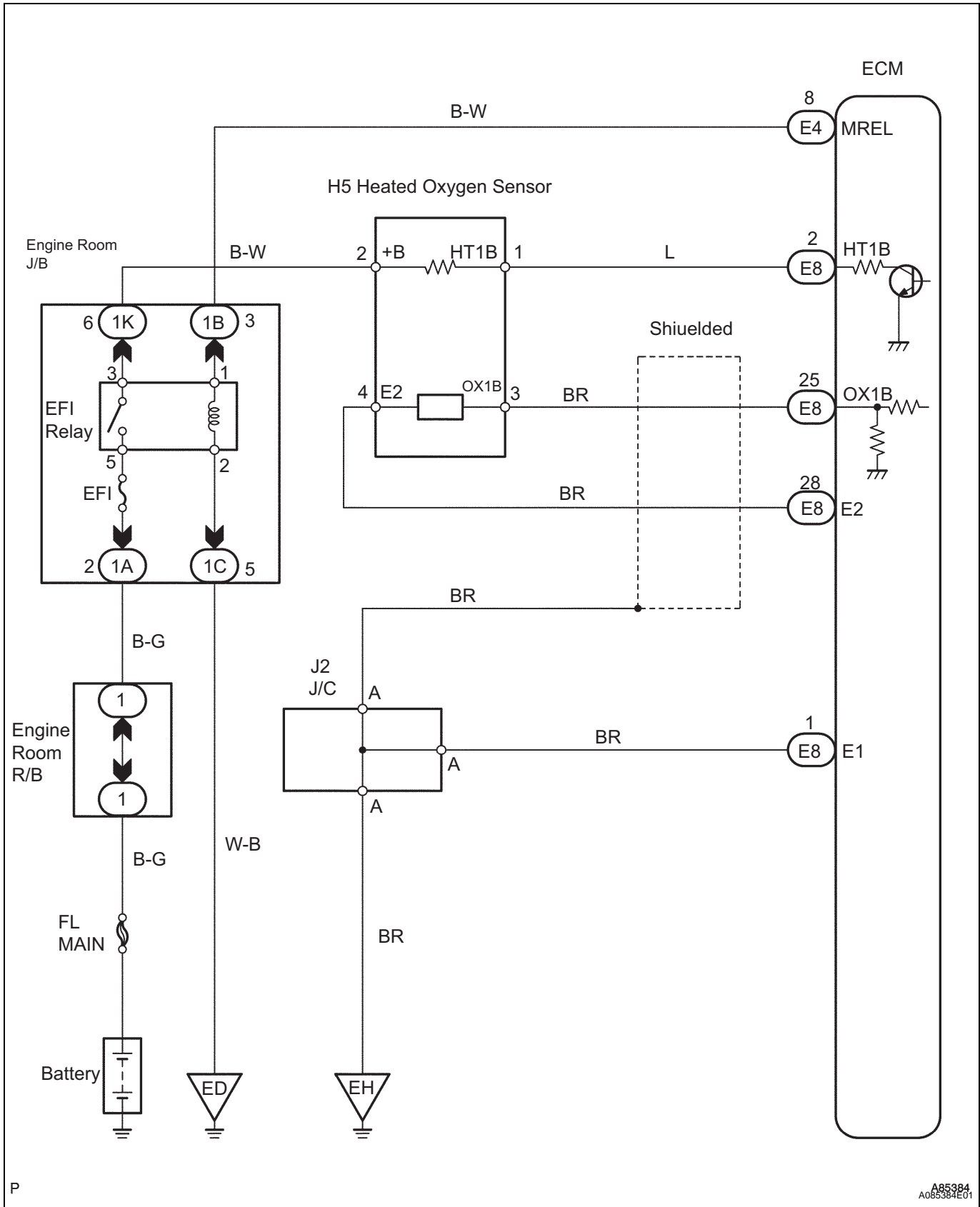
O2S TEST RESULT

Refer to "O2 TEST RESULT" for detailed information (See page [ES-15](#)).

Test ID	Test Item	Description	Unit Conversion	Unit	Standard Value
\$07	MIN HO2S V	Minimum HO2S voltage	Multiply by 0.005	V	Less than malfunction threshold
\$08	MAX HO2S V	Maximum HO2S voltage	Multiply by 0.005	V	More than malfunction threshold
\$31	Time \$31	HO2S switch time from Lean to Rich	Multiply by 0.04096	second	Less than malfunction threshold
\$32	Time \$32	HO2S switch time from 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 0.3906	%	Less than malfunction threshold
\$84	Time \$84	Percentage in monitor time when HO2S voltage is 0.7 V or higher	Multiply by 0.3906	%	More than malfunction threshold
\$85	Time \$85	Maximum time while HO2S voltage exceeded 0.45 V continuously	Multiply by 0.2621	seconds	More than malfunction threshold
\$87	Time \$87	Percentage in monitor time when HO2S voltage is 0.45 V or higher	Multiply by 0.3906	%	More than malfunction threshold

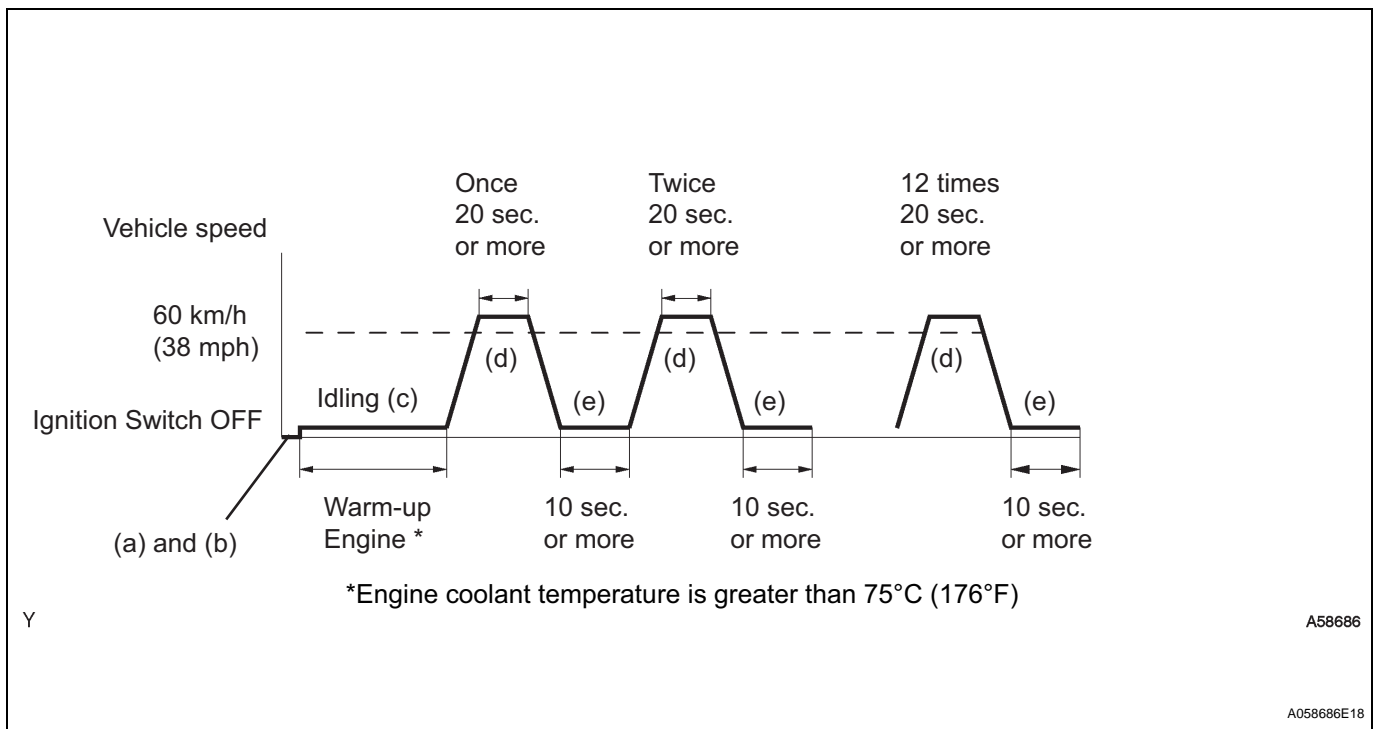
If the sensor voltage is outside the standard values, the ECM interprets this as a malfunction and sets a DTC.

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN

(a) Connect the intelligent tester to the DLC 3.



- (b) Switch the ECM from normal mode to check mode using the tester (See page [ES-29](#)).
- (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 an intelligent tester, turn the ignition switch to OFF after performing steps from (c) to (f), then perform steps (c) to (f) again.

HINT:

Intelligent tester only:

Malfunctioning areas 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.

- Connect an intelligent tester to the DLC3.
- Start the engine and turn the tester ON.
- Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
- On the tester, select the following menu items: DIAGNOSIS / EXHANCED OBD II / ACTIVE TEST / A/F CONTROL.
- 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).

Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and OS2 B1S2) displayed on the tester.

HINT:

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

Standard:

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

NOTICE:

The A/F sensor output has a few seconds of the heated oxygen sensor output has about 20 seconds of delay at maximum.

ES

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		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> A/F sensor A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> HO2 sensor HO2 sensor heater HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> Injector Fuel pressure Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

- 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 or 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.

- If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be set.

1 CHECK OTHER DTC OUTPUT

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

Result

Display (DTC Output)	Proceed to
P0138 is output	A
P0137 is output	B
P0136 is output	C

HINT:

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

B**Go to step 9****C****Go to step 6****A****2 READ VALUE OF INTELLIGENT TESTER OF OBD II SCAN TOOL (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**

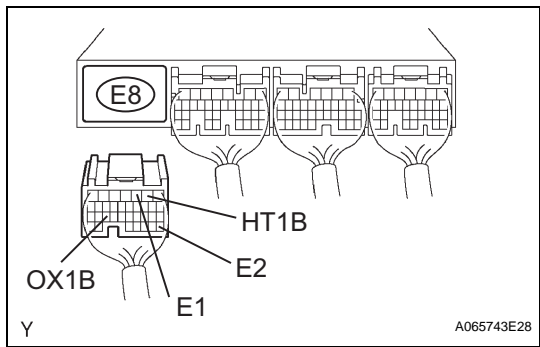
- (a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
(b) Turn the ignition switch ON.
(c) Push the intelligent tester or the OBD II scan tool main switch ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1S2.
(e) Run the engine at idle.
(f) Read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

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 WIRE HARNESS (CHECK FOR SHORT)



- (a) Turn the ignition switch OFF and wait for 5 minutes.
- (b) Disconnect the E8 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
E8-2 (HT1B) - E8-25 (OX1B)	No continuity
E8-2 (HT1B) - E8-29 (E2)	No continuity

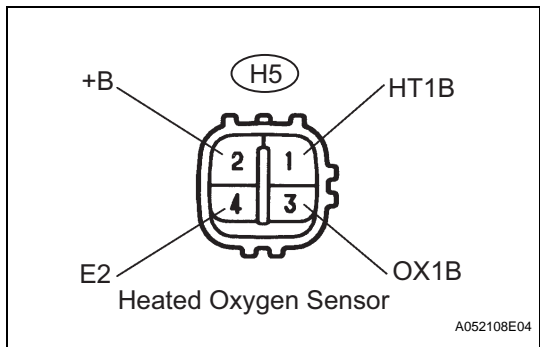
OK

REPLACE ECM

NG

4

INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)



- (a) Disconnect the H5 heated oxygen sensor connector.
- (b) Measure the resistance of the sensor side connectors.

Resistance

Tester Connection	Specified Condition
H5-2 (+B) - H5-4 (E2)	10 kΩ or higher
H5-2 (+B) - H5-3 (OX1B)	10 kΩ or higher

OK

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 an accumulated total of 10 minutes.
HINT:
The 10 minutes of driving should be driven in one instance, but it is not necessary to maintain a speed of 25 mph (40 km/h) for 10 minutes consecutively.
- (c) Read the DTC.

Result

Display (DTC output)	Proceed to
P0138 is output	A
No DTC	B

B

CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE HEATED OXYGEN SENSOR

6

READ VALUE OF INTELLIGENT TESTER OR OBD 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.**

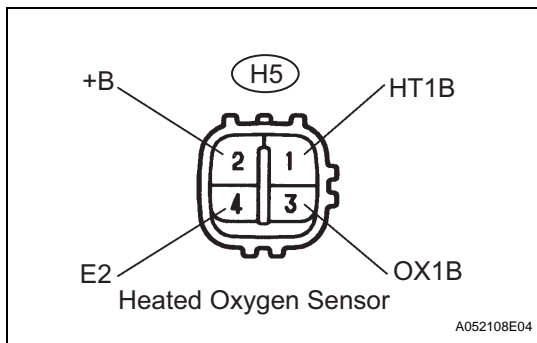
OK

Go to step 10

NG

7

INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



- (a) Disconnect the H5 heated oxygen sensor connector.
- (b) Measure the resistance of the heated oxygen sensor terminals.

Resistance

Tester Connection	Condition	Specified Condition
H5-1 (HT1B) - H5-2 (+B)	20°C (68°F)	11 to 16 Ω
H5-1 (HT1B) - H5-2 (+B)	800°C (1,472°F)	23 to 32 Ω

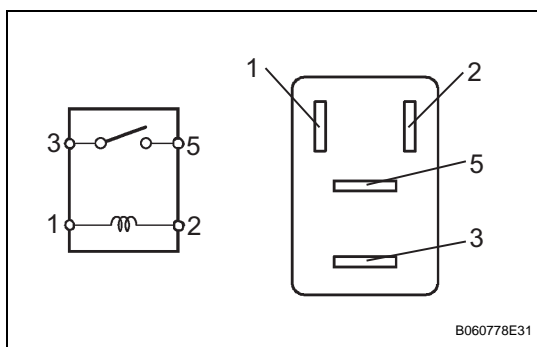
NG

REPLACE HEATED OXYGEN SENSOR

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 k Ω or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG

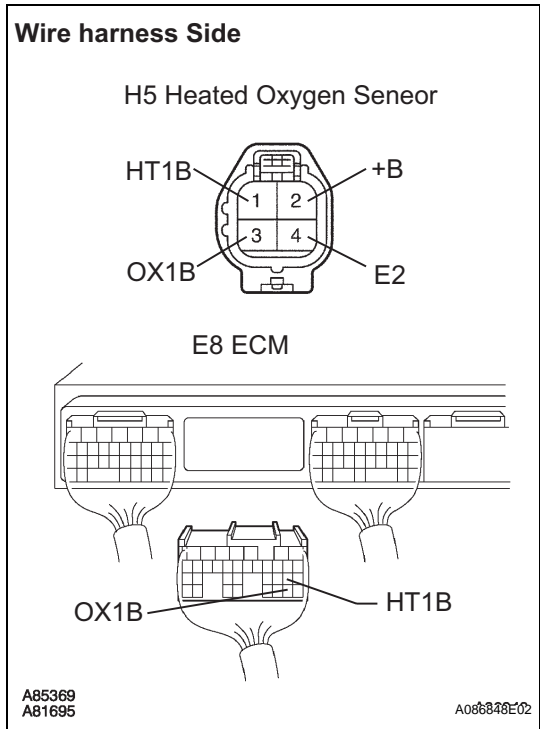
REPLACE EFI RELAY

ES

OK

9

CHECK WIRE HARNESS

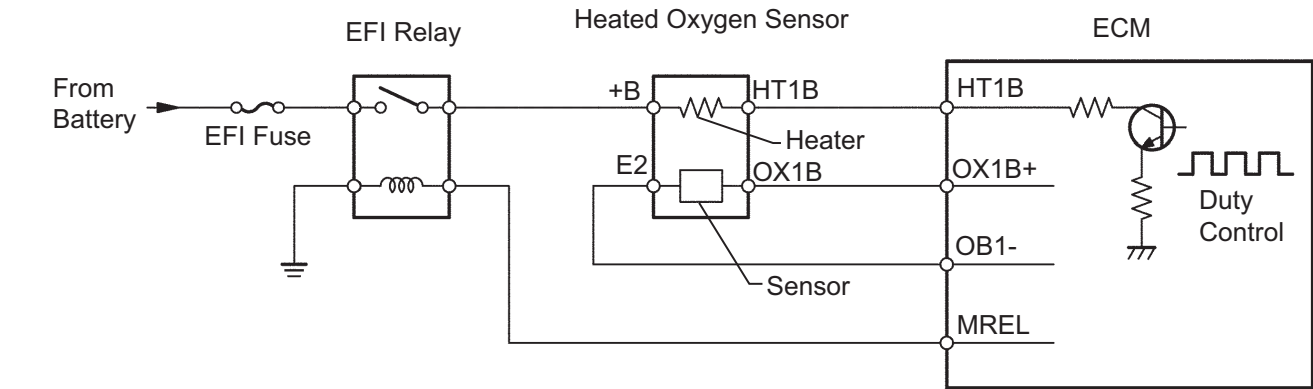


- (a) Check the wire harness between the ECM and heated oxygen sensor.
- (1) Disconnect the H5 heated oxygen sensor connector.
 - (2) Disconnect the E8 ECM connector.
 - (3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
H5-1 (HT1B) - E8-2 (HT1B) H5-3 (OX1B) - E8-25 (OX1B)	Below 1 Ω
H5-1 (HT1B) or E8-2 (HT1B) - Body ground H5-3 (OX1B) or E8-25 (OX1B) - Body ground	10 k Ω or higher

Reference



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.

NEXT**11 READ OUTPUT DTC (DTC P0136 IS OUTPUT AGAIN)**

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

Result

Display (DTC Output)	Proceed to
P0136 is not output again	A
P0136 is output again	B

A**CHECK FOR INTERMITTENT PROBLEMS****B****12 REPLACE HEATED OXYGEN SENSOR****NEXT****13 PERFORM CONFIRMATION DRIVE PATTERN**

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

NEXT**14 READ OUTPUT DTC (DTC P0136 IS OUTPUT AGAIN)**

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

Result

Display (DTC Output)	Proceed to
P0136 is not output again	A
P0136 is output again	B

A**REPAIR COMPLETED****B****ES**

15 PERFORM ACTIVE TEST USING INTELLIGENT TESTER

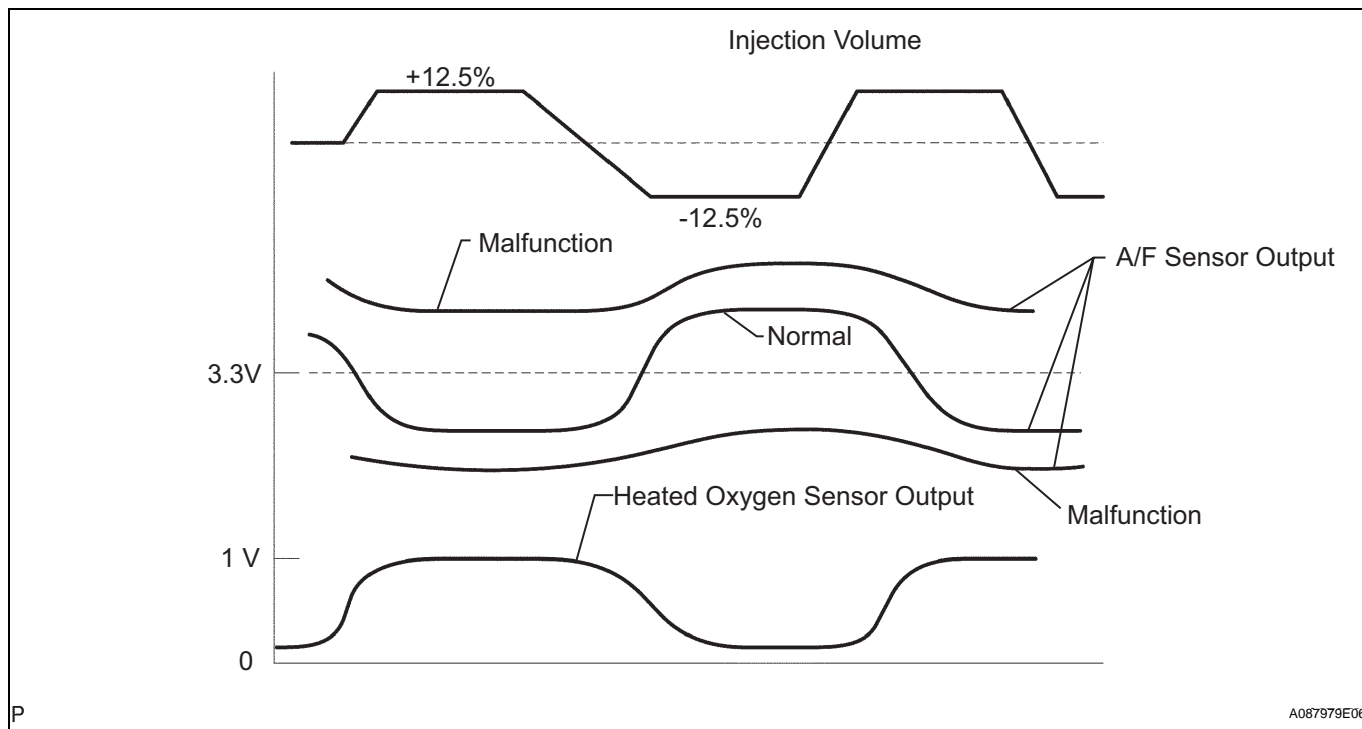
- Start the engine and warm it up.
- Connect the intelligent tester to the DLC3.
- Turn ON the ignition switch and the intelligent tester main switch.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INJ VOL.
- Using the intelligent tester, change the injection volume to check 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 MALFUNCTIONING A/F SENSOR

NG

CHECK AND REPLACE EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO

DTC	P0171	System Too Lean (Bank 1)
DTC	P0172	System Too Rich (Bank 1)

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim includes the short-term fuel trim and the long-term fuel trim.

The short-term fuel trim is the short-term fuel compensation used to maintain the air-fuel ratio at the stoichiometric air-fuel ratio. The signal from the A/F sensor indicates whether the air-fuel ratio is RICH or LEAN compared to the stoichiometric air-fuel ratio. This variance triggers a reduction in the fuel volume if the air-fuel ratio is RICH, and an increase in the fuel volume if it is LEAN.

The short-term fuel trim varies from the central value due to individual engine differences, wear over time and changes in the operating environment. The long-term fuel trim, which controls overall fuel compensation, steadies long-term deviations of the short-term fuel trim from the central value.

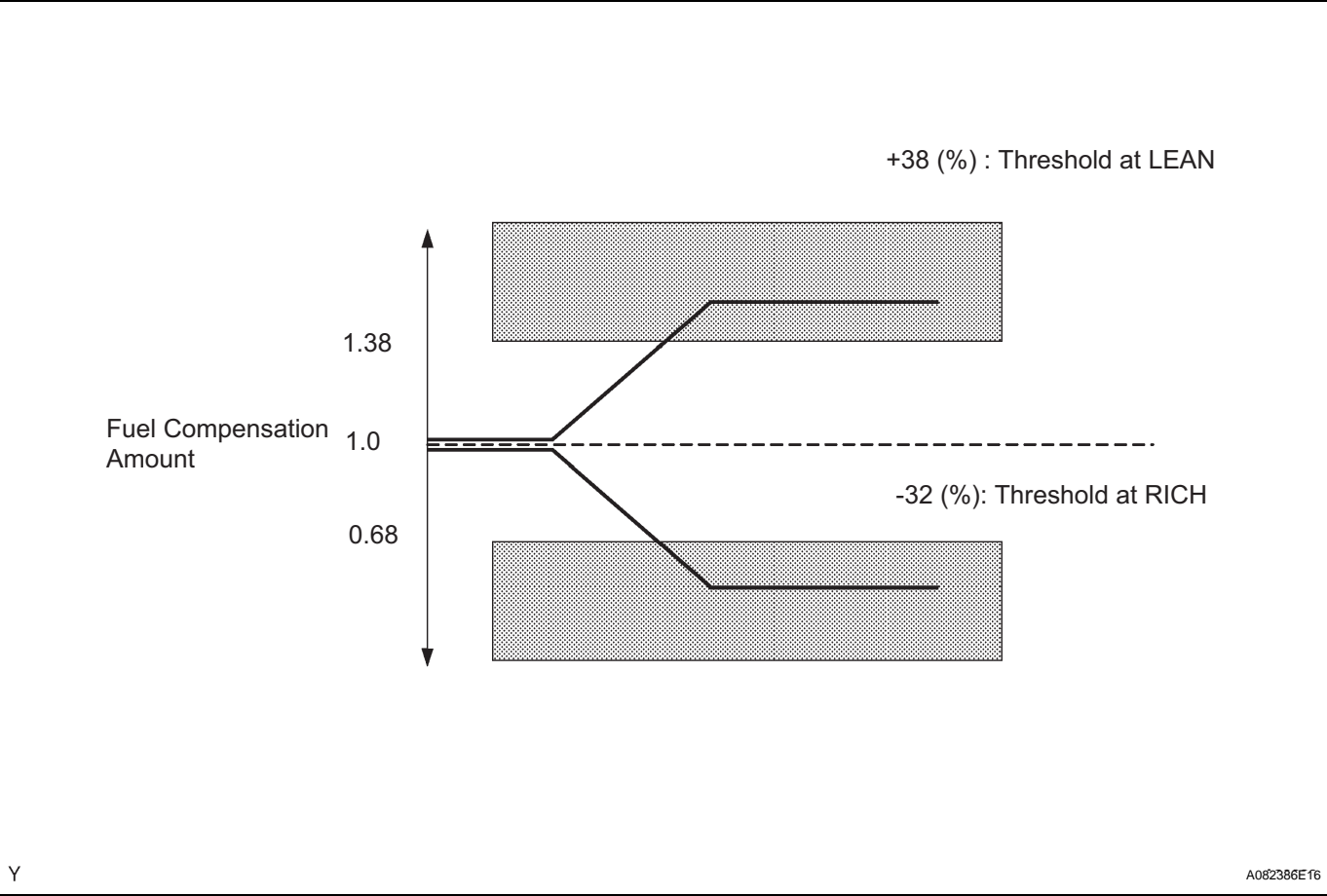
If both the short-term fuel trim and the long-term fuel trim are LEAN or RICH beyond a certain value, it is detected as a malfunction, the MIL is illuminated and a DTC is set.

DTC No.	DTC Detection Condition	Trouble Area
P0171	When air-fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on LEAN side (2 trip detection logic)	<ul style="list-style-type: none"> • Air induction system • Injector blockage • MAF meter • ECT sensor • Fuel pressure • Gas leakage in exhaust system • Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater (bank 1 sensor 1) • EFI relay • Open or short in A/F sensor heater and EFI relay circuit • PCV hose connection • PCV hose
P0172	When air-fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on RICH side (2 trip detection logic)	<ul style="list-style-type: none"> • Injector leak, blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage in exhaust system • Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • Open or short in A/F sensor heater and EFI relay circuit • EFI relay

HINT:

- When DTC P0171 is recorded, the actual air-fuel ratio is on the LEAN side. When DTC P0172 is recorded, 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 is recorded. The MIL then illuminates.

MONITOR DESCRIPTION



Under closed-loop fuel control, fuel injection amounts that deviate from the ECM's estimated fuel amount will cause a change in the long-term fuel trim compensation value. This long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. And, the deviation from the simulated fuel injection amount by the ECM affects the smoothed fuel trim learning value. The smoothed fuel trim learning value is the combination of smoothed short term fuel trim (fuel feedback compensation value) and smoothed long term fuel trim (learning value of the air-fuel ratio). When the smoothed fuel trim learning value exceeds the DTC threshold, the ECM interprets this as a fault in the fuel system and sets a DTC.

Example:
The smoothed fuel trim learning value is more than +38% or less than -32%. The ECM interprets this as a failure in the fuel system.

MONITOR STRATEGY

Related DTCs	P0171: Fuel Trim Lean P0172: Fuel Trim Rich
Required sensors/ components (Main)	Fuel system
Required sensors / components (Related)	A/F sensor, MAF sensor, Crankshaft position sensor
Frequency of operation	Continuous
Duration	Within 10 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0010 (VVT VSV) P0011, P0012 (VVT system - Advance, Retard) P0031, P0032 (A/F sensor heater) P0100 - P0103 (MAF sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0354 (Igniter) P0500 (VSS)
Fuel system status	Closed-loop
Battery voltage	11 V or more
Throttle position learning	Completed
Either of the following conditions is met:	Condition 1 or 2
1. Engine RPM	Less than 1,100 rpm
2. Intake air amount per revolution	0.22 g/rev or more

ES

TYPICAL MALFUNCTION THRESHOLDS

EVAP purge-cut	Excecuting
Either of the following conditions is met:	-
Average between short-term fuel trim and long-term fuel trim	38% or more (varies with ECT)
Average between short-term fuel trim and long-term fuel trim	-32% or less (varies with ECT)

WIRING DIAGRAM

Refer to DTC P2195 (See page [ES-256](#)).

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 %.

- Connect the intelligent tester to the DLC3 on the vehicle.
- Turn the ignition switch ON.
- Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
- 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		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> • A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> • HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> • Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensor.
- 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 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.
- A high A/F sensor voltage could be caused by a RICH air fuel mixture. Check the conditions that might cause the engine to run with a RICH air fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air fuel mixture. Check the conditions that might cause the engine to run with a LEAN air fuel mixture.

1	CHECK AIR INDUCTION SYSTEM
----------	-----------------------------------

- (a) Check for vacuum leaks in air induction system.

OK:

No vacuum leak.

NG

REPAIR OR REPLACE AIR INDUCTION
SYSTEM

OK

2

CHECK CONNECTION OF PCV HOSE

OK:

PCV hose is connected correctly and PCV hose is not
damaged

NG

REPAIR OR REPLACE PCV HOSE

OK

ES

3

INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

Standard pressure

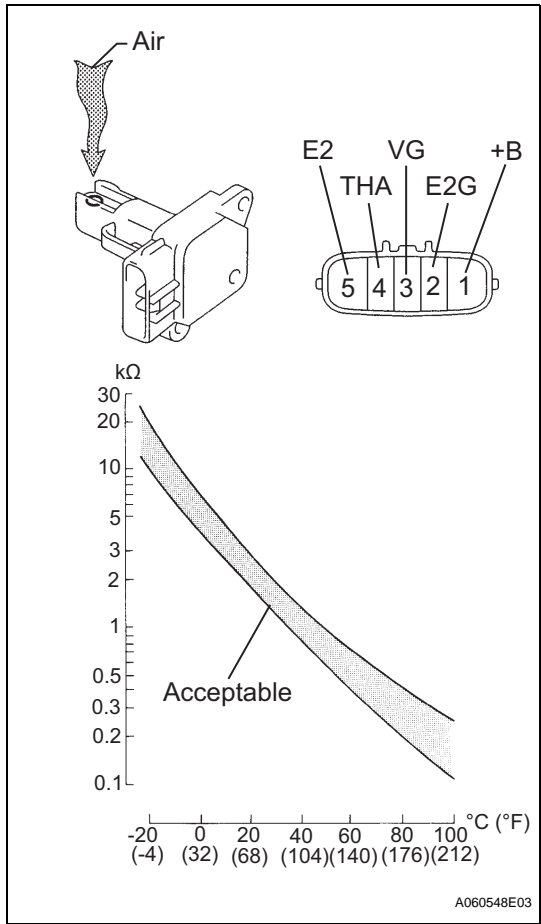
Injection Volume	Difference Between Each Injector
76 to 91 cm ³ (4.6 to 5.5 cu. in.) / 15 seconds	15 cm ³ (0.9 cu. in.) or less

NG

REPLACE FUEL INJECTOR ASSEMBLY

OK

4INSPECT MASS AIR FLOW METER



- (a) Remove the MAF meter.
- (b) Check the output voltage.
 - (1) Apply battery voltage across terminals +B and E2G.
 - (2) Connect the positive (+) tester probe to terminal VG, and negative (-) tester probe to terminal E2G.
 - (3) Blow air into the MAF meter, and check that the voltage fluctuates.
- (c) Measure the resistance of the IAT terminals.

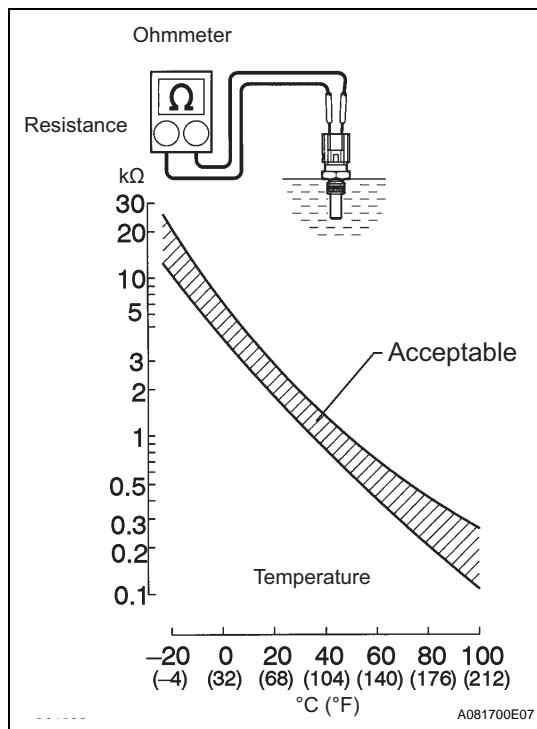
Resistance

Tester Connection	Condition	Specified Condition
4 (THA) - 5 (E2)	-20°C (-4°F)	13.6 to 18.4 kΩ
4 (THA) - 5 (E2)	20°C (68°F)	2.21 to 2.69 kΩ
4 (THA) - 5 (E2)	60°C (140°F)	0.49 to 0.67 kΩ

NG

REPLACE MASS AIR FLOW METER

OK

5 INSPECT ENGINE COOLANT TEMPERATURE SENSOR (RESISTANCE)

(a) Remove the ECT sensor.

(b) Measure the resistance of the ECT sensor terminals.

Resistance

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	2.32 to 2.59 kΩ
1 - 2	80°C (176°F)	0.310 to 0.326 kΩ

NOTICE:

When checking the ECT sensor in the water, be careful not to allow water to go into the terminals. After the check, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed ECT sensor and read the resistance. Use an infrared thermometer to measure the engine temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

NG**REPLACE ENGINE COOLANT TEMPERATURE SENSOR****OK****6 CHECK SPARK AND IGNITION****OK:**

Spark occurs.

NG**REPAIR OR REPLACE SPARK AND IGNITION****OK****7 CHECK FUEL PRESSURE**

(a) Check fuel pressure (high or low pressure).

Standard pressure

Item	Specified Condition
Fuel pressure	304 to 343 kPa (3.1 to 3.5 kgf/cm ² , 44 to 55 psi)

NG**REPLACE FUEL SYSTEM****OK****ES**

8	CHECK FOR EXHAUST GAS LEAKS
----------	------------------------------------

OK:

No gas leak.

NG	REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT
-----------	--

OK

9	READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (OUTPUT VOLTAGE OF AIR FUEL RATIO SENSOR (BANK 1 SENSOR 1))
----------	---

- (a) Connect the intelligent tester or the OBD II scan tool to the DLC 3.
- (b) Warm up the A/F sensor (bank 1 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:
Enter the following menus: ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA.
- (e) Select "AFS B1 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 engine to idle for 30 seconds.
 - (2) Running the engine at approximately 2,500 rpm (where engine RPM is not suddenly changed).
 - (3) Raise the engine speed to 4,000 rpm and quickly release the accelerator pedal so that the throttle is fully closed.

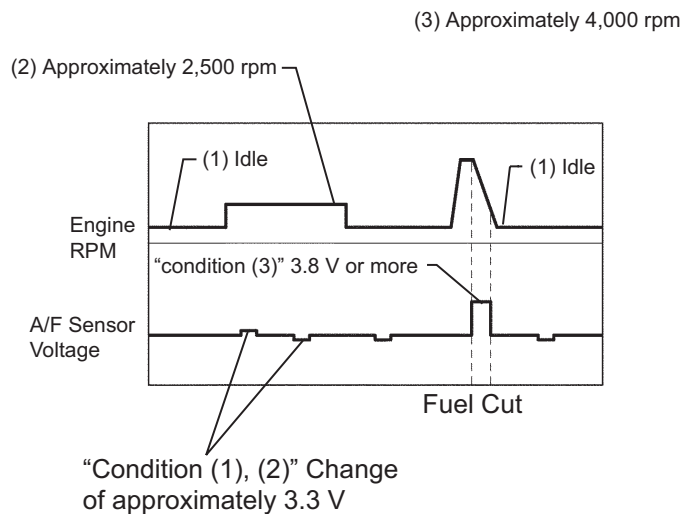
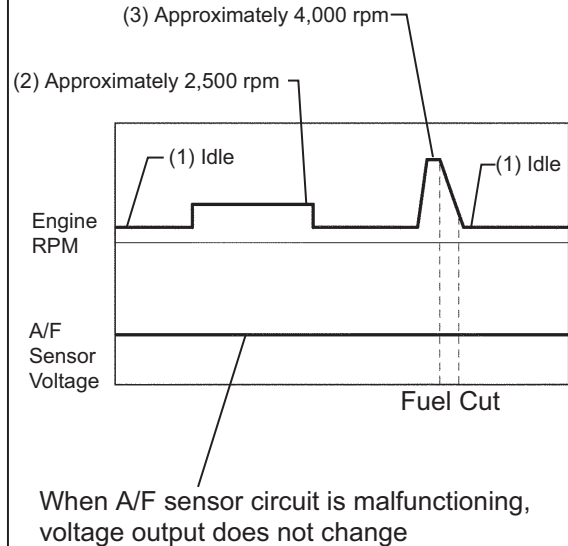
Voltage:**Condition (1) and (2):**

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 when fuel is cut during engine deceleration, as shown in the illustration.

***: Voltage when using the OBD II scan tool.**

Normal Condition**Malfunction Condition**

A072304E05

HINT:

- Whenever the output voltage of the A/F sensor 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 output voltage of the A/F sensor 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 cut) during engine deceleration. This will cause a LEAN condition and should result in a momentary increase in A/F sensor voltage output.
- 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 (16 km/h) to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
You may notice that the output voltage of the A/F sensor is below 2.8 V (0.76 V)* during fuel enrichment. For example, when the vehicle tries to overtake another vehicle on a highway, the vehicle speed is suddenly increased with the accelerator pedal fully depressed. 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

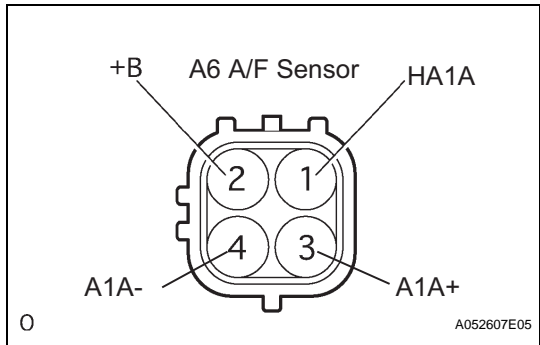
Go to step 17

NG

10

INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

ES



- (a) Disconnect the A6 A/F sensor connector.
(b) Measure the resistance of the A/F sensor terminals.
Resistance

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 kΩ

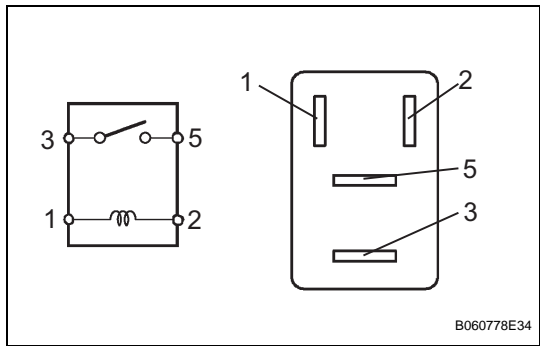
NG

REPLACE AIR FUEL RATIO SENSOR

OK

11

INSPECT EFI RELAY



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

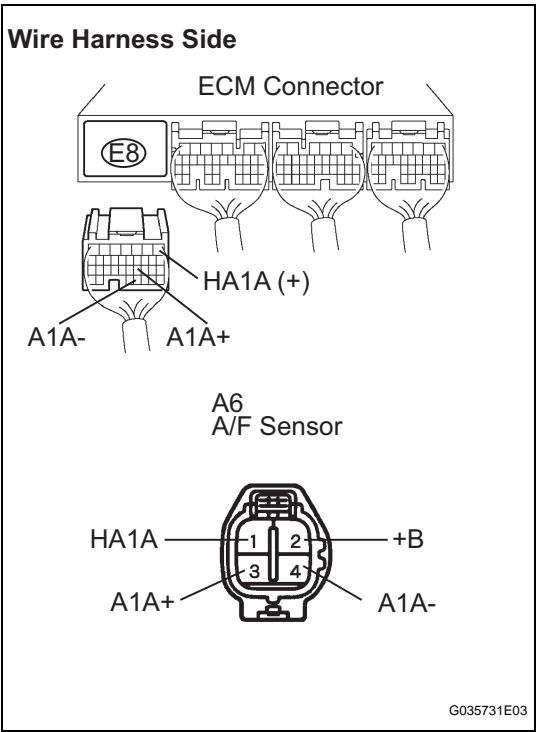
Tester Connection	Specified Condition
3 - 5	10 kΩ
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG

REPLACE EFI RELAY

OK

12 CHECK WIRE HARNESS (A/F SENSOR - ECM)



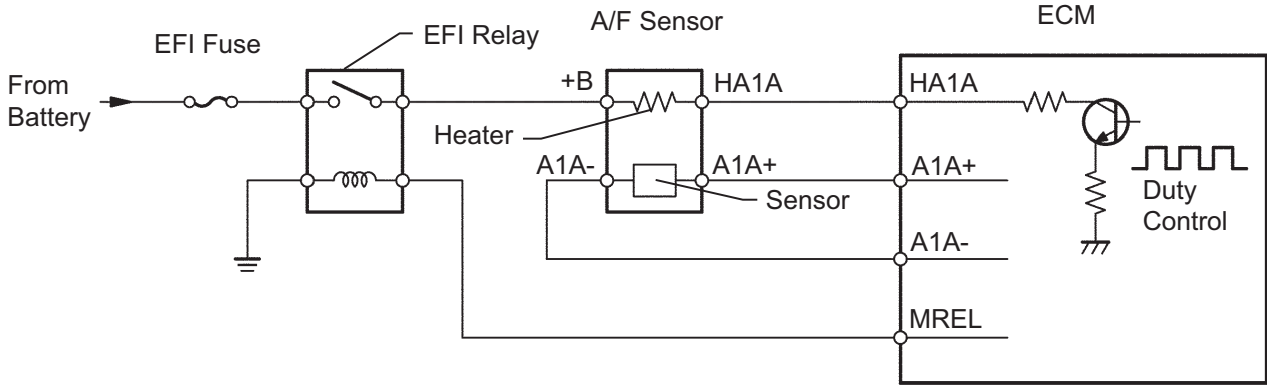
- (a) Disconnect the A6 A/F sensor connector.
- (b) Disconnect the E8 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A6-3 (A1A+) - E8-21 (A1A+) A6-4 (A1A-) - E8-31 (A1A-) A6-1 (HA1A) - E8-1 (HA1A)	Below 1 Ω
A6-3 (A1A+) or E8-21 (A1A+) - Body ground A6-4 (A1A-) or E8-31 (A1A-) - Body ground A6-1 (HA1A) or E8-1 (HA1A) - Body ground	10 k Ω or higher

ES

Reference (Bank 1 Sensor 1 System Drawing)



A087980E06

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

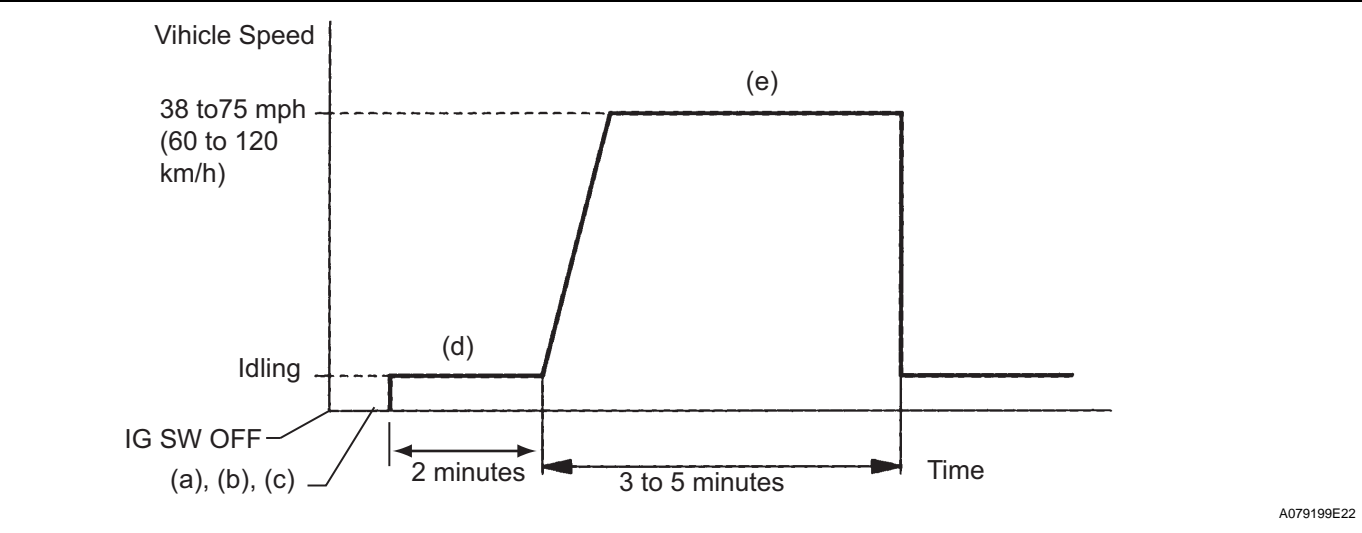
OK

13 REPLACE AIR FUEL RATIO SENSOR

NEXT

14

PERFORM CONFIRMATION DRIVING PATTERN



- (a) Clear the DTCs.
 - (1) Disconnect the battery cable or remove the EFI and ETCS fuses for 60 seconds or more.
- (b) Connect the intelligent tester to the DLC3.
- (c) Switch the intelligent tester from the normal mode to the check mode (See page ES-29).
- (d) Start the engine and warm it up with all the accessory switches OFF.
- (e) 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 (e).

NOTICE:
If the conditions in this test are not strictly followed, detecting a malfunction may be difficult. If you do not have a intelligent tester, turn the ignition switch OFF after performing steps (d) to (e), and then perform step (e) again.

NEXT

15

READ OUTPUT DTC (DTC P0171, P0172 ARE OUTPUT AGAIN)

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

Result

Display (DTC Output)	Proceed to
DTC P0171, P0172 are not output again	A
DTC P0171, P0172 are output again	B

B

REPLACE ECM AND PERFORM
CONFIRMATION DRIVING PATTERN

A**16 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST****NG****CHECK FOR INTERMITTENT PROBLEMS****OK****DTC IS CAUSED BY SHORTAGE OF FUEL (DTCS P0171, P0172)****17 PERFORM CONFIRMATION DRIVING PATTERN****HINT:**

Clear all DTCs prior to performing the confirmation driving pattern (refer to step 14).

NEXT**18 READ OUTPUT DTC (DTC P0171, P0172 ARE OUTPUT AGAIN)**

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

Result

Display (DTC Output)	Proceed to
DTC P0171, P0172 are output again	A
DTC P0171, P0172 are not output again	B

B**Go to step 22****A****19 REPLACE AIR FUEL RATIO SENSOR****NEXT****20 REPLACE PERFORM CONFIRMATION DRIVING PATTERN****HINT:**

Clear all DTCs prior to performing the confirmation driving pattern (refer to step 14).

NEXT**21 READ OUTPUT DTC**

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

ES

Result

Display (DTC Output)	Proceed to
DTC P0171, P0172 are not output again	A
DTC P0171, P0172 are output again	B

B

REPLACE ECM AND PERFORM
CONFIRMATION DRIVING PATTERN

A

22 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

ES

NG

CHECK FOR INTERMITTENT PROBLEMS

OK

DTC IS CAUSED BY SHORTAGE OF FUEL (DTCS P0171, P0172)

DTC	P0300	Random / Multiple Cylinder Misfire Detected
DTC	P0301	Cylinder 1 Misfire Detected
DTC	P0302	Cylinder 2 Misfire Detected
DTC	P0303	Cylinder 3 Misfire Detected
DTC	P0304	Cylinder 4 Misfire Detected

DESCRIPTION

When a misfire occurs in the engine, hydrocarbons (HC) are output in high concentrations. If this HC concentration is high enough, there could be an increase in exhaust emissions levels. High concentrations of HC can also cause the temperature of the catalyst to increase, possibly damaging the catalyst. To prevent increases in emissions and limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the catalyst reaches a point of thermal degradation, the ECM will blink the MIL. For monitoring a misfire, the ECM uses both the camshaft position sensor and the crankshaft position sensor. The camshaft position sensor is used to identify misfiring cylinders and the crankshaft position sensor is used to measure variations in the crankshaft rotation speed. A misfire is counted when crankshaft rotation speed variations exceed threshold values.

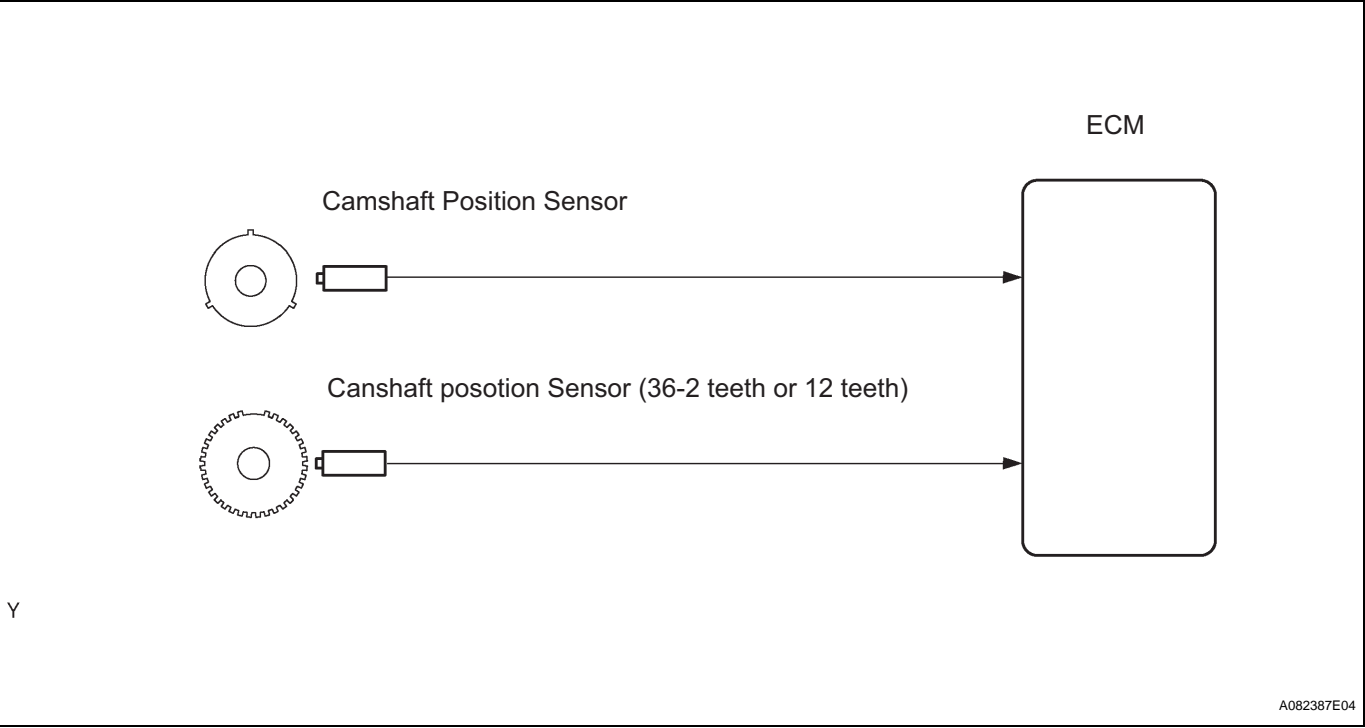
If the misfiring rate exceeds the threshold value and could cause emission deterioration, the ECM illuminates the MIL.

DTC No.	DTC Detection Condition	Trouble Area
P0300	Misfiring of random cylinder is detected	<ul style="list-style-type: none"> • Open or short in engine wire • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • MAF meter • ECT sensor • Compression pressure • Valve clearance • Valve timing • PCV hose connection • PCV hose • ECM
P0301 P0302 P0303 P0304	Misfiring of each cylinder is detected	<ul style="list-style-type: none"> • Same as DTC No. P0300

HINT:

When several codes for a misfiring cylinder are recorded repeatedly but no random misfire code is recorded, the misfires have been detected and recorded at different times.

MONITOR DESCRIPTION



The ECM illuminates the MIL (2 trip detection logic) if:

- The misfiring rate exceeds a threshold value and could cause emission deterioration.
- During the first 1,000 engine revolutions after the engine starts, an excessive misfire rate (approximately 20 to 50 misfire per 1,000 engine revolutions) occurs once.
- After the first 1,000 engine revolutions after the engine starts, an excessive misfire rate (approximately 20 to 50 misfire per 1,000 engine revolutions) occurs 4 times.

The ECM blinks the MIL (MIL blinks immediately) if:

- Within 200 engine revolutions at a high rpm, the threshold for "percent of misfire causing catalyst damage" is reached once.
- Within 200 engine revolutions at a normal rpm, the threshold for "percent of misfire causing catalyst damage" is reached 3 times. (for the 2nd trip, reaching the threshold once will cause the MIL to flash)

MONITOR STRATEGY

Related DTCs	P0300: Multiple Cylinder Misfire P0301: Cylinder 1 Misfire P0302: Cylinder 2 Misfire P0303: Cylinder 3 Misfire P0304: Cylinder 4 Misfire
Required sensors/ components (Main)	Injector, Ignition coil, Spark plug
Required sensors / components (Related)	Crankshaft position sensor, Camshaft position sensor, ECT sensor, IAT sensor, MAF 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-damage misfire
Sequence operation	None

TYPICAL ENABLING CONDITIONS**All:**

The monitor will run whenever these DTCs are not present	P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0325 - P0328 (Knock sensor) P0335 (CKP sensor) P0340 , P0341 (CMP sensor) P0500 (VSS)
Battery voltage	8 V or more
Throttle position learning	Completed
VVT system	Not operate by scan tool
Engine RPM	400 to 6,200 rpm
All of the following conditions are met:	Condition 1 and 2
1. Engine Coolant Temperature (ECT)	-10°C (14°F) or more
2. Either of the following conditions is met:	Condition (a) or (b)
(a) ECT at engine start	More than -7°C (19.4°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-damage-misfire (MIL blinks):

All of the following conditions 1, 2 and 3 met:	Crankshaft 200 revolutions
1. Driving cycles	1st
2. Check Mode	OFF
3. Engine RPM	Less than 4,300 rpm
Except above	Crankshaft 200 revolutions x 3

TYPICAL MALFUNCTION THRESHOLDS**Monitor Period of Emission-related-misfire:**

Misfire rate	1.3 % or more
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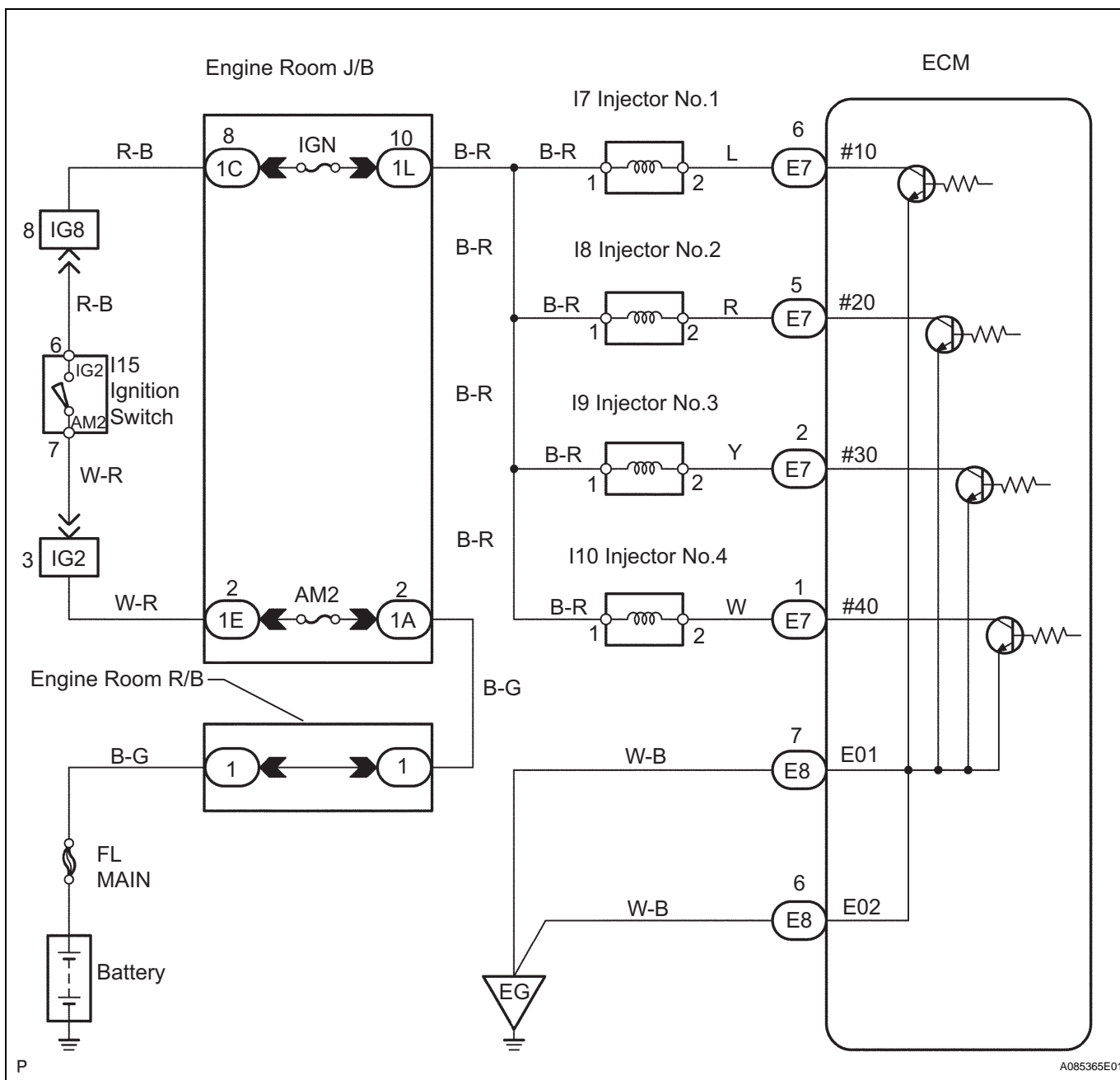
Monitor Period of Catalyst-damage-misfire (MIL blinks):

Number of misfire per 200 revolutions	101 or more (varies with intake air amount and engine RPM)
---------------------------------------	--

WIRING DIAGRAM

Refer to DTC P0351 (See page).

ES



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Record the DTCs, freeze frame data and misfire counter data.
3. Set the intelligent tester to check mode (See page ES-29).
4. Read the value on the misfire counter for each cylinder when idling. If the value is displayed on the misfire counter, skip the following procedure of confirmation driving.
5. Drive the vehicle several times with the engine speed, load and its surrounding range shown with ENGINE SPD, CALC LOAD in the freeze frame data or MISFIRE RPM, MISFIRE LOAD in the DATA LIST. If you have no intelligent tester, turn the ignition switch OFF after the symptom is simulated once. Then repeat the simulation process again.

HINT:

In order to memorize the misfire DTC, it is necessary to drive with MISFIRE RPM, MISFIRE LOAD in the DATA LIST for the period of time in the chart below. Take care not to turn the ignition switch OFF. Turning the ignition switch OFF switches the diagnosis system from check mode to normal mode and all DTCs, freeze frame data and other data are erased.

Engine Speed	Time
Idling	3 minutes 30 seconds or more
1,000 rpm	3 minutes or more
2,000 rpm	1 minute 30 seconds or more
3,000 rpm	1 minute or more

6. Check if there is misfire, DTC and the freeze frame data. Record the DTCs, freeze frame data and misfire counter data.

7. Turn the ignition switch OFF and wait for at least 5 seconds.

ES**HINT:**

- If DTCs besides misfire DTCs are memorized simultaneously, troubleshoot the non-misfire DTCs first.
- 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.
- If the misfire does not occur when the vehicle is brought to the workshop, the misfire can be confirmed by reproducing the condition of the freeze frame data. Also, after finishing the repair, confirm that there is no misfire (see confirmation driving pattern).
- On 6 and 8 cylinder engines, cylinder specific misfire fault codes are disabled at high engine speeds. If the misfire starts in a high engine speed area or the misfire occurs only in a high engine speed area, only the general fault code P0300 will be stored.

When only a general misfire fault code like P0300 is stored:

1. Erase the general misfire fault code from the ECM using the intelligent tester or OBD II scan tool.
 2. Start the engine and drive the confirmation pattern.
 3. Read the value of the misfire ratio for each cylinder. Or read the DTC.
 4. Perform repairs on the cylinder that has a high misfire ratio. Or repair the cylinder indicated by the DTC.
 5. After finishing repairs, drive the confirmation pattern again and confirm that no misfire occurs.
- When either of SHORT FT #1, LONG FT #1 in the freeze frame data is over the range of $\pm 20\%$, there is a possibility that the air-fuel ratio is becoming to RICH (-20% or less) or LEAN ($+20\%$ or more).
 - When COOLANT TEMP in the freeze frame data is less than 80°C (176°F), there is a possibility of misfire only during engine warm-up.
 - If the misfire cannot be reproduced, the following reasons may apply: 1) the vehicle has low fuel, 2) improper fuel is being used, and 3) the ignition plug is contaminated.
 - Be sure to check the value on the misfire counter after the repair.

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

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

Result

Display (DTC Output)	Proceed to
Only P0300, P0301, P0302, P0303 and P0304 are output	A
P0300, P0301, P0302, P0303, P0304 and other DTCs are output	B

HINT:

If any other codes besides P0300, P0301, P0302, P0303, P0304 are output, perform the troubleshooting for those codes first.

B

GO TO RELEVANT DTC CHART

A

2

CHECK WIRE HARNESS, CONNECTOR AND VACUUM HOSE IN ENGINE ROOM

- (a) Check the connection conditions of the wire harness and connector.
- (b) Check for the disconnection, piping and break of the vacuum hose.

OK:

They are connected correctly and no damage is found on wire harness.

NG

REPAIR OR REPLACE , THEN CONFIRM THAT THERE IS NO MISFIRE

OK

3

CHECK CONNECTION OF PCV HOSE

OK:

PCV hose is connected correctly and PCV hose has no damage.

NG

REPAIR OR REPLACE PCV HOSE

OK

4

READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (NUMBER OF MISFIRE)

- (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) Start the engine.
- (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / CYL#1 to CYL#4.
- (e) Read the number of misfires on the intelligent tester or the OBD II scan tool.

HINT:

When a misfire is not reproduced, be sure to branch below based on the stored DTC.

Result

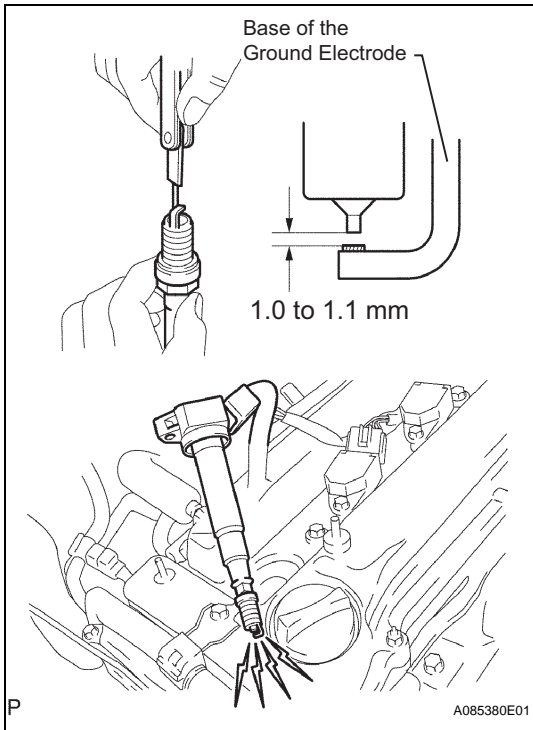
High Misfire Rate Cylinder	Proceed to
1 or 2 cylinders	A
More than 3 cylinders	B

B

Go to step 15

A

5 CHECK SPARK PLUG AND SPARK OF MISFIRING CYLINDER



- (a) Remove the ignition coil.
- (b) Remove the spark plug.
- (c) Check the spark plug type.

Recommended spark plug

DENSO made	NGK made
SK20R11	IFR6A11

- (d) Measure the spark plug electrode gap.

Standard gap:

1.0 to 1.1 mm (0.039 to 0.043 in.)

Maximum gap:

1.3 mm (0.051 in.)

NOTICE:

If adjusting the gap of a new spark plug, bend only the base of the ground electrode. Do not touch the tip. Never attempt to adjust the gap on a used plug.

- (e) Check the electrode for carbon deposits.
- (f) Perform a spark test.

CAUTION:

Always disconnect each injector connector.

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 spark occurs while the engine is being cranked.

OK:

Spark jumps across electrode gap.

OK

Go to step 8

NG

6 CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

- (a) Change to a normal spark plug.
- (b) Perform a spark test.

CAUTION:

Always disconnect each injector connector.

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 spark occurs while the engine is being cranked.

OK:

Spark jumps across electrode gap.

ES

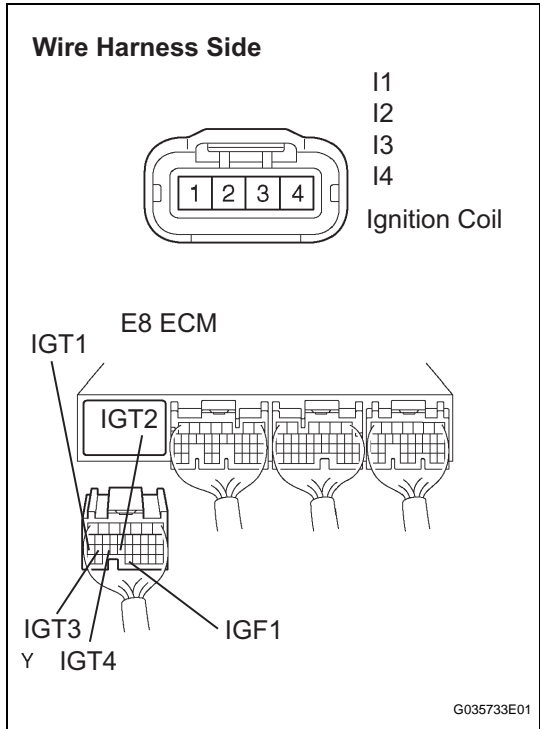
OK

REPLACE SPARK PLUG

NG

7

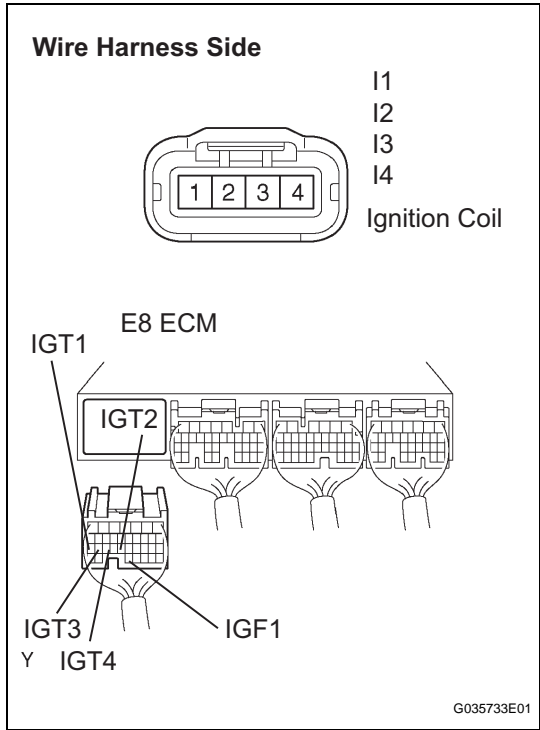
CHECK WIRE HARNESS OF MISFIRING CYLINDER (IGNITION COIL - ECM)



- (a) Check the wire harness between the ignition coil and ECM.
- (1) Disconnect the I1, I2, I3 and I4 ignition coil connectors.
 - (2) Disconnect the E8 ECM connector.
 - (3) Check the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
I1-2 - E8-23 (IGF1) I2-2 - E8-23 (IGF1) I3-2 - E8-23 (IGF1) I4-2 - E8-23 (IGF1)	Below 1 Ω
I1-2 or E8-23 (IGF1) - Body ground I2-2 or E8-23 (IGF1) - Body ground I3-2 or E8-23 (IGF1) - Body ground I4-2 or E8-23 (IGF1) - Body ground	10 kΩ or higher



- (b) Check the wire harness between the ignition coil and ECM.
- (1) Disconnect the I1, I2, I3 and I4 ignition coil connectors.
 - (2) Disconnect the E8 ECM connector.
 - (3) Check the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
I1-3 - E8-17 (IGT1) I2-3 - E8-16 (IGT2) I3-3 - E8-15 (IGT3) I4-3 - E8-14 (IGT4)	Below 1 Ω
I1-3 or E8-17 (IGT1) - Body ground I2-3 or E8-16 (IGT2) - Body ground I3-3 or E8-15 (IGT3) - Body ground I4-3 or E8-14 (IGT4) - Body ground	10 kΩ or higher

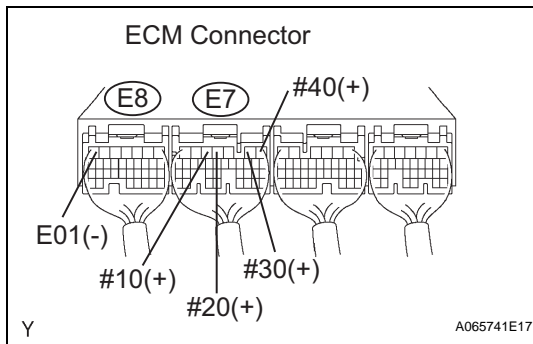
OK

REPLACE IGNITION COIL ASSEMBLY (THEN
CONFIRM THAT THERE IS NO MISFIRE)

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

8 CHECK ECM TERMINAL OF MISFIRING CYLINDER (#1, #2, #3, #4 VOLTAGE)



- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the E8 ECM connectors.

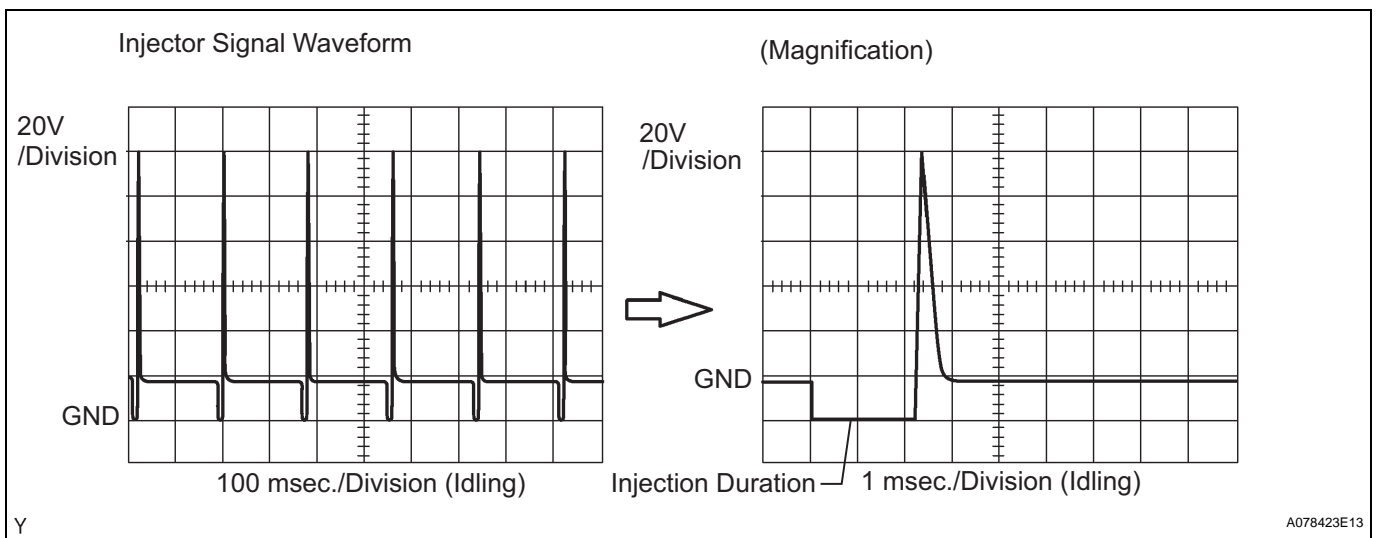
Voltage

Tester Connection	Specified Condition
E7-6 (#10) - E8-7 (E01) E7-5 (#20) - E8-7 (E01) E7-2 (#30) - E8-7 (E01) E7-1 (#40) - E8-7 (E01)	9 to 14 V

HINT:

Reference: Inspection using an oscilloscope.
 Check the waveform of the ECM connectors.

Tester Connection	Condition	Specified Condition
#10 to #40 - E01	Engine idling	Connect waveform is as shown



OK

Go to step 11

NG

9 INSPECT FUEL INJECTOR RESISTANCE OF MISFIRING CYLINDER

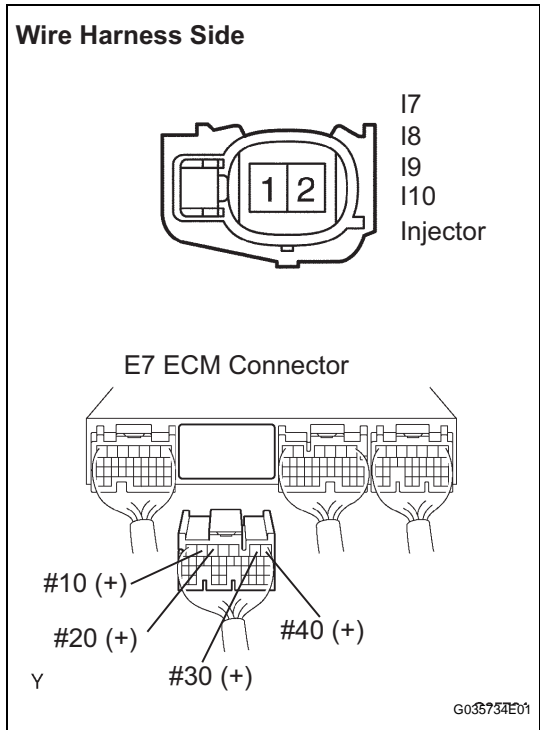
NG

REPLACE FUEL INJECTOR ASSEMBLY

OK

10

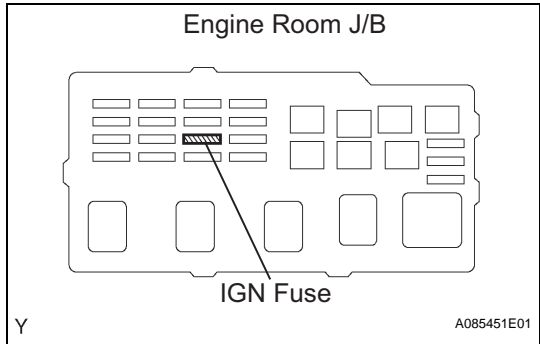
CHECK WIRE HARNESS OF MISFIRING CYLINDER (INJECTOR - ECM, INJECTOR - IGNITION SWITCH)



- (a) Check the wire harness between the injector and ECM.
- (1) Disconnect the I7, I8, I9 and I10 injector connectors.
 - (2) Disconnect the E7 ECM connector.
 - (3) Measure the resistance of the wire harness side connectors.

Resistance

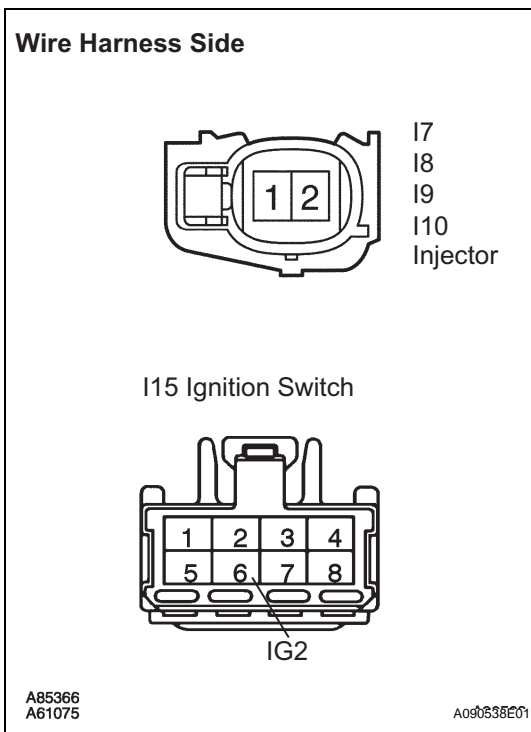
Tester Connection	Specified Condition
I7-1 - E7-6 (#10) I8-1 - E7-5 (#20) I9-1 - E7-2 (#30) I10-1 - E7-1 (#40)	Below 1 Ω
I7-1 or E7-6 (#10) - Body ground I8-1 or E7-5 (#20) - Body ground I9-1 or E7-2 (#30) - Body ground I10-1 or E7-1 (#40) - Body ground	10 kΩ or higher



- (b) Check the IGN fuse.
- (1) Remove the IGN fuse from the engine room J/B.
 - (2) Measure the resistance of the IGN fuse.

Resistance:

Below 1 Ω



(c) Check the wire harness between the injector and ignition switch.

- (1) Disconnect the I7, I8, I9 and I10 injector connectors.
A090538
- (2) Disconnect the I15 ignition switch connector.
- (3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
I7-2 - IG2 (I15-6) I8-2 - IG2 (I15-6) I9-2 - IG2 (I15-6) I10-2 - IG2 (I15-6)	Below 1 Ω
I7-2 or I15-6 (IG2) - Body ground I8-2 or I15-6 (IG2) - Body ground I9-2 or I15-6 (IG2) - Body ground I10-2 or I15-6 (IG2) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

11 INSPECT FUEL INJECTOR AND VOLUME OF MISFIRING CYLINDER

Standard pressure

Injection Volume	Difference Between Each Injector
76 to 91 cm ³ (4.6 to 5.5 cu. in.) / 15 seconds	15 cm ³ (0.9 cu. in.) or less

NG

REPLACE FUEL INJECTOR ASSEMBLY

OK

12 CHECK CYLINDER COMPRESSION OF MISFIRING CYLINDER

Standard pressure

Item	Specified Condition
Compression pressure	1.360 MPa (13.9 kgf/cm ² , 198 psi)
Minimum pressure	0.98 MPa (10 kgf/cm ² , 142 psi)
Difference between each cylinder	0.1 MPa (1.0 kgf/cm ² , 14 psi)

NG

CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK

13 CHECK VALVE CLEARANCE OF MISFIRING CYLINDER**Standard (cold)**

Item	Specified Condition
Intake	0.19 to 0.29 mm (0.0075 to 0.0114 in.)
Exhaust	0.30 to 0.40 mm (0.0118 to 0.0157 in.)

NG**ADJUST VALVE CLEARANCE****OK****ES****14 SWITCH STEP BY NUMBER OF MISFIRE CYLINDER (REFER TO RESULTS OF STEP 4)****HINT:**

- If the result of step 4 is "1 or 2 cylinders", proceed to A.
- If the result of step 4 is "more than 3 cylinders", proceed to B.

B**CHECK FOR INTERMITTENT PROBLEMS****A****15 CHECK VALVE TIMING**

- (a) Check for loose or jumped tooth of timing chain.

OK:

The matchmarks of crankshaft pulley and camshaft pulley are aligned.

NG**ADJUST VALVE TIMING****OK****16 CHECK FUEL PRESSURE****Standard pressure**

Item	Specified Condition
Fuel pressure	304 to 343 kPa (3.1 to 3.5 kgf/cm ² , 44 to 55 psi)

NG

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

OK**17 READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (INTAKE AIR TEMPERATURE AND MASS AIR FLOW RATE)**

- (a) Connect the intelligent tester or the OBD II scan tool to the DLC3.

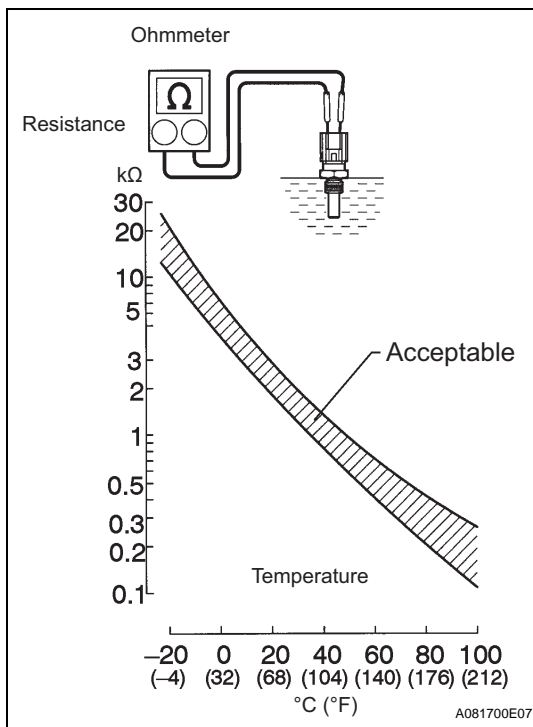
- (b) Turn the ignition switch ON.
- (c) Check the intake air temperature.
 - (1) On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR. Read the values.

Temperature:**Equivalent to ambient temperature**

- (d) Check the air flow rate.
 - (1) 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.

Standard values

Condition	Air Flow Rate (gm/s)
Ignition switch ON (do not start engine)	0
Idling	0.5 to 5
Running without load (2,500 rpm)	3 to 10
Idling to quickly accelerating	Air flow rate fluctuates

NG**REPLACE MASS AIR FLOW METER****OK****18****INSPECT ENGINE COOLANT TEMPERATURE SENSOR (RESISTANCE)**

- (a) Remove the ECT sensor.
- (b) Measure the resistance between the terminals.

Resistance

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	2.32 to 2.59 kΩ
1 - 2	80°C (176°F)	0.310 to 0.326 kΩ

NOTICE:

If checking the ECT sensor in the water, be careful not to allow water to contact the terminals. After the check, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed ECT sensor and read the resistance. Use an infrared thermometer to measure the engine temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

NG**REPLACE ENGINE COOLANT TEMPERATURE SENSOR****OK**

19

SWITCH STEP BY NUMBER OF MISFIRE CYLINDER (REFER TO RESULTS OF STEP 4)

- HINT:
- If the result of step 4 is "1 or 2 cylinders", proceed to A.
 - If the result of step 4 is "more than 3 cylinders", proceed to B.

A

B

Go to step 5

ES

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)

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. If engine knocking occurs, the ignition timing is retarded to suppress it.

ES

DTC No.	DTC Detection Condition	Trouble Area
P0327	Output voltage of the knock sensor is 0.5 V or less	<ul style="list-style-type: none"> • Short in knock sensor circuit • Knock sensor • ECM
P0328	Output voltage of the knock sensor is 4.5 V or more	<ul style="list-style-type: none"> • Open in knock sensor circuit • Knock sensor • ECM

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When a 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 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 Range Check (Low voltage) P0328: Knock Sensor 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
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

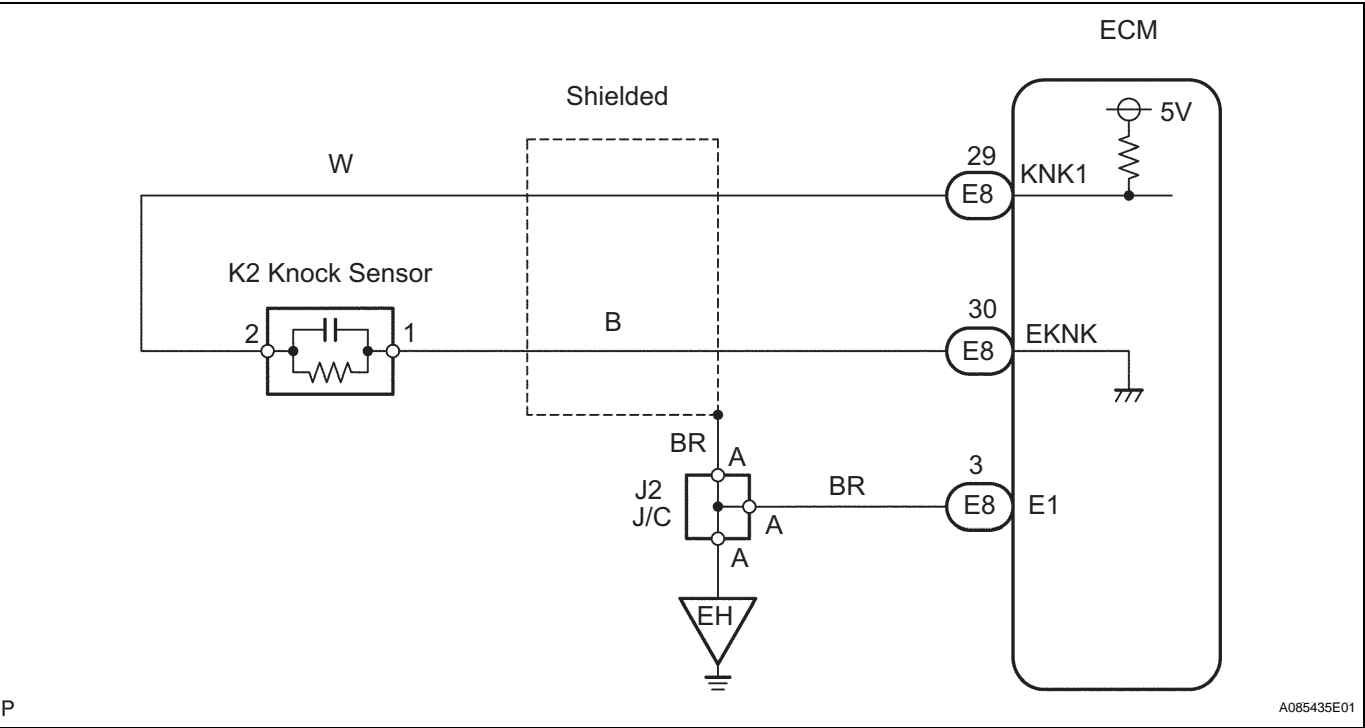
Knock Sensor Range Check (Low voltage):

Knock sensor voltage	Less than 0.5 V
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Knock Sensor Range Check (High voltage):

Knock sensor voltage	More than 4.5 V
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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 OUTPUT DTC
---	-----------------

- (a) Clear the DTC (See page ES-28).
- (b) Warm up the engine.
- (c) Run the engine at 3,000 rpm for 10 seconds or more.
- (d) Connect the intelligent tester or the OBD II scan tool to the DLC3.
- (e) Turn the ignition switch ON and push the intelligent tester or the OBD II scan tool main switch ON.
- (f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (g) Read the DTC.

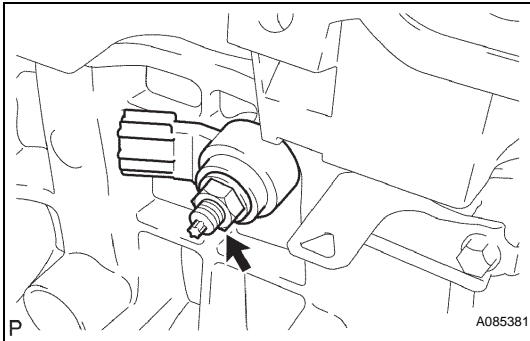
Result

Display (DTC output)	Proceed to
Only P0325 is output again	A
P0325, P0327 and/or P0328 are output again	B
P0325, P0327 and/or P0328 are not output again	C

B

CHECK FOR INTERMITTENT PROBLEMS

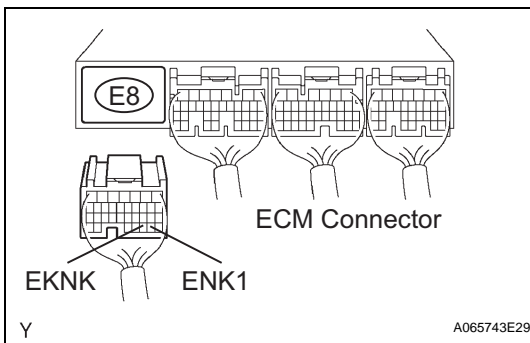
A

2 INSPECT KNOCK SENSOR

- (a) Check the knock sensor installation.

OK:

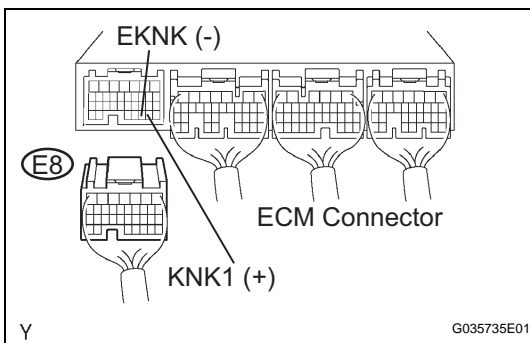
Torque is 20 N*m (204 kgf*cm, 15 ft*lbf)

NG**TIGHTEN SENSOR****OK****ES****REPLACE KNOCK SENSOR****3 CHECK WIRE HARNESS (ECM - KNOCK SENSOR)**

- (a) Disconnect the E8 ECM connector.
 (b) Measure the resistance of the wire harness side connector.

Resistance

Tester Connection	Condition	Specified Condition
E8-1 (KNK1) - E8-2 (EKNK)	20°C (68°F)	120 to 280 kΩ

NG**Go to step 5****OK****4 INSPECT ECM (KNK1 VOLTAGE)**

- (a) Disconnect the E8 ECM connector.
 (b) Turn the ignition switch ON.
 (c) Measure the voltage of ECM terminals.

Voltage

Tester Connection	Specified Condition
E8-1 (KNK1) - E8-2 (EKNK)	4.5 to 5.5 V

NOTICE:

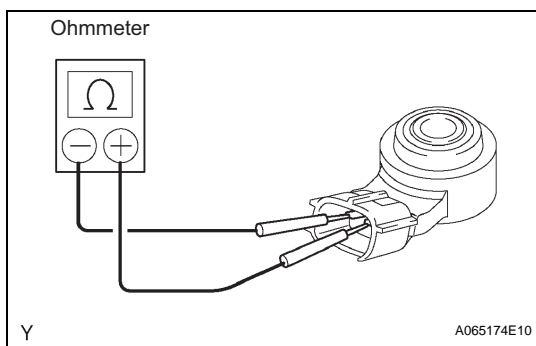
Fault may be intermittent. Check the harness and connectors carefully.

NG**REPLACE ECM**

OK

CHECK FOR INTERMITTENT PROBLEMS

5 INSPECT KNOCK SENSOR



- (a) Remove the knock sensor.
- (b) Measure the resistance between the terminals.

Resistance:**120 to 280 k Ω at 20°C (68°F)**

NG

REPLACE KNOCK SENSOR

OK

REPAIR OR REPLACE HARNESS AND CONNECTOR

REGISTRATION

NOTICE:

The Vehicle Identification Number (VIN) must be input into the replaced ECM.

HINT:

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

1. DESCRIPTION

This registration section consists of three parts, Input Instructions, Read VIN and Write VIN.

- (a) Input Instructions: Explains the general VIN input instructions using a intelligent tester.
- (b) Read VIN: Explains the VIN reading process in a flowchart. This process allows the VIN stored in the ECM to be read, in order to confirm that the two VINs, provided with the vehicle and stored in the vehicle's ECM, are the same.
- (c) Write VIN: Explains the VIN writing process in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is changed, or the VINs do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.

2. INPUT INSTRUCTIONS

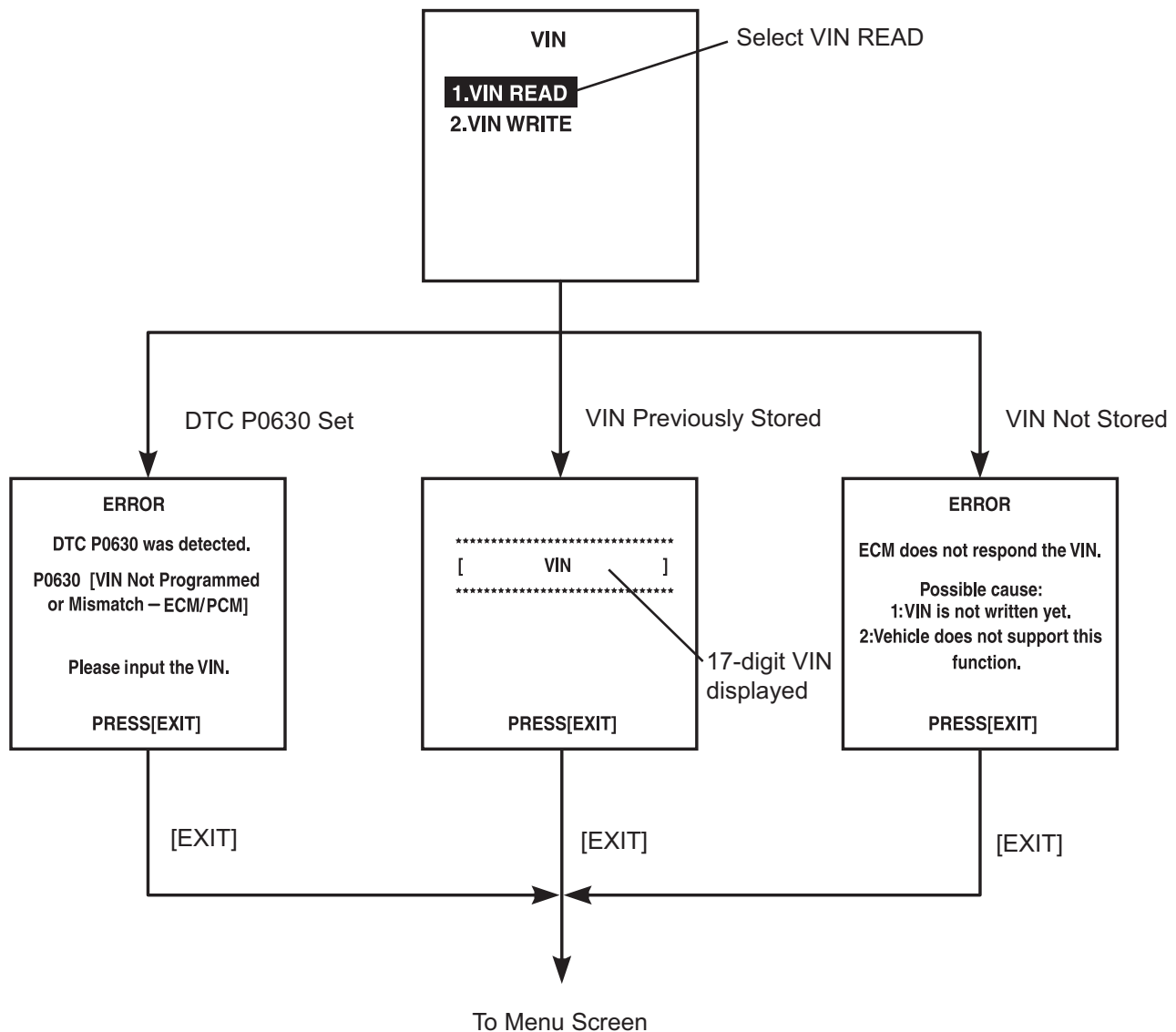
- (a) Intelligent tester
 - (1) The arrow buttons (UP, DOWN, RIGHT and LEFT) and numerical buttons (0 to 9) are used, in order to input the VIN.
- (b) Cursor Operation
 - (1) To move the cursor around the tester screen, press the RIGHT and LEFT buttons.
- (c) Alphabetical Character Input
 - (1) Press the UP and DOWN buttons to select the desired alphabetical character.
 - (2) After selection, the cursor should move.
- (d) Numeric Character Input
 - (1) Press the numerical button corresponding to the number that you want to input.
 - (2) After input, the cursor should move.
- HINT:
Numerical characters can be selected by using the UP and DOWN buttons.
- (e) Correction
 - (1) When correcting the input character(s), put the cursor onto the character using the RIGHT or LEFT button.
 - (2) Select or input the correct character using the UP/DOWN buttons, or the numerical buttons.
- (f) Finishing Input Operation
 - (1) Make sure that the input VIN matches the vehicle VIN after input.
 - (2) Press the ENTER button on the tester.

3. READ VIN (VEHICLE IDENTIFICATION NUMBER)

- (a) Explains the VIN reading process in a flowchart.
This process allows the VIN stored in the ECM to be read, in order to confirm that the two, VINs, provided with the vehicle and stored in the vehicle's ECM, are the same.
- (b) Read VIN using an intelligent tester.
- (c) Check the vehicle's VIN.
- (d) Connect the intelligent tester to the DLC3.
- (e) Turn the engine switch on (IG).
- (f) Turn the tester ON.
- (g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / VIN.

ES

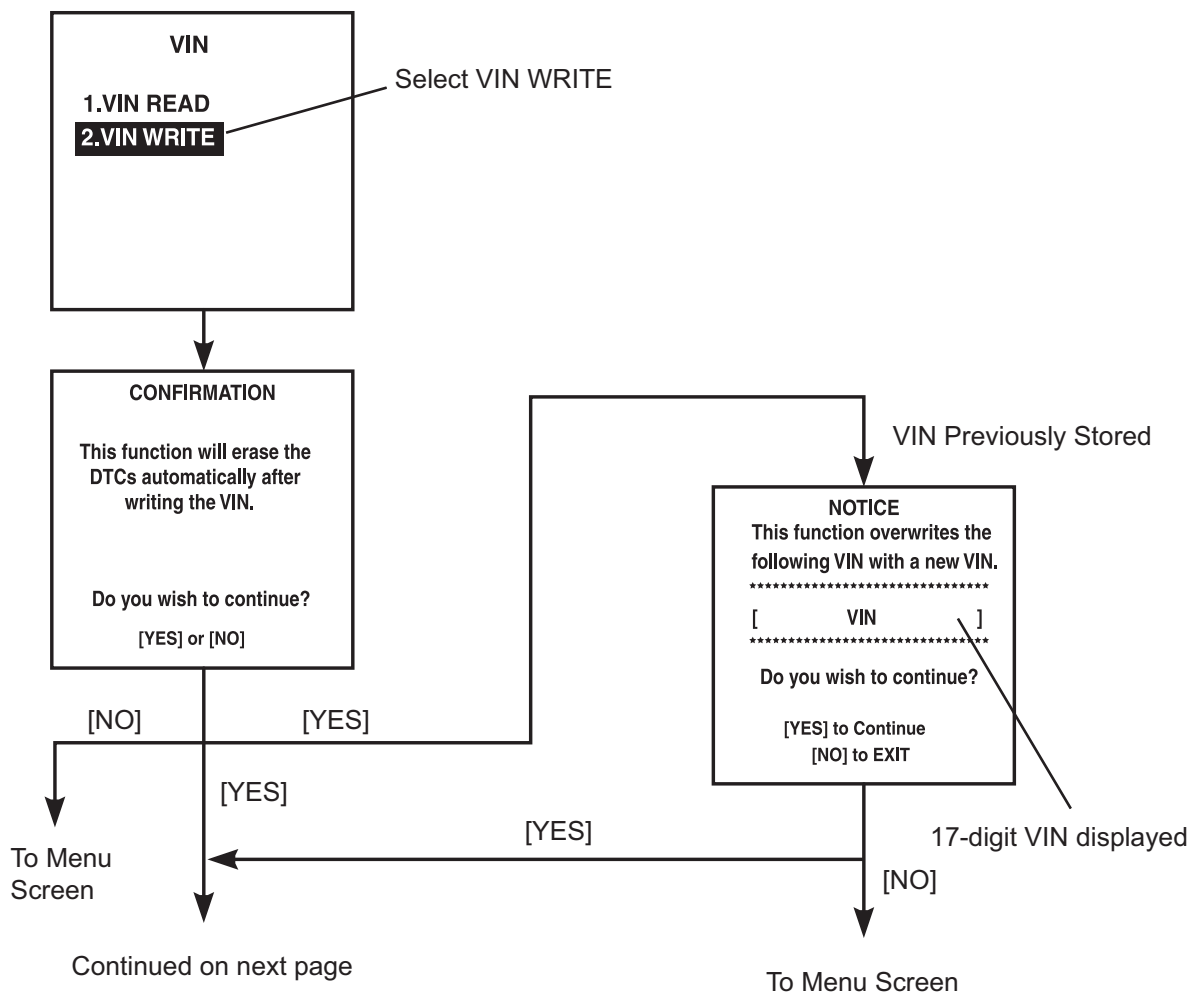
Menu Screen:



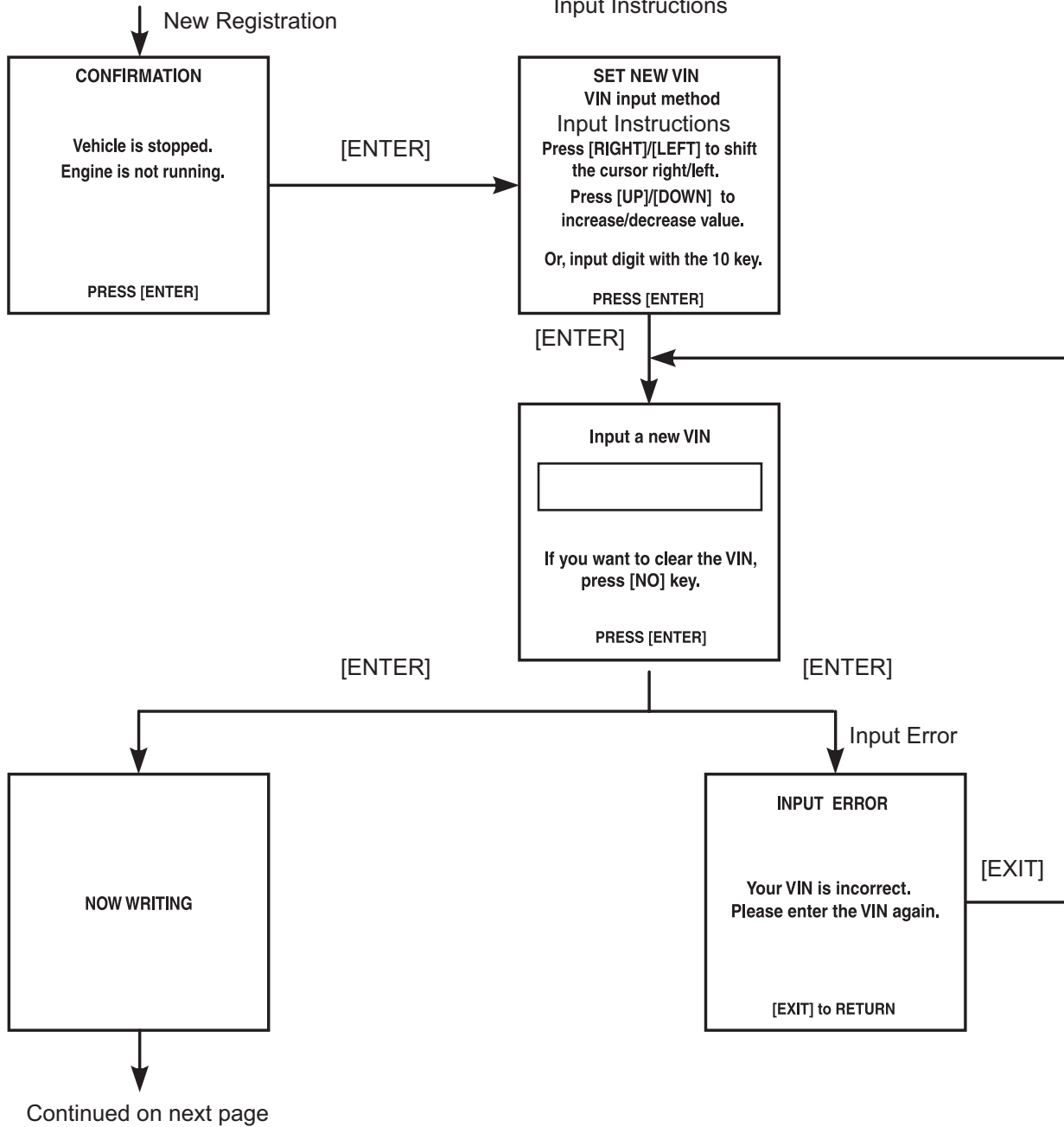
4. WRITE VIN

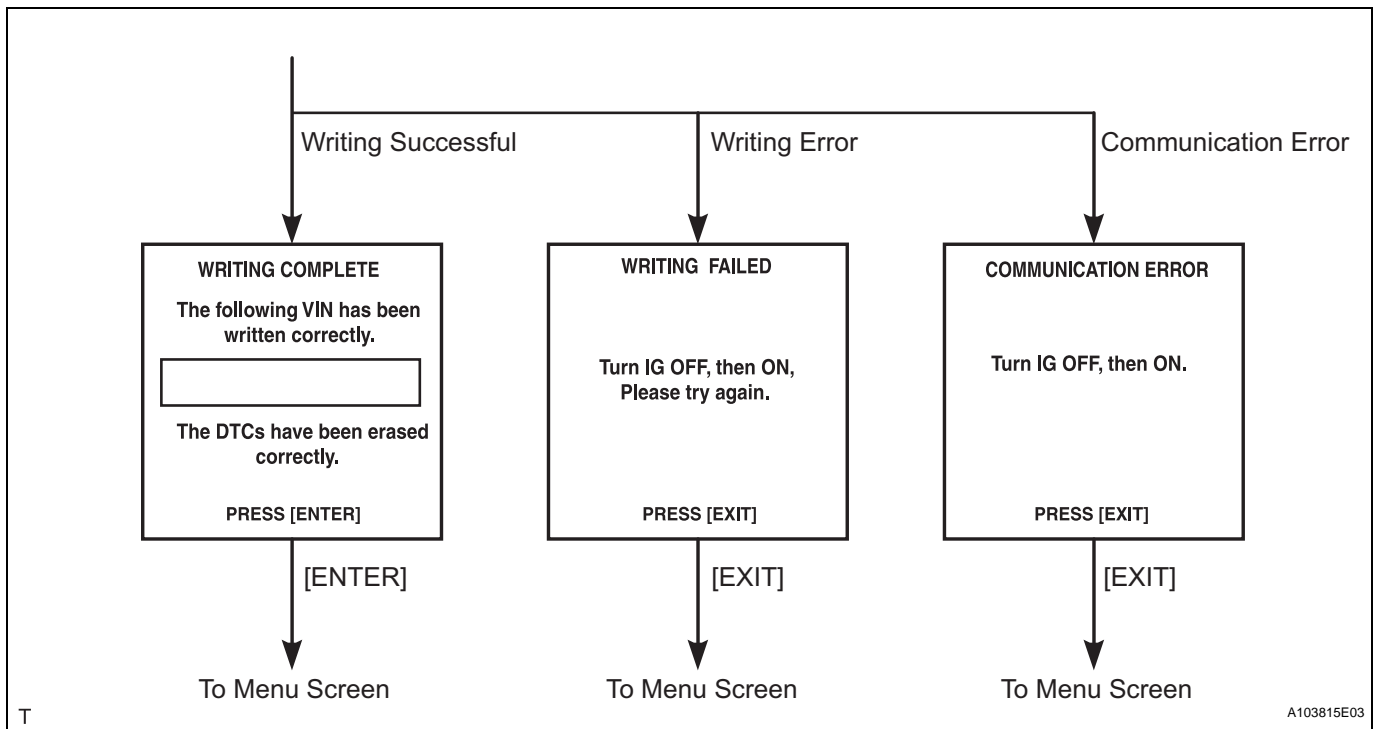
- (a) Explains the VIN writing process in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is changed, or the VIN and VIN do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.
- (b) Write VIN using the intelligent tester.
- (c) Check the vehicle's VIN.
- (d) Connect the intelligent tester to the DLC3.
- (e) Turn the engine switch on (IG).
- (f) Turn the tester ON.
- (g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / VIN.

Menu Screen:

**ES**

Continued from previous page





DTC	P0335	Crankshaft Position Sensor "A" Circuit
DTC	P0339	Crankshaft Position Sensor "A" Circuit Intermittent

DESCRIPTION

The crankshaft position sensor (CKP) system consists of a crankshaft position sensor plate and a pickup coil.

The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of an iron core and magnet. The sensor plate rotates and as each tooth passes through the pickup coil, a pulse signal is generated. The pickup coil generates 34 signals for each engine revolution. Based on these signals, the ECM calculates the crankshaft position and engine RPM. Using these calculations, the fuel injection time and ignition timing are controlled.

ES

DTC No.	DTC Detection Condition	Trouble Area
P0335	No crankshaft position sensor signal to ECM with engine speed 600 rpm or more (2 trip detection logic)	<ul style="list-style-type: none"> Open or short in crankshaft position sensor circuit Crankshaft position sensor Signal plate (Crankshaft position sensor plate No. 1) 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: 1. Engine is at 1,000 rpm or more 2. STA signal is OFF 3. 3 seconds or more have elapsed after STA signal is switched from ON to OFF	<ul style="list-style-type: none"> Same as DTC No. P0335

MONITOR DESCRIPTION

If there is no signal from the crankshaft sensor even though the engine is cranking, the ECM interprets this as a malfunction of the sensor.

MONITOR STRATEGY

Related DTCs	P0335: Crankshaft position sensor range check
Required Sensors/Components (Main)	Crankshaft position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.016 seconds
MIL Operation	2 driving cycles
Sequence Operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Starter	OFF
Engine RPM	600 rpm or more
Time after starter turns from ON to OFF	3 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

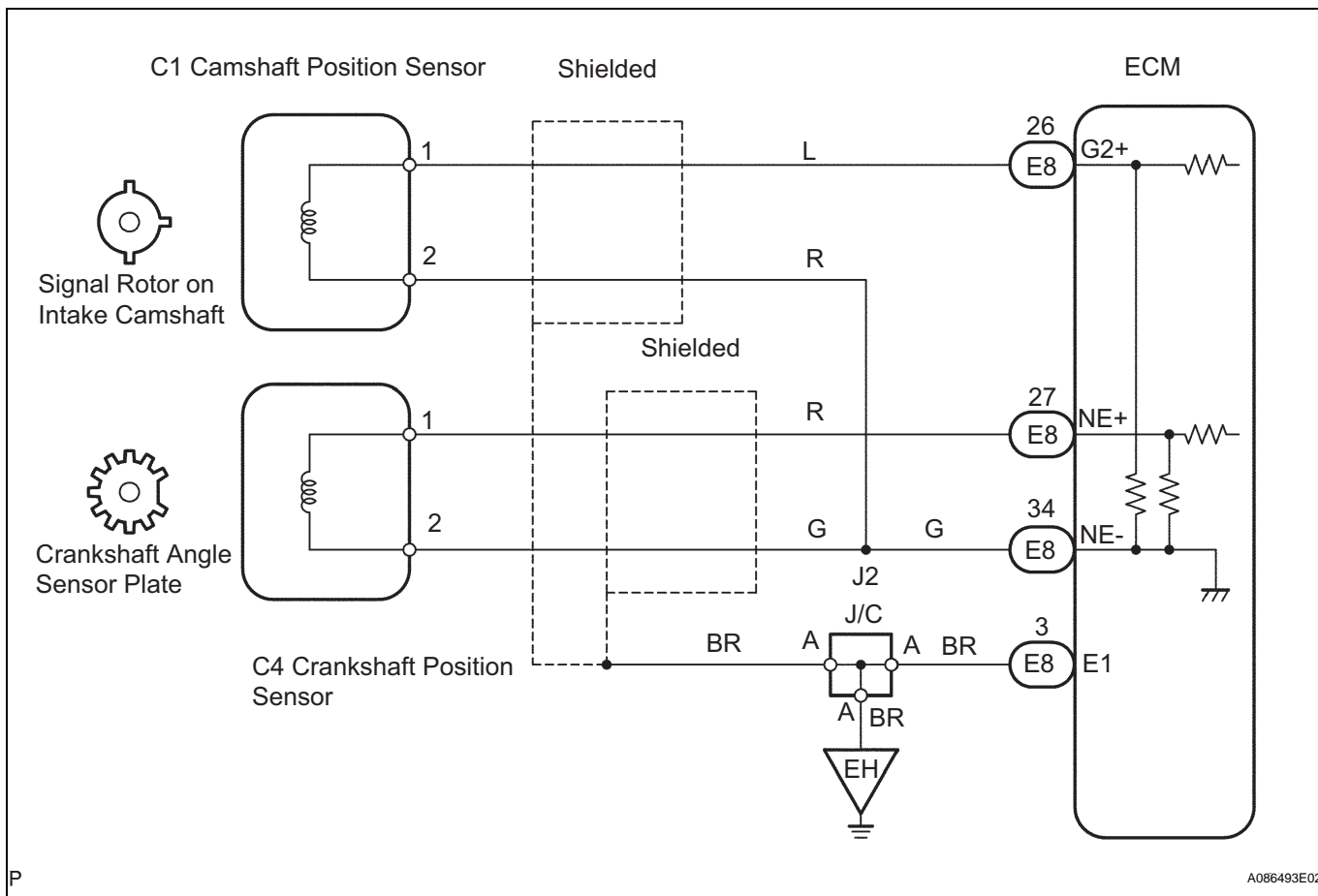
Crankshaft position sensor signal	No signal
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COMPONENT OPERATING RANGE

Crankshaft position sensor signal

- Crankshaft position sensor voltage fluctuates when crankshaft rotates
- 34 signals per revolution of crankshaft

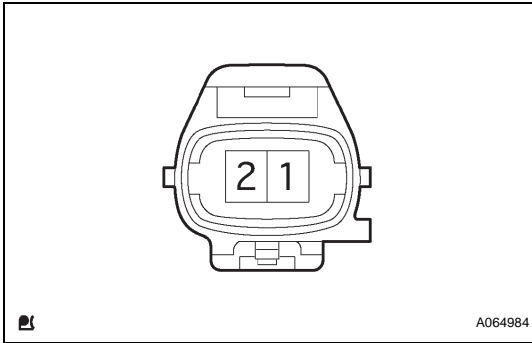
WIRING DIAGRAM



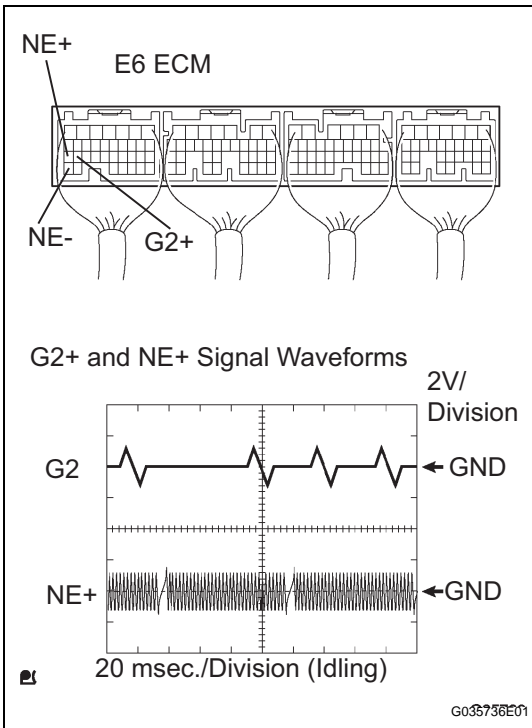
HINT:

- Read values on the intelligent tester or OBD II scan tool.
 - (a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
 - (b) Start the engine and 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 / ENGINE SPD".
- The engine speed can be confirmed in DATA LIST using the intelligent tester or OBD II scan tool. If there are no NE signals from the crankshaft position sensor despite the engine revolving, the engine speed will be indicated as zero. If voltage output of the crankshaft position sensor is insufficient, the engine speed will be indicated as lower than the actual rpm.
- 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 CRANKSHAFT POSITION SENSOR (RESISTANCE)



(a) Disconnect the C4 sensor connector.



(b) Measure the resistance between the terminals of the sensor.

Resistance

Tester Connection	Condition	Specified Condition
1 - 2	Cold	985 to 1,600 Ω
1 - 2	Hot	1,265 to 1,890 Ω

NOTICE:

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).

HINT:

Reference: Inspection using an oscilloscope. During cranking or idling, check the waveform between the terminals of the E8 ECM connector.

Tester Connection	Specified Condition
E8-26 (G2+) - E8-34 (NE-) E8-27 (NE+) - E8-34 (NE-)	Correct waveform is as shown

NG

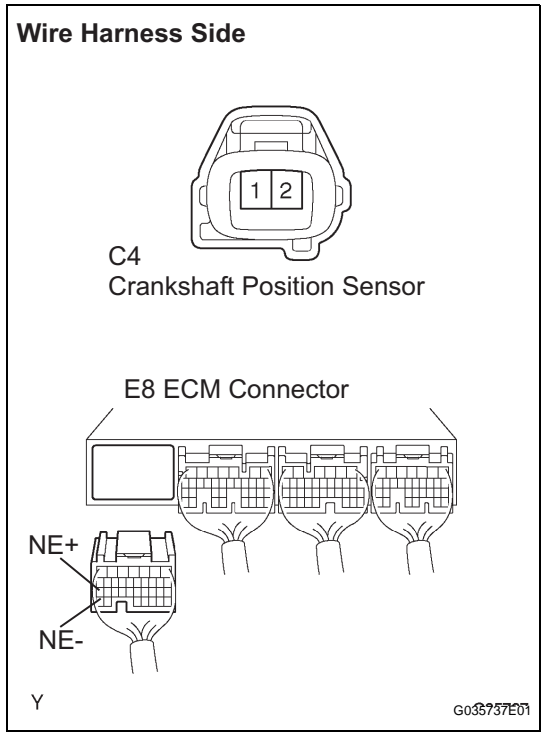
REPLACE CRANKSHAFT POSITION SENSOR

OK

ES

2

CHECK WIRE HARNESS (CRANKSHAFT POSITION SENSOR - ECM)



- (a) Disconnect the C4 sensor connector.
- (b) Disconnect the E8 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
C4-1 - E8-27 (NE+) C4-2 - E8-34 (NE-)	Below 1 Ω
C4-1 or E8-27 (NE+) - Body ground C4-2 or E8-34 (NE-) - Body ground	10 kΩ or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

3

CHECK CRANKSHAFT POSITION SENSOR INSTALLATION

- (a) Check the crankshaft position sensor installation.

OK:

Sensor is installed correctly.

NG

TIGHTEN CRANKSHAFT POSITION SENSOR

OK

4

INSPECT CRANKSHAFT POSITION SENSOR PLATE NO.1 (TEETH OF SIGNAL PLATE)

- (a) Remove the crankshaft position sensor plate No.1. (See page [EM-84](#)).
- (b) Check the teeth of the signal plate.

OK:

The pulley does not have any cracks or deformation.

NG

REPLACE CRANKSHAFT POSITION SENSOR PLATE NO.1

OK

REPLACE ECM

DTC	P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)
DTC	P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)

DESCRIPTION

The Camshaft Position (CMP) sensor, like the Crankshaft Position (CKP) sensor, consists of a magnet and an iron core wrapped in copper wire. The camshaft has 3 teeth and the CMP sensor is installed so that it can detect these teeth passing by. When the camshaft rotates and the teeth pass by the CMP sensor, the magnet on the CMP sensor creates a magnetic field and voltage is generated in the copper wire. When the crankshaft makes 2 rotations, voltage will be generated in the CMP sensor 3 times. The CKP sensor is roughly the same. When the crankshaft makes 1 rotation, its 34 teeth pass by the CKP sensor and voltage is generated 34 times. The camshaft rotates at half the speed of the crankshaft. Therefore, the CMP sensor generates voltage 3 times in the time the crankshaft takes to make 2 rotations. The Engine Control Module (ECM) detects generation of these voltages to locate the camshaft position, which are used to control the ignition timing, the fuel injection timing and the VVT system.

DTC No.	DTC Detection Condition	Trouble Area
P0340	<ul style="list-style-type: none"> No camshaft position sensor signal to ECM during cranking (2 trip detection logic) No camshaft position sensor signal to ECM with engine speed 600 rpm or more (1 trip detection logic) 	<ul style="list-style-type: none"> Open or short in camshaft position sensor circuit Camshaft position sensor Timing chain has a jumped tooth ECM
P0341	While crankshaft rotates twice, camshaft position sensor signal is input to ECM 12 times or more (1 trip detection logic)	<ul style="list-style-type: none"> Same as DTC No. P0340

HINT:

- DTC P0340 indicates a malfunction related to the camshaft position sensor (+) circuit (Wire harness (ECM - camshaft position sensor) and camshaft position sensor).
- DTC P0341 indicates a malfunction related to the camshaft position sensor (-) circuit (Wire harness (ECM - camshaft position sensor) and camshaft position sensor).

MONITOR DESCRIPTION

If there is no signal from the camshaft position sensor even though the engine is cranking, or if the rotation of the camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.

MONITOR STRATEGY

Related DTCs	P0340: Camshaft Position Sensor Range Check P0340: Camshaft Position/Crankshaft Position Misalignment P0341: Camshaft Position Sensor Malfunction
Required sensors/ components (Main)	Camshaft position sensor
Required sensors / components (Related)	Crankshaft position sensor
Frequency of operation	Continuous
Duration	5 seconds
MIL operation	2 driving cycles: Camshaft Position Sensor Range Check Immediate: Camshaft Position/Crankshaft Position Misalignment Camshaft Position Sensor Malfunction
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None
--	------

Camshaft Position Sensor Range Check P0340:

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

Camshaft Position/Crankshaft Position Misalignment P0340:

Engine RPM	600 rpm or more
Starter	OFF

Camshaft Position Sensor Malfunction P0341:

Starter	After OFF to ON timing
---------	------------------------

TYPICAL MALFUNCTION THRESHOLDS**ES****Camshaft Position Sensor Range Check P0340:**

Camshaft position sensor signal	No signal
---------------------------------	-----------

Camshaft Position/Crankshaft Position Misalignment P0340:

Camshaft position and crankshaft position phase	Misaligned
---	------------

Camshaft Position Sensor Malfunction P0341:

Camshaft position and crankshaft position phase	Misaligned
Camshaft position signal per 2 revolutions of crankshaft	12 camshaft position sensor signals or more

COMPONENT OPERATING RANGE

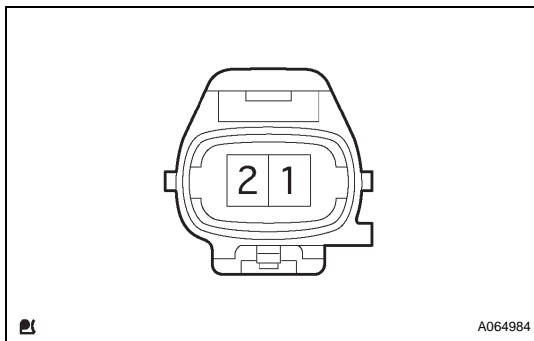
Camshaft position sensor signal	Camshaft position sensor voltage fluctuates when the camshaft rotates 3 Camshaft position signals per 1 revolution of camshaft 3 Camshaft position signals per 2 revolutions of crankshaft
---------------------------------	--

WIRING DIAGRAM

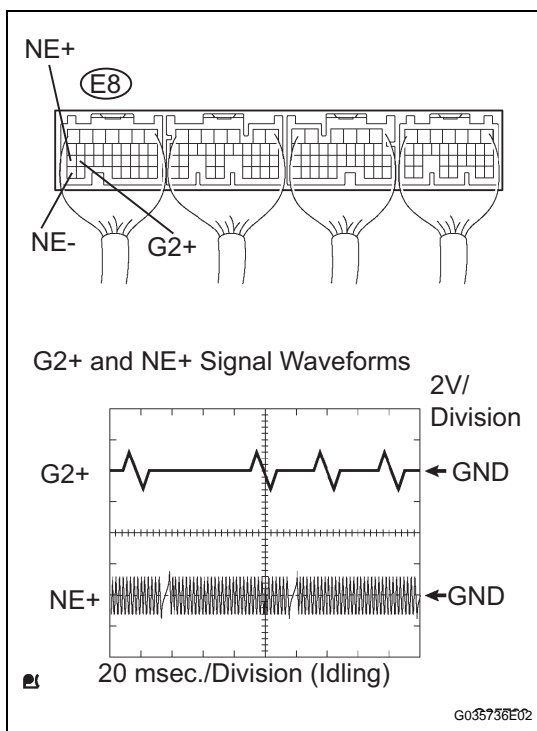
Refer to DTC P0335 (See page [ES-154](#)).

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 CRANKSHAFT POSITION SENSOR**

(a) Disconnect the C4 sensor connector.



OK

- (b) Measure the resistance between the terminals of the sensor.

Resistance

Tester Connection	Condition	Specified Condition
1 - 2	Cold	835 to 1,400 Ω
1 - 2	Hot	1,060 to 1,645 Ω

NOTICE:

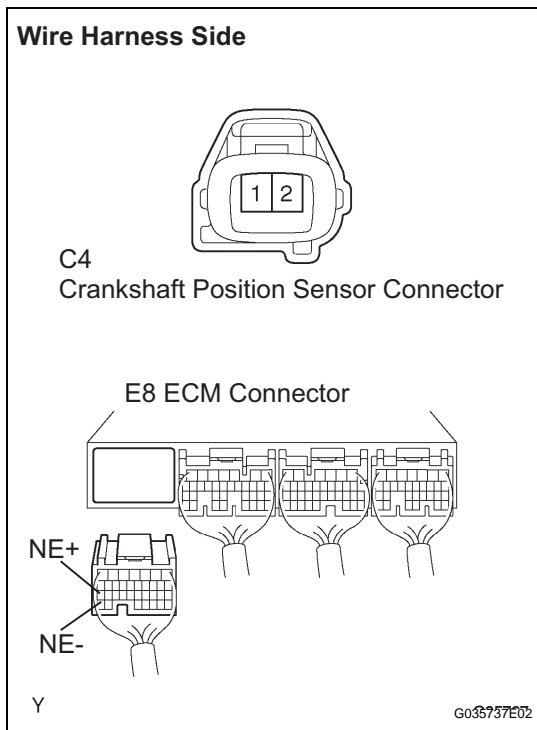
In the above section, the terms "cold" and "hot" refer to the temperature of the coils. "Cold" means approximately -10°C to 50°C (14°F to 122°F). "Hot" means approximately 50°C to 100°C (122°F to 212°F).

HINT:

Reference: Inspection using an oscilloscope. During cranking or idling, check the waveform between the terminals of the E8 ECM connector.

Tester Connection	Specified Condition
E8-26 (G2+) - E8-34 (NE-) E8-27 (NE+) - E8-34 (NE-)	Correct waveform is as shown

NG

REPLACE CAMSHAFT POSITION SENSOR**2****CHECK WIRE HARNESS (CAMSHAFT POSITION SENSOR - ECM)**

OK

- (a) Disconnect the C4 sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
C4-1 - E8-27 (G2+) C4-2 - E8-34 (NE-)	Below 1 Ω
C4-1 or E8-27 (G2+) - Body ground C4-2 or E8-34 (NE-) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR**3****CHECK CAMSHAFT POSITION SENSOR INSTALLATION**

- (a) Check the sensor installation.

OK:
Sensor is installed correctly.

NG → TIGHTEN CAMSHAFT POSITION SENSOR

OK

4 INSPECT CAMSHAFT

- (a) Remove the camshafts (See page [EM-32](#)).
- (b) Check the camshaft lobes.

OK:
The camshaft lobes do not have any cracks or deformation.

NG → REPLACE CAMSHAFT

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

HINT:

- These DTCs indicate a malfunction related to primary circuit.
- If DTC P0351 is displayed, check No. 1 ignition coil with igniter circuit.
- If DTC P0352 is displayed, check No. 2 ignition coil with igniter circuit.
- If DTC P0353 is displayed, check No. 3 ignition coil with igniter circuit.
- If DTC P0354 is displayed, check No. 4 ignition coil with igniter circuit.

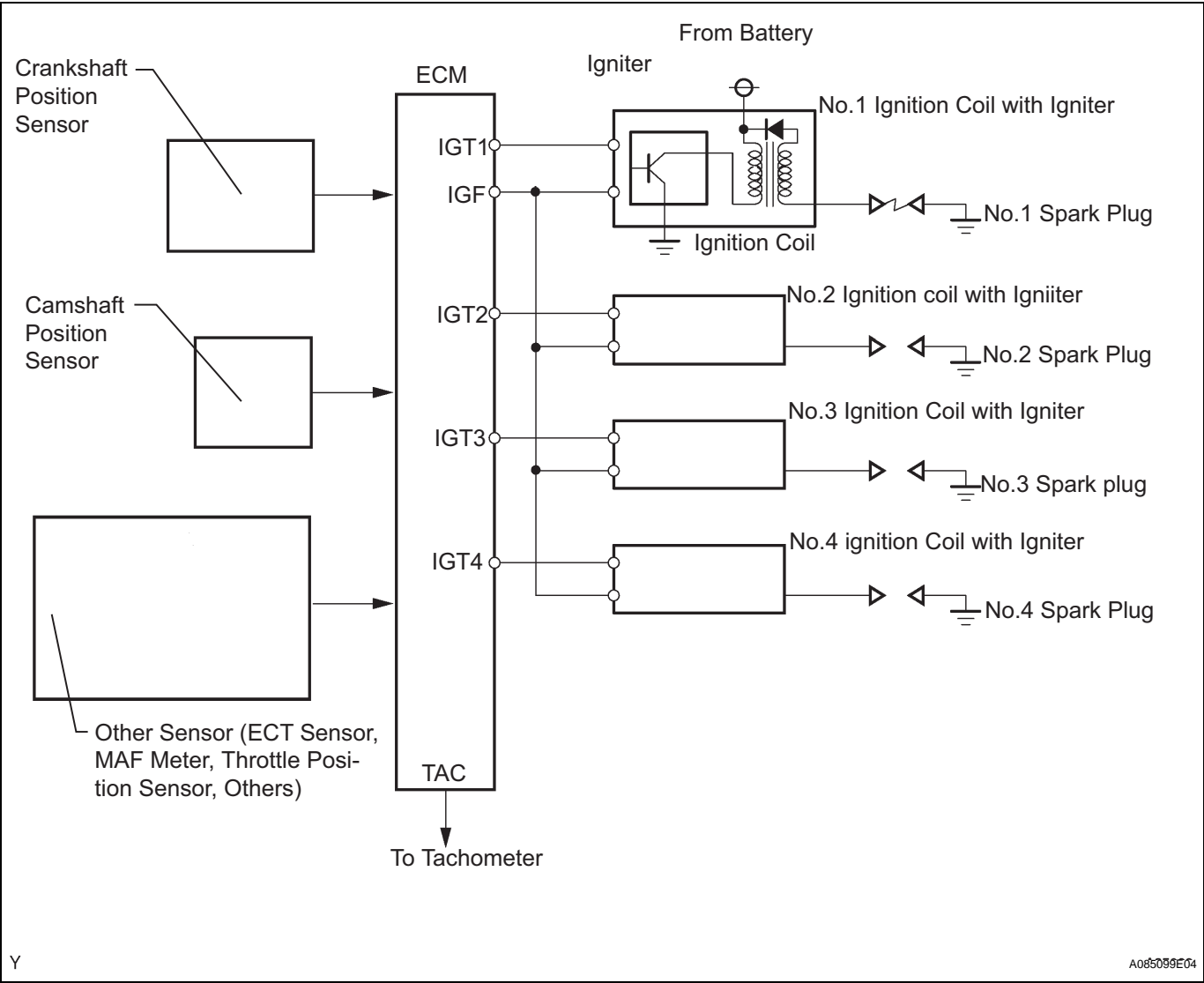
ES**DESCRIPTION**

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

The DIS is a 1-cylinder ignition system which ignites one cylinder with one ignition coil. In the 1-cylinder ignition system, one spark plug is connected to the end of the secondary winding. High-voltage is generated in the secondary winding and is applied directly to the spark plug. The spark of the spark plug passes from the center electrode to the ground electrode.

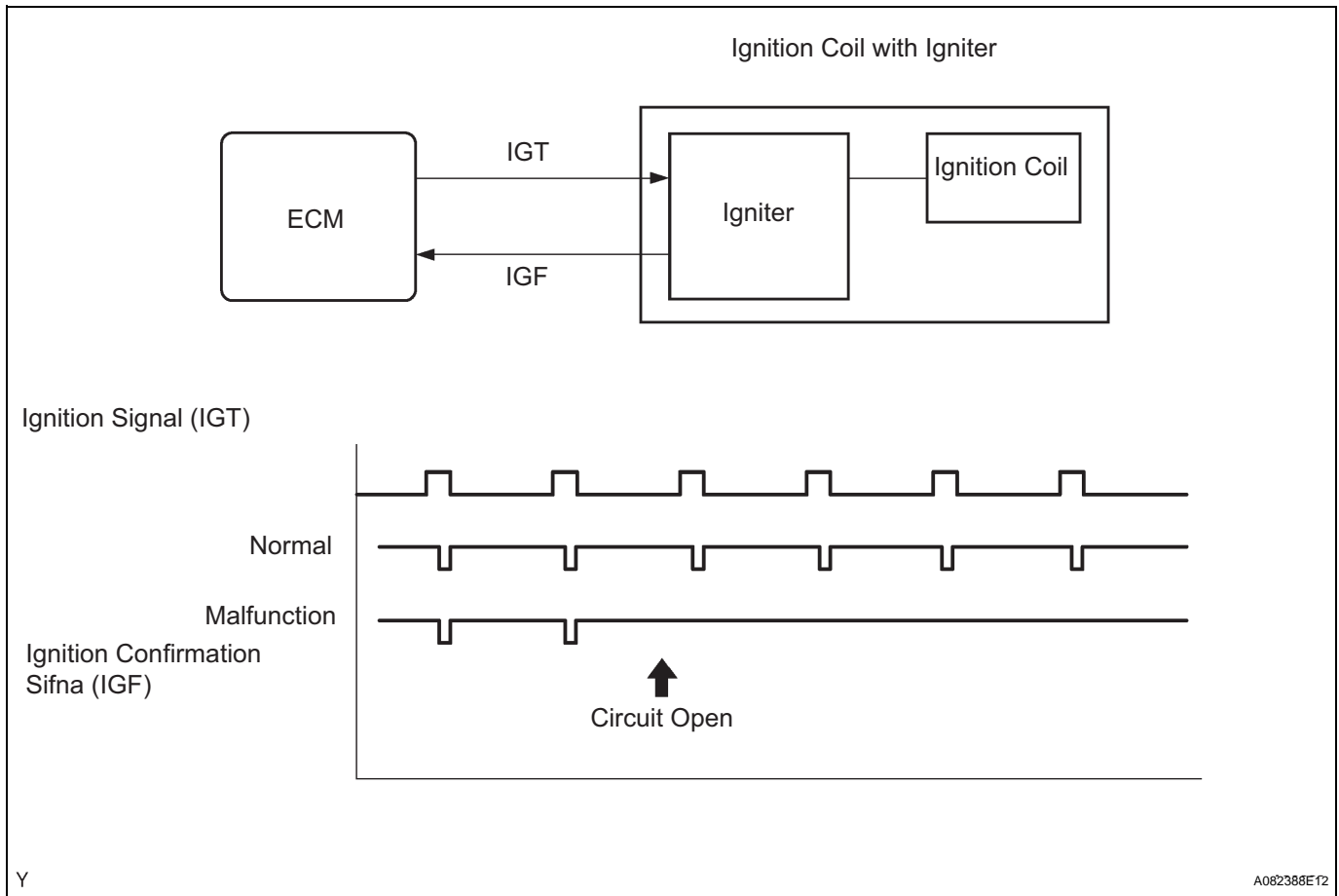
The ECM determines the ignition timing and outputs the ignition signals (IGTs) for each cylinder. Using the IGT, the ECM turns on and off the power transistor inside the igniter, which switches on and off current to the primary coil. When current to the primary coil is cut off, high-voltage is generated in the secondary coil and this voltage is applied to the spark plugs to create sparks inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back the ignition confirmation signal (IGF) for each cylinder ignition to the ECM.

ES



DTC No.	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354	No IGF signal to ECM while engine is running	<ul style="list-style-type: none">Ignition systemOpen or short in IGF and IGT circuits (1 through 4) from ignition coil assembly to ECMIgnition coil assembly (No. 1 through No. 4)ECM

MONITOR DESCRIPTION



If the ECM does not receive the IGF after sending the IGT, it interprets this as a fault in the igniter and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0351: Igniter (Cylinder 1) malfunction P0352: Igniter (Cylinder 2) malfunction P0353: Igniter (Cylinder 3) malfunction P0354: Igniter (Cylinder 4) malfunction
Required sensors/ components (Main)	Igniter
Required sensors / components (Related)	Crankshaft position sensor
Frequency of operation	Continuous
Duration	0.256 sec. + 4 sparks
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Either of the following conditions is met:	Condition 1 or 2
1. Engine RPM	1,500 rpm or less
2. Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

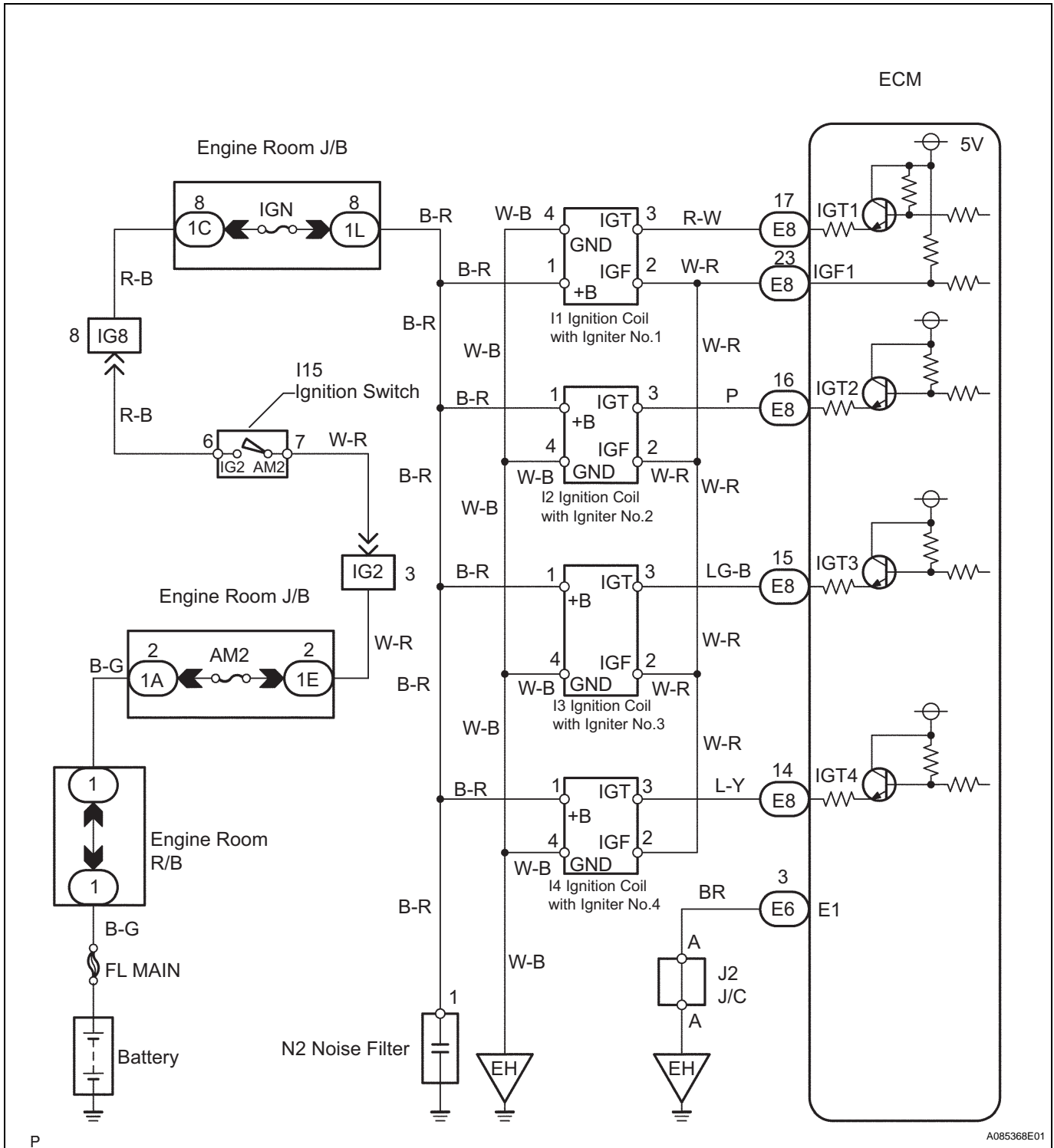
IGF signal	ECM does not receive any IGF signal despite ECM sending IGT signal to igniter
------------	---

COMPONENT OPERATING RANGE

IGF signal

Igniter outputs IGF signal when it receives IGT signal from ECM

WIRING DIAGRAM



HINT:

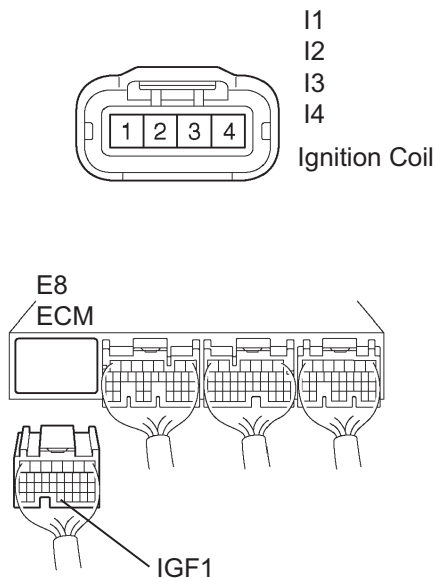
Read freeze frame data using the intelligent tester or the OBD II scan too. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When trouble shooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK SPARK PLUG AND SPARK OF MISFIRING CYLINDER
OK:

Spark occurs.

NG

Go to step 4

OK**ES**
2 CHECK WIRE HARNESS (IGNITION COIL ASSEMBLY - ECM (IGF TERMINAL))
Wire Harness Side

- Disconnect the I1, I2, I3 and I4 ignition coil connectors.
- Disconnect the E8 ECM connector.
- Measure the resistance of the wire harness side connectors.

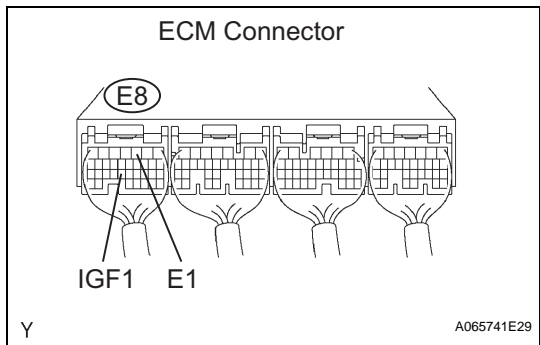
Resistance

Tester Connection	Specified Condition
I1-2 - E8-23 (IGF1) I2-2 - E8-23 (IGF1) I3-2 - E8-23 (IGF1) I4-2 - E8-23 (IGF1)	Below 1 Ω
I1-2 or E8-23 (IGF1) - Body ground I2-2 or E8-23 (IGF1) - Body ground I3-2 or E8-23 (IGF1) - Body ground I4-2 or E8-23 (IGF1) - Body ground	10 k Ω or higher

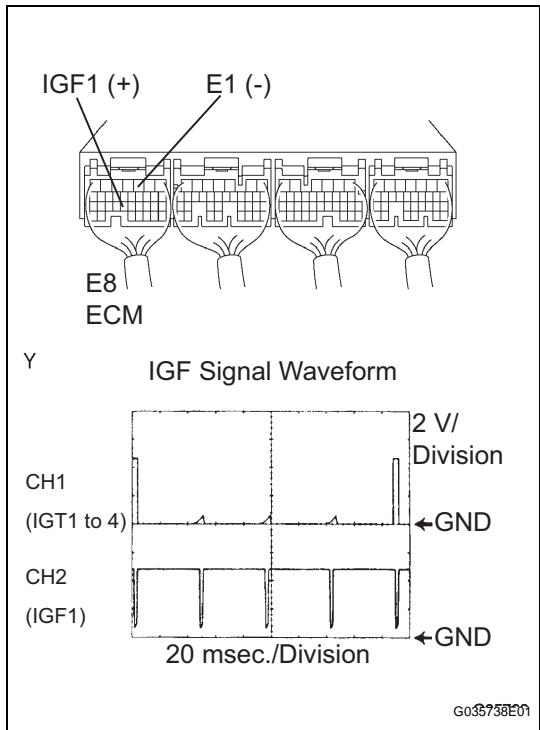
NG
REPAIR OR REPLACE HARNESS AND CONNECTOR
OK

3

CHECK ECM (IGF1 VOLTAGE)



- (a) Connect the E8 ECM connector.
(b) Turn the ignition switch ON.



- (c) Measure the voltage between the terminals of the E8 ECM connectors.

Voltage

Tester Connection	Specified Condition
E8-23 (IGF1) - E8-3 (E1)	4.5 to 5.5 V

HINT:
Reference: Inspection using an oscilloscope.
During cranking or idling, check the waveform of the ECM connectors.

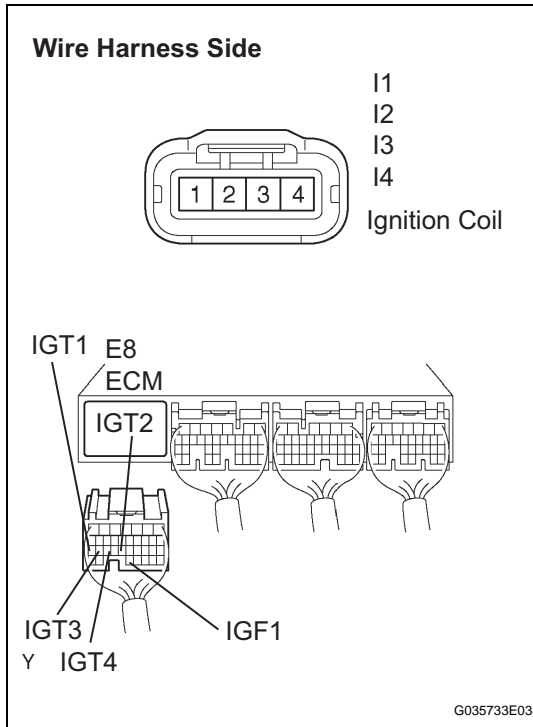
Tester Connection	Specified Condition
E8-23 (IGF1) - E8-3 (E1)	Correct waveform is as shown

NG

REPLACE ECM

OK

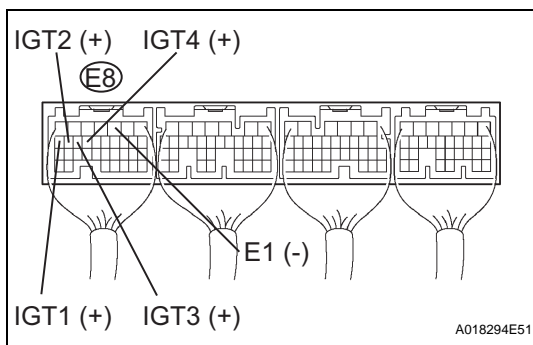
REPLACE IGNITION COIL ASSEMBLY

4 CHECK WIRE HARNESS (IGNITION COIL ASSEMBLY - ECM)

- Disconnect the I1, I2, I3 and I4 ignition coil connectors.
- Disconnect the E8 ECM connector.
- Measure the resistance of the wire harness side connectors.

Resistance

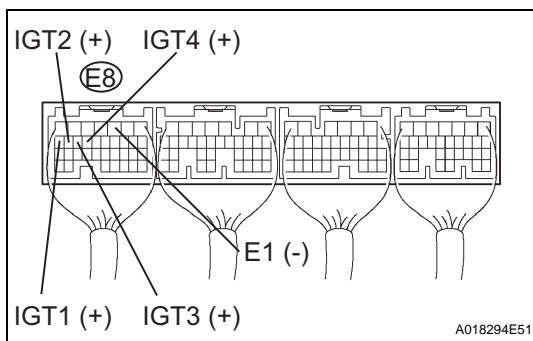
Tester Connection	Specified Condition
I1-3 - E8-17 (IGT1) I2-3 - E8-16 (IGT2) I3-3 - E8-15 (IGT3) I4-3 - E8-14 (IGT4)	Below 1 Ω
I1-3 or E8-17 (IGT1) - Body ground I2-3 or E8-16 (IGT2) - Body ground I3-3 or E8-15 (IGT3) - Body ground I4-3 or E8-14 (IGT4) - Body ground	10 k Ω or higher

NG**REPAIR OR REPLACE HARNESS AND CONNECTOR****OK****5 CHECK ECM (IGT1, IGT2, IGT3, IGT4 VOLTAGE)**

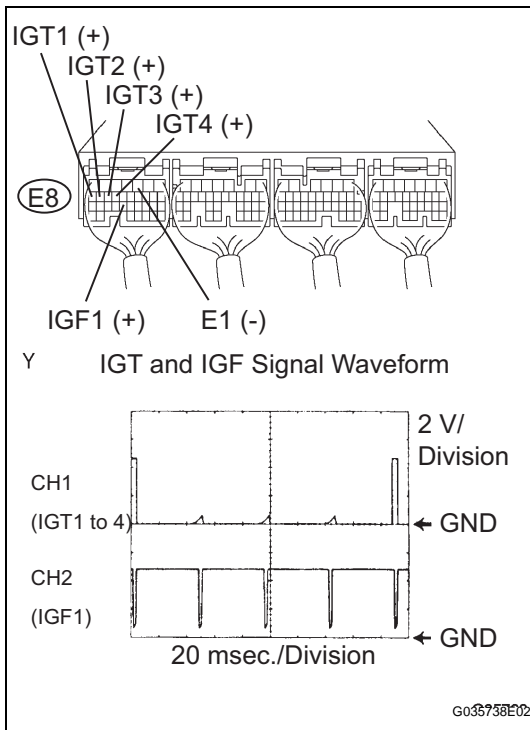
- Measure the voltage of the ECM connectors when the engine is cranked.

Voltage

Tester Connection	Specified Condition
E8-17 (IGT1) - E8-3 (E1) E8-16 (IGT2) - E8-3 (E1) E8-15 (IGT3) - E8-3 (E1) E8-14 (IGT4) - E8-3 (E1)	More than 0.1 V or less than 4.5 V



- Disconnect the I1, I2, I3 and I4 ignition coil connectors.



- (c) Measure the voltage of the ECM connectors when the engine is cranked.

Voltage

Tester Connection	Specified Condition
E8-17 (IGT1) - E8-3 (E1) E8-16 (IGT2) - E8-3 (E1) E8-15 (IGT3) - E8-3 (E1) E8-14 (IGT4) - E8-3 (E1)	4.5 V or more

HINT:

Reference: Inspection using an oscilloscope.

During cranking or idling, check the waveform of the ECM connectors.

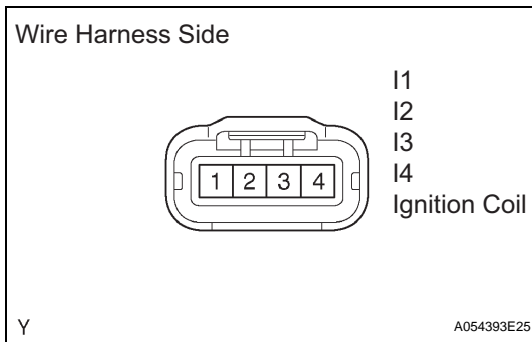
Tester Connection	Specified Condition
E8-17 (IGT1) - E8-3 (E1) E8-16 (IGT2) - E8-3 (E1) E8-15 (IGT3) - E8-3 (E1) E8-14 (IGT4) - E8-3 (E1)	Correct waveform is as shown

NG

REPLACE ECM

OK

6 CHECK IGNITION COIL ASSEMBLY (POWER SOURCE)



- (a) Disconnect the I1, I2, I3 and I4 ignition coil connectors.
(b) Turn the ignition switch ON.
(c) Measure the voltage of the wire harness side connector and body ground.

Voltage

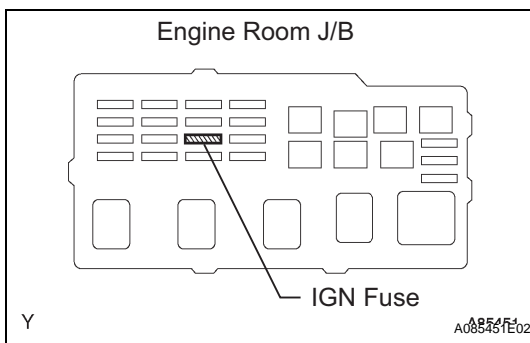
Tester Connection	Specified Condition
I1-1 - Body ground I2-1 - Body ground I3-1 - Body ground I4-1 - Body ground	9 to 14 V

OK

REPLACE IGNITION COIL ASSEMBLY

NG

7 CHECK WIRE HARNESS (IGNITION COIL ASSEMBLY - IGNITION SWITCH)

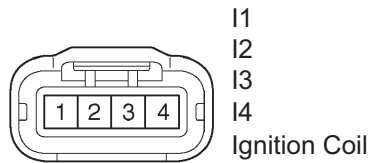


- (a) Check the IGN fuse.
(1) Remove the IGN fuse from the engine room J/B.
(2) Measure the resistance of the IGN fuse.

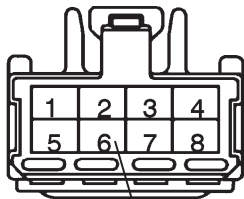
Resistance:

Below 1 Ω

Wire Harness Side



I15 Ignition Switch



Y
A54393
A61075

A085356E01

- (b) Disconnect the I1, I2, I3 and I4 ignition coil connectors.
- (c) Disconnect the I15 ignition switch connector.
- (d) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
I1-1 - I15-6 (IG2) I2-1 - I15-6 (IG2) I3-1 - I15-6 (IG2) I4-1 - I15-6 (IG2)	Below 1 Ω
I1-1 or I15-6 (IG2) - Body ground I2-1 or I15-6 (IG2) - Body ground I3-1 or I15-6 (IG2) - Body ground I4-1 or I15-6 (IG2) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE IGNITION COIL ASSEMBLY

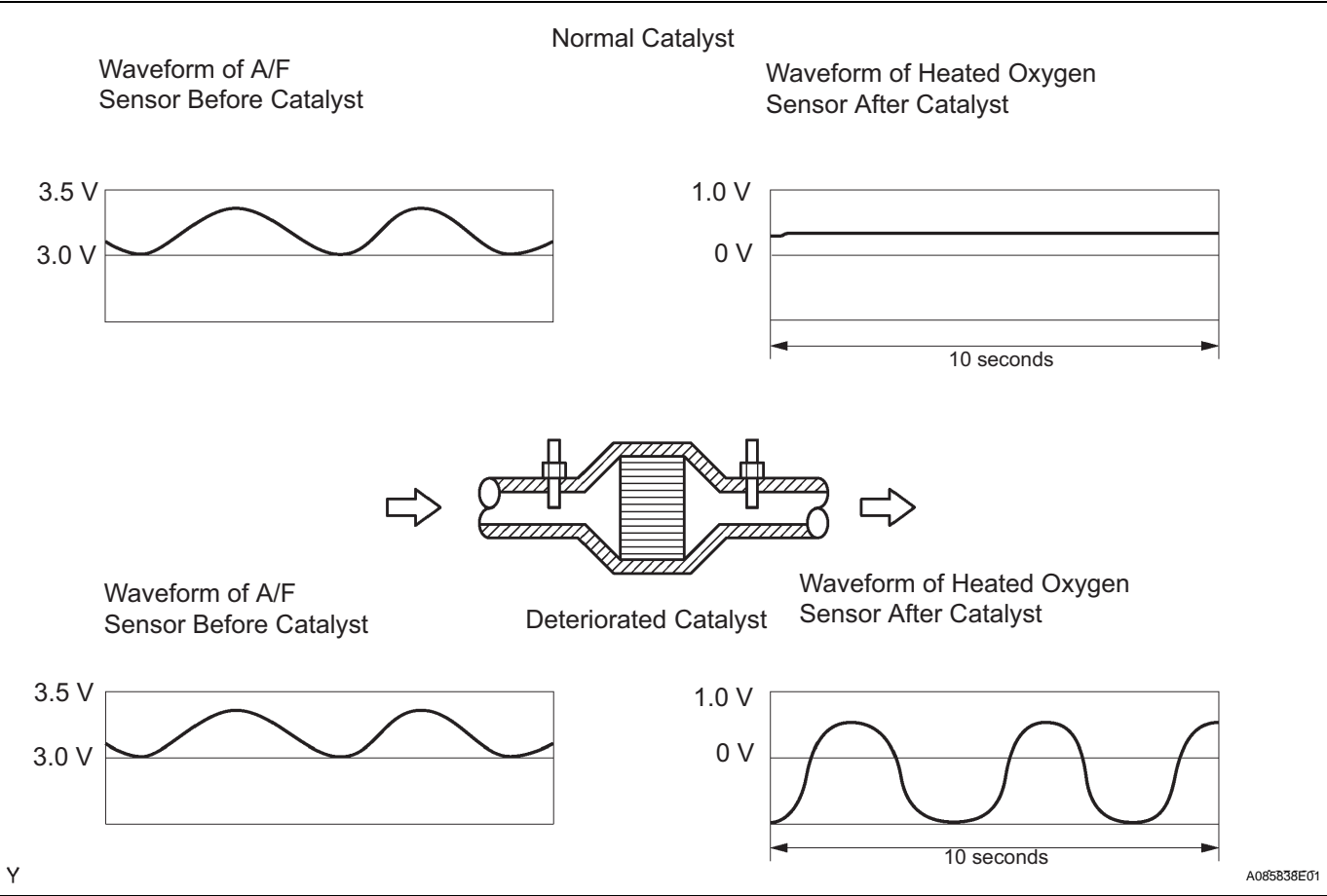
ES

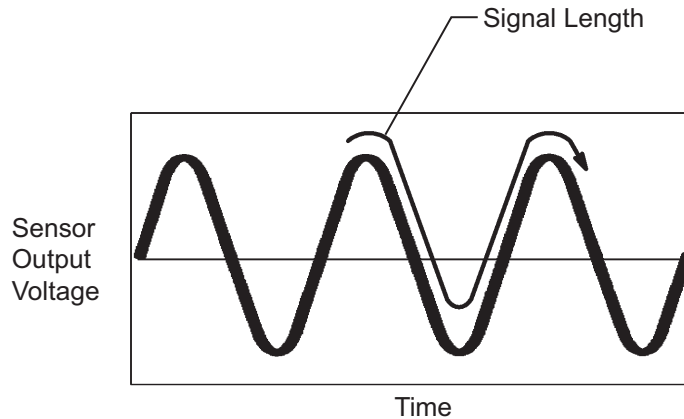
DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)
-----	-------	---

MONITOR DESCRIPTION

The ECM uses sensors mounted before and after the three-way catalyst (TWC) to monitor its efficiency. The first sensor, an Air Fuel ratio (A/F) sensor, sends pre-catalyst A/F ratio information to the ECM. The second sensor, a heated oxygen sensor (O2S), sends post-catalyst information to the ECM. The ECM compares these 2 signals to judge the efficiency of the catalyst and the catalyst's ability to store oxygen. During normal operation, the TWC stores and releases oxygen as needed. The capacity to store oxygen results in a low variation in the post-TWC exhaust stream as shown below.

If the catalyst is functioning normally, the waveform of the heated oxygen sensor slowly switches between RICH and LEAN. If the catalyst is deteriorated, the waveform will alternate frequently between RICH and LEAN. As the catalyst efficiency degrades, its ability to store oxygen is reduced and the catalyst output becomes more variable. When running the monitor, the ECM compares sensor 1 signals (A/F sensor) over a specific amount of time to determine catalyst efficiency. The ECM begins by calculating the signal length for both sensors (for the rear oxygen sensor, the ECM uses the output voltage signal length). If the oxygen sensor output voltage signal length is greater than the threshold (threshold is calculated based on the A/F sensor signal length), the ECM concludes that the catalyst is malfunctioning. The ECM will turn on the MIL and a DTC will be set.



Heated Oxygen Sensor Signal Length

A082718E05

ES

DTC No.	DTC Detection Condition	Trouble Area
P0420	After engine and catalyst are warmed up, and while vehicle is driven within set vehicle and engine speeds, waveform of heated oxygen sensor (bank 1 sensor 2) alternates frequently between RICH and LEAN (2 trip detection logic)	<ul style="list-style-type: none"> Gas leakage in exhaust system A/F sensor (bank 1 sensor 1) Heated oxygen sensor (bank 1 sensor 2) Three-way catalytic converter (Exhaust manifold)

HINT:

- Sensor 1 is the sensor closest to the engine assembly.
- Sensor 2 is the sensor farthest away from the engine assembly.

MONITOR STRATEGY

Related DTCs	P0420: Catalyst Deterioration
Required sensors/ components (Main)	Catalyst
Required sensors / components (Related)	A/F sensor, Rear HO2S, IAT sensor, MAF meter, Crankshaft position sensor, ECT sensor
Frequency of operation	Once per driving cycle
Duration	150 seconds (30 seconds x 5)
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present	P0011, P0012 (VVT system - Advance, Retard) P0031, P0032 (A/F sensor heater) P0037, P0038 (O2 sensor heater) P0100 - P0103 (MAF sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0136 (O2 sensor) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0354 (Igniter) P0500 (VSS) P2196 (A/F sensor (Rationality)) P2237 (A/F sensor (open)) P2A00 (A/F sensor (Slow response))
Accumulated time that all of the following conditions are met:	30 seconds
Battery voltage	11 V or more

IAT	-10°C (14°F) or more
Idle status	OFF
MAF (Automatic transaxle)	6 to 35 g/ second
MAF (Manual transaxle)	8 to 35 g/ second
Engine RPM	Less than 4,500 rpm
ECT	75°C (167°F) or more
Fuel system status	Closed Loop
Rich experience after fuel cut	Yes
A/F sensor	Activated
Rear HO2S	Activated
Estimated catalyst temperature	Both of the following conditions 1 and 2 are met
1. Upstream catalyst temperature	500 to 900°C (932 to 1,652°F)
2. Downstream catalyst temperature	350 to 900°C (662 to 1,652°F)

TYPICAL MALFUNCTION THRESHOLDS

Frequency of the monitor	5 times
Rear HO2S locus length (Automatic transaxle)	40 V or more (Varies with A/F sensor locus length)
Rear HO2S locus length (Manual transaxle)	35 V or more (Varies with A/F sensor locus length)

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page [ES-16](#)).

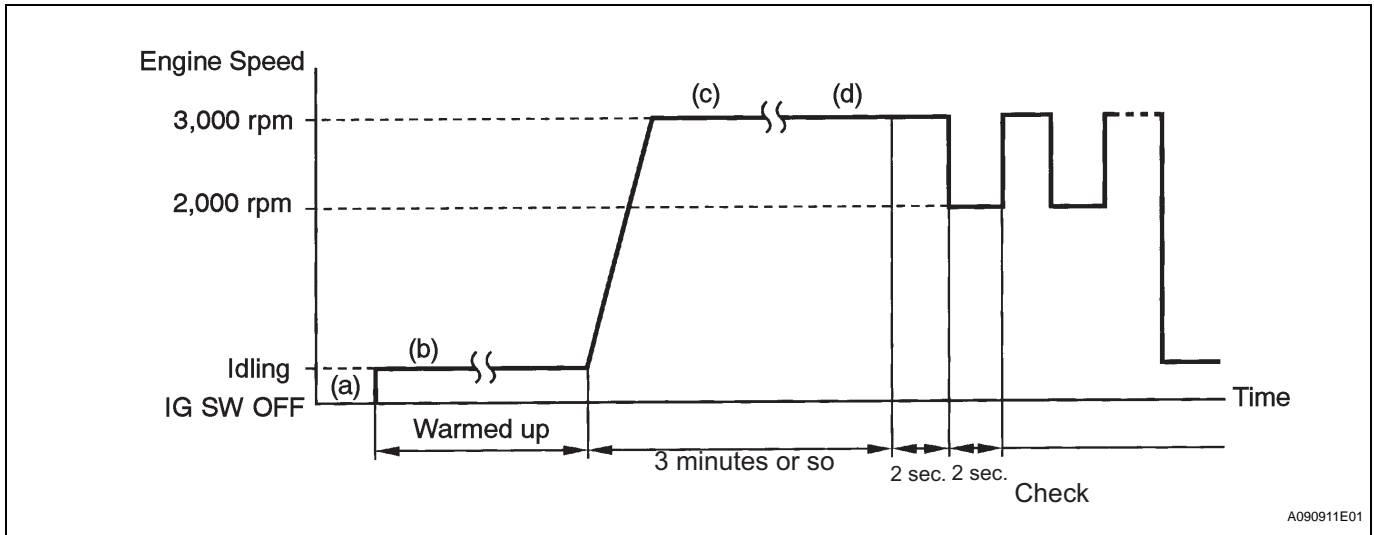
The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page [ES-17](#)).

- 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 \$01: Catalyst - Sensor 1 A/F sensor, Sensor 2 HO2S

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
0	\$01	Multiply by 0.0078 (no dimension)	Catalyst deterioration level (bank 1): Determined by waveforms of A/F sensor and HO2S 2	Malfunction criteria for catalyst deterioration

CONDITIONING FOR SENSOR TESTING



1. Connect the intelligent tester or the OBD II scan tool to the DLC3.
2. Start the engine and warm it up with all the accessories switched OFF until the Engine Coolant Temperature (ECT) is stable.
3. Run the engine at 2,500 to 3,000 rpm for about 3 minutes.
4. When alternating the engine between 3,000 rpm and 2,000 rpm for 2 seconds respectively, check the waveform of the oxygen sensor (bank 1 sensor 2).

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 P0420)

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

Result

Display (DTC Output)	Proceed to
Only P0420 is output	A
P0420 and other DTCs are output	B

HINT:

If any other codes besides P0420 are output, perform the troubleshooting for those codes first.

B

GO TO RELEVANT DTC CHART

A

2 CHECK FOR EXHAUST GAS LEAKAGE

OK:

No gas leakage.

NG

REPAIR OR REPLACE EXHAUST GAS
LEAKAGE POINT

OK

3

INSPECT AIR FUEL RATIO SENSOR (BANK 1 SENSOR 1)

NG

REPLACE AIR FUEL RATIO SENSOR

OK

ES

4

REPLACE BOTH FRONT CATALYST AND REAR CATALYST

HINT:

Intelligent tester only:

The following procedure enables the technician to identify a trouble area if malfunction in front A/F sensor or rear heated oxygen sensors other than the catalyst converter, or the malfunction that indicates the actual air-fuel ratio extremely RICH or LEAN.

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.

- (a) 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%.

















- (1) Connect the intelligent tester to the DLC3 on the vehicle.
- (2) Turn the ignition switch ON.
- (3) Warm up the engine by running the engine speed at 2,500 rpm for approximately 90 seconds.
- (4) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
- (5) Perform the A/F CONTROL operation with the engine idle (press the right or left button).

Result:

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		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> A/F sensor A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> HO2 sensor HO2 sensor heater HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> Injector Fuel pressure Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

The following of A/F CONTROL procedure enables the technician to check and graph the voltage outputs of both the heated oxygen sensors.

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".

NG

REPLACE HEATED OXYGEN SENSOR

OK

GO TO RELEVANT DTC CHART

ES

DTC	P0441	Evaporative Emission Control System Incorrect Purge Flow
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DESCRIPTION

The circuit description can be found in the EVAP System (See page [ES-282](#)).

Refer to the EVAP System (See page [ES-286](#)).

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) in it. The ECM then monitors the internal pressure using the fuel tank pressure sensor (refer to the Leak Check graphic).

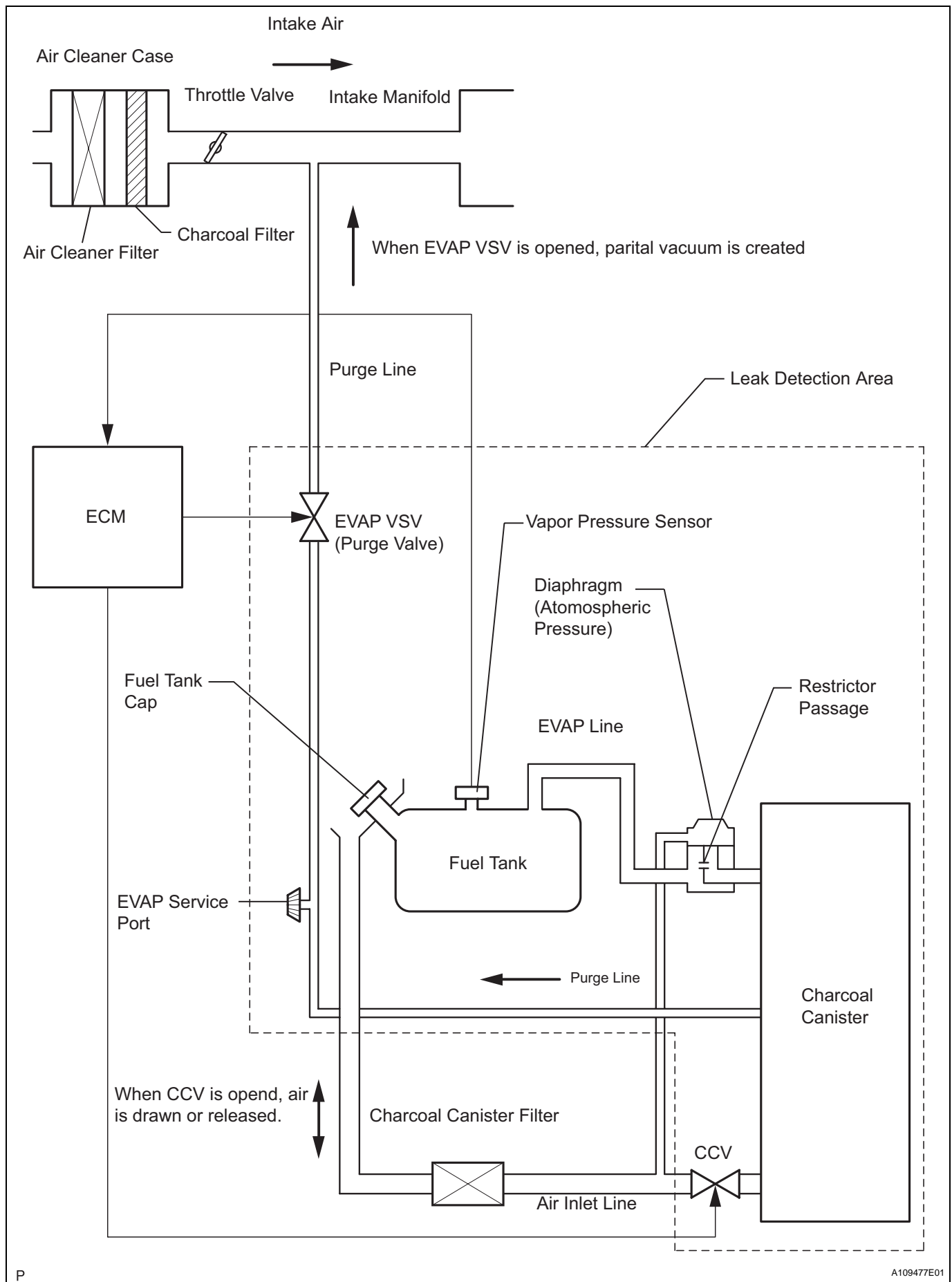
P0441

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 then turn on the MIL and set a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0441	<ul style="list-style-type: none"> 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) 	<ul style="list-style-type: none"> 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

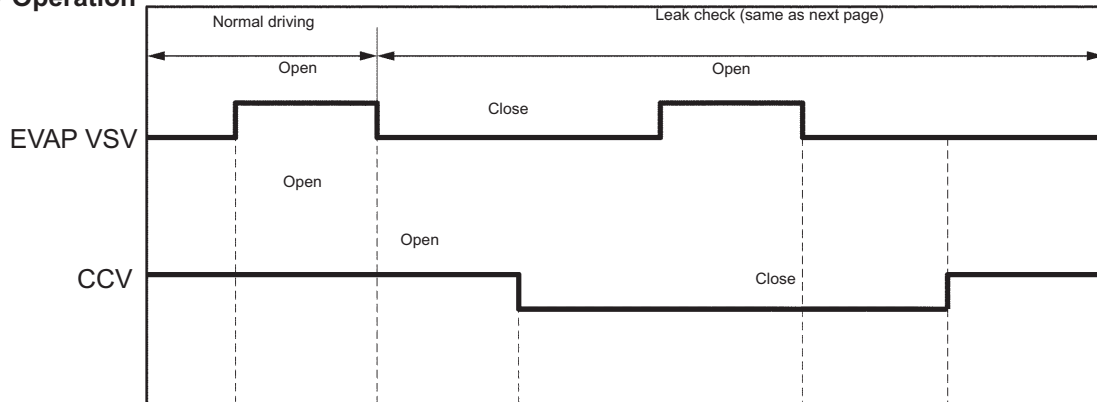


ES

VSV Malfunction Condition and Leak Check

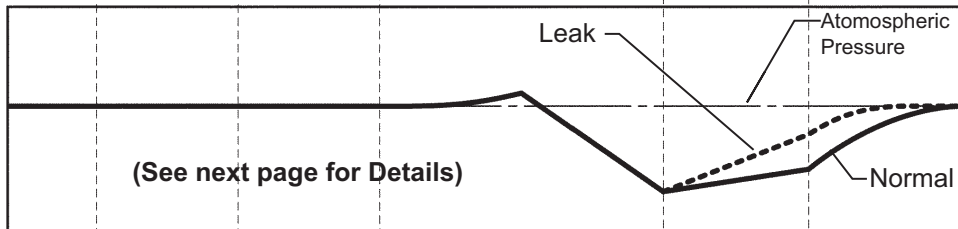
EVAP VSV is Open: ON
CCV is Open: OFF

VSV Operation

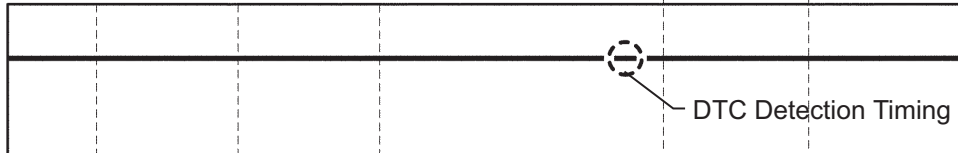


Pressure in Fuel Tank

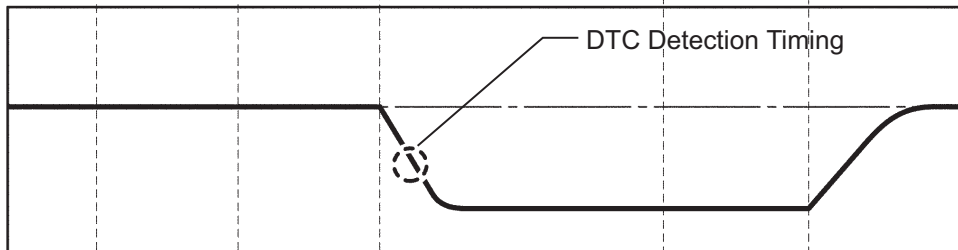
Normal Condition or
EVAP System Leak
(Normal System Line)



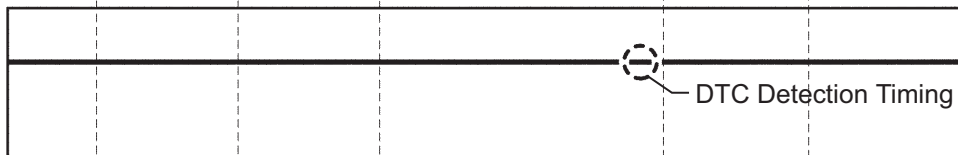
EVAP VSV Close
Malfunction (P0441)



EVAP VSV Open
Malfunction (P0441)



CCV Open
Malfunction (P0446)



CCV Close
Malfunction (P0446)

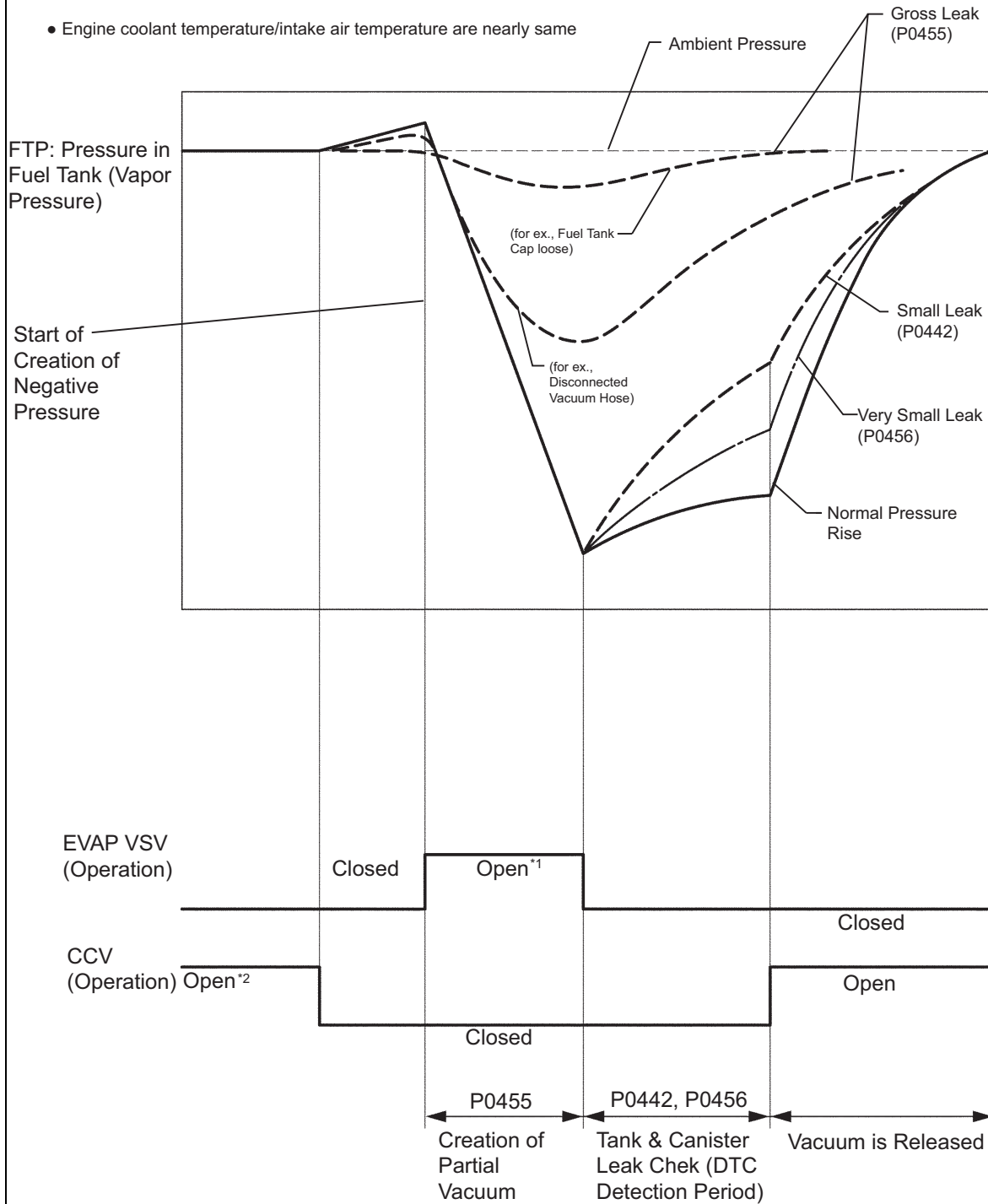


DTC Detection Timing

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

MONITOR STRATEGY

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

ES

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0011, P0012 (VVT system - Advance, 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 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0354 (Igniter) P0451 - P0453 (EVAP pressure 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	10 % or more when intake air amount is 12 g/sec. or more
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	-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 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-16](#)).

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

ES The circuit description can be found in the EVAP System (See page [ES-282](#)).

Refer to the EVAP System (See page [ES-286](#)).

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).

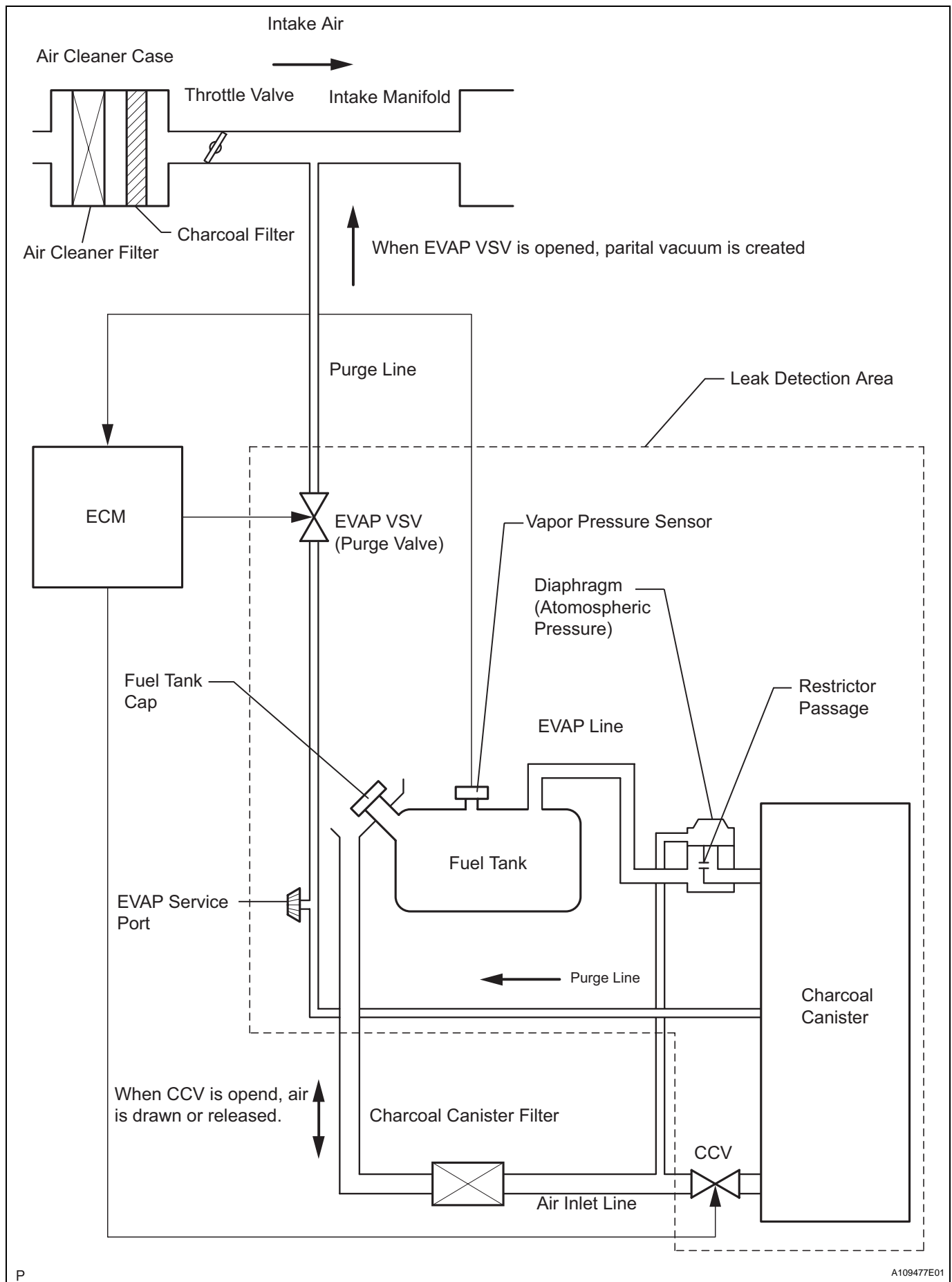
1. P0442, P0455 and P0456

When there is a leak in the evaporative emission system, the ECM sets DTC P0442, P0455, or P0456. The ECM checks if the EVAP system has a leak. 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:

- DTC P0442 is set when the internal fuel tank pressure has a large increase and the EVAP system has a small leak.
- 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.
- 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	<ul style="list-style-type: none"> 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): <ol style="list-style-type: none"> Rapid, sharp increase in pressure occurs, indicating small leak in EVAP system. DTC P0442 is set. Negative pressure (vacuum) is not strong enough, indicating large hole in EVAP system. DTC P0455 is set. Increase in pressure above expected amount occurs, indicating small leak in EVAP system. DTC P0456 is set. 	<ul style="list-style-type: none"> 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

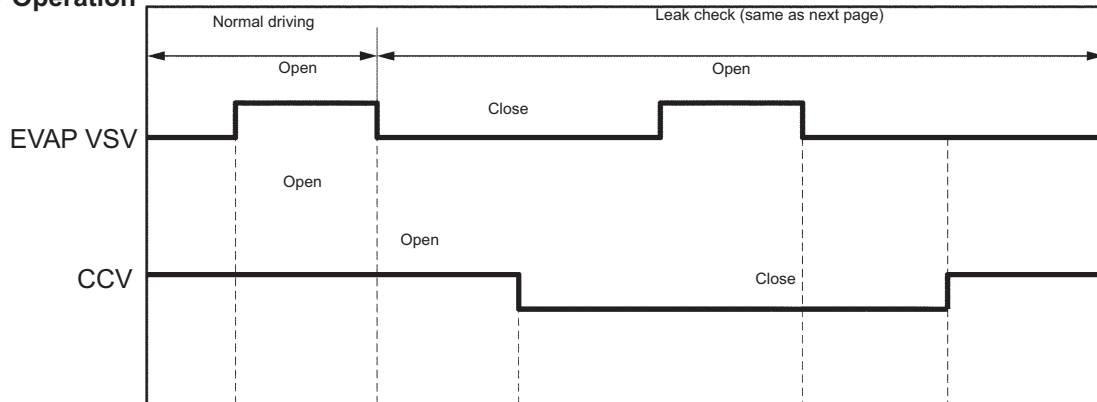


ES

VSV Malfunction Condition and Leak Check

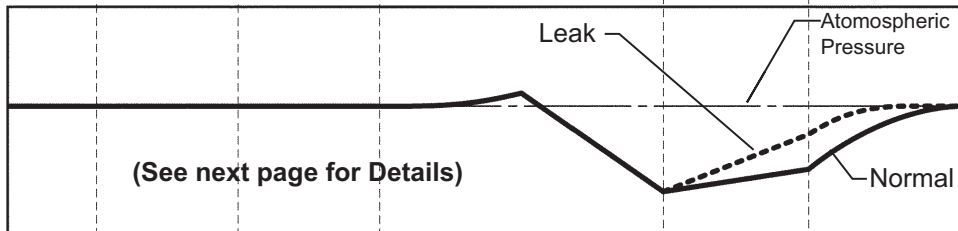
EVAP VSV is Open: ON
CCV is Open: OFF

VSV Operation

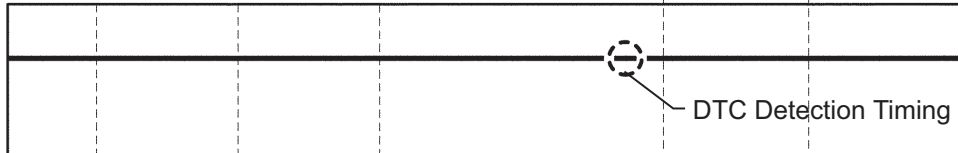


Pressure in Fuel Tank

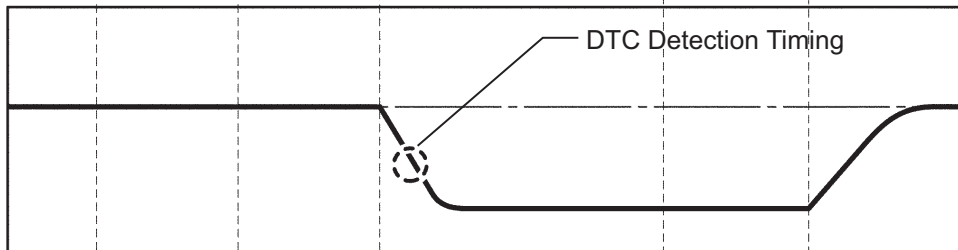
Normal Condition or
EVAP System Leak
(Normal System Line)



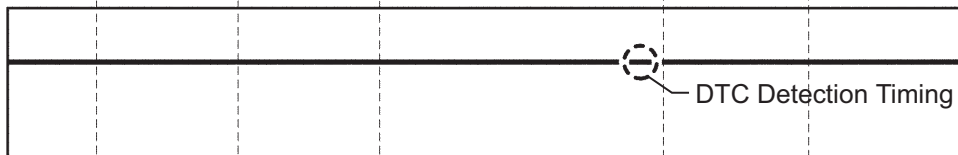
EVAP VSV Close
Malfunction (P0441)



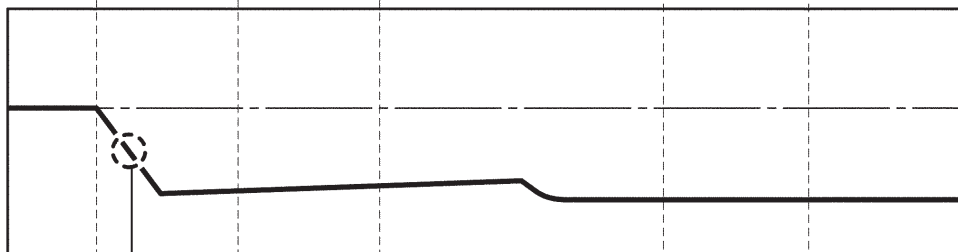
EVAP VSV Open
Malfunction (P0441)



CCV Open
Malfunction (P0446)



CCV Close
Malfunction (P0446)

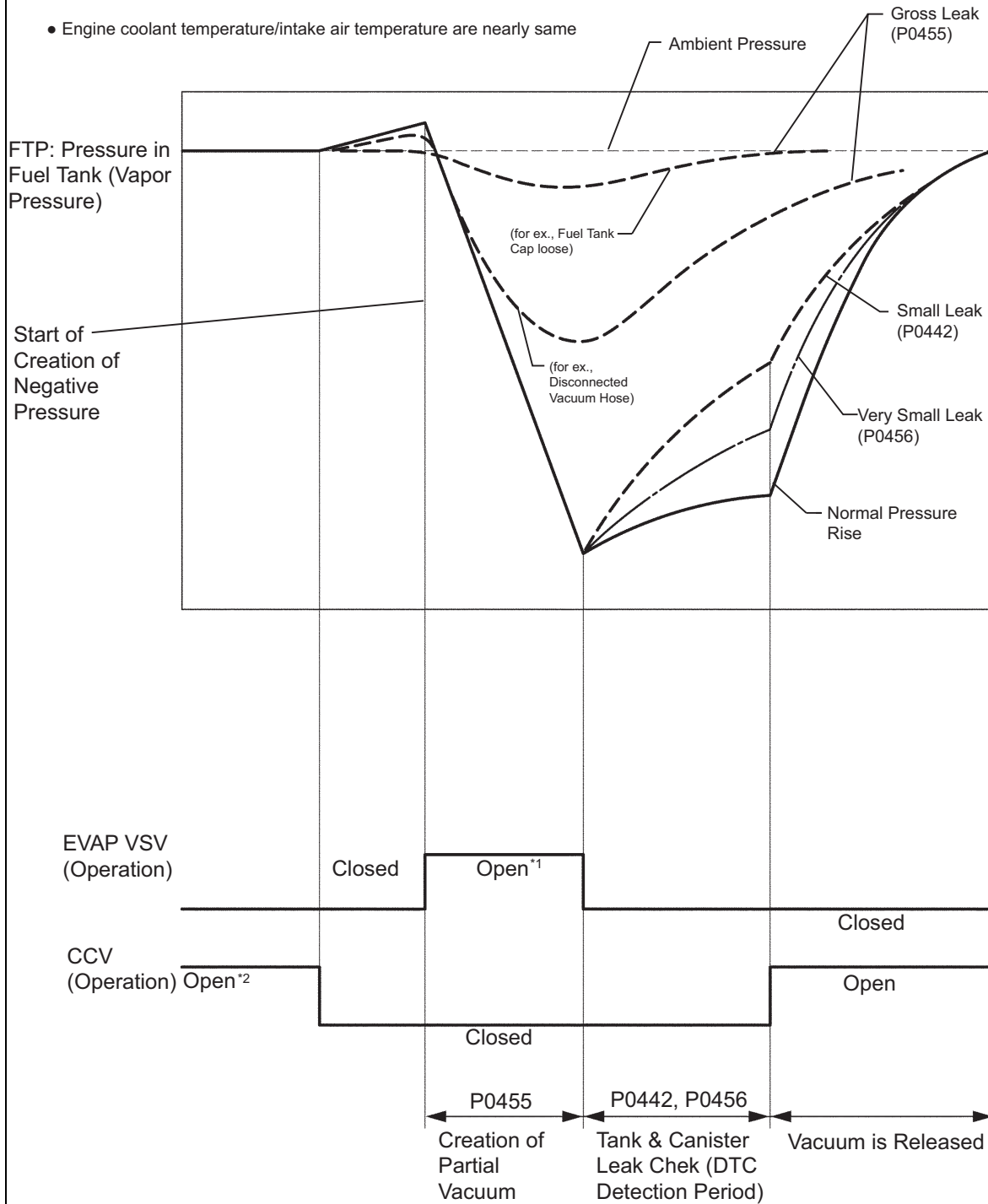


DTC Detection Timing

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

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, FTP, IAT, MAF and VSS (Vehicle Speed Sensor)
Frequency of operation	Once per driving cycle
Duration	Within 90 seconds
MIL operation	2 driving cycles
Sequence operation	None

ES

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	P0011, P0012 (VVT system - Advance, 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 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0354 (Igniter) P0451 - P0453 (EVAP pressure 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 1 or 2 is met:	-
1. Purge duty cycle	10 % or more when intake air amount is 12 g/sec or more
2. Purge concentration for 30 seconds	-5 %/% or more when vehicle speed is less than 6.25 mph (10 km/h)
Refuel during EVAP system monitor	Not refueled with engine running
FTP before EVAP system 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)	1.4 mmHg (0.19 kPa) or more
2. FTP change for 5 seconds from -17 mmHg (-2.27 kPa)	1.4 mmHg (0.19 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)	0.6 mmHg (0.08 kPa) or more
2. FTP change for 5 seconds when FTP is -20 mmHg (-2.67 kPa)	0.6 mmHg (0.08 kPa) or more

EVAP gross leak P0455:

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

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page [ES-16](#)).

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
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DESCRIPTION

The circuit description can be found in the EVAP System (See page [ES-282](#)).

Refer to the EVAP System (See page [ES-286](#)).

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 graphic (See page [ES-176](#))).

P0446 (FOR SYSTEM DIAGRAM AND DTC DETECTION TIMING CHART, REFER TO DTC P0441 (See page))

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 does 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)	<ul style="list-style-type: none"> • 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, FTP, IAT, MAF and VSS (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, P0012 (VVT system - Advance, 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 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0354 (Igniter) P0451 - P0453 (EVAP pressure 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	10 % or more when intake air amount 12 g/sec or more
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	-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 1 and 2 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-16](#)).

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	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.

1. P0451

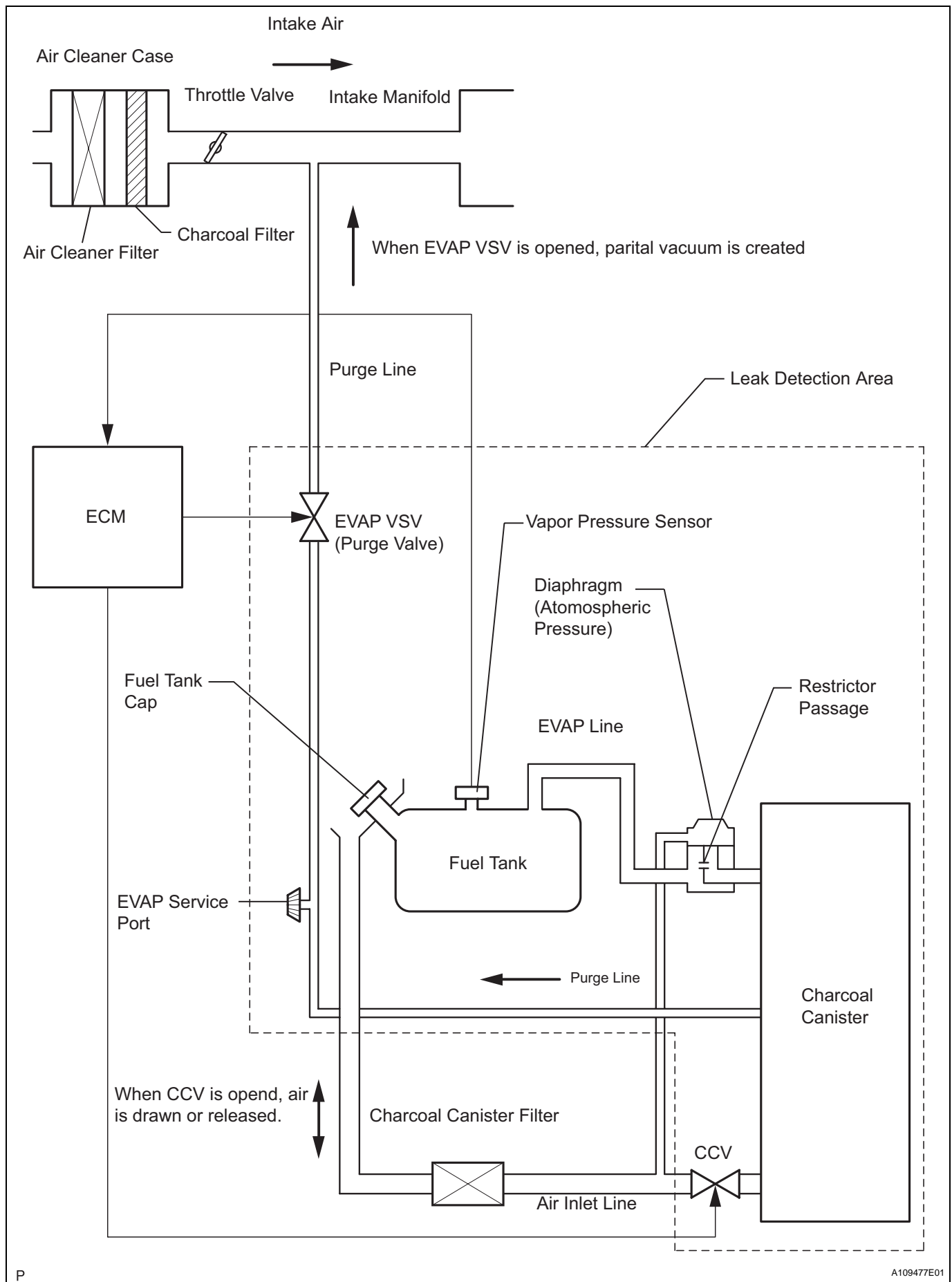
The ECM monitors the vapor pressure sensor in 2 ways:

- (a) The ECM monitors the fluctuation of electrical signals while the engine is idling. If the pressure signal varies beyond a specified range more than 7 times, the ECM interprets this as a fault in the vapor pressure sensor.
- (b) The ECM checks if the pressure signal fluctuates. 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.

2. P0452 and P0453

When the 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.



ES

DTC No.	DTC Detection Condition	Trouble Area
P0451	Vapor pressure sensor output changes extremely under the following conditions: <ul style="list-style-type: none"> Vapor pressure sensor output changes often while vehicle speed is 0 mph (0 km/h) and the engine is idling 5 second to 10 seconds (2 trip detection logic) Vapor pressure sensor output is stuck 5 minutes (2 trip detection logic) 	<ul style="list-style-type: none"> Open or short in vapor pressure sensor circuit Vapor pressure sensor ECM
P0452	Vapor pressure sensor output remains less - 30 mmHg (-3.999 kPa) (2 trip detection logic)	<ul style="list-style-type: none"> Same as DTC No. P0451
P0453	Vapor pressure sensor output remains more than 15 mmHg (1.999 kPa) (2 trip detection logic)	<ul style="list-style-type: none"> Same as DTC No. P0451

ES

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 20 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:

Engine start ECT	10 to 35°C (50 to 95°F)
Engine start IAT	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
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FTP Sensor Stuck P0451:

FTP change	No change for 5 minutes
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FTP Sensor Range Check (Low voltage) P0452:

FTP	Less than -30 mmHg (-3.999 kPa)
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FTP Sensor Range Check (High voltage) P0453:

FTP	15 mmHg (1.999 kPa) or more
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COMPONENT OPERATING RANGE

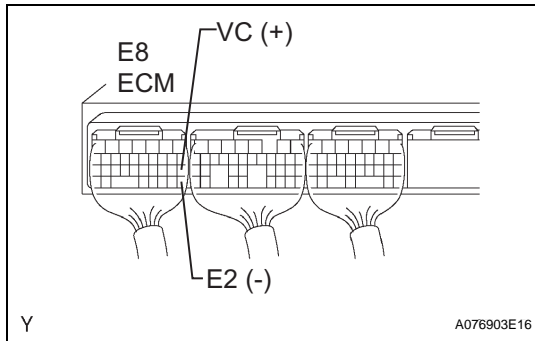
FTP	-26 to 11 mmHg (-3.5 to 1.5 kPa)
-----	----------------------------------

WIRING DIAGRAM

Refer to the EVAP System (See page [ES-285](#)).

HINT:

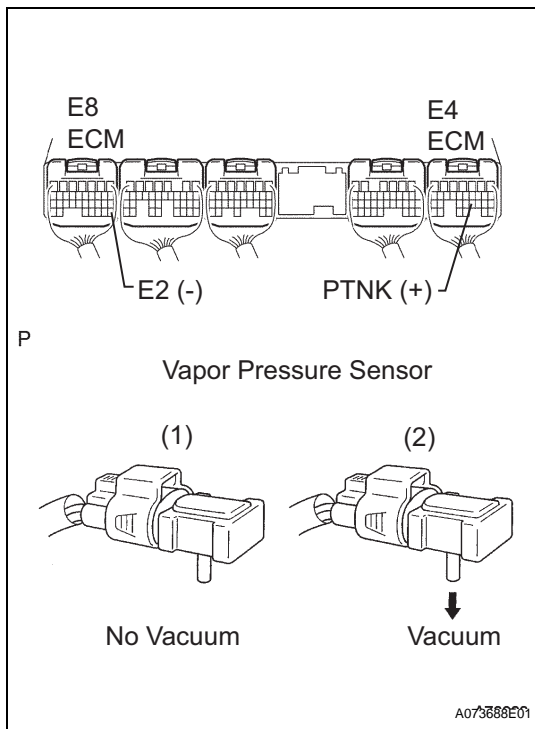
- If DTCs that are related to different systems are output simultaneously while terminal E2 is used as a ground terminal, terminal E2 may have an open circuit.
- Always troubleshoot DTCs P0441 (purge flow), P0446 (CCV), P0451, P0452 and P0453 (evaporative pressure sensor) before troubleshooting DTCs P0442, P0455 and P0456.
- 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.
- 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 E8 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 E8 and E4 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:

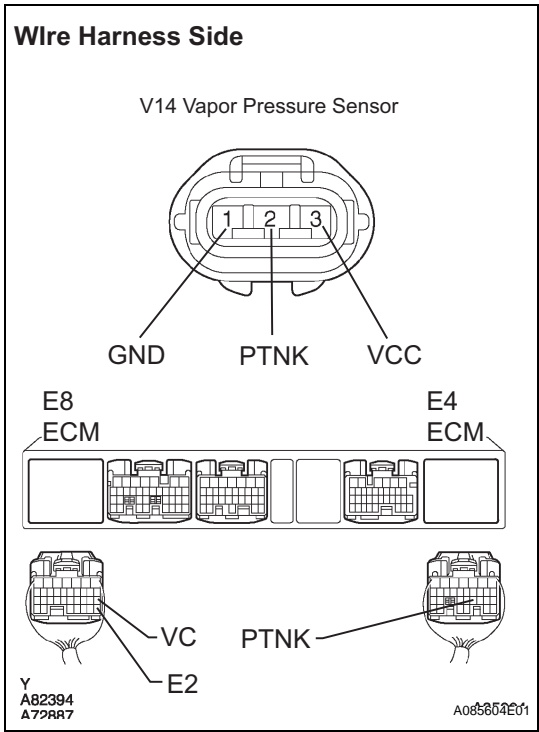
The vacuum applied to the vapor pressure sensor must be less than 66.7 kPa (500 mmHg, 19.7 in.Hg).

Voltage (2)

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

NG**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) Check 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 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

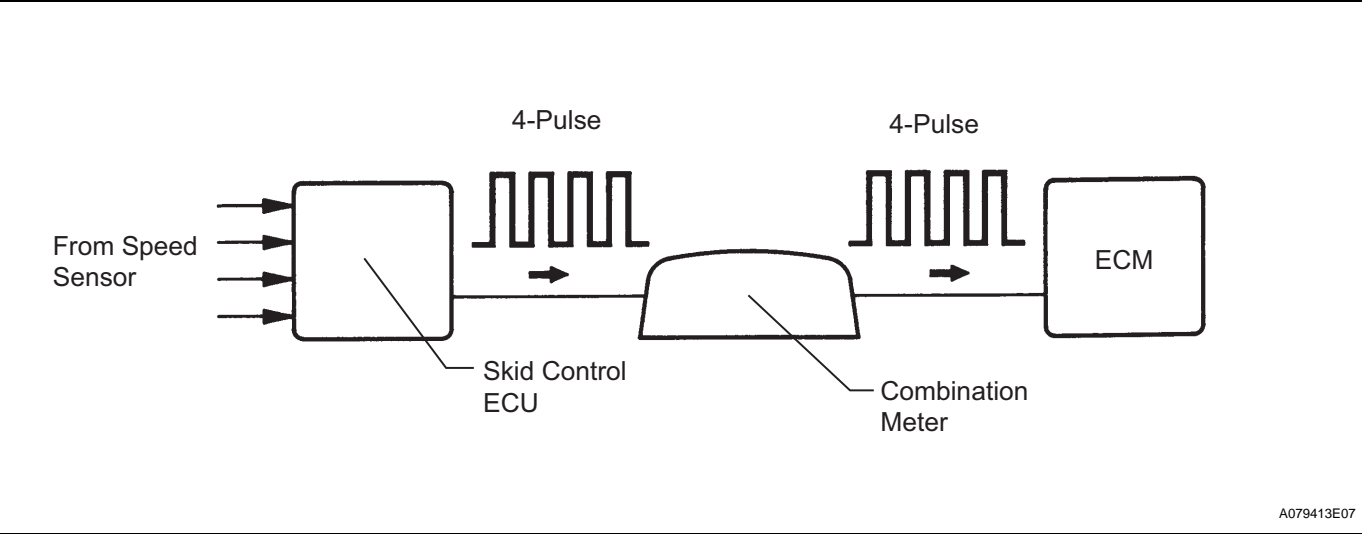
REPLACE VAPOR PRESSURE SENSOR ASSEMBLY

ES

DTC	P0500	Vehicle Speed Sensor "A"
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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	The ECM detects the following conditions simultaneously for 2 seconds: <ul style="list-style-type: none">No SPD (speed sensor) signal while ECM detects NC (transmission counter gear) signal is more than 300 rpmPark/Neutral position switch is OFF (When shift lever is in other than P and N positions)	<ul style="list-style-type: none">Combination meterOpen or short in speed sensor circuitVehicle speed sensorECMSkid 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	Case 1: 1 seconds Case 2: 8 seconds
MIL operation	Case 1: Immediate Case 2: 2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None
--	------

Case 1:

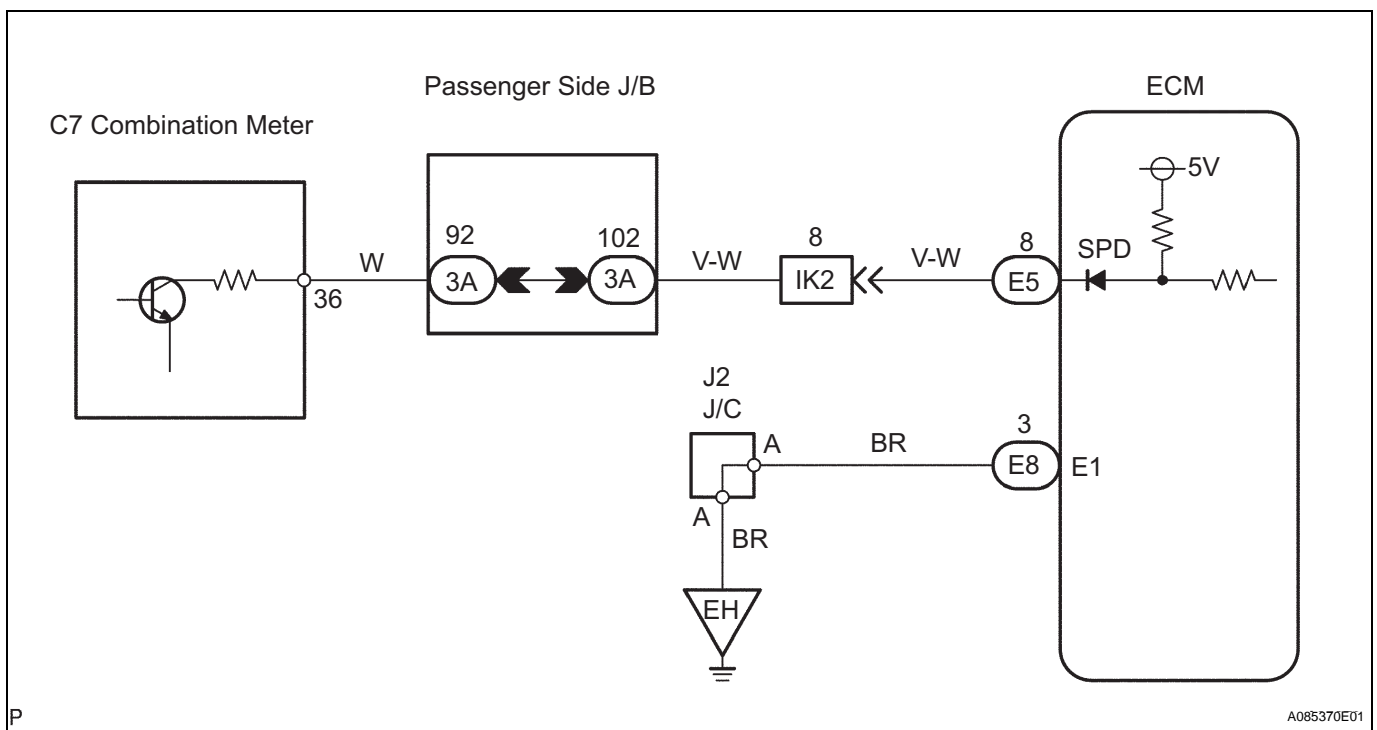
Transmission countergear speed	300 rpm or more
Engine condition	Running
Battery voltage	8 V or more
Starter	OFF
Ignition switch	ON
Either of the following conditions is met:	Conditions 1 or 2
Conditions 1:	-
Time after PNP switch ON to OFF	2 seconds or more
ECT and ECT sensor	ECT is 20°C (68°F) or more and ECT sensor does not malfunction (P0115 or P0116)
Conditions 2:	-
Time after PNP switch 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)

Case 2:

Fuel cut due to high engine RPM	Not executing
ECT	70°C (158°F) or more
Engine PRM	2,000 to 6,400 rpm
Engine load	30 % at 2,000 rpm 30 % at 3,600 rpm 35 % at 5,200 rpm 45 % at 6,800 rpm
Battery voltage	8 V or more
Starter	OFF
Ignition switch	ON

TYPICAL MALFUNCTION THRESHOLDS

VSS signal	No pulse input
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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 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.

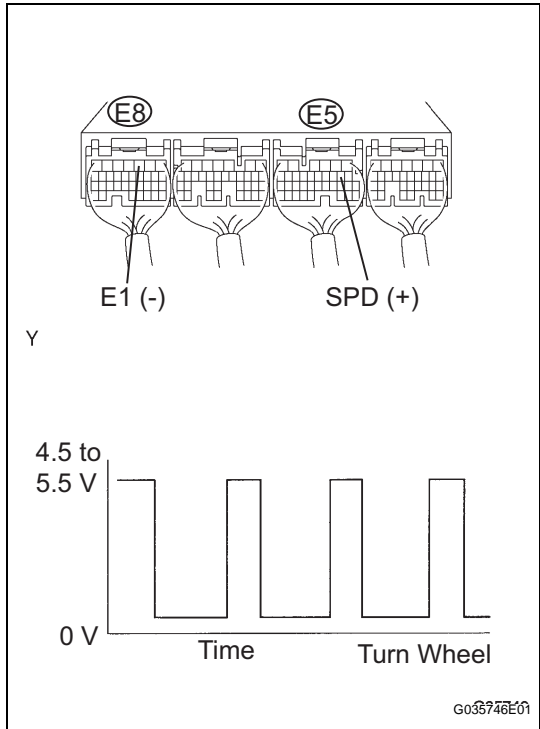
NG

CHECK SPEEDOMETER CIRCUIT

OK

2

CHECK ECM (SPD VOLTAGE)



- (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.

Voltage

Tester Connection	Specified Condition
E5-8 (SPD) - E8-3 (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 AND CONNECTOR

OK

REPLACE ECM

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

In addition to turning on the stop light, 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:

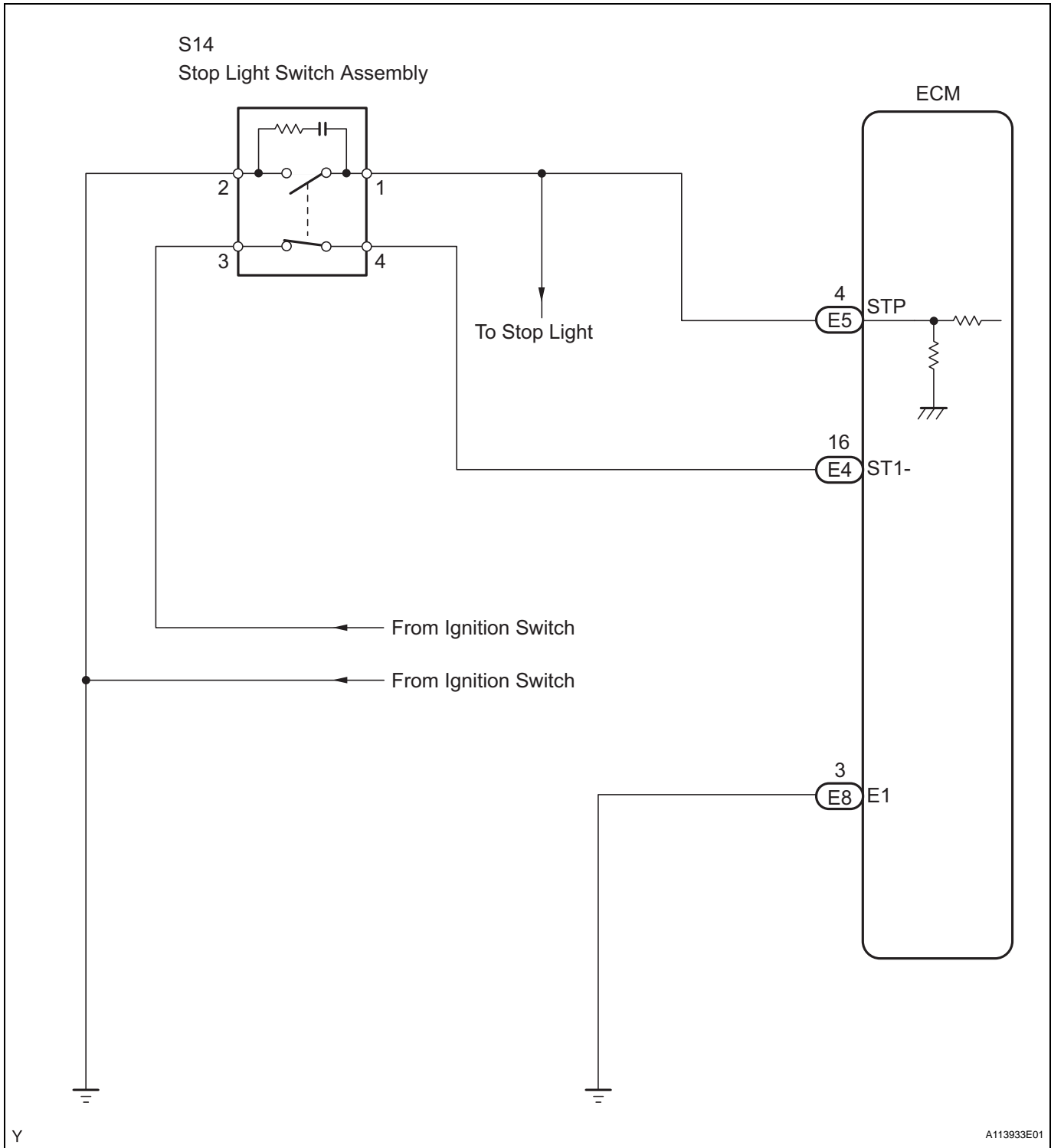
Normal condition is as shown in the table.

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

ES

DTC No.	DTC Detection Condition	Trouble Area
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more: 1. Ignition switch ON 2. Brake pedal released 3. STP signal is OFF when the ST1- signal is OFF	<ul style="list-style-type: none"> • Short in stop light switch signal circuit • STOP 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 (OPERATION)

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

OK:

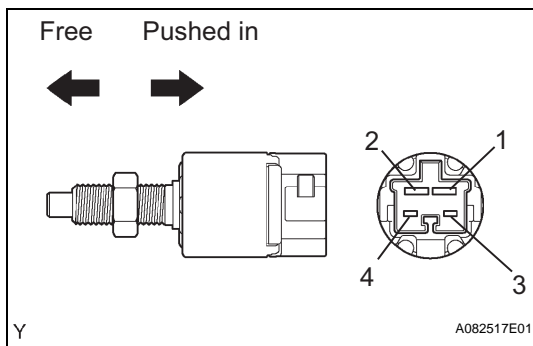
The stop lights turn on when you depress the brake pedal.

NG

REPAIR OR REPLACE STOP LIGHT SWITCH CIRCUIT

OK

ES

2 INSPECT STOP LIGHT SWITCH ASSEMBLY (RESISTANCE)

- (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 k Ω or higher
Switch pin pushed in	1 - 2	10 k Ω or higher
Switch pin pushed in	3 - 4	Below 1 Ω

NG

REPLACE STOP LIGHT SWITCH ASSEMBLY

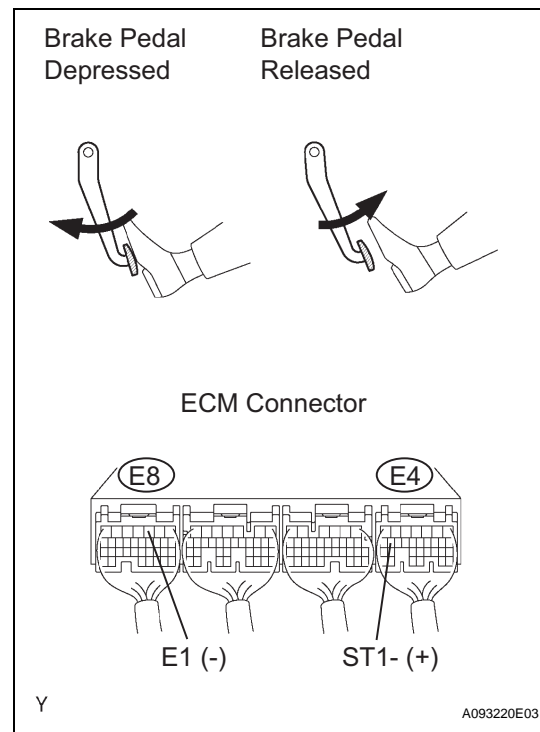
OK

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 value.

Standard

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



- (c) Measure the voltage of the E4 ECM connectors.

Voltage

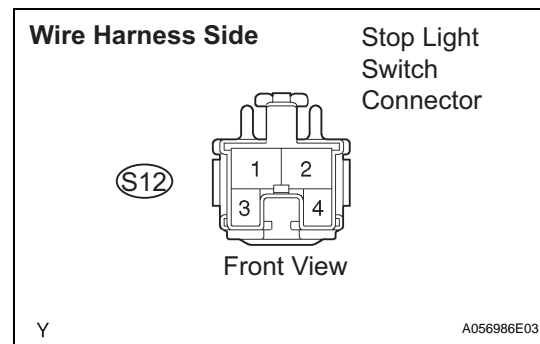
Tester Connection	Brake Pedal Condition	Specified Condition
E4-16 (ST1-) - E8-3 (E1)	Depressed	Below 1.5 V
E4-16 (ST1-) - E8-3 (E1)	Released	7.5 to 14 V

OK

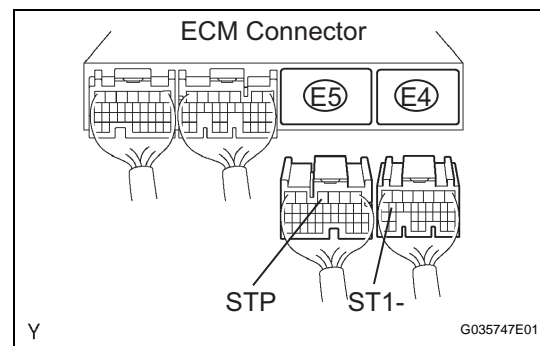
CHECK FOR INTERMITTENT PROBLEMS

NG

4 CHECK WIRE HARNESS (STOP LIGHT SWITCH - ECM)



- (a) Disconnect the S12 stop light switch connector.



- (b) Disconnect the E5 and E4 ECM connector.
 (c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
S12-1 - E5-4 (STP) S12-4 - E4-16 (ST1-)	Below 1 Ω
S12-1 or E5-4 (STP) - Body ground S12-4 or E4-16 (ST1-) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE ECM

1 CHECK STOP LIGHT (OPERATION)

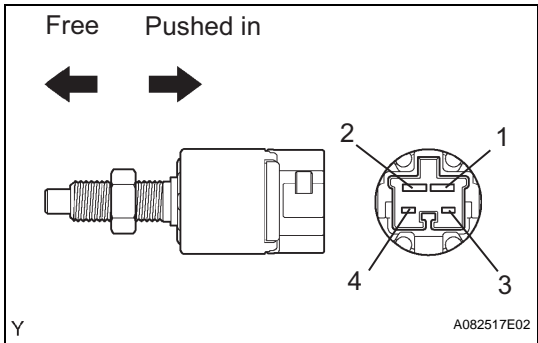
- (a) Check if the stop lights turn on and off normally when the brake pedal is depressed and released.

NG

REPAIR OR REPLACE STOP LIGHT SWITCH CIRCUIT

OK

2 INSPECT STOP LIGHT SWITCH ASSEMBLY



- (a) Measure the resistance of the switch terminals.
Resistance

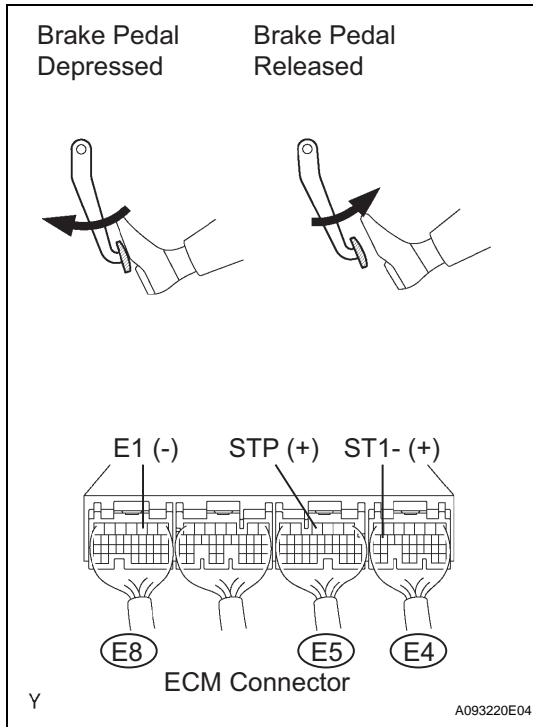
Switch Condition	Tester Connection	Specified Condition
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 k Ω or higher
Switch pin pushed in	1 - 2	10 k Ω or higher
Switch pin pushed in	3 - 4	Below 1 Ω

NG

REPLACE STOP LIGHT SWITCH ASSEMBLY

OK

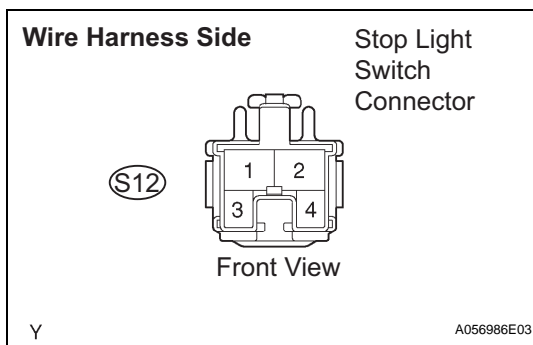
ES

3 CHECK ECM (STP, ST1 - VOLTAGE)

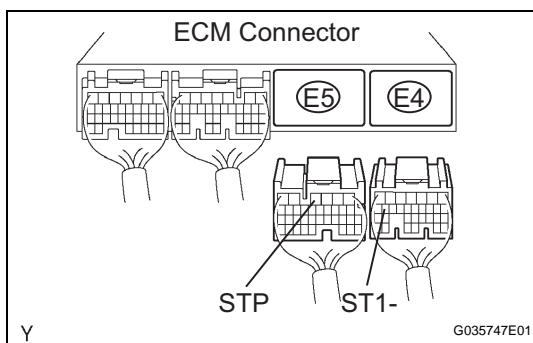
- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connectors.

Voltage

Tester Connection	Brake Pedal Condition	Specified Condition
E5-4 (STP) - E8-3 (E1)	Depressed	7.5 to 14 V
E5-4 (STP) - E8-3 (E1)	Released	Below 1.5 V
E4-16 (ST1-) - E8-3 (E1)	Depressed	Below 1.5 V
E4-16 (ST1-) - E8-3 (E1)	Released	7.5 to 14 V

NG**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 - E5-4 (STP) S12-4 - E4-16 (ST1-)	Below 1 Ω
S12-1 or E5-4 (STP) - Body ground S12-4 or E4-16 (ST1-) - Body ground	10 k Ω or higher

NG**REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

ES

DTC	P0505	Idle Control System Malfunction
-----	-------	---------------------------------

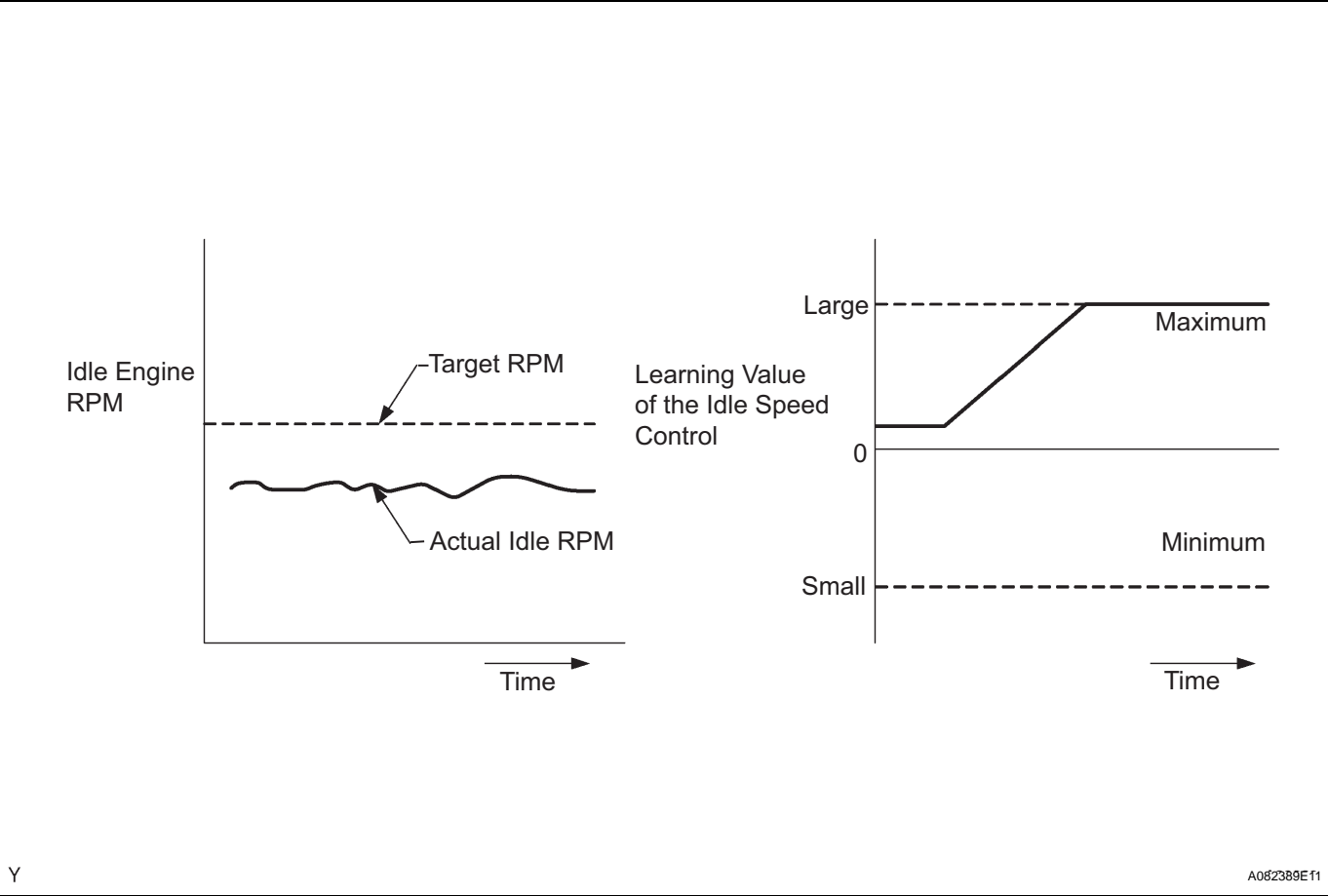
MONITOR DESCRIPTION

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 (2 trip detection logic)	<ul style="list-style-type: none">Electronic throttle control systemAir induction systemPCV hose connection

MONITOR STRATEGY

Related DTCs	P0505: ISC Function
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	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 or more
(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) ISC flow rate learning value	1.3 L/sec or less, or 4.5 L/sec or more

HINT:

- When the throttle position is slightly opened (the accelerator pedal is slightly depressed) because a floor carpet is overlapped on the accelerator pedal, or if not fully releasing the accelerator pedal, etc., DTC P0505 will possibly be detected.
- 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 P0505)

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

Result

Display (DTC Output)	Proceed to
Only P0505 is output	A
P0505 and other DTCs are output	B

HINT:

If any other DTCs besides P0505 are output, perform the troubleshooting for those DTCs first.

B

GO TO RELEVANT DTC CHART

A

ES

2

CHECK PCV HOSE

OK:
PCV hose is connected correctly and PCV hose has no damage.

NG

REPAIR OR REPLACE PCV HOSE

OK

3

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

CHECK ELECTRONIC THROTTLE CONTROL SYSTEM

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.

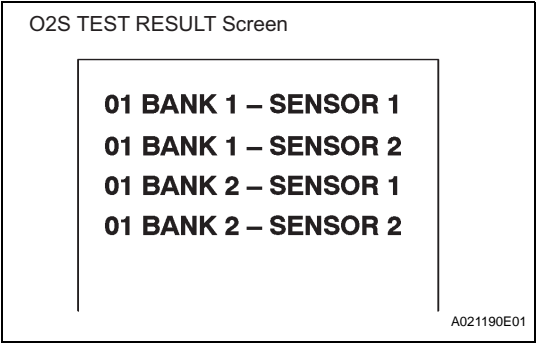
In this repair manual, the description of the O2S TEST RESULT (for O2S related DTCs) are written in a table. This table consists of 5 items:

- 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.



TEST DATA Screen

LOW SW V . . . 0.400 V
HIGH SW V . . . 0.550 V
MIN O2S V . . . 0.100 V
MAX O2S V . . . 0.900 V
TIME \$81 17

A021191E01

- (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).
 $17 \times 0.3906 = 6.6 \%$
 - (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**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	<ul style="list-style-type: none"> Open in back-up power source circuit ECM

HINT:

If DTC P0560 is present, the ECM will not store other DTCs.

ES**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

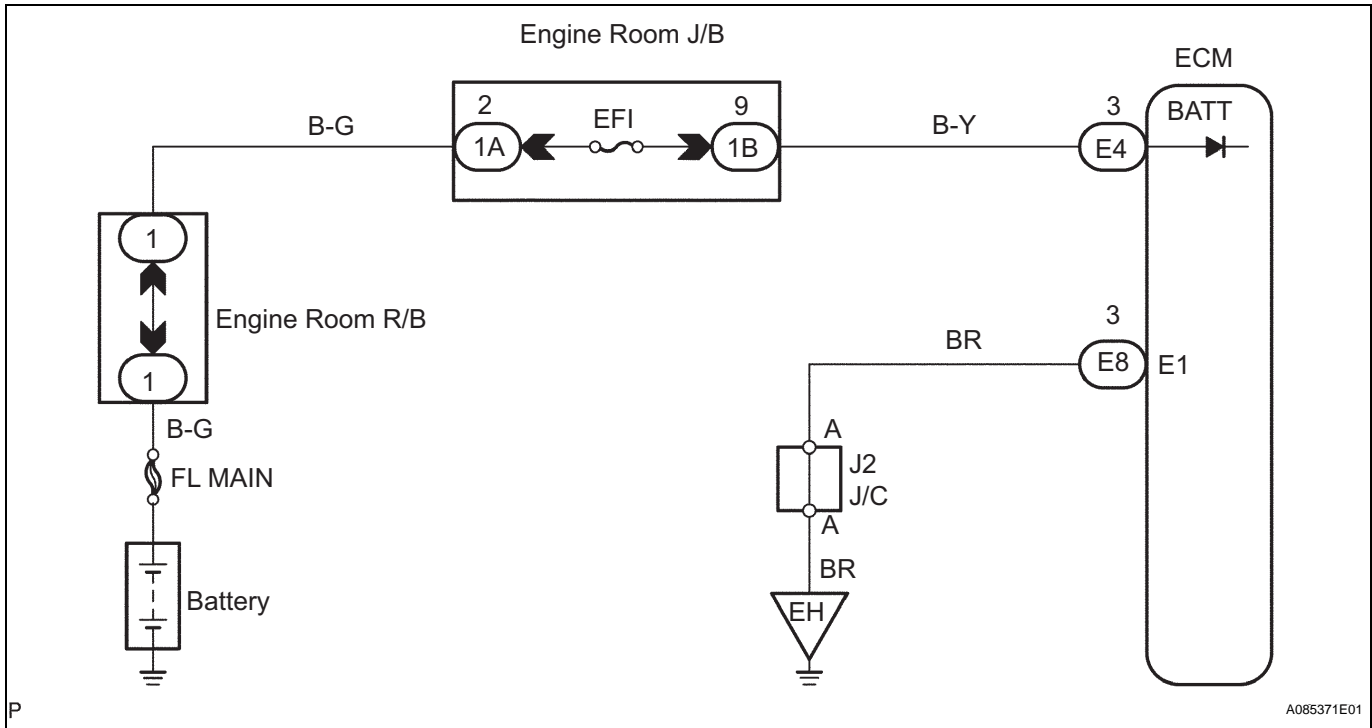
TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
--	------

TYPICAL MALFUNCTION THRESHOLDS

ECM power source	Less than 3.5 V
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WIRING DIAGRAM

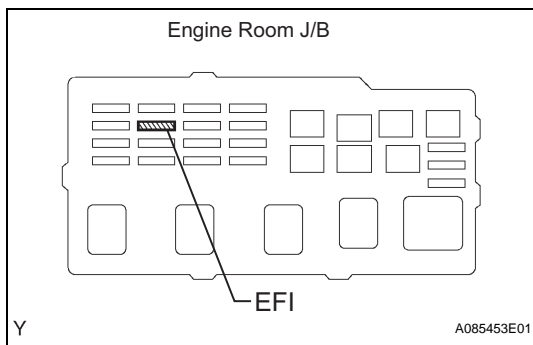


HINT:

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

INSPECT EFI FUSE



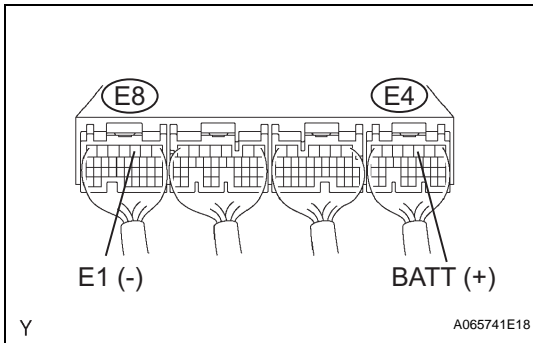
- Remove the EFI fuse from the engine room J/B.
- Measure the resistance of the EFI fuse.

Resistance:
Below 1 Ω

NG

REPLACE EFI FUSE

OK

2 CHECK ECM (BATT VOLTAGE)

- (a) Measure the voltage of the ECM connectors.

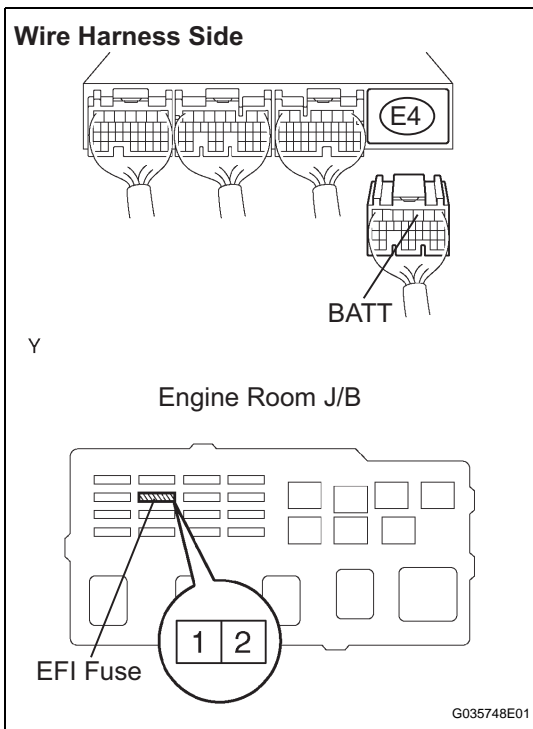
Voltage

Tester Connection	Specified Condition
E4-3 (BATT) - E8-3 (E1)	9 to 14 V

OK

REPLACE ECM

NG

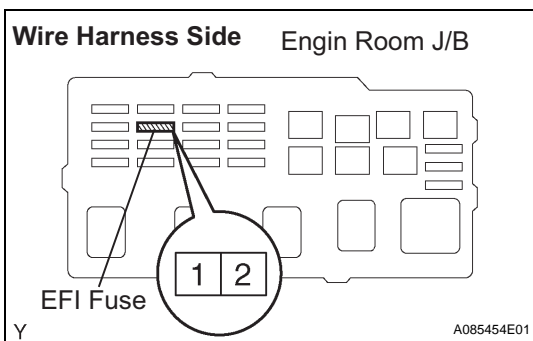
3 CHECK WIRE HARNESS (ECM - EFI FUSE, EFI FUSE - BATTERY)

- (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 k Ω 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 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

CHECK AND REPLACE ENGINE ROOM JUNCTION BLOCK

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 Errors 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 second
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 TPS 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

ECM 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 more than 1 second after ignition switch turns from OFF to ON	7 V or more
--	-------------

ES**HINT:**

Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition 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 DTC**

(a) Check for DTCs.

OK:**DTC P0604, P0606, P0607 or P0657 is not output.****NG****REPLACE ECM****OK****END**

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 Detection 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 12.4 mph (20 km/h) (b) Engine revolution greater than 1,000 rpm (c) STA signal ON	<ul style="list-style-type: none"> • Short in PNP switch (A/T) or clutch start switch (M/T) • PNP switch (A/T) • Clutch start switch (M/T) • Ignition switch • ECM

ES**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

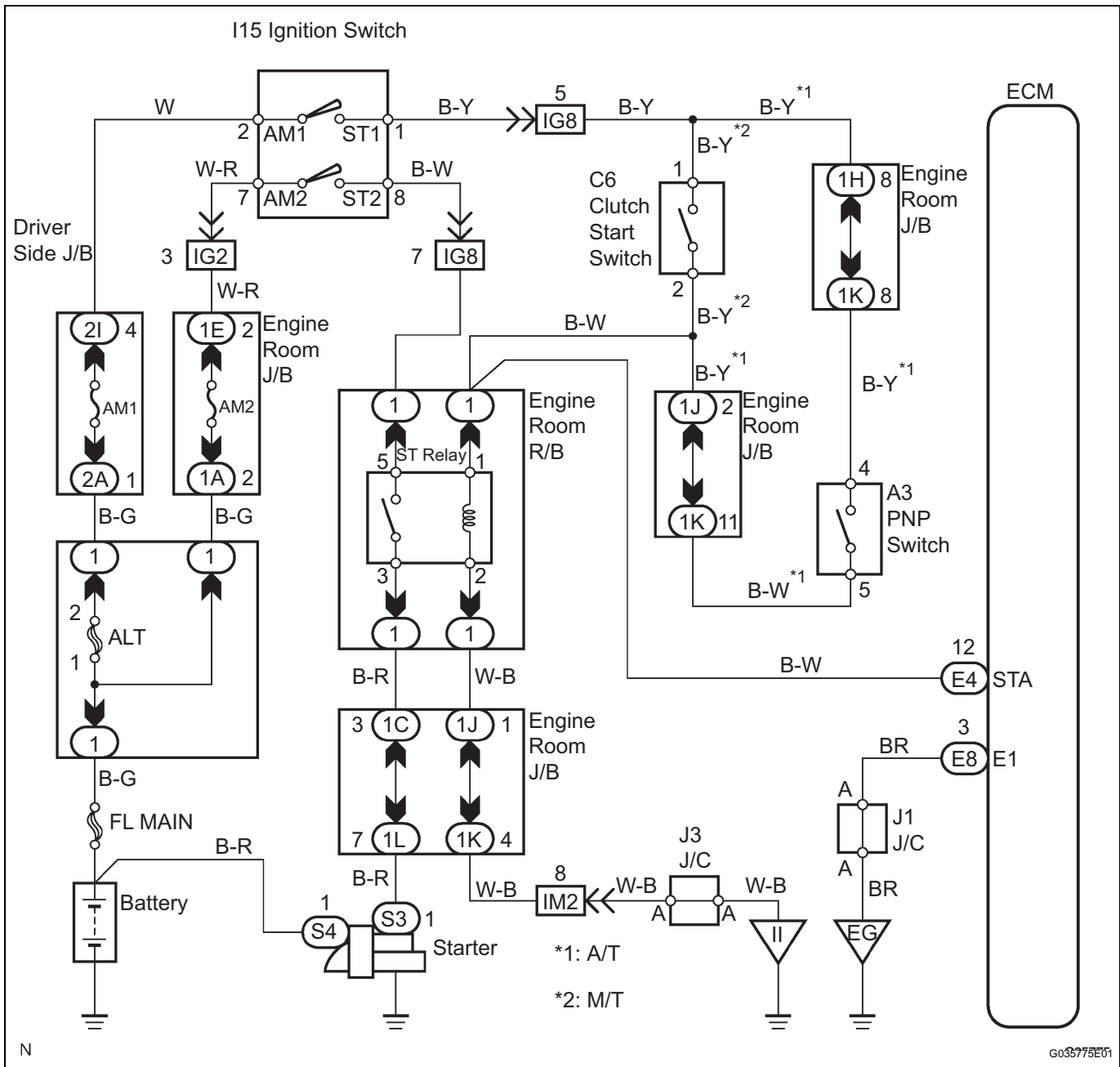
TYPICAL ENABLING CONDITIONS

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 VALUE OF INTELLIGENT TESTER (STA SIGNAL)

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON. Push the intelligent tester or the OBD II scan tool 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 OR CLUTCH START SWITCH****ES**

- (a) Check the PNP switch (A/T) (See page [AX-39](#)).

OK:

When shift lever is in the N position, the PNP switch is ON.

When shift lever is in the D position, the PNP switch is OFF.

- (b) Check the clutch start switch (M/T) (See page [CL-21](#)).

OK:

When the clutch pedal is depressed, clutch start switch turns ON.

When the clutch pedal is not released, clutch start switch turns OFF.

NG**REPLACE PARK/NEUTRAL POSITION SWITCH OR CLUTCH START SWITCH****OK****3****READ VALUE OF INTELLIGENT TESTER (STA SIGNAL)**

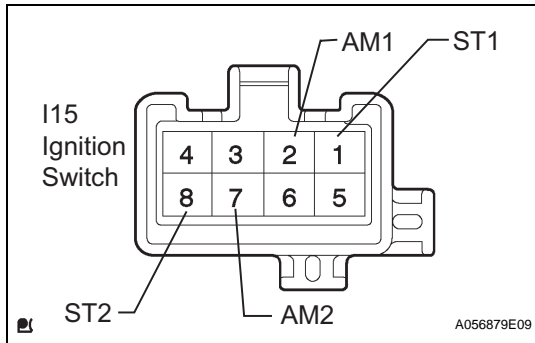
- (a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON. Push the intelligent tester or the OBD II scan tool tester main switch ON.

- (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**SYSTEM OK****NG**

4 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY

- (a) Measure the resistance of the ignition switch terminals.
Resistance

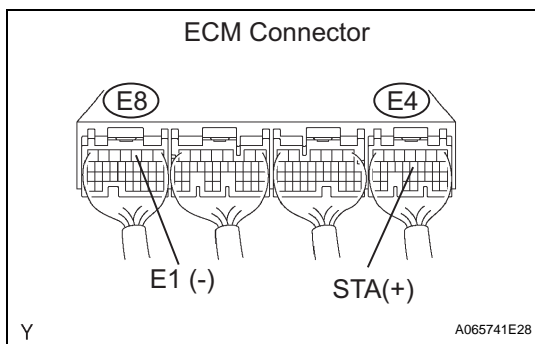
Switch Condition	Tester Condition	Specified Condition
LOCK	1 - 2, 7 - 8	10 k Ω or higher
START	1 - 2, 7 - 8	Below 1 Ω

NG**REPAIR IGNITION OR STARTER SWITCH ASSEMBLY****OK****5 READ VALUE OF INTELLIGENT TESTER (STA SIGNAL)**

- (a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON. Push the intelligent tester or the OBD II scan tool 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**SYSTEM OK****NG****REPAIR OR REPLACE HARNESS OR CONNECTOR****1 CHECK ECM**

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

Voltage

Tester Connection	Condition	Specified Condition
E4-12 (STA) - E8-3 (E1)	Ignition switch ON	0 V
E4-12 (STA) - E8-3 (E1)	Engine cranking	6 V or more

OK**REPLACE ECM****NG**

2 INSPECT PARK/NEUTRAL POSITION SWITCH OR CLUTCH START SWITCH

- (a) Inspect the PNP switch (A/T) (See page [AX-39](#)).

OK:

When shift lever is in the N position, the PNP switch is ON.

When shift lever is in the D position, the PNP switch is OFF.

- (b) Inspect the clutch start switch (M/T) (See page [CL-21](#)).

OK:

When the clutch pedal is depressed, clutch start switch turns ON.

When the clutch pedal is not released, clutch start switch turns OFF.

NG

REPLACE PARK/NEUTRAL POSITION SWITCH OR CLUTCH START SWITCH

OK

3 CHECK ECM

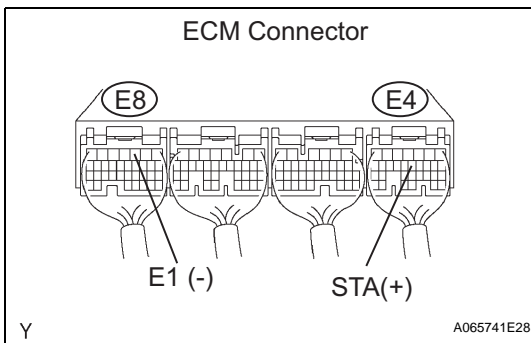
- (a) Measure the voltage of the ECM connectors.

Voltage

Tester Connection	Condition	Specified Condition
E4-12 (STA) - E8-3 (E1)	Ignition switch ON	0 V
E4-12 (STA) - E8-3 (E1)	Engine cranking	6 V or more

OK

SYSTEM OK



NG

4 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY

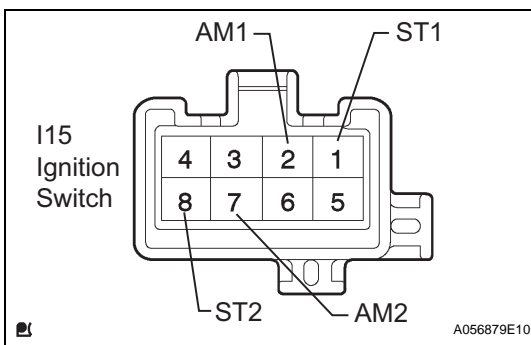
- (a) Measure the resistance of the ignition switch terminals.

Resistance

Switch Condition	Tester Condition	Specified Condition
LOCK	1 - 2, 7 - 8	10 k Ω or higher
START	1 - 2, 7 - 8	Below 1 Ω

NG

REPLACE IGNITION OR STARTER SWITCH ASSEMBLY

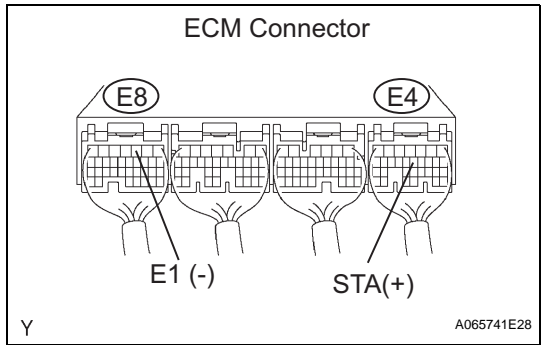


OK

ES

5

CHECK ECM



(a) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Condition	Specified Condition
E4-12 (STA) - E8-3 (E1)	Ignition switch ON	0 V
E4-12 (STA) - E8-3 (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 in 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	<ul style="list-style-type: none"> VIN is not stored in ECM Input VIN in ECM is not accurate 	<ul style="list-style-type: none"> 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	Immediately
Sequence of Operation	None

ES**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	P2102	Throttle Actuator Control Motor Circuit Low
DTC	P2103	Throttle Actuator Control Motor Circuit High

DESCRIPTION

The throttle motor 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 control motor output duty 80 % or more (b) Throttle control motor current less than 0.5 A	<ul style="list-style-type: none"> Open in throttle actuator circuit Throttle actuator ECM
P2103	Either of following conditions is met: <ul style="list-style-type: none"> Throttle control motor current 10 A or more (0.1 seconds) Throttle control motor current 7 A or more (0.6 seconds) 	<ul style="list-style-type: none"> Short in throttle actuator circuit Throttle actuator Throttle valve Throttle body assembly ECM

ES

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, the ECM concludes that there is a fault in the throttle motor. 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 motor driving duty ratio is exceeding 80 %. The ECM concludes that the current is deviated from the standard, 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
Battery voltage	8 V or more
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

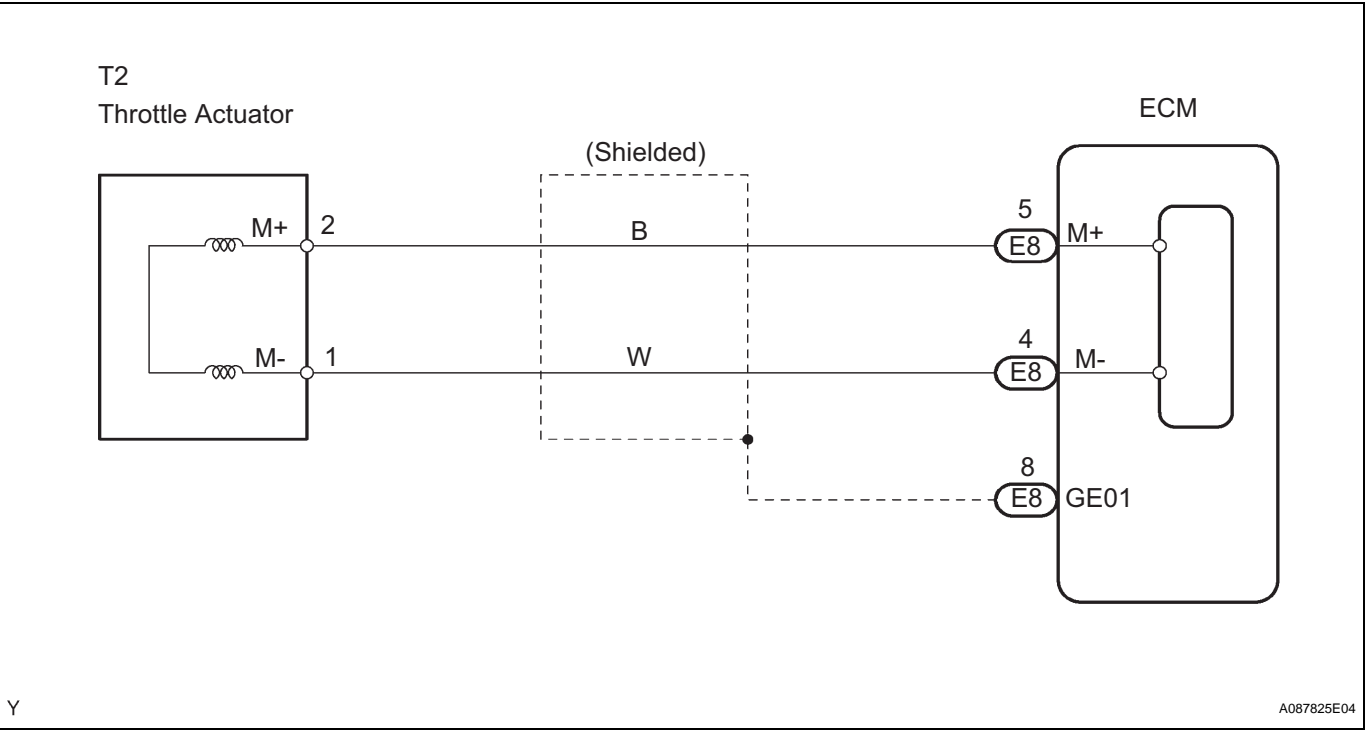
P2102:

Throttle actuator current	Less than 0.5 A
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P2103:

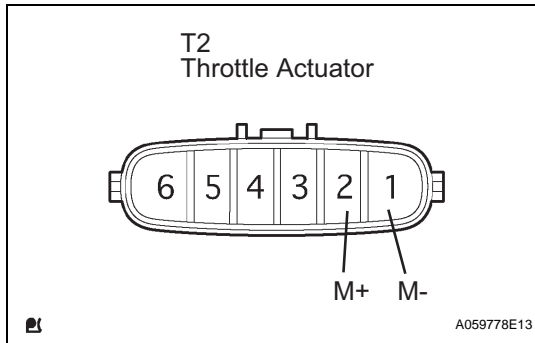
Either of the following conditions is met:	Condition 1 or 2
1. Hybrid IC diagnosis signal	Fail (for 0.1 seconds)
2. Hybrid IC current limiter port	Fail (for 0.6 seconds)

WIRING DIAGRAM



HINT:

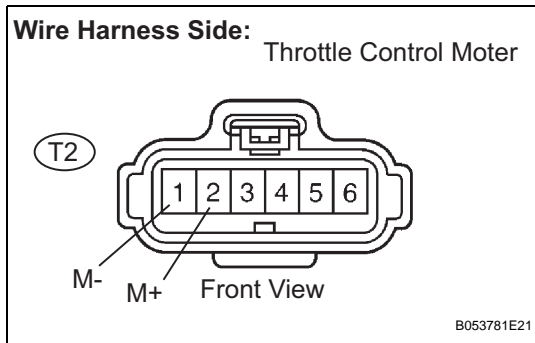
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed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

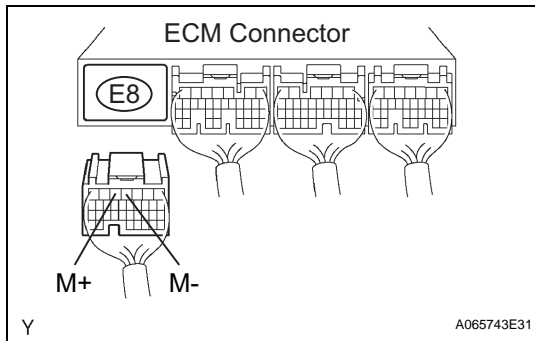
- (a) Disconnect the T2 throttle actuator connector.
 (b) Measure the resistance of the throttle actuator terminals.

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 E8 ECM connector.
 (c) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
T2-2 (M+) - E8-5 (M+) T2-1 (M-) - E8-4 (M-)	Below 1 Ω
T2-2 (M+) or E8-5 (M+) - Body ground T2-1 (M-) or E8-4 (M-) - Body ground	10 k Ω 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.

ES

NG

REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK

REPLACE ECM

DTC	P2111	Throttle Actuator Control System - Stuck Open
DTC	P2112	Throttle Actuator Control System - Stuck Closed

DESCRIPTION

The throttle actuator is operated by the ECM and 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.

ES

DTC No.	DTC Detection Condition	Trouble Area
P2111	Throttle actuator locked during ECM order to close	<ul style="list-style-type: none"> Throttle actuator circuit Throttle actuator Throttle body Throttle valve
P2112	Throttle actuator locked during ECM order to open	<ul style="list-style-type: none"> Same as DTC No. P2111

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 condition.

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 (Throttle actuator stuck open):

All of the following conditions are met:	Condition 1, 2 and 3
1. System guard*	ON

2. Throttle actuator current	2 A or more
3. Duty cycle to close throttle	80 % or more
* System guard is ON when the following conditions 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 (Throttle actuator stuck closed):

All of following conditions are met:	Condition 1, 2 and 3
1. System guard*	ON
2. Throttle actuator current	2 A or more
3. Duty cycle to open throttle	80 % or more
* System guard is ON when the following conditions 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

Throttle position sensor voltage change	No change
---	-----------

WIRING DIAGRAM

Refer to DTC P2102 (See page [ES-226](#)).

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	CHECK 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 PROBLEMS

ES

DTC	P2118	Throttle Actuator Control Motor Current Range / Performance
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DESCRIPTION

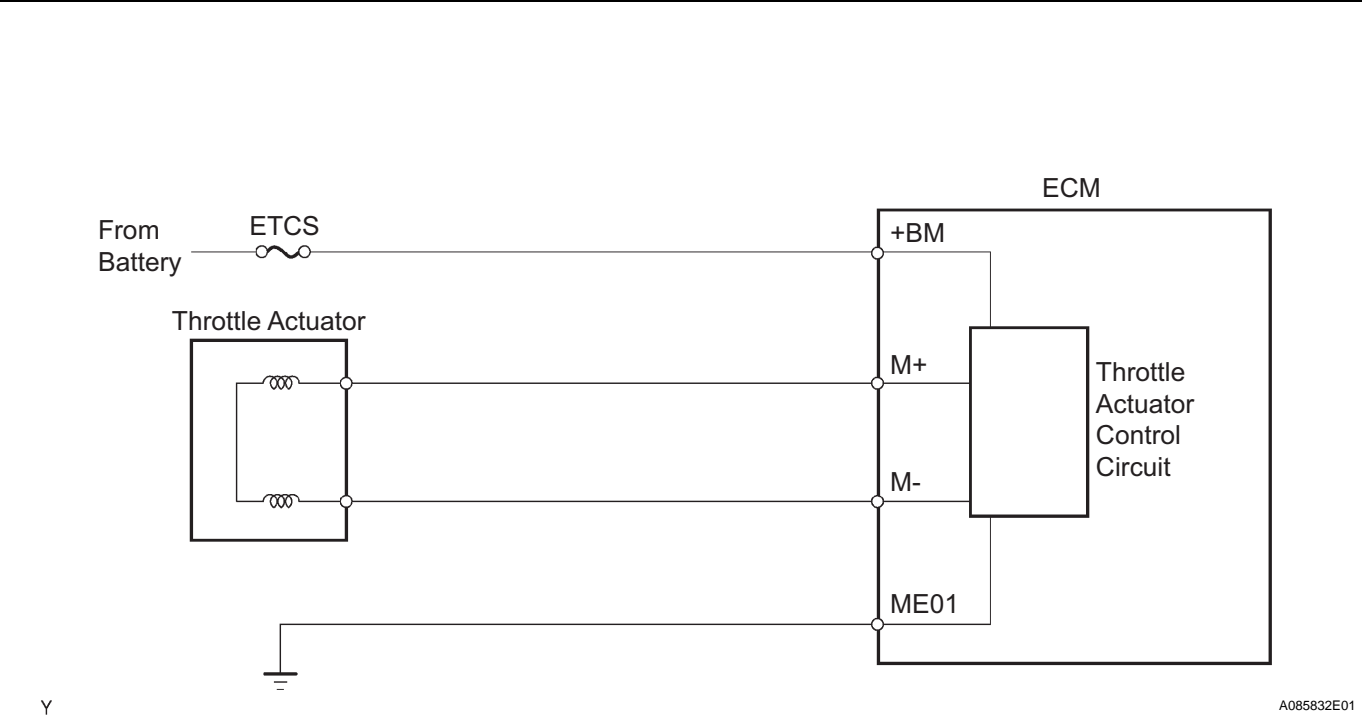
HINT:

This ETCS does not use a throttle cable.

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 4 V), the ECM concludes that the ETCS has a fault and current to the throttle actuator is cut.

When the voltage becomes unstable, the ETCS 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.

ES



DTC No.	DTC Detection Condition	Trouble Area
P2118	Open in ETCS power source circuit	<ul style="list-style-type: none">• 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 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 this DTC is not present	None
Battery voltage	More than 8 V

TYPICAL MALFUNCTION THRESHOLDS

Throttle actuator power supply voltage	Less than 4 V
--	---------------

COMPONENT OPERATING RANGE

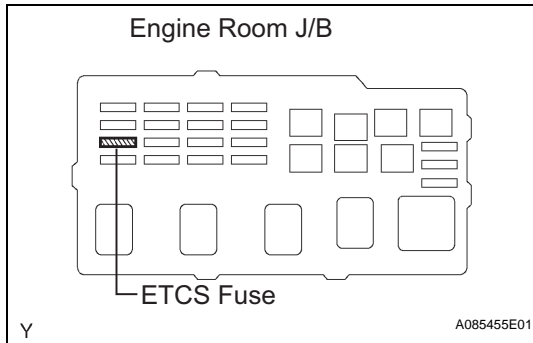
Throttle actuator power supply voltage	9 to 14 V
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ES



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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 ETCS FUSE

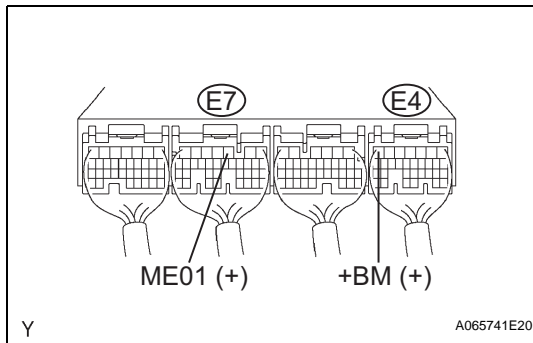
- (a) Remove the ETCS fuse from the engine room J/B.
 (b) Measure the resistance of the ETCS fuse.

Resistance:
Below 1 Ω

NG

REPLACE ETCS FUSE

OK

2 CHECK ECM (+BM VOLTAGE)

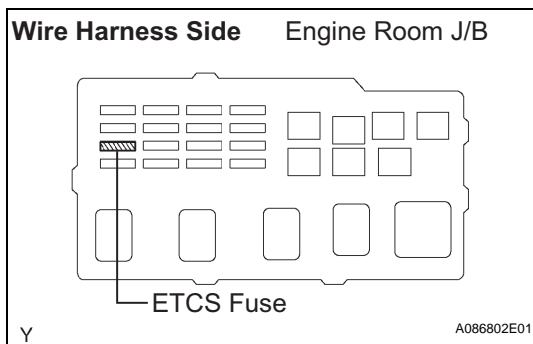
- (a) Measure the voltage of the ECM connectors.
Voltage

Tester Connection	Specified Condition
E4-7 (+BM) - E7-3 (ME01)	9 to 14 V

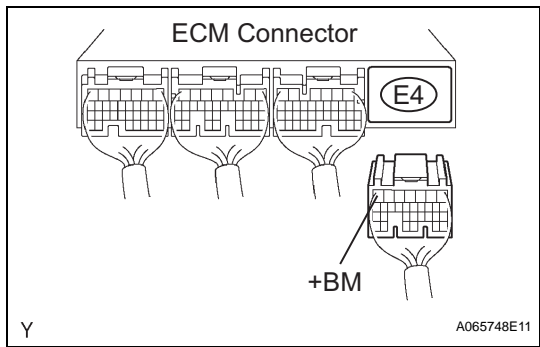
OK

REPLACE ECM

NG

3 CHECK WIRE HARNESS (ECM - ETCS FUSE, ETCS FUSE - BATTERY)

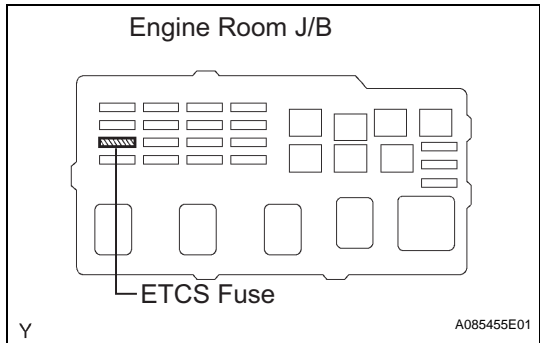
- (a) Check the wire harness between the ETCS fuse and ECM.
 (1) Remove the ETCS fuse from the engine room J/B.



- (2) Disconnect the E4 ECM connector.
- (3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
J/B ETCS fuse terminal 2 - E4-7 (+BM)	Below 1 Ω
J/B ETCS fuse terminal 2 or E4-7 (+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 positive cable.
 - (3) Measure the resistance of the wire harness side connectors.

Standard

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

CHECK ENGINE ROOM J/B

DTC	P2119	Throttle Actuator Control Throttle Body Range / Performance
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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	<ul style="list-style-type: none"> Electronic throttle control system ECM

ES

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 condition.

MONITOR STRATEGY

Related DTCs	P2119: ETCS malfunction
Required sensors/ components (Main)	Throttle actuator
Required sensors/ components (Related)	-
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
System guard	ON
*System guard is ON when the following conditions 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
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TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	Condition 1 or 2
1. Commanded closed TP - current closed TP	0.3 V or more for 1 second
2. Commanded open TP - current open TP	0.3 V or more for 0.6 seconds

WIRING DIAGRAM

Refer to DTC P2102 (See page [ES-226](#)).

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 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 REOCCURS

- Clear the DTC (See page [ES-28](#)).
- Run the engine at idle for 15 seconds.
- Pull the hand brake and shift the gear to D.
- Depress the brake pedal and the accelerator pedal fully for 5 seconds.
- 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.

OK

NORMAL

NG

REPLACE THROTTLE BODY ASSEMBLY

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

ES**HINT:**

This is the repair procedure for the "accelerator pedal position sensor".

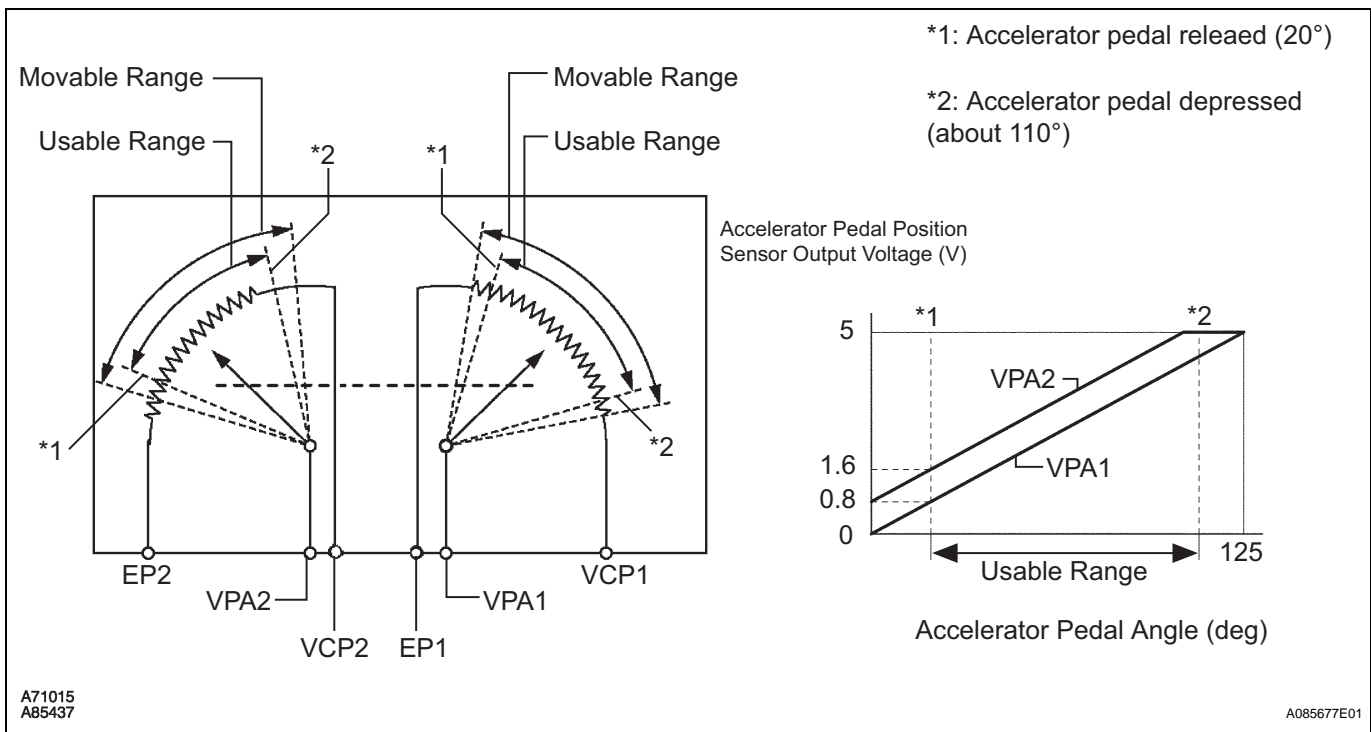
DESCRIPTION**HINT:**

- This Electronic Throttle Control System (ETCS) does not use a throttle cable.
- This description is for the accelerator pedal position sensor.

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 0 V and 5 V in proportion to the accelerator pedal angle.

The ECM monitors the accelerator pedal angle from VPA1 and VPA2 signal output, 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: (a) VPA is 0.4 V or less and VPA2 is 0.97 degrees or more; or VPA is 4.8 V or more;	<ul style="list-style-type: none"> Open or short in accelerator pedal position sensor circuit Accelerator pedal position sensor ECM
P2122	Condition (a) continues for 0.5 seconds or more when accelerator pedal is released: (a) VPA is 0.4 V or less	<ul style="list-style-type: none"> Same as DTC No. P2120
P2123	Condition (a) continues for 2.0 seconds or more: (a) VPA is 4.8 V or more	<ul style="list-style-type: none"> Same as DTC No. P2120
P2125	Condition (a) and (b) continues for 0.5 seconds or more: (a) VPA2 is 1.2 V or less or VPA2 is 4.8 V or more (b) VPA is 0.4 V or more and VPA is 3.45 V or less	<ul style="list-style-type: none"> Same as DTC No. P2120
P2127	Condition (a) continues for 0.5 seconds or more when accelerator pedal is released: (a) VPA2 is 1.2 V or less and VPA is 0.97 degrees or more	<ul style="list-style-type: none"> Same as DTC No. P2120
P2128	Conditions (a) and (b) continue for 2.0 seconds or more: (a) VPA2 is 4.8 V or more (b) VPA is 0.4 V or more and VPA is 3.45 V or less	<ul style="list-style-type: none"> Same as DTC No. P2120
P2138	Condition (a) or (b) continues for 2.0 seconds or more: (a) Difference between VPA and VPA2 is 0.02 V or less (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less	<ul style="list-style-type: none"> Same as DTC No. P2120

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 released		Accelerator pedal depressed	
	ACCEL POS #1	ACCEL POS #2	ACCEL POS #1	ACCEL POS #2
VCP circuit open	0 V	0 V	0 V	0 V
VPA circuit open or ground short	0 V	1.5 to 2.9 V	0 V	3.5 to 5.5 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 V	2.5 to 4.6 V	0 V
EPA circuit open	5 V	5 V	5 V	5 V

MONITOR DESCRIPTION

When VPA or VPA2 deviates from the standard, or the difference between the voltage output of the 2 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 2 sensor circuits and switches to fail-safe mode. In fail-safe mode, the remaining 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.

ES

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
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P2128:

VPA2 voltage when VPA1 is 0.4 to 3.45 V	4.8 V or more
---	---------------

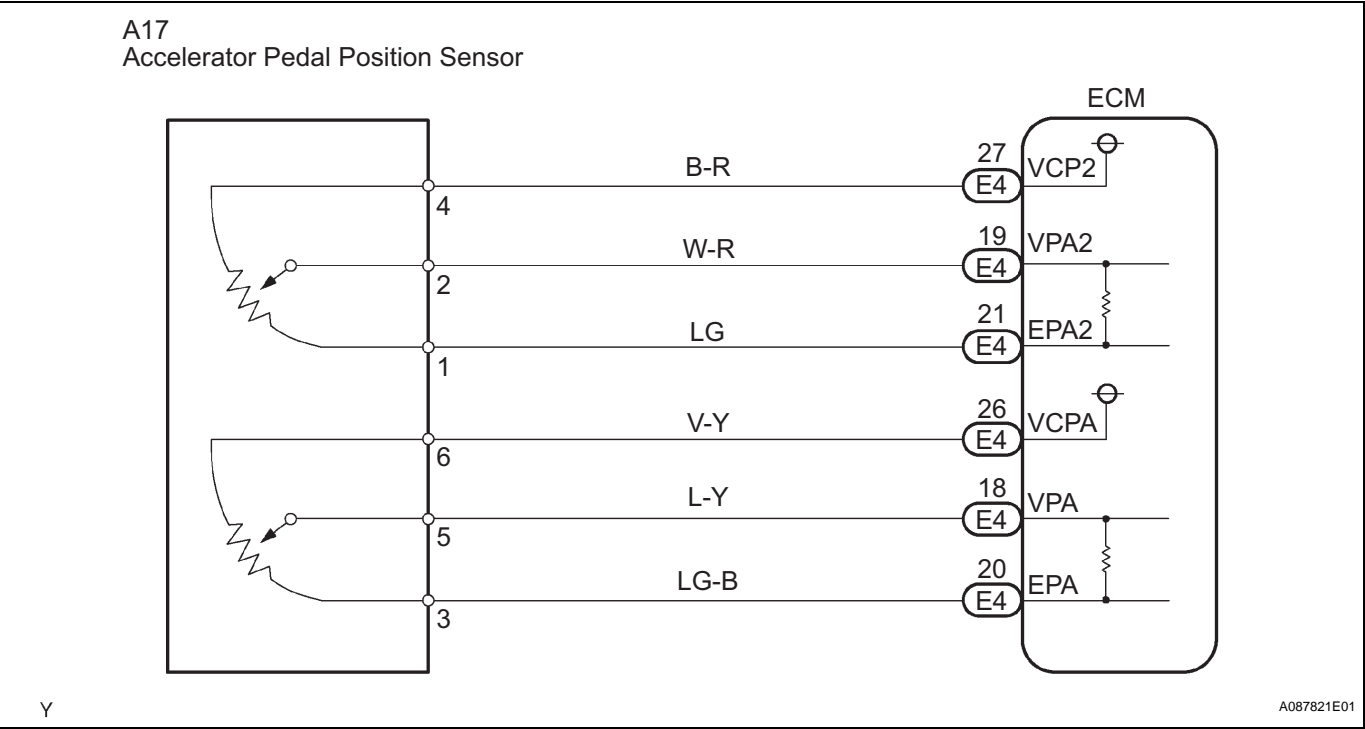
P2138:

Either of the following conditions is met:	Condition 1 or 2
1. Difference between VPA 1 and VPA2 voltage	0.02 V or less
Condition 2	-
VPA1 voltage	0.4 V or less
VPA2 voltage	1.2 V or less

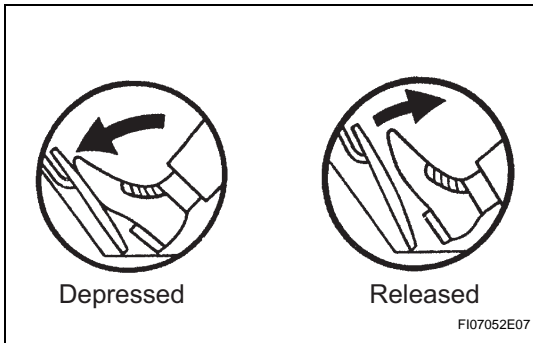
ES COMPONENT OPERATING RANGE

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, ACCEL POS #2)

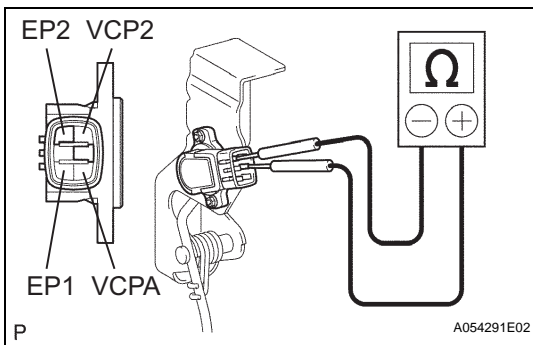
- (a) Connect the intelligent tester to the DLC3.
 (b) Turn the ignition switch ON.
 (c) On the intelligent tester, enter the following menus:
 DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS /
 ACCEL POS #1 and ACCEL POS #2. Read the values.
Voltage

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)

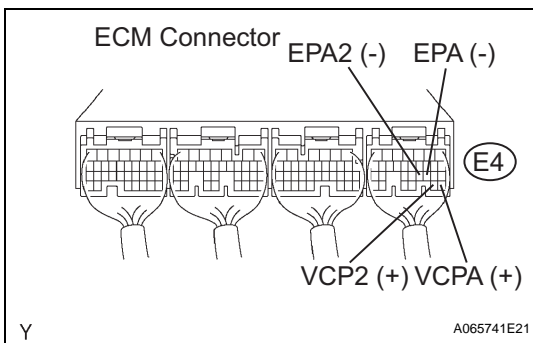
- (a) Disconnect the A17 sensor connector.
 (b) Measure the resistance of the sensor terminals.
Resistance

Tester Condition	Condition	Specified Condition
3 (EP1) - 6 (VCPA) 1 (EP2) - 4 (VCP2)	20°C (68°F)	2.25 to 4.75 kΩ

NG

REPLACE ACCELERATOR PEDAL ASSEMBLY

OK

3 CHECK ECM (VCPA, VCP2 VOLTAGE)

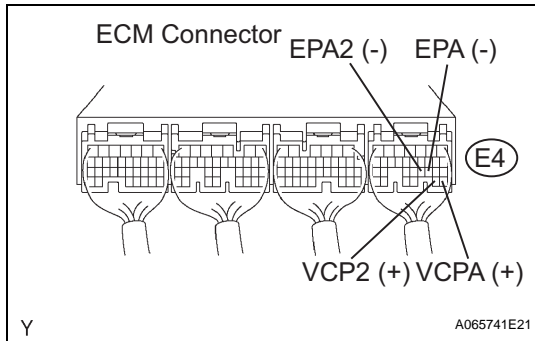
- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connector.
Voltage

Tester Condition	Specified Condition
E4-26 (VCPA) - E4-28 (EPA) E4-27 (VCP2) - E4-29 (EPA2)	4.5 to 5.5 V

NG

REPLACE ECM

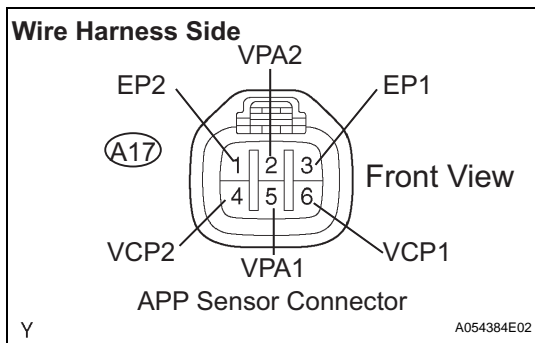
OK

4 CHECK ECM (VPA, VPA2 VOLTAGE)

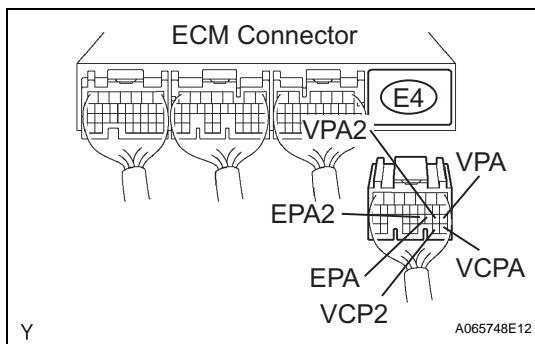
- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connector.

Voltage

Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-22 (VPA) - E4-20 (EPA)	Released	0.5 to 1.1 V
E4-22 (VPA) - E4-30 (EPA)	Depressed	2.6 to 4.5 V
E4-23 (VPA2) - E4-21 (EPA2)	Released	1.2 to 2.0 V
E4-23 (VPA2) - E4-21 (EPA2)	Depressed	3.4 to 5.3 V

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
A17-5 (VPA1) - E4-18 (VPA) A17-3 (EP1) - E4-20 (EPA) A17-6 (VCPA) - E4-26 (VCPA) A17-2 (VPA2) - E4-19 (VPA2) A17-1 (EP2) - E4-21 (EPA2) A17-4 (VCP2) - E4-27 (VCP2)	Below 1 Ω
A17-5 (VPA1) or E4-18 (VPA) - Body ground A17-3 (EP1) or E4-20 (EPA) - Body ground A17-6 (VCPA) or E4-26 (VCPA) - Body ground A17-2 (VPA2) or E4-19 (VPA2) - Body ground A17-1 (EP2) or E4-21 (EPA2) - Body ground A17-4 (VCP2) or E4-27 (VCP2) - Body ground	10 k Ω or higher

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

6 READ OUTPUT DTC (ACCELERATOR PEDAL POSITION SENSOR DTCS ARE OUTPUT AGAIN)

- Clear the DTC (See page [ES-28](#)).
- Start the engine.
- Run the engine at idle for 15 seconds or more.
- 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

ES

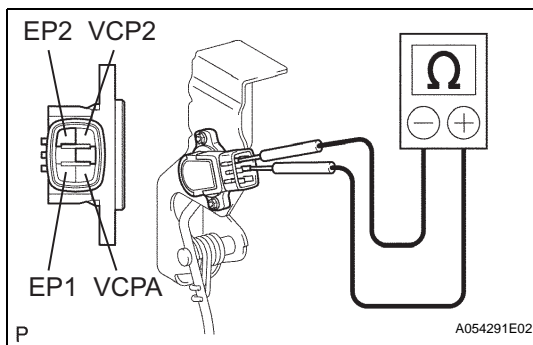
B

SYSTEM OK

A

REPLACE ECM

1 INSPECT ACCELERATOR PEDAL ASSEMBLY (ACCELERATOR PEDAL POSITION SENSOR)



- Disconnect the A17 sensor connector.
- Measure the resistance of the sensor terminals.

Resistance

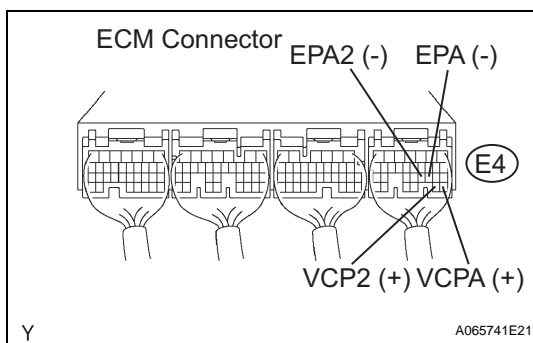
Tester Condition	Specified Condition
3 (EP1) - 6 (VCPA) 1 (EP2) - 4 (VCP2)	2.25 to 4.75 kΩ at 20°C (68°F)

NG

REPLACE ACCELERATOR PEDAL ASSEMBLY

OK

2 CHECK ECM (VCPA, VCP2 VOLTAGE)



- Turn the ignition switch ON.
- Measure the voltage of the ECM connector.

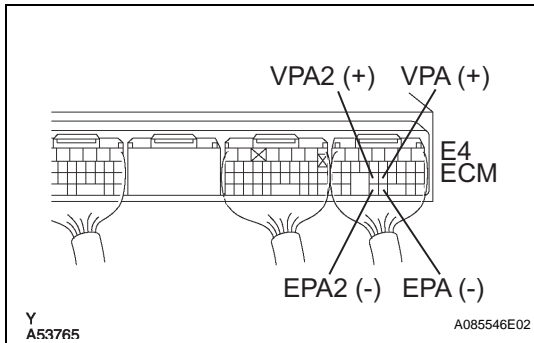
Voltage

Tester Condition	Specified Condition
E4-26 (VCPA) - E4-20 (EPA) E4-27 (VCP2) - E4-21 (EPA2)	4.5 to 5.5 V

NG

CHECK AND REPLACE ECM

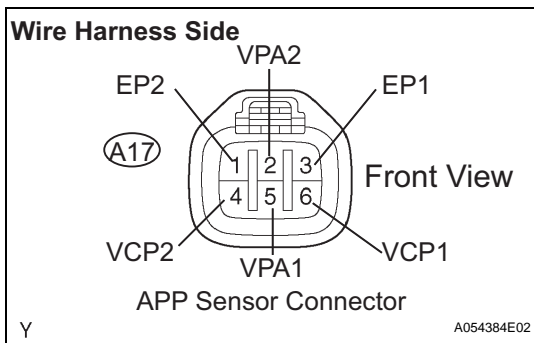
OK

3 CHECK ECM (VPA, VPA2 VOLTAGE)

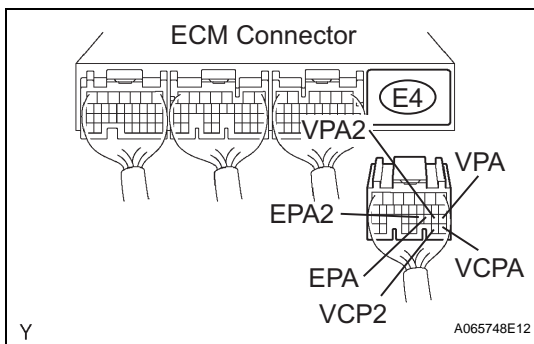
- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connector.

Voltage

Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-22 (VPA) - E4-20 (EPA)	Released	0.5 to 1.1 V
E4-22 (VPA) - E4-20 (EPA)	Depressed	2.6 to 4.5 V
E4-23 (VPA2) - E4-21 (EPA2)	Released	1.2 to 2.0 V
E4-23 (VPA2) - E4-21 (EPA2)	Depressed	3.4 to 5.3 V

OK**CHECK AND 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 Connection	Specified Condition
A17-5 (VPA1) - E4-18 (VPA) A17-3 (EP1) - E4-20 (EPA) A17-6 (VCPA) - E4-26 (VCPA) A17-2 (VPA2) - E4-19 (VPA2) A17-1 (EP2) - E4-21 (EPA2) A17-4 (VCP2) - E4-27 (VCP2)	Below 1 Ω
A17-5 (VPA1) or E4-18 (VPA) - Body ground A17-3 (EP1) or E4-20 (EPA) - Body ground A17-6 (VCPA) or E4-26 (VCPA) - Body ground A17-2 (VPA2) or E4-19 (VPA2) - Body ground A17-1 (EP2) or E4-21 (EPA2) - Body ground A17-4 (VCP2) or E4-27 (VCP2) - Body ground	10 k Ω or higher

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

5 READ OUTPUT (ACCELERATOR PEDAL POSITION SENSOR DTCS ARE OUTPUT AGAIN)

- (a) Clear the DTC (See page [ES-28](#)).
- (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****CHECK AND REPLACE ECM****ES**

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-239](#)).

DTC No.	DTC Detection Condition	Trouble Area
P2121	Conditions (a) and (b) continue for 0.5 seconds: (a) Difference between VPA and VPA2 deviates from standard (b) IDL is OFF	<ul style="list-style-type: none"> • Open or short in accelerator pedal position sensor circuit • Accelerator pedal position sensor • ECM

MONITOR DESCRIPTION

The accelerator pedal position sensor is mounted on the accelerator pedal bracket. The accelerator pedal position sensor has 2 sensor elements/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.

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 remaining circuit is used to calculate the accelerator pedal opening 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	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 this DTC is not present	None
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TYPICAL MALFUNCTION THRESHOLDS

Difference between VPA1 and VPA2 voltages	Less than 0.4 V, or more than 1.2 V
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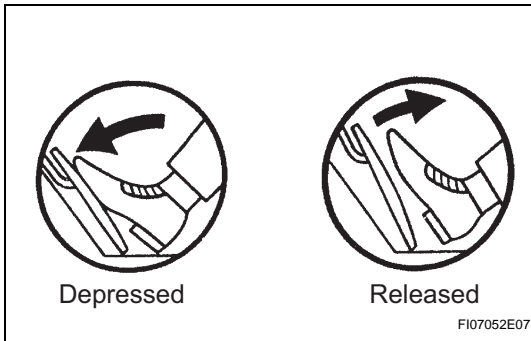
WIRING DIAGRAM

Refer to DTC P2120 (See page [ES-242](#)).

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, 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 / ETCS / ACCEL POS #1 and ACCEL POS #2. Read the values.

Voltage

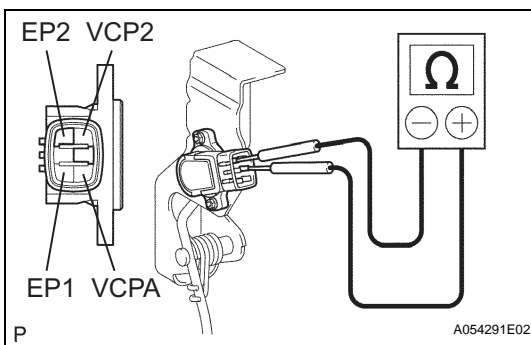
Accelerator Pedal	ACCEL POS #1	ACCEL POS #2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.3 V

OK

REPLACE ECM

NG

2 INSPECT ACCELERATOR PEDAL ASSEMBLY



- (a) Disconnect the A17 sensor connector.
 (b) Measure the resistance of the sensor terminals.

Resistance

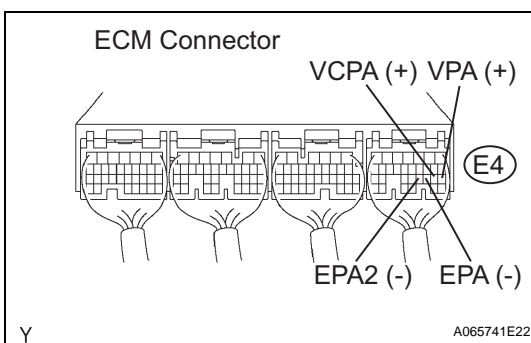
Tester Condition	Specified Condition
3 (EP1) - 6 (VCPA) 1 (EP2) - 4 (VCP2)	2.25 to 4.75 kΩ at 20°C (68°F)

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
E4-18 (VPA) - E4-20 (EPA)	Released	0.5 to 1.1 V
E4-18 (VPA) - E4-20 (EPA)	Depressed	2.6 to 4.5 V
E4-19 (VPA2) - E4-21 (EPA2)	Released	1.2 to 2.0 V

ES

Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-19 (VPA2) - E4-21 (EPA2)	Depressed	3.4 to 5.3 V

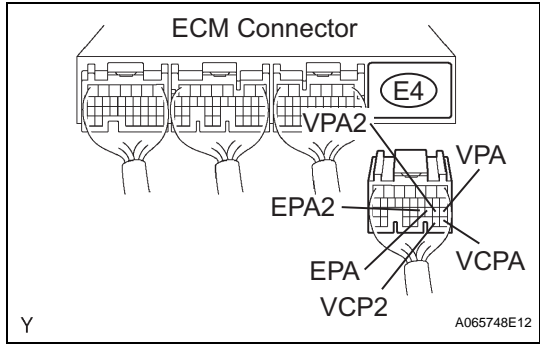
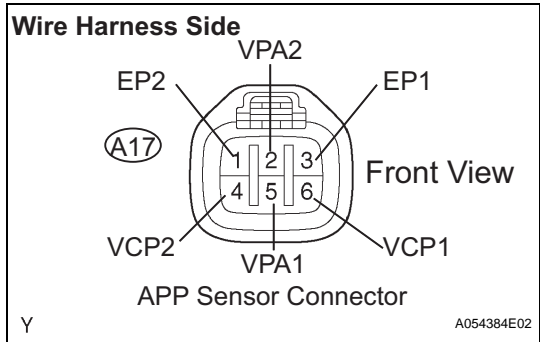
OK

REPLACE ECM

NG

4 CHECK WIRE HARNESS (ACCELERATOR PEDAL POSITION SENSOR - ECM)

ES



(a) Disconnect the A17 sensor connector.

(b) Disconnect the E4 ECM connector.

(c) Measure the resistance of the wire harness side connectors.

Resistance

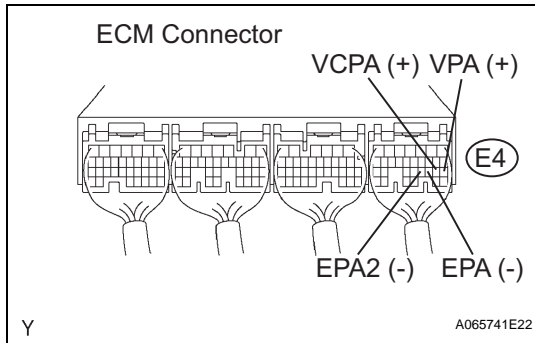
Tester Connection	Specified Condition
A17-5 (VPA1) - E4-18 (VPA) A17-3 (EP1) - E4-20 (EPA) A17-6 (VCPA) - E4-26 (VCPA) A17-2 (VPA2) - E4-19 (VPA2) A17-1 (EP2) - E4-21 (EPA2) A17-4 (VCP2) - E4-27 (VCP2)	Below 1 Ω
A17-5 (VPA1) or E4-18 (VPA) - Body ground A17-3 (EP1) or E4-20 (EPA) - Body ground A17-6 (VCPA) or E4-26 (VCPA) - Body ground A17-2 (VPA2) or E4-19 (VPA2) - Body ground A17-1 (EP2) or E4-21 (EPA2) - Body ground A17-4 (VCP2) or E4-27 (VCP2) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

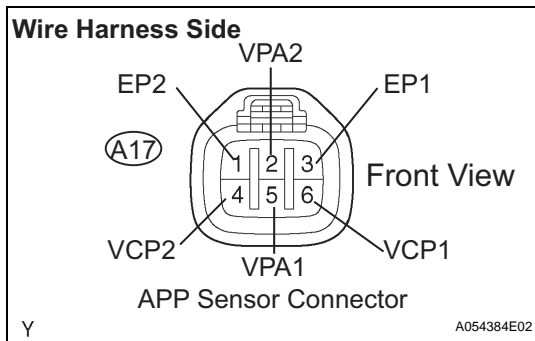
REPLACE ACCELERATOR PEDAL ASSEMBLY

1 CHECK ECM (VPA, VPA2 VOLTAGE)

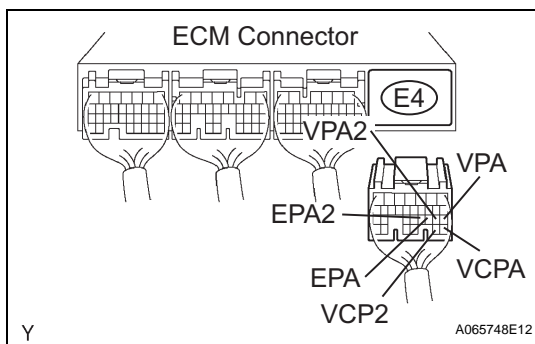
- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connector.

Voltage

Tester Condition	Accelerator Pedal Condition	Specified Condition
E4-18 (VPA) - E4-20 (EPA)	Released	0.5 to 1.1 V
E4-18 (VPA) - E4-20 (EPA)	Depressed	2.6 to 4.5 V
E4-19 (VPA2) - E4-21 (EPA2)	Released	1.2 to 2.0 V
E4-19 (VPA2) - E4-21 (EPA2)	Depressed	3.4 to 5.3 V

OK**REPLACE ECM****NG****2 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
A17-5 (VPA1) - E4-18 (VPA) A17-3 (EP1) - E4-20 (EPA) A17-6 (VCPA) - E4-26 (VCPA) A17-2 (VPA2) - E4-19 (VPA2) A17-1 (EP2) - E4-21 (EPA2) A17-4 (VCP2) - E4-27 (VCP2)	Below 1 Ω
A17-5 (VPA1) or E4-18 (VPA) - Body ground A17-3 (EP1) or E4-20 (EPA) - Body ground A17-6 (VCPA) or E4-26 (VCPA) - Body ground A17-2 (VPA2) or E4-19 (VPA2) - Body ground A17-1 (EP2) or E4-21 (EPA2) - Body ground A17- (VCP2) or E4-27 (VCP2) - Body ground	10 k Ω or higher

NG**REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ACCELERATOR PEDAL ASSEMBLY

CHECKING MONITOR STATUS

HINT:

"MONITOR RESULT" indicates normal or malfunction of each component and system when a judgement was made.

1. HOW TO READ DATA

- (a) Connect the intelligent tester to the DLC3.
- (b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR RESULT.

The Test ID will appear at the beginning of each line, followed by INCMP, PASS, or FAIL.

HINT:

- INCMP: Says for "incomplete". The judgement has not been done yet.
- PASS: Normal is detected.
- FAIL: A malfunction has been detected.

- (c) Select a Test ID from the list and press "ENTER" the following screen will appear:

- (1) VAL (TEST VALUE) [Test Data] [Unit]
- (2) LMT (TEST LIMIT) [Test Limit] [Unit]
- (3) TLT [Test Limit] [Unit]

- (d) By pressing the "HELP" button, you can see more information.

HINT:

- Monitor test results can be viewed in the MONITOR RESULT screen.
- Monitor test results indicate the latest malfunction judgement result of this diagnostic.
- TEST VALUE indicates the detection parameter value (Example: P0128 Thermostat Malfunction = Engine coolant temperature) at the time of malfunction (or normal) judgement is done.
- TEST LIMIT indicates a threshold of malfunction judgement (Example: P0128 Thermostat Malfunction = 75°C).
- When the monitor runs, the monitored Parameter's VALUE is recorded. The value is then compared to the TEST LIMIT to determine if the result is PASS or FAIL.
- By comparing the Parameter VALUE to the TEST LIMIT, it is possible to determine the degree of failure.

MONITOR RESULT

CATALYST#1 B1 .INCMP
 CATALYST#1 B2 .INCMP
 O2S HEAT B1S1 .INCMP
 O2S HEAT B1S2 .INCMP
 O2S HEAT B2S1 .INCMP
 O2S HEAT B2S2 .INCMP
 THERMOSTAT PASS

Press [ENTER] to
 Select the Label .

A082674

Thermostat malfunction
 VAL. 119.375°C
 LMT. 75.000°C
 TLT. 1

[HELP] to notice
 [EXIT] to return

A082675

When TEST is PASS,
 TLT = 0
 VALUE < LIMIT
 TLT = 1
 VALUE > LIMIT

When TEST is FAIL,
 TLT = 0
 VALUE > LIMIT
 TLT = 1
 VALUE < LIMIT
 [EXIT] to return

A082676

- In rare cases, the monitor may have passed even with a DTC set and MIL illuminated. The monitor possibly detect malfunction on a previous trip, and then passed on the most recent trip. This would indicated an intermittent problem may be the cause of the DTC.

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)

HINT:

Although the title (DTC description) says "oxygen sensor", this DTC is related to the "A/F sensor".

DESCRIPTION

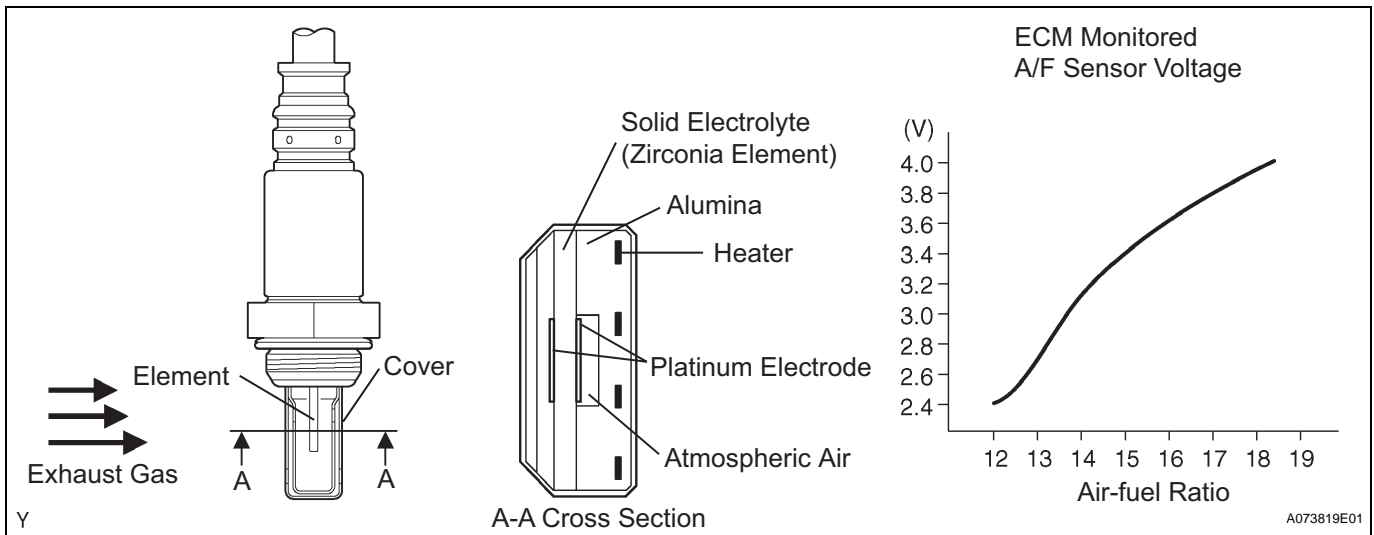
The Air-Fuel ratio (A/F) sensor provides output voltage* approximately equal to the existing air-fuel ratio. The A/F sensor output voltage is used to provide feedback for the ECM to control the air-fuel ratio. With the A/F sensor output, the ECM can determine deviation from the stoichiometric air-fuel 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 NO_x 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	Conditions (a) and (b) continue for 10 seconds or more: (a) A/F sensor voltage is more than 3.8 V (b) Rear oxygen sensor voltage is 0.15 V or more	<ul style="list-style-type: none"> • Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI relay • Open or short in A/F sensor heater and EFI relay circuits • Air induction system • Fuel pressure • Injector • ECM
P2196	Conditions (a) and (b) continue for 10 seconds or more: (a) A/F sensor voltage is less than 2.8 V (b) Rear oxygen sensor voltage is less than 0.6 V	<ul style="list-style-type: none"> • Same as DTC No. P2195

HINT:

- DTCs P2195 and P2196 indicate a malfunction related to bank 1 of the A/F sensor circuit.
- Sensor 1 is the sensor closest to the engine assembly.
- After confirming DTCs P2195 and P2196, use the intelligent tester or the OBD II scan tool to confirm A/F sensor output voltage (AFS B1S1) 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+ and A1A- 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.

ES**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 is set.

MONITOR STRATEGY

Related DTCs	P2195: A/F Sensor Signal (Bank 1) Stuck Lean P2196: A/F Sensor Signal (Bank 1) Stuck Rich
Required sensors/ components (Main)	A/F sensor
Required sensors/ components (Related)	HO2 sensor
Frequency of operation	Continuous
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	P0031, P0032 (A/F sensor heater) P0037, P0038 (O2 sensor) P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0136 (O2 sensor) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS)
--	---

P2195 (Lean side malfunction):

Duration while all of the following conditions 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	Running

P2196 (Rich side malfunction):

Duration while all of the following conditions met:	2 seconds or more
Rear HO2S voltage	Below 0.85 V
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

P2195, P2196 (Sensor current detection monitor):

Battery voltage	11 V or more
Atmospheric pressure	22.5 kPa (570 mmHg) or more
A/F sensor status	Activated
Engine coolant temperature	70°C (167°F) or more
Continuous time of fuel cut	3 to 10 seconds

ES

TYPICAL MALFUNCTION THRESHOLDS**P2195 (Lean side malfunction):**

A/F sensor voltage	More than 3.8 V
--------------------	-----------------

P2196 (Rich side malfunction):

A/F sensor voltage	Less than 2.8 V
--------------------	-----------------

P2195 (Sensor current detection monitor (High side malfunction)):

A/F sensor current	3.6 mA or more
--------------------	----------------

P2196 (Sensor current detection monitor (Rich side malfunction)):

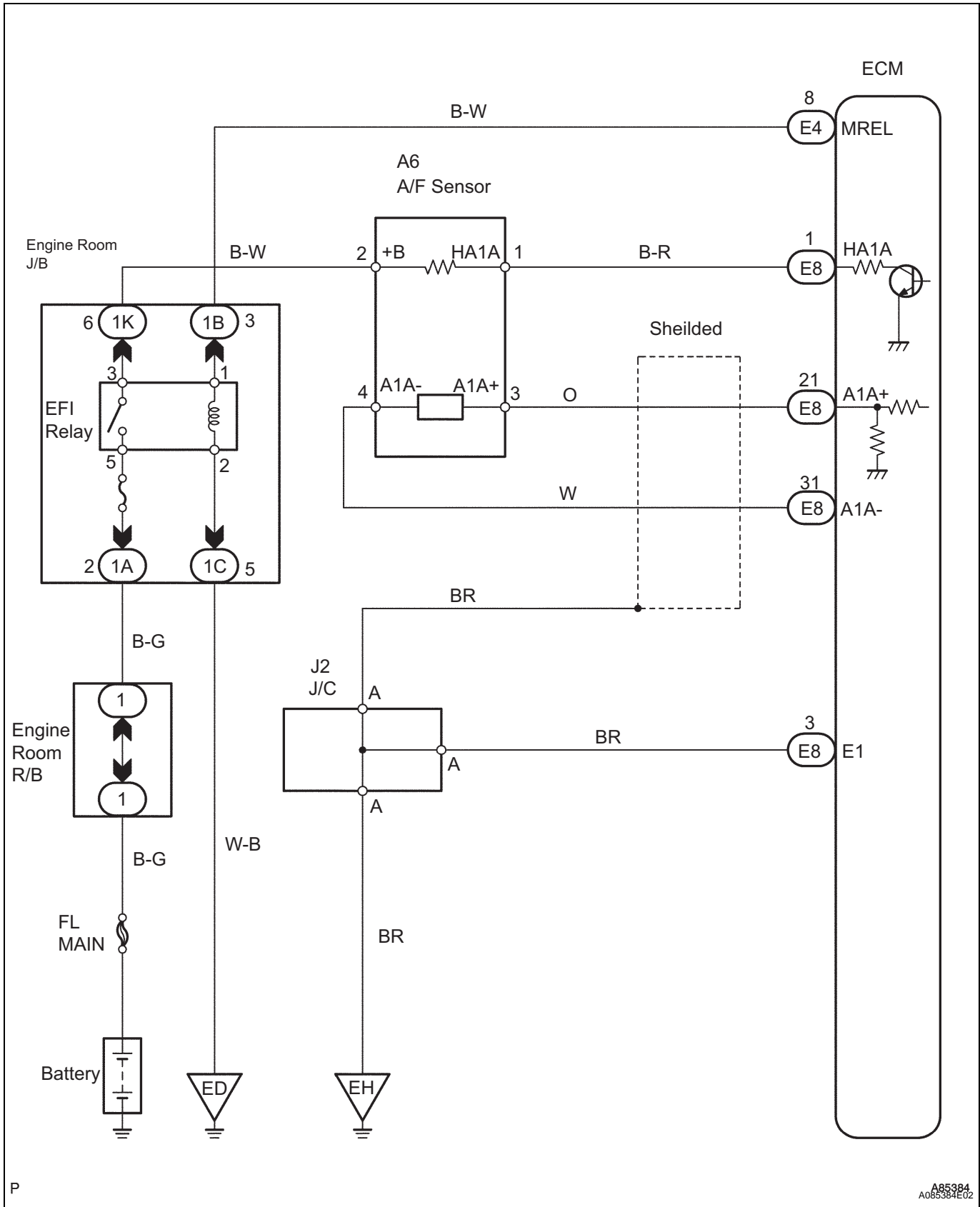
A/F sensor current	Less than 1 mA
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MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page [ES-16](#)).

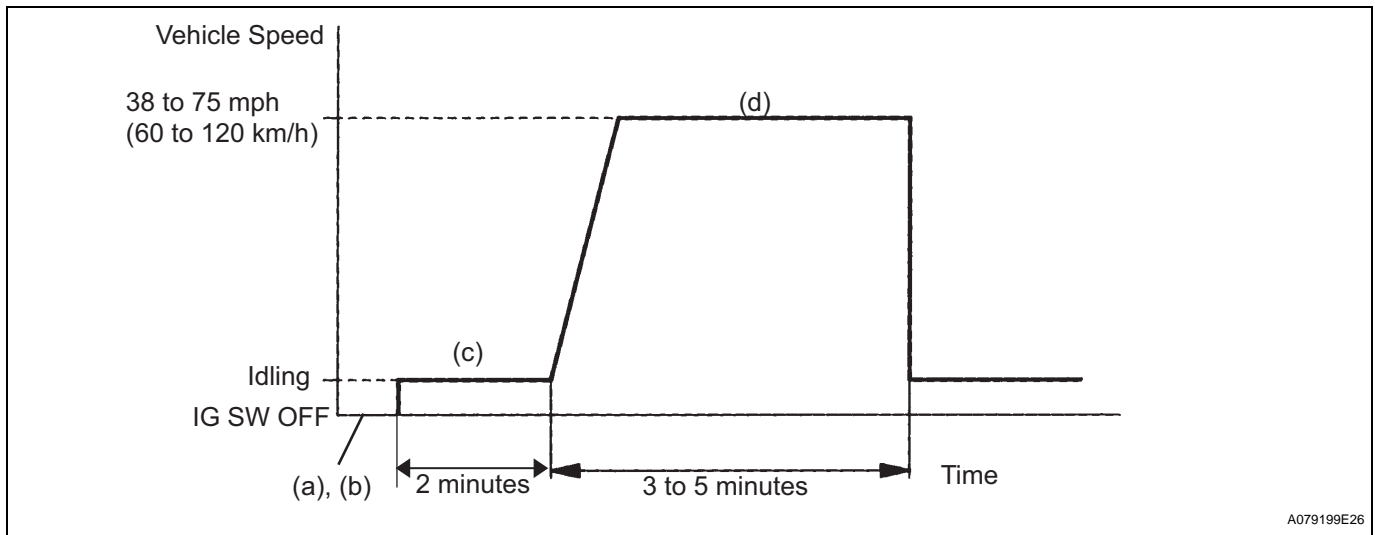
MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
\$01	\$91	Multiply by 0.003 [mA]	Air-fuel ratio sensor current or bank 1 sensor 1	Malfunction criterion for low side rationality	Malfunction criterion for high side rationality

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN

(a) Connect the intelligent tester to the DLC3.



A079199E26

(b) Switch the intelligent tester from normal mode to check mode (See page [ES-29](#)).

(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 an 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 that 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 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 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.

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		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> A/F sensor A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> HO2 sensor HO2 sensor heater HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> Injector Fuel pressure Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

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 / USE DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES", "ENTER", then press "F4".

HINT:

- If DTC P2195 or P2196 is displayed, check bank 1 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 is 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

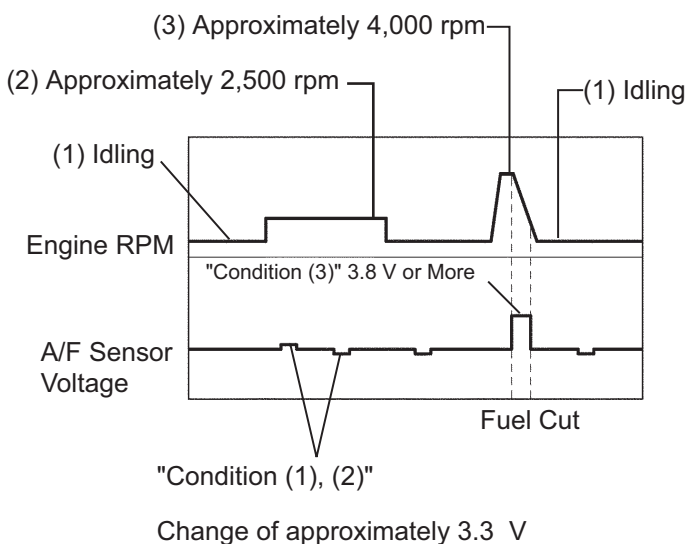
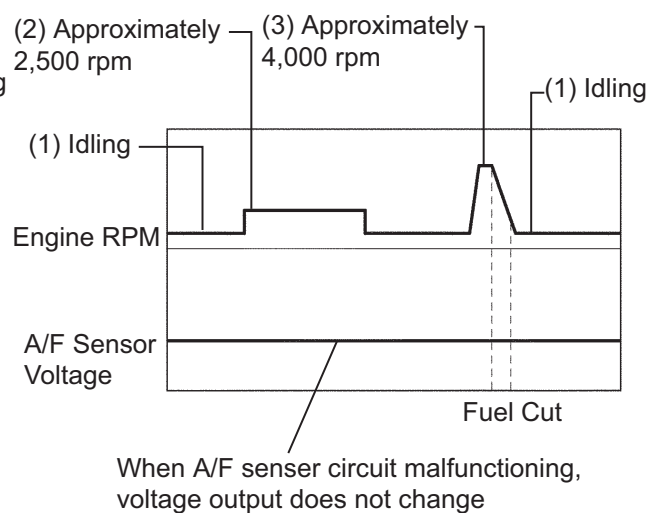
A

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 DLC 3.
- (b) Warm up the A/F sensor (bank 1 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 B1S1 / 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.

ES

Normal Condition:**Malfunction Condition:**

A072304E07

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 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.

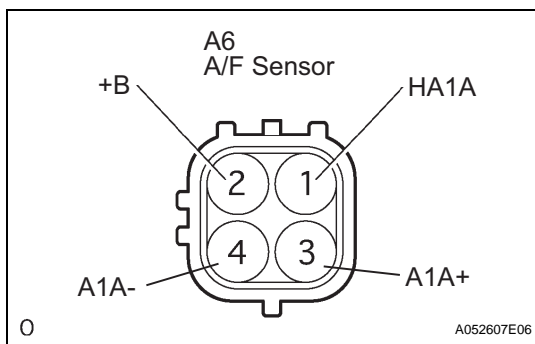
OK

Go to step 13

NG

3

INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



- Disconnect the A6 A/F sensor connector.
- Measure the resistance of the A/F sensor terminals.

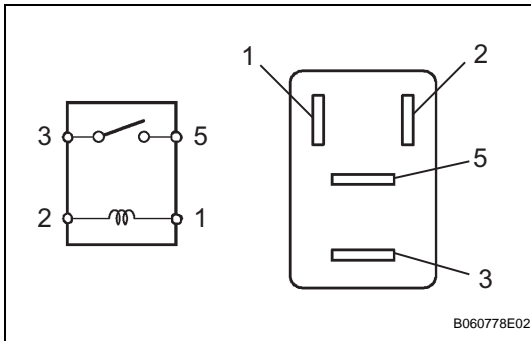
Resistance

Tester Connection	Specified Condition
1 (HA1A) - 2 (+B)	1.8 to 3.4 Ω
1 (HA1A) - 2 (+B)	10 k Ω or higher

NG

REPLACE AIR FUEL RATIO SENSOR

OK

4 INSPECT EFI RELAY

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

Resistance

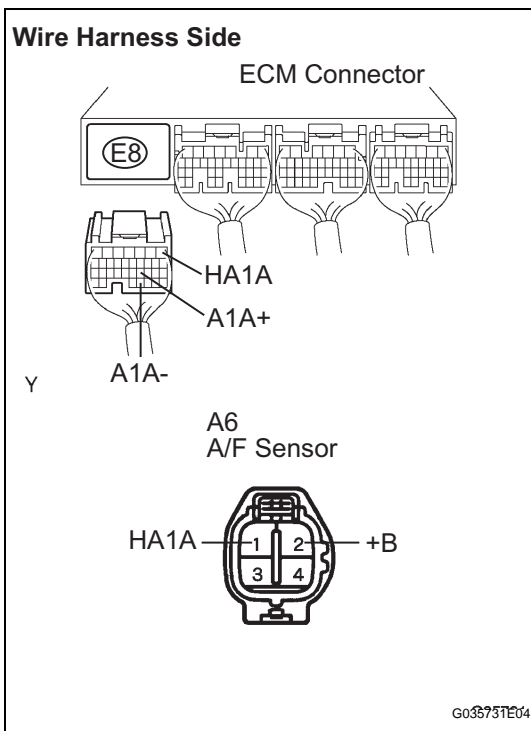
Tester Connection	Specified Condition
3 - 5	10 k Ω or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG

REPLACE EFI RELAY

ES

OK

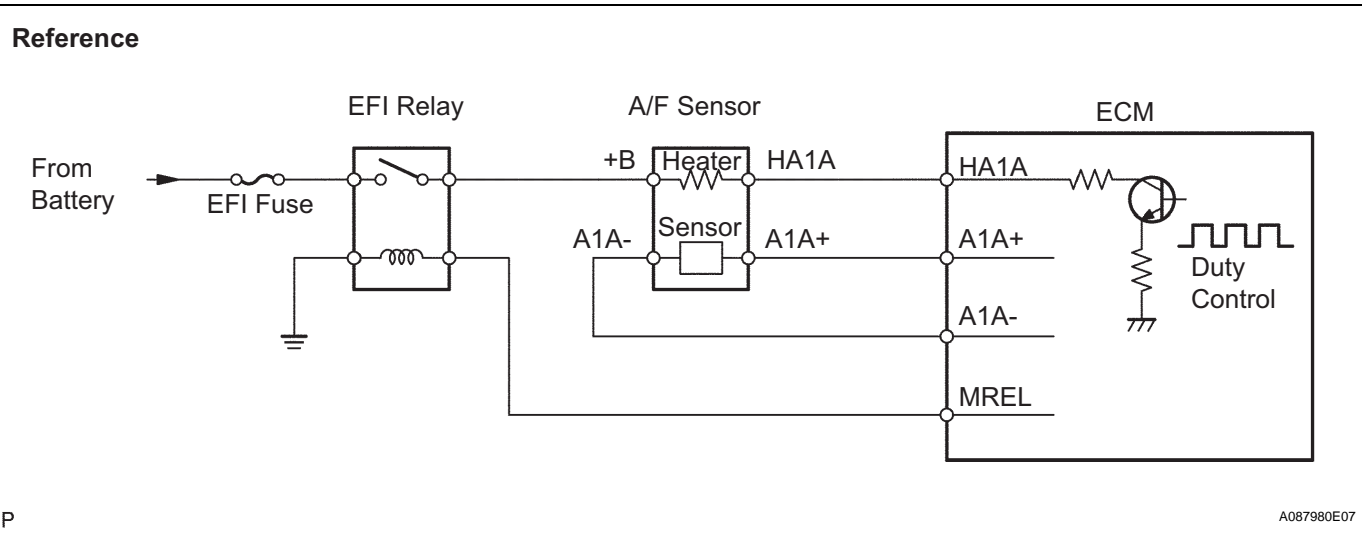
5 CHECK WIRE HARNESS (A/F SENSOR - ECM)

- (a) Check the wire harness between the ECM and A/F sensor.

- (1) Disconnect the A6 A/F sensor connector.
- (2) Disconnect the E8 ECM connector.
- (3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A6-3 (A1A+) - E8-21 (A1A+) A6-4 (A1A-) - E8-31 (A1A-) A6-1 (HA1A) - E8-1 (HA1A)	Below 1 Ω
A6-3 (A1A+) or E8-21 (A1A+) - Body ground A6-4 (A1A-) or E8-31 (A1A-) - Body ground A6-1 (HA1A) or E8-1 (HA1A) - Body ground	10 k Ω or higher



ES

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 (high or low fuel pressure).

Standard

Item	Specified Condition
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

8

INSPECT FUEL INJECTOR ASSEMBLY

(a) Check injector injection (high or low fuel injection quantity or poor injection pattern).

Standard

Injection Volume	Difference Between Each Injector
76 to 91 cm ³ (4.6 to 5.5cu in.) / 15 seconds	15 cm ³ (0.9 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 is not output	A
A/F sensor circuit DTC is output	B

B

REPLACE ECM AND PERFORM
CONFIRMATION DRIVING PATTERN

A

12

CONFIRM IF VEHICLE HAS RUN OUT FUEL IN PAST

OK:

Vehicle has run out of fuel in past.

NG

CHECK FOR INTERMITTENT PROBLEMS

OK

CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

13

PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

NEXT

ES

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 is output	A
A/F sensor circuit DTC is not output	B

B**Go to step 18****A****15 REPLACE AIR FUEL RATIO SENSOR****NEXT****16 PERFORM CONFIRMATION DRIVING 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 is not output	A
A/F sensor circuit DTC is 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**

A button with a downward-pointing arrow shape and the text "OK" inside.

DTC IS CAUSED BY RUNNING OUT OF FUEL

ES

DTC	P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)
DTC	P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)
DTC	P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)
DTC	P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

HINT:

Although the title (DTC description) says "oxygen sensor", this DTC is related to the "A/F sensor".

DESCRIPTION

Refer to DTC P2195 (See page [ES-253](#)).

DTC No.	DTC Detection Condition	Trouble Area
P2238	A/F sensor (bank 1 sensor 1) circuit low A/F sensor admittance is less than 0.022 1/Ω	HINT: Main trouble area • Open in A/F sensor circuit
P2238	<ul style="list-style-type: none"> Condition (a) continues for 10 seconds or more : (a) AF+ is 0.5 V or less Condition (a) continues for 10 seconds or more : (a) (AF+) - (AF-) is 0.1 V or less 	<ul style="list-style-type: none"> Open or short in A/F sensor circuit A/F sensor A/F sensor heater EFI relay Open or short in A/F sensor heater and EFI relay circuits ECM
P2239	Condition (a) continues for 10 seconds or more: (a) AF+ is more than 4.5 V	• Same as DTC No. P2238
P2252	Condition (a) continues for 10 seconds or more : (a) AF- is 0.5 V or less	• Same as DTC No. P2238
P2253	Condition (a) continues for 10 seconds or more : (a) AF- is more than 4.5 V	• Same as DTC No. P2238

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 (Bank1) open circuit between AF+ and AF- P2238: A/F sensor (Bank1) 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 P2252: A/F sensor (Bank 1) short circuit between AF- and GND P2253: A/F sensor (Bank 1) 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 (open circuit between AF+ and AF-):

Duration while all of the following conditions are met:	20 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	10°C (50°F) or more
Engine condition	Running
Time after engine start	20 seconds or more
Fuel-cut	OFF
A/F sensor heater duty cycle	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 (Open circuit between AF+ and AF-):

A/F sensor admittance	Below 0.022 1/ohm
-----------------------	-------------------

P2238 (Short circuit between AF+ and GND):

AF+ terminal voltage	0.5 V or less
----------------------	---------------

P2238 (Short circuit between AF+ and AF-):

Difference between AF+ terminal and AF- terminal voltages	0.1 V or less
---	---------------

P2239 (Short circuit between AF+ and +B):

AF+ terminal voltage	More than 4.5 V
----------------------	-----------------

P2252 (Short circuit between AF- and GND):

AF- terminal voltage	0.5 V or less
----------------------	---------------

P2253 (Short circuit between AF- and +B):

AF- terminal voltage	More than 4.5 V
----------------------	-----------------

WIRING DIAGRAM

Refer to DTC P2195 (See page [ES-256](#)).

HINT:

Intelligent tester only:

It is possible that 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 by 12.5% or increases the injection volume by 25%.

- Connect the intelligent tester to the DLC3 on the vehicle.
- Turn the ignition switch ON.
- Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
- 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







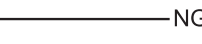

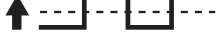







Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

+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 %		<ul style="list-style-type: none"> 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 %		<ul style="list-style-type: none"> 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 %		<ul style="list-style-type: none"> 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.

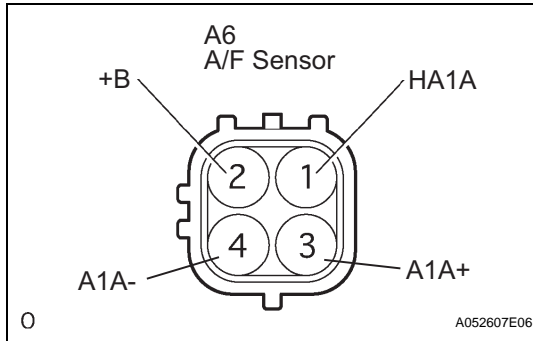
For displaying the graph, enter "ACTIVE TEST / A/F CONTROL / USER DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES", "ENTER", then press "F4".

HINT:

- If DTC P2237, P2238, P2239, P2251, P2252 or P2253 is displayed, check the bank 1 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.

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



- Disconnect the A6 A/F sensor connector.
- Measure the resistance of the A/F sensor terminals.

Resistance

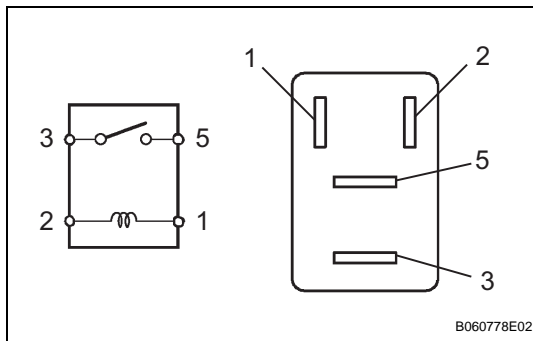
Tester Connection	Specified Condition
1 (HA1A) - 2 (+B)	1.8 to 3.4 Ω
1 (HA1A) - 2 (+B)	10 k Ω or higher

NG

REPLACE AIR FUEL RATIO SENSOR

OK

2 INSPECT EFI RELAY



- Remove the EFI relay from the engine room J/B.
- Measure the resistance of the EFI relay.

Resistance

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

NG

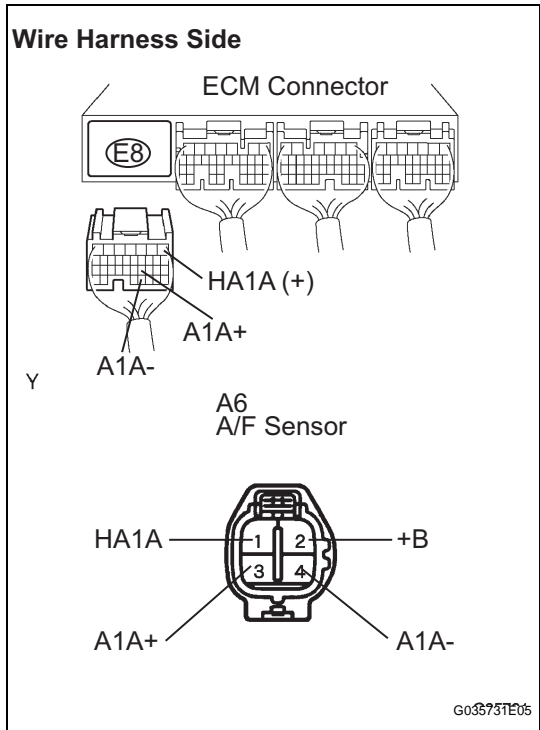
REPLACE EFI RELAY

OK

ES

3

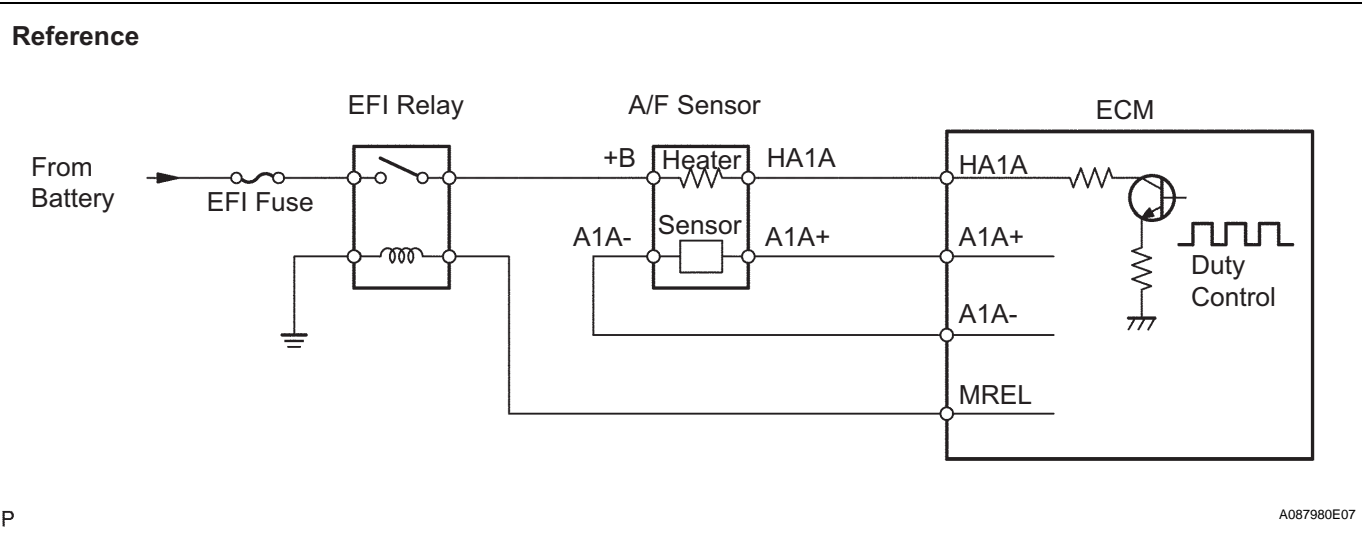
CHECK WIRE HARNESS (A/F SENSOR - ECM)



- (a) Check the wire harness between the ECM and A/F sensor.
- Disconnect the A6 A/F sensor connector.
 - Disconnect the E8 ECM connector.
 - Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A6-3 (A1A+) - E8-21 (A1A+) A6-4 (A1A-) - E8-31 (A1A-) A6-1 (HA1A) - E8-1 (HA1A)	Below 1 Ω
A6-3 (A1A+) or E8-21 (A1A+) - Body ground A6-4 (A1A-) or E8-31 (A1A-) - Body ground A6-1 (HA1A) or E8-1 (HA1A) - Body ground	10 kΩ or higher



NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

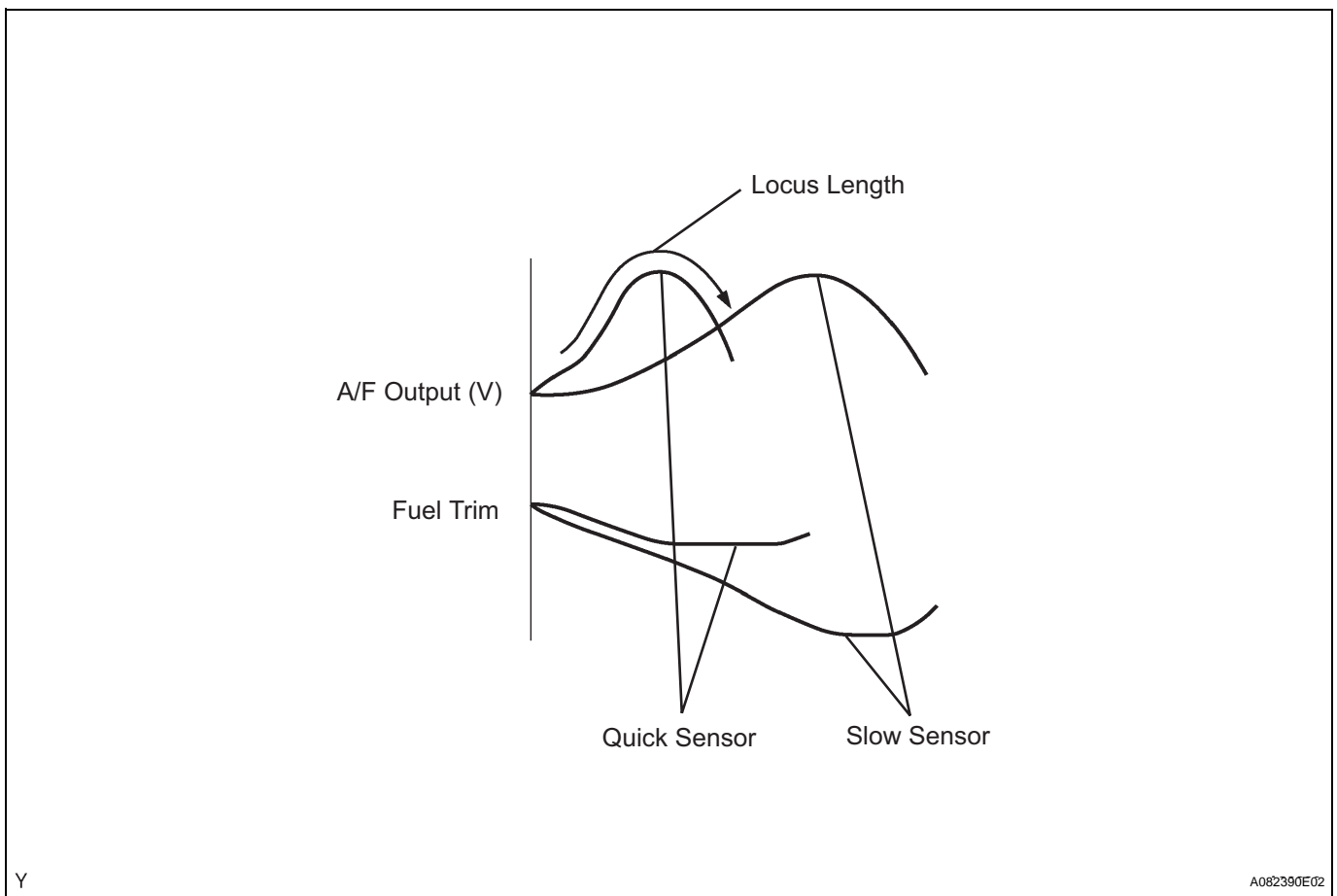
REPLACE ECM

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

DESCRIPTION

Refer to DTC P2195 (See page [ES-253](#)).

DTC No.	DTC Detection Condition	Trouble Area
P2A00	In conditions (a), (b) and (c), when A/F sensor output voltage change value is below regular value against fuel trim change value, ECM judges that A/F sensor circuit has slow response: (2 trip detection logic) (a) Engine is warmed up (b) Engine speed 1,400 rpm or more (c) Vehicle speed 37.5 to 75 mph (60 to 120 km/h)	<ul style="list-style-type: none"> • Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI relay • Open or short in A/F sensor and EFI relay circuits • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM

ES**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. A/F sensor response deterioration is determined by the ratio of the A/F sensor output voltage variation and fuel trim variation.

MONITOR STRATEGY

Related DTCs	P2A00: A/F Sensor 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 this DTC is not present	P0031, P0032 (A/F sensor heater) 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 - P0204 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS) P2196 (A/F sensor (Rationality)) P2237 (A/F sensor (Open))
Engine condition	Running
Time after engine start	2 minutes or more
Duration that vehicle has run with the following conditions 1 and 2	20 seconds or more
1. Vehicle speed	25 mph (40 km/h) or more (Driving for 20 seconds)
2. Engine RPM	900 rpm or more
Fuel system status	Closed-loop
Idle	OFF (for 2 seconds or more)
Engine RPM	1,400 to 3,200 rpm
Vehicle speed	37.5 to 75 mph (60 to 120 km/h)
Fuel-cut	OFF (for 2 seconds or more)
A/F sensor malfunction (P2195, P2196)	Not detected
A/F sensor malfunction (P2238 - P2253)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	8 or more
-----------------------------------	-----------

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page [ES-16](#)).

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

WIRING DIAGRAM

Refer to DTC P2195 (See page [ES-256](#)).

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%.

- Connect the intelligent tester to the DLC3 on the vehicle.
- Turn the ignition switch ON.
- Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
- 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 %		<ul style="list-style-type: none"> 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 %		<ul style="list-style-type: none"> 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	

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> • 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", "ENTER", then press "F4".

HINT:

- DTC P2A00 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
Only P2A00 is output	A
P2A00 and other DTC is output	B

HINT:

If any other DTCs besides P2A00 is output, perform the troubleshooting for that DTC 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)

- Connect the intelligent tester or the OBD II scan tool to the DLC3.
- Warm up the A/F sensor (bank 1 sensor 1) by running the engine at 2,500 rpm for approximately 90 seconds.
- Read A/F sensor voltage output on the the intelligent tester or OBD II scan tool.
- 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 / 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.

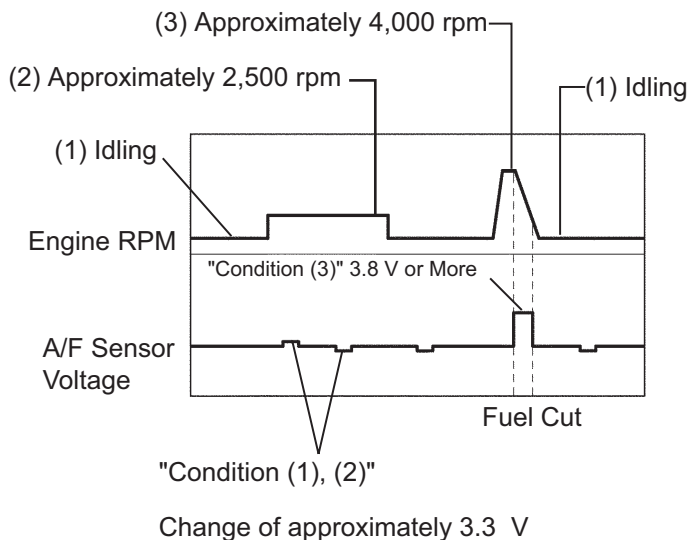
Condition (3)

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.

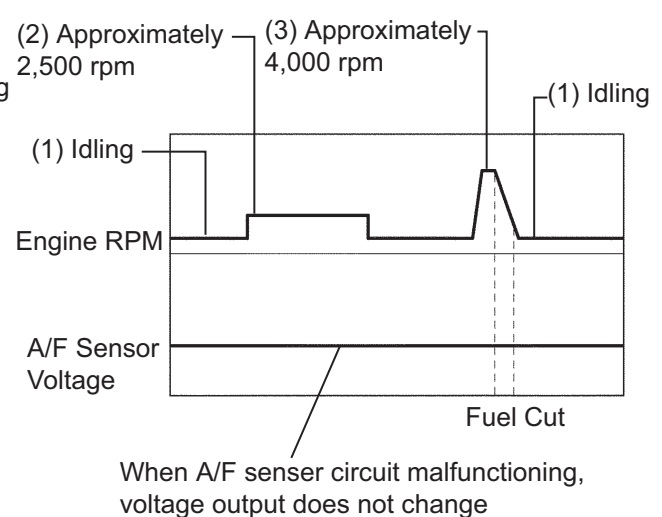
*: Voltage when using the OBD II scan tool.

ES

Normal Condition:



Malfunction Condition:



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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.

ES

- 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.

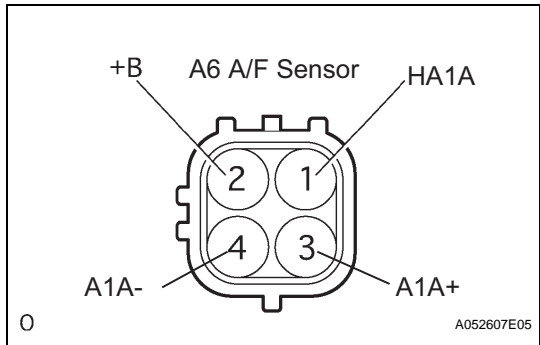
OK

Go to step 14

NG

3

INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



- (a) Disconnect the A6 A/F sensor connector.
(b) Measure the resistance of the A/F sensor terminals.

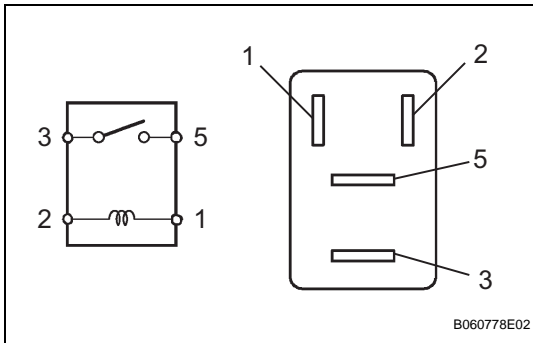
Resistance

Tester Connection	Specified Condition
1 (HA1A) - 2 (+B)	1.8 to 3.4 Ω
1 (HA1A) - 2 (+B)	10 kΩ or higher

NG

REPLACE AIR FUEL RATIO SENSOR

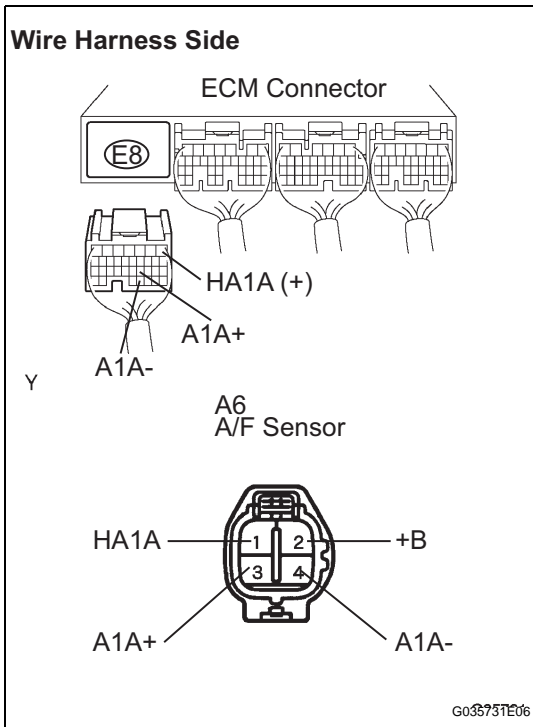
OK

4 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 k Ω or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

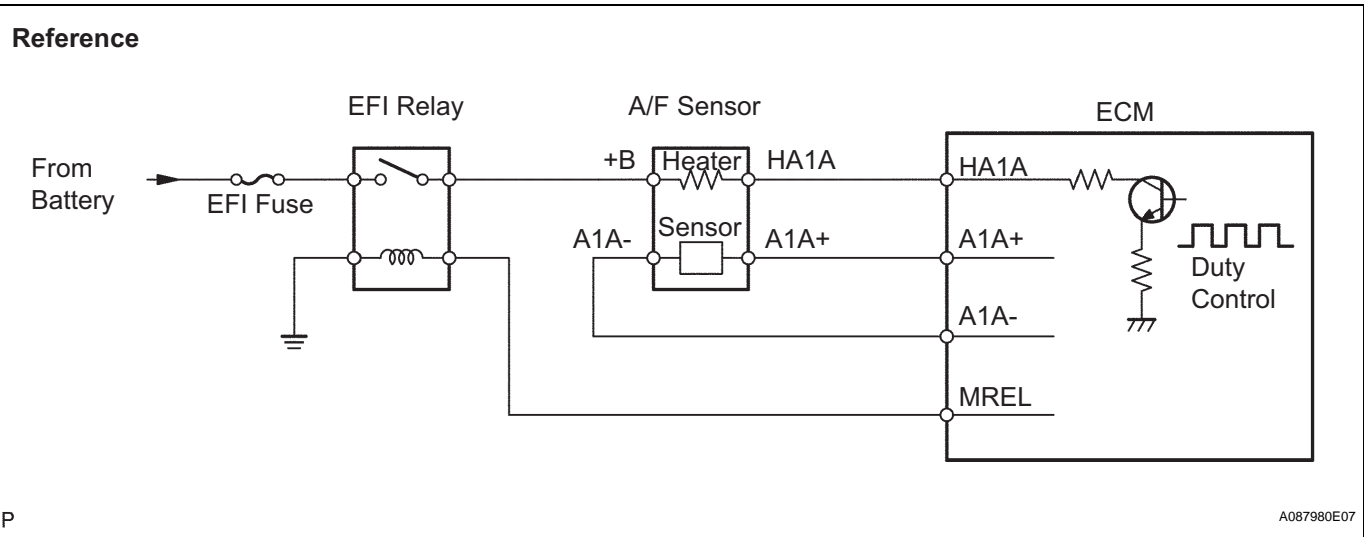
NG**REPLACE EFI RELAY****OK****ES****5 CHECK WIRE HARNESS (A/F SENSOR - ECM)**

- (a) Check the wire harness between the ECM and A/F sensor.

- (1) Disconnect the A6 A/F sensor connector.
- (2) Disconnect the E8 ECM connector.
- (3) Measure the resistance of the wire harness side connectors.

Resistance

Tester Connection	Specified Condition
A6-3 (A1A+) - E8-21 (A1A+) A6-4 (A1A-) - E8-31 (A1A-) A6-1 (HA1A) - E8-1 (HA1A)	Below 1 Ω
A6-3 (A1A+) or E8-21 (A1A+) - Body ground A6-4 (A1A-) or E8-31 (A1A-) - Body ground A6-1 (HA1A) or E8-1 (HA1A) - Body ground	10 k Ω or higher



ES

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 (high or low fuel pressure).
Standard

Item	Specified Condition
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 (high or low fuel injection quantity or poor injection pattern).

Standard

Injection Volume	Difference Between Each Injector
76 to 91 cm ³ (4.6 to 5.5cu in.) / 15 seconds	15 cm ³ (0.9 cu in.) or less

NG

REPLACE FUEL INJECTOR ASSEMBLY**ES**

OK

10 REPLACE AIR FUEL RATIO SENSOR

GO

11 PERFORM CONFIRMATION DRIVING PATTERN**HINT:**

Clear all DTCs prior to performing the confirmation driving pattern (See page [ES-17](#)).

GO

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 is not output	A
DTC P2A00 is output	B

B

**REPLACE ECM AND PERFORM
CONFIRMATION DRIVING PATTERN**

A

13 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NG

CHECK FOR INTERMITTENT PROBLEMS

OK

DTC IS 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](#)).**GO****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 is output	A
DTC P2A00 is not output	B

B**GO TO STEP 19 AND PERFORM
CONFIRMATION DRIVING PATTERN****A****16 REPLACE AIR FUEL RATIO SENSOR****GO****17 PERFORM CONFIRMATION DRIVING PATTERN**

HINT:

Clear all DTCs prior to performing the confirmation driving pattern (See page [ES-17](#)).**GO****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 is not output	A
DTC P2A00 is 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 IS CAUSED BY RUNNING OUT OF FUEL****ES**

ES

EVAP System

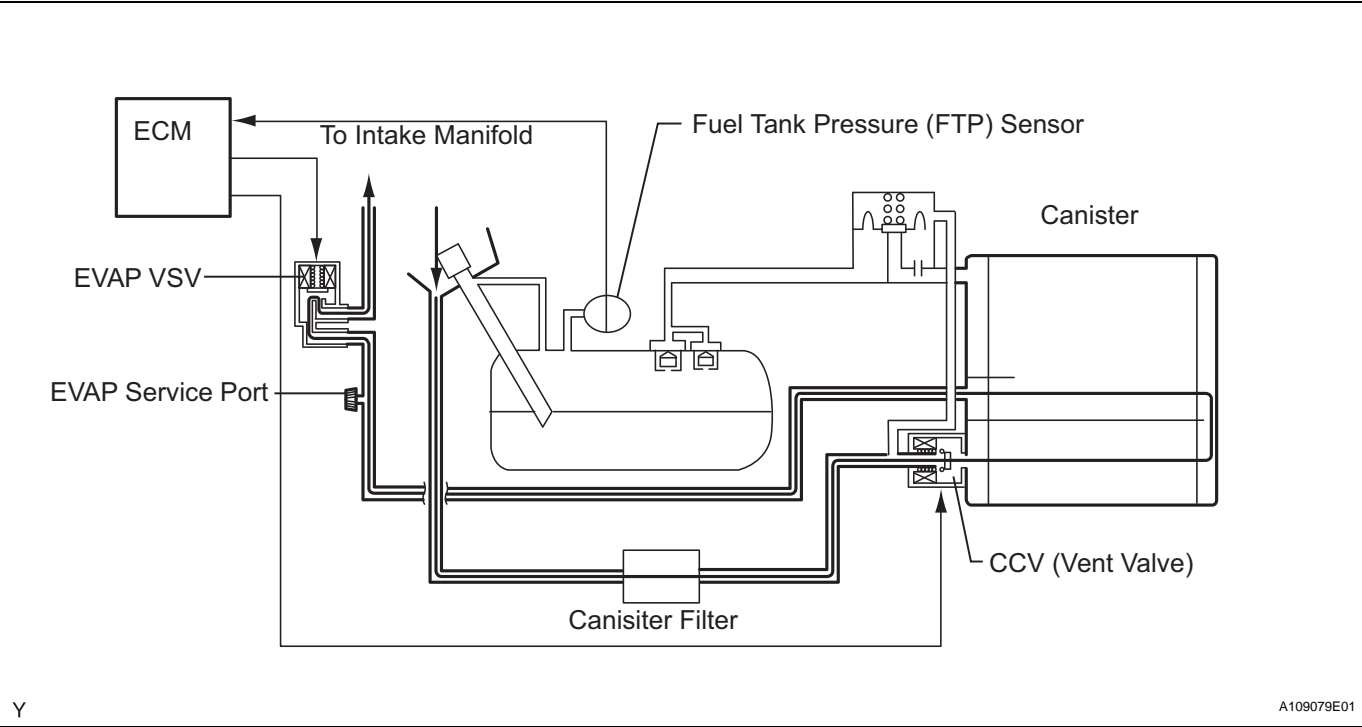
DESCRIPTION

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

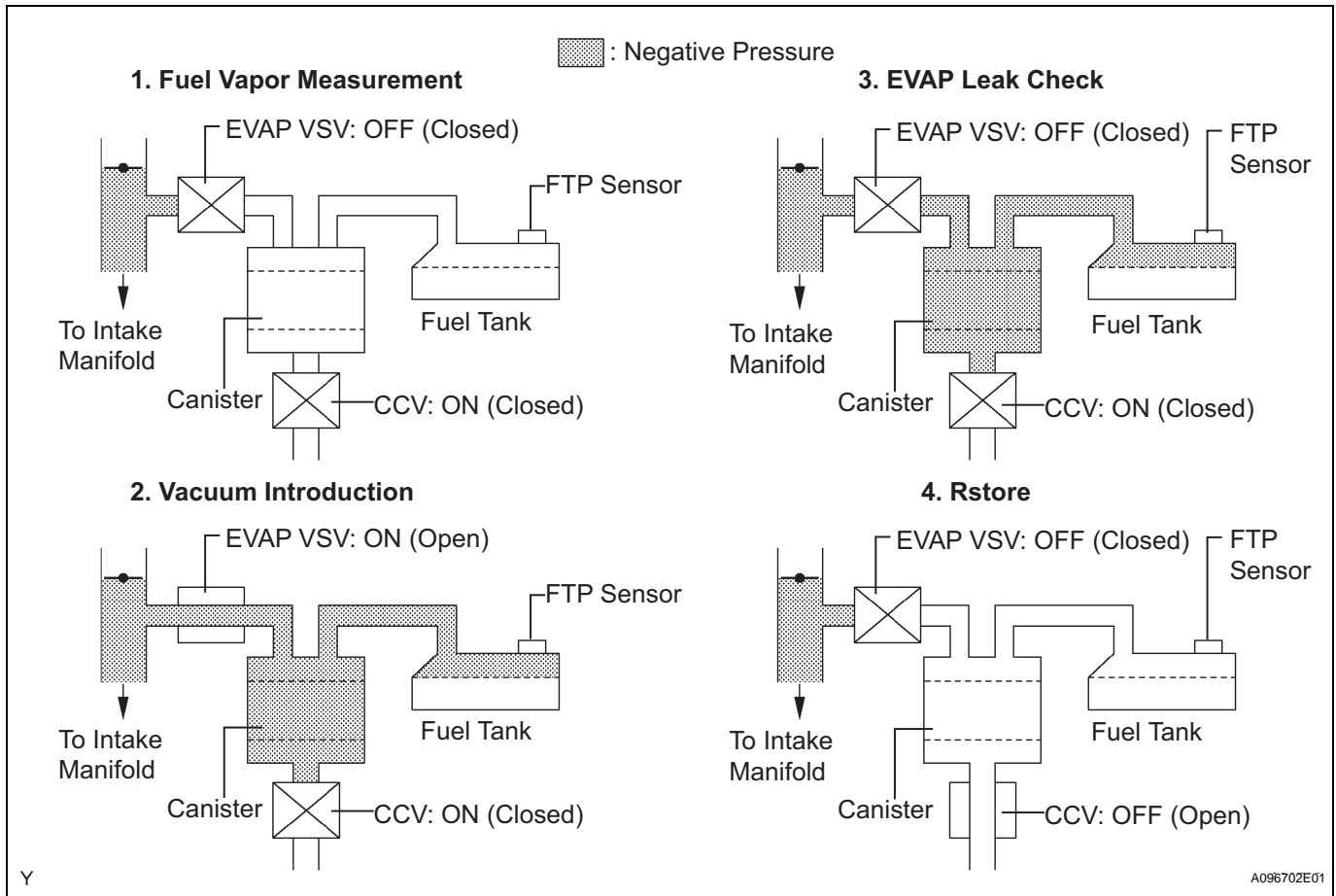


MONITOR DESCRIPTION

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:

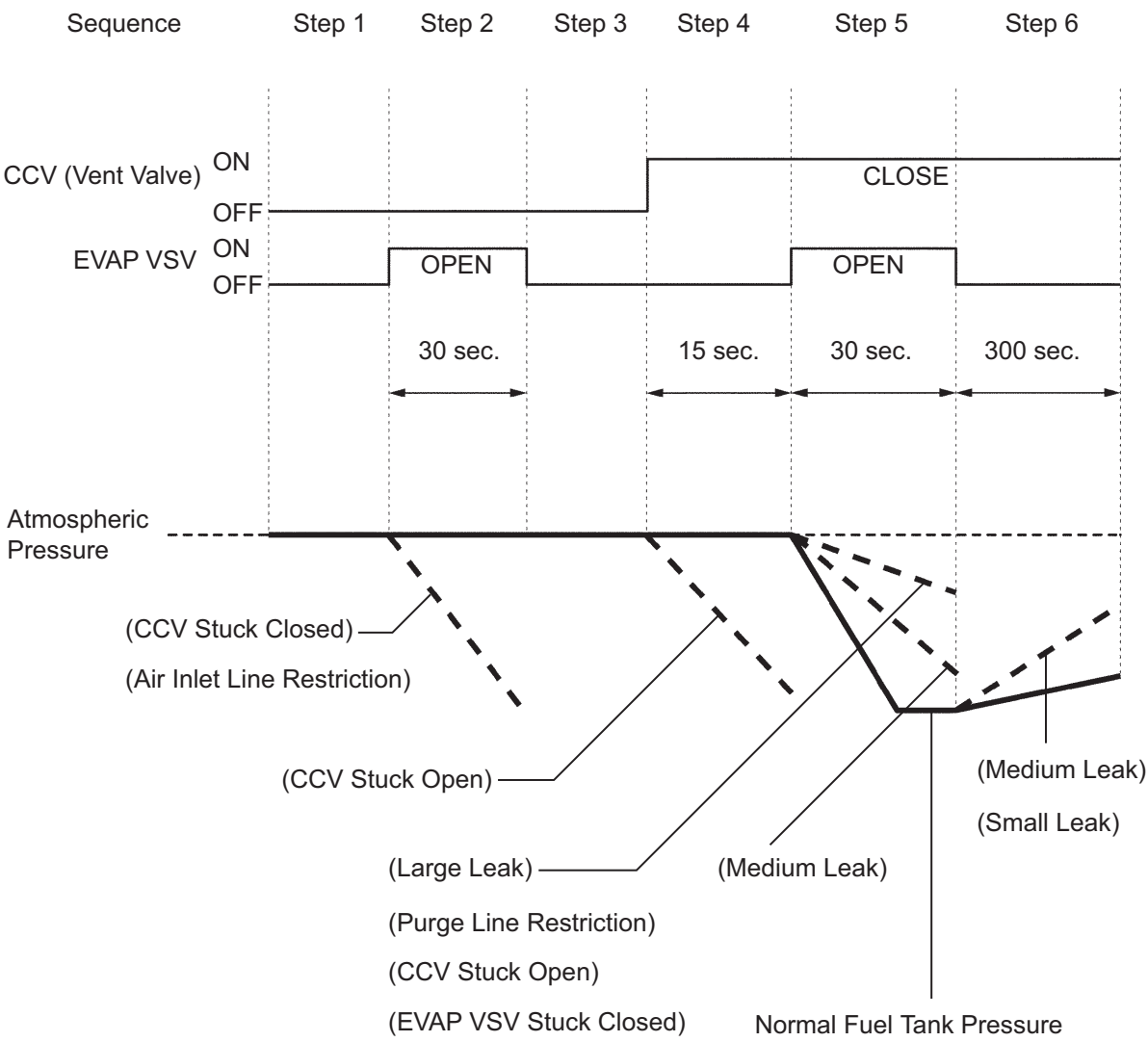
- The engine coolant and intake air temperatures are 4 to 35°C (40 to 90°F).
- The engine is idling or the vehicle is being driven at a steady speed.

- 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

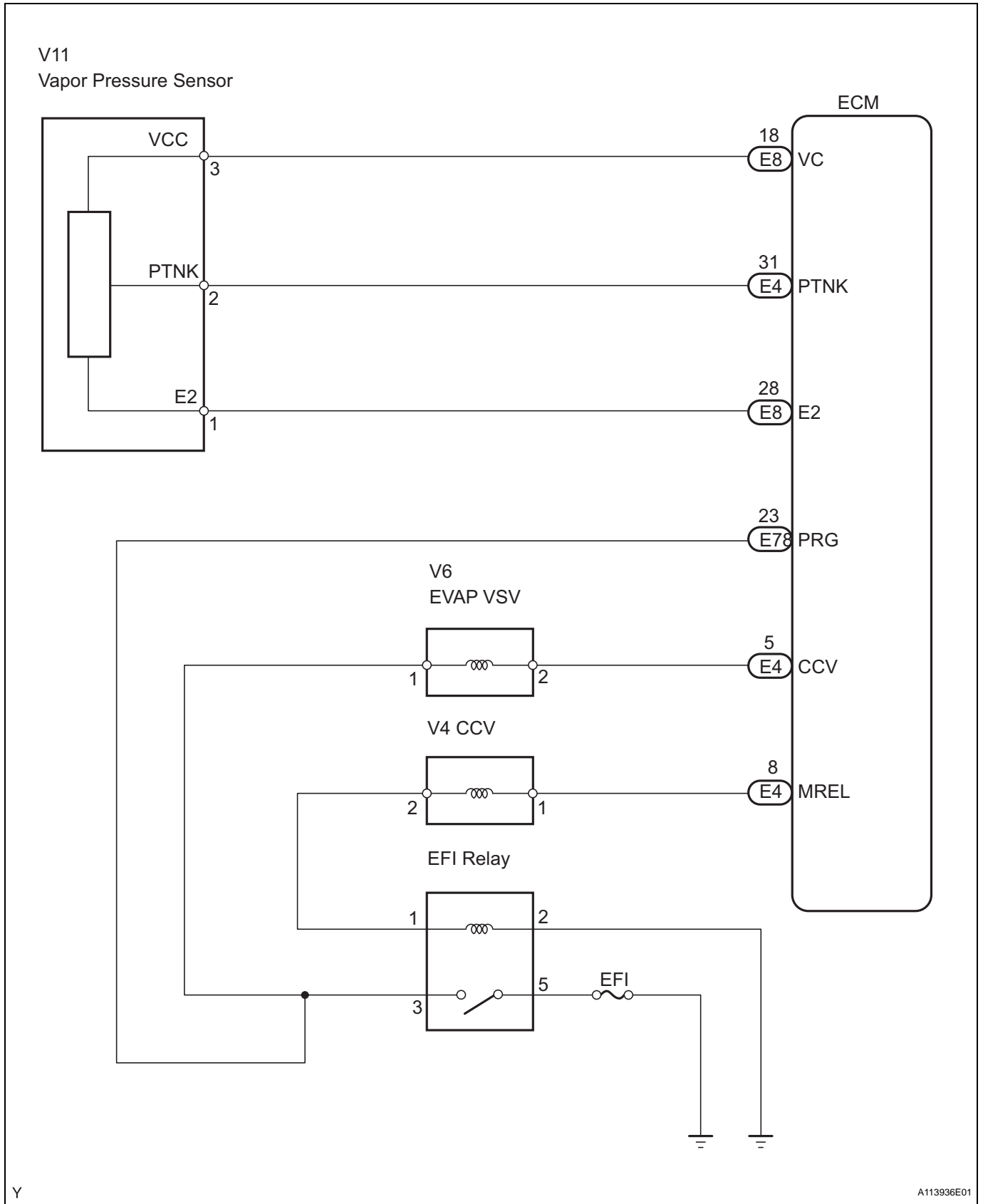


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Related DTCs

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 P0441, 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 DTC 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

Predict possible malfunction area using the matrix below.

EVAP DTC Matrix

DTCs Malfunction Area	P0441	P0442	P0446	P0451	P0452	P0453	P0455	P0456
EVAP VSV stuck closed	●	-	●	-	-	-	●	-
EVAP VSV stuck open	●	-	-	-	-	-	-	-
EVAP small leak (0.04 inch)	-	●	-	-	-	-	-	-
CCV stuck closed	-	-	●	-	-	-	-	-
CCV stuck open	●	-	●	-	-	-	●	-
FTP sensor malfunction	-	-	-	●	-	-	-	-
FTP sensor low output	-	-	-	-	●	-	-	-
FTP sensor high output	-	-	-	-	-	●	-	-
Gross leak	●	-	-	-	-	-	●	-
EVAP small leak (0.02 inch)	-	●	-	-	-	-	-	●

DTCs	Suspected Malfunction Area
P0441 only	EVAP VSV stuck open
P0446 only	CCV (vent valve) stuck open
P0442 and/or P0456	Small leak

NEXT

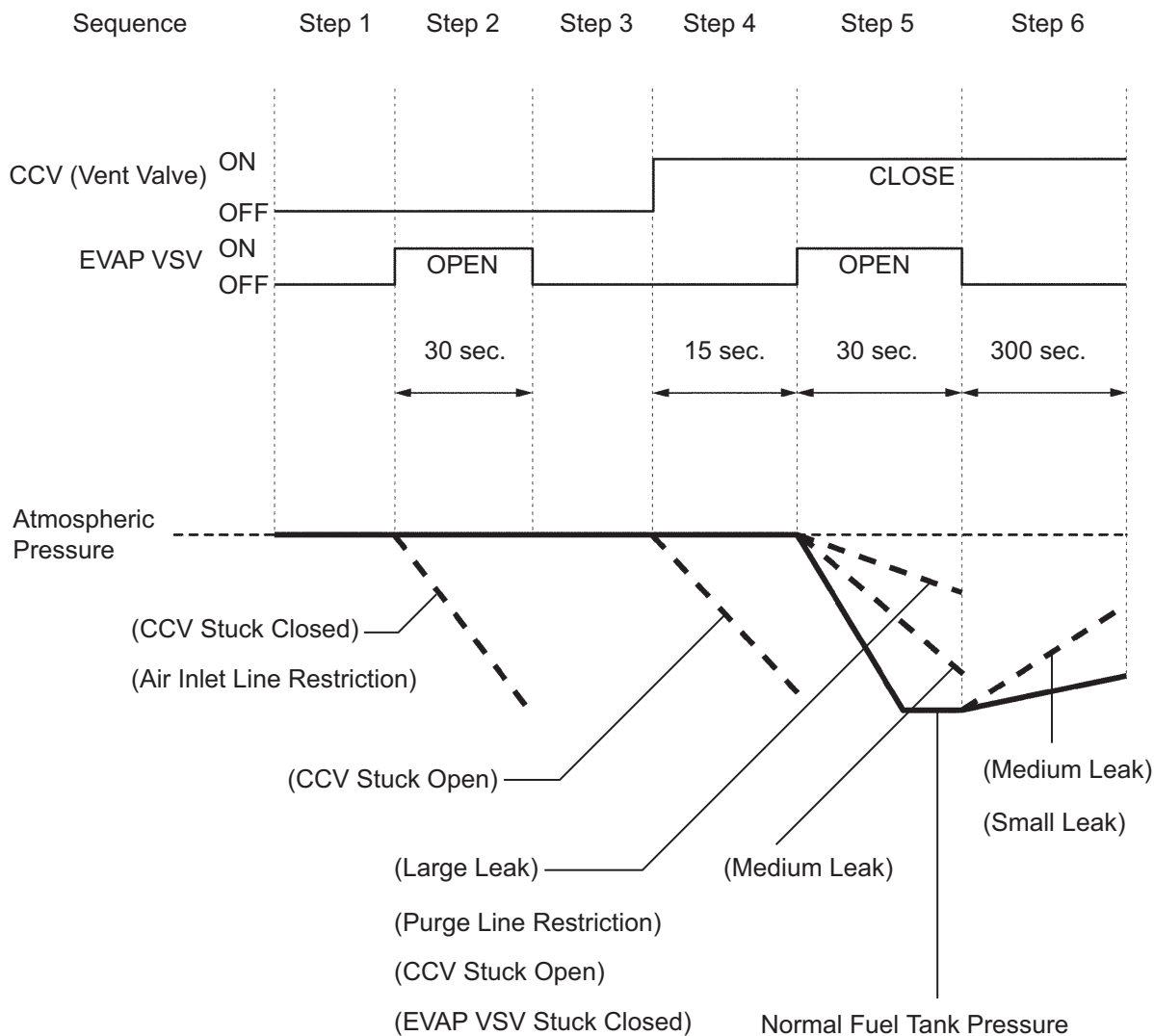
4 PERFORM EVAP SYSTEM CHECK

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 completed.

- Select the "mmHg" unit. Select the intelligent tester menus: DIAGNOSIS, SETUP, UNIT CONVERSION and VAPOR PRESS.
 - Allow the engine to idle.
 - 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.
 - Read NOTICE and press ENTER.
- Diagram of LEVII EVAP System Check

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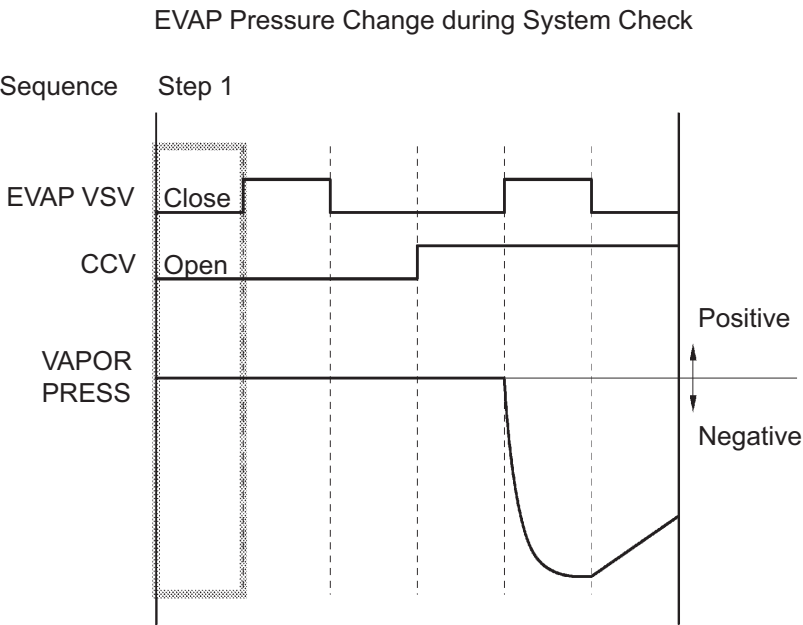
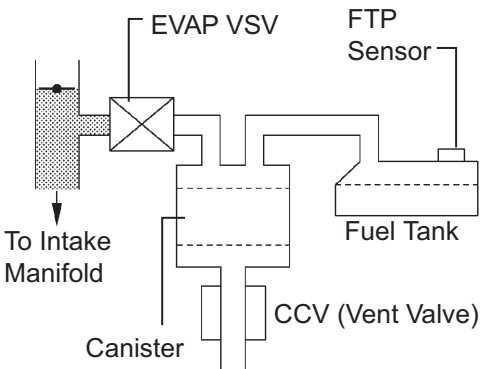
- HINT:
- The EVAP system check is most accurate when the following conditions are being set:
- Atmospheric pressure is 762 mmHg (sea level).
 - The engine coolant and intake air temperatures are 4 to 35°C (40 to 90°F).
 - The fuel tank level is 1/4 to 3/4.

NEXT

5 EVAP SYSTEM CHECK STEP 1 (INITIALIZE SYSTEM)

(a) Press ENTER to go to step 1.

Step 1. Initialize System



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(b) Wait for 30 seconds.

LEVII SYSTEM CHECK
Step 1. Initialize system

EVAP VSV.....CLOSE
CCV.....OPEN
VAPOR PRESS
.....762 mmHg-a
Time 030 seconds

Press [RIGHT]

P

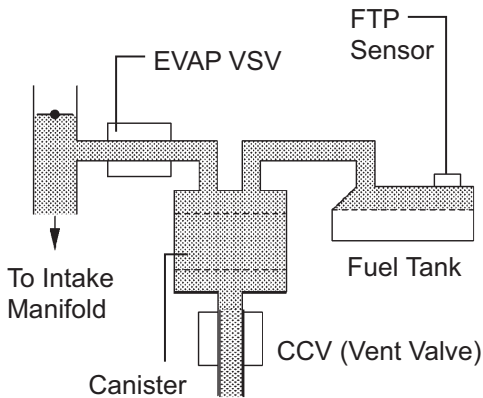
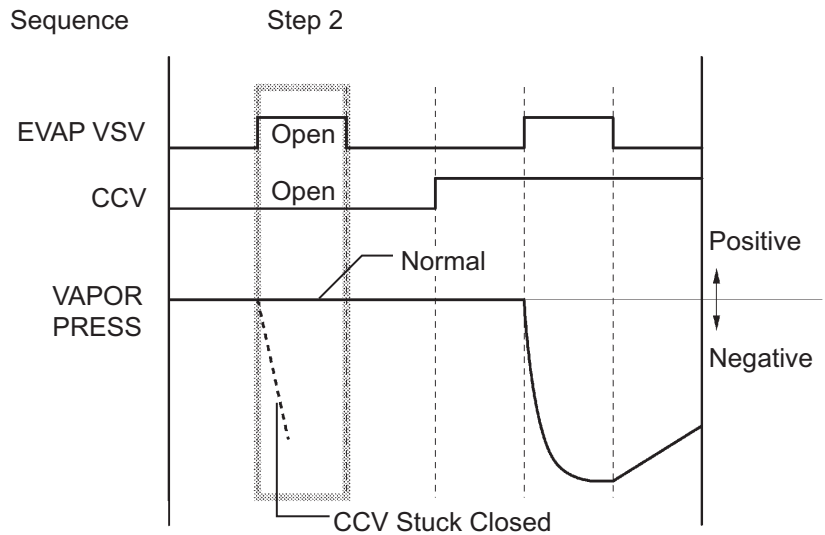
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NEXT

6

EVAP SYSTEM CHECK STEP 2 (CHECK FOR CCV)

(a) Press RIGHT to go to step 2.

Step 2. Check for CCV**EVAP Pressure Change during System Check**

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**LEVII SYSTEM CHECK
Step 2. Check for CCV**

EVAP VSV.....OPEN
CCV.....OPEN
VAPOR PRESS
.....762 mmHg-a
Time 030 seconds
Press [RIGHT]

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(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

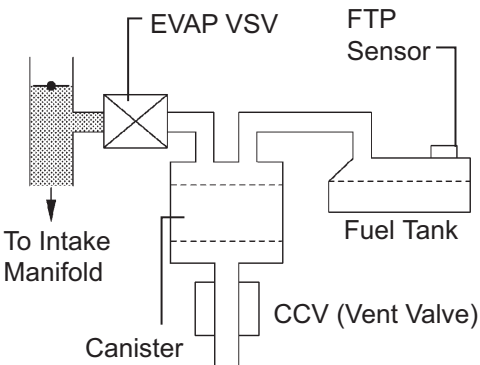
HINT:

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.

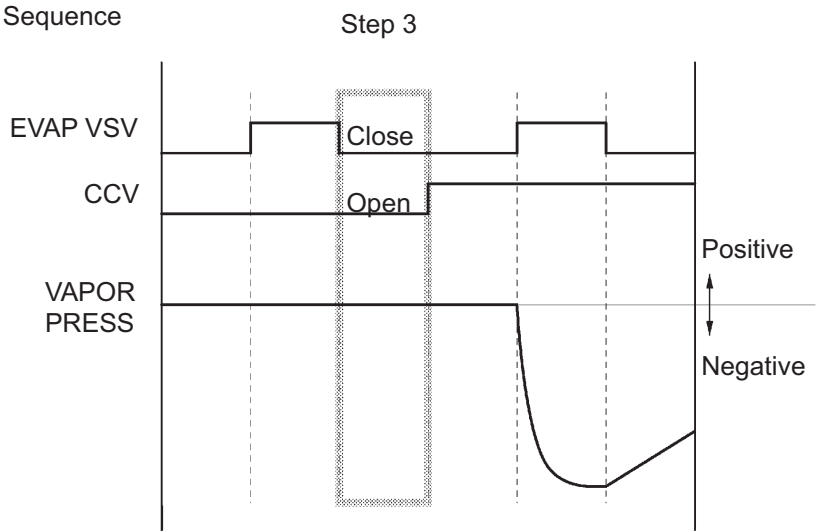
NG**Go to step 11****OK****7****EVAP SYSTEM CHECK STEP 3 (INITIALIZE SYSTEM)**

(a) Press RIGHT to go to step 3.

Step 3. Initialize System



EVAP Pressure Change during System Check



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(b) Wait for 30 seconds.

LEVII SYSTEM CHECK
Step 3. Initialize system

EVAP VSV.....CLOSE
CCV.....OPEN
VAPOR PRESS
.....762 mmHg-g
Time 030 seconds

Press [RIGHT]

P

A096684

NEXT

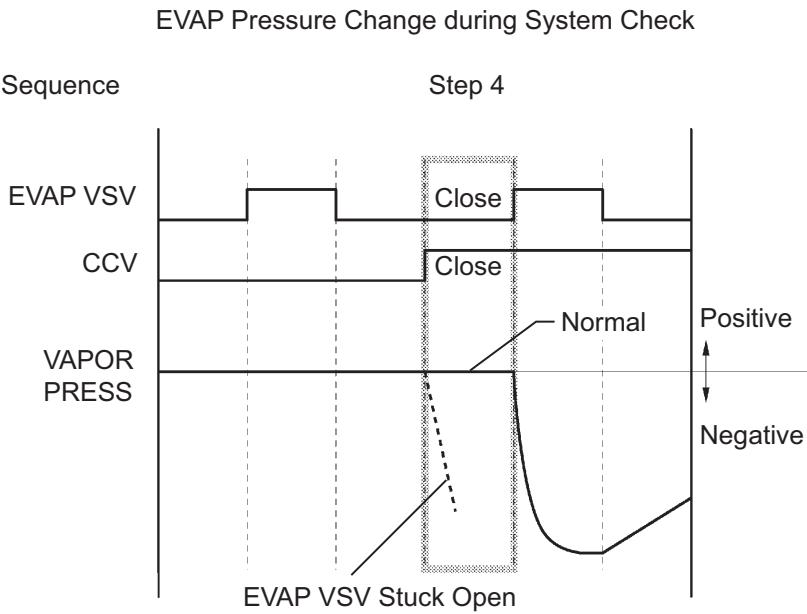
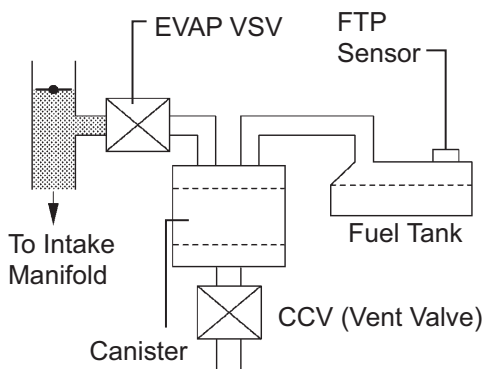
8

EVAP SYSTEM CHECK STEP 4 (CHECK FOR EVAP VSV STUCK OPEN)

(a) Press RIGHT to go to step 4.

ES

Step 4. Check for EVAP VSV



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LEVII SYSTEM CHECK
Step 4. Check for EVAP VSV
stuck open
EVAP VSV.....CLOSE
CCV.....CLOSE
VAPOR PRESS
.....762 mmHg-g
Time 015 seconds
Press [RIGHT]

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- (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

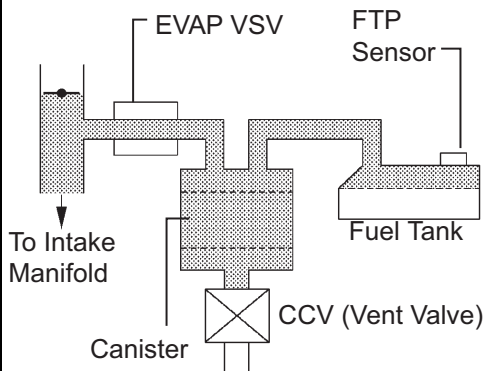
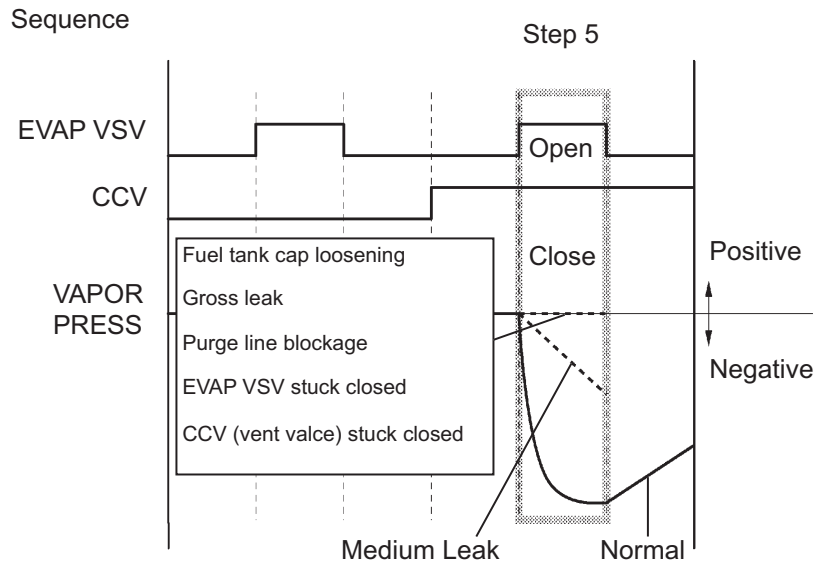
Go to step 14

OK

9

EVAP SYSTEM CHECK STEP 5 (APPLYING VACUUM)

- (a) Press RIGHT to go to step 5.

Step 5. Applying Vacuum**EVAP Pressure Change during System Check**

A097022E01

LEVII SYSTEM CHECK
Step 5. Applying vacuum

EVAP VSV.....OPEN
 CCV.....CLOSE
 VAPOR PRESS
740 mmHg-a
 Time 030 seconds
 Press [RIGHT]

P

A096686

(b) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).

Result

VAPOR PRESS	Conclusion	Proceed to
Lower than 748 mmHg-a (-14 mmHg-g)	Trouble area has not been found yet.	A
756 to 768 mmHg-a (-6 to 6 mmHg-g)	Following problems are suspected: <ul style="list-style-type: none"> 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

(1) If the pressure is lower than 740 mmHg-a (-22 mmHg-g).

NOTICE:

The intelligent tester closes the EVAP VSV.

LEVII SYSTEM CHECK
5. Applying vacuum

To avoid the damage,
 EVAP VSV was closed.
 EVAP VSV.....CLOSE
 CCV.....CLOSE
 VAPOR PRESS
740 mmHg-a
 Time 030 seconds
 Press [RIGHT]

P

A096687

ERROR

Scantool could not activate the VSV related to the EVAP system.

Please check the vehicle condition and try again.

Press [ENTER]

A085481

- (2) If the pressure is lower than 735 mmHg-a (-27 mmHg-g).

NOTICE:

The intelligent tester cancels the EVAP system check.

B

Go to step 15

C

Go to step 18

A

ES

10

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).

Step 6. Leak Check for EVAP System

EVAP Pressure Change during System Check

Sequence	Step 6
EVAP VSV	Close
CCV	Close
VAPOR PRESS	

A097023E01

LEVII SYSTEM CHECK

Step 6. Leak check for EVAP system

EVAP VSV.....CLOSE

CCV.....CLOSE

VAPOR PRESS

.....752 mmHg-g

Time 300 seconds

Press [RIGHT]

A096688

- (b) Wait for 300 seconds and check VAPOR PRESS (EVAP pressure).

Result

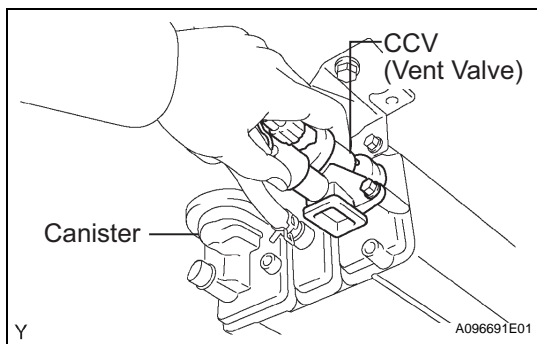
VAPOR PRESS	Conclusion	Proceed to
Less than 758 mmHg-a (-4 mmHg-g)	EVAP system is functioning normally.	OK
Higher than 758 mmHg-a (-4 mmHg-g)	Leakage	NG

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 intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
- (d) Touch the CCV and check the operation during switching the CCV.

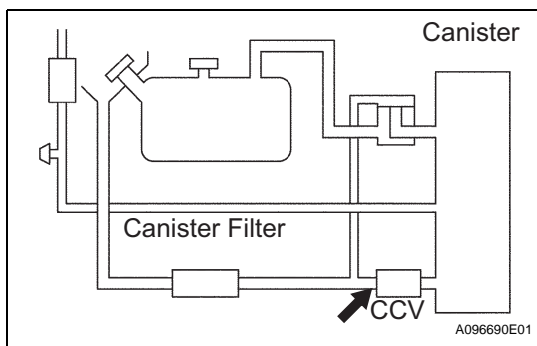
Result

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

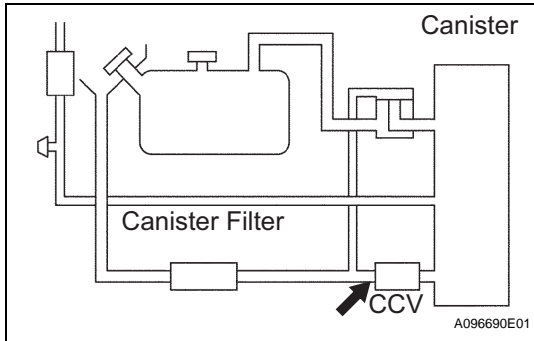
LEVII SYSTEM CHECK
Step 2. Check for CCV

EVAP VSV.....OPEN
CCV.....OPEN
VAPOR PRESS
.....762 mmHg-a
Time 030 seconds

Press [RIGHT]

A096683

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).

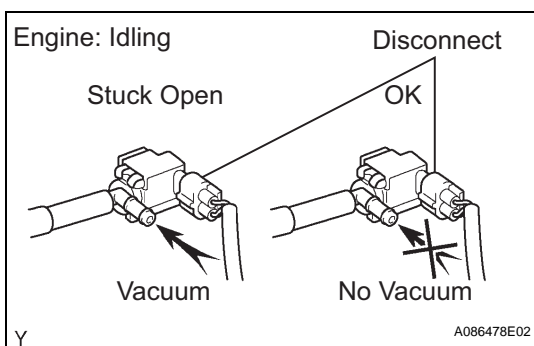
Result

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

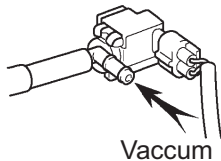
REPAIR IS COMPLETE

16

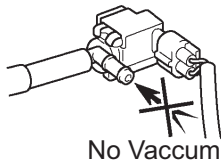
CHECK EVAP VSV (FOR EVAP VSV STUCK CLOSED)

If EVAP VSV is functioning normally:

VSV is ON



VSV is OFF



Y

A086478E03

- (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.

HINT:

The EVAP VSV can be tested with the EVAP Test Equipment (go to step 39).

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

NG

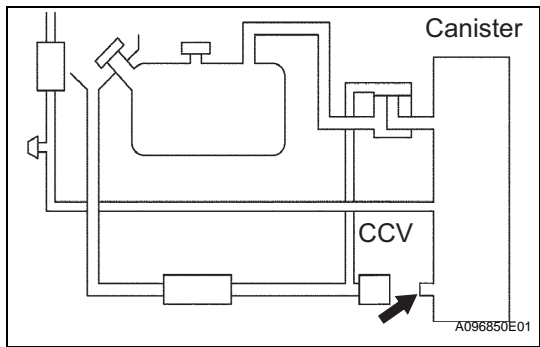
Go to step 31

OK

ES

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.

LEVII SYSTEM CHECK
Step 5. Applying vacuum

EVAP VSV.....OPEN
CCVCLOSE
VAPOR PRESS
.....740 mmHg-a
Time 030 seconds
Press [RIGHT]

P

A096686

- (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

B

Go to step 20

A

18

CHECK FUEL TANK CAP ASSEMBLY

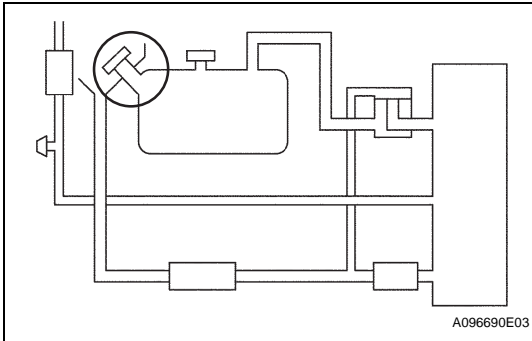
- (a) Remove the fuel tank cap and reinstall it until a few click sound is heard.
- (b) Clear the DTCs.
- (c) Check pending DTCs after the EVAP system check. If no pending DTC is set, the DTC(s) was set due to the fuel cap loosening.
If necessary, replace the fuel cap.

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.

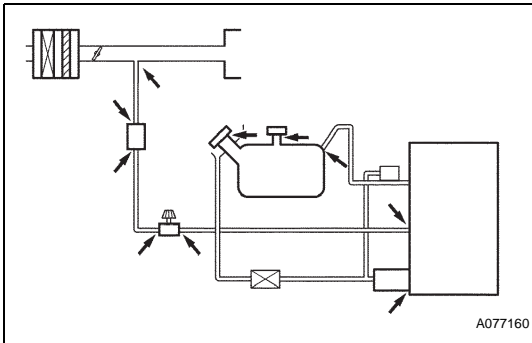
HINT:

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.

NG

REPLACE PURGE HOSE

OK

22 INSPECT CANISTER

NG

REPLACE CANISTER

OK

ES

23

INSPECT FULE 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.

OK

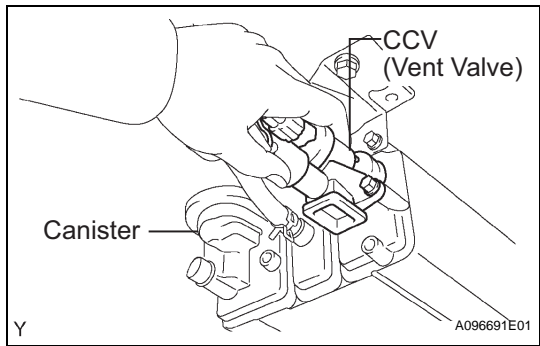
Go to step 40

NG

REPAIR OR REPLACE DEFECTIVE OR DAMAGED PARTS

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

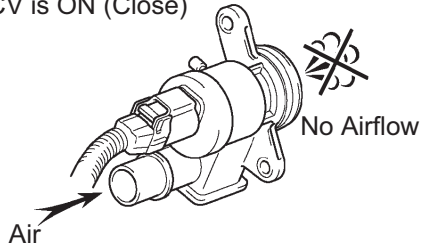
Go to step 26

A

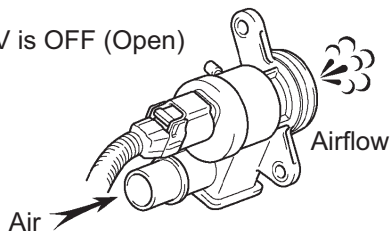
25 CHECK CCV

If CCV (vent valve) is functioning normally:

CCV is ON (Close)



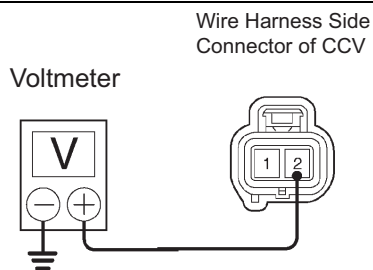
CCV is OFF (Open)



- (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

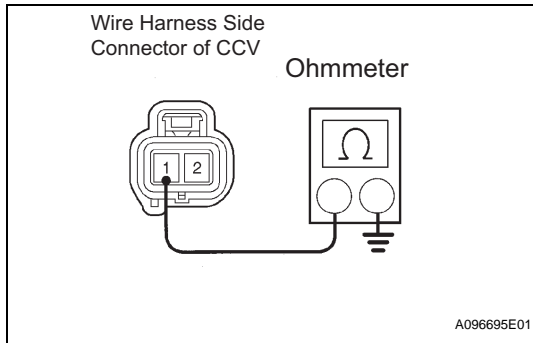
B**REPLACE CCV****A****26 CHECK WIRE HARNESS AND CONNECTOR (CCV - POWER SOURCE)**

- (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

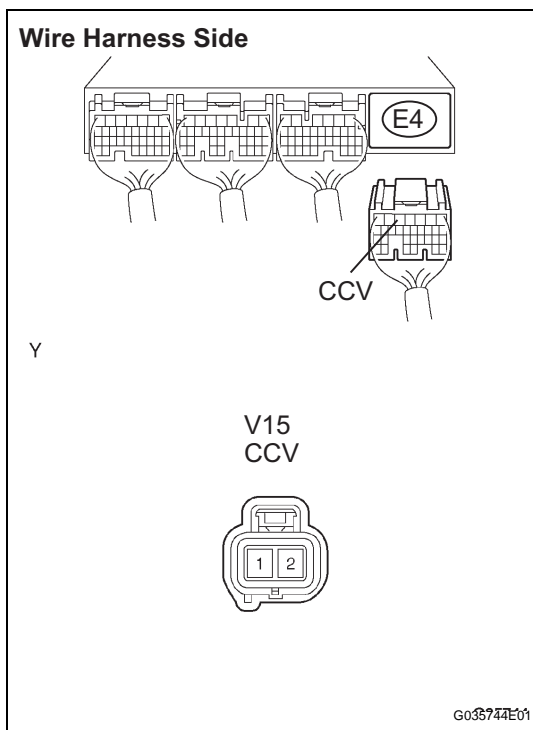
NG**REPAIR OR REPLACE WIRE HARNESS****OK****ES**

27 CHECK WIRE HARNESS AND CONNECTOR (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 k Ω 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

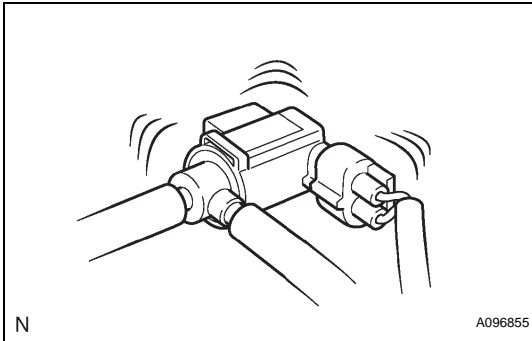
NG**Go to step 28****OK****REPLACE CCV****28 CHECK WIRE HARNESS AND CONNECTOR (CCV - ECM)**

- (a) Check the wire harness between the ECM and CCV.
- (b) Turn the ignition switch OFF.
- (c) Disconnect the E4 ECM connector.
- (d) Measure the resistance between the CCV and ECM wire harness side connectors.

Resistance

Tester Connection	Specified Condition
E4-5 (CCV) - V5-1	Below 1 Ω
V5-1 - Body ground	10 k Ω or higher

NG**REPAIR OR REPLACE HARNESS AND CONNECTOR****OK****CHECK AND REPLACE ECM**

29 CHECK EVAP VSV

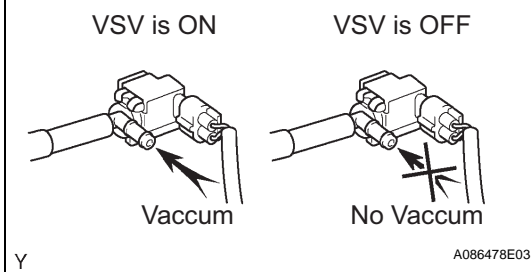
- Turn the ignition switch ON.
- Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV (Alone).
- Listen to click sounds to check the EVAP VSV operation.

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**

If EVAP VSV is functioning normally:



- Disconnect the purge hose of the canister from the EVAP VSV.
- Start the engine.
- Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV.
- 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

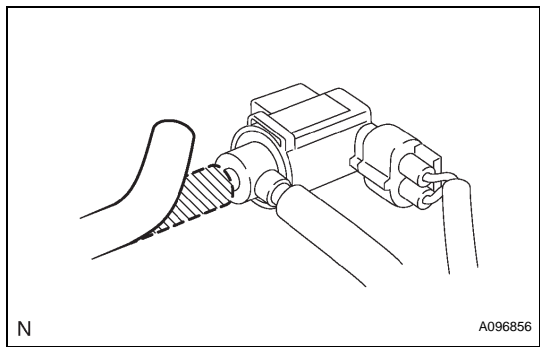
HINT:

The EVAP VSV can be tested with the EVAP Test Equipment (go to step 39).

NG**Go to step 32****OK****ES**

31

CHECK PURGE LINE (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

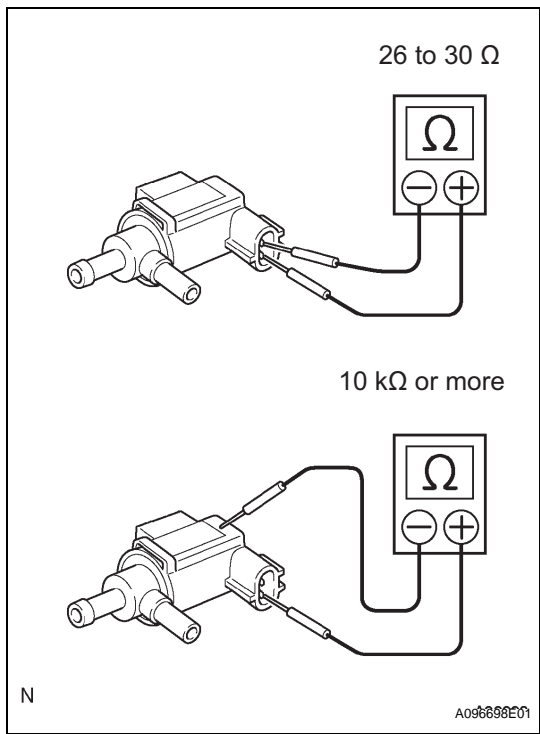
REPLACE PURGE HOSE

OK

REPLACE EVAP VSV

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 k Ω or more

NG

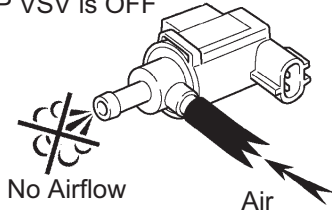
REPLACE EVAP VSV

OK

33 INSPECT EVAP VSV

If EVAP VSV is functioning normally:

EVAP VSV is OFF



N

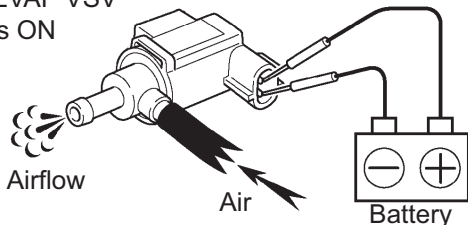
A096920E01

- (a) Remove the EVAP VSV.
- (b) Apply air to the EVAP VSV using an air gun, check the airflow.

ES

If EVAP VSV is functioning normally:

EVAP VSV
is ON



N

A096700E01

- (c) Apply battery positive voltage across the terminals.
- (d) Apply air to the EVAP VSV using an air gun, check the airflow.

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.	EVAP VSV is malfunctioning.	NG

NG**REPLACE EVAP VSV****OK****34 CHECK WIRE HARNESS AND CONNECTOR (EVAP VSV - POWER SOURCE)**

Wire Harness Side Connector of EVAP VSV



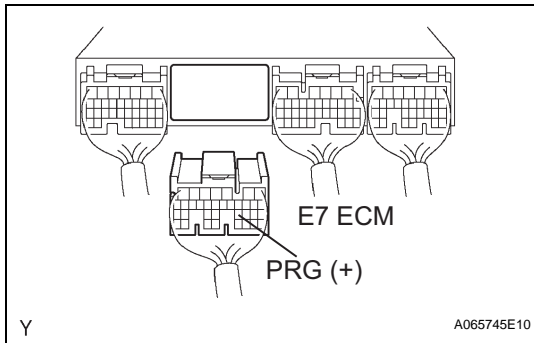
A096692E01

- (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 HARNESS AND CONNECTOR****OK**

35 CHECK WIRE HARNESS AND CONNECTOR (EVAP VSV - ECM)

- (a) Turn the ignition switch OFF.
- (b) Disconnect the E7 ECM connector.
- (c) Turn the ignition switch ON.
- (d) Measure the voltage between the terminal 23 of the wire harness side and body ground.

Voltage

Tester connection	Specified condition
E7-23 (PRG) - Body ground	9 to 14 V

NG**REPAIR OR REPLACE HARNESS AND CONNECTOR****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 FULE 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:

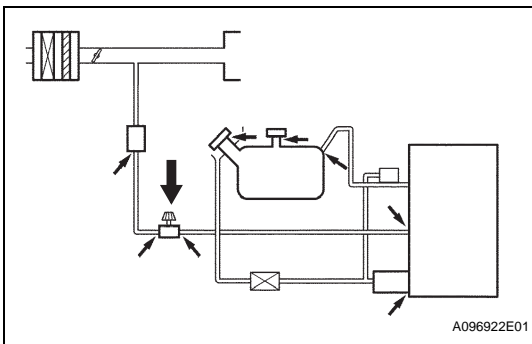
The EVAP system keeps the pressure that is 15 mmHg or higher.

NG

Go to step 38

OK

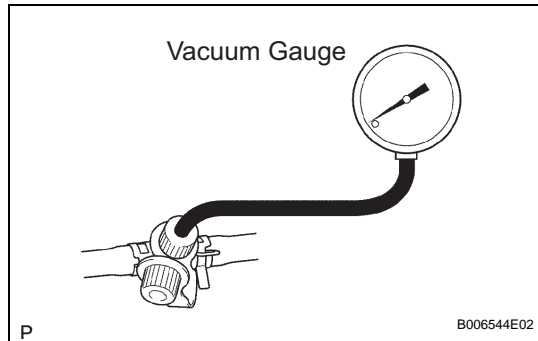
NO LEAKAGE IN EVAP SYSTEM

38 LOCK 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).
- (c) Check that the monitor result is PASS.
- (d) Confirm no pending DTC.

NEXT**REPAIR IS COMPLETE**

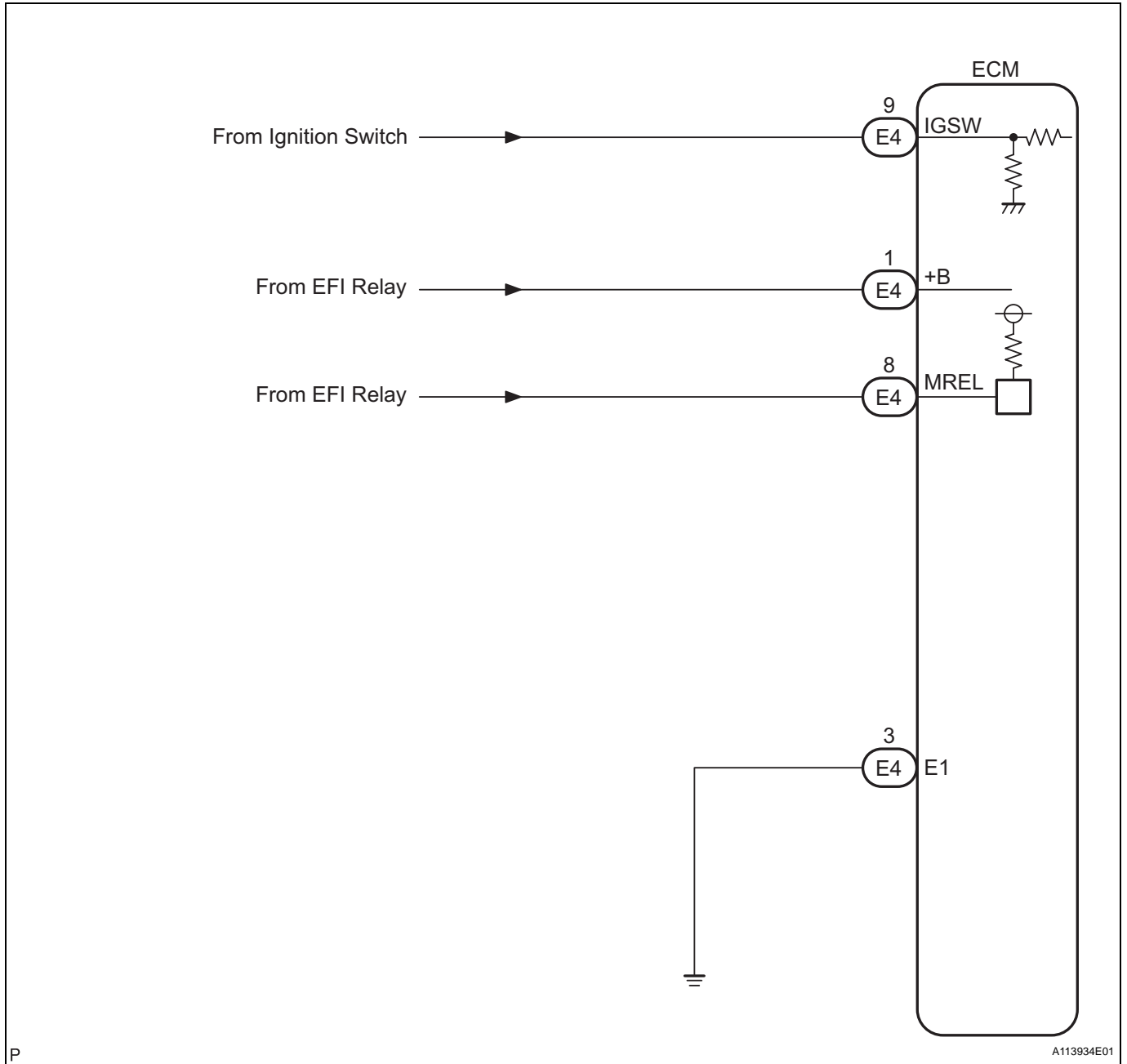
ECM Power Source Circuit

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.

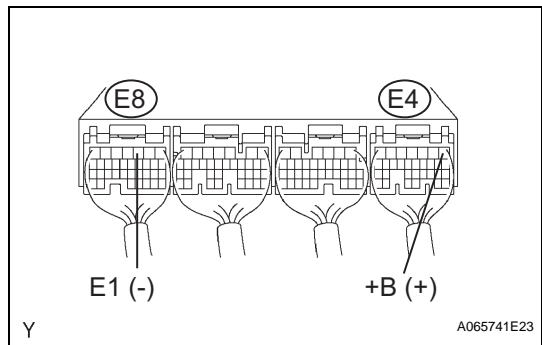
If the ignition switch is turned OFF, the ECM holds the EFI relay ON for a maximum of 2 seconds to allow the initial setting of the throttle valve.

WIRING DIAGRAM



1

CHECK ECM (+B VOLTAGE)



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

Tester Connection	Specified Condition
E4-1 (+B) - E8-3 (E1)	9 to 14 V

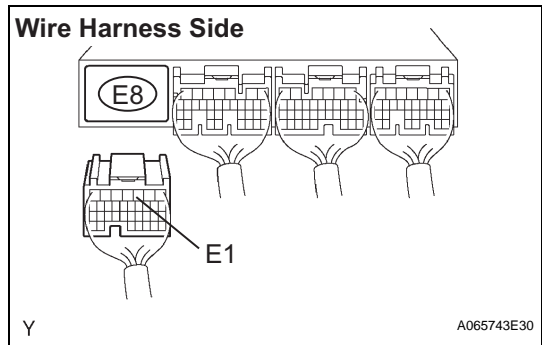
OK

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN ON PROBLEM SYMPTOMS TABLE

NG

2

CHECK WIRE HARNESS (ECM - BODY GROUND)



- (a) Disconnect the E8 ECM connector.
(b) Measure the resistance of the wire harness side connectors.
Resistance

Tester Connection	Specified Condition
E8-3 (E1) - Body ground	Below 1 Ω

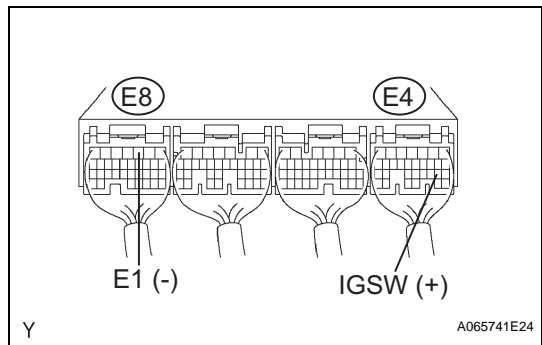
NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

3

CHECK ECM (IGSW VOLTAGE)



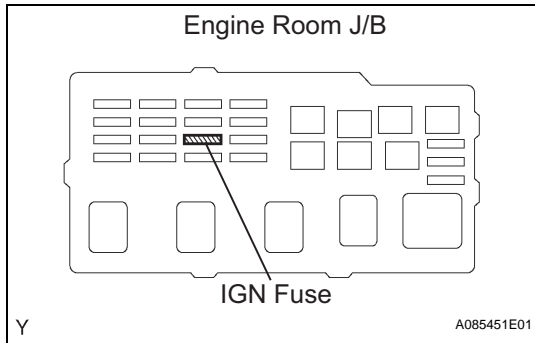
- (a) Turn the ignition switch ON.
(b) Measure the voltage of the E4 and E8 ECM connectors.
Voltage

Tester Connection	Specified Condition
E4-9 (IGSW) - E8-3 (E1)	9 to 14 V

OK

Go to step 6

NG

4 INSPECT IGN FUSE

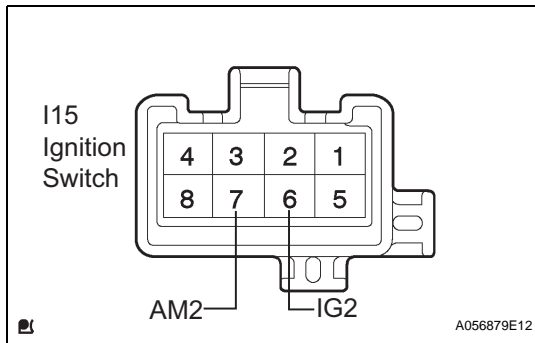
- (a) Remove the IGN fuse from the engine room J/B.
 (b) Measure the resistance of the IGN fuse.

Resistance:
Below 1 Ω

NG

REPLACE IGN FUSE

OK

5 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY

- (a) Measure the resistance of the ignition switch terminals.

Resistance

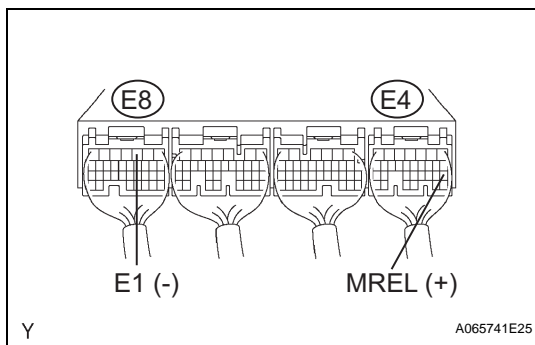
Tester Condition	Switch Condition	Specified Condition
6 (IG2) - 7 (AM2)	LOCK	10 k Ω or higher
6 (IG2) - 7 (AM2)	ON	Below 1 Ω

NG

REPLACE IGNITION OR STARTER SWITCH ASSEMBLY

OK

CHECK AND REPAIR HARNESS AND CONNECTOR (BATTERY - IGNITION SWITCH, IGNITION SWITCH - ECM)

6 CHECK 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) - E8-3 (E1)	9 to 14 V

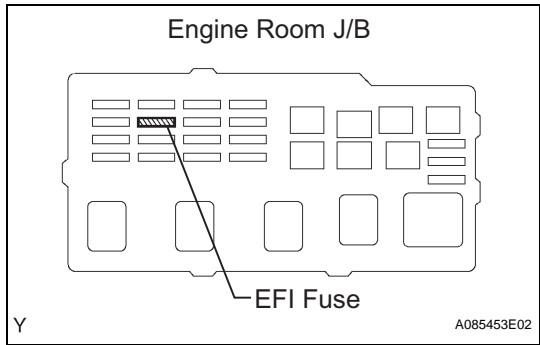
NG

REPLACE ECM

OK

7

INSPECT 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

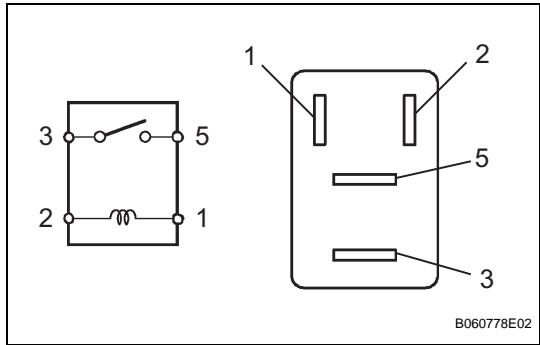
NG

INSPECT EFI 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.

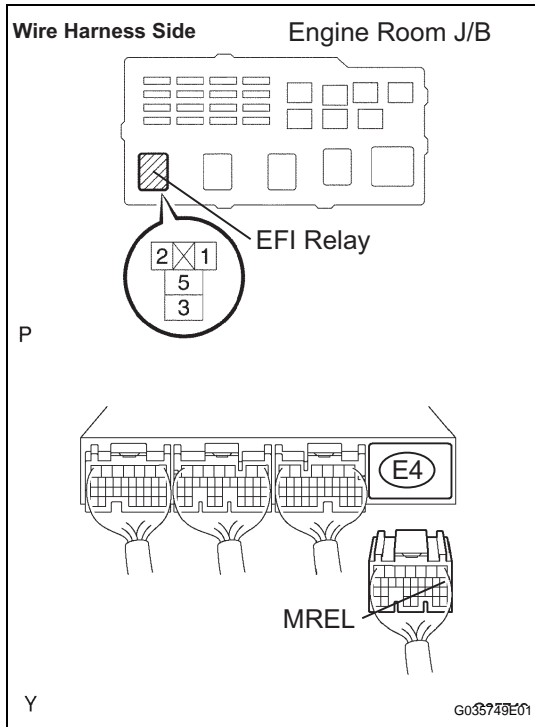
Resistance

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

NG

REPLACE EFI 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 k Ω 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 of the wire harness side connector.

Resistance

Tester Connection	Specified Condition
J/B EFI relay terminal 2 - Body ground	Below 1 Ω

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

CHECK AND REPAIR HARNESS AND CONNECTOR (TERMINAL +B OF ECM - BATTERY POSITIVE TERMINAL)

ES

Fuel Pump Control Circuit

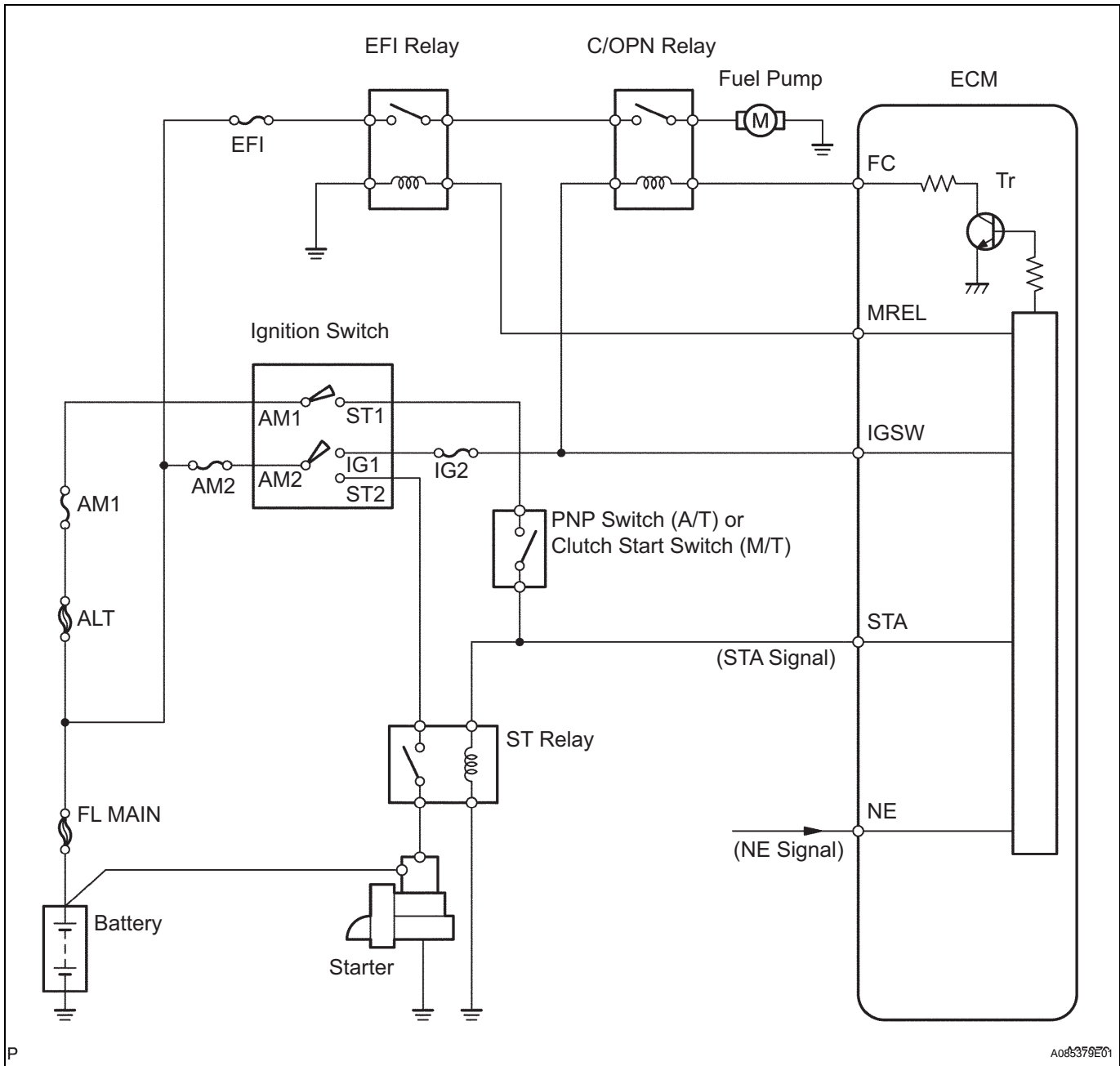
DESCRIPTION

When the engine is cranked, current flows from the ignition switch terminal ST1 to the starter relay coil (marking: ST), and current flows to terminal STA of ECM (STA signal).

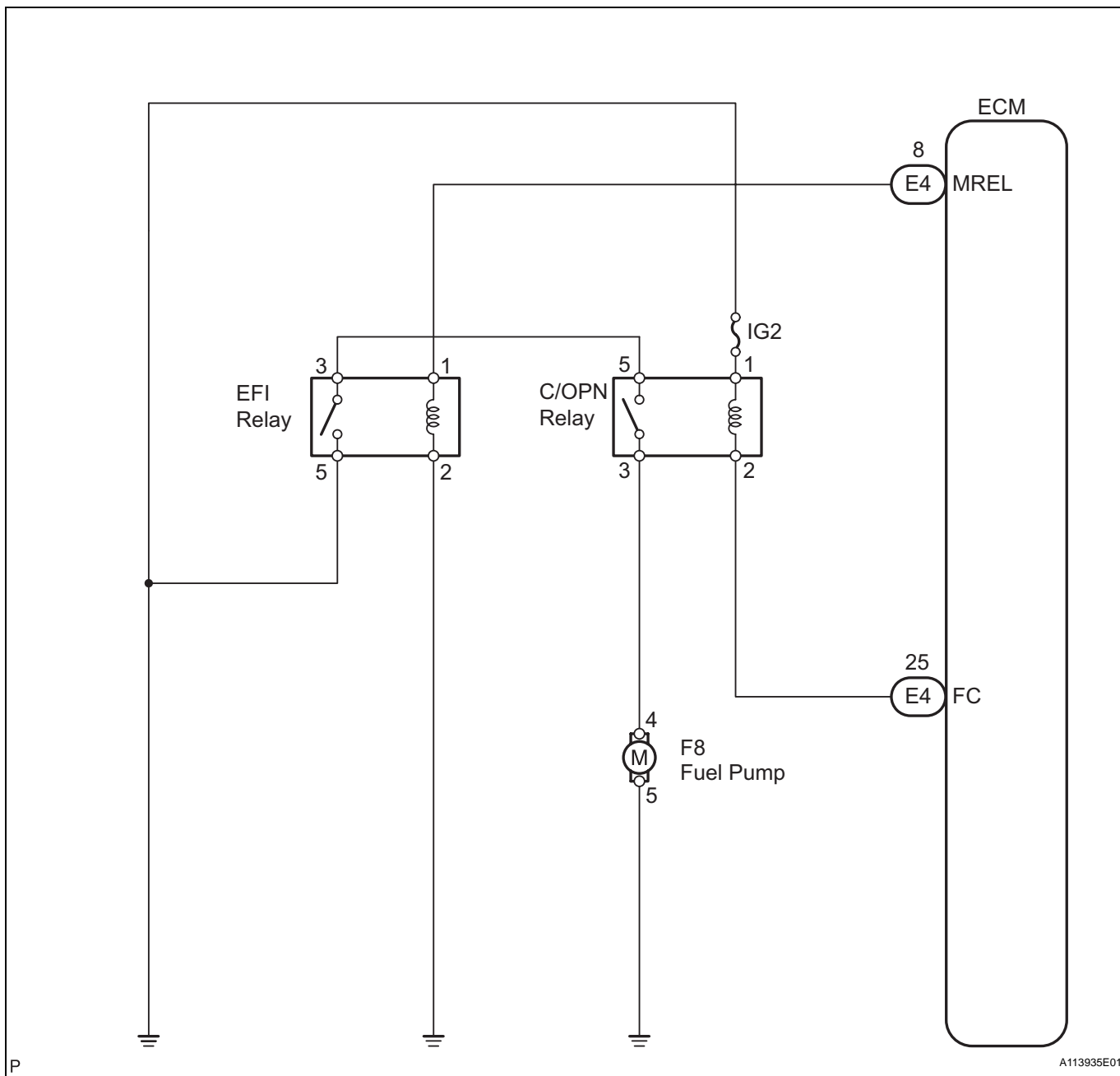
When the STA signal and NE signal are input to the ECM, Tr is turned ON, current flows to coil of the circuit opening relay (marking: C/OPN), the relay switches ON, power is supplied to the fuel pump and the fuel pump operates.

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.

ES



WIRING DIAGRAM



ES

1 PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE C/OPN RELAY)

- Connect the intelligent tester to the DLC3.
- Turn ON the ignition switch, push the intelligent tester or the OBD II scan tool main switch ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / FUEL PUMP / SPD.
- Check the relay operation while operating it using the intelligent tester.

Standard:

Operating noise can be heard from the relay.

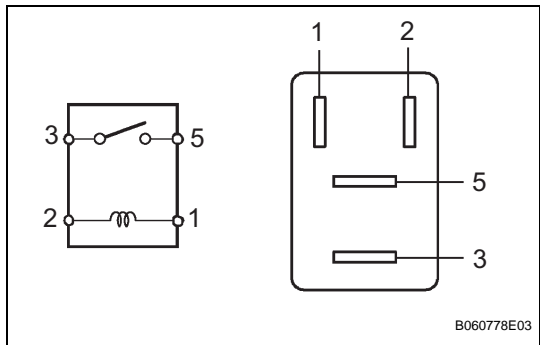
OK

Go to step 5

NG

2

INSPECT CIRCUIT OPENING 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)

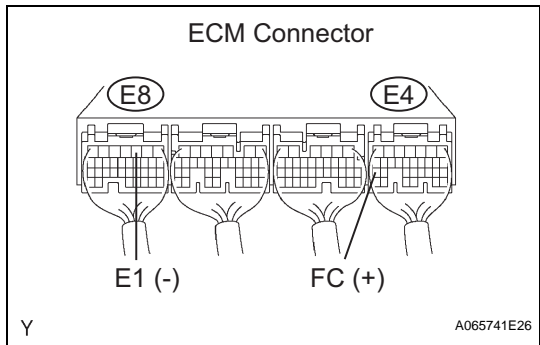
NG

REPLACE CIRCUIT OPENING 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
E4-25 (FC) - E8-3 (E1)	9 to 14 V

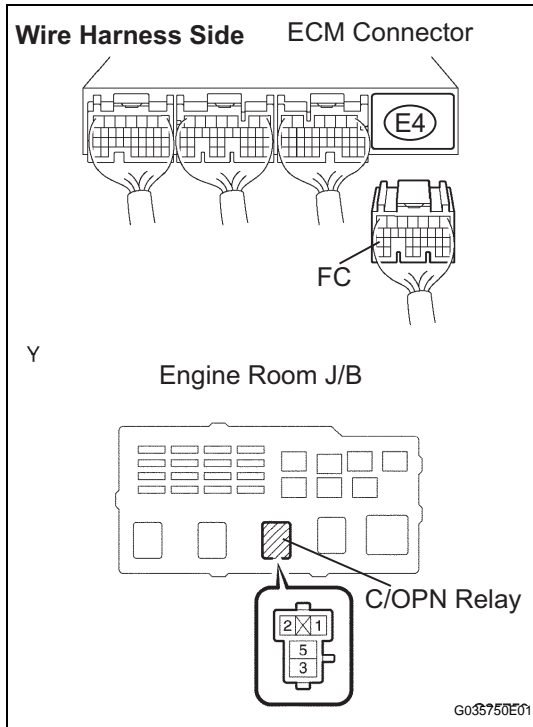
OK

REPLACE ECM

NG

4

CHECK WIRE HARNESS (ECM - C/OPN RELAY, C/OPN RELAY - IGNITION SWITCH)



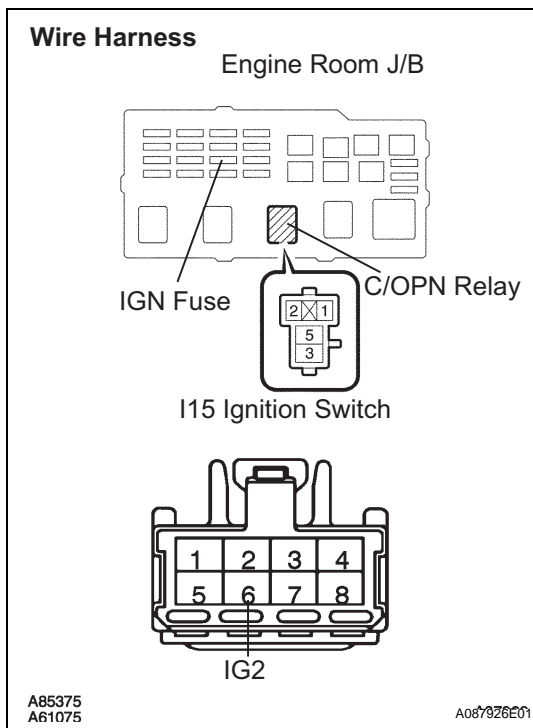
(a) Check the wire harness between the ECM and C/OPN relay.

- (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
E4-25 (FC) - J/B C/OPN relay terminal 2	Below 1 Ω
E4-25(FC) or J/B C/OPN relay terminal 2 - Body ground	10 k Ω or higher

ES



(b) Check the wire harness between the C/OPN relay and ignition switch.

- (1) Check the IGN fuse.
 - Remove the IGN fuse from the engine room J/B.
 - Check the resistance of the IGN fuse.

Resistance:**Below 1 Ω**

- Reinstall the IGN 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	Below 1 Ω
J/B C/OPN relay terminal 1 or I15-6 - Body ground	10 k Ω or higher

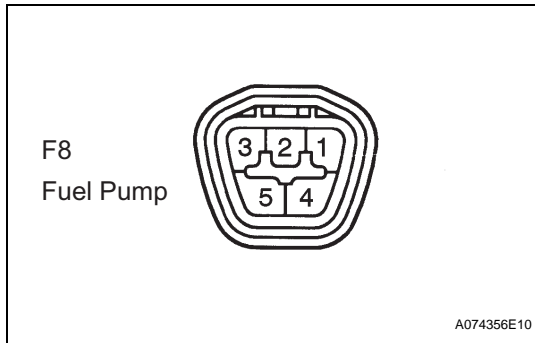
NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE ECM

5 INSPECT FUEL PUMP



- (a) Measure the resistance of the fuel pump.

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 terminals. Check that the pump operates.

NOTICE:

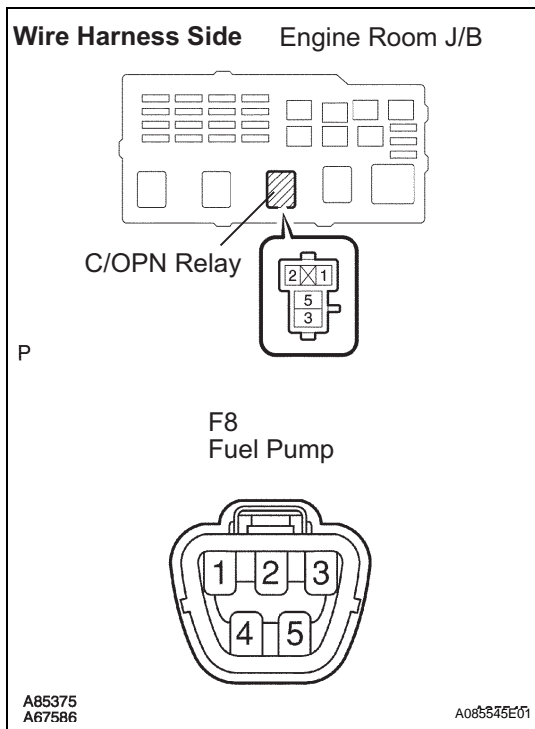
- These tests must be done quickly (within 10 seconds) to prevent the coil from burning out.
- Keep the fuel pump as far away from the battery as possible.
- Always turn ON and OFF the voltage on the battery side, not the fuel pump side.

NG

REPLACE FUEL PUMP

OK

6 CHECK WIRE HARNESS (C/OPN RELAY - FUEL PUMP, FUEL PUMP - BODY GROUND)



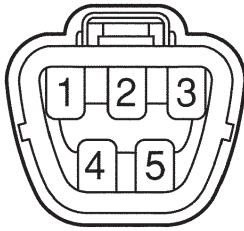
- (a) Check the wire harness between the C/OPN relay and fuel pump.

- (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 k Ω or higher

Wire Harness Side

F8
Fuel Pump

P

A067586E01

- (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 - Body ground	Below 1 Ω

OK

REPAIR OR REPLACE HARNESS AND CONNECTOR

NG

ES

REPLACE 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.

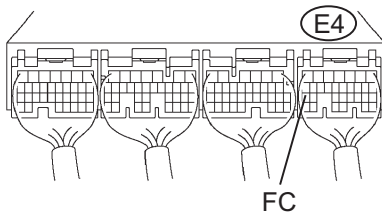
OK

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN ON PROBLEM SYMPTOMS TABLE

NG

2 CHECK CIRCUIT OPENING RELAY OPERATION

ECM Connector



Y

A065741E27

- (a) Connect terminal FC of the ECM connector and body ground, and check relay operation.

Standard:

Noise can be heard from the C/OPN relay.

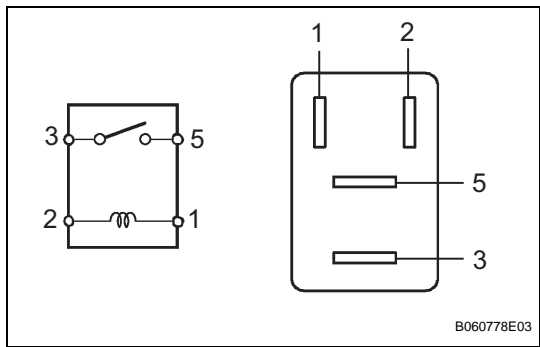
OK

Go to step 6

NG

3

INSPECT CIRCUIT OPENING 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)

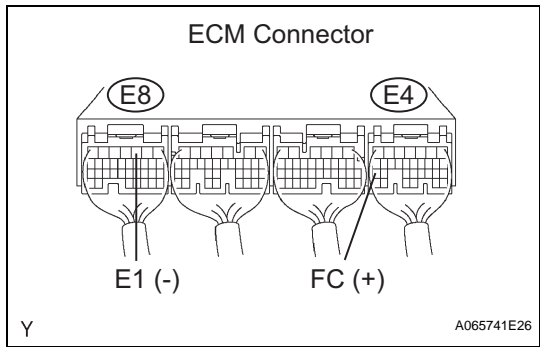
NG

REPLACE CIRCUIT OPENING 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
E4-25 (FC) - E8-3 (E1)	9 to 14 V

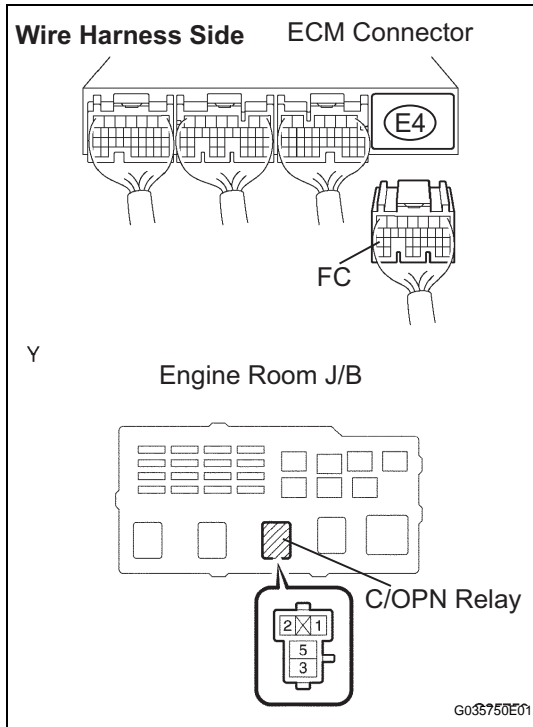
OK

REPLACE ECM

NG

5

CHECK WIRE HARNESS (ECM - C/OPN RELAY, C/OPEN RELAY - IGNITION SWITCH)



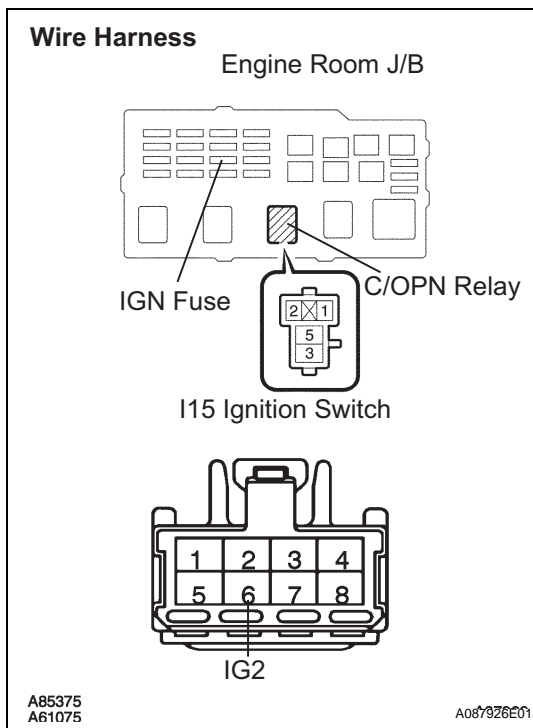
(a) Check the wire harness between the ECM and C/OPN relay.

- (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
E4-25 (FC) - J/B C/OPN relay terminal 2	Below 1 Ω
E4-25 (FC) or J/B C/OPN relay terminal 2 - Body ground	10 k Ω or higher

ES



(b) Check the wire harness between the C/OPN relay and ignition switch.

- (1) Check the IGN fuse.
 - Remove the IGN fuse from the engine room J/B.
 - Measure the resistance of the IGN fuse.

Resistance:**Below 1 Ω**

- Reinstall the IGN 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 k Ω or higher

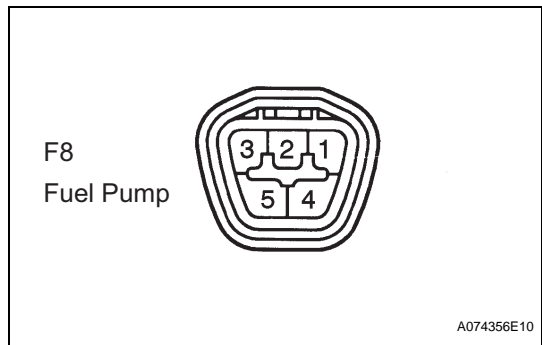
NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE ECM

6INSPECT FUEL PUMP



- (a) Measure the resistance of the fuel pump.
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.

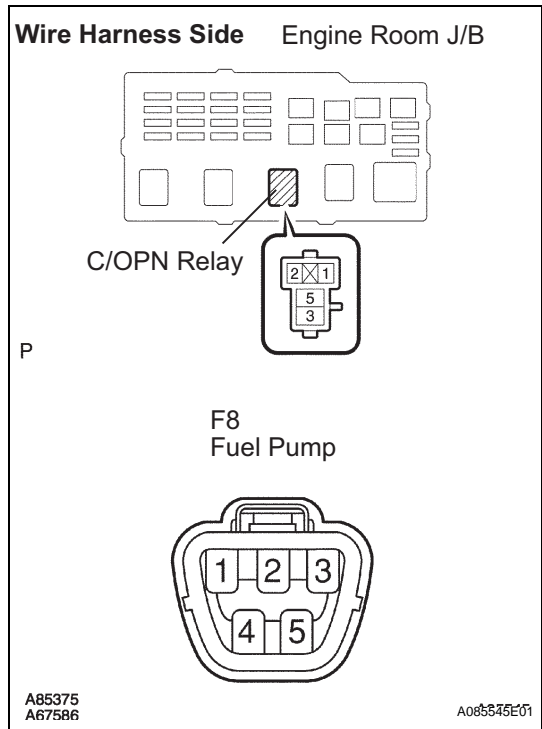
NOTICE:

- 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.

NGREPLACE FUEL PUMP

OK

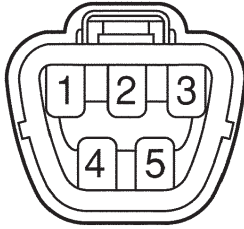
7CHECK WIRE HARNESS (C/OPN RELAY - FUEL PUMP, FUEL PUMP - BODY GROUND)



- (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

Wire Harness SideF8
Fuel Pump

P

A067586E01

(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**

MIL Circuit

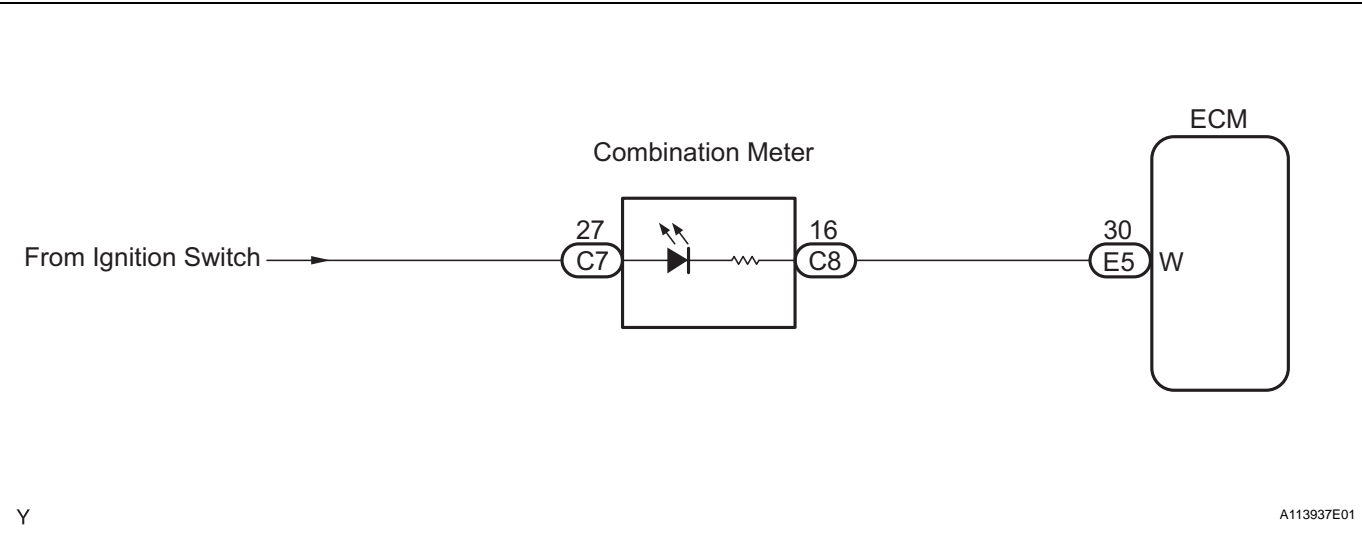
DESCRIPTION

The Malfunction Indicator Light (MIL) is used to indicate the ECM's detection of a vehicle malfunction. The instrument panel IG2 fuse provides 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 trouble 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

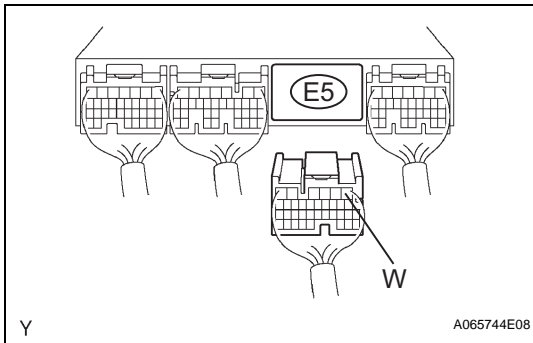
- (a) Connect the intelligent tester or the OBD II scan tool to the DLC 3.
- (b) Turn the ignition switch ON and push the intelligent tester or the OBD II scan tool main switch ON.
- (c) Read the DTC.
- (d) Clear the DTC (See page ES-28).
- (e) Check that the MIL is not illuminated.

Standard:
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 MIL is not illuminated.

Standard:**MIL is not illuminated****OK****REPLACE ECM****NG****ES****CHECK AND REPLACE HARNESS AND CONNECTOR****3 CHECK THAT MIL IS ILLUMINATED**

- (a) Check that the MIL is illuminated when turning the ignition switch ON.

Standard:**MIL is illuminated****OK****SYSTEM OK****NG****4 INSPECT COMBINATION METER ASSEMBLY (MIL CIRCUIT)**

- (a) See the combination meter troubleshooting (See page [ME-11](#)).

NG**REPAIR OR REPLACE BULB OR
COMBINATION METER ASSEMBLY****OK****CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER - ECM)**

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 report any detected abnormalities with Diagnostic Trouble Codes (DTCs). 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. From the "ENHANCED OBD II" menu, select "MONITOR STATUS" to view the readiness monitor status.
- A generic OBD II scan tool can also be used to view the readiness monitor status.
- When the readiness monitor status reads "complete", the necessary conditions have been met for running performance tests for that readiness monitor.

HINT:

Many state Inspection and Maintenance (I/M) programs require a vehicle's readiness monitor status to show "complete".

- The Readiness Monitor will be reset to "incomplete" if:
 - (a) The ECM has lost battery power or blown a fuse.
 - (b) DTCs have been cleared.
 - (c) The conditions for running the Readiness Monitor have not been met.
- If the readiness monitor status shows "incomplete", follow the appropriate readiness monitor drive pattern to change the status to "complete".

CAUTION:

Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

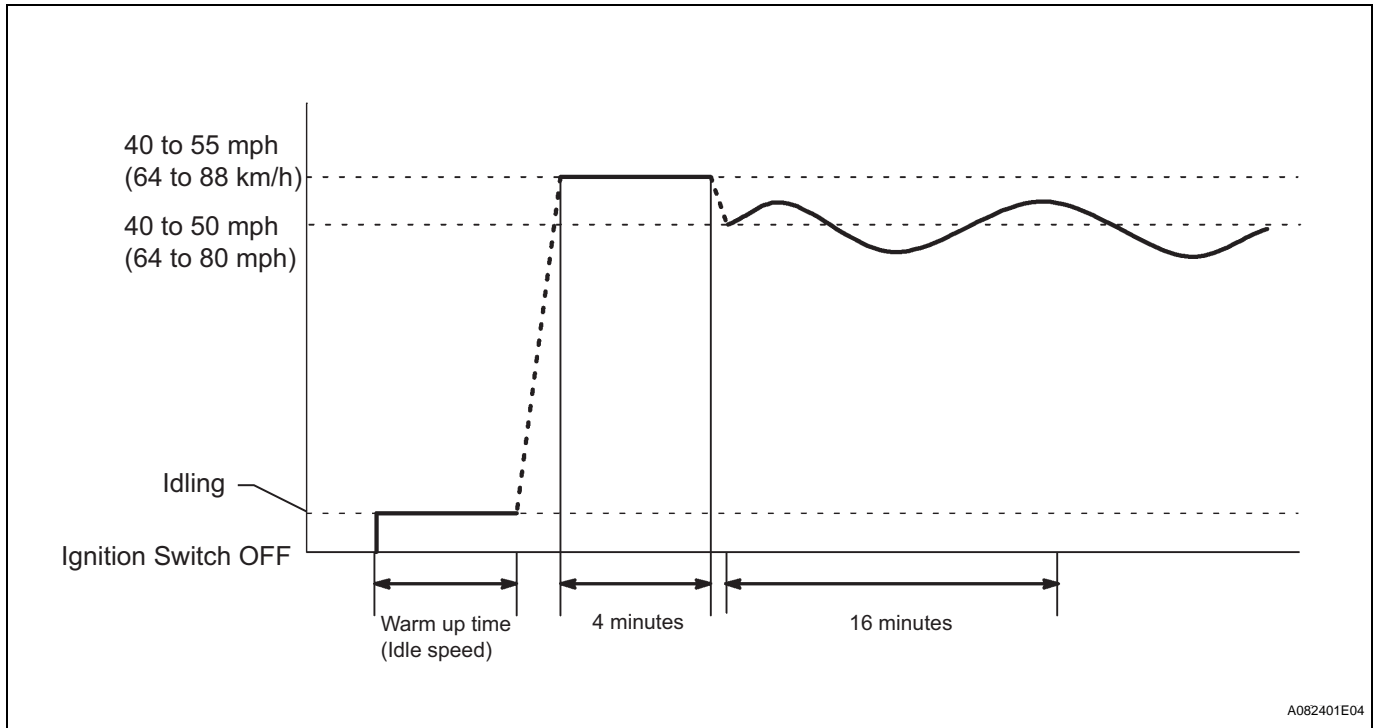
NOTICE:

The following drive patterns are the fastest method of completing all the requirements necessary for making the readiness monitor status read "complete".

If forced to momentarily stop a drive pattern due to traffic or other factors, the drive pattern can be resumed. Upon completion of the drive pattern, in most cases, the readiness monitor status will change to "complete".

Sudden changes in vehicle load and speed, such as driving up and down hills and / or sudden acceleration, hinder readiness monitor completion.

2. CATALYST MONITOR (A/F SENSOR TYPE)



A082401E04

(a) Preconditions

The monitor will not run unless:

- The MIL is OFF.
- Engine Coolant Temperature (ECT) is 75°C (167°F) or greater.
- Intake Air Temperature (IAT) is -10°C (14°F) or greater.

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

- (1) Connect the OBD II scan tool to the DLC3 to check readiness monitor status and preconditions (refer to step (a)).
- (2) Drive vehicle at 40 to 55 mph (64 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 40 to 55 mph (64 to 88 km/h) for an additional 4 minutes.

- (3) Drive vehicle allowing speed to fluctuate between 40 to 50 mph (64 to 80 km/h) for about 16 minutes.

NOTICE:

Drive with smooth throttle operation and avoid sudden closure of the throttle.

- (4) Check the status of the readiness monitor on the scan tool display. If readiness monitor status did not switch to complete, ensure preconditions are met, turn the ignition 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

The monitor will not run unless:

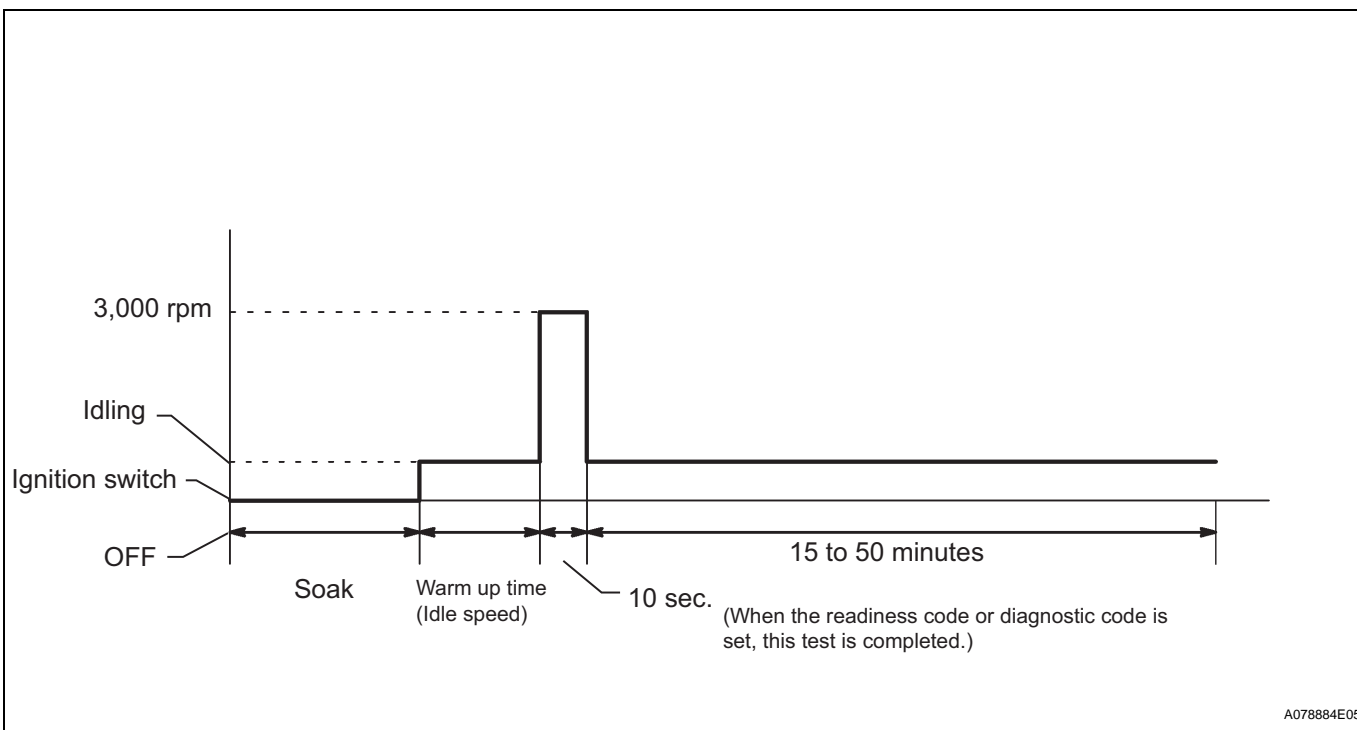
- The MIL is OFF.
- Fuel level is approximately 1/2 to 3/4 full.
- Altitude is 2,400 m (7,800 feet) or less.

(b) Cold Soak Procedure

Let vehicle cold soak for 8 hours or until "IAT - ECT" is 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).



(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 7,800 feet (2,400 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 "a").
- (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. AIR-FUEL RATIO (A/F) AND HEATED OXYGEN (HO2) SENSOR MONITORS (ACTIVE AIR-FUEL RATIO CONTROL TYPE)

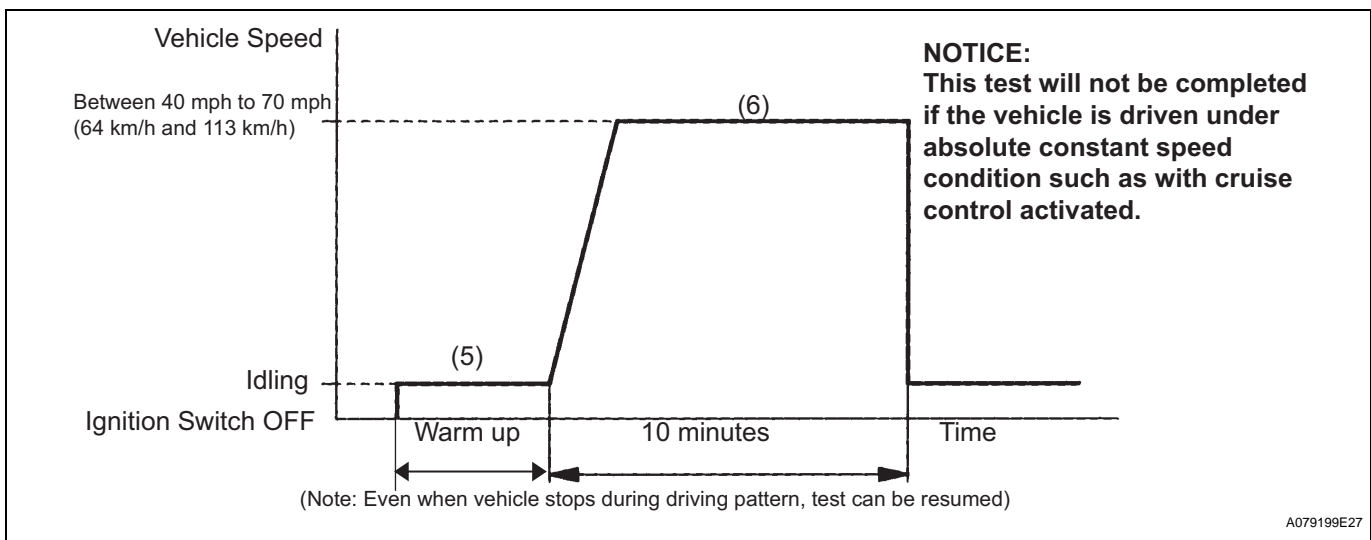
(a) Preconditions

The monitor will not run unless:

- The MIL is OFF.

(b) Drive Pattern

- (1) Connect the intelligent tester or OBD II scan tool to the DLC3.
- (2) Turn the ignition switch to ON.
- (3) Turn the tester or scan tool ON.
- (4) Clear DTCs (where set) (See page [ES-28](#)).
- (5) Start the engine and warm it up.
- (6) Drive the vehicle at between 40 mph and 70 mph (64 km/h and 113 km/h) for at least 10 minutes.



(c) Monitor Status

- (1) Check the Readiness Monitor status displayed on the tester or scan tool.
- (2) If the status does not switch to COMPL (complete), extend the driving time.

5. OXYGEN / A/F SENSOR HEATER MONITOR

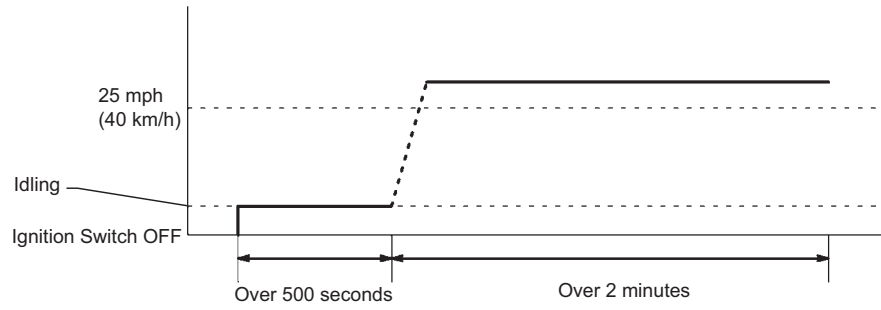
(a) Preconditions

The monitor will not run unless:

- 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 "a").
- (2) Start the engine and allow it to idle for 500 seconds or more.
- (3) Drive the vehicle at 25 mph (40 km/h) or more for at least 2 minutes.
- (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).



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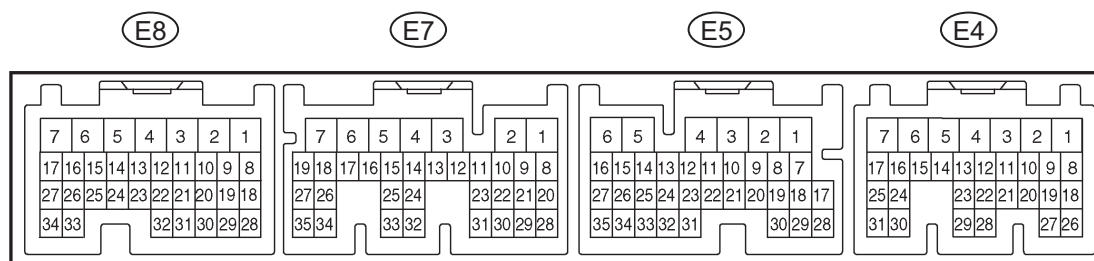
ES

PROBLEM SYMPTOMS TABLE

SFI SYSTEM (2AZ-FE)

Symptom	Suspected area	See page
Engine does not crank (does not start)	1.Starter	ST-7
	2.ST relay	ST-3
	3.Park/neutral position switch	AX-39
No initial combustion (does not start)	1.ECM power source circuit	ES-309
	2.Fuel pump control circuit	ES-314
	3.ECM	-
No complete combustion (does not start)	1.Fuel pump control circuit	ES-314
Difficult to start (engine cranks normally)	1.Starter signal circuit	ES-217
	2.Fuel pump control circuit	ES-314
	3.Compression	EM-2
Difficult to start with cold engine	1.Starter signal circuit	ES-217
	2.Fuel pump control circuit	ES-314
Difficult to start with hot engine	1.Starter signal circuit	ES-217
	2.Fuel pump control circuit	ES-314
High engine idle speed (poor idling)	1.A/C signal circuit (Compressor circuit)	AC-88
	2.ECM power source circuit	ES-309
Low engine idle speed (poor idling)	1.A/C signal circuit (Compressor circuit)	AC-88
	2.Fuel pump control circuit	ES-314
Rough idling (poor idling)	1.Compression	EM-2
	2.Fuel pump control circuit	ES-314
Hunting (poor idling)	1.ECM power source circuit	ES-309
	2.Fuel pump control circuit	ES-314
Hesitation/Poor acceleration (poor driveability)	1.Fuel pump control circuit	ES-314
	2.A/T faulty	AX-8
Surging (poor driveability)	1.Fuel pump control circuit	ES-314
Engine stalls soon after starting	1.Fuel pump control circuit	ES-314
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



Y

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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 "Specified 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 (E8-3)	B-Y - BR	Battery (for measuring battery voltage and for ECM memory)	Always	9 to 14 V
+BM (E4-7) - E1 (E8-3)	L-R - BR	Power source of throttle motor	Always	9 to 14 V
IGSW (E4-9) - E1 (E8-3)	B-O - BR	Ignition switch	Ignition switch ON	9 to 14 V
+B (E4-1) - E1 (E8-3)	B-W - BR	Power source of ECM	Ignition switch ON	9 to 14 V
OC1+ (E8-13) - OC1- (E8-12)	B-W - Y	Camshaft timing oil control valve (OCV)	Ignition switch ON	Pulse generation (See page ES-45)
MREL (E4-8) - E1 (E8-3)	B-W - BR	EFI relay	Ignition switch ON	9 to 14 V
VC (E8-18) - E2 (E8-28)	Y - BR	Power source of sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
VG (E7-28) - E2G (E7-30)	SB - L-W	Mass air flow meter	Idling, shift lever position P or N position, A/C switch OFF	0.5 to 3.0 V
THA (E7-29) - E2 (E8-28)	L-B - BR	Intake air temperature sensor	Idling, intake air temp. 20°C (68°F)	0.5 to 3.4 V
THW (E8-32) - E2 (E8-28)	SB - BR	Engine coolant temperature sensor	Idling, engine coolant temp. 80°C (176°F)	0.2 to 1.0 V
VTA1 (E8-20) - E2 (E8-28)	LG - BR	Throttle position sensor (for engine control)	<ul style="list-style-type: none"> Ignition switch ON, accelerator pedal released Ignition switch ON, accelerator pedal depressed 	0.3 to 1.0 V 3.2 to 4.9 V
VTA2 (E8-19) - E2 (E8-28)	B-R - BR	Throttle position sensor (for sensor malfunction detection)	<ul style="list-style-type: none"> Ignition switch ON, accelerator pedal released Ignition switch ON, accelerator pedal depressed 	2.1 to 3.1 V 4.5 to 5.5 V

ES

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	Specified Condition
VPA (E4-18) - EPA (E4-28)	L-Y - LG-B	Accelerator pedal position sensor (for engine control)	<ul style="list-style-type: none"> Ignition switch ON, accelerator pedal released Ignition switch ON, accelerator pedal depressed 	0.5 to 1.1 V 2.6 to 4.5 V
VPA2 (E4-19) - EPA2 (E4-21)	W-R - LG	Accelerator pedal position sensor (for sensor malfunction detection)	<ul style="list-style-type: none"> Ignition switch ON, accelerator pedal released Ignition switch ON, accelerator pedal depressed 	1.2 to 2.0 V 3.4 to 5.3 V
VCPA (E4-26) - EPA (E4-28)	V-Y - LG-B	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.5 V
VCP2 (E4-27) - EPA2 (E4-21)	B-R - LG	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.5 V
HA1A (E8-1) - E04 (E7-7)	B-R - W-B	A/F sensor heater	<ul style="list-style-type: none"> Idling Ignition switch ON 	Below 3.0 V 9 to 14 V
A1A+ (E8-21) - E1 (E8-3)	O - BR	A/F sensor	Ignition switch ON	3.0 to 3.6 V
A1A- (E8-31) - E1 (E8-3)	W - BR	A/F sensor	Ignition switch ON	2.7 to 3.3 V
HT1B (E8-2) - E2 (E8-28)	L - BR	Heated oxygen sensor heater	<ul style="list-style-type: none"> Idling Ignition switch ON 	Below 3.0 V 9 to 14 V
OX1B (E8-25) - E2 (E8-28)	BR - BR	Heated oxygen sensor	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
#10 (E8-6) - E01 (E8-7) #20 (E8-5) - E01 (E8-7) #30 (E8-4) - E01 (E8-7) #40 (E8-3) - E01 (E8-7)	L - W-B R - W-B Y - W-B W - W-B	Injector	<ul style="list-style-type: none"> Ignition switch ON Idling 	9 to 14 V Pulse generation (See page ES-135)
KNK1 (E8-29) - EKNK (E8-30)	W - B	Knock sensor	Maintain engine speed at 4,000 rpm after warming up	Pulse generation (See page ES-149)
G2+ (E8-26) - NE- (E8-34)	L - G	Camshaft position sensor	Idling	Pulse generation (See page ES-153)
NE+ (E8-27) - NE- (E8-34)	R - G	Crankshaft position sensor	Idling	Pulse generation (See page ES-153)
IGT1 (E8-17) - E1 (E8-3) IGT2 (E8-16) - E1 (E8-3) IGT3 (E8-15) - E1 (E8-3) IGT4 (E8-14) - E1 (E8-3)	R-W - BR P - BR LG-B - BR L-Y - BR	Ignition coil with igniter (ignition signal)	Idling	Pulse generation (See page ES-161)
IGF1 (E8-23) - E1 (E8-3)	W-R - BR	Ignition coil with igniter (ignition confirmation signal)	<ul style="list-style-type: none"> Ignition switch ON Idling 	4.5 to 5.5 V Pulse generation (See page ES-161)
PRG (E7-23) - E1 (E8-3)	B-R - BR	EVAP VSV	Ignition switch ON	9 to 14 V
SPD (E5-8) - E1 (E8-3)	V-W - BR	Speed signal from combination meter	Ignition switch ON, rotate driving wheel slowly	Pulse generation (See page ES-198)
STA (E4-12) - E1 (E8-3)	B-W - BR	Starter signal	Shift lever position P or N, ignition switch START	9 to 14 V
STP (E5-12) - E1 (E8-3)	G-W - BR	Stop light switch	<ul style="list-style-type: none"> Brake pedal is depressed Brake pedal is released 	7.5 to 14 V Below 1.5 V
NSW (E4-30) - E1 (E8-3)	B-Y - BR	Park/neutral position switch	<ul style="list-style-type: none"> Ignition switch ON, shift position at P or N Ignition switch ON, shift position is not P or N 	0 to 3.0 V 9 to 14 V
M+ (E8-5) - ME01 (E7-3)	B - W-B	Throttle actuator	Idling	Pulse generation
M- (E8-4) - ME01 (E7-3)	W - W-B	Throttle actuator	Idling	Pulse generation
FC (E5-25) - E1 (E8-3)	G-R - BR	Fuel pump control	Ignition switch ON	9 to 14 V
W (E5-30) - E1 (E8-3)	P - BR	MIL	<ul style="list-style-type: none"> Ignition switch ON Idling 	Below 3.0 V 9 to 14 V
ELS (E4-15) - E1 (E8-3)	G - BR	Electric load	<ul style="list-style-type: none"> Light control switch OFF Light control switch is in TAIL position 	0 to 1.5 V 9 to 14 V

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	Specified Condition
ELS2 (E5-3) - E1 (E8-3)	B-Y - BR	Electric load	<ul style="list-style-type: none"> Rear defogger switch OFF (Rear defogger system is not operating) Rear defogger switch ON (Rear defogger system is operating) 	0 to 1.5 V 9 to 14 V
TC (E5-17) - E1 (E8-3)	P-B - BR	Terminal TC of DLC 3	Ignition switch ON	9 to 14 V
SIL (E5-13) - E1 (E8-3)	W - BR	Terminal SIL of DLC3	During charge of gears	Pulse generation
TACH (E5-1) - E1 (E8-3)	W - BR	Engine speed	Idling	Pulse generation
CCV (E4-5) - E1 (E8-3)	G - BR	CCV	Ignition switch ON	9 to 14 V
PTNK (E4-31) - E2 (E8-28)	P - BR	Vapor pressure sensor	<ul style="list-style-type: none"> Ignition switch ON Apply vacuum 4.0 kPa (30 mmHg, 1.18 in.Hg) 	2.9 to 3.7 V Below 0.5 V
PSW (E7-32) - E1 (E8-3)	R-W - BR	P/S pressure switch	Ignition switch ON	9 to 14 V

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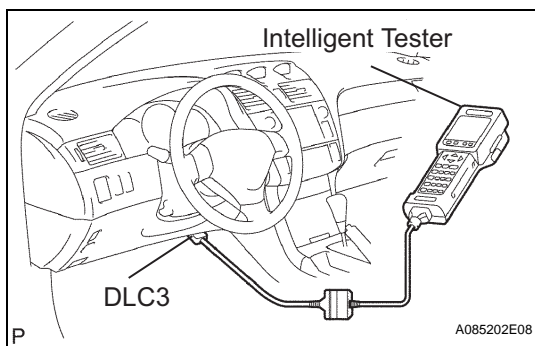
DIAGNOSIS SYSTEM

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 Light (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-36](#)).

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-36](#)).



- 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-29).
- * 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 stooped, 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.

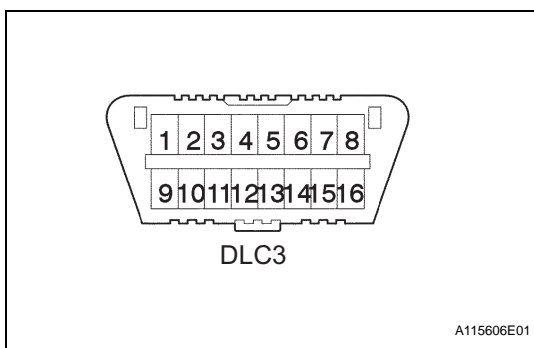
Priorities for troubleshooting:

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:

- DTCs other than fuel trim malfunction DTCs (P0171 and P0172) and misfire DTCs (P0300 to P0304).
- Fuel trim malfunction DTCs (P0171 and P0172).
- Misfire DTCs (P0300 to P0304).

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.



Symbol	Terminal No.	Name	Reference terminal	Result	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 positive	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**Voltage:****11 to 14 V**

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

4. CHECK MIL

- (a) The MIL turns ON when the ignition switch is turned ON and the engine is not running.

HINT:

If the MIL does not turn ON, troubleshoot the MIL circuit (See page [ES-324](#)).

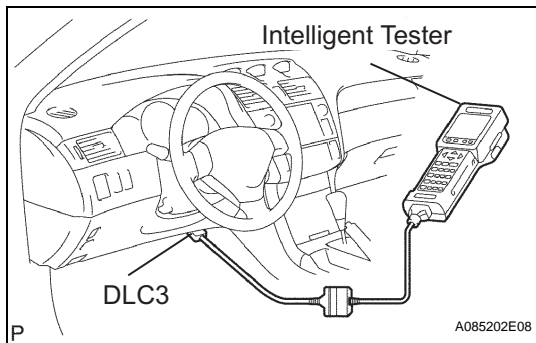
- (b) When the engine is started, the MIL should turn OFF. If the light remains ON, the diagnosis system has detected a malfunction or abnormality in the system.

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.

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1. CHECK DTC (Using the OBD II scan tool or intelligent tester)

- Connect the OBD II scan tool or intelligent tester to the DLC3.
- Turn the ignition switch ON.
- 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.

- Confirm the details of the DTCs (See page [ES-36](#)).

NOTICE:

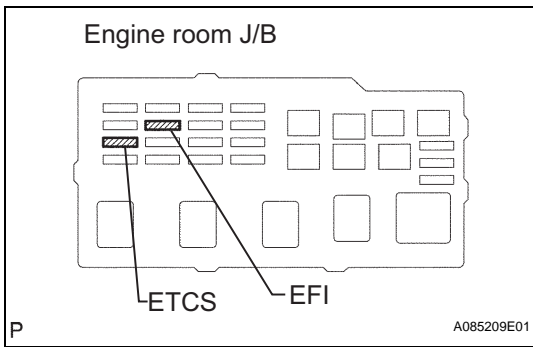
When simulating a symptom with the OBD II scan tool (excluding intelligent tester) to check for DTCs, use the normal mode. For DTCs subject to "2 trip detection logic", perform either of the following actions.

- 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)

- Connect the OBD II scan tool or the intelligent tester to the DLC3.
- Turn the ignition switch ON.
- 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.



3. CLEAR DTC (Not using the OBD II scan tool or intelligent tester)

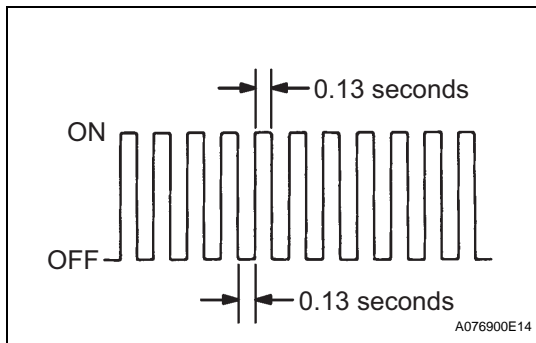
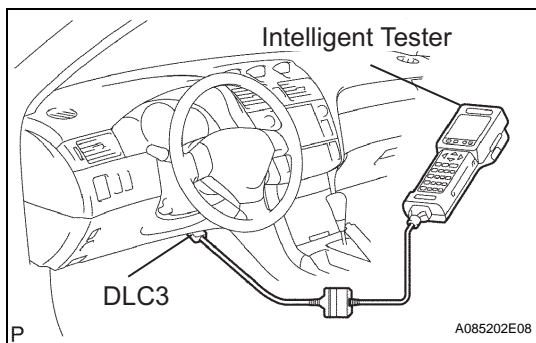
- (a) Remove the EFI and ETCS fuses from the engine room J/B for more than 60 seconds. Or, disconnect the battery terminal for more than 60 seconds. After disconnecting the battery terminal, perform the "INITIALIZE" procedure (See page [IN-24](#)).

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.

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 terminal, perform the "INITIALIZE" procedure (See page [IN-24](#)).

INSTALLATION

1. INSTALL CAMSHAFT POSITION SENSOR

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

(b) Install the sensor with the bolt.

Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

2. INSTALL AIR CLEANER ASSEMBLY

3. CHECK CONNECTION OF VACUUM HOSE

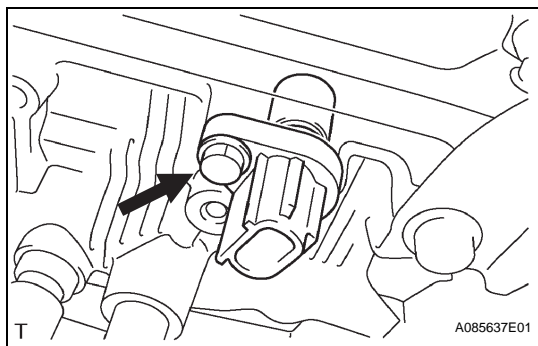
CAMSHAFT POSITION SENSOR

REMOVAL

HINT:

A bolt without a torque specification is shown in the standard bolt chart (See page [SS-2](#)).

1. REMOVE AIR CLEANER ASSEMBLY
2. REMOVE CAMSHAFT POSITION SENSOR
 - (a) Disconnect the sensor connector.
 - (b) Remove the bolt and sensor.

**ES**

INSPECTION

1. INSPECT CAMSHAFT POSITION SENSOR

- (a) Measure the resistance between the terminals.

Resistance

Temperature	Specified Condition
Cold	835 to 1,400 Ω
Hot	1,060 to 1,645 Ω

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

INSTALLATION

1. **INSTALL CRANKSHAFT POSITION SENSOR**
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
2. **INSTALL FRONT FENDER APRON SEAL RH**
3. **INSTALL ENGINE UNDER COVER RH**

CRANKSHAFT POSITION SENSOR

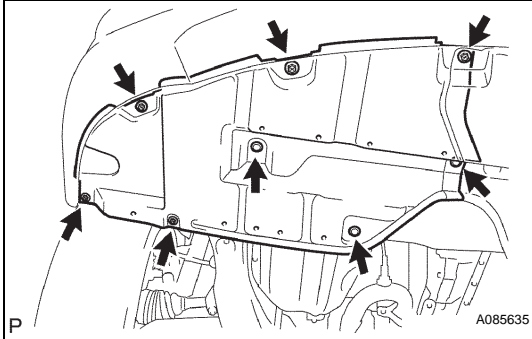
REMOVAL

HINT:

A bolt without a torque specification is shown in the standard bolt chart (See page [SS-2](#)).

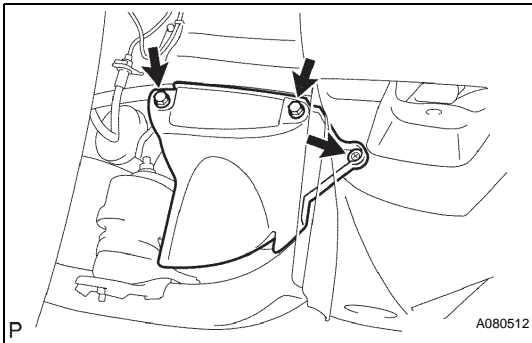
1. REMOVE ENGINE UNDER COVER RH

- (a) Remove the 5 screws, 3 clips and under cover.



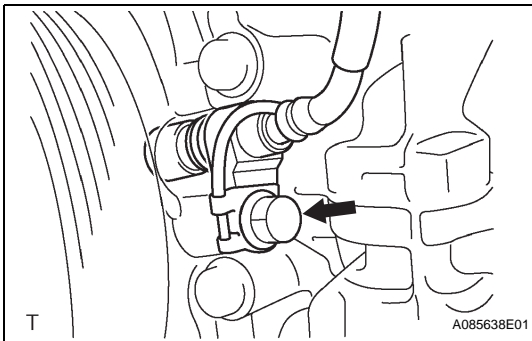
2. REMOVE FRONT FENDER APRON SEAL RH

- (a) Remove the clip, 2 bolts and apron seal.



3. REMOVE CRANKSHAFT POSITION SENSOR

- (a) Disconnect the sensor connector.
(b) Remove the bolt, clamp and sensor.



INSPECTION

1. INSPECT CRANKSHAFT POSITION SENSOR

- (a) Measure the resistance between the terminals.
Resistance

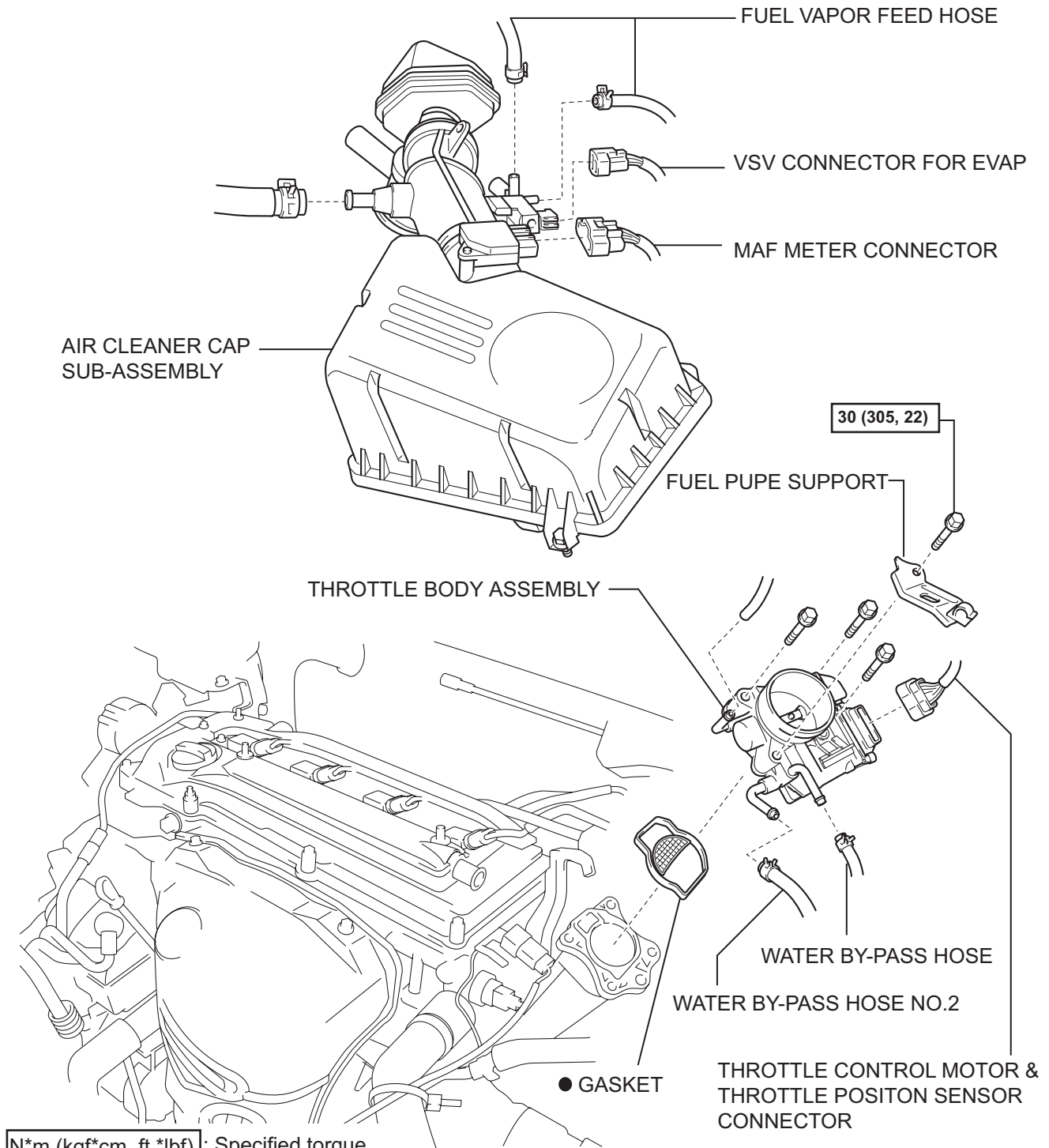
Temperature	Specified Condition
Cold	985 to1,600 Ω
Hot	1,265 to 1,890 Ω

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

THROTTLE BODY

COMPONENTS

ES



[N*m (kgf*cm, ft.*lbf)]: Specified torque

● Non-reusable part

REMOVAL

1. DRAIN ENGINE COOLANT

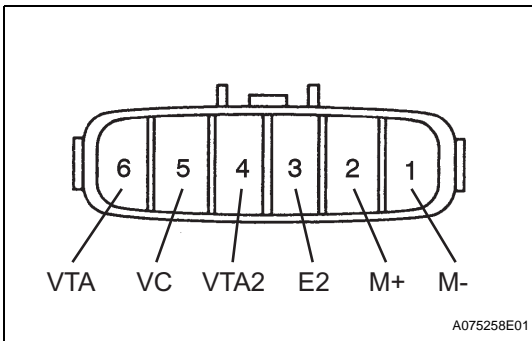
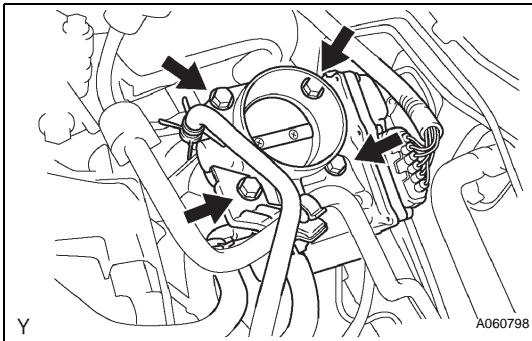
HINT:

See page [CO-8](#).

2. REMOVE AIR CLEANER CAP WITH AIR CLEANER HOSE

3. REMOVE THROTTLE BODY ASSEMBLY

- Disconnect the throttle control motor & throttle position sensor connector.
- Disconnect the vacuum hose from the throttle body.
- Disconnect the 2 water by-pass hoses.
- Remove the 4 bolts, fuel pipe support and throttle body.
- Remove the gasket.



INSPECTION

1. INSPECT THROTTLE BODY ASSEMBLY

- Measure the resistance between the terminals.

Resistance

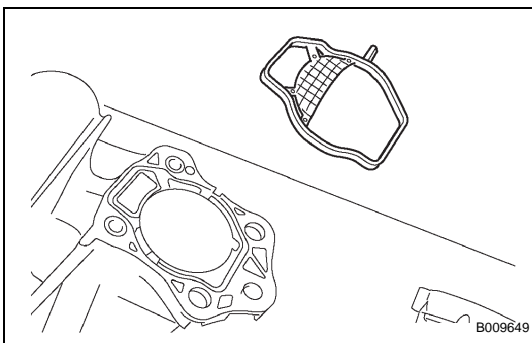
Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω
5 (VC) - 3 (E2)	20°C (68°F)	1.2 to 3.2 Ω

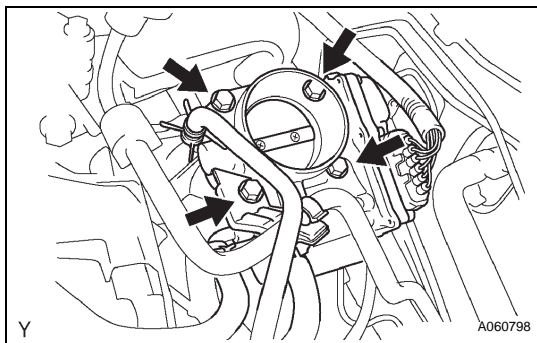
If the result is not as specified, replace the throttle body assembly.

INSTALLATION

1. INSTALL THROTTLE BODY ASSEMBLY

- Install a new gasket on the intake manifold, as shown in the illustration.





- (b) Install the throttle body and fuel pipe support with the 4 bolts.

Torque: 30 N*m (305 kgf*cm, 22 ft.*lbf)

- (c) Connect the 2 water by-pass hoses to the throttle body.
- (d) Connect the throttle control motor & throttle position sensor connector.
- (e) Connect the vacuum hose to the throttle body.

2. INSTALL AIR CLEANER CAP WITH AIR CLEANER HOSE

3. ADD ENGINE COOLANT

HINT:

See page [CO-8](#).

4. CHECK FOR ENGINE COOLANT LEAKS

HINT:

See page [CO-1](#).

KNOCK SENSOR

REMOVAL

1. DRAIN ENGINE COOLANT

HINT:

See page [CO-8](#).

2. REMOVE AIR CLEANER CAP WITH AIR CLEANER HOSE

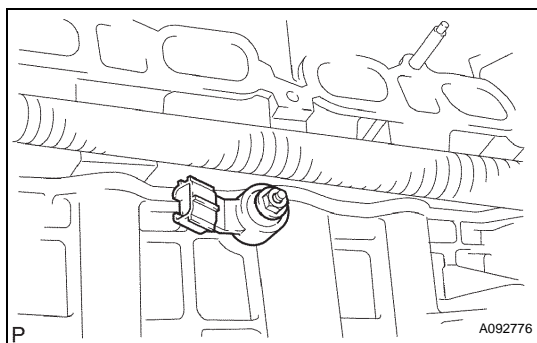
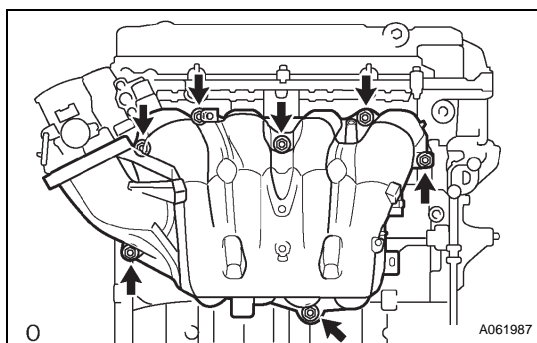
3. REMOVE THROTTLE BODY ASSEMBLY

HINT:

See page [ES-329](#).

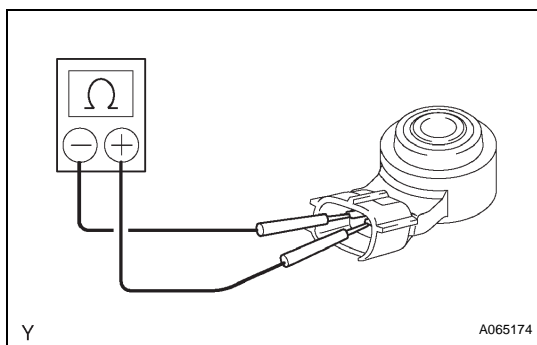
4. REMOVE INTAKE MANIFOLD

- (a) Remove the 5 bolts, 2 nuts, intake manifold and gasket.



5. REMOVE KNOCK SENSOR

- (a) Disconnect the knock sensor connector.
(b) Remove the nut and knock sensor.



INSPECTION

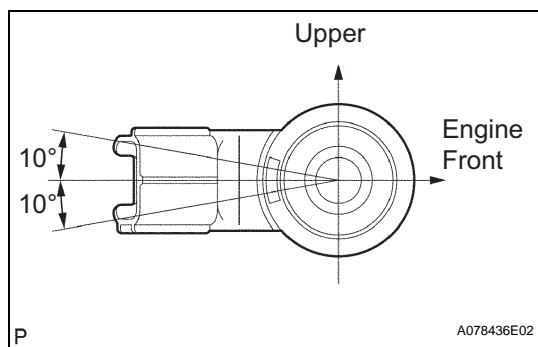
1. INSPECT KNOCK SENSOR

- (a) Using an ohmmeter, measure the resistance between the terminals.

Resistance:

120 to 280 k Ω at 20°C (68°F)

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



INSTALLATION

1. INSTALL KNOCK SENSOR

- (a) Install the sensor with the nut.

Torque: 20 N*m (199 kgf*cm, 14 ft.*lbf)

HINT:

Angling the knock sensor below the horizontal (below 0°) is recommended.

- (b) Connect the sensor connector.

2. INSTALL INTAKE MANIFOLD

- (a) Install a new gasket and the intake manifold with the 5 bolts and 2 nuts.

Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)

3. INSTALL THROTTLE BODY ASSEMBLY

HINT:

See page [ES-329](#).

4. INSTALL AIR CLEANER CAP WITH AIR CLEANER HOSE

5. CHECK CONNECTION OF VACUUM HOSE

6. ADD ENGINE COOLANT

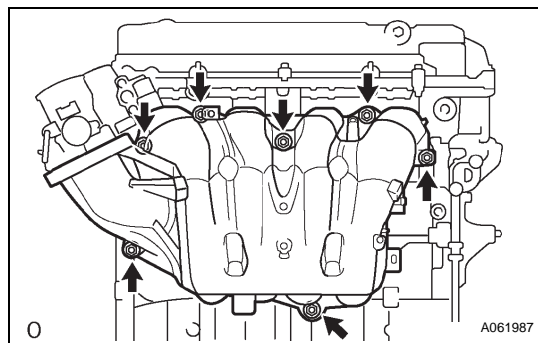
HINT:

See page [CO-8](#).

7. CHECK FOR ENGINE COOLANT LEAKS

HINT:

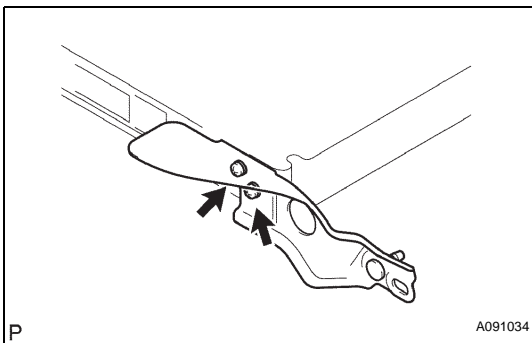
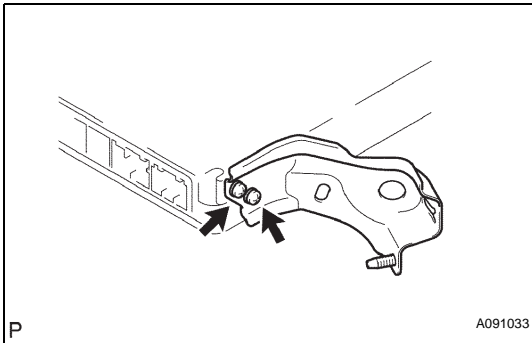
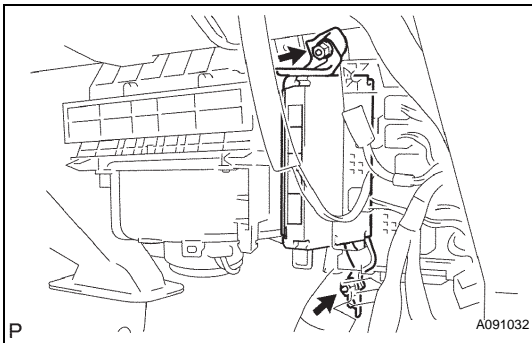
See page [CO-1](#).



ECM

REMOVAL

1. **DISCONNECT BATTERY NEGATIVE TERMINAL**
2. **REMOVE FRONT DOOR SCUFF PLATE RH**
HINT:
See page [IP-7](#) (Coupe) or See page [IP-7](#) (Convertible).
3. **REMOVE COWL SIDE TRIM SUB-ASSEMBLY RH**
HINT:
See page [IP-7](#) (Coupe) or See page [IP-7](#) (Convertible).
4. **REMOVE INSTRUMENT PANEL NO.1 UNDER COVER SUB-ASSEMBLY**
HINT:
See page [IP-11](#).
5. **REMOVE INSTRUMENT PANEL FINISH LOWER PANEL RH**
HINT:
See page [IP-8](#).
6. **REMOVE ECM**
 - (a) Remove the 2 wire harness clamps.
 - (b) Disconnect the 5 ECM connectors.
 - (c) Remove the 2 nuts and ECM.

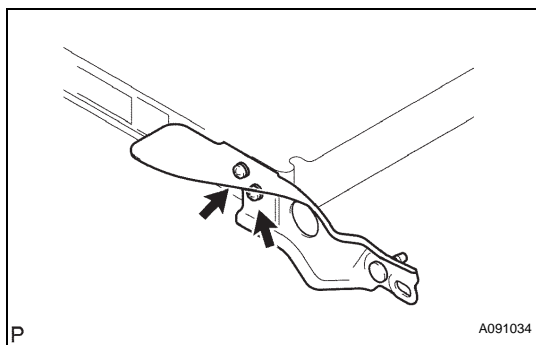
ES

7. **REMOVE ECM BRACKET**
 - (a) Remove the 2 screws and ECM bracket.
8. **REMOVE ECM BRACKET NO.2**
 - (a) Remove the 2 screws and ECM bracket.

INSTALLATION

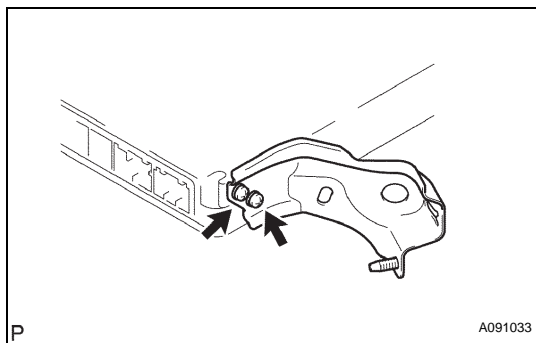
1. INSTALL ECM BRACKET NO.2

- (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

HINT:

See page [IP-15](#).

5. INSTALL INSTRUMENT PANEL NO.1 UNDER COVER SUB-ASSEMBLY

HINT:

See page [IP-15](#).

6. INSTALL COWL SIDE TRIM SUB-ASSEMBLY RH

HINT:

See page [IP-15](#).

7. INSTALL FRONT DOOR SCUFF PLATE RH

HINT:

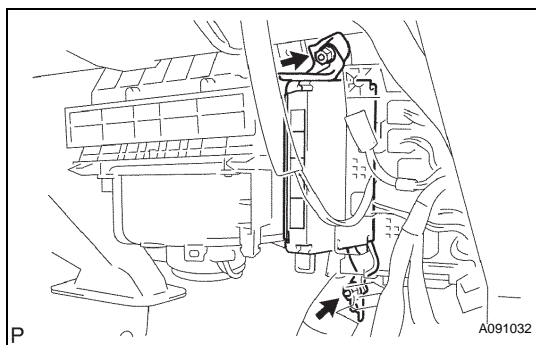
See page [IP-15](#).

8. CONNECT BATTERY NEGATIVE TERMINAL

9. SYSTEM INITIALIZE

HINT:

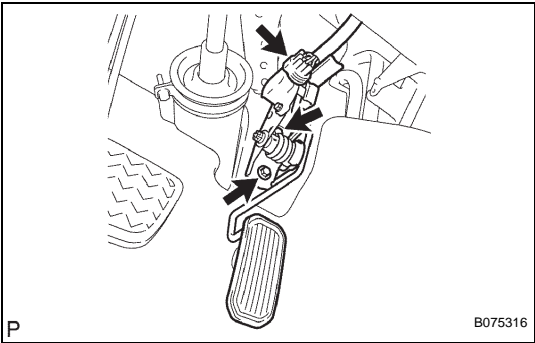
See page [IN-24](#).



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.

Resistance

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 assembly.

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)

