05J2R–01

BASIC INSPECTION

When the malfunction is not confirmed in the DTC check, troubleshooting should be carried out in all the possible circuits considered as causes of the problem. In many cases, by carrying out the basic engine check shown in the following flowchart, the location causing 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 this check with the engine stopped and power 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 ON PAGE 05–33**

OK

3 CHECK IF ENGINE STARTS

NG → **GO TO STEP 6**

OK

4 CHECK AIR FILTER

(a) Visually check if the air filter is not contaminated dirt or oil.

NG → **REPLACE**

OK

5 CHECK IDLE SPEED (See page 14–1)

NG → **PROCEED TO PAGE 14–1 AND CONTINUE TO TROUBLESHOOT**

OK

PROCEED TO PROBLEM SYMPTOMS TABLE ON PAGE 05–33

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6	CHECK FUEL PRESSURE (See page 11–7)

NG → PROCEED TO PAGE 18–3 AND CONTINUE TO TROUBLESHOOT

OK

7	CHECK FOR SPARK (See page 18–6)

NG → PROCEED TO PAGE 18–3 AND CONTINUE TO TROUBLESHOOT

OK

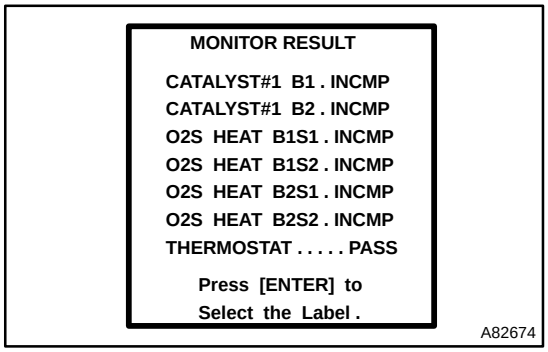
PROCEED TO PROBLEM SYMPTOMS TABLE ON PAGE 05–33

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05DJ5–03

CHECKING MONITOR STATUS

HINT:
”MONITOR RESULT” indicates normal or malfunction of each component and system when judgment has done.



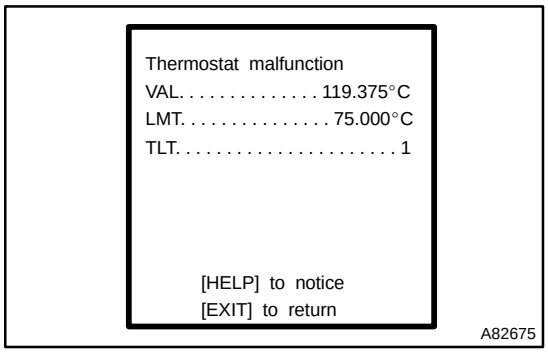
1. HOW TO READ DATA

(a) Connect the hand–held tester to the DLC 3.

(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.

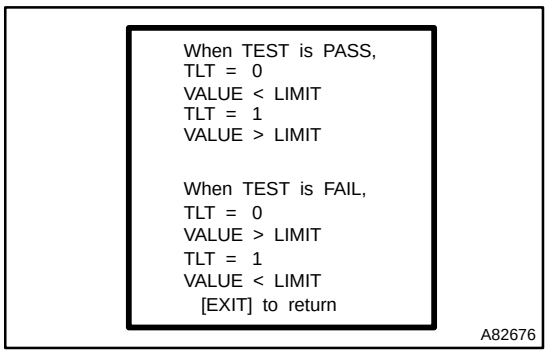
HINT:

- INCMP: Stands for ”incomplete”. The judgement has not been done yet.
- PASS: Normal is detected.
- FAIL: A malfunction has been detected.



(c) Select a Test ID that you want from the list and press the ”ENTER” button. You will see the following screen:
(1) VAL (TEST VALUE) [Test Data] [Unit]
(2) LMT (TEST LIMIT) [Test Limit] [Unit]
(3) TLT [Test Limit Type]

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(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.
- In rare cases, the monitor may have passed even with a DTC set and MIL illuminated. The monitor possibly detects malfunction on a previous trip, and then passed on the most recent trip. This would indicate an intermittent problem may be the cause of the DTC.

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05CRM–08

CHECK FOR INTERMITTENT PROBLEMS

HINT:

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

(a) Clear the DTCs (see page 05–41).
(b) Switch the hand–held tester from normal mode to check mode (see page 05–45).
(c) Perform a simulation test (see page 01–37).
(d) Check the connector(s) and terminal(s) (see page 01–37).
(e) Wiggle the harness(s) and connector(s) (see page 01–37).

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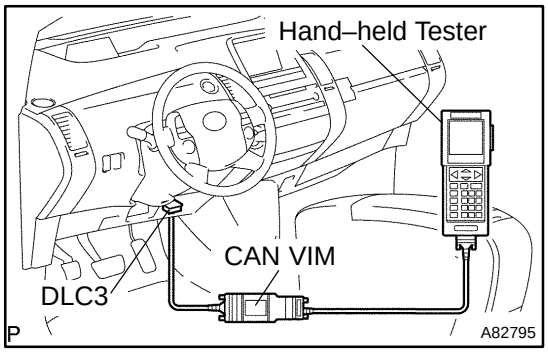
05CRI–08

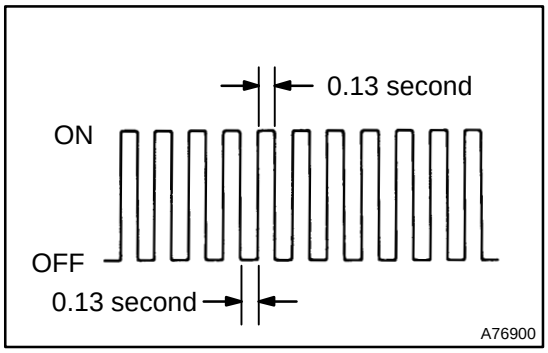
CHECK MODE PROCEDURE

HINT:

Hand–held tester only:

Compared to normal mode, check mode has more sensing ability to detect malfunction. Furthermore, the same diagnostic items which are detected in normal mode can also be detected in check mode.





1. CHECK MODE PROCEDURE(Using the hand–held tester)

(a) Check the initial conditions.
  (1) Battery positive voltage 11 V or more
  (2) Throttle valve fully closed
  (3) Shift position in the P or N
  (4) A/C switched OFF

(b) Connect the hand–held tester to the DLC3.

(c) Turn the power switch ON (IG).

(d) Change the ECM to check mode using the hand–held tester. Make sure the MIL flashes as shown in the illustration.

NOTICE:

All DTCs and freeze frame data recorded will be erased if: 1) the hand–held tester is used to change the ECM from normal mode to check mode or vice–versa, or 2) during check mode, the power switch is switched from ON to ACC or OFF.

(e) Start the HV main system (READY ON). The MIL should turn off after the system starts.

(f) Simulate the condition of the malfunction described by the customer.

(g) After simulating the malfunction conditions, check DTCs, freeze frame data and other data using the tester.

(h) After checking DTCs, inspect applicable circuits.

2. CLEAR DTC

(a) Connect the OBD II scan tool or hand–held tester to the DLC3.

(b) Turn the power switch ON (IG).

(c) On the OBD II scan tool (complying with SAE J1978) or the hand–held tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CLEAR CODES.

(d) Erase DTCs and freeze frame data by pressing the YES button on the tester. For the OBD II scan tool, see its instruction manual.

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05DJ2–03

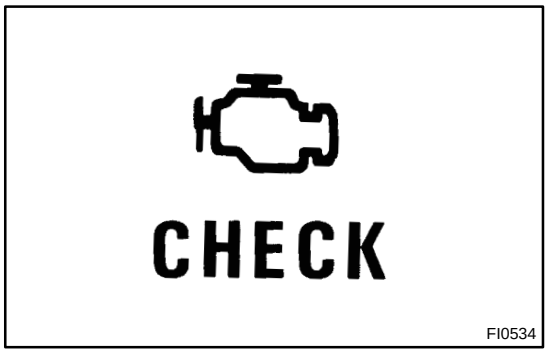
DEFINITION OF TERMS

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. While another 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 malfunction only one time 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.

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05CRG–08

DIAGNOSIS SYSTEM

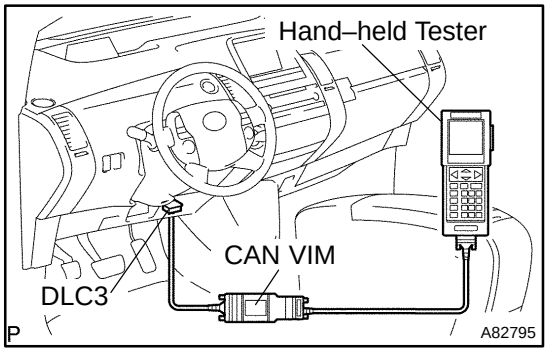


1. DESCRIPTION

- 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 hand–held tester. Various data output from the vehicle's ECM can then be read.
- OBD II regulations require that the vehicle's on–board computer illuminates the Malfunction Indicator lamp (MIL) on the instrument panel when the computer detects a malfunction in: 1) the emission control system / components, or 2) the powertrain control components (which affect vehicle emissions), or 3) the computer. In addition, the applicable Diagnostic Trouble Codes (DTCs) prescribed by SAE J2012 are recorded in the ECM memory (see page 05–55).

If the malfunction does not reoccur in 3 consecutive trips, the MIL goes off automatically but the DTCs remain recorded in the ECM memory.

- To check DTCs, connect the hand–held tester or OBD II scan tool to the Data Link Connector 3 (DLC3) of the vehicle. The hand–held tester or OBD II scan tool also enables you to erase the DTC and check the freeze frame data and various forms of engine data (see the instruction manual for the OBD II scan tool or the hand–held 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 the DTC chart on page 05–55).



- In order to enhance OBD function on vehicles and develop the Off–Board diagnosis system, CAN communication is introduced in this system (CAN: Controller Area Network). It minimizes a gap between technician skills and vehicle technology. CAN is a network, which uses a pair of data transmission lines, spanning multiple computers and sensors. It allows a high speed communication between the systems and to simplify the wire harness connection.
  Since the CAN communication is equipped in this system, CAN VIM (VIM: Vehicle Interface Module) connecting with hand–held tester is necessary to display any information from the ECM on the tester. (Also the communication between the hand–held tester and the ECM uses CAN communication signal) When confirm the DTCs and any data of the ECM, connect the CAN VIM between the DLC3 and the hand–held tester.
- The diagnosis system operates in normal mode during normal vehicle use. In "normal mode", 2 trip detection log-

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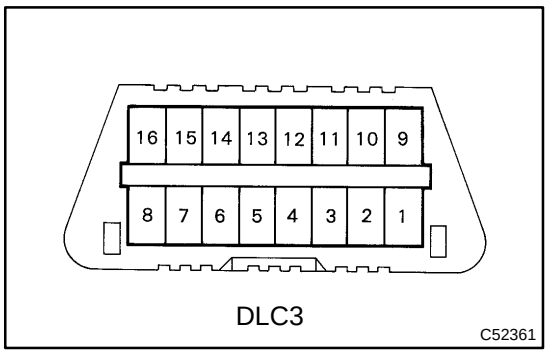
ic* is used to ensure accurate detection of malfunctions. A ”check mode”, is also available to technicians as an option. In ”check mode”, 1 trip detection logic is used for simulating malfunction symptoms and increasing the system’s ability to detect malfunctions, including intermittent malfunctions (hand–held tester only)
(see page 05–55).

- *2 trip detection logic:
  When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the power 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 freeze frame data records the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

Priorities for troubleshooting:
If troubleshooting priorities for multiple DTCs are given in the applicable DTC chart, these priorities should be followed.
If no instructions are given, perform troubleshooting for those DTCs according to the following priorities.

(a) DTCs other than fuel trim malfunction (DTCs P0171 and P0172) and misfire (DTCs P0300 to P0304).
(b) Fuel trim malfunction (DTCs P0171 and P0172).
(c) Misfire (DTCs P0300 to P0304).

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DLC3

2. CHECK DLC3

The vehicle's ECM uses the ISO 15765–4 for communication protocol. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 15765–4 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
CANH	6	CAN "High" line	CANL	54 to 69 Ω	Power switch OFF
CANH	6	CAN "High" line	Battery positive	1 MΩ or higher	Power switch OFF
CANH	6	CAN "High" line	CG	1 kΩ or higher	Power switch OFF
CANL	4	CAN "Low" line	Battery Positive	1 MΩ or higher	Power switch OFF
CANL	4	CAN "Low" line	CG	1 kΩ or higher	Power switch OFF

HINT:

When you use the hand–held tester II or the OBD scan tool, first connect its cable to the DLC3. Next, turn ON the main power of the PRIUS by pushing the power switch (IG ON). Finally turn the tester or the scan tool ON. 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, so consult the Service Department listed in its instruction manual.

3. INSPECT BATTERY VOLTAGE

Battery Voltage: 11 to 14 V

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

4. CHECK MIL

(a) The MIL comes on when the power switch is turned ON (IG) and the HV main system is not in operation.

HINT:

If the MIL is not illuminated, troubleshoot the MIL circuit (see page 05–381).

(b) When the HV main system is activated (READY ON), the MIL should turn off. If the MIL illuminates gain, the diagnosis system has detected malfunction or abnormality in the system.

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DATA LIST/ACTIVE TEST

1. DATA LIST

HINT:

Using the hand–held tester DATA LIST allows switch, sensor, actuator and other item values to be read without removing any parts. Reading 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 power switch OFF.
(c) Connect the hand–held tester to the DLC3.
(d) Turn the power switch ON (IG).
(e) Turn the hand–held tester ON.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST.
(g) According to the display on the tester, read items in DATA LIST.

Hand–Held Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
INJECTOR	Injection period of the No. 1 cylinder/ Min.: 0 ms, Max.: 32.64 ms	Idling: 1 to 3 ms (Inspection mode)	—
IGN ADVANCE	Ignition timing advance for No. 1 cylinder/ Min.: –64 deg., Max.: 63.5 deg.	Idling: BTDC 7 to 15˚ (Inspection mode)	—
CALC LOAD	Calculated load by ECM/ Min.: 0 %, Max.: 100 %	• Idling: 10 to 20 % (Inspection mode) • Running without load (1,500 rpm): 10 to 20 %	—
MAF	Air flow rate from MAF meter/ Min.: 0 g/s, Max.: 655 g/s	Idling: 3 to 7 gm/s (1,500 rpm)	If the value is approximately 0.0 g/s: • Mass air flow meter power source circuit open • VG circuit open or short If the value is 160.0 g/s or more: • E2G circuit open
ENGINE SPD	Engine speed/ Min.: 0 rpm, Max.: 16383 rpm	Idling 1,000 rpm (when putting the engine in inspection mode)	—
COOLANT TEMP	Engine coolant temperature/ Min.: –40°C, Max.: 140°C	After warming up: 80 to 100˚C (176 to 212˚F)	• If the value is –40°C (–40°F): sensor circuit is open • If the value is 140°C (284°F): sensor circuit is shorted
INTAKE AIR	Intake air temperature/ Min.: –40°C, Max.: 140°C	Equivalent to ambient air temperature	• If the value is –40°C (–40°F): sensor circuit is open • If the value is 140°C (284°F): sensor circuit is shorted
THROTTLE POS	Absolute throttle position sensor/ Min.: 0 %, Max.: 100 %	• Throttle fully closed: 10 to 24 % • Throttle fully open: 64 to 96 %	Read the value with intrusive operation (active test)
VEHICLE SPD	Vehicle speed/ Min.: 0 km/h, Max.: 255 km/h	Actual vehicle speed	Speed indicated on speedometer
THROTTLE POS #2	Throttle position sensor No.2 output voltage/ Min.: 0 V, Max.: 5.0 V	• Throttle fully closed: 2.0 to 2.9 V • Throttle fully open: 4.6 to 5.5 V	Read the value with intrusive operation (active test)
THRTL REQ POS	Throttle requirement position/ Min.: 0 V, Max.: 5 V	Idling: 0.5 to 1.0 V (Inspection mode)	—

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Hand–Held Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
THROTL OPN DUTY	Throttle motor opening duty ratio/ Min.: 0 %, Max.: 100 %	During idling: 0 to 40 %	When accelerator pedal is depressed, duty ratio is increased
THROTL CLS DUTY	Throttle motor closed duty ratio/ Min.: 0 %, Max.: 100 %	During idling: 0 to 40 %	When accelerator pedal is released quickly, duty ratio is increased
THROTTLE MOT	Whether or not throttle motor control is permitted/ ON or OFF	Idling: ON (Inspection mode)	Read the value with the power switch ON (Do not start engine)
+BM	Whether or not electric throttle control system power is inputted/ ON or OFF	Idling: ON (inspection mode)	—
ACCEL IDL POS	Whether or not accelerator pedal position sensor is detecting idle/ ON or OFF	Idling: ON (inspection mode)	—
THROTTL IDL POS	Whether or not throttle position sensor is detecting idle/ ON or OFF	Idling: ON (inspection mode)	—
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	—
THRTL LEARN VAL	Throttle valve fully closed (learned value) Min.: 0 V, Max.: 5 V	0.4 to 0.8 V	—
THROTTLE MOT	Throttle motor current Min.: 0 A, Max.: 80 A	Idling: 0 to 3.0 A (Inspection mode)	—
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2/ Min.: 0 V, Max.: 1.275 V	Driving 44 mph (70 km/h): 0.1 to 0.9 V	Performing the INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of the sensor
AFS B1 S1	A/F sensor output voltage for bank 1 sensor 1/ Min.: 0 V, Max.: 7.999 V	Idling 2.8 to 3.8 V (Inspection mode)	Performing the INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of the sensor
VAPOR PRESS	Vapor pressure/ Min.: –4.125 kPa, Max.: 2.125 kPa	Fuel tank cap removed: 0 kPa	Pressure inside fuel tank is monitored by the vapor pressure sensor
SHORT FT #1	Short–term fuel trim of bank 1/ Min.: –100 %, Max.: 99.2%	0 ± 20 %	This item is the short–term fuel compensation used to maintain the air–fuel ratio at stoichiometric air–fuel ratio
LONG FT #1	Long–term fuel trim of bank 1/ Min.: –100 %, Max.: 99.2 %	0 ± 20 %	This item is the overall fuel compensation carried out in long–term to compensate a continual deviation of the short–term fuel trim from the central value
TOTAL FT #1	Total fuel trim of bank 1: Average value for fuel trim system of bank 1/ Min.: –0.5, Max.: 0.496	Idling: –0.2 to 0.2 (Inspection mode)	—
O2FT B1 S2	Short–term fuel trim associated with the bank 1 sensor 2/ Min.: –100 %, Max.: 99.2 %	0 ± 20 %	Same as SHORT FT #1

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Hand–Held Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
AF FT B1 S1	Short–term fuel trim associated with the bank 1 sensor 1/ Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Lean • Stoichiometric air–fuel ratio=1 • Value greater than 1 (1.001 to 1.999) = RICH	—
FUEL SYS #1	Fuel system status (Bank1) / OL or CL or OL DRIVE or OL FAULT or CL FAULT	Idling after warming up: CL (Inspection mode)	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback 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 heated oxygen sensor, which is used for fuel control is malfunctioning
FC IDL	Fuel cut idle/ ON or OFF	Fuel cut operation: ON	FC IDL = ”ON” when throttle valve fully closed and engine speed is over 2,800 rpm
MIL	MIL status/ ON or OFF	MIL ON: ON	—
ST1	Starter signal/ ON or OFF	Cranking: ON	—
FUEL PUMP / SPD	Fuel pump/speed status/ ON or OFF	Idling: ON (Inspection mode)	—
EVAP VSV	VSV status for EVAP control/ ON or OFF	VSV operating: ON	VSV for EVAP is controlled by the ECM (ground side duty control)
IGNITION	Ignition counter/ Min.: 0, Max.: 800	0 to 800	—
CYL #1, #2, #3, #4	Misfire ratio of the cylinder 1 to 4/ Min.: 0, Max.: 255	0 %	This item is displayed in only idling
MISFIRE LOAD	Engine load for first misfire range/ Min.: 0 g/rev, Max.: 3.98 g/rev	Misfire 0: 0 g/rev	—
MISFIRE RPM	Engine RPM for first misfire range/ Min.: 0 rpm, Max.: 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	The fuel cut is being performed under very light load to prevent the engine combustion from becoming incomplete
CHECK MODE	Check mode/ ON or OFF	Check mode ON: ON	See page 05–45
ENG RUN TIME	Engine run time/ Min.: 0 second, Max.: 65535 seconds	Time after engine start	Service data
MIL ON RUN DIST	MIL ON Run Distance/ Min.: 0 second, Max.: 65535 seconds	Distance after DTC is detected	—
EVAP PURGE VSV	EVAP (Purge) VSV control duty/ Min.: 0 %, Max.: 100 %	0 to 100 % During idling: 1,500 rpm	Order signal from ECM
WU CYC DTC CLEAR	Warm–up cycle after DTC cleared/ Min.: 0, Max.: 255	—	Number of warm–up cycles after DTC is cleared
DIST DTC CLEAR	Distance after DTC cleared/ Min.: 0 km/h, Max.: 65535 km/h	Equivalent to drive distance after DTCs were erased	—

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Hand–Held Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
EVAP VAPOR PRES	EVAP vapor pressure/ Min.: –8192 Pa, Max.: 8191 Pa	Fuel tank cap removed: 0 Pa	—
BATTERY VOLTAGE	Battery voltage/ Min.: 0 V, Max.: 65.535 V	Idling: 9 to 14 V (Inspection mode)	—
AIR–FUEL RATIO	Air–fuel ratio: Min.: 0, Max.: 1.999	During idling: 1,500 rpm 0.8 to 1.2	—
THROTTLE POS	Throttle sensor positioning/ Min.: 0 %, Max.: 100 %	Idling 10 to 18 % (Inspection mode)	Calculated value based on VTA1
AMBIENT TEMP	Ambient air temperature/ Min.: –40°C, Max.: 215°C	Equivalent to ambient air temperature	• If the value is –40°C: sensor circuit is open • If the value is 215°C: sensor circuit is shorted
THROTTLE POS #2	Throttle sensor positioning #2/ Min.: 0 %, Max.: 100 %	—	Calculated value based on VTA2
THROTTLE MOT	Throttle motor Min.: 0 %, Max.: 100 %	Idling: 0.5 to 40 % (Inspection mode)	—
MIL ON RUN TIME	Running time from MIL ON/ Min.: 0 minute, Max.: 65535 minutes	Equivalent to running time after MIL was ON	—
TIME DTC CLEAR	Time after DTC cleared/ Min.: 0 minute, Max.: 65535 minutes	Equivalent to time after DTCs were erased	—
KNOCK CRRT VAL	Correction learning value of knocking/ Min.: –64 CA, Max.: 1984 CA	0 to 22 °CA Driving: 44 mph (70 km/h)	Service data
KNOCK FB VAL	Feedback value of knocking/ Min.: –64 CA, Max.: 1984 CA	–22 to 0 °CA Driving: 44 mph (70 km/h)	Service data
PURGE DENSITY	Learning value of purge density/ Min.: –50, Max.: 350	–40 to 0 % Idling (Inspection mode)	Service data
PURGE FLOW	Purge flow/ Min.: 0 %, Max.: 102.4 %	Idling: 0 to 100 %	—
CYLINDER	Cylinder number/ Min.: 0, Max.: 255	—	Identifying the cylinder number
MODEL YEAR	Model year/ Min.: 0, Max.: 255	—	Identifying the model year
THROTTLE POS #1	Throttle position sensor No. 1 output voltage/ Min.: 0 V, Max.: 4.9 V	• Throttle fully closed: 0.5 to 1.2 V • Throttle fully opened : 3.2 to 4.8 V	—
THROTTLE MOT	Throttle motor current/ Min.: 0 A, Max.: 19.92 A	Idling: 0 to 3.0 A	—
THROTTLE SSR #1	Throttle sensor opener position No. 1/ Min.: 0 V, Max.: 4.98 V	0.6 to 0.9 V	ETCS service data
THROTTLE SSR #2	Throttle sensor opener position No. 2/ Min.: 0 V, Max.: 4.98 V	2.2 to 2.6 V	ETCS service data
THRTL COMND VAL	Throttle position command value/ Min.: 0 V, Max.: 4.98 V	0.5 to 4.8 V	ETCS service data
THRTL SSR #1 AD	Throttle sensor opener position No.1 (AD)/ Min.: 0 V, Max.: 4.98 V	0.6 to 0.9 V	ETCS service data

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Hand–Held Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
ACTUATOR POWER	Actuator power supply/ ON or OFF	Idling ON (Inspection mode)	ETCS service data
OPN MALFUNCTION	Open side malfunction/ ON or OFF	—	ETCS service data
SYSGUARD JUDGE	System guard/ ON or OFF	—	ETCS service data
THROTTLE POS #1	Throttle position No. 1/ Min.: 0 V, Max.: 5 V	—	ETCS service data
THROTTLE POS #2	Throttle position No. 2/ Min.: 0 V, Max.: 5 V	—	ETCS service data
THRTL MOT (OPN)	Throttle motor duty ratio (open)/ Min.: 0 %, Max.: 100 %	—	ETCS service data
THRTL MOT (CLS)	Throttle motor duty ratio (close)/ Min.: 0 %, Max.: 100 %	—	ETCS service data
+BM VOLTAGE	+BM voltage/ Min.: 0, Max.: 19.92	Idling: 10 to 15 V	ETCS service data
#CODES	#Codes/ Min.: 0, Max.: 255	—	Number of detected DTCs
VVTL AIM ANGL #1	VVT aim angle (bank 1)/ Min.: 0 %, Max.: 100 %	Idling: 0 %	VVT duty signal value during intrusive operation
VVT CHNG ANGL #1	VVT change angle/ Min.: 0°FR, Max.: 60°FR	Idling: 0 to 5 °FR	Displacement angle during intrusive operation
VVT OCV DUTY B1	VVT OCV operation duty/ Min.: 0 %, Max.: 100 %	Idling: 0 %	Requested duty value for intrusive operation
VVT CTRL B1	VVT control status/ ON or OFF	—	Support for VVT active test
FAN MOTOR	Electric fan motor/ ON or OFF	—	Support for fan motor active test
TANK BYPASS VSV	Tank bypass VSV/ ON or OFF	—	Support for tank bypass VSV active test
CAN CTRL VSV	Canister control VSV/ ON or OFF	—	Support for canister control VSV active test
INI COOL TEMP	Initial engine coolant temperature/ Min.: –40°C, Max.: 140°C	Close to ambient air temperature	Service data
INI INTAKE TEMP	Initial intake air temperature/ Min.: –40°C, Max.: 140°C	Close to ambient air temperature	Service data
INJ VOL	Injection volume (cylinder 1)/ Min.: 0 ml, Max.: 2.048 ml	0 to 0.5 ml	Quantity of fuel injection volume for 10 times
CYL ALL	All cylinders misfire rate/ Min.: 0, Max.: 255	0 to 35	—
MISFIRE MARGIN	Misfire monitoring/ MIn.: –100 %, Max.: 99.22 %	–100 to 99.2 %	Misfire detecting margin
REQ ENG TRQ	Requested engine torque/ Min.: 0 kW, Max.: 16383.75 kW	0 to 57 kw	Flag information for hybrid vehicle
HV TRGT ENG SPD	HV target engine speed/ Min.: 0 rpm, Max.: 6375 rpm	0 to 5000 rpm	Flag information for hybrid vehicle
ACT ENGINE TRQ	Actual engine torque/ Min.: –128 Nm, Max.: 127 Nm	–128 to 127 Nm	Flag information for hybrid vehicle
EST ENGINE TRQ	Estimated engine torque/ Min.: 0 Nm, Max.: 510 Nm	0 to 120 Nm	Flag information for hybrid vehicle

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Hand–Held Tester Display	Measurement Item/Range (Display)	Normal Condition *	Diagnostic Note
ENGINE RUN TIME	Engine run time/ Min.: 0 second, Max.: 255 seconds	0 to 255 seconds	Flag information for hybrid vehicle
ENGINE RUN TIME	Request engine run time/ Min.: 0 second, Max.: 25.5 seconds	0 to 25.5 seconds	Flag information for hybrid vehicle
IGNITION TIME	Judgment time for ignition of engine/ Min.: 0 second, Max.: 25.5 seconds	0 to 25.5 seconds	Flag information for hybrid vehicle
OUTPUT TIME	Judgment time for engine output/ Min.: 0 second, Max.: 25.5 seconds	0 to 25.5 seconds	Flag information for hybrid vehicle
EST PORT TEMP	Estimated intake port temperature/ Min.: –40°C, Max.: 215°C	80 to 100°C	Flag information for hybrid vehicle
FUEL LEVEL	Fuel level/ 0: EMPTY/1: NOT EMP	—	Flag information for hybrid vehicle
FUEL CUT	Fuel cut for engine stop request/ 0: OFF/1: ON	—	Flag information for hybrid vehicle
INDPNDNT OPR	Engine independently operation/ 0: NOT OPR/1: OPERATE	—	Flag information for hybrid vehicle
TANK WATER TEMP	CHS tank outlet temperature sensor output/ Max: 215 °C, Min: –40 °C	—	• If the value is –40°C: sensor circuit is open • If the value is 215°C: sensor circuit is shorted
WATER FLW VLV	Water valve position signal/ Max: 4.98 V, Min: 0 V	0.45 to 4.6 V	Voltage varies based on valve position
ISC LEARN VAL	ISC learning value/ Max: 19.92 L/s, Min: 0 L/s	—	Flag information for hybrid vehicle
RACING	Rev–up operation/ 0: NOT OPR/1: OPERATE	—	Flag information for hybrid vehicle
WARM UP	Request warm–up/ 0: NOT REQ/1: REQUEST	—	Flag information for hybrid vehicle
INDPNDNT CNTRL	Engine independently control operation/ 0: NOT OPR/1: OPERATE	—	Flag information for hybrid vehicle
ENG OIL PRES SW	Engine oil pressure switch signal/ 0: OFF / 1: ON	Indicating ON while engine is running	—

*: If no condition is specifically stated for ”Idling”, it means the transaxle position is in the N or P, the A/C switch is OFF and all accessory switches are OFF.

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2. ACTIVE TEST

HINT:

Performing ACTIVE TEST using the hand–held tester or the OBD II scan tool allows the relay, VSV, actuator and so on to operate without parts removal. Performing ACTIVE TEST as a first step of troubleshooting is one method to shorten diagnostic time.

It is possible to display DATA LIST during ACTIVE TEST.

(a) Warm up the engine.
(b) Turn the power switch OFF.
(c) Connect the hand–held tester to the DLC3.
(d) Turn the power switch ON (IG).
(e) Turn the hand–held tester ON.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST.
(g) According to the display on the tester, perform items in ACTIVE TEST.

Hand–held Tester Display	Test Details	Diagnostic Note
INJ VOL	[Test Details] Control the injection volume Min.: –12.5 %, Max.: 25 % [Vehicle Condition] Engine speed: 3,000 rpm or less	• All injectors are tested at once • Injection volume is gradually changed between –12.5 and 25 %
A/F CONTROL	[Test Details] Control 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 the voltage outputs of both the A/F sensor and heated oxygen sensor To display the graph, enter ACTIVE TEST / A/F CONTROL / USER DATA, then select ”AFS B1S1 and O2S B1S2” or ”AFS B2S1 and O2S B2S2” by pressing ”YES” button and followed by ”ENTER” button and then pressing ”F4” button
CAN CTRL VSV	[Test Details] Activate the VSV for canister control ON or OFF	(See page 05–202)
EVAP VSV (ALONE)	[Test Details] Activate the VSV for EVAP controL ON or OFF	(See page 05–202)
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	• ON: Rough idle or engine stall • OFF: Normal engine speed (See page 05–63)
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	—
COOLING FAN	[Test Details] Control the electric cooling fan ON or OFF	—
TANK BYPASS VSV	[Test Details] Activate the VSV for tank bypass ON or OFF	(See page 05–202)
ETCS OPEN/CLOSE SLOW	[Test Details] Control the ETCS opening/closing slow speed ON or OFF	Throttle valve intrusive operation

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Hand–held Tester Display	Test Details	Diagnostic Note
ETCS OPEN/CLOSE FAST	[Test Details] Control the ETCS opening/closing fast speed ON or OFF	Throttle valve intrusive operation
FUEL CUT #4	[Test Details] Control the cylinder #4 fuel cut ON or OFF	Cylinder No. 4 fuel cut for power balance
FUEL CUT #3	[Test Details] Control the cylinder #3 fuel cut ON or OFF	Cylinder No. 3 fuel cut for power balance
FUEL CUT #2	[Test Details] Control the cylinder #2 fuel cut ON or OFF	Cylinder No. 2 fuel cut for power balance
FUEL CUT #1	[Test Details] Control the cylinder #1 fuel cut ON or OFF	Cylinder No. 1 fuel cut for power balance
VVT B1	[Test Details] Control the VVT (bank 1) Min.: –128 %, Max.: 127 %	—
WATER FLW VLV3	[Test Details] Activate the water valve ON or OFF	Water valve intrusive valve operation (position when engine is in pre–heat mode) (See page 05–284)
WATER FLW VLV4	[Test Details] Activate the water valve ON or OFF	Water valve intrusive valve operation (position when hot coolant recovering) (See page 05–284)
WATER FLW VLV5	[Test Details] Activate the water valve ON or OFF	Water valve intrusive valve operation (position when engine is in normal operation) (See page 05–284)
WATER PUMP	[Test Details] Activate the water pump ON or OFF	Coolant heat storage water pump

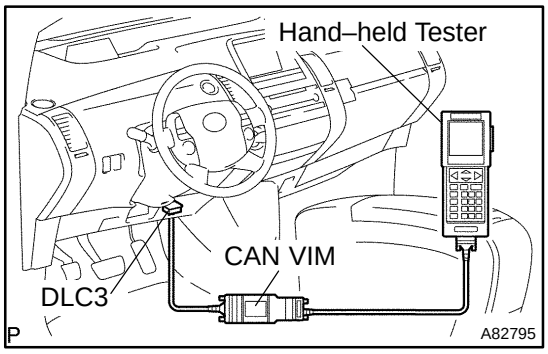
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05J2U–01

DTC CHECK/CLEAR

NOTICE:

- **If no DTC appears in normal mode:**
  On the OBD II scan tool or the hand–held tester, check the pending fault code using the Continuous Test Results function (Mode 7 for SAE J1979).
- **When the diagnosis system is changed from normal mode to check mode or vice–versa, all DTCs and freeze frame data recorded in normal mode will be erased. Before changing modes, always check and make a note of DTCs and freeze frame data.**



1. CHECK DTC (Using the OBD II scan tool or hand–held tester)

(a) Connect the OBD II scan tool or hand–held tester to the DLC3.

(b) Turn the power switch ON (IG).

(c) Check DTCs and freeze frame data using the scan tool or the tester, and then write them down. For the hand–held tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
For the OBD II scan tool, see its instruction manual.

(d) See page 05–55 to confirm the details of the DTCs.

NOTICE:

- **When simulating a symptom with the OBD II scan tool (excluding hand–held tester) to check the DTCs, use normal mode. For DTCs subject to ”2 trip detection logic”, perform either of the following actions.**
- **Turn the HV main system OFF (IG OFF) after the symptom is simulated once. Then repeat the simulation process again. When the problem has been simulated again, 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.**

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2. CLEAR DTC

(a) Connect the OBD II scan tool or the hand–held tester to the DLC3.

(b) Turn the power switch ON (IG).

(c) Erase DTCs and freeze frame data using the OBD II scan tool or the hand–held tester.

For the hand–held tester:

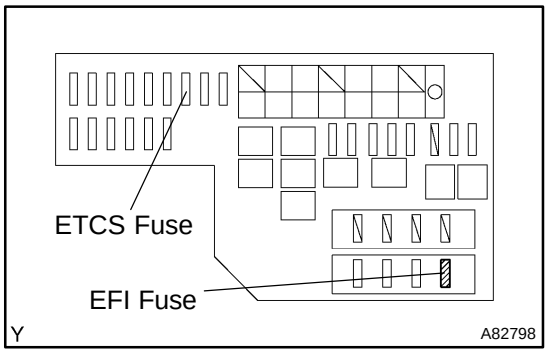
(1) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CLEAR CODES.

(2) Press YES.

(d) For the OBD II scan tool, see its instruction manual.

NOTICE:

Clearing the DTCs will also clear the freeze frame data, detailed information and operation history data.



3. CLEAR DTC (Not using the OBD II scan tool or hand–held tester)

(a) Remove the EFI and ECTS fuses from the engine room R/B for more than 60 seconds, or disconnecting the battery cable for more than 60 seconds.

NOTICE:

When disconnecting the battery cable, perform the "INITIALIZE" procedure (see page 01–28).

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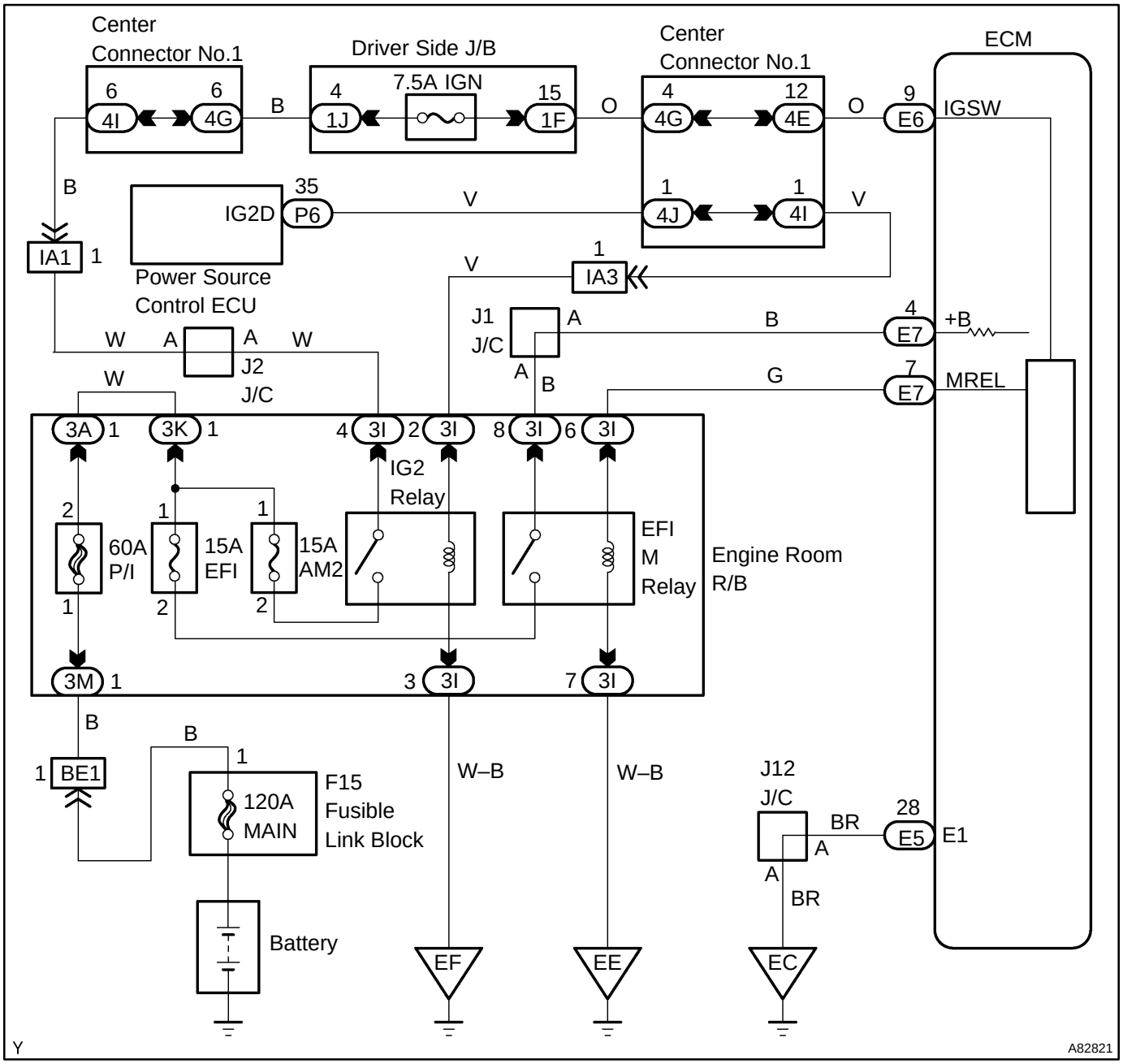
ECM POWER SOURCE CIRCUIT

CIRCUIT DESCRIPTION

The power source circuit of the hybrid system differs from the conventional power source circuit in the method in which the battery voltage is supplied to IGSW terminal of the ECM. The hybrid system has adopted one relay to serve as an ignition switch, which is controlled by the power source control ECU.
When the HV system is turned ON, the power source control ECU actuates the IG2 relay, which applies the battery voltage to IGSW terminal of the ECM. This causes the MREL terminal to transmit a signal to the EFI M relay. Then, the current that passes through the contact points of the EFI M relay (which is actuated by the MREL signal) flows to the +B terminal of the ECM.
When the power switch is turned OFF, the ECM keeps the EFI M relay ON for a maximum of 2 seconds, in order to initialize the throttle valve.

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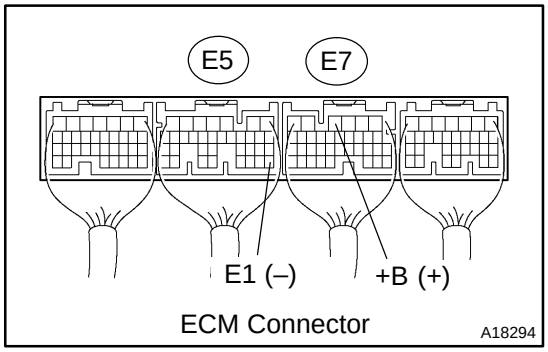
WIRING DIAGRAM



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INSPECTION PROCEDURE

1 INSPECT ECM(+B VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E7 ECM connectors.

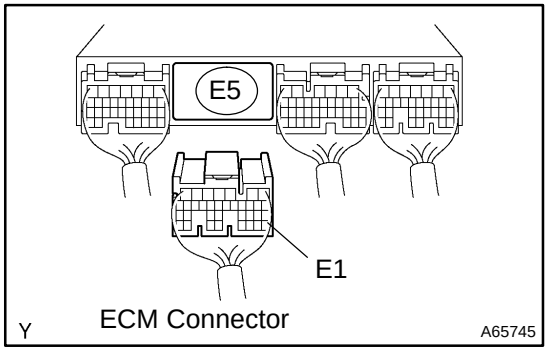
Standard:

Tester Connection	Specified Condition
+B (E7–4) – E1 (E5–28)	9 to 14 V

OK → **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN ON PROBLEM SYMPTOMS TABLE (See page 05–33)**

NG

2 CHECK HARNESS AND CONNECTOR(ECM – BODY GROUND)



(a) Disconnect the E5 ECM connector.
(b) Check the resistance between the wire harness side connectors.

Standard (Check for open):

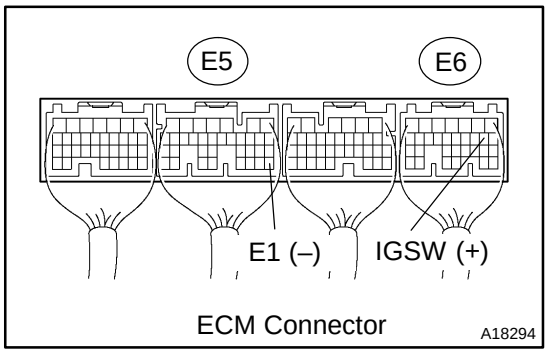
Tester Connection	Specified Condition
E1 (E5–28) – Body ground	Below 1 Ω

(c) Reconnect the ECM connector.

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

OK

3 INSPECT ECM(IGSW VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E6 ECM connectors.

Standard:

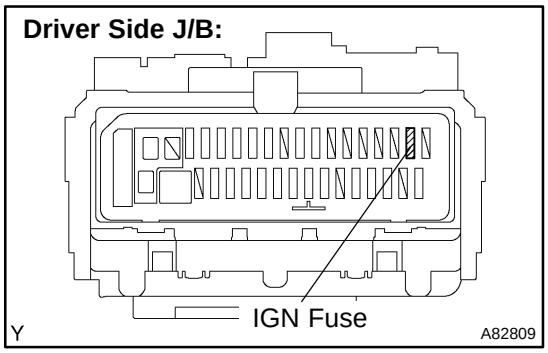
Tester Connection	Specified Condition
IGSW (E6–9) – E1 (E5–28)	9 to 14 V

OK → **Go to step 7**

NG

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4 CHECK FUSE(IGN FUSE)

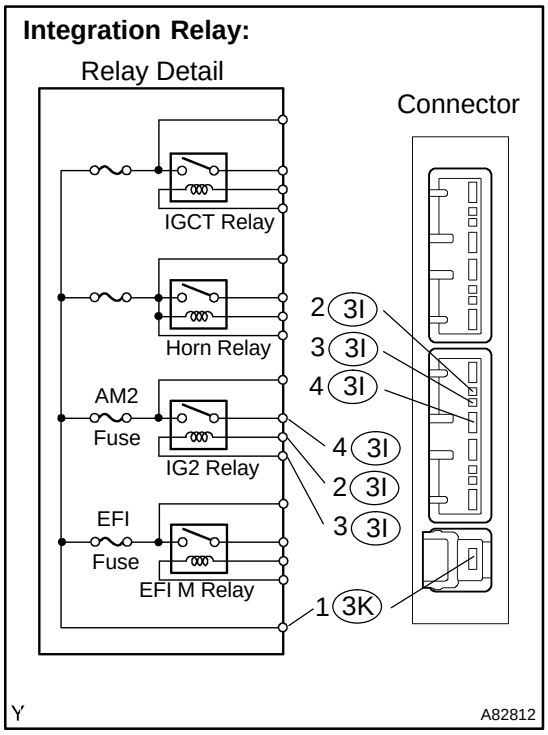


(a) Remove the IGN fuse from the driver side J/B.
(b) Check the resistance of the IGN fuse.
Standard: Below 1 Ω
(c) Reinstall the IGN fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

5 INSPECT INTEGRATION RELAY(IG2 RELAY)



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the IG2 relay.
Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–4)	10 kΩ or higher
(3K–1) – (3I–4)	Below 1 Ω (Apply battery voltage to terminals 3I–2 and 3I–3)

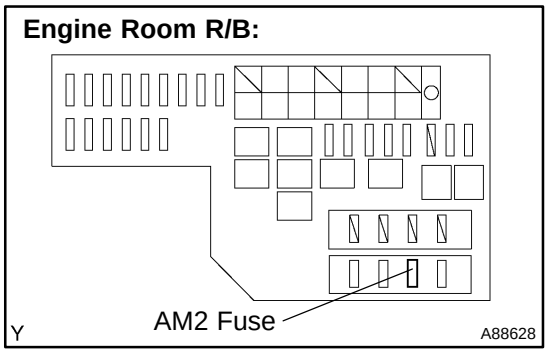
(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

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6 CHECK FUSE(AM2 FUSE)



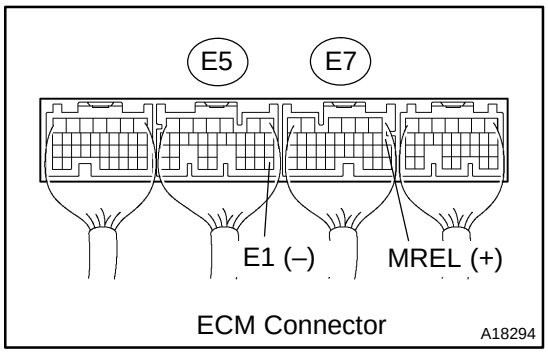
(a) Remove the AM2 fuse from the engine room R/B.
(b) Check the resistance of the AM2 fuse.
Standard: Below 1 Ω
(c) Reinstall the AM2 fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

CHECK AND REPAIR HARNESS AND CONNECTOR(BATTERY – IG2 RELAY, IG2 RELAY – ECM)

7 INSPECT ECM(MREL VOLTAGE)



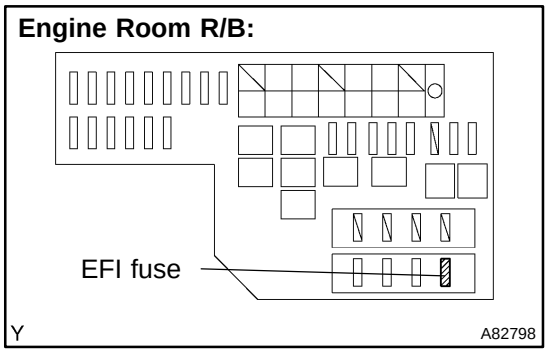
(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E7 ECM connectors.
Standard:

Tester Connection	Specified Condition
MREL (E7–7) – E1 (E5–28)	9 to 14 V

NG → **REPLACE ECM (See page 10–24)**

OK

8 CHECK FUSE(EFI FUSE)



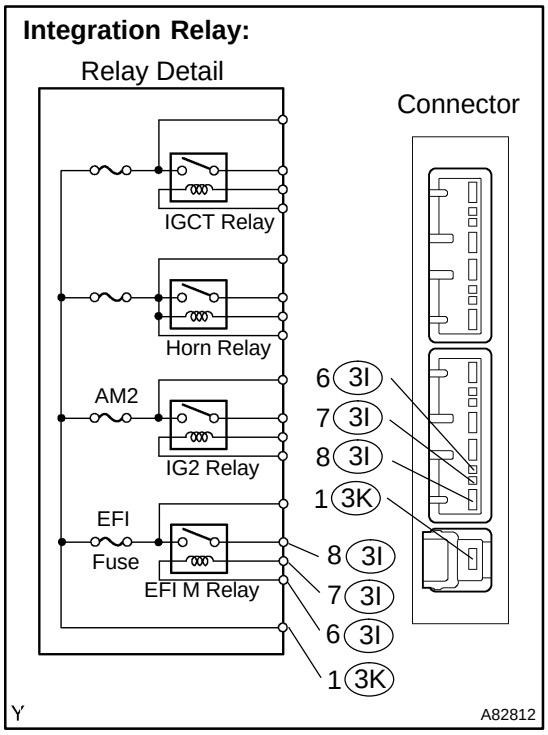
(a) Remove the EFI fuse from the engine room R/B.
(b) Check the resistance of the EFI fuse.
Standard: Below 1 Ω
(c) Reinstall the EFI fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

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9	INSPECT INTEGRATION RELAY(EFI M RELAY)



(a) Remove the integration relay from the engine room R/B.

(b) Inspect the EFI M relay.

Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

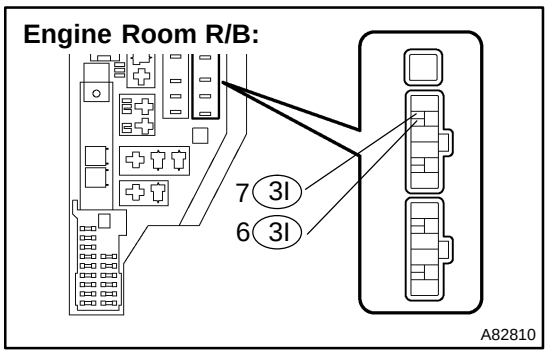
(c) Reinstall the integration relay.

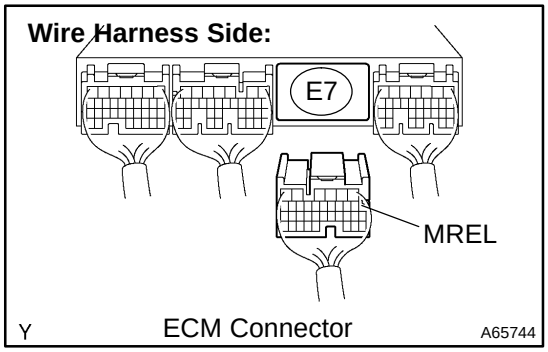
NG → **REPLACE INTEGRATION RELAY**

OK

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10	CHECK HARNESS AND CONNECTOR(EFI M RELAY – ECM, EFI M RELAY – BODY GROUND)





(a) Check the harness and connectors between the EFI M relay and ECM connector.
  (1) Remove the integration relay from the engine room R/B.
  (2) Disconnect the E7 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
EFI M relay (3I–6) – MREL (E7–7)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
EFI M relay (3I–6) or MREL (E7–7) – Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the EFI M relay and the body ground.
  (1) Remove the integration relay from the engine room R/B.
  (2) Check the resistance between the wire harness side connector and the body ground.

Standard (Check for open):

Tester Connection	Specified Condition
EFI M relay (3I–7) – Body ground	Below 1 Ω

  (3) Reinstall the integration relay.

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

OK

CHECK AND REPAIR HARNESS AND CONNECTOR (TERMINAL +B OF ECM – BATTERY POSITIVE TERMINAL)

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05J2V–01

FREEZE FRAME DATA

DESCRIPTION

The freeze frame data records the engine condition (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when malfunction is detected. When troubleshooting, it can help determine if the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was LEAN or RICH and other data. at the time of the malfunction occurred.

HINT:

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

LIST OF FREEZE FRAME DATA

LABEL (Hand–Held–Tester Display)	Measure Item/Range	Diagnostic Note
CALC LOAD	Calculate load	Calculated load by ECM
COOLANT TEMP	Engine coolant temperature	If the value is –40°C, sensor circuit is open If the value is 140°C, sensor circuit is shorted
SHORT FT #1	Short–term fuel trim	Short–term fuel compensation used to maintain the air–fuel ratio at stoichiometric air–fuel ratio
LONG FT #1	Long–term fuel trim	Overall fuel compensation carried out in long–term to compensate a continual deviation of the short–term fuel trim from the central valve
ENGINE SPD	Engine speed	—
VEHICLE SPD	Vehicle speed	Speed indicated on speedometer
IGN ADVANCE	Ignition advance	—
INTAKE AIR	Intake air temperature	If the value is –40°C, sensor circuit is open If the value is 140°C, sensor circuit is shorted
MAF	Mass air flow volume	If the value is approximately 0.0 g/s: • Mass air flow meter power source circuit • VG circuit open or short If the value is 160.0 g/s or more: • E2G circuit open
THROTTLE POS	Throttle position	Read the value with power switch ON (Do not start engine)
O2S B1 S2	Heated oxygen sensor output	Performing the INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of the sensor
O2FT B1 S2	Fuel trim at heated oxygen sensor	Same as SHORT FT #1
ENG RUN TIME	Accumulated engine running time	—
AF FT B1 S1	Fuel trim at A/F sensor	—
AFS B1 S1	A/F sensor output	Performing the INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of the sensor
EVAP PURGE VSV	EVAP purge VSV duty ratio	—
WU CYC DTC CLEAR	Warm–up cycle after DTC cleared	—
DIST DTC CLEAR	Accumulated distance from DTC cleared	—
EVAP VAPOR PRES	EVAP vapor pressure	—
CAT TEMP B1 S1	Catalyst temperature	—
CAT TEMP B1 S2	Catalyst temperature	—
BATTERY VOLTAGE	Battery voltage	—
AIR–FUEL RATIO	Air–fuel ratio	—
THROTTLE POS	Throttle sensor positioning	Read the value with the power switch ON (Do not start engine)
AMBIENT TEMP	Ambient air temperature	If the value is –40°C, sensor circuit is open If the value is 140°C, sensor circuit is shorted
THROTTLE POS #2	Throttle sensor positioning #2	—

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LABEL (Hand–Held–Tester Display)	Measure Item/Range	Diagnostic Note
THROTTLE MOT	Throttle motor	—
TIME DTC CLEAR	Cumulative time after DTC cleared	—
KNOCK CRRT VAL	Correction learning value of knocking	—
KNOCK FB VAL	Feedback value of knocking	—
PURGE DENSITY	Learning value of purge density	—
PURGE FLOW	Purge flow	—
FC IDL	Idle fuel cut	ON: when throttle valve fully closed and engine speed is over 1,500 rpm
FC TAU	FC TAU	The fuel cut is being performed under very light load to prevent the engine combustion from becoming incomplete
VVTL AIM ANGL #1	VVT aim angle	—
VVT CHNG ANGL #1	VVT change angle	—
VVT OCV DUTY B1	VVT OCV operation duty	—
EVAP VSV	EVAP purge VSV	VSV for EVAP is controlled by the ECM (ground side duty control)
FUEL PUMP / SPD	Fuel pump speed status	—
VVT CTRL B1	VVT control status	—
FAN MOTOR	Electric fan motor	—
TANK BYPASS VSV	Tank bypass VSV	VSV for purge flow controlled by ECM (ground side control)
CAN CTRL VSV	Canister control VSV	VSV for canister close is controlled by ECM (ground side control)
INI COOL TEMP	Initial engine coolant temperature	—
INI INTAKE TEMP	Initial intake air temperature	—
INJ VOL	Injection volume	—
INJECTOR	Injector	—
TOTAL FT #1	Total fuel trim	—
MISFIRE RPM	Misfire RPM	—
MISFIRE LOAD	Misfire load	—
CYL #1	Cylinder #1 misfire rate	Displayed in only idling
CYL #2	Cylinder #2 misfire rate	Displayed in only idling
CYL #3	Cylinder #3 misfire rate	Displayed in only idling
CYL #4	Cylinder #4 misfire rate	Displayed in only idling
CYL ALL	All cylinder misfire rate	Displayed in only idling
IGNITION	Ignition	—
MISFIRE MARGIN	MIsfire monitoring	—
VAPOR PRESS	Vapor pressure	Pressure inside of fuel tank as read by the vapor pressure sensor
ENG OIL PRES SW	Engine oil pressure switch signal	Always ON while engine is running

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05CRL–08

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	Heater is turned OFF	Power 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 P0117 P0118	Engine coolant temperature is fixed at 80˚C (176˚F)	”Pass” condition detected
P0120 P0122 P0123	Fuel cut intermittently	Power switch OFF
P0121	Fuel cut intermittently	”Pass” condition detected and power switch OFF
P0325	Maximum ignition timing retardation	Power switch OFF
P0351 P0352 P0353 P0354	Fuel cut	”Pass” condition detected
P657	VTA is fixed at about 16 % and fuel cut intermittently	”Pass” condition detected and power switch OFF
P1115 P1117 P1118	Engine coolant temperature is fixed at 80°C (176°F)	”Pass” condition detected
P1120 P1122 P1123	Water valve position is fixed at position when DTC is detected	”Pass” condition detected
P2102 P2103	VTA is fixed at about 16 % and fuel cut intermittently	Power switch OFF
P2119	VTA is fixed at about 16 % and fuel cut intermittently	”Pass” condition detected and power switch OFF

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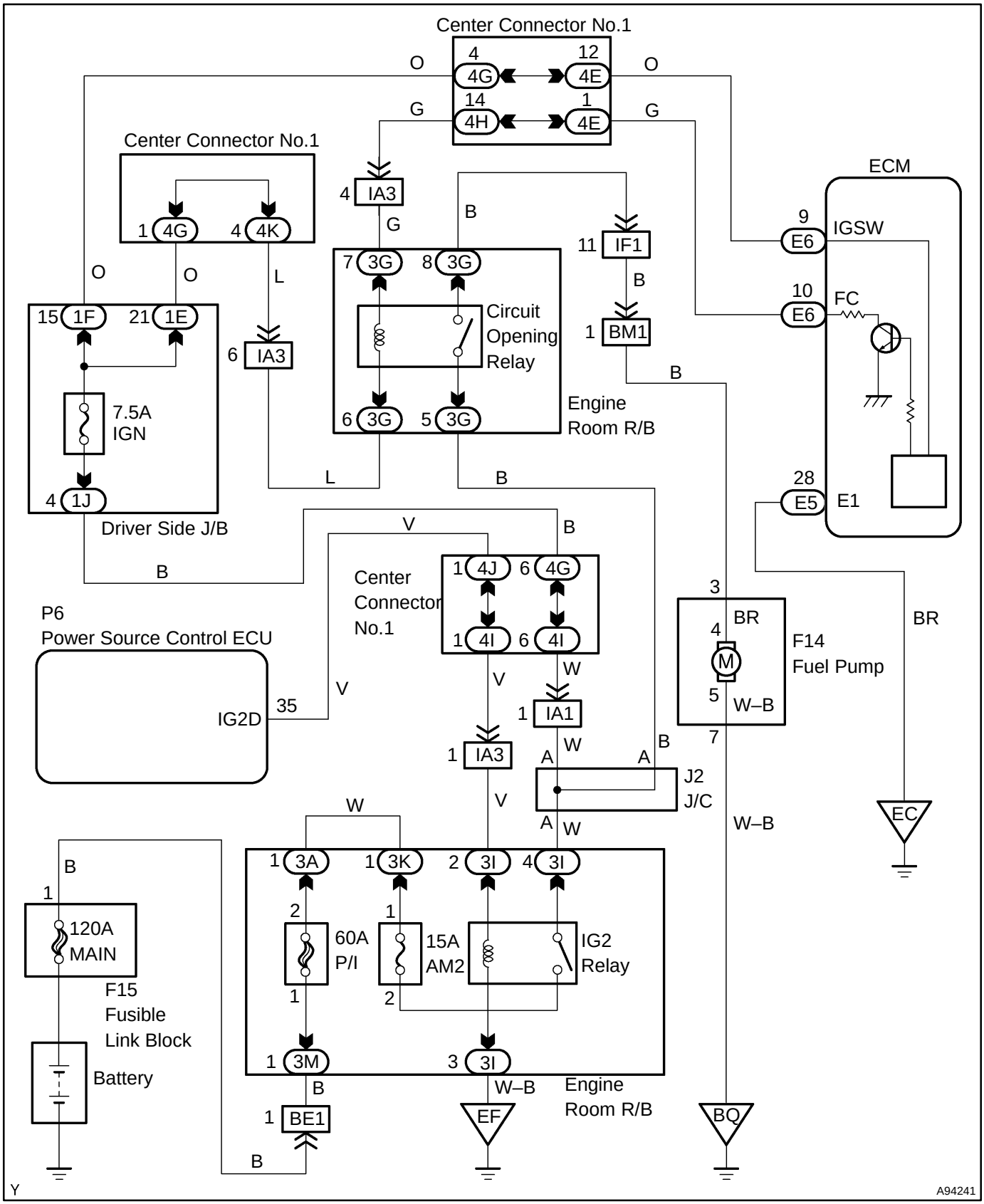
FUEL PUMP CONTROL CIRCUIT

CIRCUIT DESCRIPTION

The fuel pump is operated by the ECM according to the vehicle running condition. After the ECM receives the engine start requirement signal from the HV control ECU, an NE signal comes in immediately when the engine is cranked by MG1 (basically, the fuel pump can operate while the NE signal is generated).
The ECM grounds the FC terminal line after receiving NE signal. It causes to energize the coil in the circuit opening relay, and the current flows to the fuel pump.
When the signal to stop the engine comes from the HV control ECU to the ECM, or when the fuel cut operation is performed such as decelerating by the engine brake, the fuel pump is stopped.

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WIRING DIAGRAM



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INSPECTION PROCEDURE

Hand–held tester:

1	PERFORM ACTIVE TEST BY HAND–HELD TESTER(OPERATE CIRCUIT OPENING RELAY)

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / FUEL PUMP/ SPD.
(e) Check the relay operation while operating it using the hand–held tester.
Standard: Operating noise can be heard from the relay.

OK → **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE**

NG

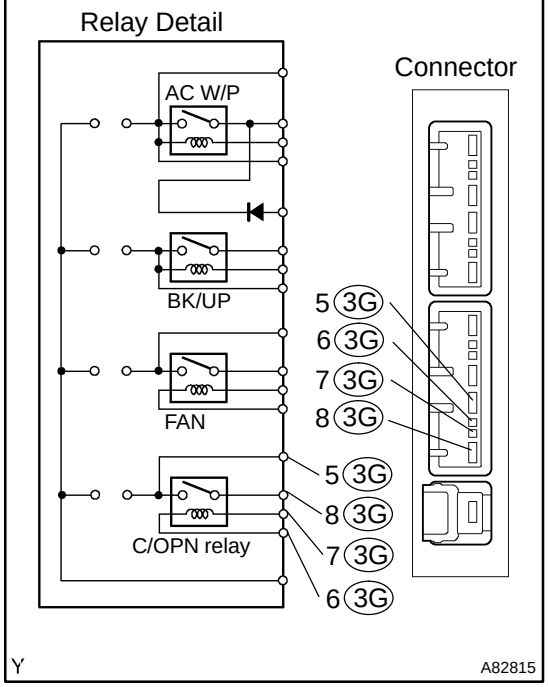
2	INSPECT POWER SOURCE CIRCUIT (See page 05–366)

NG → **REPAIR OR REPLACE POWER SOURCE CIRCUIT COMPONENTS**

OK

3	INSPECT INTEGRATION RELAY(C/OPN RELAY)

Integration Relay:



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the circuit opening relay.
Standard:

Tester Connection	Specified Condition
(3G–5) – (3G–8)	10 kΩ or higher
(3G–5) – (3G–8)	Below 1 Ω (Apply battery voltage to terminals 3G–6 and 3G–7)

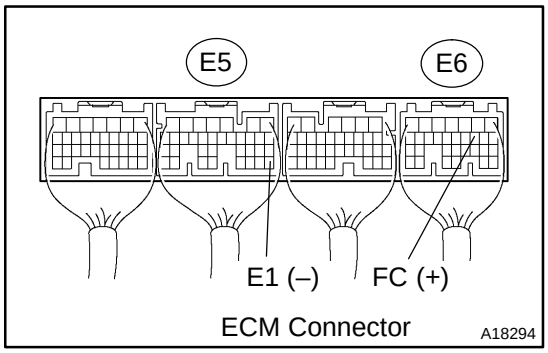
(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

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4 INSPECT ECM(FC VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E6 ECM connectors.

Standard:

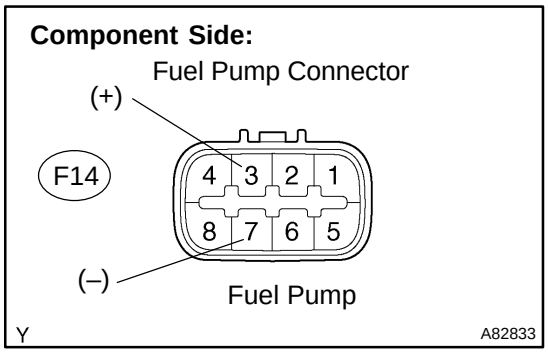
Tester Connection	Specified Condition
FC (E6–10) – E1 (E5–28)	9 to 14 V

OK → **Go to step 5**

NG

CHECK AND REPAIR HARNESS OR CONNECTOR

5 INSPECT FUEL PUMP



(a) Disconnect the F14 fuel pump connector.
(b) Inspect the fuel pump resistance.
(1) Measure the resistance between terminals 3 and 7.

Standard:

Tester Connection	Specified Condition
3 – 7	0.2 to 3.0 Ω at 20 °C (68 °F)

(c) Inspect the fuel pump operation
(1) Apply battery voltage to the fuel pump terminals. Check that the pump operates.

NOTICE:

- **These tests must be done quickly (within 10 seconds) to prevent the coil from burning out.**
- **Keep fuel pump as far away from the battery as possible.**
- **Always do the switching at the battery side.**

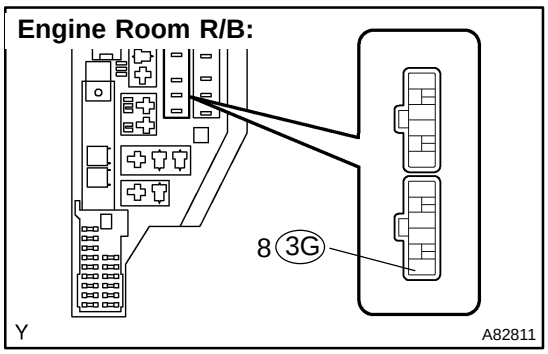
(d) Reconnect the fuel pump connector.

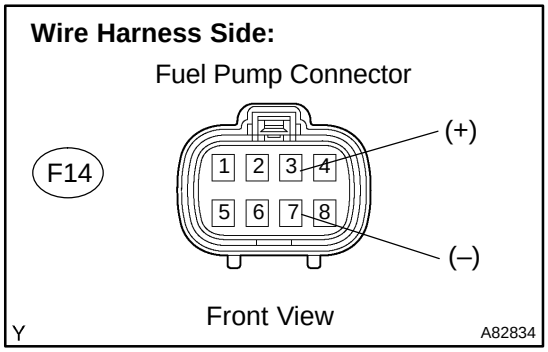
NG → **REPAIR OR REPLACE FUEL TANK ASSY**

OK

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6	CHECK HARNESS AND CONNECTOR(C/OPN RELAY – FUEL PUMP, FUEL PUMP – BODY GROUND)





(a) Check the harness and the connectors between the circuit opening relay and the fuel pump connector.
  (1) Remove the integration relay from the engine room R/B.
  (2) Disconnect the F14 fuel pump connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Circuit opening relay (3G–8) – Fuel pump (F14–3)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Circuit opening relay (3G–8) or Fuel pump (F14–3) – Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.
  (5) Reconnect the fuel pump connector.

(b) Check the harness and the connectors between the fuel pump connector and the body ground.
  (1) Disconnect the F14 fuel pump connector.
  (2) Check the resistance between the wire harness side connector and the body ground.

Standard (Check for open):

Tester Connection	Specified Condition
Fuel pump (F14–7) – Body ground	Below 1 Ω

  (3) Reconnect the fuel pump connector.

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

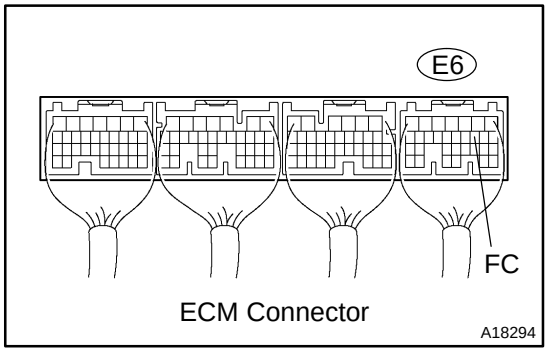
OK

REPLACE ECM (See page 10–24)

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OBD II scan tool (excluding hand–held tester):

1	CHECK FUEL PUMP OPERATION



(a) When the terminal FC of the ECM connector and the body ground are connected, check the relay operation.
Standard:
Operating noise can be heard from the circuit opening relay.

OK → **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN ON PROBLEM SYMPTOMS TABLE (See page 05–33)**

NG

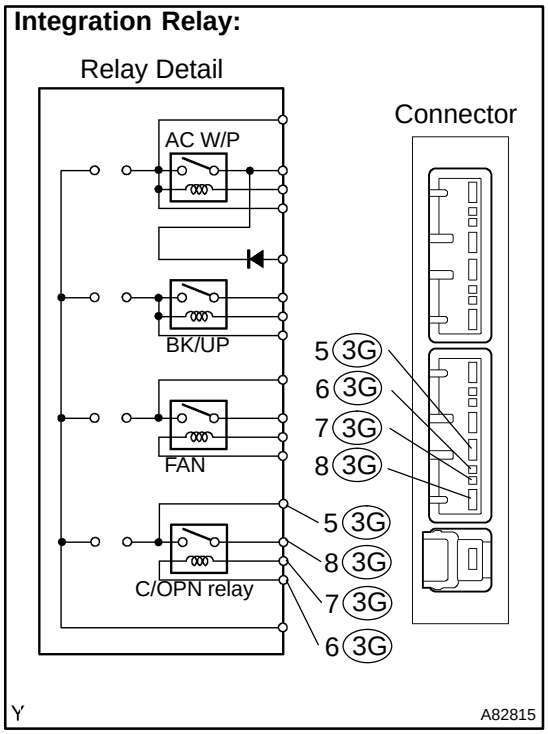
2	CHECK FOR ECM POWER SOURCE CIRCUIT (See page 05–366)

NG → **REPAIR OR REPLACE POWER SOURCE CIRCUIT COMPNENTS**

OK

3	INSPECT INTEGRATION RELAY(C/OPN RELAY)

Integration Relay:



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the circuit opening relay.
Standard:

Tester Connection	Specified Condition
(3G–5) – (3G–8)	10 kΩ or higher
(3G–5) – (3G–8)	Below 1 Ω (Apply battery voltage to terminals 3G–6 and 3G–7)

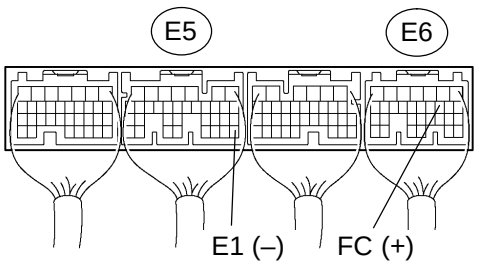
(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

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4 INSPECT ECM(FC VOLTAGE)



ECM Connector A18294

(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E6 ECM connectors.
Standard:

Tester Connection	Specified Condition
FC (E6–10) – E1 (E5–28)	9 to 14 V

OK → **Go to step 5**

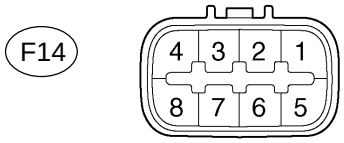
NG

CHECK AND REPAIR HARNESS OR CONNECTOR

5 INSPECT FUEL PUMP

Component Side:

Fuel Pump Connector



Front View

Y A82833

(a) Disconnect the F14 fuel pump connector.
(b) Inspect the fuel pump resistance.
(1) Measure the resistance between terminals 3 and 7.
Standard:

Tester Connection	Specified Condition
3 – 7	0.2 to 3.0 Ω at 20 °C (68 °F)

(c) Inspect the fuel pump operation
(1) Apply battery voltage to the fuel pump terminals. Check that the pump operates.

NOTICE:

- **These tests must be done quickly (within 10 seconds) to prevent the coil from burning out.**
- **Keep fuel pump as far away from the battery as possible.**
- **Always do the switching at the battery side.**

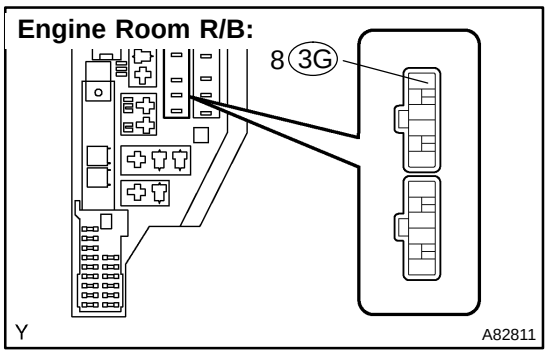
(d) Reconnect the fuel pump connector.

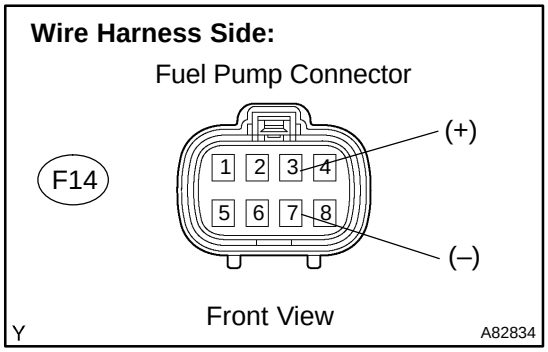
NG → **REPLACE FUEL TANK ASSY**

OK

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6	CHECK HARNESS AND CONNECTOR(C/OPN RELAY – FUEL PUMP, FUEL PUMP – BODY GROUND)





(a) Check the harness and the connectors between the circuit opening relay and the fuel pump connector.
  (1) Remove the integration relay from the engine room R/B.
  (2) Disconnect the F14 fuel pump connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Circuit opening relay (3G–8) – Fuel pump (F14–3)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Circuit opening relay (3G–8) or Fuel pump (F14–3) – Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.
  (5) Reconnect the fuel pump connector.

(b) Check the harness and the connectors between the fuel pump connector and the body ground.
  (1) Disconnect the F14 fuel pump connector.
  (2) Check the resistance between the wire harness side connector and the body ground.

Standard (Check for open):

Tester Connection	Specified Condition
Fuel pump (F14–7) – Body ground	Below 1 Ω

  (3) Reconnect the fuel pump connector.

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

OK

REPLACE ECM (See page 10–24)

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05J2T–01

LIST OF DISABLE A MONITOR

HINT:

The table below shows the ECM monitoring status for the components listed in the top of the table when the DTCs on the left of the table are set.

As for the ”X” mark, when the DTC on the left is stored, detection of the DTC in the upper column is not performed.

Monitor detected malfunction	Fault code	Fault code	Component/ system	Monitor disablement (X - disabled)																												
				P0010,P0020	P0011	P0012	P0016,P0018	P0021	P0022	P0030,50	P0135,P0155	P0036,56	P0043,44,63,64	P0100	P0101	P0105	P0106	P0110	P0115	P0116	P0120,P0121	P0125	P0128	P0130-P0153	P0134,P0154	P0136,P0156	P0142,P0162	P0171,P0172	P0300-P0308			
				P0010,P0020	P0011	P0012	P0016,P0018	P0021	P0022	P0031,32,51,52	P0031,32,51,52	P0037,38,57,58	P0043,44,63,64	P0100-P0103	P0101	P0105-P0108	P0106	P0110-P0113	P0115-P0118	P0116	P0120-P0223,P2135	P0125	P0128	P0130-P0153	P0134,P0154	P0136,P0156	P0142,P0162	P0171,P0172	P0300-P0308			
				VVT VSV1,2	VVT System1 -Advance	VVT System1 - Retard	VVT System - Misalignment	VVT System2 - Advance	VVT System2 - Retard	O2 Sensor Heater - Sensor1	A/F Sensor Heater - Sensor1	O2 Sensor Heater - Sensor2	O2 Snesor Heater - Sensor3	MAF sensor	MAF sensor	MAP sensor	MAP sensor	IAT sensor	ECT sensor	ECT sensor	TP sensor	Insufficient ECT for Closed Loop	Thermostat	O2 Sensor -Sensor1	O2 Sensor, A/F Sensor(No Activity) - Sensor1	O2 Sensor - Sensor2	O2 Snesor - Sensor3	Fuel system	Misfire			
	P0010,P0020	P0010,P0020	VVT VSV1,2																			✕					✕					
	P0011	P0011	VVT System1 - Advance				✕		✕														✕					✕					
	P0012	P0012	VVT System1 - Retard				✕		✕														✕					✕					
	P0016,P0018	P0016,P0018	VVT System - Misalignment																														
	P0021	P0021	VVT System2 - Advance			✕	✕																✕					✕					
	P0022	P0022	VVT System2 - Retard			✕																	✕					✕					
	P0030,50	P0031,32,51,52	O2 Sensor Heater - Sensor1																				✕	✕	✕	✕	✕	✕					
	P0135,P0155	P0031,32,51,52	A/F Sensor Heater - Sensor1																				✕			✕	✕	✕					
	P0036,56	P0037,38,57,58	O2 Sensor Heater - Sensor2																							✕	✕						
	P0043,44,63,64	P0043,44,63,64	O2 Sensor Heater - Sensor3																								✕						
	P0100,P0101	P0100-P0103	MAF sensor		✕	✕		✕	✕											✕		✕	✕	✕	✕	✕	✕	✕	✕	✕			
	P0105,P0106	P0105-P0108	MAP sensor		✕	✕		✕	✕											✕		✕	✕	✕	✕	✕	✕	✕	✕	✕			
	P0110	P0110-P0113	IAT sensor																			✕	✕	✕	✕	✕	✕		✕				
	P0115,P0116	P0115-P0118	ECT sensor		✕	✕	✕	✕	✕						✕		✕					✕	✕	✕	✕	✕	✕	✕	✕			
	P0120,P0121	P0120-P0223,P2135	TP sensor												✕		✕							✕	✕	✕	✕	✕	✕			
	P0125	P0125	Insufficient ECT for Closed Loop		✕	✕		✕	✕						✕		✕						✕	✕	✕	✕	✕	✕	✕			
	P0128	P0128	Thermostat																														
	P0130-P0153	P0130-P0153	O2 Sensor - Sensor1																				✕		✕	✕	✕						
	P0134,P0154	P0134,P0154	O2 Sensor, A/F Sensor(No Activity) - Sensor1								✕												✕	✕		✕	✕	✕					
	P0136,P0156	P0136,P0156	O2 Sensor - Sensor2																														
	P0142,P0162	P0142,P0162	O2 Sensor - Sensor3																														
	P0171,P0172	P0171,P0172	Fuel system																				✕	✕	✕	✕	✕						
	P0300-P0308	P0300-P0308	Misfire							✕													✕	✕	✕	✕	✕						
	P0325,P0330	P0325-P0333	Knock sensor																														
	P0335	P0335	CKP sensor		✕	✕		✕	✕						✕		✕						✕	✕	✕	✕	✕	✕	✕				
	P0340, P0341	P0340, P0341	CMP sensor		✕	✕		✕	✕						✕		✕						✕	✕	✕	✕	✕	✕	✕				
	P0340-P0346	P0340-P0346	VVT sensor1,2																				✕										
	P0351-P0358	P0351-P0358	Ignitor		✕	✕		✕	✕														✕										
	P0385	P0385	CKP sensor 2												✕		✕						✕	✕	✕	✕	✕	✕	✕				
	P0401	P0401	EGR system (closed)																				✕						✕				
	P0402	P0402	EGR system (open)																				✕	✕	✕	✕	✕	✕	✕				
	P0405,P0409	P0405-P0409	Lift sensor																										✕				
	P0420,P0430	P0420,P0430	Catalyst																														
	P0442-P0456	P0442-P0456	EVAP system																					✕	✕	✕	✕						
	P0450,P0451	P0450-P0453	EVAP press sensor																														

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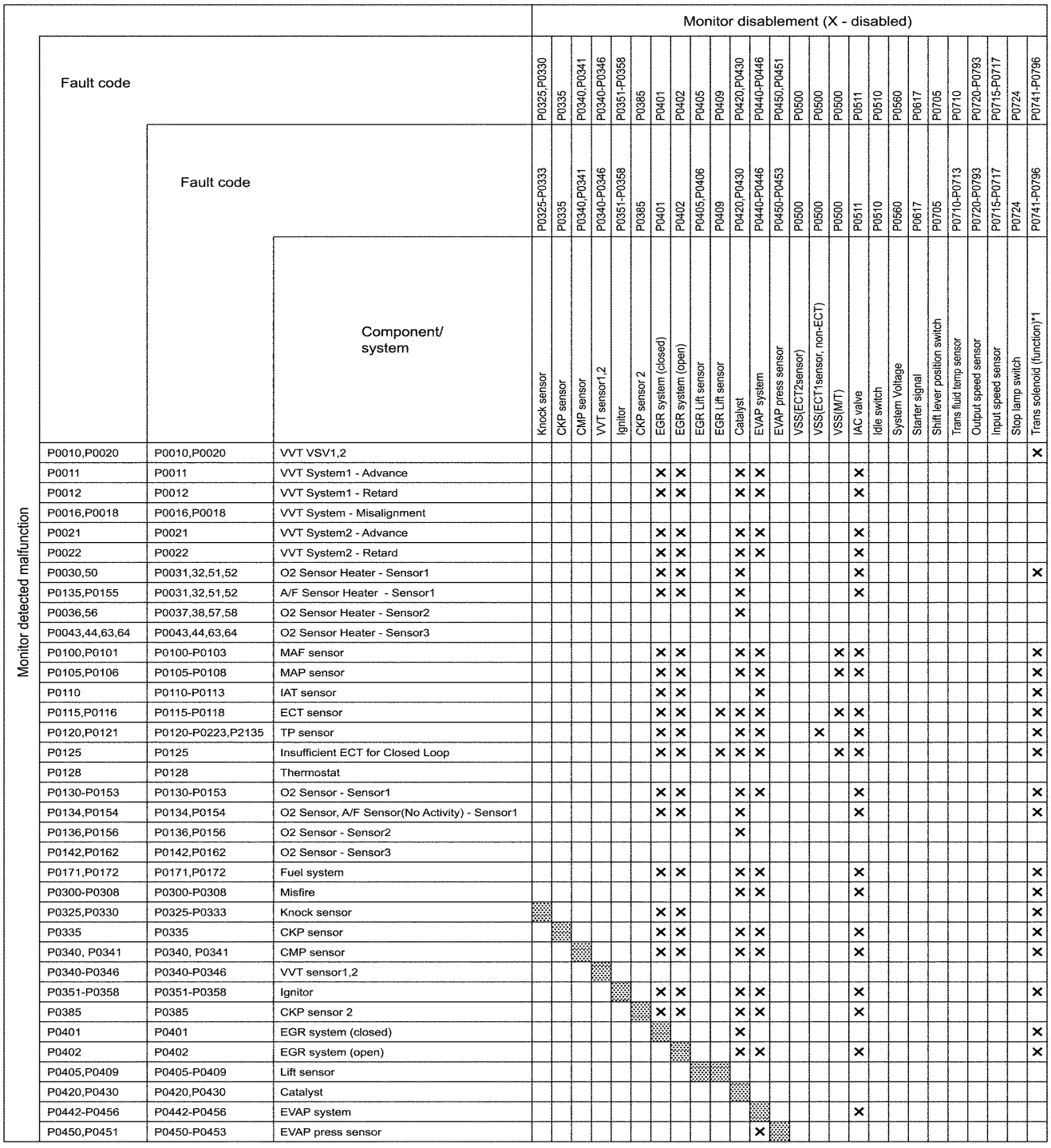
Monitor detected malfunction

Fault code	Fault code	Component/ system	Monitor disablement (X - disabled)																												
			P0010,P0020	P0011	P0012	P0016,P0018	P0021	P0022	P0030,50	P0135,P0155	P0036,56	P0043,44,63,64	P0100	P0101	P0105	P0106	P0110	P0115	P0116	P0120,P0121	P0125	P0128	P0130-P0153	P0134,P0154	P0136,P0156	P0142,P0162	P0171,P0172	P0300-P0308			
	P0010,P0020	VVT VSV1,2																													
	P0011	VVT System1 -Advance																													
	P0012	VVT System1 - Retard																													
	P0016,P0018	VVT System - Misalignment																													
	P0021	VVT System2 - Advance																													
	P0022	VVT System2 - Retard																													
	P0031,32,51,52	O2 Sensor Heater - Sensor1																													
	P0031,32,51,52	A/F Sensor Heater - Sensor1																													
	P0037,38,57,58	O2 Sensor Heater - Sensor2																													
	P0043,44,63,64	O2 Snesor Heater - Sensor3																													
	P0100-P0103	MAF sensor																													
	P0101	MAF sensor												X																	
	P0105-P0108	MAP sensor														X															
	P0106	MAP sensor														X															
	P0110-P0113	IAT sensor																													
	P0115-P0118	ECT sensor																													
	P0116	ECT sensor																													
	P0120-P0223,P2135	TP sensor																													
	P0125	Insufficient ECT for Closed Loop																													
	P0128	Thermostat																				X									
P0500	P0500	VSS																				X	X	X	X	X	X	X			
P0511	P0511	IAC valve																					X								
P0510	P0510	Idle switch												X		X						X	X		X	X	X	X			
P0560	P0560	System Voltage																													
P0617	P0617	Starter signal																													
P0705	P0705	Shift lever position switch																													
P0710	P0710-P0713	Trans fluid temp sensor																													
P0720-P0793	P0720-P0793	Output speed sensor																													
P0715-P0717	P0715-P0717	Input speed sensor																													
P0724	P0724	Stop lamp switch																													
P0741-P0796	P0741-P0796	Trans solenoid (function)																													
P0748-P0798	P0748-P0799	Trans solenoid (range)																													
P0850	P0850	PNP switch																													X
P1010,P1020	P1010,P1020	VVTL																				X					X				
P1011,12(,21,22)	P1011,12(,21,22)	VVTL system1(,2)																				X					X				
P1126	P1126	Electronic magnet clutch																													
P1129	P1129	Electronic throttle system																													
P1430	P1430	HC adsorber ACT press sensor																													
P2004,6	P2004,6	Intake Manifold Runner Control																													
P2009,10	P2009,10	Intake Manifold Runner Control Circuit																													
P2014,16,17	P2014,16,17	Intake Manifold Runner Position Sensor																													
P2102,P2103	P2102,P2103	Throttle motor																													
P2120-P2138	P2120-P2138	Accel position sensor																													
P2196,P2198	P2196,P2198	A/F sensor (rationality)																				X			X	X					
P2226	P2226	BARO sensor																					X		X	X					
P2237,P2240	P2237,P2240	A/F sensor (open)																				X			X	X					
P2423,24	P2423,24	HC Absorption Catalyst																													
P2430,2,3	P2430,2,3	AIR Pressure Sensor(Low/High)																													
P2431	P2431	AIR Pressure Sensor(Rationality)																													
P2440	P2440	AIR control valve stuck open																					X	X	X	X	X				
P2441	P2441	AIR control valve stuck close																					X	X	X	X	X				
P2444	P2444	AIP stuck On																					X	X	X	X	X				
P2445	P2445	AIP stuck Off																					X	X	X	X	X				
P2714-P2759	P2714-P2759	Trans solenoid(SLU-SLD)																													
P2A00,P2A03	P2A00,P2A03	A/F sensor (slow response)																				X			X	X					

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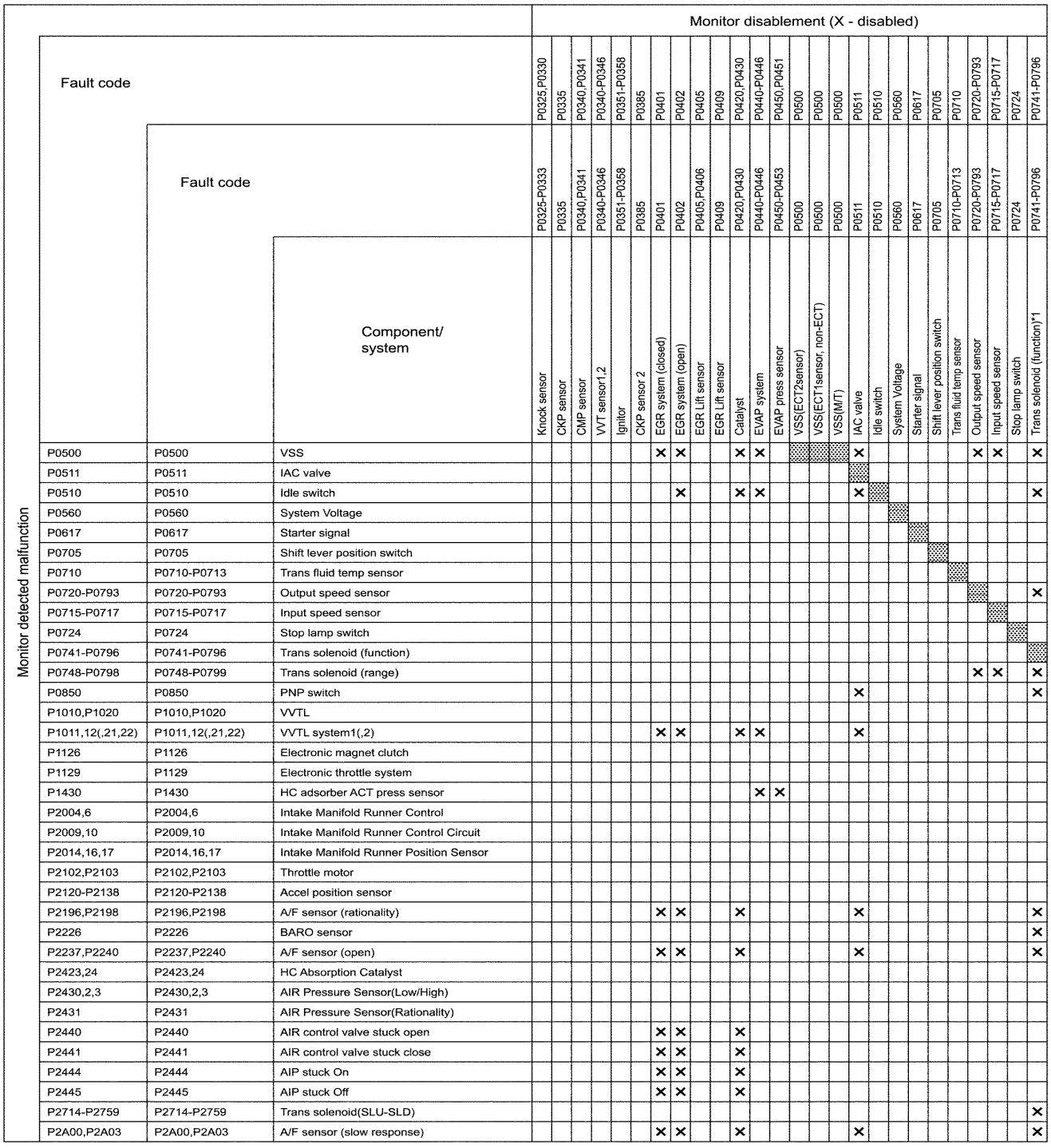


Monitor detected malfunction	Fault code	Fault code	Component/ system	Monitor disablement (X - disabled)																																		
				P0325,P0330	P0335	P0340,P0341	P0340-P0346	P0351-P0358	P0385	P0401	P0402	P0405	P0409	P0420,P0430	P0440-P0446	P0450,P0451	P0500	P0500	P0500	P0511	P0510	P0560	P0617	P0705	P0710	P0720-P0793	P0715-P0717	P0724	P0741-P0796
		P0325-P0333	P0335	P0340,P0341	P0340-P0346	P0351-P0358	P0385	P0401	P0402	P0405,P0406	P0409	P0420,P0430	P0440-P0446	P0450-P0453	P0500	P0500	P0500	P0511	P0510	P0560	P0617	P0705	P0710-P0713	P0720-P0793	P0715-P0717	P0724	P0741-P0796
			Knock sensor	CKP sensor	CMP sensor	VVT sensor1,2	Ignitor	CKP sensor 2	EGR system (closed)	EGR system (open)	EGR Lift sensor	EGR Lift sensor	Catalyst	EVAP system	EVAP press sensor	VSS(ECT2sensor)	VSS(ECT1sensor, non-ECT)	VSS(M/T)	IAC valve	Idle switch	System Voltage	Starter signal	Shift lever position switch	Trans fluid temp sensor	Output speed sensor	Input speed sensor	Stop lamp switch	Trans solenoid (function)*1
	P0010,P0020	P0010,P0020	VVT VSV1,2																										X
	P0011	P0011	VVT System1 - Advance							X	X			X	X					X									
	P0012	P0012	VVT System1 - Retard							X	X			X	X					X									
	P0016,P0018	P0016,P0018	VVT System - Misalignment																										
	P0021	P0021	VVT System2 - Advance							X	X			X	X					X									
	P0022	P0022	VVT System2 - Retard							X	X			X	X					X									
	P0030,50	P0031,32,51,52	O2 Sensor Heater - Sensor1							X	X			X						X									X
	P0135,P0155	P0031,32,51,52	A/F Sensor Heater - Sensor1							X	X			X						X									
	P0036,56	P0037,38,57,58	O2 Sensor Heater - Sensor2											X															
	P0043,44,63,64	P0043,44,63,64	O2 Sensor Heater - Sensor3																										
	P0100,P0101	P0100-P0103	MAF sensor							X	X			X	X			X	X	X									X
	P0105,P0106	P0105-P0108	MAP sensor							X	X			X	X			X	X	X									X
	P0110	P0110-P0113	IAT sensor							X	X				X														X
	P0115,P0116	P0115-P0118	ECT sensor							X	X		X	X	X			X	X	X									X
	P0120,P0121	P0120-P0223,P2135	TP sensor							X	X			X	X		X			X									X
	P0125	P0125	Insufficient ECT for Closed Loop							X	X		X	X	X			X	X	X									X
	P0128	P0128	Thermostat																										
	P0130-P0153	P0130-P0153	O2 Sensor - Sensor1							X	X			X	X					X									X
	P0134,P0154	P0134,P0154	O2 Sensor, A/F Sensor(No Activity) - Sensor1							X	X			X						X									X
	P0136,P0156	P0136,P0156	O2 Sensor - Sensor2											X															
	P0142,P0162	P0142,P0162	O2 Sensor - Sensor3																										
	P0171,P0172	P0171,P0172	Fuel system							X	X			X	X					X									X
	P0300-P0308	P0300-P0308	Misfire											X	X					X									X
	P0325,P0330	P0325-P0333	Knock sensor							X	X																		X
	P0335	P0335	CKP sensor							X	X			X	X					X									X
	P0340, P0341	P0340, P0341	CMP sensor							X	X			X	X					X									X
	P0340-P0346	P0340-P0346	VVT sensor1,2																										
	P0351-P0358	P0351-P0358	Ignitor							X	X			X	X					X									X
	P0385	P0385	CKP sensor 2							X	X			X	X					X									
	P0401	P0401	EGR system (closed)											X															X
	P0402	P0402	EGR system (open)											X	X					X									X
	P0405,P0409	P0405-P0409	Lift sensor																										
	P0420,P0430	P0420,P0430	Catalyst																										
	P0442-P0456	P0442-P0456	EVAP system																	X									
	P0450,P0451	P0450-P0453	EVAP press sensor												X														

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Monitor detected malfunction	Fault code	Fault code	Component/ system	Monitor disablement (X - disabled)																														
				P0325,P0330	P0335	P0340,P0341	P0340-P0346	P0351-P0358	P0385	P0401	P0402	P0405	P0409	P0420,P0430	P0440-P0446	P0450,P0451	P0500	P0500	P0500	P0511	P0510	P0560	P0617	P0705	P0710	P0720-P0793	P0715-P0717	P0724	P0741-P0796					
		P0325-P0333	Knock sensor																															
		P0335	CKP sensor																															
		P0340,P0341	CMP sensor																															
		P0340-P0346	VVT sensor1,2																															
		P0351-P0358	Ignitor																															
		P0385	CKP sensor 2																															
		P0401	EGR system (closed)																															
		P0402	EGR system (open)																															
		P0405,P0406	EGR Lift sensor																															
		P0409	EGR Lift sensor																															
		P0420,P0430	Catalyst																															
		P0440-P0446	EVAP system																															
		P0450-P0453	EVAP press sensor																															
		P0500	VSS(ECT2sensor)																															
		P0500	VSS(ECT1sensor, non-ECT)																															
		P0500	VSS(M/T)																															
		P0511	IAC valve																															
		P0510	Idle switch																															
		P0560	System Voltage																															
		P0617	Starter signal																															
		P0705	Shift lever position switch																															
		P0710-P0713	Trans fluid temp sensor																															
		P0720-P0793	Output speed sensor																															
		P0715-P0717	Input speed sensor																															
		P0724	Stop lamp switch																															
		P0741-P0796	Trans solenoid (function)																															
		P0748-P0798	Trans solenoid (range)																															
		P0850	PNP switch																															
		P1010,P1020	VVTL																															
		P1011,12(,21,22)	VVTL system1(,2)																															
		P1126	Electronic magnet clutch																															
		P1129	Electronic throttle system																															
		P1430	HC adsorber ACT press sensor																															
		P2004,6	Intake Manifold Runner Control																															
		P2009,10	Intake Manifold Runner Control Circuit																															
		P2014,16,17	Intake Manifold Runner Position Sensor																															
		P2102,P2103	Throttle motor																															
		P2120-P2138	Accel position sensor																															
		P2196,P2198	A/F sensor (rationality)																															
		P2226	BARO sensor																															
		P2237,P2240	A/F sensor (open)																															
		P2423,24	HC Absorption Catalyst																															
		P2430,2,3	AIR Pressure Sensor(Low/High)																															
		P2431	AIR Pressure Sensor(Rationality)																															
		P2440	AIR control valve stuck open																															
		P2441	AIR control valve stuck close																															
		P2444	AIP stuck On																															
		P2445	AIP stuck Off																															
		P2714-P2759	Trans solenoid(SLU-SLD)																															
		P2A00,P2A03	A/F sensor (slow response)																															

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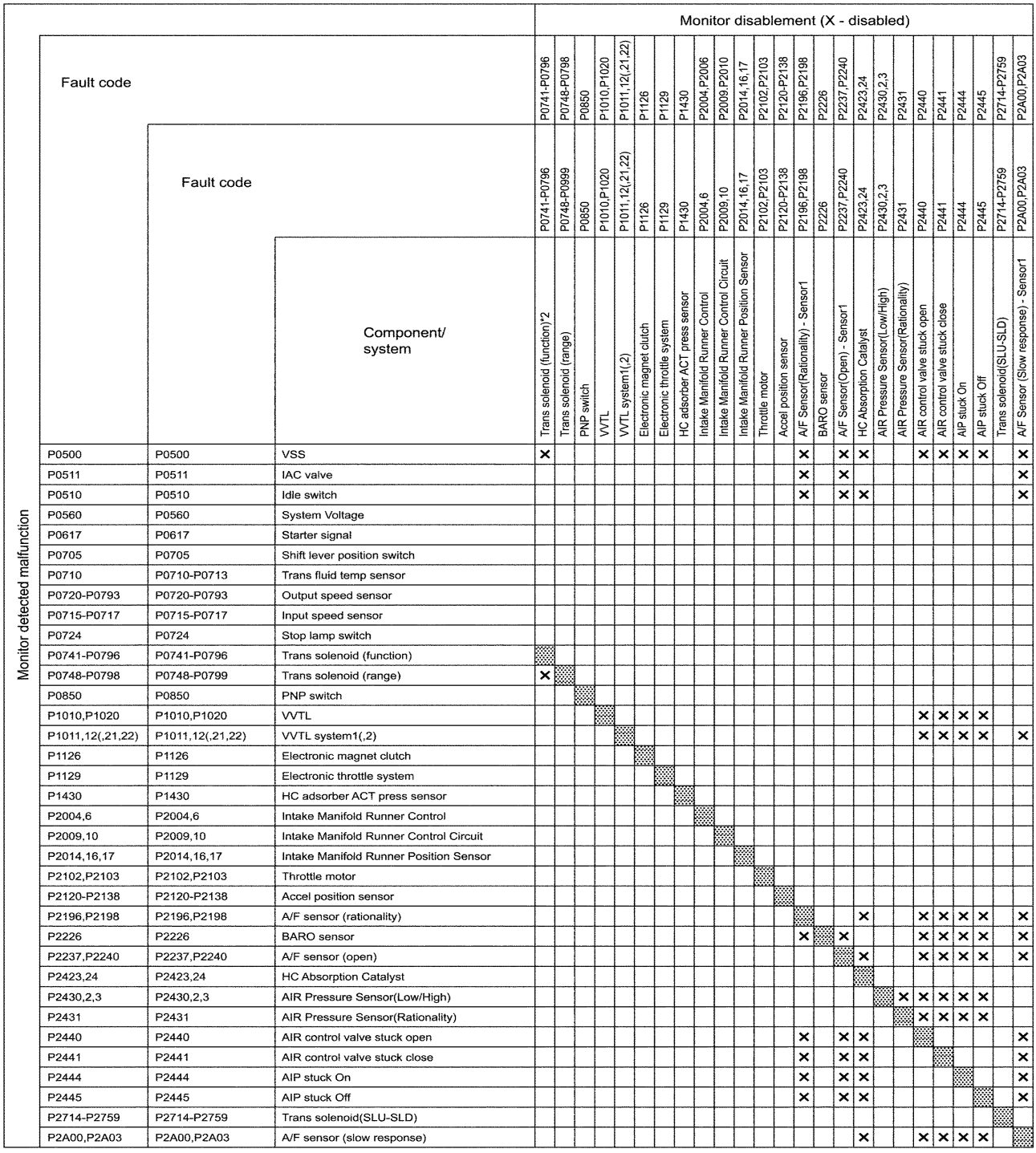
Monitor detected malfunction

Fault code	Fault code	Component/ system	Monitor disablement (X - disabled)																												
			P0741-P0796	P0748-P0798	P0850	P1010,P1020	P1011,12(,21,22)	P1126	P1129	P1430	P2004,P2006	P2009,P2010	P2014,16,17	P2102,P2103	P2120-P2138	P2196,P2198	P2226	P2237,P2240	P2423,24	P2430,2,3	P2431	P2440	P2441	P2444	P2445	P2714-P2759	P2A00,P2A03
			P0741-P0796	P0748-P0999	P0850	P1010,P1020	P1011,12(,21,22)	P1126	P1129	P1430	P2004,6	P2009,10	P2014,16,17	P2102,P2103	P2120-P2138	P2196,P2198	P2226	P2237,P2240	P2423,24	P2430,2,3	P2431	P2440	P2441	P2444	P2445	P2714-P2759	P2A00,P2A03
			Trans solenoid (function)*2	Trans solenoid (range)	PNP switch	VVTL	VVTL system1(,2)	Electronic magnet clutch	Electronic throttle system	HC adsorber ACT press sensor	Intake Manifold Runner Control	Intake Manifold Runner Control Circuit	Intake Manifold Runner Position Sensor	Throttle motor	Accel position sensor	A/F Sensor(Rationality) - Sensor1	BARO sensor	A/F Sensor(Open) - Sensor1	HC Absorption Catalyst	AIR Pressure Sensor(Low/High)	AIR Pressure Sensor(Rationality)	AIR control valve stuck open	AIR control valve stuck close	AIP stuck On	AIP stuck Off	Trans solenoid(SLU-SLD)	A/F Sensor (Slow response) - Sensor1
P0010,P0020	P0010,P0020	VVT VSV1,2																				X	X	X	X		
P0011	P0011	VVT System1 - Advance																				X	X	X	X		
P0012	P0012	VVT System1 - Retard																				X	X	X	X		
P0016,P0018	P0016,P0018	VVT System - Misalignment																				X	X	X	X		
P0021	P0021	VVT System2 - Advance																				X	X	X	X		
P0022	P0022	VVT System2 - Retard																				X	X	X	X		
P0030,50	P0031,32,51,52	O2 Sensor Heater - Sensor1																	X			X	X	X	X		
P0135,P0155	P0031,32,51,52	A/F Sensor Heater - Sensor1														X		X	X			X	X	X	X		X
P0036,56	P0037,38,57,58	O2 Sensor Heater - Sensor2														X			X								
P0043,44,63,64	P0043,44,63,64	O2 Sensor Heater - Sensor3																	X								
P0100,P0101	P0100-P0103	MAF sensor				X	X									X		X	X			X	X	X	X		X
P0105,P0106	P0105-P0108	MAP sensor				X	X									X		X	X			X	X	X	X		X
P0110	P0110-P0113	IAT sensor									X					X		X				X	X	X	X		X
P0115,P0116	P0115-P0118	ECT sensor	X			X	X				X					X		X	X			X	X	X	X		X
P0120,P0121	P0120-P0223,P2135	TP sensor														X		X	X			X	X	X	X		X
P0125	P0125	Insufficient ECT for Closed Loop	X			X										X		X	X			X	X	X	X		X
P0128	P0128	Thermostat																									
P0130-P0153	P0130-P0153	O2 Sensor - Sensor1																	X			X	X	X	X		
P0134,P0154	P0134,P0154	O2 Sensor, A/F Sensor(No Activity) - Sensor1														X		X	X			X	X	X	X		X
P0136,P0156	P0136,P0156	O2 Sensor - Sensor2														X			X								
P0142,P0162	P0142,P0162	O2 Sensor - Sensor3																	X								
P0171,P0172	P0171,P0172	Fuel system														X		X	X			X	X	X	X		X
P0300-P0308	P0300-P0308	Misfire														X		X	X			X	X	X	X		X
P0325,P0330	P0325-P0333	Knock sensor																				X	X	X	X		
P0335	P0335	CKP sensor				X	X									X		X	X			X	X	X	X		X
P0340, P0341	P0340, P0341	CMP sensor				X	X									X		X	X			X	X	X	X		X
P0340-P0346	P0340-P0346	VVT sensor1,2																				X	X	X	X		
P0351-P0358	P0351-P0358	Ignitor																	X			X	X	X	X		
P0385	P0385	CKP sensor 2				X	X									X		X	X			X	X	X	X		X
P0401	P0401	EGR system (closed)																	X								
P0402	P0402	EGR system (open)														X		X	X			X	X	X	X		X
P0405,P0409	P0405-P0409	Lift sensor																									
P0420,P0430	P0420,P0430	Catalyst																									
P0442-P0456	P0442-P0456	EVAP system														X		X				X	X	X	X		X
P0450,P0451	P0450-P0453	EVAP press sensor																				X	X	X	X		

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Monitor detected malfunction	Fault code	Fault code	Component/ system	Monitor disablement (X - disabled)																											
				P0741-P0796	P0748-P0798	P0850	P1010,P1020	P1011,12(,21,22)	P1126	P1129	P1430	P2004,P2006	P2009,P2010	P2014,16,17	P2102,P2103	P2120-P2138	P2196,P2198	P2226	P2237,P2240	P2423,24	P2430,2,3	P2431	P2440	P2441	P2444	P2445	P2714-P2759	P2A00,P2A03
	P0741-P0796	P0741-P0796	Trans solenoid (function)*2																												
	P0748-P0798	P0748-P0799	Trans solenoid (range)																												
	P0850	P0850	PNP switch																												
	P1010,P1020	P1010,P1020	VVTL																												
	P1011,12(,21,22)	P1011,12(,21,22)	VVTL system1(,2)																												
	P1126	P1126	Electronic magnet clutch																												
	P1129	P1129	Electronic throttle system																												
	P1430	P1430	HC adsorber ACT press sensor																												
	P2004,6	P2004,6	Intake Manifold Runner Control																												
	P2009,10	P2009,10	Intake Manifold Runner Control Circuit																												
	P2014,16,17	P2014,16,17	Intake Manifold Runner Position Sensor																												
	P2102,P2103	P2102,P2103	Throttle motor																												
	P2120-P2138	P2120-P2138	Accel position sensor																												
	P2196,P2198	P2196,P2198	A/F Sensor(Rationality) - Sensor1																												
	P2226	P2226	BARO sensor																												
	P2237,P2240	P2237,P2240	A/F Sensor(Open) - Sensor1																												
	P2423,24	P2423,24	HC Absorption Catalyst																												
	P2430,2,3	P2430,2,3	AIR Pressure Sensor(Low/High)																												
	P2431	P2431	AIR Pressure Sensor(Rationality)																												
	P2440	P2440	AIR control valve stuck open																												
	P2441	P2441	AIR control valve stuck close																												
	P2444	P2444	AIP stuck On																												
	P2445	P2445	AIP stuck Off																												
	P2714-P2759	P2714-P2759	Trans solenoid(SLU-SLD)																												
	P2A00,P2A03	P2A00,P2A03	A/F Sensor (Slow response) - Sensor1																												

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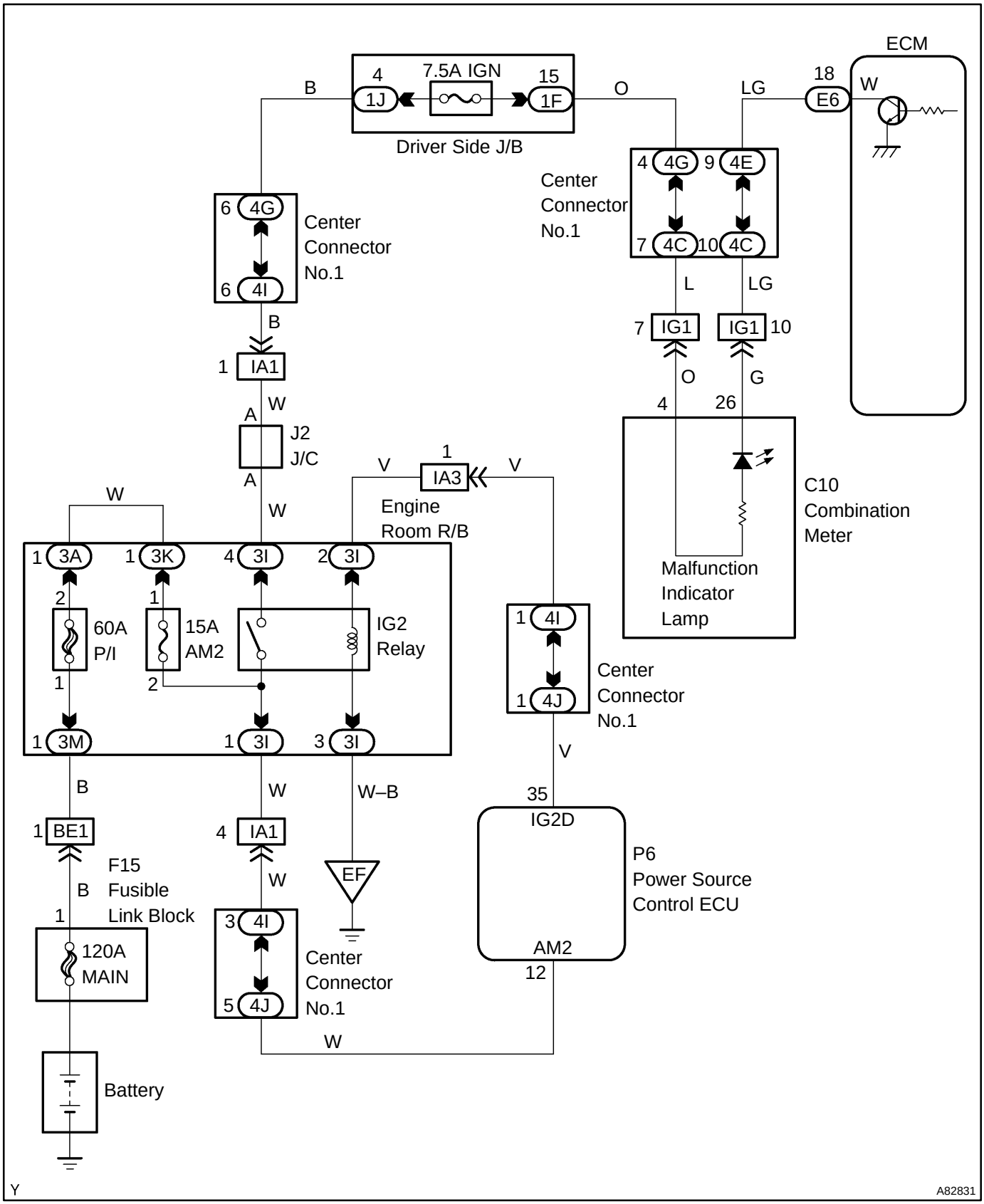
MIL CIRCUIT

CIRCUIT DESCRIPTION

The IG2 relay energized by the power source control ECU applies the battery voltage to the malfunction indicator lamp (MIL) in the combination meter while the main system is turned ON.
When it is neccesary, the ECM grounds the W terminal line and illuminates the MIL.
In order to perform functional check visually, the MIL is illuminated when the power switch is first turned ON.
If the MIL is ON or OFF all of the time, use the procedure below to troubleshoot it. The MIL is used to indicate vehicle malfunction which was detected by the ECM. Follow this procedure using the hand–held tester or the OBD II scan tool to determine cause of the problem and to check the MIL.

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WIRING DIAGRAM



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INSPECTION PROCEDURE

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

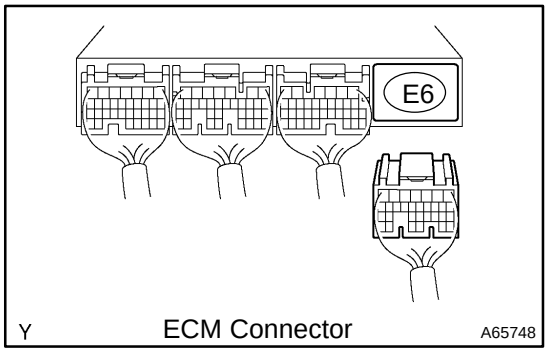
1 CLEAR DTC

(a) Connect the hand–held tester or the OBD II scan tool to the DLC 3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) Read DTCs (See page 05–41).
(e) Clear the DTCs (See page 05–41).
(f) Check that MIL is not illuminated.
Standard: MIL is not illuminated.

OK → **REPAIR CIRCUIT INDICATED BY OUTPUT CODE (See page 05–55)**

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2 CHECK HARNESS AND CONNECTOR(CHECK FOR SHORT IN WIRE HARNESS)



(a) Disconnect the E6 ECM connector.
(b) Turn the power switch ON (IG).
(c) Check that MIL is not illuminated.
Standard: MIL is not illuminated.
(d) Reconnect the ECM connector.

OK → **REPLACE ECM (See page 10–24)**

NG

CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER – ECM)

3 CHECK THAT MIL IS ILLUMINATED

(a) Check that MIL is illuminated when the power switch is turned ON (IG).
Standard: MIL is illuminated.

OK → **SYSTEM OK**

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4	INSPECT COMBINATION METER ECU (MIL CIRCUIT)

(a) See the combination meter troubleshooting on page 05–1986.

NG → REPAIR OR REPLACE BULB OR COMBINATION METER ASSEMBLY

OK

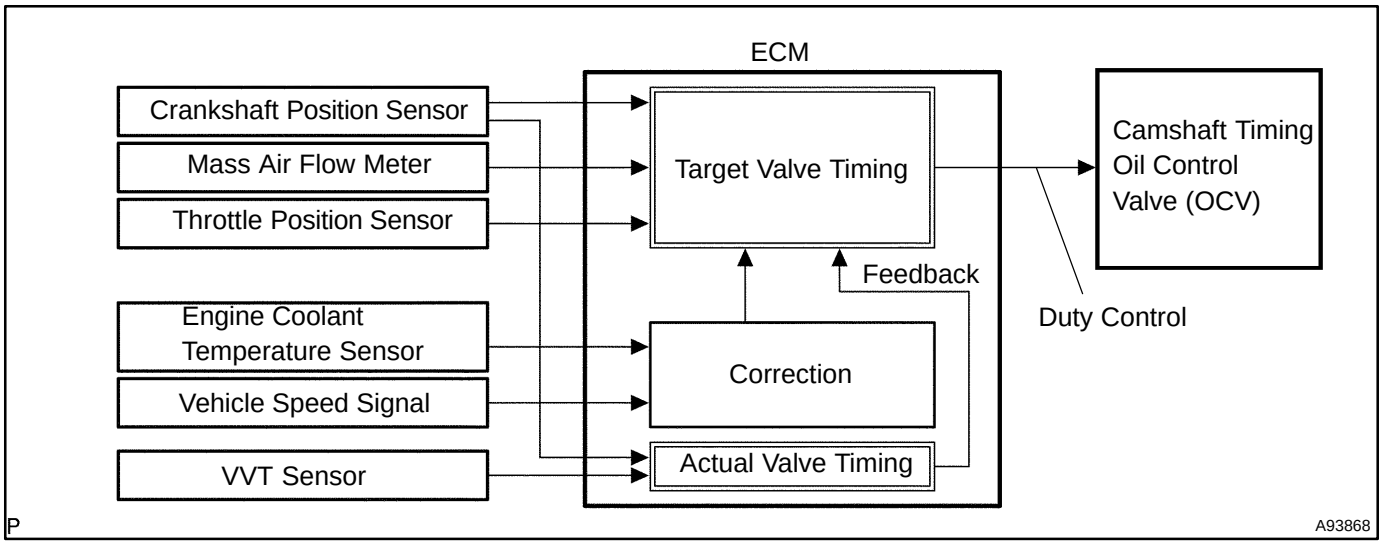
CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER – ECM)

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DTC	P0010	CAMSHAFT POSITION ”A” ACTUATOR CIRCUIT (BANK 1)

CIRCUIT 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, applied to the OCV, regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed based on engine operation condition such as intake air volume, throttle position and engine coolant temperature.
The ECM controls the OCV based on the signals from several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft is optimized, the engine torque and fuel economy improve, and exhaust emissions decrease. The ECM detects the actual valve timing using signals from the camshaft position sensor and the crankshaft position sensor. The ECM performs feedback control and verifies target valve timing.



DTC No.	DTC Detection Condition	Trouble Area
P0010	Open or short in oil control valve circuit	• Open or short in oil control valve circuit • Oil control valve • ECM

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MONITOR DESCRIPTION

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

MONITOR STRATEGY

Related DTCs	P0010: VVT oil control valve range check
Required sensors/components	OCV
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	11 V or more, and less than 13 V
Target duty ratio	less than 70 %
Starter	OFF
Current cut status	Not cut

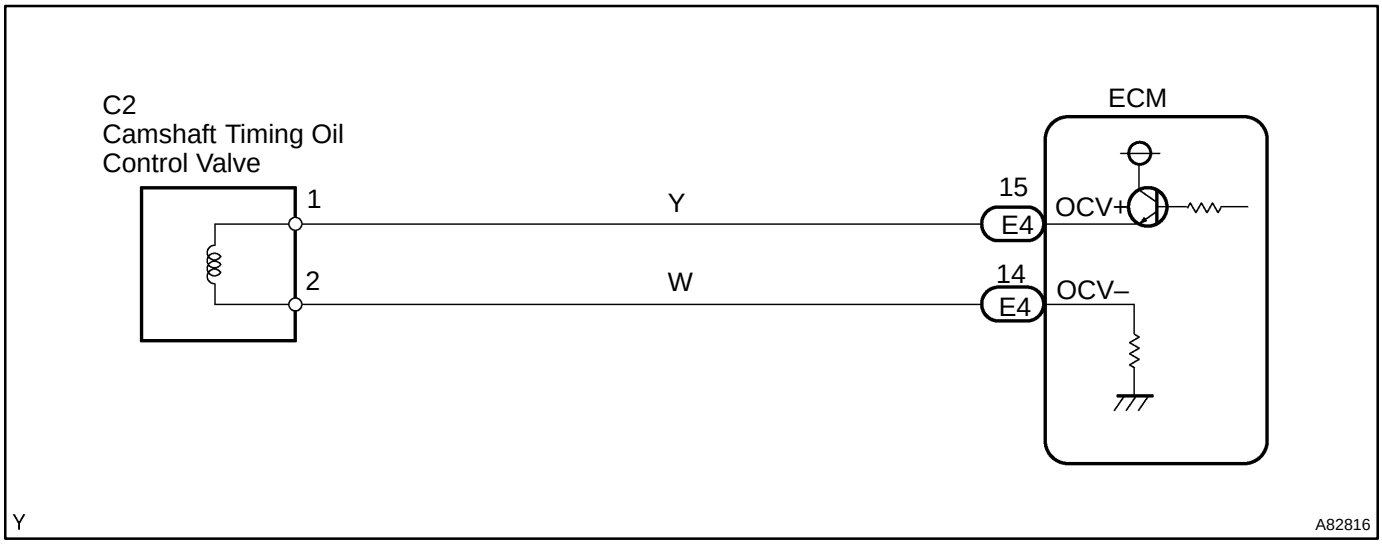
TYPICAL MALFUNCTION THRESHOLDS

Output signal duty for OCV	Output duty is 3 % or less despite the ECM supplying the current to the OCV or Output duty is 100 %

COMPONENT OPERATING RANGE

Output signal duty for OCV	More than 3 % and less than 100 %

WIRING DIAGRAM



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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

Hand–held tester:

1	PERFORM ACTIVE TEST BY HAND–HELD TESTER(OPERATE OCV)

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) Put the engine in inspection mode (see page 05–1).
(e) Start the engine and warm it up.
(f) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / VVT CTRL B1.
(g) Using the hand–held 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

NOTICE:

Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

OK → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

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2	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSY(OCV) (See page 10–5)

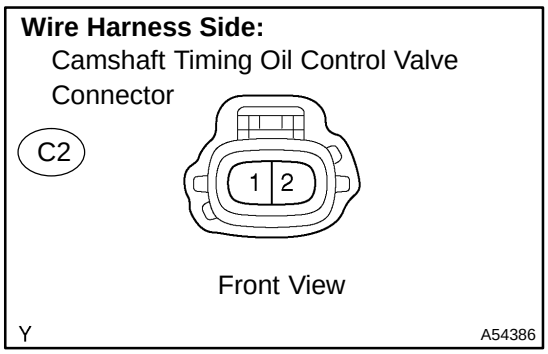
OK: OCV has no contamination and moves smoothly.

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

OK

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3 CHECK HARNESS AND CONNECTOR(CAMSHAFT TIMING OIL CONTROL VALVE (OCV) – ECM)



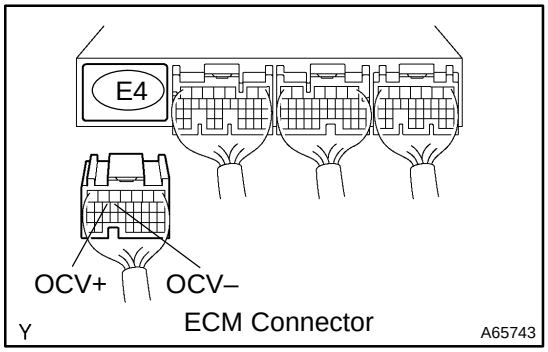
(a) Disconnect the C2 camshaft timing oil control valve connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Oil control valve (C2–1) – OCV+ (E4–15)	Below 1 Ω
Oil control valve (C2–2) – OCV– (E4–14)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Oil control valve (C2–1) or OCV+ (E4–15) – Body ground	10 kΩ or higher
Oil control valve (C2–2) or OCV– (E4–14) – Body ground	10 kΩ or higher

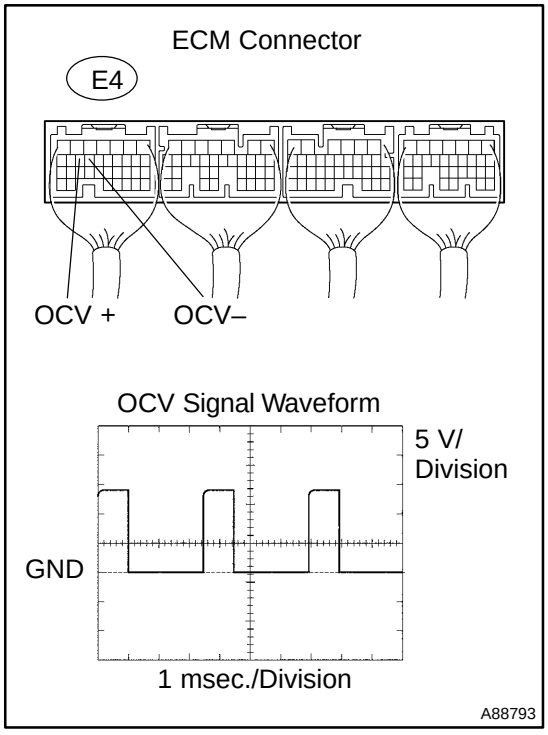


(d) Reconnect the camshaft timing oil control valve connector.
(e) Reconnect the ECM connector.

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

OK

4 INSPECT ECM(OCV SIGNAL)



(a) Put the engine in inspection mode.
(b) Start the engine and warm it up.
(c) During idling, check the waveform between the specified terminals of the E4 ECM connector using an oscilloscope.

Standard:

Tester Connection	Specified Condition
OCV+ (E4–15) – OCV– (E4–14)	Correct waveform is as shown

NG → **REPLACE ECM (See page 10–24)**

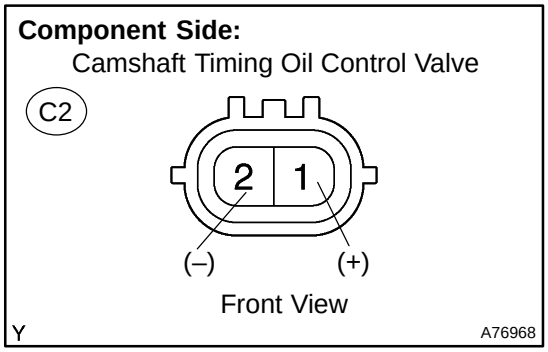
OK

CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)

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OBDII scan tool (excluding hand–held tester):

1	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSY(OPERATE OCV)



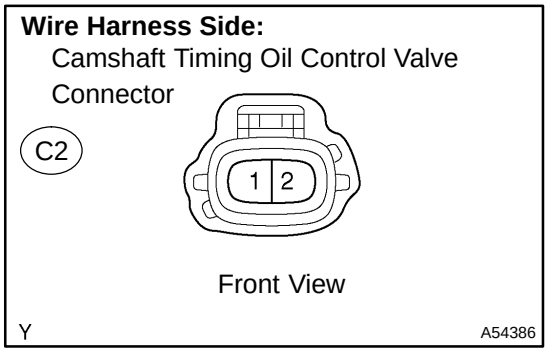
(a) Disconnect the C2 camshaft timing oil control valve connector.
(b) Put the engine in inspection mode (see page 05–1).
(c) Apply positive battery voltage between the terminals of the camshaft timing oil control valve.
(d) Check the engine speed.
OK:
Engine speed is rough idle or engine stalls.
(e) Reconnect the camshaft timing oil control valve connector.

NOTICE:
Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

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

OK

2	CHECK HARNESS AND CONNECTOR(CAMSHAFT TIMING OIL CONTROL VALVE (OCV) – ECM)



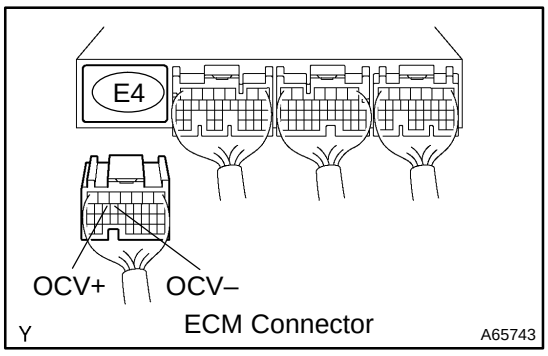
(a) Disconnect the C2 camshaft timing oil control valve connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Oil control valve (C2–1) – OCV+ (E4–15)	Below 1 Ω
Oil control valve (C2–2) – OCV– (E4–14)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Oil control valve (C2–1) or OCV+ (E4–15) – Body ground	10 kΩ or higher
Oil control valve (C2–2) or OCV– (E4–14) – Body ground	10 kΩ or higher



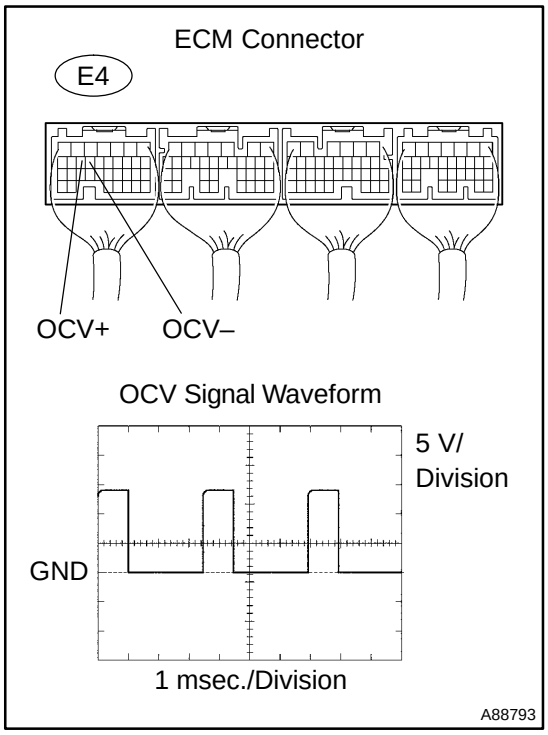
(d) Reconnect the camshaft timing oil control valve connector.
(e) Reconnect the ECM connector.

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

OK

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3 INSPECT ECM(OCV SIGNAL)



(a) Put the engine in inspection mode.
(b) Start the engine and warm it up.
(c) During idling, check the waveform between the specified terminals of the E4 ECM connector using an oscilloscope.
Standard:

Tester Connection	Specified Condition
OCV+ (E4–15) – OCV– (E4–14)	Correct waveform is as shown

NG → **REPLACE ECM (See page 10–24)**

OK

CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)

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DTC	P0011	CAMSHAFT POSITION ”A” –TIMING OVER–ADVANCED OR SYSTEM PERFORMANCE (BANK 1)

DTC	P0012	CAMSHAFT POSITION ”A” –TIMING OVER–RETARDED (BANK 1)

CIRCUIT DESCRIPTION

Refer to DTC P0010 on page 05–63.

DTC No.	DTC Detection Condition	Trouble Area
P0011 P0012	After engine is warmed up, condition (a) or (b) continues at engine speed of 900 to 5,000 rpm: (a) Valve timing does not change from current valve timing (b) Current valve timing is fixed	• Valve timing • Oil control valve • Camshaft timing gear assembly • ECM

MONITOR DESCRIPTION

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

Example:

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

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

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

MONITOR STRATEGY

Related DTCs	P0011: VVT system advance (bank 1) P0012: VVT system retard (bank 1)
Required sensors/components	Main sensors: Camshaft position sensor Related sensors: Engine coolant temperature sensor Crankshaft position sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	P0011: Immediately P0012: 2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	11 V or more
Engine speed	900 rpm or more, and 5,000 rpm or less
Engine coolant temperature	75°C (167°F) or more, and 100°C (212°F) or less

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TYPICAL MALFUNCTION THRESHOLDS

Duration time of the following condition (a) and (b) are met	4.5 seconds or more
(a) Following conditions are met:	1 & 2
1. VVT control status	Feedback
2. Deviation of valve timing (Target valve timing – Actual valve timing)	More than 5°CA
(b) Response of valve timing	1 sec/°CA or more

WIRING DIAGRAM

Refer to DTC P0010 on page 05–63.

INSPECTION PROCEDURE

HINT:

Advanced timing over standard level (Valve timing is out of specified range)	P0011
Retarded timing over (Valve timing is out of specified range)	P0012

- If DTC P0011 or P0012 is displayed, check the VVT system circuit.
- Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

Hand–held tester:

1	**CHECK VALVE TIMING(CHECK FOR LOOSE AND A JUMPED TOOTH OF TIMING CHAIN) (See page 14–6)**

OK: The match marks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING (See page 14–6)**

OK

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2	PERFORM ACTIVE TEST BY HAND–HELD TESTER(OPERATE OCV)

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) Put the engine in inspection mode (see page 05–1).
(e) Start the engine and warm it up.
(f) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / VVT CTRL B1.
(g) Using the hand–held 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

NOTICE:
Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

NG → **Go to step 4**

OK

3	CHECK IF DTC OUTPUT RECURS

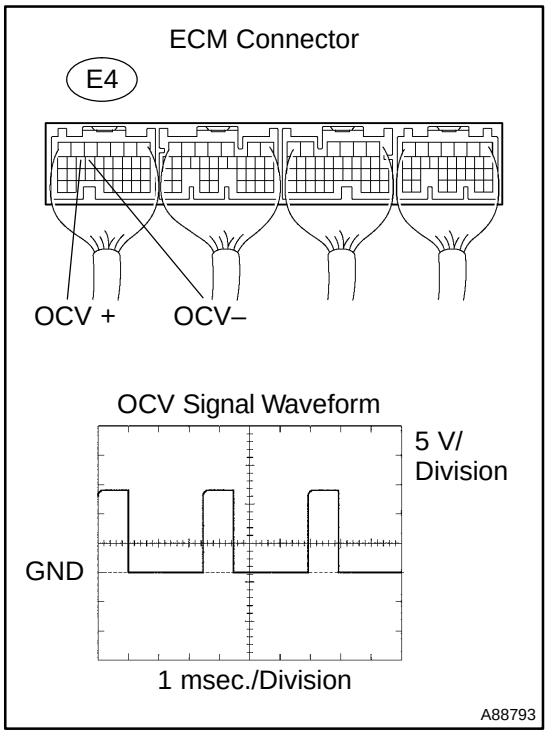
(a) Clear the DTCs (see page 05–41).
(b) Start the HV main system and warm the engine up.
(c) Drive the vehicle with the shift position in B at vehicle speed of more than 44 mph (70 km/h) approximately for 10 minutes or more.
(d) Read output DTCs using the hand–held tester.
Standard: No DTC output.
HINT:
*: DTC P0011 or P0012 is output when a foreign object in engine oil is caught in some part of the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

OK → **VVT SYSTEM OK ***

NG

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4 INSPECT ECM(OCV SIGNAL)



(a) During idling, check the waveform between the specified terminals of the E4 ECM connector using an oscilloscope.

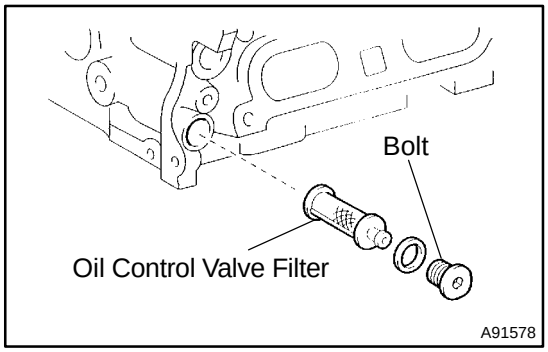
Standard:

Tester Connection	Specified Condition
OCV+ (E4–15) – OCV– (E4–14)	Correct waveform is as shown

NG → **REPLACE ECM (See page 10–24)**

OK

5 INSPECT OIL CONTROL VALVE FILTER (See page 14–124)



(a) Remove the air cleaner inlet, bolt and oil control valve filter.
(b) Check for blockages in the oil control valve filter.
(c) Reinstall the filter, bolt and air cleaner inlet.

NOTICE:
If necessary, clean the filter.

OK: The filter has not clogged.

NG → **REPLACE OIL CONTROL VALVE FILTER**

OK

6 INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSY(OCV) (See page 10–5)

OK: OCV has no contamination and moves smoothly.

OK → **Go to step 8**

NG

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7	REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSY(OCV)

GO

8	INSPECT CAMSHAFT TIMING GEAR ASSY (See page 14–95)

OK → Go to step 10

NG

9	REPLACE CAMSHAFT TIMING GEAR ASSY

GO

10	CHECK IF DTC OUTPUT RECURS

(a) Clear the DTCs (see page 05–41).
(b) Start the HV system, and warm the engine up.
(c) Drive the vehicle with the shift position in B at vehicle speed of more than 44 mph (70 km/h) approximately for 10 minutes or more.
(d) Read output DTCs using the hand–held tester.

OK: No DTC output.

HINT:

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

OK → VVT SYSTEM OK *

NG

REPLACE ECM (See page 10–24)

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OBDII scan tool (excluding hand–held tester):

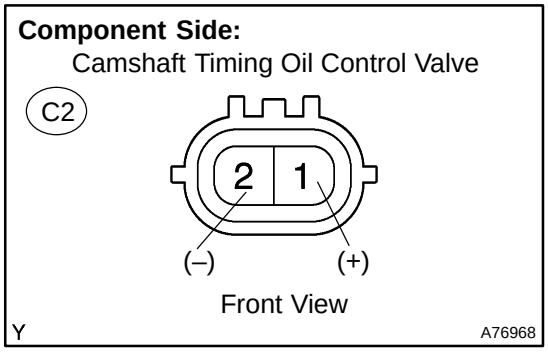
1	CHECK VALVE TIMING(CHECK FOR LOOSE AND A JUMPED TOOTH OF TIMING CHAIN) (See page 14–6)

OK: The match marks of crankshaft pulley and camshaft pulley are aligning.

OK → **ADJUST VALVE TIMING (See page 14–6)**

NG

2	CHECK OPERATION OF OCV



(a) Put the engine in inspection mode.
(b) Start the engine.
(c) Check the engine speed under conditions (1) and (2) below.
  (1) Disconnect the C2 camshaft timing oil control valve connector.
  (2) Apply the positive battery voltage between the terminals of the camshaft timing oil control valve.

Result:

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

(d) Reconnect the camshaft timing oil control valve connector.

B → **Go to step 4**

A

3	CHECK IF DTC OUTPUT RECURS

(a) Clear the DTCs (see page 05–41).
(b) Start the HV system, and warm the engine up.
(c) Drive the vehicle with the shift position in B at vehicle speed of more than 44 mph (70 km/h) approximately for 10 minutes or more.
(d) Read output DTCs using the OBD II scan tool.

OK: No DTC output.

HINT:

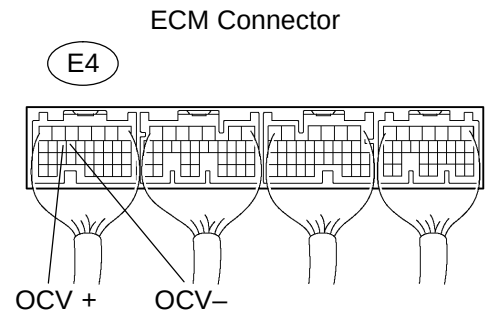
*: DTC P0011 or P0012 is output when a foreign object in engine oil is caught in some part of the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

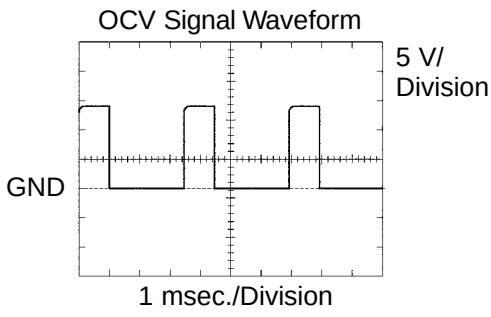
OK → **VVT SYSTEM OK ***

NG

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4	INSPECT ECM(OCV SIGNAL)





(a) Put the engine in inspection mode.
(b) Start the engine and warm it up.
(c) During idling, check the waveform between the specified terminals of the E4 ECM connector using the oscilloscope.

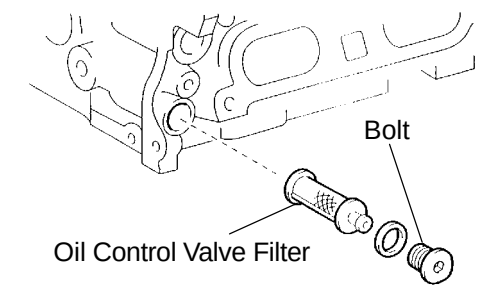
Standard:

Tester Connection	Specified Condition
OCV+ (E4–15) – OCV– (E4–14)	Correct waveform is as shown

NG → **REPLACE ECM (See page 10–24)**

OK

5	INSPECT OIL CONTROL VALVE FILTER (See page 14–124)



(a) Remove the air cleaner inlet, bolt and oil control valve filter.
(b) Check for blockages in the oil control valve filter.
(c) Reinstall the filter, bolt and air cleaner inlet.

NOTICE:

If necessary, clean the filter.

OK: The filter has not clogged.

NG → **REPLACE OIL CONTROL VALVE FILTER**

OK

6	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSY(OCV) (See page 10–5)

OK: OCV has no contamination and moves smoothly.

OK → **Go to step 8**

NG

7	REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSY(OCV)

GO

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8	INSPECT CAMSHAFT TIMING GEAR ASSY (See page 14–95)

OK: The camshaft timing gear rotate smoothly when applying pressure.

OK	Go to step 10

NG

9	REPLACE CAMSHAFT TIMING GEAR ASSY

GO

10	CHECK IF DTC OUTPUT RECURS

(a) Clear the DTCs (see page 05–41).
(b) Start the HV system, and warm the engine up.
(c) Drive the vehicle with the shift position in B at vehicle speed of more than 44 mph (70 km/h) approximately for 10 minutes or more.
(d) Read output DTCs using the OBD II scan tool.

OK: No DTC output.

HINT:

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

OK	VVT SYSTEM OK *

NG

REPLACE ECM (See page 10–24)

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DTC	P0016	CRANKSHAFT POSITION – CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR A)

CIRCUIT DESCRIPTION

Refer to DTC P0335 on page 05–177.

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and VVT sensor signal (2 trip detection logic)	• Mechanical system (Timing chain has jumped a tooth, 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, applied to the OCV, regulates the oil pressure supplied 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 valve as ”VVT learned 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 learned value meets both of the following conditions (”a” and ”b”), the ECM interprets this as a defect in the VVT system and sets a DTC.

(a) VVT learning value is less than 30°CA (CA: Crankshaft Angle), or more than 46°CA.

(b) Above condition continues for more than 18 second.

MONITOR STRATEGY

Related DTCs	P0016: Deviation in crankshaft position sensor signal and VVT sensor signal
Required sensors/components	Crankshaft position sensor, camshaft position sensor
Frequency of operation	Once per driving cycle
Duration	60 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
VVT feedback mode	ON
Engine speed	900 rpm or more, and 5,000 rpm or less

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	(a) or (b)
(a) VVT learned value	Less than 30°CA
(b) VVT learned value	More than 46°CA

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WIRING DIAGRAM

Refer to DTC P0335 on page 05–177.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	**CHECK VALVE TIMING(CHECK FOR LOOSE AND A JUMPED TOOTH OF TIMING CHAIN) (See page 14–6)**

OK: The match marks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING (See page 14–6) (REPAIR OR REPLACE TIMING CHAIN)**

OK ↓

REPLACE ECM (See page 10–24)

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DTC	P0031	OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 1)

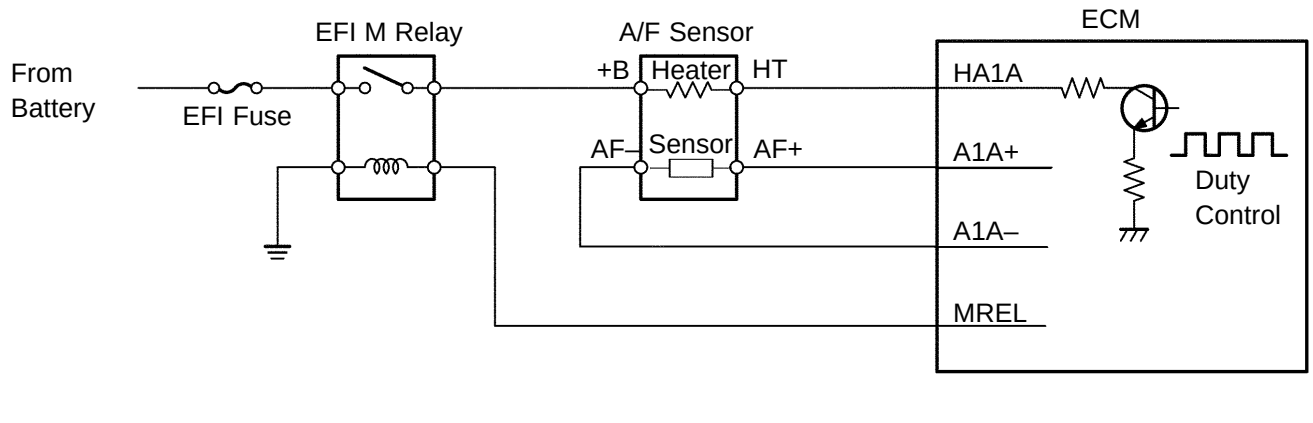
DTC	P0032	OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 1)

HINT:
Although each DTC title says ”oxygen sensor,” these DTCs are related to the air–fuel ratio sensor (A/F sensor).

CIRCUIT DESCRIPTION

Refer to DTC P2195 on page 05–314.
HINT:
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.

Reference (Bank 1 Sensor 1 System Diagram):



DTC No.	DTC Detection Condition	Trouble Area
P0031	Heater current is 0.8 A or less when the heater operates (1 trip detection logic)	• Open or short in heater circuit of A/F sensor • A/F sensor heater • EFI M relay (integration relay) • ECM
P0032	Heater current exceeds 10 A when the heater operates (1 trip detection logic)	• Short in heater circuit of A/F sensor • A/F sensor heater • EFI M relay (integration relay) • ECM

HINT:
- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far from the engine assembly.

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MONITOR DESCRIPTION

The ECM uses the Air–Fuel Ratio (A/F) sensor information to regulate the air–fuel ratio close to the stoichiometric ratio. This maximizes the catalytic converter's ability to purify exhaust gases. 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 the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The zirconia element generates a small voltage when there is a large difference between 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 output signals will be inaccurate and the ECM can not regulate the air–fuel ratio properly.

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

MONITOR STRATEGY

Related DTCs	P0031: A/F sensor heater current (low current) P0032: A/F sensor heater current (high current)
Required sensors/components	A/F sensor, ECM
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	10.5 V or more
Heater duty ratio–cycle	P0031: 50 % or more P0032: More than 0 %
Time after engine start	10 seconds 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 (MODE 06 DATA)

Test ID / Comp ID	Description of Test Data	Description of Test Limit	Conversion Factor (Unit)
$07 / $81	Maximum A/F sensor heater current	Maximum threshold heater current to detect A/F sensor circuit malfunction	Multiply by 0.173 (A)

Refer to page 05–26 for detailed information on Checking Monitor Status.

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WIRING DIAGRAM

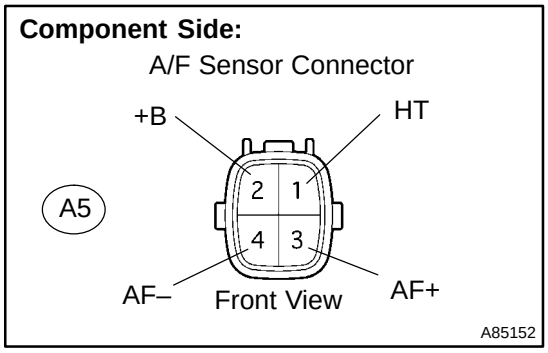
Refer to DTC P2195 on page 05–314.

INSPECTION PROCEDURE

HINT:

- When DTC P0032 is detected, proceed to step 4 if the heater resistance is in normal range.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	INSPECT AIR FUEL RATIO SENSOR(HEATER RESISTANCE)



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.

Standard:

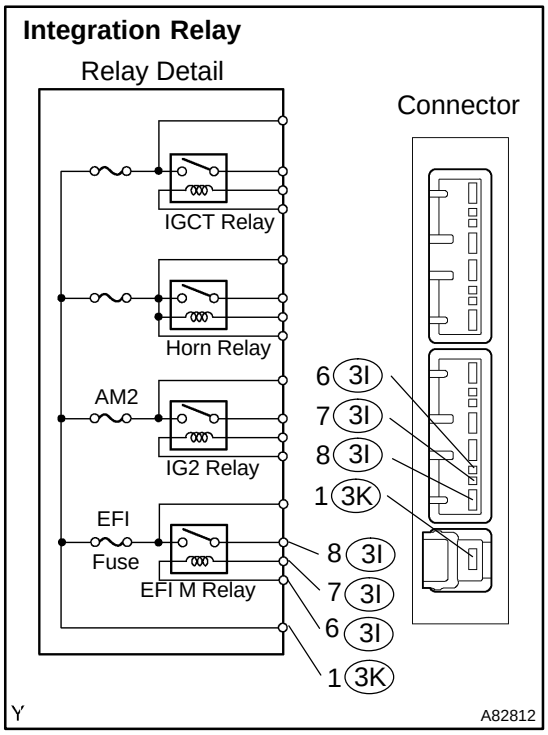
Tester Connection	Resistance
HT (1) – +B (2)	1.8 to 3.4 Ω at 20°C (68°F)

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2	INSPECT INTEGRATION RELAY(EFI M RELAY)



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the EFI M relay.

Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

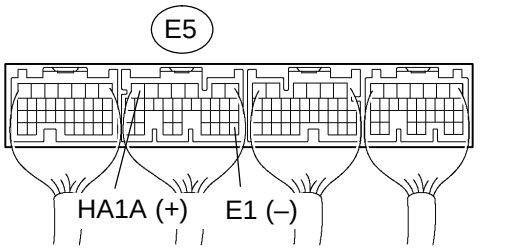
(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

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3	INSPECT ECM(HA1A VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the applicable terminals of the E5 ECM connector.

Standard:

Tester Connection	Specified Condition
HA1A (E5–7) – E1 (E5–28)	9 to 14 V

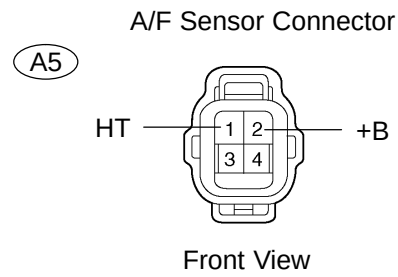
OK → **REPLACE ECM (See page 10–24)**

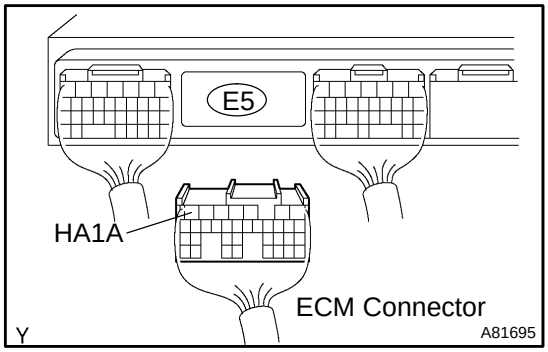
NG

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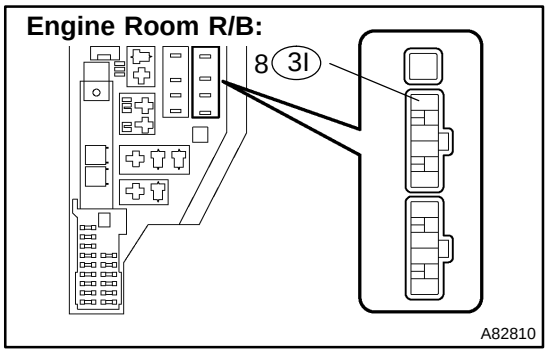
4	CHECK HARNESS AND CONNECTOR(A/F SENSOR – ECM, A/F SENSOR – EFI M RELAY)

Wire Harness Side:





Engine Room R/B:



(a) Check the harness and the connectors between the ECM and the A/F sensor connectors.
  (1) Disconnect the A5 A/F sensor connector.
  (2) Disconnect the E5 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
HT (A5–1) – HA1A (E5–7)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
HT (A5–1) or HA1A (E5–7) – Body ground	10 kΩ or higher
HT (A5–1) – +B (A5–2)	10 kΩ or higher

  (4) Reconnect the A/F sensor connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and connectors between the A/F sensor connector and the EFI M relay.
  (1) Disconnect the A5 A/F sensor connector.
  (2) Remove the integration relay from the engine room R/B.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
+B (A5–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
+B (A5–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

  (4) Reconnect the A/F sensor connector.
  (5) Reinstall the integration relay.

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

OK →

REPLACE ECM (See page 10–24)

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DTC	P0037	OXYGEN SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 2)

DTC	P0038	OXYGEN SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 2)

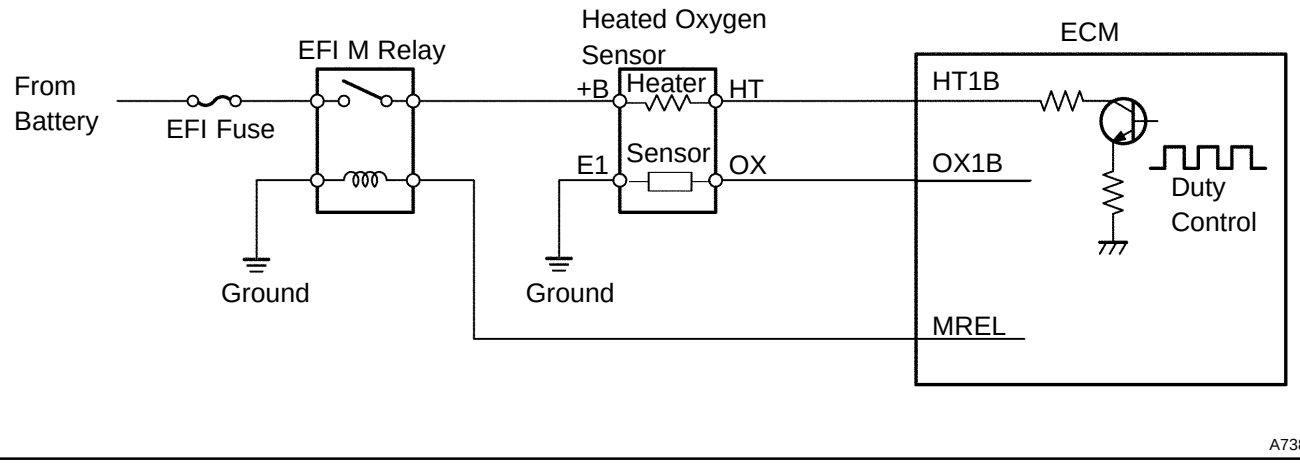
CIRCUIT DESCRIPTION

Refer to DTC P0136 on page 05–125.

HINT:

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

Reference (Bank 1 Sensor 2 System Diagram):



DTC No.	DTC Detection Condition	Trouble Area
P0037	Heater current is 0.25 A or less when the heater operates with +B greater than 11.5 V (1 trip detection logic)	• Open or short in heater circuit of the heated oxygen sensor • Heated oxygen sensor heater • EFI M relay (integration relay) • ECM
P0038	When the heater operates, heater current exceeds 2 A (1 trip detection logic)	• Short in heater circuit of the heated oxygen sensor • Heated oxygen sensor heater • EFI M relay (integration relay) • ECM

HINT:

- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far from the engine assembly.

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MONITOR DESCRIPTION

The sensing portion of the heated oxygen sensor has a zirconia element which is used to detect oxygen concentration in the exhaust gas. If the zirconia element is at the proper temperature and difference of the oxygen concentration between the inside and outside surfaces of 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 0.25 A when the heater is ON.

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater current bank 1 sensor 2 (low current) P0038: Heated oxygen sensor heater current bank 1 sensor 2 (high current)
Required sensors/components	Main sensors: Heated oxygen sensor Related sensors: Vehicle speed sensor
Frequency of operation	Continuous
Duration	0.3 second
MIL operation	1 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P0037:

The monitor will run whenever the following DTCs are not present	See page 05–20
Either of the following conditions is met:	A or B
A. Following conditions are met:	1, 2, 3, 4 and 5
1. Time after engine start	250 seconds or more, and 500 seconds or less
2. Battery voltage	More than 10.5 V
3. Vehicle speed	Less than 55.9 mph (90 km/h)
4. Misfire	Not detected
5. Pass/Fail detection in this driving cycle	Not detected
B. Following conditions are met:	1, 2, 3, 4 and 5
1. Time after engine start	500 seconds or more
2. Battery voltage	More than 10.5 V
3. Vehicle speed	24.8 mph (40 km/h) or more
4. Misfire	Not detected
5. Pass/Fail detection in this driving cycle	Pass and fail detection has not occurred yet

P0038:

The monitor will run whenever the following DTCs are not present	See page 05–20
Intrusive heating	OFF

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TYPICAL MALFUNCTION THRESHOLDS

P0037:

Heated oxygen sensor heater current	Less than 0.25 A (at 0.3 second after heater is turned ON)

P0038:

Heated oxygen sensor heater current	More than 2 A (while supplemental heating is OFF)

COMPONENT OPERATING RANGE

Heated oxygen sensor heater current (after engine is warmed up)	0.4 to 1.0 A (at idle and battery voltage 11 to 14 V)

MONITOR RESULT (MODE 06 DATA)

Heated oxygen sensor heater:

Test ID/Comp ID	Description of Test Data	Description of Test Limit	Conversion Factor (Unit)
$04/$82	Maximum heated oxygen sensor heater current	Maximum threshold heater current to detect heated oxygen sensor malfunction	Multiply by 0.000076 (A)

Refer to page 05–26 for detailed information on Checking Monitor Status.

WIRING DIAGRAM

Refer to DTC P0136 on page 05–125.

INSPECTION PROCEDURE

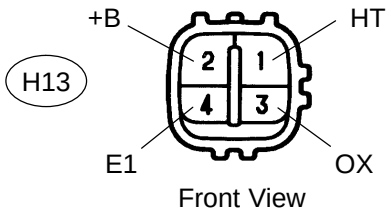
HINT:

- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- When DTC P0038 is detected, proceed to step 4 if the heater resistance is in normal range.

1 INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)

Component Side:

Heated Oxygen Sensor Connector



(a) Disconnect the H13 heated oxygen sensor connector.

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

Standard (Bank 1 sensor 2):

Tester Connection	Resistance
HT (H13–1) – +B (H13–2)	11 to 16 Ω at 20°C (68°F)
HT (H13–1) – E1 (H13–4)	10 kΩ or higher

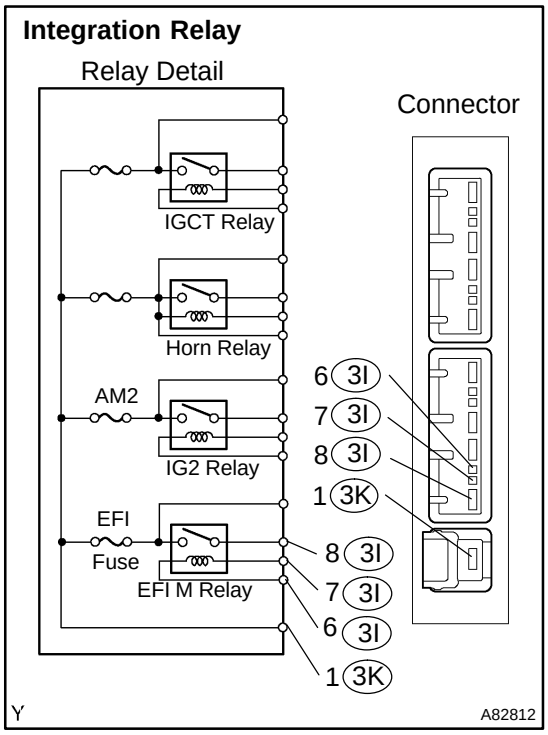
(c) Reconnect the heated oxygen sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

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2 INSPECT INTEGRATION RELAY(EFI M RELAY)



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the EFI M relay.
Standard:

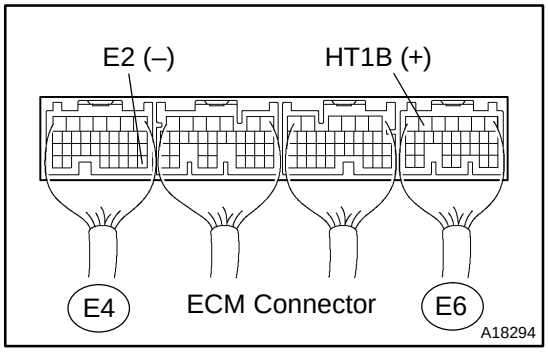
Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

3 INSPECT ECM(HT1B VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the applicable terminals of the E4 and E6 ECM connectors.
Standard:

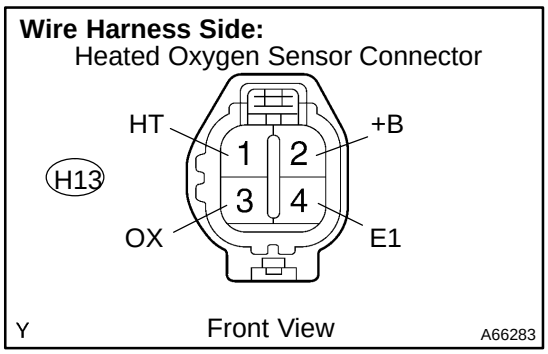
Tester Connection	Specified Condition
HT1B (E6–6) – E2 (E4–28)	9 to 14 V

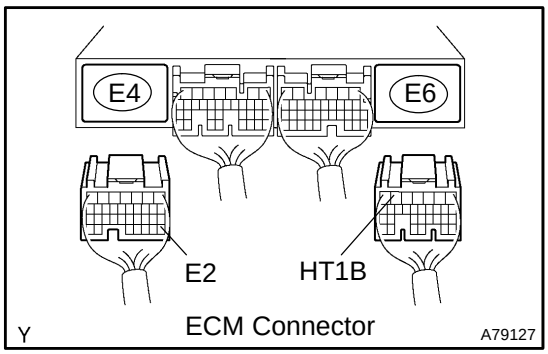
OK → **REPLACE ECM (See page 10–24)**

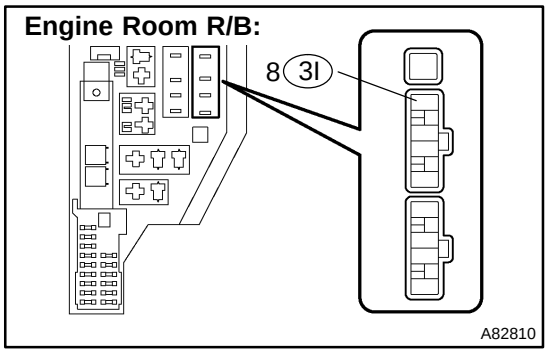
NG

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







(a) Check the harness and the connectors between the ECM and the heated oxygen sensor connectors.
(1) Disconnect the H13 heated oxygen sensor connector.
(2) Disconnect the E4 and E6 ECM connectors.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
HT (H13–1) – HT1B (E6–6)	Below 1 Ω
E1 (H13–4) – E2 (E4–28)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
HT (H17–2) or HT1B (E6–6) – Body ground	10 kΩ or higher
HT (H13–1) – +B (H13–2)	10 kΩ or higher

(4) Reconnect the heated oxygen sensor connector.
(5) Reconnect the ECM connectors.

(b) Check the harness and the connectors between the heated oxygen sensor connector and the EFI M relay.
(1) Disconnect the H13 heated oxygen sensor connector.
(2) Remove the integration relay from the engine room R/B.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
+B (H13–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
+B (H13–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

(4) Reconnect the heated oxygen sensor connector.
(5) Reinstall the integration relay.

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

OK

REPLACE ECM (See page 10–24)

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DTC	P0100	MASS OR VOLUME AIR FLOW CIRCUIT

DTC	P0102	MASS OR VOLUME AIR FLOW CIRCUIT LOW INPUT

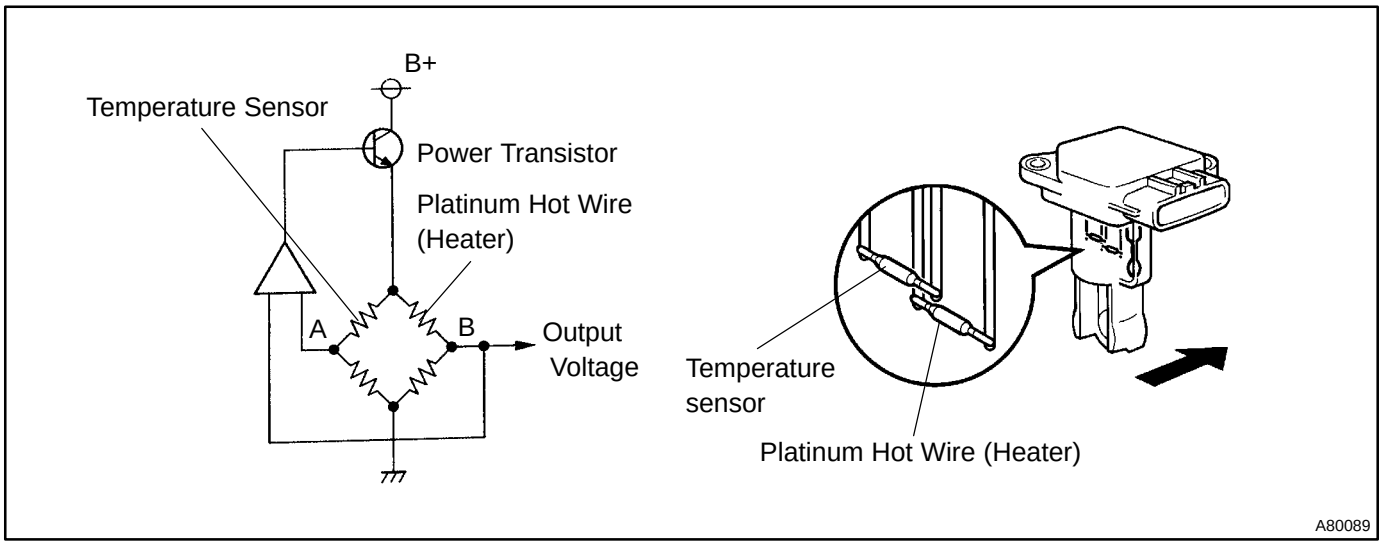
DTC	P0103	MASS OR VOLUME AIR FLOW CIRCUIT HIGH INPUT

CIRCUIT DESCRIPTION

The MAF (Mass Air Flow) meter measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and provides a proper air–fuel ratio. Inside the MAF meter, there is a heated platinum wire exposed to the flow of intake air.

By applying a specific current to the wire, the ECM heats this wire to a given temperature. The flow of incoming air cools the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter. The voltage level is proportional to the air flowing 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, and the power transistor is controlled so that the potential of A and B remains equal to maintain the set temperature.



DTC No.	DTC Detection Condition	Trouble Area
P0100	When the mass air flow meter circuit has an open or a short for more than 3 seconds	• Open or short in mass air flow meter circuit • Mass air flow meter • ECM
P0102	When the mass air flow meter circuit has an open for more than 3 seconds	• Open in mass air flow meter circuit • Mass air flow meter • ECM
P0103	When the mass air flow meter circuit has a short for more than 3 seconds	• Short in mass air flow meter circuit • Mass air flow meter • ECM

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HINT:
After confirming DTC P0100, P0102 or P0103, confirm the mass air flow ratio in DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL using the hand–held tester or the OBD II scan tool.

Air Flow Rate (gm/s)	Malfunction
Approximately 0.0	• Mass air flow meter power source circuit open • VG circuit open or short
271.0 or more	• E2G circuit open

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:
When the sensor voltage output is less than 0.2 V or more than 4.9 V and if either condition continues for more than 3 seconds.

MONITOR STRATEGY

Related DTCs	P0100: Mass air flow meter circuit range check (fluttering) P0102: Mass air flow meter circuit range check (low voltage) P0103: Mass air flow meter circuit range check (high voltage)
Required sensors/components	Mass air flow meter
Frequency of operation	Continuous
Duration	3 seconds
MIL operation	Immediately (when engine speed is less than 4,000 rpm) 2 driving cycles (when engine speed is 4,000 rpm or more)
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20

TYPICAL MALFUNCTION THRESHOLDS

P0100:

Mass air flow meter voltage	Less than 0.2 V or more than 4.9 V

P0102:

Mass air flow meter voltage	Less than 0.2 V

P0103:

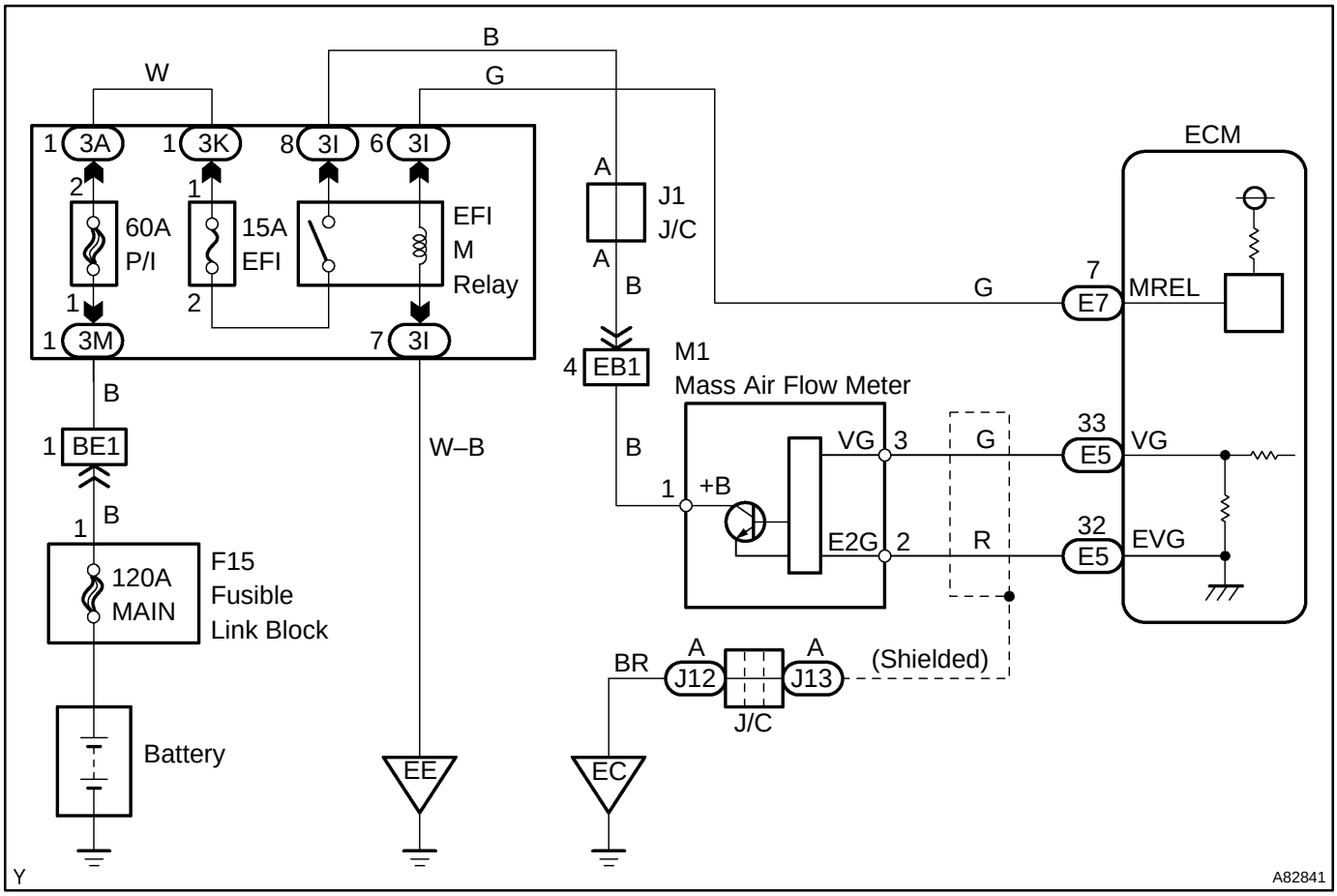
Mass air flow meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

Mass air flow meter voltage	0.4 to 2.2 V

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WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(MASS AIR FLOW RATE)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Put the engine in inspection mode (see page 05–1).
(c) Start the engine.
(d) Turn the hand–held tester or the OBD II scan tool ON.
(e) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / MAF.
(f) Read its value using the hand–held tester or the OBD II scan tool.

Result:

Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0 (*1)	C

*1: The value must be changed when the throttle valve is opened or closed.

B → **Go to step 6**

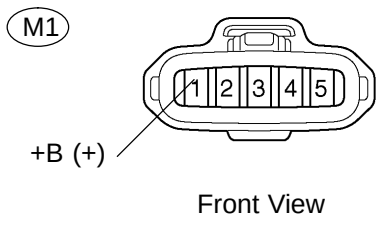
C → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

A

2	INSPECT MASS AIR FLOW METER(POWER SOURCE)

Wire Harness Side:

Mass Air Flow Meter Connector



Front View

Y A54396

(a) Turn the power switch ON (IG).
(b) Disconnect the M1 mass air flow meter connector.
(c) Measure the voltage between the terminal of the wire harness side connector and body ground.

Standard:

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

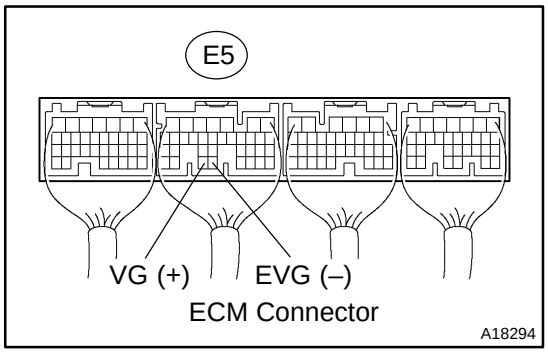
(d) Reconnect the mass air flow meter connector.

NG → **Go to step 5**

OK

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3 INSPECT ECM(VG VOLTAGE)



(a) Put the engine in inspection mode (see page 05–1).
(b) Start the engine.
(c) Measure the voltage between the specified terminals of the E5 ECM connector.

HINT:
The A/C switch should be turned OFF.

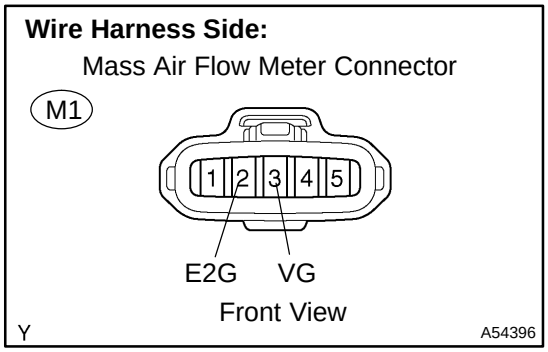
Standard:

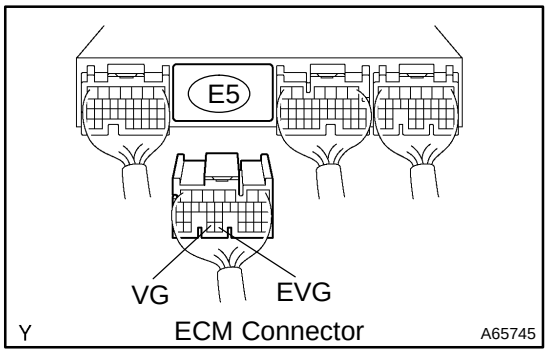
Tester Connection	Condition	Specified Condition
VG (E5–33) – EVG (E5–32)	Engine is idling	0.5 to 3.0 V

OK → **REPLACE ECM (See page 10–24)**

NG

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





(a) Disconnect the M1 mass air flow meter connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VG (M1–3) – VG (E5–33)	Below 1 Ω
E2G (M1–2) – EVG (E5–32)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VG (M1–3) or VG (E5–33) – Body ground	10 kΩ or higher

(d) Reconnect the mass air flow meter connector.
(e) Reconnect the ECM connector.

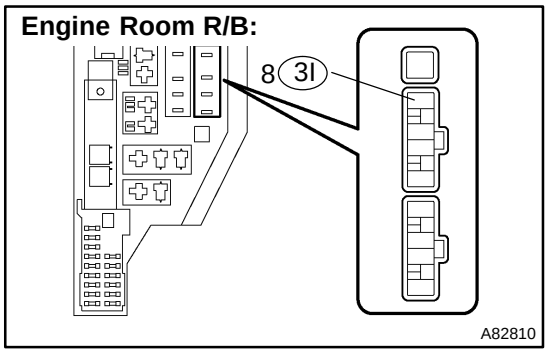
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

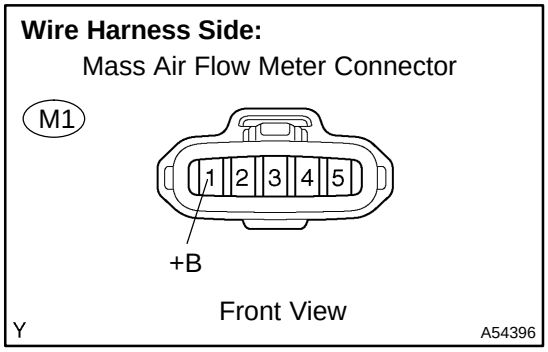
OK

REPLACE MASS AIR FLOW METER

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





(a) Remove the integration relay from the engine room R/B.
(b) Disconnect the M1 mass air flow meter connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
+B (M1–1) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
+B (M1–1) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

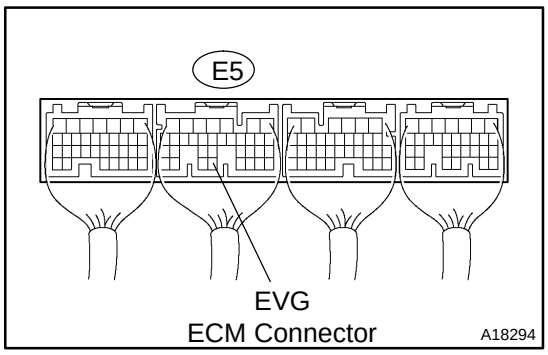
(d) Reconnect the mass air flow meter connector.
(e) Reinstall the integration relay.

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

OK

CHECK ECM POWER SOURCE CIRCUIT (See page 05–366)

6 INSPECT ECM(SENSOR GROUND)



(a) Check the resistance between the specified terminal of the E5 ECM connector and the body ground.

Standard:

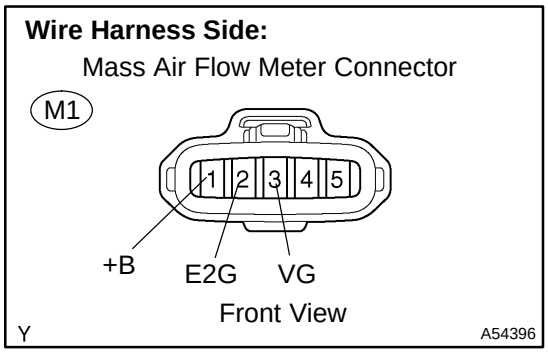
Tester Connection	Specified Condition
EVG (E5–32) – Body ground	Below 1 Ω

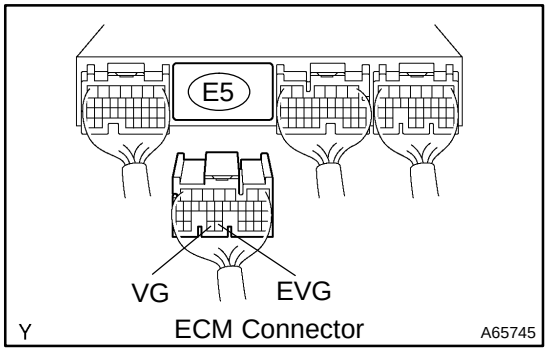
NG → **REPLACE ECM (See page 10–24)**

OK

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





(a) Disconnect the M1 mass air flow meter connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VG (M1–3) – VG (E5–33)	Below 1 Ω
E2G (M1–2) – EVG (E5–32)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VG (M1–3) – +B (M1–1)	10 kΩ or higher

(d) Reconnect the mass air flow meter connector.
(e) Reconnect the ECM connector.

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

OK

REPLACE MASS AIR FLOW METER

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DTC	P0101	MASS OR VOLUME AIR FLOW CIRCUIT RANGE/PERFORMANCE PROBLEM

CIRCUIT DESCRIPTION

Refer to DTC P0100 on page 05–89.

DTC No.	DTC Detection Condition	Trouble Area
P0101	After the engine is warmed up, conditions (a), (b), (c) and (d) continue for more than 10 seconds (2 trip detection logic): (a) Throttle valve is fully closed (b) Voltage output of the mass air flow meter is more than 2.2 V (c) Engine coolant temperature is more than 70°C (158°F) (d) Engine speed is less than 900 rpm	• Mass air flow meter
P0101	Conditions (a) and (b), or (a) and (c) continue for more than 6 seconds (2 trip detection logic): (a) Throttle position sensor output voltage is more than 0.1V (b) Voltage output of the mass air flow meter is less than 0.4 V when engine speed is less than 1,500 rpm (c) Voltage output of the mass air flow meter is less than 1.0 V when engine speed is 1,500 rpm or more	• Mass air flow meter

MONITOR DESCRIPTION

The MAF (Mass Air Flow) meter is a sensor that helps the ECM calculates the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and provide a proper air–fuel ratio. Inside the MAF meter, there is a heated platinum wire exposed to the flow of intake air. By applying a specific current to the wire, the ECM heats this wire to a given temperature. The flow of incoming air cools the wire and an internal thermistor, changing their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter. The voltage level is proportional to the air flow through the sensor and the ECM interprets this voltage as the intake air amount. 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: If the voltage is more than 2.2 V at idle or less than 0.4 V at idle off, the ECM interprets this as a defect in the MAF meter and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0101: Mass air flow meter rationality
Required sensors/components	Main sensors: Mass air flow meter Related sensors: Engine speed sensor, engine coolant temperature sensor, throttle position sensor
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

CASE1: Mass air flow meter rationality

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine speed	Less than 900 rpm
Idle	ON
Engine coolant temperature	70°C (158°F) or more

CASE2: Mass air flow meter rationality

Engine speed	0 rpm or more
Throttle position sensor output	0.1 V or more

TYPICAL MALFUNCTION THRESHOLDS

CASE1: Mass air flow meter rationality

Mass air flow meter voltage (high voltage)	More than 2.2 V

CASE2: Mass air flow meter rationality

Mass air flow meter voltage (low voltage)	Less than 0.4 V at engine speed of less than 1,500 rpm Less than 1.0 V at engine speed of 1,500 rpm or more

WIRING DIAGRAM

Refer to DTC P0100 on page 05–89.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result:

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

HINT:

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

B → **REPLACE MASS AIR FLOW METER**

A

GO TO RELEVANT DTC CHART (See page 05–55)

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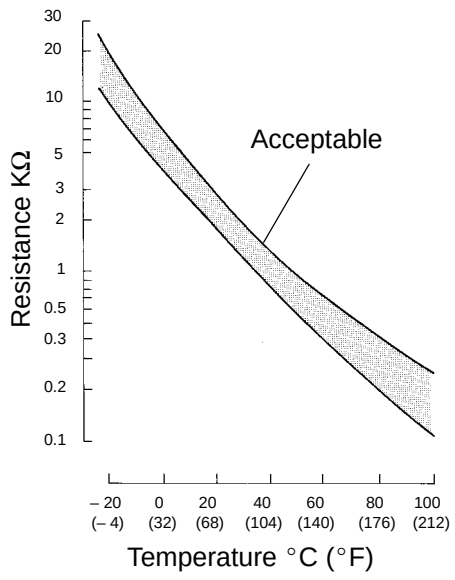
DTC	P0110	INTAKE AIR TEMPERATURE CIRCUIT

DTC	P0112	INTAKE AIR TEMPERATURE CIRCUIT LOW INPUT

DTC	P0113	INTAKE AIR TEMPERATURE CIRCUIT HIGH INPUT

CIRCUIT DESCRIPTION

(Figure 1)



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 as voltage changes to the ECM terminal (see Figure 1).

The intake air temperature sensor is connected to the ECM (see wiring diagram). The 5 V power source voltage in the ECM is applied to the intake air temperature sensor from terminal THA (THAR) via resistor R.

That is, the resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes in accordance with changes in the intake air temperature, the voltage at terminal THA (THAR) 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 intake air temperature sensor circuit for 0.5 second	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM
P0112	Step 4	Short in intake air temperature sensor circuit for 0.5 second	• Short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM
P0113	Step 2	Open in intake air temperature sensor circuit for 0.5 second	• Open in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM

HINT:

After confirming DTC P0110, P0112 or P0113, confirm the intake air temperature in DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL using the hand–held tester or the OBD II scan tool.

Temperature Displayed	Malfunction
–40˚C (–40˚F)	Open circuit
140˚C (284˚F)	Short circuit

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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:

When the sensor voltage output is equal to –40°C (–40°F), or more than 140°C (284°F), and either condition continues for 0.5 second or more.

MONITOR STRATEGY

Related DTCs	P0110: Intake air temperature sensor range check (fluttering) P0112: Intake air temperature sensor range check (low resistance) P0113: Intake air temperature sensor range check (high resistance)
Required sensors/components	Intake air temperature sensor
Frequency of operation	Continuous
Duration	0.5 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20

TYPICAL MALFUNCTION THRESHOLDS

P0110: Intake air temperature sensor range check (fluttering)

Intake air temperature sensor resistance (Intake air temperature)	Less than 98.5 Ω or more than 156 kΩ (More than 140°C (284°F) or –40°C (–40°F) or less)

P0112: Intake air temperature sensor range check (low resistance)

Intake air temperature sensor resistance (Intake air temperature)	Less than 98.5 Ω (More than 140°C (284°F))

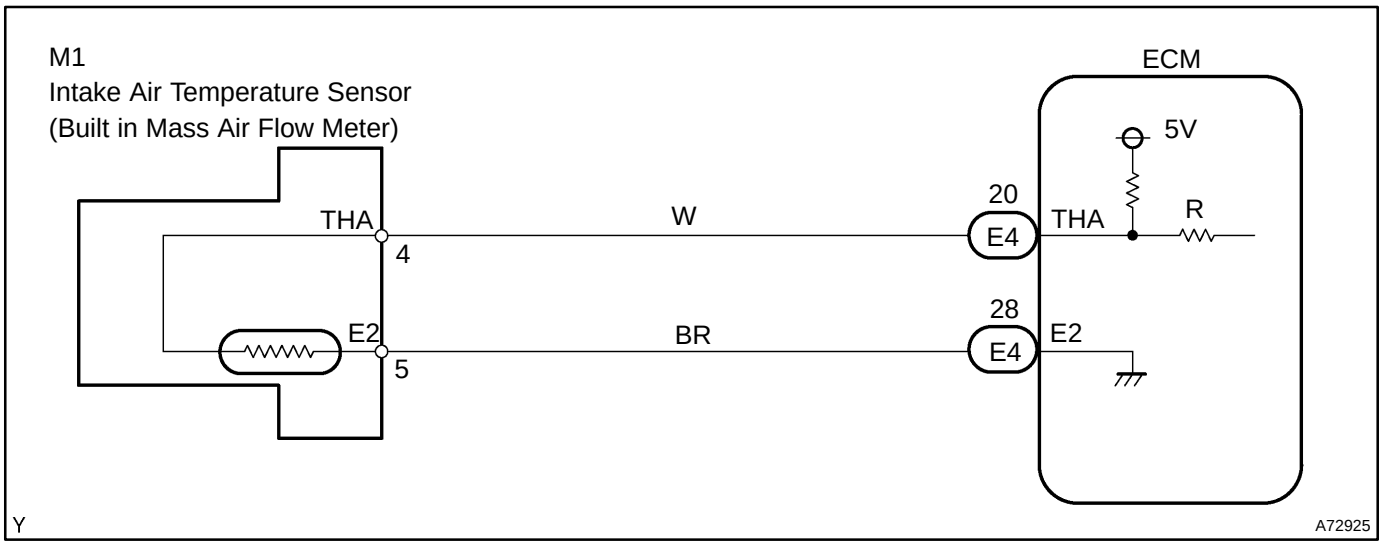
P0113: Intake air temperature sensor range check (high resistance)

Intake air temperature sensor resistance (Intake air temperature)	More than 156 kΩ (–40°C (–40°F) or less)

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



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INSPECTION PROCEDURE

HINT:

- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

1	**READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(INTAKE AIR TEMPERATURE)**

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select tha item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / INTAKE AIR.
(e) Read the value using the hand–held tester or the OBD II scan tool.
Temperature value: Same as the ambient air temperature.
Result:

Temperature Displayed	Proceed to
–40˚C (–40˚F)	A
140˚C (284˚F)	B
OK (Same as ambient air temperature)	C

HINT:

- If there is an open circuit, the hand–held tester or the OBD II scan tool indicates –40˚C (–40˚F).
- If there is a short circuit, the hand–held tester or the OBD II scan tool indicates 140˚C (284˚F).

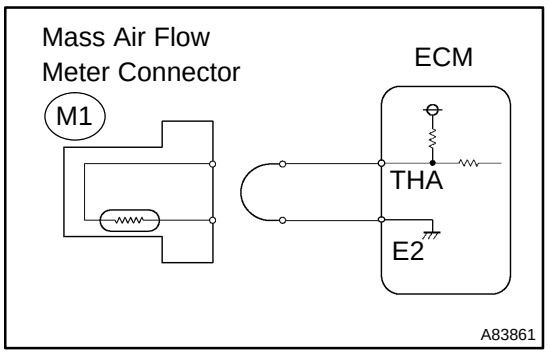
B → **Go to step 4**

C → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

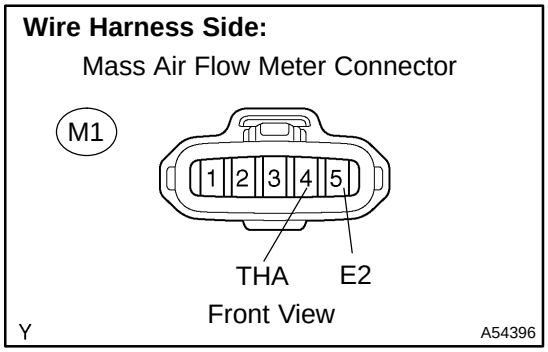
A

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2	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(CHECK FOR OPEN IN WIRE HARNESS)



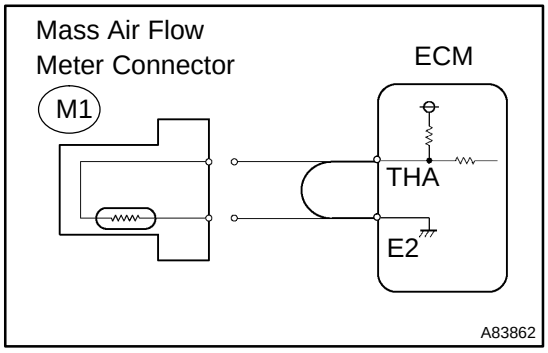
(a) Disconnect the M1 mass air flow meter connector.
(b) Connect terminals THA and E2 of the mass air flow meter wire harness side connector.
(c) Turn the power switch ON (IG).
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / INTAKE AIR. Read the value.
OK:
Temperature value: 140°C (284°F)
(e) Reconnect the mass air flow meter connector.



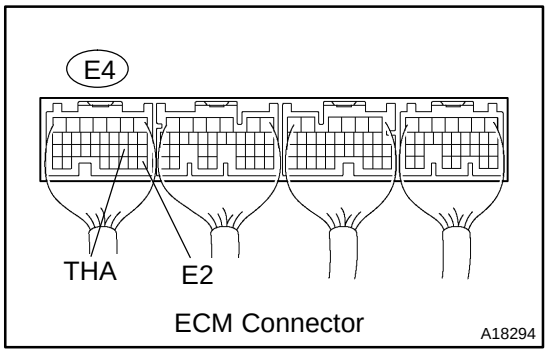
OK → **CONFIRM GOOD CONNECTION AT SENSOR. IF OK, REPLACE MASS AIR FLOW SENSOR**

NG

3	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(CHECK FOR OPEN IN ECM)



(a) Disconnect the M1 mass air flow meter connector.
(b) Connect terminals THA and E2 of the E4 ECM connector.
HINT:
Before checking, do a visual and contact pressure check for the ECM connector.
(c) Turn the power switch ON (IG).
(d) On the hand–held tester, select tha item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / INTAKE AIR. Read the value.
OK:
Temperature value: 140°C (284°F)
(e) Reconnect the mass air flow meter connector.



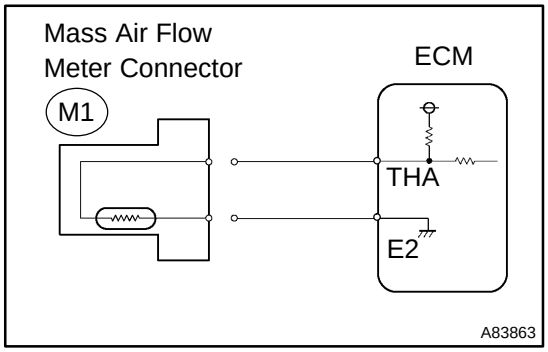
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OK	REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

CONFIRM GOOD CONNECTION AT ECM. IF OK, REPLACE ECM (See page 10–24)

4	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(CHECK FOR SHORT IN WIRE HARNESS)

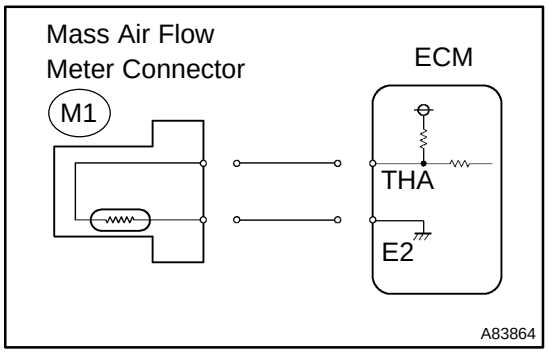


(a) Disconnect the M1 mass air flow meter connector.
(b) Turn the power switch ON (IG).
(c) On the hand–held tester, select tha item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / INTAKE AIR. Read the value.
OK:
Temperature value: –40°C (–40°F)
(d) Reconnect the mass air flow meter connector.

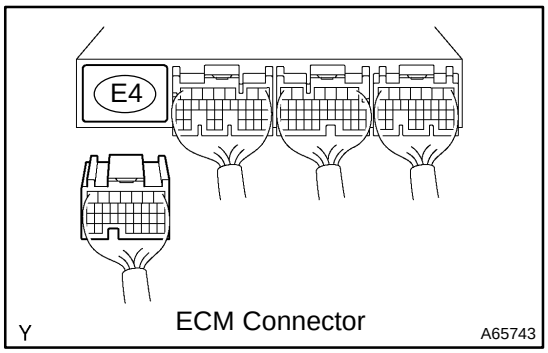
OK	REPLACE MASS AIR FLOW METER

NG

5	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(CHECK FOR SHORT IN ECM)



(a) Disconnect the E4 ECM connector.
(b) Turn the power switch ON (IG).
(c) On the hand–held tester, select tha item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / INTAKE AIR. Read the value.
OK:
Temperature value: –40°C (–40°F)
(d) Reconnect the ECM connector.



OK	REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

REPLACE ECM (See page 10–24)

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DTC	P0115	ENGINE COOLANT TEMPERATURE CIRCUIT

DTC	P0117	ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT

DTC	P0118	ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT

CIRCUIT DESCRIPTION

A thermistor is built in the engine coolant temperature sensor and changes its resistance value according to the engine coolant temperature.

The structure of the sensor and connection to the ECM is the same as those of the intake air temperature sensor.

HINT:

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

DTC No.	Proceed to	DTC Detection Condition	Trouble Area
P0115	Step 1	Open or short in engine coolant temperature sensor circuit for 0.5 second	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM
P0117	Step 4	Short in engine coolant temperature sensor circuit for 0.5 second	• Short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM
P0118	Step 2	Open in engine coolant temperature sensor circuit for 0.5 second	• Open in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM

HINT:

After confirming DTC P0115, P0117 or P0118, confirm the engine coolant temperature from DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL using the hand–held tester or the OBD II scan tool.

Temperature Displayed	Malfunction
–40˚C (–40˚F)	Open circuit
140˚C (284˚F)	Short circuit

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.

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 second or more, the ETC will set a DTC.

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MONITOR STRATEGY

Related DTCs	P0115: Engine coolant temperature sensor range check (fluttering) P0117: Engine coolant temperature sensor range check (low resistance) P0118: Engine coolant temperature sensor range check (high resistance)
Required sensors/components	Engine coolant temperature sensor
Frequency of operation	Continuous
Duration	0.5 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20

TYPICAL MALFUNCTION THRESHOLDS

P0115:

Engine coolant temperature sensor resistance (coolant temperature)	Less than 79 Ω or more than 156 kΩ (More than 140°C (284°F) or –40°C (–40°F) or less)

P0117:

Engine coolant temperature sensor resistance (coolant temperature)	Less than 79 Ω (More than 140°C (284°F))

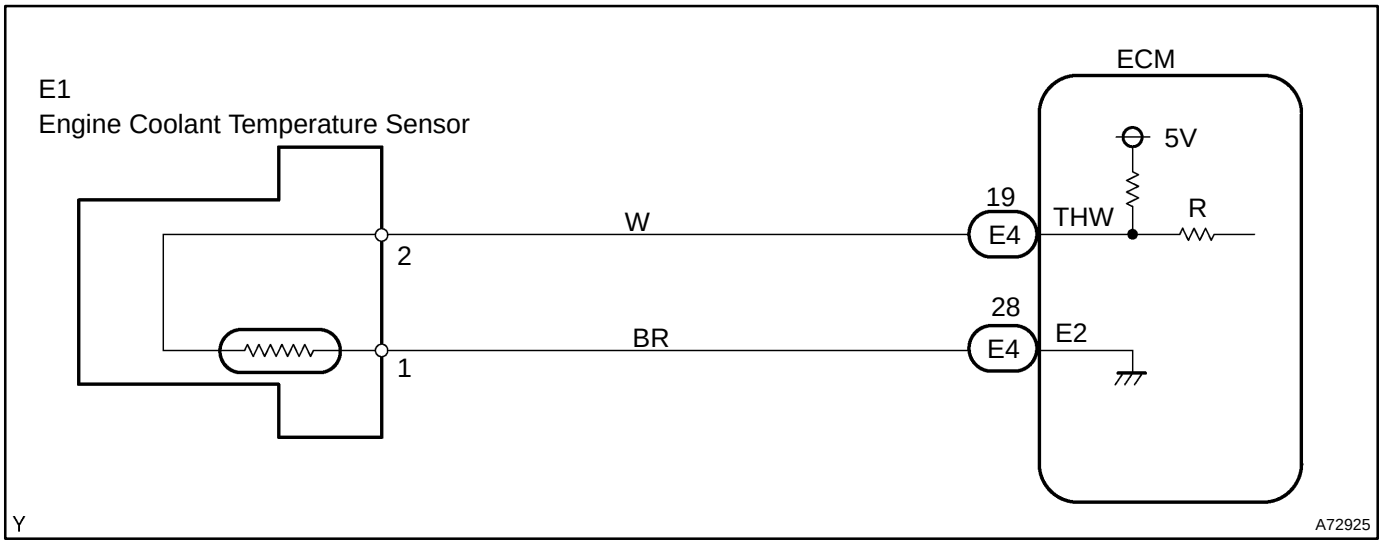
P0118:

Engine coolant temperature sensor resistance (coolant temperature)	More than 156 kΩ (–40°C (–40°F) or less)

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



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INSPECTION PROCEDURE

HINT:

- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

1	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(ENGINE COOLANT TEMPERATURE)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / COOLANT TEMP.
(e) Read the value using the hand–held tester or the OBD II scan tool.
(f) Measure the coolant temperature using a thermometer and compare the value with the value displayed on the hand–held tester or the OBD II scan tool.
Temperature value: Almost same as the actual engine coolant temperature.
Result:

Temperature Displayed	Proceed to
–40˚C (–40˚F)	A
140˚C (284˚F)	B
OK (Same as actual engine coolant temperature)	C

HINT:

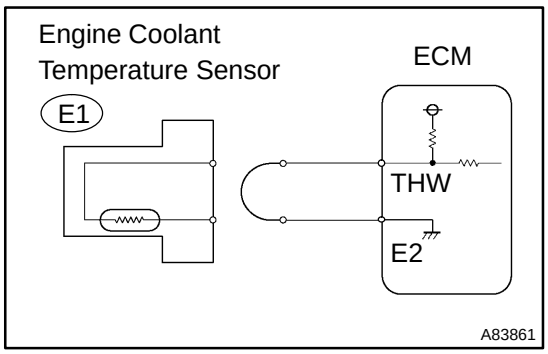
- If there is an open circuit, the hand–held tester or the OBD II scan tool indicates –40˚C (–40˚F).
- If there is a short circuit, the hand–held tester or the OBD II scan tool indicates 140˚C (284˚F).

B	**Go to step 4**
C	**CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

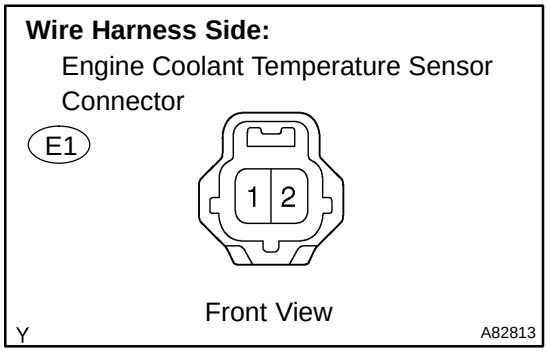
A

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2	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(CHECK FOR OPEN IN WIRE HARNESS)



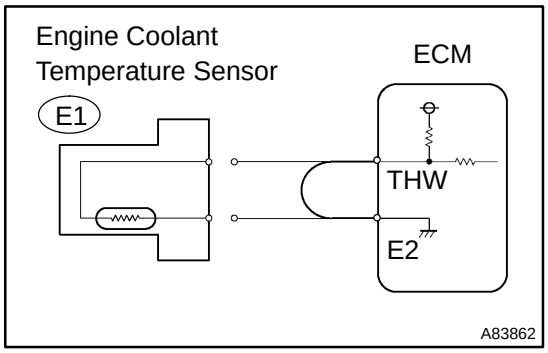
(a) Disconnect the E1 engine coolant temperature sensor connector.
(b) Connect terminals 1 and 2 of the engine coolant temperature sensor wire harness side connector.
(c) Turn the power switch ON (IG).
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / COOLANT TEMP. Read the value.
OK:
Temperature value: 140°C (284°F)
(e) Reconnect the engine coolant temperature sensor connector.



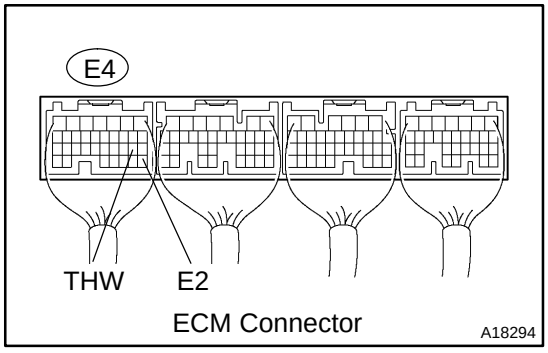
OK	CONFIRM GOOD CONNECTION AT SENSOR. IF OK, REPLACE ENGINE COOLANT TEMP. SENSOR

NG

3	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(CHECK FOR OPEN IN ECM)



(a) Disconnect the E1 engine coolant temperature sensor connector.
(b) Connect terminals THW and E2 of the E4 ECM connector.
HINT:
Before checking, do a visual and contact pressure check on the ECM connector.
(c) Turn the power switch ON (IG).
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / COOLANT TEMP. Read the value.
OK:
Temperature value: 140°C (284°F)
(e) Reconnect the engine coolant temperature sensor connector.



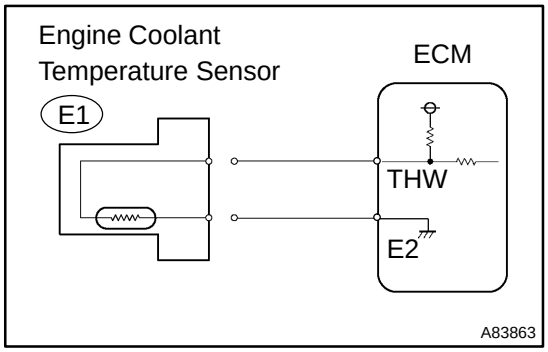
OK	REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

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CONFIRM GOOD CONNECTION AT ECM. IF OK, REPLACE ECM (See page 10–24)

4	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(CHECK FOR SHORT IN WIRE HARNESS)

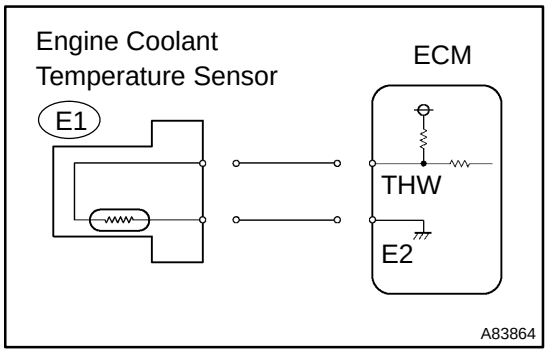


(a) Disconnect the E1 engine coolant temperature sensor connector.
(b) Turn the power switch ON (IG).
(c) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / COOLANT TEMP. Read the value.
OK:
Temperature value: –40°C (–40°F)
(d) Reconnect the engine coolant temperature sensor connector.

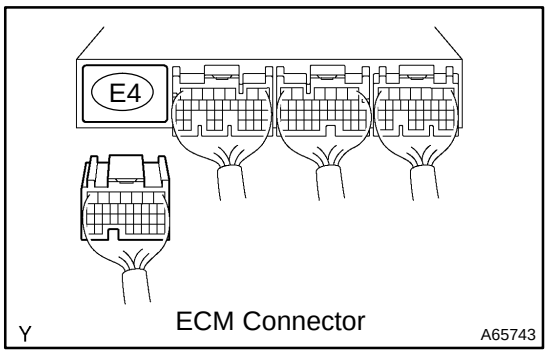
OK	REPLACE ENGINE COOLANT TEMPERATURE SENSOR

NG

5	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(CHECK FOR SHORT IN ECM)



(a) Disconnect the E4 ECM connector.
(b) Turn the power switch ON (IG).
(c) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / COOLANT TEMP. Read the value.
OK:
Temperature value: –40°C (–40°F)
(d) Reconnect the ECM connector.



OK	REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

REPLACE ECM (See page 10–24)

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DTC	P0116	ENGINE COOLANT TEMPERATURE CIRCUIT RANGE/PERFORMANCE PROBLEM

CIRCUIT DESCRIPTION

Refer to DTC P0115 on page 05–103.

DTC No.	DTC Detection Condition	Trouble Area
P0116	If the engine coolant temperature (ECT) was between 35°C (95°F) and 60°C (140°F) when starting the engine, and conditions (a) and (b) are met (2 trip detection logic): (a) Vehicle is driven at varying speeds (acceleration and deceleration) for more than 250 seconds (b) ECT remains within 3°C (5.4°F) of the engine starting temperature	• Engine coolant temperature sensor
P0116	If the engine coolant temperature was more than 60 °C (140 °F) at engine start, and conditions (a) and (b) are met (6 trip detection logic): (a) Vehicle is driven at varying speeds (under acceleration and deceleration) (b) Engine coolant temperature remains within 1 °C (1.8 °F) of the engine starting temperature, and this is successively recorded 6 times	• Engine coolant temperature sensor

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 coolant temperature (ECT) was 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 staring temperature, a DTC will be set (2 trip detection logic).

2) Upon starting the engine, the coolant temperature (ECT) was 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: Engine coolant temperature sensor range check (stuck)
Required sensors/components	Main sensors: Engine coolant temperature sensor Related sensors: Intake air temperature sensor, crankshaft position sensor,mass air flow meter
Frequency of operation	Continuous
Duration	250 seconds
MIL operation	2 driving cycles: when temperature is fixed between 35°C (95°F) and 60°C (140°F) 6 driving cycles: when temperature is fixed at 60°C (140°F) or more
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

Case 1

The monitor will run whenever the following DTCs are not present	See page 05–20
Cumulative idle off period	250 seconds or more
Speed increase by ≧ 19 mph (30 km/h)	10 times or more
Engine coolant temperature	35°C (95°F) or more, and less than 60°C (140°F)
Intake air temperature	–6.7°C (20°F) or more

Case 2

Engine coolant temperature	60°C (140°F) or more
Intake air temperature	–6.7°C (20°F) or more
Stop and go	Stop for 20 seconds or more and accelerate to more than 43.5 mph (70 km/h)
44 mph (70 km/h) in less than 40 seconds	Decelerate from 40.4 mph (65 km/h) to 1.86 mph (3 km/h) within 35 seconds and stop for 10seconds

TYPICAL MALFUNCTION THRESHOLDS

Case 1

When temperature is fixed between 35°C (95°F) and 60°C (140°F)

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

Case 2

When temperature is fixed at 60°C (140°F) or more

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

COMPONENT OPERATING RANGE

Engine coolant temperature	Changing with the actual engine coolant temperature

WIRING DIAGRAM

Refer to DTC P0115 on page 05–103.

INSPECTION PROCEDURE

HINT:

- If DTCs P0115, P0116, P0117, P0118 and P0125 are output simultaneously, engine coolant temperature sensor circuit may be open or short. Perform troubleshooting on DTC P0115, P0117 or P0118 first.
- Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, 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.

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

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DTC	P0120	THROTTLE/PEDAL POSITION SENSOR/SWITCH ”A” CIRCUIT

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

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CIRCUIT DESCRIPTION

HINT:

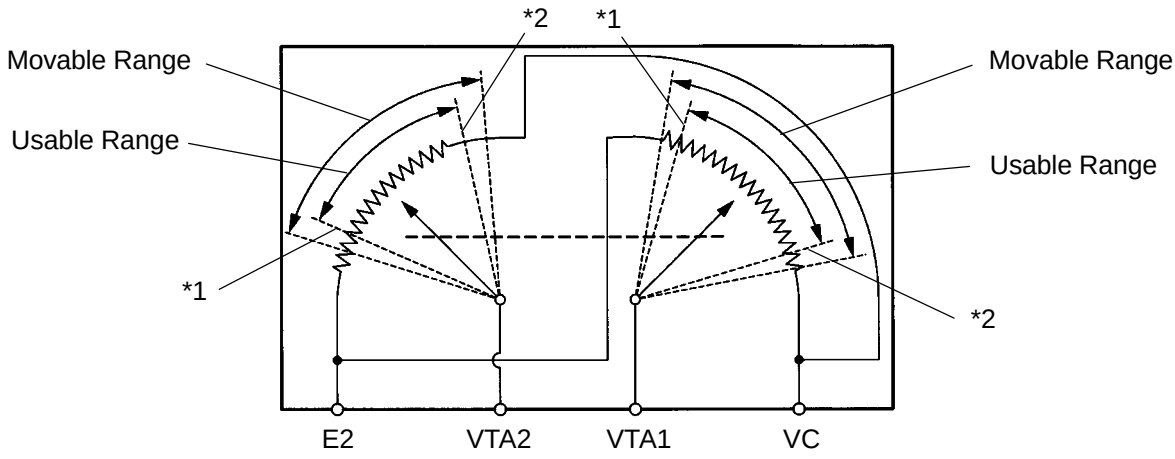
- This electrical throttle system does not use a throttle cable.
- This is the troubleshooting procedure of the throttle position sensor.

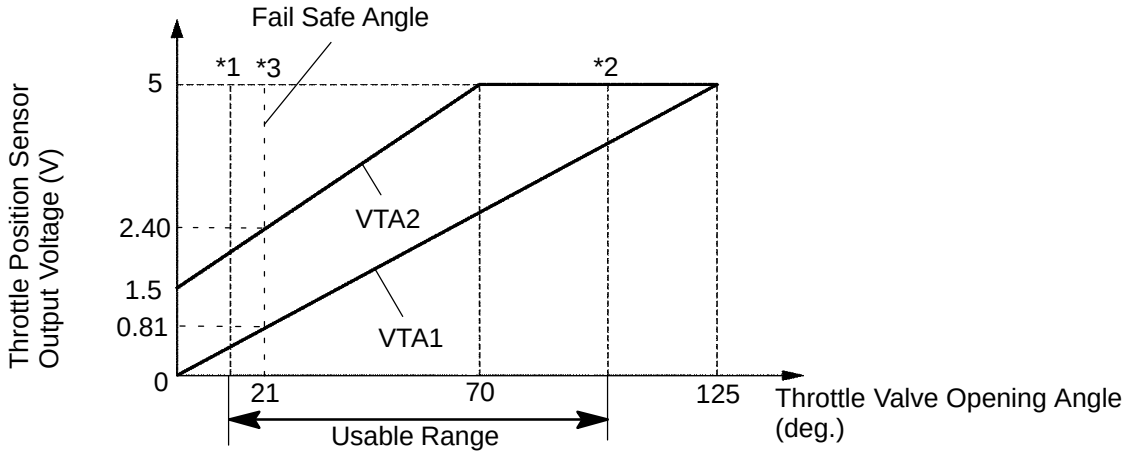
The throttle position sensor is mounted on the throttle body and it has 2 sensor terminals to detect the throttle opening angle and malfunction of the throttle position sensor itself.

The voltage applied to terminals VTA and VTA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the throttle valve. The VTA is a signal to indicate the actual throttle valve opening angle which is used for the engine control, and the VTA2 is a signal to indicate the information about the opening angle which is used for detecting malfunction of the sensor.

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

When malfunction is detected, the throttle valve is locked at a certain opening angle. Also, the whole electronically controlled throttle operation is cancelled until the system returns to normal and the power switch is turned OFF.





*1: Throttle Valve Fully Closed (13.5˚), VTA1 is 0%

*2: Throttle Valve Fully Open (97.5˚), VTA1 is approx 100 %

*3: Fail Safe Angle (16.5˚), VTA1 is 3.5%

Note: Throttle valve opening angle detected by the sensor terminal of VTA is expressed as percentage.

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DTC No.	DTC Detection Condition	Trouble Area
—	Conditions of DTC P0120, P0122, P0123, P0220, P0222 or P0223 continues for 2 seconds or more when Idle is ON	—
P0120	Detection conditions for DTCs P0122 and P0123 are not satisfied but condition (a) is satisfied (a) VTA is 0.2V or less, or 4.8 V or more	• Open or short in throttle position sensor circuit • Throttle position sensor • ECM
P0122	VTA is 0.2 V or less	• Short in throttle position sensor circuit • Throttle position sensor • ECM
P0123	VTA is 4.8 V or more	• Open in throttle position sensor circuit • Throttle position sensor • ECM
P0220	Detection conditions for DTCs P0222 and P0223 are not satisfied but condition (a) and (b) are satisfied (a) VTA2 is 0.5 V or less, or VTA2 is 4.8 V or more (b) VTA is 0.2 V or more and 1.8 V or less	• Open or short in throttle position sensor circuit • Throttle position sensor • ECM
P0222	VTA2 is 0.5 V or less	• Short in throttle position sensor circuit • Throttle position sensor • ECM
P0223	VTA2 is 4.8 V or more when VTA is 0.2 or more and 1.8 V or less	• Open in throttle position sensor circuit • Throttle position sensor • ECM
P2135	Condition (a) continues for 0.5 seconds or more, or condition (b) continues for 0.4 seconds or more: (a) Difference between VTA and VTA2 is 0.02 V or less (b) VTA is 0.2 V or less and VTA2 is 0.5 V or less	• Open or short in throttle position sensor circuit • Throttle position sensor • ECM

HINT:

DTC No.	Main Trouble Area
P0122	• Throttle position sensor • Open in VTA1 circuit • VC circuit open (when the VC circuit is open, DTCs P0222 and P2135 are also output simultaneously) • ECM
P0123	• Throttle position sensor (built in throttle body) • Open in VTA circuit • Open in E2 circuit • VC and VTA circuits are short–circuited • ECM
P0222	• Throttle position sensor • Open in VTA2 circuit • VC circuit open (when the VC circuit is open, DTCs P0122 and P2135 are also output simultaneously)
P0223	• Throttle position sensor
P2135	• VTA1 and VTA2 circuits are short–circuited • Open in VC circuit • Throttle position sensor

NOTICE:

When a malfunction is detected, the throttle valve is locked at a certain opening angle. Also, the whole electronically controlled throttle operation is cancelled until the system returns to normal and the power switch is turned OFF.

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HINT:

- After confirming DTCs, confirm condition of the throttle valve opening angle (THROTTLE POS) and the closed throttle position switch (THROTTLE POS #2) using the hand–held tester or the OBD II scan tool.
- THROTTLE POS means the VTA1 signal (expressed as percentage), and THROTTLE POS#2 means the VTA2 signal (expressed as volts.

Reference (Normal condition):

Tester display	Accelerator pedal released	Accelerator pedal depressed
THROTTLE POS	8 to 20 %	64 to 96 %
THROTTLE POS #2	1.5 to 2.9 V	3.5 to 5.5 V

MONITOR DESCRIPTION

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

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

(b) VTA1 and VTA2 each have a specific voltage operating range.

(c) VTA1 and VTA2 should never be close to the same voltage level.

If the difference between VTA1 and VTA2 is incorrect (a), the ECM interprets this as a fault and will set a DTC.

If VTA1 or VTA2 is out of the normal operating range (b), the ECM interprets this as a fault and will set a DTC.

If VTA1 is within 0.02 V of VTA2 (c), the ECM interprets this as a short circuit in the throttle position sensor system and will set a DTC.

MONITOR STRATEGY

Related DTCs	P0120: Throttle position sensor (sensor 1) range check (fluttering) P0122: Throttle position sensor (sensor 1) range check (low voltage) P0123: Throttle position sensor (sensor 1) range check (high voltage) P0220: Throttle position sensor (sensor 2) range check (fluttering) P0222: Throttle position sensor (sensor 2) range check (low voltage) P0223: Throttle position sensor (sensor 2) range check (high voltage) P2135: Throttle position sensor range check (correlation)
Required sensors/components	Throttle position sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20

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TYPICAL MALFUNCTION THRESHOLDS

P0120:

VTA1 voltage	0.2 V or less or 4.8 V or more

P0122:

VTA1 voltage	0.2 V or less

P0123:

VTA1 voltage	4.8 V or more

P0220:

VTA2 voltage	0.5 V or less or 4.8 V or more

P0222:

VTA2 voltage	0.5 V or less

P0223:

VTA2 voltage	4.8 V or more

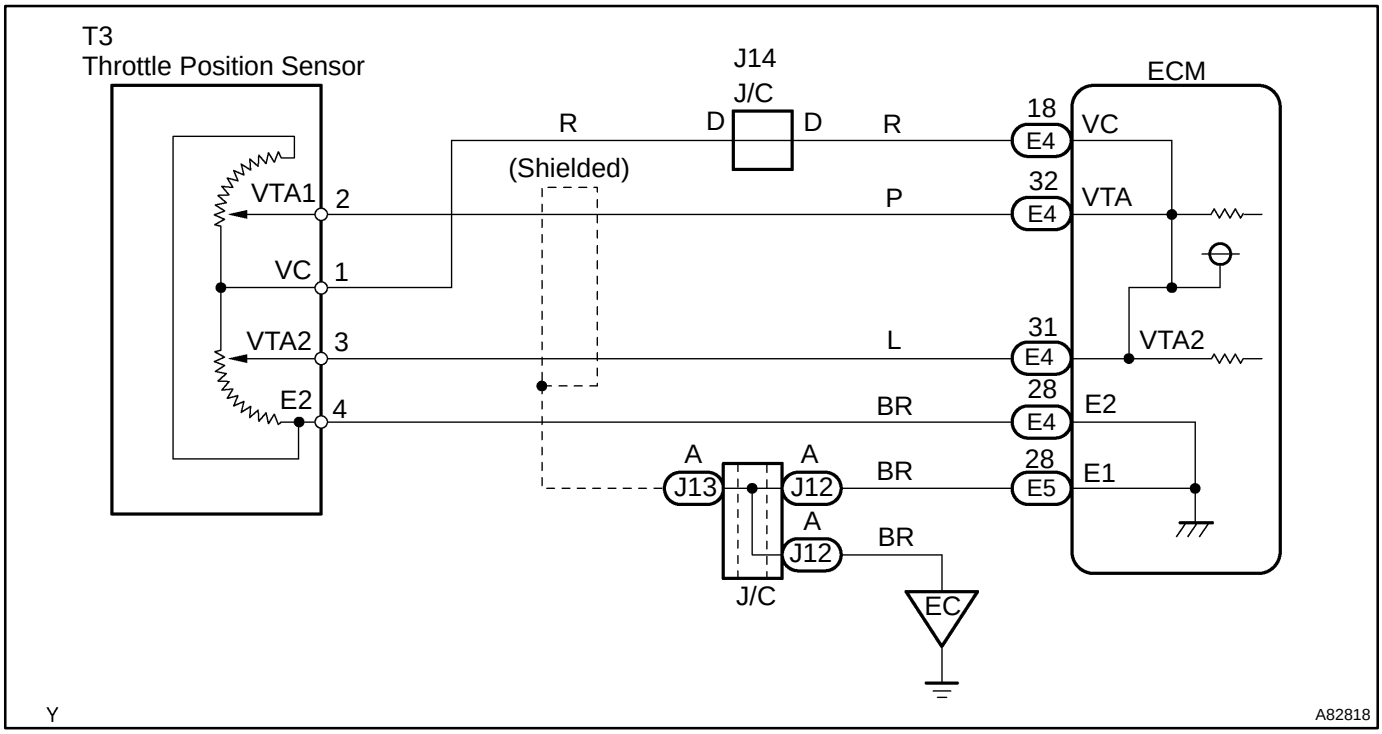
P2135:

Different between VTA1 and VTA2 voltage	0.02 V or less
Both of the following conditions are met:	(a) and (b)
(a) VTA1 voltage	0.2 V or less
(b) VTA2 voltage	0.5 V or less

COMPONENT OPERATING RANGE

Throttle position sensor VTA1 voltage	0.6 to 3.96 V
Throttle position sensor VTA2 voltage	2.25 to 5.0 V

WIRING DIAGRAM



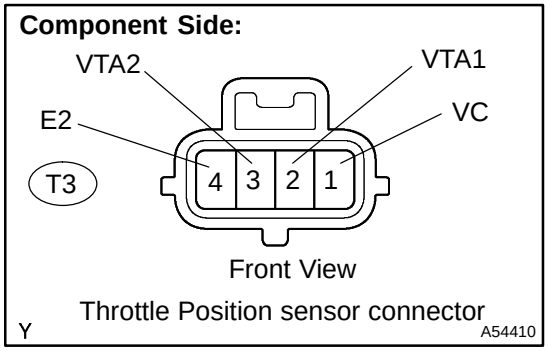
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INSPECTION PROCEDURE

HINT:

- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 INSPECT THROTTLE POSITION SENSOR(RESISTANCE)



(a) Disconnect the T3 throttle position sensor connector.
(b) Measure the resistance between the terminals of the throttle position sensor.

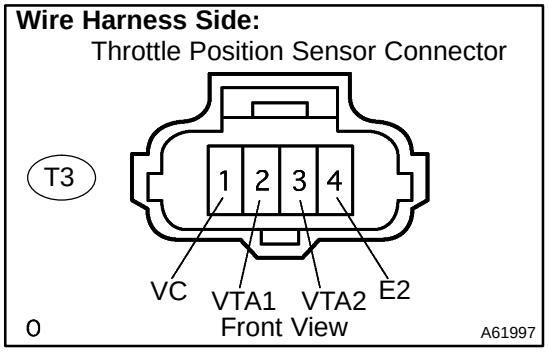
Standard:

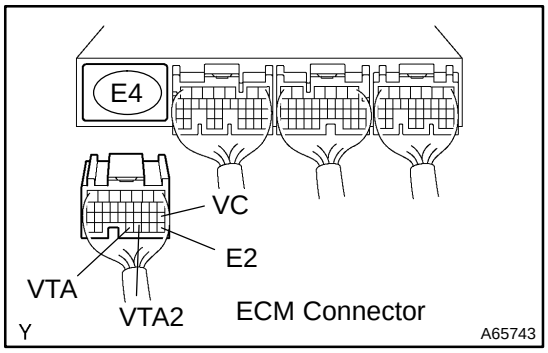
Throttle Position Sensor Terminal	Resistance
VC (1) – E2 (4)	1.2 to 3.2 kΩ at 20˚C (68˚F)
VTA1 (2) – E2 (4)	1.8 to 10.5 kΩ at 20˚C (68˚F)
VTA2 (3) – E2 (4)	1.8 to 10.5 kΩ at 20˚C (68˚F)

NG → **REPLACE THROTTLE W/MOTOR BODY ASSY (See page 10–13)**

OK

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





(a) Disconnect the T3 throttle position sensor connector.
(b) Disconnect the ECM E4 connector.
(c) Check the resistance between the wire harness side connectors.

Standard: Check for open

Tester Connection	Specified Condition
VC (T3–1) – VC (E4–18)	Below 1 Ω
VTA1 (T3–2) – VTA (E4–32)	Below 1 Ω
VTA2 (T3–3) – VTA2 (E4–31)	Below 1 Ω
E2 (T3–4) – E2 (E4–28)	Below 1 Ω

Standard: Check for short

Tester Connection	Specified Condition
VC (E4–18) – E2 (E4–28)	10 kΩ or higher
VTA (E4–32) – E2 (E4–28)	10 kΩ or higher
VTA2 (E4–31) – E2 (E4–28)	10 kΩ or higher

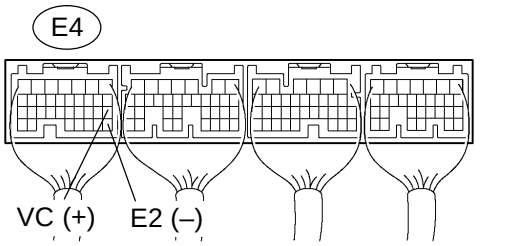
(d) Reconnect the ECM connector.

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

OK

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3	INSPECT ECM(VC – E2)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between terminals VC and E2 of the ECM connector.

Standard:

Tester Connection	Specified Condition
VC (E4–18) – E2 (E4–28)	4.5 to 5.5 V

NG → **REPLACE ECM (See page 10–24)**

OK

REPLACE THROTTLE W/MOTOR BODY ASSY (See page 10–13)

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DTC	P0121	THROTTLE/PEDAL POSITION SENSOR/SWITCH ”A” CIRCUIT RANGE/PERFORMANCE PROBLEM

CIRCUIT DESCRIPTION

Refer to DTC P0120 on page 05–110.

HINT:

This is the purpose of troubleshooting the throttle position sensor.

DTC No.	DTC Detection Condition	Trouble Area
P0121	Difference between VTA1 and VTA2 is out of threshold for 2 seconds	• Throttle position sensor

MONITOR DESCRIPTION

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

This sensor has two signals, VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunction in VTA1. There are several checks that the ECM confirms 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 VTA1 or VTA2 is out of the normal operating range, the ECM interprets this as a fault and will set a DTC.

If VTA1 is within 0.02 V of VTA2, the ECM interprets this as a short circuit in the throttle position sensor system and will set a DTC.

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

FAIL SAFE

If the Electronic Throttle Control System (ETCS) has 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 to drive.

If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

If a ”pass” condition is detected and then the power switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

MONITOR STRATEGY

Related DTCs	P0121: Throttle position sensor rationality
Required sensors/components	Throttle position sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
VTA2 voltage	Less than 4.6 V

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TYPICAL MALFUNCTION THRESHOLDS

Different between VTA1 and VTA2 [VTA1 – (VTA2 × 0.8 to 1.2)]* *: Corrected by learning value	Less than 0.8 V and more than 1.6 V

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

REPLACE THROTTLE BODY ASSY (See page 10–13)

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DTC	P0125	INSUFFICIENT COOLANT TEMPERATURE FOR CLOSED LOOP FUEL CONTROL

CIRCUIT DESCRIPTION

Refer to DTC P0115 on page 05–103.

DTC No.	DTC Detection Condition	Trouble Area
P0125	When ECT or IAT was less than –6.6˚C (20˚F) when starting engine, ECT sensor value is 20˚C (68˚F) or less even if 20 minutes or more has passed after engine start (2 trip detection logic)	• Cooling system • Engine coolant temperature sensor • Thermostat
P0125	If ECT and IAT was between –6.6˚C (20˚F) and 10˚C (50˚F) when starting engine, ECT sensor value is 20˚C (68˚F) or less even if more than 5 minutes has passed after engine start (2 trip detection logic)	• Cooling system • Engine coolant temperature sensor • Thermostat
P0125	If ECT and IAT were higher than 10˚C (50˚F) when starting engine, ECT sensor value is 20˚C (68˚F) or less even if more than 2 minutes has passed after engine start	• Cooling system • Engine coolant temperature sensor • Thermostat

HINT:
ECT represents engine coolant temperature, and IAT represents intake air temperature.

MONITOR DESCRIPTION

The engine coolant temperature (ECT) sensor is used to monitor the temperature of the engine coolant. The resistance of the sensor varies with the actual engine coolant temperature. The ECM applies voltage to the sensor and the varying resistance of the sensor causes the signal voltage to vary. The ECM monitors the ECT signal voltage after engine start–up. If, after sufficient time has passed, the sensor still reports that the engine is not warm enough for closed–loop fuel control, the ECM interprets this as a fault in the sensor or cooling system and sets a DTC.
Example:
The engine coolant temperature was 0°C (32°F) at engine start. After driving 5 minutes, the ECT sensor still indicates that the engine is not warm enough to begin the air–fuel ratio feedback control. The ECM interprets this as a fault in the sensor or cooling system and will set a DTC.

MONITOR STRATEGY

Case 1

Related DTCs	P0125: Insufficient coolant temperature for closed loop fuel control
Required sensors/components	Main: Engine coolant temperature sensor, cooling system, thermostat Related: Mass air flow meter
Frequency of operation	Continuous
Duration	2 minutes (engine starting temperature is 10°C (50°F) or more)
MIL operation	2 driving cycles
Sequence of operation	None

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Case 2

Related DTCs	P0125: Insufficient coolant temperature for closed loop fuel control
Required sensors/components	Main: Engine coolant temperature sensor, cooling system, thermostat Related: Mass air flow meter
Frequency of operation	Continuous
Duration	5 minutes (engine starting temperature is –6.6°C (20°F) to 10°C (50°F))
MIL operation	2 driving cycles
Sequence of operation	None

Case 3

Related DTCs	P0125: Insufficient coolant temperature for closed loop fuel control
Required sensors/components	Main: Engine coolant temperature sensor, cooling system, thermostat Related: Mass air flow meter
Frequency of operation	Continuous
Duration	20 minutes (engine starting temperature is less than –6.6°C (20°F))
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Intake air amount per second	0.1 g/sec or more
Fuel cut	OFF

TYPICAL MALFUNCTION THRESHOLDS

Case 1

Time until monitored engine coolant temperature reaches feedback start temperature

Engine starting temperature is 10°C (50°F) or more	Engine coolant temperature is less than "closed–loop enabling temperature" even if 2 minutes or more passed after engine start

Case 2

Time until monitored engine coolant temperature reaches feedback start temperature

Engine starting temperature is –6.6°C (20°F) to 10°C (50°F)	Engine coolant temperature is less than "closed–loop enabling temperature" even if 5 minutes or more passed after engine start

Case 3

Time until monitored engine coolant temperature reaches feedback start temperature

Engine starting temperature is –6.6°C (20°F) or less	Engine coolant temperature is less than "closed–loop enabling temperature" even if 20 minutes or more passed after engine start

WIRING DIAGRAM

Refer to DTC P0115 on page 05–103.

INSPECTION PROCEDURE

HINT:

- If DTCs P0115, P0116, P0117, P0118 and P0125 are output simultaneously, engine coolant temperature sensor circuit may be open or short. Perform troubleshooting on DTC P0115, P0117 or P0118 first.
- Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.
Result:

Display (DTC output)	Proceed to
P0125	A
P0125 and other DTCs	B

HINT:
If any other codes besides P0125 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	INSPECT THERMOSTAT (See page 16–4)

(a) Check the valve opening temperature of the thermostat.
OK:
Thermostat valve begins to open at temperature of 80 to 84°C (176 to 183°F).

HINT:
Also check that the valve is completely closed below temperature shown above.

NG → **REPLACE THERMOSTAT (See page 16–18)**

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See page 10–5)

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DTC	P0128	COOLANT THERMOSTAT (COOLANT TEMPERATURE BELOW THERMOSTAT REGULATING TEMPERATURE)

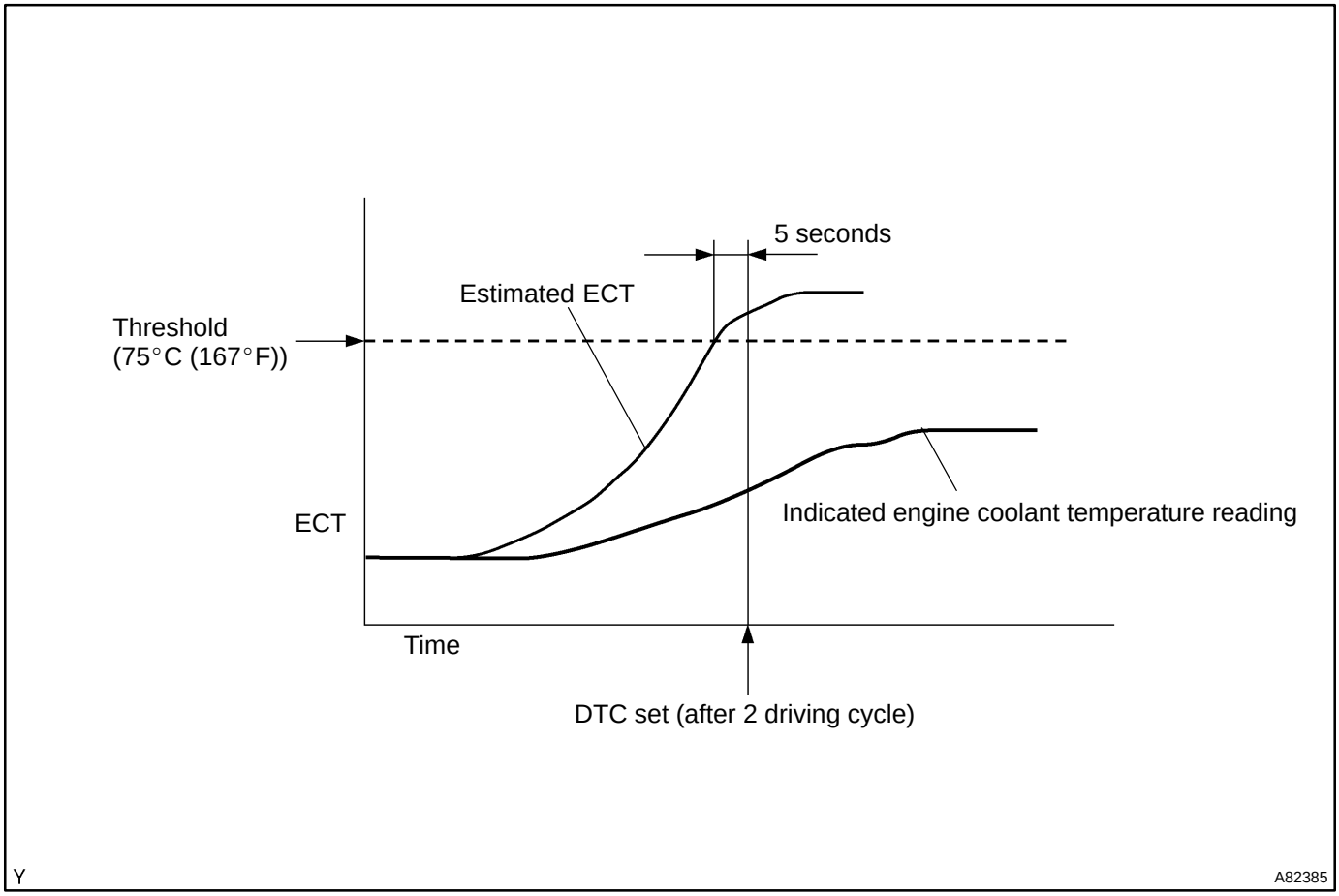
HINT:
This is the purpose of detecting the ”thermostat” malfunction.

CIRCUIT DESCRIPTION

If the engine coolant temperature (ECT) does not reach 75˚C (167˚F) despite sufficient warm–up time has elapsed.

DTC No.	DTC Detection Condition	Trouble Area
P0128	Conditions (a), (b) and (c) are met: (a) Cold start (b) After sufficient warm–up time has elapsed (c) Engine coolant temperature is less than 75˚C (167˚F)	• Thermostat • Cooling system • Engine coolant temperature sensor • ECM

MONITOR DESCRIPTION



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

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MONITOR STRATEGY

Related DTCs	P0128: Thermostat
Required sensors/components	Main: Engine coolant temperature sensor, engine cooling system, thermostat Related: Intake air temperature sensor, vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	15 minutes
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	11 V or more
Intake air temperature (at engine start)	–10°C (14°F) or more, and 35°C (95°F) or less
Engine coolant temperature (at engine start)	–10°C (14°F) or more, and 35°C (95°F) or less
Engine coolant temperature at engine start compared with intake air temperature	Maximum of 15°C (27°F) lower or 7°C (12.6°F) higher

TYPICAL MALFUNCTION THRESHOLDS

(1) Estimated engine coolant temperature	75°C (167°F) or more
(2) Estimated engine coolant temperature sensor output value	Less than 75°C (167°F)
Duration of both (1) and (2)	5 seconds or more

COMPONENT OPERATING RANGE

Engine coolant temperature sensor output value after warm–up	75°C (167°F) or more

MONITOR RESULT (MODE 06 DATA)

Test ID / Comp ID	Description Test Data	Description of Test Limit	Conversion Factor (Unit)
$08 / $81	Difference between actual and estimated engine coolant temperatures The value stored when estimated coolant temperature is 75°C (167°F)	Malfunction criteria for thermostat	Multiply by 0.625 and minus 40 (°C)

Refer to page 05–26 for detailed information on Checking Monitor Status.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1	CHECK COOLING SYSTEM

(a) Check that there is a defect in the cooling system which causes overcool, such as abnormal radiator fan operation, modified cooling system and so on.
OK:
There is no modification of cooling system.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

2	INSPECT THERMOSTAT (See page 16–4)

(a) Check the valve opening temperature of the thermostat.
OK:
Thermostat valve begins to open at temperature of 80 to 84°C (176 to 183°F).

HINT:
Also check the valve is completely closed below the temperature shown above.

NG → **REPLACE THERMOSTAT (See page 16–18)**

OK

REPLACE ECM (See page 10–24)

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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)

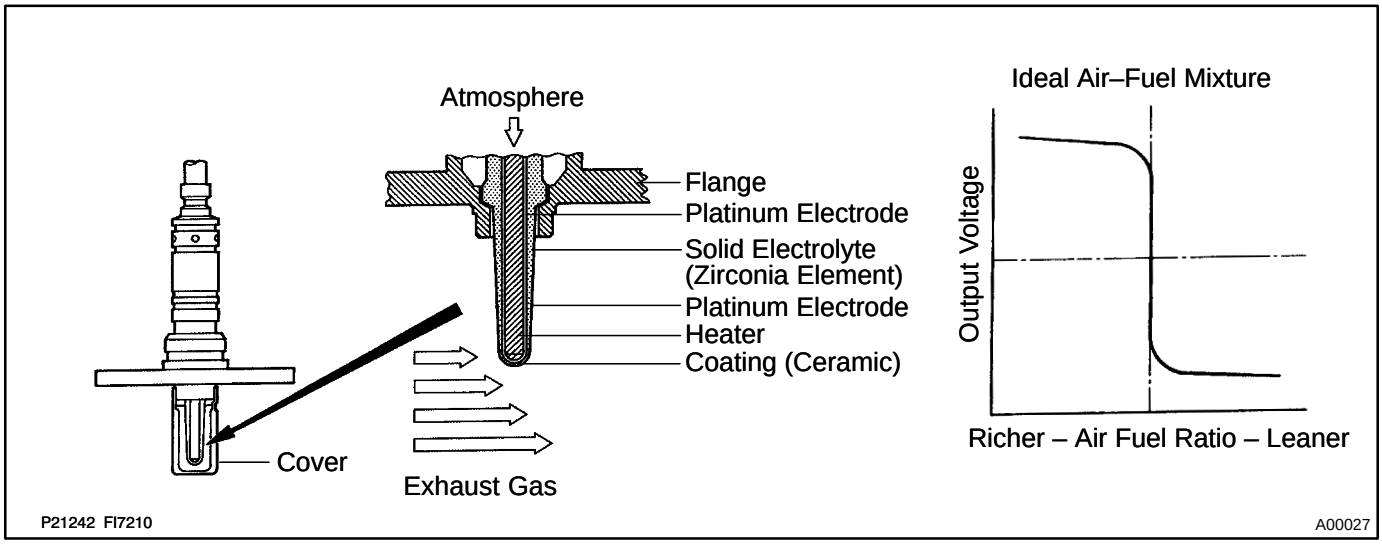
CIRCUIT DESCRIPTION

The heated oxygen sensor is used to monitor oxygen concentration in the exhaust gas. For optimum catalytic converter operation, the air–fuel mixture must be maintained near the ideal ”stoichiometric” ratio. The oxygen sensor output voltage changes suddenly in the vicinity of the stoichiometric ratio. The ECM adjusts the fuel injection time so that the air–fuel ratio is nearly stoichiometric ratio.

When the air–fuel ratio becomes LEAN, the oxygen concentration in the exhaust gas increases. The heated oxygen sensor informs the ECM of the LEAN condition (low voltage, i.e. less than 0.45 V).

When the air–fuel ratio is RICHER than the stoichiometric air–fuel ratio, the oxygen will be vanished from the exhaust gas. The heated oxygen sensor informs the ECM of the RICH condition (high voltage, i.e. more than 0.45 V).

The heated oxygen sensor includes a heater which heats the zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater in order to heat the sensor for the accurate oxygen concentration detection.



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DTC No.	DTC Detection Condition	Trouble Area
P0136	One of the following conditions is met: • Sensor impedance is less than 5 Ω when ECM presumes the sensor warmed–up as well as operated normally • Under active air–fuel ratio control, either of (a) and (b) is met: (a) Sensor output voltage is 0.2 V or more (b) Sensor output voltage is 0.6 V or less • Under active air–fuel ratio control, either of (a) and (b) is met: (a) Sensor output voltage is 0.25 V or more when OSC is 0.88 g or more and target air–fuel ratio is RICH (b) Sensor output voltage is 0.59 V or less when OSC is 0.88 g or more and target air–fuel ratio is LEAN	• Open or short in heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • Heated oxygen sensor heater (bank 1 sensor 2) • EFI M relay
P0137	Either of the following conditions is met: • Sensor impedance is more than 15 kΩ for more than 55 seconds when ECM presumes the sensor warmed–up as well as operated normally • Under active air–fuel ratio control, all of the following conditions are met: (a) Sensor output voltage is less than 0.25 V (b) Target air–fuel ratio is RICH (c) OSC is 0.88 g or more	• Open in heated oxygen sensor (bank 1 sensor 2) circuit • EFI M relay • Heated oxygen sensor (bank 1 sensor 2) • Heated oxygen sensor heater (bank 1 sensor 2)
P0138	One of the following conditions is met: • Sensor short is detected even if sensor output voltage is 1.2 V or more for 30 seconds • Under active air–fuel ratio control, all of the following conditions are met: (a) Sensor output voltage is 0.59 V or more (b) Target air–fuel ratio is LEAN (c) OSC is 0.88 g or more • Sensor output voltage is more than 1.2 V for 10 seconds	• Short in heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • Heated oxygen sensor heater (bank 1 sensor 2) • EFI M relay

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MONITOR DESCRIPTION

Active Air–Fuel Ratio Control

Usually the ECM performs the air–fuel ratio control so that the A/F sensor output indicates a near stoichiometric air–fuel ratio. This vehicle includes ”active air–fuel ratio control” besides the regular air–fuel ratio control. The ECM performs the ”active air–fuel ratio control” to detect deterioration in a catalyst and the heated oxygen sensor malfunction. (Refer to the diagram below)

The ”Active air–fuel ratio control” is performed for approximately 15 to 20 seconds during a vehicle driving with a warm engine. Under the ”active air–fuel ratio control”, the air–fuel ratio is forcibly regulated to go LEAN or RICH by the ECM.

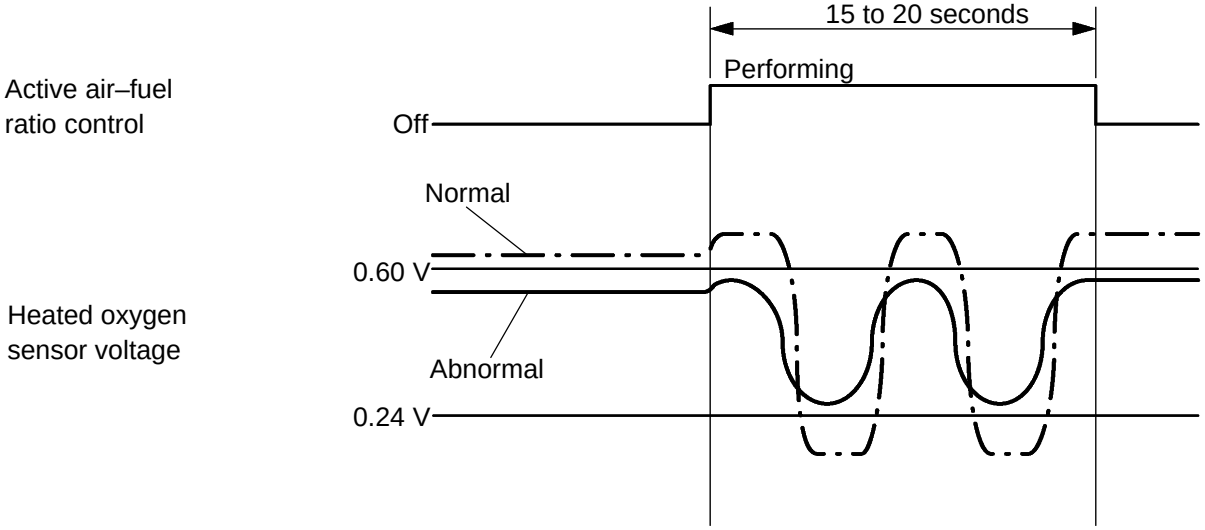
If the ECM detects malfunction, it is recorded in the following DTCs: DTC P0136 (Abnormal Voltage Output), DTC P0137 (Circuit Open) and P0138 (Circuit Short).

Abnormal Voltage Output of Heated Oxygen Sensor (DTC P0136)

As the ECM is performing the ”active air–fuel ratio control”, the air–fuel ratio is forcibly regulated to go RICH or LEAN. If the sensor is not functioning properly, the voltage output variation is smaller.

Under the ”active air–fuel ratio control”, if the maximum voltage output of the heated oxygen sensor is less than 0.6 V, or the minimum voltage output is 0.24 V or more, the ECM determines that it is abnormal voltage output of the sensor (DTC P0136).

HEATED OXYGEN SENSOR CIRCUIT MALFUNCTION (P0136: ABNORMAL VOLTAGE):



Y A76837

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Oxygen Storage Capacity Detection in the Heated Oxygen Sensor Circuit (P0136, P0137 or P0138)

Under ”active air–fuel ratio control”, the ECM calculates the Oxygen Storage Capacity (OSC)* in the catalyst by forcibly regulating the air–fuel ratio to go RICH (or LEAN).

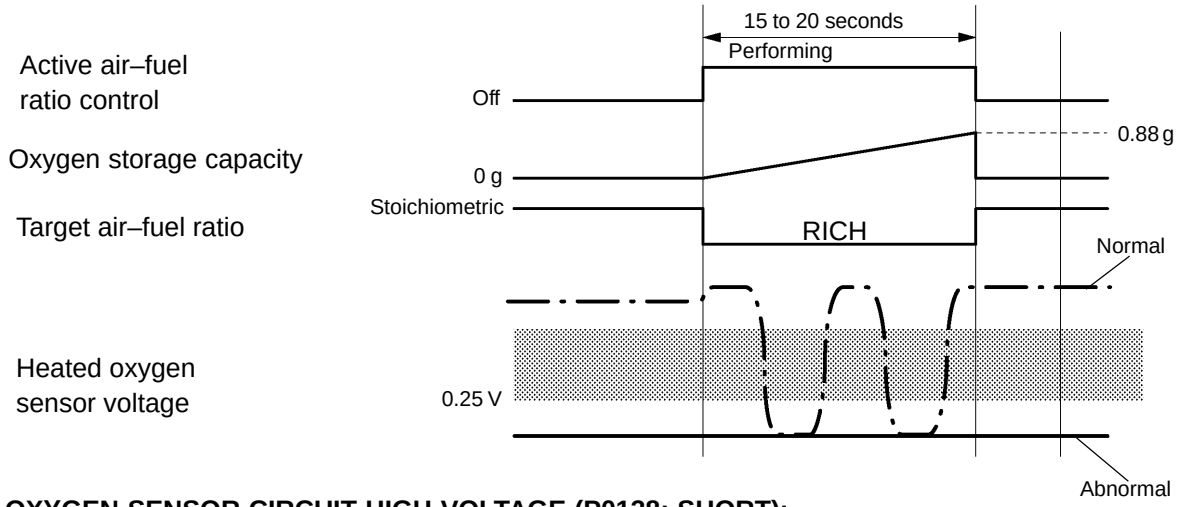
If the heated oxygen sensor has an open or short, or the voltage output by the sensor noticeably decreases, the OSC will indicate extraordinary high value. Even if the ECM attempts to continue regulating the air–fuel ratio to go RICH (or LEAN), the heated oxygen sensor output does not change.

When the value of OSC calculated by the ECM reaches 0.88 gram under the active air–fuel ratio control, although the targeted air–fuel ratio is RICH but the voltage output of the heated oxygen sensor is 0.25 V or less (LEAN), the ECM determines that it is an abnormal low voltage (DTC P0137). Also, the targeted air–fuel ratio is LEAN but the voltage output is 0.59 V or more (RICH), it is determined that the voltage output of the sensor is abnormally high (DTC P0138).

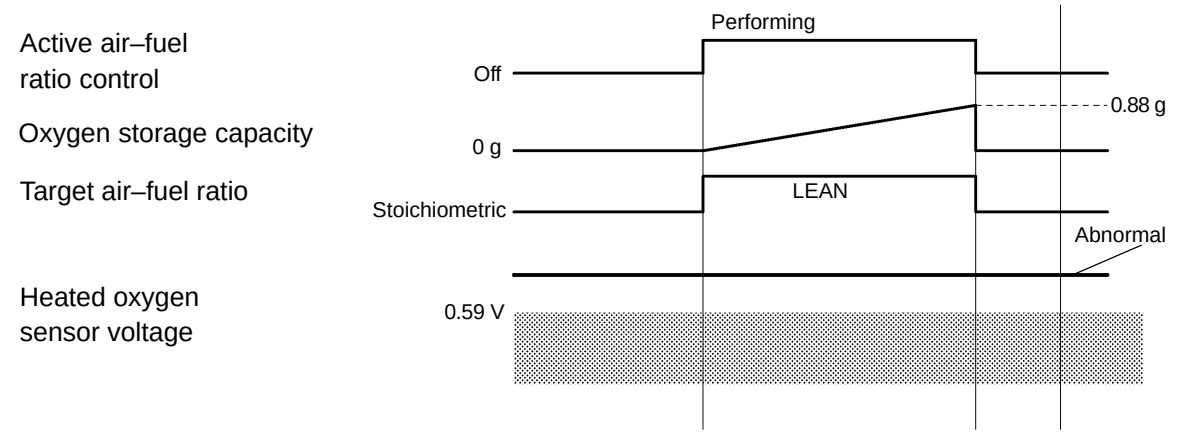
In addition to the OSC detection, if the fluctuation of the sensor voltage output is in a specific narrow range (more than 0.25 V and less than 0.59) despite the ECM ordering the air–fuel ratio to go RICH or LEAN while the OSC is above 0.88 gram, the ECM interprets this as a malfunction in the heated oxygen sensor circuit (DTC P0136).

*Oxygen Storage Capacity (OSC): A catalyst has a capability for storing oxygen. The OSC and the emission purification capacity of the catalyst are mutually related. The ECM judges if the catalyst has deteriorated based on the calculated OSC value. (See page 05–195)

HEATED OXYGEN SENSOR CIRCUIT LOW VOLTAGE (P0137: OPEN):



HEATED OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (P0138: SHORT):



Y A92775

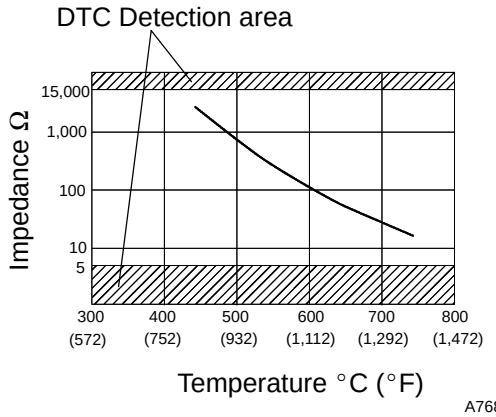
HINT:

DTC P0138 is also set if the voltage output from the heated oxygen sensor is more than 1.2 V for 10 seconds or more.

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Heated oxygen sensor impedance

Interrelation between temperature of the element and impedance:



During normal feedback control of the air–fuel ratio, there are small variations in the exhaust gas oxygen concentration. In order to continuously monitor the slight variation of the signal from the oxygen sensor while the engine is running, the impedance* of the sensor is measured by the ECM. The ECM detects that there is malfunction in the sensor when the measured impedance deviates from the standard range.

*: The effective resistance in an alternating current electrical circuit.

HINT:

- The impedance can not be measured with an ohmmeter.
- DTC P0136 indicates deterioration of the heated oxygen sensor. The ECM sets the DTC by calculating the impedance of the sensor after the typical enabling conditions are satisfied (1 driving–cycle).
- DTC P0137 indicates an open or short circuit in the heated oxygen sensor system (1 driving–cycle). The ECM sets this DTC when the impedance of the sensor exceeds the threshold 15 kΩ.

MONITOR STRATEGY

Related DTCs	P0136: Heated oxygen sensor output voltage P0137: Heated oxygen sensor output voltage (Low) P0138: Heated oxygen sensor output voltage (High)
Required sensors/components	Main: Heated oxygen sensor Related: Mass air flow meter, vehicle speed sensor
Frequency of operation	Active air–fuel ratio control detection : Once per driving cycle Impedance detection: Continuous
Duration	Impedance detection: P0136, P0138: 30 seconds, P0137: 155 seconds Active air–fuel ratio control detection: P0136, P0137, P0138: 15 to 20 seconds Output voltage (short–circuited) P0138: 10 seconds
MIL operation	Impedance detection: Immediately OSC detection with active air–fuel ratio control: Immediately Output voltage detection (only P0136): 2 driving cycles
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

Case 1: Impedance detection

P0136:

The monitor will run whenever the following DTCs are not present	See page 05–20
Following condition is met	30 seconds or more
Estimated sensor temperature	Less than 750°C (1382 °F)

P0137:

The monitor will run whenever the following DTCs are not present	See page 05–20
Following conditions are met	55 seconds or more
Estimated sensor temperature	450°C (842 °F) or more
Intake air amount per second	More than 0 g/sec

P0138:

The monitor will run whenever the following DTCs are not present	See page 05–20

Case 2: Output voltage and OSC detection

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine	Running
Battery voltage	10.5 V
Precondition of ”Active air–fuel ratio control”	Met

”Active air–fuel ratio control”

Battery voltage	11.5 V
Engine coolant temperature	75 °C (167 °F)
Continuous time of IDL ON status	Less than 1000 seconds
Engine speed	Less than 3200 rpm
A/F sensor status	Activated
Sub–feedback control	Executing
Delay time after fuel cut is OFF	10 seconds or more
Engine load	10 % or more, and less than 70 %
All of following conditions are met:	—
Intake air amount	5 g/sec or more, and less than 30 g/sec (vary with vehicle speed)
Upstream catalyst	430 °C (806 °F)or more, and less than 800 °C (1472 °F) (vary with vehicle speed)
Downstream catalyst	290 °C (554 °F) or more, and less than 675 °C (1247 °F) (vary with vehicle speed)

TYPICAL MALFUNCTION THRESHOLDS

Case 1: Impedance detection

P0136:

Heated oxygen sensor impedance	Less than 5 Ω

P0137:

Heated oxygen sensor impedance	15 kΩ or more

P0138:

Output voltage of heated oxygen sensor	1.2 V or more

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Case 2: Output voltage detection

P0136:

Either of the following conditions A or B is met:	2 times or more
A. Following conditions are met	(a) and (b)
(a) Active air–fuel ratio control	Executing
(b) Sensor output voltage	Less than 0.6 V, and 0.59 V or more
B. Following conditions are met	(a) and (b)
(a) Active air–fuel ratio control	Executing
(b) Sensor output voltage	0.24 V or more, and 0.25 V or less

Case 3: OSC detection

P0136:

Active air–fuel ratio control	Executing
Either of the following conditions A or B is met:	A or B
A. Following conditions are met	(a), (b) and (c)
(a) Target air–fuel ratio	RICH
(b) Sensor output voltage	0.25 V or more
(c) OSC	0.88 g or more
B. Following conditions are met	(a), (b) and (c)
(a) Target air–fuel ratio	LEAN
(b) Sensor output voltage	0.59 V or less
(c) OSC	0.88 g or more

P0137:

Active air–fuel ratio control	Executing
Following conditions are met:	(a), (b) and (c)
(a) Target air–fuel ratio	Rich
(b) Sensor output voltage	Less than 0.25 V
(c) OSC	0.88 g or more

P0138:

Either of the following conditions 1 or 2 is met:	1 or 2
1. Active air–fuel ratio control	Executing
Following conditions are met:	(a) and (b)
(a) Target air–fuel ratio	Lean
(b) Sensor output voltage	More than 0.59 V
(c) OSC	0.88 g or more
2. Sensor output voltage	1.2 V or more

COMPONENT OPERATING RANGE

Heated oxygen sensor voltage	0 to 1.0 V

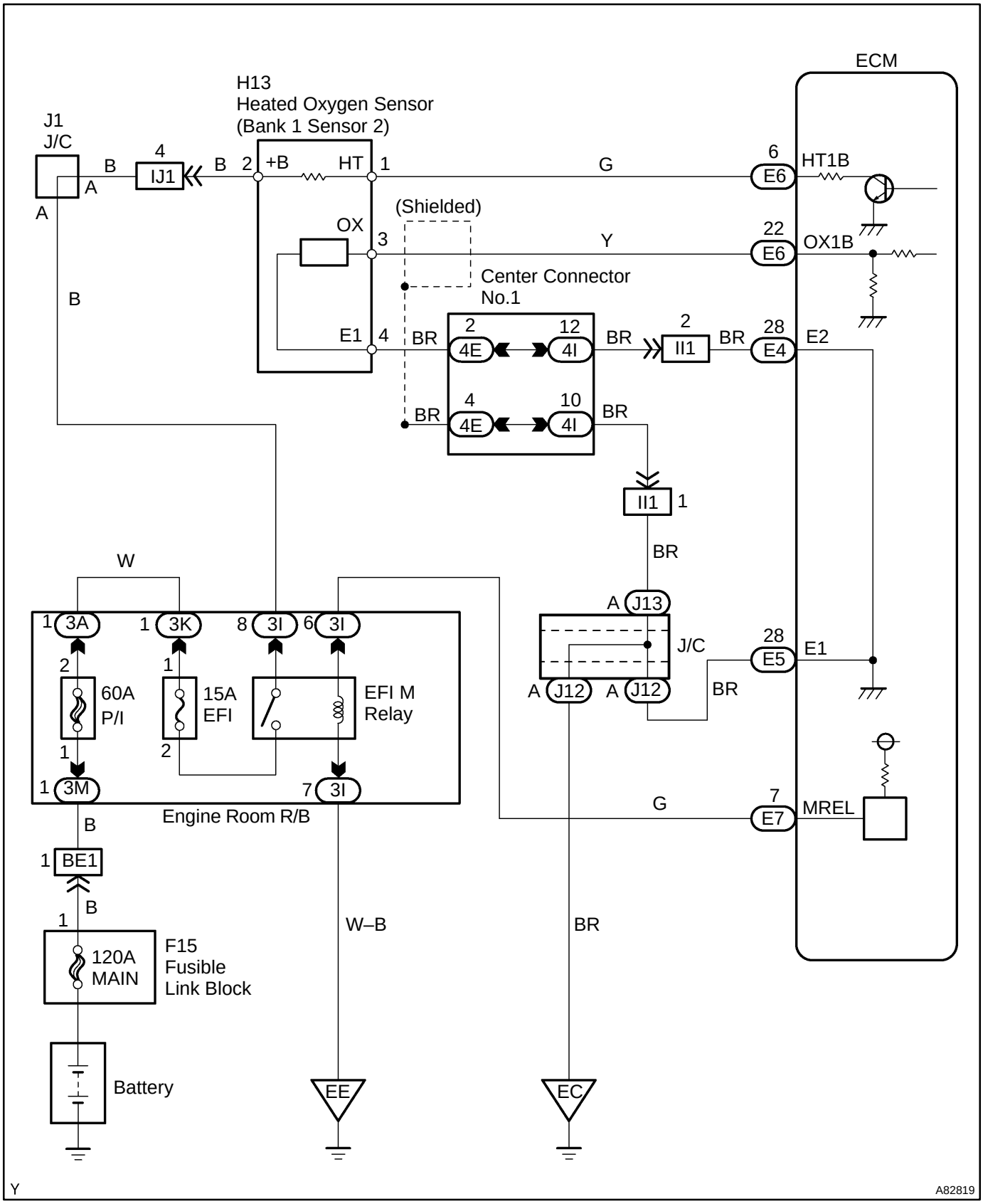
MONITOR RESULT (MODE 06 DATA)

Test ID	Description of TEST DATA	Conversion Factor	Unit	Description of TEST LIMIT
$02/$07	Minimum oxygen sensor output voltage	Multiply by 0.001	V	Malfunction criteria
$02/$08	Maximum oxygen sensor output voltage	Multiply by 0.001	V	Malfunction criteria
$02/$8F	Maximum oxygen storage capacity	Multiply by 0.0003	gram	Malfunction criteria

Refer to page 05–26 for detailed information on Checking Monitor Status.

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WIRING DIAGRAM



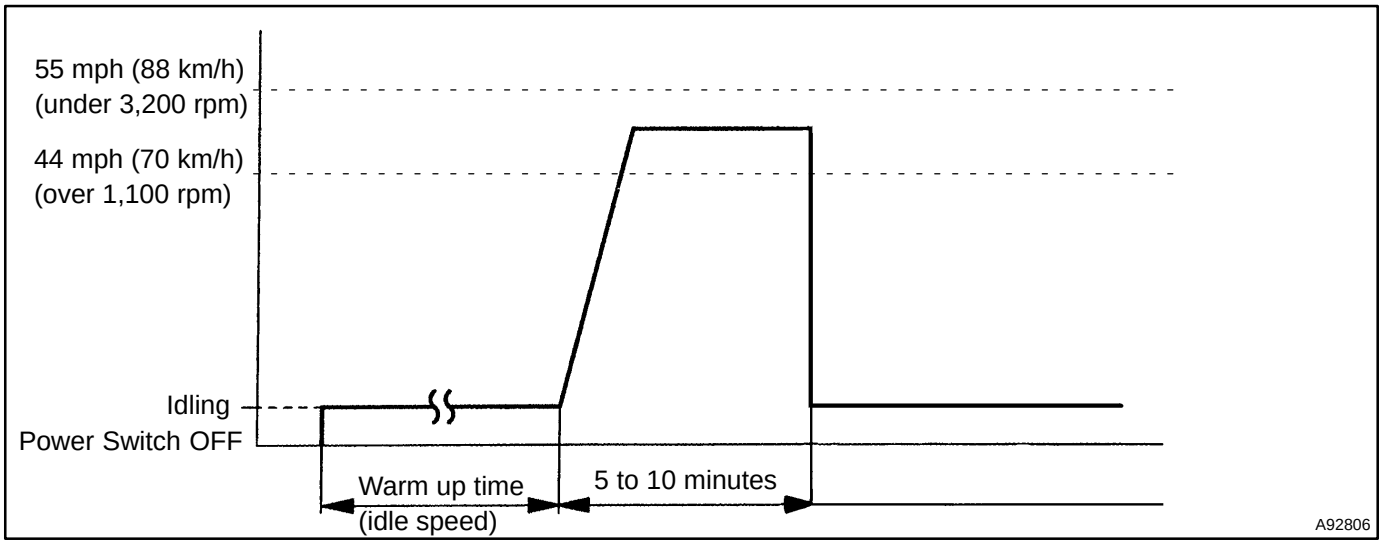
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CONFIRMATION ENGINE DRIVING PATTERN for DTC P0136 and P0137

PURPOSE

HINT:

Performing this confirmation pattern will activate the DTC detection (P0136) of the ECM. This is very useful for verifying the completion of a repair.



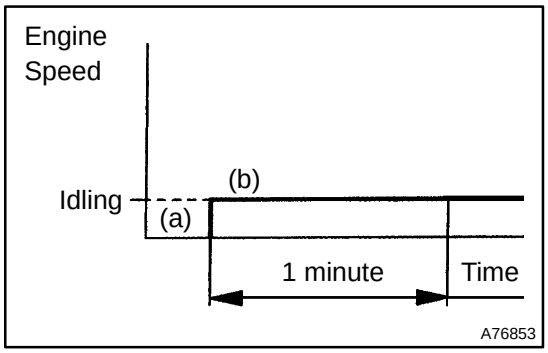
(a) Clear the DTCs (see page 05–41).
(b) Put the engine in inspection mode (see page 05–1).
(c) Start the engine and warm it up with all the accessory switches OFF.
(d) Deactivate the inspection mode and drive the vehicle at 44 to 70 mph (70 to 112 km/h) for 5 to 10 minutes.
(e) Read DTCs.

NOTICE:

- **If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have the hand–held tester, turn the power switch OFF after performing steps (c) and (e), then perform step (d) again.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

CONFIRMATION ENGINE RACING PATTERN for DTC P0138

PURPOSE



HINT:

Performing this confirmation pattern will activate the DTC detection (P0138) of the ECM. This is very useful for verifying the completion of a repair.

(a) Clear the DTCs (see page 05–41).
(b) Put the engine in inspection mode (see page 05–1).
(c) Start the engine and let the engine idle for 1 minute.
(d) Read DTCs.

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

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INSPECTION PROCEDURE

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

Hand–held tester:

1	**CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P0136, P0137 AND/OR P0138)**

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result:

Display (DTC output)	Proceed to
P0136, P0137 and/or P0138	A
P0136, P0137 and/or P0138, and other DTCs	B

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

B → **REPLACE GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	**PERFORM ACTIVE TEST USING HAND–HELD TESTER(A/F CONTROL)**

HINT:
Malfunctioning areas can be found by performing 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 area are malfunctioning or not.

(a) Perform A/F CONTROL operation using the hand–held tester.

HINT:
The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.

(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page 05–1).
(4) Warm up the engine by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60 % for approximately 90 seconds.
(5) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

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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.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Main Suspect Trouble Area
Case 1	Injection volume +25 % –12.5 % Output voltage More than 3.35 V Less than 3.0 V **OK**	Injection volume +25 % –12.5 % Output voltage More than 0.55 V Less than 0.4V **OK**	—
Case 2	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 % Output voltage More than 0.55 V Less than 0.4V **OK**	A/F sensor (A/F sensor, sensor heater, sensor circuit)
Case 3	Injection volume +25 % –12.5 % Output voltage More than 3.35 V Less than 3.0V **OK**	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Heated oxygen sensor (heated oxygen sensor, sensor heater, sensor circuit)
Case 4	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Extremely RICH or LEAN actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

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

To display the graph, enter ACTIVE TEST/ A/F CONTROL / USER DATA, select ”AFS B1S1 and O2S B1S2” by pressing the ”YES” button followed by the ”ENTER” button and then the ”F4” button.

- A high A/F sensor voltage could be caused by a RICH air–fuel mixture. Check the conditions that would cause the engine to run with the RICH air–fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air–fuel mixture. Check the conditions that would cause the engine to run with the LEAN air–fuel mixture.

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Result:

Output voltage of A/F sensor	Output voltage of heated oxygen sensor	Proceed to
OK	OK	A
NG	OK	B
OK	NG	C
NG	NG	D

B → **GO TO DTC P2238**

C → **Go to step 5**

D → **GO TO DTC P0171**

A

3 PERFORM CONFIRMATION DRIVING PATTERN

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

GO

4 READ OUTPUT DTCS (DTC P0136, P0137 AND/OR P0138 ARE OUTPUT AGAIN)

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result:

Display (DTC output)	Proceed to
P0136, P0137 and/or P0138	A
P0136, P0137 and/or P0138, and other DTCs	B

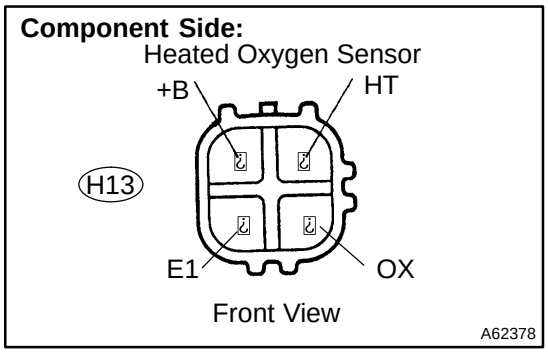
B → **REPLACE HEATED OXYGEN SENSOR**

A

CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)

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5 INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)



(a) Disconnect the H13 heated oxygen sensor connector.
(b) Measure the resistance between the terminals of the heated oxygen sensor connector.

Standard:

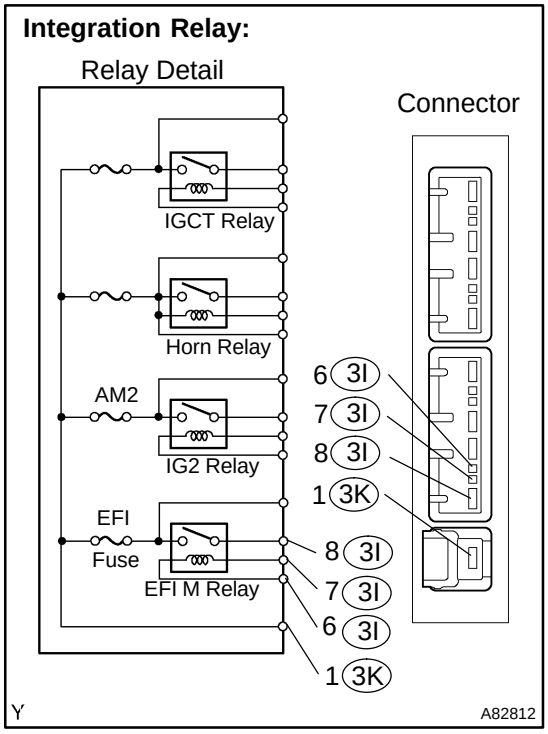
Tester Connection	Specified Condition
HT (H13–1) – +B (H13–2)	11 to 16 Ω at 20 °C (68 °F)
HT (H13–1) – E1 (H13–4)	10 kΩ or higher

(c) Reconnect the heated oxygen sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

6 INSPECT INTEGRATION RELAY(EFI M RELAY)



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the EFI M relay.

Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

(c) Reinstall the integration relay.

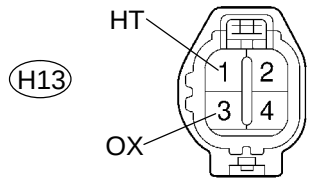
NG → **REPLACE INTEGRATION RELAY**

OK

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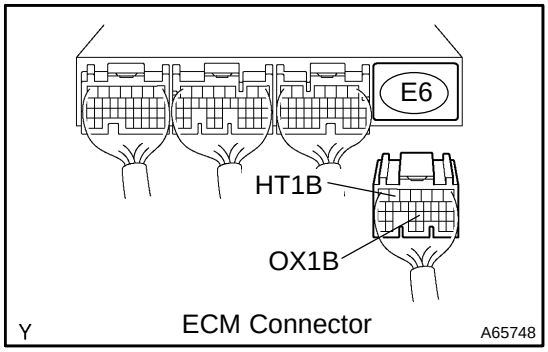
7 CHECK HARNESS AND CONNECTOR(HEATED OXYGEN SENSOR – ECM)

Wire Harness Side:
Heated Oxygen Sensor Connector



Front View

A79118



ECM Connector

A65748

(a) Disconnect the H13 heated oxygen sensor connector.
(b) Disconnect the E6 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

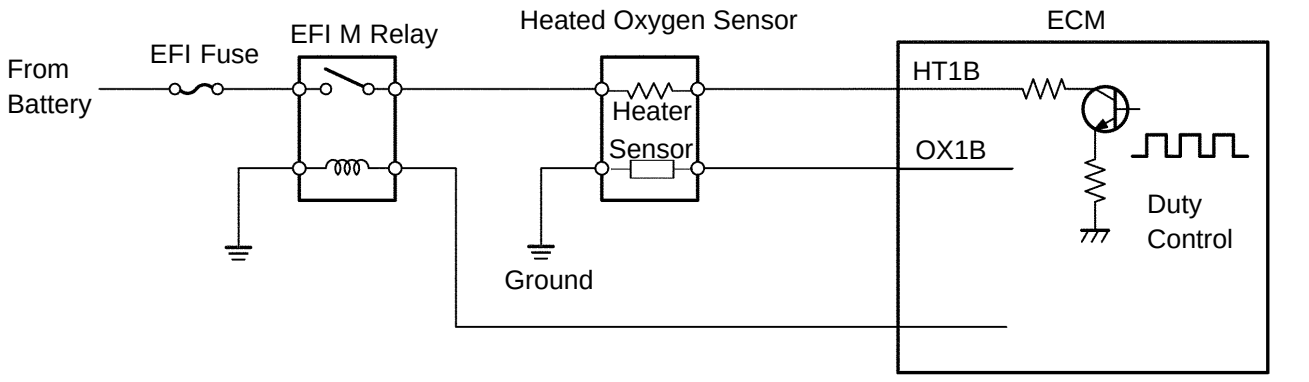
Tester Connection	Specified Condition
HT (H13–1) – HT1B (E6–6)	Below 1 Ω
OX (H13–3) – OX1B (E6–22)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
HT (H13–1) or HT1B (E6–6) – Body ground	10 kΩ or higher
OX (H13–3) or OX1B (E6–22) – Body ground	10 kΩ or higher

(d) Reconnect the heated oxygen sensor connector.
(e) Reconnect the ECM connector.

Reference (Bank 1 Sensor 2 System Diagram)



A73886

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

OK

REPLACE HEATED OXYGEN SENSOR

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OBD II scan tool (excluding hand–held tester):

1	CHECK OTHER DTC OUTPUT(IN ADDTION TO DTC P0136, P0137 AND/OR P0138)

(a) Connect the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the OBD II scan tool ON.
(d) Read DTCs using the OBD II scan tool.

Result:

Display (DTC output)	Proceed to
P0136, P0137 and/or P0138	A
P0136, P0137 and/or P0138, and other DTCs	B

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

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	INSPECT HEATED OXYGEN SENSOR(OUTPUT VOLTAGE)

(a) After warming up the engine, run the engine at 2,500 rpm for 90 seconds.
(b) Read the output voltage of the heated oxygen sensor when the engine rpm is suddenly increased.

HINT:
Quickly accelerate the engine to 2,500 rpm 3 times by using the accelerator pedal.

Heated oxygen sensor output voltage: Fluctuates.

NG → **Go to step 5**

OK

3	PERFORM CONFIRMATION DRIVING PATTERN

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

GO

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4 READ OUTPUT DTCS (DTC P0136, P0137 AND/OR P0138 ARE OUTPUT AGAIN)

(a) Connect the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the OBD II scan tool ON.
(d) Read DTCs using the OBD II scan tool.
Result:

Display (DTC output)	Proceed to
P0136, P0137 and/or P0138	A
P0136, P0137 and/or P0138, and other DTCs	B

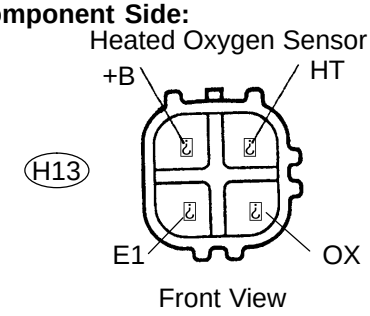
B → **REPLACE HEATED OXYGEN SENSOR**

A

CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)

5 INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)

Component Side:



(a) Disconnect the H13 heated oxygen sensor connector.
(b) Measure the resistance between the terminals of the heated oxygen sensor connector.
Standard:

Tester Connection	Specified Condition
HT (H13–1) – +B (H13–2)	11 to 16 Ω at 20 °C (68 °F)
HT (H13–1) – E1 (H13–4)	10 kΩ or higher

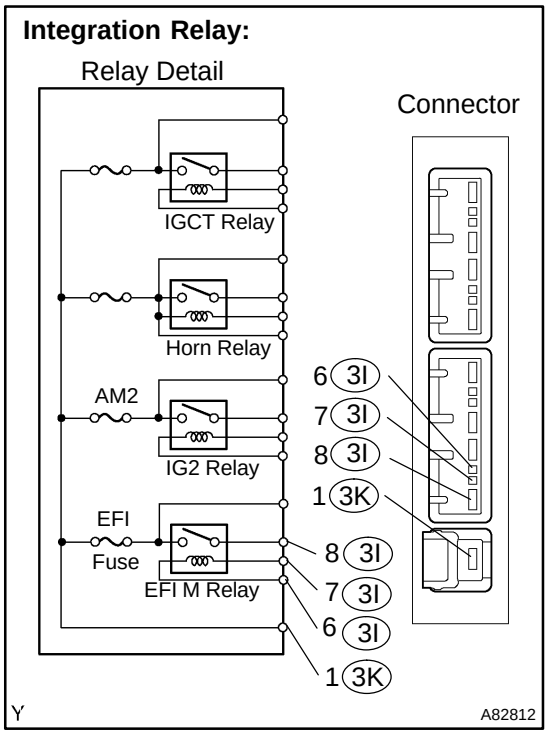
(c) Reconnect the heated oxygen sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

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6	INSPECT INTEGRATION RELAY(EFI M RELAY)



(a) Remove the integration relay from the engine room R/B.

(b) Inspect the EFI M relay.

Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

(c) Reinstall the integration relay.

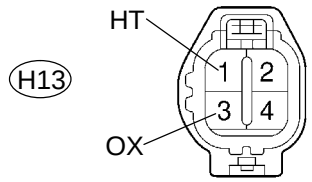
NG → **REPLACE INTEGRATION RELAY**

OK

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7 INSPECT HARNESS AND CONNECTOR(HEATED OXYGEN SENSOR – ECM)

Wire Harness Side:
Heated Oxygen Sensor Connector



Front View

A79118

(a) Disconnect the H13 heated oxygen sensor connector.
(b) Disconnect the E6 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

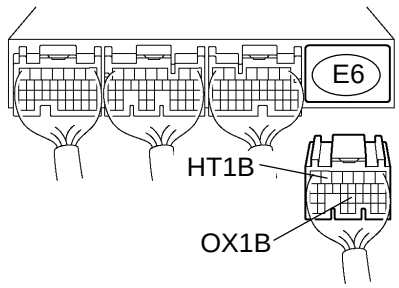
Standard (Check for open):

Tester Connection	Specified Condition
HT (H13–1) – HT1B (E6–6)	Below 1 Ω
OX (H13–3) – OX1B (E6–22)	Below 1 Ω

Standard (Check for short):

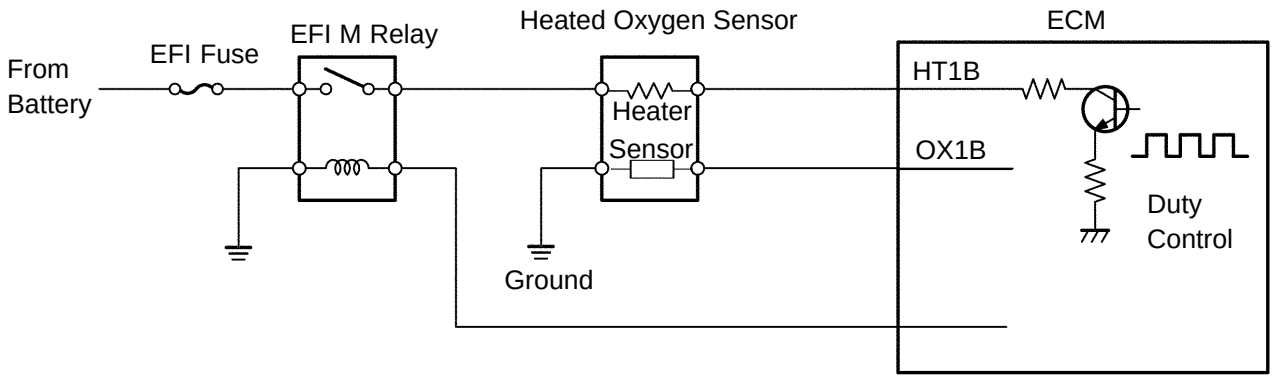
Tester Connection	Specified Condition
HT (H13–1) or HT1B (E6–6) – Body ground	10 kΩ or higher
OX (H13–3) or OX1B (E6–22) – Body ground	10 kΩ or higher

(d) Reconnect the heated oxygen sensor connector.
(e) Reconnect the ECM connector.



Y ECM Connector A65748

Reference (Bank 1 Sensor 2 System Diagram)



P A73886

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

OK →

REPLACE HEATED OXYGEN SENSOR

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DTC	P0171	SYSTEM TOO LEAN (BANK 1)

DTC	P0172	SYSTEM TOO RICH (BANK 1)

CIRCUIT 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 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 long–term fuel trim is the overall fuel compensation carried out in long–term to compensate for a continual deviation of the short–term fuel trim from the central value, due to individual engine differences, wear overtime and changes in the operating environment.

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 and the MIL is illuminated and DTC is set.

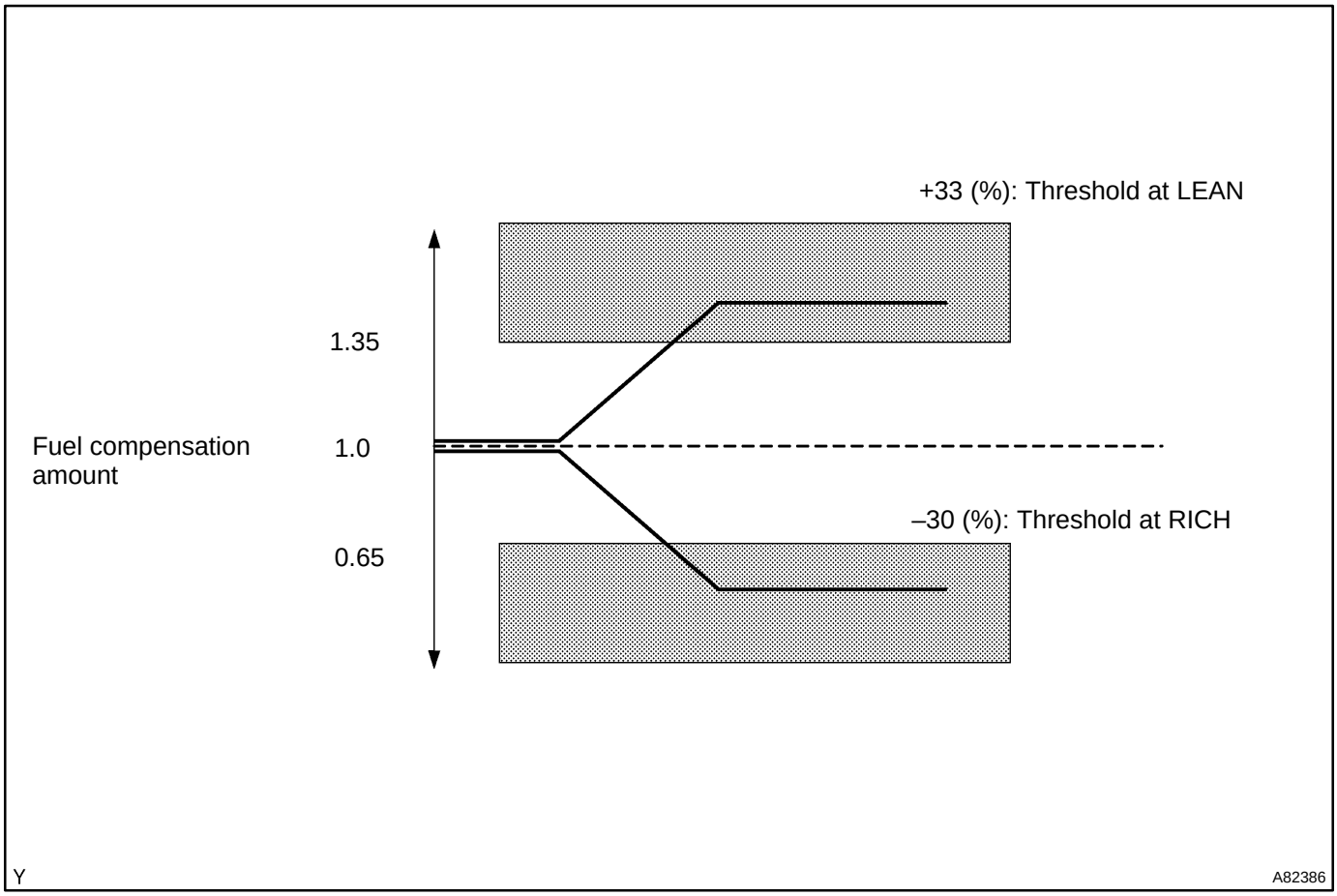
DTC No.	DTC Detection Condition	Trouble Area
P0171	When air–fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on LEAN side (2 trip detection logic)	• Air induction system • Injector blockage • Mass air flow meter • Engine coolant temperature sensor • Fuel pressure • 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 M relay • PCV valve and hose • PCV hose connection • ECM
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)	• Injector leak, blockage • Mass air flow meter • Engine coolant temperature 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 • EFI M relay • ECM

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 may be recorded. The MIL then illuminates.
- If the total of the short–term fuel trim value and long–term fuel trim value is between +33 % and –30 % (engine coolant temperature is more than 75°C (167°F)), the system is functioning normally.

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MONITOR DESCRIPTION



Under closed–loop fuel control, fuel injection amount that deviates 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 a 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 leaning value is more than +33% or less than –30%. The ECM interprets this as a failure in the fuel system.
DTC P0171 indicates that the air–fuel mixture is extremely LEAN, and P0172 indicates extremely RICH.

MONITOR STRATEGY

Related DTCs	P0171: Fuel system lean (bank 1) P0172: Fuel system rich (bank 1)
Required sensors/components	Main: A/F sensor Related: Engine coolant temperature sensor, mass air flow meter, crankshaft position sensor
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	11 V or more
Fuel system: Closed–loop	13 seconds or more
One of the following condition is met:	(a) or (b)
(a) Engine speed	Less than 1,100 rpm
(b) Intake air amount per revolution	0.22 g/rev or more
Warm–up condition enables air–fuel ratio learning control	Conditions are met

TYPICAL MALFUNCTION THRESHOLDS

Following condition is continued for 3 seconds	(a) or (b)
(a) Smoothed fuel trim learning value (lean)	33 % or more
(b) Smoothed fuel trim learning value (rich)	–30 % or less

WIRING DIAGRAM

Refer to DTC P2195 on page 05–314.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be found by performing 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 area 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 hand–held tester to the DLC3 on the vehicle.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page 05–1).
(4) Warm up the engine by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(5) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

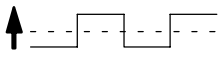
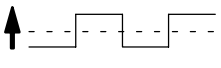
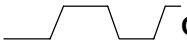
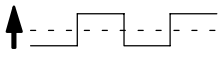
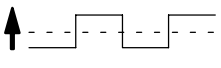
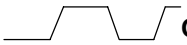
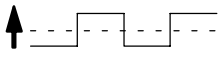
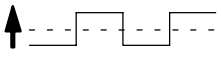
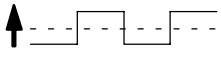
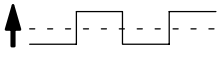
Result:

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.

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	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Main Suspect Trouble Area
Case 1	Injection volume +25 % –12.5 %  Output voltage More than 3.35 V Less than 3.0 V  **OK**	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	—
Case 2	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	A/F sensor (A/F sensor, sensor heater, sensor circuit)
Case 3	Injection volume +25 % –12.5 %  Output voltage More than 3.35 V Less than 3.0V  **OK**	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Heated oxygen sensor (heated oxygen sensor, sensor heater, sensor circuit)
Case 4	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Extremely RICH or LEAN actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.
To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, select ”AFS B1S1 and O2S B1S2” by pressing the ”YES” button followed by the ”ENTER” button and then the ”F4” button.
HINT:

- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high A/F sensor voltage could be caused by a RICH air–fuel mixture. Check the conditions that would cause the engine to run with the RICH air–fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air–fuel mixture. Check the conditions that would cause the engine to run with the LEAN air–fuel mixture.

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1	CHECK AIR INDUCTION SYSTEM

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

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

3	INSPECT FUEL INJECTOR ASSY(INJECTION AND VOLUME) (See page 11–9)

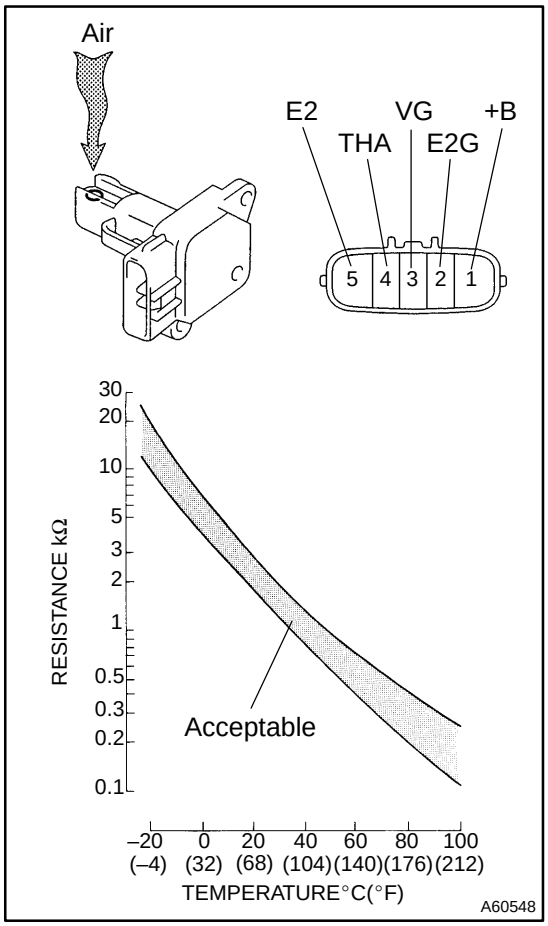
OK:
Injection volume: 36 to 46 cm^3 (2.1 to 2.8 cu in.) per 15 seconds.

NG → **REPLACE FUEL INJECTOR ASSY (See page 11–12)**

OK

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4 INSPECT MASS AIR FLOW METER



(a) Remove the mass air flow meter.

(b) Inspect output voltage.

(1) Apply battery voltage across terminals +B and E2G.

(2) Connect the positive (+) tester prove to terminal VG, and negative (–) tester prove to terminal E2G.

(3) Blow air into the mass air flow meter, and check that the voltage fluctuates.

Standard:

Tester Connection	Specified Condition
VG (3) – E2G (2)	Sensor output voltage fluctuates between 0.3 V and 4.8 V

(c) Inspect resistance.

(1) Measure the resistance between the terminals of the mass air flow meter.

Standard:

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

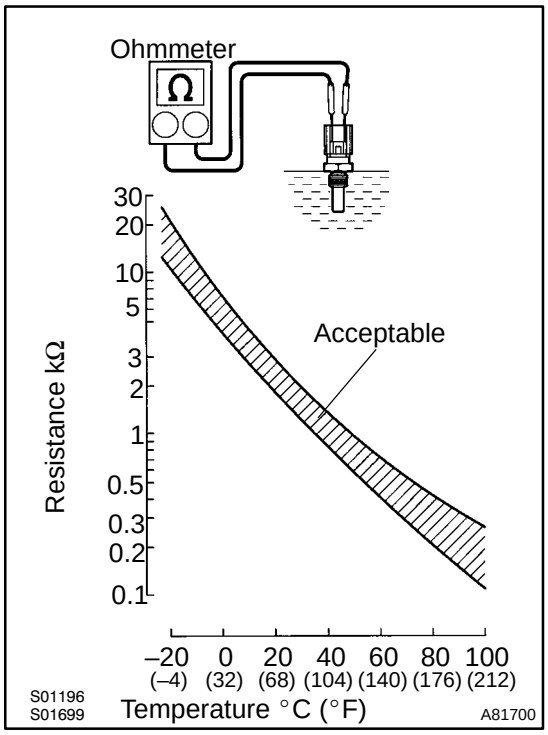
(d) Reinstall the mass air flow meter.

NG → **REPLACE MASS AIR FLOW METER**

OK

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5	INSPECT ENGINE COOLANT TEMPERATURE SENSOR(RESISTANCE)



(a) Remove the engine coolant temperature sensor.
(b) Measure the resistance between the terminals of the engine coolant temperature sensor.

Standard:

Tester Connection	Specified Condition
1 – 2	2 to 3 kΩ at 20°C (68°F)
1 – 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
When checking the engine coolant temperature sensor in water, be careful not to allow water to contact the terminals. After checking, dry the sensor.
HINT:
Alternate procedure: Connect an ohmmeter to the installed engine coolant temperature 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.
(c) Reinstall the engine coolant temperature sensor.

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

6	CHECK FOR SPARK AND IGNITION (See page 18–3)

OK: Spark occurs.

NG → **REPAIR OR REPLACE IGNITION SYSTEM COMPONENTS**

OK

7	CHECK FUEL PRESSURE (See page 11–7)

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

OK:

Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf·cm^2, 44 to 50 psi)

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

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8	CHECK FOR EXHAUST GAS LEAKAGE

OK: No gas leak.

NG → **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT (See page 15–1)**

OK

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

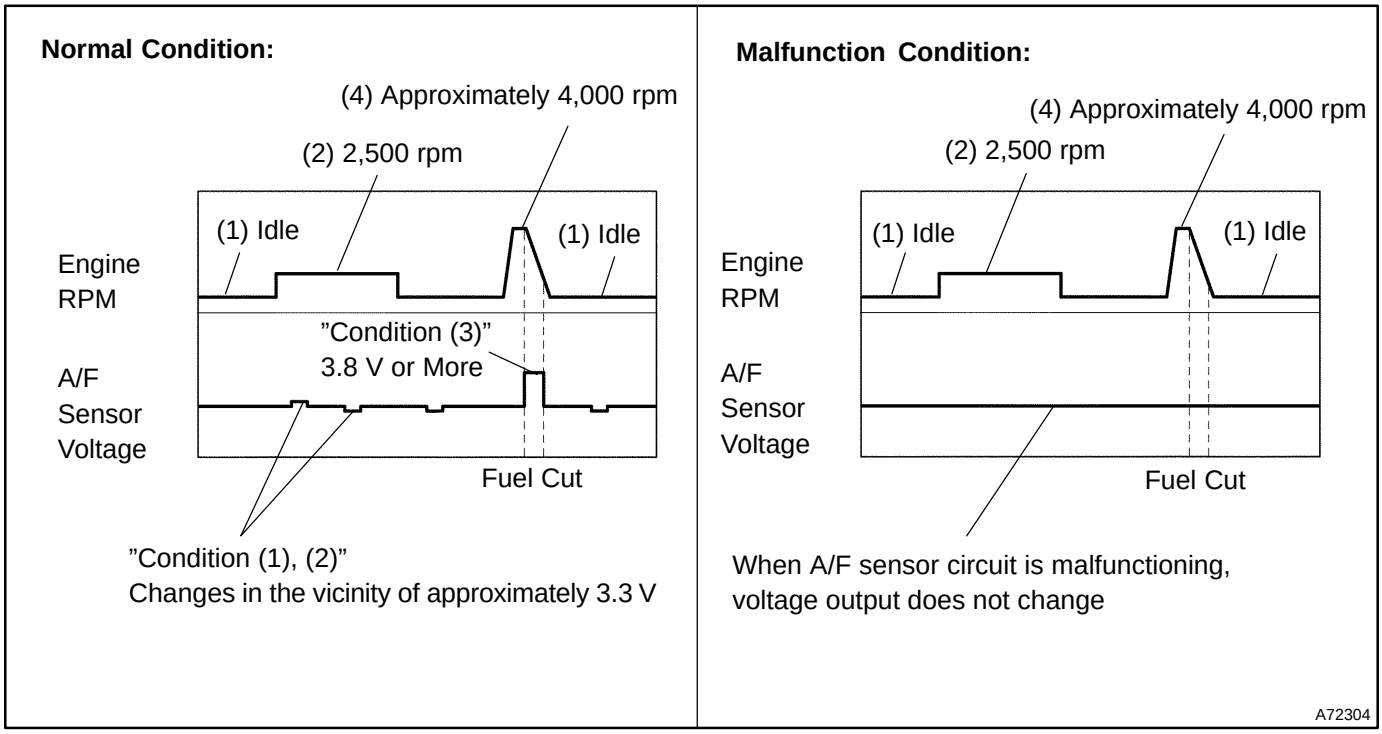
(a) Connect the hand–held tester or the OBD II scan tool to the DLC 3.
(b) Put the engine in inspection mode (see page 05–1).
(c) Warm up the A/F sensors (bank 1 sensor 1) by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(d) Read A/F sensor voltage output on the OBD II scan tool or the hand–held tester.
(e) Hand–held tester only:
On the hand–held tester, enter the menus: ENHANCED OBD II / ENGINE AND ECT / SNAPSHOT / MANUAL SNAPSHOT / USER DATA.
(f) Select ”AFS B1 S1/ENGINE SPD” and press button ”YES”.
(g) Monitor the A/F sensor voltage carefully.
(h) Check the A/F sensor voltage output under the following conditions:
(1) Put the engine in inspection mode and allow the engine to idle for 30 seconds.
(2) Put the engine in inspection mode and running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % (where engine RPM is not suddenly changed).
(3) Deactivate the inspection mode and drive the vehicle with shift position ”B” range.
(4) Accelerate the vehicle to 44 mph (70 km/h) and quickly release the accelerator pedal so that the throttle valve is fully closed.

CAUTION:

- **Strictly observe of posted speed limits, traffic laws, and road conditions when performing these drive patterns.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

Standard:
Condition (1) and (2)
Voltage changes in the vicinity of 3.3 V (0.66 V)* (between approximately 3.1 to 3.5 V) as shown in the illustration.
Condition (4)
A/F sensor voltage increases to 3.8 V (0.76 V)* or more during engine deceleration (when fuel cut) as shown in the illustration.
***: Voltage when using the OBD II scan tool.**

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HINT:

- Whenever the output voltage of the A/F sensor remains at approximately 3.3 V (0.660 V)* (see diagram Malfunction Condition) 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 diagram Malfunction Condition) 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 was reconnected, the vehicle must be driven over 10 mph to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V (0.76 V)* during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F sensor or ECM, you will observe a constant voltage.

*: Voltage when using the OBD II scan tool.

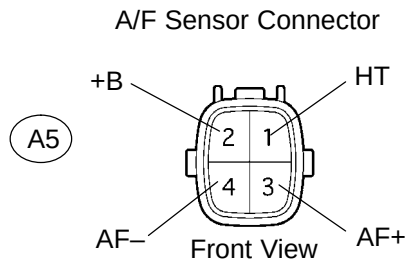
OK	**Go to step 17**

NG

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10 INSPECT AIR FUEL RATIO SENSOR(HEATER RESISTANCE)

Component Side:



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.

Standard:

Tester Connection	Specified Condition
HT (1) – +B (2)	1.8 to 3.4 Ω at 20°C (68 °F)

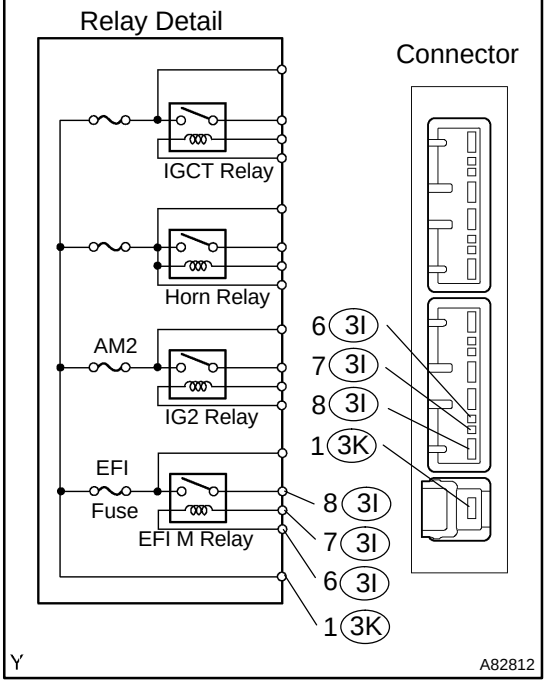
(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

11 INSPECT INTEGRATION RELAY(EFI M RELAY)

Integration Relay:



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the EFI M relay.

Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

(c) Reinstall the integration relay.

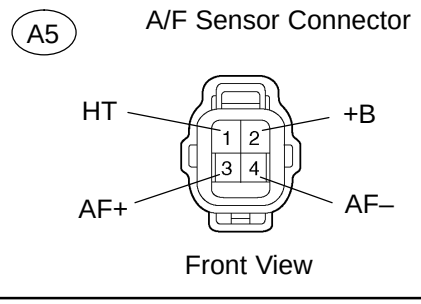
NG → **REPLACE INTEGRATION RELAY**

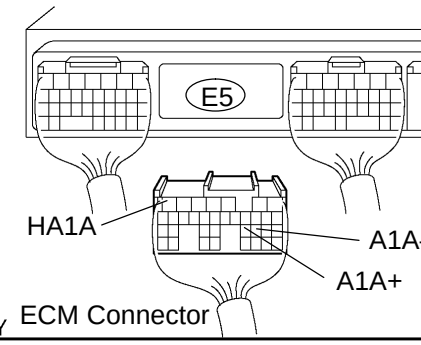
OK

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12 CHECK HARNESS AND CONNECTOR(A/F SENSOR – ECM)

Wire Harness Side:





(a) Disconnect the A5 A/F sensor connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

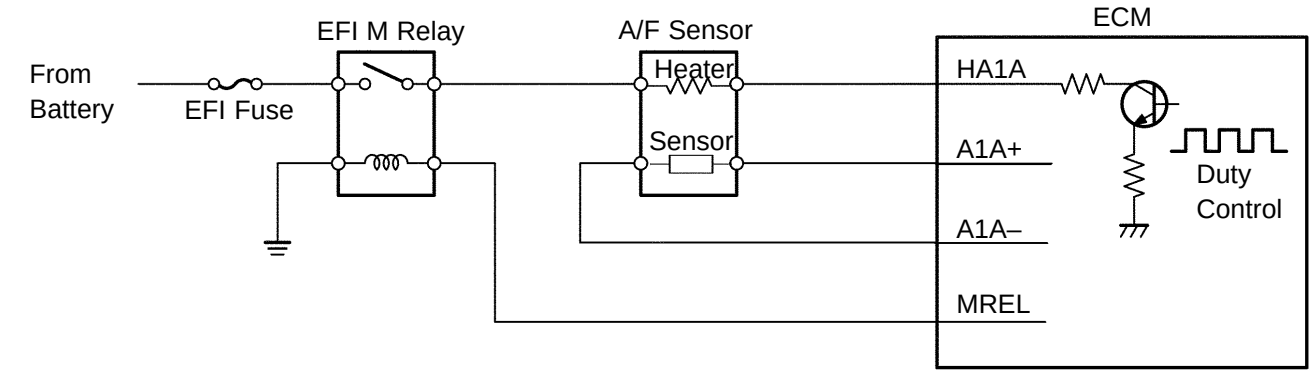
Tester Connection	Specified Condition
AF+ (A5–3) – A1A+ (E5–23)	Below 1 Ω
AF– (A5–4) – A1A– (E5–22)	Below 1 Ω
HT (A5–1) – HA1A (E5–7)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
AF+ (A5–3) or A1A+ (E5–23) – Body ground	10 kΩ or higher
AF– (A5–4) or A1A– (E5–22) – Body ground	10 kΩ or higher
HT (A5–1) or HA1A (E5–7) – Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.
(e) Reconnect the ECM connector.

Reference (Bank 1 Sensor 1 System Diagram)



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

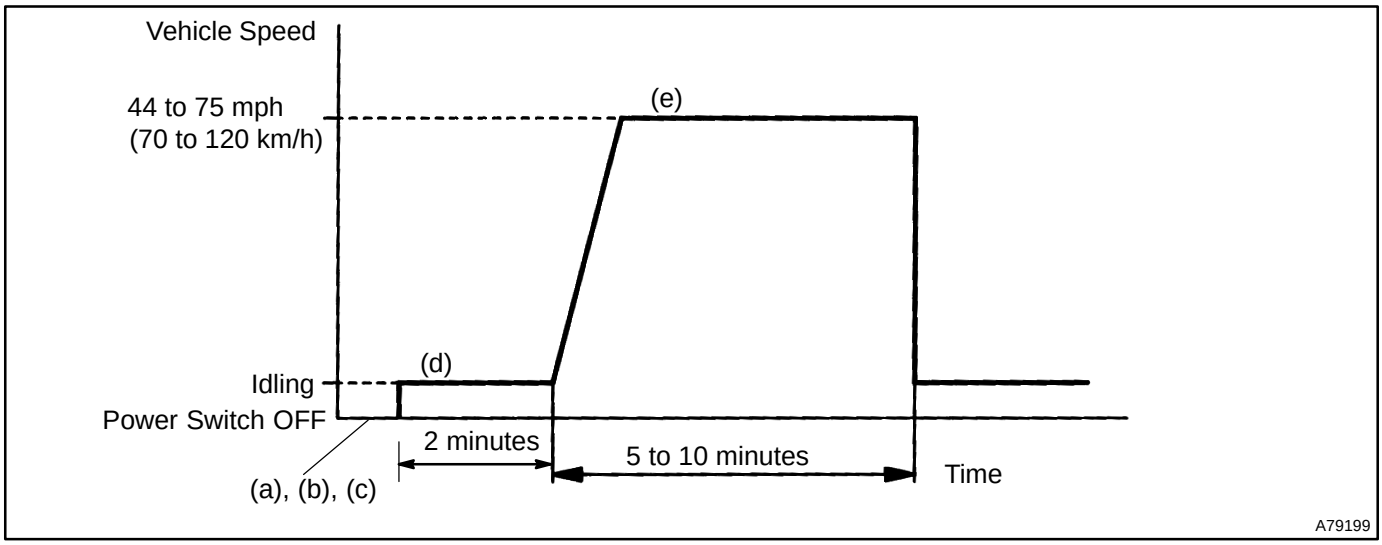
OK

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13	REPLACE AIR FUEL RATIO SENSOR

GO

14	PERFORM CONFIRMATION DRIVING PATTERN



(a) Clear the DTCs (see page 05–41).
(b) Connect the hand–held tester to the DLC3.
(c) Switch the ECM from normal mode to check mode using the hand–held tester (see page 05–45).
(d) Put the engine in inspection mode, and start the engine and warm it up with all the accessory switches OFF.
(e) Deactivate inspection mode and drive the vehicle at 44 to 75 mph (70 to 120 km/h) and engine speed of 1,100 to 3,200 rpm for 5 to 10 minutes.

HINT:
If malfunction exists, the MIL will be illuminated during step (e).

NOTICE:

- **If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have a hand–held tester, turn the power switch OFF after performing steps (d) and (e), then perform step (e) again.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

GO

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15	READ OUTPUT DTCS(SEE IF DTC P0171 AND/OR P0172 ARE OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
No output	A
P0171 and/or P0172	B

B → **REPLACE ECM (See page 10–24) AND PERFORM CONFIRMATION DRIVING PATTERN (Refer to step 14)**

A

16	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

YES

DTCS ARE CAUSED BY RUNNING OUT OF FUEL (DTCS P0171 and/or P0172)

17	PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (Refer to step 14).

GO

18	READ OUTPUT DTCS(SEE IF DTC P0171 AND/OR P0172 ARE OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
P0171 and/or P0172	A
No output	B

B → **Go to step 22**

A

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19	REPLACE AIR FUEL RATIO SENSOR

GO

20	PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (Refer to step 14).

GO

21	READ OUTPUT DTCS(SEE IF DTC P0171 AND/OR P0172 ARE OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
No output	A
P0171 and/or P0172	B

B → **REPLACE ECM (See page 10–24) AND PERFORM CONFIRMATION DRIVING PATTERN (Refer to step 14)**

A

22	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

YES

DTCS ARE CAUSED BY RUNNING OUT OF FUEL

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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

CIRCUIT DESCRIPTION

When a misfire occurs in the engine, hydrocarbons (HC) enter the exhaust gas 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 to temperature of the catalyst to increase, possibly damaging the catalyst. To prevent this increase 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 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. The misfire counter increments when crankshaft rotation speed variations exceed threshold values.

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

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DTC No.	DTC Detection Condition	Trouble Area
P0300	Misfiring of random cylinders is detected during any particular 200 or 1,000 revolutions 1 trip detection logic: MIL blinks 2 trip detection logic: MIL illuminates	• Open or short in engine wire harness • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve clearance • Valve timing • PCV hose connection • PCV hose • ECM
P0301 P0302 P0303 P0304	• For any particular 200 revolutions of engine, misfiring is detected which can cause catalyst overheating (This causes MIL to blink) • For any particular 1,000 revolutions of engine, misfiring is detected which causes a deterioration in emissions (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve clearance • Valve timing • PCV hose connection • PCV hose • ECM

HINT:

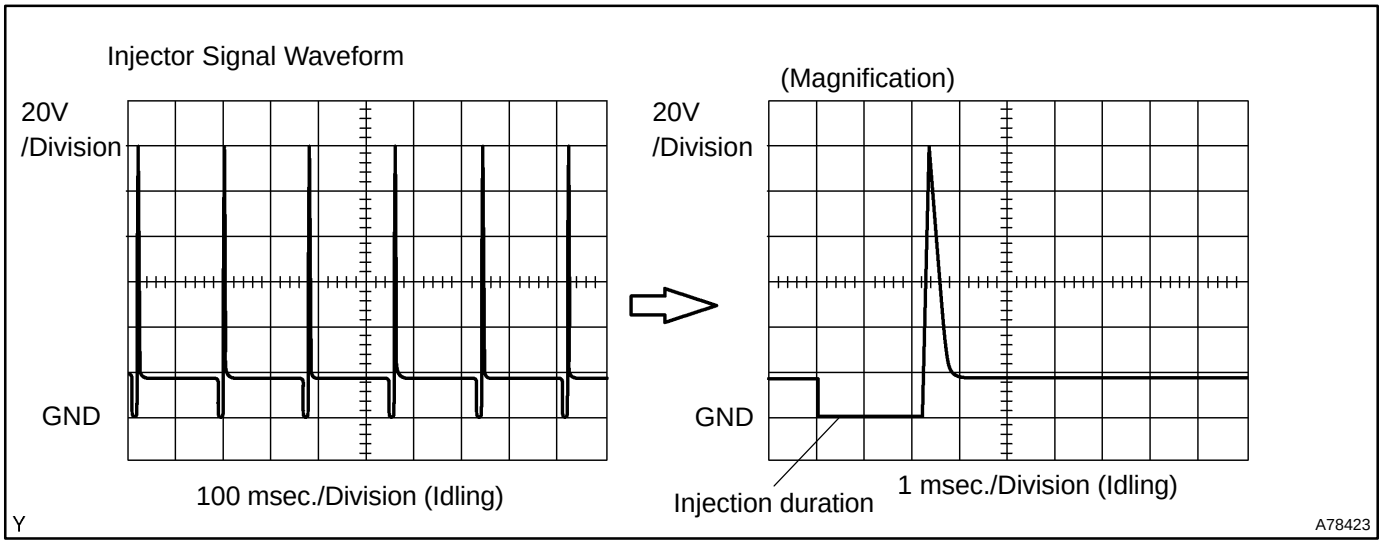
When several codes for a misfiring cylinder are recorded repeatedly but no random misfire code is recorded, it indicates that the misfires have been detected and recorded at different times.

Reference: Inspection using oscilloscope

With the engine idling, check the waveform between terminals #10 to #40 and E01 of the ECM connectors.

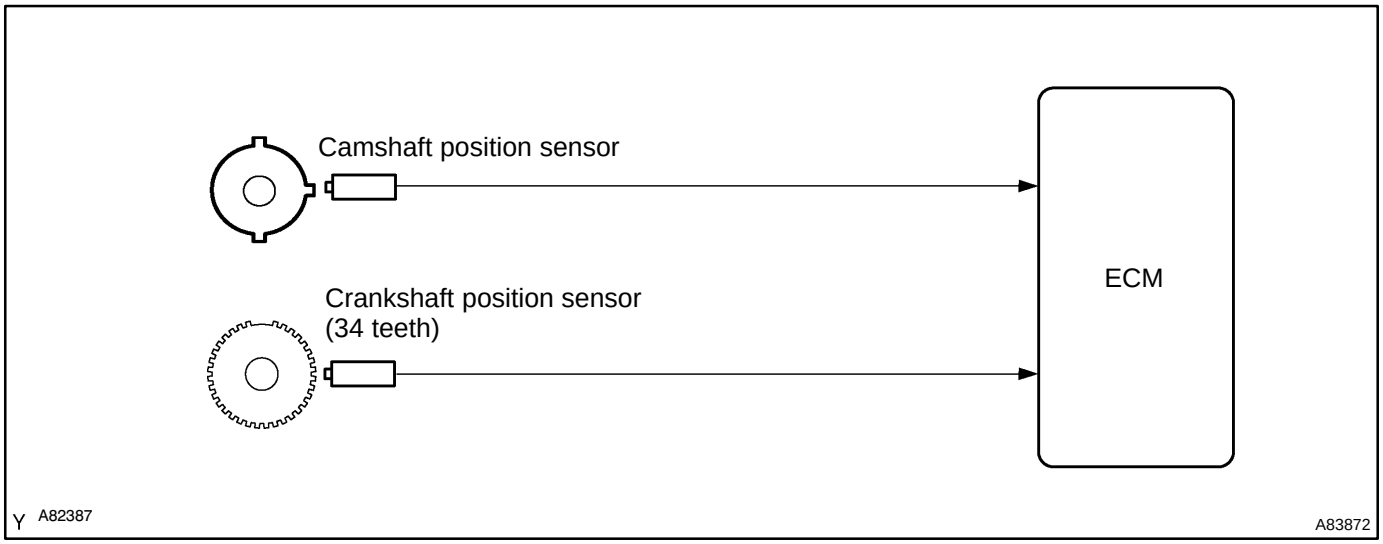
HINT:

The correct waveform is as shown.



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MONITOR DESCRIPTION



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

- The percent misfire exceeds the specified limit per 1,000 engine revolutions. One occurrence of excessive misfire during engine start will set the MIL. After engine start, four occurrences of excessive misfire set the MIL.

The ECM blinks the MIL (immediately) if:

- The threshold for percent of misfire causing catalyst damage is reached 1 time in 200 engine revolutions at a high rpm, and 3 times in 200 engine revolutions at a normal rpm.
- The threshold for percent of misfire causing catalyst damage is reached

MONITOR STRATEGY

Related DTCs	P0300: Random/Multiple cylinder misfire detected P0301: Cylinder 1 misfire detected P0302: Cylinder 2 misfire detected P0303: Cylinder 3 misfire detected P0304: Cylinder 4 misfire detected
Required sensors/components	Main: Camshaft position sensor, crankshaft position sensor Related: Engine coolant temperature sensor, intake air temperature sensor, throttle position sensor
Frequency of operation	Continuous
Duration	Every 1,000 revolutions: Every 200 revolutions:
MIL operation	2 driving cycles: MIL ON Immediately: MIL blinking (catalyst deteriorating)
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	More than 8 V
VVT	Normal operation (i. e. not under scan–tool control)
Engine speed fluctuation	Engine speed should not have changed rapidly
Engine speed	850 rpm or more, and 5,300 rpm or less
Intake air temperature	–10°C (14°F) or more
Engine coolant temperature	–10°C (14°F) or more
Intake air amount per revolution (varies with engine speed)	0.095 g/rev
Throttle position learning	Completed
Throttle position	Rapid throttle opening or closing operation has not occurred
Rough road counter	Less than 10 times/1,000 revolutions (not running on rough road)

TYPICAL MALFUNCTION THRESHOLDS

Emission related misfire:

One of the following conditions is met	(a) or (b)
(a) Misfire rate when engine start at cold	2.0 % or more/1,000 revolutions
(b) Misfire rate when engine start at hot	5.0 % or more/1,000 revolutions

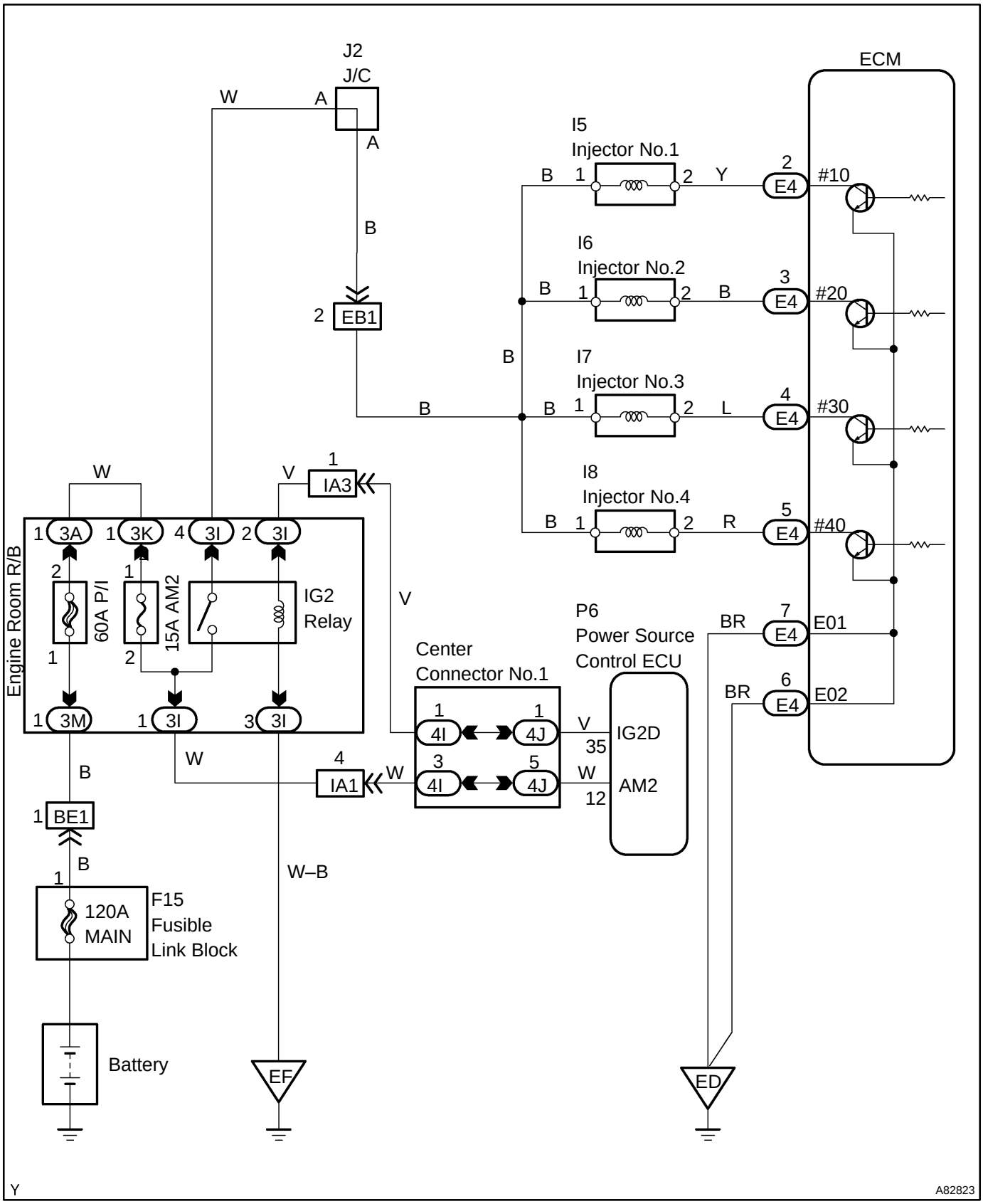
Catalyst damage misfire:

Either of the following conditions is met	
Misfire counts	108 or more/200 revolutions at intake air amount: 0.2 g/rev and engine rpm: 1,600 rpm
Misfire counts of paired cylinder	150 per 200 revolutions

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WIRING DIAGRAM

Refer to DTC P0351 on page 05–185 for the wiring diagram of the ignition system.



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CONFIRMATION DRIVING PATTERN

(a) Connect the hand–held tester to the DLC3.
(b) Record DTCs and the freeze frame data.
(c) Switch the ECM from normal mode to check mode using the hand–held tester (see page 05–45).
(d) 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.
(e) Drive the vehicle several times with an engine speed (ENGINE SPD), engine load (CALC LOAD) and other data stored in the freeze frame data.

If you have no hand–held tester, turn the power switch OFF after the symptom is simulated once. Then repeat the simulation process again.

HINT:

In order to memorize the misfire DTCs, it is necessary to drive with MISFIRE RPM and MISFIRE LOAD in the DATA LIST for the period of time in the chart below. Take care not to turn the power switch OFF. Turning the power 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 (Inspection mode)	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

(f) Check if there is a misfire, DTC and the freeze frame data. Record DTCs, freeze frame data and misfire counter data.
(g) Turn the power switch OFF and wait at least for 5 seconds.

INSPECTION PROCEDURE

HINT:

- If DTCs besides misfire DTCs are memorized simultaneously, troubleshoot the non–misfire DTCs first.
- Read freeze frame data using the intelligent tester II. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- 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 repairs, confirm that there is no misfire (see confirmation driving pattern).
- When either of SHORT FT #1 and LONG FT #1 in the freeze frame data is over the range of ±20 %, there is a possibility that the air–fuel ratio is inclining either 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 reason may be because of the driving the vehicle with lack of fuel, use of improper fuel, a stain on the ignition plug, etc.
- Be sure to check the value on the misfire counter after repairs.

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

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.
Result:

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

HINT:
If any other codes besides P0300, P0301, P0302, P0303 or P0304 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	CHECK WIRE HARNESS, CONNECTOR AND VACUUM HOSE IN ENGINE ROOM

(a) Check the connection conditions of the wire harness and connectors.
(b) Check the vacuum hose piping for disconnection or breakage.
OK: Connected correctly and no damage 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 has no damage.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

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4	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(NUMBER OF MISFIRE CYLINDER)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) Put the engine in inspection mode (see page 05–1).
(e) Start the engine.
(f) Select the items: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / CYL#1 – CYL#4.
(g) Read the number of misfire cylinders on the hand–held 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:

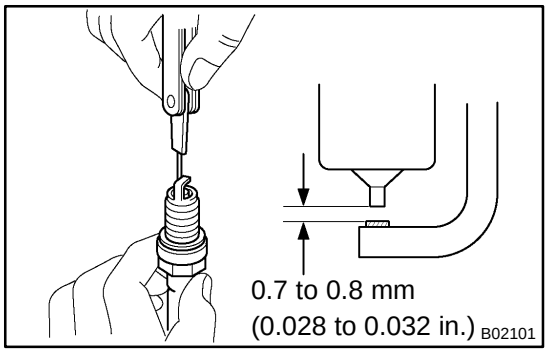
High Misfire Rate Cylinder	Proceed to
1 or 2 cylinders	A
More than 3 cylinders	B

B → **Go to step 15**

A

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5	CHECK SPARK PLUG AND SPARK OF MISFIRING CYLINDER



(a) Remove the ignition coil No.1.
(b) Remove the spark plug.
(c) Check the spark plug type.
Recommended spark plug:

DENSO made	SK16R11

(d) Check the spark plug electrode gap.
Electrode gap: 0.7 to 0.8 mm (0.028 to 0.032 in.)
Maximum electrode gap: 1.16 mm (0.046 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 the used plug.

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

CAUTION:
Absolutely disconnect the each injector connector.
NOTICE:
Do not crank the engine for more than 2 seconds.

(1) Install the spark plug to the ignition coil No.1, and connect the ignition coil No.1 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.

(g) Reinstall the spark plug.
(h) Reinstall the ignition coil No.1.

OK → **Go to step 8**

NG

6	CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

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

CAUTION:
Absolutely disconnect each injector connector.
NOTICE:
Do not crank the engine for more than 2 seconds.

(1) Install the spark plug to the ignition coil No.1, and connect the ignition coil No.1 connector.
(2) Disconnect the injector connector.
(3) Ground the spark plug.
(4) Check if spark occurs while the engine is being cranked.

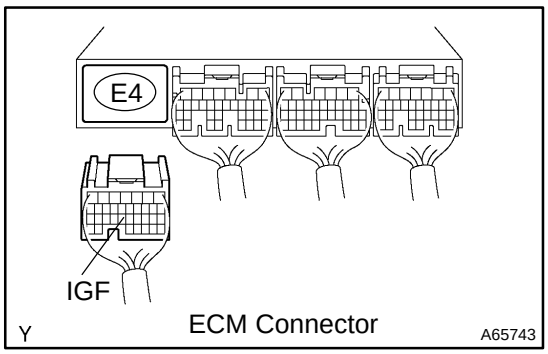
OK: Spark jumps across electrode gap.

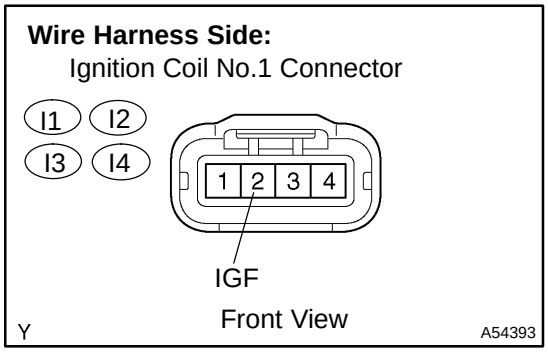
OK → **REPLACE SPARK PLUG**

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7	CHECK HARNESS AND CONNECTOR OF MISFIRING CYLINDER(IGNITION COIL NO.1 – ECM)





(a) Check the harness and connectors between the ignition coil No.1 and ECM (IGF terminal) connectors
  (1) Disconnect the I1, I2, I3 or I4 ignition coil No.1 connector.
  (2) Disconnect the E4 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

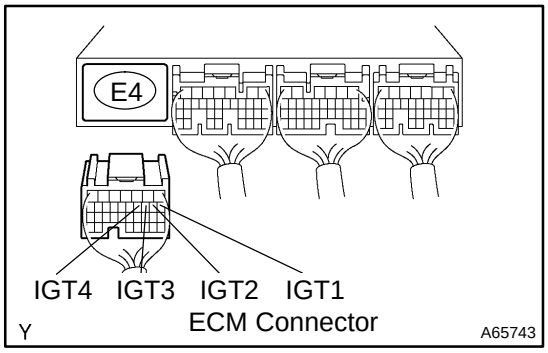
Standard (Check for open):

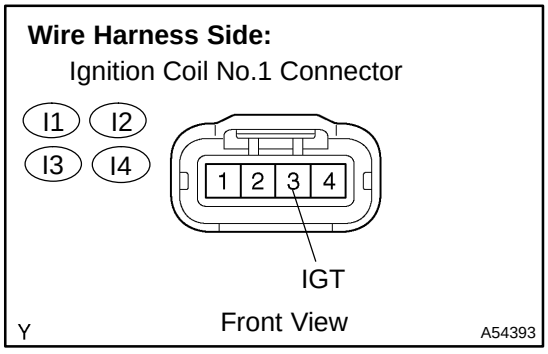
Tester Connection	Specified Condition
IGF (I1–2) – IGF (E4–23)	Below 1 Ω
IGF (I2–2) – IGF (E4–23)	Below 1 Ω
IGF (I3–2) – IGF (E4–23)	Below 1 Ω
IGF (I4–2) – IGF (E4–23)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
IGF (I1–2) or IGF (E4–23) – Body ground	10 kΩ or higher
IGF (I2–2) or IGF (E4–23) – Body ground	10 kΩ or higher
IGF (I3–2) or IGF (E4–23) – Body ground	10 kΩ or higher
IGF (I4–2) or IGF (E4–23) – Body ground	10 kΩ or higher

  (4) Reconnect the ignition coil No.1 connector.
  (5) Reconnect the ECM connector.





(b) Check the harness and connectors between the ignition coil No.1 and ECM (IGT terminal) connectors
  (1) Disconnect the I1, I2, I3 or I4 ignition coil No.1 connector.
  (2) Disconnect the E4 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
IGT (I1–3) – IGT1 (E4–8)	Below 1 Ω
IGT (I2–3) – IGT2 (E4–9)	Below 1 Ω
IGT (I3–3) – IGT3 (E4–10)	Below 1 Ω
IGT (I4–3) – IGT4 (E4–11)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
IGT (I1–3) or IGT1 (E4–8) – Body ground	10 kΩ or higher
IGT (I2–3) or IGT2 (E4–9) – Body ground	10 kΩ or higher
IGT (I3–3) or IGT3 (E4–10) – Body ground	10 kΩ or higher
IGT (I4–3) or IGT4 (E4–11) – Body ground	10 kΩ or higher

  (4) Reconnect the ignition coil No.1 connector.
  (5) Reconnect the ECM connector.

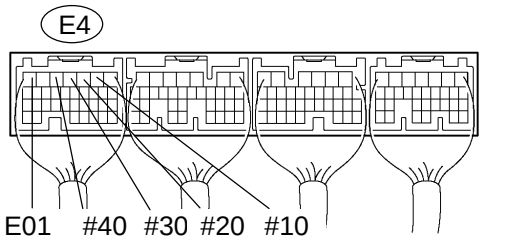
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OK	REPLACE IGNITION COIL NO.1 (THEN CONFIRM THAT THERE IS NO MISFIRE)

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

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



(a) Turn the power switch ON (IG).

(b) Measure the voltage between the applicable terminals of the E4 ECM connector.

Standard:

Symbols (Terminal No.)	Specified condition
#10 (E4–2) – E01 (E4–7)	9 to 14 V
#20 (E4–3) – E01 (E4–7)	9 to 14 V
#30 (E4–4) – E01 (E4–7)	9 to 14 V
#40 (E4–5) – E01 (E4–7)	9 to 14 V

OK	Go to step 11

NG

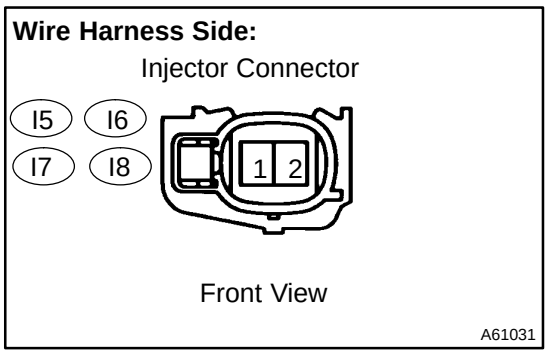
9 INSPECT FUEL INJECTOR RESISTANCE OF MISFIRING CYLINDER (See page 11–9)

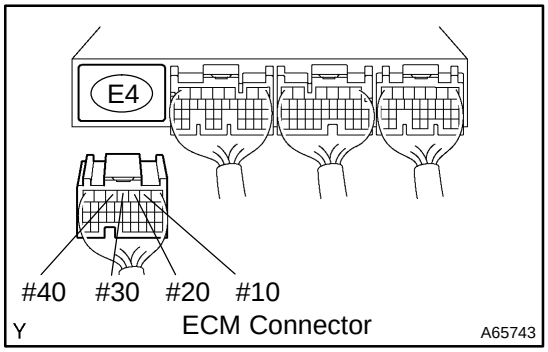
NG	REPLACE FUEL INJECTOR ASSY (See page 11–12)

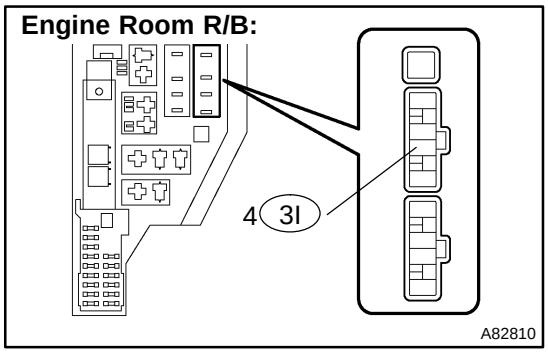
OK

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10	CHECK HARNESS AND CONNECTOR OF MISFIRING CYLINDER(INJECTOR – ECM, INJECTOR – IG2 RELAY)







(a) Check the harness and connectors between the injector connector and ECM connector.

(1) Disconnect the I5, I6, I7 or I8 injector connector.

(2) Disconnect the E4 ECM connector.

(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Injector (I5–2) – #10 (E4–2)	Below 1 Ω
Injector (I6–2) – #20 (E4–3)	Below 1 Ω
Injector (I7–2) – #30 (E4–4)	Below 1 Ω
Injector (I8–2) – #40 (E4–5)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Injector (I5–2) or #10 (E4–2) – Body ground	10 kΩ or higher
Injector (I6–2) or #20 (E4–3) – Body ground	10 kΩ or higher
Injector (I7–2) or #30 (E4–4) – Body ground	10 kΩ or higher
Injector (I8–2) or #40 (E4–5) – Body ground	10 kΩ or higher

(4) Reconnect the injector connector.

(5) Reconnect the ECM connector.

(b) Check the harness and connectors between the injector connector and IG2 relay.

(1) Disconnect the I5, I6, I7 or I8 injector connector.

(2) Remove the integration relay from the engine room R/B.

(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Injector (I5–1) – IG2 relay (3I–4)	Below 1 Ω
Injector (I6–1) – IG2 relay (3I–4)	Below 1 Ω
Injector (I7–1) – IG2 relay (3I–4)	Below 1 Ω
Injector (I8–1) – IG2 relay (3I–4)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Injector (I5–1) or IG2 relay (3I–4) – Body ground	10 kΩ or higher
Injector (I6–1) or IG2 relay (3I–4) – Body ground	10 kΩ or higher
Injector (I7–1) or IG2 relay (3I–4) – Body ground	10 kΩ or higher
Injector (I8–1) or IG2 relay (3I–4) – Body ground	10 kΩ or higher

(4) Reconnect the injector connector.

(5) Reinstall the integration relay connector.

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

OK

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11	INSPECT FUEL INJECTOR INJECTION AND VOLUME OF MISFIRING CYLINDER (See page 11–9)

OK:
Injection volume: 36 to 46 cm^3 (2.1 to 2.8 cu in.) per 15 seconds.

NG → REPLACE FUEL INJECTOR ASSY (See page 11–12)

OK

12	CHECK CYLINDER COMPRESSION PRESSURE OF MISFIRING CYLINDER (See page 14–1)

OK:
Compression pressure: 728 kPa (7.4 kgf/cm^2, 106 psi)
Minimum pressure: 537 kPa (5.4 kgf/cm^2, 77 psi)

NG → REPAIR OR REPLACE

OK

13	CHECK VALVE CLEARANCE OF MISFIRING CYLINDER (See page 14–6)

OK:
Valve clearance (cold):
Intake: 0.17 to 0.23 mm (0.007 to 0.009 in.)
Exhaust: 0.27 to 0.33 mm (0.011 to 0.013 in.)

NG → ADJUST VALVE CLEARANCE (See page 14–6)

OK

14	SWITCH STEP BY NUMBER OF MISFIRE CYLINDER(REFER TO RESULT 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 (See page 05–17)

A

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15	CHECK VALVE TIMING(CHECK FOR LOOSENESS OR A JUMPED TOOTH OF THE TIMING CHAIN) (See page 14–6)

OK: The match marks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING (See page 14–6) (REPAIR OR REPLACE TIMING CHAIN)**

OK

16	CHECK FUEL PRESSURE (See page 11–7)

OK:

Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

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

OK

17	READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL(INTAKE AIR TEMPERATURE AND MASS AIR FLOW RATE)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) Check the intake air temperature.
  (1) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / INTAKE AIR.
  (2) Read the value.

  Temperature: Equivalent to ambient air temperature.
(e) Check the air flow rate.
  (1) On the hand–held tester or the OBD II scan tool, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / MAF.
  (2) Read the value.

  Standard:

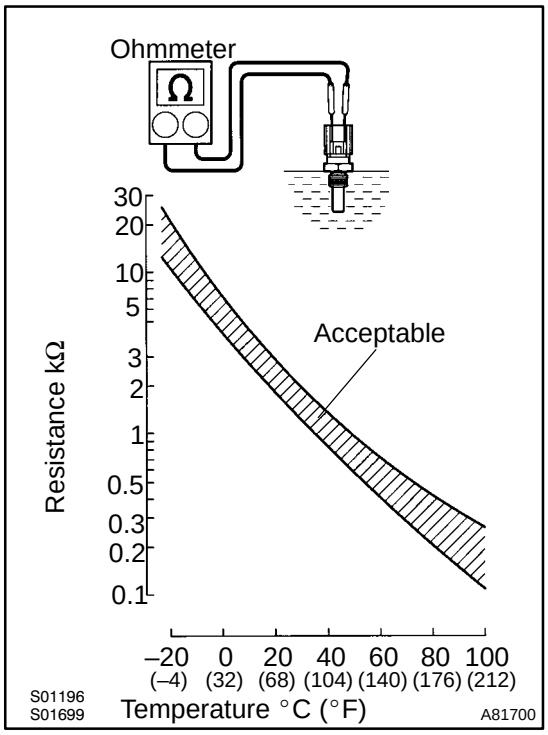
Condition	Air flow rate (gm/s)
Power switch ON (do not start engine)	0.0
Idling (Inspection mode)	3.2 to 4.7
Running without load (Inspection mode, engine speed of 2,500 rpm)	13.1 to 18.9
During vehicle running (Vehicle speed of more than 38 mph)	Air flow rate fluctuates

NG → **REPLACE MASS AIR FLOW METER**

OK

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18	INSPECT ENGINE COOLANT TEMPERATURE SENSOR(RESISTANCE)



(a) Remove the engine coolant temperature sensor.
(b) Measure the resistance between the terminals of the engine coolant temperature sensor.

Standard:

Tester Connection	Specified Condition
1 – 2	2 to 3 kΩ at 20°C (68°F)
1 – 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:

When checking the engine coolant temperature sensor in water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed engine coolant temperature 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 RESULT 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 → **AGAIN GO TO STEP 5**

A

CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)

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DTC	P0325	KNOCK SENSOR 1 CIRCUIT (BANK 1 OR SINGLE SENSOR)

DTC	P0327	KNOCK SENSOR 1 CIRCUIT LOW INPUT (BANK 1 OR SINGLE SENSOR)

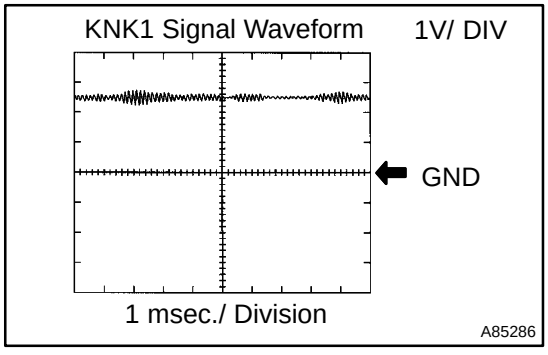
DTC	P0328	KNOCK SENSOR 1 CIRCUIT HIGH INPUT (BANK 1 OR SINGLE SENSOR)

CIRCUIT DESCRIPTION

A flat type knock sensor (non–resonant type) has the structure that can detect vibration in a wider band of the frequency from about 6 kHz to 15 kHz and has the following features.
Knock sensors are fitted on the cylinder block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates voltage when it becomes deformed. The generation of the voltage occurs when the cylinder block vibrates due to the knocking. If the engine knocking occurs, in order to suppress it, the ignition timing is retarded.

DTC No.	DTC Detecting Condition	Trouble Area
P0325	Knock sensor signal level remains at low for more than 10 seconds	• Open or short in knock sensor circuit • Knock sensor (under–torqued or looseness) • ECM
P0327	Output voltage of the knock sensor is 0.5 V or less	• Short in knock sensor circuit • Knock sensor • ECM
P0328	Output voltage of the knock sensor is 4.5 V or more	• Open in knock sensor circuit • Knock sensor • ECM

HINT:
If the ECM detects the DTC P0325,P0327 and P0328, it enters fail–safe mode in which the corrective retarded angle value is set to its maximum value.



Reference: Inspection by using an oscilloscope.
(1) After warming up, run the engine at 2,500 rpm, check the waveform between terminals KNK1 and EKNK of the ECM connector.

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knocks. When the spark knocks occur, the sensor picks–up vibrates in a specific frequency range. When the ECM detects the voltage in this frequency range, it retards the ignition timing to suppress the spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, and if the knock sensor output voltage is out of the normal range, the ECM interprets this as a fault in the knock sensor and sets a DTC.

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MONITOR STRATEGY

Related DTCs	P0325: Knock sensor (bank 1) range check or rationality P0327: Knock sensor (bank 1) range check (low voltage) P0328: Knock sensor (bank 1) range check (high voltage)
Required sensors/components	Main: Knock sensor Related: Crankshaft position sensor, Camshaft position sensor, Engine coolant temperature sensor, Mass air flow meter
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	10.5 V or more
Idle	OFF
Time after engine start	5 seconds or more
Engine coolant temperature	60°C (140°F) or more
Intake air amount per revolution	0.3 g/rev or more

TYPICAL MALFUNCTION THRESHOLDS

Case 1: P0325 (Range check/Rationality)

Time while the voltage output of the knock sensor is below the specific threshold	10 seconds

Case 2: P0325 (Fluttering *)

Knock sensor voltage	Less than 0.5 V and more than 4.5 V

Case 3: P0327

Knock sensor voltage	Less than 0.5 V

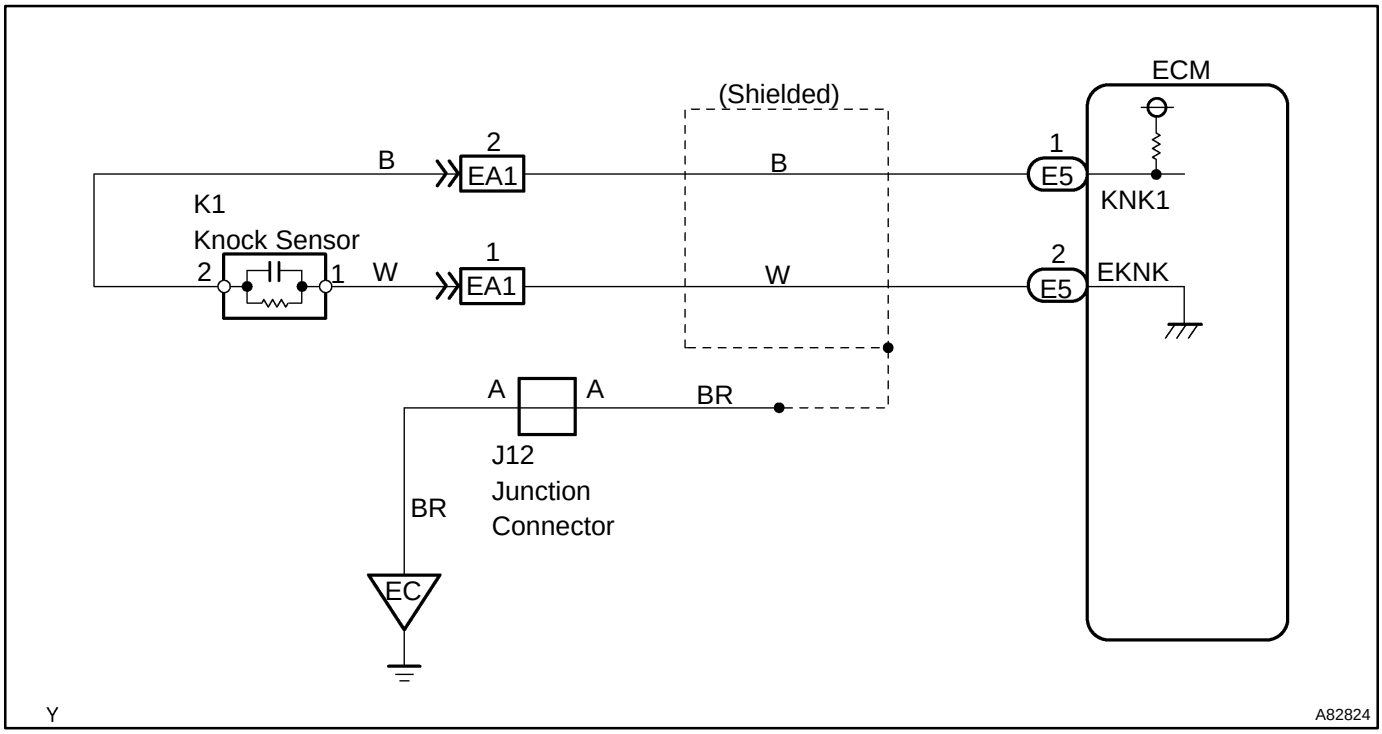
Case 4: P0328

Knock sensor voltage	More than 4.5 V

*: Two different malfunctions intermingle.

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WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1 READ OUTPUT DTCS

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Clear the DTCs.
(f) Put the engine in inspection mode (see page 05–1).
(g) Warm up the engine.
(h) Run the engine at 2,500 rpm for 10 seconds or more.
(i) Read DTCs.

Result :

Display (DTC output)	Proceed to
P0325	A
P0325, P0327 and/or P0328	B
No output	C

B → **Go to step 3**

C → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

A

2 INSPECT KNOCK SENSOR

(a) Check the knock sensor installation.

OK:

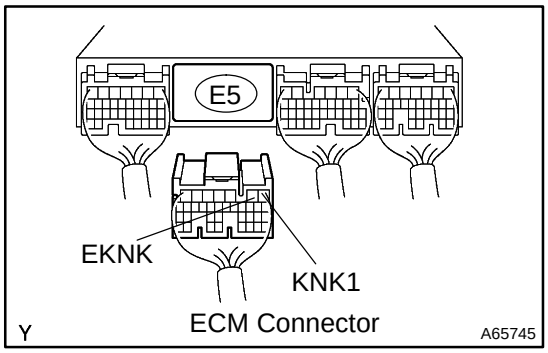
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)

NG → **SECURELY REINSTALL SENSOR**

OK

REPLACE KNOCK SENSOR

3 CHECK HARNESS AND CONNECTOR(ECM – KNOCK SENSOR)



(a) Disconnect the E5 ECM connector.
(b) Measure the resistance between the terminals of the E5 ECM connector.

Standard:

Tester Connection	Specified Condition
KNK1 (E5–1) – EKNK (E5–2)	120 to 280 KΩ at 20°C (68°F)

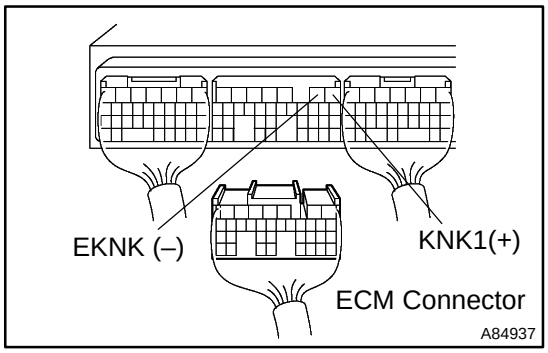
(c) Reconnect the ECM connector.

NG → **Go to step 5**

OK

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4	INSPECT ECM(KNK1 – EKNK VOLTAGE)



(a) Disconnect the E5 ECM connector.
(b) Turn the power switch ON (IG).
(c) Measure the voltage between the terminals of the E5 ECM terminals.
Standard:

Tester Connection	Specified Condition
KNK1 (E5–1) – EKNK (E5–2)	4.5 to 5.5 V

(d) Reconnect the ECM connector.

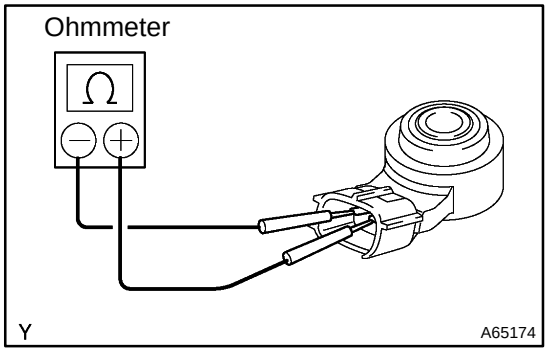
NG → **REPLACE ECM (See page 10–24)**

OK

CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)

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

5	INSPECT KNOCK SENSOR



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

Tester Connection	Specified Condition
KNK1 (K1–2) – EKNK (K1–1)	120 to 280 KΩ at 20°C (68°F)

(c) Reinstall the knock sensor.

NG → **REPLACE KNOCK SENSOR**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

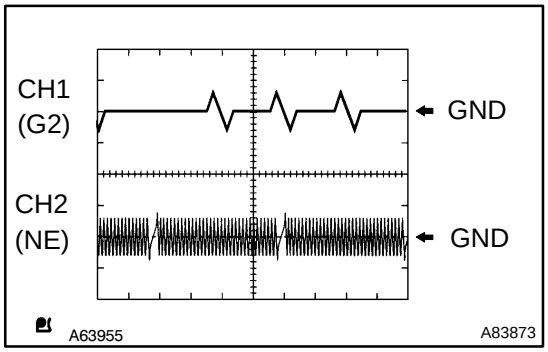
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DTC	P0335	CRANKSHAFT POSITION SENSOR ”A” CIRCUIT

CIRCUIT DESCRIPTION

The crankshaft position sensor (CKP) system consists of a crankshaft position sensor plate and a pick–up coil. The sensor plate has 34 teeth and is installed on the crankshaft. The pick–up coil is made of an iron core and magnet. The sensor plate rotates and as each tooth passes through the pick–up coil, a pulse signal is created. The pick–up coil generates 34 signals per 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.

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)	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Signal plate (crankshaft) • ECM



Reference: Inspection using an oscilloscope.

HINT:

The correct waveform is as shown on the left.

Item	Contents
Terminal	CH1: G2 – NE– CH2: NE+ – NE–
Equipment Setting	5 V/Division, 20 ms/Division
Condition	During cranking or idling

MONITOR DESCRIPTION

If there is no signal from the crankshaft sensor despite the engine revolving, the ECM interprets this as malfunction of the sensor.

MONITOR STRATEGY

Related DTCs	P0335: Crankshaft position sensor range check or rationality
Required sensors/components	Crankshaft position sensor
Frequency of operation	Continuous
Duration	4.7 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

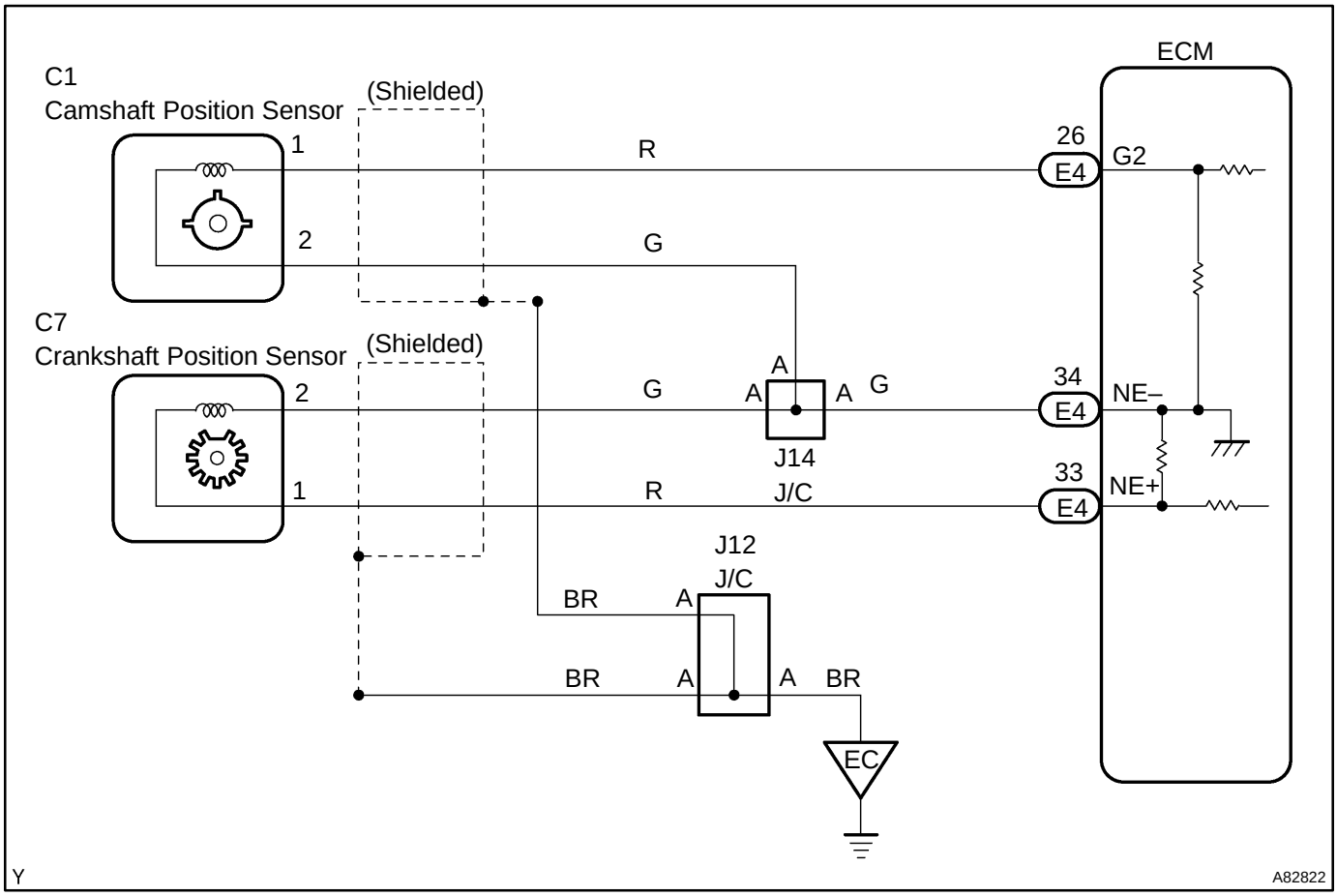
The monitor will run whenever the following DTCs are not present	See page 05–20
Power switch	ON
Engine rotating signal from HV ECU	HV ECU judges that the engine is running

TYPICAL MALFUNCTION THRESHOLDS

Engine speed signal	No signal for 4.7 seconds

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WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

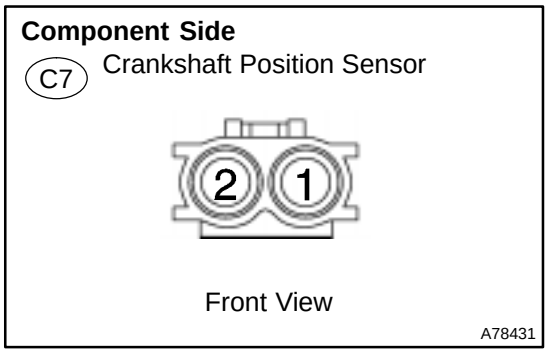
- Perform troubleshooting on DTC P0335 first. If no trouble is found, troubleshoot the engine mechanical systems.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

- READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL
  (a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
  (b) Turn the power switch ON (IG).
  (c) Turn the hand–held tester or the OBD II scan tool ON.
  (d) Put the engine in inspection mode (see page 05–1).
  (e) Start the engine.
  (f) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DATA LIST / ALL / ENGINE SPD.
  (g) Read the value using the hand–held tester or the OBD II scan tool.

The engine speed can be observed in DATA LIST using the hand–held tester or OBD II scan tool. If there is no NE signal from the crankshaft position sensor despite the engine revolving, the engine speed will be indicated as zero. If voltage output from the crankshaft position sensor is insufficient, the engine speed will be indicated as lower PRM (than the actual RPM).

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1 INSPECT CRANKSHAFT POSITION SENSOR(RESISTANCE)



(a) Disconnect the C7 crankshaft position sensor connector.
(b) Measure the resistance between the terminals of the crankshaft position sensor connector.

Standard:

Tester Connection	Specified Condition
1 – 2	985 to 1,600 Ω at cold
1 – 2	1,265 to 1,890 Ω at hot

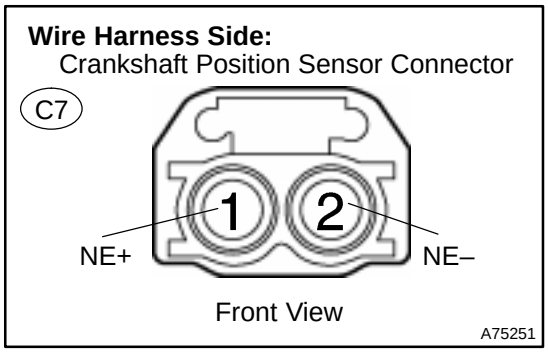
NOTICE:
Terms "cold" and "hot" refer to the temperature of the coils. "Cold" means approximately –10°C to 50°C (14°F to 122°F). "Hot" means approximately 50°C to 100°C (122°F to 212°F).

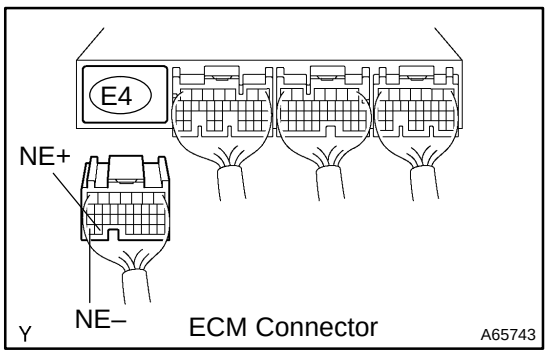
(c) Reconnect the crankshaft position sensor connector.

NG → **REPLACE CRANKSHAFT POSITION SENSOR (See page 18–10)**

OK

2 CHECK HARNESS AND CONNECTOR(CRANKSHAFT POSITION SENSOR – ECM)





(a) Disconnect the C7 crankshaft position sensor connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
NE+ (C7–1) – NE+ (E4–33)	Below 1 Ω
NE– (C7–2) – NE– (E4–34)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
NE+ (C7–1) or NE+ (E4–33) – Body ground	10 kΩ or higher
NE– (C7–2) or NE– (E4–34) – Body ground	10 kΩ or higher

(d) Reconnect the crankshaft position sensor connector.
(e) Reconnect the ECM connector.

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

OK

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3	CHECK SENSOR INSTALLATION(CRANKSHAFT POSITION SENSOR)

(a) Check that the crankshaft position sensor is properly installed.
OK: Sensor is installed correctly.

NG → **SECURELY REINSTALL SENSOR**

OK

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

(a) Check the teeth of the sensor plate.
OK: No deformation on the teeth of sensor plate.

NG → **REPLACE CRANKSHAFT POSITION SENSOR PLATE**

OK

REPLACE ECM (See page 10–24)

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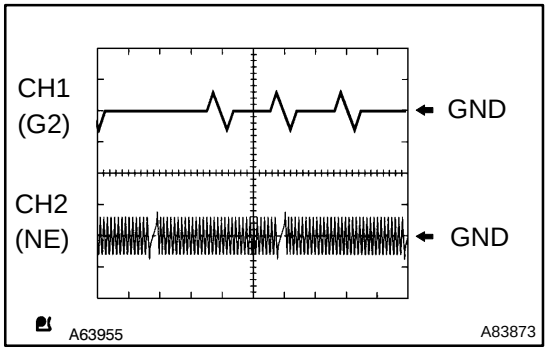
DTC	P0340	CAMSHAFT POSITION SENSOR ”A” CIRCUIT (BANK 1 OR SINGLE SENSOR)

DTC	P0341	CAMSHAFT POSITION SENSOR ”A” CIRCUIT RANGE/PERFORMANCE (BANK 1 OR SINGLE SENSOR)

CIRCUIT DESCRIPTION

The variable valve timing (VVT) sensor consists of a magnet, iron core and pickup coil.
The variable valve (VV) signal plate has 3 teeth on its outer circumference and is installed on the camshaft. When the camshafts rotate, the protrusion on the signal plate and the air gap on the pickup coil change, causing fluctuations in the magnetic field and generating voltage in the pickup coil.
This sensor monitors a timing rotor located on the camshaft and is used to detect an camshaft angle by the ECM. The camshaft rotation synchronizes with the crankshaft rotation, and this sensor communicates the rotation of the camshaft timing rotor as a pulse signal to the ECM. Based on the signal, the ECM controls fuel injection time and ignition timing.

DTC No.	DTC Detection Condition	Trouble Area
P0340	• No camshaft position sensor signal to ECM at engine speed of 600 rpm or more (1 trip detection logic)	• Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing pulley • Timing chain has jumped a tooth • ECM
P0341	While crankshaft rotates twice, camshaft position sensor signal is input to ECM 12 times or more (1 trip detection logic) • Hint: Under normal condition, the camshaft position sensor signal is input into the ECM 3 times per 2 engine revolutions	• Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing pulley • Timing chain has jumped a tooth • ECM



Reference: Inspection using an oscilloscope.
HINT:
The correct waveform is as shown on the left.

Item	Contents
Terminal	CH1: G2 – NE– CH2: NE+ – NE–
Equipment Setting	5 V/Division, 20 ms/Division
Condition	During cranking or idling

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MONITOR DESCRIPTION

If there is no signal from the VVT sensor even though the engine is turning, 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 (bank 1) range check or rationality P0341: Camshaft position sensor (bank 1) range check or rationality
Required sensors/components	Main: Camshaft position sensor Related: Crankshaft position sensor, engine speed sensor
Frequency of operation	Continuous
Duration	5 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P0340:

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine speed	600 rpm or more

P0341:

The monitor will run whenever the following DTCs are not present	See page 05–20
Starter	OFF
Engine revolution angle	720 °CA*

*: CA stands for Crankshaft Angle.

TYPICAL MALFUNCTION THRESHOLDS

P0340:

Crankshaft/camshaft synchronization	Not synchronized (judged by comparing the crankshaft position with the camshaft position)
Camshaft position sensor signal	No input in appropriate timing

P0341:

Crankshaft/Camshaft synchronization	Not synchronized
Camshaft position sensor count	12 or more / 720°CA (= 2 engine revolutions)

COMPONENT OPERATING RANGE

Camshaft position sensor signal input every 720°CA	3 times

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WIRING DIAGRAM

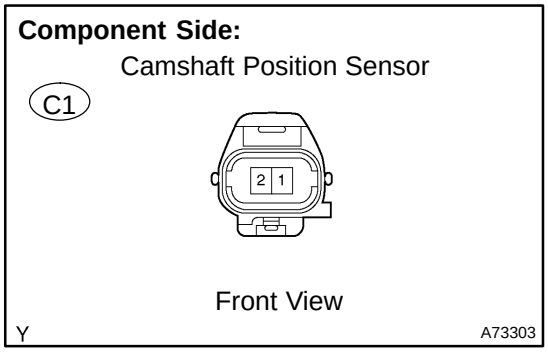
Refer to DTC P0335 on page 05–177.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 INSPECT CAMSHAFT POSITION SENSOR(RESISTANCE)



(a) Disconnect the C1 camshaft position sensor connector.

(b) Measure the resistance between the terminals of camshaft position sensor connector.

Standard:

Tester Connection	Specified Condition
1 – 2	1,630 to 2,740 Ω at cold
1 – 2	2,065 to 3,225 Ω at hot

NOTICE:

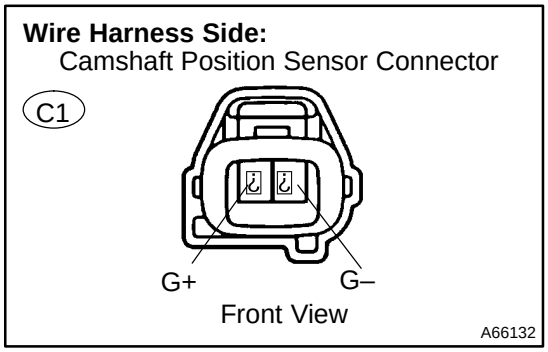
Terms ”cold” and ”hot” refer to the temperature of the coils. ”Cold” means approximately –10°C to 50°C (14°F to 122°F). ”Hot” means approximately 50°C to 100°C (122°F to 212°F).

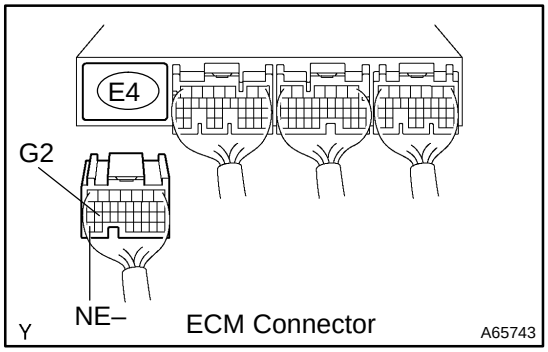
(c) Reconnect the camshaft position sensor connector.

NG → **REPLACE CAMSHAFT POSITION SENSOR**

OK

2 CHECK HARNESS AND CONNECTOR(CAMSHAFT POSITION SENSOR – ECM)





(a) Disconnect the C1 camshaft position sensor connector.

(b) Disconnect the E4 ECM connector.

(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
G+ (C1–1) – G2 (E4–26)	Below 1 Ω
G– (C1–2) – NE– (E4–34)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
G+ (C1–1) or G2 (E4–26) – Body ground	10 kΩ or higher
G– (C1–2) or NE– (E4–34) – Body ground	10 kΩ or higher

(d) Reconnect the camshaft position sensor connector.

(e) Reconnect the ECM connector.

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NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3	CHECK SENSOR INSTALLATION(CAMSHAFT POSITION SENSOR)

(a) Check that the camshaft position sensor is properly installed.
OK: Sensor is installed correctly.

NG → SECURELY REINSTALL SENSOR

OK

4	CHECK CAMSHAFT TIMING GEAR ASSY

(a) Remove the camshaft.
(b) Check the camshaft lobes.
OK: No deformation on the camshaft lobe.

NG → REPLACE CAMSHAFT TIMING GEAR ASSY

OK

REPLACE ECM (See page 10–24)

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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

CIRCUIT DESCRIPTION

HINT:

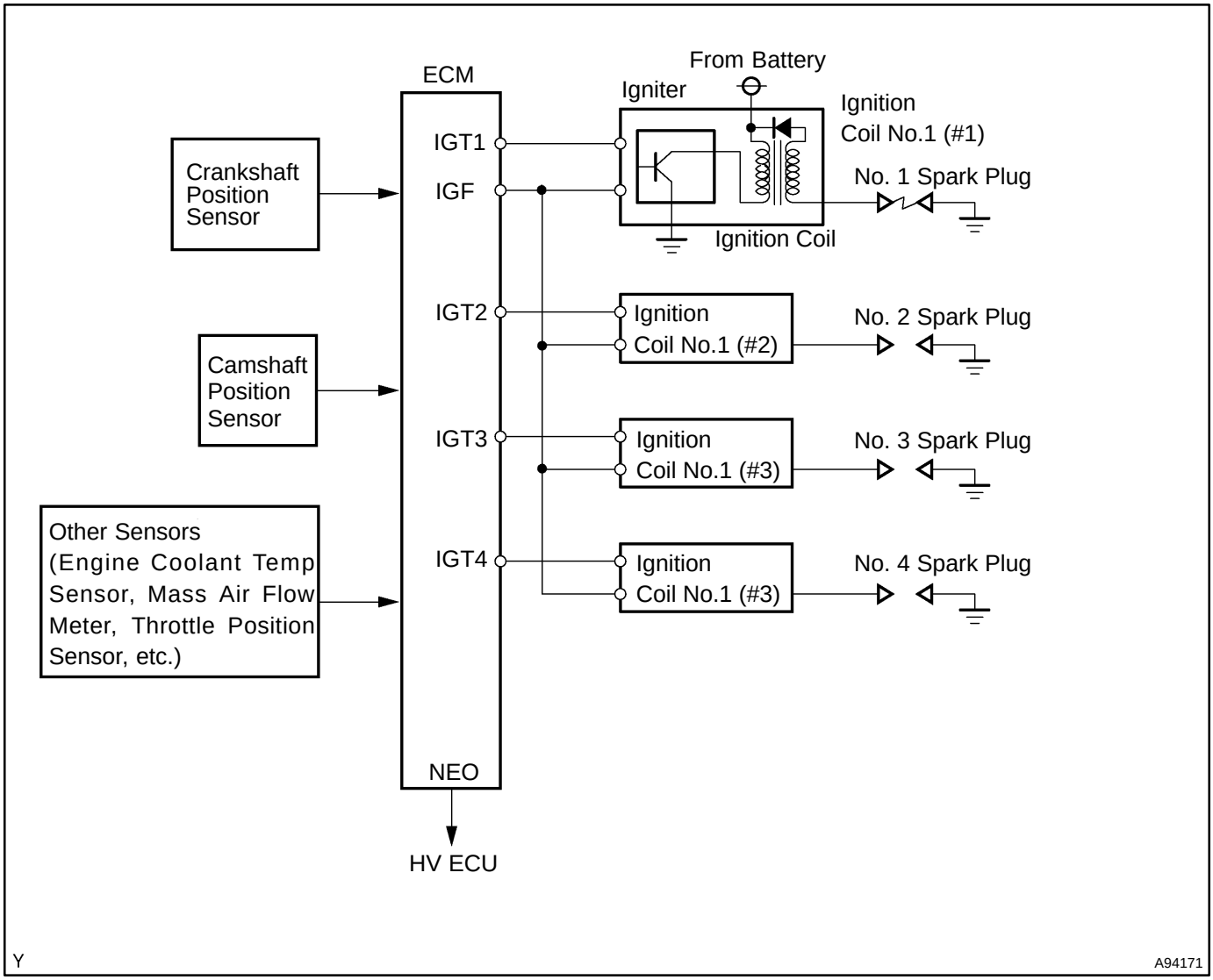
- These DTCs indicate malfunction related to the primary circuit.
- If DTC P0351 is displayed, check the ignition coil No.1 (#1) circuit.
- If DTC P0352 is displayed, check the ignition coil No.1 (#2) circuit.
- If DTC P0353 is displayed, check the ignition coil No.1 (#3) circuit.
- If DTC P0354 is displayed, check the ignition coil No.1 (#4) circuit.

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

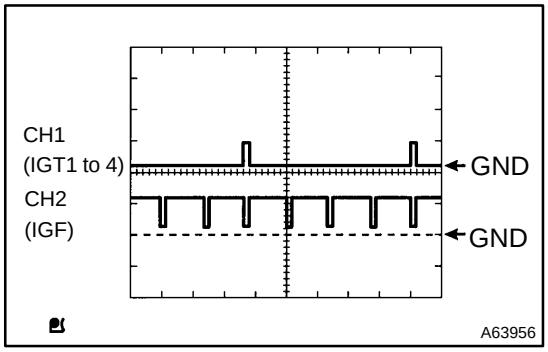
The DIS is a 1–cylinder ignition system which ignites one cylinder with one ignition coil. In the 1–cylinder ignition system, the one spark plug is connected to the end of the secondary winding. High voltage generated in the secondary winding is applied directly to the spark plug. The spark of the spark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

The ECM determines the ignition timing and outputs the ignition (IGT) signals for each cylinder. Using the IGT signal, the ECM turns ON and OFF the power transistor inside the igniter and this switches ON and OFF the current to the primary coil. When the current flow 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 spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back the ignition confirmation (IGF) signal to the ECM.

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DTC No.	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354	No IGF signal to ECM while engine is running	• Ignition system • Open or short in IGF or IGT circuit from ignition coil with igniter to ECM (ignition coil circuit 1 through 4) • Ignition coil with igniter (ignition coil circuit 1 through 4) • ECM

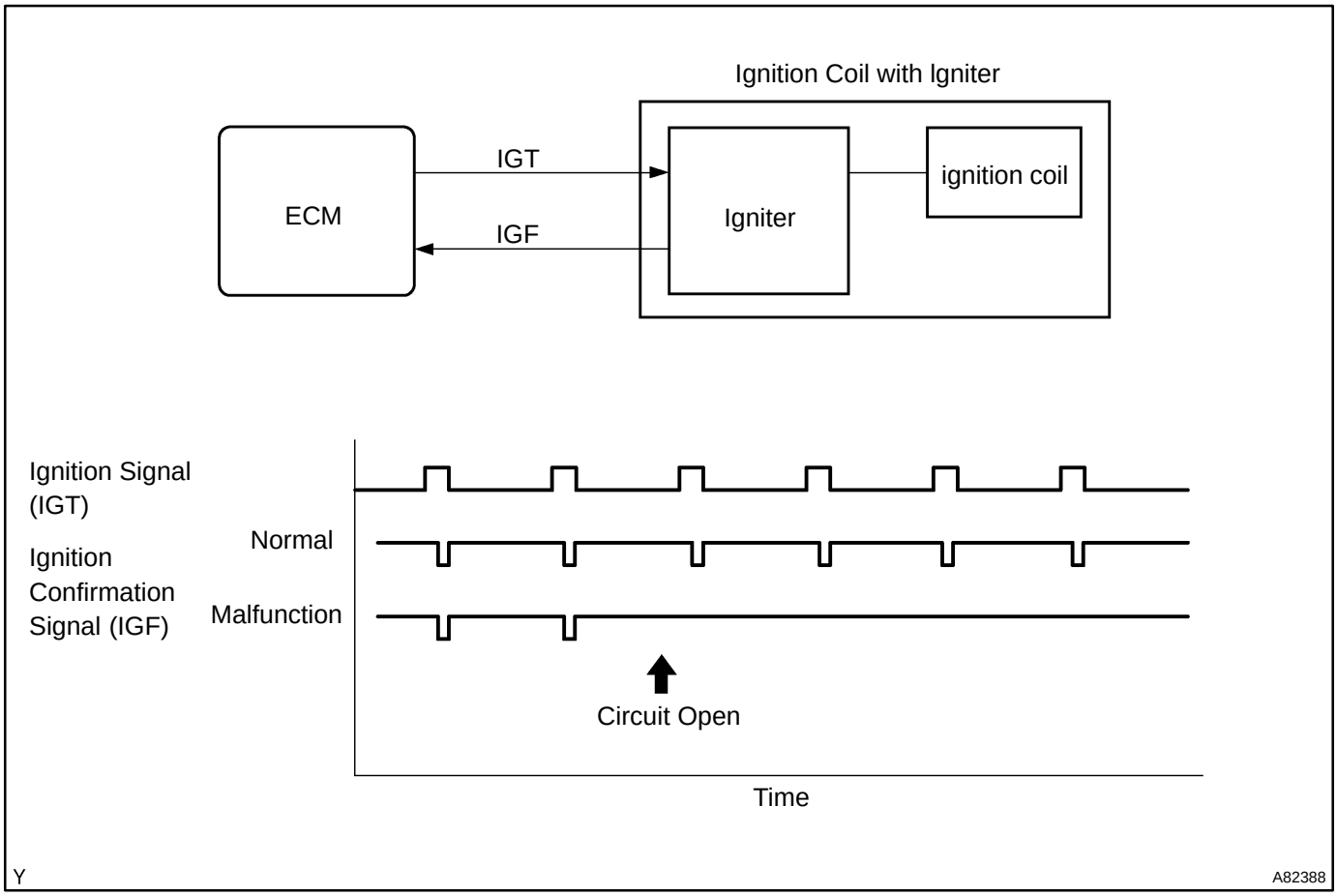


Reference: Inspection using an oscilloscope.
HINT:
The correct waveform is as shown on the left.

Item	Contents
Terminal	CH1: IGT1, IGT2, IGT3, IGT4 – E1 CH2: IGF – E1
Equipment Setting	2 V/Division, 20 ms/Division
Condition	While the engine is cranking or idling

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MONITOR DESCRIPTION



If the ECM does not receive the ignition confirmation (IGF) signal after sending the ignition (IGT) signal, the ECM interprets this as a fault in the igniter and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0351: Ignition coil with igniter circuit (#1) malfunction P0352: Ignition coil with igniter circuit (#2) malfunction P0353: Ignition coil with igniter circuit (#3) malfunction P0354: Ignition coil with igniter circuit (#4) malfunction
Required sensors/components	Igniter
Frequency of operation	Continuous
Duration	0.256 second
MIL operation	Immediately
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine speed	1,500 rpm or less
Either of the following conditions is met:	(a) or (b)
(a) Following conditions are met:	1 & 2
1. Engine speed	500 rpm or less
2. Battery voltage	6 V or more
(b) Following conditions are met:	1 & 2
1. Engine speed	More than 500 rpm
2. Battery voltage	10 V or more

TYPICAL MALFUNCTION THRESHOLDS

Ignition signal fail count*	More than 2 times

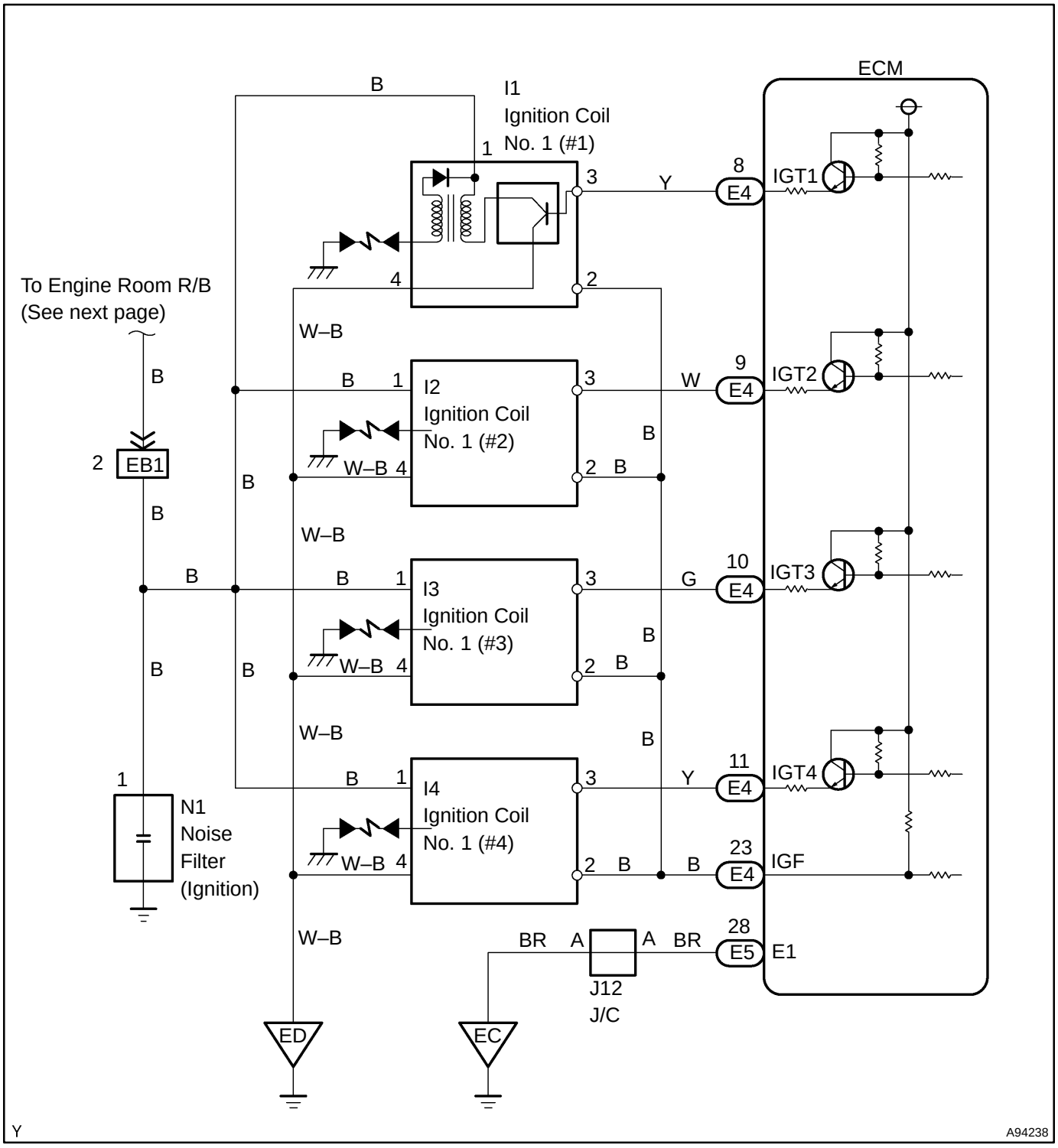
*: Counted when the IGF signal is not returned to the ECM despite sending the IGT signal.

COMPONENT OPERATING RANGE

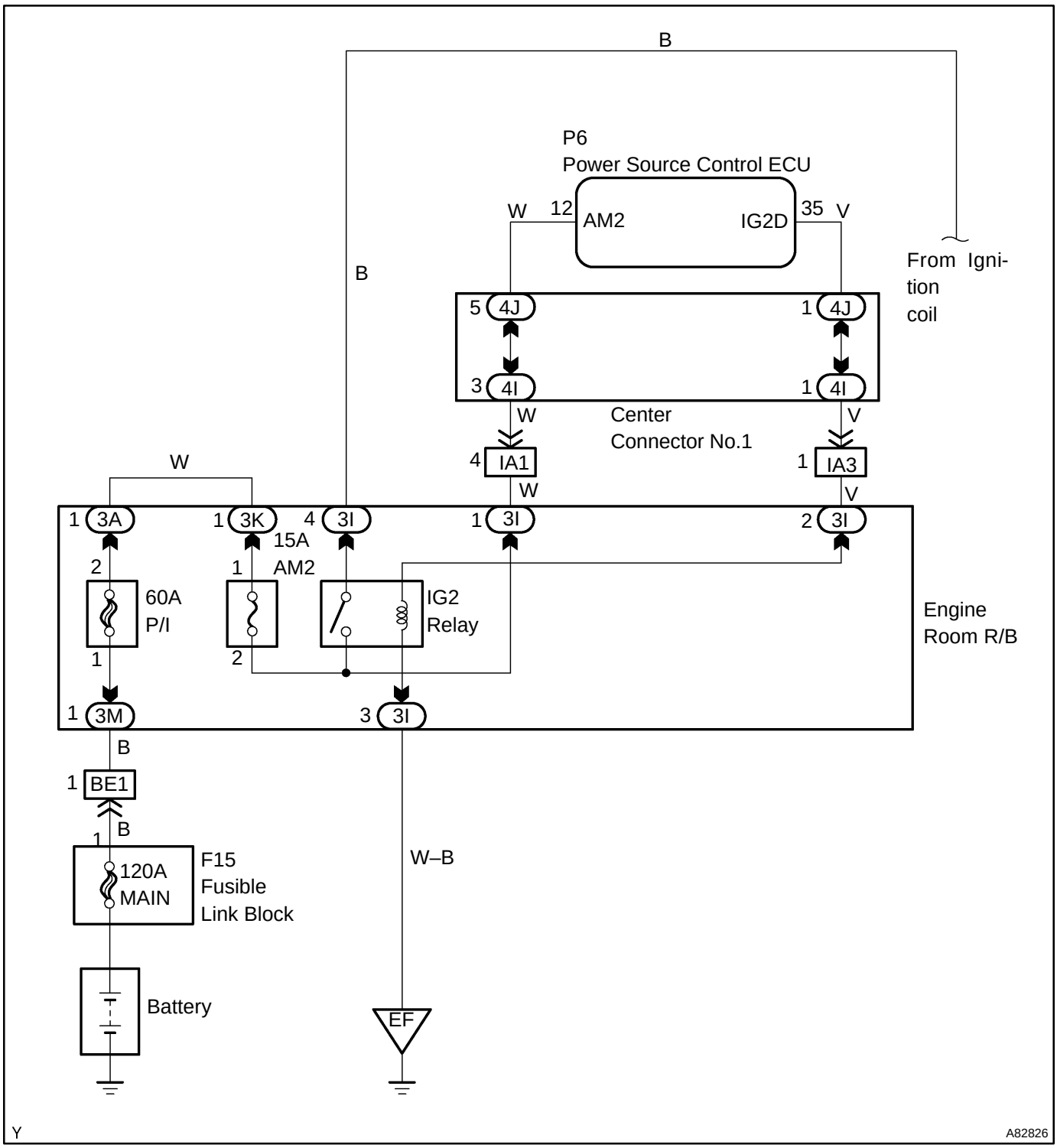
Number of IGF signals	Equals the number of IGT signals

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WIRING DIAGRAM



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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

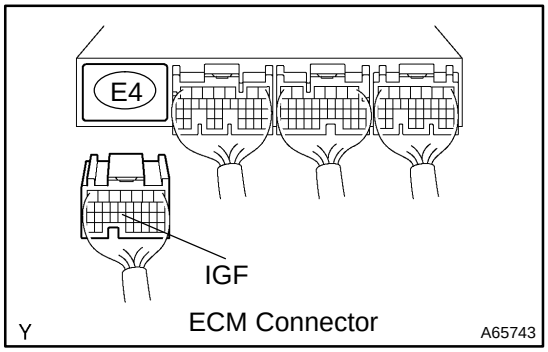
1	CHECK SPARK PLUG AND SPARK OF MISFIRING CYLINDER (See page 18–3)

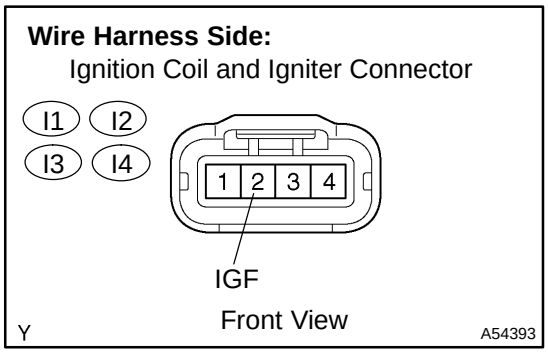
OK: Spark occurs.

NG → **Go to step 4**

OK

2	CHECK HARNESS AND CONNECTOR(IGNITION COIL NO.1 – ECM (IGF SIGNAL TERMINAL))





(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.

(b) Disconnect the E4 ECM connector.

(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
IGF (I1–2) – IGF (E4–23)	Below 1 Ω
IGF (I2–2) – IGF (E4–23)	Below 1 Ω
IGF (I3–2) – IGF (E4–23)	Below 1 Ω
IGF (I4–2) – IGF (E4–23)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
IGF (I1–2) or IGF (E4–23) – Body ground	10 kΩ or higher
IGF (I2–2) or IGF (E4–23) – Body ground	10 kΩ or higher
IGF (I3–2) or IGF (E4–23) – Body ground	10 kΩ or higher
IGF (I4–2) or IGF (E4–23) – Body ground	10 kΩ or higher

(d) Reconnect the ignition coil and igniter connector.

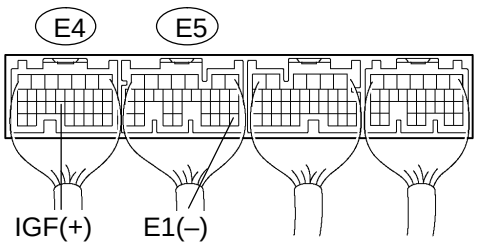
(e) Reconnect the ECM connector.

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

OK

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3 INSPECT ECM(IGF VOLTAGE)



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.
(b) Turn the power switch ON (IG).
(c) Measure the voltage between the specified terminals of the E4 and E5 ECM connectors.

Standard:

Tester Connection	Specified Condition
IGF (E4–23) – E1 (E5–28)	4.5 to 5.5 V

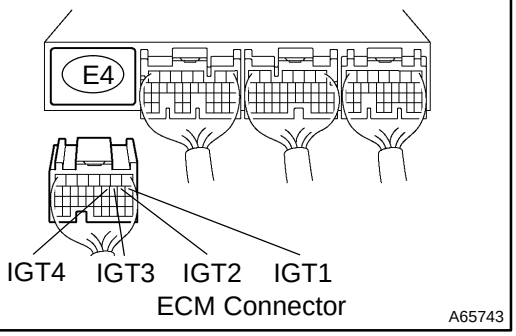
(d) Reconnect the ignition coil and igniter connector.

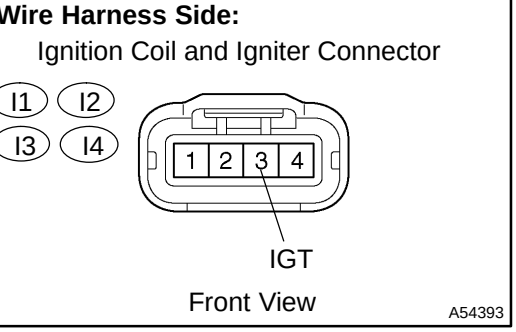
NG → **REPLACE ECM (See page 10–24)**

OK

REPLACE IGNITION COIL NO.1

4 CHECK HARNESS AND CONNECTOR(IGNITION COIL NO.1 – ECM (IGT SIGNAL TERMINAL))





(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
IGT (I1–3) – IGT1 (E4–8)	Below 1 Ω
IGT (I2–3) – IGT2 (E4–9)	Below 1 Ω
IGT (I3–3) – IGT3 (E4–10)	Below 1 Ω
IGT (I4–3) – IGT4 (E4–11)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
IGT (I1–3) or IGT1 (E4–8) – Body ground	10 kΩ or higher
IGT (I2–3) or IGT2 (E4–9) – Body ground	10 kΩ or higher
IGT (I3–3) or IGT3 (E4–10) – Body ground	10 kΩ or higher
IGT (I4–3) or IGT4 (E4–11) – Body ground	10 kΩ or higher

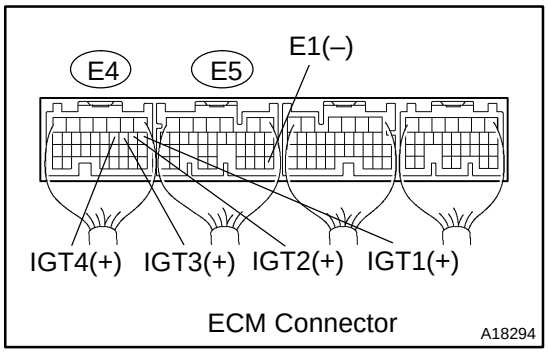
(d) Reconnect the ignition coil and igniter connector.
(e) Reconnect the ECM connector.

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

OK

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5 INSPECT ECM(IGT1, IGT2, IGT3 OR IGT4 VOLTAGE)



(a) Measure the voltage between the applicable terminals of the E4 and E5 ECM connectors when the engine is cranked.

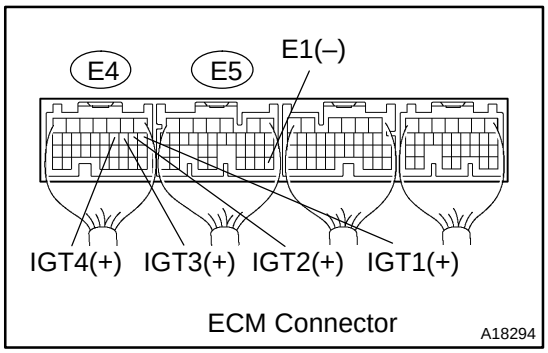
Standard:

Tester Connection	Specified Condition
IGT1 (E4–8) – E1 (E5–28)	Between 0.1 V and 4.5 V
IGT2 (E4–9) – E1 (E5–28)	Between 0.1 V and 4.5 V
IGT3 (E4–10) – E1 (E5–28)	Between 0.1 V and 4.5 V
IGT4 (E4–11) – E1 (E5–28)	Between 0.1 V and 4.5 V

NG → **REPLACE ECM (See page 10–24)**

OK

6 INSPECT ECM(IGT1, IGT2, IGT3 OR IGT4 VOLTAGE)



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.

(b) Measure the voltage between the applicable terminals of the E4 and E5 ECM connectors when the engine is cranked.

Standard:

Tester Connection	Specified Condition
IGT1 (E4–8) – E1 (E5–28)	4.5 V or more
IGT2 (E4–9) – E1 (E5–28)	4.5 V or more
IGT3 (E4–10) – E1 (E5–28)	4.5 V or more
IGT4 (E4–11) – E1 (E5–28)	4.5 V or more

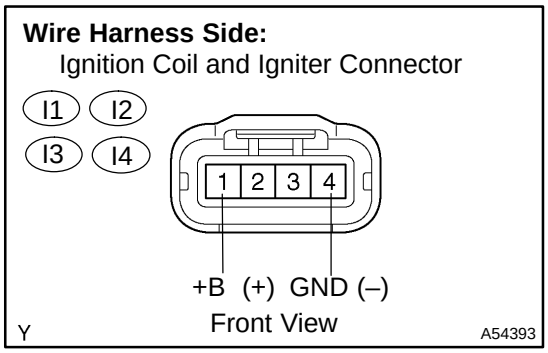
(c) Reconnect the ignition coil and igniter connector.

NG → **REPLACE ECM (See page 10–24)**

OK

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7 INSPECT IGNITION COIL NO.1(POWER SOURCE)



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.
(b) Turn the power switch ON (IG).
(c) Measure the voltage between the terminal of the wire harness side connector and body ground.

Standard:

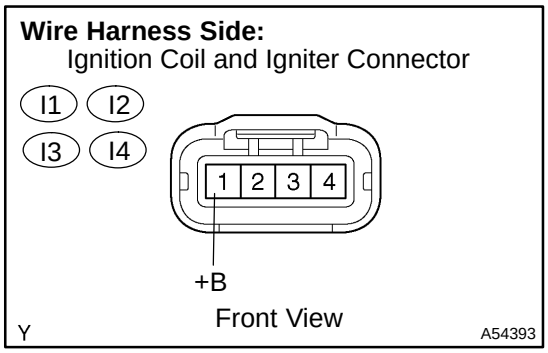
Tester Connection	Specified Condition
+B (I1–1) – GND (I1–4)	9 to 14 V
+B (I2–1) – GND (I2–4)	9 to 14 V
+B (I3–1) – GND (I3–4)	9 to 14 V
+B (I4–1) – GND (I4–4)	9 to 14 V

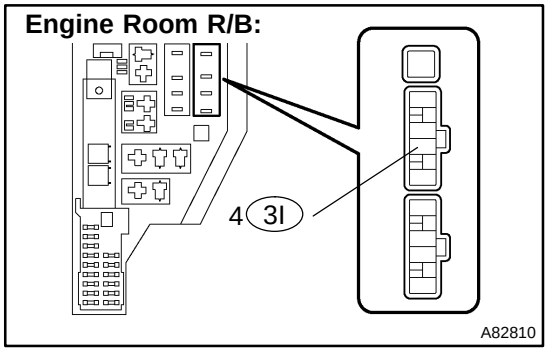
(d) Reconnect the ignition coil and igniter connector.

OK → **REPLACE IGNITION COIL NO.1**

NG

8 CHECK HARNESS AND CONNECTOR(IGNITION COIL NO.1 – IG2 RELAY)





(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.
(b) Remove the integration relay from engine room R/B.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
+B (I1–1) – IG2 relay(3I–4)	Below 1 Ω
+B (I2–1) – IG2 relay(3I–4)	Below 1 Ω
+B (I3–1) – IG2 relay(3I–4)	Below 1 Ω
+B (I4–1) – IG2 relay(3I–4)	Below 1 Ω
GND (I1–4) – (Body ground)	Below 1 Ω
GND (I2–4) – (Body ground)	Below 1 Ω
GND (I3–4) – (Body ground)	Below 1 Ω
GND (I4–4) – (Body ground)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
+B (I1–1) or IG2 relay(3I–4) – Body ground	10 kΩ or higher
+B (I2–1) or IG2 relay(3I–4) – Body ground	10 kΩ or higher
+B (I3–1) or IG2 relay(3I–4) – Body ground	10 kΩ or higher
+B (I4–1) or IG2 relay(3I–4) – Body ground	10 kΩ or higher

(d) Reconnect the ignition coil and igniter connector.
(e) Reinstall the integration relay.

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

OK

REPLACE IGNITION COIL NO.1

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DTC	P0420	CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1)

MONITOR DESCRIPTION

The ECM uses 2 sensors mounted before and after the three–way catalytic converter (TWC) to monitor its' efficiency. The air–fuel ratio (A/F) sensor (sensor 1) sends pre–catalyst information to the ECM. The heated oxygen (O2) sensor (sensor 2) sends post–catalyst information to the ECM.

In order to detect deterioration in the catalyst, the ECM calculates Oxygen Storage Capacity (OSC) in the catalyst based on voltage output of the sensor 2 while performing "active air–fuel ratio control" instead of the conventional detecting method which uses the locus ratio.

The OSC is an indication value of the catalyst oxygen storage capacity and is used for representing how much the catalyst can store oxygen. When the vehicle is being driven with a warm engine, the active air–fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the air–fuel ratio is forcibly regulated to go LEAN or RICH by the ECM, and if a RICH and LEAN cycle of the sensor 2 is long, the OSC will become greater. The greater OSC and capability of the catalyst are mutually related. The ECM judges if the catalyst has deteriorated based on the calculated OSC value. The ECM will illuminate the MIL and a DTC will be set.

DTC No.	DTC Detection Condition	Trouble Area
P0420	OSC value is smaller than the standard value under "active air–fuel ratio control"	• Exhaust manifold with front catalyst and exhaust front pipe with rear catalyst • Gas leakage in exhaust system • A/F sensor • Heated oxygen sensor

HINT:

- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far from the engine assembly.

MONITOR STRATEGY

Related DTCs	P0420: Bank 1 catalyst is deterioration
Required sensors/components	Main: A/F sensor, heated oxygen sensor Related: Mass air flow meter, engine coolant temperature sensor, engine speed sensor, intake air temperature sensor
Frequency of operation	Once per driving cycle
Duration	30 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	11.5 V or more
Intake air temperature	–10°C (14°F) or more
Idle	OFF
Engine speed	Less than 3,200 rpm
Engine coolant temperature	75°C (157°F) or more
Estimated catalyst temperature conditions are met:	1 & 2
1. Upstream estimated catalyst temperature	Less than 800°C (1,508°F), and 430 °C (806 °F) or more
2. Downstream estimated catalyst temperature	Less than 675°C (1,292°F), and 290 °C (554 °F) or more
Fuel system status	Closed–loop

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TYPICAL MALFUNCTION THRESHOLDS

Oxygen storage capacity	Less than 0.08 g

MONITOR RESULT (MODE 06 DATA)

Test ID/Comp ID	Description of Test Data	Description of Test Limit	Conversion Factor (Unit)
$01/$01	Catalyst deterioration level is determined by waveforms of A/F sensor and heated oxygen sensor	Malfunction criteria for catalyst deterioration	Multiply by 0.07812 (No dimension)

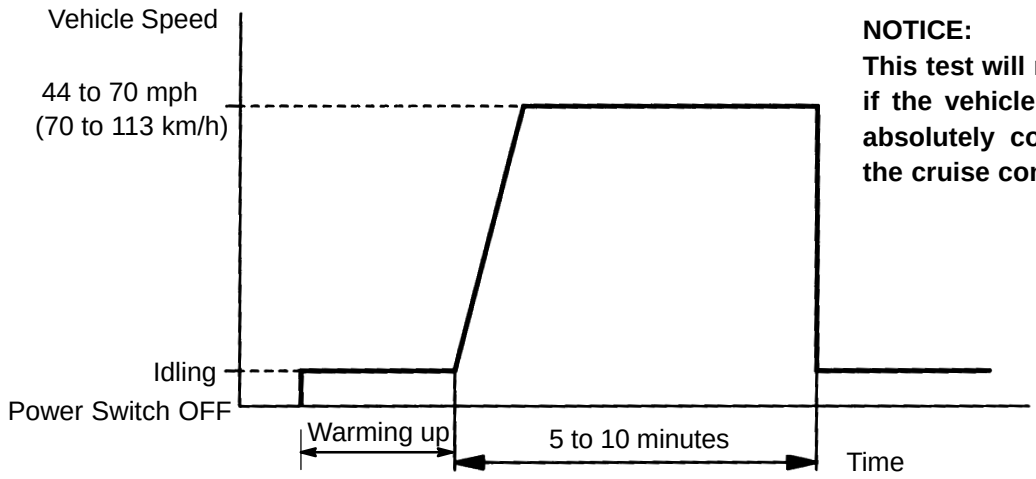
Refer to page 05–26 for detailed information on Checking Monitor Status.

CONFIRMATION DRIVING PATTERN FOR READINESS MONITOR

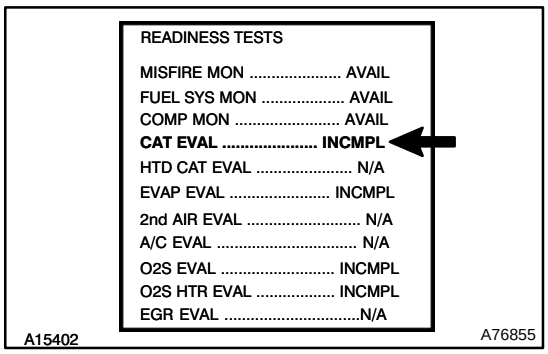
PURPOSE (See page 05–28)

HINT:

Performing this confirmation pattern will activate the catalyst monitoring by the ECM. This is very useful for verifying the completion of repairs.



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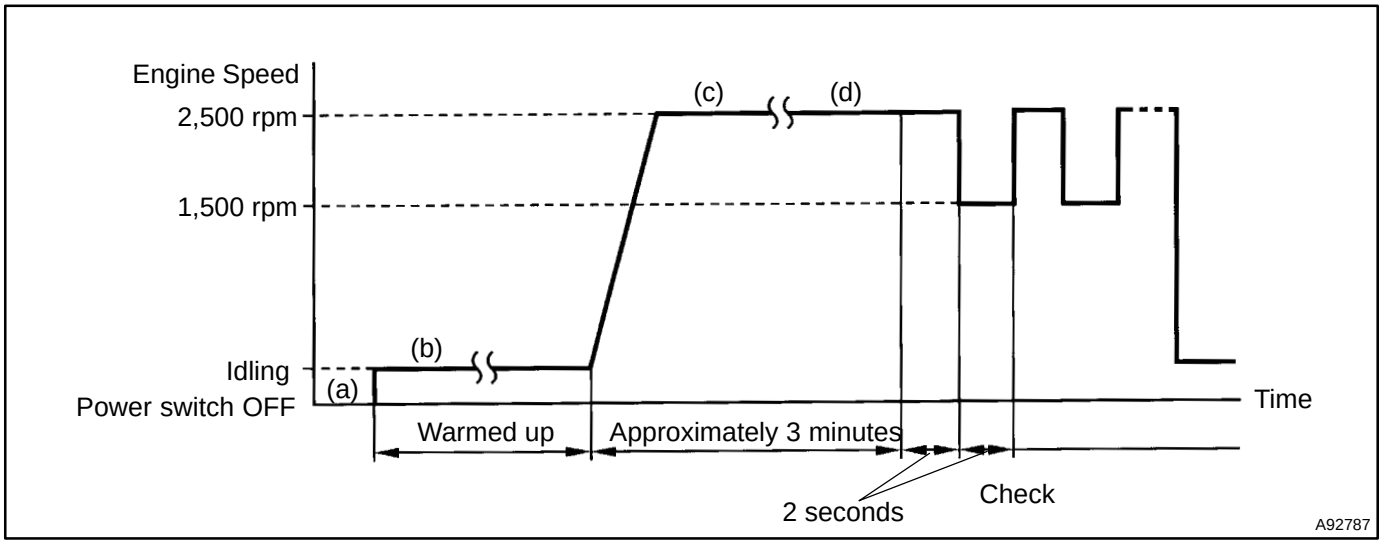
(a) Clear the DTCs.
(b) Connect the hand–held tester to the DLC3.
(c) Select the item: DIAGNOSIS / CARB OBD II / READINESS TESTS. Check that CAT EVAL is INCMPL (incomplete).
(d) Drive the vehicle according to the confirmation driving pattern. Note the state of the Readiness Tests. They will change to COMPL (complete) as the CAT evaluation monitors operate.
(e) Select the item: DIAGNOSIS / ENHANCED OBD II /ENGINE AND ECT / DTC INFO / PENDING CODES. Check if any DTC (any pending code) is set.

If the READINESS CODE of CAT EVAL was INCMPL and any DTC (includes pending codes) was not set, extend the driving time.

NOTICE:

If you do not have the hand–held tester, perform again the same confirmation driving pattern after turning OFF the power switch upon finishing the first confirmation driving pattern.

CONDITIONING THE A/F SENSOR AND HEATED OXYGEN SENSOR FOR TESTING

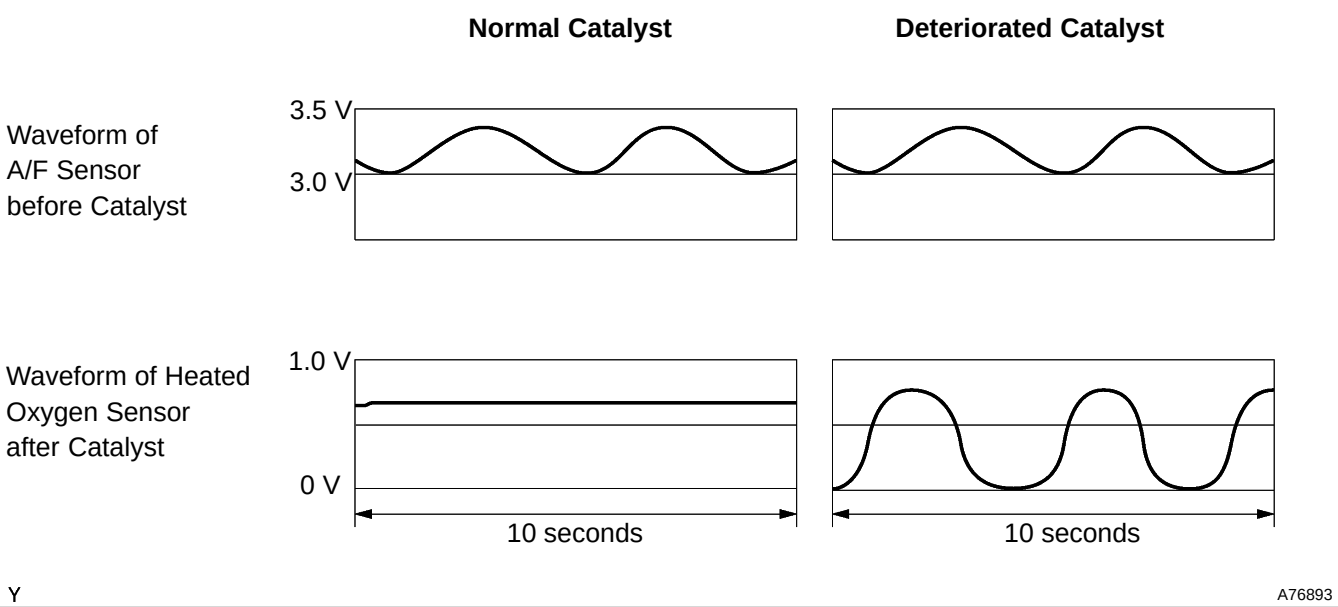


(a) Connect the OBD II scan tool or the hand–held tester to the DLC3.
(b) Put the engine in inspection mode (see page 05–1).
(c) Start the engine and warm it up with all the accessories switched OFF until the engine coolant temperature becomes table.
(d) Run the engine at 2,500 rpm for approximately 3 minutes.
(e) Run the engine at 2,500 rpm for 2 seconds and then 1,500 rpm for 2 seconds
(f) Check the waveform of the oxygen sensor (sensor 2).

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HINT:
If output of the A/F sensor or the heated oxygen sensor does not fluctuate or has noise, the sensor may be malfunctioning.
If voltage output of both sensors remain at LEAN or RICH, the air–fuel ratio may be extremely LEAN or RICH. In such a case, perform the following A/F CONTROL operation in ACTIVE TEST using the hand–held tester.
If the catalyst has deteriorated, the voltage output of the heated oxygen sensor fluctuates up and down widely even under normal driving (”active air–fuel ratio control” is not performed).

Voltage output when ”active air–fuel ratio control” is not performed:



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P0420)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
P0420	A
P0420 and other DTCs	B

HINT:
If any other codes besides P0420 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

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) (See page 05–314)

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

4	INSPECT HEATED OXYGEN SENSOR(BANK 1 SENSOR 2) (See page 05–125)

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

REPLACE THREE–WAY CATALYTIC CONVERTER (REPLACE FRONT PIPE)

HINT:
Malfunctioning areas can be found by performing 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 area are malfunctioning or not.
(a) Perform the ACTIVE TEST A/F CONTROL operation.

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HINT:

The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.

(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page 05–1).
(4) Warm up the engine by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(5) Select the item: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (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:

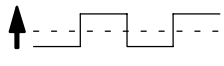
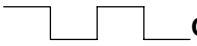
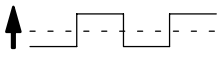
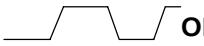
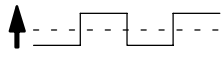
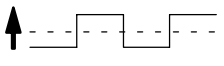
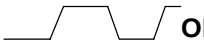
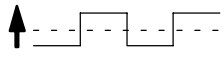
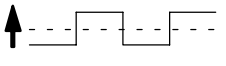
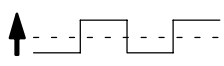
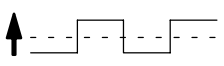
+25 % → rich output: More than 0.55 V

–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.

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	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Main Suspect Trouble Area
Case 1	Injection volume +25 % –12.5 %  Output voltage More than 3.35 V Less than 3.0 V  **OK**	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	—
Case 2	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	A/F sensor (A/F sensor, sensor heater, sensor circuit)
Case 3	Injection volume +25 % –12.5 %  Output voltage More than 3.35 V Less than 3.0V  **OK**	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Heated oxygen sensor (heated oxygen sensor, sensor heater, sensor circuit)
Case 4	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Extremely RICH or LEAN actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and the heated oxygen sensor.
To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, select ”AFS B1S1 and O2S B1S2” by pressing the ”YES” button followed by the ”ENTER” button and then the ”F4” button.

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DTC	P0441	EVAPORATIVE EMISSION CONTROL SYSTEM INCORRECT PURGE FLOW

DTC	P0446	EVAPORATIVE EMISSION CONTROL SYSTEM VENT CONTROL CIRCUIT

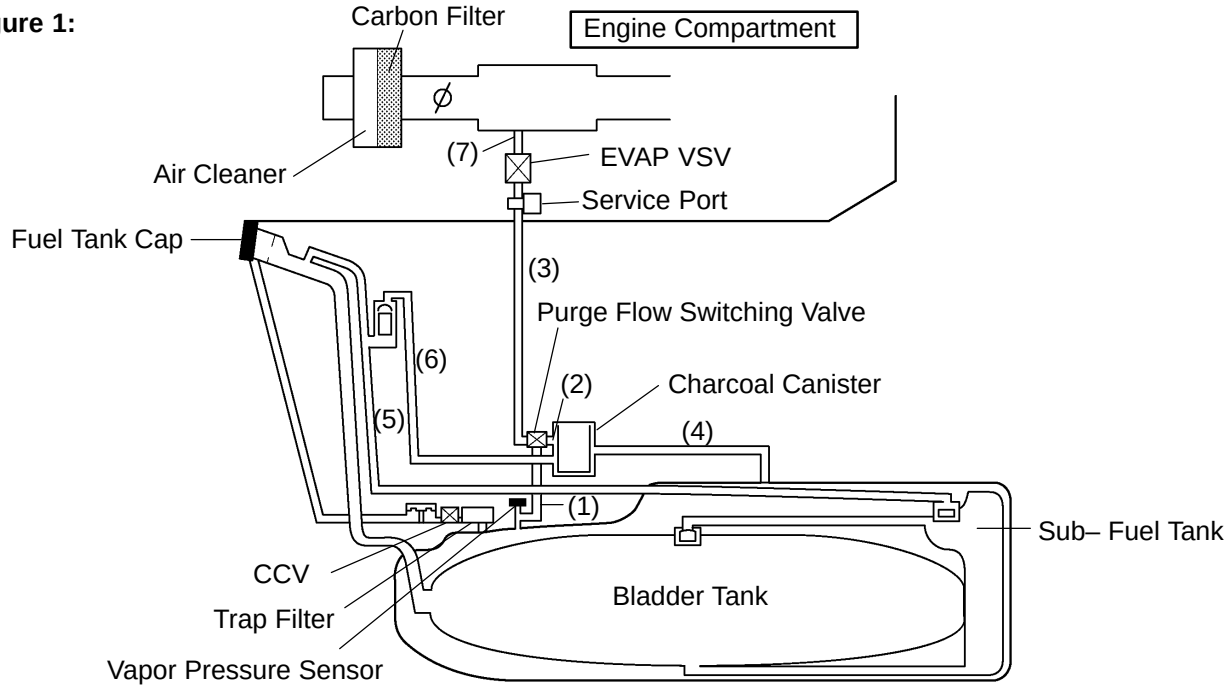
CIRCUIT DESCRIPTION

The vapor pressure sensor and VSV for canister closed valve (CCV) are used to detect abnormalities in the evaporative emission control system.

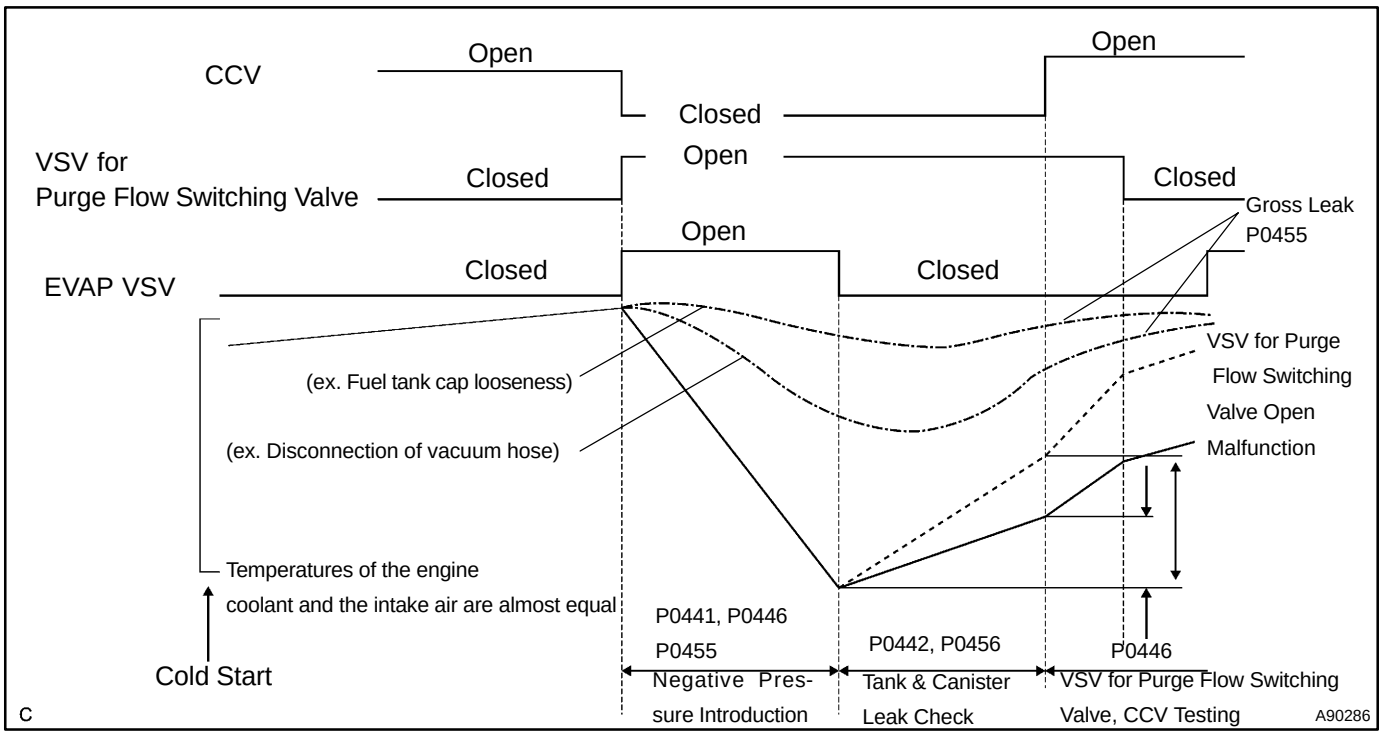
The ECM decides whether there is an abnormality in the evaporative emission control system based on the vapor pressure sensor signal.

DTCs P0441 and P0446 are recorded by the ECM when evaporative emissions leak from the components within the dotted line in figure 1 below, or when there is malfunction in either the EVAP VSV or the vapor pressure sensor itself.

Figure 1:



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DTC No.	DTC Detection Condition	Trouble Area
P0441	• Pressure in charcoal canister and fuel tank does not drop during purge control (2 trip detection logic) • During purge cut–off, pressure is very low compared with atmospheric pressure (2 trip detection logic)	• Fuel tank cap is incorrectly installed • Fuel tank cap is cracked or damaged • Vacuum hose is cracked, blocked, damaged or disconnected ((1), (2), (3), (4), (5), (6) and (7) in fig. 1) • 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 • Open or short in VSV for purge flow switching valve circuit • VSV for purge flow switching valve • Fuel tank is cracked or damaged • Charcoal canister is cracked or damaged • Fuel tank over fill check valve is cracked or damaged • ECM
P0446	• No rise in fuel tank pressure when commanding the CCV to open after an EVAP leak test • No change in fuel tank pressure when commanding the pressure switching valve to close after an EVAP leak test • A high negative pressure (vacuum) does not occur in the system when commanding the EVAP VSV to open with the CCV closed	• Fuel tank cap is incorrectly installed • Fuel tank cap is cracked or damaged • Vacuum hose is cracked, blocked, damaged or disconnected ((1), (2), (3), (4), (5), (6) and (7) in Fig. 1) • 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 • Open or short in VSV for purge flow switching valve circuit • VSV for purge flow switching valve • Fuel tank is cracked or damaged • Charcoal canister is cracked or damaged • Fuel tank over fill check valve is cracked or damaged • ECM

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HINT:
Typical DTC output of each trouble part.

Trouble Part	Trouble Condition	Typical DTC Output (*1)
—	Small Leak	P0442 and/or P0456 (*2)
—	Medium Leak (ex: Vacuum hose looseness)	P0455
—	Large Leak (ex: Fuel tank cap looseness)	P0441 and P0455 and P0446
EVAP VSV	Open Malfunction	P0441
EVAP VSV	Close Malfunction	P0441 and P0446 and P0455
CCV	Open Malfunction	P0441 and P0446 and P0455
CCV	Close Malfunction	P0446
VSV for Purge Flow Switching	Open Malfunction	P0446
VSV for Purge Flow Switching	Close Malfunction	P0441 and P0446 and P0455

*1: ECM may output some other DTCs combination.
*2: Refer to P0442 and P0456 on page 05–231.

MONITOR DESCRIPTION

The ECM tests the evaporative emissions (EVAP) system using the fuel tank pressure sensor, the canister close valve (CCV), and the EVAP VSV. The ECM closes the EVAP system and introduces negative pressure (vacuum) into it. The ECM then monitors the internal pressure using the fuel tank pressure sensor.

P0441

The ECM checks for a stuck closed malfunction in the EVAP VSV by commanding it to open with the CCV closed. If a high negative pressure does not develop in the fuel tank, the ECM determines that the EVAP VSV remains closed. The ECM turns on the MIL and a DTC is set.
The ECM checks for EVAP VSV ”stuck open” fault by commanding both valves (EVAP VSV and CCV) to close at a time when the fuel tank is at atmospheric pressure. If the fuel tank develops a high negative pressure at this early stage of the test, the ECM determines that the EVAP VSV has stuck OPEN.
The ECM will turn on the MIL and a DTC is set.

P0446

If there is malfunction detected in the VSV for evaporative emission (EVAP), the canister closed valve (CCV) and the VSV for purge flow switching valve; the ECM will illuminate the MIL and set a DTC.
This portion of the EVAP diagnosis checks the following EVAP system functions:

(a) CCV stuck closed.
The ECM checks for a CCV ”stuck closed” malfunction by commanding the CCV to open after an EVAP leak test. If the fuel tank pressure does not rise (lose vacuum), the ECM determines that the CCV has stuck closed. The ECM will turn on the MIL and a DTC is set.

(b) VSV for purge flow switching valve stuck closed.
The ECM checks for a VSV for purge flow switching valve ”stuck closed” malfunction by commanding the VSV for purge flow switching valve to close after an EVAP leak test. If the fuel tank pressure does not change, the ECM determines that the VSV for purge flow switching valve is malfunctioning. The ECM will turn on the MIL and a DTC is set.

(c) EVAP VSV (Purge line to intake manifold) stuck closed.
The ECM checks for a stuck closed malfunction in the EVAP VSV by commanding it to open with the CCV closed. If a high negative pressure does not develop in the fuel tank, the ECM determines that the EVAP VSV remains closed. The ECM turns on the MIL and a DTC is set.

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MONITOR STRATEGY

Related DTCs	P0441: EVAP VSV malfunction P0446: Canister close valve stuck malfunction
Required sensors/components	Main: Vapor pressure sensor Related: Engine coolant temperature sensor, intake air temperature sensor, vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	90 seconds: EVAP VSV malfunction 10 seconds: Canister close valve malfunction
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P0441: EVAP VSV malfunction

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	11 V or more
Altitude	Less than 2,400 m (8,000 ft)
Intake air temperature (IAT)	10 °C (50 °F) or more
Intake air temperature (IAT) at engine start	Between 10 °C (50 °F) and 35 °C (92 °F)
Engine coolant temperature (ECT) at engine start	Between 10 °C (50 °F) and 35 °C (92 °F)
Intake air temperature at engine start compared with engine coolant temperature	Maximum of 7°C (12.6°F) lower or 11.1°C (19.9°F) higher
EVAP VSV and CCV malfunction	Not detected
Time after engine start	Less than 60 minutes
Vehicle speed	Less than 130 km/h
Fuel slosh	No sloshing, i.e. fairly smooth road
MAF	No great change
Fuel tank pressure change	Minimal change

P0446: Canister close valve stuck, Purge flow switching valve malfunction

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	11 V or more
Altitude	Less than 2,400 m (8,000 ft)
Intake air temperature (IAT)	10 °C (50 °F) or more
Intake air temperature (IAT) at engine start	CCV stuck open malfunction: Between 10 °C (50 °F) and 35 °C (92 °F) CCV stuck close malfunction: 4.4 °C (39.9 °F) or more Purge flow switching valve malfunction: Between 10 °C (50 °F) and 35 °C (92 °F)
Engine coolant temperature (ECT) at engine start	CCV stuck open malfunction: Between 10 °C (50 °F) and 35 °C (92 °F) CCV stuck close malfunction: 4.4 °C (39.9 °F) or more Purge flow switching valve malfunction: Between 10 °C (50 °F) and 35 °C (92 °F)
Intake air temperature at engine start compared with engine coolant temperature	Maximum of 7°C (12.6°F) lower or 11.1°C (19.9°F) higher
EVAP VSV and CCV malfunction	Not detected
Time after engine start	Less than 60 minutes
Vehicle speed	Less than 130 km/h
Fuel slosh	No sloshing, i.e. fairly smooth road
MAF	No great change
Fuel tank pressure change	Minimal change

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TYPICAL MALFUNCTION THRESHOLDS

P0441: EVAP VSV malfunction

A. Following conditions are met:	(a) and (b)
(a) Fuel tank pressure at the vacuum introduction start	Less than –2.66 kPa (–20 mmHg)
(b) Difference between the fuel tank pressure at the vacuum introduction start and completion	Less than 0.93 kPa (7 mmHg)
B. Following conditions are met:	(a) and (b)
(a) Time after fuel tank pressure measurement start	9 seconds
(b) Fuel tank pressure	Less than –1.3 kPa (–10 mmHg)

P0446: Canister close valve stuck malfunction

Either of following conditions is met:	1 or 2
1. EVAP VSV monitoring	Stuck close malfunction
2. Following conditions (a) and (b) are met:	4 seconds
(a) Accumulated purge volume	0.5 g or more
(b) Fuel tank pressure	Less than –1.4 kPa
3. Following conditions are met:	(a) and (b)
(a) Fuel tank pressure difference between before and after switching canister bypass valve	–0.267 kPa or more
(b) Fuel tank pressure	More than –2.667 kPa

P0446: Purge flow switching valve malfunction

1. Following conditions are met:	(a) and (b)
(a) Fuel tank pressure difference between before and after switching canister bypass valve	–0.267 kPa or more
(b) Fuel tank pressure	More than –2.667 kPa

MONITOR RESULT (MODE 06 DATA)

Test ID/Comp ID	Description of Test Data	Description of Test Limit	Conversion Factor (Unit)
$02/$81	Tank pressure change value during vacuum introduction of the EVAP system	Malfunction criteria for the EVAP VSV	Multiply by 0.001 (kPa)
$02/$82	Tank pressure change value at switching over the canister close valve	Malfunction criteria for canister close valve	Multiply by 100 (ms)
$02/$05	Pressure difference at switching over the canister bypass valve (open stuck is detected by the time threshold, but the time is converted to appropriate pressure value)	Malfunction criteria for the canister bypass valve	Multiply by 0.001 (kPa)

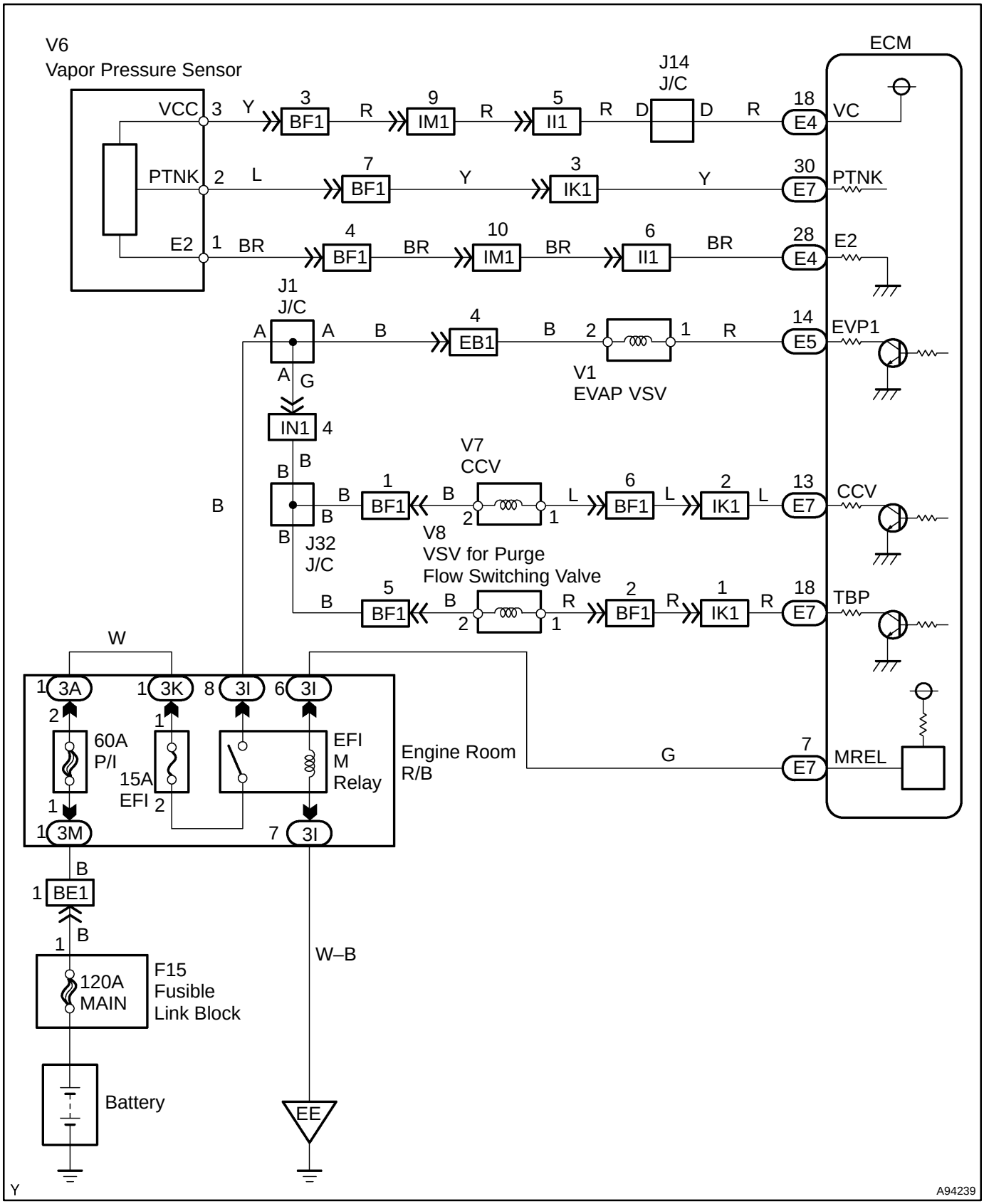
Refer to page 05–26 for detailed information on Checking Monitor Status.

*The ECM operates the purge VSV and the CCV as the following chart when the EVAP system is being monitored.

EVAP system condition	Purge VSV	CCV	EVAP (FTP) pressure
Before negative pressure introduction	Closed (OFF)	Open (OFF)	Positive
During negative pressure introduction	Open (ON)	Closed (OFF)	Intake manifold pressure is applied to EVAP system
After negative pressure introduction	Closed (OFF)	Open (OFF)	Negative

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WIRING DIAGRAM



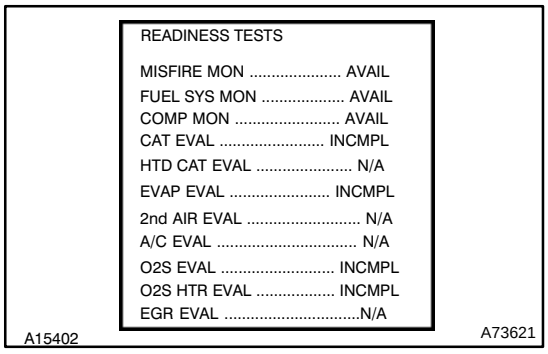
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CONFIRMATION READINESS TEST

First Trip Procedure

(a) The vehicle must be cold and the ambient air temperature must be approximately 10° (50°) to 35°C (95°F).

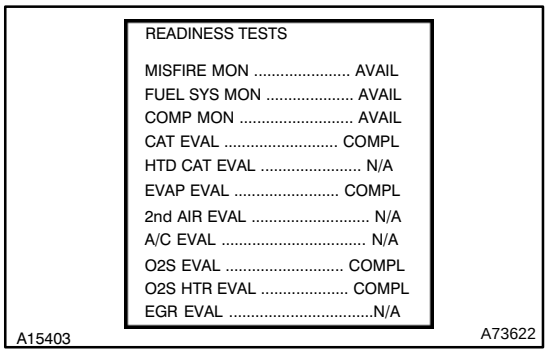
(b) The Intake Air Temperature (IAT) and the Engine Coolant Temperature (ECT) sensors indicate almost the same value.



(c) Clear the DTCs (see page 05–41).
- READINESS TESTS will show INCMPL (incomplete).

(d) Drive the vehicle on a freeway. Write down the initial status of the READINESS TESTS. As each Readiness Test passes EVAP evaluation monitors, its status will change to COMPL (complete). This procedure may take approximately 20 minutes or more.

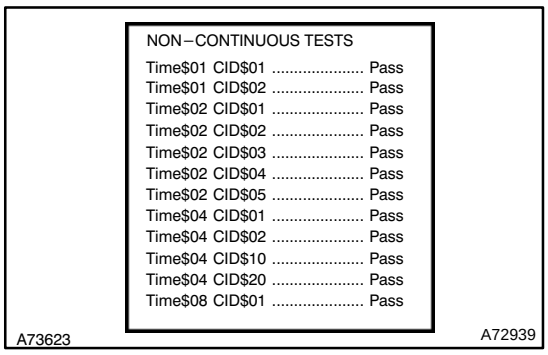
NOTICE:
Do not shut off the engine – the results will be invalid.



Pass Condition – No problem Found by the ECM

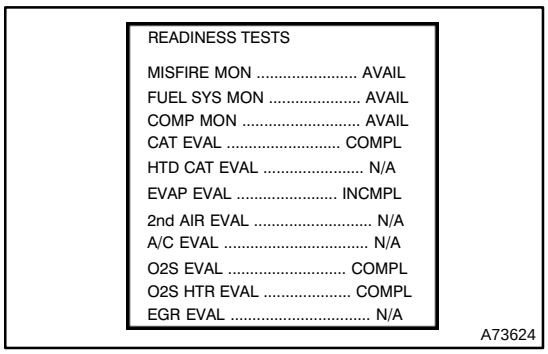
If the EVAP evaluation monitor shows COMPL, go to the NON–CONTINUOUS TESTS screen.
- Enter the following menus: ADVANCED OBD II / ONBOARD TESTS / NON–CONTINUOUS.

NOTICE:
Do not shut off the engine – the results will be invalid.



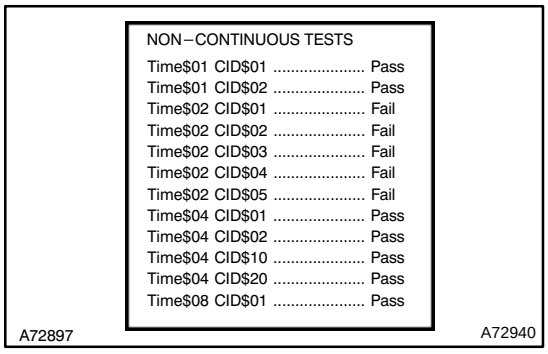
If all of the tests in the ”Time $02” category show ”Pass”, the EVAP evaluation monitor detected no problem.

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Fail Condition – Problem Detected by the ECM

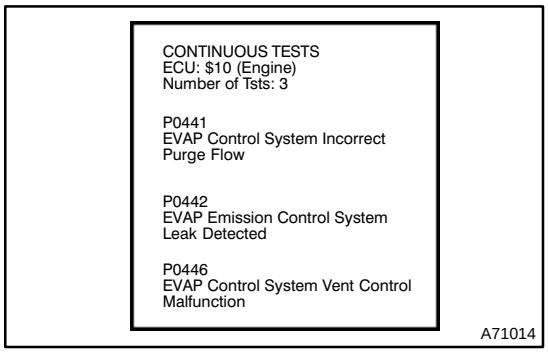
If the EVAP evaluation monitor shows COMPL, go to the NON–CONTINUOUS TESTS screen.



(1) If all tests show ”Pass”, one of the following may has occurred:
- The EVAP evaluation monitor did not operate.
- The EVAP evaluation monitor did not finish its tests.
- The ECM has withheld judgement.

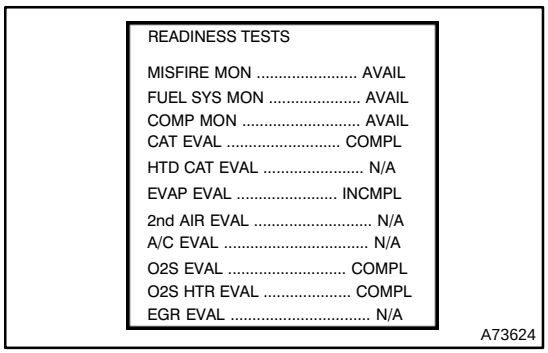
(2) If one or more of the tests in the time $02 category show ”Fail”, the EVAP evaluation monitor did operate and the ECM detected a problem.

(3) Go to the CONTINUOUS TESTS screen. This is the only place DTCs are listed for the first trip.



NOTICE:

The listed DTCs may be invalid. A second trip is needed to confirm listed DTCs.



Second Trip Procedure

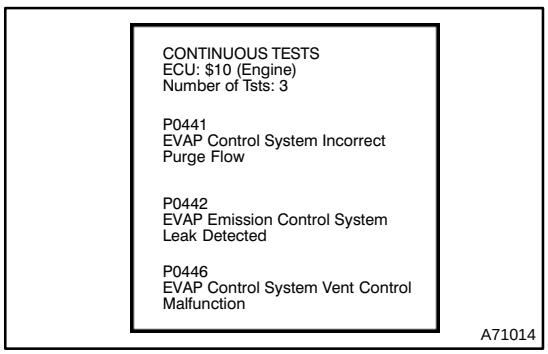
(e) The vehicle must be cold, and the ambient air temperature must be approximately 50 to 95˚F.

(f) Go to the READINESS TESTS screen.

(g) Drive the vehicle on a freeway. Write down the initial status of the READINESS TESTS. This procedure may take approximately 20 minutes or more.

NOTICE:

Do not shut off the engine – the results will be invalid.



(h) If the READINESS TESTS change to COMPL, the EVAP evaluation monitor has operated. Check for any stored DTCs.
- If a DTC was stored, the problem has been detected and confirmed by the ECM.
- If no DTC was found, the EVAP monitor operated but no problem was detected.

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INSPECTION PROCEDURE

HINT:

- When using the hand–held tester, follow the procedures under the title ”Hand–held tester ” (see next page).
- When using the OBD II scan tool, follow the procedures under the title ”OBD II scan tool (excluding hand–held tester)” (see the procedures after the hand–held tester procedures).
- Always troubleshoot DTCs P0441 (purge flow), P0446 (CCV), P0451, P0452 and P0453 (evaporative pressure sensor) before troubleshooting DTCs P0442 or P0456.
- Ask the customer the following questions:
  1) When the MIL came on, if the fuel tank cap was loose and if it was then tightened.
  2) When refueling, if the fuel tank cap was loose.
  If the fuel tank cap was loose, that is why the DTC was stored.
  If the fuel cap was not loose or if the customer cannot remember, troubleshoot according to the procedures on the following page.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If the ENGINE RUN TIME in the freeze frame data is less than 200 seconds, carefully check the vapor pressure sensor.

DTC Output	Malfunction Indicated	Troubleshooting Procedures	Operation
P0441 only	Open Malfunction of EVAP VSV	Execute steps from 13 to 16	Check and replace of EVAP VSV
P0446 only	Close Malfunction of CCV	Execute steps from 17	Check and replace of CCV
P0442 and/or P0456	Very small or small or medium leak	Refer to DTC P0442 (see page 05–202)	—
P0455 only	Medium leak (for example, vacuum hose is disconnected or hole is about ϕ 2.0)	Refer to DTC P0442 (see page 05–202)	—
P0441, P0455 and P0446	Large leak (for example, fuel tank cap is loose) or VSV malfunction (open malfunction of CCV or close malfunction of EVAP VSV)	Execute steps from 2* and refer to DTC P0442 (see page 05–202)	Inspect fuel tank cap

*: In most cases, troubleshooting can be completed by checking if the fuel tank cap was loose, or repairing the CCV or the EVAP VSV.

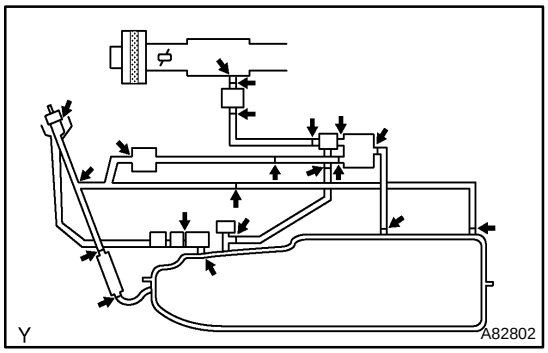
HINT:

Use the chart above to check the malfunction for each DTC output. Then perform the necessary repairs listed under ”Operation.”

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Hand–held tester:

1	CHECK WHETHER THERE ARE SIGNS OF ANY ACCIDENT NEAR FUEL TANK OR CHARCOAL CANISTER



(a) Check if any hoses close to the fuel tank have been modified, and check if there are signs of any accident or damage near the fuel tank or the charcoal canister.
  (1) Check the following parts for cracks, deformation or loose connections:
- Fuel tank
- Charcoal canister
- Fuel tank filler pipe
- Hoses and tubes around the fuel tank and charcoal canister

NG → **REPAIR OR REPLACE**

OK

2	INSPECT FUEL TANK CAP ASSY(CHECK THAT FUEL TANK CAP MEETS SPECIFICATIONS)

OK: Tank cap meets specifications in the owner's manual.

NG → **REPLACE FUEL TANK CAP ASSY**

OK

3	CHECK THAT FUEL TANK CAP IS CORRECTLY INSTALLED

OK: Tank cap is correctly installed.

NG → **CORRECTLY REINSTALL FUEL TANK CAP**

OK

4	INSPECT FUEL TANK CAP ASSY (See page 12–9)

OK: No deformation on the fuel tank cap.

NG → **REPLACE FUEL TANK CAP ASSY**

OK

5	CHECK FILLER NECK FOR DAMAGE

OK: Filler neck has no damage.

NG → **REPLACE FUEL TANK INLET PIPE SUB–ASSY**

OK

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6	CHECK HOSES AND TUBES(VAPOR PRESSURE SENSOR – VSV FOR PURGE FLOW SWITCHING VALVE, CHARCOAL CANISTER – EVAP VSV)

(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 → REPAIR OR CONNECT VSV AND SENSOR CONNECTORS

OK

7	CHECK HOSES AND TUBES(FUEL TANK – CHARCOAL CANISTER)

(a) Check the connection between the fuel tank and fuel EVAP pipe, fuel EVAP pipe and under–floor fuel tube, and under–floor fuel tube and charcoal canister.
(b) Check the hose and tube for cracks, holes and damage.

NG → REPAIR OR REPLACE HOSE AND TUBE

OK

8	CHECK EACH CONNECTOR FOR LOOSENESS AND DISCONNECTION(EVAP VSV, CCV, VSV FOR PURGE FLOW SWITCHING VALVE AND VAPOR PRESSURE SENSOR)

NG → REPAIR OR CONNECT VSV AND SENSOR CONNECTORS

OK

9	CHECK VACUUM HOSES((4), (5), (6) AND (7) IN FIG. 1 IN CIRCUIT DESCRIPTION)

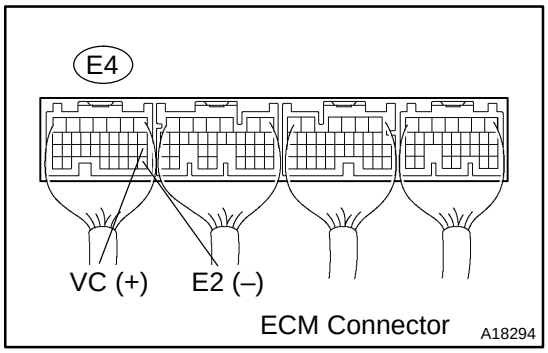
(a) Check that the vacuum hoses are connected correctly.
(b) Check the vacuum hoses for looseness or disconnection.
(c) Check the vacuum hoses for cracks, holes, damage and blockages.

NG → REPAIR OR REPLACE VACUUM HOSES

OK

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10 INSPECT ECM(VC VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E4 ECM connector.

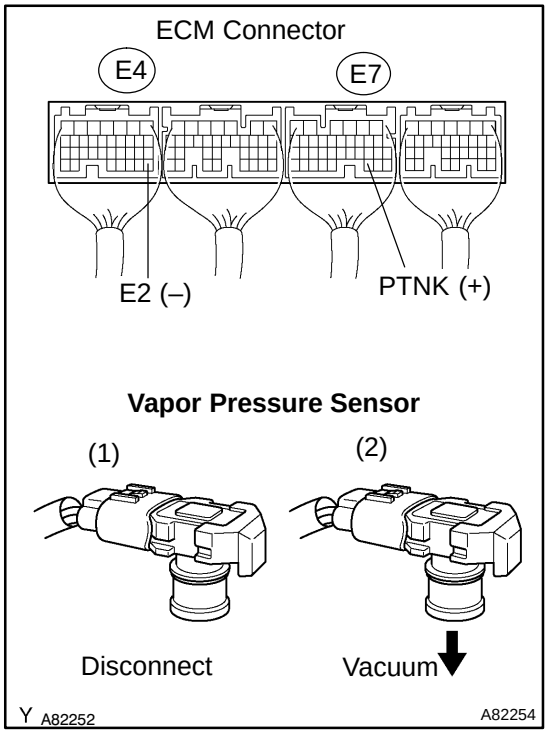
Standard:

Tester Connection	Specified Condition
VC (E4–18) – E2 (E4–28)	4.5 to 5.5 V

NG → **REPLACE ECM (See page 10–24)**

OK

11 INSPECT ECM(PTNK VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E4 and E7 ECM connectors.
(1) Remove the vapor pressure sensor.

Standard (1):

Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	2.9 to 3.7 V

(2) Using the 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).

Standard (2):

Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	0.5 V or less

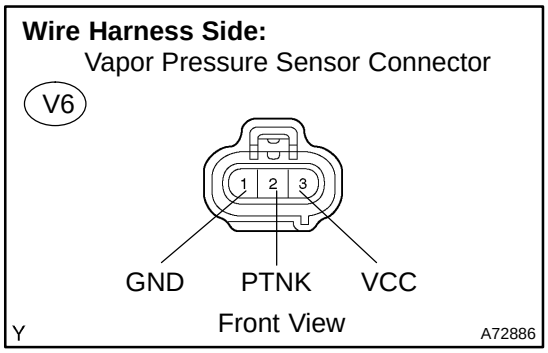
(3) Reinstall the vapor pressure sensor.

OK → **Go to step 13**

NG

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12 CHECK HARNESS AND CONNECTOR(VAPOR PRESSURE SENSOR – ECM)



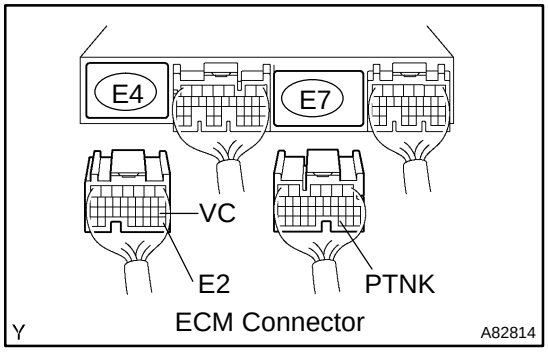
(a) Disconnect the V6 vapor pressure sensor connector.
(b) Disconnect the E4 and E7 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
PTNK (V6–2) – PTNK (E7–30)	Below 1 Ω
GND (V6–1) – E2 (E4–28)	Below 1 Ω
VCC (V6–3) – VC (E4–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
PTNK (V6–2) or PTNK (E7–30) – Body ground	10 kΩ or higher
VCC (V6–3) or VC (E4–18) – Body ground	10 kΩ or higher



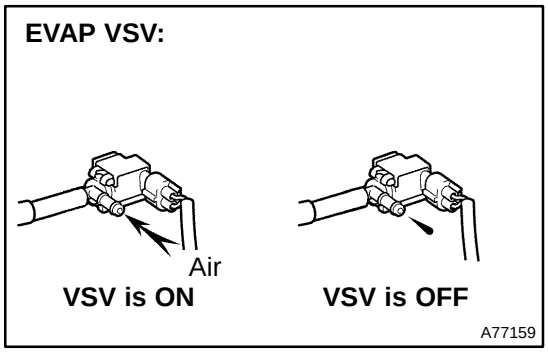
(d) Reconnect the vapor pressure sensor connector.
(e) Reconnect the ECM connectors.

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

OK

REPLACE VAPOR PRESSURE SENSOR ASSY

13 PERFORM ACTIVE TEST BY HAND–HELD TESTER(EVAP VSV PURGE FLOW)



(a) Disconnect the vacuum hose of the EVAP VSV from the charcoal canister.
(b) Put the engine in inspection mode (see page 05–1).
(c) Start the engine.
(d) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / EVAP VSV (press the right or left button).
(e) When the EVAP VSV is operated using the hand–held tester, check whether the disconnected hose applies suction to your finger.

Standard:

Tester Operation	Specified Condition
VSV is ON	Disconnected hose applies suction to your finger
VSV is OFF	Disconnected hose applies no suction to your finger

(f) Reconnect the vacuum hose.

OK → **Go to step 17**

NG

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14	CHECK VACUUM HOSES(INTAKE MANIFOLD – EVAP VSV, EVAP VSV – CHARCOAL CANISTER)

(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 blockages.

NG → **REPAIR OR REPLACE VACUUM HOSES**

OK

15	CHECK OPERATION OF EVAP VSV (See page 12–9)

OK: Air from port E flows out through port F when applying the battery voltage.

OK → **Go to step 16**

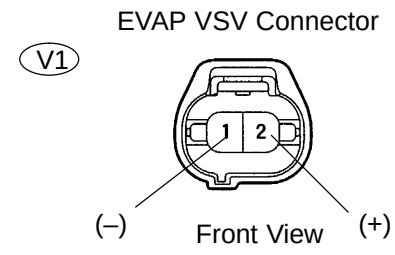
NG

REPLACE VSV AND CHARCOAL CANISTER, AND THEN CLEAN VACUUM HOSE

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16	CHECK HARNESS AND CONNECTOR(EVAP VSV – ECM, EVAP VSV – EFI M RELAY)

Wire Harness Side:



(a) Disconnect the V1 EVAP VSV connector.
(b) Turn the power switch ON (IG).
(c) Measure the voltage between the specified terminal of the V1 EVAP VSV connector and body ground.

Standard :

Tester Connection	Specified Condition
EVAP VSV (V1–2) – Body ground	9 to 14 V

(d) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / EVAP VSV (press the right or left button).
(e) When the EVAP VSV is operated using the hand–held tester, measure the voltage between the specified terminals of the V1 EVAP VSV connector.

Standard :

Tester Operation	Tester Connection	Specified Condition
VSV is ON	EVAP VSV: (V1–1) – (V1–2)	9 to 14 V
VSV is OFF	EVAP VSV: (V1–1) – (V1–2)	0 V

(f) Turn the power switch OFF.
(g) Check the resistance in EVAP VSV wire harness.

Standard :

Tester Connection	Specified Condition
EVAP VSV (V1–1) – Body ground	10 Ω or higher
EVAP VSV (V1–2) – Body ground	10 Ω or higher

(h) Reconnect the EVAP VSV connector.

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

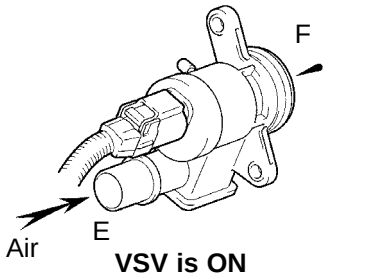
OK

REPLACE ECM (See page 10–24)

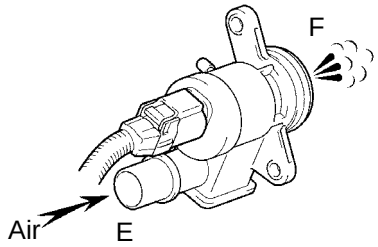
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17	PERFORM ACTIVE TEST BY HAND–HELD TESTER(CCV)

CCV:



VSV is ON



VSV is OFF

A72896

(a) Remove the CCV.
(b) Turn the power switch ON (IG).
(c) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / CAN CTRL VSV (press the right or left button).
(d) Check the CCV operation while operating it with using hand–held tester.

Standard:

Tester Operation	Specified Condition
VSV is ON	Air does not flow from port E to F
VSV is OFF	Air from port E flows out through port F

(e) Reinstall the CCV.

OK → **Go to step 21**

NG

18	CHECK VACUUM HOSES(CCV – CHARCOAL CANISTER)

(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 blockages.

NG → **REPAIR OR REPLACE VACUUM HOSE**

OK

19	CHECK OPERATION OF CCV (See page 12–9)

OK: Air does not flow from port E to F when applying the battery voltage.

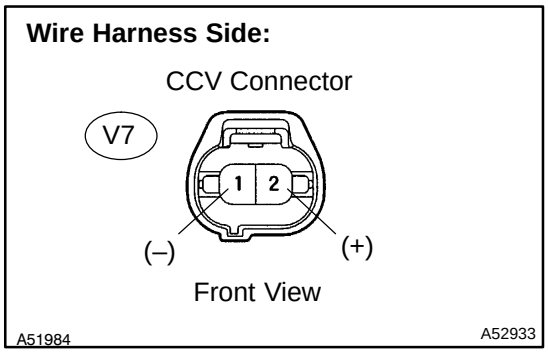
OK → **Go to step 20**

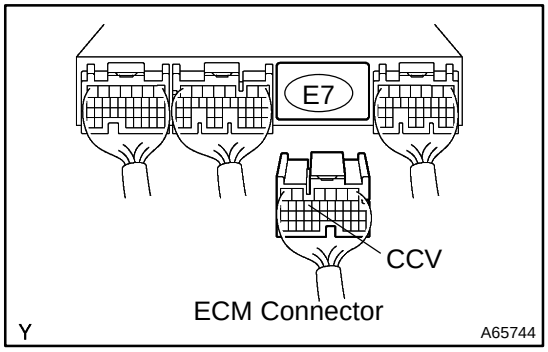
NG

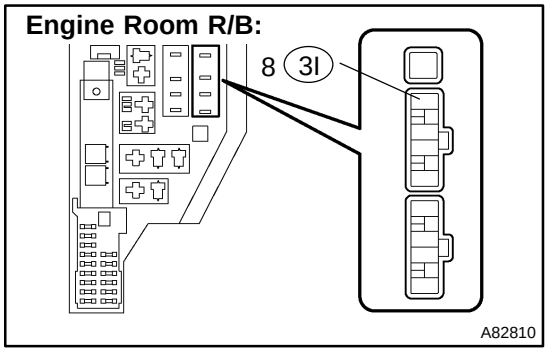
REPLACE VSV AND CHARCOAL CANISTER, AND THEN CLEAN VACUUM HOSE

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20 CHECK HARNESS AND CONNECTOR(CCV – ECM, CCV – EFI M RELAY)







(a) Check the harness and connectors between the CCV and ECM.
(1) Disconnect the V7 CCV connector.
(2) Disconnect the E7 ECM connector.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CCV (V7–1) – CCV (E7–13)	Below 1 Ω

Tester Connection	Specified Condition
CCV (V7–1) or CCV (E7–13) – Body ground	10 kΩ or higher

(4) Reconnect the CCV connector.
(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the CCV and the EFI M relay.
(1) Disconnect the V7 CCV connector.
(2) Remove the integration relay from the engine room R/B.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CCV (V7–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CCV (V7–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

(4) Reconnect the CCV connector.
(5) Reinstall the integration relay.

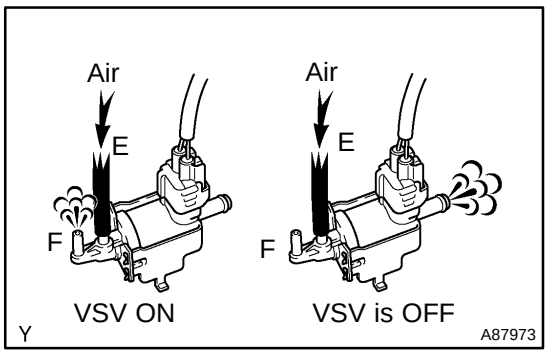
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM (See page 10–24)

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21	PERFORM ACTIVE TEST BY HAND–HELD TESTER(VSV FOR PURGE FLOW SWITCHING VALVE)



(a) Remove the VSV for purge flow switching valve.
(b) Turn the power switch ON (IG).
(c) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / TANK BYPASS VSV (press the right or left button).
(d) Check the VSV for purge flow switching valve operation while operating it using the hand–held tester.

Standard:

Tester Operation	Specified Condition
VSV is ON	Air from port E flows out through port F
VSV is OFF	Air does not flow from port E to F

(e) Reinstall the VSV for purge flow switching valve.

OK → **Go to step 24**

NG

22	INSPECT VSV FOR PURGE FLOW SWITCHING VALVE(OPERATION) (See page 12–9)

OK: Air from port E flows out through port F when applying the battery voltage.

NG → **Go to step 23**

OK

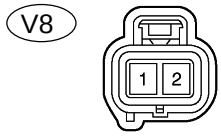
REPLACE VSV AND CHARCOAL CANISTER, AND THEN CLEAN VACUUM HOSE

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23	CHECK HARNESS AND CONNECTOR(VSV FOR PURGE FLOW SWITCHING VALVE – EFI M RELAY, VSV FOR PURGE FLOW SWITCHING VALVE – ECM)

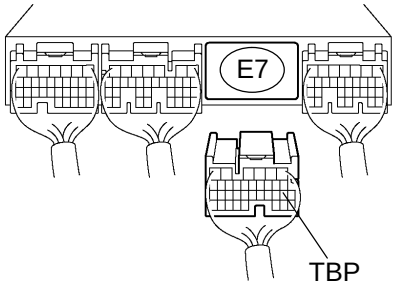
Wire Harness Side:

VSV for Purge Flow Switching Valve



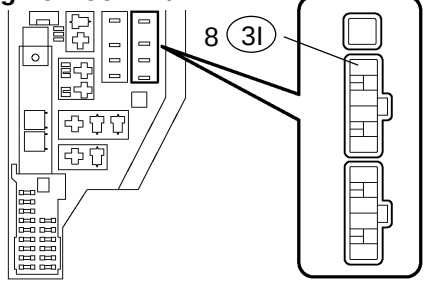
Front View

Y A72890



Y ECM Connector A65744

Engine Room R/B:



A82810

(a) Check the harness and the connectors between the VSV for purge flow switching valve and the ECM.
  (1) Disconnect the V8 VSV for purge flow switching valve connector.
  (2) Disconnect the E7 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–1) – TBP (E7–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–1) or TBP (E7–18) – Body ground	10 kΩ or higher

  (4) Reconnect the VSV for purge flow switching valve connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the VSV for purge flow switching valve and the EFI M relay.
  (1) Disconnect the V8 VSV for purge flow switching valve connector.
  (2) Remove the integration relay from the engine room R/B.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

  (4) Reconnect the VSV for purge flow switching valve connector.
  (5) Reinstall the integration relay.

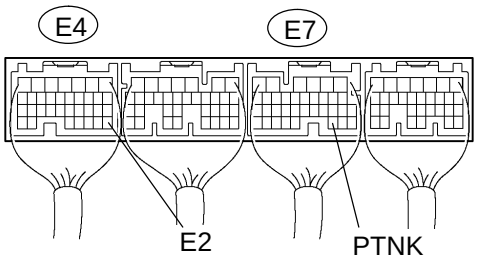
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM (See page 10–24)

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24	PERFORM ACTIVE TEST BY HAND–HELD TESTER(CHARCOAL CANISTER AND FUEL TANK)



(a) Connect the hand–held tester to the DLC3.
(b) Put the engine in inspection mode (see page 05–1).
(c) Start the engine.
(d) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / CAN CTRL VSV, and turn ON the CCV.
(e) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / EVAP VSV.
(f) Turn ON the EVAP VSV until voltage between terminals PTNK and E2 becomes 1.2 V.
(g) Turn EVAP VSV OFF.
(h) Measure the voltage between terminals PTNK and E2 of the ECM connector for 30 seconds after switching the VSV for EVAP from ON to OFF

Standard:

Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	2.3 V or less

OK → **REPLACE ECM (See page 10–24)**

NG

25	INSPECT FUEL TANK ASSY

OK: Fuel tank has no damage (crack or hole).

NG → **REPLACE FUEL TANK ASSY**

OK

26	INSPECT CHARCOAL CANISTER ASSY (See page 12–9)

OK: Canister has no crack or hole.

NG → **REPLACE CHARCOAL CANISTER ASSY**

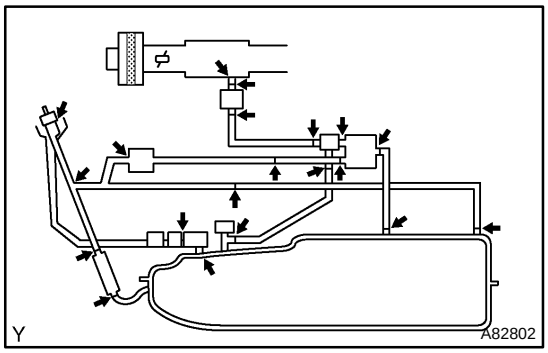
OK

REPLACE ECM (See page 10–24)

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OBD II scan tool (excluding hand–held tester):

1	CHECK WHETHER THERE ARE SIGNS OF ANY ACCIDENT NEAR FUEL TANK OR CHARCOAL CANISTER(OR ANY MODIFICATION)



(a) Check whether hoses close to the fuel tank have been modified, and check if there are signs of any accident near the fuel tank.
  (1) Check the following parts for cracks, deformation or loose connections:
    - Fuel tank
    - Fuel tank filler pipe
    - Hoses and tubes around fuel tank

NG → REPAIR OR REPLACE

OK

2	INSPECT FUEL TANK CAP ASSY(CHECK THAT FUEL TANK CAP MEETS SPECIFICATIONS)

NG → REPLACE CAP ASSY, FUEL TANK

OK

3	CHECK THAT FUEL TANK CAP IS CORRECTLY INSTALLED

NG → CORRECTLY REINSTALL FUEL TANK CAP

OK

4	CHECK FUEL TANK CAP ASSY (See page 12–9)

NG → REPLACE FUEL TANK CAP ASSY

OK

5	CHECK FILLER NECK FOR DAMAGE

NG → REPLACE FUEL TANK INLET PIPE SUB–ASSY

OK

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6	CHECK EACH VSV CONNECTOR FOR LOOSENESS AND DISCONNECTION(EVAP VSV, CCV, VSV FOR PURGE FLOW SWITCHING VALVE AND VAPOR PRESSURE SENSOR)

(a) Check that the vacuum hoses are connected correctly.
(b) Check the vacuum hoses for looseness or disconnection.
(c) Check the vacuum hoses for cracks, holes or damage.

NG → **REPAIR OR CONNECT VSV AND SENSOR CONNECTOR**

OK

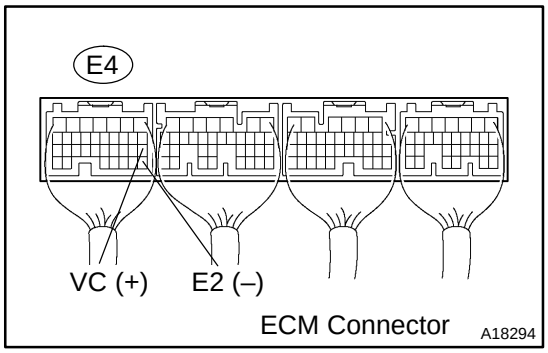
7	CHECK VACUUM HOSES

(a) Check the connection between the fuel tank and fuel EVAP pipe, the fuel EVAP pipe and under–floor fuel tube, the under–floor fuel tube and charcoal canister.
(b) Check the hose and the tube for cracks, holes or damage.

NG → **REPAIR OR REPLACE VACUUM HOSES**

OK

8	INSPECT ECM(VC – E2 VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E4 ECM connector.

Standard:

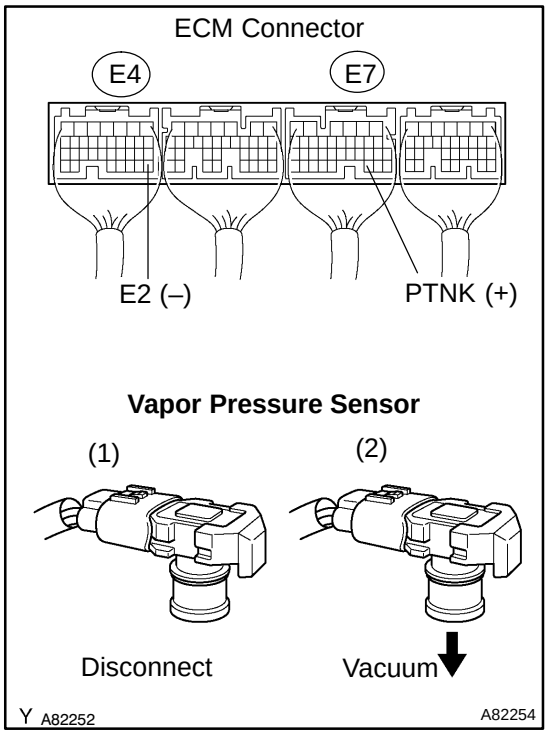
Tester Connection	Specified Condition
VC (E4–18) – E2 (E4–28)	4.5 to 5.5 V

NG → **REPLACE ECM (See page 10–24)**

OK

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9 INSPECT ECM(PTNK – E2 VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E4 and E7 ECM connectors.
(1) Remove the vapor pressure sensor.
Standard (1):

Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	2.9 to 3.7 V

(2) Using the 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).

Standard (2):

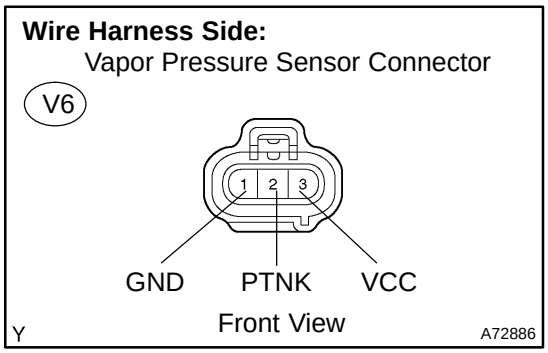
Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	0.5 V or less

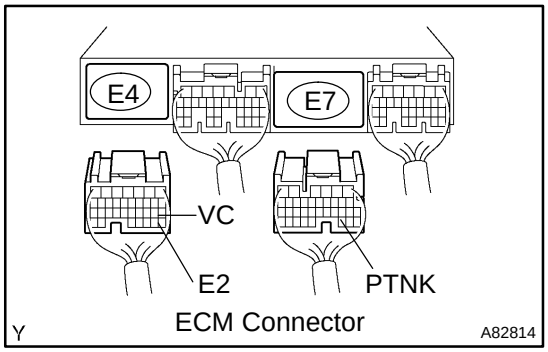
(3) Reinstall the vapor pressure sensor.

NG → **Go to step 11**

OK

10 CHECK HARNESS AND CONNECTOR(VAPOR PRESSURE SENSOR – ECM)





(a) Disconnect the V6 vapor pressure sensor connector.
(b) Disconnect the E4 and E7 ECM connectors.
(c) Check the resistance between the wire harness side connectors.
Standard (Check for open):

Tester Connection	Specified Condition
PTNK (V6–2) – PTNK (E7–30)	Below 1 Ω
GND (V6–1) – E2 (E4–28)	Below 1 Ω
VCC (V6–3) – VC (E4–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
PTNK (V6–2) or PTNK (E7–30) – Body ground	10 kΩ or higher
VCC (V6–3) or VC (E4–18) – Body ground	10 kΩ or higher

(d) Reconnect the vapor pressure sensor connector.
(e) Reconnect the ECM connectors.

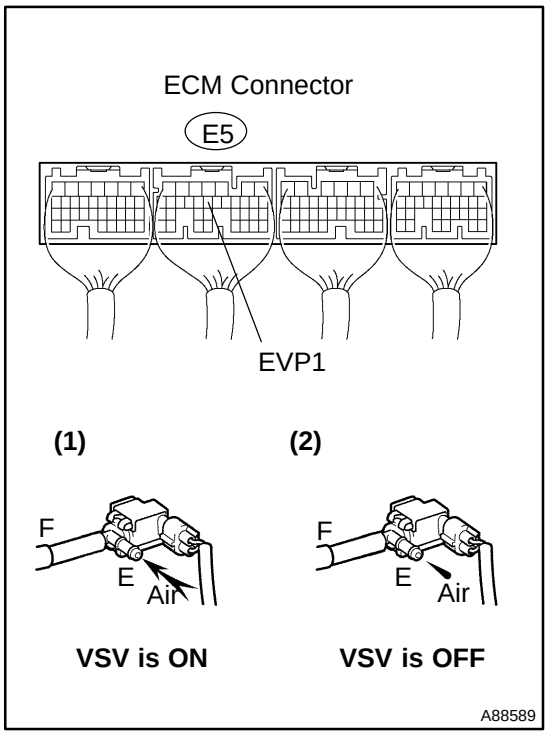
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

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REPLACE VAPOR PRESSURE SENSOR ASSY

11 INSPECT EVAP VSV



(a) Remove the EVAP VSV.
(b) Turn the power switch ON (IG).
(c) Check the VSV function.
(1) Connect terminal EVP1 (E5–14) of the ECM connector and the body ground (EVAP VSV should be OPEN, i.e. ON).
Standard (1):
Air from port E flows out through port F.
(2) Disconnect between terminal EVP1 of the ECM connector and the body ground (EVAP VSV should CLOSED, i.e. OFF).
Standard (2):
Air does not flow from port E to port F.
(d) Reinstall the EVAP VSV.

OK → **Go to step 14**

NG

12 CHECK OPERATION OF EVAP VSV (See page 12–9)

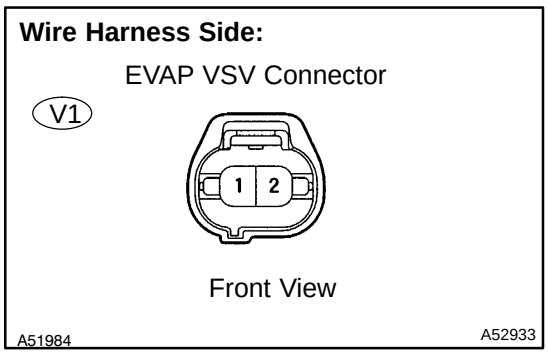
OK → **Go to step 13**

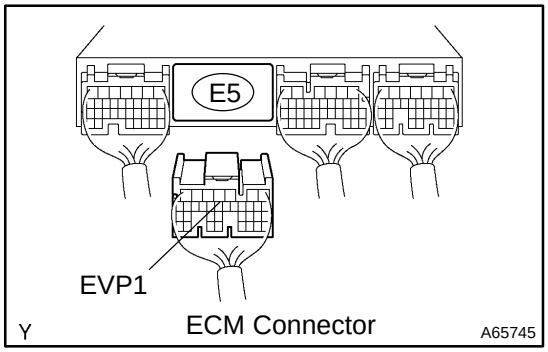
NG

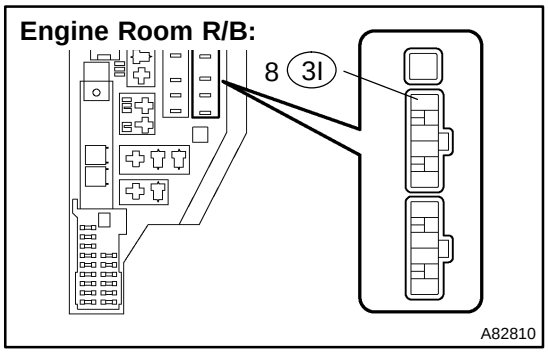
REPLACE VSV AND CLEAN VACUUM HOSES, AND THEN CHECK CHARCOAL CANISTER

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13	CHECK HARNESS AND CONNECTOR(EFI M RELAY – EVAP VSV, EVAP VSV – ECM)







(a) Check the harness and the connectors between the EVAP VSV and the ECM connectors.
  (1) Disconnect the V1 VSV for EVAP connector.
  (2) Disconnect the E5 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
EVAP VSV (V1–1) – EVP1 (E5–14)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
EVAP VSV (V1–1) or EVP1 (E5–14) – Body ground	10 kΩ or higher

  (4) Reconnect the EVAP VSV connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the EVAP VSV connector and the EFI M relay.
  (1) Disconnect the V1 EVAP VSV connector.
  (2) Remove the integration relay from the engine room R/B.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
EVAP VSV (V1–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
EVAP VSV (V1–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

  (4) Reconnect the EVAP VSV connector.
  (5) Reinstall the integration relay.

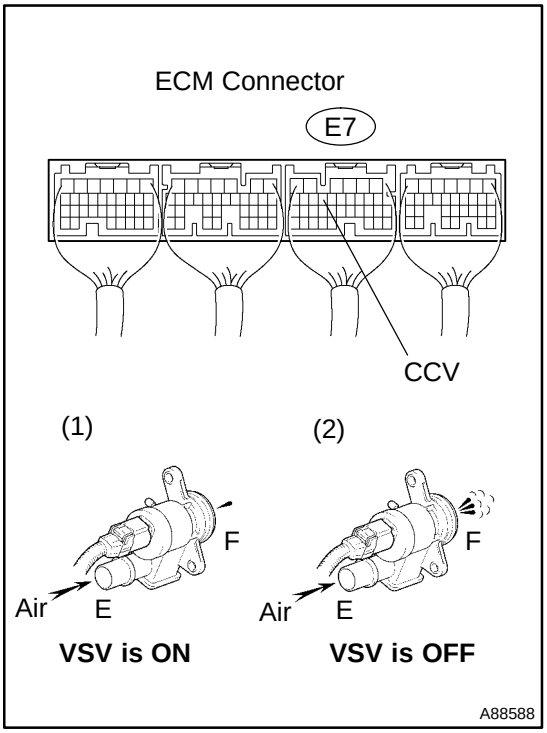
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM (See page 10–24)

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14	INSPECT CCV



(a) Remove the CCV.
(b) Turn the power switch ON (IG).
(c) Check the VSV function.
(1) Connect terminal CCV (E7–13) of the ECM connector and the body ground (CCV should be CLOSED, i.e. ON).
Standard (1):
Air does not flow from port E to port F.
(2) Disconnect between terminal CCV of the ECM connector and the body ground (CCV should be OPEN, i.e. OFF).
Standard (2):
Air from port E flows out through port F.
(d) Reinstall the CCV.

OK → **Go to step 17**

NG

15	CHECK OPERATION OF CCV (See page 12–9)

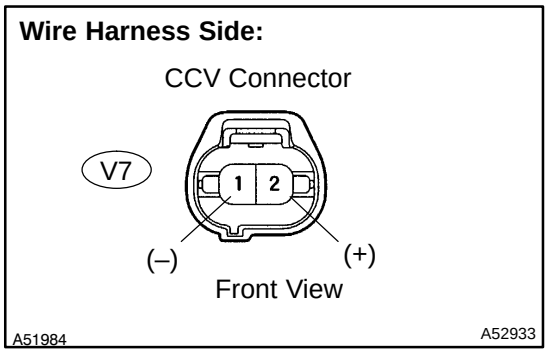
OK → **Go to step 16**

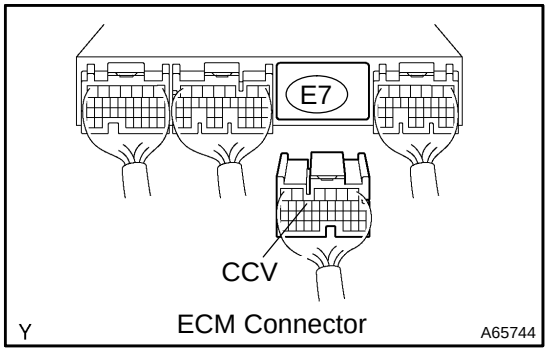
NG

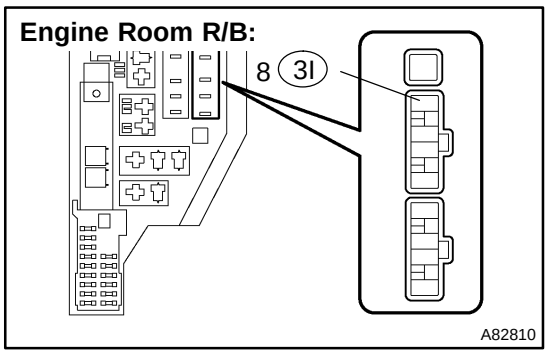
REPLACE VSV AND CHARCOAL CANISTER, AND THEN CLEAN VACUUM HOSE (VACUUM HOSE BETWEEN CHARCOAL CANISTER AND CCV)

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16 CHECK HARNESS AND CONNECTOR(EFI M RELAY – CCV, CCV – ECM)







(a) Check the harness and the connectors between the CCV connector and the ECM connectors.
(1) Disconnect the V7 CCV connector.
(2) Disconnect the E7 ECM connector.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CCV (V7–1) – CCV (E7–13)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CCV (V7–1) or CCV (E7–13) – Body ground	10 kΩ or higher

(4) Reconnect the CCV connector.
(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the CCV connector and the EFI M relay.
(1) Disconnect the V7 CCV connector.
(2) Remove the integration relay from the engine room R/B.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CCV (V7–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CCV (V7–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

(4) Reconnect the CCV connector.
(5) Reinstall the integration relay.

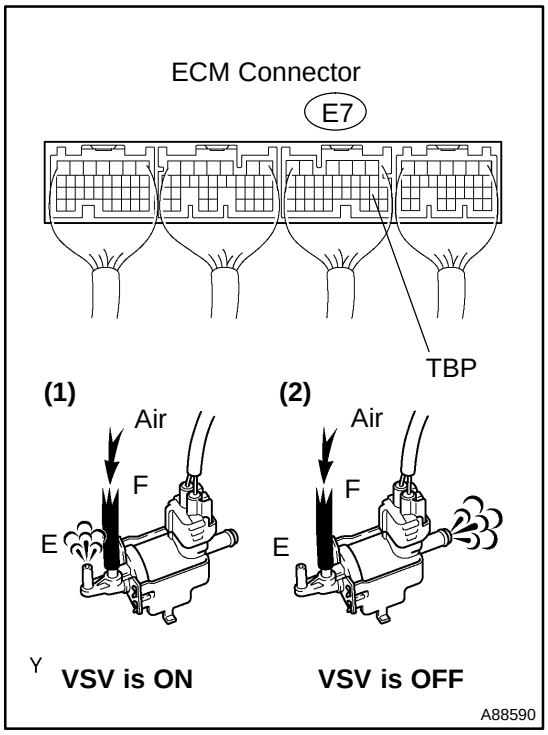
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM (See page 10–24)

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17	INSPECT VSV FOR PURGE FLOW SWITCHING VALVE



(a) Remove the VSV for purge flow switching valve.
(b) Turn the power switch ON (IG).
(c) Check the VSV function.
(1) Connect terminal TBP (E7–18) of the ECM connector and the body ground (VSV for purge flow switching valve should be OPEN, i.e. ON).

Standard (1):

Air from port E flows out through port F.

(2) Disconnect between terminal TBP of the ECM connector and the body ground (VSV for purge flow switching valve should be CLOSED, i.e. OFF).

Standard (2):

Air does not flow from port E to port F.

(d) Reinstall the VSV for purge flow switching valve.

OK → **REPLACE CHARCOAL CANISTER ASSY**

NG

18	CHECK OPERATION OF VSV(FOR PURGE FLOW SWITCHING VALVE) (See page 12–9)

OK → **Go to step 19**

NG

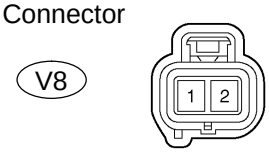
REPLACE VSV AND CHARCOAL CANISTER, AND THEN CLEAN VACUUM HOSE

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19	CHECK HARNESS AND CONNECTOR(EFI M RELAY – VSV FOR PURGE FLOW SWITCHING VALVE, VSV FOR PURGE FLOW SWITCHING VALVE – ECM)

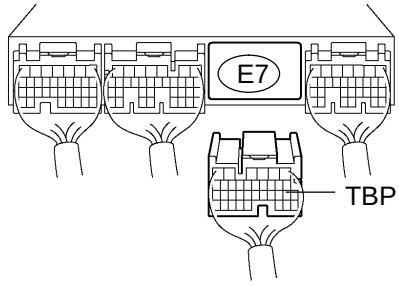
Wire Harness Side:

VSV for Purge Flow Switching Valve Connector



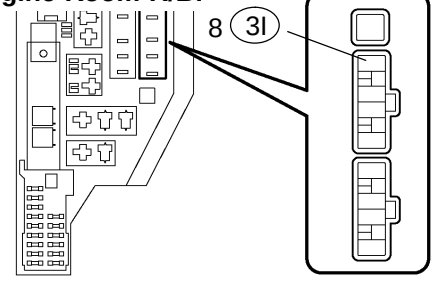
Front View

Y A72890



Y ECM Connector A65744

Engine Room R/B:



A82810

(a) Check the harness and the connectors between the VSV connector for purge flow switching valve and the ECM connectors.

(1) Disconnect the V8 VSV for purge flow switching valve connector.

(2) Disconnect the E7 ECM connector.

(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–1) – TBP (E7–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–1) or TBP (E7–18) – Body ground	10 kΩ or higher

(4) Reconnect the VSV for purge flow switching valve connector.

(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the VSV for purge flow switching valve connector and the EFI M relay.

(1) Disconnect the V8 VSV for purge flow switching valve connector.

(2) Remove the integration relay from the engine room R/B.

(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

(4) Reconnect the VSV for purge flow switching valve connector.

(5) Reinstall the integration relay.

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

OK

REPLACE ECM (See page 10–24)

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DTC	P0442	EVAPORATIVE EMISSION CONTROL SYSTEM LEAK DETECTED (SMALL LEAK)

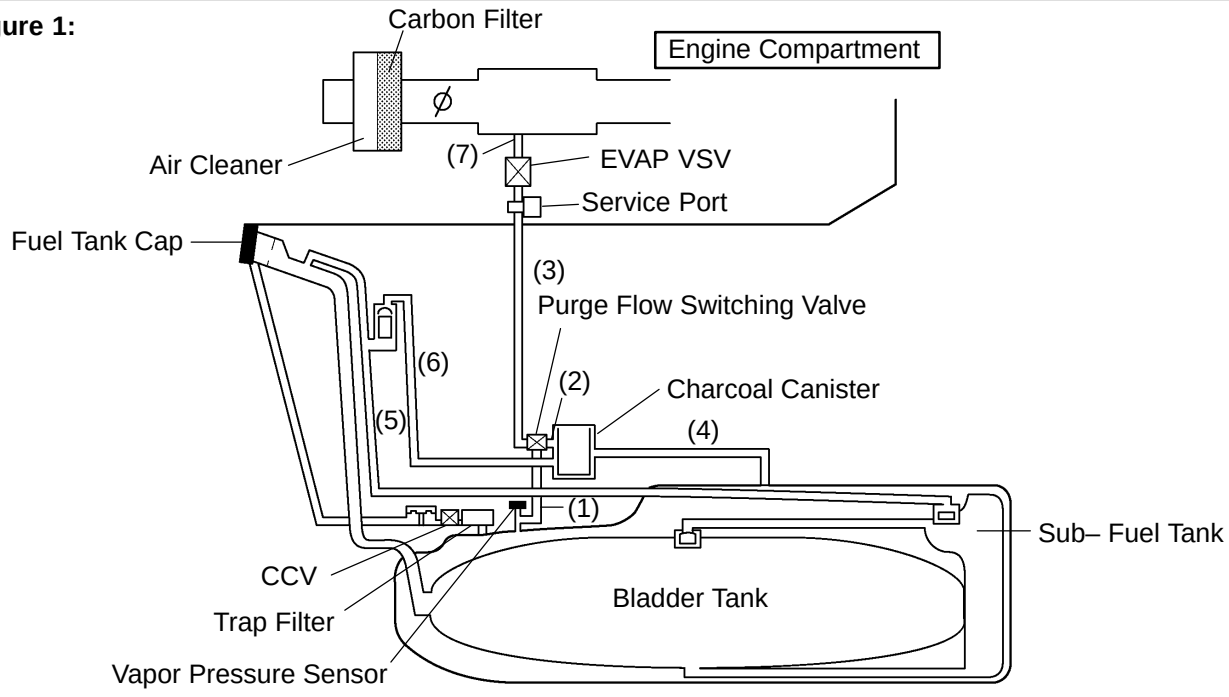
DTC	P0455	EVAPORATIVE EMISSION CONTROL SYSTEM LEAK DETECTED (GROSS LEAK)

DTC	P0456	EVAPORATIVE EMISSION CONTROL SYSTEM LEAK DETECTED (VERY SMALL LEAK)

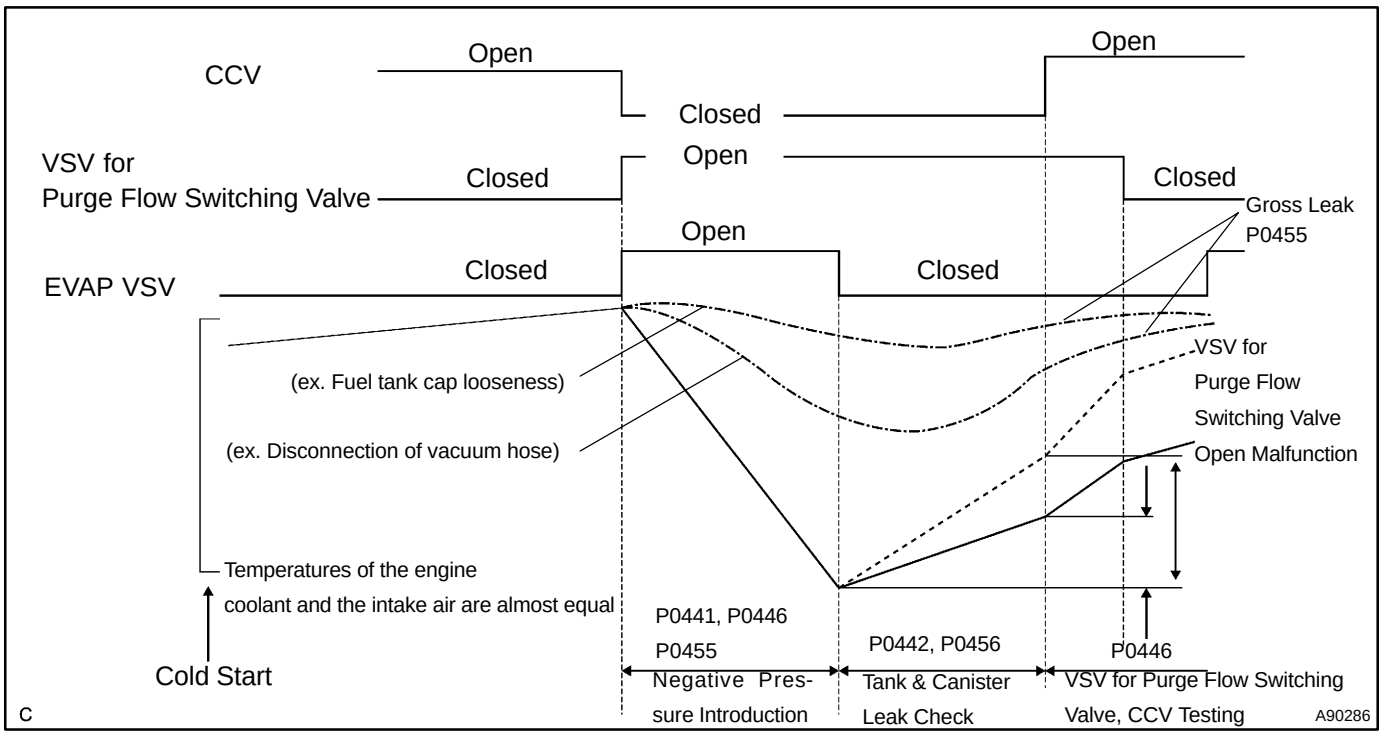
CIRCUIT DESCRIPTION

The vapor pressure sensor and the VSV for the canister closed valve (CCV) are used to detect abnormalities in the evaporative emission control system. The ECM decides whether there is an abnormality in the evaporative emission control system based on the vapor pressure sensor signal.
DTC P0442, P0455 or P0456 is recorded by the ECM when evaporative emissions leak from the components within the dotted line in figure 1 below, or when the vapor pressure sensor malfunctions.

Figure 1:



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DTC No.	DTC Detection Condition	Trouble Area
P0442	After negative pressure (vacuum) introduction is completed, if the pressure in the EVAP system sharply increases (small leak) (2 trip detection logic)	• Fuel tank cap is incorrectly installed • Fuel tank cap is cracked or damaged • Vacuum hose cracks is blocked, damaged or disconnected ((1), (2), (3), (4), (5), (6) and (7) in Fig. 1) • 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 • Open or short in VSV for purge flow switching valve circuit • VSV for purge flow switching valve • Fuel tank is cracked, or damaged • Charcoal canister is cracked, or damaged • Fuel tank over fill check valve is cracked or damaged • ECM
P0455	Following conditions are met: • While the negative pressure introduction is performed, if the fuel tank pressure does not reach standard level • If the pressure in the EVAP system sharply increases during leak check	• Same as DTC P0442
P0456	If the pressure in the EVAP system slightly increases while the ECM performs a leak check (very small leak) (2 trip detection logic)	• Same as DTC P0442

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HINT:
Typical DTC output of each trouble part.

Trouble Part	Trouble Condition	Typical DTC Output (*1)
—	Small leak	P0442 and/or P0456
—	Medium leak (ex: Vacuum hose looseness)	P0442 and/or P0455
—	Large leak (ex: Fuel tank cap looseness)	P0441 and P0442 and P0446 and P0455 (*2)
EVAP VSV	Open malfunction	P0441
EVAP VSV	Close malfunction	P0441 and P0442 and P0446
CCV	Open malfunction	P0441 and P0442 and P0446 and P0455
CCV	Close malfunction	P0446
VSV for Purge flow Switching valve	Open malfunction	P0446
VSV for Purge flow Switching valve	Close malfunction	P0441 and P0442 and P0446

*1: ECM may output some other DTCs combination.
*2: Refer to DTCs P0441 and P0446 on page 05–231.

MONITOR DESCRIPTION

The evaporative emission system consists of the vapor pressure sensor, the canister close valve (CCV), the VSV for purge flow switching valve and the EVAP VSV (Purge VSV). These are used to detect malfunction in the system by ECM.
This test will run once per driving cycle when the ECM detects stable vapor pressure in the fuel tank. While the vehicle is being driven on rough or winding roads, the movement of the fuel in the tank will cause unstable fuel tank vapor pressure and the diagnostic test will not be executed.
The ECM performs the following steps:
(a) Closes the canister close valve (CCV) (shuts the system).
(b) Checks the stability of the fuel tank pressure. If the variation in the pressure is greater than the specified value, disables the diagnosis.
(c) Opens the EVAP VSV to introduce negative pressure (vacuum) from the intake manifold into the fuel tank.
(d) Closes the EVAP VSV to seal the fuel tank for storing the negative pressure.
(e) Monitors the negative pressure in the fuel tank for:
    (1) Rapid decrease, i.e. a large leak, 0.040 inch or more
    (2) Decrease greater than the normal value
    If the ECM detects either of above conditions, the ECM interprets this as a leak in the EVAP system. The ECM will illuminate the MIL (2 trip detection logic) and set a DTC.

MONITOR STRATEGY

Related DTCs	P0442: Small leak (0.040inch or more hole) detected P0455: Large leak detected P0456: Very small leak (0.020 inch or more hole)
Required sensors/components	Main: Vapor pressure sensor, EVAP VSV (purge VSV), CCV, Related: Engine coolant temperature sensor, Mass air flow meter
Frequency of operation	Once per driving cycle
Duration	60 seconds
MIL operation	2 driving cycles
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Battery voltage	11 V or more
Altitude	Less than 2,400 m (8,000 ft)
Intake air temperature (IAT)	10 °C (50 °F) or more
Intake air temperature (IAT) at engine start	0.040 inch malfunction: Between 10 °C (50 °F) and 35 °C (92 °F) 0.020 inch malfunction: Between 10 °C (50 °F) and 32 °C (89.6 °F) Gross leak malfunction: Between 10 °C (50 °F) and 35 °C (92 °F)
Engine coolant temperature (ECT) at engine start	Between 10 °C (50 °F) and 35 °C (92 °F)
Intake air temperature at engine start compared with engine coolant temperature	Maximum of 7°C (12.6°F) lower or 11.1°C (19.9°F) higher
EVAP VSV and CCV	Not operated by scan tool
Time after engine start	Less than 60 minutes
Vehicle speed	Less than 130 km/h
Fuel slosh	No sloshing, i.e. fairly smooth road
MAF	No great change
Fuel tank pressure change	Minimal change

TYPICAL MALFUNCTION THRESHOLDS

P0442: 0.040 inch malfunction detection

Fuel tank pressure changing value for 5 seconds from –2.0 kPa (–15 mmHg) point	Increases 0.187 kPa (1.4 mmHg) or more
Fuel tank pressure changing value for 5 seconds from –2.6 kPa (–20 mmHg) point	Increases 0.187 kPa (1.4 mmHg) or more

P0455: gloss leak

Fuel tank pressure changing value for 5 seconds from –2.0 kPa (–15 mmHg) point	Increases more than 0.187 kPa (1.4 mmHg)
Fuel tank pressure changing value for 5 seconds from –2.6 kPa (–20 mmHg) point	Increases more than 0.187 kPa (1.4 mmHg)
Fuel tank pressure minimum value	More than –2.4 kPa (18 mmHg)

P0456: 0.020 inch malfunction detection

Fuel tank pressure changing value for 5 seconds from –2.3 kPa (–17 mmHg) point	Increases more than 0.0533 kPa (0.4 mmHg)
Fuel tank pressure changing value for 5 seconds from –2.6 kPa (–20 mmHg) point	Increases more than 0.0533 kPa (0.4 mmHg)

MONITOR RESULT (MODE 06 DATA)

Test ID/Comp ID	Description of Test Data	Description of Test Limit	Conversion Factor (Unit)
$02/$03	Tank pressure change value monitored by the EVAP OBD pressure sensor	Malfunction criteria for vapor leak around fuel tank and canister	Multiply by 0.001 (kPa)

Refer to page 05–26 for detailed information on Checking Monitor Status.

*The ECM operates the purge VSV and the CCV as the following chart when the EVAP system is being monitored.

EVAP system condition	Purge VSV	CCV	EVAP (FTP) pressure
Before negative pressure introduction	Closed (OFF)	Open (OFF)	Positive
During negative pressure introduction	Open (ON)	Closed (OFF)	Intake manifold pressure is applied to EVAP system
After negative pressure introduction	Closed (OFF)	Open (OFF)	Negative

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INSPECTION PROCEDURE

HINT:

- When using the hand–held tester, follow the procedures under the title ”Hand–held tester ” (see below).
- When using the OBD II scan tool, follow the procedures under the title ”OBD II scan tool (excluding hand–held tester)” (see the procedures after the ”Hand–held tester” procedures).
- Always troubleshoot DTCs P0441 (purge flow), P0446 (CCV), P0451, P0452 and P0453 (evaporative pressure sensor) before troubleshooting DTCs P0442 or P0456.
- Ask the customer the following questions:
  1) When the MIL came on, if the fuel tank cap was loose and if it was then tightened.
  2) When refueling, if the fuel tank cap was loose.
  If the fuel tank cap was loose, that is why the DTC was stored.
  If the fuel cap was not loose or if the customer cannot remember, troubleshoot according to the procedures on the following page.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If the ENGINE RUN TIME in the freeze frame data is less than 200 seconds, carefully check the vapor pressure sensor.

Hand–held Tester:

1	**CHECK FUEL TANK CAP ASSY(CHECK THAT FUEL TANK CAP MEETS SPECIFICATIONS)**

OK: Tank cap meets specifications in the owner’s manual.

NG → **FUEL TANK CAP ASSY**

OK

2	**CHECK THAT FUEL TANK CAP IS CORRECTLY INSTALLED**

OK: Tank cap is correctly installed.

NG → **CORRECTLY REINSTALL FUEL TANK CAP**

OK

3	**INSPECT FUEL TANK CAP ASSY (See page 12–9)**

OK: Tank cap has no deformation.

NG → **REPLACE FUEL TANK CAP ASSY**

OK

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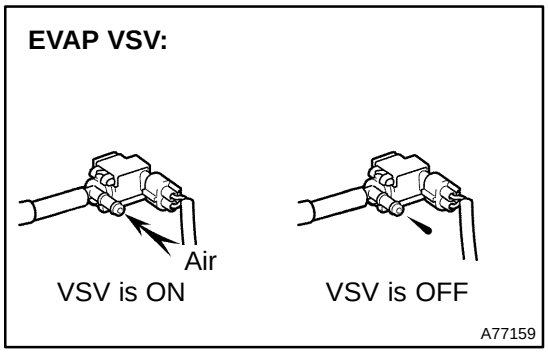
4	CHECK FILLER NECK FOR DAMAGE

(a) Remove the fuel tank cap.
(b) Visually check the fuel inlet pipe for damage.
(c) Reinstall the fuel tank cap.
OK: Filler neck has no damage.

NG → **REPLACE FUEL TANK INLET PIPE SUB–ASSY**

OK

5	PERFORM ACTIVE TEST BY HAND–HELD TESTER(CHECK FOR EVAP PURGE FLOW)



(a) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST on the hand–held tester.
(b) Disconnect the vacuum hose of the EVAP VSV from the charcoal canister.
(c) Put the engine in inspection mode (see page 05–1).
(d) Start the engine.
(e) Select the item: EVAP VSV (ALON) / ALL and operate EVAP VSV (press the right or left button).
(f) When the EVAP VSV is operated using the hand–held tester, check if the disconnected hose applies suction to your finger.
Result:
VSV is ON: Disconnected hose sucks.
VSV is OFF: Disconnected hose does not suck.
(g) Reconnect the vacuum hose.

OK → **Go to step 9**

NG

6	CHECK VACUUM HOSES(INTAKE MANIFOLD – EVAP VSV, EVAP VSV – CHARCOAL CANISTER)

(a) Check that the vacuum hoses are connected correctly.
(b) Check the vacuum hoses for looseness or disconnection.
(c) Check the vacuum hoses for cracks, hole, damage or blockages.

NG → **REPAIR OR REPLACE VACUUM HOSE**

OK

7	INSPECT EVAP VSV(OPERATION) (See page 12–9)

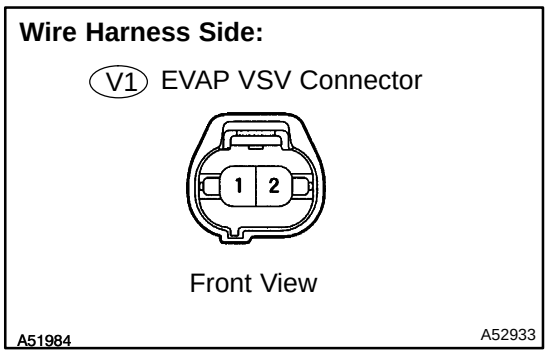
OK: Air from port E flows out through port F when applying the battery voltage.

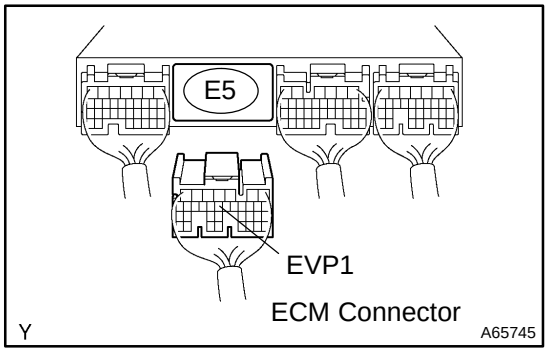
NG → **REPLACE EVAP VSV**

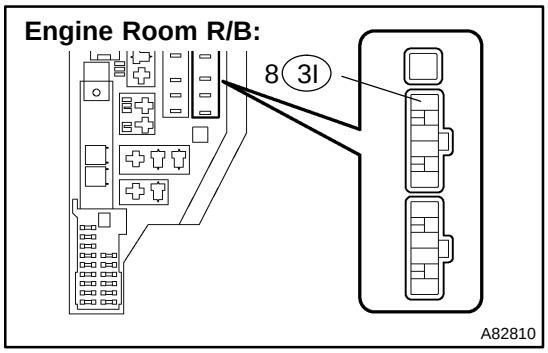
OK

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8	CHECK HARNESS AND CONNECTOR(EFI M RELAY – EVAP VSV, EVAP VSV – ECM)







(a) Check the harness and the connectors between the EVAP VSV and ECM connectors.
  (1) Disconnect the V1 EVAP VSV connector.
  (2) Disconnect the E5 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
EVAP VSV (V1–1) – EVP1 (E5–14)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
EVAP VSV (V1–1) or EVP1 (E5–14) – Body ground	10 kΩ or higher

  (4) Reconnect the EVAP VSV connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the EVAP VSV connector and EFI M relay.
  (1) Disconnect the V1 EVAP VSV connector.
  (2) Remove the integration relay from the engine room R/B.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
EVAP VSV (V1–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
EVAP VSV (V1–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

  (4) Reconnect the EVAP VSV connector.
  (5) Reinstall the integration relay.

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

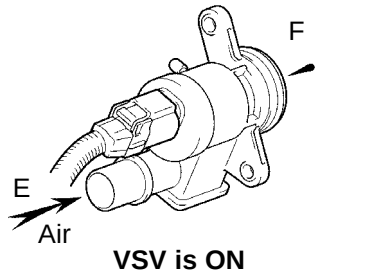
OK

REPLACE ECM (See page 10–24)

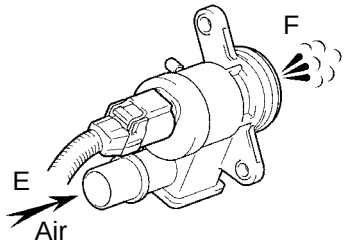
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9	PERFORM ACTIVE TEST BY HAND–HELD TESTER(CCV)

CCV:



VSV is ON



VSV is OFF

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(a) Disconnect the vacuum hose of the CCV from the charcoal canister.
(b) Put the engine in inspectio mode (see page 05–1).
(c) Start the engine.
(d) Select the item: DIAGNOSIS/ENHANCED OBD II/ENGINE AND ECT/ACTIVE TEST on the hand–held tester.
(e) Select the item: CAN CTRL VSV/ALL and operate CAN CTRL VSV (press the right or left button).
(f) Check the VSV operation when it is operated using the hand–held tester.

Standard:

Tester Operation	Specified Condition
VSV is ON	Air does not flow from port E to F
VSV is OFF	Air from port E flows out through port F

OK → **Go to step 13**

NG

10	CHECK VACUUM HOSES(CCV – CHARCOAL CANISTER)

(a) Check that the vacuum hoses are connected correctly.
(b) Check the vacuum hoses for looseness or disconnection.
(c) Check the vacuum hoses for cracks, hole, damage or blockages.

NG → **REPAIR OR REPLACE VACUUM HOSES**

OK

11	INSPECT CCV(OPERATION) (See page 12–9)

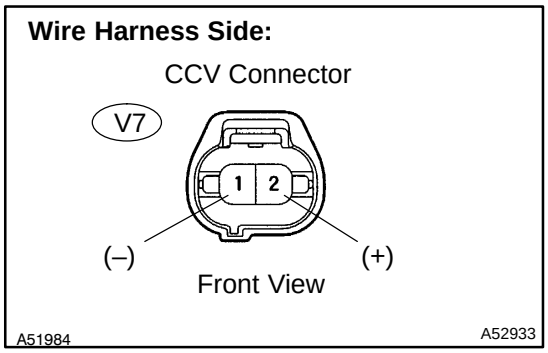
OK: Air does not flow from port E to F when applying the battery voltage.

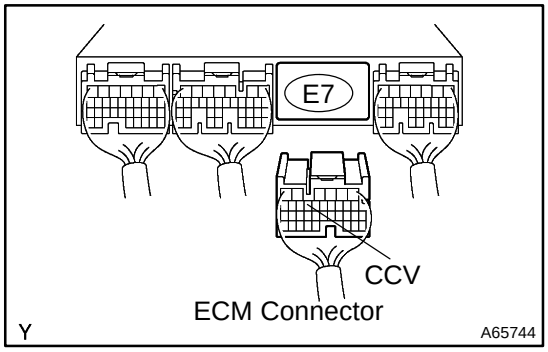
NG → **REPLACE CCV**

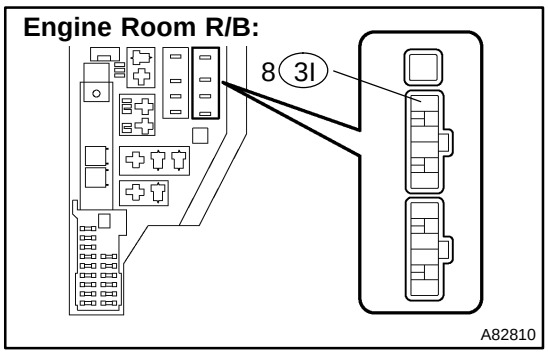
OK

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12 CHECK HARNESS AND CONNECTOR(EFI M RELAY – CCV, CCV – ECM)







(a) Check the harness and connectors between the CCV and ECM.
(1) Disconnect the V7 CCV connector.
(2) Disconnect the E7 ECM connector.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CCV (V7–1) – CCV (E7–13)	Below 1 Ω

Tester Connection	Specified Condition
CCV (V7–1) or CCV (E7–13) – Body ground	10 kΩ or higher

(4) Reconnect the CCV connector.
(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the CCV connector and EFI M relay.
(1) Disconnect the V7 CCV connector.
(2) Remove the integration relay from the engine room R/B.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CCV (V7–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CCV (V7–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

(4) Reconnect the CCV connector.
(5) Reinstall the integration relay.

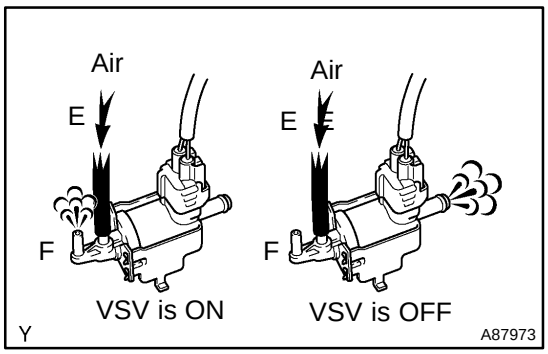
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM (See page 10–24)

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13	PERFORM ACTIVE TEST BY HAND–HELD TESTER(VSV FOR PURGE FLOW SWITCHING VALVE)



(a) Select the item: DIAGNOSIS/ENHANCED OBD II/ENGINE AND ECT/ACTIVE TEST on the hand–held tester.
(b) Select the item: TANK BYPASS VSV/ALL and operate TANK BYPASS VSV (press the right or left button).
(c) Check the VSV operation when it is operated using the hand–held tester.

Standard:

Tester Operation	Specified Condition
VSV is ON	Air from port E flows out through port F
VSV is OFF	Air does not flow from port E to F

OK → **Go to step 16**

NG

14	INSPECT VSV FOR PURGE FLOW SWITCHING VALVE(OPERATION) (See page 12–9)

OK: Air from port E flows out through port F when applying the battery voltage.

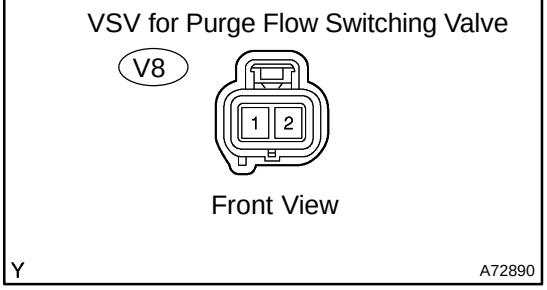
NG → **REPLACE VSV FOR PURGE FLOW SWITCHING VALVE**

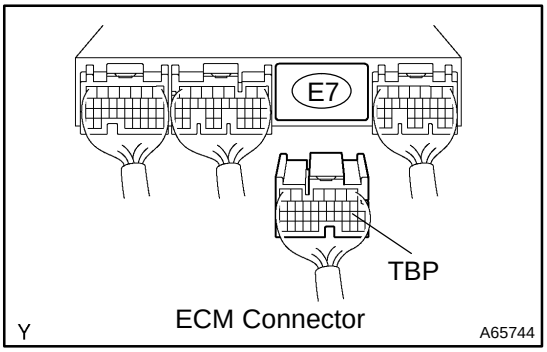
OK

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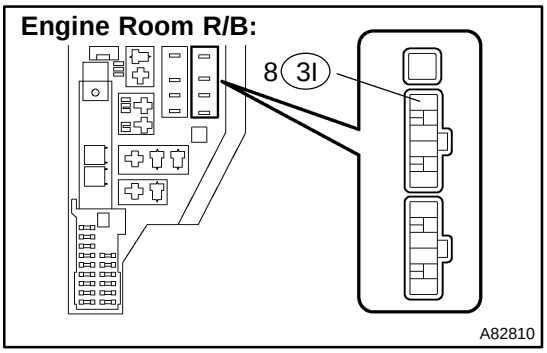
15	CHECK HARNESS AND CONNECTOR(EFI M RELAY – VSV FOR PURGE FLOW SWITCHING VALVE, VSV FOR PURGE FLOW SWITCHING VALVE – ECM)

Wire Harness Side:





Engine Room R/B:



(a) Check the harness and the connectors between the VSV for purge flow switching valve and the ECM connectors.
  (1) Disconnect the V8 VSV for purge flow switching valve connector.
  (2) Disconnect the E7 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–1) – TBP (E7–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–1) or TBP (E7–18) – Body ground	10 kΩ or higher

  (4) Reconnect the VSV for purge flow switching valve connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the VSV for purge flow switching valve connector and EFI M relay.
  (1) Disconnect the V8 VSV for purge flow switching valve connector.
  (2) Remove the integration relay from the engine room R/B.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

  (4) Reconnect the VSV for purge flow switching valve connector.
  (5) Reinstall the integration relay.

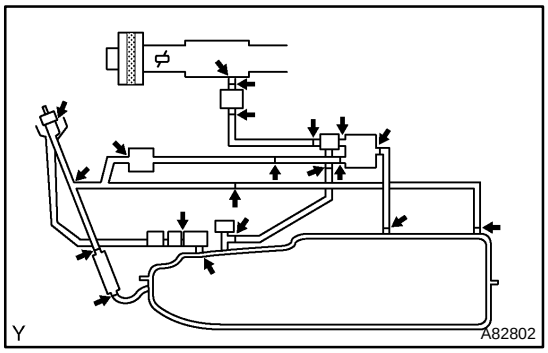
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM (See page 10–24)

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16 CHECK FOR EVAPORATIVE EMISSIONS LEAK(NEAR FUEL TANK)



(a) Check whether hoses close to the fuel tank have been modified, and check if there are signs of any accident near the fuel tank.
  (1) Check the following parts for cracks, deformation or loose connections:
    - Fuel tank
    - Fuel tank filler pipe
    - Hoses and tubes around fuel tank

  OK: No leakage in the system

NG	REPAIR OR REPLACE EVAPORATIVE EMISSIONS LEAK PART

OK

17 CHECK VACUUM HOSES((1), (2) AND (3))

(a) Check that the vacuum hoses are connected correctly.
(b) Check the vacuum hoses for looseness or disconnection.
(c) Check the vacuum hoses for cracks, hole or damage.

NG	REPAIR OR REPLACE VACUUM HOSE

OK

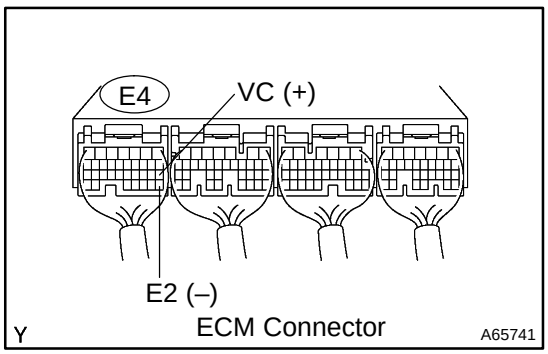
18 CHECK HOSE AND TUBE(FUEL TANK – CHARCOAL CANISTER)

(a) Check the connection between the fuel tank and fuel EVAP pipe, the fuel EVAP pipe and under–floor fuel tube, the under–floor fuel tube and charcoal canister.
(b) Check the hose and the tube for cracks, holes or damage.

NG	REPAIR OR REPLACE HOSE AND TUBE

OK

19 INSPECT ECM(VC VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the terminals of the E4 ECM connector.

Standard:

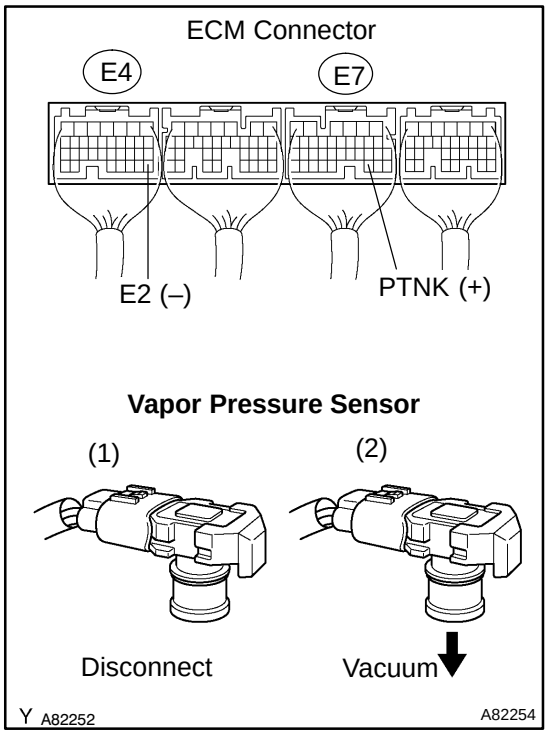
Tester Connection	Specified Condition
VC (E4–18) – E2 (E4–28)	4.5 to 5.5 V

NG	REPLACE ECM (See page 10–24)

OK

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20 INSPECT ECM(PTNK VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between terminals of the E4 and E7 ECM connectors.
(1) Disconnect the vacuum hose from the vapor pressure sensor.

Standard (1):

Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	2.9 to 3.7 V

NOTICE:

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

(2) Using the MITYVAC (Hand–held Vacuum Pump), apply a vacuum of 4.0 kPa (30 mmHg, 1.18 in.Hg) to the vapor pressure sensor.

Standard (2):

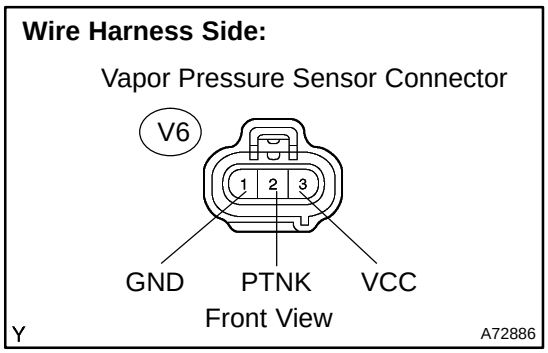
Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	0.5 V or less

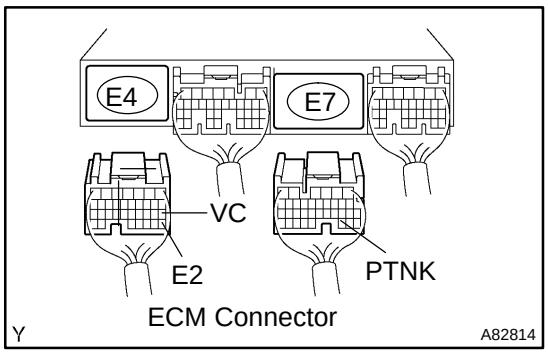
(3) Reconnect the vacuum hose.

OK → **Go to step 22**

NG

21 CHECK HARNESS AND CONNECTOR(VAPOR PRESSURE SENSOR – ECM)





(a) Disconnect the V6 vapor pressure sensor connector.
(b) Disconnect the E4 and E7 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
PTNK (V6–2) – PTNK (E7–30)	Below 1 Ω
GND (V6–1) – E2 (E4–28)	Below 1 Ω
VCC (V6–3) – VC (E4–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
PTNK (V6–2) or PTNK (E7–30) – Body ground	10 kΩ or higher
VCC (V6–3) or VC (E4–18) – Body ground	10 kΩ or higher

(d) Reconnect the vapor pressure sensor connector.
(e) Reconnect the ECM connectors.

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

OK

REPLACE VAPOR PRESSURE SENSOR ASSY

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22	INSPECT FUEL TANK ASSY

OK: Fuel tank has no crack or hole.

NG → **REPLACE FUEL TANK ASSY**

OK ↓

23	INSPECT CHARCOAL CANISTER ASSY(CRACKS, HOLES AND DAMAGE)

OK: Canister has no crack or holes.

NG → **REPAIR OR REPLACE CHARCOAL CANISTER ASSY**

OK ↓

REPLACE ECM (See page 10–24)

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OBDII scan tool (excluding Hand–held Tester):

1	CHECK FUEL TANK CAP ASSY(CHECK THAT FUEL TANK CAP MEETS SPECIFICATIONS)

NG → REPLACE FUEL TANK CAP ASSY

OK

2	CHECK THAT FUEL TANK CAP IS CORRECTLY INSTALLED

NG → CORRECTLY REINSTALL FUEL TANK CAP

OK

3	INSPECT FUEL TANK CAP ASSY (See page 12–9)

NG → REPLACE FUEL TANK CAP ASSY

OK

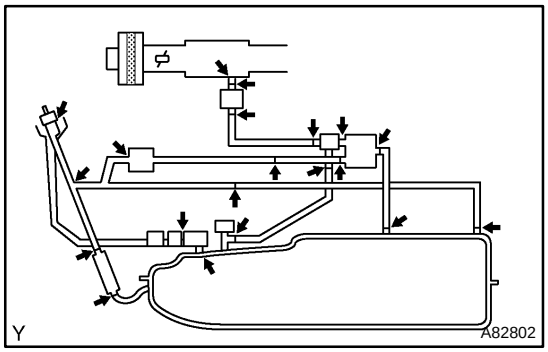
4	CHECK FILLER NECK FOR DAMAGE

(a) Remove the fuel tank cap.
(b) Visually check the fuel inlet pipe for damage.

NG → REPLACE FUEL TANK INLET PIPE SUB–ASSY

OK

5	CHECK FOR EVAPORATIVE EMISSIONS LEAK(NEAR FUEL TANK OR CHACOAL CANISTER)



(a) Check whether hoses close to the fuel tank have been modified, and check if there are signs of any accident near the fuel tank or the charcoal canister.
  (1) Check the following parts for cracks, deformation or loose connection:
    - Fuel tank
    - Charcoal canister
    - Fuel tank filler pipe
    - Hoses and tubes around fuel tank and charcoal canister

NG → REPAIR OR REPLACE EVAPORATIVE EMISSIONS LEAK PART

OK

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6	CHECK VACUUM HOSES((1), (2) AND (3))

(a) Check that the vacuum hoses are connected correctly.
(b) Check the vacuum hoses for looseness or disconnection.
(c) Check the vacuum hoses for cracks, holes or damage.

NG → REPAIR OR REPLACE VACUUM HOSE

OK

7	CHECK HOSE AND TUBE(FUEL TANK – CHARCOAL CANISTER)

(a) Check the connection between the fuel tank and fuel EVAP pipe, the fuel EVAP pipe and under–floor fuel tube, the under–floor fuel tube and charcoal canister.
(b) Check the hose and the tube for cracks, hole or damage.

NG → REPAIR OR REPLACE HOSE AND TUBE

OK

8	CHECK VACUUM HOSES((5), (6), (7), (8) AND (9) IN FIG. 1 IN CIRCUIT DESCRIPTION)

(a) Check that the vacuum hoses are connected correctly.
(b) Check the vacuum hoses for looseness or disconnection.
(c) Check the vacuum hoses for cracks, hole or damage.

NG → REPAIR OR REPLACE VACUUM HOSES

OK

9	CHECK EACH VSV CONNECTOR FOR LOOSENESS AND DISCONNECTION(EVAP VSV, CCV, VSV FOR PURGE FLOW SWITCHING VALVE)

NG → REPAIR OR CONNECT VSV AND SENSOR CONNECTOR

OK

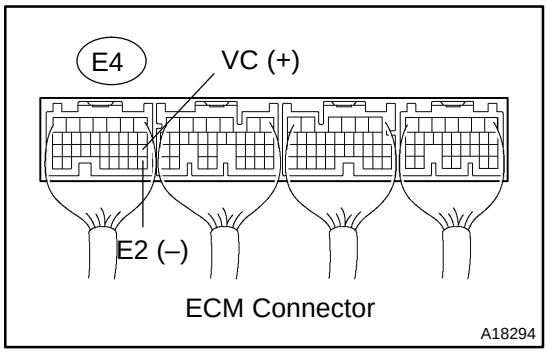
10	INSPECT CHARCOAL CANISTER ASSY(CRACKS, HOLES AND DAMAGE) (See page 12–9)

NG → CHECK AND REPLACE CHARCOAL CANISTER ASSY

OK

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11 INSPECT ECM(VC VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure voltage between the terminals of the E4 ECM connector.

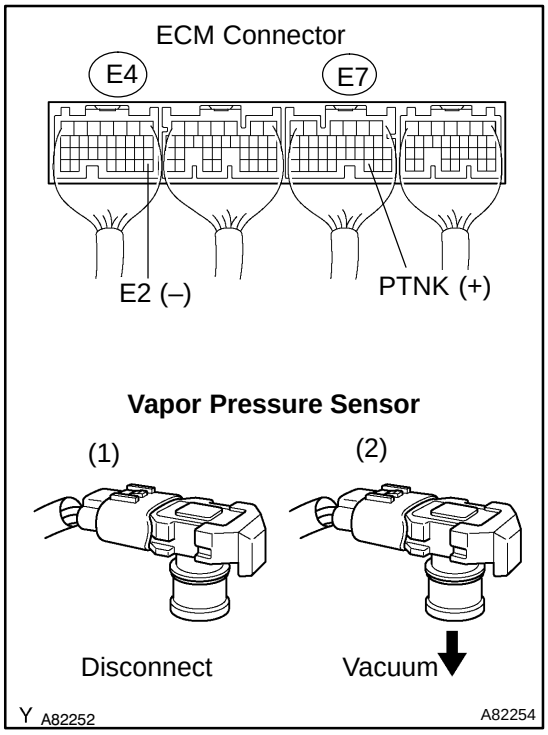
Standard:

Tester Connection	Specified Condition
VC (E4–18) – E2 (E4–28)	4.5 to 5.5 V

NG → **REPLACE ECM (See page 10–24)**

OK

12 INSPECT ECM(PTNK VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the terminals of the E4 and E7 ECM connector.
(1) Disconnect the vacuum hose from the vapor pressure sensor.

Standard (1):

Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	2.9 to 3.7 V

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

(2) Using the MITYVAC (Hand–held Vacuum Pump), apply a vacuum of 4.0 kPa (30 mmHg, 1.18 in.Hg) to the vapor pressure sensor.

Standard (2):

Tester Connection	Specified Condition
PTNK (E6–21) – E2 (E3–28)	0.5 V or less

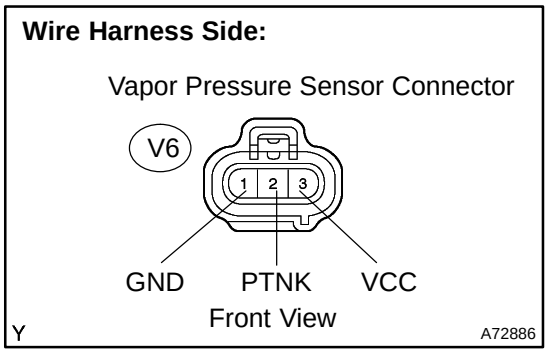
(3) Reconnect the vacuum hose from the vapor pressure sensor.

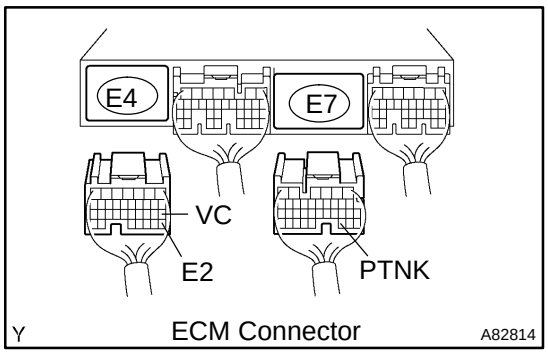
OK → **Go to step 14**

NG

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13 CHECK HARNESS AND CONNECTOR(VAPOR PRESSURE SENSOR – ECM)





(a) Disconnect the V6 vapor pressure sensor connector.
(b) Disconnect the E4 and E7 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
PTNK (V6–2) – PTNK (E7–30)	Below 1 Ω
GND (V6–1) – E2 (E4–28)	Below 1 Ω
VCC (V6–3) – VC (E4–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
PTNK (V6–2) or PTNK (E7–30) – Body ground	10 kΩ or higher
VCC (V6–3) or VC (E4–18) – Body ground	10 kΩ or higher

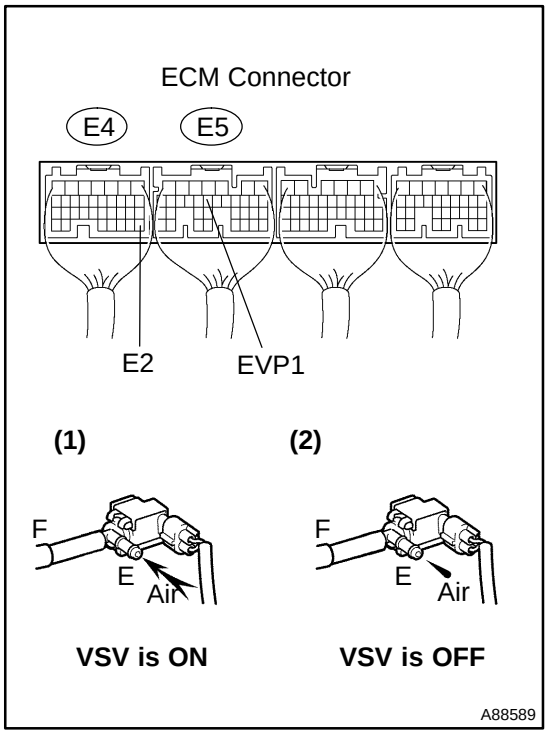
(d) Reconnect the vapor pressure sensor connector
(e) Reconnect the ECM connectors.

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

OK

REPLACE VAPOR PRESSURE SENSOR ASSY

14 INSPECT EVAP VSV(FUNCTION)



(a) Turn the power switch ON (IG).
(b) Check the VSV function.
(1) Connect terminals EVP1 and E2 of the ECM connector (VSV ON).

VSV is ON:
Air from port E flows out through port F

(2) Disconnect terminals EVP1 and E2 of the ECM connector (VSV OFF).

VSV is OFF:
Air does not flow from port E to port F

OK → **Go to step 17**

NG

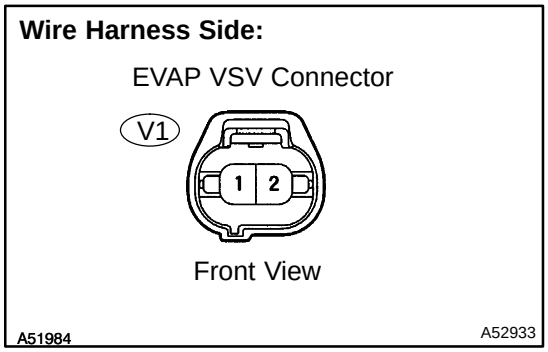
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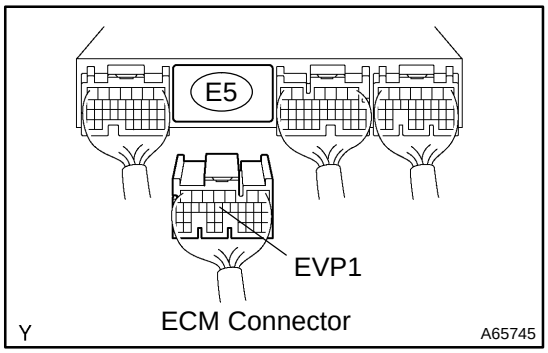
15	INSPECT EVAP VSV(OPERATION) (See page 12–9)

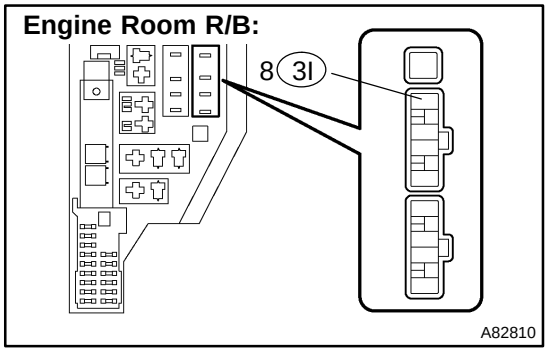
NG → REPLACE EVAP VSV

OK

16	CHECK HARNESS AND CONNECTOR(EFI M RELAY – EVAP VSV, EVAP VSV – ECM)







(a) Check the harness and connectors between the EVAP VSV and ECM connectors.
  (1) Disconnect the V1 EVAP VSV connector.
  (2) Disconnect the E5 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
EVAP VSV (V1–1) – EVP1 (E5–14)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
EVAP VSV (V1–1) or EVP1 (E5–14) – Body ground	10 kΩ or higher

  (4) Reconnect the EVAP VSV connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and connectors between the EVAP VSV connector and EFI M relay.
  (1) Disconnect the V1 EVAP VSV connector.
  (2) Remove the integration relay from the engine room R/B.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
EVAP VSV (V1–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
EVAP VSV (V1–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

  (4) Reconnect the EVAP VSV connector.
  (5) Reinstall the integration relay.

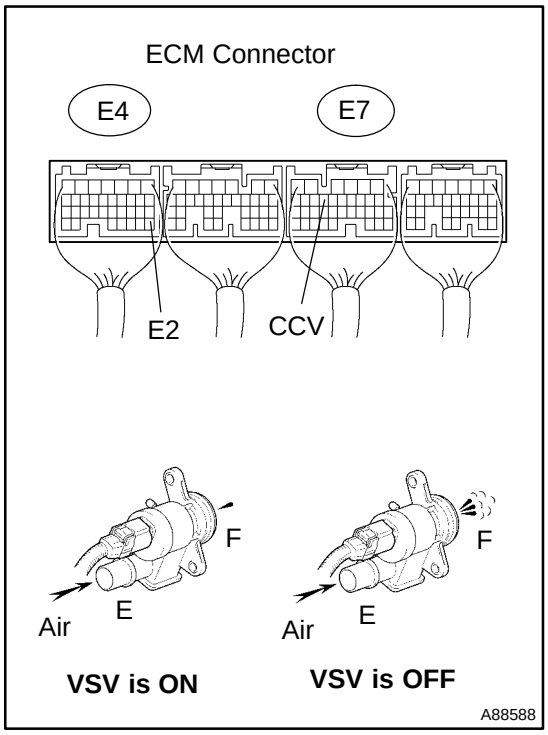
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (See page 10–24)

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17	INSPECT CCV(FUNCTION)



(a) Turn the power switch ON (IG).
(b) Check the VSV function.
(1) Connect terminals CCV and E2 of the ECM connector (VSV ON).
VSV is ON:
Air from port E flows out through port F
(2) Disconnect terminals CCV and E2 of the ECM connector (VSV OFF).
VSV is OFF:
Air does not flow from port E to port F

OK → **Go to step 20**

NG

18	INSPECT CCV(OPERATION) (See page 12–9)

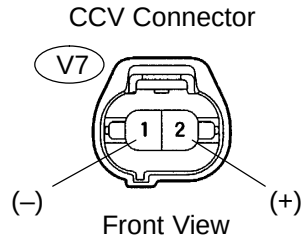
NG → **REPLACE CCV**

OK

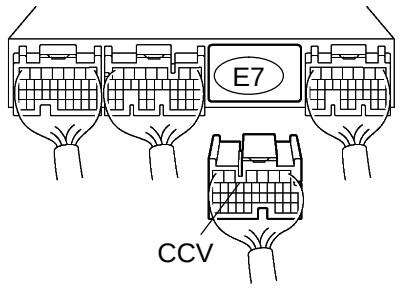
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19	CHECK HARNESS AND CONNECTOR(EFI M RELAY – CCV, CCV – ECM)

Wire Harness Side:

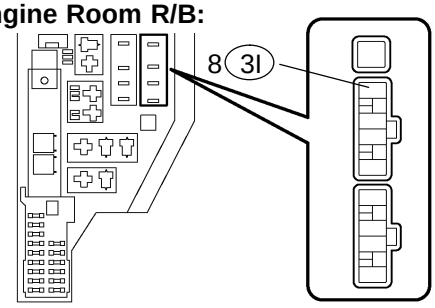


A51984 A52933



A65744

Engine Room R/B:



A82810

(a) Check the harness and the connectors between the CCV and ECM connectors.
(1) Disconnect the V7 CCV connector.
(2) Disconnect the E7 ECM connector.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CCV (V7–1) – CCV (E7–13)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CCV (V7–1) or CCV (E7–13) – Body ground	10 kΩ or higher

(4) Reconnect the CCV connector.
(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the CCV connector and EFI M relay.
(1) Disconnect the V7 CCV connector.
(2) Remove the integration relay from the engine room R/B.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CCV (V7–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CCV (V7–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

(4) Reconnect the CCV connector.
(5) Reinstall the integration relay.

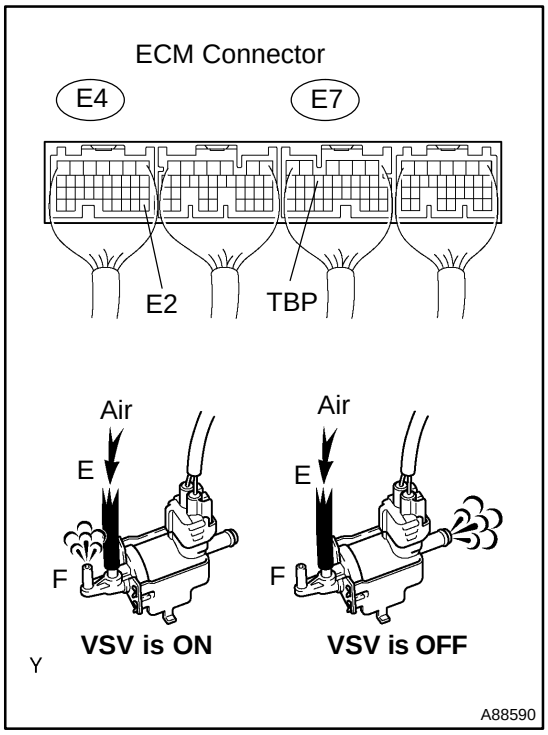
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM (See page 10–24)

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20	INSPECT VSV FOR PURGE FLOW SWITCHING VALVE(FUNCTION)



(a) Turn the power switch ON (IG).
(b) Check the VSV function.
(1) Connect terminals TBP and E2 of the ECM connector (VSV ON).
VSV is ON: Air from port E flows out through port F
(2) Disconnect terminals TBP and E2 of the ECM connector (VSV OFF).
VSV is OFF: Air does not flow from port E to port F

OK	Go to step 23

NG

21	INSPECT VSV FOR PURGE FLOW SWITCHING VALVE(OPERATION) (See page 12–9)

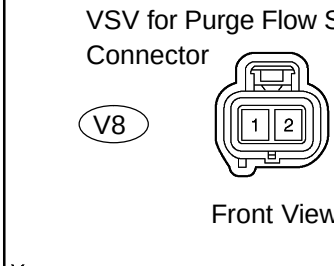
NG	REPLACE VSV FOR PURGE FLOW SWITCHING VALVE

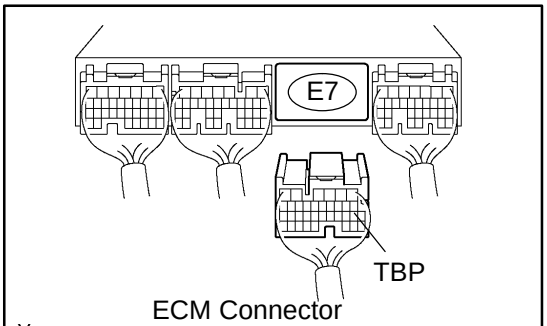
OK

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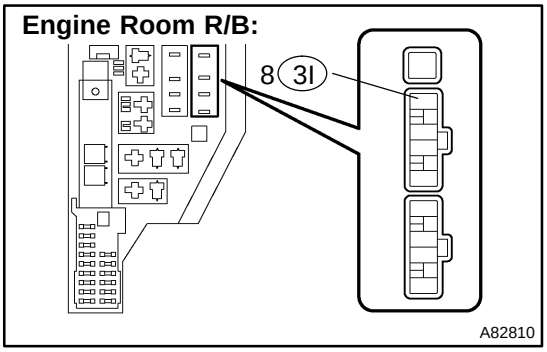
22	CHECK HARNESS AND CONNECTOR(EFI M RELAY – VSV FOR PURGE FLOW SWITCHING VALVE, VSV FOR PURGE FLOW SWITCHING VALVE – ECM)

Wire Harness Side:





Engine Room R/B:



(a) Check the harness and the connectors between the VSV for purge flow switching valve and ECM connectors.
  (1) Disconnect the V8 VSV for purge flow switching valve connector.
  (2) Disconnect the E7 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–1) – TBP (E7–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–1) or TBP (E7–18) – Body ground	10 kΩ or higher

  (4) Reconnect the VSV for purge flow switching valve connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the VSV for purge flow switching valve connector and EFI M relay.
  (1) Disconnect the V8 VSV for purge flow switching valve connector.
  (2) Remove the integration relay from the engine room R/B.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–2) – EFI M relay (3I–8)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
VSV for purge flow switching valve (V8–2) or EFI M relay (3I–8) – Body ground	10 kΩ or higher

  (4) Reconnect the VSV for purge flow switching valve connector.
  (5) Reinstall the integration relay.

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

OK

REPLACE ECM (See page 10–24)

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23	INSPECT FUEL TANK ASSY

NG → REPLACE FUEL TANK ASSY

OK

IT IS LIKELY THAT VEHICLE USER DID NOT PROPERLY CLOSE FUEL TANK CAP

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DTC	P0451	EVAPORATIVE EMISSION CONTROL SYSTEM PRESSURE SENSOR/SWITCH RANGE/PERFORMANCE

DTC	P0452	EVAPORATIVE EMISSION CONTROL SYSTEM PRESSURE SENSOR/SWITCH LOW INPUT

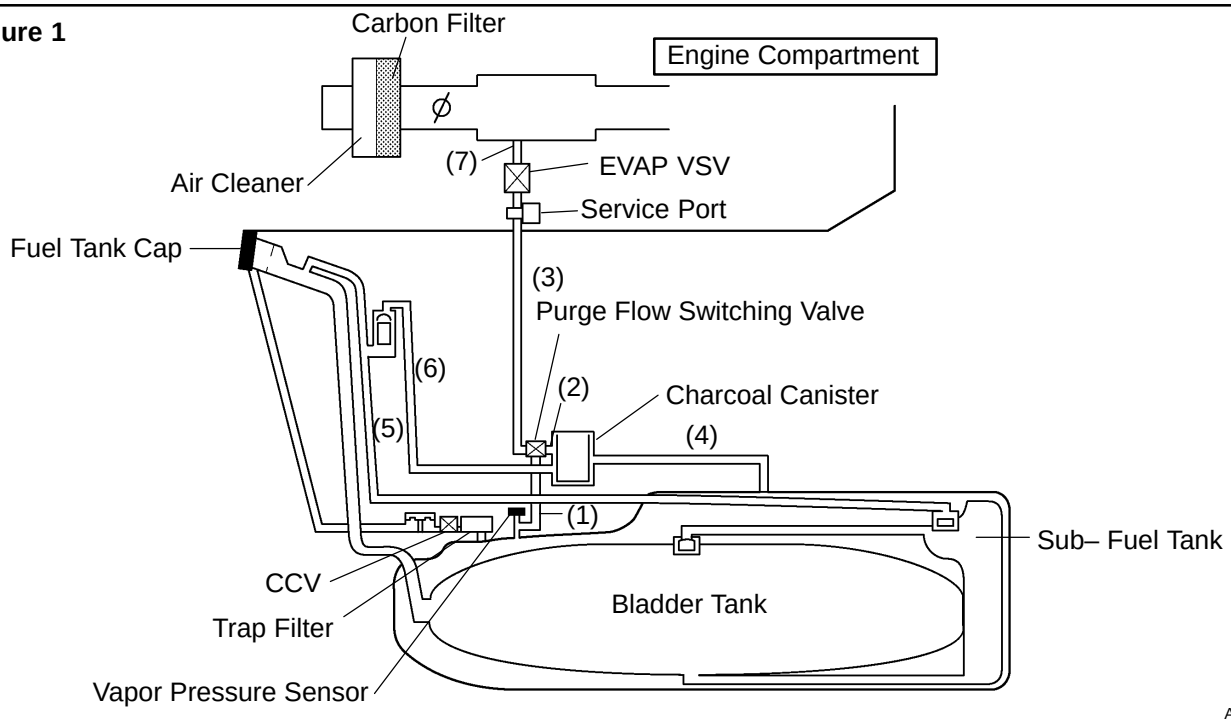
DTC	P0453	EVAPORATIVE EMISSION CONTROL SYSTEM PRESSURE SENSOR/SWITCH HIGH INPUT

CIRCUIT DESCRIPTION

The vapor pressure sensor, VSV for canister closed valve (CCV) and VSV for purge flow switching valve are used to detect abnormalities in the evaporative emission control system.

The ECM decides whether there is an abnormality in the evaporative emission control system based on the vapor pressure sensor signal.

Figure 1



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DTC No.	DTC Detection Condition	Trouble Area
P0451	Either condition (a) or (b) is met (2 trip detection logic): (a) Output of vapor pressure sensor frequently changes when vehicle speed is 0 mph and engine speed is idling (b) Output of vapor pressure sensor remains stuck for 5 minutes or more	• Open or short in vapor pressure sensor circuit • Vapor pressure sensor • ECM
P0452	Output of vapor pressure sensor remains below threshold: (2 trip detection logic)	• Open or short in vapor pressure sensor circuit • Vapor pressure sensor • ECM
P0453	Output of vapor pressure sensor remains above threshold: (2 trip detection logic)	• Open or short in vapor pressure sensor circuit • Vapor pressure sensor • ECM

MONITOR DESCRIPTION

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

P0451

The ECM senses pressure in the fuel tank using the vapor pressure sensor. The ECM supplies the sensor with a regulated 5 V reference–voltage and the sensor returns a signal voltage between 0.5 V and 4.5 V according to the pressure level in the fuel tank.
When the pressure in the fuel tank is low, the output voltage of the vapor pressure sensor is low. When it is high, the output voltage is high.
For this DTC P0451, the ECM checks for a ”noisy” sensor or a ”stuck” sensor.
The ECM checks for the ”noisy” sensor by monitoring the fuel tank pressures when the vehicle is stationary and there should be little variation in the tank pressure. If the indicated pressure exceeds specified limits, the ECM will illuminate the MIL and a DTC is set.
The ECM checks for the ”stuck” sensor by monitoring the fuel tank pressure for an extended time period. If the indicated pressure does not change over this period, the ECM will conclude that the fuel tank pressure sensor is malfunctioning. The ECM will illuminate the MIL and a DTC is set.

P0452 and P0453

The ECM senses pressure in the fuel tank using the vapor pressure sensor. The ECM supplies the sensor with a regulated 5 V reference–voltage and the sensor returns a signal voltage between 0.5 V and 4.5 V according to the pressure level in the fuel tank.
When the pressure in the fuel tank is low, the output voltage of the vapor pressure sensor is low. When it is high, the output voltage is high.
If the output voltage of the vapor pressure sensor is out of the normal range, the ECM will determine that there is malfunction in the sensor or sensor circuit.
When pressure indicated by the vapor pressure sensor is below –3.999 kPa (–30 mmHg) or above 1.999 kPa (15 mmHg), the ECM interprets this as malfunction in the vapor pressure sensor. The ECM will turn on the MIL and a DTC will be set.

MONITOR STRATEGY

Case 1

Related DTCs	P0451: Evaporative emission control system pressure sensor range/performance (Signal fluctuation monitoring)
Required sensors/components	Main: Vapor pressure sensor Related: Mass air flow meter, engine coolant temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

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Case 2

Related DTCs	P0451: Evaporative emission control system pressure sensor range/performance (No signal change monitoring)
Required sensors/components	Main: Vapor pressure sensor Related: Mass air flow meter, engine coolant temperature sensor
Frequency of operation	Once per driving cycle
Duration	20 minutes
MIL operation	2 driving cycles
Sequence of operation	None

Case 3

Related DTCs	P0452: Evaporative emission control system pressure sensor low input P0453: Evaporative emission control system pressure sensor high input
Required sensors/components	Main: Vapor pressure sensor Related: Mass air flow meter, engine coolant temperature sensor
Frequency of operation	Once per driving cycle
Duration	7 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Case 1

P0451: Evaporative emission control system pressure sensor range/performance (Signal fluctuation monitoring)

The monitor will run whenever the following DTCs are not present	See page 05–20
Intake air temperature at engine atart compared with engine coolant temperature	Maximum of 7°C (19.4°F) lower or 11.1°C (19.9°F) higher
Engine coolant temperature at engine start	4.4°C (40°F) or more, and 35°C (95°F)
Intake air temperature at engine start	4.4°C (40°F) or more, and 35°C (95°F)

Case 2

P0451: Evaporative emission control system pressure sensor range/performance (Stuck monitoring)

The monitor will run whenever the following DTCs are not present	See page 05–20
Intake air temperature at engine atart compared with engine coolant temperature	Maximum of 7°C (19.4°F) lower or 11.1°C (19.9°F) higher
Engine coolant temperature at engine start	4.4°C (40°F) or more, and 35°C (95°F)
Intake air temperature at engine start	4.4°C (40°F) or more, and 35°C (95°F)

Case 3

(a) P0452: Evaporative emission control system pressure sensor low input

(b) P0453: Evaporative emission control system pressure sensor high input

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine coolant temperature at engine start compared with intake air temperature	Less than 12°C (21.6°F)
Engine coolant temperature at engine start	10°C (50°F) or more, and 35°C (95°F) or less
Intake air temperature at engine start	10°C (50°F) or more, and 35°C (95°F) or less
Engine	Running

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TYPICAL MALFUNCTION THRESHOLDS

Case 1:

P0451: Evaporative emission control system pressure sensor range/performance (Signal fluctuation monitoring)

The number of times the sensor output changed ±0.7 kPa (5 mmHg) or more for 5 to 15 seconds after vehicle stop	7 times or more

Case 2

P0451: Evaporative emission control system pressure sensor range/performance (Stuck monitoring)

Fuel tank pressure "no change" time (variation is less than 0.138 kPa (0.02 mmHg) after engine start)	20 minutes or more

Case 3

(a) P0452: Evaporative emission control system pressure sensor low input

Fuel tank pressure	Less than –3.999 kPa (–30 mmHg) / when engine running

(b) P0453: Evaporative emission control system pressure sensor high input

Fuel tank pressure	1.999 kPa (15 mmHg) or more / when engine running

WIRING DIAGRAM

Refer to DTCs P0441 and P0446 on page 05–202.

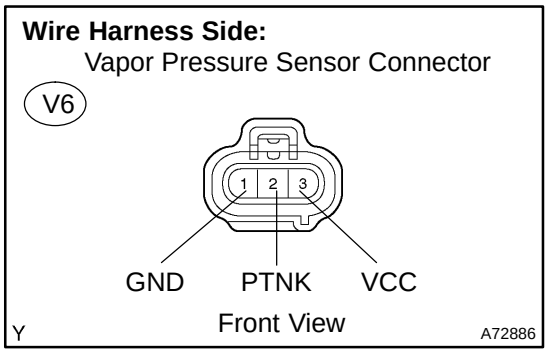
INSPECTION PROCEDURE

HINT:

- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- If DTC P0441 (Purge Flow), P0446 (CCV), P0451, P0452 or P0453 (Evaporative Pressure Sensor) is output with DTC P0442 or P0456, troubleshoot DTC P0441, P0446, P0451, P0452 or P0453 first. If no malfunction is detected, troubleshoot DTC P0442 or P0456 next.
- Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- When the ENGINE RUN TIME in the freeze frame data is less than 200 seconds, carefully check the vapor pressure sensor.

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1 CHECK HARNESS AND CONNECTOR(VAPOR PRESSURE SENSOR – ECM)



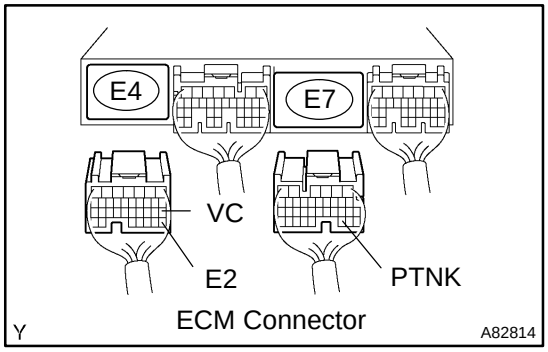
(a) Disconnect the V6 vapor pressure sensor connector.
(b) Disconnect the E4 and E7 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
PTNK (V6–2) – PTNK (E7–30)	Below 1 Ω
GND (V6–1) – E2 (E4–28)	Below 1 Ω
VCC (V6–3) – VC (E4–18)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
PTNK (V6–2) or PTNK (E7–30) – Body ground	10 kΩ or higher
VCC (V6–3) or VC (E4–18) – Body ground	10 kΩ or higher

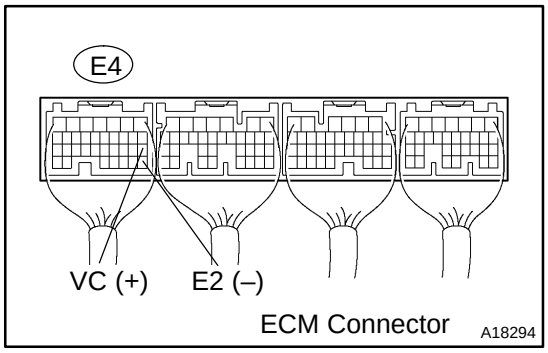


(d) Reconnect the vapor pressure sensor connector.
(e) Reconnect the ECM connector.

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

OK

2 INSPECT ECM(VC VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E4 ECM connector.

Standard:

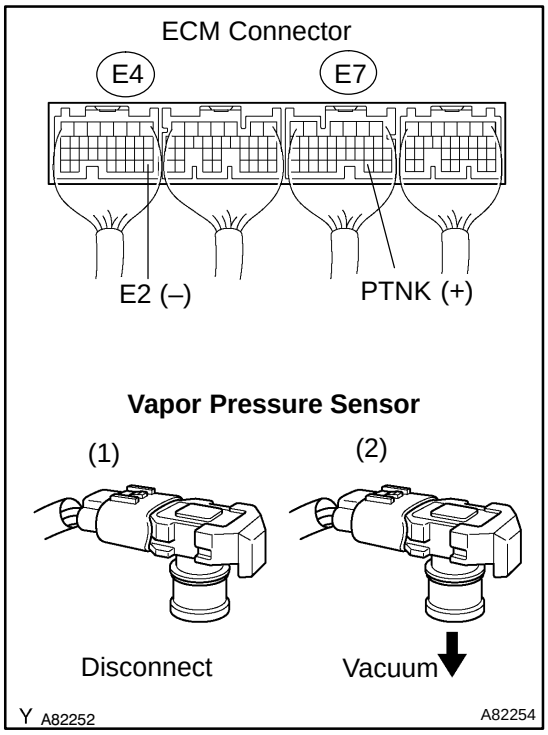
Tester Connection	Specified Condition
VC (E4–18) – E2 (E4–28)	4.5 to 5.5 V

NG → **REPLACE ECM (See page 10–24)**

OK

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3 INSPECT ECM(PTNK VOLTAGE)



(a) Turn the power switch ON (IG).

(b) Measure the voltage between the specified terminals of the E4 and E7 ECM connectors.

(1) Remove the vapor pressure sensor.

Standard (1):

Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	2.9 to 3.7 V

(2) Using the 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).

Standard (2):

Tester Connection	Specified Condition
PTNK (E7–30) – E2 (E4–28)	0.5 V or less

(3) Reinstall the vapor pressure sensor.

OK → **REPLACE ECM (See page 10–24)**

NG

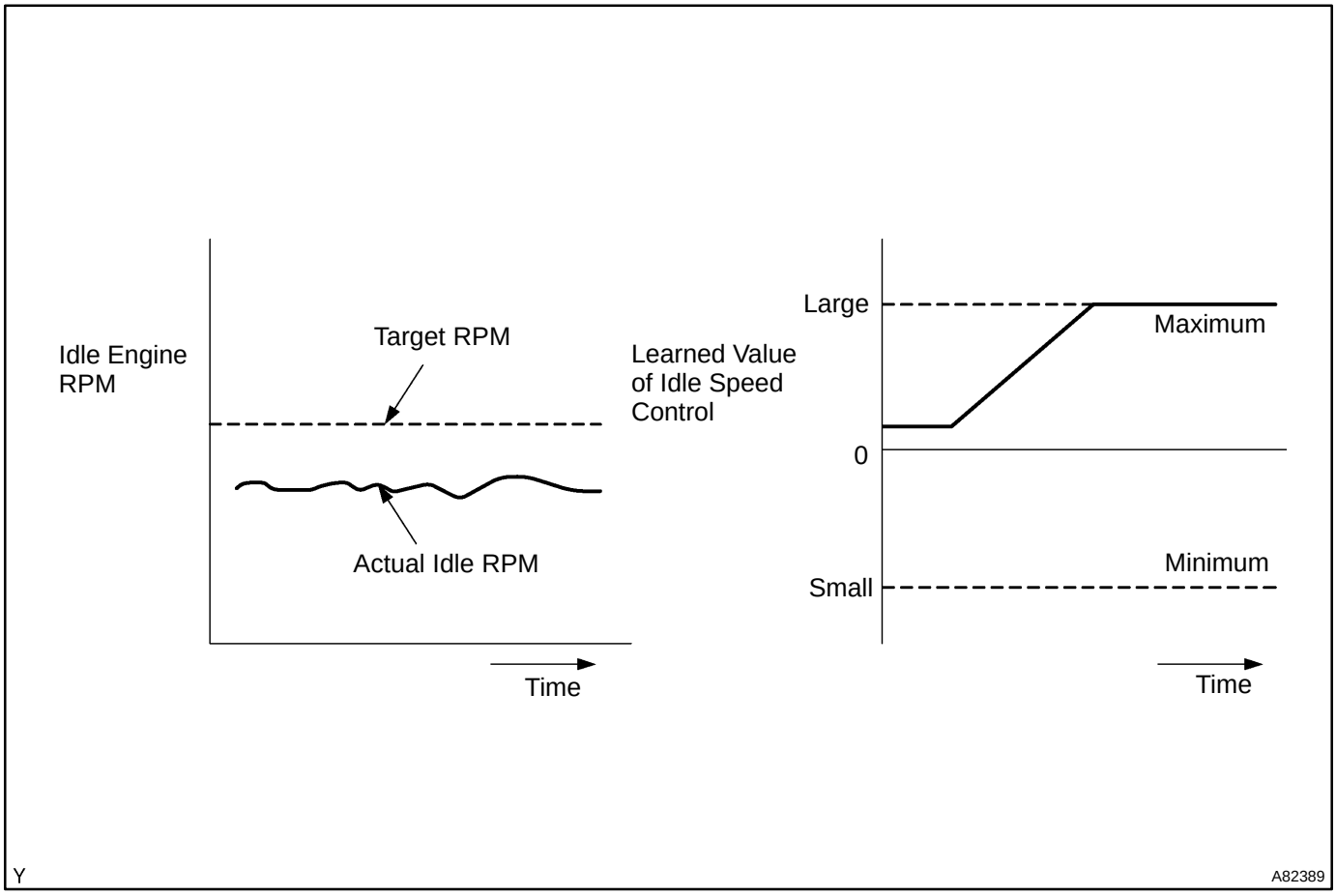
REPLACE VAPOR PRESSURE SENSOR ASSY

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DTC	P0505	IDLE AIR CONTROL SYSTEM

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. If the actual idle RPM varies more than a specified amount or a learned value of the idle speed control remains at the maximum or minimum five times or more during a trip, the ECM concludes that there is a problem in the idle speed control ECM function. The ECM will turn on the MIL and a DTC is set.
Example:
If the actual idle RPM varies from the target idle RPM by more than 200 (*1) rpm five times during a drive cycle, the ECM will turn on the MIL and a DTC is set.
HINT:
*1: RPM threshold varies depending on engine loads.



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

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MONITOR STRATEGY

Related DTCs	P0505: Idle air control malfunction (Functional check)
Required sensors/components	Main: Crankshaft position sensor Related: Vehicle speed sensor, engine coolant temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 minutes
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Following conditions are met: (during idling after driving for more than 6.2 mph (10 km/h) per cycle)	A & B & C
A. Either of following conditions is met:	1 or 2
1. Deviation of engine speed (when shift position N or A/C ON)	Less than –100 rpm, or more than 200 rpm
2. Deviation of engine speed (when shift position D or A/C OFF)	Less than –100 rpm, or more than 150 rpm
B. IAC flow rate (learned value)	0.6 L/sec or less or 4.5 L/sec or more
C. Number of detection	5 times/trip

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P0505)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
P0505	A
P0505 and other DTCs	B

HINT:
If any other codes besides P0505 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	CHECK CONNECTION OF PCV HOSE

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

NG → **REPAIR OR REPLACE PCV HOSE**

OK

3	CHECK AIR INDUCTION SYSTEM

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

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

OK

CHECK ELECTRIC THROTTLE CONTROL SYSTEM (See page 10–3)

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DTC P0560 SYSTEM VOLTAGE

MONITOR DESCRIPTION

The battery supplies electricity to the ECM even if the ignition switch is OFF. This electricity allows the ECM to store DTC history, freeze frame data, fuel trim values, and other data. If the battery voltage falls below a minimum level, the ECM will conclude that there is a fault in the power supply circuit. The next time the engine starts, the ECM will turn on the MIL and a DTC will be set.

DTC No.	DTC Detection Condition	Trouble Area
P0560	Open in back–up power source circuit	• Open in back–up power source circuit • ECM

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

MONITOR STRATEGY

Related DTCs	P0560: System voltage malfunction
Required sensors/components	ECM
Frequency of operation	Continuous
Duration	3 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

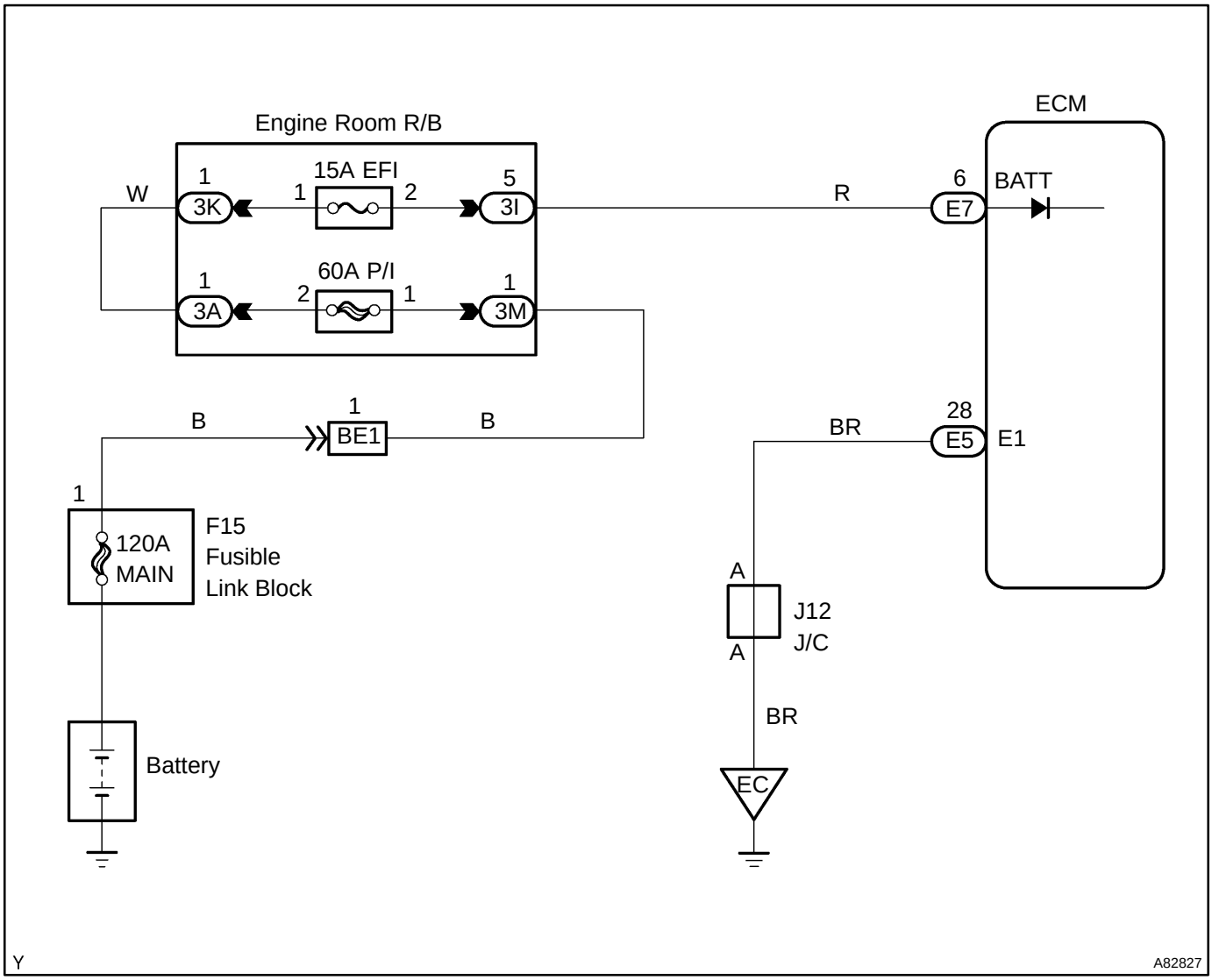
The monitor will run whenever the following DTCs are not present	See page 05–20
Stand–by RAM	Initialized

TYPICAL MALFUNCTION THRESHOLDS

Battery voltage	Less than 3.5 V

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WIRING DIAGRAM



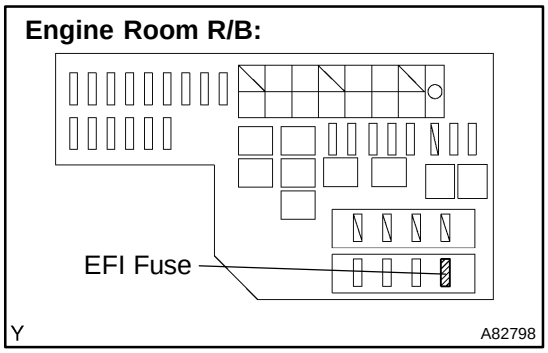
INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1 CHECK FUSE(EFI FUSE)

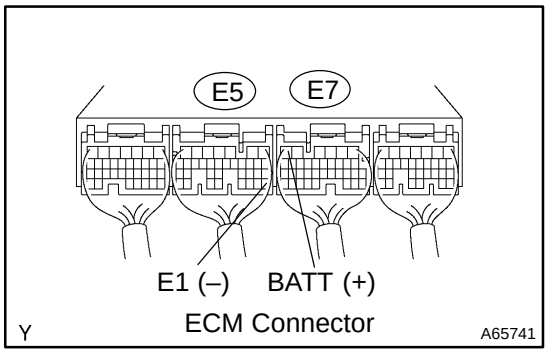


(a) Remove the EFI fuse from the engine room R/B.
(b) Check the resistance of the EFI fuse.
Standard: Below 1 Ω
(c) Reinstall the EFI fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

2 INSPECT ECM(BATT VOLTAGE)



(a) Measure the voltage between the specified terminals of the E5 and E7 ECM connectors.
Standard:

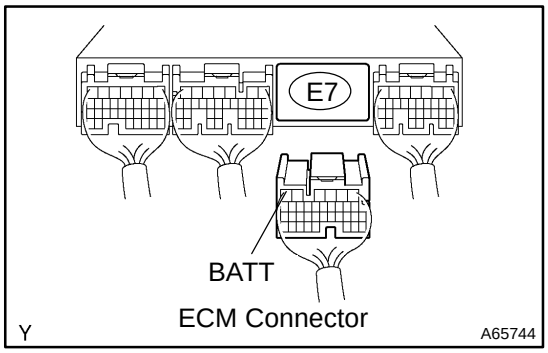
Tester Connection	Specified Condition
BATT (E7–6) – E1 (E5–28)	9 to 14 V

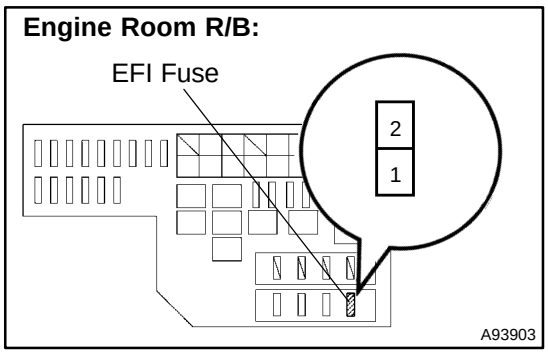
OK → **REPLACE ECM (See page 10–24)**

NG

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3	CHECK HARNESS AND CONNECTOR(ECM – EFI FUSE, EFI FUSE – BATTERY)





(a) Check the harness and the connectors between the EFI fuse and the ECM connector.
  (1) Remove the integration relay from the engine room R/B.
  (2) Disconnect the E7 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
EFI fuse (2) – BATT (E7–6)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
EFI fuse (2) or BATT (E7–6) – Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the EFI fuse and the battery.
  (1) Remove the integration relay from the engine room R/B.
  (2) Disconnect the positive battery terminal.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Battery positive terminal – EFI fuse (1)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Battery positive terminal or EFI fuse (1) – Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.
  (5) Reconnect the positive battery terminal.

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

OK

CHECK AND REPLACE ENGINE ROOM RELAY BLOCK

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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 two CPUs also perform continuous mutual monitoring.

The ECM sets a DTC if: 1) output from the 2 CPUs are different and deviate from the standards, 2) the signals to the throttle actuator deviate from the standards, 3) 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 errors	• ECM

MONITOR STRATEGY

Related DTCs	P0604: ECM RAM errors P0606: ECM CPU malfunction P0657: ETCS power supply function of ECM malfunction
Required sensors/ components	ECM
Frequency of operation	Continuous
Duration	Within 1 second
MIL operation	Immediately
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20

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TYPICAL MALFUNCTION THRESHOLDS

ECM RAM errors:

Difference between main and sub CPUs output	Larger than the specified range

ECM CPU malfunction:

Either of the following conditions is met:	
Difference between throttle position of main CPU and throttle position of sub CPU	0.3 V or more
Difference between accelerator pedal position of main CPU and accelerator pedal position of sub CPU	0.3 V or more

Electronic throttle control system power supply function of ECM malfunction:

Electronic throttle control system power supply when ignition switch is turned from OFF to ON	7 V or more

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

REPLACE ECM (See page 10–24)

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DTC	P1115	COOLANT TEMPERATURE SENSOR CIRCUIT FOR COOLANT HEAT STORAGE SYSTEM

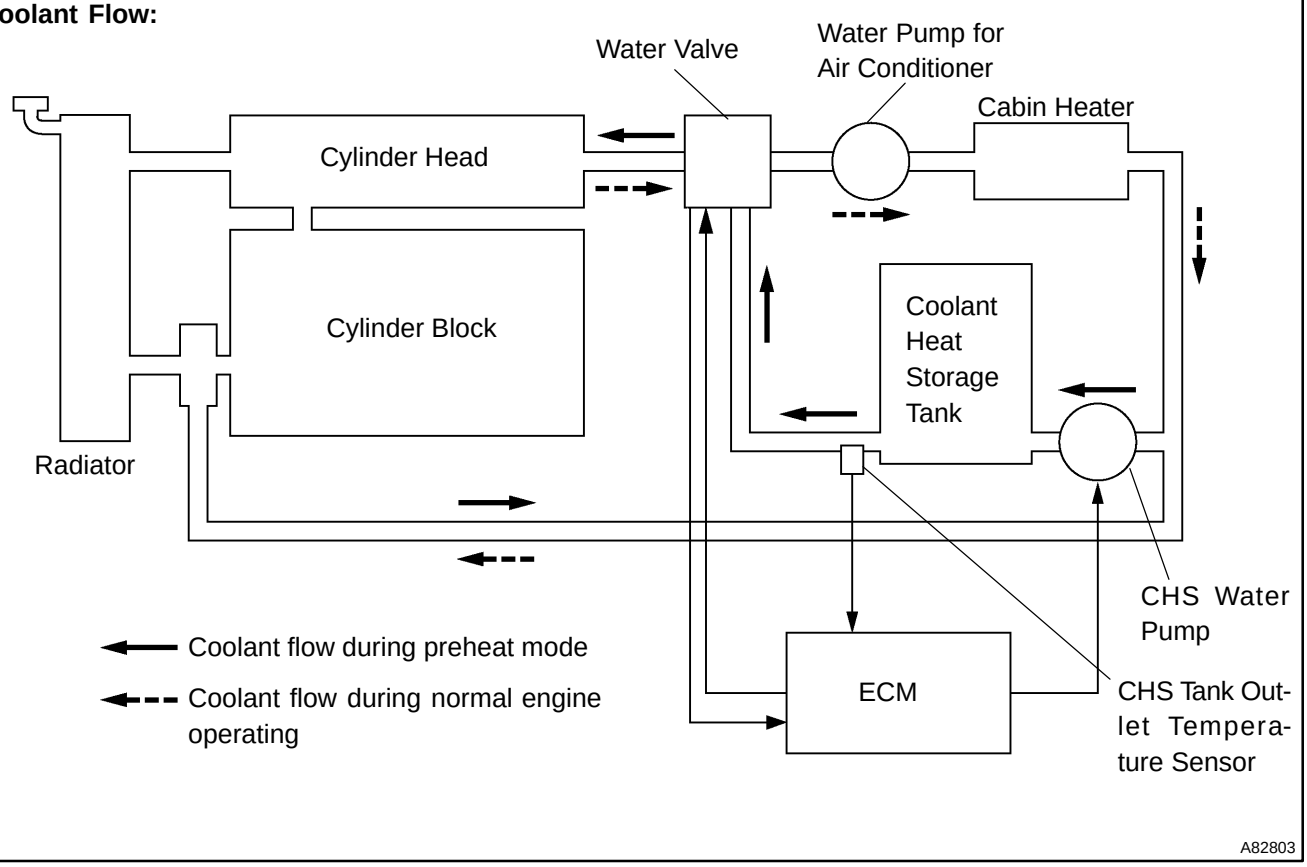
DTC	P1117	COOLANT TEMPERATURE SENSOR CIRCUIT LOW FOR COOLANT HEAT STORAGE SYSTEM

DTC	P1118	COOLANT TEMPERATURE SENSOR CIRCUIT HIGH FOR COOLANT HEAT STORAGE SYSTEM

HINT:
Although each DTC title says ”Coolant Temperature Sensor”, these DTCs are related to the coolant heat storage tank outlet temperature sensor.

CIRCUIT DESCRIPTION

Coolant Heat Storage System (CHS System)
Coolant Flow:



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This system uses an electric pump to supply hot coolant stored in the coolant heat storage tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the heat storage tank into the engine, in order to heat the cylinder head (this process is called ”preheat mode”). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During the normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.
The sensor for the system, which is provided at the tank outlet, is constructed similarly to the engine coolant temperature sensor and is connected to the ECM. The CHS tank outlet temperature sensor has a built in thermistor, whose resistance varies with the coolant temperature.
HINT:
If the ECM detects the DTC P0115, P0117 or P0118, it operates the fail–safe function in which the engine coolant temperature is assumed to be 80°C (176°F).

DTC No.	Proceed to	DTC Detection Condition	Trouble Area
P1115	Step 1	Open or short in CHS tank outlet temperature sensor circuit for 0.5 second	• Open or short in CHS tank outlet temperature sensor circuit • CHS tank outlet temperature sensor • ECM
P1117	Step 4	Short in CHS tank outlet temperature sensor circuit.	• Short in CHS tank outlet temperature sensor circuit • CHS tank outlet temperature sensor • ECM
P1118	Step 2	Open in CHS tank outlet temperature sensor circuit	• Open or short in CHS tank outlet temperature sensor circuit • CHS tank outlet temperature sensor • ECM

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to control the coolant heat storage (CHS) system properly. If the sensor output voltage deviates from the normal operating range, the ECM determines that the CHS tank outlet temperature sensor circuit has malfunctioned, and outputs a DTC.
Example:
A sensor output voltage of –40°C (–40°F) or 140°C (284°F) is determined to be malfunction.

MONITOR STRATEGY

Related DTCs	P1115: Coolant temperature sensor circuit for coolant heat storage system P1117: Coolant temperature sensor circuit low for coolant heat storage system P1118: Coolant temperature sensor circuit high for coolant heat storage system
Required sensors / components	Coolant heat storage tank outlet temperature sensor
Frequency of operation	Continuous
Duration	0.5 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20

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TYPICAL MALFUNCTION THRESHOLDS

P1115:

Sensor resistance (coolant temperature at CHS tank outlet)	Less than 79 Ω or more than 156 kΩ (more than 140°C (284°F) or –40°C (–40°F) or less)

P1117:

Sensor resistance (coolant temperature at CHS tank outlet)	Less than 79 Ω (more than 140°C (284°F))

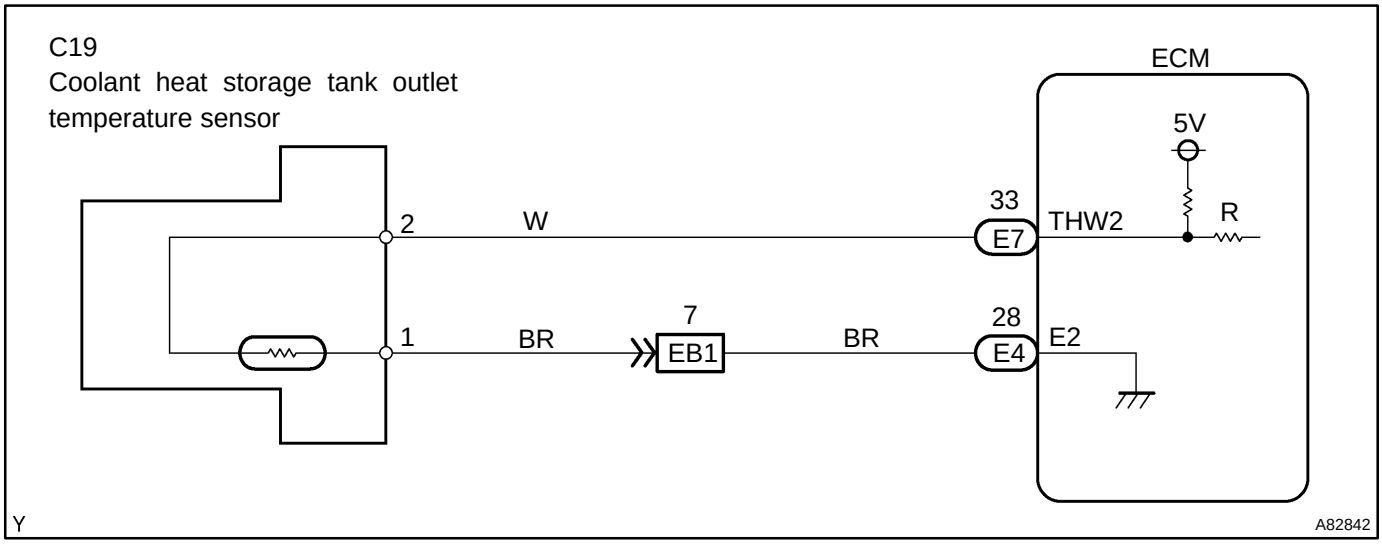
P1118:

Sensor resistance (coolant temperature at CHS tank outlet)	More than 156 kΩ (–40°C (–40°F) or less)

COMPONENT OPERATING RANGE

Sensor resistance	79 Ω (140°C (284°F)) to 156 kΩ (–40°C (–40°F))

WIRING DIAGRAM



INSPECTION PROCEDURE

CAUTION:

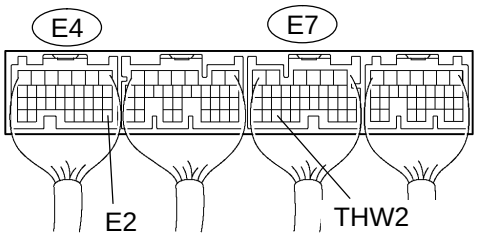
Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- If different DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester II. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

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1 INSPECT ECM(THW2 – E2 VOLTAGE)



ECM Connector
A18294

(a) Turn the power switch ON (IG).
(b) Measure voltage between the terminals THW2 and E2 of the ECM E4 and E7 connector.

Standard:

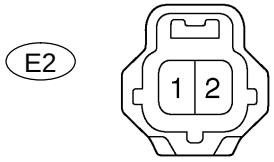
Water Temperature ˚C (˚F)	Voltage
20 (68)	0.5 to 3.4 V
60 (140)	0.2 to 1.0 V

OK → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

NG

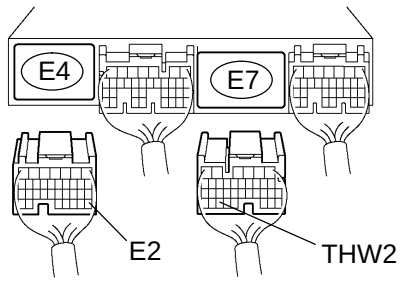
2 CHECK HARNESS AND CONNECTOR(CHS TANK OUTLET TEMPERATURE SENSOR – ECM)

Wire Harness Side:
CHS Tank Outlet Temperature Sensor Connector



Front View

Y
A82813



Y
ECM Connector
A82814

(a) Check the harness and the connectors between the coolant heat storage tank outlet temperature sensor and the ECM connectors.
(1) Disconnect the E2 engine coolant heat storage tank outlet temperature sensor connector.
(2) Disconnect the E4 and E7 ECM connector.
(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CHS temperature sensor (E2–2) – THW2 (E7–33)	Below 1 Ω
CHS temperature sensor (E2–1) – E2 (E4–28)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CHS temperature sensor (E2–2) or THW2 (E7–33) – Body ground	10 kΩ or higher

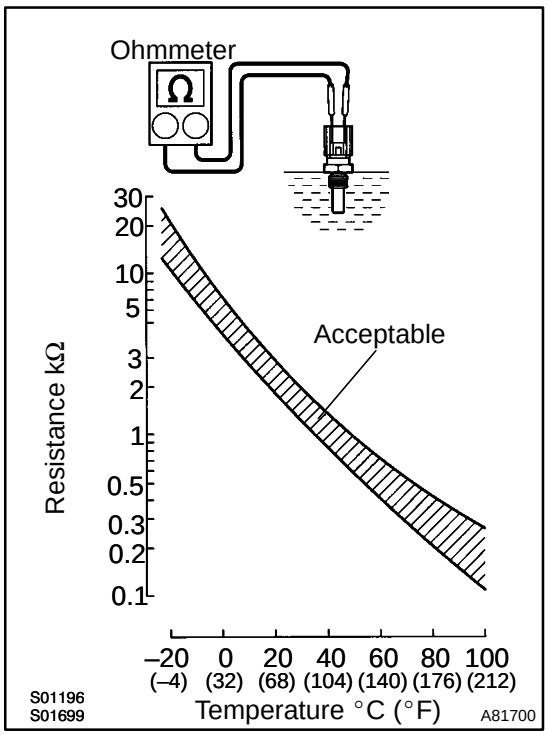
(4) Reconnect the coolant heat storage tank outlet temperature sensor connector.
(5) Reconnect the ECM connector.

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

OK

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3	INSPECT TEMPERATURE SENSOR(CHS TANK OUTLET TEMPERATURE SENSOR)



(a) Remove the coolant heat storage (CHS) tank outlet temperature sensor.

(b) Measure the resistance between the terminals.

Standard:

Tester Connection	Specified Condition
1 – 2	2 to 3 kΩ at 20°C (68°F)
1 – 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:

In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet 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.

(c) Reinstall the coolant heat storage tank outlet temperature sensor.

NG → **REPLACE TEMPERATURE SENSOR**

OK

REPLACE ECM (See page 10–24)

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DTC	P1116	COOLANT TEMPERATURE SENSOR CIRCUIT STACK FOR COOLANT HEAT STORAGE SYSTEM

CIRCUIT DESCRIPTION

Refer to DTC P1115 on page 05–270.

DTC No.	Detection Condition	Trouble Area
P1116	• Temperature change during hot coolant recovering: 1°C (1.8 °F) or less • Difference between CHS tank outlet temperature and engine coolant temperature during hot coolant recovering: 25°C (45°F) or more	• Coolant heat storage tank outlet temperature sensor • Cooling system (clogging)

MONITOR DESCRIPTION

The coolant heat storage (CHS) tank outlet temperature sensor is used for monitoring coolant temperature in the vicinity of the outlet port of the heat storage tank of the CHS system. The resistance of the sensor increases when the CHS tank outlet temperature is low, and conversely, the resistance decreases when the temperature is high. The changes in resistance are reflected in the voltage that is output by the sensor. The ECM monitors the sensor voltage and uses this value to control CHS system properly.

If the sensor output voltage deviates from the normal operating range, the ECM determines that the CHS tank outlet temperature sensor circuit has malfunctioned, and sets a DTC.

Examples:

1) No changes occur in the CHS tank outlet temperature sensor signal (over 1°C [1.8 °F]) after a predetermined length of time has elapsed from the start of the coolant recovering.

2) A significant difference (over 25°C [45 °F]) exists between the engine coolant temperature signal and the CHS tank outlet temperature sensor signal after a predetermined length of time has elapsed from the start of the coolant recovering.

MONITOR STRATEGY

Related DTCs	P1116 : Coolant temperature sensor circuit range check (stuck)
Required sensors/components	Main: Coolant heat storage tank outlet temperature sensor Related: Engine coolant temperature sensor
Frequency of operation	Once per driving cycle
Duration	45 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Coolant heat storage system malfunction	Not detected
Coolant heat recovering	ON
Difference between engine coolant temperature and CHS tank outlet temperature	More than 30°C (54 °F)

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TYPICAL MALFUNCTION THRESHOLDS

Temperature variation of CHS tank outlet during hot coolant recovery	1°C or less
Difference between temperatures of CHS tank outlet and engine coolant during hot coolant recovery	More than 25°C (45 °F)

WIRING DIAGRAM

Refer to DTC P1115 on page 05–270

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester II. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

1	CHECK COOLING SYSTEM(CHECK FOR CLOGGING IN THE COOLANT SYSTEM)

OK: Coolant passage has no blockage.

NG → REPAIR OR REPLACE COOLING SYSTEM

OK ↓

REPLACE TEMPERATURE SENSOR (CHS TANK OUTLET TEMPERATURE SENSOR)

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DTC	P1120	COOLANT FLOW CONTROL VALVE POSITION SENSOR CIRCUIT

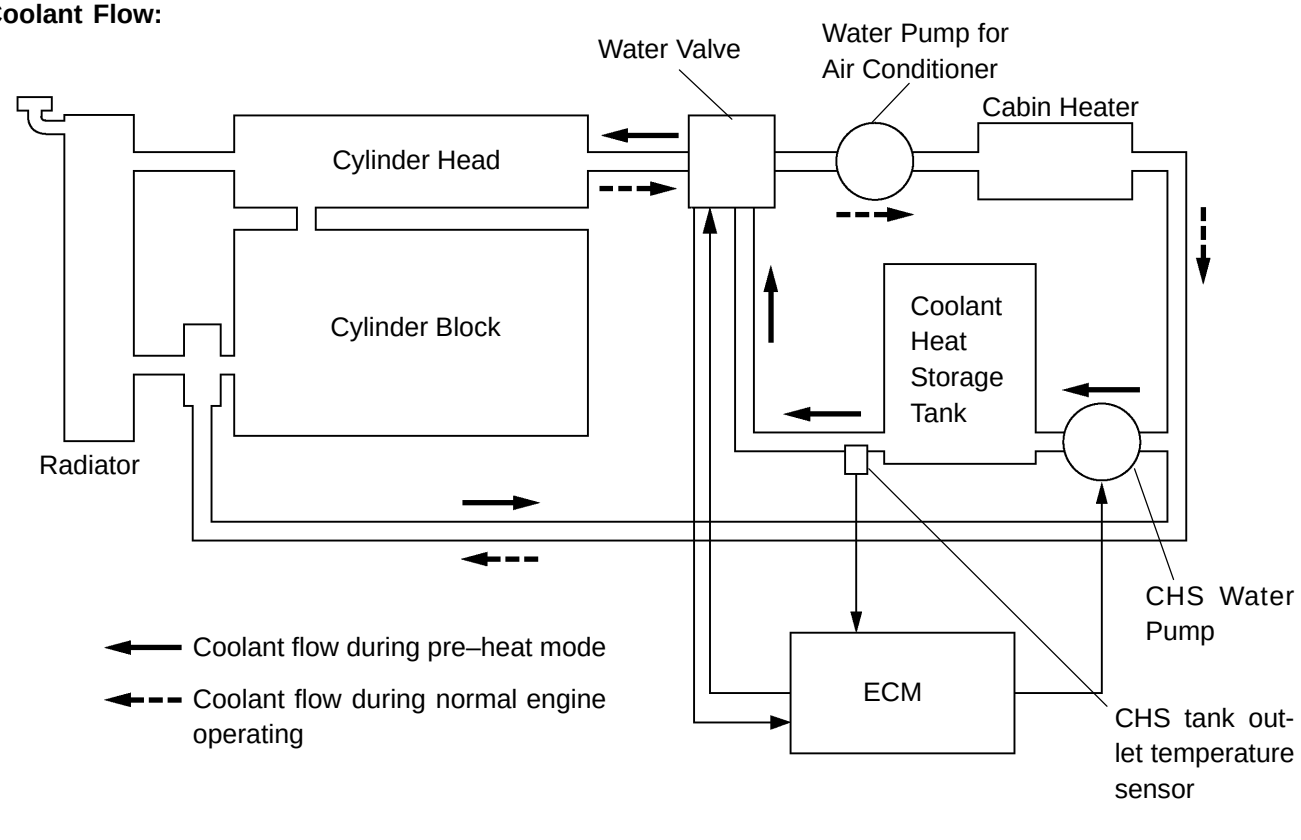
DTC	P1122	COOLANT FLOW CONTROL VALVE POSITION SENSOR CIRCUIT LOW

DTC	P1123	COOLANT FLOW CONTROL VALVE POSITION SENSOR CIRCUIT HIGH

HINT:
Although each DTC title says ”Coolant Flow Control Valve”, these DTCs are related to the water valve.

CIRCUIT DESCRIPTION

Coolant Heat Storage System (CHS System)
Coolant Flow:



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This system uses an electric pump to supply hot coolant stored in the heat storage tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the heat storage tank into the engine, in order to heat the cylinder head (this process is called ”preheat mode”). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During the normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.

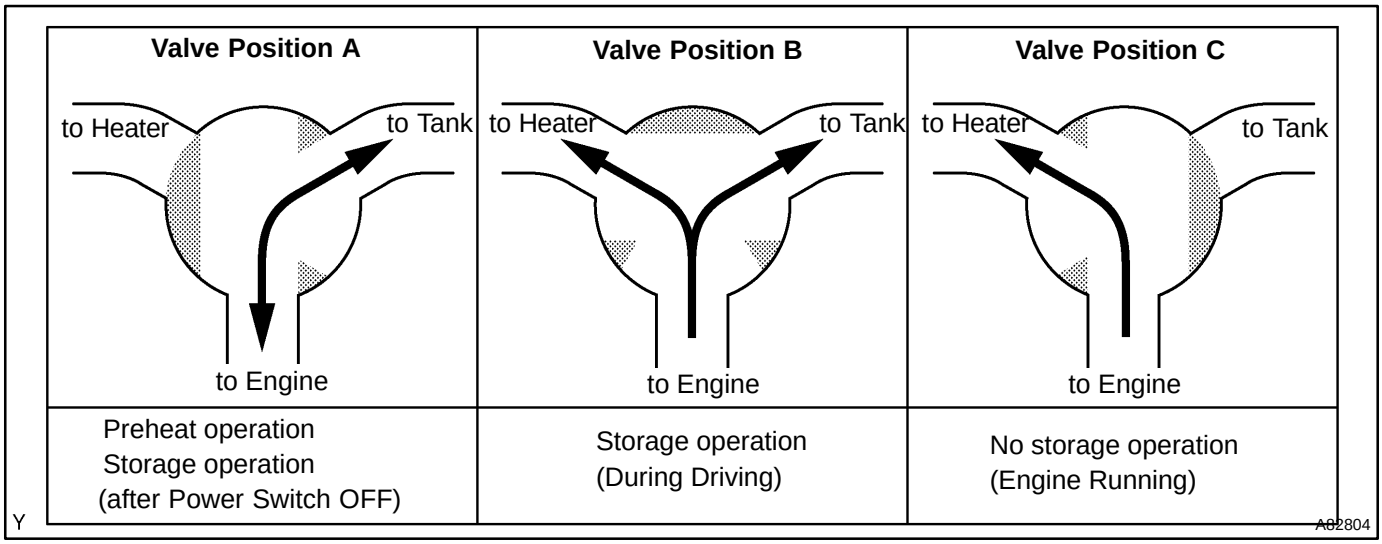
The water valve for the coolant heat storage (CHS) system, which is located at the heater hoses, controls the coolant passages to the engine, heater core, and the CHS tank in accordance with the operating conditions of the system.

The water valve consists of a water valve, valve position sensor, and valve control motor. The potentiometer, which is coupled coaxially to the water valve, converts the valve position into voltage and transmits it to the ECM in the form of a position signal.

DTC No.	Detection Condition	Trouble Area
P1120	WBAD is less than 0.2V or more than 4.8V	• Open or short in water valve position sensor circuit • Water valve (Coolant flow control valve) • ECM
P1122	WBAD stays less than 0.2V for 2 seconds or more	• Water valve (Coolant flow control valve) • Short in WBAD circuit • Open in VC circuit • ECM
P1123	WBAD stays more than 4.8V for 2 seconds or more	• Water valve (Coolant flow control valve) • Open in WBAD circuit • Open in E2 circuit • VC and WBAD circuits are short–circuited • ECM

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MONITOR DESCRIPTION



A potentiometer is provided in the coolant heat storage (CHS) system. The ECM uses the valve position signal output by the water valve for effecting control that is appropriate for the operating condition of the engine. The water valve effects control in three steps as indicated below, and the ECM determines the position of the valve according to the voltage of the respective step.
If the signal output by the water valve exceeds the normal range, the ECM determines that a malfunction has occurred in the water valve position sensor circuit and outputs a DTC.

Water Valve Operation

System Condition	Valve Position	Coolant Flow
Normal engine operation	C	Engine to Cabin heater
Preheat mode	A	Coolant heat storage tank to Engine
Coolant recovering (after engine stop)	A	Engine to Coolant heat storage tank
Coolant recovering (while engine is running)	B	Engine to Cabin heater and Coolant heat storage tank
Soak mode	A	Coolant heat storage tank to Engine

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MONITOR STRATEGY

Related DTCs	• P1120: Coolant flow control valve (Water valve) position sensor circuit range check (fluttering) • P1122: Coolant flow control valve (Water valve) position sensor circuit range check (low voltage) • P1123: Coolant flow control valve (Water valve) position sensor circuit range check (high voltage)
Required sensors / components	Water valve position sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20

TYPICAL MALFUNCTION THRESHOLDS

P1120:

Water valve position signal	Less than 0.2V or more than 4.8V

P1122:

Water valve position signal	Less than 0.2V

P1123:

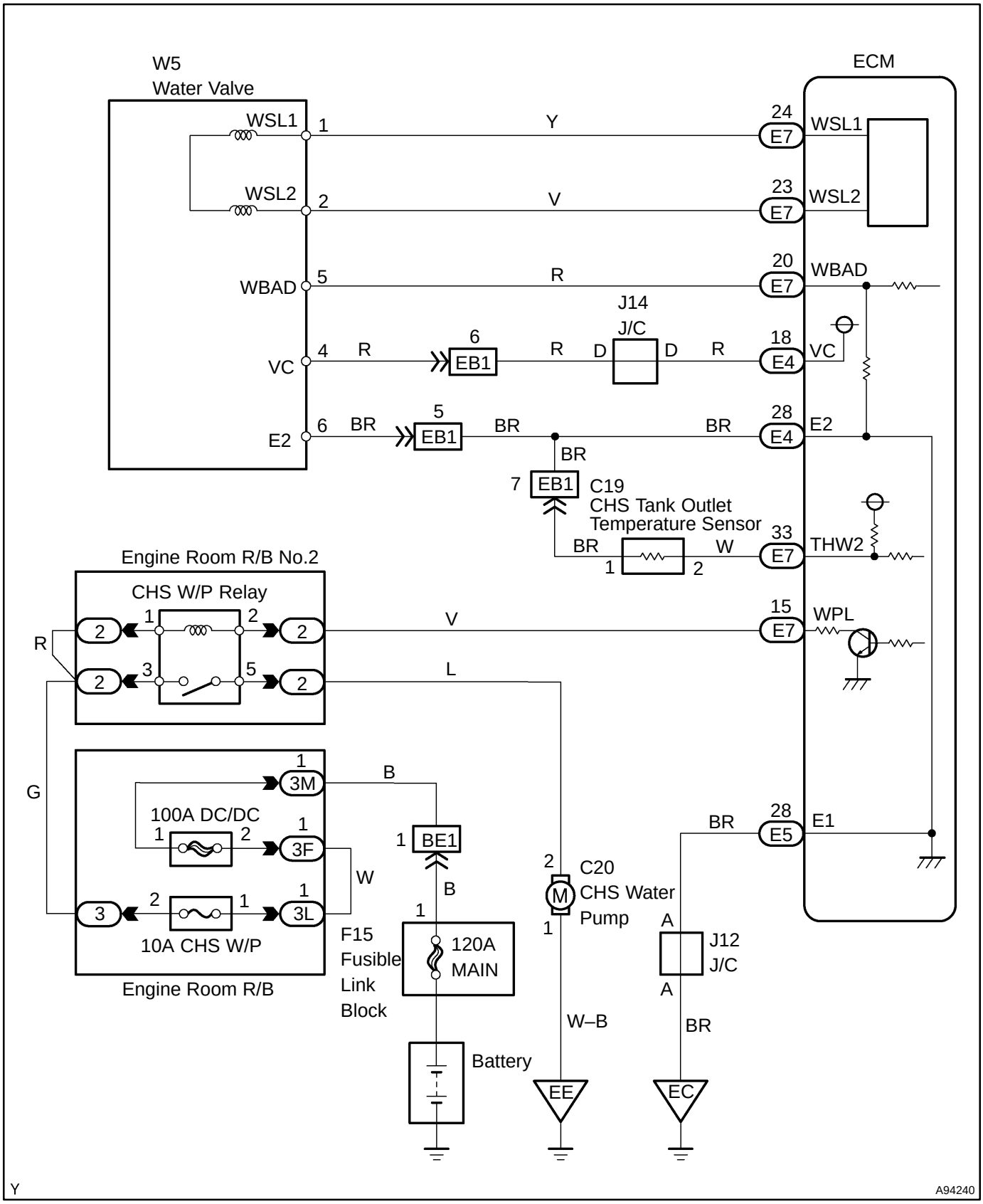
Water valve position signal	More than 4.8V

COMPONENT OPERATING RANGE

Water valve position signal	0.4 to 2.2V

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WIRING DIAGRAM



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INSPECTION PROCEDURE

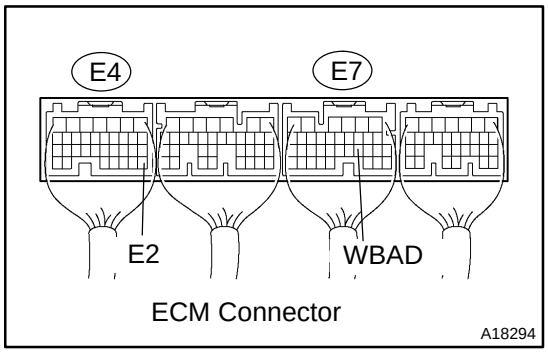
CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

1 INSPECT ECM (WBAD – E2 VOLTAGE)



(a) Turn the power switch ON (IG).

(b) Measure voltage between the terminals WBAD and E2 of the E4 and E7 ECM connectors.

Standard:

Throttle Valve	Voltage V
Valve position ”A” (Preheat mode)	Approximately 2.5 V
Valve position ”B” (Recovering mode)	Approximately 3.5 V
Valve position ”C” (Normal Operation)	Approximately 4.5 V

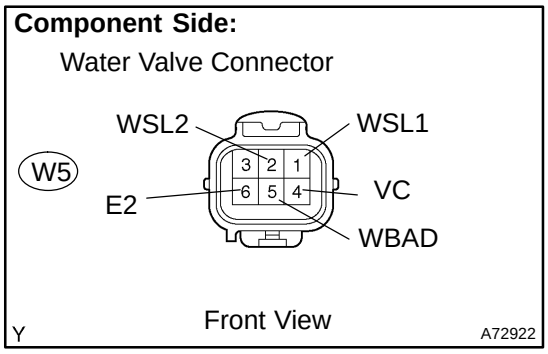
HINT:

After the HV main system is turned OFF (READY to IG OFF condition), the valve position will be set to position A.

OK → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

NG

2 INSPECT WATER W/BRACKET VALVE ASSY



(a) Disconnect the W5 water valve connector.

(b) Measure resistance between terminals WSL1 and WSL2 of the water valve connector.

(c) Measure resistance between terminals WBAD and E2 of the water valve connector.

RESISTANCE:

Terminals	Condition	Resistance kΩ
1 – 2	Motor resistance	Approximately 0.04
5 – 6	Sensor resistance	0.2 to 5.7

NG → **REPLACE WATER W/BRACKET VALVE ASSY**

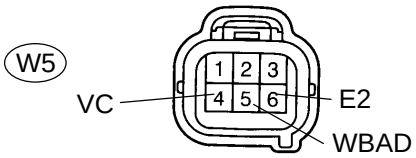
OK

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3 CHECK HARNESS AND CONNECTOR(WATER VALVE – ECM)

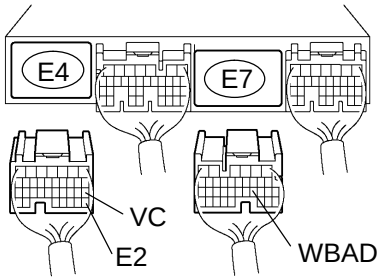
Wire Harness Side:

Water Valve Connector



Front View

A75544



Y ECM Connector A82814

(a) Disconnect the W5 water valve connector.
(b) Disconnect the E4 and E7 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Water valve (W5–5) – WBAD (E7–20)	Below 1 Ω
Water valve (W5–4) – VC (E4–18)	Below 1 Ω
Water valve (W5–6) – E2 (E4–28)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Water valve (W5–5) or WBAD (E7–20) – Body ground	10 kΩ or higher

(d) Reconnect the water valve connector.
(e) Reconnect the ECM connectors.

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

OK

REPLACE ECM (See page 10–24)

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DTC	P1121	COOLANT FLOW CONTROL VALVE POSITION SENSOR CIRCUIT STUCK

HINT:

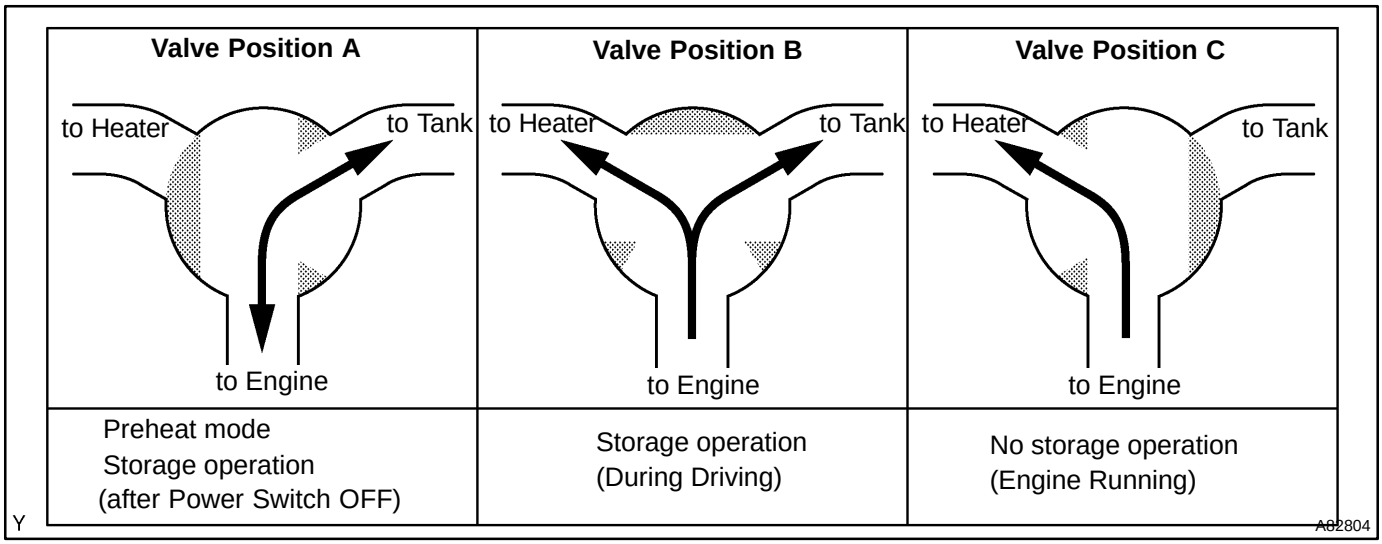
- Although each DTC title says ”Coolant Flow Control Valve”, these DTCs are related to the water valve.
- CHS stands for Coolant Heat Storage.

CIRCUIT DESCRIPTION

Refer to DTC P1120 on page 05–277.

DTC No.	Detection Condition	Trouble Area
P1121	• Water valve position sensor output voltage: No change despite the ECM sending a valve control signal or slow response • CHS tank outlet temperature sensor output: 60°C or more (when hot coolant recovering starts) • CHS tank outlet temperature sensor output: No change despite the hot coolant is recovered	• Water valve • Cooling system (clogging) • ECM

MONITOR DESCRIPTION



The ECM monitors the position of the water valve based on the valve position signal that is output by the water valve position sensor (potentiometer), which is coupled coaxially to the valve. The water valve effects control in three steps as indicated above, and the ECM determines the position of the valve according to the voltage of the respective step.

In order to ensure the proper monitoring of the water valve, the ECM checks for malfunctions with the combination of the output of the potentiometer and CHS tank outlet temperature sensor.

If no changes occur in the valve position signal that is being input into the ECM or if the response signal from the water valve is very slow, despite of the ECM commanding the water valve motor to operate the ECM determines that malfunction has occurred in the water valve position sensor circuit, and sets a DTC.

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MONITOR STRATEGY

Potentiometer detection

Related DTCs	P1121: Coolant flow control valve position sensor circuit stuck
Required sensors/components	Main: Water valve Related: CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	20 seconds
MIL operation	1 driving cycle
Sequence of operation	None

Tank outlet coolant temperature detection

Related DTCs	P1121: Coolant flow control valve position sensor circuit stuck
Required sensors/components	Main: Water valve Related: CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Potentiometer detection

The monitor will run whenever the following DTCs are not present	See page 05–20
Coolant heat storage system malfunction	Not detected
Battery voltage	10 V or more
Engine coolant temperature	0°C (32°F) or more
Water valve operation	Commanded
Respons time of valve movement	Time under calculation with valve position

Tank outlet coolant temperature detection

The monitor will run whenever the following DTCs are not present	See page 05–20
Coolant heat storage system malfunction	Not detected
Battery voltage	10 V or more
System status	During recovering
CHS tank outlet temperature difference between preheating start and engine start	20°C (36 °F) or more
Difference between engine coolant temperature and CHS tank outlet temperature	30°C (54 °F) or more

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TYPICAL MALFUNCTION THRESHOLDS

Potentiometer detection

Either of the following conditions is met:	(a) or (b)
(a) Potentiometer output difference [D divided C] C: Difference between previous and current target D: Difference between potentiometer output and previous target	10 % or more
(b) Potentiometer output deviation from target	0.1 V or more

Tank outlet coolant temperature detection

Either of the following conditions is met:	(a) or (b)
(a) Heat storage tank outlet coolant temperature when recover starts	60°C (108 °F) or more
(b) Heat storage tank outlet coolant temperature difference during water valve check	Less than 3°C (5.4 °F)

WIRING DIAGRAM

Refer to DTC P1120 on page 05–277.

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- If DTCs P1121 and P1150 are detected simultaneously, there may be malfunction in the water valve system.
- If DTC P1121 is detected, coolant passages may be clogged.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester II. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

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Hand–held tester:

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P1121)

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs.
Result:

Display (DTC Output)	Proceed to
P1121	A
P1121 and other DTCs	B

HINT:
If any other codes besides P1121 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	PERFORM ACTIVE TEST BY HAND–HELD TESTER

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) Put the engine in inspection mode (see page 05–1).
(e) Start the engine and warm it up.
(f) Select the items: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / WATER FLW VLV3, WATER FLW VLV4 or WATER FLW VLV5.
(g) Measure the voltage between terminals WBAD and E2 of the ECM connector.
Standard:

Tester Operation	Specified Condition
”WATER FLW VLV 3” ON	Approximately 2.5 V
”WATER FLW VLV 4” ON	Approximately 3.5 V
”WATER FLW VLV 5” ON	Approximately 4.5 V

NG → **REPLACE WATER W/BRACKET VALVE ASSY**

OK

3	CHECK COOLING SYSTEM

OK: Coolant passages are not clogged.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

REPLACE ECM (See page 10–24)

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OBD II scan tool (excluding hand–held tester):

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P1121)

(a) Connect the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the OBD II scan tool ON.
(d) Read DTCs using the OBD II scan tool.

Result:

Display (DTC Output)	Proceed to
P1121	A
P1121 and other DTCs	B

HINT:
If any other codes besides P1121 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	CHECK COOLING SYSTEM

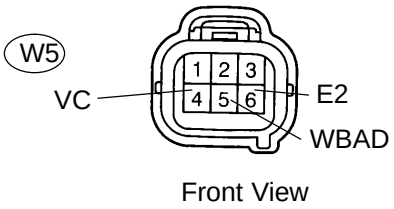
NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

3	CHECK HARNESS AND CONNECTOR(WATER VALVE – ECM)

Wire Harness Side:

Water Valve Connector



Front View

A75544

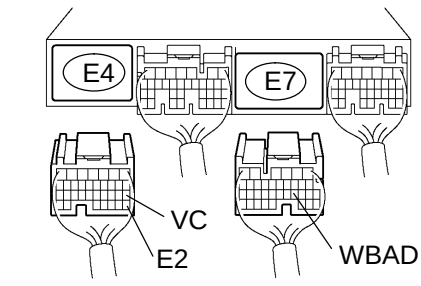
(a) Disconnect the W5 water valve connector.
(b) Disconnect the E4 and E7 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Water valve (W5–5) – WBAD (E7–20)	Below 1 Ω
Water valve (W5–4) – VC (E4–18)	Below 1 Ω
Water valve (W5–6) – E2 (E4–28)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Water valve (W5–5) or WBAD (E7–20) – Body ground	10 kΩ or higher



Y

ECM Connector

A82814

(d) Reconnect the water valve connector.
(e) Reconnect the ECM connectors.

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

OK

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4	REPLACE WATER W/BRACKET VALVE ASSY

GO

5	PERFORM SIMULATION TEST

(a) Put the engine in inspection mode and start the engine.
(b) Warm up the engine until the engine coolant temperature reaches more than 90°C (185°F).
(c) Cool the engine down completely.
(d) Perform the processes (a) to (c) twice.

GO

6	CHECK IF DTC OUTPUT RECURS

(a) Connect the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the OBD II scan tool ON.
(d) Read DTCs using the OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
No output	A
P1121	B

B → **REPLACE ECM (See page 10–24)**

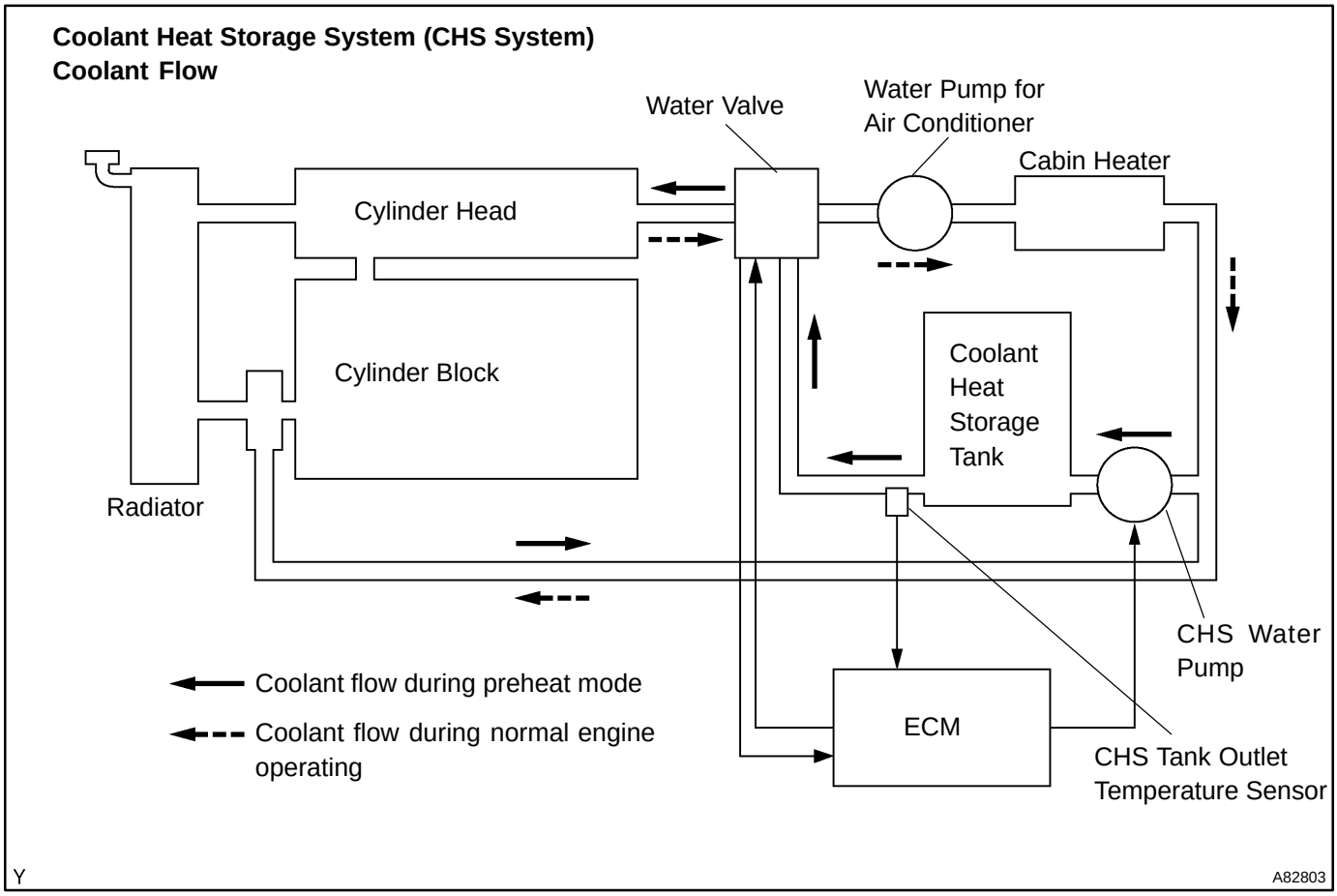
A

SYSTEM OK

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DTC	P1150	COOLANT PATH CLOG UP FOR COOLANT HEAT STORAGE SYSTEM

CIRCUIT DESCRIPTION



This system uses an electric pump to supply hot coolant stored in the coolant heat storage (CHS) tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the CHS tank into the engine, in order to heat the cylinder head (this process is called ”preheat mode”). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During the preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.

This system consists of the CHS tank, CHS water pump, CHS tank outlet temperature sensor, water valve, and a soak timer that is built in the ECM.

DTC No.	Detection Condition	Trouble Area
P1150	Following conditions are met: • Change in CHS tank outlet temperature and engine coolant temperature after water pump is ON during preheat mode: below 2°C (3.6 °F) • Change in CHS tank outlet temperature as water valve is opened to tank, on a warm engine: below 3°C (5.4 °F)	• CHS tank outlet temperature sensor • Water valve (Coolant flow control valve) • Cooling system (clogging) • ECM

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MONITOR DESCRIPTION

The ECM detects malfunction in the coolant heat storage (CHS) system with the CHS tank outlet temperature signal, the position of the water valve and the engine running condition. In order to ensure the reliable malfunction detection, the ECM detects coolant passage clogging malfunction in two ways. Thus, when the following two detection conditions are met, the ECM determines that the coolant passage has clogged and sets a DTC.

- When starting the engine, a variation in the CHS tank outlet temperature and engine coolant temperature before and after preheating is below 2 °C (3.6 °F).
- After the engine is warmed up, a variation in the CHS tank outlet temperature when the ECM opens the water valve is below 3°C (5.4 °F).

MONITOR STRATEGY

Related DTCs	P1150: Coolant path clog up for coolant heat storage system
Required sensors/components	CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	1 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Coolant heat storage system malfunction	Not detected
Coolant heat storage water pump operation time	3 seconds or more
Variation in CHS tank coolant temperature and engine coolant temperature before and after preheating	2°C (3.6°F) or less
Engine coolant temperature	65°C (149°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Variation in CHS tank coolant temperature during passage clogging check	Less than 3°C (5.4°F)

WIRING DIAGRAM

Refer to DTC P1115 on page 05–270.

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine and the radiator are cold.

HINT:

- The detection of this DTC may indicate that the coolant heat storage (CHS) tank outlet water temperature sensor stuck or the water valve stuck.
- If DTC P1121 is detected, coolant passages may be clogged.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester II. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

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Hand–held tester:

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P1150)

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs.
Result:

Display (DTC Output)	Proceed to
P1150	A
P1150 and other DTCs	B

HINT:
If any other codes besides P1150 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	PERFORM ACTIVE TEST BY HAND–HELD TESTER

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) Put the engine in inspection mode (see page 05–1).
(e) Start the engine and warm it up.
(f) Select the items: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / WATER FLW VLV3, WATER FLW VLV4 and WATER FLW VLV5.
(g) Measure the voltage between terminals WBAD and E2 of the ECM connector.
Standard:

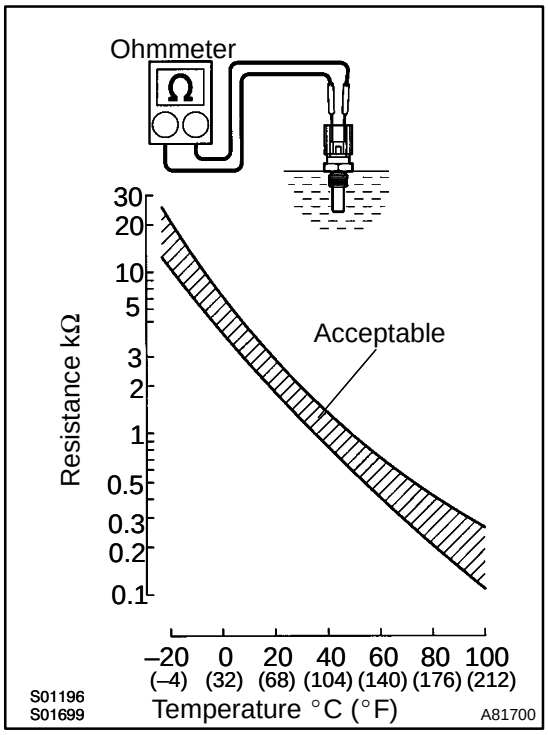
Tester Operation	Specified Condition
”WATER FLW VLV 3” ON	Approximately 2.5 V
”WATER FLW VLV 4” ON	Approximately 3.5 V
”WATER FLW VLV 5” ON	Approximately 4.5 V

NG → **REPLACE WATER W/BRACKET VALVE ASSY**

OK

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3	INSPECT TEMPERATURE SENSOR



(a) Remove the CHS tank outlet temperature sensor.
(b) Measure the resistance between the terminals.
Resistance:

Tester Connection	Specified Condition
1 – 2	2 to 3 kΩ at 20°C (68°F)
1 – 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
In case of checking the CHS tank outlet temperature sensor in water, be careful not to allow water to contact the terminals. After checking, dry the sensor.
HINT:
Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet 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.
(c) Reinstall the CHS tank outlet temperature sensor.

NG → **REPLACE TEMPERATURE SENSOR**

OK ↓

4	CHECK COOLING SYSTEM(CHECK FOR CLOGGING IN THE COOLANT SYSTEM)

OK: Coolant passages are not clogged.

NG → **REPAIR OR REPLACE COOLING SYSTEM COMPONENT**

OK ↓

REPLACE ECM (See page 10–24)

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OBD II scan tool (excluding hand–held tester):

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P1150)

(a) Connect the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the OBD II scan tool ON.
(d) Read DTCs using the OBD II scan tool.
Result:

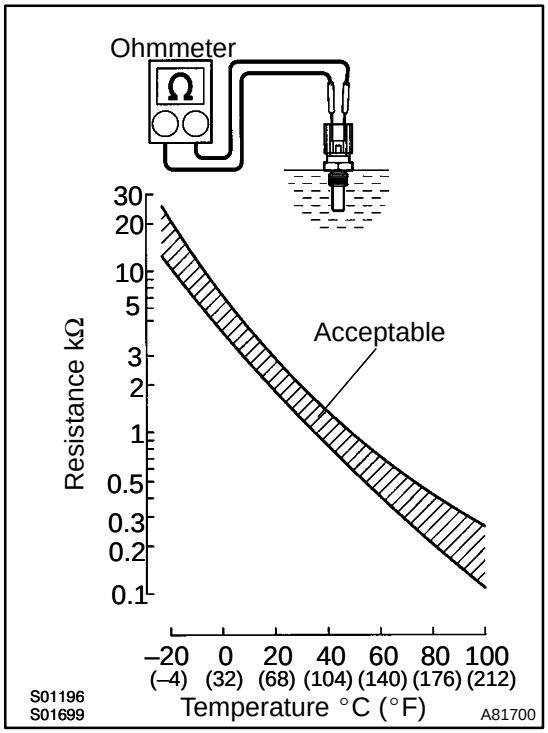
Display (DTC Output)	Proceed to
P1150	A
P1150 and other DTCs	B

HINT:
If any other codes besides P1150 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	INSPECT TEMPERATURE SENSOR



(a) Remove the CHS tank outlet temperature sensor.
(b) Measure the resistance between the terminals.
Resistance:

Tester Connection	Specified Condition
1 – 2	2 to 3 kΩ at 20°C (68°F)
1 – 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
In case of checking the CHS tank outlet temperature sensor in water, be careful not to allow water to contact the terminals. After checking, dry the sensor.
HINT:
Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet 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.
(c) Reinstall the CHS tank outlet temperature sensor.

NG → **REPLACE TEMPERATURE SENSOR**

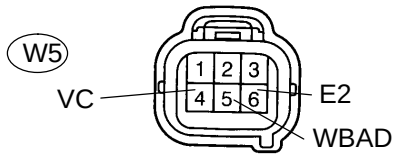
OK

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3	CHECK HARNESS AND CONNECTOR

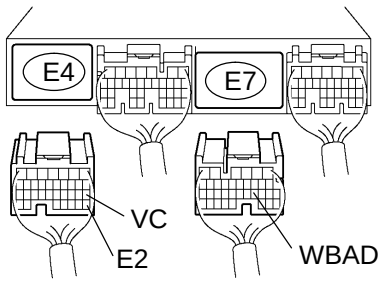
Wire Harness Side:

Water Valve Connector



Front View

A75544



Y ECM Connector A82814

(a) Disconnect the W5 water valve connector.
(b) Disconnect the E4 and E7 ECM connectors.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Water valve (W5–5) – WBAD (E7–20)	Below 1 Ω
Water valve (W5–4) – VC (E4–18)	Below 1 Ω
Water valve (W5–6) – E2 (E4–28)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Water valve (W5–5) or WBAD (E7–20) – Body ground	10 kΩ or higher

(d) Reconnect the water valve connector.
(e) Reconnect the ECM connectors.

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

OK

4	CHECK COOLING SYSTEM

OK: Coolant passages are not clogged.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

5	REPLACE WATER W/BRACKET VALVE ASSY

GO

6	PERFORM SIMULATION TEST

(a) Put the engine in inspection mode and start the engine.
(b) Warm up the engine until the engine coolant temperature reaches more than 85°C (185 °F).
(c) Cool the engine down completely.
(d) Perform the steps (a) to (c) twice.

GO

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7	READ OUTPUT DTCS

(a) Connect the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the OBD II scan tool ON.
(d) Read DTCs using the OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
No output	A
DTC P1150	B

B → **REPLACE ECM (See page 10–24)**

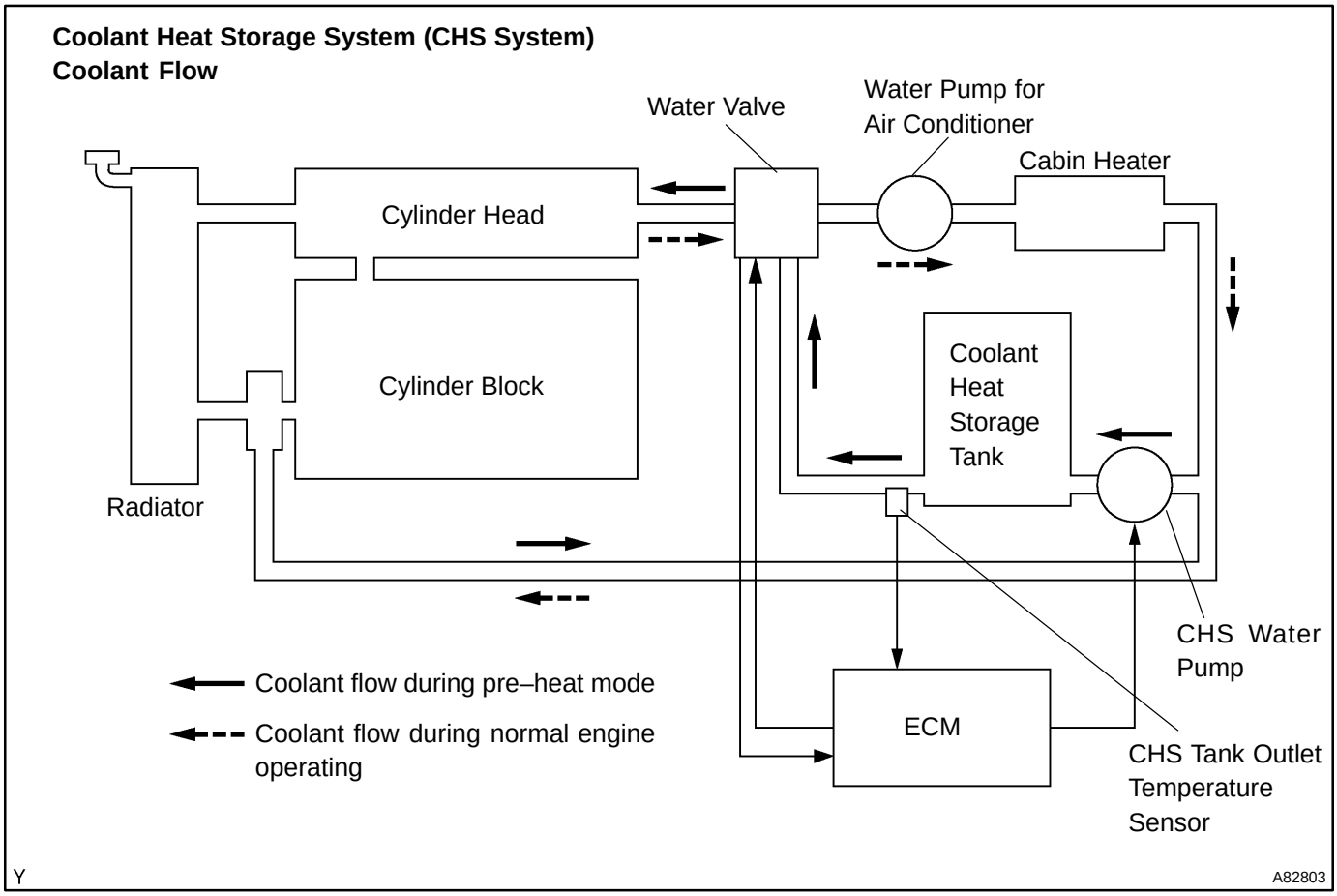
A →

SYSTEM OK

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DTC	P1151	COOLANT HEAT STORAGE TANK

CIRCUIT DESCRIPTION



This system uses an electric pump to supply hot coolant stored in the coolant heat storage (CHS) tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the CHS tank into the engine, in order to heat the cylinder head (this process is called ”preheat mode”). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During the preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.
This system consists of the CHS tank, CHS water pump, CHS tank outlet temperature sensor, water valve, and a soak timer that is built in the ECM.

DTC No.	DTC Detecting Condition	Trouble Area
P1151	Following conditions are successively met: • CHS tank outlet temperature during preheating: below 50°C (122°F) (2 trip detection condition) • CHS tank outlet temperature during soaking: 30 °C (54 °F) or more lower than during coolant recovering	• Coolant heat storage tank

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MONITOR DESCRIPTION

The ECM detects malfunction in the coolant heat storage (CHS) system with the CHS tank coolant temperature, the position of the water valve, the running condition of the engine and the operating condition of the soak timer. The soak timer built in the ECM prompts the ECM to actuate the water pump 5 hours after the HV main system has been turned OFF by using the power switch. The ECM then checks the heat retention condition of the CHS tank. In order to ensure the reliable malfunction detection, the ECM detects the CHS tank heat retention malfunction in two ways. thus, when the following two detection conditions are consecutively met, the ECM determines that the heat retention has deteriorated and sets a DTC.

(1) During preheating, the CHS tank outlet water temperature is below 50°C (122°F) (2 trip detection logic).

(2) During soaking, the CHS tank outlet temperature is more than 30°C (86°F) lower than that during the got coolant recovery.

MONITOR STRATEGY

Related DTCs	P1151: Coolant heat storage tank
Required sensors/components	CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Coolant heat storage system malfunction	Not detected
Coolant heat storage water pump operation time	3 seconds or more
Storage coolant temperature	More than 75°C (167°F)

TYPICAL MALFUNCTION THRESHOLDS

Difference storage coolant temperature and heat storage tank outlet coolant temperature	30°C (54 °F) or more

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine and the radiator are cold.

NOTICE:

If air breeding is not performed completely, this DTC may be detected after changing the coolant.

HINT:

- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

REPLACE COOLANT HEAT STORAGE TANK

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DTC	P1455	VAPOR REDUCING FUEL TANK SYSTEM MALFUNCTION

CIRCUIT DESCRIPTION

Using the heated oxygen sensor and VSV for purge flow switching valve (bypass VSV), the ECM detects fuel leaks from inside a bladder tank the fuel tank.
Based on signals from the heated oxygen sensor while the VSV for purge flow switching valve is ON, the ECM judges if fuel is leaked from the bladder tank or not.

DTC No.	DTC Detection Condition	Trouble Area
P1455	When VSV for purge flow switching valve is ON, vapor density of air which flows from EVAP VSV into intake manifold is high	• Hose and pipe for EVAP system • Fuel system • ECM

MONITOR DESCRIPTION

The ECM detects leakage of evaporative emissions from the bladder membrane by using the heated oxygen sensor and VSV for the purge switching valve. By opening the EVAP VSV and then closing the VSV for purge flow switching valve, air in the outer tank is drawn into the intake manifold.
The ECM checks concentration of hydrocarbon (HC) molecules in the air drawn from the bladder membrane area. Also, the ECM checks the sensor output before and after closing the VSV for purge switching valve. If there is change in the HC concentration when the VSV is opened or closed, the ECM will conclude that the bladder membrane is leaking. The ECM will illuminates the MIL and a DTC is set.

MONITOR STRATEGY

Related DTCs	P1455: Vapor reducing fuel tank system leak detected (small leak) monitor
Required sensors/components	Fuel tank, heated oxygen sensor, VSV for purge flow switching valve
Frequency of operation	Once per driving cycle
Duration	None
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine coolant temperature at engine start compared with intake air temperature	–7°C (19°F) or more, and 11°C (52°F)
Engine coolant temperature at engine start	10°C (50°F) or more, and 35°C (95°F)
Intake air temperature at engine start	10°C (50°F) or more, and 35°C (95°F)
Intake air temperature	10°C (50°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Vapor concentration in purge air	Less than –7 to –4 %/% (depending on intake air temperature)
FAF smoothing value	Less than 5 %
VSV for purge flow switching valve	No malfunction
Purge air volume after purge flow switching valve monitoring	2 g

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MONITOR RESULT (MODE 06 DATA)

Test ID/Comp ID	Description of Test Data	Description of Test Limit	Conversion Factor (Unit)
$02/$86	Fuel vapor concentration in outer–tank	Malfunction criteria for the fuel leakage from bladder tank	Multiply by 0.01 (mmHg)

Refer to page 05–26 for detailed information on Checking Monitor Status.

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P1455)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs using hand–held tester or OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
P1455	A
P1455 and other DTCs	B

HINT:
If any other codes besides P1455 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2 INSPECT FUEL TANK ASSY

(a) Remove the fuel tank (see page 11–21).
(b) Drain fuel from the tank and turn it upside down.
OK:
Fuel does not come out from anywhere except the main fuel hose.

OK → **REPLACE ECM (See page 10–24)**

NG

REPLACE FUEL TANK ASSY

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DTC	P2102	THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW

DTC	P2103	THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH

CIRCUIT 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 motor and monitor the throttle opening angle as the ECM responds to driver inputs.
HINT:
This Electrical 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 is 80 % or more (b) Throttle control motor current is 0.5 A or less	• Open in throttle control motor circuit • Throttle control motor • ECM
P2103	Following conditions are met. • Throttle control motor current is 10 A or more (0.6 second) • Hybrid IC current limiter port: Fail When electric throttle actuator is ON (i.e. actuator power ON or actuator power supply voltage is 8 V or more)	• Short in throttle control motor circuit • Throttle control motor • Throttle valve • Throttle body assembly • ECM

MONITOR DESCRIPTION

The ECM monitors the flow of electrical current through the electronic throttle motor, and detects malfunction or open circuits in the throttle motor based on the value of the electrical current. When the current deviates from the standard values, the ECM concludes that there is a fault in the throttle motor. Or, if the throttle valve is not functioning properly (for example, stuck ON), the ECM concludes that there is a fault in the throttle motor and turns on the MIL and a DTC is set.
Example:
When the current is more than 10A. Or, the current is less than 0.5A when the motor driving duty ratio is more than 80%. The ECM concludes that the current is deviated from the standard values, turns on the MIL and a DTC is set.

FAIL SAFE

If the 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 to drive.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a ”pass” condition is detected and then the power switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

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MONITOR STRATEGY

Case 1

Related DTCs	P2102: Throttle actuator control motor current (low current)
Required sensors/components	Throttle actuator motor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately
Sequence of operation	None

Case 2

Related DTCs	P2103: Throttle actuator control motor current (high current)
Required sensors/components	Throttle actuator motor
Frequency of operation	Continuous
Duration	0.6 second
MIL operation	1 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Case 1

P2102: Throttle actuator control motor current (low current)

The monitor will run whenever the following DTCs are not present	See page 05–20
Throttle motor	ON
Difference between motor current of present and 0.016 second ago	Less than 0.2 A

Case 2

P2103: Throttle actuator control motor current (high current)

The monitor will run whenever the following DTCs are not present	See page 05–20
Throttle motor	ON

TYPICAL MALFUNCTION THRESHOLDS

Case 1

P2102: Throttle actuator control motor current (low current)

Throttle motor current	Less than 0.5 A (when motor drive duty is 80 % or more)

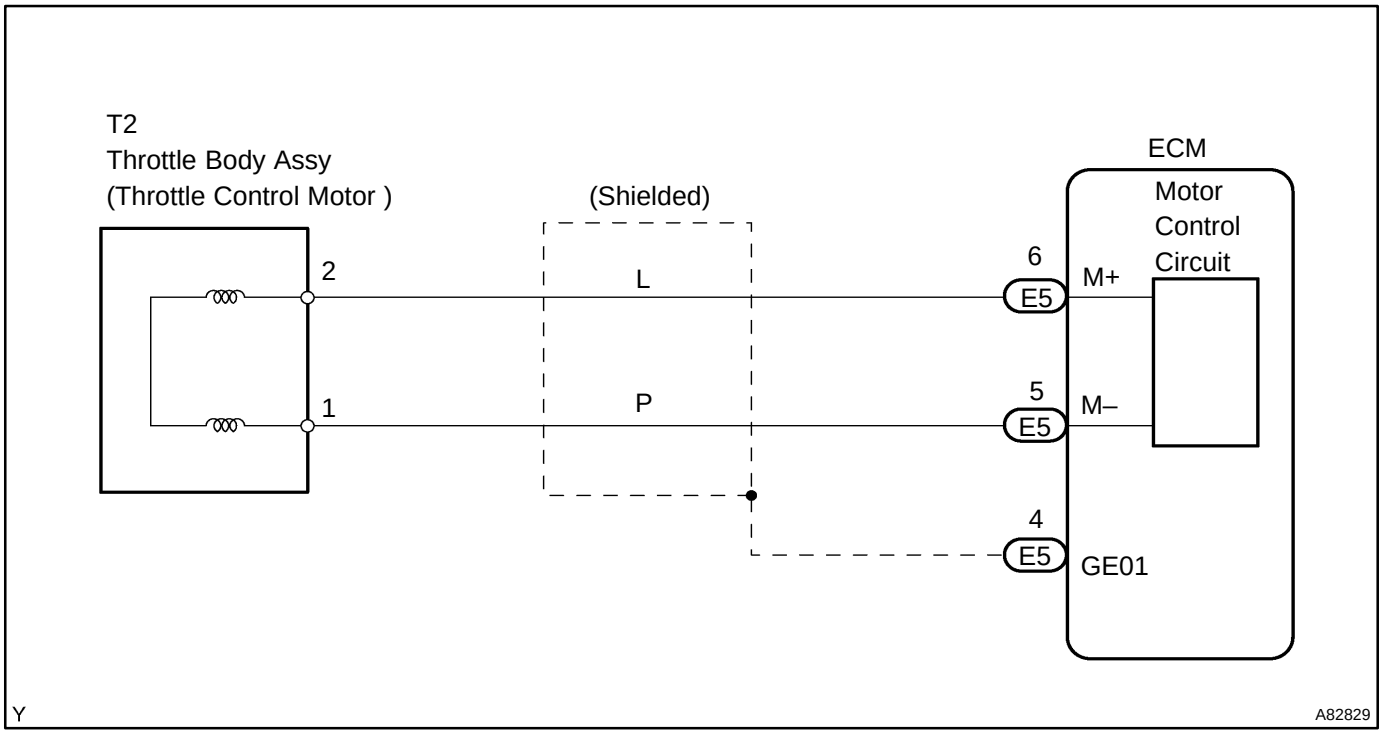
Case 2

P2103: Throttle actuator control motor current (high current)

Hybrid IC	Fail

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WIRING DIAGRAM



INSPECTION PROCEDURE

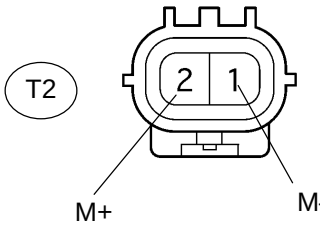
HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	INSPECT THROTTLE W/MOTOR BODY ASSY(THROTTLE CONTROL MOTOR)

Component Side:

Throttle Control Motor Connector



(a) Disconnect the throttle control motor connector.

(b) Using an ohmmeter, measure the motor resistance between terminals 1 (M–) and 2 (M+).

Standard:

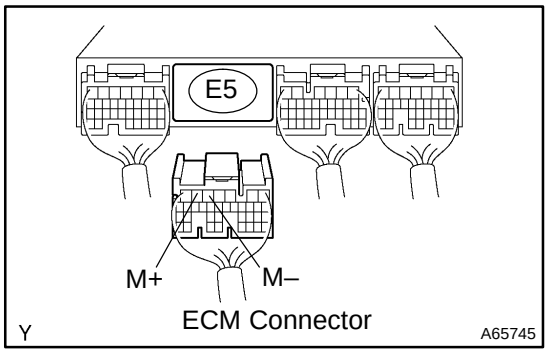
Tester Connection	Specified Condition
M– (1) – M+ (2)	0.3 to 100 Ω at 20 °C (68 °F)

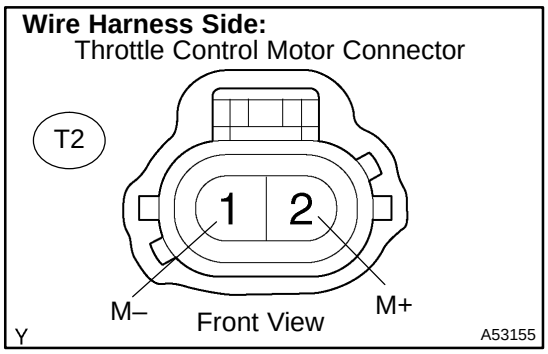
NG → **REPLACE THROTTLE W/MOTOR BODY ASSY (See page 10–13)**

OK

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2 CHECK HARNESS AND CONNECTOR(ECM – THROTTLE CONTROL MOTOR)





(a) Disconnect the E5 ECM connector.
(b) Disconnect the throttle control motor connector.
(c) Check the resistance between the wire harness side connectors.

Standard: (check for open)

Tester Connection	Specified Condition
Throttle control motor (2) – M+ (E5 –6)	Below 1 Ω
Throttle control motor (1) – M– (E5 –5)	Below 1 Ω

Standard: (check for short)

Tester Connection	Specified Condition
Throttle control motor (2) or M+ (E5–6) – Body ground	10 kΩ or higher
Throttle control motor (1) or M– (E5–5) – Body ground	10 kΩ or higher

(d) Reconnect the ECM connector and the throttle control motor connector.

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

OK

3 INSPECT THROTTLE W/MOTOR BODY ASSY

(a) Visually check between the throttle valve and the housing for foreign objects.
Also, check if the valve can open and close smoothly.

OK: The throttle valve is not contaminated by foreign objects and can move smoothly.

NG → **REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY**

OK

REPLACE ECM (See page 10–24)

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DTC	P2111	THROTTLE ACTUATOR CONTROL SYSTEM – STUCK OPEN

DTC	P2112	THROTTLE ACTUATOR CONTROL SYSTEM – STUCK CLOSED

CIRCUIT DESCRIPTION

The throttle motor 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 to ECM with feedback to control the throttle motor and set the throttle valve angle in response to driver input.

HINT:

This Electrical Throttle Control System (ETCS) does not use a throttle cable.

DTC No.	DTC Detection Condition	Trouble Area
P2111	Throttle motor locked during ECM orders to open	• Throttle control motor circuit • Throttle control motor • Throttle body • Throttle valve
P2112	Throttle motor locked during ECM orders to close	• Throttle control motor circuit • Throttle control motor • Throttle body • Throttle valve

MONITOR DESCRIPTION

The ECM concludes that there is malfunction of the ETCS when the throttle valve remains at a fixed angle despite high drive current supplying from the ECM. The ECM will turn on the MIL and a DTC is set.

FAIL SAFE

If the Electronic Throttle Control System (ETCS) has 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 to drive.

If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

If a ”pass” condition is detected and then the power switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

MONITOR STRATEGY

Related DTCs	P2111: Throttle motor actuator lock (open) P2112: Throttle motor actuator lock (closed)
Main sensors/components	Throttle actuator motor
Frequency of operation	Continuous
Duration	0.5 second
MIL operation	Immediately
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

P2111:

The monitor will run whenever the following DTCs are not present	See page 05–20
Throttle motor current	2 A or more
Throttle motor duty to open	80 % or more

P2112:

The monitor will run whenever the following DTCs are not present	See page 05–20
Throttle motor current	2 A or more
Throttle motor duty to close	80 % or more

TYPICAL MALFUNCTION THRESHOLDS

Difference between throttle position sensor output voltage of present and 16 milliseconds ago	Less than 0.1 V

WIRING DIAGRAM

Refer to DTC P2102 on page 05–301.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	**CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P2111 AND/OR P2112)**

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result:

Display (DTC Output)	Proceed to
P2111 or P2112	A
P2111 or P2112, and other DTCs	B

HINT:

If any other codes besides P2111 and/or P2112 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

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2	INSPECT THROTTLE W/MOTOR BODY ASSY(VISUALLY CHECK THROTTLE VALVE)

(a) Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

NG → **REPLACE THROTTLE W/MOTOR BODY ASSY**

OK

3	CHECK IF DTC OUTPUT RECURS(DTC P2111 AND/OR P2112)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) Clear the DTC.
(e) Put the engine in inspection mode (see page 05–1).
(f) Start the engine, and depress and release the accelerator pedal quickly (fully open and fully close).
(g) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(h) Start the engine, and depress and release the accelerator pedal quickly (fully open and fully close).
(i) Read DTCs using the hand–held tester or the OBD II scan tool.

Result:

Display (DTC Output)	Proceed to
No output	A
P2111 and/or P2112	B

B → **REPLACE ECM (See page 10–24)**

A

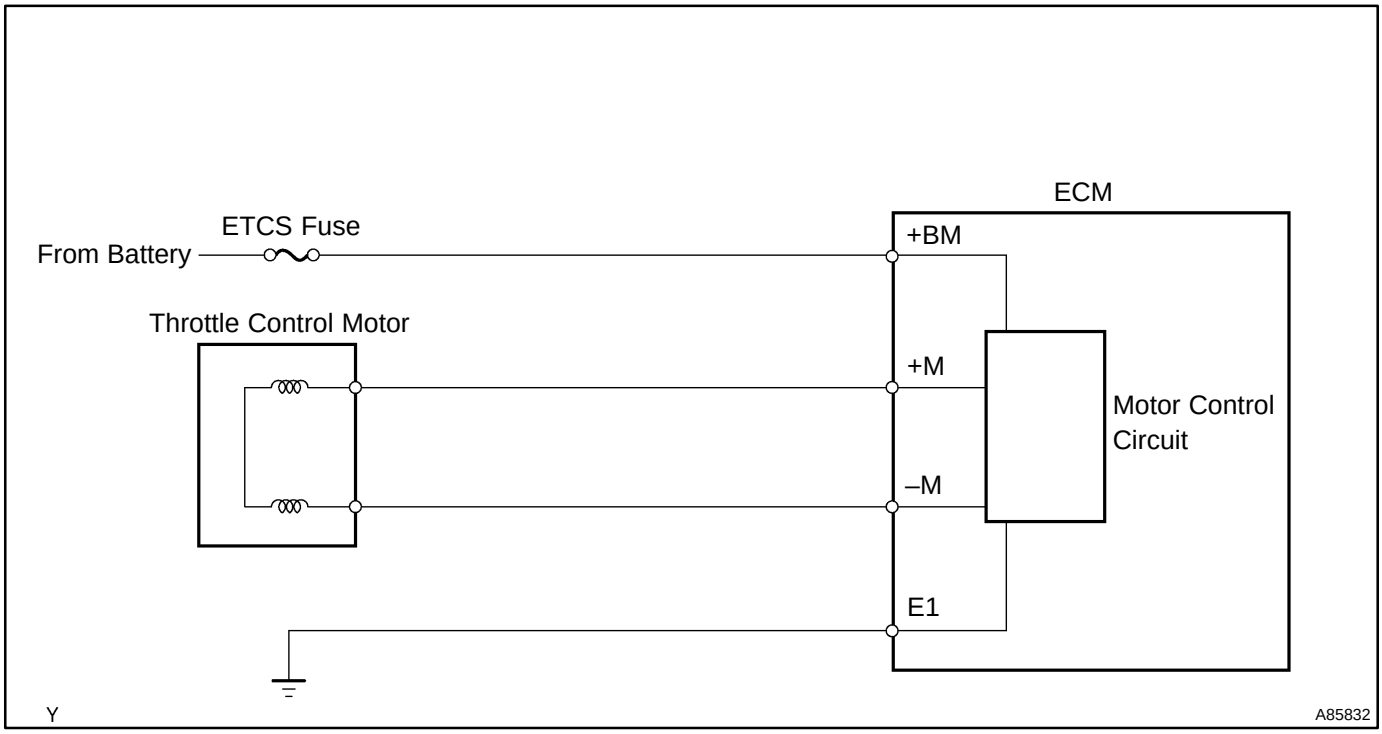
CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)

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DTC	P2118	THROTTLE ACTUATOR CONTROL MOTOR CURRENT RANGE/PERFORMANCE

CIRCUIT DESCRIPTION

The Electronic Throttle Control System (ETCS) has a dedicated power supply circuit. The voltage (+BM) is monitored and when the voltage is low (less than 4V), the ECM concludes that the ETCS has a fault and current to the throttle control motor is cut.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the motor is cut. If repairs are made and the system has returned to normal, turn the power switch OFF. The ECM then allows current to flow to the motor and the motor can be restarted.
HINT:
This Electrical Throttle Control System (ETCS) does not use a throttle cable.



DTC No.	DTC Detection Condition	Trouble Area
P2118	Open in ETCS power source circuit	• Open in ETCS power source circuit • ETCS fuse • ECM

MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the electronic throttle motor. When the power supply voltage drops below the threshold, the ECM concludes that there is an open in the power supply circuit. A DTC is set and the MIL is turned on.

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FAIL SAFE

If the Electronic Throttle Control System (ETCS) has 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 to drive.

If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

If a ”pass” condition is detected and then the power switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

MONITOR STRATEGY

Related DTCs	P2118: Throttle actuator motor power supply line range check (low voltage)
Required sensors/components	Throttle actuator motor
Frequency of operation	Continuous
Duration	0.8 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Actuator power	ON
Battery voltage	8 V or more

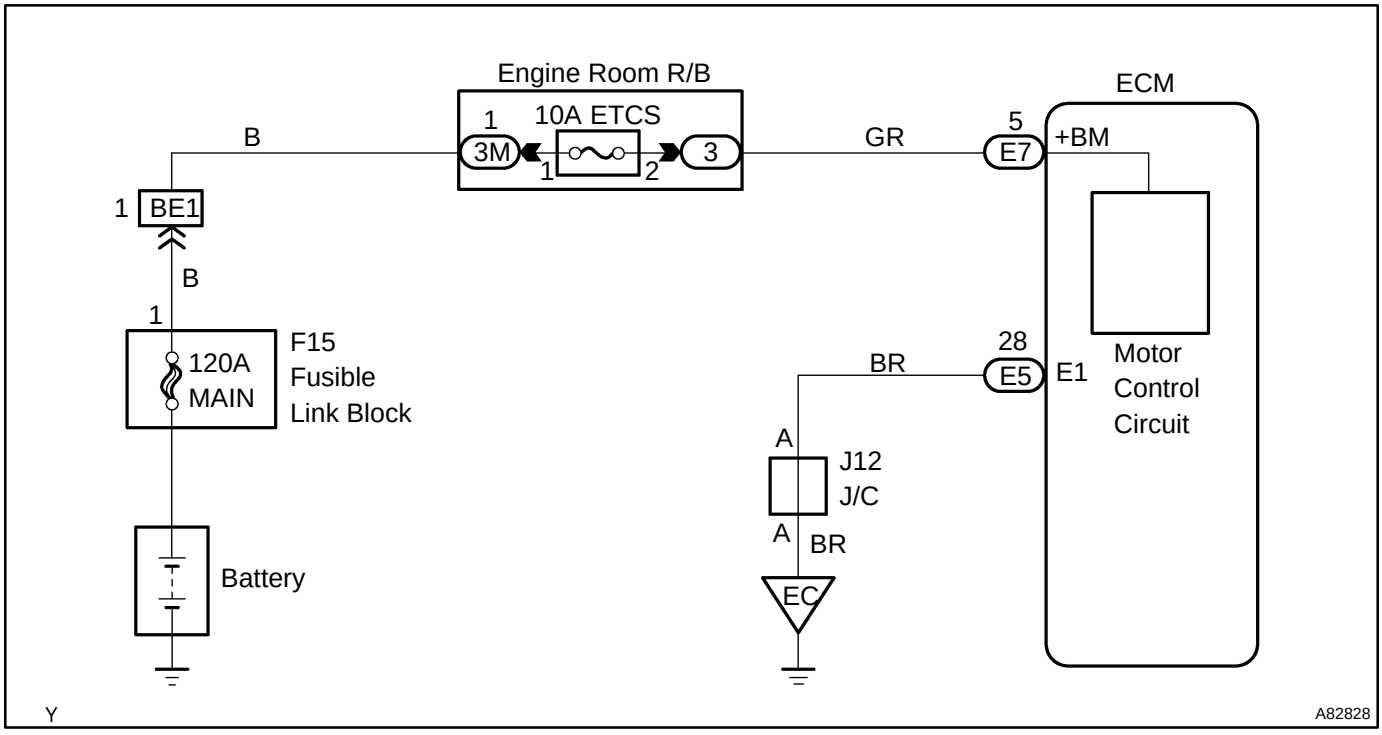
TYPICAL MALFUNCTION THRESHOLDS

Throttle actuator motor power supply voltage	Less than 4 V

COMPONENT OPERATING RANGE

Throttle actuator motor power supply voltage	9 to 14 V

WIRING DIAGRAM



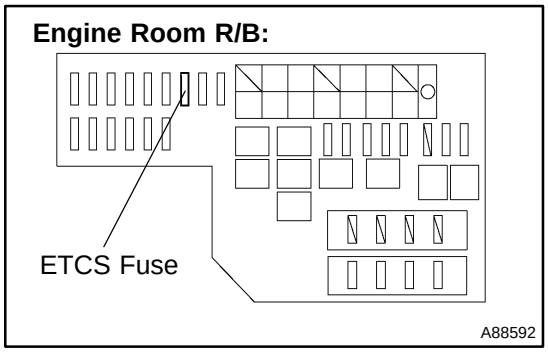
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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK FUSE(ETCS FUSE)

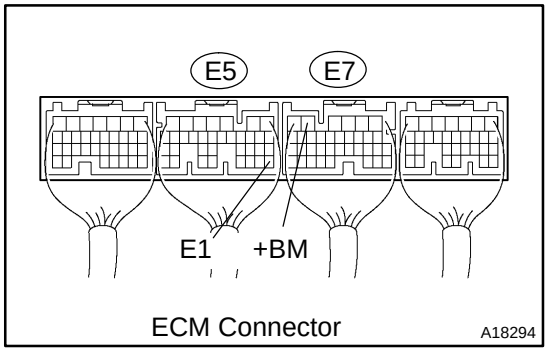


(a) Remove the ETCS fuse from the engine room R/B.
(b) Check the resistance of the ETCS fuse.
Standard: Below 1 Ω
(c) Reinstall the ETCS fuse.

NG → **CHECK FOR SHORT IN ALL HARNESSES AND COMPONENTS CONNECTED FUSE**

OK

2	INSPECT ECM(+BM VOLTAGE)



(a) Measure the voltage between the specified terminals of the E5 and E7 ECM connectors.
Standard:

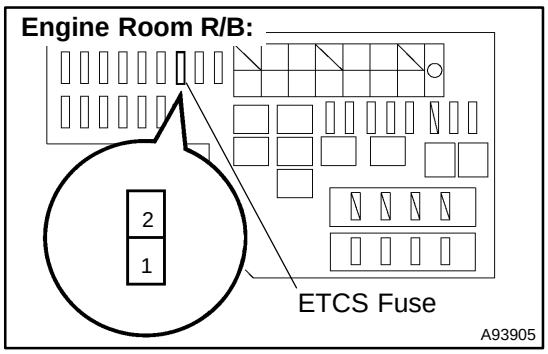
Tester Connection	Specified Condition
+BM (E7–5) – E1 (E5–28)	9 to 14 V

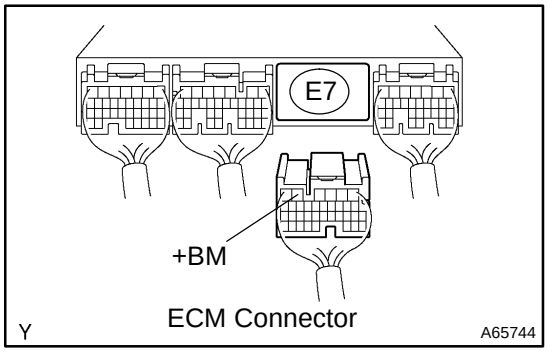
OK → **REPLACE ECM (See page 10–24)**

NG

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3	CHECK HARNESS AND CONNECTOR(ECM – ETCS FUSE, ETCS FUSE – BATTERY)





(a) Check the harness and the connectors between the ETCS fuse and the ECM connector.
  (1) Remove the ETCS fuse from the engine room R/B.
  (2) Disconnect the E7 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
ETCS fuse (2) – +BM (E7–5)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
ETCS fuse (2) or +BM (E7–5) – Body ground	10 kΩ or higher

  (4) Reinstall the ETCS fuse.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the ETCS fuse and the battery.
  (1) Remove the ETCS fuse from the engine room R/B.
  (2) Disconnect the positive battery terminal.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Battery positive terminal – ETCS fuse (1)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
Battery positive terminal or ETCS fuse (1) – Body ground	10 kΩ or higher

  (4) Reinstall the ETCS fuse.
  (5) Reconnect the positive battery terminal.

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

OK

CHECK AND REPLACE FUSIBLE LINK BLOCK ASSY

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DTC	P2119	THROTTLE ACTUATOR CONTROL THROTTLE BODY RANGE/PERFORMANCE

CIRCUIT DESCRIPTION

The Electric Throttle Control System (ETCS) is composed of a throttle motor 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, mounted on the throttle body, 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 its target angle	• Electric throttle control system • ECM

MONITOR DESCRIPTION

The ECM determines the ”actual” throttle valve angle based on the throttle position sensor signal. The ”actual” throttle valve position is compared to the ”target” throttle valve position commanded by the ECM. If the difference of these two 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 Electronic Throttle Control System (ETCS) has 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 to drive.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a ”pass” condition is detected and then the power switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

MONITOR STRATEGY

Related DTCs	P2119: Electronic throttle control system failure
Required sensors/components	Main: Throttle actuator motor Related: Throttle position sensor
Frequency of operation	Continuous
Duration	Within 1 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20

TYPICAL MALFUNCTION THRESHOLDS

Difference between commanded throttle valve position and current throttle valve position	0.3 V or more

COMPONENT OPERATING RANGE

Commanded throttle valve position	Same as current throttle valve position

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WIRING DIAGRAM

Refer to DTC P2102 on page 05–301.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P2119)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result:

Display (DTC Output)	Proceed to
P2119	A
P2119 and other DTCs	B

HINT:

If any other codes besides P2119 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	CHECK IF DTC OUTPUT RECURS

(a) Clear the DTCs (see page 05–41).
(b) Allow the engine to idle for 15 seconds.
(c) Securely apply the parking brake, and place the shift position in D.
(d) Depress the brake pedal securely and the accelerator pedal fully for 5 seconds.
(e) Read DTCs.

HINT:

Actual throttle position (TP) sensor voltage can be confirmed using the hand–held tester [DATA LIST / ALL /THROTTLE POS #1].

Standard: No DTC output.

OK → **SYSTEM OK**

NG

REPLACE THROTTLE W/MOTOR BODY ASSY (See page 10–13)

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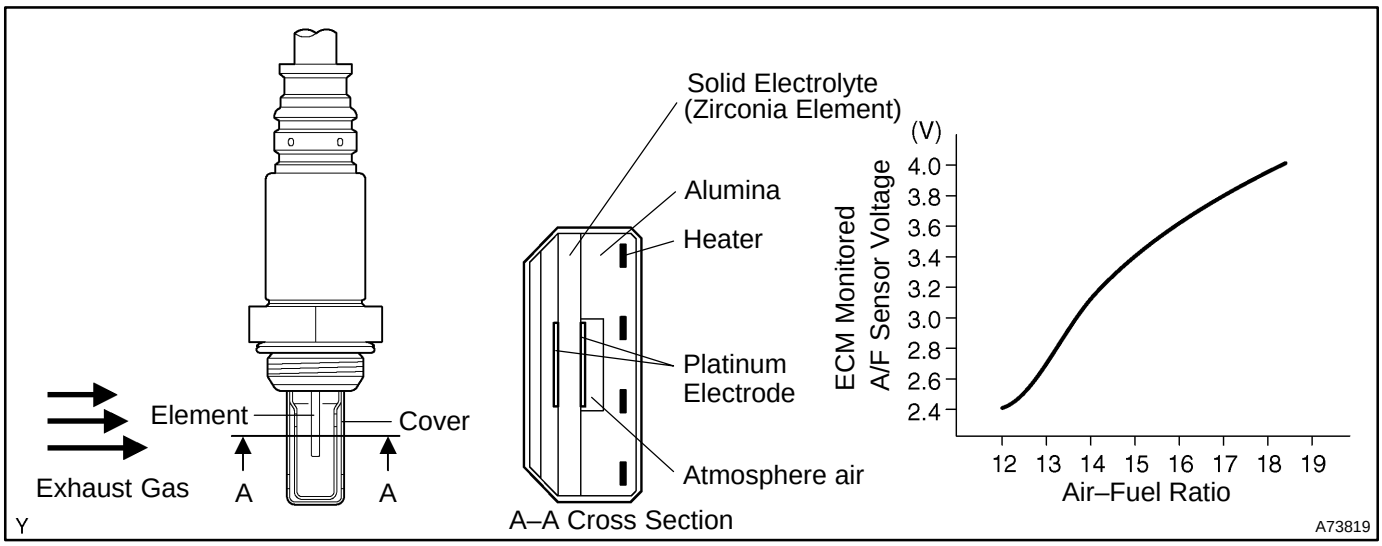
DTC	P2195	OXYGEN (A/F) SENSOR SIGNAL STUCK LEAN (BANK 1 SENSOR 1)

DTC	P2196	OXYGEN (A/F) SENSOR SIGNAL STUCK RICH (BANK 1 SENSOR 1)

HINT:
Although each DTC title says ”oxygen sensor”, these DTCs are related to the A/F sensor.

CIRCUIT DESCRIPTION

The air–fuel ratio (A/F) sensor provides output voltage* which is almost 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 the 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 carbon monoxides (CO), hydrocarbons (HC) and nitrogen oxides (NOx) components of the exhaust gas, a three–way catalytic converter is used. The converter is most efficient when the air–fuel ratio is maintained near the stoichiometric air–fuel ratio.
*: The voltage value changes inside the ECM only.



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DTC No.	DTC Detecting Condition	Trouble Area
P2195	Conditions (a) and (b) continue for 2 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	• Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • Integration relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM
P2196	Conditions (a) and (b) continue for 2 seconds or more : (a) A/F sensor voltage is less than 2.8 V (b) Rear oxygen sensor voltage is less than 0.85 V	• Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • Integration relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- After confirming DTC P2195 and P2196, use the OBD II scan tool or the hand−held tester to confirm voltage output of A/F sensor (AFS B1 S1) from the ”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 hand−held 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 OBDII scan tool or the hand–held tester.
- The OBD II scan tool (excluding hand−held tester) displays the one fifth of the A/F sensor output voltage which is displayed on the hand−held tester.

MONITOR DESCRIPTION

Under the air–fuel ratio feedback control, if the voltage output of the A/F sensor indicates RICH or LEAN for a certain period of time or more, the ECM concludes that there is a fault in the A/F sensor system. The ECM will turn on the MIL and a DTC is set.

If the A/F sensor voltage output is less than 2.8 V (indicates very RICH) 10 seconds even though voltage output of the heated oxygen sensor output voltage is less than 0.85 V, the ECM sets DTC P2196 Also, 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 (indicates very LEAN) for 10 seconds, DTC P2195 or is set.

MONITOR STRATEGY

Related DTCs	P2195: A/F sensor signal stuck lean P2196: A/F sensor signal stuck rich
Required sensors/components	Main: A/F sensor Related: Heated oxygen sensor
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Time after first engine start	30 seconds or more
A/F status	Activated
A/F sensor admittance	0.014 1/Ω
Fuel system status	Closed–loop
Engine	Running
Sub–feedback status	Executing
Heated oxygen sensor voltage	P2195: 0.15 V or more P2196: Less than 0.95 V

TYPICAL MALFUNCTION THRESHOLDS

Case 1

P2195: A/F sensor signal stuck lean

Time while the following condition is met	2 seconds or more
A/F output voltage	More than 3.8 V

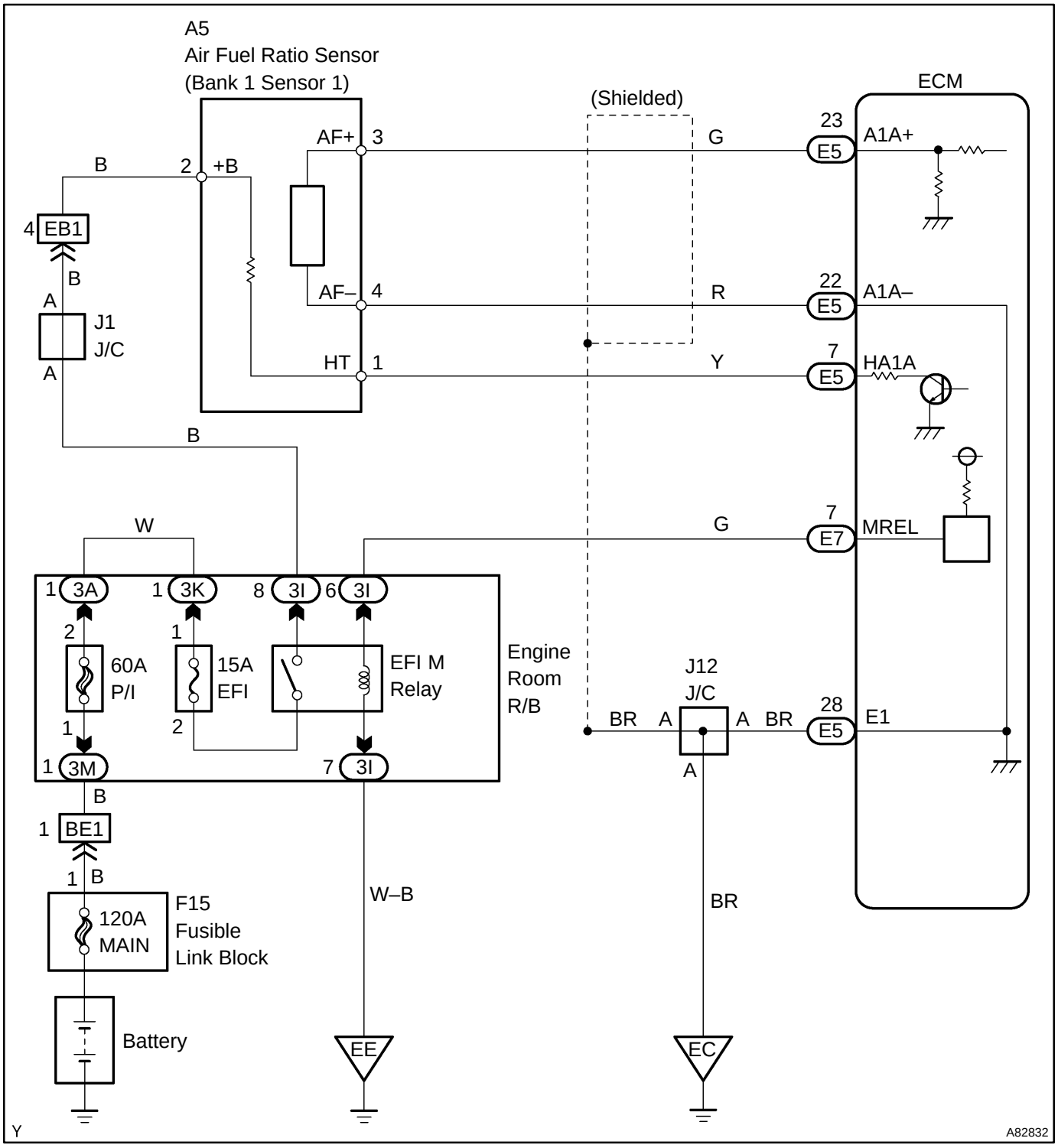
Case 2

P2196: A/F sensor signal stuck rich

Time while the following condition is met	2 seconds or more
A/F output voltage	Less than 2.8 V

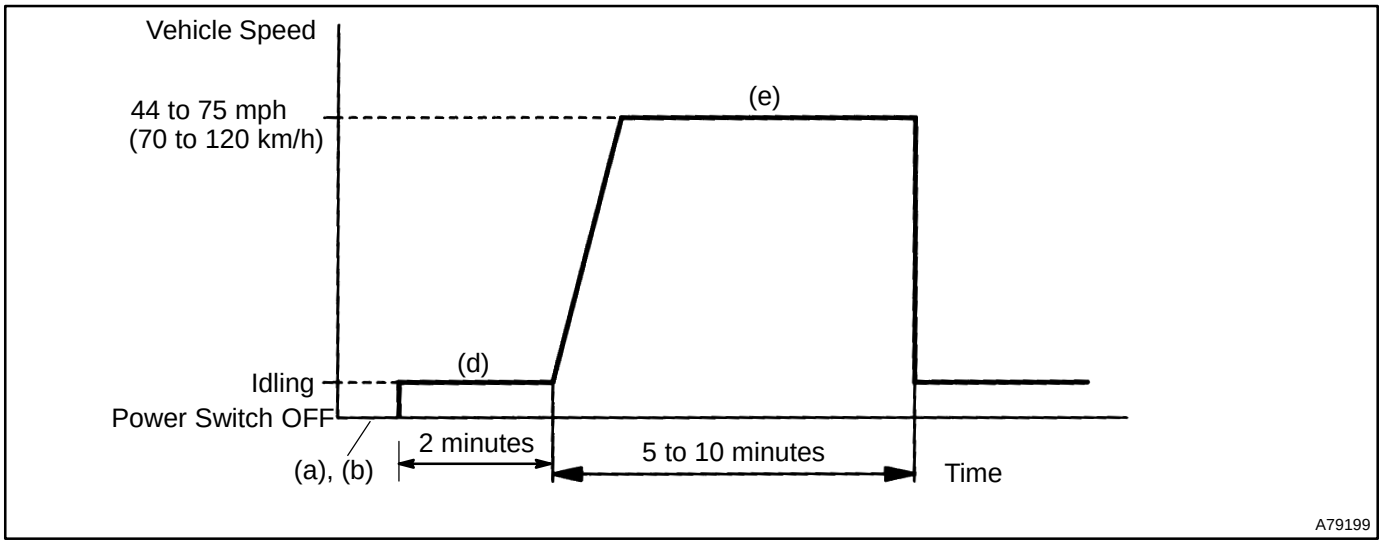
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WIRING DIAGRAM



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CONFIRMATION DRIVING PATTERN



(a) Connect the hand–held tester to the DLC3.
(b) Switch the ECM from normal mode to check mode using the hand–held tester (see page 05–45).
(c) Put the engine in inspection mode (see page 05–1).
(d) Start the engine and warm it up with all the accessory switches OFF.
(e) Deactivate the inspection mode and drive the vehicle at 44 to 75 mph (70 to 120 km/h) for 5 to 10 minutes (the engine must be run during monitoring).

HINT:
If malfunction exists, the MIL will be illuminated during step (d).

NOTICE:

- **If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have the hand–held tester, turn the power switch OFF after performing steps (d) and (e), then perform steps (d) and (e) again.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

INSPECTION PROCEDURE

HINT:
Malfunctioning areas can be found by performing 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 area 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 hand–held tester to the DLC3 on the vehicle.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page 05–1).
(4) Warm up the engine by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(5) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

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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

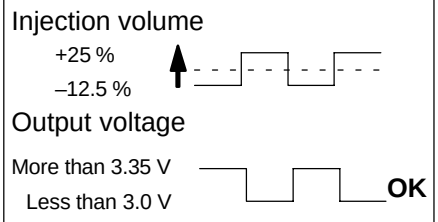
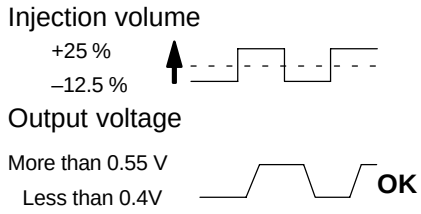
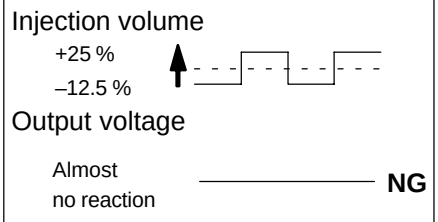
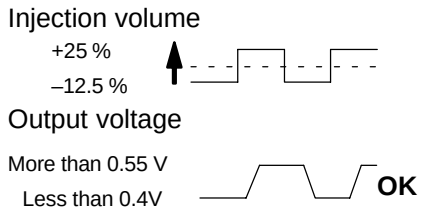
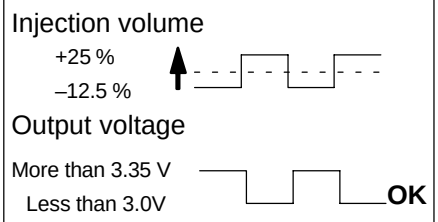
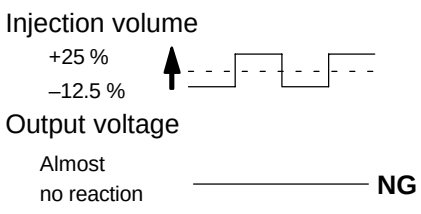
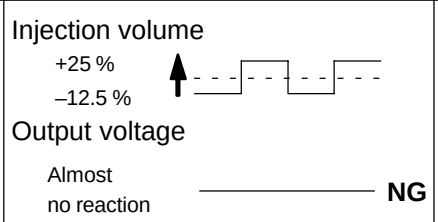
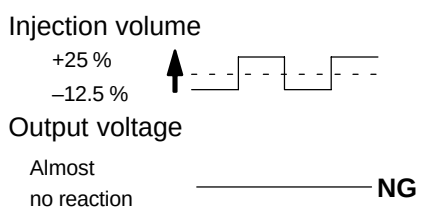
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

+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.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Main Suspect Trouble Area
Case 1			—
Case 2			A/F sensor (A/F sensor, sensor heater, sensor circuit)
Case 3			Heated oxygen sensor (heated oxygen sensor, sensor heater, sensor circuit)
Case 4			Extremely RICH or LEAN actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

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

To display the graph, enter ACTIVE TEST / A/F CONTROL / USER DATA, select ”AFS B1S1 and O2S B1S2” by pressing the ”YES” button followed by the ”ENTER” button and then the ”F4” button.

- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high A/F sensor voltage could be caused by a RICH air–fuel mixture. Check the conditions that would cause the engine to run with the RICH air–fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air–fuel mixture. Check the conditions that would cause the engine to run with the LEAN air–fuel mixture.

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1	CHECK OTHER DTC OUTPUT(IN ADDITION TO A/F SENSOR DTCS)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result :

Display	Proceed to
A/F sensor circuit DTC	A
A/F sensor circuit DTCs and other DTCs	B

HINT:
If any other codes besides A/F sensor DTCs are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

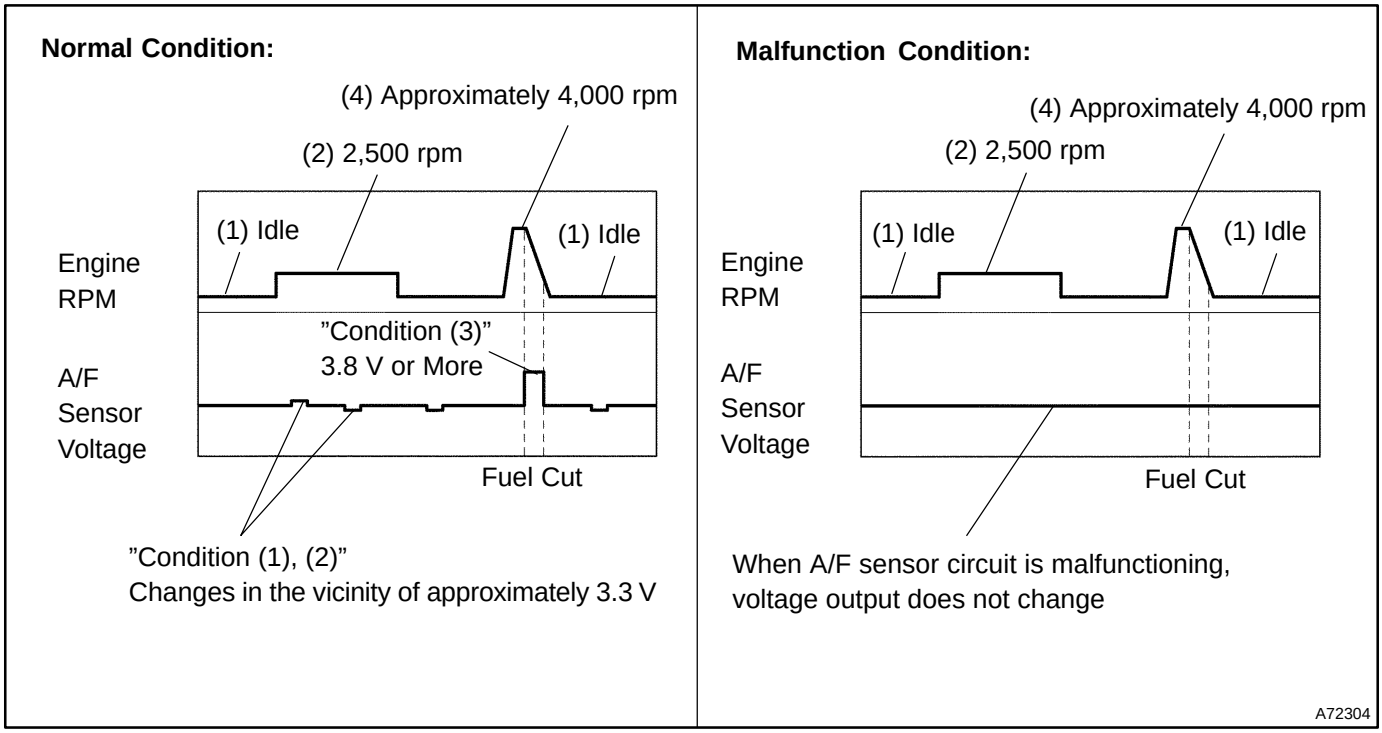
2	READ VALUE OF OBD II SCAN TOOL OR HAND–HELD TESTER(OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC 3.
(b) Put the engine in inspection mode (see page 05–1).
(c) Warm up the A/F sensors (bank 1 sensor 1) by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(d) Read A/F sensor voltage output on the OBD II scan tool or the hand–held tester.
(e) Hand–held tester only:
On the hand–held tester, enter the menus: ENHANCED OBD II / ENGINE AND ECT / SNAPSHOT / MANUAL SNAPSHOT / USER DATA.
(f) Select ”AFS B1 S1/ENGINE SPD” and press button ”YES”.
(g) Monitor the A/F sensor voltage carefully.
(h) Check the A/F sensor voltage output under the following conditions:
  (1) Put the engine in inspection mode and allow the engine to idle for 30 seconds.
  (2) Put the engine in inspection mode and running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % (where engine RPM is not suddenly changed).
  (3) Deactivate the inspection mode and drive the vehicle with shift position ”B” range.
  (4) Accelerate the vehicle to 44 mph (70 km/h) and quickly release the accelerator pedal so that the throttle valve is fully closed.

CAUTION:
- **Strictly observe of posted speed limits, traffic laws, and road conditions when performing these drive patterns.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

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Standard:
Condition (1) and (2)
Voltage changes in the vicinity of 3.3 V (0.66 V)* (between approximately 3.1 to 3.5 V) as shown in the illustration.
Condition (4)
A/F sensor voltage increases to 3.8 V (0.76 V)* or more during engine deceleration (when fuel cut) as shown in the illustration.
***: Voltage when using the OBD II scan tool.**



HINT:

- Whenever the output voltage of the A/F sensor remains at approximately 3.3 V (0.660 V)* (see diagram Malfunction Condition) 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 diagram Malfunction Condition) 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 was reconnected, the vehicle must be driven over 10 mph to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V (0.76 V)* during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F sensor or ECM, you will observe a constant voltage.

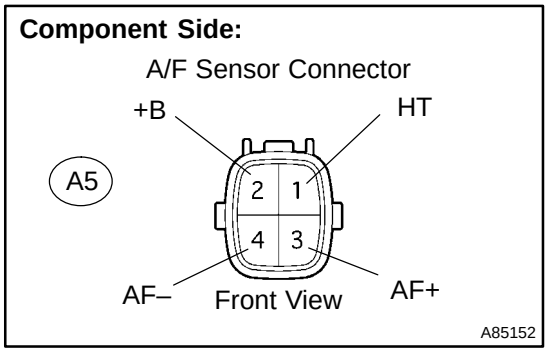
*: Voltage when using the OBD II scan tool.

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OK → Go to step 13

NG

3 INSPECT AIR FUEL RATIO SENSOR(RESISTANCE OF A/F SENSOR HEATER)



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.
Resistance:

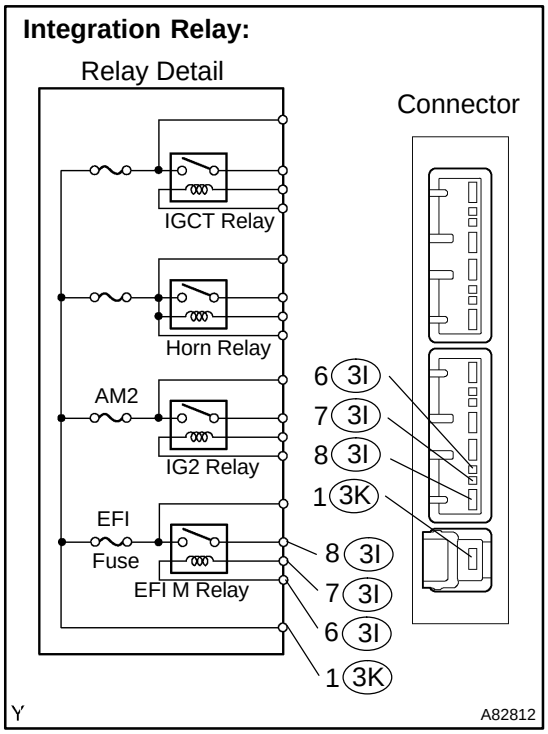
Tester Connection	Resistance
HT (1) – +B (2)	1.8 to 3.4 Ω at 20°C (68°F)

(c) Reconnect the A/F sensor connector.

NG → REPLACE AIR FUEL RATIO SENSOR

OK

4 INSPECT INTEGRATION RELAY(EFI M RELAY)



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the EFI M relay.
Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

(c) Reinstall the integration relay.

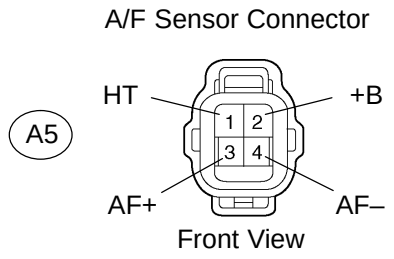
NG → REPLACE INTEGRATION RELAY

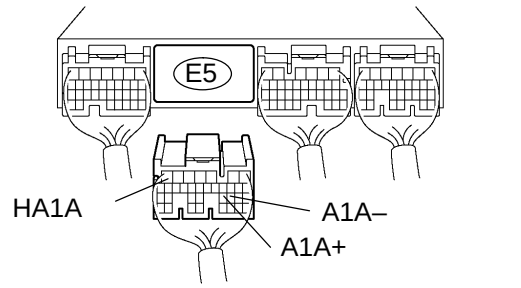
OK

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5 CHECK HARNESS AND CONNECTOR(A/F SENSOR – ECM)

Wire Harness Side:





(a) Disconnect the A5 A/F sensor connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

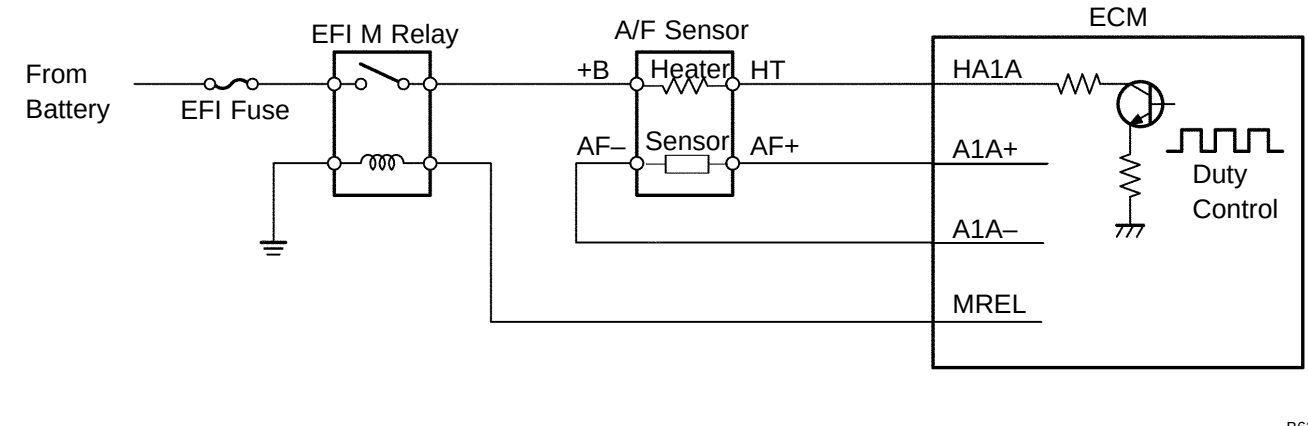
Tester Connection	Specified Condition
AF+ (A5–3) – A1A+ (E5–23)	Below 1 Ω
AF– (A5–4) – A1A– (E5–22)	Below 1 Ω
HT (A5–1) – HA1A (E5–7)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
AF+ (A5–3) or A1A+ (E5–23) – Body ground	10 kΩ or higher
AF– (A5–4) or A1A– (E5–22) – Body ground	10 kΩ or higher
HT (A5–1) or HA1A (E5–7) – Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.
(e) Reconnect the ECM connector.

Reference (Bank 1 Sensor 1 System Drawing):



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

OK →

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6	CHECK AIR INDUCTION SYSTEM

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

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

OK

7	CHECK FUEL PRESSURE (See page 11–7)

(a) Check fuel pressure (High or low fuel pressure).
OK:
Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8	INSPECT FUEL INJECTOR ASSY (See page 11–9)

(a) Check injector injection (high or low fuel injection quantity or poor injection pattern).
OK:
Injection volume: 36 to 46 cm^3 (2.1 to 2.8 cu in.) per 15 seconds.

NG → **REPLACE FUEL INJECTOR ASSY (See page 11–15)**

OK

9	REPLACE AIR FUEL RATIO SENSOR

GO

10	PERFORM CONFIRMATION DRIVING PATTERN

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

GO

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11	READ OUTPUT DTCS(SEE IF A/F SENSOR DTCS ARE OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result :

Display	Proceed to
No output	A
A/F sensor circuit DTCs	B

B → **REPLACE ECM (See page 10–24) AND PERFORM CONFIRMATION DRIVING PATTERN**

A

12	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK: Vehicle has run out of fuel in past.

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

YES

DTCS ARE CAUSED BY RUNNING OUT OF FUEL

13	PERFORM CONFIRMATION DRIVING PATTERN

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

GO

14	READ OUTPUT DTCS(SEE IF A/F SENSOR DTCS ARE OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result :

Display	Proceed to
A/F sensor circuit DTCs	A
No output	B

B → **Go to step 18**

A

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15	REPLACE AIR FUEL RATIO SENSOR

GO

16	PERFORM CONFIRMATION DRIVING PATTERN

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

GO

17	READ OUTPUT DTCS(SEE IF A/F SENSOR DTCS ARE OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result :

Display	Proceed to
No output	A
A/F sensor circuit DTCs	B

B → **REPLACE ECM (See page 10–24) 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.

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

YES

DTCS ARE CAUSED BY RUNNING OUT OF FUEL

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DTC	P2238	OXYGEN SENSOR PUMPING CURRENT CIRCUIT LOW (FOR A/F SENSOR)(BANK 1 SENSOR 1)

DTC	P2239	OXYGEN SENSOR PUMPING CURRENT CIRCUIT HIGH (FOR A/F SENSOR)(BANK 1 SENSOR 1)

DTC	P2252	OXYGEN SENSOR REFERENCE GROUND CIRCUIT LOW (FOR A/F SENSOR)(BANK 1 SENSOR 1)

DTC	P2253	OXYGEN SENSOR REFERENCE GROUND CIRCUIT HIGH (FOR A/F SENSOR)(BANK 1 SENSOR 1)

HINT:
Although the each DTC title says ”oxygen sensor”, these DTCs are related to the A/F sensor.

CIRCUIT DESCRIPTION

Refer to DTC P2195 on page 05–314.

DTC No.	DTC Detection Condition	Trouble Area
P2238	• Conditions (a) or (b) continues for 5 seconds or more : (a) AF+ is 0.5 V or less (b) (AF+) – (AF–) is 0.8 V or more • A/F sensor admittance: Less than 0.022 1/Ω	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • ECM
P2239	• Condition (a) continues for 5.0 seconds or more : (a) AF+ is more than 4.5 V (b) (AF+) – (AF–) is more than 0.8 V	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • ECM
P2252	AF– is 0.5 V or less for 5.0 seconds or more	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • ECM
P2253	AF– is more than 4.5 V for 5.0 seconds or more	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • ECM

MONITOR DESCRIPTION

The air fuel ratio (A/F) sensor has a characteristic that it varies its voltage output in proportion to the air–fuel ratio. If impedance (alternating current resistance) or voltage output of the sensor extraordinarily deviates from the standard range, the ECM determines to detect an open or short malfunction in the A/F sensor circuit.

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MONITOR STRATEGY

Related DTCs	P2238: A/F sensor pumping current circuit low P2239: A/F sensor pumping current circuit high P2252: A/F sensor reference ground circuit low P2253: A/F sensor reference ground circuit high
Required sensors/components	Main: A/F sensor Related: Engine speed sensor, vehicle speed sensor, engine coolant temperature sensor
Frequency of operation	Continuous
Duration	5 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

"General precondition" is defined as follows:

Battery voltage	10.5 V or more
Power switch	ON
Time after power switch from OFF to ON	5 seconds or more

"A/F sensor admittance precondition" is defined as follows:

Engine coolant temperature	30°C (86 °F) or more
Engine	Running
Time after first engine start	20 seconds or more
Time after A/F sensor heating	20 seconds or more

Case 1

P2238: A/F sensor pumping current circuit low
(AF+, AF– open)

The monitor will run whenever the following DTCs are not present	See page 05–20
Time while A/F sensor admittance precondition is met	20 seconds or more

Case 2

P2238: A/F sensor pumping current circuit low
(AF+, AF– short)

General precondition	Met

Case 3

P2238: A/F sensor pumping current circuit low
(AF+, GND short)

General precondition	Met

Case 4

P2239: A/F sensor pumping current circuit high

General precondition	Met

Case 5

P2252: A/F sensor reference ground circuit low

General precondition	Met

Case 6

P2253: A/F sensor reference ground circuit high

General precondition	Met

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TYPICAL MALFUNCTION THRESHOLDS

Case 1

P2238: A/F sensor pumping current circuit low
(AF+, AF– open)

A/F sensor admittance	Less than 0.022 1/Ω

Case 2

P2238: A/F sensor pumping current circuit low
(AF+, AF– short)

AF+ terminal voltage	Less than 0.1 V

Case 3

P2238: A/F sensor pumping current circuit low
(AF+, GND short)

Difference between voltage of terminals AF+ and AF–	Less than 0.5 V

Case 4

P2239: A/F sensor pumping current circuit high

AF+ terminal voltage (AF+ and +B, or AF+ and VCC short)	More than 4.5 V

Case 5

P2252: A/F sensor reference ground circuit low

AF– terminal voltage (AF– and GND short)	0.5 V or less

Case 6

P2253: A/F sensor reference ground circuit high

AF– terminal voltage (AF– and +B, or AF– and VCC short)	More than 4.5 V

WIRING DIAGRAM

Refer to DTC P2195 on page 05–314.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be found by performing 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 area 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 hand–held tester to the DLC3 on the vehicle.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page 05–1).
(4) Warm up the engine by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(5) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

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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

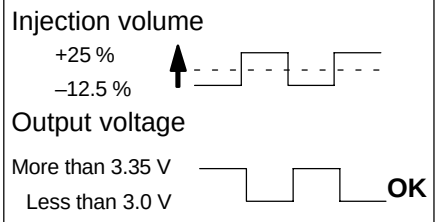
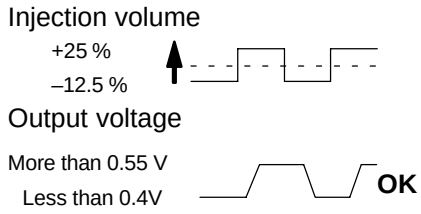
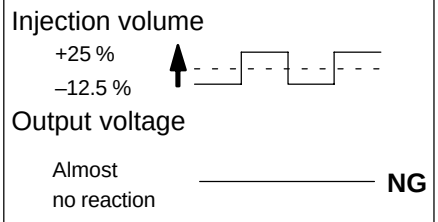
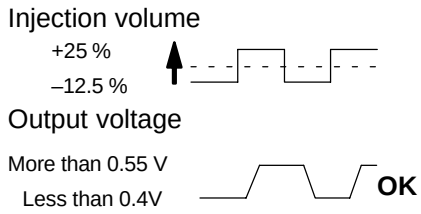
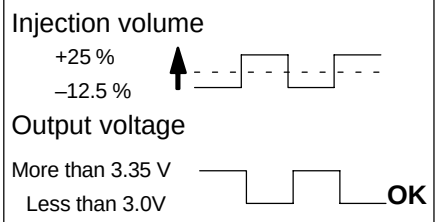
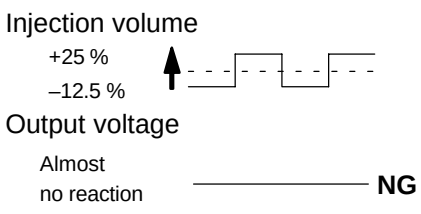
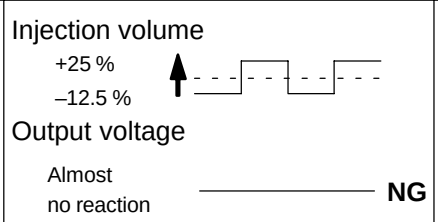
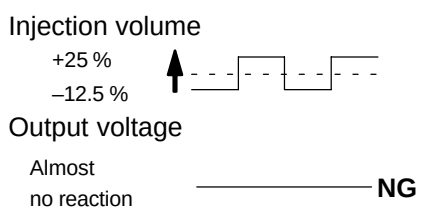
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

+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.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Main Suspect Trouble Area
Case 1			—
Case 2			A/F sensor (A/F sensor, sensor heater, sensor circuit)
Case 3			Heated oxygen sensor (heated oxygen sensor, sensor heater, sensor circuit)
Case 4			Extremely RICH or LEAN actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

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

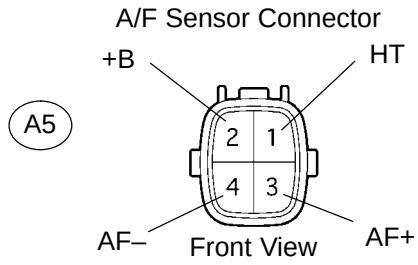
To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, select ”AFS B1S1 and O2S B1S2” by pressing the ”YES” button followed by the ”ENTER” button and then the ”F4” button.

- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high A/F sensor voltage could be caused by a RICH air–fuel mixture. Check the conditions that would cause the engine to run with the RICH air–fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air–fuel mixture. Check the conditions that would cause the engine to run with the LEAN air–fuel mixture.

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1 INSPECT AIR FUEL RATIO SENSOR(RESISTANCE OF A/F SENSOR HEATER)

Component Side:



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.

Standard:

Tester Connection	Resistance
HT (1) – +B (2)	1.8 to 3.4 Ω at 20°C (68°F)

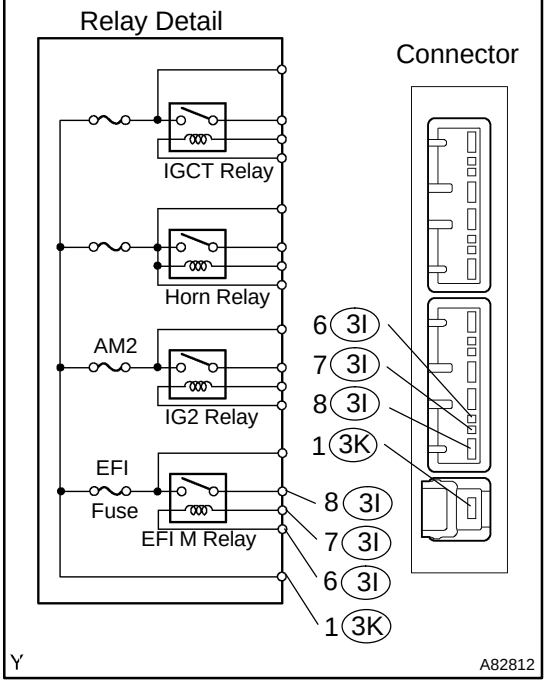
(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT INTEGRATION RELAY(EFI M RELAY)

Integration Relay:



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the EFI M relay.

Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

(c) Reinstall the integration relay.

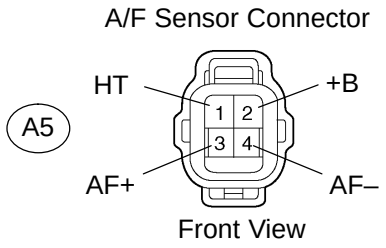
NG → **REPLACE INTEGRATION RELAY**

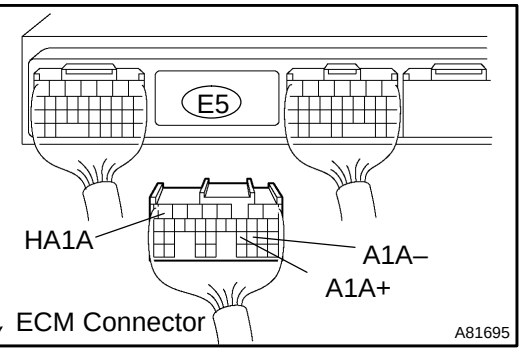
OK

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3 CHECK HARNESS AND CONNECTOR(A/F SENSOR – ECM)

Wire Harness Side:





(a) Disconnect the A5 A/F sensor connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

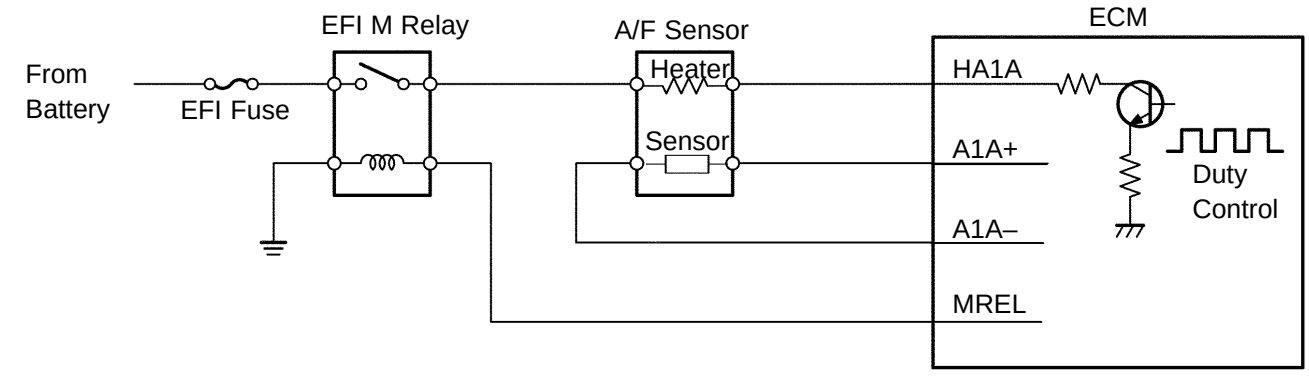
Tester Connection	Specified Condition
AF+ (A5–3) – A1A+ (E5–23)	Below 1 Ω
AF– (A5–4) – A1A– (E5–22)	Below 1 Ω
HT (A5–1) – HA1A (E5–7)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
AF+ (A5–3) or A1A+ (E5–23) – Body ground	10 kΩ or higher
AF– (A5–4) or A1A– (E5–22) – Body ground	10 kΩ or higher
HT (A5–1) or HA1A (E5–7) – Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.
(e) Reconnect the ECM connector.

Reference (Bank 1 Sensor 1 System Diagram):



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

OK →

REPLACE ECM (See page 10–24)

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DTC	P2601	COOLANT PUMP CONTROL CIRCUIT RANGE/PERFORMANCE

HINT:

- CHS stands for Coolant Heat Storage.
- Although the DTC title says ”Coolant Pump”, this DTC is related to the CHS water pump.

CIRCUIT DESCRIPTION

The coolant heat storage system uses an electric pump to supply hot coolant stored in the CHS tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the CHS tank into the engine, in order to heat the cylinder head (this process is called ”preheat mode”). This system consists of the CHS tank, CHS water pump, CHS tank outlet temperature sensor, water valve, and a soak timer that is built in the ECM.

DTC No.	DTC Detecting Condition	Trouble Area
P2601	Following conditions are successively met: • Difference in CHS tank outlet water temperature and engine coolant temperatures before and after starting preheating: below 2°C (3.6 °F) • Change in CHS tank outlet water temperature during soaking: Within 1°C (1.8 °F) of its temperature before CHS water pump is ON	• CHS water pump • CHS water pump relay • Open or short in CHS water pump circuit • ECM

MONITOR DESCRIPTION

The ECM detects malfunction in the coolant heat storage (CHS) system with the CHS tank coolant temperature, the position of the water valve, the running condition of the engine and the operating condition of the soak timer.

The soak timer built in the ECM prompts the ECM to actuate the water pump 5 hours after the HV system has been turned OFF by using the power switch. The ECM then checks the HV main system based on variations in the CHS tank outlet temperature (soak mode).

In order to ensure the reliable malfunction detection, the ECM detects the CHS water pump malfunction DTC in two ways. Thus, when the following two detection conditions are consecutively met, the ECM determines that there is malfunction in the water pump circuit and sets the DTC.

(1) Difference in the CHS tank outlet temperature and the engine coolant temperature before and after starting preheating at engine start (system start) is below 2 °C (3.6 °F).

(2) Variation in the CHS tank outlet temperature during soak mode is within 1 °C (1.8 °F) of its temperature before the CHS water pump was ON.

MONITOR STRATEGY

Related DTCs	P2601: Coolant pump control circuit range/performance
Required sensors/components	Coolant heat storage tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	1 driving cycle
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Coolant heat storage system malfunction	Not detected
CHS water pump operation time	3 seconds or more
Variation in CHS tank outlet temperature and engine coolant temperature before and after preheating	2°C (3.6°F) or less
Storage coolant temperature	More than 75°C (167°F)

TYPICAL MALFUNCTION THRESHOLDS

Difference in CHS tank outlet coolant temperature before and after CHS water pump ON	Less than 1°C (1.8°F)

WIRING DIAGRAM

Refer to DTC P1120 on page 05–277.

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the CHS system or changing the coolant because the coolant in the CHS tank is hot even if the engine and the radiator are cold.

NOTICE:

If air breeding is not performed completely, this DTC may be detected after changing the coolant.

HINT:

- The detection of this DTC indicates a malfunction in both the CHS water pump and the CHS W/P relay. Therefore, make sure to also check the relay when this DTC is output.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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Hand–held tester:

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P2601)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.
Result:

Display (DTC Output)	Proceed to
P2601	A
P2601 and other DTCs	B

HINT:
If any other codes besides P2601 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	PERFORM ACTIVE TEST BY HAND–HELD TESTER(OPERATE WATER PUMP)

(a) Connect the hand–held tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / WATER PUMP.
(e) Check that the CHS W/P relay operates and the operating sounds of the water pump occurs.
Standard:

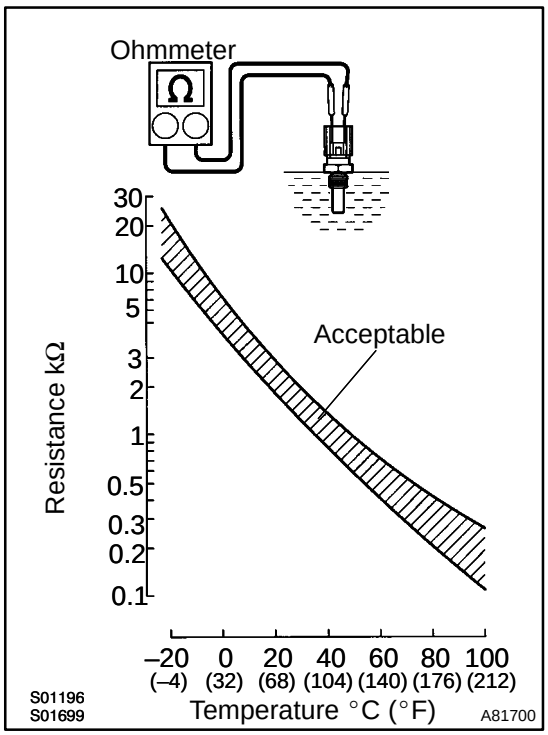
Tester Operation	Specified Condition
WATER PUMP ON	CHS W/P relay and water pump operates

NG → **Go to step 5**

OK

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3	INSPECT TEMPERATURE SENSOR (CHS TANK OUTLET TEMPERATURE SENSOR)



(a) Remove the coolant heat storage (CHS) tank outlet temperature sensor.

(b) Measure the resistance between the terminals.

Standard:

Tester Connection	Specified Condition
1 – 2	2 to 3 kΩ at 20°C (68°F)
1 – 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:

In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:

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

(c) Reinstall the CHS tank outlet temperature sensor.

NG → **REPLACE TEMPERATURE SENSOR**

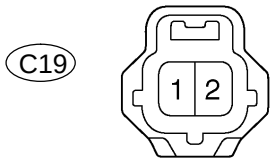
OK

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4	CHECK HARNESS AND CONNECTOR(ECM – CHS TANK OUTLET TEMPERATURE SENSOR)

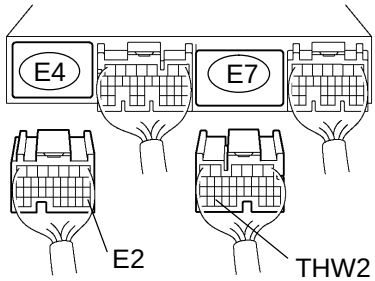
Wire Harness Side:

CHS Tank Outlet Temperature Sensor Connector



Front View

Y A82813



Y ECM Connector A82814

(a) Check the harness and the connectors between the CHS tank outlet temperature sensor connector and the ECM connector.

(1) Disconnect the C19 CHS tank outlet temperature sensor connector.

(2) Disconnect the E5 and E7 ECM connectors.

(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CHS tank outlet temperature sensor (C19–2) – THW2 (E7–33)	Below 1 Ω
CHS tank outlet temperature sensor (E2–1) – E2 (E4–28)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CHS tank outlet temperature sensor (C19–2) or THW2 (E7–33)– Body ground	10 kΩ or higher

(4) Reconnect the CHS tank outlet temperature sensor connector.

(5) Reconnect the ECM connectors.

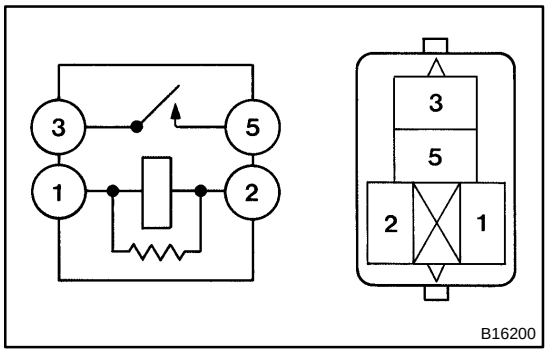
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ECM (See page 10–24)

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5 INSPECT CHS W/P RELAY(CHS WATER PUMP RELAY)



(a) Remove the CHS W/P relay from the engine room R/B No.2.

(b) Inspect the CHS W/P relay.

Standard:

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

(c) Reinstall the CHS W/P relay.

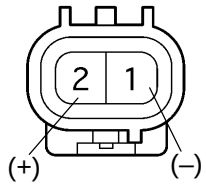
NG → **REPLACE CHS W/P RELAY**

OK

6 INSPECT WATER W/MOTOR & BRACKET PUMP ASSY

Component Side:

C20 CHS Water Pump Connector



Front View

A75926

(a) Disconnect the C20 CHS water pump connector.

(b) Measure the resistance between the terminals of the water pump.

Standard:

Tester Connection	Specified Condition
1 – 2	0.3 to 100 Ω

(c) Reconnect the CHS water pump connector.

NG → **REPLACE WATER W/MOTOR & BRACKET PUMP ASSY**

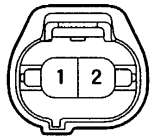
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7	CHECK HARNESS AND CONNECTOR(ECM – CHS W/P RELAY, CHS W/P RELAY – WATER PUMP, WATER PUMP – GROUND)

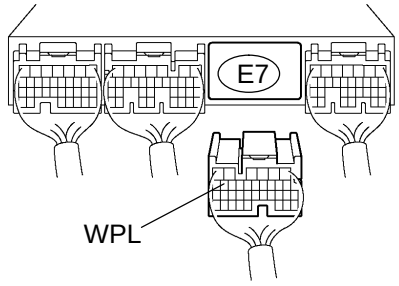
Wire Harness Side:

C20 CHS Water Pump Connector



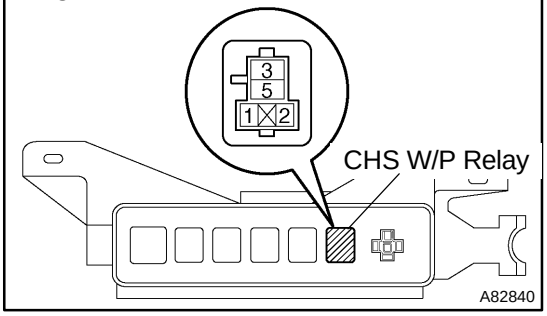
Front View

A51984 A52933



Y ECM Connector A65744

Engine Room R/B No.2



(a) Check the harness and the connectors between the CHS water pump connector and the ECM connector.
  (1) Remove the CHS W/P relay from the engine room R/B No.2.
  (2) Disconnect the E7 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
WPL (E7–15) – CHS W/P relay (2)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CHS W/P relay (2) or WPL (E7–15) – Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the CHS water pump connector and the CHS W/P relay.
  (1) Disconnect the CHS water pump connector.
  (2) Remove the CHS W/P relay from the engine room R/B No.2.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CHS water pump (2) – CHS W/P relay (5)	Below 1 Ω
CHS water pump (1) – Body ground	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CHS water pump (2) or CHS W/P relay (5) – Body ground	10 kΩ or higher

  (4) Reconnect the CHS water pump connector.
  (5) Reinstall the integration relay.

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

OK

REPLACE ECM (See page 10–24)

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OBD II scan tool (excluding hand–held tester):

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P2601)

(a) Connect the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the OBD II scan tool ON.
(d) Read the DTCs using the OBD II scan tool.
Result:

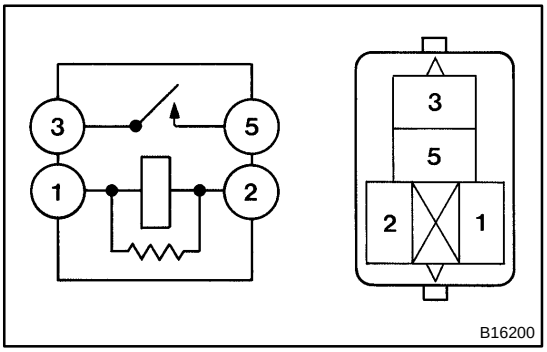
Display (DTC Output)	Proceed to
P2601	A
P2601 and other DTCs	B

HINT:
If any other codes besides P2601 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	INSPECT CHS W/P RELAY(CHS WATER PUMP RELAY)



(a) Remove the CHS W/P relay from the engine room R/B No.2.
(b) Inspect the CHS W/P relay.
Standard:

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

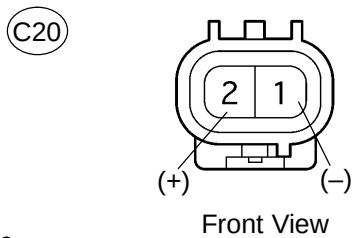
(c) Reinstall the CHS W/P relay.

NG → **REPLACE CHS W/P RELAY**

OK

3	INSPECT PUMP ASSY, WATER W/MOTOR & BRACKET

Component Side:
CHS Water Pump Connector



(a) Disconnect the C20 CHS water pump connector.
(b) Measure the resistance between the terminals of the water pump.
Standard:

Tester Connection	Specified Condition
1 – 2	0.3 to 100 Ω

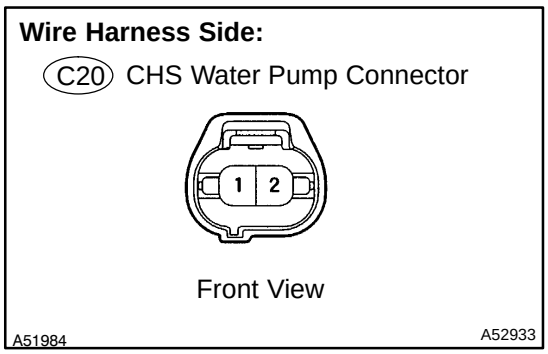
(c) Reconnect the CHS water pump connector.

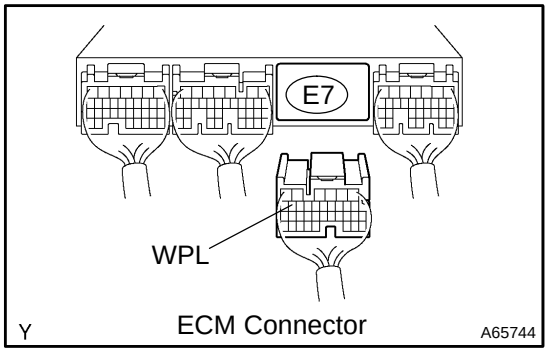
NG → **REPLACE WATER W/MOTOR & BRACKET PUMP ASSY**

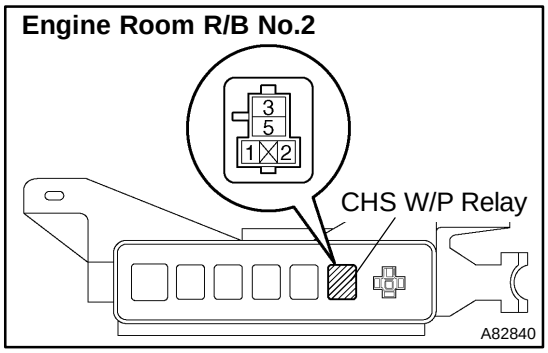
OK

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4	CHECK HARNESS AND CONNECTOR(ECM – CHS W/P RELAY, CHS W/P RELAY – WATER PUMP, WATER PUMP – GROUND)







(a) Check the harness and the connectors between the CHS water pump connector and the ECM connector.
  (1) Remove the CHS W/P relay from the engine room R/B No.2.
  (2) Disconnect the E7 ECM connector.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
WPL (E7–15) – CHS W/P relay (2)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CHS W/P relay (2) or WPL (E7–15) – Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the water pump connector and the CHS W/P relay.
  (1) Disconnect the CHS water pump connector.
  (2) Remove the CHS W/P relay from the engine room R/B No.2.
  (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CHS Water pump (2) – CHS W/P relay (5)	Below 1 Ω
CHS Water pump (1) – Body ground	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CHS Water pump (2) or CHS W/P relay (5) – Body ground	10 kΩ or higher

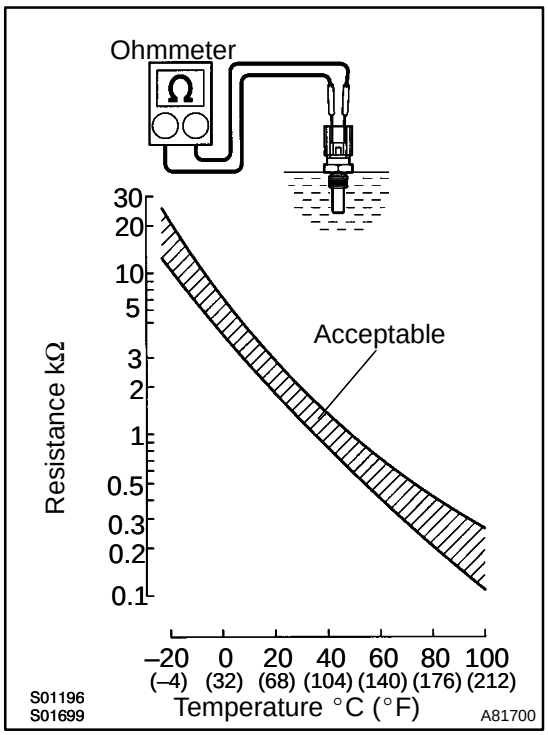
  (4) Reconnect the CHS water pump connector.
  (5) Reinstall the CHS W/P relay.

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

OK

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5	INSPECT TEMPERATURE SENSOR (CHS TANK OUTLET TEMPERATURE SENSOR)



(a) Remove the coolant heat storage (CHS) tank outlet temperature sensor.

(b) Measure the resistance between the terminals.

Standard:

Tester Connection	Specified Condition
1 – 2	2 to 3 kΩ at 20°C (68°F)
1 – 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:

In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:

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

(c) Reinstall the CHS tank outlet temperature sensor.

NG → **REPLACE TEMPERATURE SENSOR**

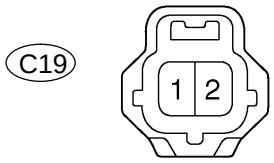
OK

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6	CHECK HARNESS AND CONNECTOR(ECM – CHS TANK OUTLET TEMPERATURE SENSOR)

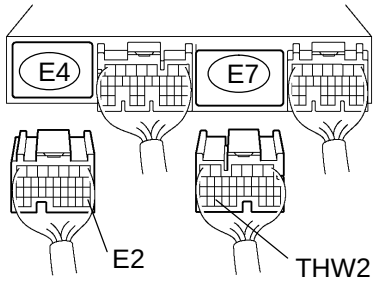
Wire Harness Side:

CHS Tank Outlet Temperature Sensor Connector



Front View

Y A82813



Y ECM Connector A82814

(a) Check the harness and the connectors between the CHS tank outlet temperature sensor connector and the ECM connector.

(1) Disconnect the C19 CHS tank outlet temperature sensor connector.

(2) Disconnect the E4 and E7 ECM connectors.

(3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
CHS tank outlet temperature sensor (C19–2) – THW2 (E7–33)	Below 1 Ω
CHS tank outlet temperature sensor (C19–1) – E2 (E4–28)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
CHS tank outlet temperature sensor (C19–2) or THW2 (E7–33) – Body ground	10 kΩ or higher

(4) Reconnect the CHS tank outlet temperature sensor connector.

(5) Reconnect the ECM connectors.

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

OK

REPLACE ECM (See page 10–24)

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DTC	P2610	ECM/PCM INTERNAL ENGINE OFF TIMER PERFORMANCE

MONITOR DESCRIPTION

To check the heat retention of the tank in the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
A timer and a clock are contained in the ECM internal circuit, and the timer starts when the ignition switch is turned OFF (this process is called the ”soak mode”).
When the HV main system is started at the power switch, the ECM monitors its internal circuit. If the ECM detects a deviation between the clock and the timer, or an abnormal condition during a comparison between the starting history and the length of time the HV main power has been turned OFF, the ECM determines that its internal circuit has malfunction and sets a DTC

DTC No.	DTC Detection Condition	Trouble Area
P2610	ECM internal error	• ECM

MONITOR STRATEGY

Related DTCs	P2610: ECM internal engine off timer performance
Required sensors/components	ECM
Frequency of operation	Once per driving cycle
Duration	600 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Case 1

Time internal engine off timer clock reads when CPU clock has elapsed 600 seconds	780 seconds

Case 2

Presens of history that ECM had woken up by internal engine off timer	YES
Time period vehicle has been soaked	Less than programmed period

Case 3

Presens of history that ECM had woken up by internal engine off timer	NO
Time period vehicle has been soaked	More than or equal to programmed period

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

REPLACE ECM (See page 10–24)

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DTC	P2A00	A/F SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 1)

CIRCUIT DESCRIPTION

Refer to DTC P2195 on page 05–314.

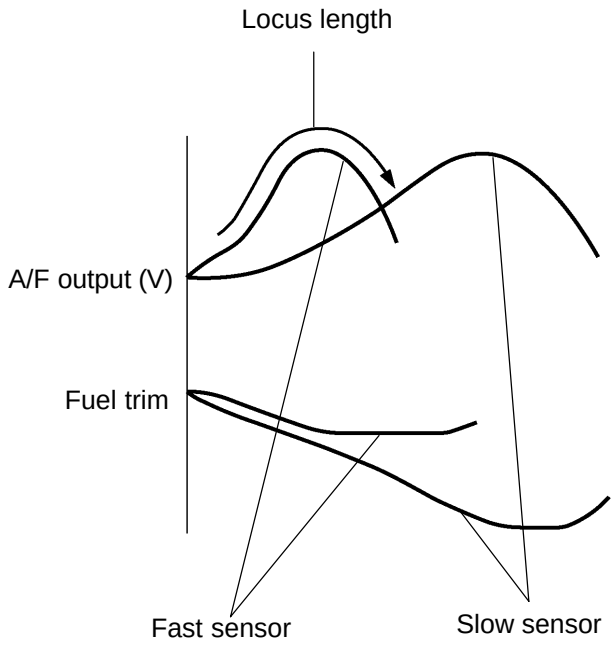
DTC No.	DTC Detection Condition	Trouble Area
P2A00	When A/F sensor output voltage change is below compared to fuel trim change, ECM judges that A/F sensor circuit response is slow if conditions (a), (b) and (c) are met (2 trip detection logic): (a) After engine is warmed up (b) Engine speed is 1,100 rpm or more (c) Vehicle speed 37.5 mph (60 km/h) or more	• Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM

HINT:

Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.

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MONITOR DESCRIPTION



The air fuel–ratio (A/F) sensor varies its output voltage in proportion to the air–fuel ratio. Based on the output voltage, the ECM determines if the air–fuel ratio is RICH or LEAN and adjusts the stoichiometric air–fuel ratio. The ECM also checks the fuel injection volume compensation value to check if the A/F sensor is deteriorating or not. The output voltage variation, known as locus length, should be high when the air–fuel ratio fluctuates. When the A/F sensor response rate has deteriorated, the locus length should be short.
The ECM concludes that there is malfunction in the A/F sensor when the locus length is short and the response rate has deteriorated.

MONITOR STRATEGY

Related DTCs	P2A00: A/F sensor circuit slow response
Required sensors/components	Main: A/F sensor Related: Engine speed sensor, vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	40 seconds
MIL operation	2 driving cycles
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Engine	Running
Time after first engine start	120 seconds
Fuel system status	Closed–loop
A/F sensor status	Activated
Idle	OFF
Time after idle off	2 seconds
Engine speed	1,100 rpm or more, and 3,400 rpm or less
Vehicle speed	37.5 mph (60 km/h) or more, and 75 mph (120 km/h) or less
Fuel cut	OFF
Time after fuel cut is off	3 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	8 or more

COMPONENT OPERATING RANGE

Heated oxygen sensor heater current	0.4 to 1.0 A (during idling and battery voltage 11 to 14 V)

MONITOR RESULT (MODE 06 DATA)

A/F sensor deterioration:

Test ID/Comp ID	Description of Test Data	Description of Test Limit	Conversion Factor (Unit)
$06/$81	The ratio of fuel trim locus length to A/F sensor locus length	Malfunction threshold of the ratio of fuel trim locus length to A/F sensor locus length to detect response rate deterioration level	Multiply by 0.000244 (No dimension)

Refer to page 05–26 for detailed information on Checking Monitor Status.

WIRING DIAGRAM

Refer to DTC P2195 on page 05–314.

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INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be found by performing 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 area 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 hand–held tester to the DLC3 on the vehicle.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page 05–1).
(4) Warm up the engine by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(5) Select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

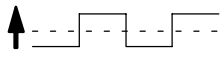
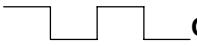
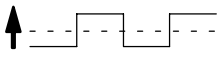
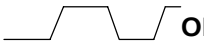
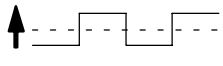
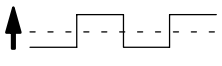
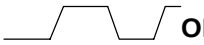
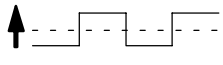
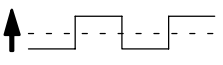
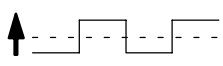
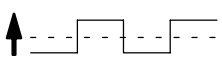
Result:

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.

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	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Main Suspect Trouble Area
Case 1	Injection volume +25 % –12.5 %  Output voltage More than 3.35 V Less than 3.0 V  **OK**	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	—
Case 2	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	A/F sensor (A/F sensor, sensor heater, sensor circuit)
Case 3	Injection volume +25 % –12.5 %  Output voltage More than 3.35 V Less than 3.0V  **OK**	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Heated oxygen sensor (heated oxygen sensor, sensor heater, sensor circuit)
Case 4	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 %  Output voltage Almost no reaction **NG**	Extremely RICH or LEAN actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.
To display the graph, enter ACTIVE TEST / A/F CONTROL / USER DATA, select ”AFS B1S1 and O2S B1S2” by pressing the ”YES” button followed by the ”ENTER” button and then the ”F4” button.

- DTC P2A00 may be also detected, when the air–fuel ratio stays RICH or LEAN.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high A/F sensor voltage could be caused by a RICH air–fuel mixture. Check the conditions that would cause the engine to run with the RICH air–fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air–fuel mixture. Check the conditions that would cause the engine to run with the LEAN air–fuel mixture.

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1	CHECK OTHER DTC OUTPUT(IN ADDITION TO A/F SENSOR DTC)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result :

Display (DTC Output)	Proceed to
P2A00	A
P2A00 and other DTCs	B

HINT:
If any other code besides P2A00 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

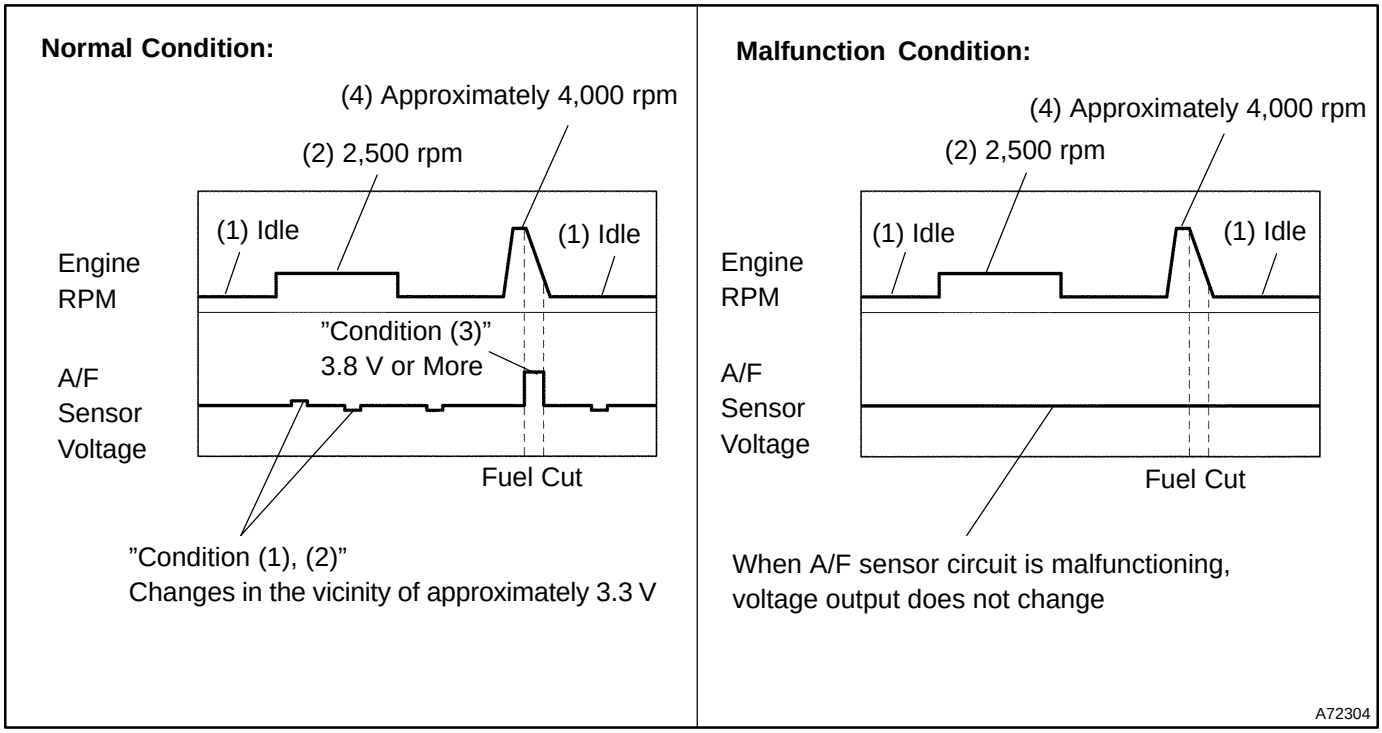
2	READ VALUE OF OBD II SCAN TOOL OR HAND–HELD TESTER(OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC 3.
(b) Put the engine in inspection mode (see page 05–1).
(c) Warm up the A/F sensors (bank 1 sensor 1) by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60 % for approximately 90 seconds.
(d) Read A/F sensor voltage output on the OBD II scan tool or the hand–held tester.
(e) Hand–held tester only:
On the hand–held tester, enter the menus: ENHANCED OBD II / ENGINE AND ECT / SNAPSHOT / MANUAL SNAPSHOT / USER DATA.
(f) Select ”AFS B1 S1/ENGINE SPD” and press button ”YES”.
(g) Monitor the A/F sensor voltage carefully.
(h) Check the A/F sensor voltage output under the following conditions:
  (1) Put the engine in inspection mode and allow the engine to idle for 30 seconds.
  (2) Put the engine in inspection mode and running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % (where engine RPM is not suddenly changed).
  (3) Deactivate the inspection mode and drive the vehicle with shift position ”B” range.
  (4) Accelerate the vehicle to 44 mph (70 km/h) and quickly release the accelerator pedal so that the throttle valve fully close.

CAUTION:
- **Strictly observe of posted speed limits, traffic laws, and road conditions when performing these drive patterns.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

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Standard:
Condition (1) and (2)
Voltage changes in the vicinity of 3.3 V (0.66 V)* (between approximately 3.1 to 3.5 V) as shown in the illustration.
Condition (4)
A/F sensor voltage increases to 3.8 V (0.76 V)* or more during engine deceleration (when fuel cut) as shown in the illustration.
***: Voltage when using the OBD II scan tool.**



HINT:

- Whenever the output voltage of the A/F sensor remains at approximately 3.3 V (0.660 V)* (see diagram Malfunction Condition) 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 diagram Malfunction Condition) 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 was reconnected, 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:
  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 speeds 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.

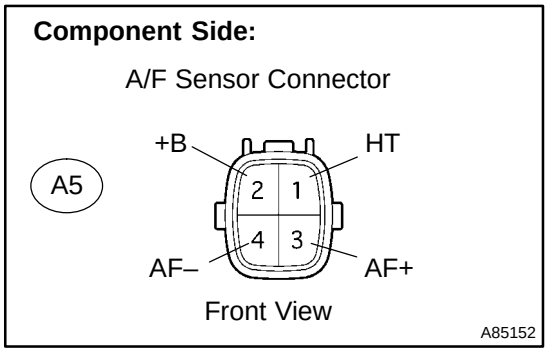
*: Voltage when using the OBD II scan tool.

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OK → Go to step 14

NG

3 INSPECT AIR FUEL RATIO SENSOR(RESISTANCE OF A/F SENSOR HEATER)



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.
Standard:

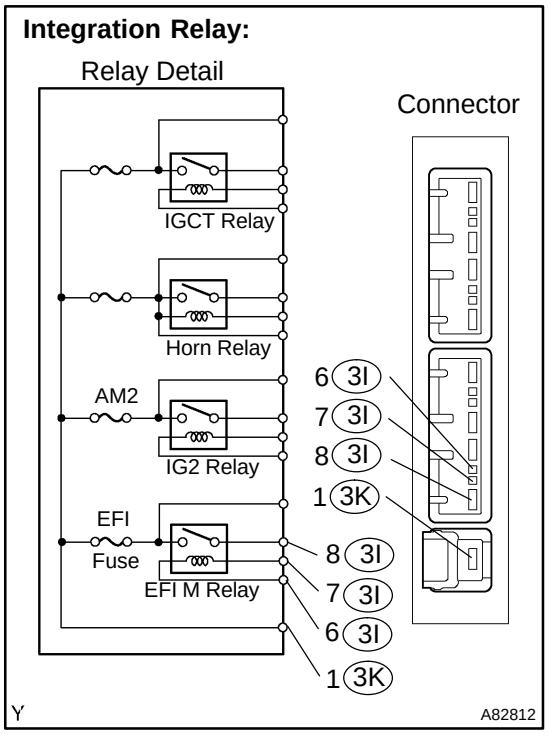
Tester Connection	Resistance
HT (1) – +B (2)	1.8 to 3.4 Ω at 20°C (68°F)

(c) Reconnect the A/F sensor connector.

NG → REPLACE AIR FUEL RATIO SENSOR

OK

4 INSPECT INTEGRATION RELAY(EFI M RELAY)



(a) Remove the integration relay from the engine room R/B.
(b) Inspect the EFI M relay.
Standard:

Tester Connection	Specified Condition
(3K–1) – (3I–8)	10 kΩ or higher
(3K–1) – (3I–8)	Below 1 Ω (Apply battery voltage to terminals 3I–6 and 3I–7)

(c) Reinstall the integration relay.

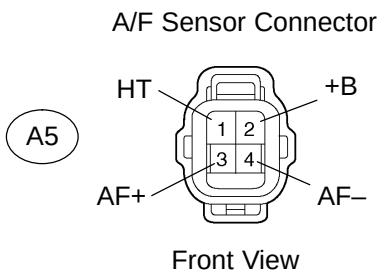
NG → REPLACE INTEGRATION RELAY

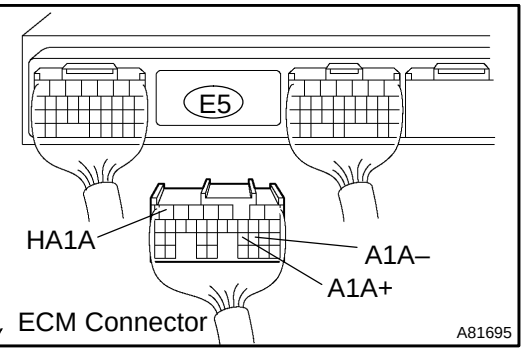
OK

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5 CHECK HARNESS AND CONNECTOR(A/F SENSOR – ECM)

Wire Harness Side:





(a) Disconnect the A5 A/F sensor connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance between the wire harness side connectors.

Standard (Check for open):

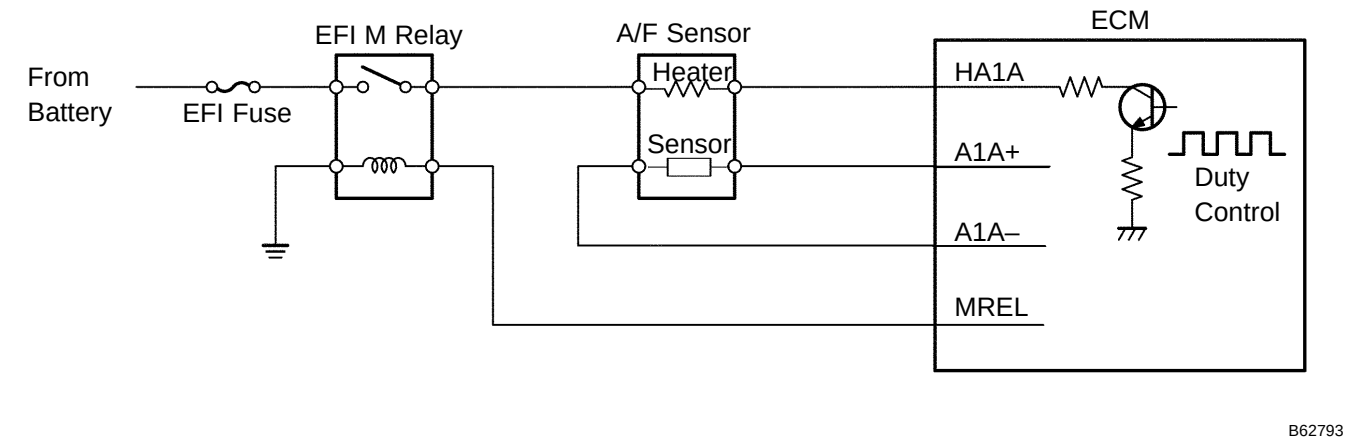
Tester Connection	Specified Condition
AF+ (A5–3) – A1A+ (E5–23)	Below 1 Ω
AF– (A5–4) – A1A– (E5–22)	Below 1 Ω
HT (A5–1) – HA1A (E5–7)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
AF+ (A5–3) or A1A+ (E5–23) – Body ground	10 kΩ or higher
AF– (A5–4) or A1A– (E5–22) – Body ground	10 kΩ or higher
HT (A5–1) or HA1A (E5–7) – Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.
(e) Reconnect the ECM connector.

Reference (Bank 1 Sensor 1 System Diagram):



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

OK

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6	CHECK AIR INDUCTION SYSTEM

(a) Check for vacuum leaks in the air induction system.
OK: There is no leakage in the 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 (See page 11–7)

(a) Check fuel pressure (high or low fuel pressure).
OK:
Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

9	INSPECT FUEL INJECTOR ASSY (See page 11–12)

(a) Check the injector injection (high or low fuel injection quantity or poor injection pattern).
OK:
Injection volume: 36 to 46 cm^3 (2.1 to 2.8 cu in.) per 15 seconds.

NG → **REPLACE FUEL INJECTOR ASSY (See page 11–12)**

OK

10	REPLACE AIR FUEL RATIO SENSOR

GO

11	PERFORM CONFIRMATION DRIVING PATTERN (See page 05–314)

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (see page 05–314).

GO

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12	READ OUTPUT DTC(SEE IF A/F SENSOR DTC IS OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result :

Display (DTC output)	Proceed to
No output	A
P2A00 again.	B

B → **REPLACE ECM (See page 10–24) AND PERFORM CONFIRMATION DRIVING PATTERN (See page 05–314)**

A

13	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK: Vehicle has run out of the fuel in the past.

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

YES

DTC IS CAUSED BY RUNNING OUT OF FUEL

14	PERFORM CONFIRMATION DRIVING PATTERN (See page 05–314)

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (see page 05–314).

GO

15	READ OUTPUT DTC(SEE IF A/F SENSOR DTC IS OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result :

Display (DTC output)	Proceed to
P2A00	A
No output	B

B → **Go to step 19**

A

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16	REPLACE AIR FUEL RATIO SENSOR

GO

17	PERFORM CONFIRMATION DRIVING PATTERN (See page 05–314)

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (see page 05–314).

GO

18	READ OUTPUT DTC(SEE IF A/F SENSOR DTC IS OUTPUT AGAIN)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result :

Display (DTC output)	Proceed to
No output	A
P2A00	B

B → **REPLACE ECM (See page 10–24) AND PERFORM CONFIRMATION DRIVING PATTERN (See page 05–314)**

A

19	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK: Vehicle has run out of the fuel in the past.

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

YES

DTC IS CAUSED BY RUNNING OUT OF FUEL

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DTC	P3190	POOR ENGINE POWER

DTC	P3191	ENGINE DOES NOT START

DTC	P3193	FUEL RUN OUT

CIRCUIT DESCRIPTION

From the HV ECU, the ECM receives data such as power output required for the engine (required output), estimated torque produced by the engine (estimated torque), engine RPM of control target (target RPM), whether the engine is in start mode or not. Then, based on the required output and target RPM, the ECM calculates a target torque that is to be produced by the engine and compares it with the estimated torque. If the estimated torque is very low compared with the target torque, or the engine start mode continues for the specific duration calculated by water temperature, an abnormal condition is detected.

DTC No.	DTC Detection Condition	Trouble Area
P3190	Following conditions continue at a fixed engine RPM or a fixed length of time: • Communication with HV ECU is normal • Engine RPM is a fixed value or more • Engine start mode is not active • Target torque is a fixed value • Ratio of estimated torque against target torque is less than 20 %	• Air induction system • Throttle body • Fuel pressure • Engine • Mass Air flow meter • Out of fuel • Engine coolant temperature sensor • Crankshaft position sensor • Camshaft position sensor • ECM
P3191	Following conditions continue at a fixed engine RPM or a fixed length of time: • Communication with HV ECU is normal • Engine RPM is a fixed value or more • Engine start mode is active	• Air induction system • Throttle body • Fuel pressure • Engine • Mass Air flow meter • Out of fuel • Engine coolant temperature sensor • Crankshaft position sensor • Camshaft position sensor • ECM
P3193	Following conditions are met: • Fuel low level signal input into ECM • Detection condition for P3190 or P3191 is satisfied	• Out of fuel • ECM

MONITOR DESCRIPTION

The ECM and HV control ECU are connected by a communication line called CAN. The ECM sends information on the engine speed and other data to the HV control ECU while the HV control ECU sends the information such as a requirement for the engine power to the ECM using tha CAN communication line.
When the communication between the ECM and HV control ECU is normal and the following items becomes specific condition, the ECM will illuminates the MIL and sets a DTC.

(a) Engine speed
(b) Power switch
(c) Target torque
(d) Ratio of target torque against estimated torque
(e) Fuel level

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MONITOR STRATEGY

Related DTCs	P3190: Poor engine power P3191: Engine does not start P3193: Fuel run out
Required sensors/components	Main sensors: Crankshaft position sensor Related sensors: HV control ECU
Frequency of operation	Continuous
Duration	100 engine revolutions and 6 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Fuel cut operation	Not operated
Engine speed	800 rpm or more (varies with engine coolant temperature)

TYPICAL MALFUNCTION THRESHOLDS

Case1: P3190

Time for low engine torque	100 engine revolutions or more, and 6 seconds or more (varies with engine coolant temperature)
Fuel level	Not empty

Case2: P3191

Engine start no–determination time (receive from HV ECU)	100 engine revolutions or more, and 6 seconds or more (varies with engine coolant temperature)
Fuel level	Not empty

Case3: P3193

Time for low engine torque or Engine start no–determination time	100 engine revolutions or more, and 6 seconds or more (varies with engine coolant temperature)
Fuel level	Empty

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the hand–held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P3190, P3191 AND/OR P3193)

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the hand–held tester or the OBD II scan tool ON.
(d) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / ENGINE AND ECT / DTC INFO / CURRENT CODES.
(e) Read DTCs using the hand–held tester or the OBD II scan tool.

Result:

Display (DTC output)	Proceed to
P3190, P3191 and/or P3193	A
P3190, P3191 and/or P3193, and other DTCs	B

HINT:
If any other codes besides P3190, P3191 and/or P3193 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–55)**

A

2	CHECK SHORTAGE OF FUEL

NG → **REFILL FUEL**

OK

3	CHECK AIR INDUCTION SYSTEM

OK: The air induction system has no leakage and blockages.

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

OK

4	CHECK FOR UNUSUAL NOISE OR VIBRATION WHEN STARTING ENGINE OR REVVING UP

OK: Unusual noise and vibration do not occur.

NG → **REPAIR OR REPLACE**

OK

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5	CHECK FUEL PRESSURE (See page 11–9)

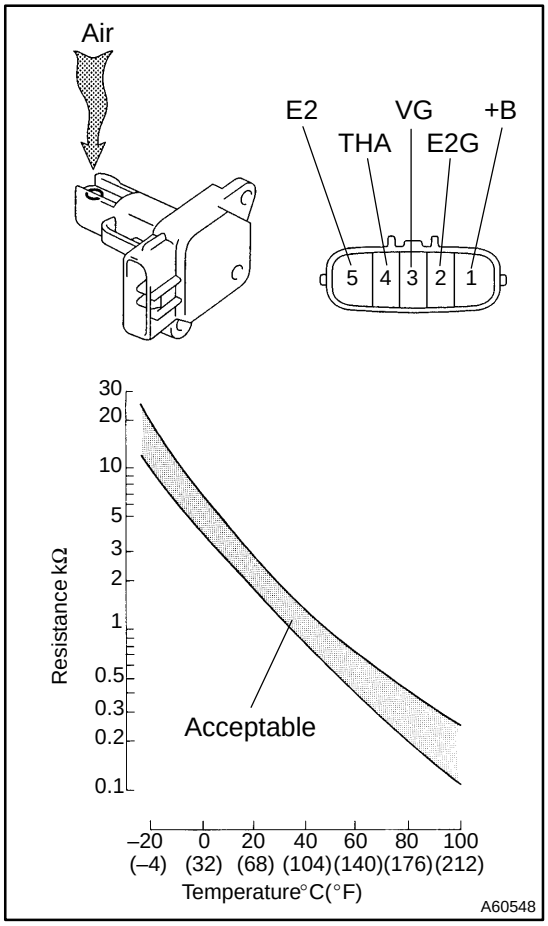
OK:

Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

NG → **CHECK AND REPAIR FUEL SYSTEM**

OK

6	INSPECT MASS AIR FLOW METER



(a) Remove the mass air flow meter.

(b) Inspect output voltage.

(1) Apply battery voltage across terminals +B and E2G.

(2) Connect the positive (+) tester prove to terminal VG, and negative (–) tester prove to terminal E2G.

(3) Blow air into the mass air flow meter, and check that the voltage fluctuates.

Standard:

Tester Connection	Specified Condition
VG (3) – E2G (2)	Sensor output voltage fluctuates between 0.3 V and 4.8 V

(c) Inspect resistance.

(1) Measure the resistance between the terminals of the mass air flow meter.

Standard:

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

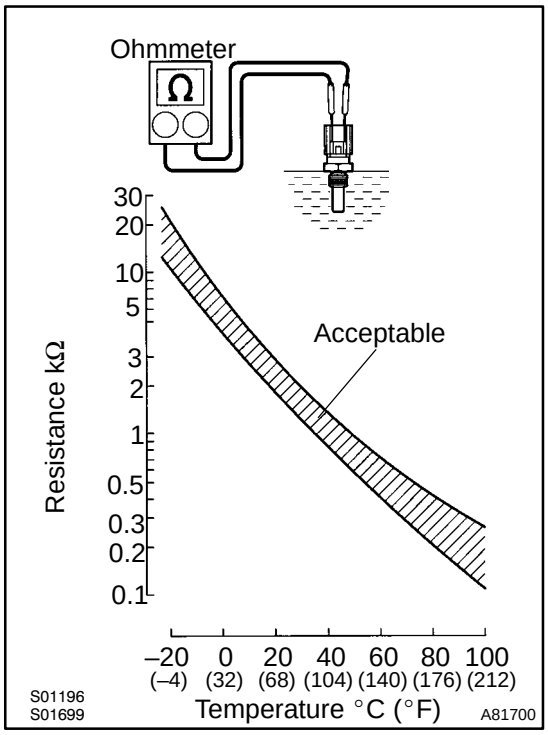
(d) Reinstall the mass air flow meter.

NG → **REPLACE MASS AIR FLOW METER**

OK

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7 INSPECT ENGINE COOLANT TEMPERATURE SENSOR



(a) Remove the engine coolant temperature sensor.
(b) Measure the resistance between the terminals of the engine coolant temperature sensor.

Standard:

Tester Connection	Specified Condition
1 – 2	2 to 3 kΩ at 20°C (68°F)
1 – 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:

In case of checking the engine coolant temperature sensor in water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed engine coolant temperature 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.

(c) Reinstall the engine coolant temperature sensor.

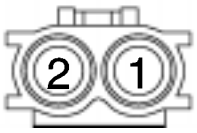
NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

8 INSPECT CRANKSHAFT POSITION SENSOR

Component Side:

C7 Crankshaft Position Sensor



Front View

A78431

(a) Disconnect the C7 crankshaft position sensor connector.
(b) Measure the resistance between the terminals of the crankshaft position sensor connector.

Standard:

Tester Connection	Specified Condition
1 – 2	985 to 1,600 Ω at cold
1 – 2	1,265 to 1,890 Ω at hot

(c) Reconnect the crankshaft position sensor connector.

NOTICE:

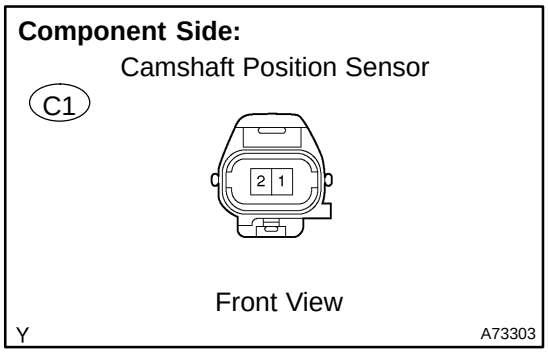
Terms "cold" and "hot" refer to the temperature of the coils. "Cold" means approximately –10°C to 50°C (14°F to 122°F). "Hot" means approximately 50°C to 100°C (122°F to 212°F).

NG → **REPLACE CRANKSHAFT POSITION SENSOR**

OK

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9 INSPECT CAMSHAFT POSITION SENSOR



(a) Disconnect the C1 camshaft position sensor connector.
(b) Measure the resistance between the terminals of camshaft position sensor connector.

Standard:

Tester Connection	Specified Condition
1 – 2	1,630 to 2,740 Ω at cold
1 – 2	2,065 to 3,225 Ω at hot

(c) Reconnect the camshaft position sensor connector.

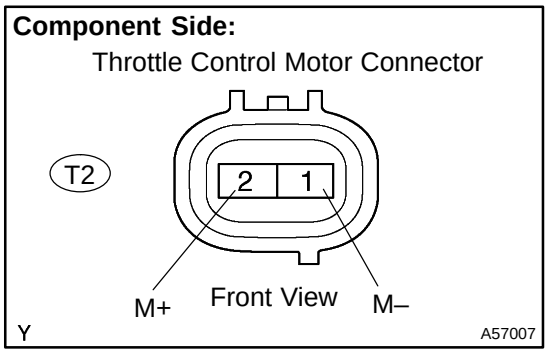
NOTICE:

Terms ”cold” and ”hot” refer to the temperature of the coils. ”Cold” means approximately –10°C to 50°C (14°F to 122°F). ”Hot” means approximately 50°C to 100°C (122°F to 212°F).

NG → **REPLACE CAMSHAFT POSITION SENSOR**

OK

10 INSPECT THROTTLE CONTROL MOTOR



(a) Disconnect the throttle control motor connector.
(b) Using an ohmmeter, measure the motor resistance between terminals 1 (M–) and 2 (M+).

Standard:

Tester Connection	Specified Condition
1 – 2	0.3 to 100 Ω at 20 °C (68 °F)

NG → **REPLACE THROTTLE CONTROL MOTOR**

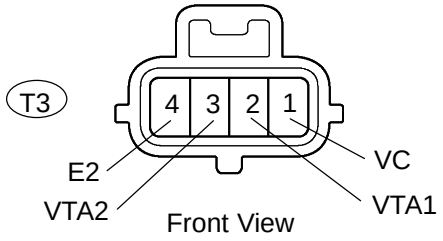
OK

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11	INSPECT THROTTLE POSITION SENSOR

Component Side:

Throttle Position Sensor Connector



Y A54410

(a) Disconnect the throttle position sensor connector.

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

Standard:

Throttle position sensor terminal	Resistance
VC (1) – E2 (4)	1.2 to 3.2 kΩ at 20°C (68°F)
VTA1 (2) – E2 (4)	1.8 to 10.5 kΩ at 20°C (68°F)
VTA2 (3) – E2 (4)	1.8 to 10.5 kΩ at 20°C (68°F)

NG → **REPLACE THROTTLE POSITION SENSOR**

OK

REPLACE ECM (See page 10–24)

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05FNI–02

READINESS MONITOR DRIVE PATTERN

1. PURPOSE OF THE 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 hand–held 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:
  - The ECM has lost battery power or a fuse has blown.
  - DTCs have been cleared.
  - The conditions for running the Readiness Monitor have not been met.
- If the readiness monitor status shows "incomplete", follow the appropriate readiness monitor drive pattern to change the status to "complete".

CAUTION:

Strictly observe of posted speed limits, traffic laws, and road conditions when performing these drive patterns.

NOTICE:

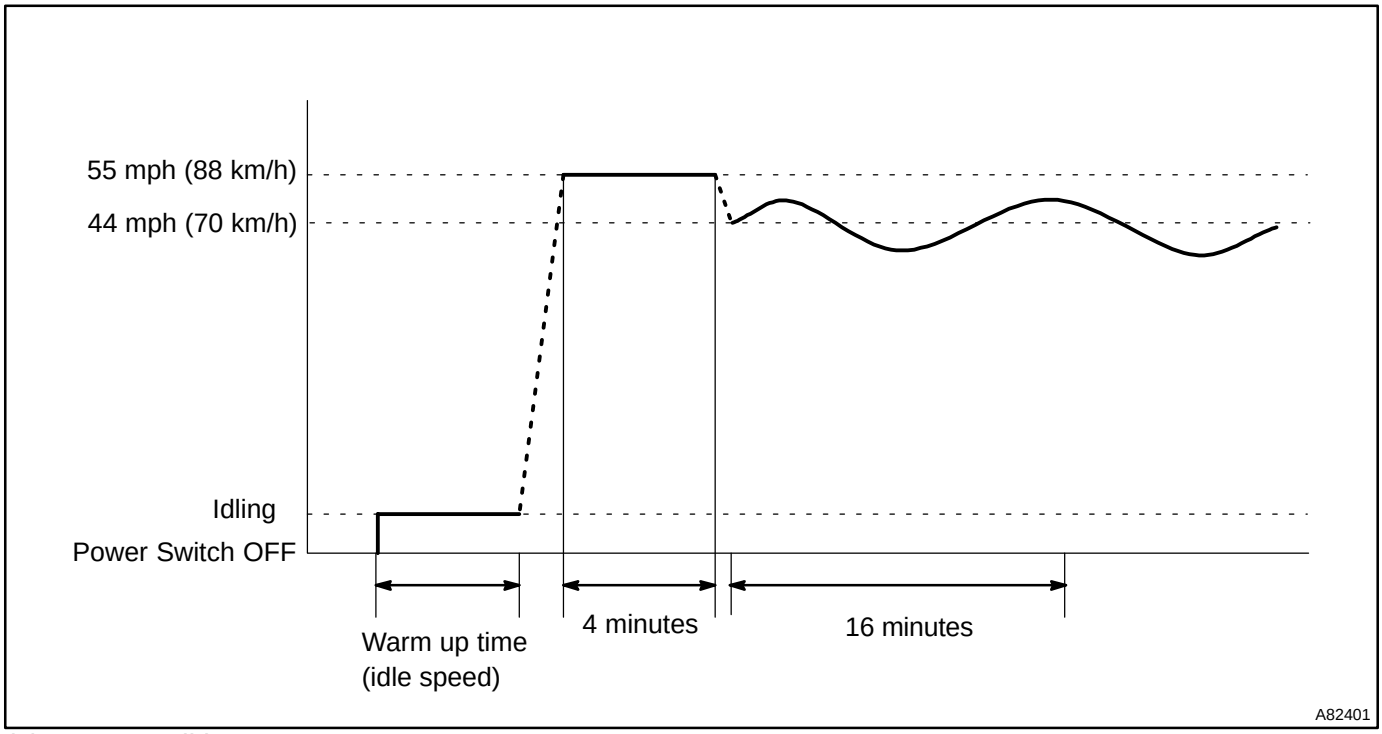
The following drive patterns are the fastest method of completing all the requirements necessary for making the readiness monitor status read "complete".

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 loads and speeds, such as driving up and down hills and / or sudden acceleration, hinder readiness monitor completion.

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2. CATALYST MONITOR (A/F SENSOR TYPE)



(a) Preconditions

The monitor will not run unless:

- MIL is OFF.
- Engine Coolant Temperature (ECT) is 80˚C (176˚F) or greater.
- Intake Air Temperature (IAT) is –10˚C (14˚F) or greater.*

NOTICE:

*** 2002 and later MY vehicles:**

To completed the readiness test in cold ambient conditions (less than –10˚C [14˚F]), turn the power switch OFF and then turn it ON again. Perform the drive pattern a second time.

(b) Drive Pattern

(1) Connect the hand–held tester or OBD II scan tool to DLC3 to check readiness monitor status and preconditions.

(2) Put the engine in inspection mode (see page 05–1).

(3) Start the engine and warm it up.

(4) Deactivate inspection mode and drive the vehicle with shift position in B at 44 to 55 mph (70 to 88 km/h) for approximately 4 minutes(the engine must be run during monitoring).

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 44 to 55 mph (70 to 88 km/h) for additional 4 minutes.

(5) Drive the vehicle allowing speed to fluctuate between 44 to 55 mph (70 to 88 km/h) for about 16 minutes.

NOTICE:

Drive with smooth throttle operation and avoid sudden closure of the throttle valve.

(6) Check the status of the readiness monitor on the scan tool display. If readiness monitor status did not switch to complete, verify that the preconditions are met, turn the power switch OFF, and then repeat steps (4) and (5).

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3. EVAP MONITOR (VACUUM PRESSURE MONITOR)

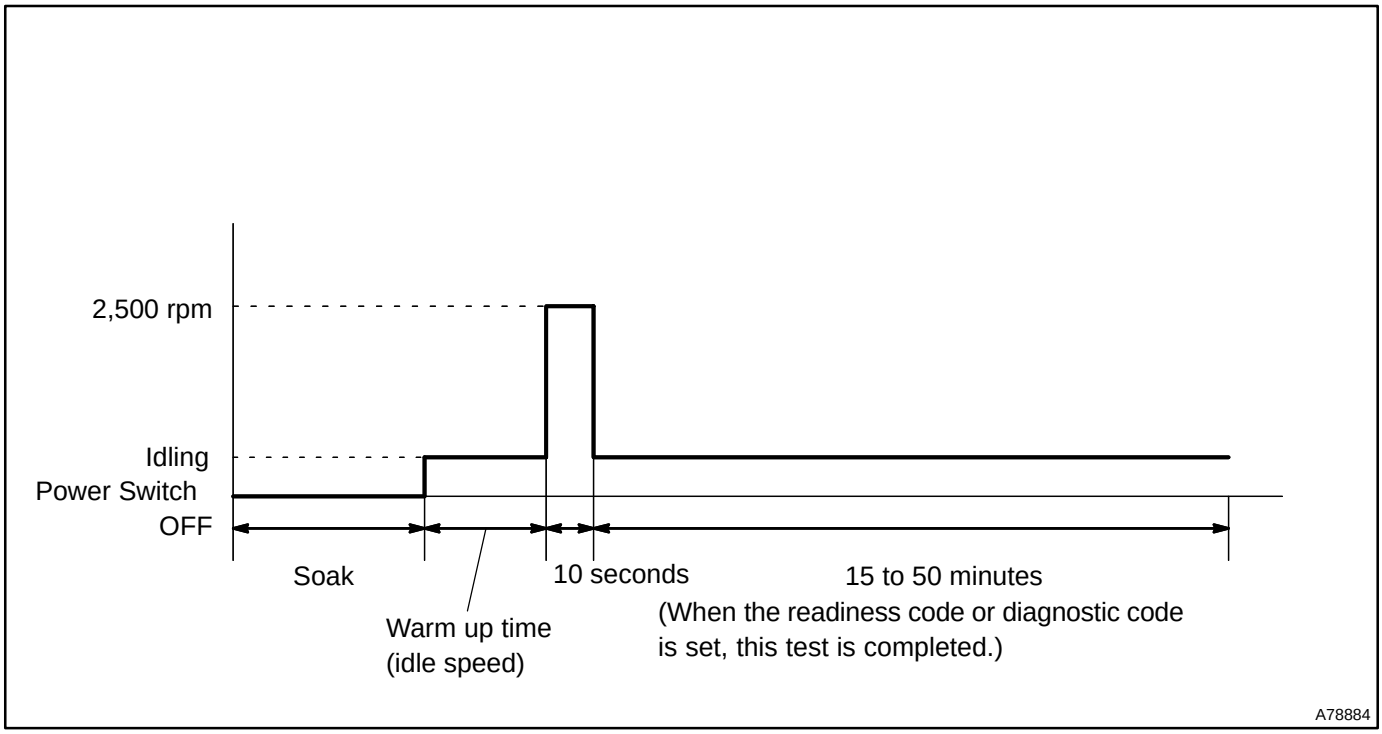
NOTICE:

A cold soak must be performed prior to conducting the drive pattern to complete the Internal Pressure Readiness Monitor.

(a) Cold Soak Preconditions
- MIL is OFF.
- Fuel level is approximately 1/2 to 3/4 full.
- Altitude is 8,000 feet (2,438 m) or less.

(b) Cold Soak Procedure

Let the vehicle cold soak for 8 hours or until the difference between IAT and ECT reaches less than 7˚C (13˚F).



(c) EVAP Monitor Preconditions

The monitor will not run unless:
- MIL is OFF.
- Fuel level is approximately 1/2 to 3/4 full.
- Altitude is 8,000 feet (2438 m) or less.*
- Engine Coolant Temperature (ECT) is between 4.4˚C and 35˚C (40˚F and 95˚F).
- Intake Air Temperature (IAT) is between 4.4˚C and 35˚C (40˚F and 95˚F).*
- 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 the difference between ECT and IAT is greater than 7˚C (13˚F).

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- 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 the difference between ECT and IAT is less than 7˚C (13˚F).

NOTICE:

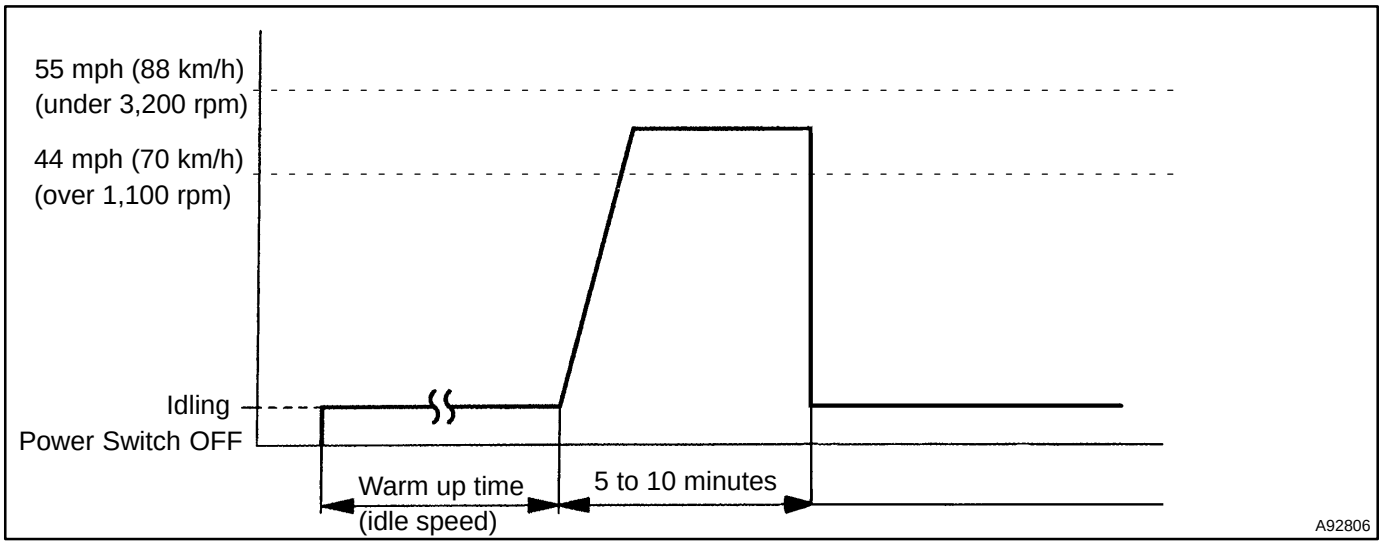
*** NOTE for 2002 and later MY vehicles:**

The readiness test can be completed in cold ambient conditions (less than 4.4˚C [40˚F]) and/or at high altitudes (more than 8,000 feet / 2,438 m).Finish the drive pattern, turn the power switch OFF and then turn ON the HV main system again, and repeat the drive pattern a second time.

(d) Drive Pattern

(1) Connect the hand–held tester or OBD II scan tool to DLC3 to check monitor status and preconditions (refer to step ”c”).
(2) Release pressure in fuel tank by removing the fuel tank cap, and then reinstall it.
(3) Put the engine in inspection mode (see page 05–1).
(4) Start the engine and allow it to idle until ECT reaches 75˚C (167˚F) or higher.
(5) Run the engine at 2,500 rpm for about 10 seconds.
(6) Allow the engine to idle with the A/C ON (to create slight load) for 15 to 50 minutes.

4. OXYGEN / AIR FUEL RATIO SENSOR MONITOR (FRONT A/F SENSOR AND REAR O2S SYSTEM)



(a) Preconditions
The monitor will not run unless:
MIL is OFF

(b) Drive Pattern

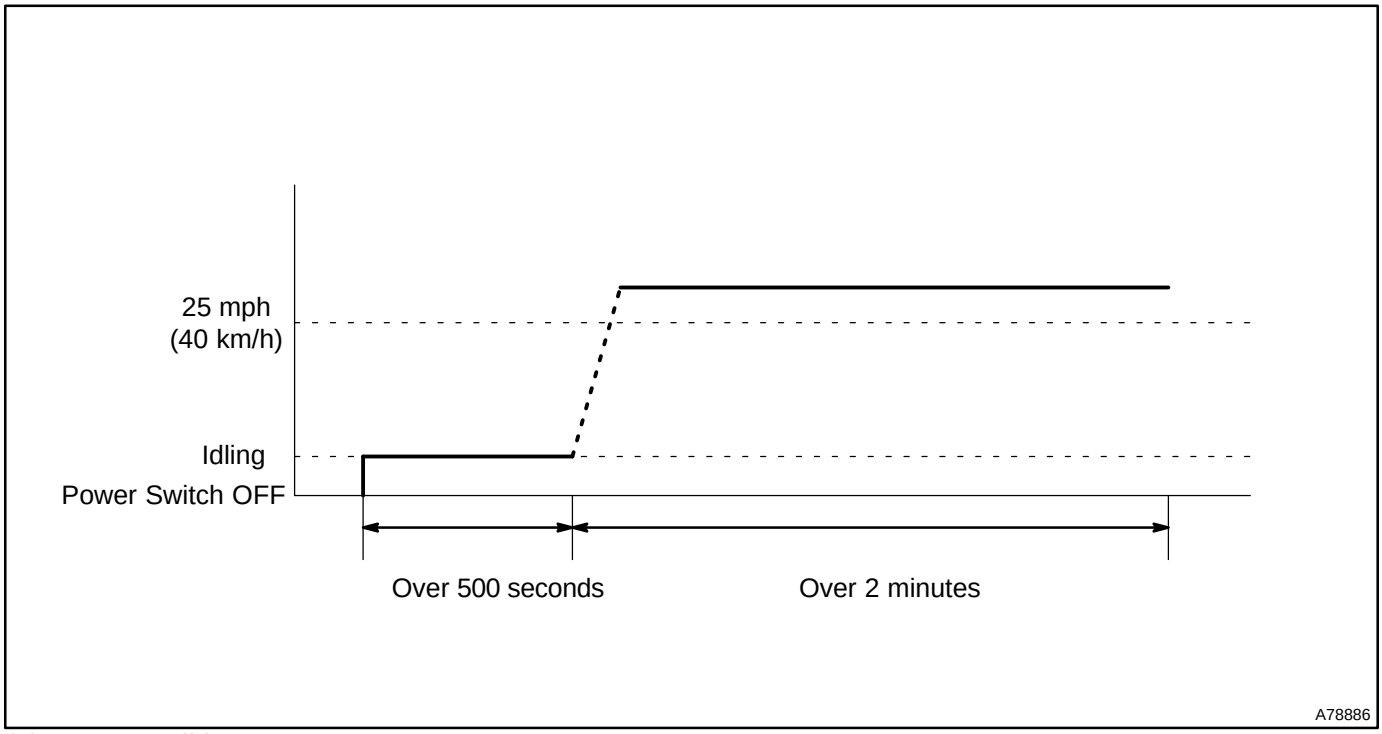
(1) Connect the hand–held tester or OBD II scan tool to DLC3 to check monitor status and preconditions.
(2) Put the engine in inspection mode.
(3) Start the engine and allow it to idle for 2 minutes.
(4) Deactivate the inspection mode and drive the vehicle at 44 to 55 mph (70 to 88 km/h) or more for 5 to 10 minutes.
(5) Check the readiness monitor status. If the readiness monitor status did not switch to ”complete,” check the preconditions, turn the power switch OFF, and then repeat steps (1) to (9).

NOTICE:

Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

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5. OXYGEN / A/F SENSOR HEATER MONITOR



(a) Preconditions

The monitor will not run unless:

MIL is OFF.

(b) Drive Pattern

(1) Connect the hand–held tester or OBD II scan tool to DLC3 to check monitor status and preconditions.

(2) Put the engine in inspection mode.

(3) Start the engine and allow it to idle for 500 seconds or more.

(4) Deactivate the inspection mode and drive the vehicle at 25 mph (40 km/h) or more at least for 2 minutes.

(5) Check the readiness monitor status. If the readiness monitor status did not change to ”complete”, check the preconditions, turn the power switch OFF, and repeat steps (2) and (3).

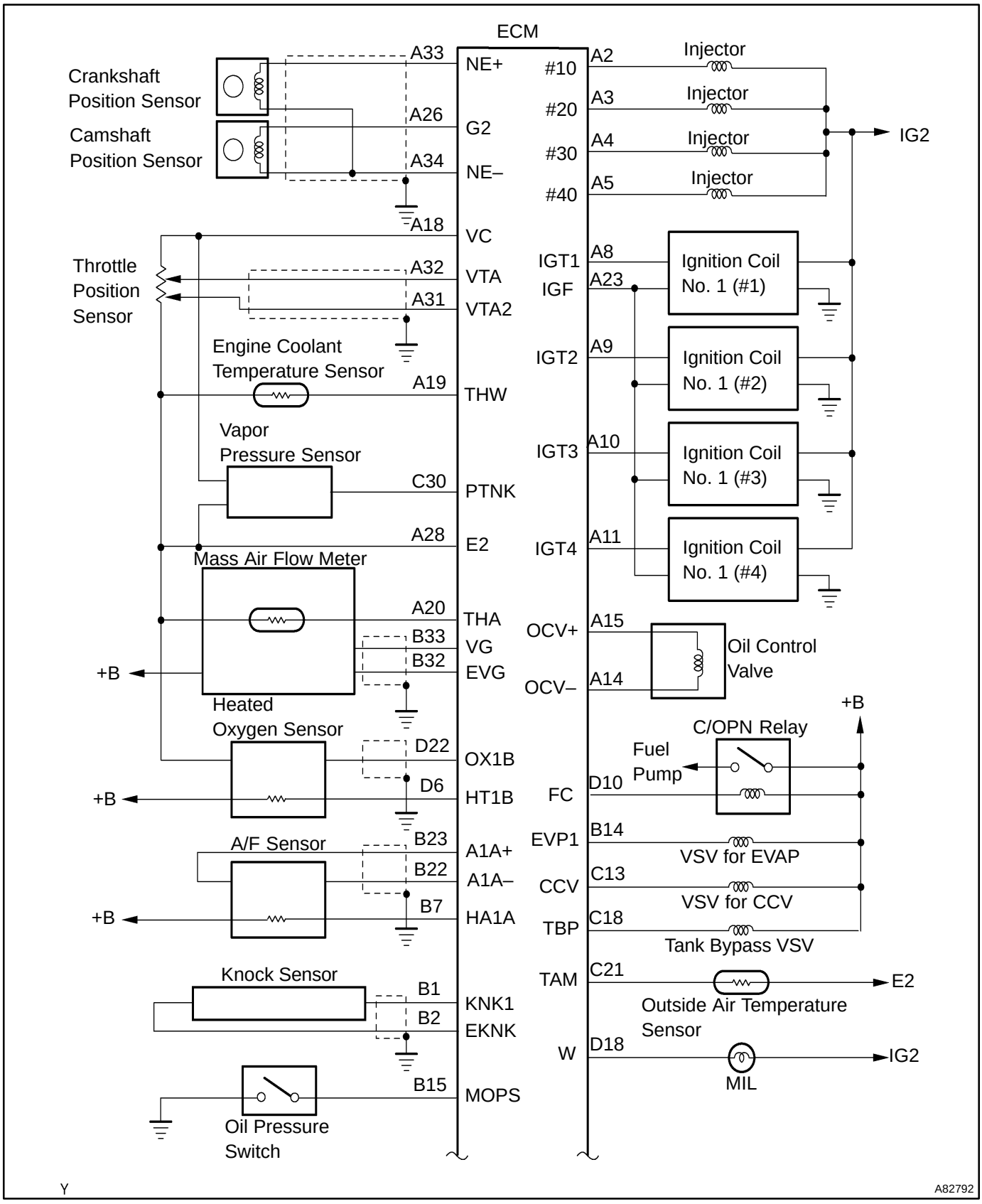
NOTICE:

Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

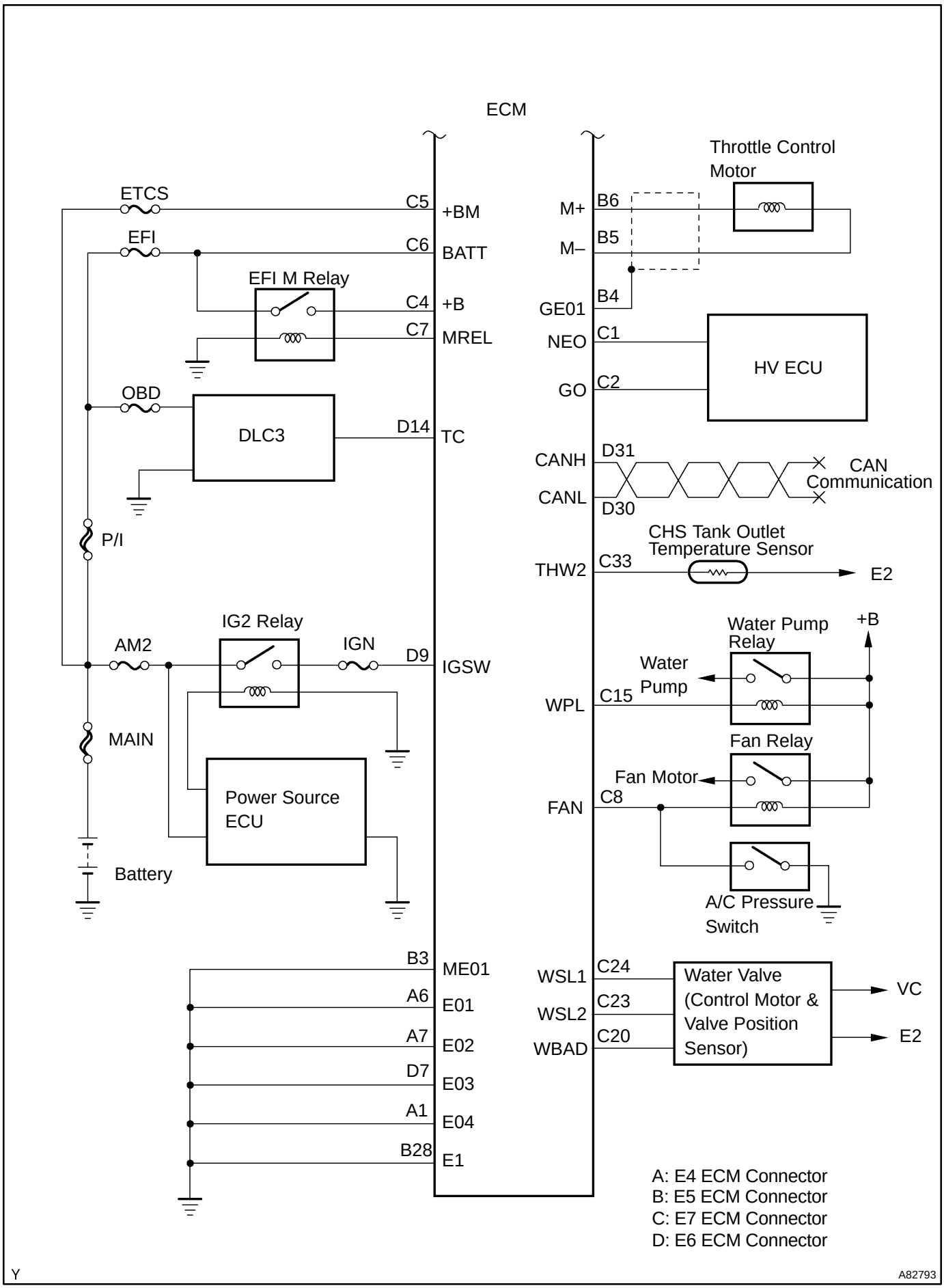
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SYSTEM DIAGRAM

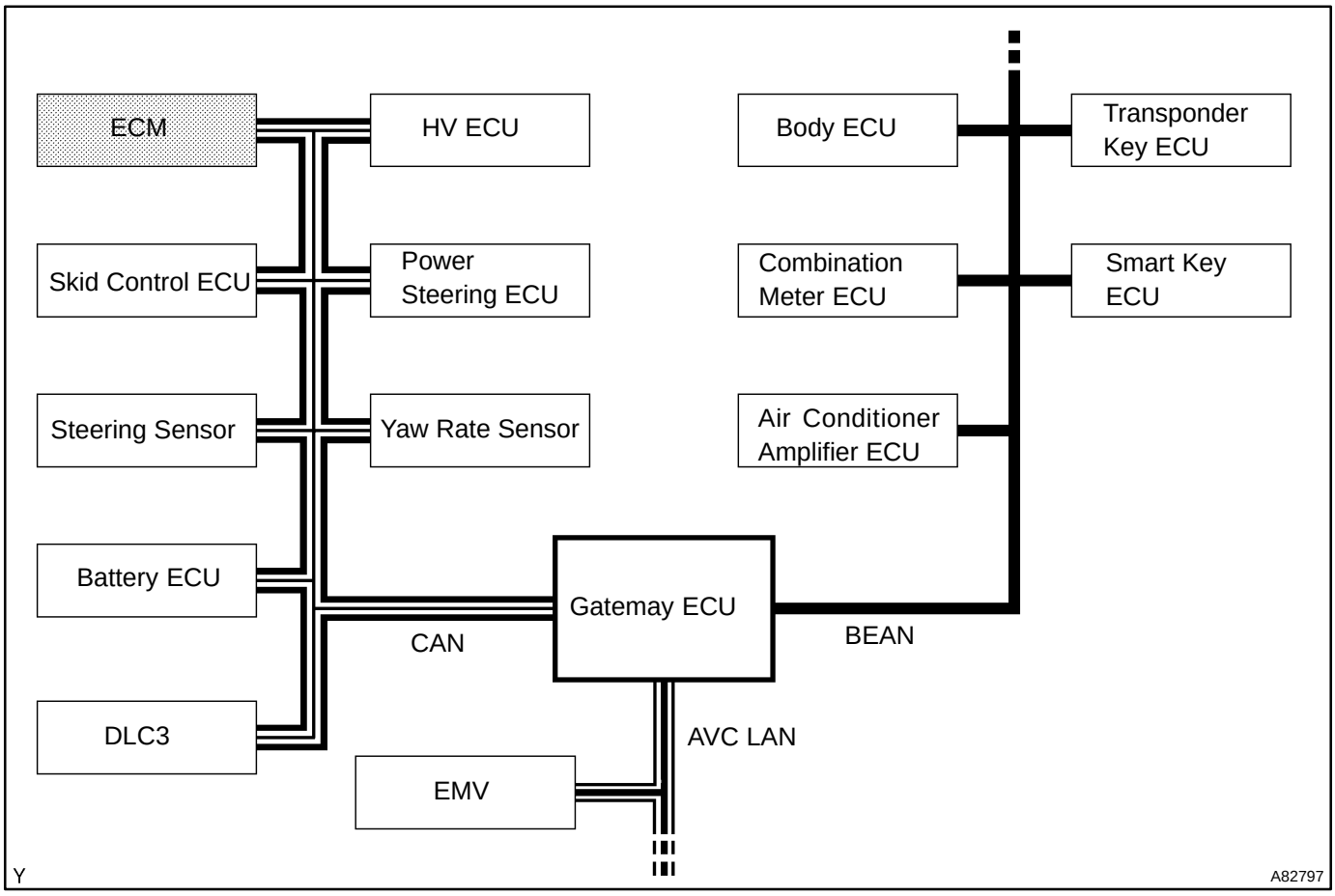


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COMMUNICATION WITH OTHER COMPUTERS



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COMMUNICATIONS

The ECM communicates with the following ECM and ECUs using the signals listed below. The following table explains receiving and sending signals by ECM or ECU.

Transmit To	Receive From	Signal	Communication Line
HV ECU	ECM	• Inspection mode signal • MIL illumination requirement • Shift position information • Ready state • Starter ON	CAN
ECM	HV ECU	• Ambient temperature • Intake air temperature • Radiator fan drive • Engine warm–up requirement • Engine rpm	CAN
ECM	Battery ECU	• Engine rpm	CAN
ECM	Power steering ECU	• Inspection mode	CAN
ECM	Skid Control ECU	• Inspection mode	CAN
ECM	Body ECU	• Inspection mode • Engine rpm	BEAN, CAN
METER	ECM	• Fuel level	BEAN, CAN
ECM	Combination Meter ECU	• Engine coolant temperature • Engine rpm • Injection volume • Inspection mode • Engine oil pressure switch	BEAN, CAN
ECM	Airconditioner Amplifier ECU	• Engine coolant temperature • Engine rpm • Ambient temperature • Coolant heat storage water valve close	BEAN, CAN
ECM	Smart Key ECU	• Engine rpm	BEAN, CAN
ECM	EMV	• Engine coolant temperature • Inspection mode • Engine oil pressure switch	ACV LAN, CAN

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PART AND SYSTEM NAME LIST

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

Part and system 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, Purge VSV	Evaporative emissions canister purge valve
VSV for purge flow 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	Heated oxygen sensor
Oxygen sensor pumping current circuit	Heated oxygen sensor output signal
Oxygen sensor reference ground circuit	Heated 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
Intermediate shaft speed sensor ”A”	Counter gear speed sensor

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Part and system name	Definition
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

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DTC U0293 LOST COMMUNICATION WITH HV ECU

CIRCUIT DESCRIPTION

The Controller Area Network (CAN) is a serial data communication system for real–time application. It is a multiplex communication system designed for on–vehicle use that provides a superior communication speed of 500 kbps and a capability to detect malfunction. Through the combination of the CANH and CANL bus lines, the CAN is able to maintain communication based on differential voltage.

HINT:

- Malfunction in the CAN bus (communication line) can be checked through the DLC3 connector, except in case of an open circuit in the DLC3 sub bus line.
- DTCs pertaining to CAN communication can be accessed through the use of the intelligent tester II (with CAN extension module).
- Malfunction in the DLC3 sub bus line cannot be detected through CAN communication, even though the DLC3 connector is connected to CAN communication.

DTC No.	DTC Detecting Condition	Trouble Area
U0293	When communication with HV ECU is interrupted	• Wire harness • HV ECU • ECM

MONITOR DESCRIPTION

The ECM and the HV control ECU are connected through a set of communication lines on the CAN, in order to maintain mutual communication. The ECM uses the communication lines to transmit the engine speed or other pieces of information to the HV control ECU. The HV control ECU transmits signals such as a engine torque request signal to the ECM.

A few seconds after the power switch is turned ON, the ECM starts checking for any malfunction in the communication with the HV ECU. If the ECM detects a malfunction in the communication, the ECM sets a DTC and illuminates the MIL.

MONITOR STRATEGY

Related DTCs	U0293: Lost communication with HV ECU
Required sensors/ components	ECM
Frequency of operation	Continuous
Duration	0.68 second
MIL operation	Immediately
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05–20
Power switch	ON

TYPICAL MALFUNCTION THRESHOLDS

Communication signal	No signal from HV ECU

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WIRING DIAGRAM

Refer to CAN Communication System on page 05–2599.

INSPECTION PROCEDURE

Refer to CAN Communication System on page 05–2602.

HINT:

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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CUSTOMER PROBLEM ANALYSIS CHECK

ENGINE CONTROL SYSTEM Check Sheet

Inspector's Name _____

Customer's Name		VIN	
License Plate No.		Production Date	
Date Vehicle Brought in		Odometer Reading	km miles

Problem Symptoms	☐ Engine does not Start	☐ Engine does not crank ☐ No initial combustion ☐ No complete combustion
	☐ Difficult to Start	☐ Engine cranks slowly ☐ Other _____
	☐ Poor Idling	☐ Incorrect first idle ☐ Idling rpm is abnormal ☐ High (rpm) ☐ Low (rpm) ☐ Rough idling ☐ Other _____
	☐ Poor Driveability	☐ Hesitation ☐ Back fire ☐ Muffler explosion (after–fire) ☐ Surging ☐ Knocking ☐ Other _____
	☐ Engine Stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ During A/C operation ☐ Shifting from N to D ☐ Other _____
	☐ Others	

Data Problem Occurred		
Problem Frequency		☐ Constant ☐ Sometimes (times per day/month) ☐ Once only ☐ Other _____
Condition When Problem Occurs	Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Various/Other _____
	Outdoor Temperature	☐ Hot ☐ Warm ☐ Cool ☐ Cold (approx. ____ °C/____ °F)
	Place	☐ Highway ☐ Suburbs ☐ Inner City ☐ Uphill ☐ Downhill ☐ Rough road ☐ Other _____
	Engine Temp.	☐ Cold ☐ Warming up ☐ After Warming up ☐ Any temp. ☐ Other _____
	Engine Operation	☐ Starting ☐ Just after starting (min.) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch ON/OFF ☐ Other _____

Condition of malfunction indicator lamp (MIL)		☐ Remains on ☐ Sometimes lights up ☐ Does not light up
DTC Inspection	Normal mode (Pre–check)	☐ Normal ☐ Malfunction code(s) (code) ☐ Freeze frame data ( )
	Check Mode	☐ Normal ☐ Malfunction code(s) (code) ☐ Freeze frame data ( )

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DIAGNOSTIC TROUBLE CODE CHART

HINT:

Parameters listed in the chart may not be exactly the same as your readings due to the type of instrument or other factors.

If a malfunction code is displayed during the DTC check in check mode, check the circuit for the codes listed in the table below. For details of each code, refer to ”See Page” under the respective ”DTC No.” in the this chart.

DTC No. (See Page)	Detection Item	Trouble Area	MIL*1	Memory
P0010 (05–63)	Camshaft Position ”A” Actuator Circuit (Bank 1)	• Open or short in oil control valve circuit • Oil control valve • ECM	○	○
P0011 (05–69)	Camshaft Position ”A” –Timing Over–Advanced or System Performance (Bank 1)	• Valve timing • Oil control valve • Camshaft timing gear assembly • ECM	○	○
P0012 (05–69)	Camshaft Position ”A” –Timing Over– Retarded (Bank 1)	• Same as DTC P0011	○	○
P0016 (05–77)	Crankshaft Position – Camshaft Position Correlation (Bank 1 Sensor A)	• Mechanical system (Timing chain has jumped a tooth, chain stretched) • ECM	○	○
P0031 (05–79)	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	• Open or short in heater circuit of A/F sensor • A/F sensor heater • EFI M relay (Integration relay) • ECM	○	○
P0032 (05–79)	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	• Short in heater circuit of A/F sensor • A/F sensor heater • EFI M relay (Integration relay) • ECM	○	○
P0037 (05–84)	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	• Open or short in heater circuit of the heated oxygen sensor • Heated oxygen sensor heater • EFI M relay (integration relay) • ECM	○	○
P0038 (05–84)	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	• Short in heater circuit of the heated oxygen sensor • Heated oxygen sensor heater • EFI M relay (integration relay) • ECM	○	○
P0100 (05–89)	Mass or Volume Air Flow Circuit	• Open or short in mass air flow meter circuit • Mass air flow meter • ECM	○	○
P0101 (05–96)	Mass or Volume Air Flow Circuit Range/Performance Problem	• Mass air flow meter	○	○
P0102 (05–89)	Mass or Volume Air Flow Circuit Low Input	• Open in mass air flow meter circuit • Mass air flow meter • ECM	○	○
P0103 (05–89)	Mass or Volume Air Flow Circuit High Input	• Short in mass air flow meter circuit • Mass air flow meter • ECM	○	○
P0110 (05–98)	Intake Air Temperature Circuit	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM	○	○
P0112 (05–98)	Intake Air Temperature Circuit Low Input	• Short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM	○	○
P0113 (05–98)	Intake Air Temperature Circuit High Input	• Open in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM	○	○

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DTC No. (See Page)	Detection Item	Trouble Area	MIL*1	Memory
P0115 (05–103)	Engine Coolant Temperature Circuit	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM	○	○
P0116 (05–108)	Engine Coolant Temperature Circuit Range/Performance Problem	• Engine coolant temperature sensor	○	○
P0117 (05–103)	Engine Coolant Temperature Circuit Low Input	• Short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM	○	○
P0118 (05–103)	Engine Coolant Temperature Circuit High Input	• Open in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM	○	○
P0120 (05–110)	Throttle/Pedal Position Sensor/ Switch "A" Circuit	• Open or short in throttle position sensor circuit • Throttle position sensor (built in throttle body) • ECM	○	○
P0121 (05–117)	Throttle/Pedal Position Sensor/ Switch "A" Circuit Range/Performance Problem	• Throttle position sensor (built in throttle body)	○	○
P0122 (05–110)	Throttle/Pedal Position Sensor/ Switch "A" Circuit Low Input	• Throttle position sensor • Open in VTA1 circuit • Open in VC circuit (when the VC circuit is open, DTCs P0222 and P2135 are also output simultaneously) • ECM	○	○
P0123 (05–110)	Throttle/Pedal Position Sensor/ Switch "A" Circuit High Input	• Throttle position sensor (built in throttle body) • Open in VTA circuit • Open in E2 circuit • VC and VTA circuits are short–circuited • ECM	○	○
P0125 (05–119)	Insufficient Coolant Temperature for Closed Loop Fuel Control	• Cooling system • Engine coolant temperature sensor • Thermostat	○	○
P0128 (05–122)	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	• Thermostat • Cooling system • Engine coolant temperature sensor • ECM	○	○
P0136 (05–125)	Oxygen Sensor Circuit Malfunction (Bank 1 sensor 2)	• Heated oxygen sensor	○	○
P0137 (05–125)	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI M relay (integration relay)	○	○
P0138 (05–125)	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	• Short in heated oxygen sensor circuit • Heated oxygen sensor	○	○
P0171 (05–143)	System Too Lean (Bank 1)	• Air induction system • Injector has blockage • Mass air flow meter • Engine coolant temperature 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 M relay (integration relay) • PCV valve and hose • PCV hose connection • ECM	○	○

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DTC No. (See Page)	Detection Item	Trouble Area	MIL*1	Memory
P0172 (05–143)	System Too Rich (Bank 1)	• Injector has leakage or blockage • Mass air flow meter • Engine coolant temperature 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 (bank 1 sensor 1) • EFI M relay (integration relay) • ECM	○	○
P0220 (05–110)	Throttle/Pedal Position Sensor/ Switch "B" Circuit	• Open or short in throttle position sensor circuit • Throttle position sensor • ECM	○	○
P0222 (05–110)	Throttle/Pedal Position Sensor/ Switch "B" Circuit Low Input	• Throttle position sensor • Open in VTA2 circuit • Open in VC circuit (when the VC circuit is open, DTCs P0122 and P2135 are also output simultaneously)	○	○
P0223 (05–110)	Throttle/Pedal Position Sensor/ Switch "B" Circuit High Input	• Throttle position sensor	○	○
P0300 (05–157)	Random/Multiple Cylinder Misfire Detected	• Open or short in engine wire harness • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve clearance • Valve timing • PCV hose connection • PCV hose • ECM	○*2	○
P0301 (05–157)	Cylinder 1 Misfire Detected	• Same as DTC P0300	○*2	○
P0302 (05–157)	Cylinder 2 Misfire Detected	• Same as DTC P0300	○*2	○
P0303 (05–157)	Cylinder 3 Misfire Detected	• Same as DTC P0300	○*2	○
P0304 (05–157)	Cylinder 4 Misfire Detected	• Same as DTC P0300	○*2	○
P0325 (05–172)	Knock Sensor 1 Circuit (Bank 1 or Single Sensor)	• Open or short in knock sensor circuit • Knock sensor (looseness) • ECM	○	○
P0327 (05–172)	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	• Short in knock sensor circuit • Knock sensor • ECM	○	○
P0328 (05–172)	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	• Open in knock sensor circuit • Knock sensor • ECM	○	○
P0335 (05–177)	Crankshaft Position Sensor "A" Circuit	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Signal plate (crankshaft) • ECM	○	○

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DTC No. (See Page)	Detection Item	Trouble Area	MIL*1	Memory
P0340 (05–181)	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	• Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing pulley • Timing chain has jumped a tooth • ECM	○	○
P0341 (05–181)	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 1 or Single Sensor)	• Same as DTC P0340	○	○
P0351 *3 (05–185)	Ignition Coil "A" Primary/Secondary Circuit	• Ignition system • Open or short in IGF or IGT1 circuit between ignition coil with igniter and ECM • No.1 ignition coil with igniter • ECM	○	○
P0352 *3 (05–185)	Ignition Coil "B" Primary/Secondary Circuit	• Ignition system • Open or short in IGF or IGT2 circuit between ignition coil with igniter and ECM • No.2 ignition coil with igniter • ECM	○	○
P0353 *3 (05–185)	Ignition Coil "C" Primary/Secondary Circuit	• Ignition system • Open or short in IGF or IGT3 circuit between ignition coil with igniter and ECM • No.3 ignition coil with igniter • ECM	○	○
P0354 *3 (05–185)	Ignition Coil "D" Primary/Secondary Circuit	• Ignition system • Open or short in IGF or IGT4 circuit between ignition coil with igniter and ECM • No.4 ignition coil with igniter • ECM	○	○
P0420 (05–195)	Catalyst System Efficiency Below Threshold (Bank 1)	• 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)	○	○
P0441 (05–202)	Evaporative Emission Control System Incorrect Purge Flow	• Fuel tank cap is incorrectly installed • Fuel tank cap is cracked or damaged • Vacuum hose is cracked, blocked, damaged or disconnected ((1), (2), (3), (4), (5), (6) and (7) in Fig. 1) • Open or short in vapor pressure sensor circuit • Vapor pressure sensor • Open or short in VSV circuit for EVAP • VSV for EVAP • Open or short in VSV circuit for CCV • VSV for CCV • Open or short in VSV circuit for pressure switching valve • VSV for pressure switching valve • Fuel tank is cracked or damaged • Charcoal canister is cracked or damaged • Fuel tank over fill check valve is cracked or damaged • ECM	○	○

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DTC No. (See Page)	Detection Item	Trouble Area	MIL*1	Memory
P0442 (05–231)	Evaporative Emission Control System Leak Detected (small leak)	• Fuel tank cap is incorrectly installed • Fuel tank cap is cracked or damaged • Vacuum hose cracks is blocked, damaged or disconnected ((1), (2), (3), (4), (5), (6) and (7) in Fig. 1 of the circuit description) • Open or short in vapor pressure sensor circuit • Vapor pressure sensor • Open or short in VSV circuit for EVAP • VSV for EVAP • Open or short in VSV circuit for CCV • VSV for CCV • Open or short in VSV circuit for pressure switching valve • VSV for pressure switching valve • Fuel tank is cracked or damaged • Charcoal canister is cracked or damaged • Fuel tank over fill check valve is cracked or damaged • ECM	○	○
P0446 (05–202)	Evaporative Emission Control System Vent Control Circuit	• Same as DTC P0441	○	○
P0451 (05–255)	Evaporative Emission Control System Pressure Sensor/Switch Range/Performance	• Open or short in vapor pressure sensor circuit • Vapor pressure sensor • ECM	○	○
P0452 (05–255)	Evaporative Emission Control System Pressure Sensor/Switch Low Input	• Same as DTC P0451	○	○
P0453 (05–255)	Evaporative Emission Control System Pressure Sensor/Switch High Input	• Same as DTC P0451	○	○
P0455 (05–231)	Evaporative Emission Control System Leak Detected (gross leak)	• Same as DTC P0442		
P0456 (05–231)	Evaporative Emission Control System Leak Detected (very small leak)	• Same as DTC P0442	○	○
P0505 (05–261)	Idle Air Control System	• Open or short in idle speed control (ISC) valve circuit • Idle speed control (ISC) valve has stuck closed • ECM • Air induction system • PCV valve and hose	○	○
P0560 (05–264)	System Voltage	• Open in back up power source circuit • ECM	○	○
P0604 (05–268)	Internal Control Module Random Access Memory (RAM) Error	• ECM	○	○
P0606 (05–268)	ECM/PCM Processor	• ECM	○	—
P0607 (05–268)	Control Module Performance	• ECM	○	○
P0657 (05–268)	Actuator Supply Voltage Circuit/ Open	• ECM	○	○
P1115 (05–270)	Coolant Temperature Sensor Circuit For Coolant Heat Storage System	• Coolant heat storage tank outlet temperature sensor • Open or short in temperature sensor circuit • ECM	○	○
P1116 (05–275)	Coolant Temperature Sensor Circuit Stuck For Coolant Heat Storage System	• Coolant heat storage tank outlet temperature sensor • Cooling system (clogging)	○	○
P1117 (05–270)	Coolant Temperature Sensor Circuit Low For Coolant Heat Storage System	• Coolant heat storage tank outlet temperature sensor • Short in temperature sensor circuit • ECM	○	○

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DTC No. (See Page)	Detection Item	Trouble Area	MIL*1	Memory
P1118 (05–270)	Coolant Temperature Sensor Circuit High For Coolant Heat Storage System	• Coolant heat storage tank outlet temperature sensor • Open in temperature sensor circuit • ECM	○	○
P1120 (05–277)	Coolant Flow Control Valve Position Sensor Circuit	• Open or short in water valve position sensor circuit • Water valve (Coolant flow control valve) • ECM	○	○
P1121 (05–284)	Coolant Flow Control Valve Position Sensor Circuit Stuck	• Water valve (Coolant flow control valve) • Cooling system (clogging)	○	○
P1122 (05–277)	Coolant Flow Control Valve Position Sensor Circuit Low	• Water valve (Coolant flow control valve) • Short in WBAD (valve position signal) circuit • Open in VC circuit • ECM	○	○
P1123 (05–277)	Coolant Flow Control Valve Position Sensor Circuit High	• Water valve (Coolant flow control valve) • Open in E2 circuit • VC and WBAD circuits are short–circuited • Open in WBAD circuit • ECM	○	○
P1150 (05–290)	Coolant Path Clog Up For Coolant Heat Storage System	• Coolant heat storage tank outlet temperature sensor • Water valve (Coolant flow control valve) • Cooling system (clogging) • Heat storage tank • ECM	○	○
P1151 (05–297)	Coolant Heat Storage Tank	• Heat storage tank	○	○
P1455 (05–299)	Vapor Reducing Fuel Tank System Malfunction	• Fuel Tank	○	○
P2102 (05–301)	Throttle Actuator Control Motor Circuit Low	• Open or short in throttle control motor circuit • Throttle control motor • ECM	○	○
P2103 (05–301)	Throttle Actuator Control Motor Circuit High	• Short in throttle control motor circuit • Throttle control motor • Throttle valve • Throttle body assembly • ECM	○	○
P2111 (05–305)	Throttle Actuator Control System Stuck Open	• Throttle control motor circuit • Throttle control motor • Throttle body • Throttle valve	○	○
P2112 (05–305)	Throttle Actuator Control System Stuck Closed	• Throttle control motor circuit • Throttle control motor • Throttle body • Throttle valve	○	○
P2118 (05–308)	Throttle Actuator Control Motor Current Range/Performance	• Open in ETCS power source circuit • ETCS fuse • ECM	○	○
P2119 (05–312)	Throttle Actuator Control Throttle Body Range/Performance	• Electric throttle control system • ECM	○	○
P2135 (05–110)	Throttle/Pedal Position Sensor/ Switch ”A”/”B” Voltage Correlation	• VTA and VTA2 circuits are short–circuited • Open in VC circuit • Throttle position sensor	○	○

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DTC No. (See Page)	Detection Item	Trouble Area	MIL*1	Memory
P2195 (05–314)	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	• Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • Integration relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM	○	○
P2196 (05–314)	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	• Same as DTC P2195	○	○
P2238 (05–327)	Oxygen Sensor Pumping Current Circuit Low (for A/F sensor Bank 1 sensor 1)	• Open or short in A/F sensor (bank 1 sensor 1) • A/F sensor (bank 1 sensor 1) • A/F sensor heater • EFI M relay (integration relay) • A/F sensor heater and relay circuit • ECM	○	○
P2239 (05–327)	Oxygen Sensor Pumping Current Circuit High (for A/F sensor Bank 1 sensor 1)	• Same as DTC P2238	○	○
P2252 (05–327)	Oxygen Sensor Reference Ground Circuit Low (for A/F sensor Bank 1 sensor1)	• Same as DTC P2238	○	○
P2253 (05–327)	Oxygen Sensor Reference Ground Circuit High (for A/F sensor Bank 1 sensor1)	• Same as DTC P2238	○	○
P2601 (05–333)	Coolant Pump Control Circuit Range/Performance	• CHS water pump • CHS water pump relay • Open or short in CHS water pump circuit • ECM	○	○
P2610 (05–344)	ECM/PCM Internal Engine Off Timer Performance	• ECM	○	○
P2A00 (05–345)	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	• Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • EFI M relay (integration relay) • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM	○	○
P3190 (05–357)	Poor Engine Power	• Air induction system • Throttle body • Fuel pressure • Engine • Air flow meter • Lack of fuel • Engine coolant temperature sensor • Crankshaft position sensor • Camshaft position sensor • ECM	○	○

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DTC No. (See Page)	Detection Item	Trouble Area	MIL*1	Memory
P3191 (05–357)	Engine Does Not Start	• Air induction system • Throttle body • Fuel pressure • Engine • Air flow meter • Lack of fuel • Engine coolant temperature sensor • Crankshaft position sensor • Camshaft position sensor • ECM	○	○
P3193 (05–357)	Fuel Run Out	• Lack of fuel • ECM	○	○
U0293 (05–364)	Lost Communication With HV ECU	• Wire harness • HV ECU • ECM	○	○

*1: "○" ... MIL illuminates, "—" ... MIL does not illuminate.
*2: MIL illuminates or blinks
*3: This DTC indicates malfunction related to the primary circuit.

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05288–26

HOW TO PROCEED WITH TROUBLESHOOTING

The hand–held tester can be used at step 3, 4, 5, 7 and 10.

1	**VEHICLE BROUGHT TO WORKSHOP**

2	**CUSTOMER PROBLEM ANALYSIS (See page 05–16)**

3	**CONNECT HAND–HELD TESTER TO DLC3**

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

4	**CHECK DTC AND FREEZE FRAME DATA (See page 05–41)**

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

5	**CLEAR DTC AND FREEZE FRAME DATA (See page 05–41)**

6	**VISUAL INSPECTION**

7	**SETTING CHECK MODE DIAGNOSIS (See page 05–45)**

8	**PROBLEM SYMPTOM CONFIRMATION**

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

Malfunction does not occur	A
Malfunction occurs	B

B → **GO TO STEP 10**

A

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9	SYMPTOM SIMULATION

10	DTC CHECK (See page 05–41)

Malfunction code	A
No code	B

B → GO TO STEP 12

A

11	DTC CHART (See page 05–55)

GO TO STEP 14

12	BASIC INSPECTION (See page 05–18)

Wrong parts not confirmed	A
Wrong parts confirmed	B

B → GO TO STEP 17

A

13	PROBLEM SYMPTOMS TABLE (See page 05–33)

Wrong circuit confirmed	A
Wrong parts confirmed	B

B → GO TO STEP 17

A

14	CHECK ECM POWER SOURCE CIRCUIT (See page 05–366)

15	CIRCUIT INSPECTION

Malfunction not confirmed	A
Malfunction confirmed	B

B → GO TO STEP 18

A

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16	CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)

GO TO STEP 18

17	PARTS INSPECTION

18	IDENTIFICATION OF PROBLEM

19	ADJUSTMENT AND/OR REPAIR

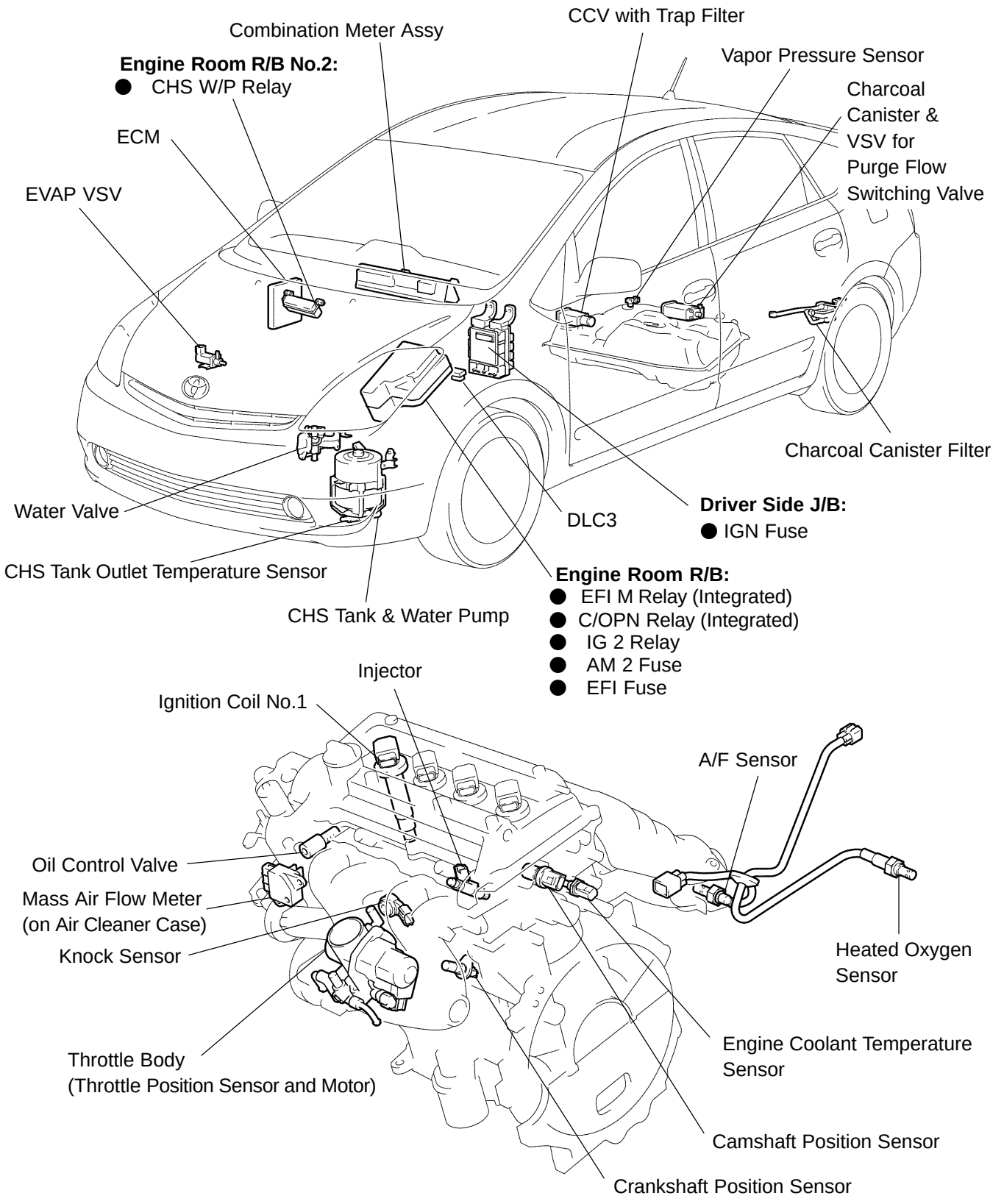
20	CONFIRMATION TEST

END

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05285–27

LOCATION



● **Built in R/B or J/B**

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SFI SYSTEM

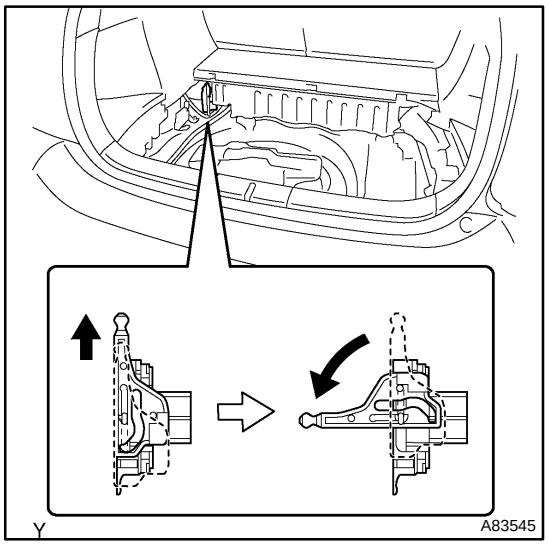
05FNG–02

PRECAUTION

1. PRECAUTIONS FOR HIGH–VOLTAGE CIRCUIT INSPECTION AND SERVICE

(a) Technicians to be engaged in inspection and service on high–voltage components and systems should receive special training.

(b) All the high–voltage wire harness connectors are colored orange: the HV battery and other high–voltage components are identified by the ”High Voltage” caution labels. Do not touch these connectors and components before removing the service plug. Remove the service plug prior to touching these connectors and components.

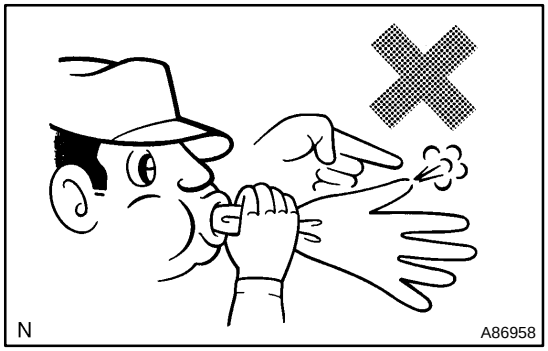


(c) Before inspecting or servicing the high–voltage components/systems, be sure to take safety precautions such as wearing insulated gloves and removing the service plug to prevent electric shock or electrocution. Store the removed service plug in your pocket to prevent other technicians from reinstalling it while you are servicing high–voltage components/systems.

(d) After removing the service plug, wait at least for 5 minutes before touching any of the high–voltage connectors and terminals.

HINT:

At least 5 minutes is required to discharge electricity from the high–voltage condenser inside the inverter.

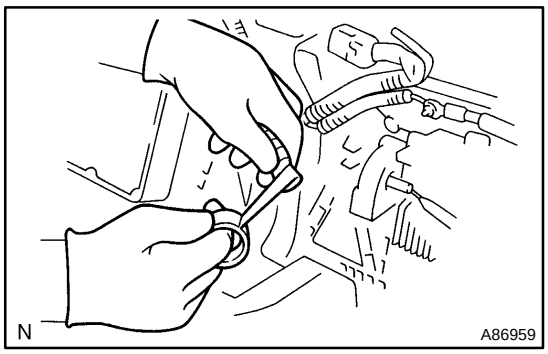


(e) Before wearing insulated gloves, make sure that they are not ruptured, torn or damaged in any other way. Do not wear wet insulated gloves.

(f) When servicing, be careful not to drop metallic materials like a mechanical pencil or tools etc. Causing a short circuit may result.

(g) Wear the insulated gloves before touching a bare high–voltage terminal. Verify that electricity has discharged from the terminal (approximately 0 V) using an electrical tester.

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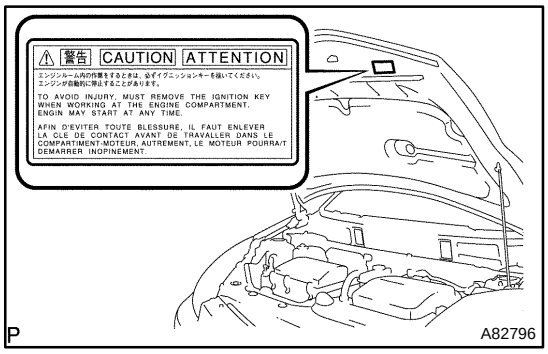


(h) After disconnecting or exposing a high–voltage connector or terminal, insulate it immediately using insulation tape.

(i) The screw of a high–voltage terminal should be tightened firmly to the specified torque. Either insufficient or excessive tightening torque can cause HV system failure.

(j) Call other technicians' attention to prevent accidents during working on the high–voltage components/systems by posting a sigh to notify them (see page 01–5).

(k) Prior to reinstalling the service plug, again, verify whether or not any parts or tools have been left behind, and check if high–voltage terminal screws have been securely tightened as well as the connectors have been properly reconnected.



2. PRECAUTIONS TO BE OBSERVED WHEN INSPECTING OR SERVICING ENGINE COMPARTMENT

The PRIUS automatically turns the engine ON and OFF when the power switch is ON (READY lamp on the instrument panel is being illuminated). Turn the HV main system OFF before servicing inside the engine compartment.

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3. INSPECTION MODE

HINT:

- The PRIUS automatically stops the engine while the vehicle is stopped with the engine warmed up and battery well charged if the A/C compressor operation is not required. Therefore, even if the vehicle stops for any reason such as a check of ignition timing, inspection mode should be activated when continuous operation of the engine is required.

Activating inspection mode (Using the hand–held tester)

(1) Connect the hand–held tester to the DLC3.
(2) Turn the power switch ON (IG).
(3) Turn the hand–held tester ON.
(4) On the hand–held tester, select the item: DIAGNOSIS / ENHANCED OBD II / HV ECU / ACTIVE TEST / INSPECTION MOD1 / ON.
(5) Activate inspection mode and check that the HV system warning on the multi–information display flashes and the master warning lamp on the combination meter is illuminated.
(6) Start the engine by pushing the power switch with depressing the brake pedal.

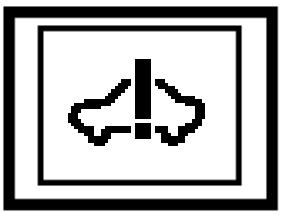
Deactivating inspection mode

(1) Turn the power switch OFF. Inspection mode and the HV main system are killed simultaneously.

NOTICE:

- **The idling speed in inspection mode is approximately 1,000 rpm. The number of revolutions will increase up to 1,500 rpm if the accelerator pedal is depressed to a degree of less than 60%, and up to 2,500 rpm in a case of 60% or more.**
- **If a diagnosis code is recorded when entering inspection mode, the master warning lamp and the error warning lamp on the multi–center display illuminates.**
- **When the master warning lamp illuminates during operation in inspection mode, deactivate inspection mode and inspect the diagnosed area.**
- **Traveling on a road without deactivating inspection mode may damage the transaxle.**

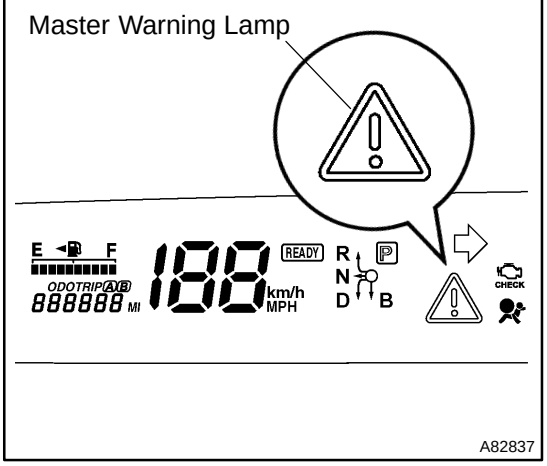
Multi–Information Display:



HV System Warning

A82839

Combination Meter:



A82837

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4. FOR USING OBD II SCAN TOOL OR HAND–HELD TESTER

CAUTION:

Observe the following items for safety reasons:

- **Read its instruction books before using the scan tool or the tester.**
- **Prevent the tester cable from being caught on the pedals, shift lever and steering wheel when driving with the tester connected to the vehicle.**
- **When driving the vehicle for testing purposes using the scan tool or the tester, two persons are required. One is for driving the vehicle, and the other operates the tester.**

5. INITIALIZATION

NOTICE:

When disconnecting the negative (–) battery cable, initialize the following systems after the terminal is reconnected.

System Name	See page
Power Window Control System	05–2028

HINT:

Initialization can not be completed by only removing the battery.

6. NOTICES FOR HYBRID SYSTEM ACTIVATION

- **When the warning lamp is illuminated or the battery has been disconnected and reconnected, pressing the power switch may not start the system on the first try. If so, press the power switch again.**
- **With the power switch's power mode changed to ON (IG), disconnect the battery. If the key is not in the key slot during reconnection, DTC B2799 may be output.**

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05287–27

PROBLEM SYMPTOMS TABLE

When the malfunction is not confirmed in the diagnostic trouble code check and the problem still can not be confirmed in the basic inspection, use this table and troubleshoot according to the priority order given below.

Symptom	Suspected Area	See page
Engine does not crank (Does not start)	26.MG1 27.Hybrid system 28.Immobilizer 29.Push start system	– 05–404 05–2330 –
No initial combustion (Does not start)	1. ECM power source circuit 2. Fuel pump control circuit 3. Spark plug 4. Immobilizer system 5. Injector 6. ECM 7. Crankshaft position sensor circuit	05–366 05–373 18–3 05–2330 11–7 10–5 05–177
No complete combustion (Does not start)	1. Fuel pump control circuit 2. Spark plug 3. Immobilizer system 4. Injector 5. Crankshaft position sensor circuit	05–373 18–3 05–2330 11–7 05–177
Engine cranks normally but difficult to start	1. Fuel pump control circuit 2. Compression 3. Spark plug 4. Injector 5. Crankshaft position sensor circuit	05–373 14–1 18–3 11–7 05–177
Difficult to start with cold engine	1. Fuel pump control circuit 2. Spark plug 3. Injector 4. Crankshaft position sensor circuit	05–373 18–3 11–7 05–177
Difficult to start with hot engine	1. Fuel pump control circuit 2. Spark plug 3. Injector 4. Crankshaft position sensor circuit	05–373 18–3 11–7 05–177
High engine idle speed (Poor idling)	1. ECM power source circuit 2. Electronic throttle control system	05–366 05–13
Low engine idle speed (Poor idling)	1. Fuel pump control circuit 2. Electronic throttle control system 3. Injector	05–373 05–13 11–7
Rough idling (Poor idling)	1. Compression 2. Electronic throttle control system 3. Injector 4. Fuel pump control circuit 5. Spark plug	14–1 05–13 11–7 05–373 18–3
Hunting (Poor idling)	1. ECM power source circuit 2. Electronic throttle control system 3. Fuel pump control circuit	05–366 05–13 05–373
Hesitation/Poor acceleration (Poor driveability)	1. Fuel pump control circuit 2. Injector 3. Spark plug 4. HV transaxle	05–373 11–7 18–3 –
Surging (Poor driveability)	1. Fuel pump control circuit 2. Spark plug 3. Injector	05–373 18–3 11–7

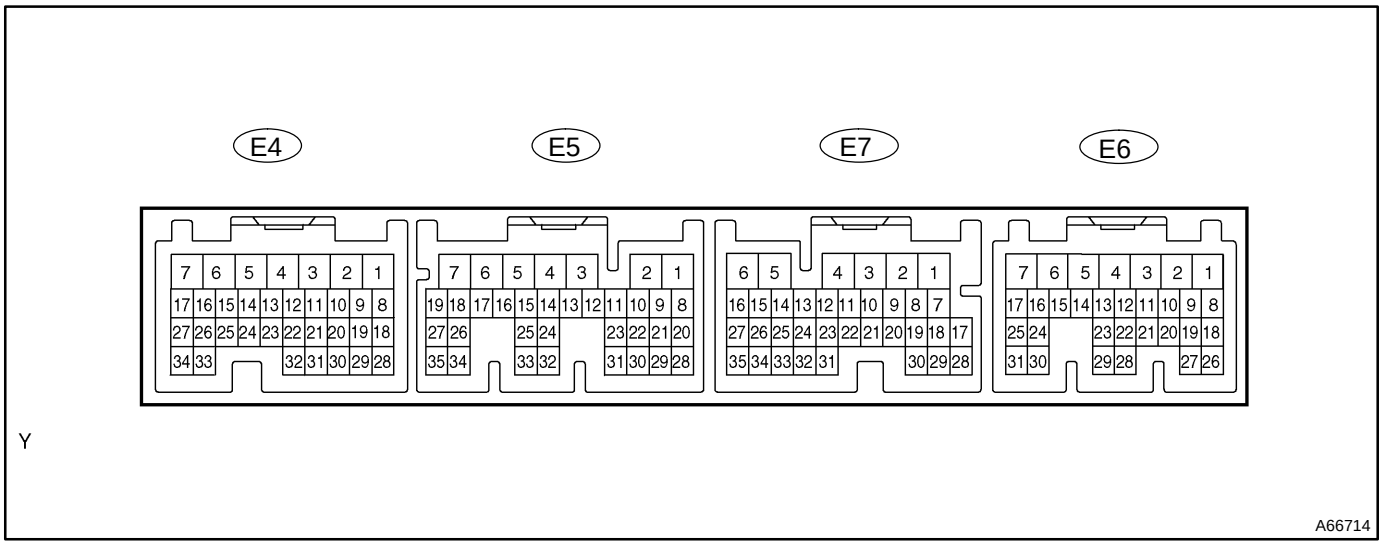
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Symptom	Suspected Area	See page
Engine stalls soon after starting	1. Fuel pump control circuit 2. Electronic throttle control system 3. Immobilizer 4. Crankshaft position sensor circuit	05–373 05–13 05–2330 05–177
Unable to refuel/Difficult to refuel	1. ORVR system	

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05286–26

TERMINALS OF ECM



Each ECM terminal's standard voltage is shown in the table below.
In the table, first follow the information under "Condition". Look under "Symbols (Terminals No.)" for the terminals to be inspected. The standard voltage between the terminals is shown under "STD voltage".
Use the illustration above as a reference for the ECM terminals.

Symbols (Terminals No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
BATT (E7–6) – E1 (E5–28)	R – BR	Battery	Always	9 to 14
+B (E7–4) – E1 (E5–28)	B – BR	Power source of ECM	Power switch ON (IG)	9 to 14
+BM (E7–5) – E1 (E5–28)	GR – BR	Power source of ETCS	Always	9 to 14
IGSW (E6–9) – E1 (E5–28)	O – BR	Power switch signal	Power switch ON (IG)	9 to 14
MREL (E7–7) – E1 (E5–28)	G – BR	Main relay control signal	Power switch ON (IG)	9 to 14
VC (E4–18) – E2 (E4–28)	R – BR	Power source of sensor (a specific voltage)	Power switch ON (IG)	4.5 to 5.5
NE+ (E4–33) – NE– (E4–34)	R – G	Crankshaft position sensor	Idling (during inspection mode)	Pulse generation (See page 05–177)
G2 (E4–26) – NE– (E4–34)	R – G	Camshaft position sensor	Idling (during inspection mode)	Pulse generation (See page 05–177)
VTA (E4–32) – E2 (E4–28)	P – BR	Throttle position sensor	Power switch ON (IG), Throttle valve fully closed	0.5 to 1.2
VTA (E4–32) – E2 (E4–28)	P – BR	Throttle position sensor	HV system ON, During active test to open throttle valve (see page 05–47)	3.2 to 4.8
VTA2 (E4–31) – E2 (E4–28)	L – BR	Throttle position sensor	Power switch ON (IG), Accelerator pedal released	2.0 to 2.9
VTA2 (E4–31) – E2 (E4–28)	L – BR	Throttle position sensor	HV system ON, During active test to open throttle valve (see page 05–47)	4.6 to 5.5
VG (E5–33) – EVG (E5–32)	G – R	Mass air flow meter	Idling (during inspection mode), A/C switch OFF	1.0 to 1.5
THA (E4–20) – E2 (E4–28)	W – BR	Intake air temperature sensor	Idling (during inspection mode), Intake air temperature at 20°C	0.5 to 3.4
THW (E4–19) – E2 (E4–28)	W – BR	Engine coolant temperature sensor	Idling (during inspection mode), Engine coolant temperature at 80°C	0.2 to 1.0
#10 (E4–2) – E01 (E4–7)	Y – BR	Injector	Power switch ON (IG)	9 to 14
#20 (E4–3) – E01 (E4–7)	B – BR	Injector	Power switch ON (IG)	9 to 14
#30 (E4–4) – E01 (E4–7)	L – BR	Injector	Power switch ON (IG)	9 to 14
#40 (E4–5) – E01 (E4–7)	R – BR	Injector	Power switch ON (IG)	9 to 14

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Symbols (Terminals No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
IGT1 (E4–8) – E1 (E5–28)	Y – BR	Ignition coil No. 1 (#1) (Ignition signal)	Idling (during inspection mode)	Pulse generation (See page 05–185)
IGT2 (E4–9) – E1 (E5–28)	W – BR	Ignition coil No. 1 (#2) (Ignition signal)	Idling (during inspection mode)	Pulse generation (See page 05–185)
IGT3 (E4–10) – E1 (E5–28)	G – BR	Ignition coil No. 1 (#3) (Ignition signal)	Idling (during inspection mode)	Pulse generation (See page 05–185)
IGT4 (E4–11) – E1 (E5–28)	Y – BR	Ignition coil No. 1 (#4) (Ignition signal)	Idling (during inspection mode)	Pulse generation (See page 05–185)
KNK1 (E5–1) – EKNK (E5–2)	B – W	Knock sensor	Idling (during inspection mode)	Pulse generation (See page 05–172)
IGF (E4–23) – E1 (E5–28)	B – BR	Ignition confirmation signal	Idling (inspection mode)	Pulse generation (See page 05–185)
A1A+ (E5–23) – E1 (E5–28)	G – BR	A/F sensor	Power switch ON (IG)	3.0 to 3.6
A1A– (E5–22) – E1 (E5–28)	R – BR	A/F sensor	Power switch ON (IG)	2.7 to 3.3
OX1B (E6–22) – E2 (E4–28)	Y – BR	Heated oxygen sensor	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
HA1A (E5–7) – E04 (E4–1)	Y – BR	A/F sensor heater	Idling (during inspection mode)	Below 3.0
HA1A (E5–7) – E04 (E4–1)	Y – BR	A/F sensor heater	Power switch ON (IG)	9 to 14
HT1B (E6–6) – E03 (E6–7)	G – BR	Heated oxygen sensor heater	Idling (during inspection mode)	Below 3.0
HT1B (E6–6) – E03 (E6–7)	G – BR	Heated oxygen sensor heater	Power switch ON (IG)	9 to 14
PTNK (E7–30) – E2 (E4–28)	Y – BR	Vapor pressure sensor	Power switch ON (IG)	2.9 to 3.7
PTNK (E7–30) – E2 (E4–28)	Y – BR	Vapor pressure sensor	Apply vacuum 4.0 kPa	Below 0.5
EVP1 (E5–14) – E1 (E5–28)	R – BR	EVAP VSV	Power switch ON (IG)	9 to 14
CCV (E7–13) – E1 (E5–28)	L – BR	CCV	Power switch ON (IG)	9 to 14
TBP (E7–18) – E1 (E5–28)	R – BR	Tank bypass VSV	Power switch ON (IG)	9 to 14
M+ (E5–6) – E1 (E5–28)	L – BR	Throttle actuator control motor	Idling (during inspection mode)	Pulse generation
M– (E5–5) – E1 (E5–28)	P – BR	Throttle actuator control motor	Idling (during inspection mode)	Pulse generation
OCV+ (E4–15) – OCV– (E4–14)	Y – W	Camshaft timing oil control	Power switch ON (IG)	Pulse generation (See page 05–63)
TAM (E7–21) – E2 (E4–28)	W – BR	Outside air temperature sensor	Ambient air temperature –40°C to 140°C (–40 to 284°F)	0.8 to 1.3
MOPS (E5–15) – E1 (E5–28)	Y – BR	Engine oil pressure	Power switch ON (IG), not engine running	9 to 14
WBAD (E7–20) – E1 (E5–28)	R – BR	Water valve position signal	Power switch ON (IG)	0.3 to 4.7
THW2 (E7–33) – E1 (E5–28)	W – BR	CHS tank outlet temperature sensor	Power switch ON (IG), Coolant temperature at 80°C	0.2 to 1.0
WSL1 (E7–24) – WSL2 (E7–23)	Y – V	Water valve motor	Changing valve position	Pulse generation
WPL (E7–15) – E1 (E5–28)	V – BR	CHS water pump	Pre–heat mode	0 to 2
FAN (E7–8) – E1 (E5–28)	LG – BR	Cooling fan relay	Power switch ON (IG), Engine coolant temperature less than 94.5°C	9 to 14
W (E6–18) – E1 (E5–28)	LG – BR	MIL	Idling (during inspection mode)	9 to 14
W (E6–18) – E1 (E5–28)	LG – BR	MIL	Power switch ON (IG)	Below 3.0
FC (E6–10) – E1 (E5–28)	G – BR	Fuel pump control	Power switch ON (IG)	9 to 14
FC (E6–10) – E1 (E5–28)	G – BR	Fuel pump control	Idling (during inspection mode)	Below 3.0
TC (E6–14) – E1 (E5–28)	P – BR	Terminal TC of DLC3	Power switch ON (IG)	9 to 14
NEO (E7–1) – E1 (E5–28)	LG – BR	Revolution signal	Idling (during inspection mode)	Pulse generation
GO (E7–2) – E1 (E5–28)	Y – BR	Revolution signal	Idling (during inspection mode)	Pulse generation

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Symbols (Terminals No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
CANH (E6–31) – E1 (E5–28)	B – BR	CAN communication line	Power switch ON (IG)	Pulse generation
CANL (E6–30) – E1 (E5–28)	W – BR	CAN communication line	Power switch ON (IG)	Pulse generation

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