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.

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:

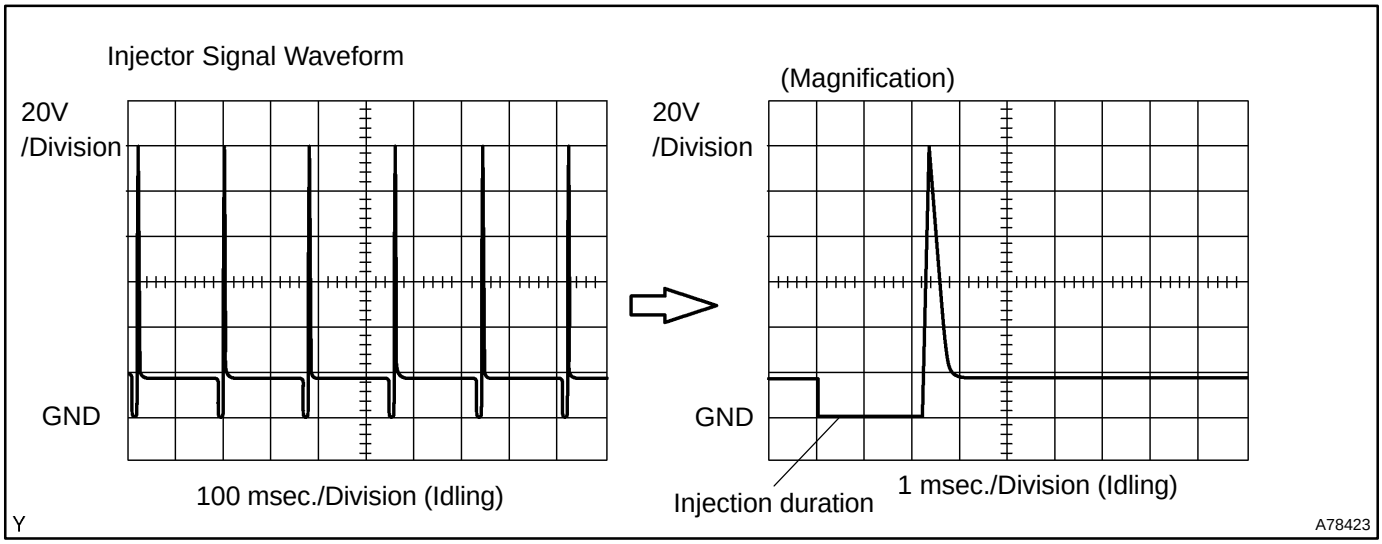
When several codes for a misfiring cylinder are recorded repeatedly but no random misfire code is recorded, it indicates that the misfires have been detected and recorded at different times.

Reference: Inspection using oscilloscope

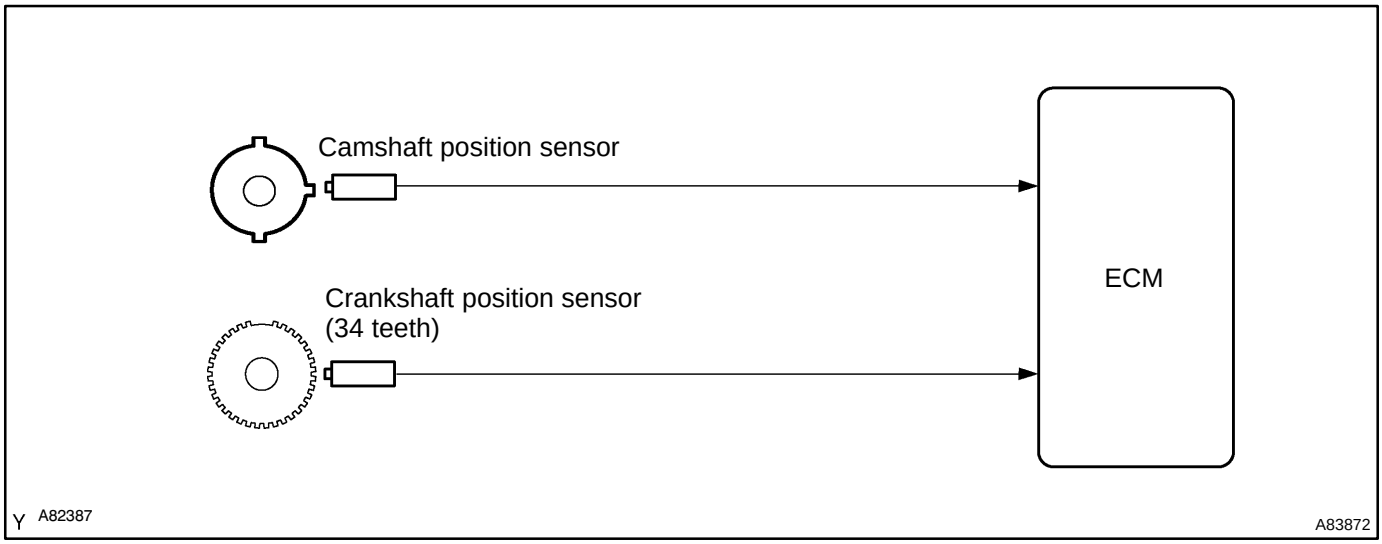
With the engine idling, check the waveform between terminals #10 to #40 and E01 of the ECM connectors.

HINT:

The correct waveform is as shown.



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

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:

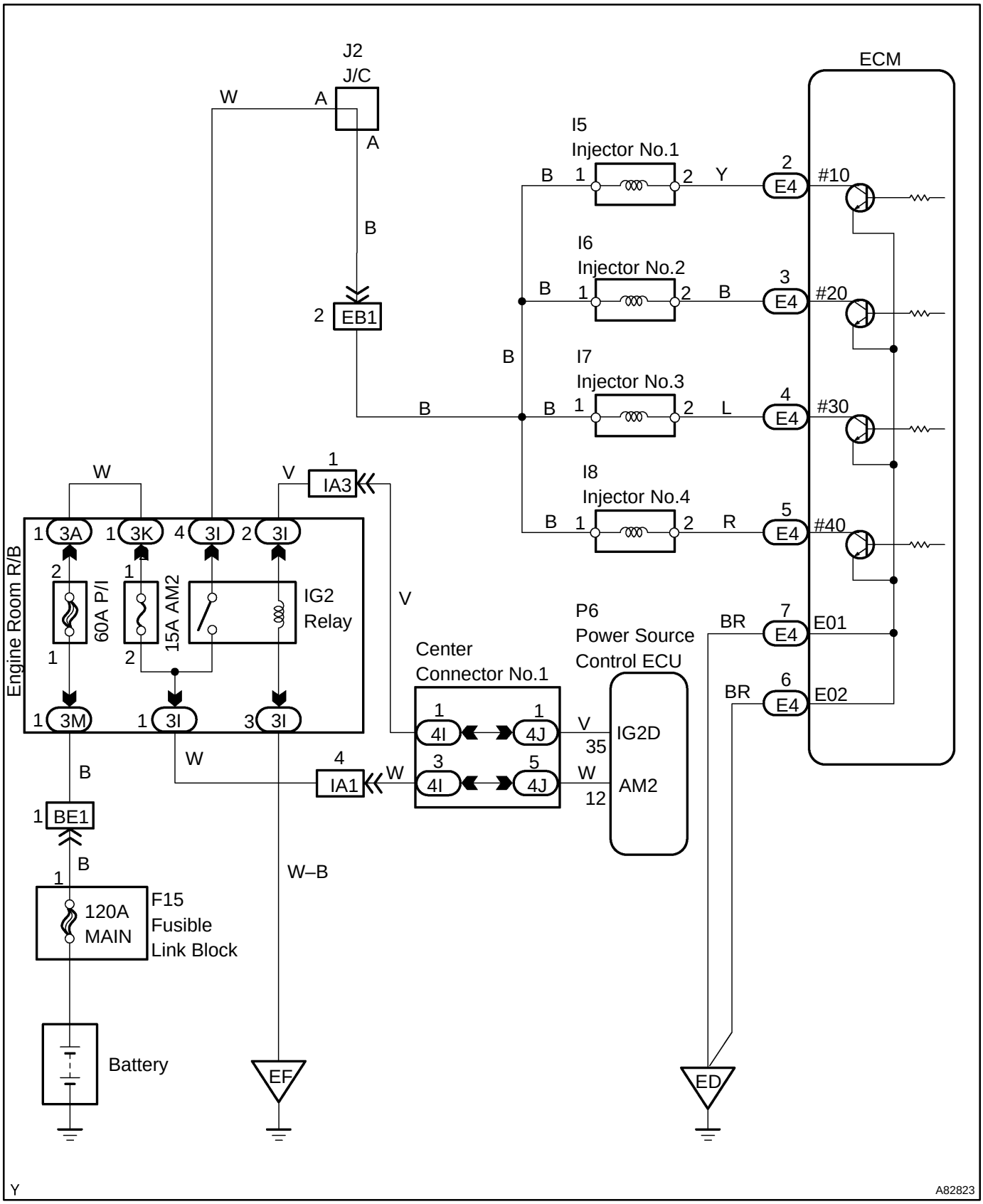
One of the following conditions is met	(a) or (b)
(a) Misfire rate when engine start at cold	2.0 % or more/1,000 revolutions
(b) Misfire rate when engine start at hot	5.0 % or more/1,000 revolutions

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

WIRING DIAGRAM

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



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.

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

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.

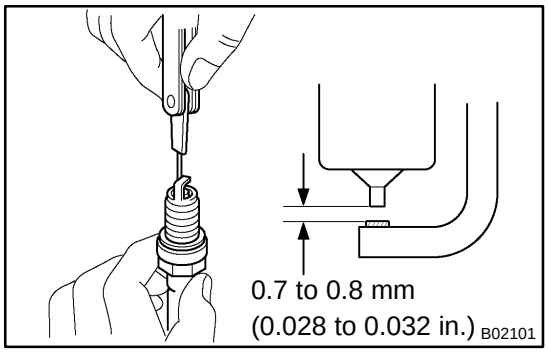
Result:

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

B → **Go to step 15**

A

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.

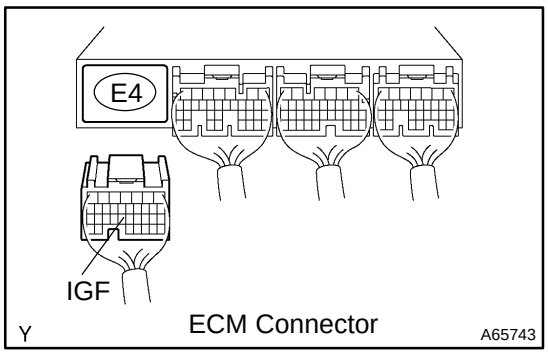
(1) Install the spark plug to the ignition coil No.1, and connect the ignition coil No.1 connector.
(2) Disconnect the injector connector.
(3) Ground the spark plug.
(4) Check if spark occurs while the engine is being cranked.

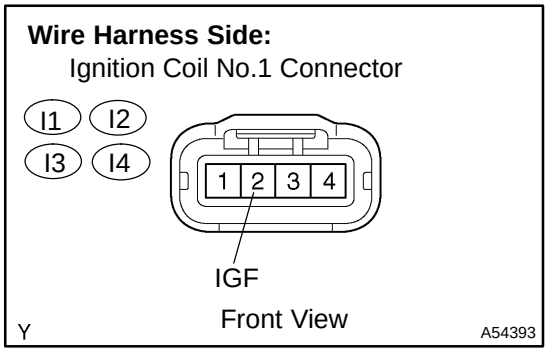
OK: Spark jumps across electrode gap.

OK → **REPLACE SPARK PLUG**

NG

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.

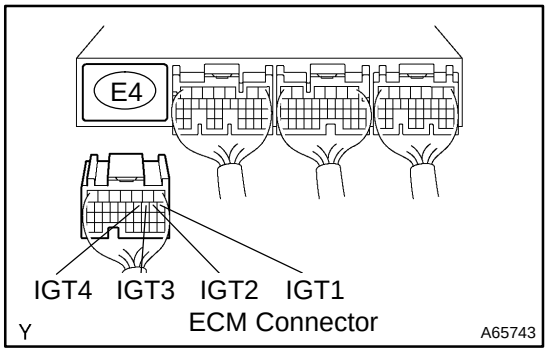
Standard (Check for open):

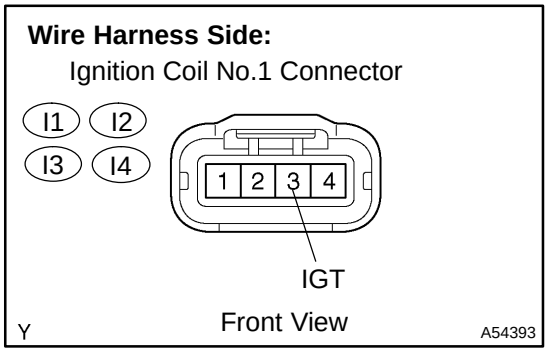
Tester Connection	Specified Condition
IGF (I1–2) – IGF (E4–23)	Below 1 Ω
IGF (I2–2) – IGF (E4–23)	Below 1 Ω
IGF (I3–2) – IGF (E4–23)	Below 1 Ω
IGF (I4–2) – IGF (E4–23)	Below 1 Ω

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

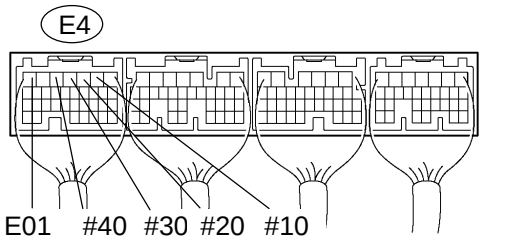
  (4) Reconnect the ignition coil No.1 connector.
  (5) Reconnect the ECM connector.

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

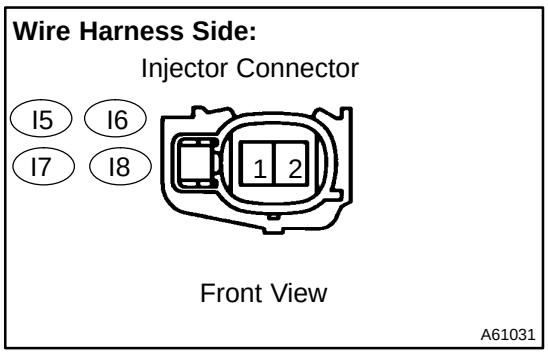
NG

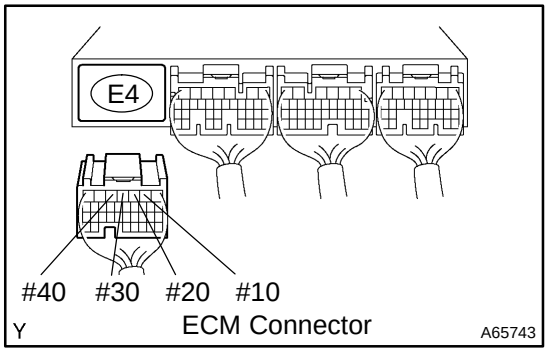
9 INSPECT FUEL INJECTOR RESISTANCE OF MISFIRING CYLINDER (See page 11–9)

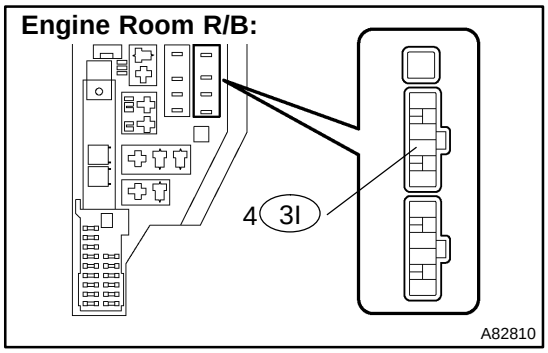
NG	REPLACE FUEL INJECTOR ASSY (See page 11–12)

OK

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

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

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.

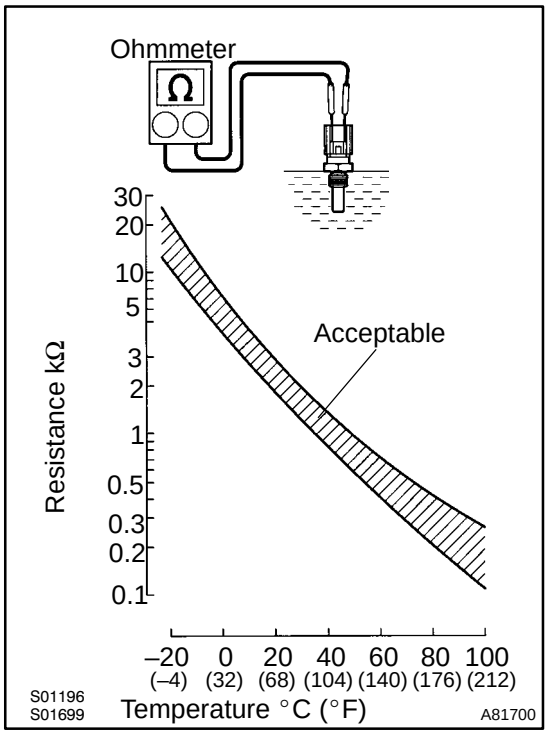
  Standard:

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

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)