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

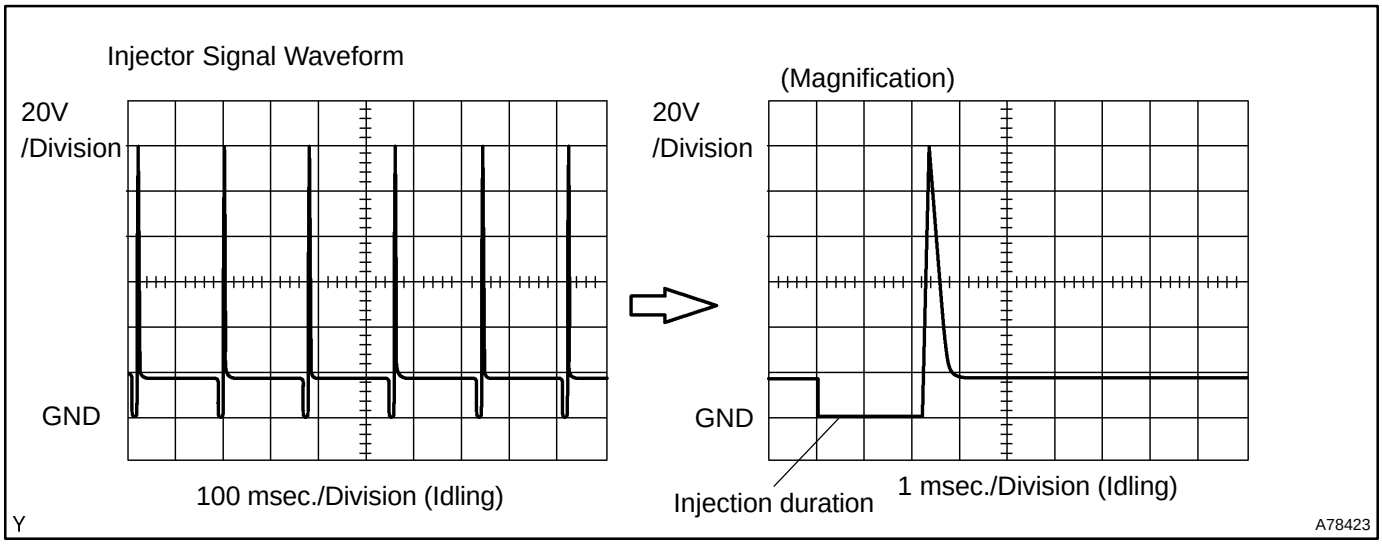
When a misfire occurs in the engine, hydrocarbons (HC) enter the exhaust in high concentrations. If this HC concentration is high enough, there could be an increase in exhaust emissions levels. High concentrations of HC passing through the catalyst also cause to temperature of the catalyst to increase, 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.
The ECM illuminates the MIL if the misfiring rate exceeds a threshold value and could cause emissions deterioration.

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 to blink 2 trip detection logic: MIL to light up	• Open or short in engine wire • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass air flow sensor • 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)	

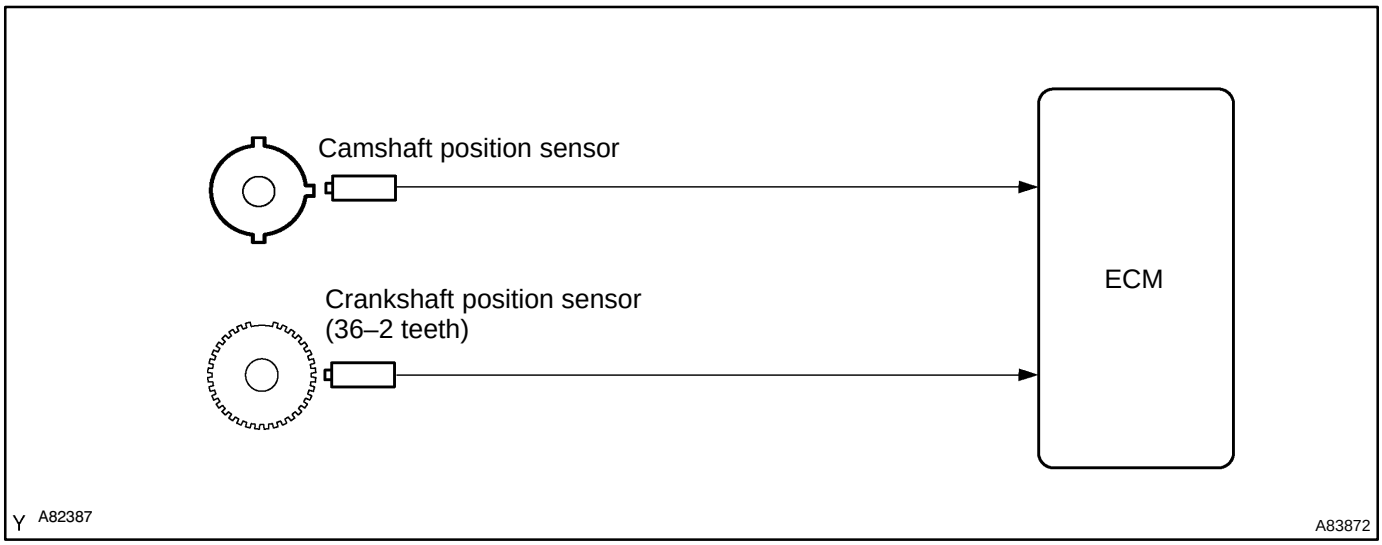
HINT:
When codes for a misfiring cylinder are recorded repeatedly but no random misfire code is recorded, it indicates that the misfires have been detected and recorded at different times.

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 if the misfiring rate exceeds a threshold value and could cause emissions deterioration.
The ECM will illuminate the MIL when the percent misfire exceeds the specified limit per 1,000 engine revolutions. One occurrence of excessive misfire during engine start will set the MIL. Four occurrences are required to set the MIL 1,000 revolutions after engine start.
(2 trip detection logic)
The MIL blinks when ”percent misfire causing catalyst damage” per 200 revolution is met 3 times (1 time if the engine rpm is in high speed range).
(MIL blinks immediately)

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 sensors	Camshaft position sensor, crankshaft position sensor
	Related sensors	Engine coolant temperature sensor, intake air temperature sensor, throttle position sensor
Frequency of operation	Continuous	
Duration	Every 1,000 revolutions (soon after engine is started: 1 time, other 4 times) (emission related misfire) Every 200 revolutions (1 or 3 times) (catalyst deteriorating misfire)	
MIL operation	2 driving cycles MIL ON Immediate MIL blinking (Catalyst deteriorating misfire)	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

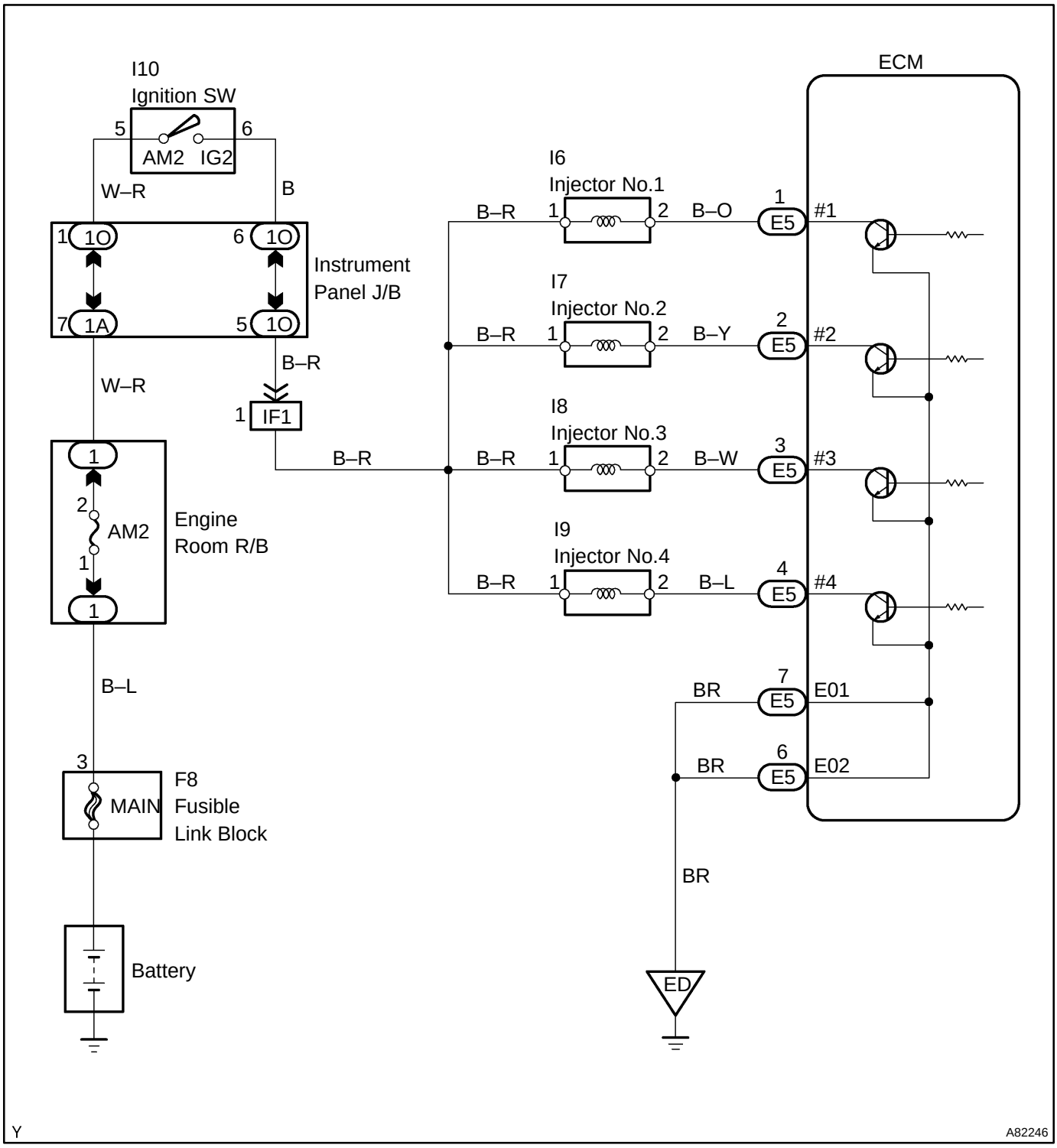
Item	Specification	
	Minimum	Maximum
The monitor will run whenever the following DTCs are not present	See ”List of Disable a Monitor” table (On page 05–24)	
Battery voltage	8 V	–
VVT	Normal operation (i. e. not under scan–tool control)	
Engine speed fluctuation	Engine speed should not have changed rapidly	
Engine speed (Two full revolutions (2 rev.) after engine has started)	450 rpm	6,600 rpm
Engine coolant temperature	–10°C (14°F)	–
Intake air temperature	–10°C (14°F)	–
Intake air amount per revolution (varies with engine speed)	0.117 g/rev (A/T) 0.109 g/rev (M/T)	–
Throttle position learning	Completed	
Throttle position	Rapid throttle opening or closing operation has not occurred	
	–	Changing value of throttle position < 0.5 °/0.008 sec
Transient spark retard (The spark timing delay control in a short time for preventing surge at the time of a sudden acceleration.)	Not commanded	
Rough road counter	–	10 times/1,000 revolutions (not running on rough road)

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
Emission related misfire rate: 1. During the first 1,000 revolutions after engine start (1 time will set MIL) 2. After the first 1,000 revolutions have occurred (4 times will set MIL)	1.63 %/1,000 revolution
Catalyst damage misfire count: 1. Low engine rpm area (ex. less than 3,800 rpm): 200 rev. (3 times to set MIL) 2. High engine rpm area: Every 200 revolutions	74 count/200 revolution (threshold varies with engine speed, intake air amount per revolution)

WIRING DIAGRAM

Refer to DTC P0351 on page 05–165 for the wiring diagram of the ignition system.



CONFIRMATION DRIVING PATTERN

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Record DTC and the freeze frame data.
(c) Use the hand–held tester to set the check mode (See page 05–11).
(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 the engine speed, load and its surrounding range shown with ENGINE SPD, CALC LOAD in the freeze frame data or MISFIRE RPM, MISFIRE LOAD in the DATA LIST.

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

HINT:

In order to memorize the DTC of misfire, it is necessary to drive around MISFIRE RPM, MISFIRE LOAD in the DATA LIST for the following period of time. Take care not to turn the ignition switch OFF. Turning the ignition switch OFF switches the diagnosis system from check mode to normal mode. So all DTCs, etc., are erased.

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

(f) Check whether there is misfire or not by monitoring DTC and the freeze frame data. After that, record them.
(g) Turn the ignition switch OFF and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- If DTCs besides misfire are memorized simultaneously, first perform the troubleshooting for them.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.
- If the misfire does not occur when the vehicle is brought to the workshop, the misfire can be confirmed by reproducing the condition of the freeze frame data. Also, after finishing the repair, confirm that there is no misfire (See confirmation driving pattern).
- When either of SHORT FT #1 or 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, the use of improper fuel, a stain on the ignition plug, etc.
- Be sure to check the value on the misfire counter after the repair.

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

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester or the OBD II scan tool main switch ON.
(c) Select the item ”DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES”.
(d) Read the DTCs using the hand–held tester or the OBD II scan tool.

Result:

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

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

B → **GO TO RELEVANT DTC CHART (See page 05–34)**

A

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

(a) Check the connection conditions of the wire harness and connector.
(b) Check the vacuum hose piping for disconnection or breaks.

NG → **REPAIR OR REPLACE, THEN CONFIRM THAT THERE IS NO MISFIRE**

OK

3	CHECK CONNECTION OF PCV HOSE

NG → **REPAIR OR REPLACE PCV HOSE**

OK

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

(a) Connect the hand–held tester or the OBD II scan tool to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester or the OBD II scan tool main switch ON.
(c) Start the engine.
(d) Select the item ”DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / CYL#1 – CYL#4”.
(e) Read the number of misfire 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.

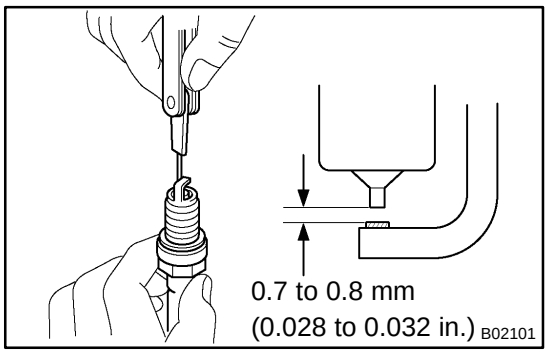
Result:

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 assy.
(b) Remove the spark plug.
(c) Check the spark plug type.
Recommended spark plug:

DENSO made	K16R–U
NGK made	BKR5EYA

(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 a 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, and connect the ignition coil connector.
(2) Disconnect the injector connector.
(3) Ground the spark plug.
(4) Check if spark occurs while the engine is being cranked.

Standard: Spark jumps across electrode gap.

(g) Reinstall the spark plug.
(h) Reinstall the ignition coil assy.

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.

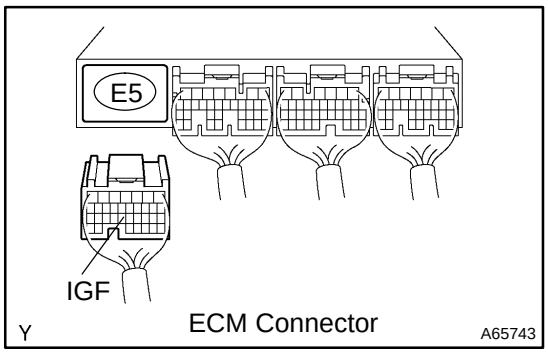
(1) Install the spark plug to the ignition coil, and connect the ignition coil connector.
(2) Disconnect the injector connector.
(3) Ground the spark plug.
(4) Check if spark occurs while the engine is being cranked.

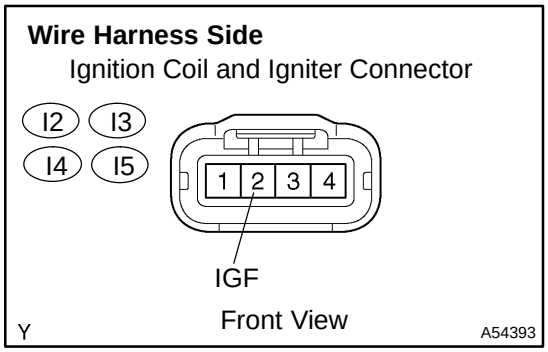
Standard: Spark jumps across electrode gap.

OK → **REPLACE SPARK PLUG**

NG

7	CHECK HARNESS AND CONNECTOR OF MISFIRING CYLINDER(IGNITION COIL – ECM)





(a) Check the harness and connector between the ignition coil and ECM (IGF terminal) connectors
(1) Disconnect the I2, I3, I4 or I5 ignition coil and igniter connector.
(2) Disconnect the ECM E5 connector.
(3) Measure the resistance between the wire harness side connectors.

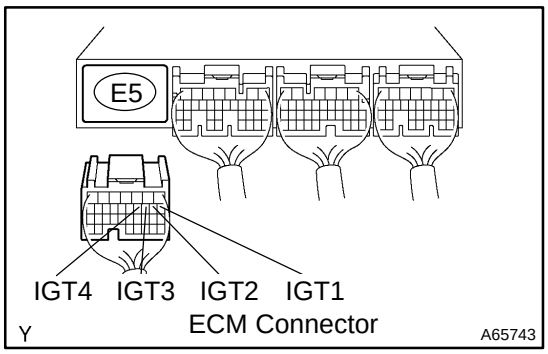
Standard (Check for open):

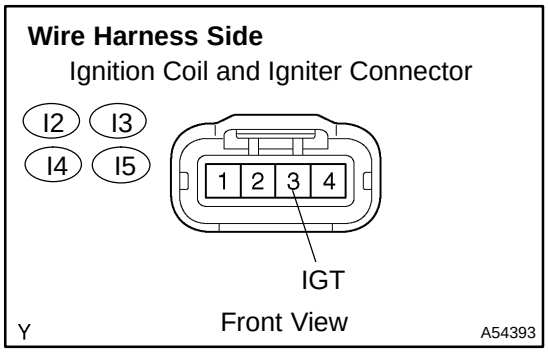
Tester Connection	Specified Condition
IGF (I2–2) – IGF (E5–23)	Below 1 Ω
IGF (I3–2) – IGF (E5–23)	
IGF (I4–2) – IGF (E5–23)	
IGF (I5–2) – IGF (E5–23)	

Standard (Check for short):

Tester Connection	Specified Condition
IGF (I2–2) or IGF (E5–23) – Body ground	10 kΩ or higher
IGF (I3–2) or IGF (E5–23) – Body ground	
IGF (I4–2) or IGF (E5–23) – Body ground	
IGF (I5–2) or IGF (E5–23) – Body ground	

(4) Reconnect the ignition coil and igniter connector.
(5) Reconnect the ECM connector.





(b) Check the harness and connector between the ignition coil and ECM (IGT terminal) connectors
(1) Disconnect the I2, I3, I4 or I5 ignition coil and igniter connector.
(2) Disconnect the ECM E5 connector.
(3) Measure the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
IGT (I2–3) – IGT1 (E5–8)	Below 1 Ω
IGT (I3–3) – IGT2 (E5–9)	
IGT (I4–3) – IGT3 (E5–10)	
IGT (I5–3) – IGT4 (E5–11)	

Standard (Check for short):

Tester Connection	Specified Condition
IGT (I2–3) or IGT1 (E5–8) – Body ground	10 kΩ or higher
IGT (I3–3) or IGT2 (E5–9) – Body ground	
IGT (I4–3) or IGT3 (E5–10) – Body ground	
IGT (I5–3) or IGT4 (E5–11) – Body ground	

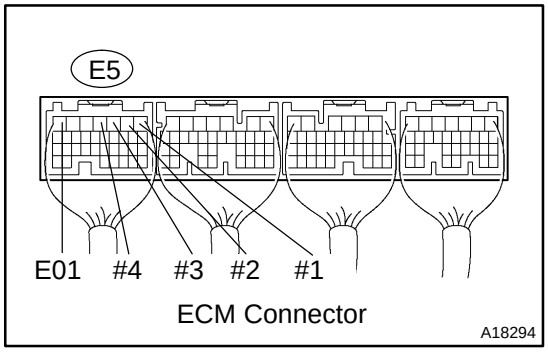
(4) Reconnect the ignition coil and igniter connector.
(5) Reconnect the ECM connector.

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 ignition switch ON.
(b) Measure the voltage between the applicable terminals of the E5 ECM connector.

Standard:

Tester Connection	Specified Condition
#1 (E5–1) – E01 (E5–7)	9 to 14 V
#2 (E5–2) – E01 (E5–7)	
#3 (E5–3) – E01 (E5–7)	
#4 (E5–4) – E01 (E5–7)	

OK → **Go to step 11**

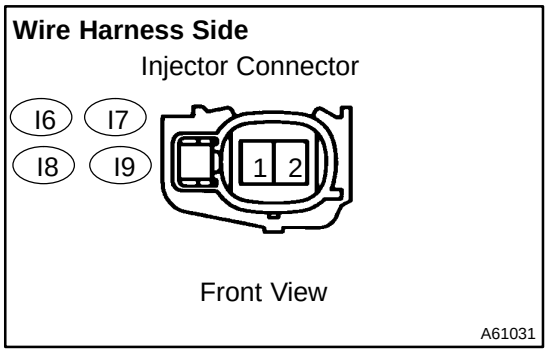
NG

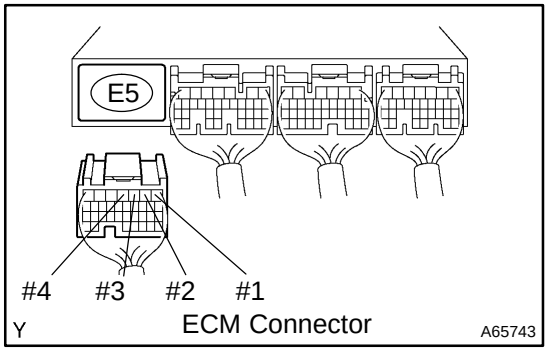
9	INSPECT FUEL INJECTOR RESISTANCE OF MISFIRING CYLINDER (See page 11–7)

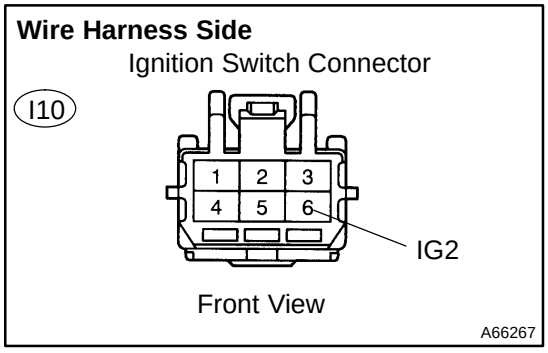
NG → REPLACE FUEL INJECTOR ASSY (See page 11–10)

OK

10	CHECK HARNESS AND CONNECTOR OF MISFIRING CYLINDER(INJECTOR – ECM, INJECTOR – IGNITION SWITCH)







(a) Check the harness and connector between the injector connector and ECM connector.
(1) Disconnect the I6, I7, I8 or I9 injector connector.
(2) Disconnect the E5 ECM connector.
(3) Measure the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Injector (I6–2) – #1 (E5–1)	Below 1 Ω
Injector (I7–2) – #2 (E5–2)	
Injector (I8–2) – #3 (E5–3)	
Injector (I9–2) – #4 (E5–4)	

Standard (Check for short):

Tester Connection	Specified Condition
Injector (I6–2) or #1 (E5–1) – Body ground	10 kΩ or higher
Injector (I7–2) or #2 (E5–2) – Body ground	
Injector (I8–2) or #3 (E5–3) – Body ground	
Injector (I9–2) or #4 (E5–4) – Body ground	

(4) Reconnect the injector connector.
(5) Reconnect the ECM connector.

(b) Check the harness and connector between the injector connector and ignition switch connector.
(1) Disconnect the I6, I7, I8 or I9 injector connector.
(2) Disconnect the I10 ignition switch connector.
(3) Measure the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
Injector (I6–1) – IG2 (I10–6)	Below 1 Ω
Injector (I7–1) – IG2 (I10–6)	
Injector (I8–1) – IG2 (I10–6)	
Injector (I9–1) – IG2 (I10–6)	

Standard (Check for short):

Tester Connection	Specified Condition
Injector (I6–1) or IG2 (I10–6) – Body ground	10 kΩ or higher
Injector (I7–1) or IG2 (I10–6) – Body ground	
Injector (I8–1) or IG2 (I10–6) – Body ground	
Injector (I9–1) or IG2 (I10–6) – Body ground	

(4) Reconnect the injector connector.

(5) Reconnect the ignition switch connector.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

11	INSPECT FUEL INJECTOR INJECTION AND VOLUME OF MISFIRING CYLINDER (See page 11–7)

NG → REPLACE FUEL INJECTOR ASSY

OK

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

NG → REPAIR OR REPLACE

OK

13	CHECK VALVE CLEARANCE OF MISFIRING CYLINDER (See page 14–7)

NG → ADJUST VALVE CLEARANCE (See page 14–7)

OK

14	SWITCH STEP BY NUMBER OF MISFIRE CYLINDER(REFER 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 05–41)

A

15	CHECK VALVE TIMING(CHECK FOR LOOSENESSOR A JUMPED TOOTH OF THE TIMING CHAIN) (See page 14–68)

NG → ADJUST VALVE TIMING (See page 14–68) (REPAIR OR REPLACE TIMING CHAIN)

OK

16	CHECK FUEL PRESSURE (See page 11–4)

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 ignition switch ON.
(c) Check the intake air temperature.
  (1) Select the item ”DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR” and read its value displayed on the hand–held tester or the OBD II scan tool.

  Temperature: Equivalent to ambient temperature
(d) Check the air flow rate.
  (1) Select the item ”DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / MAF” and read its value displayed on the hand–held tester or the OBD II scan tool.

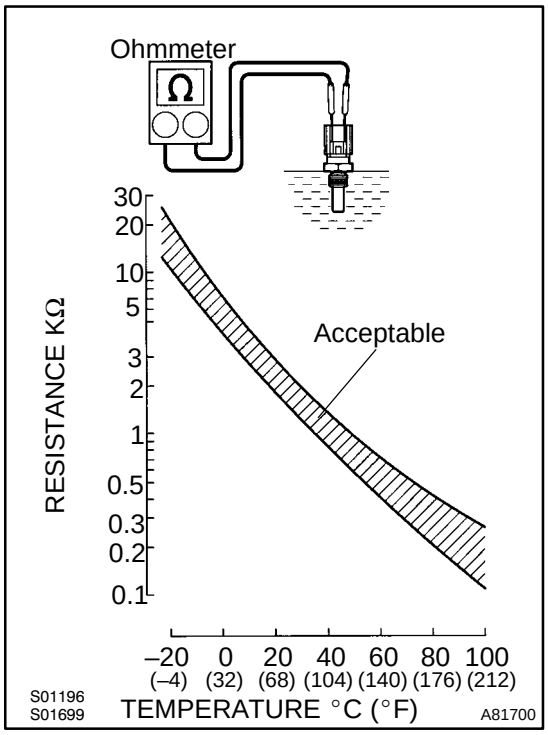
  Standard:

Condition	Air flow rate (gm/s)
Ignition switch On (do not start engine)	0
Idling	3.2 to 4.7
Running without load (2,500 rpm)	13.1 to 18.9
From idling to quick accelerating	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.

Resistance:

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

NOTICE:

In case of checking the engine coolant temperature sensor in water, be careful not to allow water to go into 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 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 05–41)