DTC	P0300	Random / Multiple Cylinder Misfire Detected

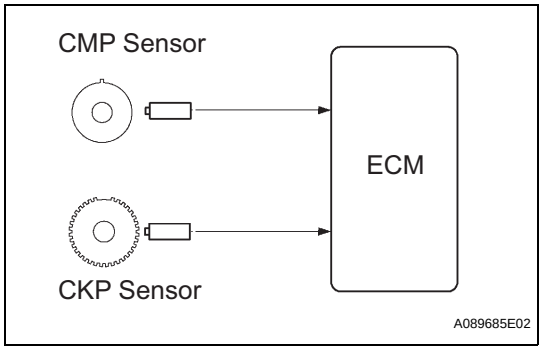
DTC	P0301	Cylinder 1 Misfire Detected

DTC	P0302	Cylinder 2 Misfire Detected

DTC	P0303	Cylinder 3 Misfire Detected

DTC	P0304	Cylinder 4 Misfire Detected

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent these increases in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire exceeds the threshold levels, and could cause emission deterioration, the ECM illuminates the MIL and sets a DTC.

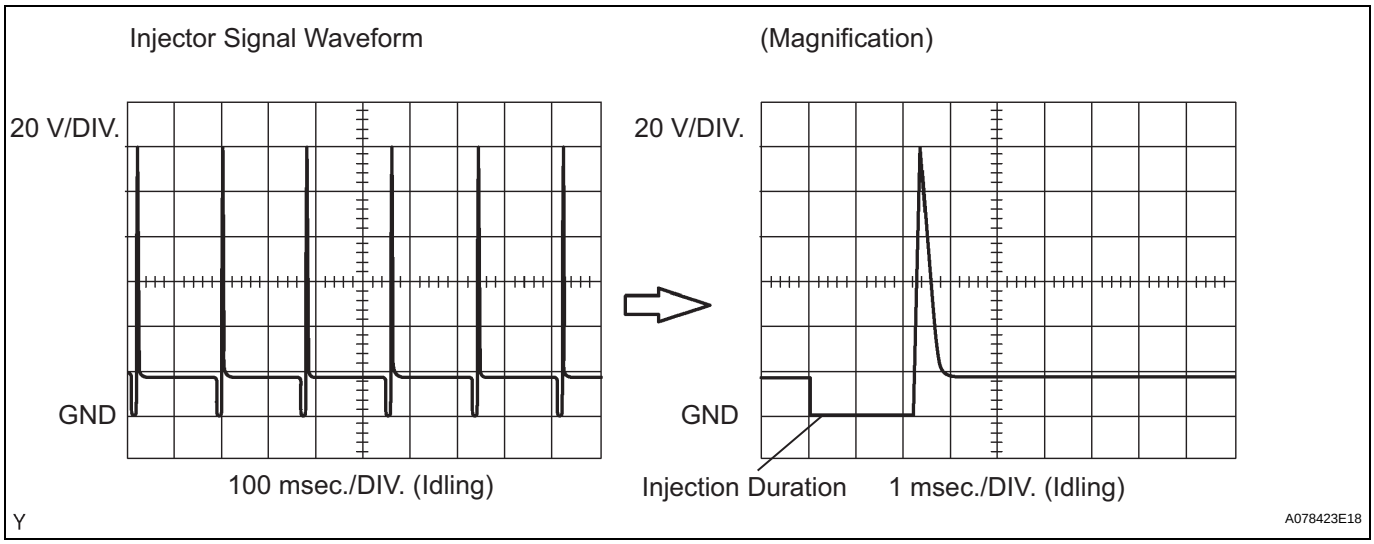
DTC No.	DTC Detection Condition	Trouble Area
P0300	Misfiring of random cylinders is detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connections • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve clearance • Valve timing • Ventilation hose connections • Ventilation valve and hose • ECM
P0301 P0302 P0303 P0304	Misfiring of each cylinder is detected (2 trip detection logic)	

HINT:
When the DTCs for misfiring cylinders are recorded repeatedly but no random misfire DTC is recorded, it indicates that the misfires have been set and recorded at different times. Random misfire codes are recorded only when several misfires occur at the same time.
Reference: Inspection using the oscilloscope

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

Item	Content
Terminals	#10 to #40 - E01
Equipment Settings	20 V/DIV., 100 or 1 ms/DIV.
Conditions	Idling

HINT:
The correct waveform is as shown.



MONITOR DESCRIPTION

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

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

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

- In every 200 crankshaft revolutions at a high engine rpm, the threshold misfiring percentage is recorded once.
- In every 200 crankshaft revolutions at a normal engine rpm, the threshold misfiring percentage is recorded 3 times.

MONITOR STRATEGY

Related DTCs	P0300: Multiple cylinder misfire P0301: No. 1 cylinder misfire P0302: No. 2 cylinder misfire P0303: No. 3 cylinder misfire P0304: No. 4 cylinder misfire
Required sensors/ components (Main)	Injector, Ignition coil, Spark plug
Required sensors / components (Related)	Crankshaft, Camshaft, Engine coolant temperature, Intake air temperature sensors and Mass air flow meter
Frequency of operation	Continuous
Duration	1,000 to 4,000 crankshaft revolutions: Emission related misfire 200 to 600 crankshaft revolutions: Catalyst damaged misfire
MIL operation	2 driving cycles: Emission related misfire MIL flashes immediately: Catalyst damage misfire

Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0123 (TP sensor) P0125 (insufficient ECT for closed loop) P0327 - P0328 (knock sensor) P0335 (crankshaft position sensor) P0340 (camshaft position sensor) P0500 (VSS)
Battery voltage	8 V or more
Engine RPM	450 rpm to 6,600 rpm
Both of following 1 and 2 met	-
1. Engine coolant temperature	-10°C (14°F) or more
2. Either of following conditions (a) or (b) met	-
(a) Engine coolant temperature at engine start	More than -7°C (19°F)
(b) Engine coolant temperature	More than 20°C (68°F)

Throttle position learning	Completed
VVT system	Not operated by scan tool
Fuel cut	OFF

Monitor period of emission-related misfire:

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

Monitor period of emission-related misfire:

Except above	Crankshaft 200 revolutions x 3
All of following conditions 1, 2 and 3 are met	Crankshaft 200 revolutions
1. Driving cycles	1st
2. Check Mode	OFF
3. RPM	Less that 3,800 revolutions

TYPICAL MALFUNCTION THRESHOLDS

P0301 to P0304:

With conditions of either emission related misfire or catalyst damaged misfire met, specific misfiring cylinder DTCs set when misfire counts of those cylinders exceed threshold	7 or more per 1,000 revolutions

Emission-related-misfire:

Misfire rate	1.63% or more

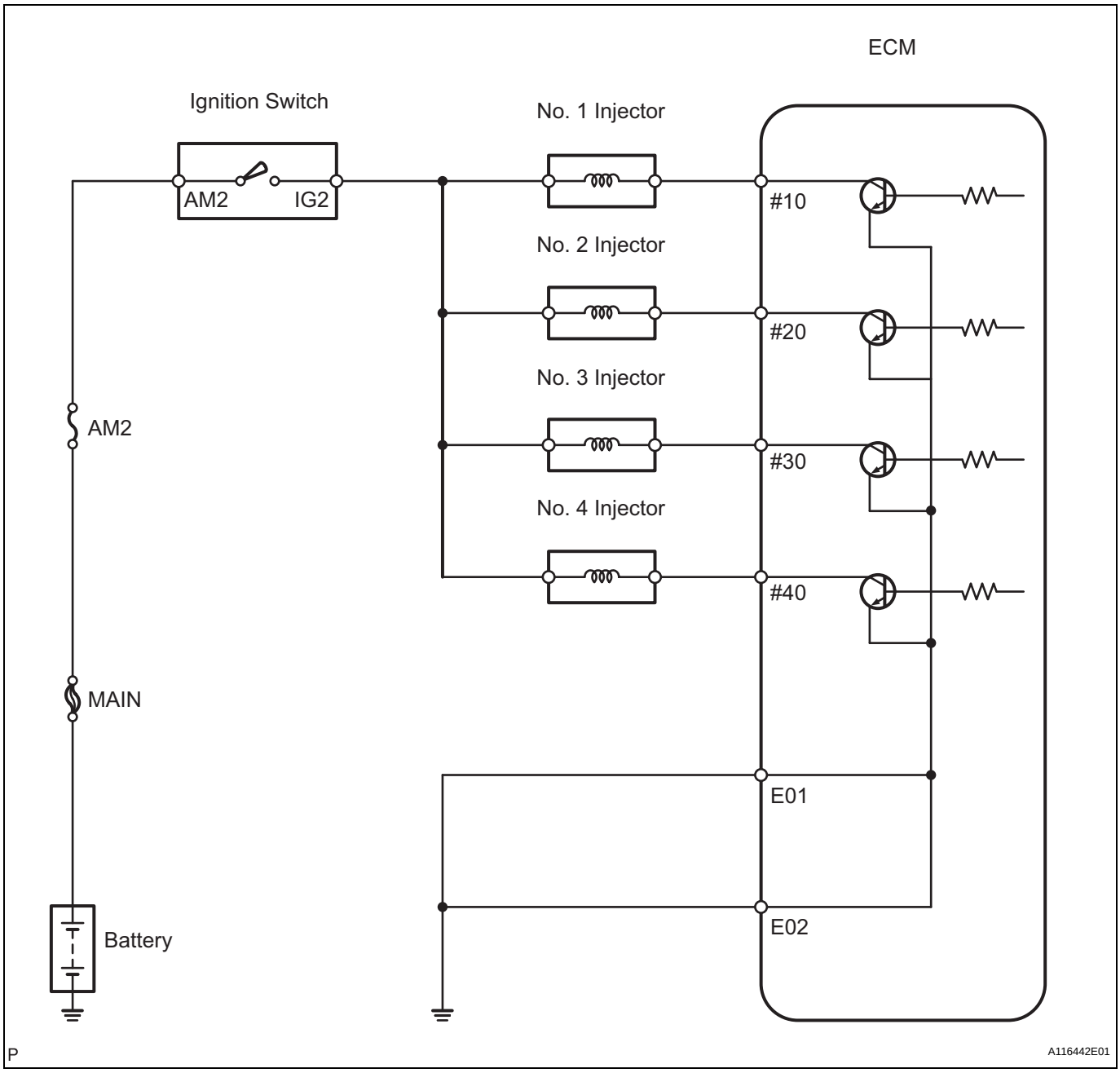
Catalyst-damage-misfire (MIL flashes immediately):

Misfire counts	136 or more* per 200 revolutions (at intake air amount: 0.3 g/rev and engine RPM: 1,600 rpm)

HINT:
*:The threshold value varies with the intake air amount and the engine RPM.

WIRING DIAGRAM

Refer to DTC P0351 (see page ES-188).



CONFIRMATION DRIVING PATTERN

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Record the DTC(s) and freeze frame data.
(d) Using the tester, switch the ECM from normal mode to check mode (see page ES-41).
(e) Read the misfire counts of each cylinder (CYL #1 to #4) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
(f) Drive the vehicle several times with the conditions, such as engine rpm and engine load, shown in MISFIRE RPM, MISFIRE LOAD in the DATA LIST.
HINT:
In order to store misfire DTCs, it is necessary to drive the vehicle for the period of time shown in the table below, with the MISFIRE RPM and MISFIRE LOAD in the DATA LIST.

Engine RPM	Duration
Idling	3.5 minutes or more

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

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

HINT:
- If any DTCs other than the misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.
- If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:
  (a) The in the fuel tank is low.
  (b) Improper fuel is used.
  (c) The ignition plugs have been contaminated.
  (d) The problem is complex.
- After finishing repairs, check the misfire counts of the cylinders (CYL #1, #2, #3 and #4).
- Be sure to confirm that no misfiring cylinder DTCs are set again by conducting the confirmation driving pattern after repairs.
- For 6 and 8 cylinder engines, the ECM intentionally does not set the specific misfiring cylinder DTCs at high engine RPM. If misfires occur only in high engine RPM areas, only DTC P0300 is set.
  In the event of DTC P0300 being present, perform the following operations:
  (a) Clear the DTC (see page ES-37).
  (b) Start the engine and conduct the confirmation driving pattern.
  (c) Read the misfiring rates of each cylinder or DTC(s) using the tester.
  (d) Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.
  (e) After finishing repairs, conduct the confirmation driving pattern again in order to verify that DTC P0300 is not set.
- When one of SHORT FT #1, LONG FT #1 in the freeze frame data is outside the range of +-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).
- When the COOLANT TEMP in the freeze frame data is less than 75°C (167°F), the misfires have occurred only while warming up the engine.

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read DTCs (see page ES-48).

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 DTCs besides P0300, P0301, P0302, P0303 and P0304 are output, perform troubleshooting for those DTCs first.

B → **GO TO DTC CHART**

A

ES

2 READ VALUE OF INTELLIGENT TESTER (MISFIRE RPM, MISFIRE LOAD)

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

NEXT

3 CHECK VENTILATION HOSE CONNECTIONS

OK:
Ventilation hose is connected correctly, and is not damaged.

NG → **REPAIR OR REPLACE VENTILATION HOSE**

OK

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTC (see page ES-37).
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1, #2, #3 and #4.
(e) Allow the engine to idle.
(f) Read each value of CYL #1 to #4 displayed on the tester. If no misfire counts occur in any cylinders, perform the following operations:
(1) Move the gear selector lever to the D position.
(2) Repeat steps (c) and (d) above.
(3) Check the CYL #1 to #4.

(4) If misfire counts are still not displayed, repeat (e) and then check the misfire counts again.

(g) Drive the vehicle with the MISFIRE RPM and MISFIRE LOAD noted in step 2.

(h) Read the CYL #1 to #4 or DTCs displayed on the tester.

Result

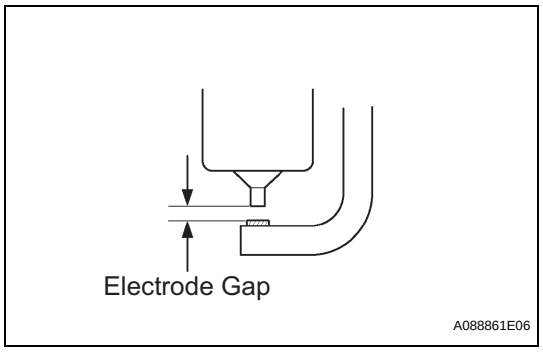
Misfire Count	Proceed to
1 or 2 cylinders have misfire counts	A
3 cylinders or more have misfire counts	B

B → **Go to step 13**

A

ES

5 CHECK SPARK PLUG



(a) Remove the No. 2 cylinder head cover (see page EM-40).

(b) Remove the ignition coil and the spark plug of misfire cylinder.

(c) Measure the spark plug electrode gap.

Standard gap:
0.7 to 0.8 mm (0.028 to 0.032 in.)
Maximum electrode gap:
1.16 mm (0.046 in.)

(d) Check the electrode for carbon deposits.

Recommended spark plug

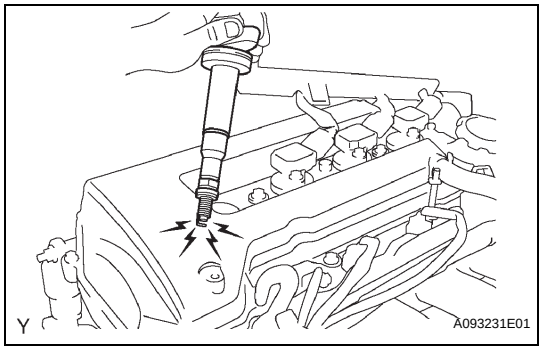
Manufacturer	Product
DENSO	K16R-U
NGK	BKR5EYA

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

NG → **REPLACE SPARK PLUG**

OK

6 CHECK SPARK AND IGNITION



(a) Disconnect the injector connectors to prevent the engine starting.

(b) Install the spark plug to the ignition coil.

(c) Attach the spark plug to the cylinder head cover.

(d) Crank the engine within 2 seconds and check the spark.

OK:
Spark jumps across electrode gap.

NG → **Go to step 8**

OK

7	CHECK CYLINDER COMPRESSION PRESSURE OF MISFIRING CYLINDER

(a) Measure the cylinder compression pressure of the misfiring cylinder.

OK → Go to step 9

NG

ES

REPAIR OR REPLACE MALFUNCTIONING PARTS

8	CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

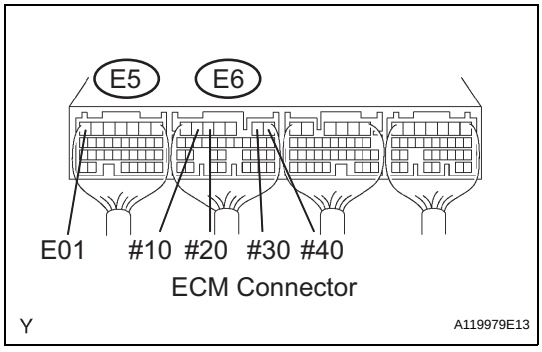
(a) Change to a normal spark plug.
(b) Perform a spark test.
CAUTION:
Always disconnect each injector connector.
NOTICE:
Do not crank the engine for more than 2 seconds.
(1) Install the spark plug to the ignition coil and connect the ignition coil connector.
(2) Disconnect the injector connector.
(3)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

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

OK

REPLACE SPARK PLUG

9	INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30 AND/OR #40 VOLTAGE)



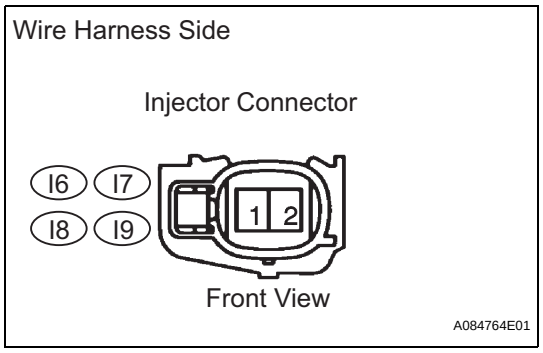
(a) Turn the ignition switch ON.
(b) Measure the voltage of the E5 and E6 ECM connectors.
Standard voltage

Tester Connection	Specified Condition
#10 (E6-6) - E01 (E5-7)	9 to 14 V
#20 (E6-5) - E01 (E5-7)	9 to 14 V
#30 (E6-2) - E01 (E5-7)	9 to 14 V
#40 (E6-1) - E01 (E5-7)	9 to 14 V

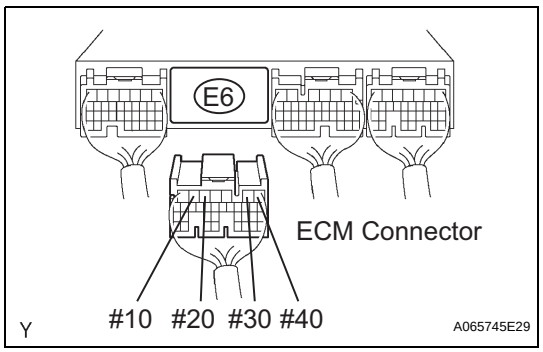
OK → Go to step 11

NG

10 CHECK HARNESS AND CONNECTOR (INJECTOR - ECM)



(a) Disconnect the injector connector (of the misfire cylinder).



(b) Disconnect the E6 ECM connector.
(c) Turn the ignition switch ON.
(d) Measure the resistance and voltage between the injector and the ECM connector terminals.

Standard voltage

Tester Connection	Specified Condition
I6-1 - Body ground	11 to 14 V
I7-1 - Body ground	11 to 14 V
I8-1 - Body ground	11 to 14 V
I9-1 - Body ground	11 to 14 V

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

Standard resistance

Cylinder	Tester Connection	Specified Condition
No. 1	I6-2 - Body ground	10 kΩ or higher
No. 1	I6-2 - #10 (E6-6)	Below 1 Ω
No. 2	I7-2 - Body ground	10 kΩ or higher
No. 2	I7-2 - #20 (E6-5)	Below 1 Ω
No. 3	I8-2 - Body ground	10 kΩ or higher
No. 3	I8-2 - #30 (E6-2)	Below 1 Ω
No. 4	I9-2 - Body ground	10 kΩ or higher
No. 4	I9-2 - #40 (E6-1)	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

11 CHECK FUEL INJECTOR OF MISFIRING CYLINDER

(a) Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor).

NG → REPLACE FUEL INJECTOR

OK

12	CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

NG → ADJUST VALVE CLEARANCE

OK

13	CHECK AIR INDUCTION SYSTEM

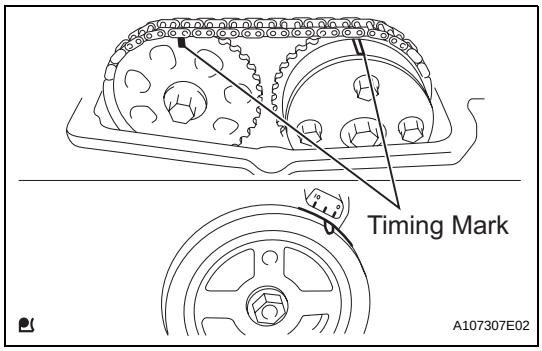
ES

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

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

14	CHECK VALVE TIMING



(a) Remove the cylinder head cover (see page EM-25).
(b) Turn the crankshaft pulley, then align its groove with the timing mark "0" of the timing chain cover.
(c) Check that both timing marks on the camshaft timing sprocket and camshaft timing gear are facing upward as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.
OK:
Timing marks on camshaft timing gears are aligned with timing chain cover surface.

NG → ADJUST VALVE TIMING

OK

15	CHECK FUEL PRESSURE

(a) Check the fuel pressure (see page FU-7).

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

OK

16	READ VALUE OF INTELLIGENT TESTER (COOLANT TEMP)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.

(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(d) Read the COOLANT TEMP twice when the engine is both cold and warmed up.
Standard:
With cold engine: Same as ambient air temperature.
With warm engine: 75°C to 95°C (167°F to 203°F).

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

17	READ VALUE OF INTELLIGENT TESTER (MAF)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF and COOLANT TEMP.
(d) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
(e) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.
Standard:
MAF while engine idling: Between 1.4 g/sec. and 2.3 g/sec. (shift position: N; A/C: OFF).
MAF at engine speed of 2,500 rpm: 5.4 g/sec. to 7.9 g/sec. (shift position: N; A/C: OFF).

NG → **REPLACE MASS AIR FLOW METER**

OK

CHECK FOR INTERMITTENT PROBLEMS