P0306

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
DTC P0305 CYLINDER 5 MISFIRE DETECTED
DTC P0306 CYLINDER 6 MISFIRE DETECTED

CIRCUIT DESCRIPTION

DTC Detection Conditions:

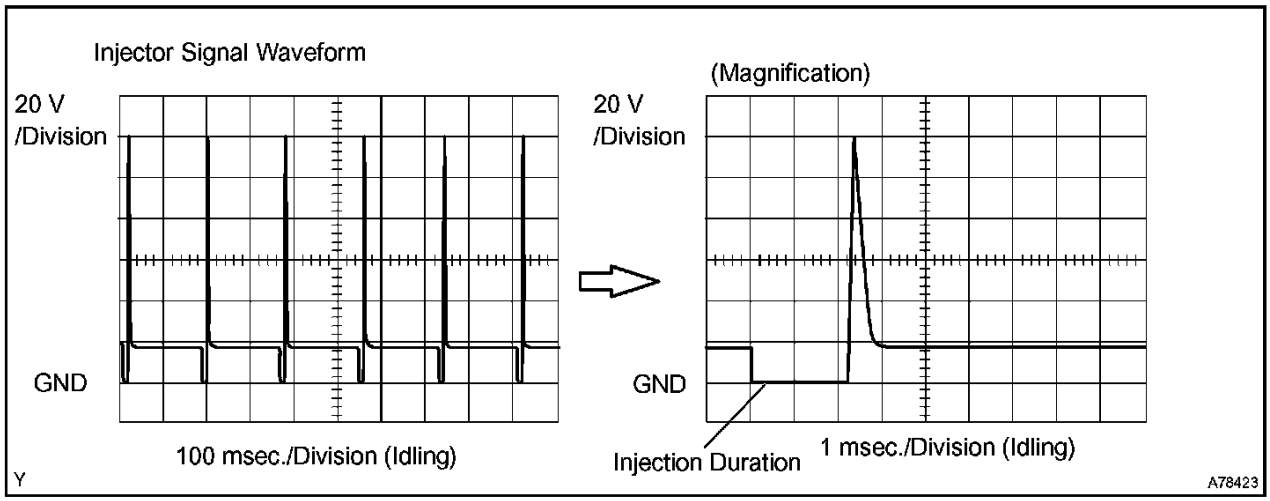
DTC No.	DTC Detection Conditions	Trouble Areas
P0300	Simultaneous misfiring of several cylinders detected (2 trip detection logic)	□Open or short in engine wire harness □Connector connection □Vacuum hose connection □Ignition system □Injector □Fuel pressure □Mass Air Flow (MAF) meter □Engine Coolant Temperature (ECT) sensor □Compression pressure □Valve clearance □Valve timing □PCV hose □PCV hose connection □Air induction system □ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder detected (2 trip detection logic)	□Open or short in engine wire harness □Connector connection □Vacuum hose connection □Ignition system □Injector □Fuel pressure □MAF meter □ECT sensor □Compression pressure □Valve clearance □Valve timing □PCV hose □PCV hose connection □Air induction system □ECM

When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increase 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 this increase 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.

HINT: When DTCs for misfiring cylinders are randomly set, but DTC P0300 is not set, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only set when several misfiring cylinders are detected at the same time.

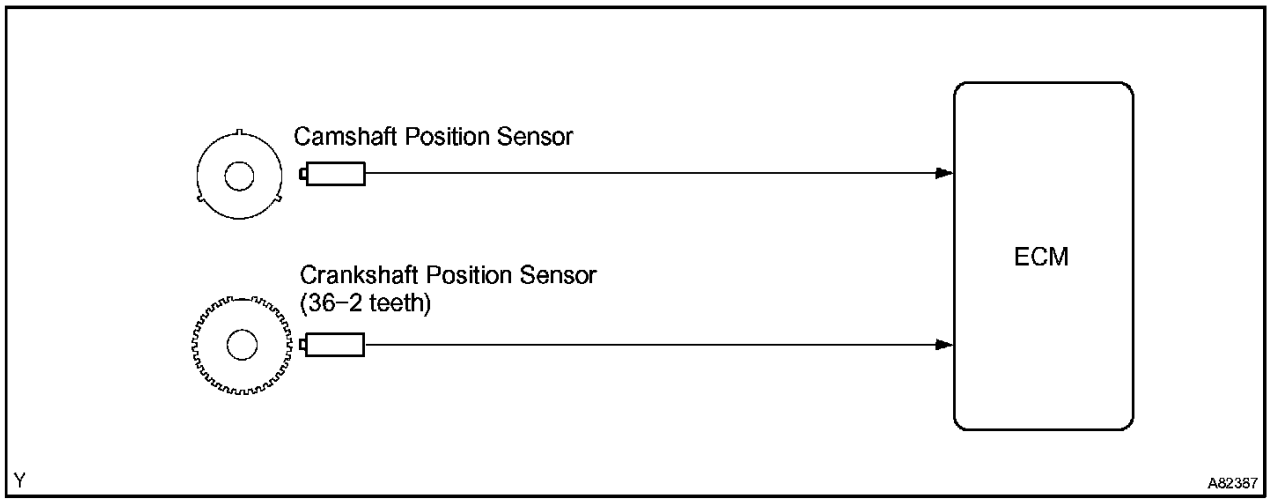
Items	Contents
Terminals	#10 to #60 – E01
Equipment Settings	20 V/Division, 100 or 1 ms/Division
Conditions	Idling



Reference: Inspection using an oscilloscope
With the engine idling, check the waveform between terminals #10 to #60 and E01 of the ECM connectors.

MONITOR DESCRIPTION

Monitor Description:



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 P0305: Cylinder 5 misfire detected P0306: Cylinder 6 misfire detected
Required sensors / components (Main)	Injector, Ignition coil, Spark plug
Required sensors / components (Related)	Crankshaft position sensor, Camshaft position sensor, ECT sensor, IAT sensor MAF meter
Frequency of operation	Continuous
Duration	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 cycle: emission−related misfire MIL flashes immediately: catalyst−damage misfire
Sequence operation	None

Typical Enabling Conditions:

The monitor will run whenever these DTCs are not present	See Monitors, Trips and/or Drive Cycle
Battery voltage	8 V or more
VVT system	Not operate by scan tool
Engine RPM	450 to 5,400 rpm (Automatic transmission)
Either of the following conditions is met:	Condition (a) or (b)
(a) Engine coolant temperature at engine start	More than −7℃ (19℉)
(b) Engine coolant temperature	More than 20℃ (68℉)
Fuel cut	OFF

Monitor period of emission−related−misfire:

First 1,000 revolutions after engine start, or check mode	Crankshaft 1,000 revolutions
Except above	Crankshaft 1,000 revolutions x 4

Monitor period of catalyst−damage−misfire (MIL blinks):

All of the following conditions 1, 2 and 3 are met	Crankshaft 200 revolutions
1. Driving cycle	1st
2. Check mode	OFF
3. Engine RPM	Less than 2,800 rpm
Except above	Crankshaft 200 revolutions x 3

Typical Malfunction Thresholds:

Monitor period of emission−related−misfire:

Misfire rate	2 % or more (Automatic transmission)

Monitor period of catalyst−damage−misfire (MIL blinks):

Number of misfire per 200 revolutions	77 or more (varies with intake air amount and RPM)
Paired cylinders misfire	Detected

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. Four occurrences are required to set the MIL 1,000 revolutions after engine start.

The ECM blinks the MIL (MIL blinks immediately) if:
- The threshold for percent of misfire causing catalyst damage is reached 1 time within 200 engine revolutions at a high engine rpm.
- The threshold for percent of misfire causing catalyst damage is reached 3 times within 200 engine revolutions at a normal engine rpm.

Monitor Result:

Refer for detailed information on Checking Monitor Status.

Misfire monitor – All cylinders

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$A1	$0B	Multiply by 1 [time]	Exponential Weighted Moving Average misfire counts for last 10 driving cycles – total	0	65535
$A1	$0C	Multiply by 1 [time]	Misfire counts for last and current driving cycles –total	0	65535

Misfire monitor – Cylinder 1

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$A2	$0B	Multiply by 1 [time]	Exponential Weighted Moving Average misfire counts for last 10 driving cycles – total	0	65535
$A2	$0C	Multiply by 1 [time]	Misfire counts for last and current driving cycles –total	0	65535

Misfire monitor – Cylinder 2

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$A3	$0B	Multiply by 1 [time]	Exponential Weighted Moving Average misfire counts for last 10 driving cycles – total	0	65535
$A3	$0C	Multiply by 1 [time]	Misfire counts for last and current driving cycles –total	0	65535

Misfire monitor – Cylinder 3

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$A4	$0B	Multiply by 1 [time]	Exponential Weighted Moving Average misfire counts for last 10 driving cycles – total	0	65535
$A4	$0C	Multiply by 1 [time]	Misfire counts for last and current driving cycles –total	0	65535

Misfire monitor – Cylinder 4

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$A5	$0B	Multiply by 1 [time]	Exponential Weighted Moving Average misfire counts for last 10 driving cycles – total	0	65535
$A5	$0C	Multiply by 1 [time]	Misfire counts for last and current driving cycles –total	0	65535

Misfire monitor – Cylinder 5

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$A6	$0B	Multiply by 1 [time]	Exponential Weighted Moving Average misfire counts for last 10 driving cycles – total	0	65535
$A6	$0C	Multiply by 1 [time]	Misfire counts for last and current driving cycles –total	0	65535

Misfire monitor – Cylinder 6

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$A7	$0B	Multiply by 1 [time]	Exponential Weighted Moving Average misfire counts for last 10 driving cycles – total	0	65535
$A7	$0C	Multiply by 1 [time]	Misfire counts for last and current driving cycles –total	0	65535

MONITOR RESULT

CONFIRMATION DRIVING PATTERN

Engine RPM	Duration
Idling	3.5 minutes or more
1,000	3 minutes or more
2,000	1.5 minutes or more
3,000	1 minute or more

a. Connect the hand-held tester to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Record the DTC(s) and freeze frame data.
e. Using the tester, switch the ECM from normal mode to check mode.
f. Read the misfire counts of each cylinder (CYL #1 to #6) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
g. Drive the vehicle several times with the conditions, such as engine rpm and engine load, shown in MISFIRE RPM and MISFIRE LOAD in the DATA LIST.

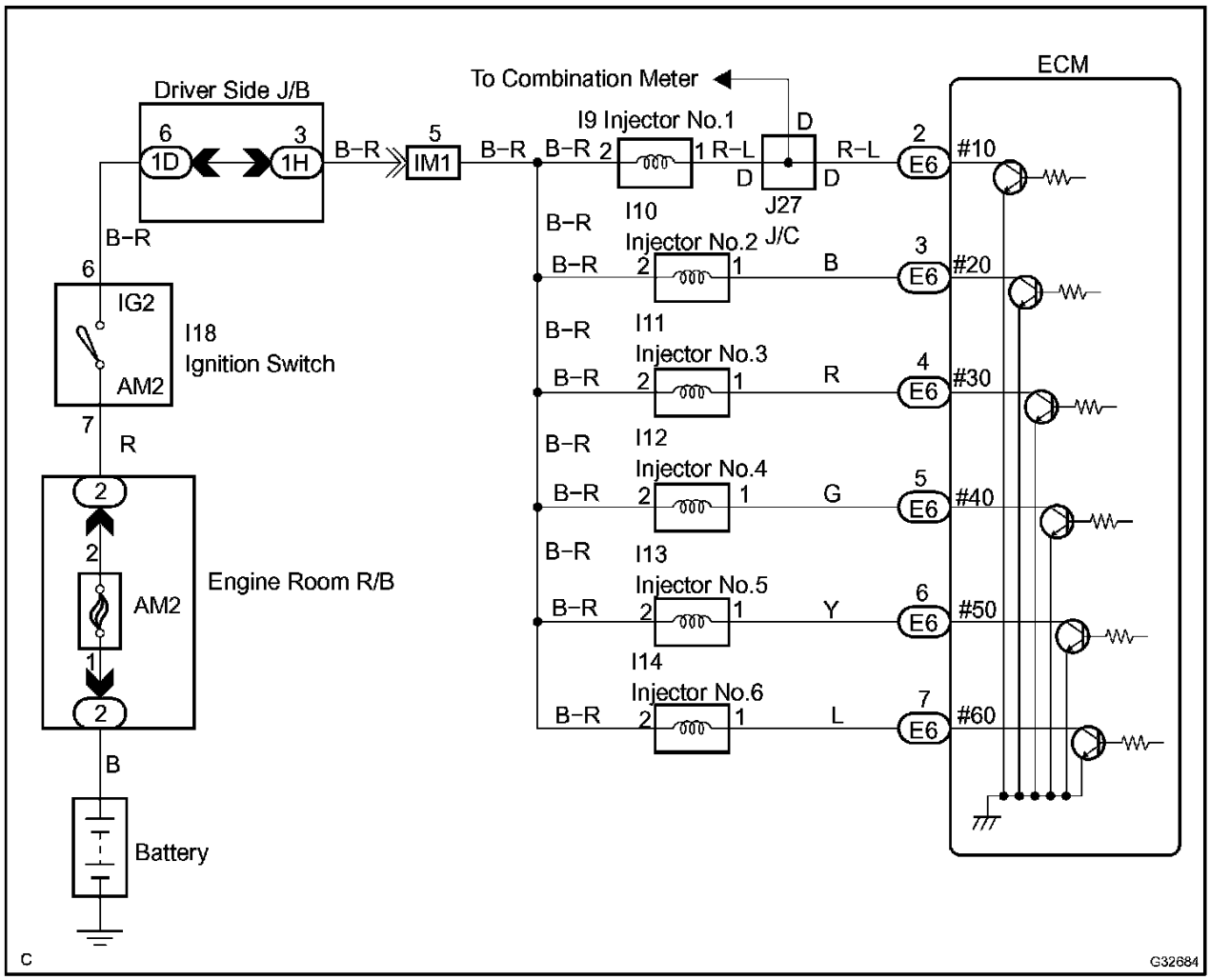
HINT: In order to store misfire DTCs, it is necessary to drive the vehicle for the period of time shown in the table below, with the MISFIRE RPM and MISFIRE LOAD in the DATA LIST.

h. Check whether misfires have occurred by checking DTCs and freeze frame data.

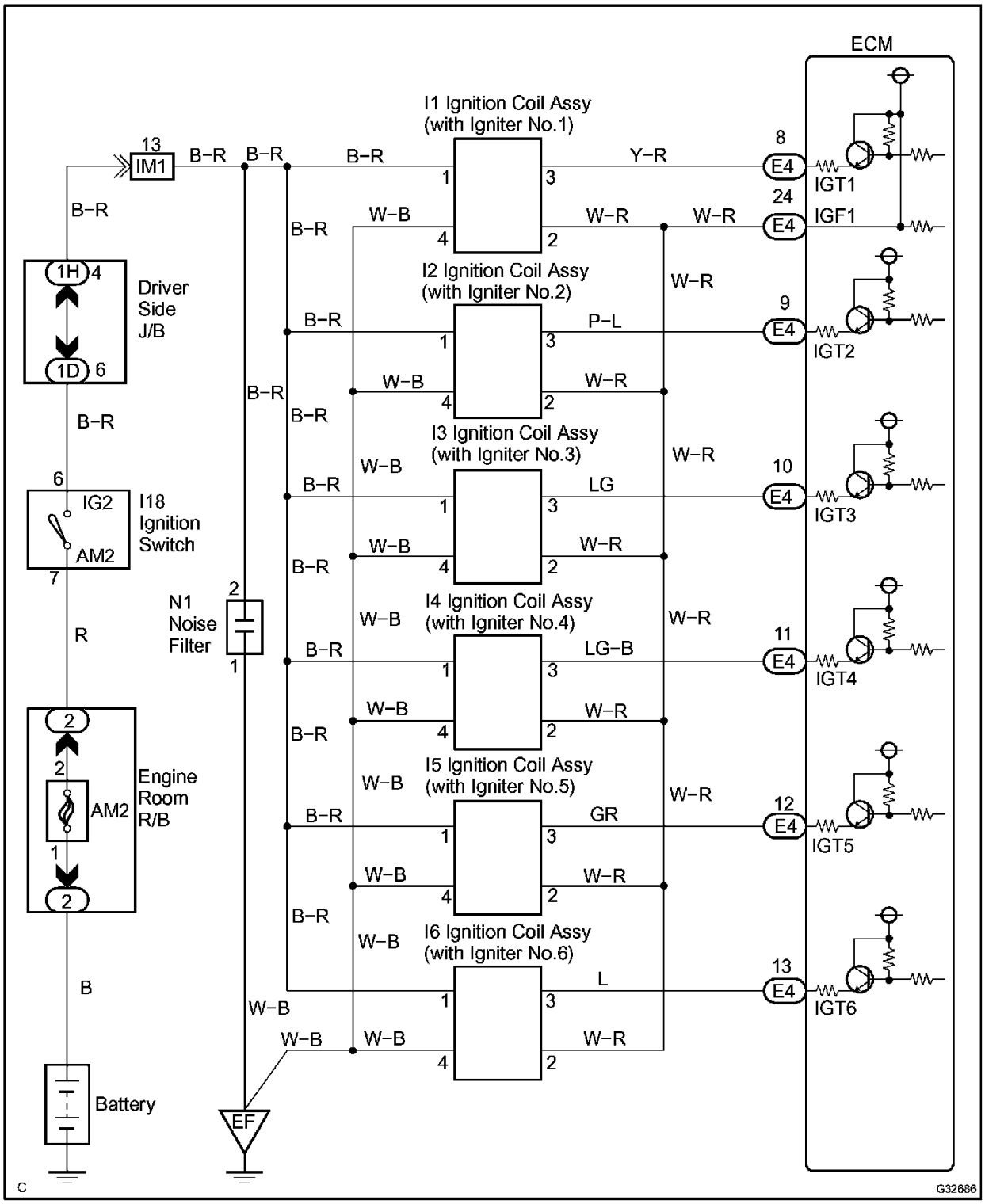
HINT: Do not turn the ignition switch to OFF until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be erased.

i. Record the DTC(s), freeze frame data and misfire counts.
j. Turn the ignition switch to OFF and wait for at least **5 seconds**.

Wiring Diagram:



Wiring Diagram:


ECM
I1 Ignition Coil Assy
(with Igniter No.1)
I2 Ignition Coil Assy
(with Igniter No.2)
I3 Ignition Coil Assy
(with Igniter No.3)
I4 Ignition Coil Assy
(with Igniter No.4)
I5 Ignition Coil Assy
(with Igniter No.5)
I6 Ignition Coil Assy
(with Igniter No.6)
13
IM1
B-R
B-R
B-R
Y-R
8
E4
IGT1
24
E4
IGF1
W-B
W-R
W-R
B-R
1H
4
Driver
Side
J/B
1D
6
B-R
9
E4
IGT2
P-L
W-R
W-B
B-R
6
IG2
I18
Ignition
Switch
AM2
7
10
E4
IGT3
LG
W-R
W-B
B-R
2
N1
Noise
Filter
1
R
11
E4
IGT4
LG-B
W-R
W-B
B-R
2
2
2
AM2
Engine
Room
R/B
1
2
12
E4
IGT5
GR
W-R
W-B
B-R
B
13
E4
IGT6
L
W-R
W-B
W-B
W-B
Battery
EF
C
G32686

Step 1:

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

(a) Connect the hand−held tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result:

Display (DTC Output)	Proceed To
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:
If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

Step 2-4:

2	READ VALUE USING HAND−HELD TESTER(MISFIRE RPM AND MISFIRE LOAD)

(a) Connect the hand−held tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / MISFIRE RPM and MISFIRE LOAD.
(d) Read and note the MISFIRE RPM and MISFIRE LOAD (engine load) values.

HINT:
The MISFIRE RPM and MISFIRE LOAD indicate the vehicle conditions under which the misfire occurred.

NEXT

3	CHECK PCV HOSE CONNECTIONS

OK: PCV hose is connected correctly and is not damaged.

NG → REPAIR OR REPLACE PCV HOSE

OK

4	CHECK MISFIRE COUNT(CYL #1, #2, #3, #4, #5 AND #6)

(a) Connect the hand−held tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Clear DTCs.
(e) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1, #2, #3, #4, #5 and #6.
(f) Allow the engine to idle.
(g) Read each value of CYL #1 to #6 displayed on the tester. If no misfire counts occur in any cylinders, perform the following operations:
  (1) Shift the gear selector lever to the D position.
  (2) Repeat steps (d) and (f) above.
  (3) Check the CYL #1 to #6.
  (4) If misfire counts are still not displayed, repeat (g) and then check the misfire counts again.
(h) Drive the vehicle with the MISFIRE RPM and MISFIRE LOAD noted in step 2.
(i) Read the CYL #1 to #6 or DTCs displayed on the tester.

Result:

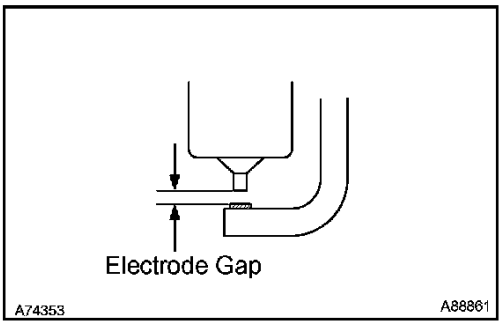
Misfire Count	Proceed To
One or two cylinders have misfire counts	A
Three cylinders or more have misfire counts	B

B → Go to step 13

A

Step 5-7:

5	CHECK SPARK PLUG



(a) Remove the ignition coil and the spark plug of the misfiring cylinder.
(b) Measure the spark plug electrode gap.
Standard:
Between 1.0 mm and 1.1 mm (0.039 in. and 0.043 in.)
NOTICE:
If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.
Recommended spark plug:

Manufacturers	Products
DENSO	K20HR-U11
NGK	LFR6C-11

(c) Check the electrode for carbon deposits.

NG → **REPLACE SPARK PLUG**

OK

6	CHECK FOR SPARKS AND IGNITION

(a) Disconnect the injector connectors, in order to prevent the engine from starting.
(b) Install the spark plug to the ignition coil, and connect the ignition coil connector.
(c) Attach the spark plug assy to the cylinder head cover.
(d) Crank the engine for less than 2 seconds and check the spark.
OK: Sparks jump across electrode gap
(e) Reconnect the injector connectors.

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

REPAIR OR REPLACE MALFUNCTION PARTS

Step 8-9:

8	CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

(a) Change the installed spark plug to a spark plug that functions normally.
(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.

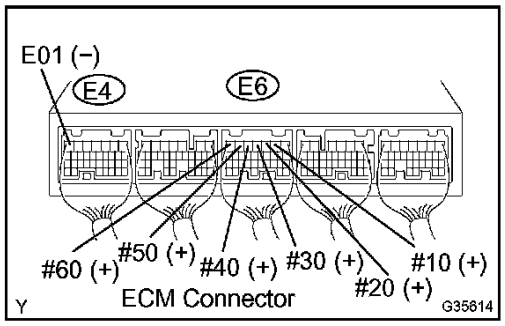
OK: Sparks jump across electrode gap.

NG > **Go to step 9**

OK

END

9	INSPECT ECM TERMINAL OF MISFIRING CYLINDER(#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE)



(a) Turn the ignition switch to ON.
(b) Measure the voltage between the terminals of the E4 and E6 ECM connector.

Standard:

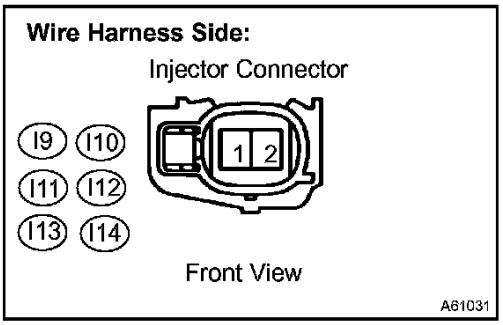
Tester Connections	Specified Conditions
#10 (E6-2) − E01 (E4-7)	9 to 14 V
#20 (E6-3) − E01 (E4-7)	9 to 14 V
#30 (E6-4) − E01 (E4-7)	9 to 14 V
#40 (E6-5) − E01 (E4-7)	9 to 14 V
#50 (E6-6) − E01 (E4-7)	9 to 14 V
#60 (E6-7) − E01 (E4-7)	9 to 14 V

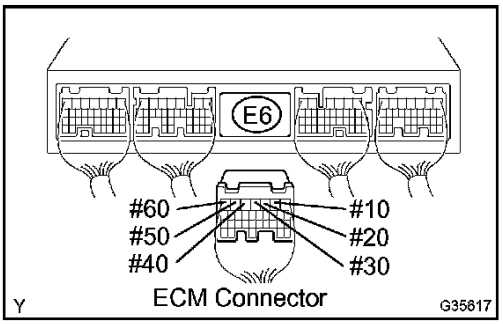
OK > **Go to step 11**

NG

Step 10:

10	CHECK HARNESS AND CONNECTOR(INJECTOR − ECM)





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

Standard (Cylinder No.1):

Tester Connections	Specified Conditions
I9−1 − Ground	11 to 14 V
I9−2 − Ground	10 kΩ or higher
I9−2 − #10 (E6−2)	Below 1 Ω

Standard (Cylinder No.2):

Tester Connections	Specified Conditions
I10−1 − Ground	11 to 14 V
I10−2 − Ground	10 kΩ or higher
I10−2 − #20 (E6−3)	Below 1 Ω

Standard (Cylinder No.3):

Tester Connections	Specified Conditions
I11−1 − Ground	11 to 14 V
I11−2 − Ground	10 kΩ or higher
I11−2 − #30 (E6−4)	Below 1 Ω

Standard (Cylinder No.4):

Tester Connections	Specified Conditions
I12−1 − Ground	11 to 14 V
I12−2 − Ground	10 kΩ or higher
I12−2 − #40 (E6−5)	Below 1 Ω

Standard (Cylinder No.5):

Tester Connections	Specified Conditions
I13−1 − Ground	11 to 14 V
I13−2 − Ground	10 kΩ or higher
I13−2 − #50 (E6−6)	Below 1 Ω

Standard (Cylinder No.6):

Tester Connections	Specified Conditions
I14−1 − Ground	11 to 14 V
I14−2 − Ground	10 kΩ or higher
I14−2 − #60 (E6−7)	Below 1 Ω

(e) Reconnect the injector connector.
(f) Reconnect the ECM connector.

NG	REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

Step 11-14:

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 ASSY

OK

12	CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

NG → ADJUST VALVE CLEARANCE

OK

13	CHECK AIR INDUCTION SYSTEM

(a) Check the air induction system for vacuum leakage.
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.
(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.
(c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.

If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

OK:
Point marks on camshaft timing gears are aligned as shown in the illustration.

(d) Reinstall the cylinder head cover.

NG → ADJUST VALVE TIMING

OK

Step 15-17:

15	CHECK FUEL PRESSURE

(a) Check the fuel pressure.

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

OK

16	READ VALUE USING HAND−HELD TESTER(COOLANT TEMP)

(a) Connect the hand−held tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) 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: Between 75℃ and 95℃ (167℉ and 203℉).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR

OK

17	READ VALUE USING HAND−HELD TESTER(MAF)

(a) Connect the hand−held tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF and COOLANT TEMP.
(e) Allow the engine to idle until the COOLANT TEMP reaches 75℃ (167℉) or more.
(f) 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 3.2 g/s and 4.7 g/s (shift position: N, A/C: OFF).
MAF at engine speed of 2,500 rpm: Between 13.1 g/s and 18.9 g/s (shift position: N, A/C: OFF).

NG → REPLACE MASS AIR FLOW METER

OK

CHECK FOR INTERMITTENT PROBLEMS

INSPECTION PROCEDURE

HINT:

- If any DTCs other than the misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the hand-held tester. Freeze frame data record the engine conditions 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.
- 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:

1. The fuel tank is low full.
2. Improper fuel is used.
3. The spark plugs have been contaminated.
4. The problem is complex.

- After finishing repairs, check the misfire counts of the cylinders (CYL #1, #2, #3, #4, #5 and #6).
- 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:
1. Clear the DTC.
2. Start the engine and conduct the confirmation driving pattern.
3. Read the misfiring rates of each cylinder or DTC(s) using the tester.
4. Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.
5. 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, SHORT FT #2 or LONG FT #2 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 degrees C (167 degrees F)**, the misfires have occurred only while warming up the engine.