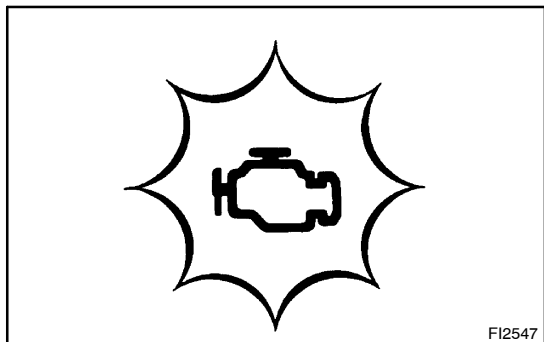


PRE-CHECK



1. DIAGNOSIS SYSTEM

(a) Description

- When troubleshooting Multiplex OBD (M-OBD) vehicles, the only difference from the usual troubleshooting procedure is that you connect the vehicle to the hand-held tester, and read off various data output from the vehicle's ECM.
- The vehicle's on-board computer lights up the check engine warning light on the instrument panel when the computer detects a malfunction in the computer itself or in drive system components. In addition to the check engine warning light lighting up when a malfunction is detected, the applicable diagnostic trouble codes are recorded in the ECM memory. (See page 05-164)

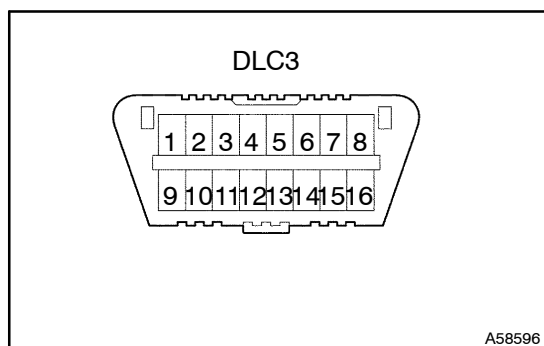
If the malfunction has been repaired, the check engine warning light goes off automatically but the diagnostic trouble codes remain recorded in the ECM memory.

- To check the diagnostic trouble codes, connect the hand-held tester to Data Link Connector 3 (DLC3) on the vehicle or read the number of blinks of the check engine warning light when TC and CG terminals on the DLC3 are connected. The hand-held tester also enables you to erase the diagnostic trouble codes and activate the several actuators and check freeze frame data and various forms of engine data. (For operating instructions, see the hand-held tester instruction book.)
- The diagnosis system operates in normal mode during normal vehicle use. It also has a check (test) mode for technicians to simulate malfunction symptoms and troubleshoot. Some diagnostic trouble codes use 2 trip detection logic* to prevent erroneous detection and ensure thorough malfunction detection. By switching the ECM to check (test) mode using hand-held tester when troubleshooting, the technician can cause the check engine warning light to light up for a malfunction that is only detected once or momentarily. (hand-held tester only) (See page 05-164)

- *2 trip detection logic:
When a logic malfunction is first detected, the malfunction is temporarily stored in the ECM memory.

If the same malfunction is detected again during the second drive test, this second detection causes the check engine warning light to light up. The 2 trip repeats the same mode a 2nd time. (However, the ignition switch must be turned OFF between the 1st trip and 2nd trip).

- Freeze frame data:
Freeze frame data records the engine condition when malfunction is detected. Because freeze frame data records the engine conditions (fuel system, calculator load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when the 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.



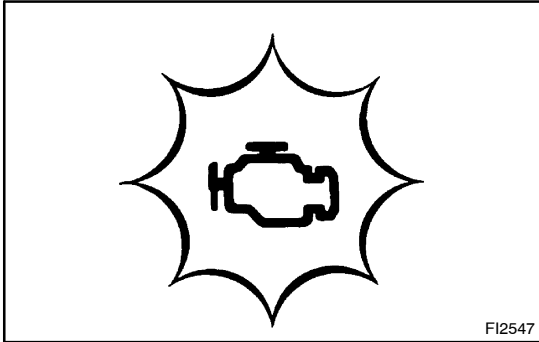
- (b) Check the DLC3.
The vehicle's ECM uses ISO 14230 for communication. The terminal arrangement of the DLC3 complies with ISO 15031 – 3 and matches the ISO 14230 format.

Terminal No.	Connection/Voltage or Resistance	Condition
7	Bus + Line/Pulse generation	During transmission
4	Chassis Ground – Body Ground/1 Ω or less	Always
16	Battery Positive – Body Ground/9 – 14 V	Always

HINT:

If your display shows UNABLE TO CONNECT TO VEHICLE when you have connected the cable of the hand-held tester to the DLC3, turned the ignition switch ON and operated the hand-held tester, there is a problem on the vehicle side or tool side.

- (1) If communication is normal when the tool is connected to another vehicle, inspect the DLC3 on the original vehicle.
- (2) If communication is still not possible when the tool is connected to another vehicle, the problem is probably in the tool itself, so consult the Service Department listed in the tool's instruction manual.



2. Normal Mode: INSPECT DIAGNOSIS

- (a) Check the check engine warning light.
- (1) The check engine warning light comes on when the ignition switch is turned ON and the engine is not running.

HINT:

If the check engine warning light does not light up, troubleshoot the combination meter.

- (2) When the engine is started, the check engine warning light should go off. If the lamp remains on, the diagnosis system has detected a malfunction or abnormality in the system.

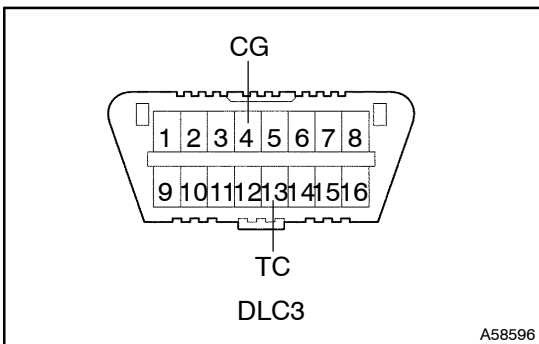
- (b) Check the DTC using hand-held tester.

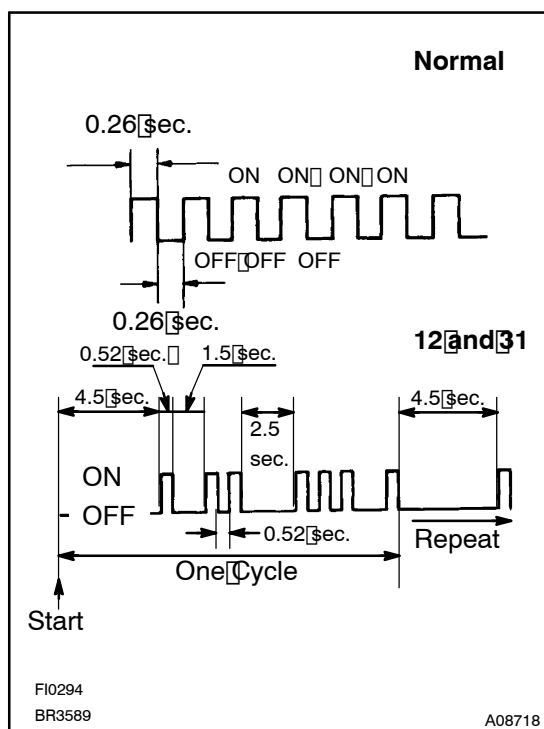
NOTICE:

When the diagnosis system is switched from the normal mode to the check (test) mode, it erases all DTCs and freeze frame data recorded in the normal mode. So before switching modes, always check the DTCs and freeze frame data, and note them down.

- (1) Prepare the hand-held tester.
 - (2) Connect the hand-held tester to the DLC3.
 - (3) Turn the ignition switch ON and switch the hand-held tester main switch ON.
 - (4) Use the hand-held tester to check the DTCs and freeze frame data, note them down. (For operating instructions, see the hand-held tester's instruction book.)
 - (5) Confirm the details of the DTCs.
- (c) Check the DTC not using hand-held tester.
- (1) Turn the ignition switch ON.
 - (2) Using SST, connect between terminals 13 (TC) and 4 (CG) of the DLC3.

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- (3) Read the DTC from the check engine warning light. As an example, the blinking patterns for codes; normal, 12 and 31 are as shown in the illustration.

HINT:

If a DTC is not output, check the diagnostic connector (DLC3) circuit (See page 05-277).

- (4) Check the details of the malfunction using the DTC chart (See page 05-164).
- (5) After completing the check, disconnect terminals 3 (TC) and 4 (CG) and turn off the display.

HINT:

In the event of 2 or more malfunction codes, the indication will begin from the smaller numbered code to the larger in order.

NOTICE:

When simulating symptoms without a hand-held tester to check the DTCs, use the normal mode. For code on the DTCs chart subject to "2 trip detection logic", turn the ignition switch OFF after the symptom is simulated the first time. Then repeat the simulation process again. When the problem has been simulated twice, the check engine warning light lights up and the DTCs are recorded in the ECM.

3. Check (Test) Mode: INSPECT DIAGNOSIS

HINT:

Hand-held tester only:

Compared to the normal mode, the check mode has an increased sensitivity to detect malfunctions.

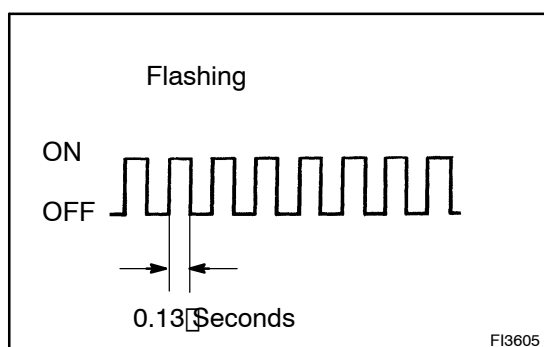
Furthermore, the same diagnostic items which are detected in the normal mode can also be detected in the check (test) mode.

- (a) Check the DTC.

- (1) Initial conditions.
 - Battery positive voltage 11 V or more
 - Throttle valve fully closed
 - Transmission in neutral position
 - A/C switched OFF.
- (2) Turn the ignition switch OFF.
- (3) Prepare the hand-held tester.
- (4) Connect the hand-held tester to the DLC3.
- (5) Turn the ignition switch ON and push the hand-held tester main switch ON.
- (6) Switch the hand-held tester from the normal mode to the check (test) mode. (Check that the check engine warning light flashes.)
- (7) Start the engine. (The check engine warning light goes out after the engine start.)
- (8) Simulate the conditions of the malfunction described by the customer.

NOTICE:

Leave the ignition switch ON until you have checked the DTCs, etc.



- (9) After simulating the malfunction conditions, use the hand-held tester diagnosis selector to check the DTCs and freeze frame data, etc.

HINT:

Take care not to turn the ignition switch OFF. Turning the ignition switch OFF switches the diagnosis system from the check (test) mode to the normal mode, so all diagnostic codes, etc. are erased.

- (10) After checking the DTCs, inspect the applicable circuit.
- (b) Clear the DTC.
- The following actions will erase the DTCs and freeze frame data.
- Operating the hand-held tester to erase the codes. (See the hand-held tester's instruction book for operating instructions.)
 - Disconnecting the battery terminals or ECD fuse.

NOTICE:

If the hand-held tester switches the ECM from the normal mode to the check (test) mode or vice-versa, or if the ignition switch is turned from ON to ACC or LOCK during the check (test) mode, the DTCs and freeze frame data will be erased.

4. FAIL-SAFE CHART

If any of the following codes is recorded, the ECM enters fail-safe mode.

DTC No.	Fail-Safe Operation	Fail-Safe Deactivation Conditions
12	Out put limit	Return to normal condition
15	Out put limit	+B OFF
19 (1)	Out put limit	+B OFF
22	Engine coolant temp. is fixed at 107°C (224.6°F)	Return to normal condition
24	Intake air temp. is fixed at 90°C (194.0°F)	Return to normal condition
32	Compensation value is set at fixed value	Return to normal condition
35	Turbo pressure is set at fixed value	Return to normal condition
39	Fuel temp. is fixed at 40°C (104.0°F)	Return to normal condition
42	Vehicle speed is fixed at 0 km/h (0 mph)	Vehicle speed > 0 km/h (0 mph)
49	Out put limit	+B OFF
78 (1)	Fuel cut	+B OFF
78 (3)	Out put limit	+B OFF
97	Fuel cut	IG OFF→ON or Starter ON
	Out put limit	

5. CHECK FOR INTERMITTENT PROBLEMS

HINT:

Hand-held tester only:

By putting the vehicle's ECM in the check (test) mode, 1 trip detection logic is possible instead of 2 trip detection logic and sensitivity to detect open circuits is increased. This makes it easier to detect intermittent problems.

- (1) Clear the DTC (See step 3)
- (2) Set the check (test) mode (See step 3)
- (3) Perform a simulation test (See page 01-20)
- (4) Check the connector and terminal (See page 01-30)
- (5) Handle the connector (See page 01-30)

6. REFERENCE VALUE OF ECM DATA

NOTICE:

The values given below for "Normal Condition" are representative values, so a vehicle may still be normal even if its values differ from those listed here. So do not decide whether a part is faulty or not solely according to the "Normal Condition" here.

HINT:

The ECM data can be monitored by hand-held tester.

- (a) Connect the hand-held tester to the DLC3.
- (b) Monitor ECM data by following the prompts on the tester screen. Please refer to the hand-held tester operator's manual for further detail.

Item	Inspection Condition	Reference Value
INJECTION VOLUME	Engine at idling*	3 – 10 mm ³ /st
INJECTION VOLUME	Engine racing at 2,000 rpm*	3 – 10 mm ³ /st
INJECTION VOLUME	Engine racing at 3,000 rpm*	5 – 12 mm ³ /st
INJECTION TIMING	Engine at idling*	-1 – 5°CA
INJECTION TIMING	Engine racing at 2,000 rpm*	0 – 4°CA
INJECTION TIMING	Engine racing at 3,000 rpm*	1 – 5°CA
ENGINE SPD	RPM kept stable (Comparison with tachometer)	No great changes
PIM	Engine at idling*	85 – 110 kPa
PIM	Engine racing at 2,000 rpm*	80 – 110 kPa
PIM	Engine racing at 3,000 rpm*	90 – 130 kPa
ACCELE POSITION	Accelerator pedal fully closed	0 %
ACCELE POSITION	Accelerator pedal fully opened	100 %
IDL SIG	Accelerator pedal full closed	ON
STARTER SIG	During cranking	ON
AFM	Air Flow Rate Through Air Flow Meter at idling	3 – 9 g/sec
COMN RAIL PRESS	Engine at idling*	25 – 45 Mpa
M – INJ/PILOT ON	Engine at idling*	600 – 1200 μs
M – INJ/PILOT OFF	Engine at idling*	0 μs
PILOT – INJ	Engine at idling*	400 – 700 μs
PUMP VCM ANGLE	Engine at idling*	70 – 90°CA

HINT:

*: All accessories and A/C are switched OFF.

BASIC INSPECTION

When the malfunction code is not confirmed in the DTC check, troubleshooting should be carried out in order for all possible circuits to be considered as the cases of the problems.

In many cases, by carrying out the basic engine check shown in the following flow chart, the location causing the problem can be found quickly and efficiently. Therefore, use of this check is essential in engine troubleshooting.

1 CHECK BATTERY VOLTAGE

NOTICE:

Carry out this check under the engine stoppage condition.

	OK	NG
Voltage	11 V or more	Less than 11 V

NG

CHARGE OR REPLACE BATTERY

OK

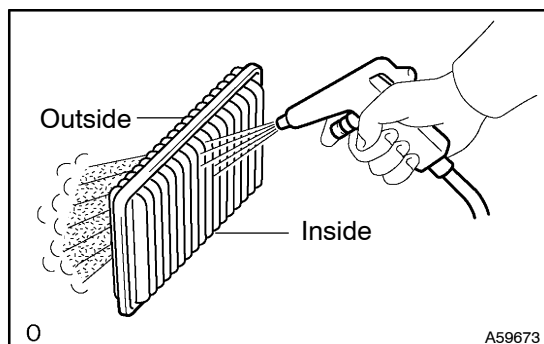
2 CHECK IF ENGINE IS CRANKED

NG

PROCEED TO PROBLEM TABLE ON PAGE

OK

3 CHECK AIR FILTER



- (a) Visually check that the air filter is not excessively dirty or oily.

NOTICE:

If necessary, clean the filter with compressed air. First blow from inside thoroughly, the blow from outside of filter.

NG

REPAIR OR REPLACE

OK

4 CHECK FUEL QUALITY

- (a) Check that use only diesel fuel.
(b) Check that the fuel does not contain any impurity.

NG

REPLACE FUEL

OK

5 CHECK ENGINE OIL (See page 17-19)

NG ADD OR REPLACE

OK

6 CHECK COOLANT (See page 16-19)

NG REPLACE COOLANT

OK

7 CHECK DIAGNOSTIC CONNECTOR (DLC3) CIRCUIT (See page 05-277)

NG REPAIR OR REPLACE

OK

8 CHECK PCV SYSTEM (See page 12-5)

NG REPAIR OR REPLACE

OK

PROCEED TO PROBLEM SYMPTOMS TABLE ON PAGE (See page 05-170)