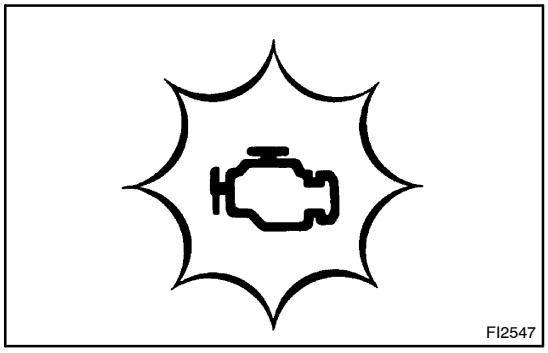
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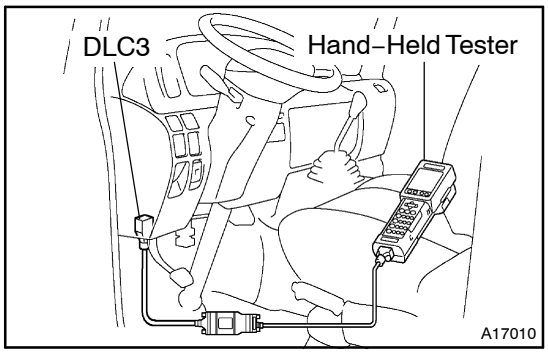
PRE–CHECK

1. DIAGNOSIS SYSTEM

(a) Description

- When troubleshooting Multiplex OBD (M–OBD) vehicles, the only difference from the usual troubleshooting procedure is that you connect to the vehicle the hand–held tester, and read off various data output from the vehicle's engine ECU.
- 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 engine ECU memory. (See page DI–13)

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



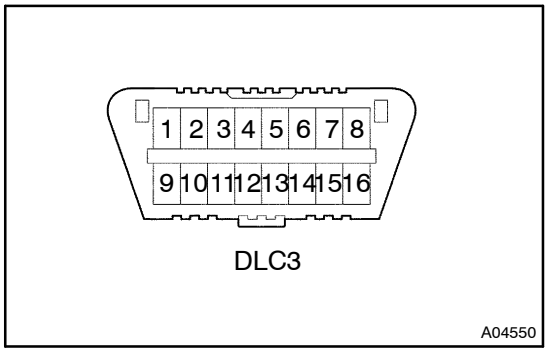
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- To check the diagnostic trouble codes, connect the hand–held tester to the Data Link Connector 3 (DLC3) on the vehicle or read the number of blinks of the check engine warning light when TC and CG terminals on the DLC3 are connected. The hand–held tester also enables you to erase the diagnostic trouble codes and activate the several actuators and check freeze frame date 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 engine ECU 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 DI–13)

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

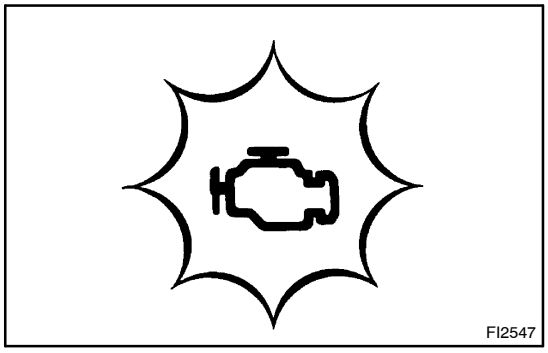


(b) Check the DLC3.
The vehicle's engine ECU uses ISO 14230 for communication. The terminal arrangement of DLC3 complies with ISO 15031–3 and matches the ISO 14230 format.

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 18 – 27 V	Always

HINT:
If your display shows UNABLE TO CONNECT TO VEHICLE when you have connected the cable of the hand–held tester to 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.


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2. INSPECT DIAGNOSIS (Normal Mode)

(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 freezed frame data recorded in the normal mode. So before switching modes, always check the DTCs and freezed frame data, and note them down.

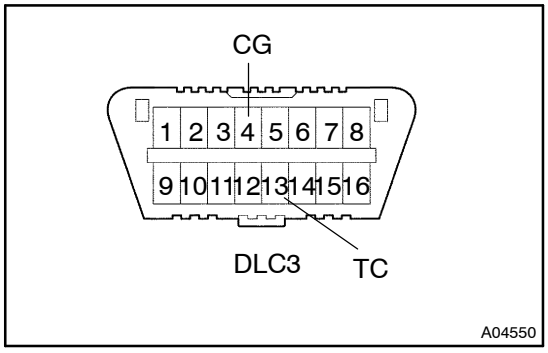
(1) Prepare the hand–held tester.

(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 freezed frame data, note them down. (for operating instructions, see the hand–held tester's instruction book.)

(5) Confirm the details of the DTCs.



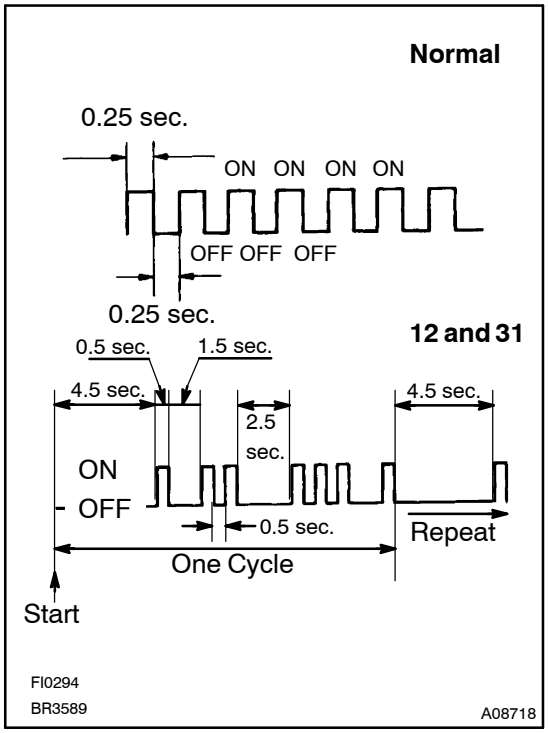
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(c) Check the DTC not using hand–held tester.

(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 DI–84).

(4) Check the details of the malfunction using the DTC chart on page DI–13.

(5) After completing the check, disconnect terminals 13 (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 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 engine ECU.

3. INSPECT DIAGNOSIS (Check (Test) Mode)

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.

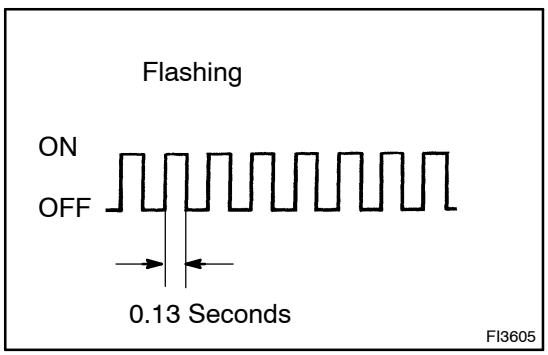
(1) Initial conditions.
- Battery voltage 22 V or more
- Throttle valve fully closed.
- Transmission in neutral position

(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 freezed frame data, etc.

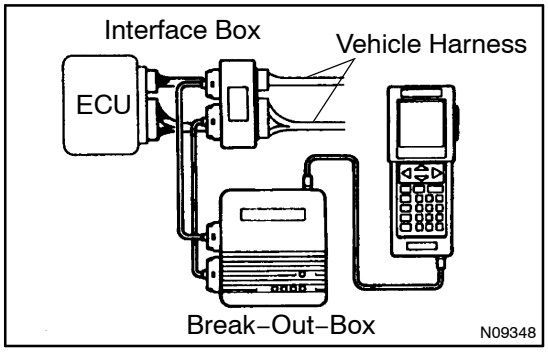
HINT:
Take care not to turn the ignition switch OFF. Turning the ignition switch OFF switches the diagnosis system from check (test) mode to the normal mode, so all diagnostic codes, etc. are erased.

(10) After checking the DTCs, inspect the applicable circuit.

(b) Clear the DTC.
The following actions will erase the DTCs and freezed 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 engine ECU from the normal mode to the check (test) mode or vice–versa, or if the ignition switch is turned from ON to ACC or OFF during the check (test) mode, the DTCs and freezed frame data will be erased.



(c) Measure the engine ECU terminal values using break–out box and hand–held tester.

(1) Hook up the break–out–box and hand–held tester to the vehicle.

(2) Read the engine ECU input/output values by following the prompts on the tester screen.

HINT:
Hand–held tester has a "Snapshot" function.
This records the measured values and is effective in the diagnosis of intermittent problems.
Please refer to the hand–held tester/break–out–box operator's manual for further details.

4. FAIL–SAFE CHART

If any of the following codes is recorded, the engine ECU 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)	Accelerator pedal closed position SW ON : Accelerator pedal position is fixed at 0 % Accelerator pedal closed position SW OFF : Out put limited accelerator pedal position	+B OFF
19 (2)	Accelerator pedal closed position SW ON : Accelerator pedal position is fixed at 0 % Accelerator pedal closed position SW OFF : Out put limited accelerator pedal position	+B OFF
	Out put limit	+B OFF
19 (3)	When the idle SW is faulty. Accelerator pedal closed position SW ON: Accelerator pedal position is fixed at 0 % Accelerator pedal closed position SW OFF: Out put limited accelerator pedal position	+B OFF
	When the idle SW is okay. Accelerator pedal closed position SW ON: Accelerator pedal position is fixed at 0 % SW OFF→Out put limited accelerator pedal position	+B OFF
19 (4)	Out put limit	+B OFF
22	Engine coolant temp. is fixed at 108°C (226.4°F)	Return to normal condition
24	Intake air temp. is fixed at 20°C (68°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 50°C (122°F)	Return to normal condition
42	Vehicle speed is fixed at 0 km/h (0 mph)	Vehicle speed > 10 km/h
97	Fuel cut	IG OFF→ON or Starter ON
	Out put limit	

5. CHECK FOR INTERMITTENT PROBLEMS

Hand–held tester only:

By putting the vehicle's engine ECU 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.

(a) Clear the DTC (See page DI–4).
(b) Set the check (test) mode (See page DI–4).
(c) Perform a simulation test (See page IN–10).
(d) Check the connector and terminal (See page IN–20).
(e) Handle the connector (See page IN–20).

6. 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 case 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	**Is battery positive voltage 22 V or more when engine is stopped?**

NO → Charge or replace battery.

YES

2	Is engine cranked?

NO → Proceed to problem symptoms table on page DI–18.

YES

3	Check air filter (See Pub. No. RM464E EM section).

NG → Repair or replace.

OK

4	Check fuel quality.

CHECK:

- Check that use only diesel fuel.
- Check that the fuel does not contain any impurity.

NG → Replace fuel.

OK

5	Check engine oil (See page LU–1).

NG → Add or replace.

OK

6	Check coolant (See page CO–1).

NG → Replace coolant.

OK

7	Check injection timing (See page EM–2).

NG → Adjusting injection timing.

OK

8	Check idle speed and maximum speed (See page EM–3).

NG → Repair or replace injection pump.

OK

9	Check diagnostic connector (DLC3) circuit (See page DI–84).

NG → Repair or replace.

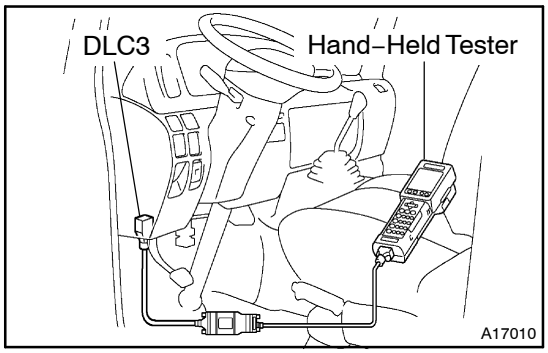
OK

10	Check vacuum pump (See page EC–3).

NG → Repair or replace.

OK

Proceed to problem symptoms table on page DI–18.



7. REFERENCE VALUE OF ENGINE ECU DATA

NOTICE:

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

HINT:

Engine ECU data can be monitored by hand–held tester.

(a) Connect the hand–held tester to the DLC3.

(b) Monitor engine ECU data by following the prompts on the tester screen.

Please refer to the hand–held tester operator's manual for further detail.

(c) Reference Value

Item	Inspection Condition	Reference Value
INJECTION VOLUME	Engine at idling *1	6 – 8 mm^3/st
	Engine racing at 2,000 rpm *1	10 – 14 mm^3/st
	Engine racing at 3,000 rpm *1	17 – 23 mm^3/st
INJECTION TIMING	Engine at idling *1	9 – 13°CA
	Engine racing at 2,000 rpm *1	–0.5 – 3.5°CA
	Engine racing at 3,000 rpm *1	6.5 – 10.5°CA
ENGINE SPD	RPM kept stable (Comparison with tachometer)	No great changes
PIM	Engine at idling *1	95 – 105 kPa
	Engine racing at 2,000 rpm *1	101 – 111 kPa
	Engine racing at 3,000 rpm *1	133 – 147 kPa
COOLANT TEMP	Engine at normal operating temp.	75 – 95°C (167 – 203°F) *2
INTAKE AIR	Engine at normal operating temp.	Ambient temp. –140°C
FUEL TEMP	Engine at normal operating temp.	Ambient temp. –65°C
ACCELE POSITION	Accelerator pedal fully closed	0 %
	Accelerator pedal fully opened	100 %
	From closed position to wide open accelerator pedal	Gradually increases
VEHICLE SPD	During driving (Comparison with speed meter)	No large differences
IDL SIG	Accelerator pedal full closed	ON
STARTER SIG	During cranking	ON
EGR SYSTEM	Engine at idling	ON
PS OIL PRESS SW	Power steering oil pressure switch signal	Turn steering wheel: ON
ACCEL CLOSE SW	Accelerator pedal fully closed	ON

HINT:

*1: All accessories are switched OFF.

*2: If the water temp. sensor circuit is open or shorted, the engine ECU.