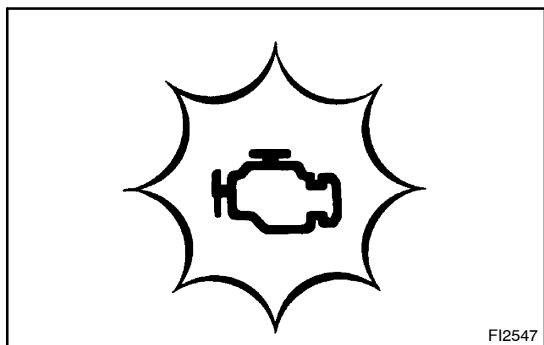




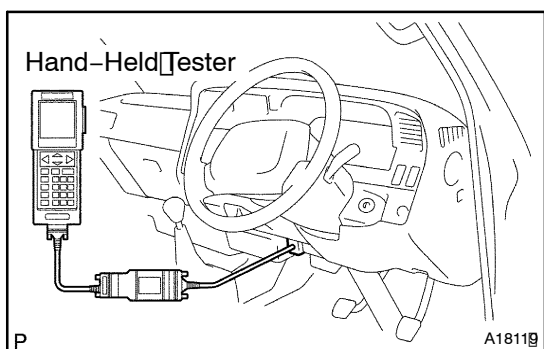
PRE-CHECK

1. DIAGNOSIS SYSTEM

(a) Description

- When troubleshooting Multiplex (OBD (M-OBD)) vehicles, the only difference from the usual troubleshooting procedure is that you need to connect the vehicle to 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 the 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).

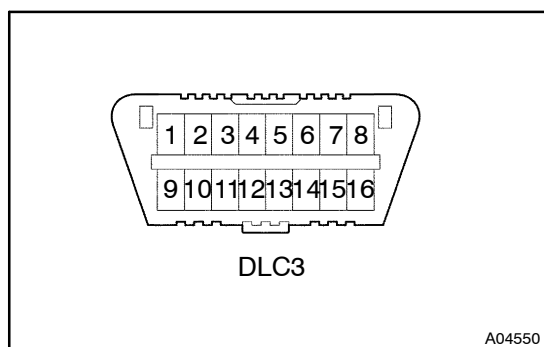
If the malfunction has been repaired, the check engine warning light goes off automatically, but the diagnostic trouble codes remain recorded in the engine ECU memory.



- To check the diagnostic trouble codes, connect the hand-held tester to the Data Link Connector (DLC3) on the vehicle or read the number of blinks of the check engine warning light when the 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 the normal mode during a normal vehicle use. It also has a check (test) mode for technicians to simulate the malfunction symptoms and make a troubleshooting. Some diagnostic trouble codes use 2-trip detection logic* to prevent an erroneous detection and ensure thorough the malfunction detection. By switching the engine ECU to the check (test) mode using hand-held tester when troubleshooting, a 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 twice. (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 (fuel system, calculator load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) 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.



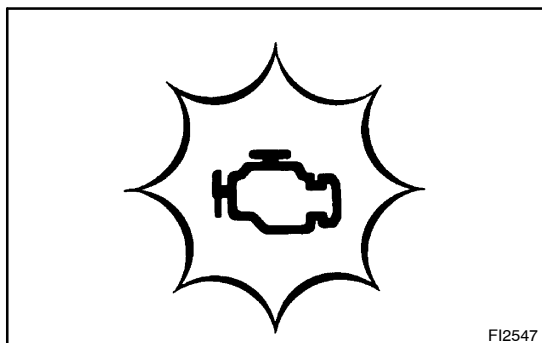
- (b) Check the DLC3.
The vehicle's engine ECU uses ISO 14230 for communication. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 14230 format.

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 the 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.

- If the communication is normal when the tool is connected to another vehicle, inspect the DLC3 on the original vehicle.
- If the communication is still impossible 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. 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 light remains on, the diagnosis system has detected a malfunction or abnormality in the system.

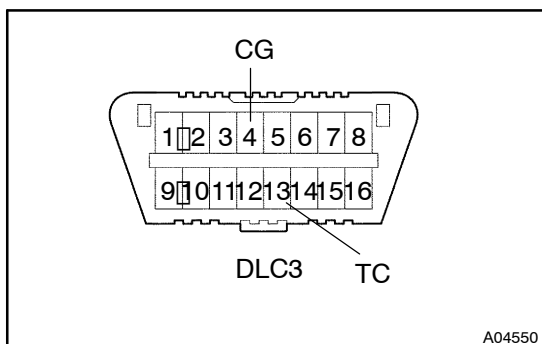
(b) When using hand-held tester:

Check the DTC.

NOTICE:

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

- (1) Connect the hand-held tester to the DLC3.
- (2) Turn the ignition switch ON and switch the hand-held tester main switch ON.
- (3) Check the DTCs and freeze frame data, and then note them down (for operating instructions, see the hand-held tester's instruction book.).
- (4) Confirm the details of the DTCs.

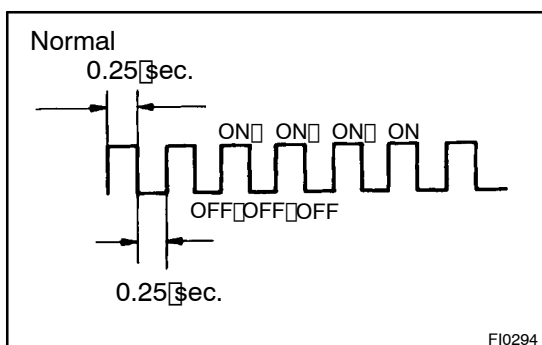


(c) When not using hand-held tester:

Check the DTC.

- (1) Turn the ignition switch ON.
- (2) Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

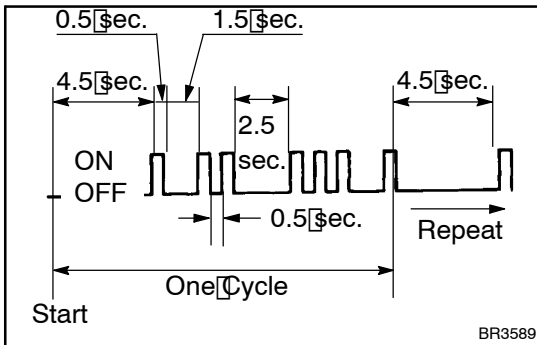
SST 09843-18040



- (3) Read the diagnostic trouble code from the check engine warning light.

HINT:

- If a diagnostic trouble code is not output, check the DLC3 circuit (See page DI-92).



- As an example, the blinking patterns for codes; normal, 12 and 31 are as shown in the illustration.
- (4) Check the details of the malfunction using the DTC chart on [page DI-13](#).
- (5) After completing the check, disconnect terminals TC and CG and turn off the display.

HINT:

If 2 or more malfunction codes are output simultaneously, indication will begin from the smaller numbered code and continue in order to the larger numbered code.

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 one. 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)**HINT:**

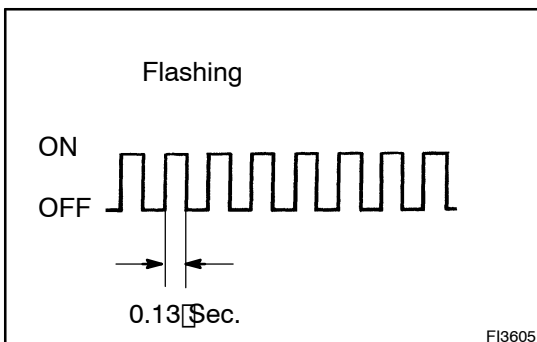
Hand-held tester only:

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
- Air conditioning switch is OFF

(2) Turn the ignition switch OFF.**(3) Connect the hand-held tester to the DLC3.****(4) Turn the ignition switch ON and push the hand-held tester main switch ON**

- (5) Switch the hand-held tester from the normal mode to the check (test) mode. (Check that the check engine warning light flashes.)
- (6) Start the engine. (The check engine warning light goes off after the engine is started.)
- (7) Simulate the conditions of the malfunction described by the customer.

NOTICE:

Leave the ignition switch ON until you have checked the DTCs, 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 the diagnostic codes, etc. will be erased.

- (b) Clear the DTC.

The following actions will erase the DTCs and froze frame data.

- (1) Operating the hand-held tester to erase the codes. (See the hand-held tester's instruction book for operating instructions.)
- (2) Disconnecting the battery terminals or ECD fuse.

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 freeze frame data will be erased.

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

5L, 5L-E ENGINE SUP (RM890E)

5. CHECK FOR INTERMITTENT PROBLEMS

HINT:

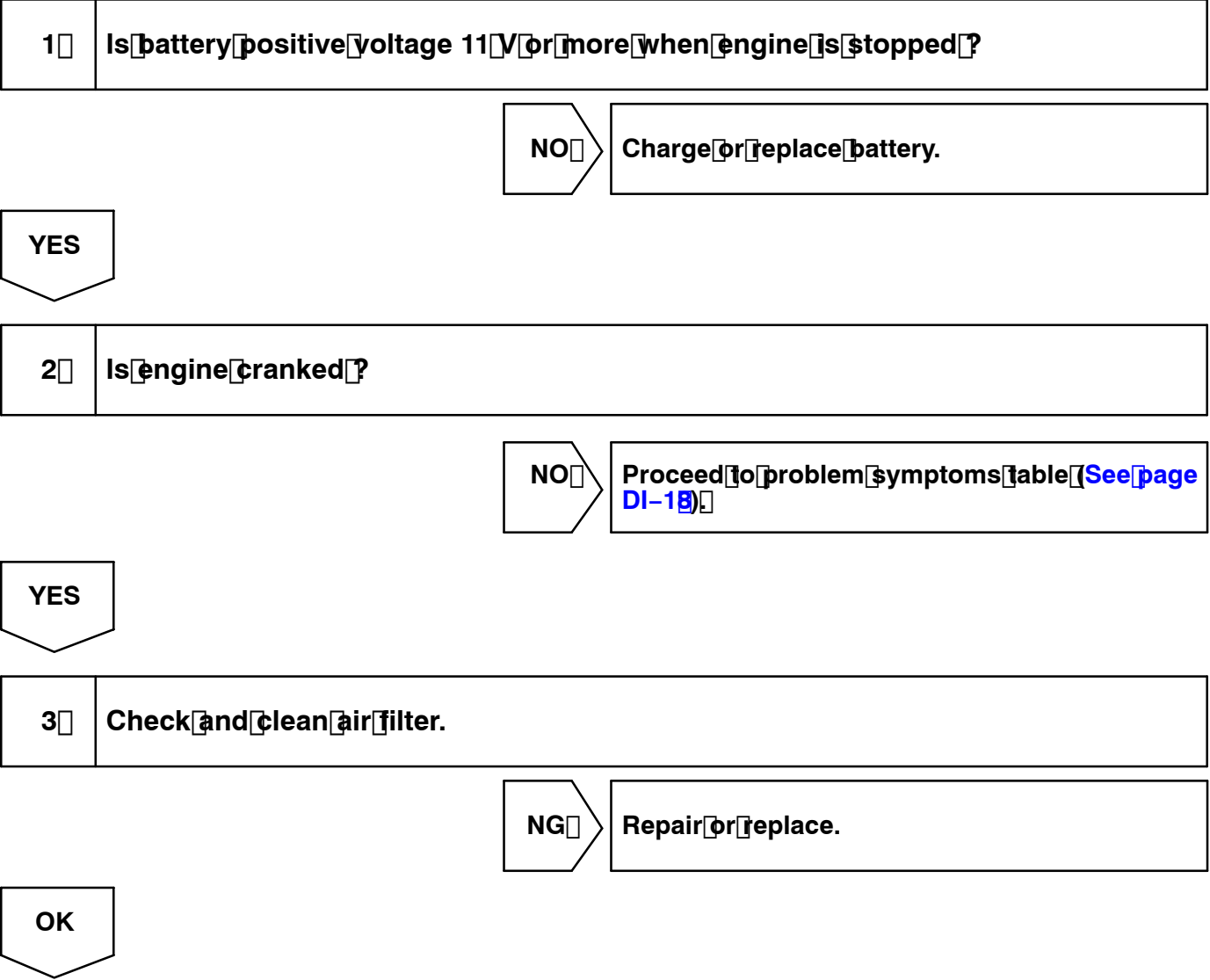
Hand-held tester only:

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

- (a) Clear the DTC (See step 2).
- (b) Set the check (test) mode (See step 3).
- (c) Perform a simulation test (See page N-9).
- (d) Check the connector and terminal (See page N-19).
- (e) Handle the connector (See page N-19).

6. BASIC INSPECTION

When no malfunction code can be confirmed in the DTC check, troubleshoot all the possible circuits to be considered as a cause 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 the engine troubleshooting.



4 Check fuel quality.**CHECK:**

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

NG**Replace fuel.****OK****5 Check engine oil level and quality.****NG****Add or replace.****OK****6 Check engine coolant level and quality.****NG****Replace coolant.****OK****7 Check injection timing.****CHECK:**

Using a mirror, check that the punching line of the injection pump flange and the punching line of the timing belt case aligned.

NG**Adjusting injection timing.****OK**

8 Check idle speed and maximum speed.

OK:

Idle speed: 720 – 800 rpm

Maximum speed: 4,770 – 5,030 rpm

NG

Replace supply pump.

OK

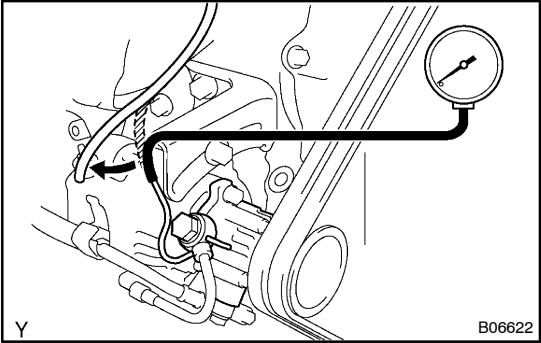
9 Check DLC3 circuit (See page DI-92).

NG

Repair or replace.

OK

10 Check vacuum pump.



CHECK:

Using a vacuum gauge, measure the vacuum of the vacuum pump.

OK:

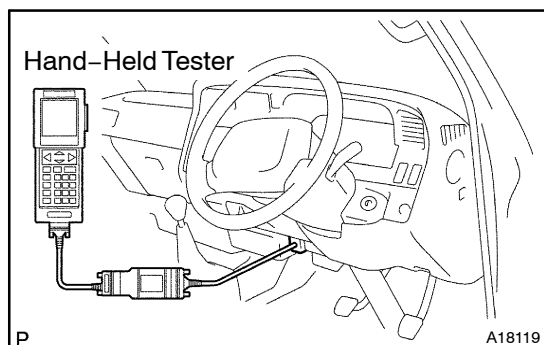
Vacuum: 86.7 kPa (650 mmHg, 25.6 in.Hg) or more

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 the 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 Engine ECU data can be monitored by the hand-held tester.

- (a) Connect the hand-held tester to the DLC3.
- (b) Monitor the engine ECU data by following the prompts on the tester screen.
Refer to the hand-held tester operator's manual for further detail.
- (c) Reference Value

Item	Inspection Condition	Normal Condition
INJECTION VOLUME	Engine at idling *1	10 mm ³ or less
	Engine racing at 2,000 rpm *1	13 mm ³ or less
	Engine racing at 3,000 rpm *1	15 mm ³ or less
INJECTION TIMING	Engine at idling *1	16 – 18 °CA
	Engine racing at 2,000 rpm *1	19 – 23 °CA
	Engine racing at 3,000 rpm *1	24 – 28 °CA
ENGINE SPD	RPM kept stable (Comparison with tachometer)	No great changes
PIM	Engine at idling *1	98–101 kPa (735–758 mmHg, 28.9–29.8 in.Hg)
	Engine racing at 2,000 rpm *1	96 – 101 kPa
	Engine racing at 3,000 rpm *1	95 – 100 kPa
COOLANT TEMP	Engine at normal operating temp.	75–95 °C (185–203 °F) *2
INTAKE AIR	Engine at normal operating temp.	Ambient temp. ~100°C
FUEL TEMP	Engine at normal operating temp.	Ambient temp. ~90°C
ACCELE POSITION	Accelerator pedal is fully closed	0 – 6 %
	Accelerator pedal is fully opened	80 – 100 %
	From closed position to wide open accelerator pedal	Gradually increases
VEHICLE SPD	During driving (Comparison with speedometer)	No large differences
Item	Inspection Condition	Normal Condition
A/C SIG	A/C switch ON	ON
IDL SIG	Accelerator pedal is full closed	ON
STARTER SIG	During cranking	ON
A/C CUT SIG	A/C switch OFF	ON
EGR SYSTEM	Idling *1	ON

*1: All accessories and A/C are switched OFF, and the engine warmed up

*2: If the water temperature sensor circuit is open or short, the engine ECU.