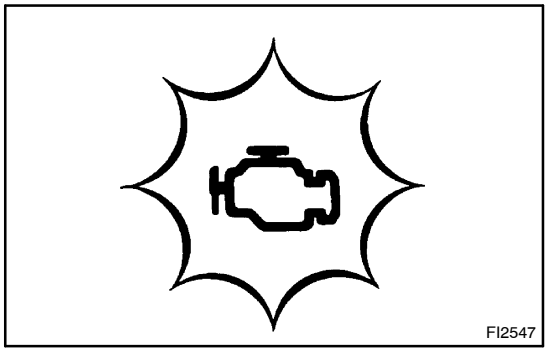
DI9SW–01

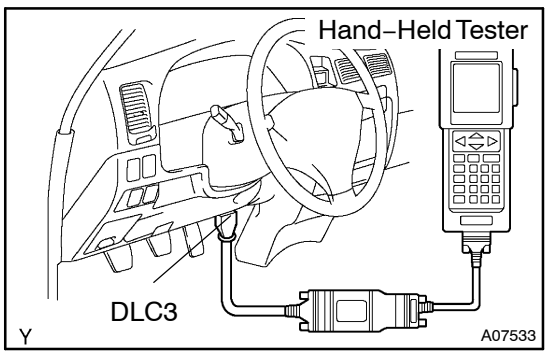

FI2547

PRE–CHECK

1. DIAGNOSIS SYSTEM

(a) Description for EURO–OBD

- When troubleshooting the Euro–OBD vehicles, the only difference from the usual troubleshooting procedure is that you connect the vehicle to the OBD scan tool complying with ISO 15031–4 or the hand–held tester, and read off various data output from the vehicle's engine ECU.
  Euro–OBD regulations require that the vehicle's on–board computer lights up the check engine warning ignit (CHK ENG) the instrument panel when the computer detects a malfunction in the emission control system/components or in the power train control components which affect the vehicle emissions, or a malfunction in the computer. In addition to the check engine warning light (CHK ENG) lighting up when a malfunction is detected, the applicable Diagnostic Trouble Codes (DTCs) prescribed by ISO15031–6 are recorded in the engine ECU memory (See page DI–13). If the malfunction does not reoccur in 3 consecutive trips, the engine warning light (CHK ENG) goes off automatically but the DTCs remain recorded in the engine ECU memory.



- To check the DTCs, connect the OBD scan tool or the hand–held tester to the Data Link Connector 3 (DLC3) on the vehicle. The OBD scan tool or the hand–held tester also enables you to erase the DTCs and check freeze frame data and various forms of engine data. (For operating instructions, see the OBD scan tool's instruction book.)
  DTCs include ISO controlled codes and manufacturer controlled codes. ISO controlled codes must be set as prescribed by the ISO, while manufacturer controlled codes can be set freely by the manufacturer within the prescribed limits. (See DTC chart on page DI–13)
- The diagnosis system operates in the normal mode during normal vehicle use. It also has a check mode for technicians to simulate malfunction symptoms and wake a troubleshooting. Most DTCs use 2 trip detection logic* to prevent on erroneous detection, and ensure thorough malfunction detection. By switching the engine ECU to the check mode 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 step 2)

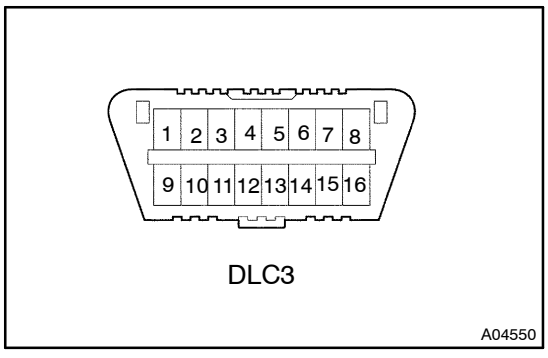
- *2 trip detection logic:
  When a malfunction is first detected, the malfunction is temporarily stored in the engine ECU memory. (1st trip) If the same malfunction is detected again during the second drive test, this second detection causes the engine warning light (CHK ENG) to light up. (2nd trip) (However, the ignition switch must be turned OFF between the 1st trip and the 2nd trip.)
- Freeze frame data:
  Freeze frame data records the engine condition when a misfire (DTCs P0300 – P0304) or fuel trim malfunction (DTCs P0171 and P0172) or other malfunction (first malfunction only), is detected.
  Because freeze frame data records the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when the malfunction is detected. When troubleshooting, it is useful to determine 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) Priorities for troubleshooting.

If troubleshooting priorities for multiple DTCs are given in the applicable DTC chart, these should be followed.

If no instructions are given, troubleshoot DTCs according to the following priorities.

(1) DTCs other than fuel trim malfunction (DTCs P0171 and P0172) and EGR (DTCs P0401 and P0402).
(2) Fuel trim malfunction (DTCs P0171 and P0172).
(3) Misfire (DTCs P0300 – P0304).



DLC3

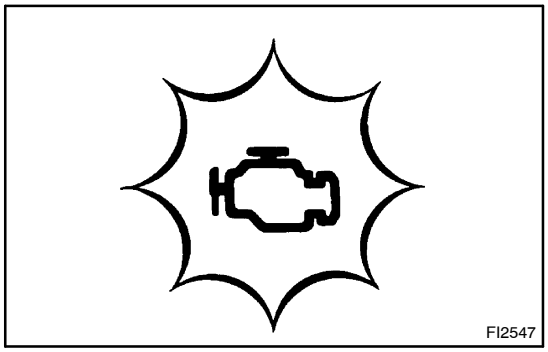
(c) Check the DLC3.

The vehicle's engine ECU uses the ISO 14230 for communication. The terminal arrangement of the DLC3 complies with the 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 of 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.


FI2547

2. Normal Mode:
INSPECT DIAGNOSIS

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

HINT:
If the check engine warning light (CHK ENG) 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) Check the DTC, using the hand–held tester.

NOTICE:
(Hand–held tester only): When the diagnosis system is switched from the normal mode to the check (test) mode, all the DTCs and freeze frame data recorded in the normal mode will be erased. 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 the hand–held tester main switch ON.
  (4) Using the hand–held tester, check the DTCs and freeze frame data, and note them down. (For operating instructions, see the hand–held tester’s instruction book.)

(5) See page DI–13 to confirm the details of the DTCs.

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.

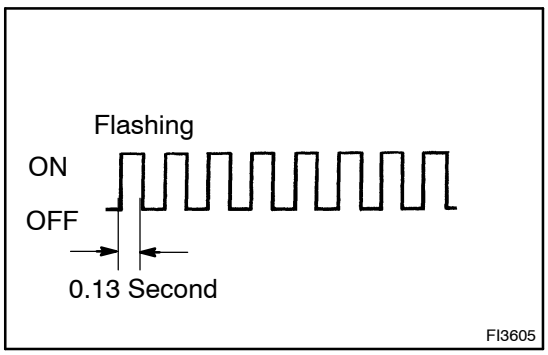
(1) Initial conditions
- Battery positive voltage 11 V or more
- Throttle valve fully closed
- Transmission in ”P” or ”N” position
- Air conditioning switched OFF

(2) Turn the ignition switch OFF.

(3) Prepare the hand–held tester.

(4) Connect the hand–held tester to the DLC3 on the lower left of the instrument panel.

(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 (CHK ENG) flashes.)

(7) Start the engine. (The check engine warning (CHK ENG) light goes off after the engine is started.)

(8) Simulate the conditions of the malfunction described by the customer.

NOTICE:

Leave the ignition switch ON until you have checked the DTC, 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 the DTCs, etc. will be 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 EFI fuse.

NOTICE:
If the hand–held tester switches the engine ECU from the normal mode to the check mode or vice–versa, or if the ignition switch is turned from ON to ACC or OFF during the check mode, the DTCs and freeze frame data will be erased.

4. FAIL–SAFE CHART

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

DTC No.	Fail–Safe Operation	Fail–Safe Deactivation Conditions
P0100	• Ignition timing fixed at 5°BTDC • Injection time fixed Starting – – – – – – – –11.6 msec. CTP switch ON – – – – 3.2 msec. CTP switch OFF – – – – 6.0 msec.	Returned to normal condition
P0110	Intake air temperature fixed at 20°C(68°F)	Returned to normal condition
P0115	Water temperature fixed at 80°(176°F)	Returned to normal condition
P0120	VTA fixed at 0°	The following condition must be repeated at least 2 times consecutively When closed throttle position switch is ON: VTA ≧ 0.1 V and ≦ 0.95 V
P0141	Abnormal heater circuit turned off	Ignition switch OFF
P0325	Max. timing retardation	Ignition switch OFF
P0340	Fuel cut	Returned to normal condition
P0500	High RPM for cut prohibited ISC control prohibited	Returned to normal condition
P1300 P1310	Fuel cut	Returned to normal condition

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 can be used 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 IN–9).
(4) Check the connector and terminal (See page IN–19).
(5) Do a visual check and contact pressure check (See page IN–19).
(6) Connect the connector (See page IN–19).

6. BASIC INSPECTION

When no malfunction code can be confirmed in the DTC check, troubleshoot all the possible circuits 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.

1	**Is battery positive voltage 11 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–21.**

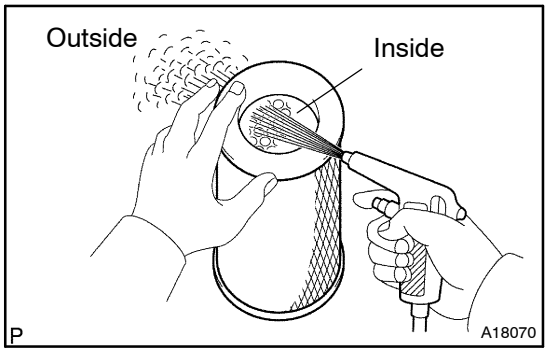
YES

3	**Does engine start ?**

NO → **Go to step 7.**

YES

4	**Check air filter.**

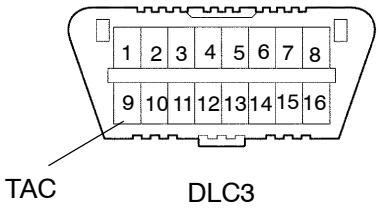


PREPARATION:
Remove the air filter.
CHECK:
Visually check that the air filter is not excessively dirty or oily.
HINT:
If necessary, clean the filter with compressed air. First blow from the inside thoroughly, then blow from the outside of the filter.

NG → **Repair or replace.**

OK

5	Check engine idle speed.



PREPARATION:

(a) Warm up the engine to the normal operating temperature.
(b) Switch off the all accessories.
(c) Switch off the air conditioning.
(d) Shift transmission into the ”N” position.
(e) Connect the hand–held tester to the DLC3 of the vehicle.
(f) If you have no hand–held tester, connect a tachometer test probe to terminal 9 (TAC) of the DLC3.
SST 09843–18030

NOTICE:

As some tachometer are not compatible with this ignition system, we recommend that you confirm the compatibility of yours until before use.

CHECK:

Check the idle speed.

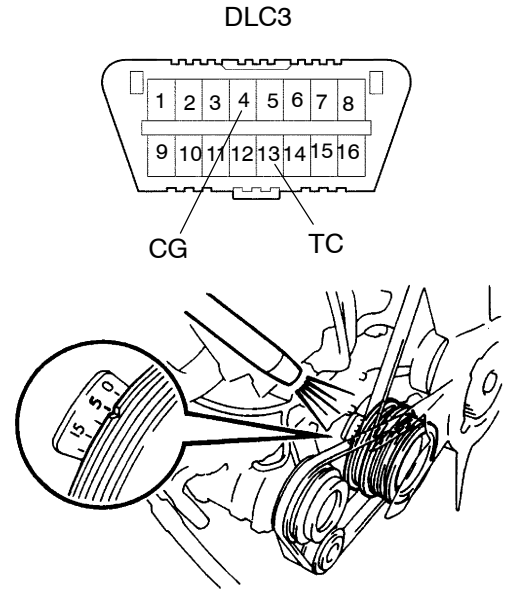
OK:

Idle speed: 650 – 750 rpm

NG	Proceed to problem symptoms table on page DI–21.

OK

6	Check ignition timing.



PREPARATION:

(a) Warm up the engine to the normal operating temperature.
(b) Switch off the all accessories.
(c) Switch off the air conditioning
(d) Shift the transmission into the ”N” position.
(e) Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.
SST 09843–18040
(f) Using a timing light, connect a tester to the No.1 high–tension cord.

CHECK:

Check the ignition timing.

OK:

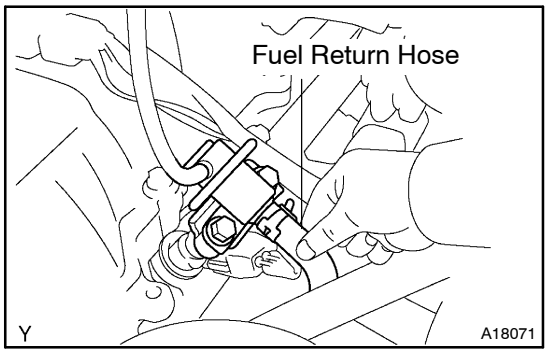
Ignition timing: 3° – 7° BTDC at idle

NG	Proceed to page IG–1 and continue to trouble-shoot.

OK

Proceed to problem symptoms table on page DI–21.

7	**Check fuel pressure.**



PREPARATION:

(a) Be sure that enough fuel is in the tank.
(b) Turn the ignition switch ON.
(c) Connect the hand–held tester to the DLC3.
(d) Use the ACTIVE TEST mode to operate the fuel pump.
(e) Refer to the hand–held tester operator's manual for further details.
(f) If you have no hand–held tester, connect the positive (+) and negative (–) leads from the battery to the fuel pump connector.

CHECK:

Check the fuel pressure in the fuel return hose when it is pinched by hand.

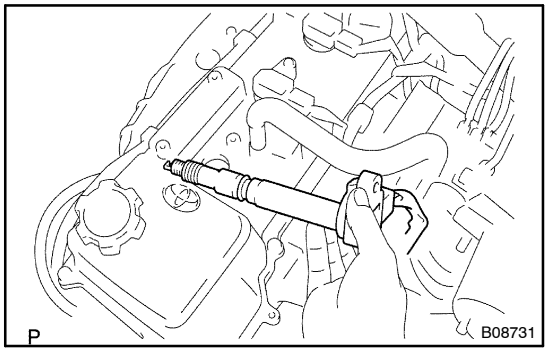
HINT:

At this time, you will hear a fuel flowing noise.

NG → **Proceed to page FI–1 of Pub. No. RM652E and continue to troubleshoot.**

OK

8	**Check for spark.**



PREPARATION:

(a) Remove the ignition coil.
(b) Remove the spark plug.
(c) Install the spark plug to the ignition coil, and connect the ignition coil connector.
(d) Hold the end at about 12.5 mm (0.5 in.) from the ground.
(e) Disconnect the injector connector.

CHECK:

Check if spark occurs while the engine is being cranked.

NOTICE:

To prevent excess fuel from being injected from the injectors during this test, do not crank the engine for more than 5 – 10 seconds at a time.

NG → **Proceed to page IG–1 and continue to trouble-shoot.**

OK

Proceed to problem symptoms table on page DI–21.

7. ENGINE OPERATING CONDITION

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.

(a) CARB mandated signals.

Hand–held tester display	Measurement Item	Normal Condition*
FUEL SYS #1	Fuel System Bank 1 OPEN: Air–fuel ratio feedback stopped CLOSED: Air–fuel ratio feedback operating	Idling after warming up: CLOSED
CALC LOAD	Calculator Load: Current intake air volume as a proportion of max. intake air volume	Idling: 15.9 – 22.8 % Racing without load (2,500 rpm): 15.2 – 22.1 %
WATER TEMP	Water temperature Sensor Value	After warming up: 80 – 95°C (176 – 203°F)
SHORT FT #1	Short–term Fuel Trim Bank 1	0 ± 20 %
LONG FT #1	Long–term Fuel Trim Bank 1	0 ± 20 %
ENGINE SPD	Engine Speed	Idling: 650 – 750 rpm
VEHICLE SPD	Vehicle Speed	Vehicle stopped: 0 km/h (0 mph)
IGN ADVANCE	Ignition Advance: Ignition Timing of Cylinder No.1	Idling: BTDC 4 – 17°
INTAKE AIR	Intake Air temperature Sensor Value	Equivalent to ambient temperature
AIR FLOW	Air Flow Rate Through Air Flow Meter	Idling: 2.7 – 3.9 gm/sec. Racing without load (2,500 rpm): 9.2 – 13.3 gm/sec.
THROTTLE POS	Output voltage of Throttle Position Sensor Calculated as a percentage: 0 V → 0 %, 5 V → 100 %	Throttle fully closed: 7 – 11 % Throttle fully open: 65 – 75 %
O2S B1 S1	Output voltage of Oxygen Sensor Bank 1 Sensor 1	Idling: 0.1 – 0.9 V (0.56 – 0.76 V)
O2FT B1 S1	Oxygen Sensor Fuel Trim Bank 1 Sensor 1 (Same as SHORT FT #1)	0 ± 20 %
A/FS B1 S1	Voltage Output of A/F Sensor Bank 1 Sensor 1	Idling: 2.8 – 3.8 V
A/FFT B1 S1	A/F Sensor Fuel Trim Bank 1 Sensor 1 (Same as SHORT FT #1)	O ± 20 %

*1: If no conditions are specifically stated for "Idling", it means the shift lever is at the N or P position, the A/C switch is OFF and all accessory switches are OFF.

(b) TOYOTA enhanced signals.

Hand–held tester display	Measurement Item	Normal Condition*
MISFIRE RPM	Engine RPM for first misfire range	Misfire 0: 0 rpm
MISFIRE LOAD	Engine load for first misfire range	Misfire 0: 0 g/r
INJECTOR	Fuel injection time for cylinder No.1	Idling: 2.5 – 4.3 ms
ISC DUTY RATIO	Intake Air Control Valve Duty Ratio Opening ratio rotary solenoid type ISC valve	Idling: 24.8 – 50.0 %
STARTER SIG	Starter Signal	Cranking: ON
CTP SW	Closed Throttle Position Switch Signal	Throttle fully closed: ON
A/C SIG	A/C Switch Signal	A/C ON: ON
STOP LIGHT SW	Stop Light Switch Signal	Stop light switch ON: ON
FC IDL	Fuel Cut Idle: Fuel cut when throttle valve fully closed, during deceleration	Fuel cut operating: ON
FC TAU	Fuel Cut TAU: Fuel cut during very light load	Fuel cut operating: ON
CYL#1, CYL#2, CYL#3, CYL#4	Abnormal revolution variation for each cylinder	0 %
IGNITION	Total number of ignition for every 1,000 revolutions	0 – 2,000
EGRT GAS	EGR Gas temperature Sensor Value	EGR not operating: temperature between intake air temperature and water temperature
EGR SYSTEM	EGR System Operating Condition	Idling: OFF
A/C CUT SIG	A/C Cut Signal	A/C S/W OFF: ON
FUEL PUMP	Fuel Pump Signal	Idling: ON
EVAP (PURGE) VSV	EVAP VSV Signal	Idling: Below 30 %
TOTAL FT B1	Total Fuel Trim Bank 1: Average value for fuel trim system of bank 1	Idling: 0.8 – 1.2 V
O2 LR B1 S1	Oxygen Sensor Lean Rich Bank 1 Sensor 1: Response time for oxygen sensor output to switch from lean to rich	Idling after warming up: 0 – 1,000 msec.
O2 RL B1 S1	Oxygen Sensor Rich Lean Bank 1 Sensor 1: Response time for oxygen sensor output to switch from rich to lean	Idling after warming up: 0 – 1,000 msec.

*1: If no conditions are specifically stated for ”Idling”, it means the shift lever is at N or P position, the A/C switch is OFF and all accessory switches are OFF.