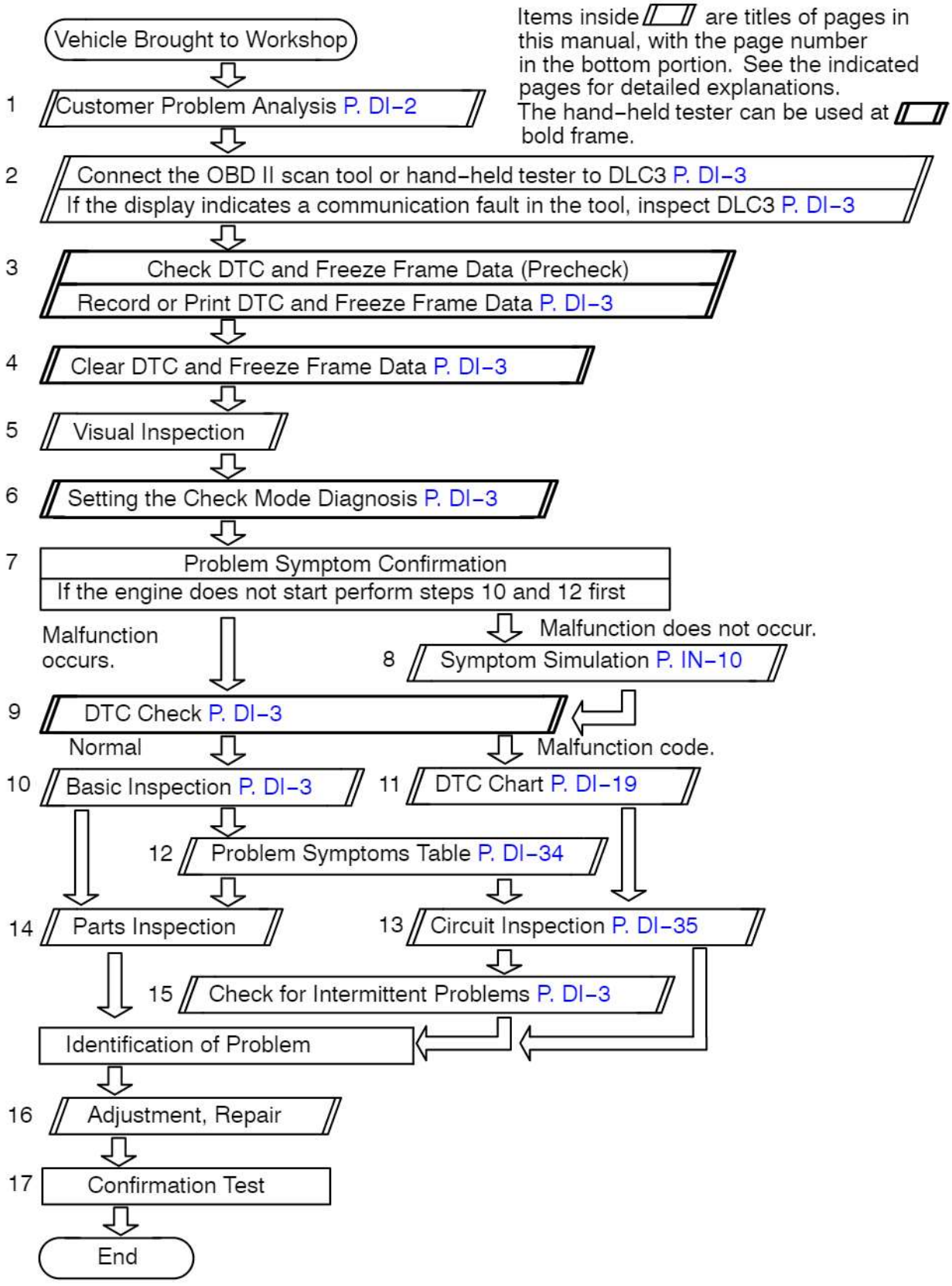
ENGINE

DI078–23

HOW TO PROCEED WITH TROUBLESHOOTING

Troubleshoot in accordance with the procedure on the following page.



DI079–16

CUSTOMER PROBLEM ANALYSIS CHECK

ENGINE CONTROL SYSTEM Check Sheet

Inspector's Name _____

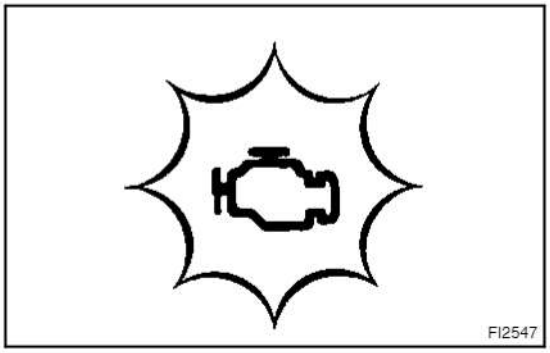
Customer's Name		VIN	
Driver's Name		Production Date	
Data Vehicle Brought in		Licence Plate No.	
Engine model		Odometer Reading	km miles

Problem Symptoms	☐ Engine does not Start	☐ Engine does not crank ☐ No initial combustion ☐ No complete combustion
	☐ Difficult to Start	☐ Engine cranks slowly ☐ Other _____
	☐ Poor Idling	☐ Incorrect first idle ☐ Idling rpm is abnormal ☐ High (rpm) ☐ Low (rpm) ☐ Rough idling ☐ Other _____
	☐ Poor Driveability	☐ Hesitation ☐ Back fire ☐ Muffler explosion (after–fire) ☐ Surging ☐ Knocking ☐ Other _____
	☐ Engine Stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ During A/C operation ☐ Shifting from N to D ☐ Other _____
	☐ Others	

Dates Problem Occurred		
Problem Frequency		☐ Constant ☐ Sometimes (times per day/month) ☐ Once only ☐ Other _____
Condition When Problem Occurs	Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Various/Other _____
	Outdoor Temperature	☐ Hot ☐ Warm ☐ Cool ☐ Cold (approx. ____ °C/____ °F)
	Place	☐ Highway ☐ Suburbs ☐ Inner city ☐ Uphill ☐ Downhill ☐ Rough road ☐ Other _____
	Engine Temp.	☐ Cold ☐ Warming up ☐ After warming up ☐ Any temp. ☐ Other _____
	Engine Operation	☐ Starting ☐ Just after starting (min.) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch ON/OFF ☐ Other _____

Condition of malfunction indicator light (MIL)		☐ Remains on	☐ Sometimes light up ☐ Does not light up
DTC Inspection	Normal Mode (Pre–check)	☐ Normal	☐ Malfunction code(s) (code) ☐ Freezed frame data ( )
	Check Mode	☐ Normal	☐ Malfunction code(s) (code) ☐ Freezed frame data ( )

DICT8–02


FI2547

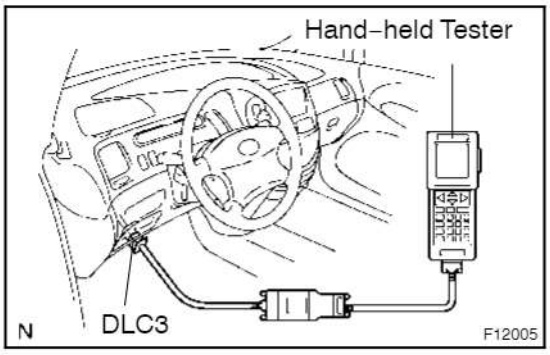
PRE–CHECK

1. DIAGNOSIS SYSTEM

(a) Description for Euro–OBD (European spec.)

- When troubleshooting Euro–OBD vehicles, you should connect a hand–held tester to the vehicle, and read various data output from the vehicle's engine control ECU.
- Euro–OBD regulations require that the vehicle's on–board computer illuminates the Check Engine Warning Light (CHK ENG) on the instrument panel when: (1) the computer detects a malfunction in the emission control system or components, (2) the power train control components (which affect vehicle emissions), or a computer malfunction occurs. In addition to the illumination of the CHK ENG when a malfunction is detected, the applicable Diagnostic Trouble Codes (DTCs) prescribed by ISO 15031–4 are recorded in the engine ECU memory (See page DI–19).

If the malfunction does not reoccur in 3 consecutive trips, the CHK ENG goes off automatically but the DTCs remain recorded in the engine ECU memory.

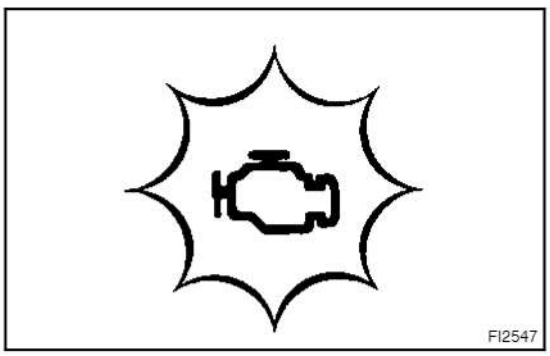


- To check the DTCs, connect the hand–held tester to Data Link Connector 3 (DLC3) on the vehicle. The hand–held tester also enables you to erase the DTCs and check freeze frame data and various forms of engine data.

  DTCs include ISO controlled codes and manufacturer defined codes. ISO controlled codes must be set as prescribed by the ISO, while manufacturer defined codes can be set freely by the manufacturer within the prescribed limits (See DTC Chart on page DI–19).

- The diagnosis system operates in normal mode during normal vehicle use. It also has check (test) mode for technicians to simulate malfunction symptoms and troubleshoot. Most DTCs use 2 trip detection logic* to prevent erroneous detection, and to ensure a thorough malfunction detection. By switching the engine ECU to check (test) mode using the hand–held tester when troubleshooting, a technician can cause the CHK ENG to illuminate for a malfunction that is only detected once or momentarily.
- *2 trip detection logic:
  When a malfunction is first detected, the pending fault code is 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 CHK ENG to illuminate (2nd trip). 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, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

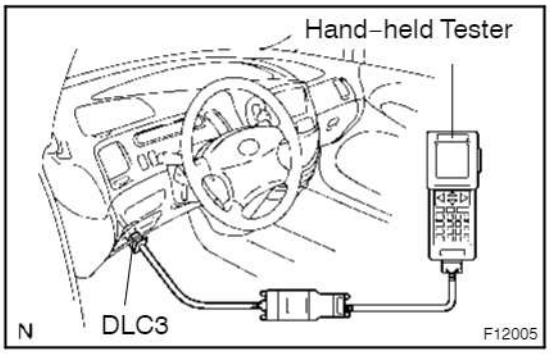
(b) Description for M–OBD (Except European specification)
When troubleshooting Multiplex On–Board Diagnostic (M–OBD) vehicles, the vehicle must be connected to the hand–held tester. Various data output from the engine ECU can then be read.



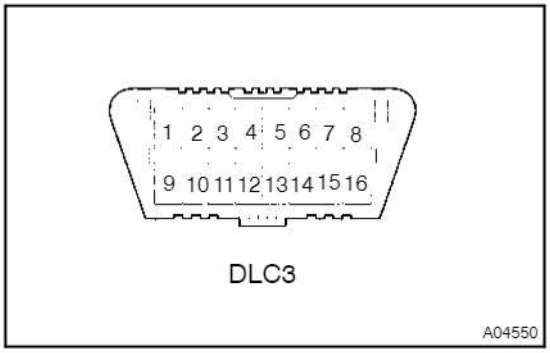
OBD regulations require that the vehicle's on–board computer illuminates the MIL on the instrument panel when the computer detects a malfunction in:

- The emission control system ./ components
- The powertrain control components (Which affect vehicle emissions)
- The computer
  In addition to, the applicable Diagnostic Trouble Codes (DTCs) are recorded in the ECU memory (See page DI–19).

If the malfunction does not recur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECU memory.



- To check the DTCs, connect the hand–held tester to the Data Link Connector 3 (DLC3) on the vehicle. Or, connect TC and CG terminals on the DLC3 and read the DTC on the multi information display. The hand–held tester also enables you to erase the DTCs and check the freeze frame data and various forms of engine data. (For operating instructions, see the instruction book.)
- The diagnosis system operates in normal mode during normal vehicle use. It also has check (test) mode for technicians to simulate malfunction symptoms and troubleshoot. Most DTCs use 2 trip detection logic* to prevent erroneous detection and to ensure thorough malfunction detection. By switching the engine ECU to check (test) mode using the hand–held tester when troubleshooting, a technician can cause the CHK ENG to illuminate for a malfunction that is only detected once or momentarily (hand–held tester only) (See step 3).
- * 2 trip detection logic:
  When a malfunction is first detected, the pending fault code is 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 CHK ENG to illuminate (2nd trip). However, the ignition switch must be turned OFF between the 1st trip and 2nd trip.
- Freeze frame data:
  Freeze frame data records the engine conditions (fuel system, calculator load, water temperature, fuel trim, engine speed, vehicle speed, etc.) when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.



(c) Check the DLC3.
The vehicle's engine ECU uses the ISO 9141–2 (Euro–OBD)/ ISO 14230 (M–OBD) communication protocol. The terminal arrangement of the DLC3 complies with ISO 15031–03 and matches the ISO 9141–2/ISO 14230 format.

Tester Connection	Condition	Specified Condition
7 (Bus + line) – 5 (Signal ground)	During communication	pulse generation
4 (Chassis ground) – Body ground	Constant	Below 1 Ω
5 (Signal ground) – Body ground	Constant	
16 (B+) – Body ground	Constant	9 to 14 V

HINT:
Connect the cable of the hand–held tester to the DLC3, turn the ignition switch ON and attempt to use the hand–held tester. If the screen displays UNABLE TO CONNECT TO VEHICLE, a problem exists in the vehicle side or the tester side.

- If communication is normal when the tester is connected to another vehicle, inspect the DLC3 on the original vehicle.
- If communication is still not possible when the tester is connected to another vehicle, the problem is probably in the tester itself. Consult the Service Department listed in the tester instruction manual.

(d) Inspect the battery voltage.
Battery voltage: 11 to 14 V

If voltage is below 11 V, recharge the battery before proceeding.

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

HINT:
If the CHK ENG is not illuminated, at this time troubleshoot the combination meter (See page DI–247).

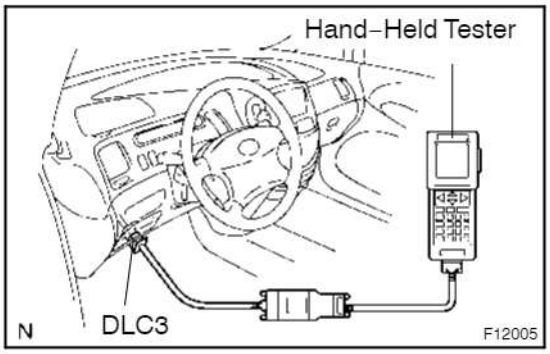
(2) When the engine is started, the CHK ENG should turn off. If the CHK ENG remains on, the diagnosis system has detected a malfunction or abnormality in the system.

**2. Normal Mode:
CHECK DTC**

NOTICE:

Hand–held tester only:

When the diagnosis system is switched from normal mode to check mode, all DTCs and freeze frame data recorded in the normal mode are erased. Before switching modes, always make check the DTCs and freeze frame data and note them down.



(a) Check DTCs.
  (1) Connect the hand–held tester to the DLC3.
  (2) Turn the ignition switch ON and push the hand–held tester main switch ON.
  (3) Use the hand–held tester to check the DTCs and freeze frame data and then write them down. If you need help with the hand–held tester, refer to the hand–held tester's instruction book.
  (4) See page DI–19 to confirm the details of the DTCs.

(b) Clear the DTC.
The DTCs and freeze frame data will be erased by either actions.
  (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 EFI and ECD and ETCS fuses.

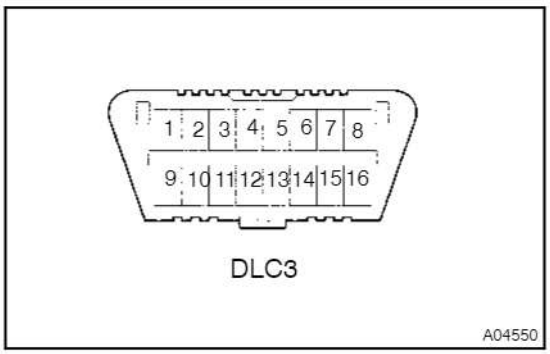
NOTICE:

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.

(c) Check the DTC for ETCS
  (1) Turn ignition switch ON.

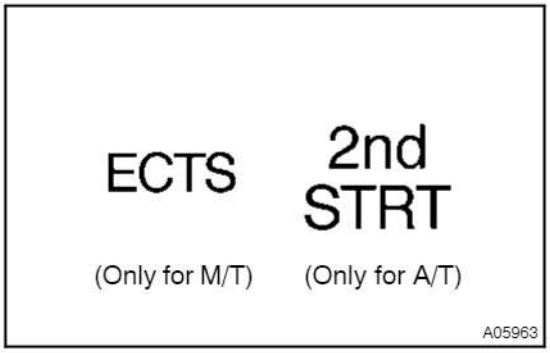
HINT:

If the 2nd STRT indicator (only for A/T)/ETCS indicator (only for M/T) does not light up, troubleshoot the combination meter.



  (2) Using SST, connect between terminals 13 (TC) and 4 (CG) of DLC3.

SST 09843–18040

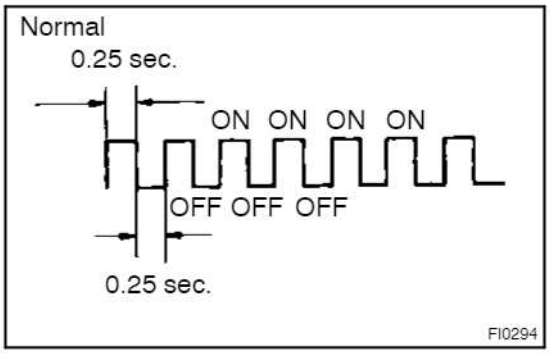


(3) Read the diagnostic trouble code from 2nd STRT indicator (only for A/T)/ETCS indicator (only for M/T) on the combination meter.

HINT:
If a DTC is not output, check the TC terminal circuit.

(4) Check details of the malfunction using the DTC chart on page DI–19.

(5) After completing the check, disconnect terminals 13 (TC) and 4 (CG) and turn off the display.

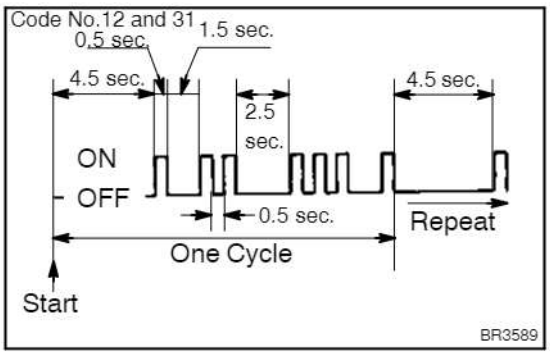


HINT:
In the event of 2 or more malfunction codes, indication will begin from the smaller numbered code and continue in order to the lager.

(d) Clear the DTC.
The DTCs and freezed frame data will be erased by either actions.

(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 of EFI and ECD and ETCS fuses.



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

3. Check Mode: CHECK DTC

HINT:
Hand–held tester only:
Compared to the normal mode, the check mode is more sensitive to malfunctions. Furthermore, the same diagnostic items which are detected in the normal mode can also be detected in the check (test) mode.

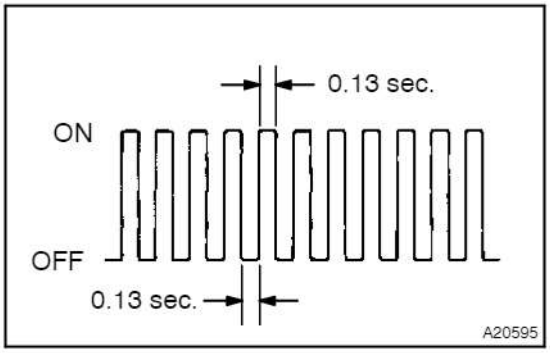
(a) Procedure for check mode using the hand–held tester.

(1) Check the initial conditions.
- Battery positive voltage 11 V or more.
- Throttle valve fully closed.
- Transmission in the P or N position.
- A/C switched 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 normal mode to check (test) mode. The CHK ENG blinks at 0.13 second intervals as shown in the illustration.

NOTICE:

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

(6) Start the engine (The CHK ENG goes off after the engine start.).

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

NOTICE:

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

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

HINT:

Be sure not to turn the ignition switch OFF. Doing so would change the engine control ECU from check mode to normal mode,resulting in all of the DTCs and freeze frame data being erased.

(9) After checking the DTCs, inspect the applicable circuits.

4. FAIL–SAFE CHART

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

DTC No.	Fail–Safe Operation	Fail–Safe Deactivation Conditions
P0031 P0032 P0037 P0038 P0051 P0052 P0057 P0058	Turn off heater of HO2S heater	Ignition switch OFF
P0100 P0102 P0103	Ignition timing is calculated from engine speed and throttle angle	"Pass" condition detected
P0110 P0112 P0113	Intake air temperature is fixed at 20°C (68°F)	"Pass" condition detected
P0115 P0117 P0118	Engine coolant temperature is fixed at 80°C (176°F)	"Pass" condition detected

P0120 P0121 P0122 P0123 P0220 P0222 P0223 P0604 P0607 P0657 P2102 P2103 P2111 P2112 P2118 P2119 P2135	If the Electronic Throttle Control System (ETCS) has a malfunction, the engine control ECU cuts off current to the throttle control motor. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of the return spring. The engine control ECU then adjusts the engine output by controlling the fuel injection (intermittent fuel–cut) and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue at a minimal speed.	"Pass" condition is detected and then the ignition switch is turned OFF.
P0325 P0330	Max. timing retardation	Ignition switch OFF
P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	Fuel cut	"Pass" condition detected
P2120 P2121 P2122 P2123 P2125 P2127 P2128 P2138	The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the engine control ECU switches to limp mode. In limp mode, the remaining circuit is used to calculate the accelerator pedal opening to allow the vehicle to continue driving. If both circuits malfunction, the engine control ECU regards the opening angle of the accelerator pedal to be fully closed. In this case, the throttle valve will remain closed as if the engine is idling.	"Pass" condition is detected and the ignition switch is turned OFF.

5. CHECK FOR INTERMITTENT PROBLEMS

Hand–held tester only:

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

(a) Clear the DTC (See step 2).
(b) Set the check mode (See step 3).
(c) Perform a simulation test (See page IN–10).
(d) Check the connector and terminal (See page IN–20).
(e) Wiggle the harness and the connector (See page IN–10).

6. DATA LIST

HINT:

Using the DATA LIST displayed by the hand–held tester, you can read the value of the switches, sensors, actuators and other parts without parts removal. Reading the DATA LIST as the first step of troubleshooting is one way to shorten the diagnostic time.

NOTICE:

The values given below for "Normal Condition" are representative values. A vehicle may still be normal even if its value differs from those listed here. Do not solely depend on the "Normal Condition" here when deciding whether a part is faulty or not.

(a) Warm up the engine.
(b) Turn the ignition switch OFF.
(c) Connect the hand–held tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Push the "ON" button of the hand–held tester.
(f) Select the item "DIAGNOSIS / OBD/MOBD / DATA LIST".
(g) According to the display on the tester, read the "DATA LIST".

HINT:

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

Item	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
INJECTOR	Injection period of the No. 1 cylinder/ Min.: 0 ms, Max.: 32.64 ms	Idling: 2.1 to 3.9 ms	–
IGN ADVANCE	Ignition timing advance for No.1 cylinder/ Min.: –64 deg., Max.: 63.5 deg.	Idling: BTDC 5 to 25˚	–
CALC LOAD	Calculated load by engine control ECU/ Min.: 0%, Max.: 100%	• Idling: 12.5 to 19.7% • Racing without load (2,500 rpm): 10.7 to 17.9%	–
MAF	Air flow rate from MAF sensor/ Min.: 0 gm/s, Max.: 655 gm/s	• Idling: 4.1 to 6.4 gm/sec. • Racing without load (2,500 rpm): 12.5 to 20.8 gm/sec.	If value is approximately 0.0 gm/s: • Mass air flow meter power source circuit open • VG circuit open or short If value is 160.0 gm/s or more: • E2G circuit open
ENGINE SPD	Engine Speed/ Min.: 0 rpm, Max.: 16,383 rpm	Idling: 650 to 750 rpm	–
COOLANT TEMP	Coolant temperature/ Min.: –40˚C, Max.: 140˚C	After warming up: 80 to 95˚C (176 to 203˚F)	• If value is –40°C (–40°F): sensor circuit is open. • If value is 140°C (284°F) or more: sensor circuit is shorted.
INTAKE AIR	Intake air temperature/ Min.: –40 ˚C, Max.: 140 ˚C	Equivalent to ambient temp. (After cold soak)	
THROTTLE POS	Absolute throttle position sensor/ Min.: 0%, Max.: 100%	• Throttle fully closed: 10 to 24% • Throttle fully open: 66 to 98%	Read value with the ignition switch ON (Do not start engine).
THROTTLE INITIAL	Throttle fully closed rearing value	0.5 to 0.9 V	–
CTP SW	Closed throttle position switch/ ON or OFF	• Throttle fully closed: ON • Throttle open: OFF	–
VEHICLE SPD	Vehicle speed/ Min.: 0 km/h, Max.: 255 km/h	Vehicle stopped: 0 km/h (0 mph)	Speed indicated on speedometer

O2S B1 S1 (*1)	Oxygen sensor output voltage of the bank 1 sensor 1/ Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check the voltage output of each sensor.
O2S B2 S1 (*1)	Oxygen sensor output voltage of the bank 2 sensor 1/ Min.: 0 V, Max.: 1.275 V		Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check the voltage output of each sensor.
O2S B1 S2 (*1)	Oxygen sensor output voltage of the bank 1 sensor 2/ Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check the voltage output of each sensor.
O2S B2 S2 (*1)	Oxygen sensor output voltage of the bank 2 sensor 2/ Min.: 0 V, Max.: 1.275 V		Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check the voltage output of each sensor.
SHORT FT #1 (*1)	Short term fuel trim of bank 1/ Min.: –100%, Max.: 100%	0 ± 20%	This item is short–term fuel compensation used to maintain air–fuel ratio at stoichiometric air–fuel ratio
LONG FT #1 (*1)	Long term fuel trim of bank 1/ Min.: –100%, Max.: 100%	0 ± 20%	This item is overall, long–term fuel compensation that helps to maintain air–fuel ratio at stoichiometric air–fuel ratio (steadies long term deviations of short–term fuel trim from central value)
TOTAL FT #1 (*1)	Total fuel trim of bank 1/ (SHORT FT #1 + LONG FT #1) Min.: 0.5, Max.: 1.496	0.6 to 1.4	–
SHORT FT #2 (*1)	Short term fuel trim of bank 2/ Min.: –100%, Max.: 100%	0 ± 20%	Same as SHORT FT #1
LONG FT #2 (*1)	Long term fuel trim of bank 2/ Min.: –100%, Max.: 100%	0 ± 20%	Same as LONG FT #1
TOTAL FT #2 (*1)	Total fuel trim of bank 2/ (SHORT FT #2 + LONG FT #2) Min.: 0.5, Max.: 1.496	0.6 to 1.4	–
O2FT B1 S1 (*1)	Short term fuel trim associated with the bank 1, sensor 1/ Min.: –100%, Max.: 100%	0 ± 20%	Same as SHORT FT #1
O2FT B1 S2 (*1)	Short term fuel trim associated with the bank 1, sensor 2/ Min.: –100%, Max.: 100%	0 ± 20%	Same as SHORT FT #2
O2FT B2 S1 (*1)	Short term fuel trim associated with the bank 2, sensor 1/ Min.: –100%, Max.: 100%	0 ± 20%	Same as SHORT FT #1
O2FT B2 S2 (*1)	Short term fuel trim associated with the bank 2, sensor 2/ Min.: –100%, Max.: 100%	0 ± 20%	Same as SHORT FT #2
O2 LR B1 S1 (*1)	Response time of the O2 sensor lean to rich (bank 1, sensor 1)/ Min.: 0 ms, Max.: 16,711 ms	Idling after warming up: 0 to 1,000 ms	–
O2 LR B2 S1 (*1)	Response time of the O2 sensor lean to rich (bank 2, sensor 1)/ Min.: 0 ms, Max.: 16,711 ms	Idling after warming up: 0 to 1,000 ms	–

O2 RL B1 S1 (*1)	Response time of the O2 sensor rich to lean (bank 1, sensor 1)/ Min.: 0 ms, Max.: 16,711 ms	Idling after warming up: 0 to 1,000 ms	–
O2 RL B2 S1 (*1)	Response time of the O2 sensor rich to lean (bank 2, sensor 1)/ Min.: 0 ms, Max.: 16,711 ms		–
O2 LR B1 S2 (*1)	Response time of the O2 sensor lean to rich (bank 1, sensor 2)/ Min.: 0 ms, Max.: 16,711 ms	–	–
O2 LR B2 S2 (*1)	Response time of the O2 sensor lean to rich (bank 2, sensor 2)/ Min.: 0 ms, Max.: 16,711 ms	–	–
O2 RL B1 S2 (*1)	Response time of the O2 sensor rich to lean (bank 1, sensor 2)/ Min.: 0 ms, Max.: 16,711 ms	–	–
O2 RL B2 S2 (*1)	Response time of the O2 sensor rich to lean (bank 2, sensor 2)/ Min.: 0 ms, Max.: 16,711 ms		–
FUEL SYS #1 (*1)	Fuel system status (Bank1)/ OL or CL or OLDRIVE or OL-FAULT or CLFAULT	Idling after warming up: CL	• Fuel System Status (Bank 1)/ • OL: Open Loop • CL: Closed Loop • OL DRIVE: OL due to driving conditions (ex: when fuel enrichment) • OL FAULT: OL due to detected system fault • CL FAULT: CL is controlled by only one front HO2S (the other front HO2S malfunctions)
FUEL SYS #2 (*1)	Fuel system status (Bank2)/ OL or CL or OLDRIVE or OL-FAULT or CLFAULT		
FC IDL	Idle fuel cut/ ON or OFF	Fuel cut operation: ON	FC IDL = "ON" when throttle valve fully closed and engine speed is over 1,500 rpm.
MIL	MIL status/ ON or OFF	MIL ON: ON	–
STARTER SIG	Starter signal/ ON or OFF	Cranking: ON	–
A/C SIG	A/C signal/ ON or OFF	A/C ON: ON	–
PNP SW [NSW] (*2)	Park/neutral position switch signal/ ON or OFF	P or N range: ON	–
ELECT LOAD SIG	Electrical load signal/ ON or OFF	Defogger switch ON: ON	–
STOP LIGHT SW	Stop light switch/ ON or OFF	• Brake pedal depressed: ON • Brake pedal released: OFF	–
FUEL PMP SP CTL	Fuel pump speed control status/ ON (Low speed) or OFF (High speed)	Idling: ON	–
FUEL PUMP/SPD	Fuel pump/speed status/ ON or OFF	Idling: ON	–
A/C MAG CLUTCH	A/C magnet clutch status/ ON or OFF	A/C magnet clutch ON: ON	–

EVAP VSV	VSV status for EVAP control/ ON or OFF	VSV operating: ON	VSV for EVAP is controlled by the engine control ECU (ground side duty control)
IGNITION (*1)	Ignition counter/ Min.: 0, Max.: 400	0 to 400	–
CYL #1 – CYL #8 (*1)	Misfire ratio of the cylinder/ Min.: 0%, Max.: 50%	0%	This item is displayed in only idling
MISFIRE LOAD (*1)	Engine load for first misfire range/ Min.: 0 g/rev, Max.: 3.98 g/rev	Misfire 0: 0 g/rev	–
MISFIRE RPM (*1)	Engine RPM for first misfire range/ Min.: 0 rpm, Max.: 6,375 rpm	Misfire 0: 0 rpm	–
MIL ON RUN DIST (*1)	This parameter indicates the distance travelled while CHK ENG is activated/ Min.: 0 km, Max.: 65.535 km	When there is no DTC: 0 km	–

*1: Unleaded gasoline engine only.
*2: A/T only

7. ACTIVE TEST

HINT:
Performing the hand–held tester ACTIVE TEST allows relay, VSV, actuator and other items to be operated without parts removal. Performing the ACTIVE TEST early in troubleshooting is one way to shorten labor time.
The DATA LIST can be displayed during the ACTIVE TEST.

(a) Turn the ignition switch OFF.
(b) Connect the hand–held tester.
(c) Turn the ignition switch ON.
(d) Push the "ON" button of the hand–held tester.
(e) Select the item "DIAGNOSIS / OBD/MOBD / ACTIVE TEST".
(f) According to the display on the tester, perform the "ACTIVE TEST".

Hand–held Tester Display	Test Details	Diagnostic Note
INJ VOL	[Test Details] Control injection volume Min.: –12.5 %, Max.: 25 % [Vehicle Condition] Engine speed: 3,000 rpm or less	Injector volume is gradually changed between –12.5 and 25 %
A/F CONTROL	[Test Details] Control injection volume –12.5 or 25 % (Change the injection volume –12.5 % or 25 %) [Vehicle Condition] Engine speed: 3,000 rpm or less	Following procedure of A/F CONTROL enables the technician to check and graph voltage outputs of both the A/F sensor and heated oxygen sensor: (a) Enter "ACTIVE TEST / A/F CONTROL / USER DATA" (b) Select "F4"
EVAP (PURGE) VSV	Activate VSV for EVAP (Purge) control ON or OFF	–
A/C MAG CLUTCH	[Test Details] Control A/C magnet clutch ON or OFF	–
FUEL PUMP SP CTL	ON: Low speed OFF: High speed	–

FUEL PUMP / SPD	[Test Details] Control fuel pump ON or OFF	–
TC/TE1	[Test Details] Connection TC and TE1 ON: TC and TE1 connected OFF: TC and TE1 disconnected	–
FC IDL PROHBT	[Test Details] Deceleration fuel–cut prohibit ON or OFF	–

8. BASIC INSPECTION

When the malfunction is not confirmed in the DTC check, troubleshooting should be carried out in all the possible circuits considered as causes of the problem. In many cases, by carrying out the basic engine check shown in the following flowchart, the location causing the problem can be found quickly and efficiently. Therefore, using this check is essential in the engine troubleshooting.

1	**Is battery positive voltage 11 V or more when engine stopped?**

NO → **Charge or replace battery.**

YES

2	**Is engine cranked?**

NO → **Proceed to page DI–34, and continue to troubleshoot.**

YES

3	**Does engine start?**

NO → **Go to step 6.**

YES

4	**Check air filter.**

PREPARATION:
Remove the air filter.
CHECK:
Visual check that the air filter is not excessively dirty or oily.

NG → **Repair or replace air filter.**

OK ↓

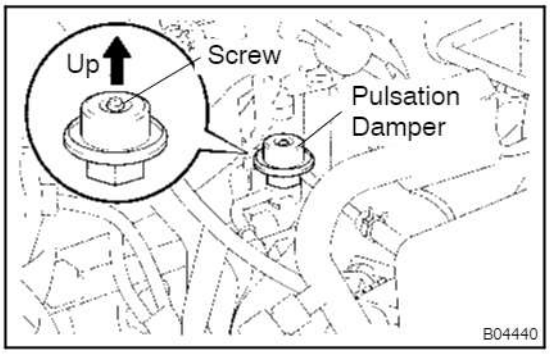
5	**Check idle speed.**

PREPARATION:
(a) Warm up the engine to the normal operating temperature.
(b) Switch off all the accessories.
(c) Switch off the A/C.
(d) Shift the transmission into the N position.
(e) Connect the hand–held tester to the DLC3 of the vehicle.
CHECK:
Use CURRENT DATA to check the idle speed.
OK:
Idle speed: 650 to 750 rpm

NG → **Proceed to problem symptoms table on page DI–34.**

OK ↓

6	**Check fuel pressure.**



PREPARATION:

(a) Be sure that enough fuel is in the tank.
(b) Connect the hand–held tester to the DLC3.
(c) Turn the ignition switch ON and push the hand–held tester main switch ON.
(d) Use the ACTIVE TEST mode to operate the fuel pump.
(e) Please 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 (See Pub. No. RM630E, page FI–7).

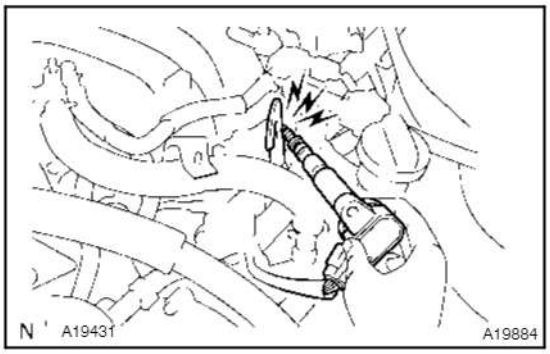
CHECK:

Check that the pulsation damper screw rises up when the fuel pump operation (See Pub. No. RM630E, page FI–7).
HINT:
At this time, you will hear a fuel flowing noise.

NG → **Proceed to Pub. No. RM630E, page FI–7 and continue to troubleshoot.**

OK

7	Check for spark.



PREPARATION:

(a) Disconnect the ignition coil.
(b) Remove the spark plug.
(c) Install the spark plug to the ignition coil.
(d) Disconnect the injector connector.
(e) Ground the spark plug.

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, don't crank the engine for more than 5 to 10 seconds at a time.

NG → **Proceed to Pub. No. RM630E, page IG–1 and continue to troubleshoot.**

OK

Proceed to problem symptoms table on page DI–34.

DI1L4–23

DIAGNOSTIC TROUBLE CODE CHART

HINT:

Parameters listed in the chart may not be exactly the same as your reading due to the type of instrument or other factors.

If a malfunction code is displayed during the DTC check in check mode, check the circuit for the codes listed in the table below. For details of each code, refer to the "See page" under the respective "DTC No." in the DTC chart.

UNLEADED GASOLINE ENGINE:

DTC No. (See page)	Detection Item	Trouble Area	CHK ENG*1	Memory
P0031 (DI–35)	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	• Open in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine ECU	○	○
P0032 (DI–35)	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 1)	• Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine ECU	○	○
P0037 (DI–35)	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	• Open in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine ECU	○	○
P0038 (DI–35)	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	• Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine ECU	○	○
P0051 (DI–35)	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	• Open in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine ECU	○	○
P0052 (DI–35)	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 1)	• Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine ECU	○	○
P0057 (DI–35)	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)	• Open in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine ECU	○	○
P0058 (DI–35)	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	• Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine ECU	○	○
P0100 (DI–42)	Mass or Volume Air Flow Circuit	• Open or short in mass air flow meter circuit • Mass air flow meter • Engine ECU	○	○
P0102 (DI–42)	Mass or Volume Air Flow Circuit Low Input	• Open or short in mass air flow meter circuit • Mass air flow meter • Engine ECU	○	○
P0103 (DI–42)	Mass or Volume Air Flow Circuit High Input	• Open or short in mass air flow meter circuit (+B circuit) • Mass air flow meter • Engine ECU	○	○

P0110 (DI–50)	Intake Air Temperature Circuit	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • Engine ECU	○	○
P0112 (DI–50)	Intake Air Temperature Circuit Low Input	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • Engine ECU	○	○
P0113 (DI–50)	Intake Air Temperature Circuit High Input	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • Engine ECU	○	○
P0115 (DI–56)	Engine Coolant Temperature Circuit	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • Engine ECU	○	○
P0116 (DI–62)	Engine Coolant Temperature Circuit Range/Performance Problem	• Engine coolant temperature sensor	○	○
P0117 (DI–56)	Engine Coolant Temperature Circuit Low Input	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • Engine ECU	○	○
P0118 (DI–56)	Engine Coolant Temperature Circuit High Input	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • Engine ECU	○	○
P0120 (DI–63)	Throttle Pedal Position Sensor/ Switch "A" Circuit	• Throttle control motor and sensor • Engine ECU	○	○
P0121 (DI–74)	Throttle/Pedal Position Sensor/ Switch "A" Circuit Range/Performance Problem	• Throttle control motor and sensor	○	○
P0122 (DI–63)	Throttle/Pedal Position Sensor/ Switch "A" Circuit Low Input	• Throttle control motor and sensor • Short in VTA1 circuit • Open in VC circuit • Engine ECU	○	○
P0123 (DI–63)	Throttle/Pedal Position Sensor/ Switch "A" Circuit High Input	• Throttle control motor and sensor • Open in VTA1 circuit • Open in E2 circuit • VC and VTA1 circuit are short–circuited • Engine ECU	○	○
P0130*3 (DI–75)	Oxygen Sensor Circuit (Bank 1 Sensor 1)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • Injector • Engine ECU	○	○
P0133*3 (DI–85)	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 1)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • Injector • Engine ECU	○	○

P0134 (DI–95)	Oxygen Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • PCV hose connection • PCV valve and hose • Injector • Gas leakage on exhaust system • PCV piping • Engine ECU	○	○
P0136 (DI–104)	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay	○	○
P0150*3 (DI–75)	Oxygen Sensor Circuit (Bank 2 Sensor 1)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • Injector • Engine ECU	○	○
P0153*3 (DI–85)	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 1)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • Injector • Engine ECU	○	○
P0154 (DI–95)	Oxygen Sensor Circuit No Activity Detected (Bank 2 Sensor 1)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • PCV hose connection • PCV valve and hose • Injector • Gas leakage on exhaust system • PCV piping • Engine ECU	○	○
P0156 (DI–104)	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay	○	○

P0171*3 (DI–111)	System too Lean (Bank 1)	• Air induction system • Injector blockage • Mass air flow meter • Engine coolant temperature sensor • Fuel pressure • Gas leakage on exhaust system • Open or short in heated oxygen sensor (bank 1 sensor 1) circuit • Heated oxygen sensor (bank 1 sensor 1) • Heated oxygen sensor heater • EFI or ECD relay • PCV piping • Engine ECU	○	○
P0172*3 (DI–111)	System too Rich (Bank 1)	• Injector leak, blockage • Mass air flow meter • Engine coolant temperature sensor • Ignition system • Fuel pressure • Gas leakage in exhaust system • Open or short in heated oxygen sensor (bank 1 sensor 1) circuit • Heated oxygen sensor (bank 1 sensor 1) • Engine ECU	○	○
P0174*3 (DI–111)	System too Lean (Bank 2)	• Air induction system • Injector blockage • Mass air flow meter • Engine coolant temperature sensor • Fuel pressure • Gas leakage on exhaust system • Open or short in heated oxygen sensor (bank 2 sensor 1) circuit • Heated oxygen sensor (bank 2 sensor 1) • Heated oxygen sensor heater • EFI or ECD relay • PCV piping • Engine ECU	○	○
P0175*3 (DI–111)	System too Rich (Bank 2)	• Injector leak, blockage • Mass air flow meter • Engine coolant temperature sensor • Ignition system • Fuel pressure • Gas leakage in exhaust system • Open or short in heated oxygen sensor (bank 2 sensor 1) circuit • Heated oxygen sensor (bank 2 sensor 1) • Engine ECU	○	○
P0220 (DI–63)	Throttle/Pedal Position Sensor/ Switch "B" Circuit	• Throttle control motor and sensor • Engine ECU	○	○
P0222 (DI–63)	Throttle/Pedal Position Sensor/ Switch "B" Circuit Low Input	• Throttle control motor and sensor • Short in VTA2 circuit • Open in VC circuit • Engine ECU	○	○
P0223 (DI–63)	Throttle/Pedal Position Sensor/ Switch "B" Circuit High Input	• Throttle control motor and sensor • Open in VTA2 circuit • Open in E2 circuit • VC and VTA2 circuit are short–circuited • Engine ECU	○	○

P0230 (DI–125)	Fuel Pump Primary Circuit	• Open or short in fuel pump relay circuit • Fuel pump relay • Circuit opening relay • Fuel pump • Engine ECU	–	○
P0300*3 (DI–130)	Random/Multiple Cylinder Misfire Detected	• Open or short in engine wire • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve clearance • Valve timing • PCV piping • Engine ECU	○*2	○
P0301*3 (DI–130)	Cylinder 1 Misfire Detected		○*2	○
P0302*3 (DI–130)	Cylinder 2 Misfire Detected		○*2	○
P0303*3 (DI–130)	Cylinder 3 Misfire Detected		○*2	○
P0304*3 (DI–130)	Cylinder 4 Misfire Detected		○*2	○
P0305*3 (DI–130)	Cylinder 5 Misfire Detected		○*2	○
P0306*3 (DI–130)	Cylinder 6 Misfire Detected		○*2	○
P0307*3 (DI–130)	Cylinder 7 Misfire Detected		○*2	○
P0308*3 (DI–130)	Cylinder 8 Misfire Detected		○*2	○
P0325 (DI–148)	Knock Sensor 1 Circuit (Bank 1 or Single Sensor)	• Open or short in knock sensor 1 circuit • Knock sensor 1 (looseness) • Engine ECU	○	○
P0330 (DI–148)	Knock Sensor 2 Circuit (Bank 2)	• Open or short in knock sensor 2 circuit • Knock sensor 2 (looseness) • Engine ECU	○	○
P0335 (DI–152)	Crankshaft Position Sensor "A" Circuit	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Signal plate • Engine ECU	○	○
P0339 (DI–152)	Crankshaft Position Sensor "A" Circuit Intermittent	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Signal plate • Engine ECU	–	○
P0340 (DI–157)	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	• Open or short in camshaft position sensor circuit • Camshaft position sensor • LH camshaft timing pulley • Jumping teeth of timing belt • Engine ECU	○	○
P0341 (DI–157)	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 1 or Single Sensor)		○	○
P0351 (DI–161)	Ignition Coil "A" Primary/Secondary Circuit	• Open or short in IGF 1 and IGT 1 circuit from No. 1 ignition coil with igniter to engine ECU • No. 1 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0352 (DI–161)	Ignition Coil "B" Primary/Secondary Circuit	• Open or short in IGF 2 and IGT 2 circuit from No. 2 ignition coil with igniter to engine ECU • No. 2 ignition coil with igniter • Ignition system • Engine ECU	○	○

P0353 (DI–161)	Ignition Coil "C" Primary/Secondary Circuit	• Open or short in IGF 2 and IGT 3 circuit from No. 3 ignition coil with igniter to engine ECU • No. 3 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0354 (DI–161)	Ignition Coil "D" Primary/Secondary Circuit	• Open or short in IGF 1 and IGT 4 circuit from No. 4 ignition coil with igniter to engine ECU • No. 4 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0355 (DI–161)	Ignition Coil "E" Primary/Secondary Circuit	• Open or short in IGF 2 and IGT 5 circuit from No. 5 ignition coil with igniter to engine ECU • No. 5 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0356 (DI–161)	Ignition Coil "F" Primary/Secondary Circuit	• Open or short in IGF 1 and IGT 6 circuit from No. 6 ignition coil with igniter to engine ECU • No. 6 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0357 (DI–161)	Ignition Coil "G" Primary/Secondary Circuit	• Open or short in IGF 1 and IGT 7 circuit from No. 7 ignition coil with igniter to engine ECU • No. 7 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0358 (DI–161)	Ignition Coil "H" Primary/Secondary Circuit	• Open or short in IGF 2 and IGT 8 circuit from No. 8 ignition coil with igniter to engine ECU • No. 8 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0420*3 (DI–172)	Catalyst System Efficiency Below Threshold (Bank 1)	• Gas leakage on exhaust system • Heated oxygen sensor (bank 1 sensor 1, 2) • Three–way catalytic converter	○	○
P0430*3 (DI–172)	Catalyst System Efficiency Below Threshold (Bank 2)	• Gas leakage on exhaust system • Heated oxygen sensor (bank 2 sensor 1, 2) • Three–way catalytic converter	○	○
P0443 (DI–179)	Evaporative Emission Control System Purge Control Valve Circuit	• VSV for EVAP • Open or short in VSV circuit for EVAP • Engine ECU	○	○
P0500 (DI–182)	Vehicle Speed Sensor "A"	• Combination meter • Open or short in vehicle speed sensor circuit • Vehicle speed sensor • Engine ECU	○	○
P0503 (DI–182)	Vehicle Speed Sensor "A" Intermittent/Erratic/High		–	○
P0504 (DI–185)	Brake Switch "A"/"B" Correlation	• Short in stop lamp switch signal circuit • STOP fuse • Stop lamp switch • Engine ECU	–	○
P0505*3 (DI–193)	Idle Air Control System	• Air induction system • Electric throttle control system • PCV hose connection	○	○
P0560 (DI–196)	System Voltage	• Back–up power source circuit • EFI or ECD No. 1 fuse • Engine ECU	○	○
P0604 (DI–199)	Internal Control Module Random Access Memory (RAM) Error	• Engine ECU	○	○

P0606 (DI–199)	Engine ECU/PCM Processor	• Engine ECU	○	○
P0607 (DI–199)	Control Module Performance	• Engine ECU	○	○
P0617 (DI–200)	Starter Relay Circuit High	• Park/neutral position switch • Starter relay circuit • Ignition switch • Engine ECU	○	○
P0657 (DI–199)	Actuator Supply Voltage Circuit / Open	• Engine ECU	○	○
P2102 (DI–206)	Throttle Actuator Control Motor Circuit Low	• Open in throttle control motor and sensor circuit • Throttle control motor and sensor • Engine ECU	○	○
P2103 (DI–206)	Throttle Actuator Control Motor Circuit High	• Short in throttle control motor and sensor circuit • Throttle control motor and sensor • Throttle valve • Throttle body • Engine ECU	○	○
P2111 (DI–209)	Throttle Actuator Control System – Stuck Open	• Throttle control motor and sensor circuit • Throttle control motor and sensor • Throttle valve • Throttle body	○	○
P2112 (DI–209)	Throttle Actuator Control System – Stuck Closed	• Throttle control motor and sensor circuit • Throttle control motor and sensor • Throttle valve • Throttle body	○	○
P2118 (DI–212)	Throttle Actuator Control Motor Current Range/Performance	• Open in throttle control motor and sensor power source circuit • ETCS fuse • Engine ECU	○	○
P2119 (DI–216)	Throttle Actuator Control Throttle Body Range/Performance	• Electric throttle control system • Throttle body	○	○
P2120 (DI–218)	Throttle/Pedal Position Sensor/ Switch "D" Circuit	• Accelerator pedal position sensor • Engine ECU	○	○
P2121 (DI–225)	Throttle/Pedal Position Sensor/ Switch "D" Circuit Range/Performance	• Accelerator pedal position sensor	○	○
P2122 (DI–218)	Throttle/Pedal Position Sensor/ Switch "D" Circuit Low Input	• Accelerator pedal position sensor • VCPA circuit open • VPA circuit open or ground short • Engine ECU	○	○
P2123 (DI–218)	Throttle/Pedal Position Sensor/ Switch "D" Circuit High Input	• Accelerator pedal position sensor • EPA circuit open • Engine ECU	○	○
P2125 (DI–218)	Throttle/Pedal Position Sensor/ Switch "E" Circuit	• Accelerator pedal position sensor • Engine ECU	○	○
P2127 (DI–218)	Throttle/Pedal Position Sensor/ Switch "E" Circuit Low Input	• Accelerator pedal position sensor • VCP2 circuit open • VPA2 circuit open or ground short • Engine ECU	○	○
P2128 (DI–218)	Throttle/Pedal Position Sensor/ Switch "E" Circuit High Input	• Accelerator pedal position sensor • EPA circuit open • Engine ECU	○	○

P2135 (DI–63)	Throttle Pedal Position Sensor/ Switch "A" / "B" Voltage Correlation	• VTA1 and VTA2 circuit are short–circuited • Throttle control motor and sensor • Engine ECU	○	○
P2138 (DI–218)	Throttle Pedal Position Sensor/ Switch "D" / "E" Voltage Correlation	• VPA and VPA2 circuit are short circuited • Accelerator pedal position sensor • Engine ECU	○	○
P2195*3 (DI–75)	Oxygen Sensor Signal Stuck Lean (Bank 1 Sensor 1)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • Injector • Engine ECU	○	○
P2196*3 (DI–75)	Oxygen Sensor Signal Stuck Rich (Bank 1 Sensor 1)		○	○
P2197*3 (DI–75)	Oxygen Sensor Signal Stuck Lean (Bank 2 Sensor 1)		○	○
P2198*3 (DI–75)	Oxygen Sensor Signal Stuck Rich (Bank 2 Sensor 1)		○	○

*1: – .... Check engine warning light does not light up.
○ .... Check engine warning light lights up.
*2: Check engine warning light lights up or blinks.
*3: Europe only

LEADED GASOLINE ENGINE:

DTC No. (See page)	Detection Item	Trouble Area	CHK ENG*1	Memory
P0100/31 (DI–42)	Mass or Volume Air Flow Circuit	• Open or short in mass air flow meter circuit • Mass air flow meter • Engine ECU	○	○
P0102/31 (DI–42)	Mass or Volume Air Flow Circuit Low Input	• Open or short in mass air flow meter circuit • Mass air flow meter • Engine ECU	○	○
P0103/31 (DI–42)	Mass or Volume Air Flow Circuit High Input	• Open or short in mass air flow meter circuit (+B circuit) • Mass air flow meter • Engine ECU	○	○
P0110/24 (DI–50)	Intake Air Temperature Circuit	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • Engine ECU	○	○
P0112/24 (DI–50)	Intake Air Temperature Circuit Low Input	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • Engine ECU	○	○
P0113/24 (DI–50)	Intake Air Temperature Circuit High Input	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • Engine ECU	○	○
P0115/22 (DI–56)	Engine Coolant Temperature Circuit	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • Engine ECU	○	○
P0117/22 (DI–56)	Engine Coolant Temperature Circuit Low Input	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • Engine ECU	○	○
P0118/22 (DI–56)	Engine Coolant Temperature Circuit High Input	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • Engine ECU	○	○
P0120/41 (DI–63)	Throttle Pedal Position Sensor/ Switch "A" Circuit	• Throttle control motor and sensor • Engine ECU	○	○
P0121/41 (DI–74)	Throttle/Pedal Position Sensor/ Switch "A" Circuit Range/Performance Problem	• Throttle control motor and sensor	○	○
P0122/41 (DI–63)	Throttle/Pedal Position Sensor/ Switch "A" Circuit Low Input	• Throttle control motor and sensor • Short in VTA1 circuit • Open in VC circuit • Engine ECU	○	○
P0123/41 (DI–63)	Throttle/Pedal Position Sensor/ Switch "A" Circuit High Input	• Throttle control motor and sensor • Open in VTA1 circuit • Open in E2 circuit • VC and VTA1 circuit are short–circuited • Engine ECU	○	○
P0220/41 (DI–63)	Throttle/Pedal Position Sensor/ Switch "B" Circuit	• Throttle control motor and sensor • Engine ECU	○	○
P0222/41 (DI–63)	Throttle/Pedal Position Sensor/ Switch "B" Circuit Low Input	• Throttle control motor and sensor • Short in VTA2 circuit • Open in VC circuit • Engine ECU	○	○

P0223/41 (DI–63)	Throttle/Pedal Position Sensor/ Switch "B" Circuit High Input	• Throttle control motor and sensor • Open in VTA2 circuit • Open in E2 circuit • VC and VTA2 circuit are short–circuited • Engine ECU	○	○
P0230/78 (DI–125)	Fuel Pump Primary Circuit	• Open or short in fuel pump relay circuit • Fuel pump relay • Circuit opening relay • Fuel pump • Engine ECU	–	○
P0325//52 (DI–148)	Knock Sensor 1 Circuit (Bank 1 or Single Sensor)	• Open or short in knock sensor 1 circuit • Knock sensor 1 (looseness) • Engine ECU	○	○
P0330/55 (DI–148)	Knock Sensor 2 Circuit (Bank 2)	• Open or short in knock sensor 2 circuit • Knock sensor 2 (looseness) • Engine ECU	○	○
P0335/12, 13 (DI–152)	Crankshaft Position Sensor "A" Circuit	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Signal plate • Engine ECU	○	○
P0339/13 (DI–152)	Crankshaft Position Sensor "A" Circuit Intermittent	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Signal plate • Engine ECU	–	○
P0340/12 (DI–157)	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	• Open or short in camshaft position sensor circuit • Camshaft position sensor • LH camshaft timing pulley • Jumping teeth of timing belt • Engine ECU	○	○
P0341/12 (DI–157)	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 1 or Single Sensor)		○	○
P0351/14 (DI–161)	Ignition Coil "A" Primary/Secondary Circuit	• Open or short in IGF 1 and IGT 1 circuit from No. 1 ignition coil with igniter to engine ECU • No. 1 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0352/14 (DI–161)	Ignition Coil "B" Primary/Secondary Circuit	• Open or short in IGF 2 and IGT 2 circuit from No. 2 ignition coil with igniter to engine ECU • No. 2 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0353/15 (DI–161)	Ignition Coil "C" Primary/Secondary Circuit	• Open or short in IGF 2 and IGT 3 circuit from No. 3 ignition coil with igniter to engine ECU • No. 3 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0354/15 (DI–161)	Ignition Coil "D" Primary/Secondary Circuit	• Open or short in IGF 1 and IGT 4 circuit from No. 4 ignition coil with igniter to engine ECU • No. 4 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0355/14 (DI–161)	Ignition Coil "E" Primary/Secondary Circuit	• Open or short in IGF 2 and IGT 5 circuit from No. 5 ignition coil with igniter to engine ECU • No. 5 ignition coil with igniter • Ignition system • Engine ECU	○	○

P0356/14 (DI–161)	Ignition Coil "F" Primary/Secondary Circuit	• Open or short in IGF 1 and IGT 6 circuit from No. 6 ignition coil with igniter to engine ECU • No. 6 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0357/15 (DI–161)	Ignition Coil "G" Primary/Secondary Circuit	• Open or short in IGF 1 and IGT 7 circuit from No. 7 ignition coil with igniter to engine ECU • No. 7 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0358/15 (DI–161)	Ignition Coil "H" Primary/Secondary Circuit	• Open or short in IGF 2 and IGT 8 circuit from No. 8 ignition coil with igniter to engine ECU • No. 8 ignition coil with igniter • Ignition system • Engine ECU	○	○
P0500/42 (DI–182)	Vehicle Speed Sensor "A"	• Combination meter • Open or short in vehicle speed sensor circuit • Vehicle speed sensor • Engine ECU	○	○
P0504/51 (DI–185)	Brake Switch "A"/"B" Correlation	• Short in stop lamp switch signal circuit • STOP fuse • Stop lamp switch • Engine ECU	–	○
P0604/89 (DI–199)	Internal Control Module Random Access Memory (RAM) Error	• Engine ECU	○	○
P0606/89 (DI–199)	Engine ECU/PCM Processor	• Engine ECU	○	○
P0607/89 (DI–199)	Control Module Performance	• Engine ECU	○	○
P0657/89 (DI–199)	Actuator Supply Voltage Circuit / Open	• Engine ECU	○	○
P2102/41 (DI–206)	Throttle Actuator Control Motor Circuit Low	• Open in throttle control motor and sensor circuit • Throttle control motor and sensor • Engine ECU	○	○
P2103/41 (DI–206)	Throttle Actuator Control Motor Circuit High	• Short in throttle control motor and sensor circuit • Throttle control motor and sensor • Throttle valve • Throttle body • Engine ECU	○	○
P2111/41 (DI–209)	Throttle Actuator Control System – Stuck Open	• Throttle control motor and sensor circuit • Throttle control motor and sensor • Throttle valve • Throttle body	○	○
P2112/41 (DI–209)	Throttle Actuator Control System – Stuck Closed	• Throttle control motor and sensor circuit • Throttle control motor and sensor • Throttle valve • Throttle body	○	○
P2118/89 (DI–212)	Throttle Actuator Control Motor Current Range/Performance	• Open in throttle control motor and sensor power source circuit • ETCS fuse • Engine ECU	○	○
P2119/89 (DI–216)	Throttle Actuator Control Throttle Body Range/Performance	• Electric throttle control system • Throttle body	○	○
P2120/19 (DI–218)	Throttle/Pedal Position Sensor/ Switch "D" Circuit	• Accelerator pedal position sensor • Engine ECU	○	○

P2121/19 (DI–225)	Throttle/Pedal Position Sensor/ Switch "D" Circuit Range/Performance	• Accelerator pedal position sensor	○	○
P2122/19 (DI–218)	Throttle/Pedal Position Sensor/ Switch "D" Circuit Low Input	• Accelerator pedal position sensor • VCPA circuit open • VPA circuit open or ground short • Engine ECU	○	○
P2123/19 (DI–218)	Throttle/Pedal Position Sensor/ Switch "D" Circuit High Input	• Accelerator pedal position sensor • EPA circuit open • Engine ECU	○	○
P2125/19 (DI–218)	Throttle/Pedal Position Sensor/ Switch "E" Circuit	• Accelerator pedal position sensor • Engine ECU	○	○
P2127/19 (DI–218)	Throttle/Pedal Position Sensor/ Switch "E" Circuit Low Input	• Accelerator pedal position sensor • VCP2 circuit open • VPA2 circuit open or ground short • Engine ECU	○	○
P2128/19 (DI–218)	Throttle/Pedal Position Sensor/ Switch "E" Circuit High Input	• Accelerator pedal position sensor • EPA circuit open • Engine ECU	○	○
P2135/41 (DI–63)	Throttle Pedal Position Sensor/ Switch "A" / "B" Voltage Correlation	• VTA1 and VTA2 circuit are short–circuited • Throttle control motor and sensor • Engine ECU	○	○
P2138/19 (DI–218)	Throttle Pedal Position Sensor/ Switch "D" / "E" Voltage Correlation	• VPA and VPA2 circuit are short circuited • Accelerator pedal position sensor • Engine ECU	○	○

*1: – .... Check engine warning light does not lights up.
○ .... Check engine warning light lights up.
*2: Check engine warning light lights up or blinks.

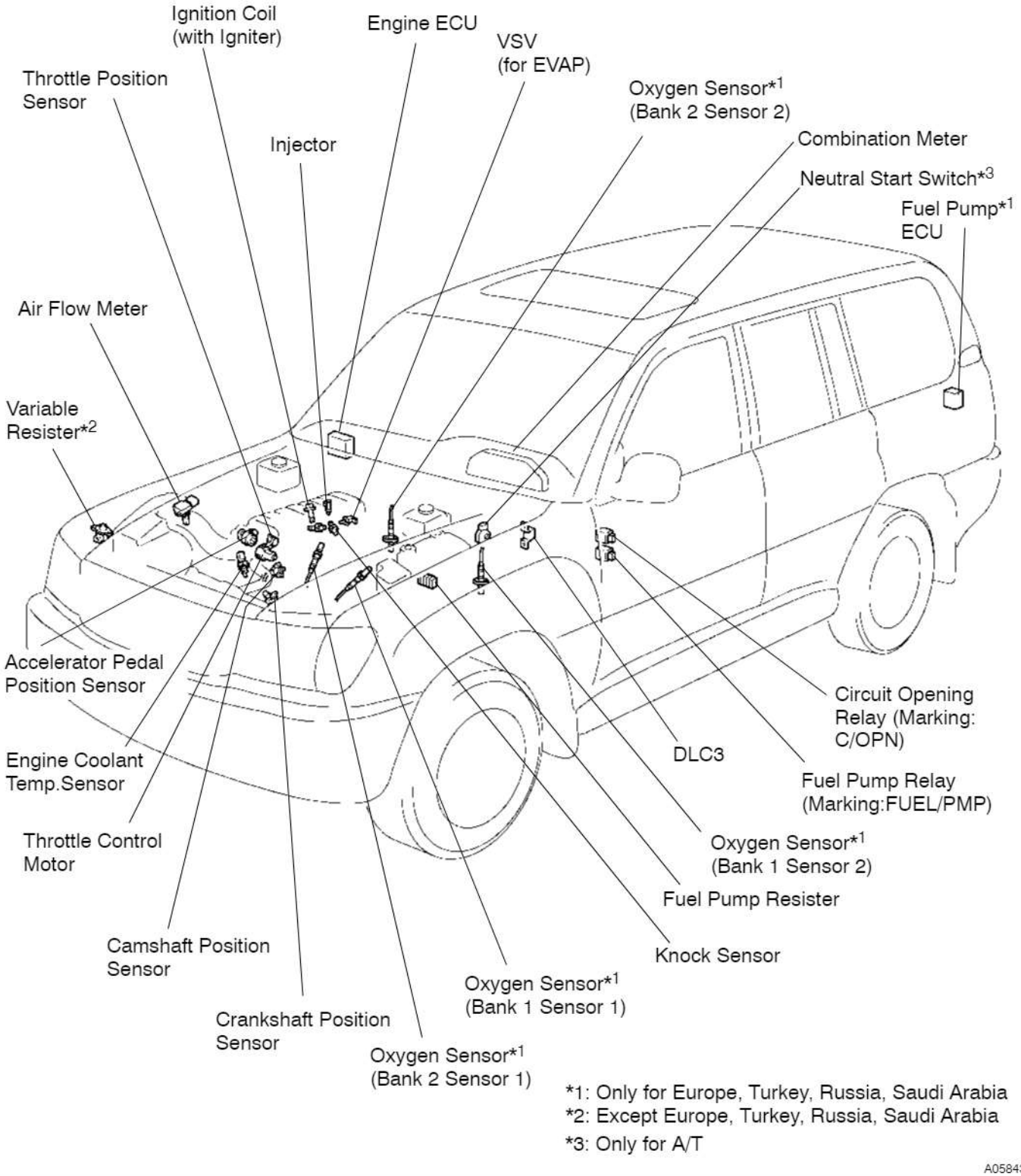
ETCS Trouble Codes

DTC No. (See Page)	Detection Item	Trouble Area	ETCS* 2nd START*	Memory
21 (DI–206)	Throttle Control Motor Circuit Malfunction	• Same as DTC No. P2102/41	○	○
23 (DI–212)	ETCS Actuator Power Source Circuit Malfunction	• Same as DTC No. P2118/89	○	○
24 (DI–212)	ETCS Actuator Power Source Circuit Malfunction	• Same as DTC No. P2103/41	○	○
31 (DI–209)	Throttle Control Motor Lock Malfunction	• Same as DTC No. P2111/89, P2112/89	○	○
32, 38, 39 (DI–216)	Electric Throttle Control System Malfunction	• Same as DTC No. P2119/89	○	○
33, 36 (DI–199)	ECU Malfunction (ETCS)	• Same as DTC No. P0606/89	○	○
34, 35 (DI–199)	Control Module Performance	• Same as DTC No. P0607/89	○	○

*: ○ ... Check ETCS indicator light (M/T) or 2nd START indicator light (A/T) lights up

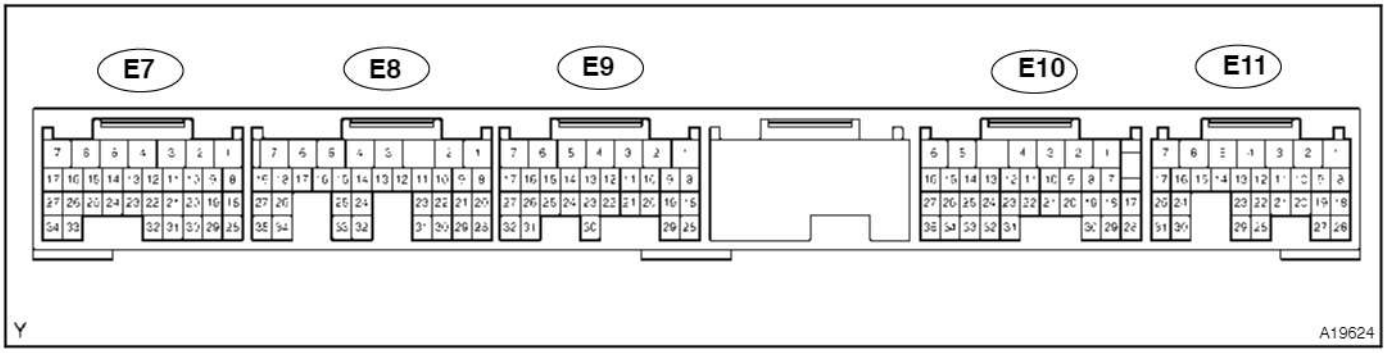
DI1L5-21

PARTS LOCATION



DI1L7–20

TERMINALS OF ECM



Each engine control ECU terminals standard normal voltage is shown in the table below. In the table, first follow the information under "Condition".
Look under "Symbols (Terminals No.)" for the terminals to be inspected.
The standard normal voltage between the terminals is shown under "STD Voltage".
Use the illustration above as a reference for the engine control ECU terminals.

Symbols (Terminals No.)	Wiring Color	Condition	STD Voltage
BATT (E11–3) – E1 (E9–1)	B–R – BR	Always	9 to 14 V
+BM (E10–6) – E1 (E9–1)	Y–B – BR		
IGSW (E11–9) – E1 (E9–1)	B–R – BR	IG switch ON	9 to 14 V
+B (E11–1) – E1 (E9–1)	B–Y – BR		
MREL (E11–8) – E1 (E9–1)	B–W – BR	IG switch ON	9 to 14 V
VC (E7–18) – E2 (E7–28)	L–R – BR–W	IG switch ON	4.5 to 5.5 V
VG (E7–30) – E2G (E7–29)	L–Y – G–W	Idling, P or N position, A/C switch OFF	0.5 to 3.0 V
THA (E7–20) – E2 (E7–28)	Y–B – BR–W	Idling, Intake air temp. 20°C (68°F)	0.5 to 3.4 V
THW (E7–19) – E2 (E7–28)	G–B – BR–W	Idling, Engine coolant temp. 80°C (176°F)	0.2 to 1.0 V
VTA1 (E7–21) – E2 (E7–28)	R–Y – BR–W	IG switch ON, Accelerator pedal released	0.5 to 1.2 V
		IG switch ON, Accelerator pedal depressed	3.2 to 4.8 V
VTA2 (E7–31) – E2 (E7–28)	Y–B – BR–W	IG switch ON, Accelerator pedal released	2.0 to 3.1 V
		IG switch ON, Accelerator pedal depressed	4.7 to 5.1 V
VPA (E11–22) – E2 (E7–28)	R – BR–W	IG switch ON, Accelerator pedal released	0.3 to 0.9 V
		IG switch ON, Accelerator pedal depressed	3.2 to 4.8 V
VPA2 (E11–23) – E2 (E7–28)	R–B – BR–W	IG switch ON, Accelerator pedal released	1.8 to 2.7 V
		IG switch ON, Accelerator pedal depressed	4.7 to 5.1 V
VCPA (E11–26) – EPA (E11–28)	L–R – BR–W	IG switch ON	4.5 to 5.5 V
VCP2 (E11–27) – EPA2 (E11–29)	W – W–R	IG switch ON	4.5 to 5.5 V
OX1A (E8–23) – E1 (E9–1) OX1B (E8–29) – E1 (E9–1)	*3 B – BR *3 B – BR	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation (See page DI–172)
OX2A (E8–22) – E1 (E9–1) OX2B (E8–21) – E1 (E9–1)	*3 W – BR *3 W – BR	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation (See page DI–172)
HT1A (E8–4) – E1 (E9–1)	*3 R (*1) W (*2) – BR	Idling	Below 3.0 V
HT1B (E8–5) – E1 (E9–1) HT2A (E8–33) – E1 (E9–1) HT2B (E8–25) – E1 (E9–1)	*3 L – BR *3 Y – BR *3 R – B – BR	IG switch ON	9 to 14 V

#1 (E7–1) – E01 (E7–7) #2 (E7–2) – E01 (E7–7) #3 (E7–3) – E01 (E7–7) #4 (E7–4) – E01 (E7–7) #5 (E7–5) – E01 (E7–7) #6 (E8–3) – E01 (E7–7) #7 (E9–6) – E01 (E7–7) #8 (E9–5) – E01 (E7–7)	Y – W–B B – W–B L – W–B R – W–B G – W–B R–L – W–B W – W–B B–W – W–B	IG switch ON	9 to 14 V
		Idling	Pulse generation (See page DI–130)
KNK1 (E8–1) – E1 (E9–1)	B – BR	Maintain engine speed at 4,000 rpm after warming up	Pulse generation (See page DI–148)
KNK2 (E8–2) – E1 (E9–1)	W – BR		
G2+ (E9–27) – G2– (E9–32)	R – G	Idling	Pulse generation (See page DI–152)
NE+ (E9–25) – NE– (E9–24)	L – G		
PRG (E7–34) – E1 (E9–1)	L–B – BR	IG switch ON	9 to 14 V
SPD (E10–17) – E1 (E9–1)	V – BR	IG switch ON, Rotate driving wheel slowly	Pulse generation (See page DI–182)
M+ (E9–3) – E1 (E9–1) M– (E9–2) – E1 (E9–1)	R – BR W – BR	Idling	Pulse generation (See page DI–206)
FPR (E7–33) – E1 (E9–1)	G–W – BR	IG switch ON	0 to 3.0 V
FC (E11–10) – E1 (E9–1)	B–W – BR	IG switch ON	9 to 14 V
IGT1 (E7–9) – E1 (E9–1) IGT2 (E7–8) – E1 (E9–1) IGT3 (E7–25) – E1 (E9–1) IGT4 (E7–11) – E1 (E9–1) IGT5 (E7–12) – E1 (E9–1) IGT6 (E7–26) – E1 (E9–1) IGT7 (E7–13) – E1 (E9–1) IGT8 (E7–10) – E1 (E9–1)	B – BR R – BR L – BR G – BR Y – BR B–Y – BR B–L – BR L–B – BR	Idling	Pulse generation (See page DI–161)
IGF1 (E7–24) – E1 (E9–1) IGF2 (E7–23) – E1 (E9–1)	B–W – BR B–R – BR	IG switch ON	4.5 to 5.5 V
		Idling	Pulse generation (See page DI–161)
STP (E10–19) – E1 (E9–1)	G–W – BR	Brake pedal is depressed	7.5 to 14 V
		Brake pedal is released	Below 1.5 V
ST1– (E10–12) – E1 (E9–1)	R–G – BR	Brake pedal is depressed	Below 1.5 V
		Brake pedal is released	7.5 to 14 V
STA (E7–17) – E1 (E9–1)	B–R – BR	Shift lever range P or N, Ignition switch START	6.0 V or more
STSW (E9–12) – E1 (E9–1)	B–W – BR	Shift lever range P or N, ignition switch START	6.0 V or more
ACCR (E7–15) – E1 (E9–1)	R–G – BR	Shift lever range P or N, ignition switch START	9 to 14 V
STAR (E8–9) – E1 (E9–1)	B–W – BR	Shift lever range P or N, ignition switch START	9 to 14 V
NSW (E7–16) – E1 (E9–1)	B–W – BR	IG switch ON, Other shift position in P, N	9 to 14 V
		IG switch ON, Shift position in P, N	0 to 3.0 V
W (E11–11) – E1 (E9–1)	W – BR	Idling	9 to 14 V
		IG switch ON	Below 3.0 V
SIL (E11–18) – E1 (E9–1)	V–W – BR	During transmission	Pulse generation
TACH (E11–5) – E1 (E9–1)	B – BR	Idling	Pulse generation

*1: LHD

*2: RHD

*3: LHD Europe, Saudi Arabia, Peru
RHD Europe, Australia

DI1L9–16

PROBLEM SYMPTOMS TABLE

Symptom	Suspect Area	See page
Engine does not crank (Does not start)	1. Starter 2. Starter relay 3. Park/neutral position switch	ST–17*1 ST–19*1 DI–32*2
No initial combustion (Does not start)	1. Engine control ECU power source circuit 2. Fuel pump control circuit 3. Engine control ECU	DI–237 DI–242 IN–20
No complete combustion (Does not start)	1. Fuel pump control circuit	DI–242
Engine cranks normally but difficult to start	1. Starter signal circuit 2. Fuel pump control circuit 3. Compression	DI–228 DI–242 EM–5*1
Difficult to start with cold engine	1. Starter signal circuit 2. Fuel pump control circuit	DI–228 DI–242
Difficult to start with hot engine	1. Starter signal circuit 2. Fuel pump control circuit	DI–228 DI–242
High engine idle speed (Poor idling)	1. A/C switch circuit 2. Engine control ECU power source circuit	– DI–237
Low engine idle speed (Poor idling)	1. A/C switch circuit 2. Fuel pump control circuit	– DI–242
Rough idling (Poor idling)	1. Compression 2. Fuel pump control circuit	EM–5*1 DI–242
Hunting (Poor idling)	1. Engine control ECU power source circuit 2. Fuel pump control circuit	DI–237 DI–242
Hesitation/Poor acceleration (Poor driveability)	1. Fuel pump control circuit 2. A/T faulty	DI–242 DI–5*3
Surging (Poor driveability)	1. Fuel pump control circuit	DI–242
Engine stalls soon after starting	1. Fuel pump control circuit	DI–242
Engine stalls during A/C operation	1. A/C switch circuit 2. Engine control ECU	– IN–20
Unable to refuel/Difficult to refuel	1. ORVR system	–

*1: See Pub. No. RM630E
*2: See Pub. No. RM970E
*3: See Pub. No. RM1072E

DIC22-03

CIRCUIT INSPECTION

DTC	P0031	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC	P0032	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC	P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC	P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC	P0051	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC	P0052	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 1)

DTC	P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC	P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

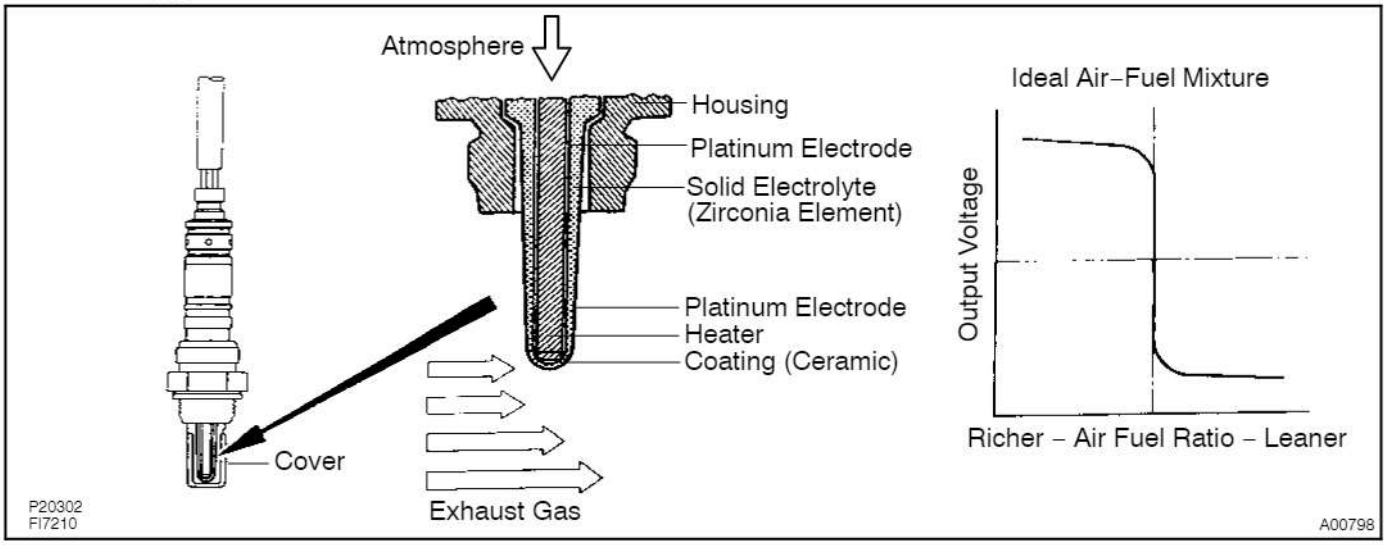
CIRCUIT DESCRIPTION

To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three–way catalytic converter is used, but for the most efficient use of the three–way catalytic converter, the air–fuel ratio must be precisely controlled so that it is always close to the stoichiometric air–fuel ratio.

The heated oxygen sensor has the characteristic which its output voltage changes suddenly in the vicinity of the stoichiometric air–fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide the engine control ECU with feedback to control the air–fuel ratio.

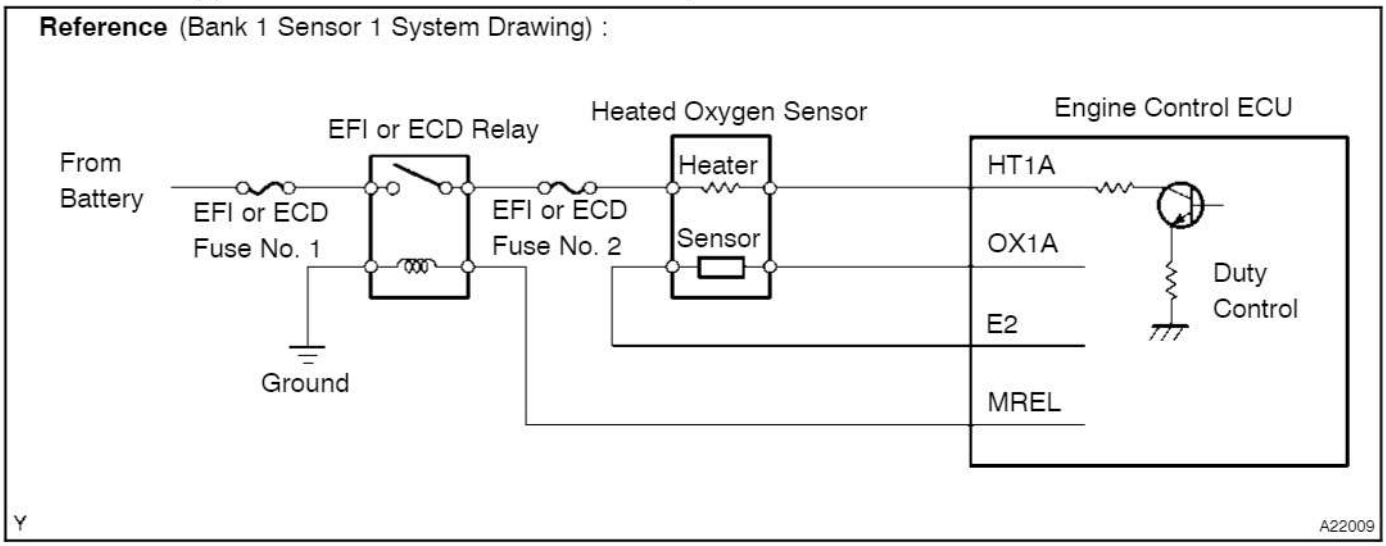
When the air–fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the heated oxygen sensor informs the engine control ECU of the LEAN condition (low voltage, i.e. less than 0.45 V).

When the air–fuel ratio is RICHER than the stoichiometric air–fuel ratio, the oxygen concentration in the exhaust gas is reduced and the heated oxygen sensor informs the engine control ECU of the RICH condition (high voltage, i.e. more than 0.45 V). The engine control ECU judges by the voltage output from the heated oxygen sensor whether the air–fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the heated oxygen sensor causes output of abnormal voltage, this disables the engine control ECU for performing an accurate air–fuel ratio control. The heated oxygen sensors include a heater which heats the zirconia element. The heater is controlled by the engine control ECU. When the intake air volume is low (the temperature of the exhaust gas is low) current flows to the heater to heat the sensor for accurate oxygen concentration detection.



HINT:

The engine control ECU provides a pulse width modulated control circuit to adjust current through the heater. The heated oxygen sensor heater circuit uses a relay on the B+ side of the circuit.



DTC No.	DTC Detecting Condition	Trouble Area
P0031 P0037 P0051 P0057	Heater current is 0.25 A or less when the heater operates with more than 10.5 V positive battery voltage (1 trip detection logic)	• Open in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine control ECU
P0032 P0038 P0052 P0058	When heater does not operates, heater current exceeds 2.0 A (1 trip detection logic)	• Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine control ECU

HINT:

- Bank 1 refers to bank the includes cylinder No. 1.
- Bank 2 refers to bank that does not includes cylinder No. 1.
- Sensor 1 refers to the sensor closer to the engine assembly.
- Sensor 2 refers to the sensor farther away from the engine assembly.

MONITOR DESCRIPTION

The sensing portion of the heated oxygen sensor has a zirconia element which is used to detect oxygen concentration in the exhaust. If the zirconia element is at the proper temperature and difference of the oxygen concentration between the inside and outside surface of sensor is large, the zirconia element will generate voltage signals. In order to increase the oxygen concentration detecting capacity in the zirconia element, the engine control ECU supplements the heat from the exhaust with heat from a heating element inside the sensor. When heater current in the sensor is out of the standard operating range, the engine control ECU interprets this as a fault in the heated oxygen sensor and sets a DTC.

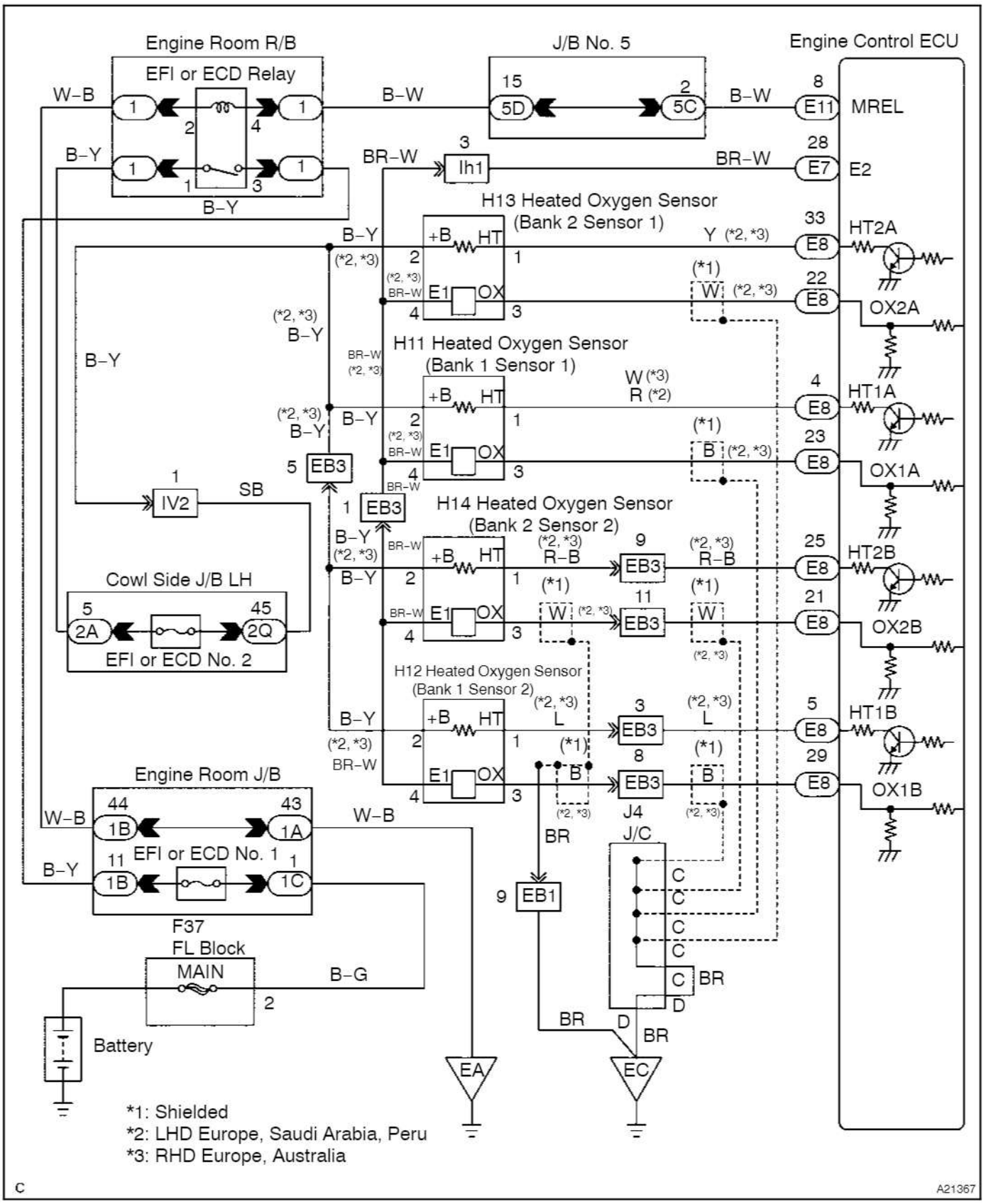
Example:

The engine control ECU will set a high current DTC if the current in the sensor is more than 2.0 A. Similarly, the engine control ECU will set a low current DTC if the current is less than 0.25 A when the heater is ON.

The monitor runs if conditions below is met:

Engine is started and run at idle for 9 minutes or more.

WIRING DIAGRAM



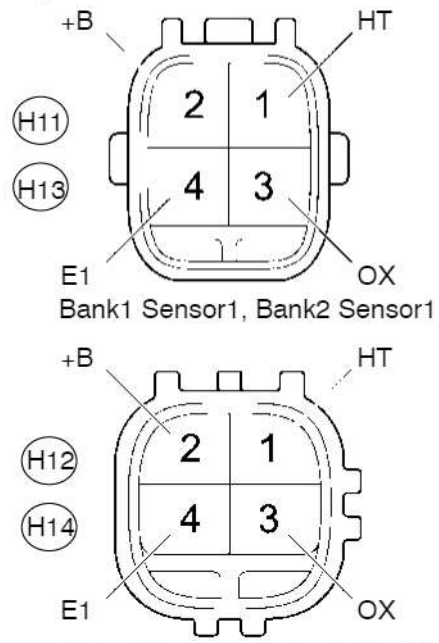
INSPECTION PROCEDURE

HINT:

Read freeze frame data using hand–held tester. Because freeze frame records the engine conditions 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.

1	**Check resistance of heated oxygen sensor heater.**

Components Side:



PREPARATION:

Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

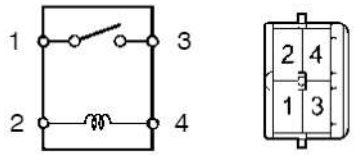
Tester Connection	Specified Condition
HT (H11–1) – +B (H11–2)	11.7 to 14.3 Ω (20°C)
HT (H12–1) – +B (H12–2)	11.7 to 14.3 Ω (20°C)
HT (H13–1) – +B (H13–2)	11.7 to 14.3 Ω (20°C)
HT (H14–1) – +B (H14–2)	11.7 to 14.3 Ω (20°C)

NG → **Replace heated oxygen sensor.**

OK

2	Check EFI or ECD relay.

EFI or ECD Relay



A21543

PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Inspect the EFI or ECD relay.

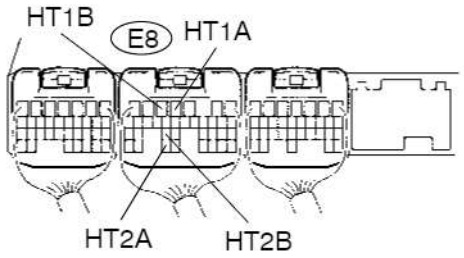
OK:

Terminal No.	Condition	Specified Condition
2 – 4	Constant	Continuity
1 – 3	Usually	No Continuity
	Apply B+ between terminals 2 and 4	Continuity

NG → **Replace EFI or ECD relay.**

OK

3	Check voltage between terminals HT1A, HT2A, HT1B, HT2B of engine control ECU connectors and body ground.



PREPARATION:

Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals of the engine control ECU connectors and body ground.

HINT:

- Connect terminal HT1A to the bank 1 sensor 1.
- Connect terminal HT1B to the bank 1 sensor 2.
- Connect terminal HT2A to the bank 2 sensor 1.
- Connect terminal HT2B to the bank 2 sensor 2.

OK:

Tester Connection	Specified Condition
HT1A (E8–4) – Body ground	9 to 14 V
HT1B (E8–5) – Body ground	9 to 14 V
HT2A (E8–33) – Body ground	9 to 14 V
HT2B (E8–25) – Body ground	9 to 14 V

OK → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

NG

Check and repair harness or connector between EFI or ECD relay and heated oxygen sensor, and heated oxygen sensor and engine control ECU (See page IN–20).

DIC23-03

DTC	P0100/31	Mass or Volume Air Flow Circuit

DTC	P0102/31	Mass or Volume Air Flow Circuit Low Input

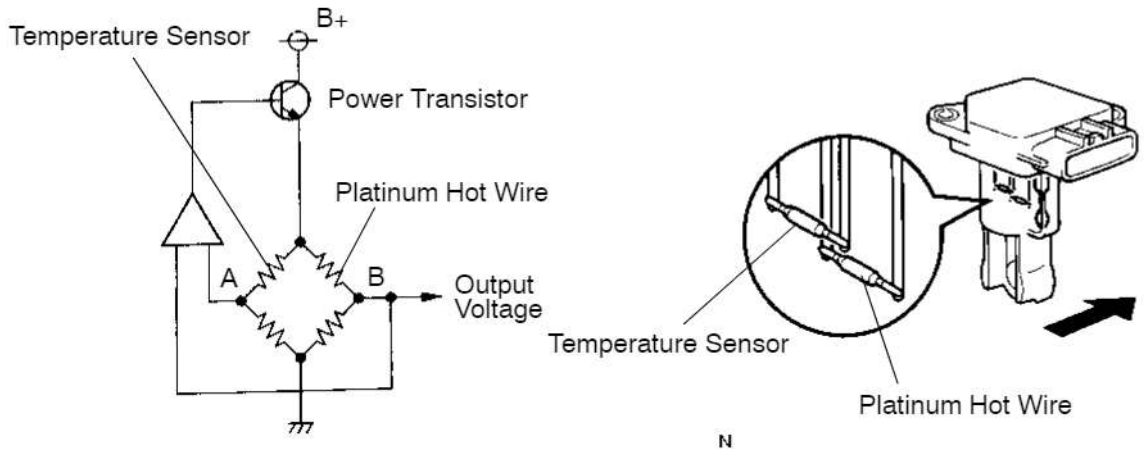
DTC	P0103/31	Mass or Volume Air Flow Circuit High Input

CIRCUIT DESCRIPTION

The Mass Air Flow (MAF) meter measures the amount of air flowing through the throttle valve. The engine control ECU uses this information to determine the fuel injection time and provide a proper air fuel ratio. Inside the MAF meter, there is a heated platinum wire exposed to the flow of intake air.

By applying a specific current to the wire, the engine control ECU heats this wire to a given temperature. The flow of incoming air cools the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the engine control ECU varies the voltage applied to these components in the MAF meter. The voltage level is proportional to the airflow through the sensor. The engine control ECU interprets this voltage as the intake air amount.

The circuit is constructed so that the platinum hot wire and temperature sensor provide a bridge circuit, with the power transistor controlled so that the potential of A and B remains equal to maintain the set temperature.



FI6929
A09074

A09707

DTC No.	DTC Detection Condition	Trouble Area
P0100/31	Open or short in mass air flow meter circuit for more than 3 sec. (MAF sensor voltage is less than 0.2 V or more than 4.9 V) (1 trip detection logic)	• Open or short in mass air flow meter circuit • Mass air flow meter • Engine control ECU
P0102/31	Open or short in mass air flow meter circuit for more than 3 sec.(MAF sensor voltage is less than 0.2 V) (1 trip detection logic)	
P0103/31	Open in mass air flow meter circuit for more than 3 sec. (EVG circuit) Short in mass air flow meter circuit for more than 3 sec. (+B circuit)(MAF sensor voltage is more than 4.9 V) (1 trip detection logic)	

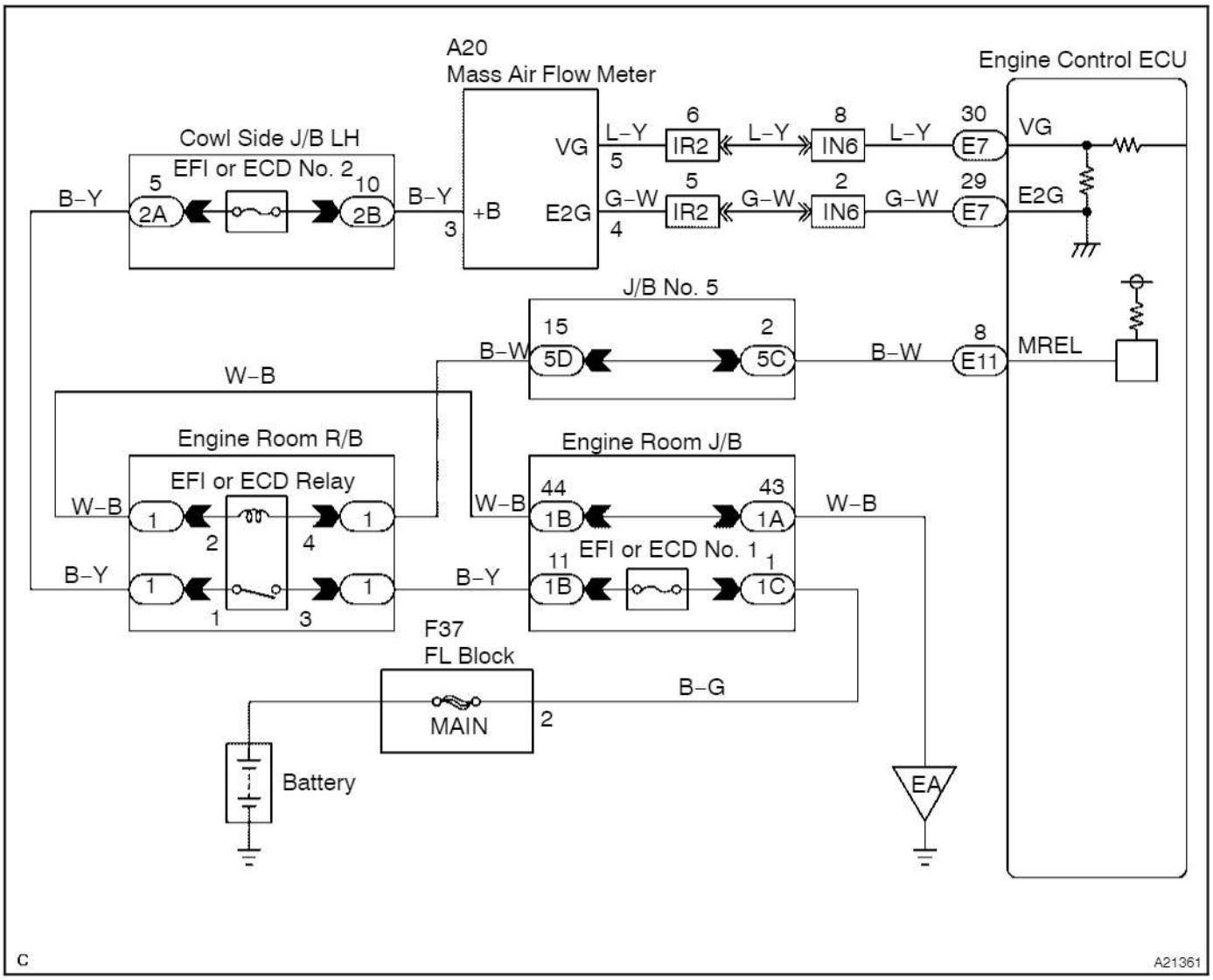
HINT:
After confirming DTC P0100/31, P0102/31 or P0103/31, use the hand–held tester to confirm the MAF ratio from the ALL menu (to reach the ALL menu: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL).

Mass Air Flow Value (gm/sec.)	Malfunction
Approx. 0.0	• Mass air flow meter power source circuit open • VG circuit open or short
271.0 or more	• EVG circuit open

MONITOR DESCRIPTION

If there is a defect in the MAF (Mass Air Flow) meter or an open or short circuit, the voltage level will deviate outside the normal operating range. The engine control ECU interprets this deviation as a defect in the MAF meter and sets a DTC.
Example:
When the MAF meter voltage output is less than 0.2 V, or more than 4.9 V, and if either the condition continues for more than 3 sec.
This monitor runs for 3 seconds (the first 3 of engine idle) after the engine started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	**Connect hand–held tester, and read value of mass air flow rate.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) Start the engine.
(d) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / MAF.

CHECK:

Read the mass air flow rate on the hand–held tester.

RESULT:

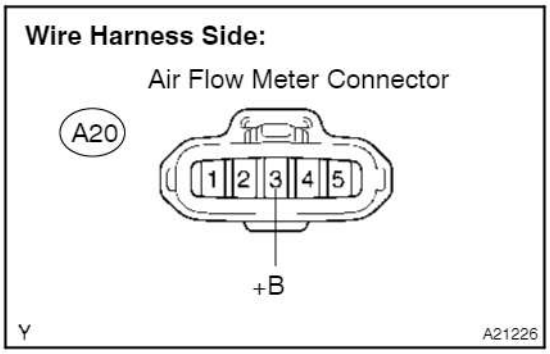
Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
Between 1 and 270.0 (*1)	C

*1: The value must be changed when the throttle valve is opened or closed.

B	**Go to step 6.**
C	**Check for intermittent problems (See page DI–3).**

A

2	Check voltage of air flow meter power source.



PREPARATION:

(a) Disconnect the A20 air flow meter connector.

(b) Turn the ignition switch ON.

CHECK:

Measure voltage between terminal of the mass air flow meter connector and body ground.

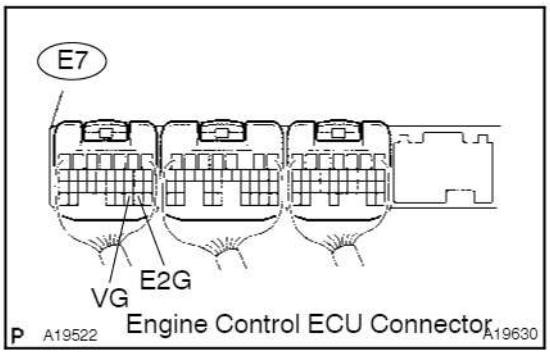
OK:

Tester Connection	Specified Condition
+B (A20–3) – Body ground	9 to 14 V

NG → **Go to step 5.**

OK

3	Check voltage between terminal VG of engine control ECU connector and body ground.



PREPARATION:

Start the engine.

CHECK:

Measure the voltage between the specified terminal of the E7 engine control ECU connector.

HINT:

The shift position should be P or N and the A/C switch should be turned OFF.

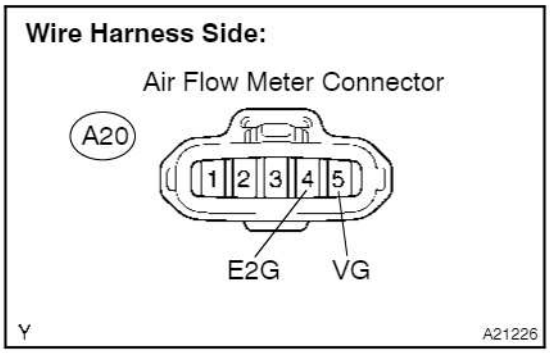
OK:

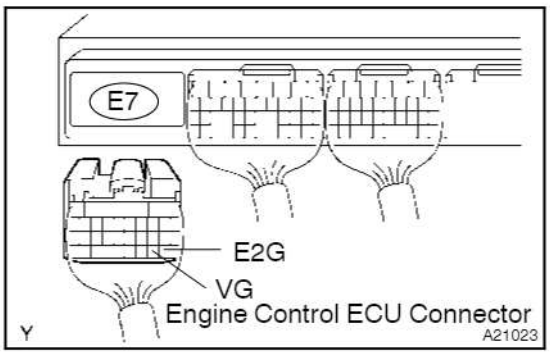
Tester Connection	Condition	Specified Condition
VG (E7–30) – E2G (E7–29)	Engine is idling	0.5 to 3.0 V

OK → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

NG

4	**Check for open and short in harness and connector between air flow meter and engine control ECU.**





PREPARATION:

(a) Disconnect the A20 air flow meter connector.

(b) Disconnect the E7 engine control ECU connector.

CHECK:

Check the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
VG (A20–5) – VG (E7–30)	Below 1 Ω
E2G (A20–4) – E2G (E7–29)	Below 1 Ω
VG (A20–5) or VG (E7–30) – Body ground	10 kΩ or higher

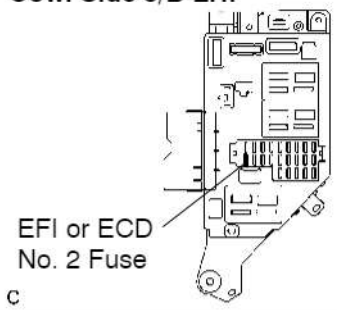
NG → **Repair or replace harness or connector.**

OK

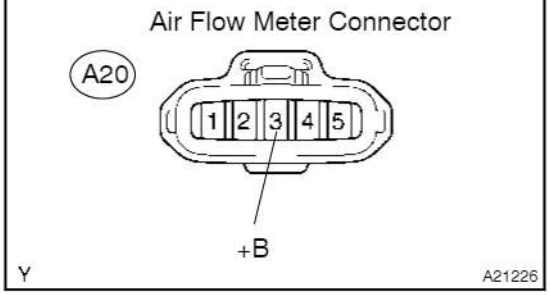
Replace air flow meter.

5	**Check for open and short in harness and connector between air flow meter and EFI or ECD relay.**

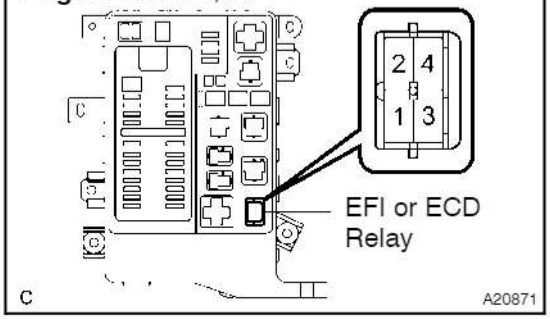
Cowl Side J/B LH:



Wire Harness Side:



Engine Room J/B:



Check EFI or ECD No. 2 fuse:

PREPARATION:

Remove the EFI or ECD No. 2 fuse from the cowl side J/B LH.

CHECK:

Check for continuity in the EFI or ECD No. 2 fuse.

OK:

Continuity

Check harness and connector:

PREPARATION:

(a) Install the EFI or ECD No. 2 fuse.
(b) Disconnect the A20 air flow meter connector.
(c) Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Check the resistance between the wire harness side connectors.

OK:

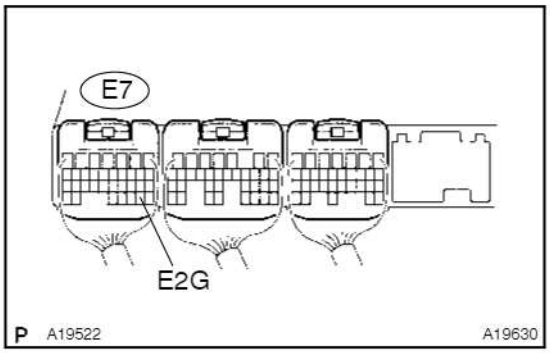
Tester Connection	Specified Condition
+B (A20–3) – Engine Room J/B (EFI or ECD relay terminal 1)	Below 1 Ω
+B (A20–3) or Engine room J/B (EFI or ECD relay terminal 1) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK

Check engine control ECU power source circuit (See page DI–237).

6	Check continuity between terminal E2G of engine control ECU connector and body ground.



CHECK:

Check the resistance between terminal of the E7 engine control ECU connector and body ground.

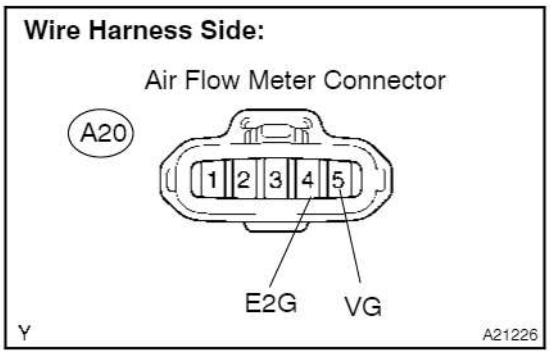
OK:

Tester Connection	Specified Condition
E2G (E7–29) – Body ground	Below 1 Ω

NG → **Go to step 8.**

OK

7	Check for open in harness and connector between air flow meter and engine control ECU.



PREPARATION:

(a) Disconnect the A20 air flow meter connector.

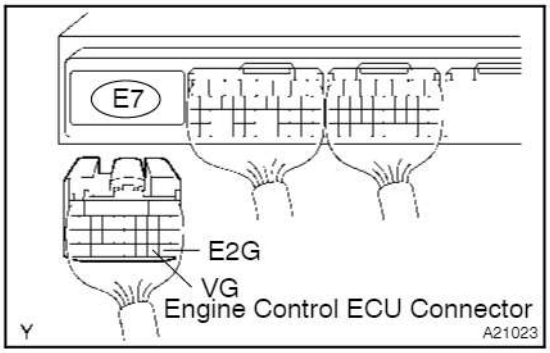
(b) Disconnect the E7 engine control ECU connector.

CHECK:

Check the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
VG (A20–5) – VG (E7–30)	Below 1 Ω
E2G (A20–4) – E2G (E7–29)	Below 1 Ω
VG (A20–5) or VG (E7–30) – Body ground	10 kΩ or higher
E2G (A20–4) or E2G (E7–29) – Body ground	10 kΩ or higher



NG → **Repair or replace harness or connector.**

OK

Replace mass air flow meter.

8	Check for open in harness and connector between terminal E1 of engine control ECU and body ground (See page IN–20).

NG → Repair or replace harness or connector.

OK →

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DI1LE-15

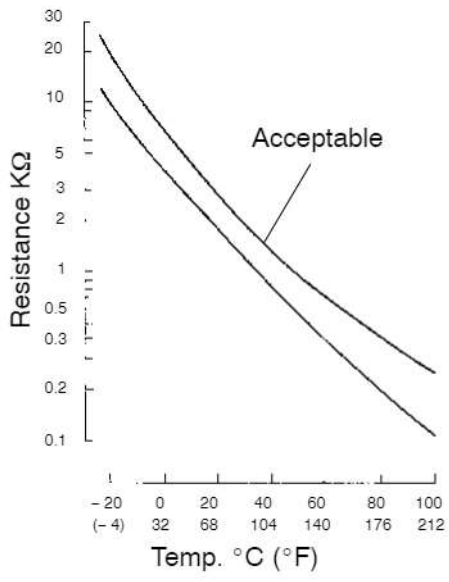
DTC	P0110/24	Intake Air Temperature Circuit

DTC	P0112/24	Intake Air Temperature Circuit Low Input

DTC	P0113/24	Intake Air Temperature Circuit High Input

CIRCUIT DESCRIPTION

(Fig.1)



The intake air temperature (IAT) sensor, mounted on the mass air flow (MAF) meter, monitors the intake air temperature. The IAT sensor has a thermistor that varies its resistance depending on the temperature of the intake air. When the air temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. The variations in resistance are reflected as voltage changes to the engine control ECU terminal.
(See Fig. 1).
The intake air temperature sensor is connected to the engine control ECU (See below). The 5 V power source voltage in the engine control ECU is applied to the intake air temperature sensor from terminal THA (THAR) via resistor R.
That is, the resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes in accordance with changes in the intake air temperature, the voltage at terminal THA (THAR) also changes. Based on this signal, the engine control ECU increases the fuel injection volume to improve the driveability during cold engine operation.

DTC No.	Proceed to	DTC Detection Condition	Trouble Area
P0110/24	Step 1	Open or short in intake air temperature sensor circuit for 0.5 sec. (IAT equal to –40°C (–40°F) or more than 140°C (284°F)) (1 trip detection logic)	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • Engine control ECU
P0112/24	Step 4	Short in intake air temperature sensor circuit for 0.5 sec. (IAT is more than 140°C (284°F)) (1 trip detection logic)	
P0113/24	Step 2	Open in intake air temperature sensor circuit for 0.5 sec. (IAT is –40°C (–40°F)) (1 trip detection logic)	

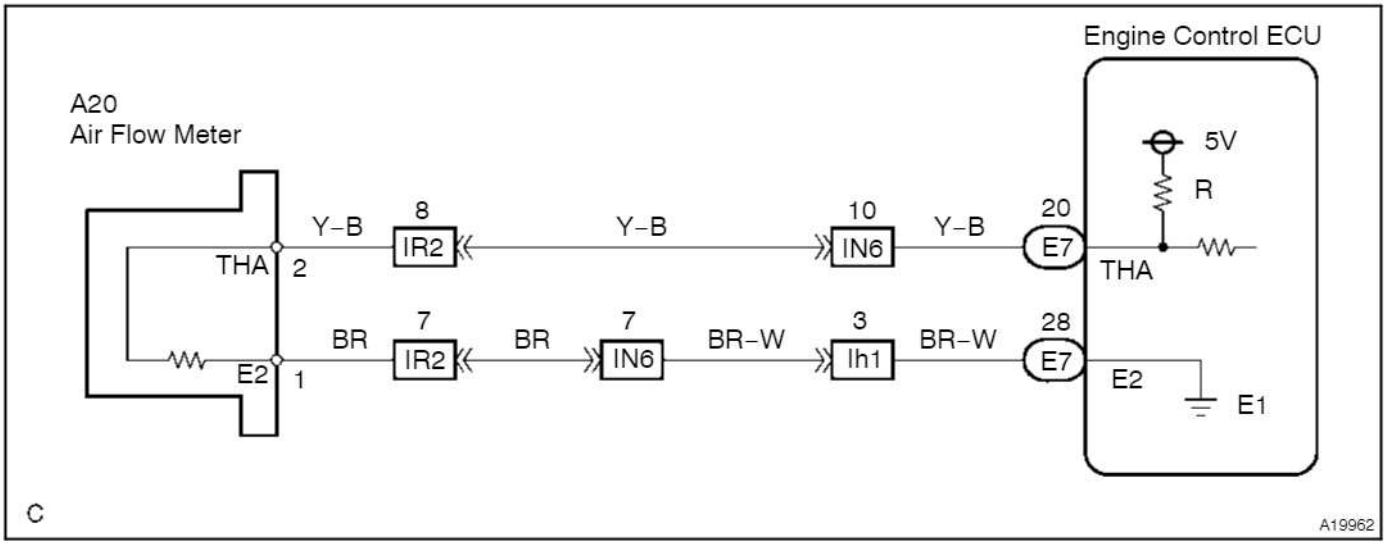
HINT:
After confirming DTC "P0110/24, P0112/24 or P0113/24", use the hand–held tester to confirm the intake air temperature in the "DIAGNOSIS / OBD/MOBD / DATA LIST / ALL".

Temperature Displayed	Malfunction
–40°C (–40°F)	Open circuit
140°C (284°F) or more	Short circuit

MONITOR DESCRIPTION

The engine control ECU monitors the sensor voltage and uses this value to calculate the intake air temperature. When the sensor output voltage deviates from the normal operating range, the engine control ECU interprets this as a fault in the IAT (Intake Air Temperature) sensor and sets a DTC.
Example:
When the sensor voltage output equal to –40°C (–40°F), or more than 140°C (284°F).
This monitor runs 0.5 seconds after the ignition switch is turned ON.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	**Connect hand–held tester, and read value of intake air temperature.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / INTAKE AIR.

CHECK:

Read the temperature value on the hand–held tester.

OK:

Same as actual intake air temperature.

RESULT:

Temperature Displayed	Proceed to
–40°C (–40°F)	A
140°C (284°F) or more	B
OK (Same as present temperature)	C

HINT:

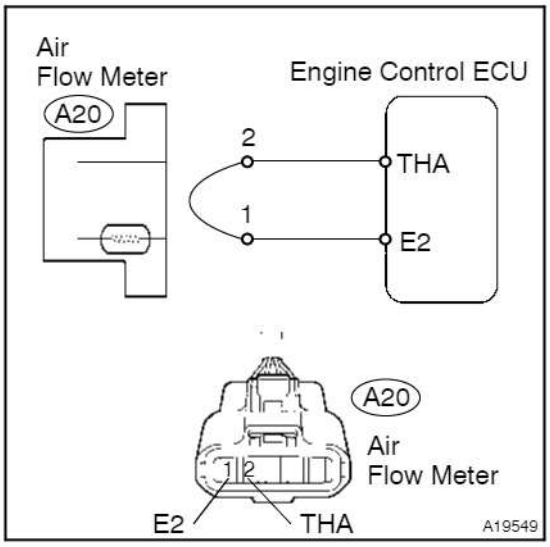
- If there is an open circuit, the hand–held tester indicates –40°C (–40°F).
- If there is a short circuit, the hand–held tester indicates 140°C (284°F) or more.

B → **Go to step 4.**

C → **Check for intermittent problems** (See page DI–3).

A

2	Check for open in harness or engine control ECU.



PREPARATION:

(a) Disconnect the A20 air flow meter connector.
(b) Connect terminals 1 and 2 of the air flow meter wire harness side connector.
(c) Turn the ignition switch ON.
(d) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / INTAKE AIR.

CHECK:

Read the temperature value on the hand–held tester.

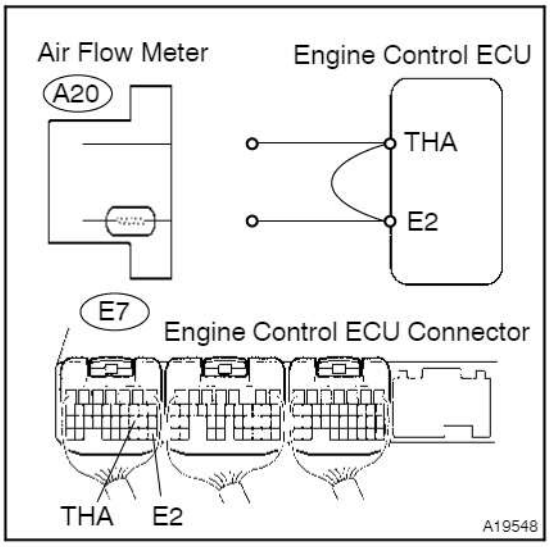
OK:

Temperature value: 140°C (284°F) or more

OK	Confirm good connection at sensor. If OK, replace mass air flow meter.

NG

3	Check for open in harness or engine control ECU.



PREPARATION:

(a) Connect terminals THA and E2 of the E7 engine control ECU connector.

HINT:

Before checking, do a visual and contact pressure checks for the engine control ECU connector.

(b) Turn the ignition switch ON.

(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / INTAKE AIR.

CHECK:

Read the temperature value on the hand–held tester.

OK:

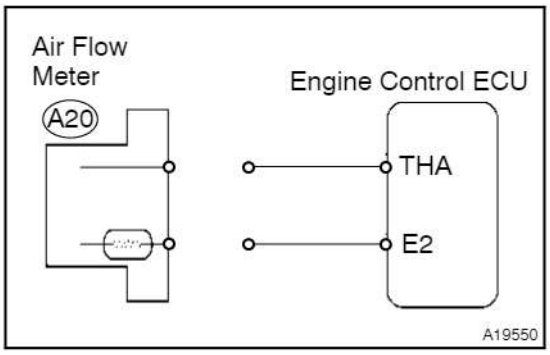
Temperature value: 140°C (284°F) or more

OK	Repair or replace harness or connector.

NG

Confirm good connection at engine control ECU. If OK, check and replace engine control ECU (See page IN–20).

4	Check for short in harness and engine control ECU.



PREPARATION:

(a) Disconnect the A20 air flow meter connector.

(b) Turn the ignition switch ON.

(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / INTAKE AIR.

CHECK:

Read the temperature value on the hand–held tester.

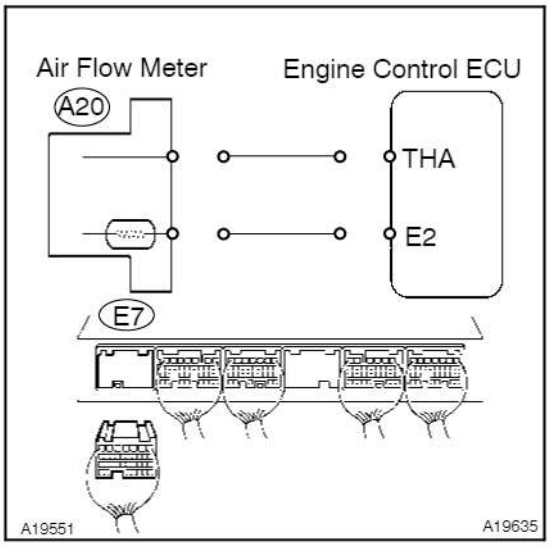
OK:

Temperature value: –40°C (–40°F)

OK	Replace mass air flow meter.

NG

5	Check for short in harness or engine control ECU.



PREPARATION:

(a) Disconnect the E7 engine control ECU connector.
(b) Turn the ignition switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / INTAKE AIR.

CHECK:

Read the temperature value on the hand–held tester.

OK:

Temperature value: –40°C (–40°F)

OK → **Repair or replace harness or connector.**

NG

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DI1LF–15

DTC	P0115/22	Engine Coolant Temperature Circuit

DTC	P0117/22	Engine Coolant Temperature Circuit Low Input

DTC	P0118/22	Engine Coolant Temperature Circuit High Input

CIRCUIT DESCRIPTION

A thermistor is built in the Engine Coolant Temperature (ECT) sensor and changes the resistance value according to the engine coolant temperature.
The structure of the sensor and connection to the engine control ECU is the same the Intake Air Temperature (IAT) sensor.
HINT:
If the engine control ECU detects the DTC "P0115/22, P0117/22 or P0118/22", it operates the fail–safe function in which the ECT is assumed to be 80 °C (176 °F).

DTC No.	Proceed to	DTC Detection Condition	Trouble Area
P0115/22	Step 1	Open or short in engine coolant temperature sensor circuit for 0.5 sec. (ECT equal to –40°C (–40°F) or more than 140°C (284°F)) (1 trip detection logic)	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • Engine control ECU
P0117/22	Step 4	Short in engine coolant temperature sensor circuit for 0.5 sec. (ECT is more than 140°C (284°F)) (1 trip detection logic)	
P0118/22	Step 2	Open in engine coolant temperature sensor circuit for 0.5 sec. (ECT is –40°C (–40°F)) (1 trip detection logic)	

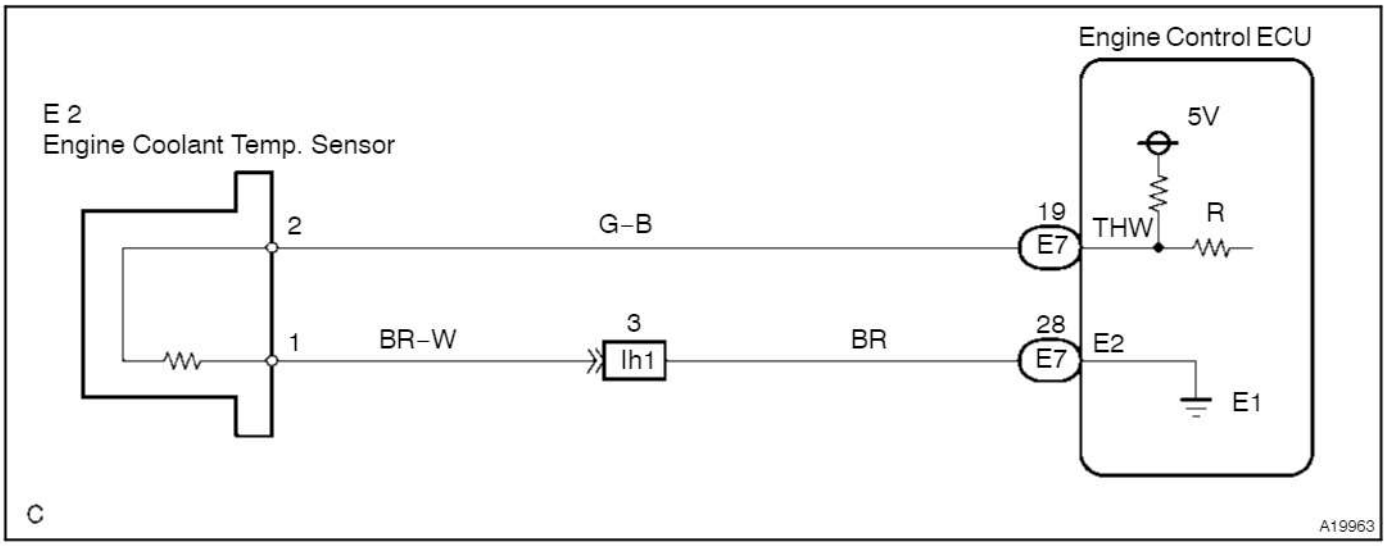
HINT:
After confirming DTC "P0115, P0117 or P0118," use the hand–held tester to confirm the engine coolant temperature from the DIAGNOSIS / OBD/MOBD / DATA LIST / ALL.

Temperature Displayed	Malfunction
–40°C (–40°F)	Open circuit
140°C (284°F) or more	Short circuit

MONITOR DESCRIPTION

The ECT (Engine Coolant Temperature) sensor is used to monitor the engine coolant temperature. The ECT sensor has a thermistor that varies its resistance depending on the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. The variations in resistance are reflected in the voltage output from the sensor.
The engine control ECU monitors the sensor voltage and uses this value to calculate the engine coolant temperature. When the sensor output voltage deviates from the normal operating range, the engine control ECU interprets this as a fault in the ECT sensor and sets a DTC.
Example:
When the engine control ECU calculates that the ECT is less than –40°C (–40°F), or more than 140°C (284°F), and if either the condition continues for 0.5 sec. or more, the engine control ECU will set a DTC.
This monitor runs 0.5 seconds after the ignition switch turned ON.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	**Connect hand–held tester, and read value of engine coolant temperature.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / COOLANT TEMP.

CHECK:

Read the temperature value on the hand–held tester.

OK:

Same value as actual engine coolant temperature.

RESULT:

Temperature Displayed	Proceed to
–40°C (–40°F)	A
140°C (284°F) or more	B
OK (Same as present temperature)	C

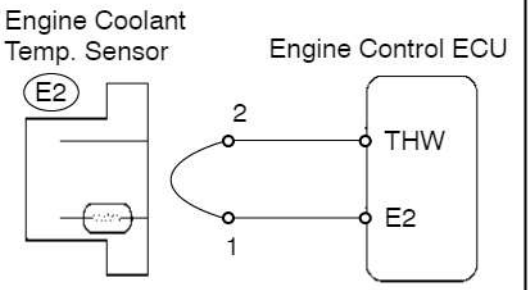
HINT:

- If there is an open circuit, hand–held tester indicates –40°C (–40°F).
- If there is a short circuit, hand–held tester indicates 140°C (284°F) or more.

B	**Go to step 4.**
C	**Check for intermittent problems (See page DI–3).**

A

2	**Check for open in harness or engine control ECU.**



PREPARATION:

(a) Disconnect the E2 engine coolant temperature (ECT) sensor connector.
(b) Connect terminals 1 and 2 of the engine coolant temperature sensor wire harness side connector.
(c) Turn the ignition switch ON.
(d) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / COOLANT TEMP.

CHECK:

Read the temperature value on the hand–held tester.

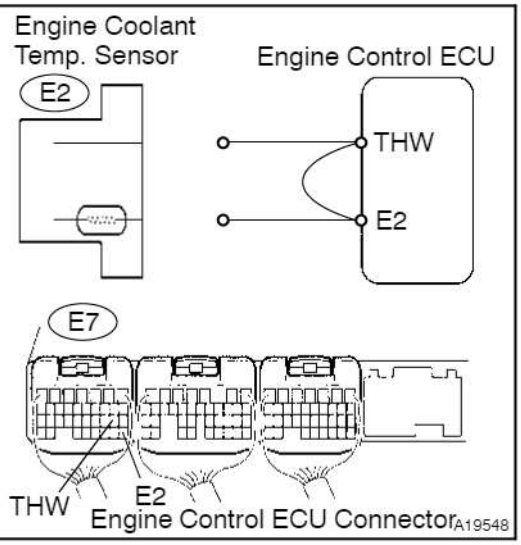
OK:

Temperature value: 140°C (284°F) or more

OK	**Confirm good connection at sensor. If OK, replace engine coolant temperature sensor.**

NG

3	Check for open in harness or engine control ECU.



PREPARATION:

(a) Disconnect the E2 engine coolant temperature sensor connector.

(b) Connect terminals THW and E2 of the E7 engine control ECU connector.

HINT:

Before checking, do a visual and contact pressure checks for the engine control ECU connector.

(c) Turn the ignition switch ON.

(d) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / COOLANT TEMP.

CHECK:

Read the temperature value on the hand–held tester.

OK:

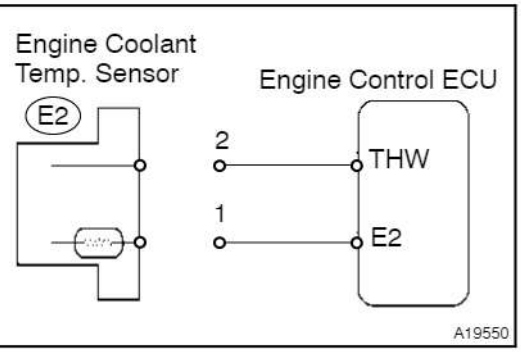
Temperature value: 140°C (284°F) or more

OK	Repair or replace harness or connector.

NG

Confirm good connection at engine control ECU. If OK, check and replace engine control ECU (See page IN–20).

4	Check for short in harness and engine control ECU.



PREPARATION:

(a) Disconnect the E2 engine coolant temperature sensor connector.

(b) Turn the ignition switch ON.

(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / COOLANT TEMP.

CHECK:

Read the temperature value on the hand–held tester.

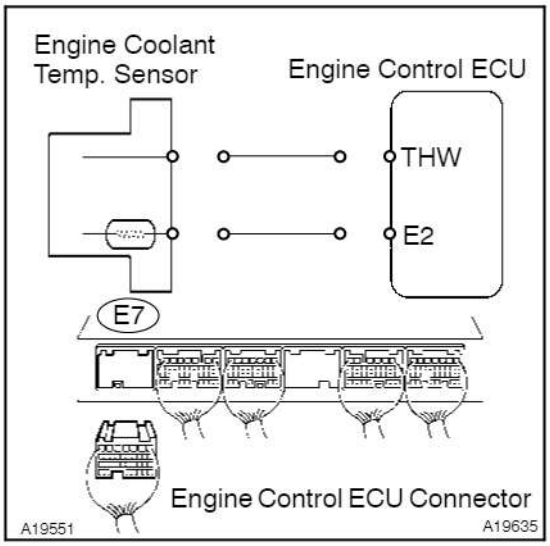
OK:

Temperature value: –40°C (–40°F)

OK	Replace engine coolant temperature sensor.

NG

5	Check for short in harness or engine control ECU.



PREPARATION:

(a) Disconnect the E7 engine control ECU connector.
(b) Turn the ignition switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / COOLANT TEMP.

CHECK:

Read the temperature value on the hand–held tester.

OK:

Temperature value: –40°C (–40°F)

OK → **Repair or replace harness or connector.**

NG

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DI1LG–17

DTC	P0116	Engine Coolant Temperature Circuit Range/ Performance Problem

CIRCUIT DESCRIPTION

Refer to DTC P0115 on page DI–56.

DTC No.	DTC Detecting Condition	Trouble Area
P0116	If the engine coolant temperature was 35°C (95°F) or more but less than 60°C (140°F) when the engine is started, and if conditions (a) and (b) are met: (a) Vehicle has accelerated and decelerated. (b) Engine coolant temperature remains within 3°C (5.4°F) of the initial engine coolant temperature (2 trip detection logic)	• Engine coolant temperature sensor
	• If the engine coolant temperature is more than 60°C (140°F) when the engine is started and the vehicle has accelerated and decelerated • If the engine coolant temperature sensor records a temperature variation below 1°C (1.8°F) successively 6 times (6 trip detection logic)	

MONITOR DESCRIPTION

The ECT (Engine Coolant Temperature) sensor is used to monitor the engine coolant temperature. The ECT sensor has a thermistor that varies its resistance depending on the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. The variations in resistance are reflected in the voltage output from the sensor. The engine control ECU monitors the sensor voltage and uses this value to calculate the engine coolant temperature. When the sensor output does not change, the engine control ECU interprets this as a fault in the ECT sensor and sets a DTC.

Examples:

(1) Upon starting the engine, the ECT is between 35°C (95°F) and 60°C (140°F). If after driving for 250 sec., the ECT still remains within 3°C (5.4°F) of the starting temperature, a DTC will be set (2 trip detection logic).

(2) Upon starting the engine, the ECT is over 60°C (140°F). If after driving for 250 sec., the ECT still remains within 1°C (1.8°F) of the starting temperature, a DTC will be set (6 trip detection logic).

INSPECTION PROCEDURE

HINT:

- If DTC P0115, P0116, P0117, P0118 and P0125 are output simultaneously, ECT sensor circuit may be open or shorted. Perform the troubleshooting of DTC P0115, P0117 or P0118 first.
- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

Replace engine coolant temperature sensor.

DTC	P0120/41	Throttle/Pedal Position Sensor/Switch ”A” Circuit

DTC	P0122/41	Throttle/Pedal Position Sensor/Switch ”A” Circuit Low Input

DTC	P0123/41	Throttle/Pedal Position Sensor/Switch ”A” Circuit High Input

DTC	P0220/41	Throttle/Pedal Position Sensor/Switch ”B” Circuit

DTC	P0222/41	Throttle/Pedal Position Sensor/Switch ”B” Circuit Low Input

DTC	P0223/41	Throttle/Pedal Position Sensor/Switch ”B” Circuit High Input

DTC	P2135/41	Throttle/Pedal Position Sensor/Switch ”A”/”B” Voltage Correction

HINT:
This is the purpose for the ”throttle position sensor”.

CIRCUIT DESCRIPTION

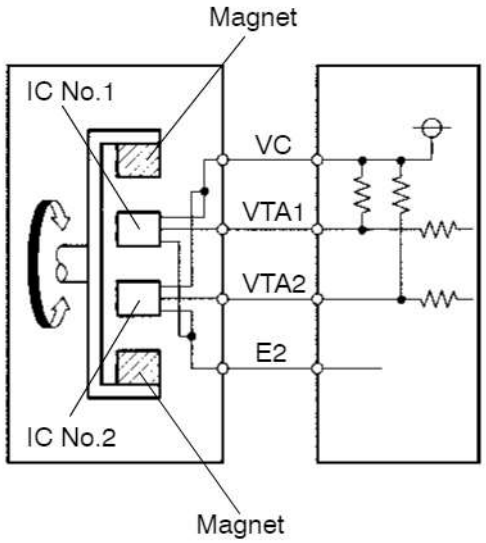
HINT:

- This Electrical Throttle Control System (ETCS) does not use a throttle cable.
- This throttle position sensor is a non–contact type.

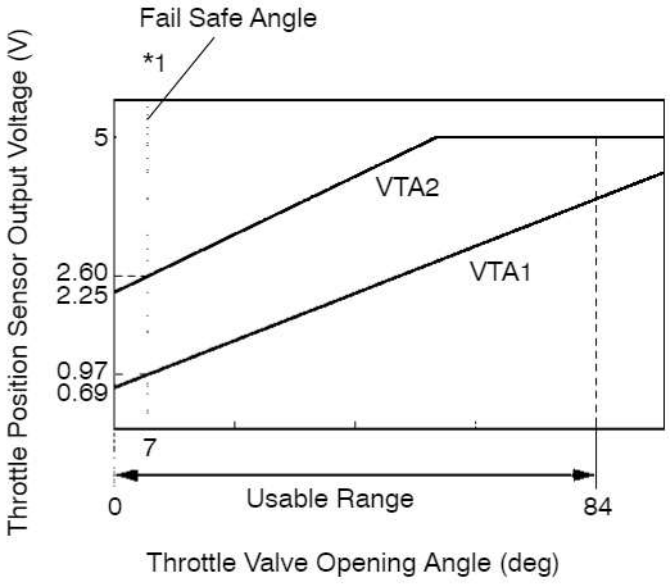
The throttle position sensor is mounted on the throttle body and it detects the opening angle of the throttle valve. This sensor is electronically controlled and uses Hall–effect elements, so that accurate control and reliability can be obtained. The throttle position sensor has 2 sensor elements / signal outputs: VTA1 and VTA2. VTA1 used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. Voltage applied to VTA1 and VTA2 change between 0V and 5V in proportion to the opening angle of the throttle valve. There are several checks that the engine control ECU performs to confirm proper operation of the throttle position sensor and VTA1.

The engine control ECU judges the current opening angle of the throttle valve from these signals input from terminals VTA1 and VTA2, and the engine control ECU controls the throttle motor to make the throttle valve angle properly in response to driver inputs.

Throttle Position Sensor Engine Control ECU



A19755



A21037

Throttle Valve Fully Closed
(Throttle Position expressed as percentage
(VTA1) 10 to 20%)

Throttle Valve Fully Opened
(Throttle Position expressed as percentage
(VTA1) 64 to 96%)

*1: Fail Safe Angle 7°
(Throttle Position expressed as percentage
(VTA1) about 10 to 24%)

DTC No.	DTC Detection Condition	Trouble Area
Condition (a) of DTC P0120, P0122, P0123, P0220, P0222 or P0223 continues for 2 sec. (Open or short in the throttle control motor and sensor circuit)		
P0120/41	Detection conditions for DTCs P0122 and P0123 are not satisfied but condition (a) is satisfied (a) VTA1 is "0.2 V or less" or VTA1 is "4.8 V or more" (1 trip detection logic)	• Throttle control motor and sensor • Engine control ECU
P0122/41	(a) VTA1 is 0.2 V or less (1 trip detection logic)	• Throttle control motor and sensor • Short in VTA1 circuit • Open in VC circuit • Engine control ECU
P0123/41	(a) VTA1 is 4.8 V or more (1 trip detection logic)	• Throttle control motor and sensor • Open in VTA1 circuit • Open in E2 circuit • VC and VTA1 circuit are short–circuited • Engine control ECU
P0220/41	Detection conditions for DTCs P0222 and P0223 are not satisfied but condition (a) is satisfied (a) VTA2 is "0.5 V or less" or VTA2 is "4.8 V or more" and VTA1 is "0.2 V or more" and VTA1 is "1.8 V or less" (1 trip detection logic)	• Throttle control motor and sensor • Engine control ECU
P0222/41	(a) VTA2 is 0.5 V or less (1 trip detection logic)	• Throttle control motor and sensor • Short in VTA2 circuit • Open in VC circuit • Engine control ECU
P0223/41	(a) VTA2 is "4.8 V or more" and VTA1 is "0.2 V or more" and VTA1 is "1.8 V or less" (1 trip detection logic)	• Throttle control motor and sensor • Open in VTA2 circuit • Open in E2 circuit • VC and VTA2 circuit are short–circuited • Engine control ECU
P2135/41	Condition (a) continues for 0.5 sec. or more, or condition (b) continues for 0.4 sec. or more: (a) Difference between VTA1 and VTA2 is 0.02 V or less (b) VTA1 is "0.2 V or less" and VTA2 is "0.5 V or less" (1 trip detection logic)	• VTA1 and VTA2 circuit are short–circuited • Throttle control motor and sensor • Engine control ECU

HINT:

- After confirming DTCs, use the hand–held tester to confirm the throttle valve opening percentage and closed throttle position switch condition.
- THROTTLE POS means VTA1 signal as well as the THROTTLE POS #2 for the VTA2 signal.

Reference (Normal condition):

Tester display	Accelerator pedal fully released	Accelerator pedal fully depressed
THROTTLE POS	10 to 24 %	66 to 98%
THROTTLE POS #2	2.1 to 3.1 V	4.5 to 5.0 V

MONITOR DESCRIPTION

The engine control ECU uses throttle position sensor to monitor the throttle valve opening angle.

(a) There is a specific voltage difference expected between VTA1 and VTA2 for each throttle opening angle.

- If the difference between VTA1 and VTA2 is incorrect the engine control ECU interprets this as a fault and will set a DTC.

(b) VTA1 and VTA2 each have a specific voltage operating range.

- If VTA1 or VTA2 is out of the normal operating range the engine control ECU interprets this as a fault and will set a DTC.

(c) VTA1 and VTA2 should never be close to the same voltage levels.

- If VTA1 is within 0.02 V of VTA2 the engine control ECU interprets this as a short circuit in the throttle position sensor system and will set a DTC.

This monitor runs for 2 seconds (for first 2 seconds of engine idle) after the engine started.

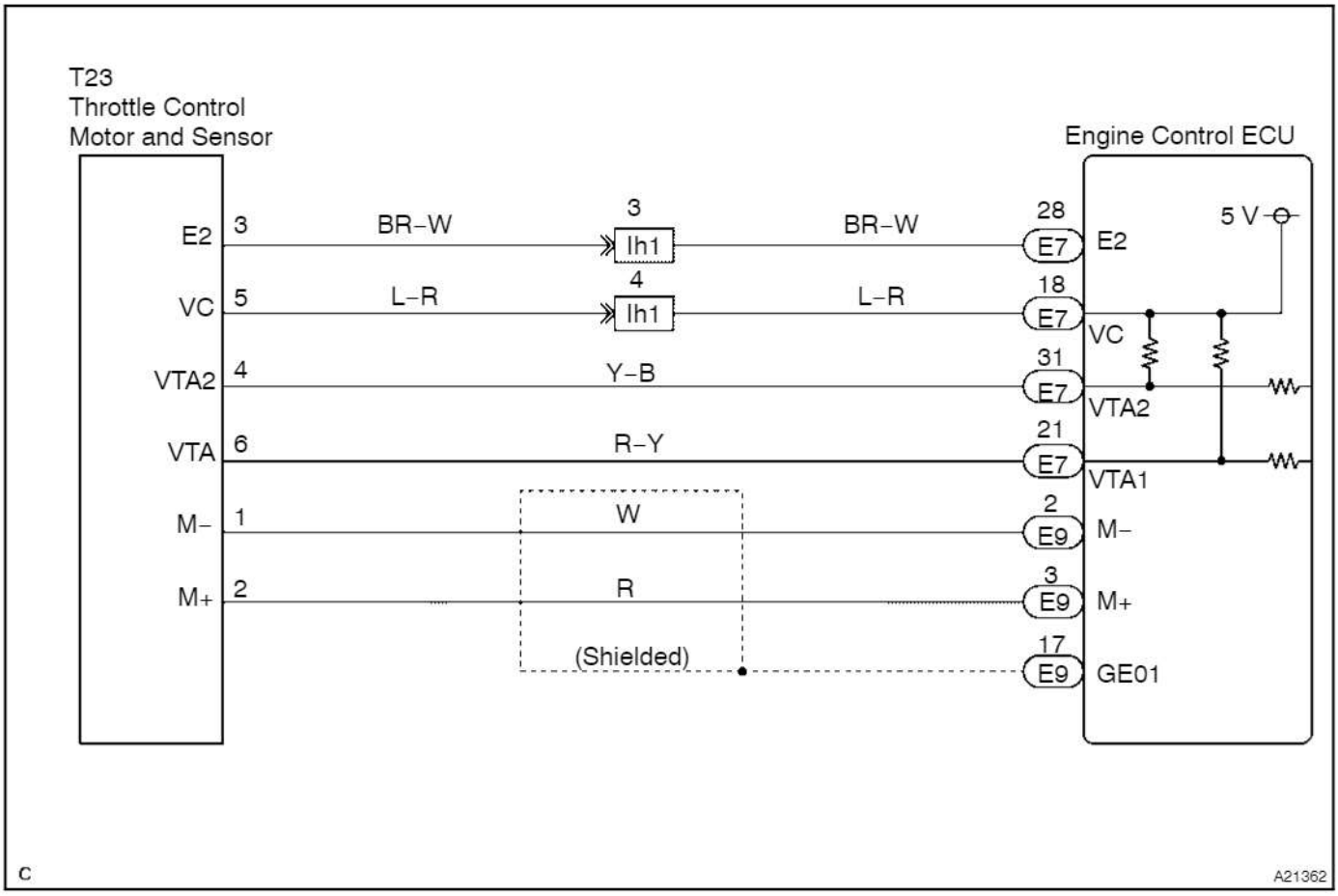
FAIL SAFE

If the ETCS (Electronic Throttle Control System) has a malfunction, the engine control ECU cuts off current to the throttle control motor. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of the return spring. The engine control ECU then adjusts the engine output by controlling the fuel infection (intermittent fuel–cut) and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue at a minimum speed.

If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

If a "pass" condition is detected and then the ignition switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- If DTCs related to different system that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

Hand–held tester:

1	**Connect hand–held tester, and read the voltage for throttle position sensor data.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) Enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / THROTTLE POS and THROTTLE POS #2.

CHECK:

Read voltage value displayed on the hand–held tester.

OK:

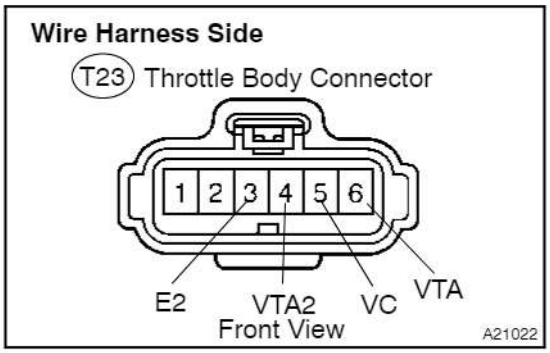
RESULT:

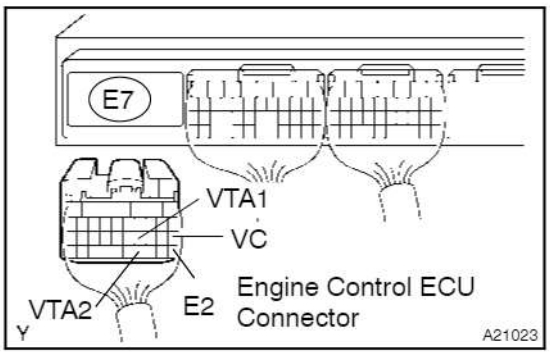
Throttle position expressed as percentage and voltage				Trouble area	Proceed to
Accelerator pedal released		Accelerator pedal depressed			
THROTTLE POS (VTA1)	THROTTLE POS #2 (VTA2)	THROTTLE POS (VTA1)	THROTTLE POS #2 (VTA2)		
0 %	0 to 0.2 V	0 %	0 to 0.2 V	VC circuit open	A
100 %	4.5 to 5.0 V	100 %	4.5 to 5.0 V	E2 circuit open	
0 % or 100 %	2.1 to 3.1 V (Fail safe)	0 % or 100 %	2.1 to 3.1 V (Fail safe)	VTA1 circuit open or ground short	
about 16 % (Fail safe)	0 to 0.2 or 4.5 to 5.0 V	about 16 % (Fail safe)	0 to 0.2 or 4.5 to 5.0 V	VTA2 circuit open or ground short	
10 to 24 %	2.15 to 3.05 V	64 to 96 % (Does not fail safe)	4.5 to 5.0 V (Does not fail safe)	Throttle position sensor circuit is normal	B

B	**Go to step 5.**

A

2	**Check for open and short in harness and connector between engine control ECU and throttle position sensor.**





PREPARATION:

(a) Disconnect the T23 throttle control motor and sensor connector.

(b) Disconnect the E7 engine control ECU connector.

CHECK:

Check the resistance between the wire harness side connectors.

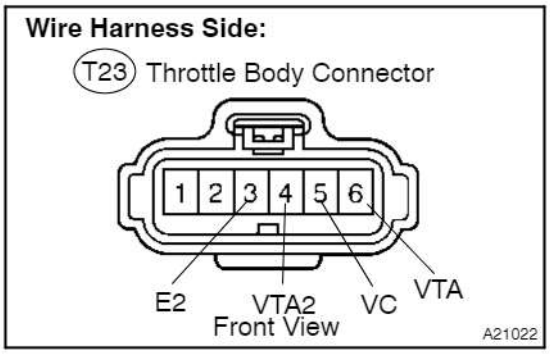
OK:

Tester Connection	Specified Condition
VC (T23–5) – VC (E7–18)	Below 1 Ω
VTA (T23–6) – VTA1 (E7–21)	
VTA2 (T23–4) – VTA2 (E7–31)	
E2 (T23–3) – E2 (E7–28)	
VC (T23–5) or VC (E7–18) – Body ground	10 kΩ or higher
VTA (T23–6) or VTA1 (E7–21) – Body ground	
VTA2 (T23–4) or VTA2 (E7–31) – Body ground	

NG → **Repair or replace harness or connector.**

OK

3	Check voltage between terminals VC and E2 of engine control ECU connector.



PREPARATION:

(a) Disconnect the T23 throttle control motor and sensor connector.

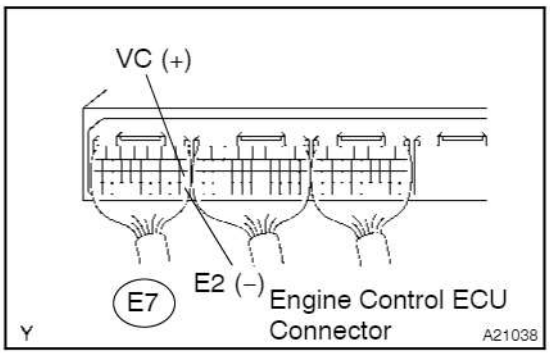
(b) Turn the ignition switch ON.

CHECK:

Measure the voltage between the specified terminals of the E7 engine control ECU connector.

OK:

Tester Connection	Specified Condition
VC (E7–18) – E2 (E7–28)	4.5 to 5.5 V



NG → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

OK

4	Replace throttle body (See Pub. No. RM630E, page FI–42).

Go

5	**Check if DTC output recur.**

PREPARATION:

(a) Clear the DTC (See page DI–3).
(b) Start the engine.
(c) Run the engine at idle for 15 seconds or more.

CHECK:

Read the DTC (See page DI–3).

RESULT:

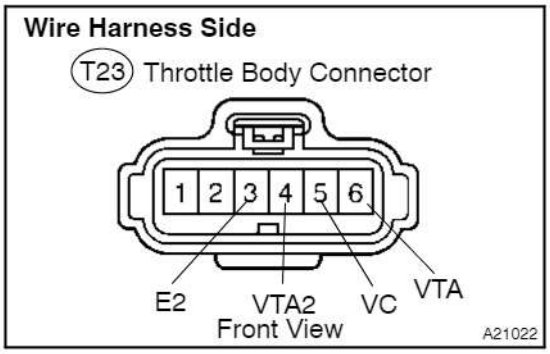
Display (DTC Output)	Proceed to
"P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135" are output again	A
No DTC output	B

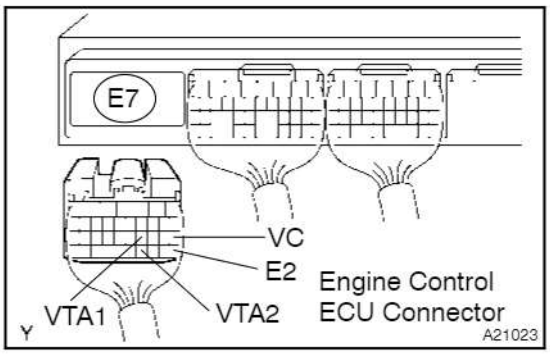
B → **System is OK.**

A → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

When not using hand–held tester:

1	**Check for open and short in harness and connector between engine control ECU and throttle position sensor.**





PREPARATION:

(a) Disconnect the T23 throttle control motor and sensor connector.

(b) Disconnect the E7 engine control ECU connector.

CHECK:

Check the resistance between the wire harness side connectors.

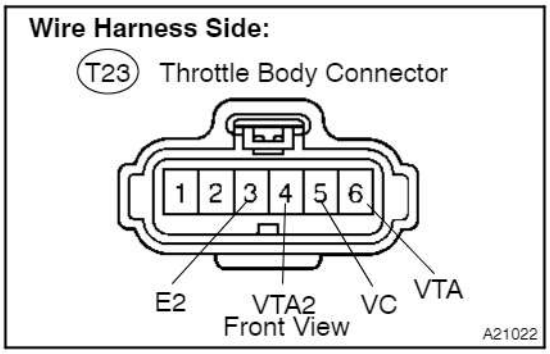
OK:

Tester Connection	Specified Condition
VC (T23–5) – VC (E7–18)	Below 1 Ω
VTA (T23–6) – VTA1 (E7–21)	
VTA2 (T23–4) – VTA2 (E7–31)	
E2 (T23–3) – E2 (E7–28)	
VC (T23–5) or VC (E7–18) – Body ground	10 kΩ or higher
VTA (T23–6) or VTA1 (E7–21) – Body ground	
VTA2 (T23–4) or VTA2 (E7–31) – Body ground	

NG → **Repair or replace harness or connector.**

OK

2	Check voltage between terminals VC and E2 of engine control ECU connector.



PREPARATION:

(a) Disconnect the T23 throttle control motor and sensor connector.

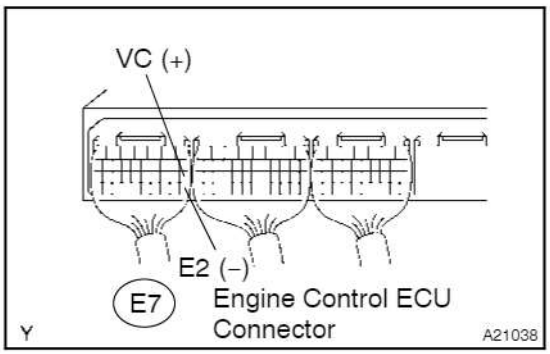
(b) Turn the ignition switch ON.

CHECK:

Measure the voltage between the specified terminals of the E7 engine control ECU connector.

OK:

Tester Connection	Specified Condition
VC (E7–18) – E2 (E7–28)	4.5 to 5.5 V



NG → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

OK

3	Replace throttle body (See Pub. No. RM630E, page FI–42).

Go

4	**Check if DTC output recur.**

PREPARATION:

(a) Clear the DTC (See page DI–3).
(b) Start the engine.
(c) Run the engine at idle for 15 seconds or more.

CHECK:

Read the DTC (See page DI–3).

RESULT:

Display (DTC Output)	Proceed to
"P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135" are output again	A
No DTC output	B

B → **System is OK.**

A → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

DTC	P0121/41	Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance Problem

HINT:
This is the purpose of the "throttle position sensor".

CIRCUIT DESCRIPTION

Refer to DTC P0120 on page DI–63.

DTC No.	DTC Detecting Condition	Trouble Area
P0121/41	Condition (a) continues for 2.0 sec.: (a) Difference between VTA1 and VTA2 deviates from the threshold (1 trip detection logic)	Throttle control motor and sensor

MONITOR DESCRIPTION

The engine control ECU uses throttle position sensor to monitor the throttle valve opening angle.
This sensor including two signals, VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. There are several checks that the engine control ECU performs confirm proper operation of the throttle position sensor and VTA1.
There is a specific voltage difference expected between VTA1 and VTA2 for each throttle opening angle.
If the voltage output difference of the VTA1 and VTA2 deviates from the normal operating range, the engine control ECU interprets this as a malfunction of the throttle position sensor. The engine control ECU will turn on the MIL and a DTC is set.
This monitor runs for 2 seconds (the first 2 seconds of engine idle) after the engine is started.

FAIL SAFE

If the ETCS (Electronic Throttle Control System) has a malfunction, the engine control ECU cuts off current to the throttle control motor. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of the return spring. The engine control ECU then adjusts the engine output by controlling the fuel infection (intermittent fuel–cut) and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue at a minimum speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

Replace throttle control motor and sensor (See Pub. No. RM630E, page FI–42).

DIC26-02

DTC	P0130	Oxygen Sensor Circuit (Bank 1 Sensor 1)

DTC	P0150	Oxygen Sensor Circuit (Bank 2 Sensor 1)

DTC	P2195	Oxygen Sensor Signal Stack Lean (Bank 1 Sensor 1)

DTC	P2196	Oxygen Sensor Signal Stack Rich (Bank 1 Sensor 1)

DTC	P2197	Oxygen Sensor Signal Stack Lean (Bank 2 Sensor 1)

DTC	P2198	Oxygen Sensor Signal Stack Rich (Bank 2 Sensor 1)

CIRCUIT DESCRIPTION

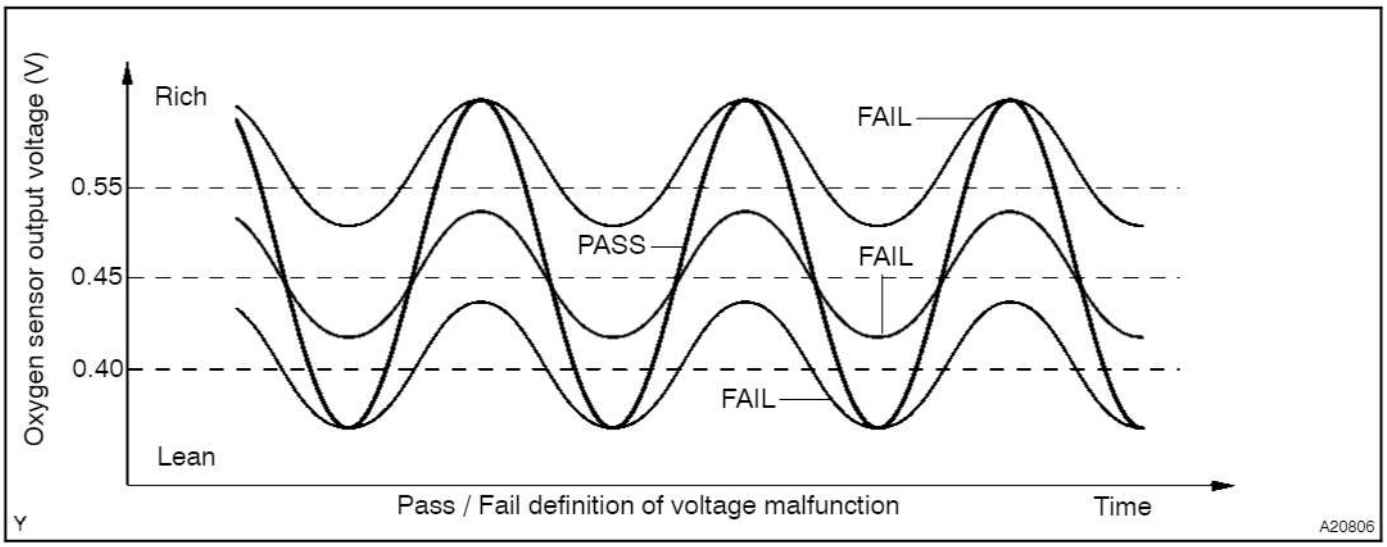
Refer to DTC P0031 on page DI–35.

DTC No.	Detection Item	Trouble Area
P0130 P0150	Output voltage of heated oxygen sensor remains at 0.4 V or more, or 0.55 V or less, during idling after engine is warmed up (2 trip detection logic)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • Injector • Engine control ECU
P2195 P2197	Output voltage of heated oxygen sensor remains at 0.55 V or less, during idling after engine is warmed up (2 trip detection logic)	
P2196 P2198	Output voltage of heated oxygen sensor remains at 0.4 V or more, during idling after engine is warmed up (2 trip detection logic)	

HINT:

- Bank 1 refers to bank that includes cylinder No. 1.
- Bank 2 refers to bank that does not includes cylinder No. 2.
- Sensor 1 refers to the sensor closer to the engine assembly.
- The heated oxygen sensor's output voltage and the short–term fuel trim value can be read using the hand–held tester.

MONITOR DESCRIPTION



The engine control ECU uses the HO2S information to regulate the air–fuel ratio close to the stoichiometric ratio. This maximizes the catalytic converter's ability to purify the exhaust gases. The HO2S detects oxygen levels in the exhaust gas and sends a signal to the engine control ECU.

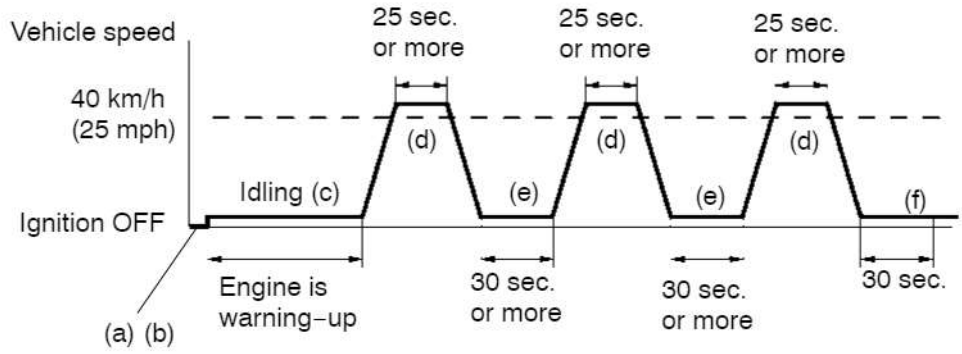
The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to the exhaust gases. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The HO2S's output voltage changes suddenly in the vicinity of the stoichiometric air–fuel ratio. The HO2S generates output voltage between 0.1 V and 0.9 V in response to the oxygen concentration in exhaust gas. When the front HO2S voltage is 0.45 V or more, the engine control ECU judges that the air–fuel ratio is RICH. When it is 0.45 V or less, the engine control ECU judges that the air–fuel ratio is LEAN.

The HO2S should indicate RICH and LEAN alternately at a regular cycle under the air–fuel ratio feedback control. If the HO2S voltage remains at RICH or LEAN for about 20 seconds (x 3 times) on 3 different occasions, the engine control ECU interprets this as malfunction of the HO2S. The engine control ECU illuminates the MIL (2 trip detection logic) and sets a DTC.

WIRING DIAGRAM

Refer to DTC P0031 on page DI–35.

CONFIRMATION DRIVING PATTERN



(a) Connect the hand–held tester to the DLC3.
(b) Switch the hand–held tester from the "normal mode" to the "check mode" (See page DI–3).
(c) Start the engine and let the engine idle for until the Engine Coolant Temperature reaches 75 °C (167 °F).
(d) Drive the vehicle at 25 mph (40 km/h) or more for 25 seconds or more.
(e) Let the engine idle for 30 seconds or more. Perform steps (d) and (e) at 3 times.
(f) Let the engine idle for 30 seconds.

HINT:
If a malfunction exists, the MIL will light up during step (f).

NOTICE:
If the conditions in this test are not strictly followed, you should perform steps (d) and (e).
If you do not have a hand–held tester, turn the ignition switch OFF after performing steps (c) to (f), then perform steps (c) to (f) again.

INSPECTION PROCEDURE

HINT:
Hand–held tester only:
The narrowing down the trouble area is possible by performing ACTIVE TEST of the following "A/F CONTROL" (Heated oxygen sensor or another can be distinguished).

(a) Perform ACTIVE TEST by hand–held tester (A/F CONTROL).

HINT:
"A/F CONTROL" is an ACTIVE TEST which changes the injection volume to –12.5 % or +25 %.

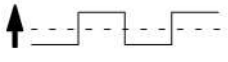
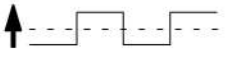
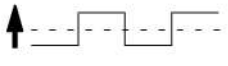
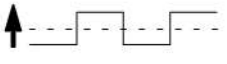
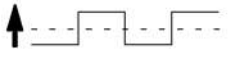
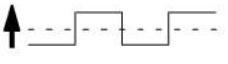
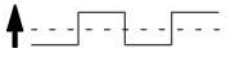
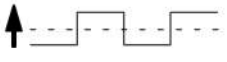
(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine with the engine speed at 2,500 rpm for approximately 90 seconds.
(4) Select the item "DIAGNOSIS / OBD/MOBD / ACTIVE TEST / A/F CONTROL".
(5) Perform "A/F CONTROL" with the engine in an idle condition (press the right or left button).

RESULT:

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume
+25% → rich output: More than 0.55 V
–12.5% → lean output: Less than 0.4 V

NOTICE:

However, there is a few seconds delay in the sensor 1 (front sensor) output. And there is a maximum 20 seconds delay in the sensor 2 (rear sensor).

	Output voltage of heated oxygen sensor (sensor 1: front sensor)	Output voltage of heated oxygen sensor (sensor 2: rear sensor)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4 V  OK	Injection volume +25 % –12.5 %  Output voltage More than 0.5 V Less than 0.4 V  OK	—
Case 2	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Injection volume +25 % –12.5 %  Output voltage More than 0.5 V Less than 0.4 V  OK	Sensor 1: front sensor (sensor 1, heater, sensor 1 circuit)
Case 3	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4 V  OK	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Extremely rich or lean of the actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of the heated oxygen sensors (sensor 1 and 2).

For displaying the graph indication, enter "ACTIVE TEST / A/F CONTROL / USER DATA" then select "O2S B1S1 and O2S B1S2" by pressing "YES" button and push "ENTER" button before pressing "F4" button.

NOTICE:

If the vehicle is short of fuel, the air–fuel ratio becomes LEAN and heated oxygen sensor DTCs will be recorded, and the MIL then comes on.

HINT:

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a 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.
- A high heated oxygen sensor (sensor 1) voltage (0.5 V or more) could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1	**Are there any other codes (besides DTC P0130, P0150, P2195, P2197, P2196 or P2198) being output?**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES.

CHECK:

Read the DTC using the hand–held tester.

RESULT:

Display (DTC Output)	Proceed to
"P0130, P0150, P2195, P2196, P2197 and/or P2198"	A
"P0130, P0150 P2195, P2196, P2197 or P2198" and other DTCs	B

HINT:

If any other codes besides "P0130, P0150, P2195, P2196, P2197 and/or P2198" are output, perform the troubleshooting for those DTCs first.

B → **Go to relevant DTC chart (See page DI–19).**

A

2	**Check output voltage of heated oxygen sensor during idling.**

PREPARATION:

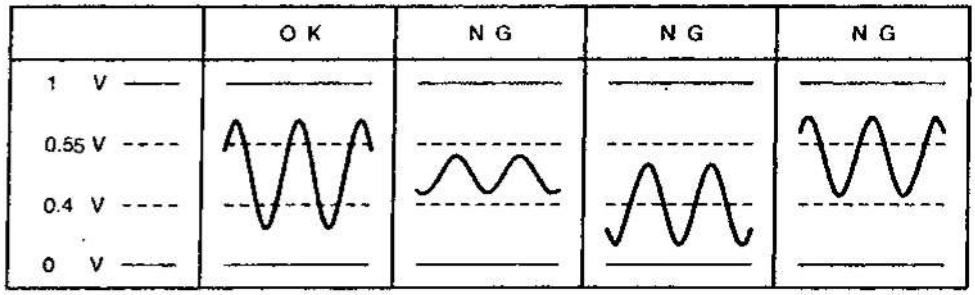
(a) Warm up the heated oxygen sensor with the engine speed at 2,500 rpm for approximately 90 seconds.
(b) Connect the hand–held tester to the DLC3.
(c) When using hand–held tester, enter the following menu: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / O2S B1 S1 or B2 S1.

CHECK:

Check the output voltage of the heated oxygen sensor during idling the hand–held tester.

OK:

Heated oxygen sensor output voltage:
Alternates repeatedly between less than 0.4 V and more than 0.55 V (See the following table).



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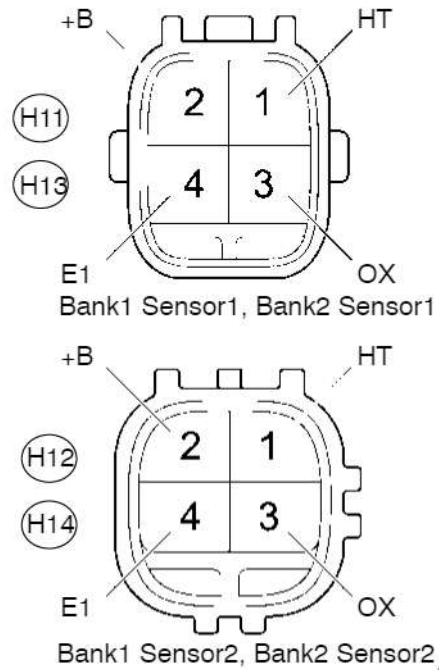
OK	**Go to step 9.**

NG

3	Check resistance of heated oxygen sensor heater.

Components Side:



PREPARATION:

Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

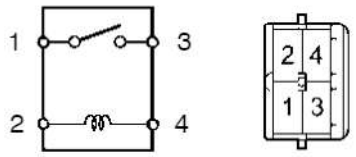
Tester Connection	Specified Condition
HT (H11–1) – +B (H11–2)	11.7 to 14.3 Ω (20°C)
HT (H12–1) – +B (H12–2)	11.7 to 14.3 Ω (20°C)
HT (H13–1) – +B (H13–2)	11 .7to 14.3 Ω (20°C)
HT (H14–1) – +B (H14–2)	11 .7to 14.3 Ω (20°C)

NG → **Replace heated oxygen sensor.**

OK

4	Check EFI or ECD relay.

EFI or ECD Relay



PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Inspect the EFI or ECD relay.

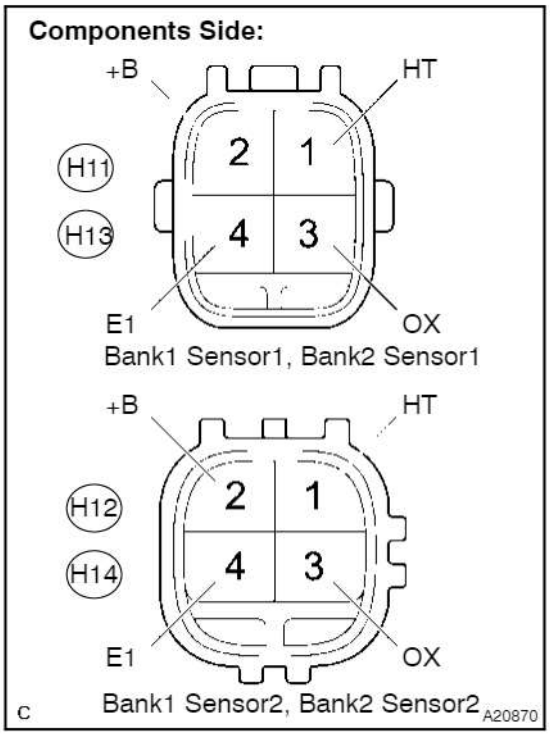
OK:

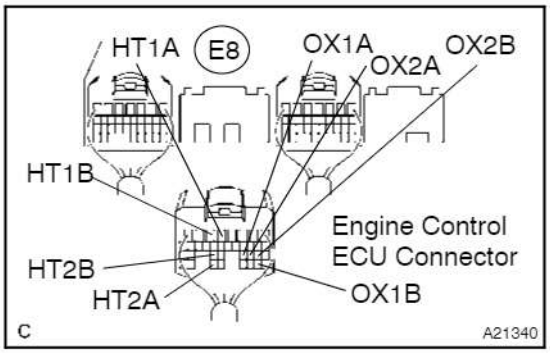
Terminal No.	Condition	Specified Condition
1 – 3	Usually	10 kΩ or higher
	Apply B+ between terminals 2 and 4	Below 1 Ω

NG → **Replace EFI or ECD relay.**

OK

5	**Check for open and short in harness and connector between engine control ECU and heated oxygen sensor.**





PREPARATION:

(a) Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

(b) Disconnect the E8 engine control ECU connector.

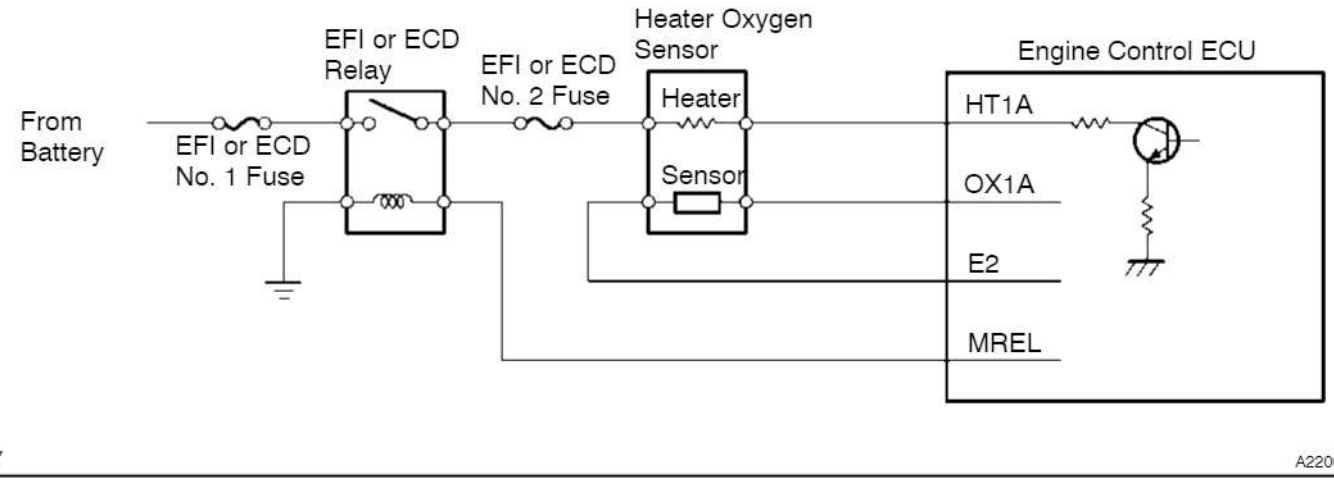
CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
OX (H11–3) – OX1A (E8–23)	Below 1 Ω
HT (H11–1) – HT1A (E8–4)	Below 1 Ω
OX (H12–3) – OX1B (E8–29)	Below 1 Ω
HT (H12–1) – HT1B (E8–5)	Below 1 Ω
OX (H13–3) – OX2A (E8–22)	Below 1 Ω
HT (H13–1) – HT2A (E8–33)	Below 1 Ω
OX (H14–3) – OX2B (E8–21)	Below 1 Ω
HT (H14–1) – HT2B (E8–25)	Below 1 Ω
OX (H11–3) or OX1A (E8–23) – Body ground	10 kΩ or higher
HT (H11–1) or HT1A (E8–4) – Body ground	10 kΩ or higher
OX (H12–3) or OX1B (E8–29) – Body ground	10 kΩ or higher
HT (H12–1) or HT1B (E8–5) – Body ground	10 kΩ or higher
OX (H13–3) or OX2A (E8–22) – Body ground	10 kΩ or higher
HT (H13–1) or HT2A (E8–33) – Body ground	10 kΩ or higher
OX (H14–3) or OX2B (E8–21) – Body ground	10 kΩ or higher
HT (H14–1) or HT2B (E8–25) – Body ground	10 kΩ or higher

Reference (Bank 1 Sensor 1 System Drawing)



NG	**Repair or replace harness or connector.**

OK

6	**Check air induction system (See Pub. No. RM630E, page FI–1).**

CHECK:

Check the air induction system for vacuum leaks.

NG	**Repair or replace air induction system.**

OK

7	**Check fuel pressure (See Pub. No. RM630E, page FI–1).**

CHECK:

Check the fuel pressure (high or low pressure).

NG	**Check and repair fuel pump, pressure regulator, fuel pipe line and filter (See Pub. No. RM630E, page FI–7).**

OK

8	**Check injector injection (See Pub. No. RM630E, page FI–24).**

NG → **Replace injector.**

OK

Replace heated oxygen sensor.

9	**Perform confirmation driving pattern.**

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

Go

10	**Is there DTC P0130, P0150, P2195, P2196, P2197 or P2198 being output again?**

NO → **Check for intermittent problems (See page DI–3).**

YES

Replace heated oxygen sensor.

DIC27-02

DTC	P0133	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 1)

DTC	P0153	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 1)

CIRCUIT DESCRIPTION

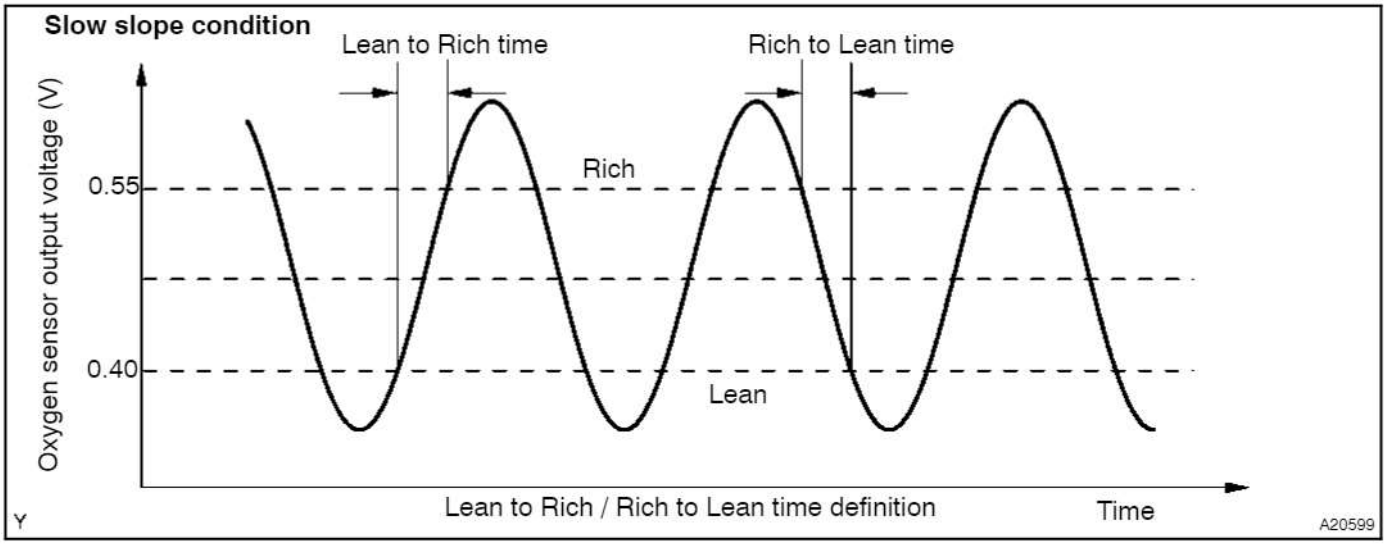
Refer to DTC P0031 on page DI–35.

DTC No.	DTC Detecting Condition	Trouble Area
P0133 P0153	Voltage of Heated Oxygen Sensor (HO2S) sensor 1 does not switch between Lean and Rich for 0.9 seconds (2 trip detection logic) Lean: 0.4 V or less Rich: 0.55 V or more	• Open or short in front heated oxygen sensor circuit • Front heated oxygen sensor • Front heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • Injector • Engine control ECU

HINT:

- Bank 1 refers to bank that includes cylinder No. 1.
- Bank 2 refers to bank that does not includes cylinder No. 1.
- Sensor 1 refers to the sensor closer to the engine assembly.

MONITOR DESCRIPTION



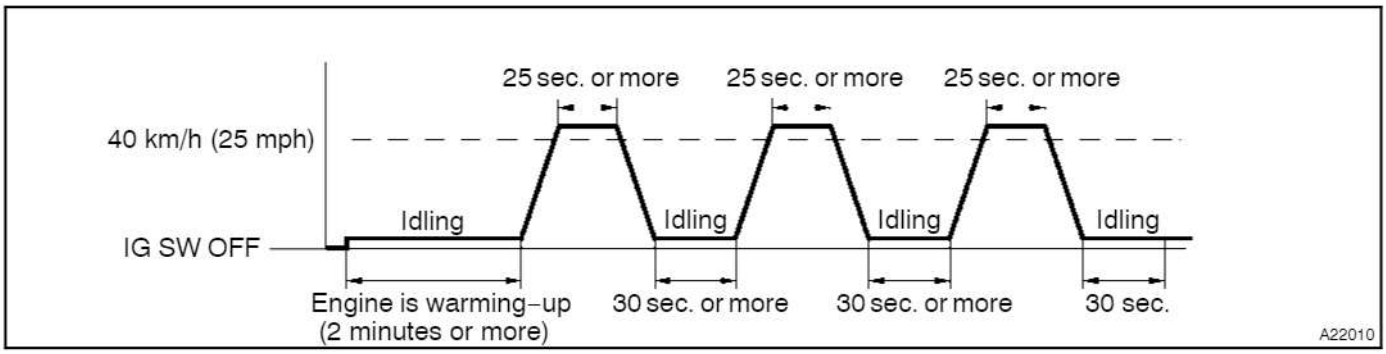
The engine control ECU uses the heated oxygen sensor information to regulate the air–fuel ratio close to a stoichiometric ratio. This maximizes the catalytic converter's ability to purify the exhaust gases. The sensor detects oxygen levels in the exhaust gas and sends this signal to the engine control ECU.

The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The heated oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air–fuel ratio. The heated oxygen sensor generates waveforms of a voltage between 0 V and 1 V in response to the oxygen concentration in exhaust gas. When the output voltage of the heated oxygen sensor is 0.55 V or more, the engine control ECU judges that the air–fuel ratio is RICH. When it is 0.40 V or less, the engine control ECU judges that the air–fuel ratio is LEAN. The engine control ECU monitors the response feature of the heated oxygen sensor. If the response time of the heated oxygen sensor output status change from RICH to LEAN or vice versa becomes longer, the engine control ECU interprets this as a malfunction in the heated oxygen sensor and sets a DTC.

WIRING DIAGRAM

Refer to DTC P0031 on page DI–35.

CONFIRMATION DRIVING PATTERN



(a) Connect the hand–held tester to the DLC3.
(b) Switch from normal mode to check mode (see page DI–3).
(c) Allow the engine to idle until the Engine Coolant Temperature (ECT) reaches 75°C (167°F).
(d) Allow the vehicle to run at 40 km/h (25 mph) or more for 25 seconds or more.
(e) Allow the engine to idle for 30 seconds or more. Perform steps (d) and (e) at least 3 times.
(f) Allow the engine to idle for 30 seconds.

HINT:

If a malfunction exists, the check engine warning light will be illuminated on the multi–information display during step (f).

NOTICE:

If the conditions in this test are not strictly followed, you should perform steps (d) and (e).
If you do not have the Intelligent Tester II, turn the ignition switch OFF after performing steps from (c) to (f), then perform steps from (c) to (f) again.

INSPECTION PROCEDURE

HINT:

Hand–held tester only:

The narrowing down the trouble area is possible by performing ACTIVE TEST of the following "A/F CONTROL" (Heated oxygen sensor or another can be distinguished).

(a) Perform ACTIVE TEST by hand–held tester (A/F CONTROL).

HINT:

"A/F CONTROL" is the ACTIVE TEST which changes the injection volume to –12.5 % or +25 %.

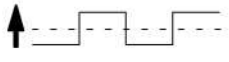
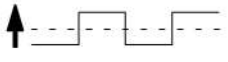
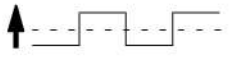
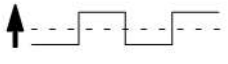
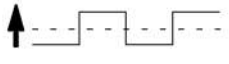
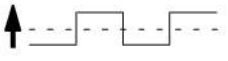
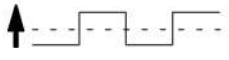
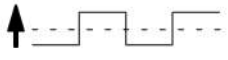
(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine with the engine speed at 2,500 rpm for approximately 90 seconds.
(4) Select the item "DIAGNOSIS / OBD/MOBD / ACTIVE TEST / A/F CONTROL".
(5) Perform "A/F CONTROL" with the engine in an idle condition (press the right or left button).

RESULT:

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume
+25 % → rich output: More than 0.5 V
–12.5 % → lean output: Less than 0.4 V

NOTICE:

However, there is a few second delay in the sensor 1 (front sensor) output. And there is a maximum 20 seconds delay in the sensor 2 (rear sensor).

	Output voltage of heated oxygen sensor (sensor 1: front sensor)	Output voltage of heated oxygen sensor (sensor 2: rear sensor)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4 V  OK	Injection volume +25 % –12.5 %  Output voltage More than 0.5 V Less than 0.4 V  OK	—
Case 2	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Injection volume +25 % –12.5 %  Output voltage More than 0.5 V Less than 0.4 V  OK	Sensor 1: front sensor (sensor 1, heater, sensor 1 circuit)
Case 3	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4 V  OK	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Extremely rich or lean of the actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of the heated oxygen sensors (sensor 1 and 2).

For displaying the graph indication, enter "ACTIVE TEST / A/F CONTROL / USER DATA" then select "O2S B1S1 and O2S B1S2" by pressing "YES" button and push "ENTER" button before pressing "F4" button.

NOTICE:

If the vehicle is short of fuel, the air–fuel ratio becomes LEAN and DTCs P0133 and/or P0153 will be recorded, and the MIL then comes on.

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a 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.
- A high heated oxygen sensor (sensor 1) voltage (0.55 V or more) could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1	**Are there any other codes (besides DTC P0133 or P0153) being output?**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES.

CHECK:

Read the DTC using the hand–held tester.

RESULT:

Display (DTC Output)	Proceed to
"P0133 and/or P0153"	A
"P0133 or P0153" and other DTCs	B

HINT:

If any other codes besides "P0133 and/or P0153" are output, perform the troubleshooting for those DTCs first.

B → **Go to relevant DTC chart (See page DI–19).**

A

2	Check output voltage of heated oxygen sensor during idling.

PREPARATION:

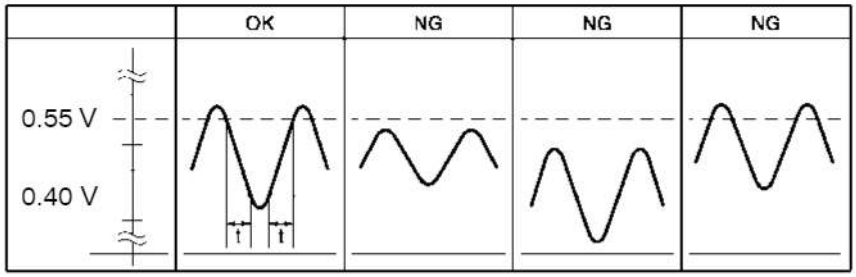
(a) Warm up the heated oxygen sensor with the engine speed at 2,500 rpm for approximately 90 seconds.
(b) Connect the hand–held tester to the DLC3.
(c) When using hand–held tester, enter the following menu: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / O2S B1 S1 or B2 S1.

CHECK:

Check the output voltage of the heated oxygen sensor while idling the hand–held tester.

OK:

Heated oxygen sensor output voltage:
Alternates between less than 0.40 V and more than 0.55 V, and period of "t" must exist less than 0.9 seconds (See the following table).



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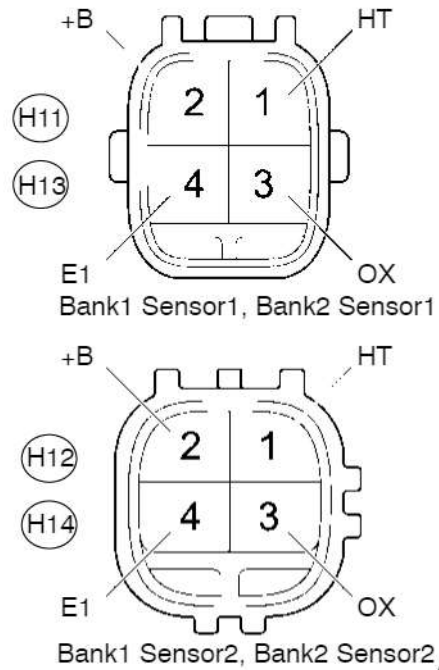
OK	Go to step 9.

NG

3	Check resistance of heated oxygen sensor heater.

Components Side:



PREPARATION:

Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

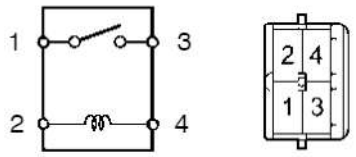
Tester Connection	Specified Condition
HT (H11–1) – +B (H11–2)	11.7 to 14.3 Ω (20°C)
HT (H12–1) – +B (H12–2)	11.7 to 14.3 Ω (20°C)
HT (H13–1) – +B (H13–2)	11.7 to 14.3 Ω (20°C)
HT (H14–1) – +B (H14–2)	11.7 to 14.3 Ω (20°C)

NG → **Replace heated oxygen sensor.**

OK

4	Check EFI or ECD relay.

EFI or ECD Relay



PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Inspect the EFI or ECD relay.

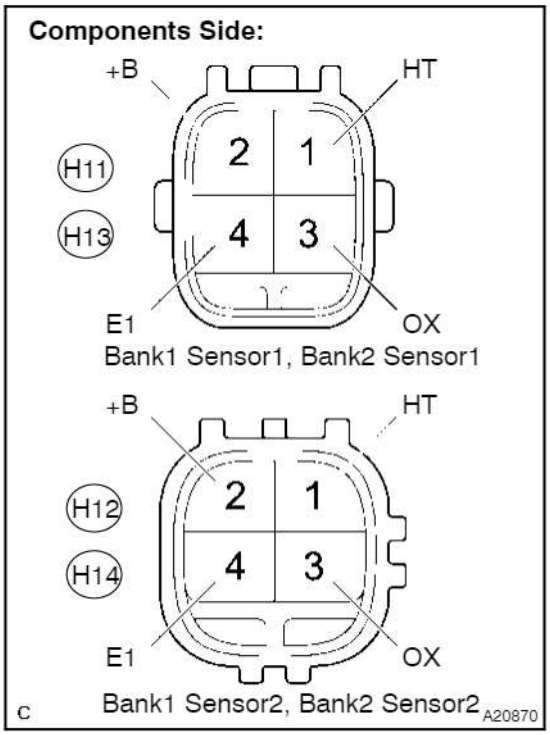
OK:

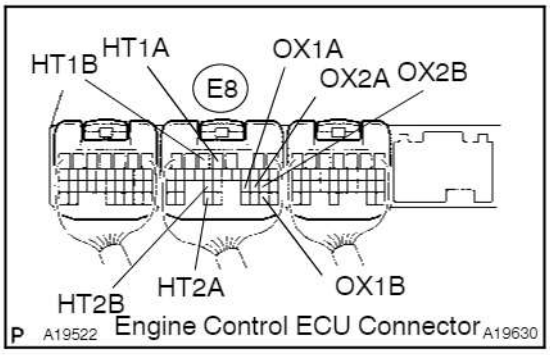
Terminal No.	Condition	Specified Condition
1 – 3	Usually	10 kΩ or higher
	Apply B+ between terminals 2 and 4	Below 1 Ω

NG → **Replace EFI or ECD relay.**

OK

5	**Check for open and short in harness and connector between engine control ECU and heated oxygen sensor.**





PREPARATION:

(a) Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

(b) Disconnect the E8 engine control ECU connector.

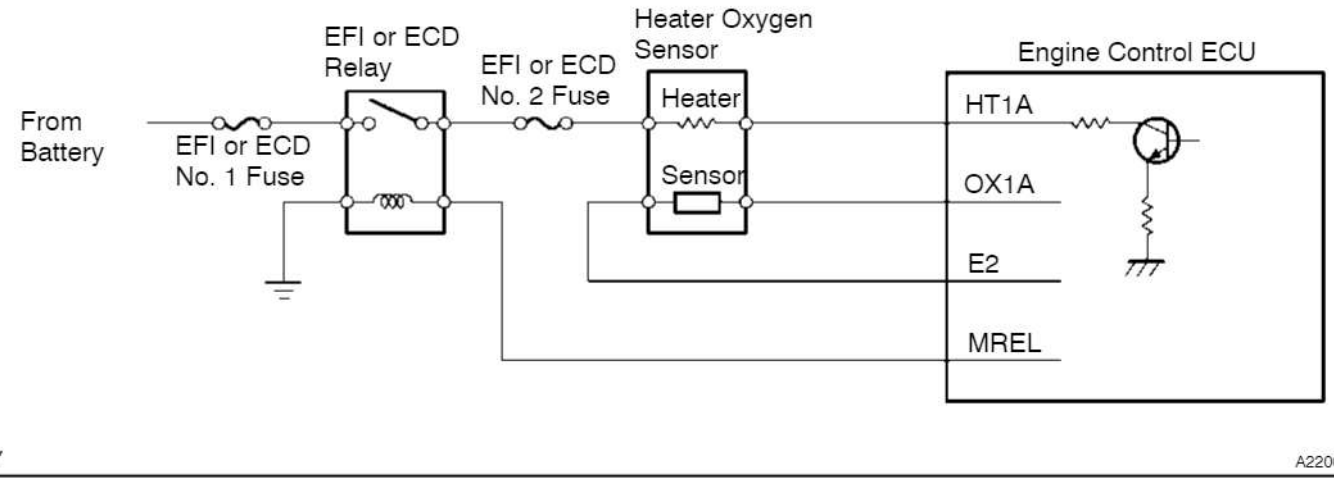
CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
OX (H11–3) – OX1A (E8–23)	Below 1 Ω
HT (H11–1) – HT1A (E8–4)	Below 1 Ω
OX (H12–3) – OX1B (E8–29)	Below 1 Ω
HT (H12–1) – HT1B (E8–5)	Below 1 Ω
OX (H13–3) – OX2A (E8–22)	Below 1 Ω
HT (H13–1) – HT2A (E8–33)	Below 1 Ω
OX (H14–3) – OX2B (E8–21)	Below 1 Ω
HT (H14–1) – HT2B (E8–25)	Below 1 Ω
OX (H11–3) or OX1A (E8–23) – Body ground	10 kΩ or higher
HT (H11–1) or HT1A (E8–4) – Body ground	10 kΩ or higher
OX (H12–3) or OX1B (E8–29) – Body ground	10 kΩ or higher
HT (H12–1) or HT1B (E8–5) – Body ground	10 kΩ or higher
OX (H13–3) or OX2A (E8–22) – Body ground	10 kΩ or higher
HT (H13–1) or HT2A (E8–33) – Body ground	10 kΩ or higher
OX (H14–3) or OX2B (E8–21) – Body ground	10 kΩ or higher
HT (H14–1) or HT2B (E8–25) – Body ground	10 kΩ or higher

Reference (Bank 1 Sensor 1 System Drawing)



NG → **Repair or replace harness or connector.**

OK

6	**Check air induction system (See Pub. No. RM630E, page FI–1).**

CHECK:

Check the air induction system for vacuum leaks.

NG → **Repair or replace air induction system.**

OK

7	**Check fuel pressure (See Pub. No. RM630E, page FI–1).**

CHECK:

Check the fuel pressure (high or low pressure).

NG → **Check and repair fuel pump, pressure regulator, fuel pipe line and filter (See Pub. No. RM630E, page FI–7).**

OK

8	**Check injector injection (See Pub. No. RM630E, page FI–24).**

NG → **Replace injector.**

OK

Replace heated oxygen sensor.

9	**Perform confirmation driving pattern.**

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

Go

10	**Is there DTC P0133 or P0153 being output again?**

NO → **Check for intermittent problems (See page DI–3).**

YES

Replace heated oxygen sensor.

DTC	P0134	Oxygen Sensor Circuit No Activity Detected (Bank 1 Sensor 1)

DTC	P0154	Oxygen Sensor Circuit No Activity Detected (Bank 2 Sensor 1)

CIRCUIT DESCRIPTION

Refer to DTC P0031 on page DI–35.

DTC No.	DTC Detecting Condition	Trouble Area
P0134 P0154	After the engine is warmed up, front heated oxygen sensor output does not indicate RICH (more than 0.45 V) even once when the following conditions continue for 65 sec. or more: (a) Engine speed: 1,400 rpm or more (b) Vehicle speed: 25 mph (40 km/h) or more (c) Throttle valve does not fully closed (d) 180 sec. or more after starting engine (e) Engine coolant temperature more than 40°C (104°F) (1 trip detection logic)	• Open or short in front heated oxygen sensor circuit • Front heated oxygen sensor • Front heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • PCV hose connection • PCV valve and hose • Injector • Gas leakage on exhaust system • PCV piping • Engine control ECU

HINT:

- Bank 1 refers to bank that includes cylinder No. 1.
- Bank 2 refers to bank that does not includes cylinder No. 1.
- Sensor 1 refers to the sensor closer to the engine assembly.
- After confirming DTC P0134 and P0154, check the output voltage of the heated oxygen sensor in the "DIAGNOSIS / OBD/MOBD / DATA LIST / ALL" using the hand–held tester. If output voltage of the heated oxygen sensor is always less than 0.1 V, heated oxygen sensor circuit may be open or short.

MONITOR DESCRIPTION

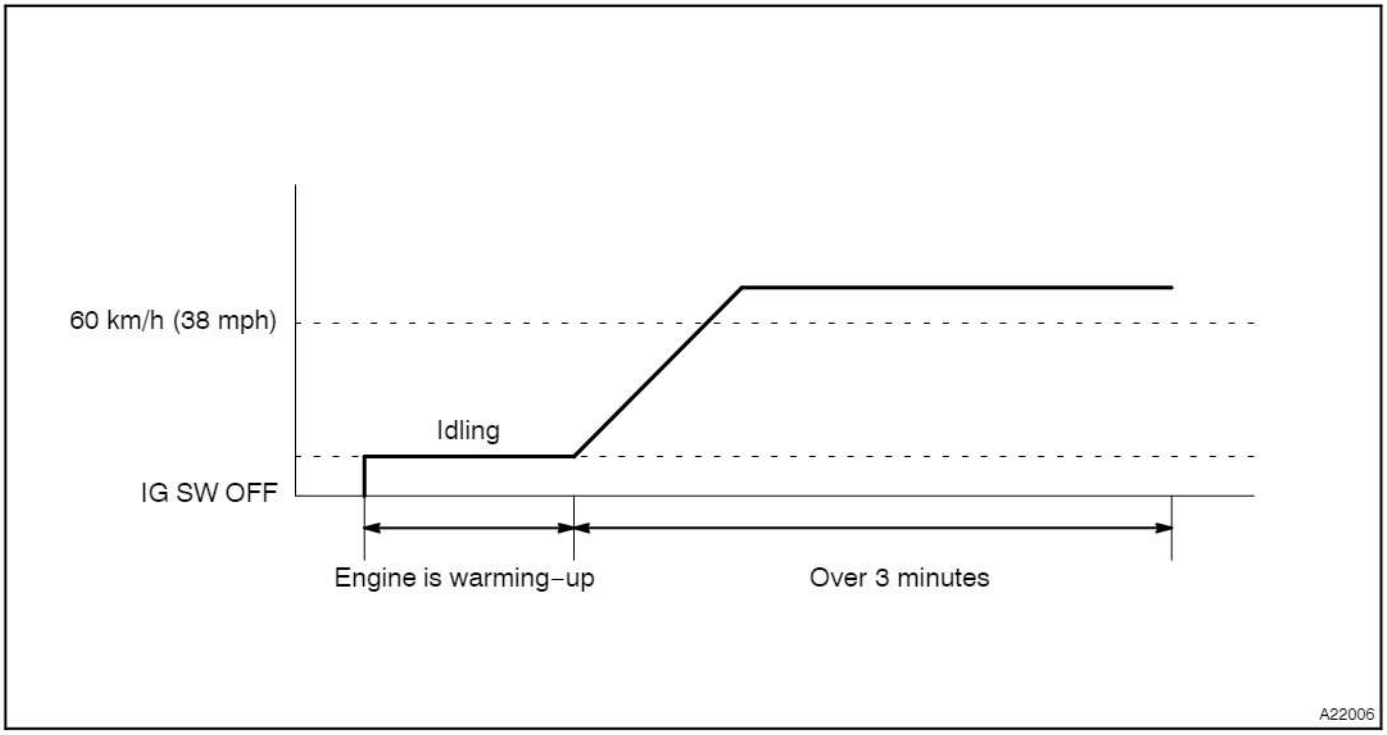
The engine control ECU uses the heated oxygen sensor to optimize the air–fuel mixture in closed–loop fuel control. This control helps decrease exhaust emissions by providing the catalyst with a nearly stoichiometric mixture.

The sensor detects the oxygen level in the exhaust gas and the engine control ECU uses this data to control the air–fuel ratio. The sensor output voltage ranges from 0 V to 1 V. If the signal voltage is less than 0.4 V, the air–fuel ratio is LEAN. If the signal voltage is more than 0.55 V, the air–fuel ratio is RICH. If the conditions for the closed–loop fuel control are met and after a specified time–period, the sensor's output signal never indicates RICH, the engine control ECU will conclude that the closed–loop fuel control is malfunctioning. The engine control ECU will illuminate the MIL and a DTC is set.

WIRING DIAGRAM

Refer to DTC P0031 on page DI–35.

CONFIRMATION DRIVING PATTERN



(a) Connect the hand–held tester to the DLC3.
(b) Allow the engine to idle until the ECT reaches 40°C (104°F).
(c) Allow the vehicle to run at 60 km/h (38 mph) or more for 3 minutes or more.

INSPECTION PROCEDURE

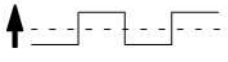
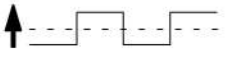
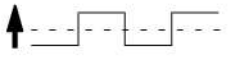
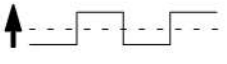
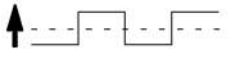
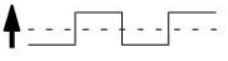
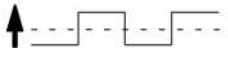
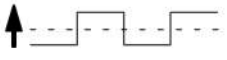
HINT:
Hand–held tester only:
The narrowing down the trouble area is possible by performing ACTIVE TEST of the following "A/F CONTROL" (Heated oxygen sensor or another can be distinguished).
(a) Perform ACTIVE TEST by hand–held tester (A/F CONTROL).
HINT:
"A/F CONTROL" is the ACTIVE TEST which changes the injection volume to –12.5 % or +25 %.
(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine with the engine speed at 2,500 rpm for approximately 90 seconds.
(4) Select the item "DIAGNOSIS / OBD/MOBD / ACTIVE TEST / A/F CONTROL".
(5) Perform "A/F CONTROL" with the engine in an idle condition (press the right or left button).

RESULT:

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume
+25 % → rich output: More than 0.5 V
–12.5 % → lean output: Less than 0.4 V

NOTICE:

However, there is a few seconds delay in the sensor 1 (front sensor) output. And there is a maximum 20 seconds delay in the sensor 2 (rear sensor).

	Output voltage of heated oxygen sensor (sensor 1: front sensor)	Output voltage of heated oxygen sensor (sensor 2: rear sensor)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 %  Output voltage More than 0.5 V Less than 0.4 V  OK	Injection volume +25 % –12.5 %  Output voltage More than 0.5 V Less than 0.4 V  OK	—
Case 2	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Injection volume +25 % –12.5 %  Output voltage More than 0.5 V Less than 0.4 V  OK	Sensor 1: front sensor (sensor 1, heater, sensor 1 circuit)
Case 3	Injection volume +25 % –12.5 %  Output voltage More than 0.5 V Less than 0.4 V  OK	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Injection volume +25 % –12.5 %  Output voltage Almost no reaction NG	Extremely rich or lean of the actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of the heated oxygen sensors (sensor 1 and 2).

For displaying the graph indication, enter "ACTIVE TEST / A/F CONTROL / USER DATA" then select "O2S B1S1 and O2S B1S2" by pressing "YES" button and push "ENTER" button before pressing "F4" button.

HINT:

- If different DTCs related to different systems terminal E2 as the ground terminal are output simultaneously, terminal E2 may be open.
- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a 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.
- A high heated oxygen sensor (sensor 1) voltage (0.5 V or more) could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1	**Are there any other codes (besides DTCs P0134 and P0154) being output?**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES.

CHECK:

Read the DTC using the hand–held tester.

RESULT:

Display (DTC Output)	Proceed to
"P0134 and/or P0154"	A
"P0134 or P0154" and other DTCs	B

HINT:

If any other codes besides P0134 and/or P0154 are output, perform the troubleshooting for those codes first.

B → **Go to relevant DTC chart (See page DI–19).**

A

2	**Connect hand–held tester, and read value for voltage output of heated oxygen sensor (bank 1, 2 sensor 1).**

PREPARATION:

(a) Connect the the hand–held tester to the DLC3.
(b) Warm up the engine until the engine coolant temperature (ECT) reaches 40 °C (104 °F).
(c) When using hand–held tester, enter the following menu: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / O2S B1 S1 or B2 S1.

CHECK:

Read the voltage output of the heated oxygen sensors when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4,000 rpm 3 times by using the accelerator pedal.

OK:

Heated oxygen sensor output a RICH signal (0.45 V or more) at least once.

OK → **Go to step 12.**

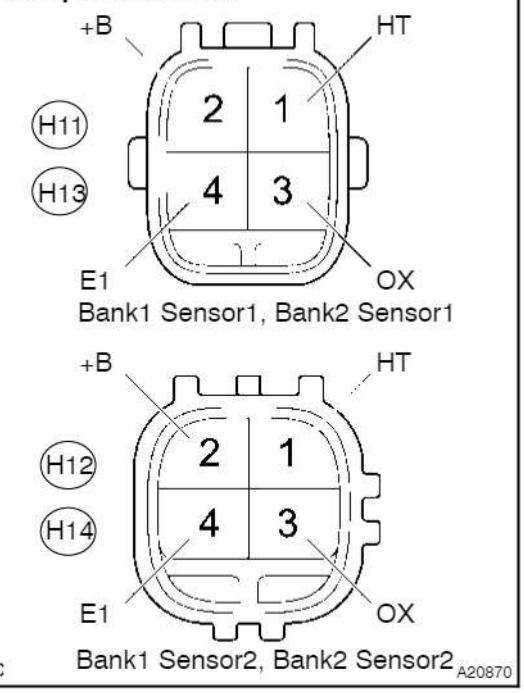
NG

3	Check connection of PCV piping.

NG → Repair or replace PCV piping.

OK

4	Check resistance of heated oxygen sensor heater.



PREPARATION:

Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

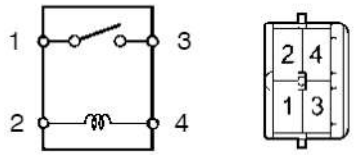
Tester Connection	Specified Condition
HT (H11–1) – +B (H11–2)	11.7 to 14.3 Ω (20°C)
HT (H12–1) – +B (H12–2)	11.7 to 14.3 Ω (20°C)
HT (H13–1) – +B (H13–2)	11.7 to 14.3 Ω (20°C)
HT (H14–1) – +B (H14–2)	11.7 to 14.3 Ω (20°C)

NG → Replace heated oxygen sensor.

OK

5	Check EFI or ECD relay.

EFI or ECD Relay



A21543

PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Inspect the EFI or ECD relay.

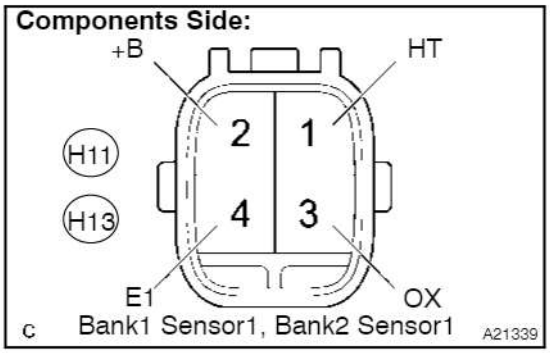
OK:

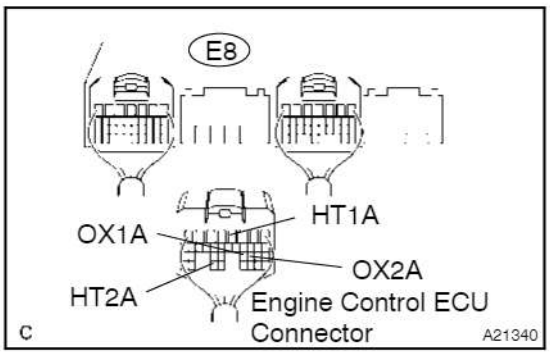
Terminal No.	Condition	Specified Condition
1 – 3	Usually	10 kΩ or higher
	Apply B+ between terminals 2 and 4	Below 1 Ω

NG → **Replace EFI or ECD relay.**

OK

6	**Check for open and short in harness and connector between engine control ECU and heated oxygen sensor (bank 1, 2 sensor 1).**





PREPARATION:

(a) Disconnect the H11 or H13 heated oxygen sensor connector.

(b) Disconnect the E8 engine control ECU connector.

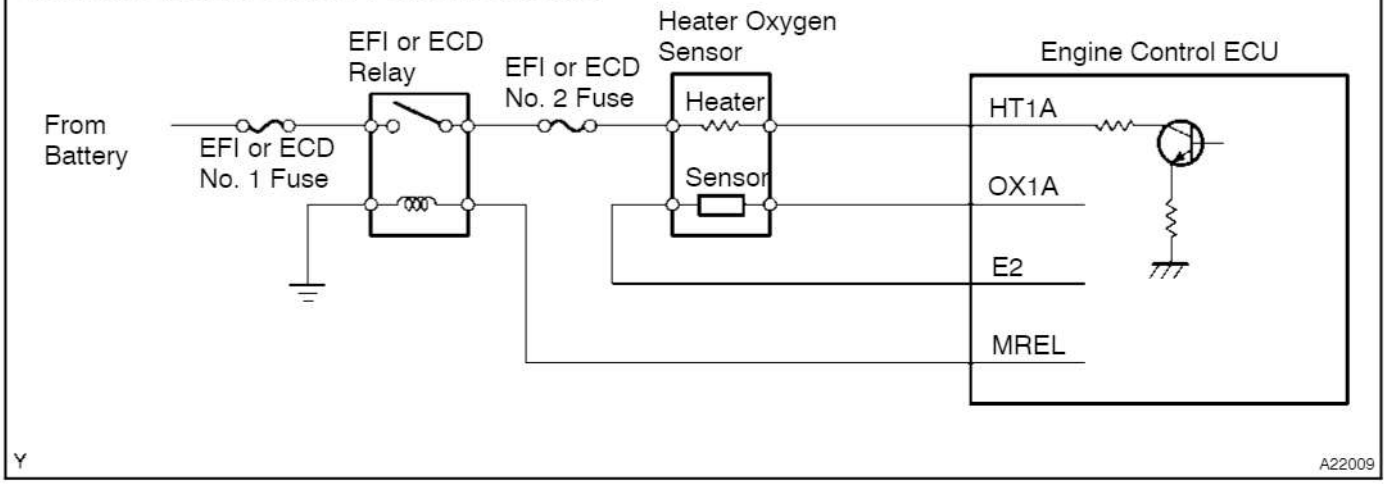
CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
OX (H11–3) – OX1A (E8–23)	Below 1 Ω
HT (H11–1) – HT1A (E8–4)	Below 1 Ω
OX (H13–3) – OX2A (E8–22)	Below 1 Ω
HT (H13–1) – HT2A (E8–33)	Below 1 Ω
OX (H11–3) or OX1A (E8–23) – Body ground	10 kΩ or higher
HT (H11–1) or HT1A (E8–4) – Body ground	10 kΩ or higher
OX (H13–3) or OX2A (E8–22) – Body ground	10 kΩ or higher
HT (H13–1) or HT2A (E8–33) – Body ground	10 kΩ or higher

Reference (Bank 1 Sensor 1 System Drawing)



NG → **Repair or replace harness or connector.**

OK

7	**Check whether misfire is occurred or not by monitoring DTC and data list.**

NG → **Perform troubleshooting for misfire (See page DI–130).**

OK

8	**Check air induction system (See Pub. No. RM630E, page FI–1).**

CHECK:
Check the air induction system for vacuum leaks.

NG → **Repair or replace air induction system.**

OK

9	**Check fuel pressure (See Pub. No. RM630E, page FI–1).**

CHECK:
Check the fuel pressure (high or low pressure).

NG → **Check and repair fuel pump, pressure regulator, fuel pipe line and filter (See Pub. No. RM630E, page FI–7).**

OK

10	**Check injector injection (See Pub. No. RM630E, page FI–24)**

NG → **Replace injector.**

OK

11	**Check exhaust system for gas leakage.**

NG → **Repair or replace exhaust gas leakage point.**

OK

Replace heated oxygen sensor (bank 1, 2 sensor 1).

12	**Perform confirmation driving pattern (See page DI–104).**

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

Go

13	**Are there DTCs P0134 and P0154 being output again?**

YES → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

NO

14	**Confirm if vehicle has run out of fuel in past.**

NO → **Check for intermittent problems (See page DI–3).**

YES

DTCs P0134 and P0154 are caused by running out of fuel.

DIC29–03

DTC	P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC	P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)

CIRCUIT DESCRIPTION

Refer to DTC P0031 on page DI–35.

DTC No.	DTC Detecting Condition	Trouble Area
P0136 P0156	The following condition continues 5 minute or more. • During driving with the engine warmed up, rear heated oxygen sensor output does not change.	• Open or short in rear heated oxygen sensor circuit • Rear heated oxygen sensor • Rear heated oxygen sensor heater • EFI or ECD relay

HINT:

- Bank 1 refers to bank that includes cylinder No. 1.
- Bank 2 refers to bank that does not includes cylinder No. 1.
- Sensor 2 refers to the sensor farther away from the engine assembly.

MONITOR DESCRIPTION

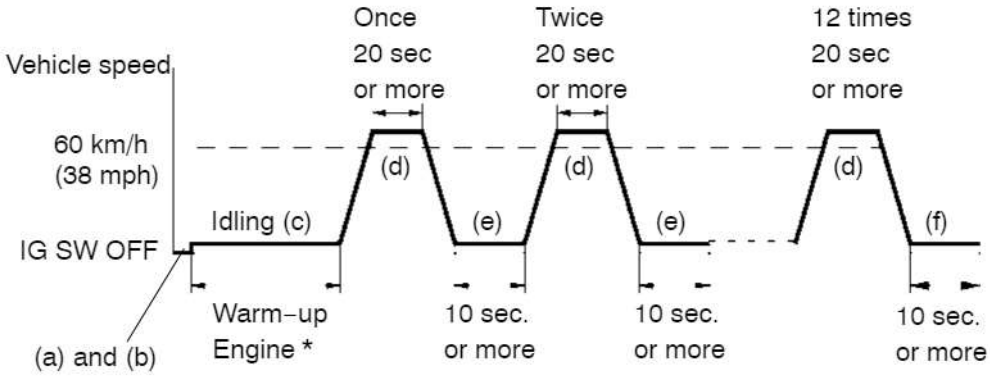
The ECM monitors the HO2S (sensor 2) by checking to make sure:

- The HO2S voltage does not remain Rich (above 0.5 volts) or Lean (below 0.4 volts) while the vehicle is accelerating and decelerating for 4 to 8 minutes. If the voltage remains either Rich or Lean, the ECM interprets this as a malfunction, illuminates the MIL and sets a DTC.

WIRING DIAGRAM

Refer to DTC P0031 on page DI–35.

CONFIRMATION DRIVING PATTERN



(a) Connect the hand–held tester to the DLC3.
(b) Switch from normal mode to check mode (see page DI–3).
(c) Warm up the engine until the engine coolant temperature reaches to 75°C (167°F).
(d) Drive the vehicle at 60 km/h (38 mph) or more for 20 seconds or more.
(e) Allow the engine to idle for 10 seconds or more.
(f) Perform steps (d) to (e) at least 12 times.

HINT:
If a malfunction exists, the check engine warning light is illuminated during step (f).

NOTICE:
If the conditions in this test are not strictly followed, detection of a malfunction will not occur. If you do not have the Intelligent Tester II, turn the ignition switch OFF after performing steps from (c) to (f), then perform steps from (c) to (f) again.

INSPECTION PROCEDURE

HINT:
Hand–held tester only:
The narrowing down the trouble area is possible by performing ACTIVE TEST of the following "A/F CONTROL" (Heated oxygen sensor or another can be distinguished).

(a) Perform ACTIVE TEST by hand–held tester (A/F CONTROL).

HINT:
"A/F CONTROL" is the ACTIVE TEST which changes the injection volume to –12.5 % or +25 %.

(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine with the engine speed at 2,500 rpm for approximately 90 seconds.
(4) Select the item "DIAGNOSIS / OBD/MOBD / ACTIVE TEST / A/F CONTROL".
(5) Perform "A/F CONTROL" with the engine in an idle condition (press the right or left button).

RESULT:

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume
+25 % → rich output: More than 0.5 V
–12.5 % → lean output: Less than 0.4 V

NOTICE:
However, there is a few seconds delay in the sensor 1 (front sensor) output. And there is a maximum 20 seconds delay in the sensor 2 (rear sensor).

	Output voltage of heated oxygen sensor (sensor 1: front sensor)	Output voltage of heated oxygen sensor (sensor 2: rear sensor)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V OK	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V OK	—
Case 2	Injection volume +25 % –12.5 % Output voltage Almost no reaction NG	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V OK	Sensor 1: front sensor (sensor 1, heater, sensor 1 circuit)
Case 3	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V OK	Injection volume +25 % –12.5 % Output voltage Almost no reaction NG	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 % –12.5 % Output voltage Almost no reaction NG	Injection volume +25 % –12.5 % Output voltage Almost no reaction NG	Extremely rich or lean of the actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of the heated oxygen sensors.
For displaying the graph indication, first enter "ACTIVE TEST / A/F CONTROL / USER DATA," then select "02S B1S1and O2S B1S2" by pressing "YES" button, and push "ENTER" button before pressing "F4" button.
HINT:

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a 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.

1	Are there any other codes (besides DTC P0136 or P0156) being output?

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES.

CHECK:

Read the DTC using the hand–held tester.

RESULT:

Display (DTC Output)	Proceed to
P0136 or P0156	A
"P0136 or P0156" and other DTCs	B

HINT:

If any other codes besides P0136 are output, perform the troubleshooting for those DTCs first.

B → **Go to relevant DTC chart (See page DI–19).**

A

2	Check output voltage of heated oxygen sensor.

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Run the engine at 2,500 rpm for 3 minutes.
(c) When using hand–held tester, enter the following menu: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / O2S B1 S2 or B2 S2.

CHECK:

Read the voltage output of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4,000 rpm 3 minutes by using the accelerator pedal.

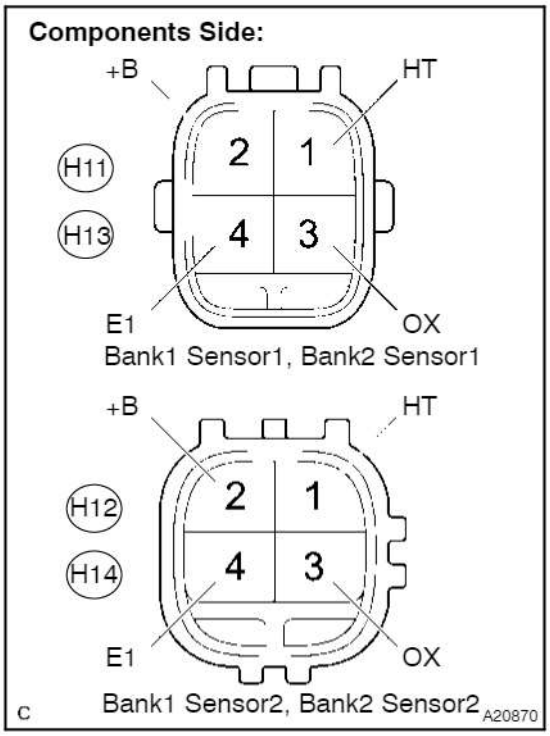
OK:

Heated oxygen sensor output voltage: Alternates from 0.4 V or less to 0.5 V or more.

OK → **Go to step 6.**

NG

3	Check resistance of heated oxygen sensor heater.



PREPARATION:

Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

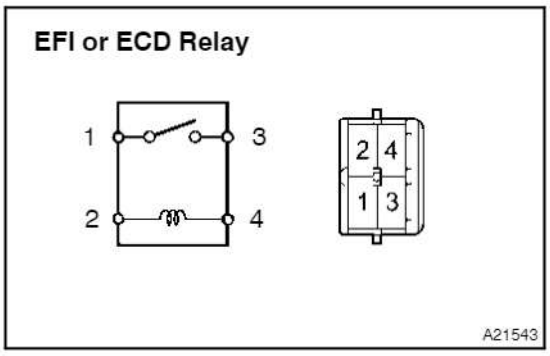
OK:

Tester Connection	Specified Condition
HT (H11–1) – +B (H11–2)	11.7 to 14.3 Ω (20°C)
HT (H12–1) – +B (H12–2)	11.7 to 14.3 Ω (20°C)
HT (H13–1) – +B (H13–2)	11.7 to 14.3 Ω (20°C)
HT (H14–1) – +B (H14–2)	11.7 to 14.3 Ω (20°C)

NG → **Replace heated oxygen sensor.**

OK

4	Check EFI or ECD relay.



PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Inspect the EFI or ECD relay.

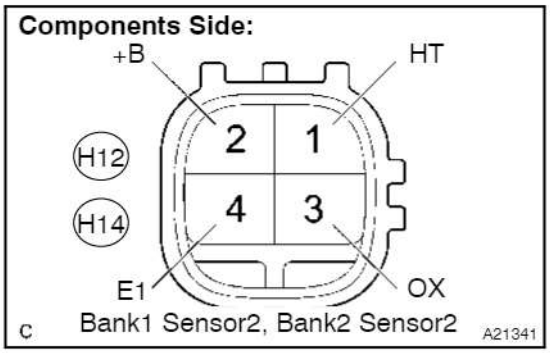
OK:

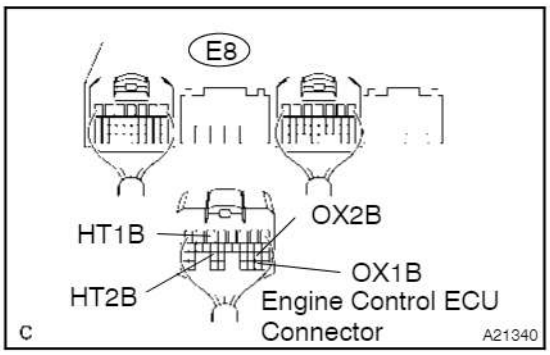
Terminal No.	Condition	Specified Condition
1 – 3	Usually	10 kΩ or higher
	Apply B+ between terminals 2 and 4	Below 1 Ω

NG → **Replace EFI or ECD relay.**

OK

5	**Check for open and short in harness and connector between engine control ECU and heated oxygen sensor.**





PREPARATION:

(a) Disconnect the H12 or H14 heated oxygen sensor connector.

(b) Disconnect the E8 engine control ECU connector.

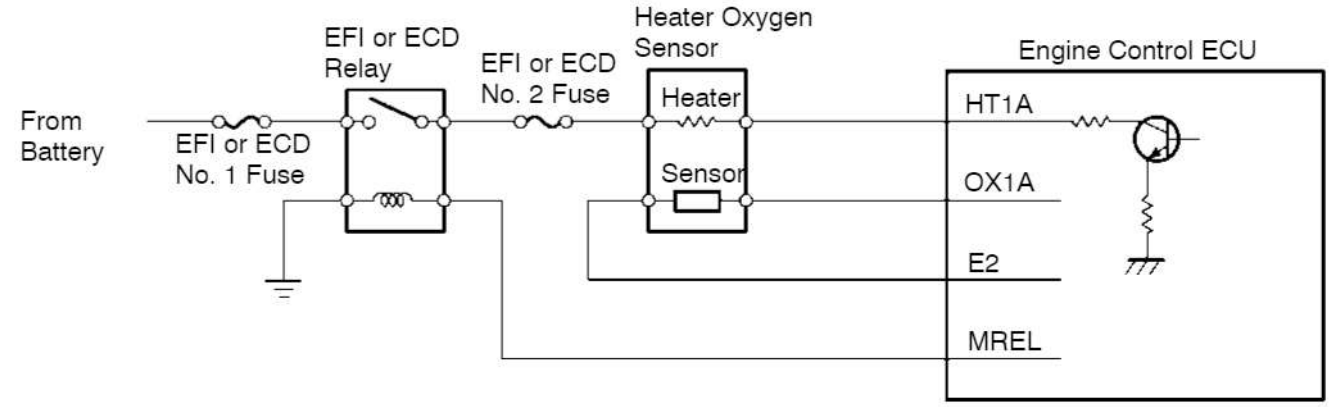
CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
OX (H12–3) – OX1B (E8–29)	Below 1 Ω
HT (H12–1) – HT1B (E8–5)	Below 1 Ω
OX (H14–3) – OX2B (E8–21)	Below 1 Ω
HT (H14–1) – HT2B (E8–25)	Below 1 Ω
OX (H12–3) or OX1B (E8–29) – Body ground	10 kΩ or higher
HT (H12–1) or HT1B (E8–5) – Body ground	10 kΩ or higher
OX (H14–3) or OX2B (E8–21) – Body ground	10 kΩ or higher
HT (H14–1) or HT2B (E8–25) – Body ground	10 kΩ or higher

Reference (Bank 1 Sensor 1 System Drawing)



NG → **Repair or replace harness or connector.**

OK

Replace heated oxygen sensor.

6	**Perform confirmation driving pattern.**

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

Go

7	**Is the DTC P0136 or P0156 being output again?**

NO → **Check for intermittent problems.**

YES

Replace heated oxygen sensor.

DIC2A–02

DTC	P0171	System too Lean (Bank 1)

DTC	P0172	System too Rich (Bank 1)

DTC	P0174	System too Lean (Bank 2)

DTC	P0175	System too Rich (Bank 2)

CIRCUIT DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim includes the short–term fuel trim and the long–term fuel trim.

The short–term fuel trim is the short–term fuel compensation used to maintain the air–fuel ratio at stoichiometric air–fuel ratio. The signal from the heated oxygen sensor indicates whether the air–fuel ratio is RICH or LEAN compared to the stoichiometric air–fuel ratio. This variance triggers a reduction in the fuel volume if the air–fuel ratio is RICH, and an increase in the fuel volume if it is LEAN.

The long–term fuel trim is the overall fuel compensation carried out in long–term to compensate for a continual deviation of the short–term fuel trim from the central value, due to individual engine differences, wear overtime and changes in the operating environment.

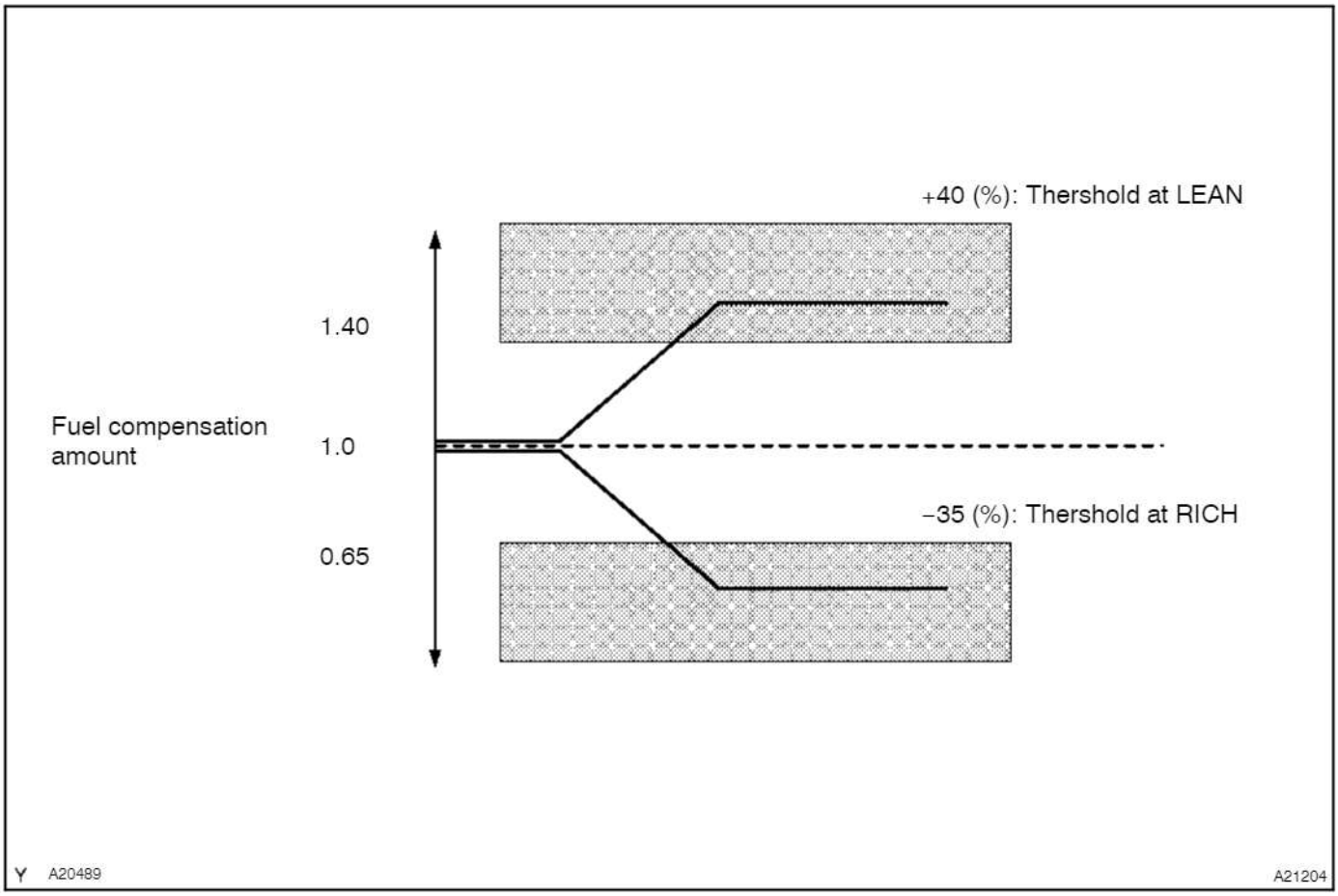
If both the short–term fuel trim and the long–term fuel trim are LEAN or RICH beyond a certain value, it is detected as a malfunction and the MIL is illuminated and a DTC is set.

DTC No.	DTC Detecting Condition	Trouble Area
P0171 P0174	When air–fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on LEAN side (2 trip detection logic)	• Air induction system • Injector blockage • Mass air flow meter • Engine coolant temperature sensor • Fuel pressure • Gas leakage in exhaust system • Open or short in heated oxygen sensor (bank 1, 2 sensor 1) circuit • Heated oxygen sensor (bank 1, 2 sensor 1) • Heated oxygen sensor heater (bank 1, 2 sensor 1) • EFI or ECD relay • PCV piping • Engine control ECU
P0172 P0175	When air–fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on RICH side (2 trip detection logic)	• Injector leak, blockage • Mass air flow meter • Engine coolant temperature sensor • Ignition system • Fuel pressure • Gas leakage in exhaust system • Open or short in heated oxygen sensor (bank 1, 2 sensor 1) circuit • Heated oxygen sensor (bank 1, 2 sensor 1) • Engine control ECU

HINT:

- When DTC P0171 or P0174 is recorded, the actual air–fuel ratio is on the LEAN side. When DTC P0172 or P0175 is recorded, the actual air–fuel ratio is on the RICH side.
- If the vehicle runs out of fuel, the air–fuel ratio is LEAN and DTC P0171 or P0174 may be recorded. The MIL then comes on.
- If the total of the short–term fuel trim value and long–term fuel trim value is within ± 35 % (engine coolant temperature is more than 75 °C (167°F)), the system is functioning normally.

MONITOR DESCRIPTION



Under closed–loop fuel control, fuel injection amounts that deviate from the engine control ECU's estimated fuel amount will cause a change in the long–term fuel trim compensation value. This long–term fuel trim is adjusted when there are persistent deviations in the short–term fuel trim values. And the deviation from a simulated fuel injection amount by the engine control ECU affects a smoothed fuel trim learning value. The smoothed fuel trim learning value is the combination of smoothed short term fuel trim (fuel feedback compensation value) and smoothed long term fuel trim (learning value of the air–fuel ratio). When the smoothed fuel trim learning value exceeds the DTC threshold, the engine control ECU interprets this as a fault in the fuel system and sets a DTC.

Example:

If the smoothed fuel trim learning value is more than +40% or less than –35% the engine control ECU interprets this as a malfunction in the fuel system.

WIRING DIAGRAM

Refer to DTC P0031 on page DI–35.

INSPECTION PROCEDURE

HINT:

Hand–held tester only:

The narrowing down the trouble area is possible by performing ACTIVE TEST of the following "A/F CONTROL" (Heated oxygen sensor or another can be distinguished).

(a) Perform ACTIVE TEST by hand–held tester (A/F CONTROL).

HINT:

"A/F CONTROL" is the ACTIVE TEST which changes the injection volume to –12.5 % or +25 %.

(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine with the engine speed at 2,500 rpm for approximately 90 seconds.
(4) Select the item "DIAGNOSIS / OBD/MOBD / ACTIVE TEST / A/F CONTROL".
(5) Perform "A/F CONTROL" with the engine in an idle condition (press the right or left button).

RESULT:

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume
+25 % → rich output: More than 0.5 V
–12.5 % → lean output: Less than 0.4 V

NOTICE:

However, there is a few seconds delay in the sensor 1 (front sensor) output. And there is a maximum 20 seconds delay in the sensor 2 (rear sensor).

	Output voltage of heated oxygen sensor (sensor 1: front sensor)	Output voltage of heated oxygen sensor (sensor 2: rear sensor)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	—
Case 2	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	Sensor 1: front sensor (sensor 1, heater, sensor 1 circuit)
Case 3	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Extremely rich or lean of the actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of the heated oxygen sensors (sensor 1 and 2).
For displaying the graph indication, enter "ACTIVE TEST / A/F CONTROL / USER DATA" then select "O2S B1S1 and O2S B1S2" by pressing "YES" button and push "ENTER" button before pressing "F4" button.
HINT:

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a 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.
- A high heated oxygen sensor (sensor 1) voltage (0.5 V or more) could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1	**Check air induction system (See Pub. No. RM630E, page FI–1).**

CHECK:
Check the air induction system for vacuum leaks.

NG → **Repair or replace air induction system.**

OK

2	**Check connection of PCV piping.**

NG → **Repair or replace PCV piping.**

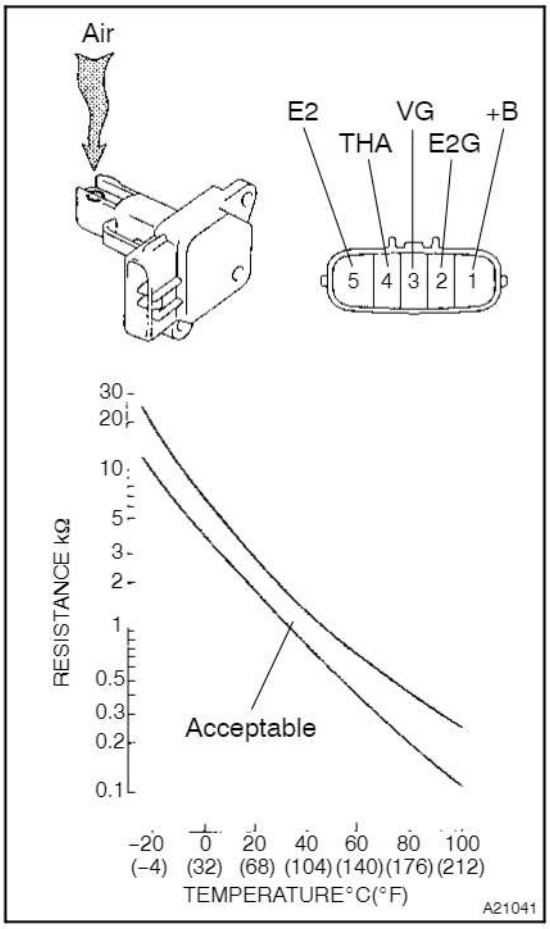
OK

3	**Check injector injection (See Pub. No. RM630E, page FI–24).**

NG → **Replace injector.**

OK

4	**Check air flow meter.**



PREPARATION:

Remove the air flow meter.

CHECK:

(a) Inspect output voltage.
  (1) Apply battery voltage across terminals +B and E2G.
  (2) Connect the positive (+) tester prove to terminal VG, and negative (–) tester prove to terminal E2G.
  (3) Blow air into the mass air flow sensor, and check that the voltage fluctuates.

(b) Inspect resistance.
  (1) Measure the resistance between terminals of the intake air temperature sensor.

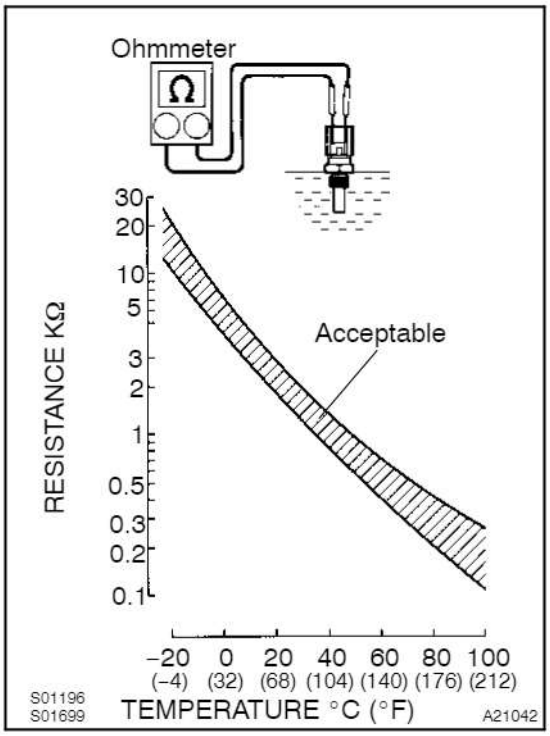
Resistance:

Tester Connection	Temperature	Specified Condition
THA (4) – E2 (5)	–20°C (–4°F)	13.6 to 18.4 kΩ
	20°C (68°F)	2.21 to 2.69 kΩ
	60°C (140°F)	0.49 to 0.67 kΩ

NG → **Replace air flow meter.**

OK

5	Check engine coolant temperature sensor.



PREPARATION:

Remove the engine coolant temperature sensor.

CHECK:

(a) Measure the resistance between the terminals of the engine coolant temperature sensor.

Resistance:

Tester Connection	Specified Condition
1 – 2	2.32 to 2.59 kΩ (20°C (68°F))
	0.310 to 0.326 kΩ (80°C (176°F))

NOTICE:

In case of checking the engine coolant temperature sensor in the water, be careful not to allow water to go into the terminals. After checking, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed engine coolant temperature sensor and read the resistance. Use an infrared thermometer to measure the engine temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

(b) Reinstall the engine coolant temperature sensor.

NG → **Repair or replace engine coolant temperature sensor.**

OK

6	Check for spark and ignition (See Pub. No. RM630E, page IG–1).

NG → **Repair or replace ignition system.**

OK

7	**Check fuel pressure (See Pub. No. RM630E, page FI–1).**

CHECK:

Check the fuel pressure (high or low pressure).

NG → **Check and replace fuel pump, pressure regulator, fuel pipe line and filter (See Pub. No. RM630E, page FI–7).**

OK ↓

8	**Check exhaust system for gas leakage.**

NG → **Repair or replace exhaust gas leakage point.**

OK ↓

9	**Check output voltage of heated oxygen sensor (bank 1, 2 sensor 1) during idling.**

PREPARATION:

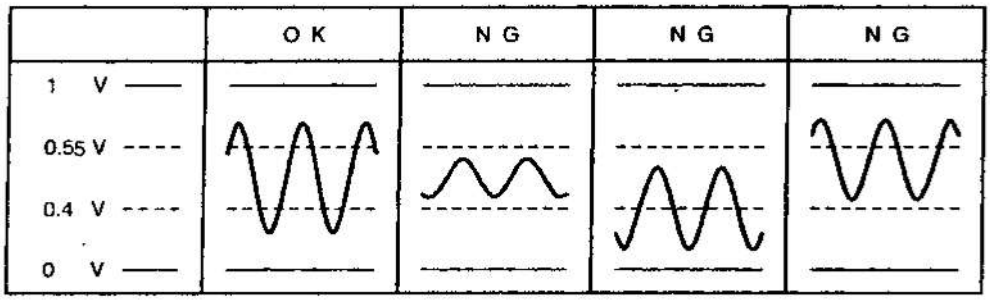
(a) Warm up the heated oxygen sensor with the engine speed at 2,500 rpm for approximately 90 seconds.
(b) Connect the hand–held tester to the DLC3.
(c) When using hand–held tester, enter the following menu: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / O2S B1 S1 or B2 S1.

CHECK:

Check the output voltage of the heated oxygen sensor during idling using the hand–held tester.

OK:

Heated oxygen sensor output voltage:
Alternates between less than 0.4 V and more than 0.55 V (See the following table).



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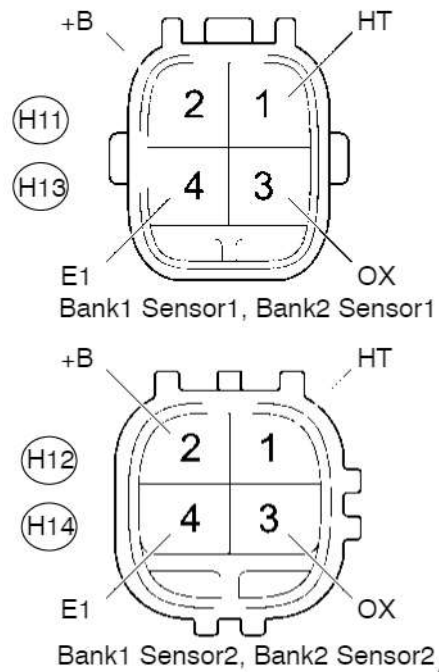
OK	**Go to step 17.**

NG

10	Check resistance of heated oxygen sensor heater.

Components Side:



PREPARATION:

Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

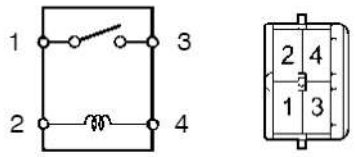
Tester Connection	Specified Condition
HT (H11–1) – +B (H11–2)	11.7 to 14.3 Ω (20°C)
HT (H12–1) – +B (H12–2)	11.7 to 14.3 Ω (20°C)
HT (H13–1) – +B (H13–2)	11.7 to 14.3 Ω (20°C)
HT (H14–1) – +B (H14–2)	11.7 to 14.3 Ω (20°C)

NG → **Replace heated oxygen sensor.**

OK

11	Check EFI or ECD relay.

EFI or ECD Relay



PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Inspect the EFI or ECD relay.

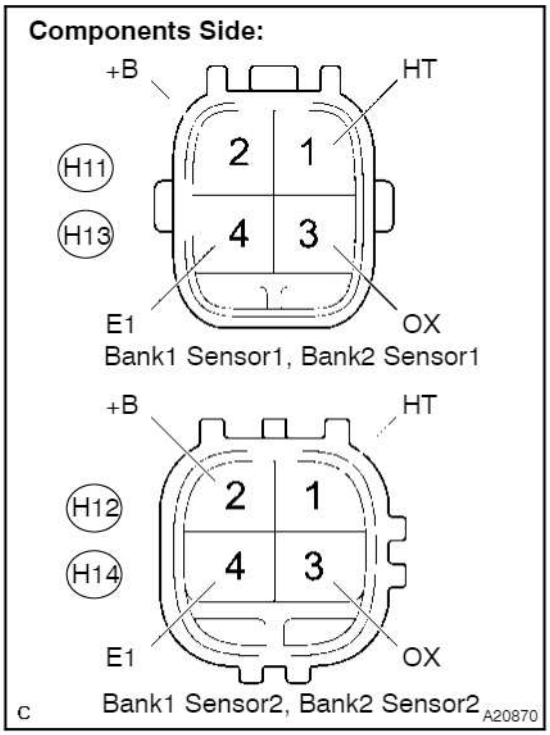
OK:

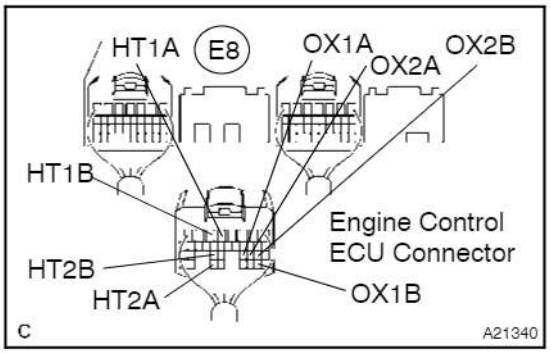
Terminal No.	Condition	Specified Condition
1 – 3	Usually	10 kΩ or higher
	Apply B+ between terminals 2 and 4	Below 1 Ω

NG → **Replace EFI or ECD relay.**

OK

12	**Check for open and short in harness and connector between engine control ECU and heated oxygen sensor.**





PREPARATION:

(a) Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

(b) Disconnect the E8 engine control ECU connector.

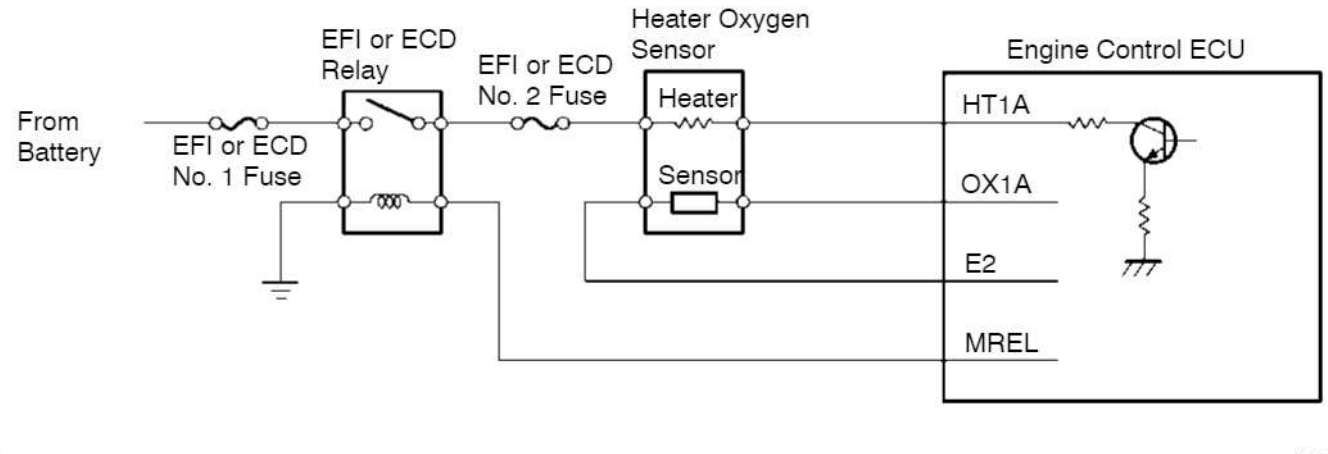
CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
OX (H11–3) – OX1A (E8–23)	Below 1 Ω
HT (H11–1) – HT1A (E8–4)	Below 1 Ω
OX (H12–3) – OX1B (E8–29)	Below 1 Ω
HT (H12–1) – HT1B (E8–5)	Below 1 Ω
OX (H13–3) – OX2A (E8–22)	Below 1 Ω
HT (H13–1) – HT2A (E8–33)	Below 1 Ω
OX (H14–3) – OX2B (E8–21)	Below 1 Ω
HT (H14–1) – HT2B (E8–25)	Below 1 Ω
OX (H11–3) or OX1A (E8–23) – Body ground	10 kΩ or higher
HT (H11–1) or HT1A (E8–4) – Body ground	10 kΩ or higher
OX (H12–3) or OX1B (E8–29) – Body ground	10 kΩ or higher
HT (H12–1) or HT1B (E8–5) – Body ground	10 kΩ or higher
OX (H13–3) or OX2A (E8–22) – Body ground	10 kΩ or higher
HT (H13–1) or HT2A (E8–33) – Body ground	10 kΩ or higher
OX (H14–3) or OX2B (E8–21) – Body ground	10 kΩ or higher
HT (H14–1) or HT2B (E8–25) – Body ground	10 kΩ or higher

Reference (Bank 1 Sensor 1 System Drawing)



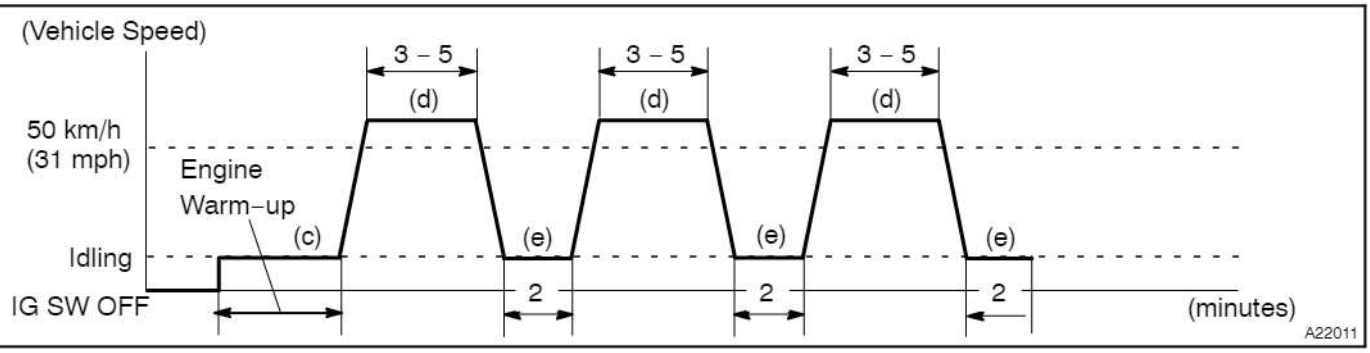
NG	**Replace or replace harness or connector.**

OK

13	**Replace heated oxygen sensor.**

Go

14	Perform confirmation driving pattern.



(a) Connect the Intelligent Tester II to the DLC3.
(b) Switch from normal mode to check mode.
(c) Warm up the engine until the Engine Coolant Temperature (ECT) reaches to 75°C (167°F).
(d) Drive the vehicle at 31 mph (50 km/h) or more for 3 to 5 minutes.
(e) Allow the engine to idle for 2 minutes.
(f) Perform procedure (d) and (e) at least 3 times.
(g) Confirm that no DTC occurs.

GO

15	Is there DTC P0171, P0172, P0174 or P0175 being output again?

YES → **Replace engine control ECU (See Pub. No. RM630, page FI–74) and perform confirmation driving pattern (Refer to step 14).**

NO

16	**Confirm if vehicle has run out of fuel in past.**

NO → **Check for intermittent problems (See page DI–3).**

YES

DTC P0171, P0172, P0174 or P0175 is caused by running out of fuel.

17	**Perform confirmation driving pattern.**

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (Refer to step 14).

Go

18	**Is there DTC P0171, P0172 P0174 and/or P0175 being output again?**

NO → **Go to step 22.**

YES

19	**Replace heated oxygen sensor.**

Go

20	**Perform confirmation driving pattern.**

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (Refer to step 14).

Go

21	Is the DTC P0171, P0172, P0174 and/or P0175 being output again?

YES → Replace engine control ECU (See Pub. No. RM630, page FI–74) and perform confirmation driving pattern (Refer to step 14).

No

22	Confirm if vehicle has run out of fuel in past.

NO → Check for intermittent problems. (See page DI–3).

YES

DTC is caused by running out of fuel (DTCs P0171, P0172 P0174 and/or P0175).

DIC2E–03

DTC	P0230/78	Fuel Pump Primary Circuit

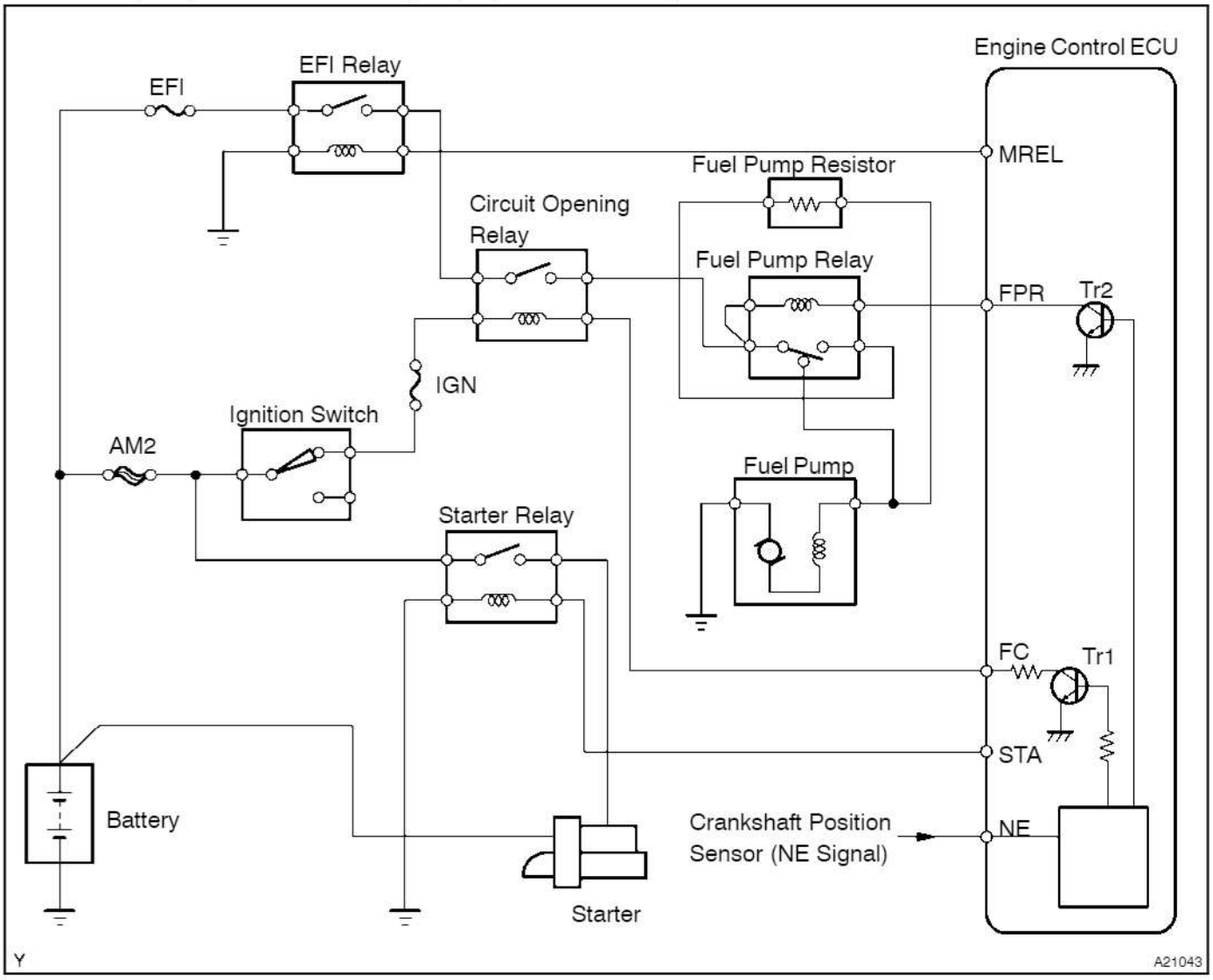
CIRCUIT DESCRIPTION

In the diagram below, when the engine is cranked, current flows from terminal STAR of the engine control ECU to the starter relay coil and also current flows to terminal STA of the engine control ECU (STA signal). When the STA signal and NE signal are input to the engine control ECU, the Tr1 is turned ON, current flows to the coil of the circuit opening relay, the relay switches on, power is supplied to the fuel pump, and the fuel pump operates.

While the NE signal is generated (engine running), the engine control ECU keeps the Tr1 ON (circuit opening relay ON) and the fuel pump also keeps operating.

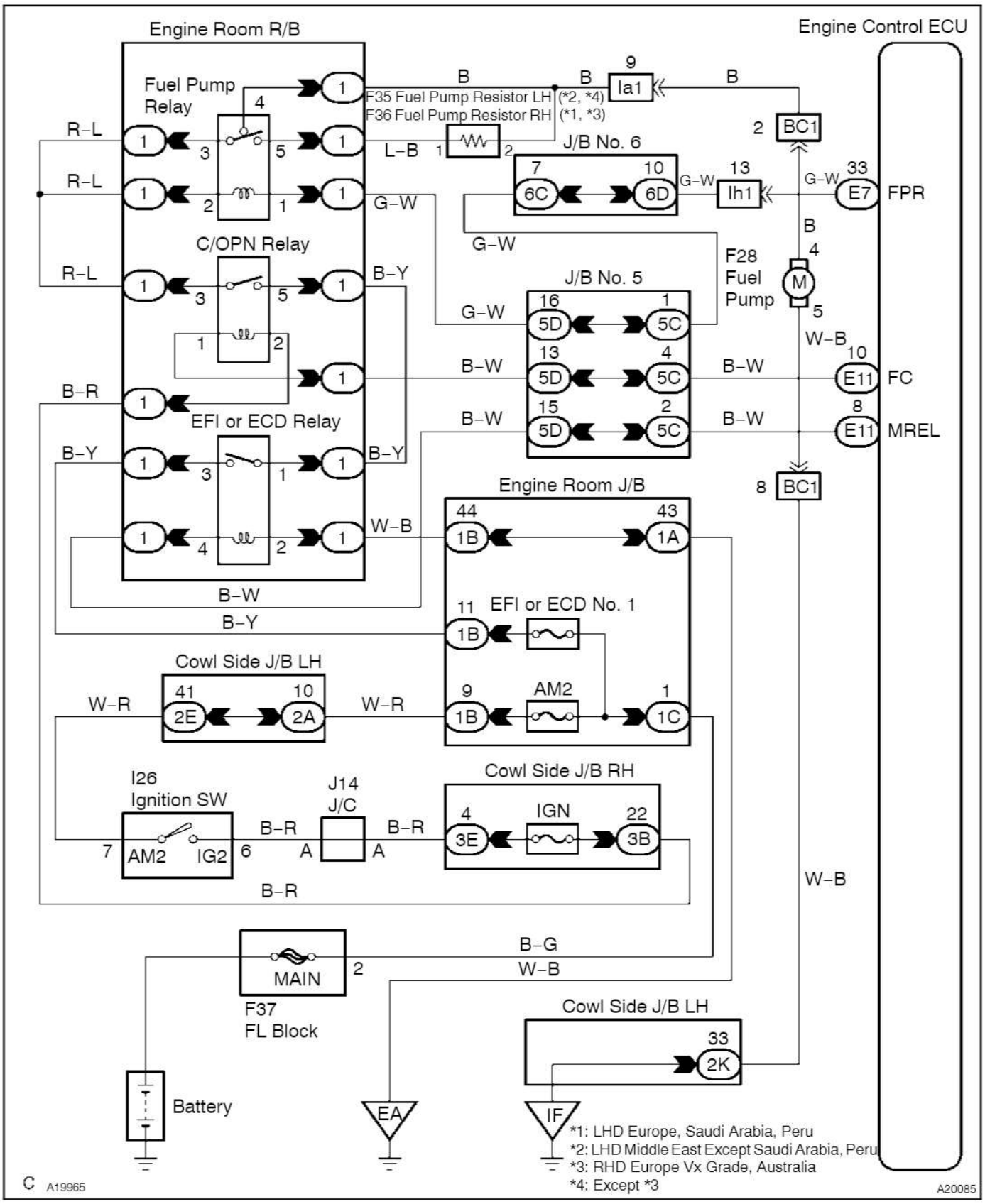
The fuel pump speed is controlled at two levels (high speed or low speed) by the condition of the engine (starting, light load, heavy load). When the engine starts (STA ON), the Tr2 in the engine control ECU is OFF, so the fuel pump relay closes and battery positive voltage is applied directly to the fuel pump. The fuel pump operates at high speed.

After the engine starts during idling or light loads, since the Tr2 goes ON, power is supplied to the fuel pump via the fuel pump resistor. The fuel pump operates at low speed.



DTC No.	DTC Detecting Condition	Trouble Area
P0230/78	Open or short in fuel pump relay circuit	• Open or short in fuel pump relay circuit • Fuel pump relay • Circuit opening relay • Fuel pump • Engine control ECU

WIRING DIAGRAM



HINT:

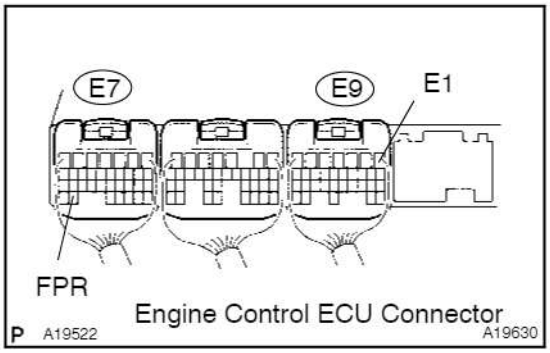
This diagnostic chart is based on premise that engine is started. If the engine is not started, proceed to problem symptoms table on DI–34.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Check voltage between terminal FPR and E1 of engine control ECU.**



CHECK:

Measure the voltage between terminals of E7 and E9 engine control ECU connectors.

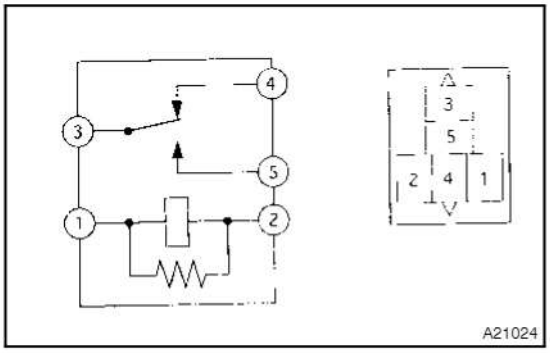
OK:

Tester Connection	Condition	Specified Condition
FPR (E7–33) – E1 (E9–1)	STA signal ON	9 to 14 V
FPR (E7–33) – E1 (E9–1)	STA signal OFF	0 to 3 V

OK → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

NG

2	**Check fuel pump relay.**



PREPARATION:

Remove the fuel pump relay from the engine room R/B.

CHECK:

Inspect the fuel pump relay.

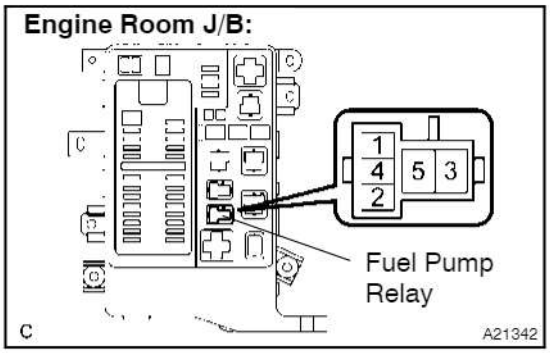
OK:

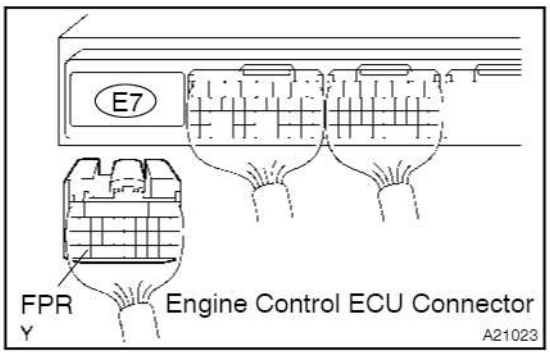
Tester Connection	Specified Condition
3 – 4	Below 1 Ω
3 – 5	10 kΩ or higher
3 – 5	Below 1 Ω (Apply battery voltage terminal 1 and 2)

NG → **Replace fuel pump relay.**

OK

3	**Check for open and short in harness and connector between fuel pump relay and engine control ECU.**





PREPARATION:

(a) Remove the fuel pump relay from the engine room J/B.

(b) Disconnect the E7 engine control ECU connector.

CHECK:

Measure the resistance between wire harness side connectors.

OK:

Tester Connection	Specified Condition
Engine Room J/B (Fuel pump relay terminal 1) – FPR (E7–33)	Below 1 Ω
Engine Room J/B (Fuel pump relay terminal 1) or FPR (E7–33) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK →

Replace engine control ECU (See Pub. No. RM630, page FI–74).

DIC2C-02

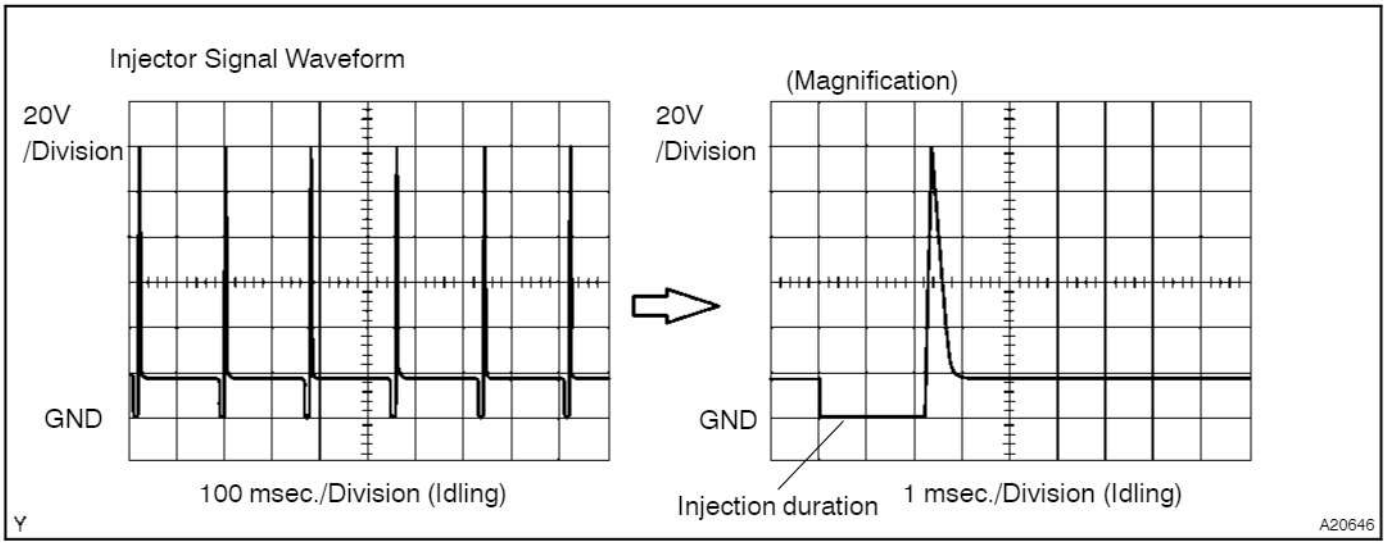
DTC	P0300	Random/Multiple Cylinder Misfire Detected
DTC	P0301	Cylinder 1 Misfire Detected
DTC	P0302	Cylinder 2 Misfire Detected
DTC	P0303	Cylinder 3 Misfire Detected
DTC	P0304	Cylinder 4 Misfire Detected
DTC	P0305	Cylinder 5 Misfire Detected
DTC	P0306	Cylinder 6 Misfire Detected
DTC	P0307	Cylinder 7 Misfire Detected
DTC	P0308	Cylinder 8 Misfire Detected

CIRCUIT DESCRIPTION

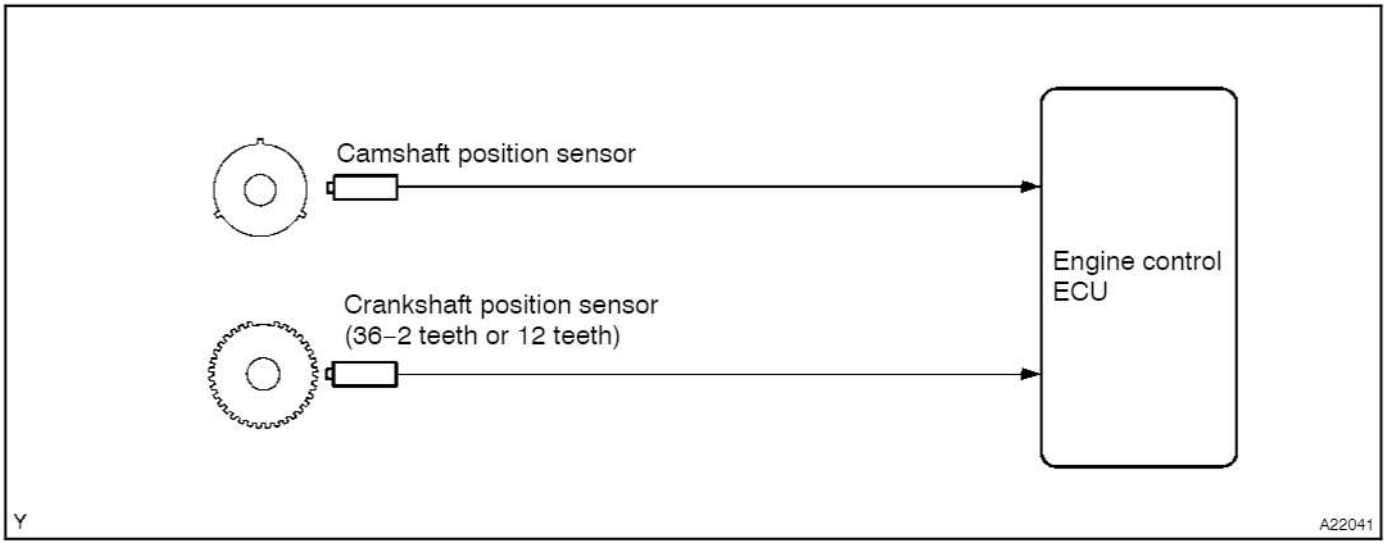
When a misfire occurs in the engine, hydrocarbons (HC) enter the exhaust in high concentrations. If this HC concentration is high enough, there could be an increase in exhaust emissions levels. High concentrations of HC can also cause to temperature of the catalyst to increase, possibly damaging the catalyst. To prevent this increase in emissions and limit the possibility of thermal damage, the engine control ECU monitors the misfire rate. When the temperature of the catalyst reaches a point of thermal degradation, the engine control ECU will blink the MIL. For monitoring misfire, the engine control ECU uses both the camshaft position sensor and the crankshaft position sensor. The camshaft position sensor is used to identify misfiring cylinders and the crankshaft position sensor is used to measure variations in the crankshaft rotation speed. The misfire counter increments when crankshaft rotation speed variations exceed threshold values.
If the misfiring rate exceeds the threshold value and could cause emissions deterioration, the engine control ECU illuminates the MIL.

DTC No.	DTC Detecting Condition	Trouble Area
P0300	Misfiring of random cylinders is detected (2 trip detection logic)	• Open or short in engine wire • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve clearance • Valve timing • PCV piping • Engine control ECU
P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	Misfiring of each cylinder is detected (2 trip detection logic)	

HINT:
Mill blink immediately when catalyst damage level misfire occur.
HINT:
When several codes for a misfiring cylinder are recorded repeatedly but no random misfire code is recorded, it indicates that the misfires have been detected and recorded at different times.
Reference: Inspection using the oscilloscope.
With the engine idling, check the waveform between terminals #1 to #8 and E01 of the engine control ECU connectors.
HINT:
The correct waveform is as shown.



MONITOR DESCRIPTION



The ECM illuminates the MIL (2 trip detection logic) as follows (DTC is stored after 2 trip detection):

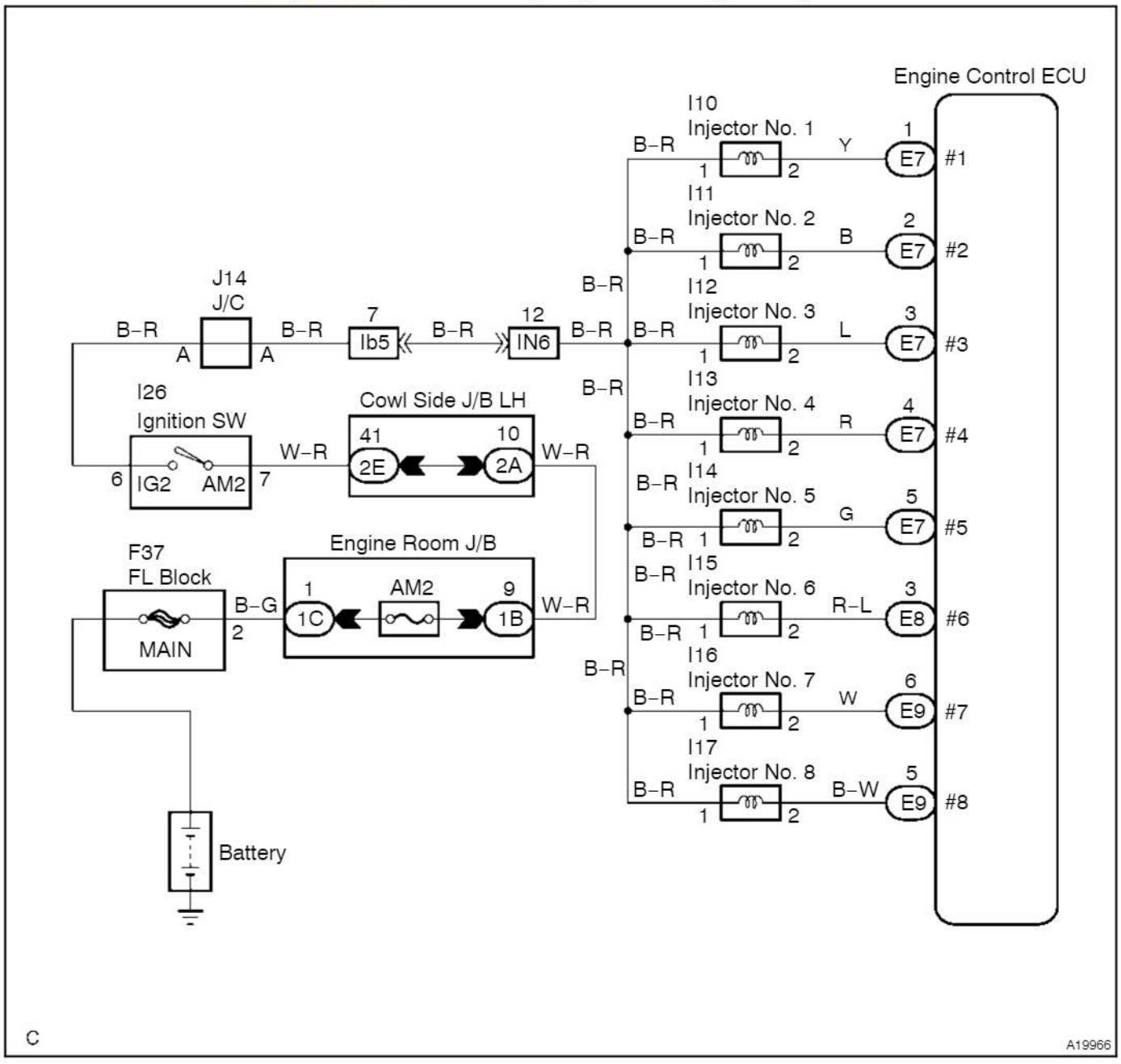
- The misfiring rate exceeds a threshold value and could cause emissions deterioration.
- An excessive misfire rate (approximately 20 to 60 misfires per 1,000 crankshaft revolutions) occurs 4 times.

The ECM flashes the MIL (MIL flashes immediately) as follows (DTC is stored after 2 trip detection):

- Within 200 crankshaft revolutions at a high rpm, the threshold for "percent of misfire causing catalyst damage" is reached once.
- Within 200 crankshaft revolutions at a normal rpm, the threshold for "percent of misfire causing catalyst damage" is reached 3 times.

WIRING DIAGRAM

Refer to DTC P0351 on page DI–161 for the wiring diagram of the ignition system.



CONFIRMATION DRIVING PATTERN

(a) Connect the hand–held tester to the DLC3.
(b) Record DTC and the freeze frame data.
(c) Use the hand–held tester to set to the check mode (See page DI–3).
(d) Read the value on the misfire counter for each cylinder when idling. If the value is displayed on the misfire counter, skip the following procedure of confirmation driving.
(e) Drive the vehicle several times with the engine speed, load and its surrounding range shown with ENGINE SPD, CALC LOAD in the freeze frame data or MISFIRE RPM, MISFIRE LOAD in the DATA LIST.

If you have no hand–held tester, turn the ignition switch OFF after the symptom is simulated once. Then repeat the simulation process again.

HINT:

In order to memorize the DTC of misfire, it is necessary to drive around MISFIRE RPM, MISFIRE LOAD in the DATA LIST for the following period of time. Take care not to turn the ignition switch OFF. Turning the ignition switch OFF switches the diagnosis system from check mode to normal mode. So all DTCs, etc., are erased.

Engine Speed	Time
Idling	3 minutes 30 seconds or more
1,000 rpm	3 minutes or more
2,000 rpm	1 minute 30 seconds or more
3,000 rpm	1 minute or more

(f) Check if there is misfire and DTC and the freeze frame data. Record the DTC's, freeze frame data and misfire counter data.
(g) Turn the ignition switch OFF and wait at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- If DTCs besides misfire DTCs are memorized simultaneously, troubleshoot the non–misfire DTCs first.
- If the misfire does not occur when the vehicle is brought to the workshop, the misfire can be confirmed by reproducing the condition of the freeze frame data. Also, after finishing the repair, confirm that there is no misfire (See confirmation driving pattern).
- On 6 and 8 cylinder engines, misfiring cylinder identification is disabled at high engine speed and only a general misfire fault code P0300 is stored instead of a cylinder specific misfire fault code (P0301 to P0308).
  If the misfire starts in a high engine speed area or the misfire occurs only in a high engine speed area, only code P0300 may be stored.

When only a general misfire fault code like P0300 is stored:

- Erase the general misfire fault code from the hand–held tester.
- Start the engine and drive the confirmation patten.
- Read the value of the misfire ratio for each cylinder. Or read the DTC.
- Perform repairs on the cylinder that has a high misfire ratio. Or repair the cylinder indicated by the DTC.
- After finishing repairs, drive the confirmation pattern again and confirm that no misfire occurs.
- When either of SHORT FT #1, LONG FT #1, SHORT FT #2 or LONG FT #2 in the freeze frame data is over the range of ±20 %, there is a possibility that the air–fuel ratio is becoming RICH (–20 % or less) or LEAN (+20 % or more).
- When COOLANT TEMP in the freeze frame data is less than 80°C (176°F), there is a possibility of misfire only during engine warm–up.
- If the misfire cannot be reproduced, the following reasons may apply: 1) the vehicle has low fuel, 2) improper fuel is being used, and 3) the ignition plug is contaminated.

- Be sure to check the value on the misfire counter after the repair.

1	**Are there any other codes (besides DTC P0300, P0301, P0302, P0303, P0304 P0305, P0306, P0307 or P0308) being output?**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES.

CHECK:

Read the DTC using hand–held tester.

RESULT:

Display (DTC Output)	Proceed to
"P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and/or P0308"	A
"P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308" and other DTCs	B

HINT:

If any other codes besides "P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307 or P0308" are output, perform the troubleshooting for those DTC.

B → **Go to relevant DTC chart (See page DI–19).**

A

2	**Check wire harness, connector and vacuum hose in engine room.**

CHECK:

(a) Check the connection conditions of the wire harness and connector.
(b) Check for the disconnection, piping and brake of the vacuum hose.

NG → **Repair or replace, then confirm that there is no misfire (See confirmation driving pattern).**

OK

3	**Check connection of PCV piping.**

NG → **Repair or replace PCV piping.**

OK

4	**Connect hand–held tester, and read the number of misfire.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) Start the engine.
(d) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / CYL#1 to CYL#8.

CHECK:

Read the number of misfire on the hand–held tester.

HINT:

When a misfire is not reproduced, be sure to branch below based on the stored DTC.

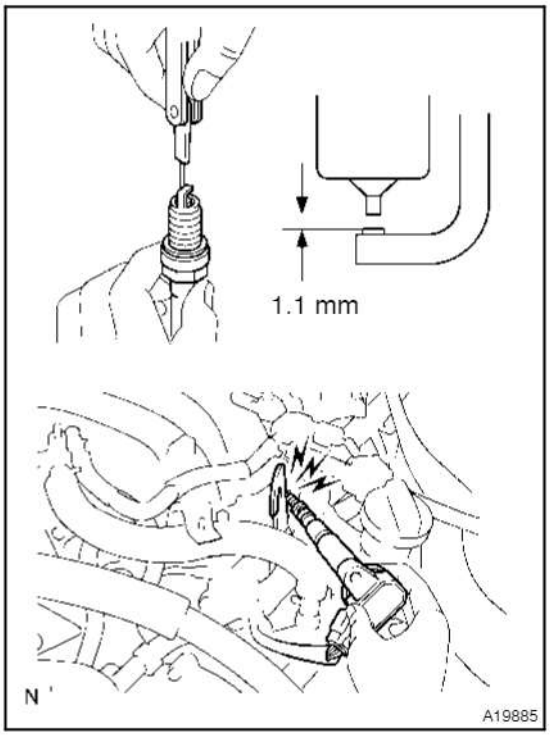
RESULT:

High Misfire Rate Cylinder	Proceed to
1 or 2 cylinders	A
More than 3 cylinders	B

B → **Go to step 15.**

A

5	Check spark plug and spark of misfiring cylinder.



PREPARATION:

(a) Remove the ignition coil assembly.
(b) Remove the spark plug.

CHECK:

(a) Check the electrode for carbon deposits.
(b) Check the spark plug type.
(c) Check electrode gap.

OK:

No large carbon deposit present.
Not wet with gasoline or oil.
Electrode gap:

	Type	Specified Condition
DENSO made	SK20R11	1.0 to 1.3 mm (0.039 to 0.050 in.)
NGK made	IFR6A11	1.0 to 1.3 mm (0.039 to 0.050 in.)
DENSO made*	K20R–U	0.7 to 1.0 mm (0.027 to 0.039 in.)
NGK made*	BKR6EYA	0.7 to 1.0 mm (0.027 to 0.039 in.)

*: Australia spec only

NOTICE:

If adjusting the gap of a new spark plug, bend only "the base / ground" electrode. Do not touch the tip. Never attempt to adjust the gap on a used plug.

PREPARATION:

(a) Install the spark plug to the ignition coil assembly.
(b) Disconnect the injector connector.
(c) Ground spark plug.

CHECK:

Check if spark occurs while engine is being cracked.

CAUTION:

Always disconnect each injector connector.

NOTICE:

Do not crank the engine for more than 2 seconds.

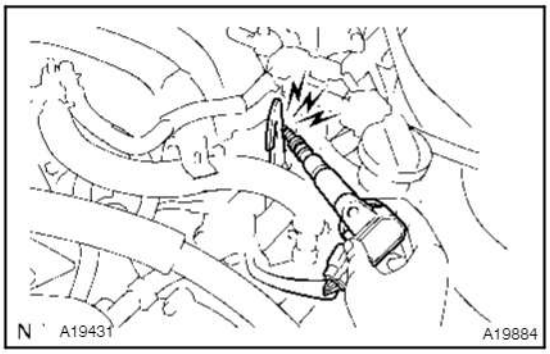
OK:

Spark occurs across electrode gap.

OK	Go to step 8.

NG

6	Change normal spark plug and check spark of misfiring cylinder.



PREPARATION:

(a) Change to the normal spark plug.
  (1) Remove the spark plug that may be faulty from the ignition coil assembly.
  (2) Install the spark plug to the ignition coil assembly.
(b) Disconnect the injector connector.
(c) Ground the spark plug.

CHECK:

Check if spark occurs while the engine is being cranked.

CAUTION:

Always disconnect each injector connector.

NOTICE:

Do not crank the engine for more than 2 seconds.

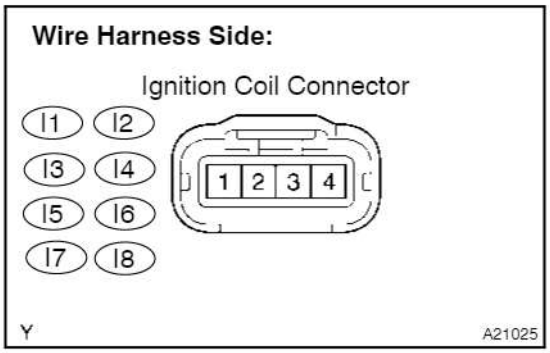
OK:

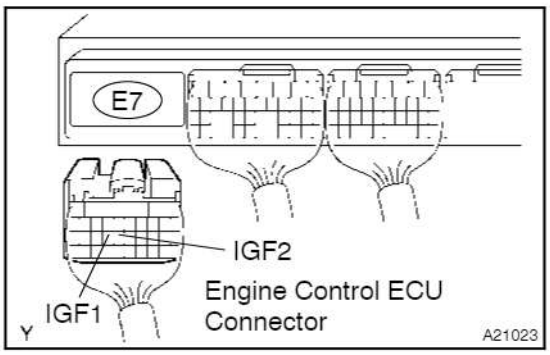
Spark jumps across electrode gap.

OK	Replace spark plug.

NG

7	**Check for open and short in harness and connector between ignition coil and engine control ECU.**





Check the harness and connector between the ignition coil and the engine control ECU (IGF terminal) connectors:

PREPARATION:

(a) Disconnect the I1, I2, I3, I4, I5, I6, I7 or I8 ignition coil connector.

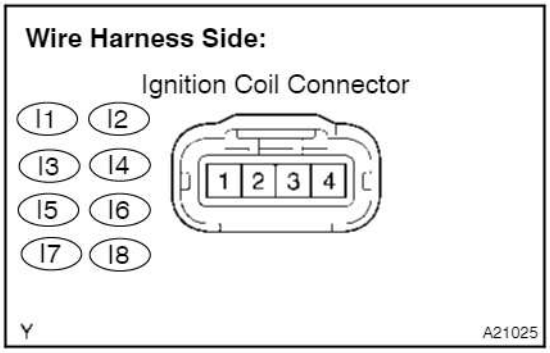
(b) Disconnect the E7 engine control ECU connector.

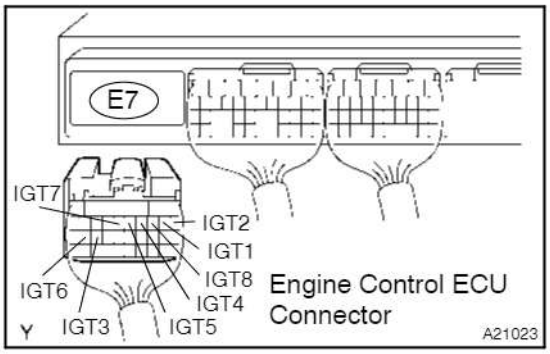
CHECK:

Check the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
Ignition coil (I1–2) – IGF1 (E7–24)	Below 1 Ω
Ignition coil (I2–2) – IGF2 (E7–23)	Below 1 Ω
Ignition coil (I3–2) – IGF1 (E7–24)	Below 1 Ω
Ignition coil (I4–2) – IGF2 (E7–23)	Below 1 Ω
Ignition coil (I5–2) – IGF1 (E7–24)	Below 1 Ω
Ignition coil (I6–2) – IGF2 (E7–23)	Below 1 Ω
Ignition coil (I7–2) – IGF1 (E7–24)	Below 1 Ω
Ignition coil (I8–2) – IGF2 (E7–23)	Below 1 Ω
Ignition coil (I1–2) or IGF1 (E7–24) – Body ground	10 kΩ or higher
Ignition coil (I2–2) or IGF2 (E7–23) – Body ground	10 kΩ or higher
Ignition coil (I3–2) or IGF1 (E7–24) – Body ground	10 kΩ or higher
Ignition coil (I4–2) or IGF2 (E7–23) – Body ground	10 kΩ or higher
Ignition coil (I5–2) or IGF1 (E7–24) – Body ground	10 kΩ or higher
Ignition coil (I6–2) or IGF2 (E7–23) – Body ground	10 kΩ or higher
Ignition coil (I7–2) or IGF1 (E7–24) – Body ground	10 kΩ or higher
Ignition coil (I8–2) or IGF2 (E7–23) – Body ground	10 kΩ or higher





Check the harness and connector between the ignition coil and the engine control ECU (IGT terminal) connectors:

PREPARATION:

(a) Disconnect the I1, I2, I3, I4, I5, I6, I7 or I8 ignition coil connector.

(b) Disconnect the E7 engine control ECU connector.

CHECK:

Check the resistance between the wire harness side connectors.

OK:

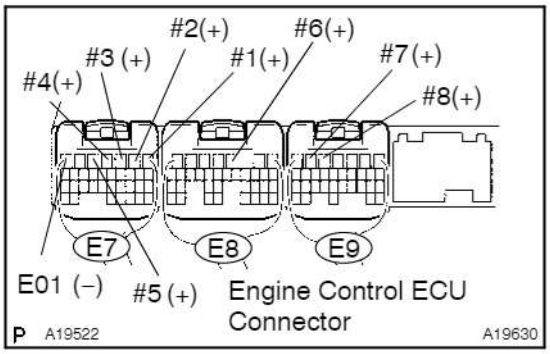
Tester Connection	Specified Condition
Ignition coil (I1–3) – IGT1 (E7–9)	Below 1 Ω
Ignition coil (I2–3) – IGT2 (E7–8)	Below 1 Ω
Ignition coil (I3–3) – IGT3 (E7–25)	Below 1 Ω
Ignition coil (I4–3) – IGT4 (E7–11)	Below 1 Ω
Ignition coil (I5–3) – IGT5 (E7–12)	Below 1 Ω
Ignition coil (I6–3) – IGT6 (E7–26)	Below 1 Ω
Ignition coil (I7–3) – IGT7 (E7–13)	Below 1 Ω
Ignition coil (I8–3) – IGT8 (E7–10)	Below 1 Ω
Ignition coil (I1–3) or IGT1 (E7–9) – Body ground	10 kΩ or higher
Ignition coil (I2–3) or IGT2 (E7–8) – Body ground	10 kΩ or higher
Ignition coil (I3–3) or IGT3 (E7–25) – Body ground	10 kΩ or higher
Ignition coil (I4–3) or IGT4 (E7–11) – Body ground	10 kΩ or higher
Ignition coil (I5–3) or IGT5 (E7–12) – Body ground	10 kΩ or higher
Ignition coil (I6–3) or IGT6 (E7–26) – Body ground	10 kΩ or higher
Ignition coil (I7–3) or IGT7 (E7–13) – Body ground	10 kΩ or higher
Ignition coil (I8–3) or IGT8 (E7–10) – Body ground	10 kΩ or higher

OK → **Replace ignition coil with igniter, then confirm that there is no misfire.**

NG

Repair or replace harness or connector.

8	Check engine control ECU terminal of misfiring cylinder.



PREPARATION:

Turn the ignition switch ON.

CHECK:

Measure the voltage between the terminals of the E7, E8 and E9 engine control ECU connectors.

OK:

Tester Connection	Specified Condition
#1 (E7–1) – E01 (E7–7)	9 to 14 V
#2 (E7–2) – E01 (E7–7)	9 to 14 V
#3 (E7–3) – E01 (E7–7)	9 to 14 V
#4 (E7–4) – E01 (E7–7)	9 to 14 V
#5 (E7–5) – E01 (E7–7)	9 to 14 V
#6 (E8–3) – E01 (E7–7)	9 to 14 V
#7 (E9–6) – E01 (E7–7)	9 to 14 V
#8 (E9–5) – E01 (E7–7)	9 to 14 V

OK → **Go to step 11.**

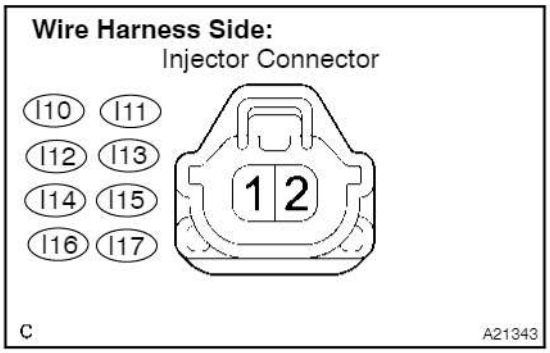
NG

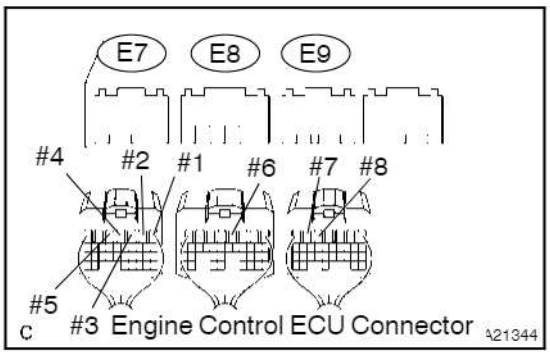
9	Check injector resistance of misfiring cylinder (See Pub. No. RM630E, page FI–24).

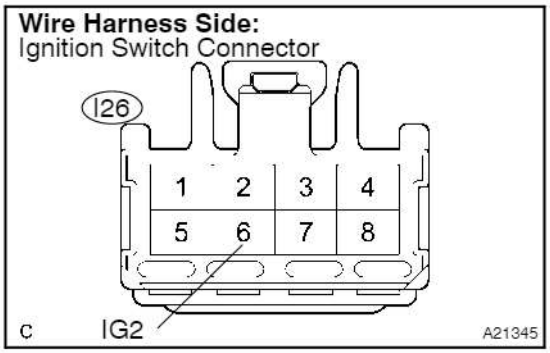
NG → **Replace injector.**

OK

10	**Check for open and short in harness and connector between ignition SW and injector, injector and engine control ECU of misfiring cylinder.**







Check the harness and the connector between the injector connector and the engine control ECU connector:

PREPARATION:

(a) Disconnect the I10, I11, I12, I13, I14, I15 I16 or I17 injector connector.

(b) Disconnect the E7, E8 or E9 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
Injector (I10–2) – #1 (E7–1)	Below 1 Ω
Injector (I11–2) – #2 (E7–2)	Below 1 Ω
Injector (I12–2) – #3 (E7–3)	Below 1 Ω
Injector (I13–2) – #4 (E7–4)	Below 1 Ω
Injector (I14–2) – #5 (E7–5)	Below 1 Ω
Injector (I15–2) – #6 (E8–3)	Below 1 Ω
Injector (I16–2) – #7 (E9–6)	Below 1 Ω
Injector (I17–2) – #8 (E9–5)	Below 1 Ω
Injector (I10–2) or #1 (E7–1) – Body ground	10 kΩ or higher
Injector (I11–2) or #2 (E7–2) – Body ground	10 kΩ or higher
Injector (I12–2) or #3 (E7–3) – Body ground	10 kΩ or higher
Injector (I13–2) or #4 (E7–4) – Body ground	10 kΩ or higher
Injector (I14–2) or #5 (E7–5) – Body ground	10 kΩ or higher
Injector (I15–2) or #6 (E8–3) – Body ground	10 kΩ or higher
Injector (I16–2) or #7 (E9–6) – Body ground	10 kΩ or higher
Injector (I17–2) or #8 (E9–5) – Body ground	10 kΩ or higher

Check the harness and connector between the injector connector and the ignition switch:

PREPARATION:

(a) Disconnect the I10, I11, I12, I13, I14, I15, I16 or I17 injector connector.

(b) Disconnect the I26 ignition switch connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
Injector (I10–1) – IG2 (I26–6)	Below 1 Ω
Injector (I11–1) – IG2 (I26–6)	Below 1 Ω
Injector (I12–1) – IG2 (I26–6)	Below 1 Ω
Injector (I13–1) – IG2 (I26–6)	Below 1 Ω
Injector (I14–1) – IG2 (I26–6)	Below 1 Ω
Injector (I15–1) – IG2 (I26–6)	Below 1 Ω
Injector (I16–1) – IG2 (I26–6)	Below 1 Ω
Injector (I17–1) – IG2 (I26–6)	Below 1 Ω
Injector (I10–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Injector (I11–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Injector (I12–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Injector (I13–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Injector (I14–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Injector (I15–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Injector (I16–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Injector (I17–1) or IG2 (I26–6) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK →

11	Check injector injection of misfiring cylinder (See Pub. No. RM630E, page FI–29).

NG → Replace injector.

OK

12	Check compression pressure of misfiring cylinder (See Pub. No. RM630E, page EM–3).

NG → Repair or replace.

OK

13	Check valve clearance of misfiring cylinder (See Pub. No. RM630E, page EM–6).

NG → Adjust valve clearance.

OK

14	Check result of step 4 switch step by number of misfire cylinder.

High misfire rate cylinder	Proceed to
1 or 2 cylinders	A
More than 3 cylinders	B

B → Check for intermittent problems (See page DI–3).

A

15	Check valve timing (Check for looseness or a jumped tooth of timing belt) (See Pub. No. RM630E, page EM–14).

NG → Adjust valve timing (Repair or replace timing belt).

OK ↓

16	Check fuel pressure (See Pub. No. RM630E, page FI–1).

NG → Check and repair fuel pump, pressure regulator, fuel pipe line and filter (See Pub. No. RM630E, page FI–7).

OK ↓

17	**Check intake air temperature and air flow rate.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON.

CHECK:

Check the intake air temperature.

(1) Select the item "DIAGNOSIS/OBD/MOBD/DATA LIST/ALL/INTAKE AIR".
(2) Read its value displayed on the hand–held tester.

OK:

Equivalent to ambient temperature

CHECK:

Check the air flow rate.

(1) Select the item "DIAGNOSIS/OBD/MOBD/DATA LIST/ALL/MAF".
(2) Read its value displayed on the hand–held tester.

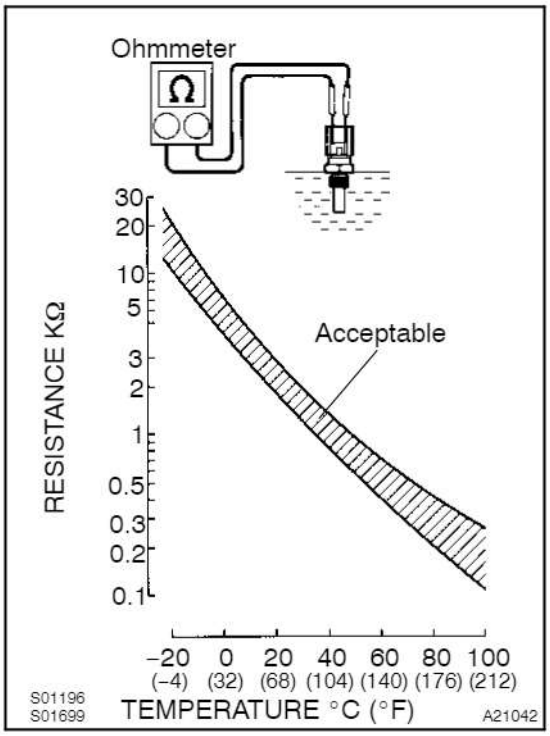
OK:

Condition	Air Flow Rate (gm/s)
Ignition switch ON (do not start engine)	0
Idling	4 to 6
Running without load (2,500 rpm)	13 to 20
Idling to quickly accelerating	Air flow rate fluctuates

NG → **Replace air flow meter.**

OK

18	Check engine coolant temperature sensor.



PREPARATION:

Remove the engine coolant temperature sensor.

CHECK:

Measure the resistance between the terminals of the engine coolant temperature sensor.

Resistance:

Tester Connection	Specified Condition
1 – 2	2.32 to 2.59 kΩ (20°C (68°F))
	0.310 to 0.326 kΩ (80°C (176°F))

NOTICE:

In case of checking the engine coolant temperature sensor in the water, be careful not to allow water to go into the terminals. After checking, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed engine coolant temperature sensor and read the resistance. Use an infrared thermometer to measure the engine temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

NG → **Replace engine coolant temperature sensor.**

OK

19	Switch step by number of misfire cylinder (Refer result of step 4).

High misfire rate cylinder	Proceed to
1 or 2 cylinders	A
More than 3 cylinders	B

B → **Go to step 5.**

A

Check for intermittent problems (See page DI–3).

DI1LQ-17

DTC	P0325/52	Knock Sensor 1 Circuit (Bank 1 or Single Sensor)

DTC	P0330/55	Knock Sensor 2 Circuit (Bank 2)

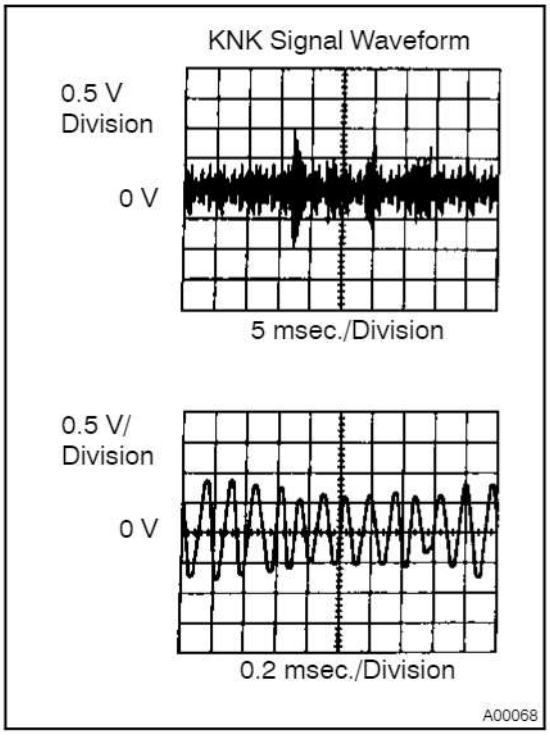
CIRCUIT DESCRIPTION

Each knock sensor is fitted to the right bank and left bank of the cylinder block to detect engine knocking. This sensor contains a piezoelectric element which generates a voltage when it becomes deformed. The piezoelectric element sends a signal to the engine control ECU, when the cylinder block vibrates due to knocking. If engine knocking occurs, ignition timing is retarded to suppress it.

DTC No.	DTC Detecting Condition	Trouble Area
P0325/52	Output voltage of the knock sensor 1 decreases beyond a threshold (threshold varies according to an engine speed) with engine speed 2,000 rpm to 5,000 rpm (1 trip detection logic)	• Open or short in knock sensor 1 circuit • Knock sensor 1 (looseness) • Engine control ECU
P0330/55	Output voltage of the knock sensor 2 decreases beyond a threshold (threshold varies according to an engine speed) with engine speed 2,000 rpm to 5,000 rpm (1 trip detection logic)	• Open or short in knock sensor 2 circuit • Knock sensor 2 (looseness) • Engine control ECU

HINT:

- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers the the bank that does not include cylinder No. 1.



Reference: INSPECTION USING OSCILLOSCOPE

- With the engine racing (4,000 rpm), check the waveform between terminals KNK1 and KNK2 of the engine control ECU connector and body ground.

HINT:

The correct waveform is as shown.

- Spread the time on the horizontal axis, and confirm that period of the wave is 0.13 msec. (Normal mode vibration frequency of knock sensor: 8.1 kHz)

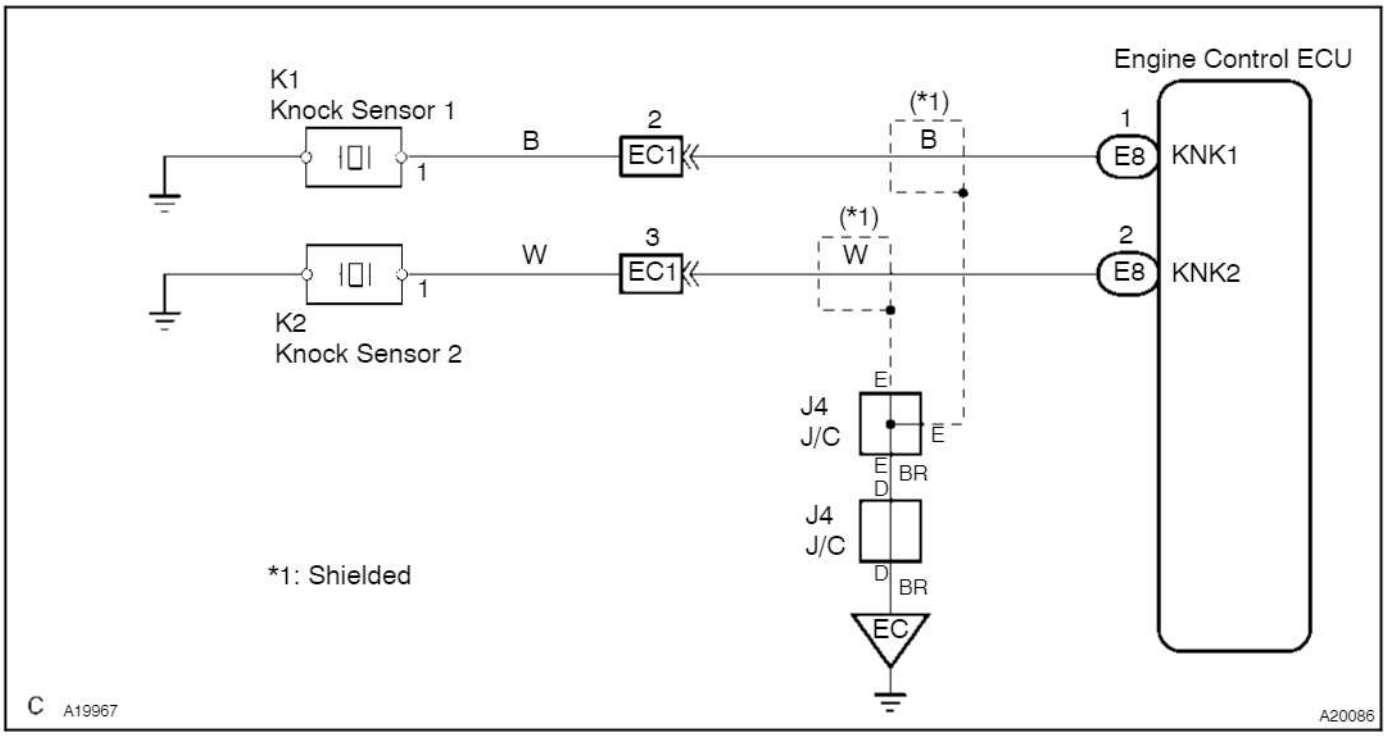
HINT:

If normal mode vibration frequency is not 8.1 kHz, the sensor has malfunction.

MONITOR DESCRIPTION

The knock sensor located on the cylinder block, detects spark knock.
When spark knock occurs, the sensor pick–up vibrates in a specific frequency range. When the engine control ECU detects the voltage in this frequency range, it retards the ignition timing to suppress the spark knock. The engine control ECU also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 sec., and if the knock sensor output voltage is out of normal range, the engine control ECU interprets this as a fault in the knock sensor and sets a DTC.
This monitor run after engine is warmed up (Engine Coolant Temperature (ECT) is 60 °C or more) and the vehicle is driven over 40 km/h for 1 minutes.

WIRING DIAGRAM

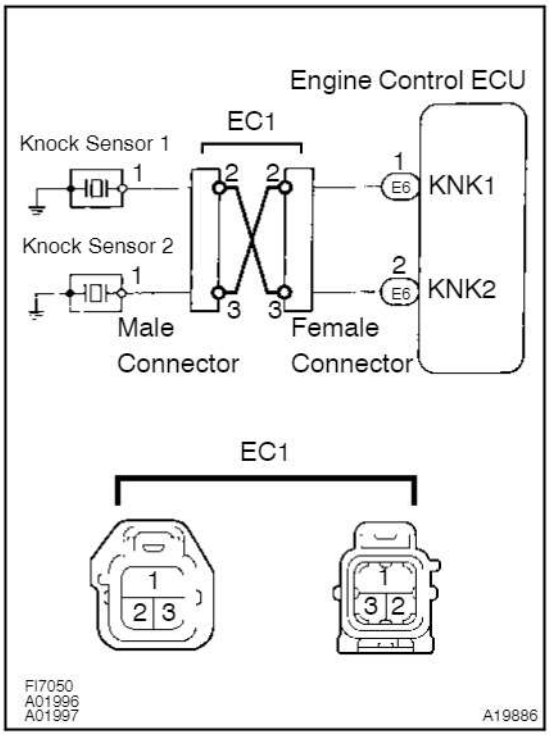


INSPECTION PROCEDURE

HINT:

- DTC P0325 is for the bank 1 knock sensor circuit.
- DTC P0330 is for the bank 2 knock sensor circuit.
- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Connect hand–held tester, and check knock sensor circuit.**



PREPARATION:

(a) Connect hand–held tester to the DLC3.
(b) Disconnect the EC1 connector.
(c) Connect the terminals of the disconnected EC1 male connector and EC1 female as follows.

Male connector ↔ Female connector
Terminal 2 ↔ Terminal 3
Terminal 3 ↔ Terminal 2

(d) Turn ignition switch ON and push the hand–held tester main switch ON.
(e) After the engine is warmed up, perform quick racing to 4,000 rpm 3 times.

CHECK:

Check the DTC.

RESULT:

Type I	DTC same as when vehicle brought in P0325 → P0325 or P0330 → P0330
Type II	DTC different to when vehicle brought in P0325 → P0330 or P0330 → P0325

Type II	**Go to step 3.**

Type I

2	**Check for open and short in harness and connector between EC1 connector and engine control ECU (See page IN–20).**

NG → **Repair or replace harness or connector.**

OK

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

3	**Check for open and short in harness and connector between EC1 connector and knock sensor (See page IN–20).**

HINT:

- If DTC P0325 has changed to P0330, check the knock sensor circuit on the bank 1 side.
- If DTC P0330 has changed to P0325, check the knock sensor circuit on the bank 2 side.

NG → **Repair or replace harness or connector.**

OK

Replace knock sensor.

DIC2D–03

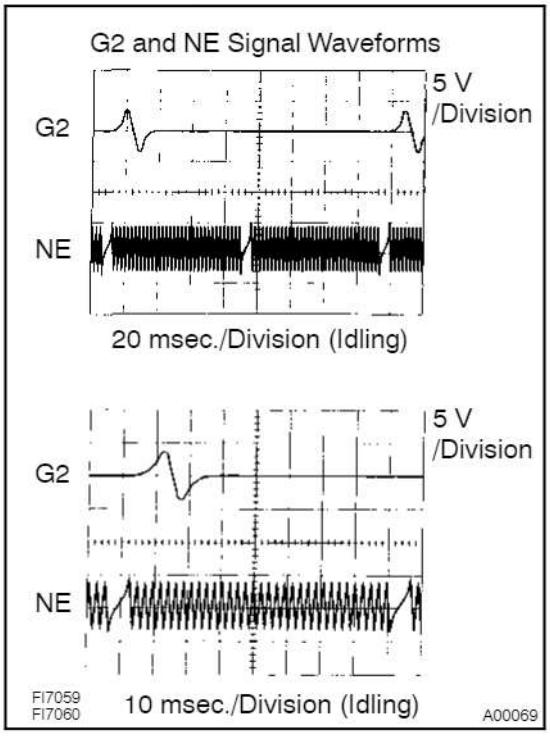
DTC	P0335/12/13	Crankshaft Position Sensor ”A” Circuit

DTC	P0339/13	Crankshaft Position Sensor ”A” Circuit Intermittent

CIRCUIT DESCRIPTION

The crankshaft position sensor system consists of a crankshaft position sensor plate and a pick–up coil. The sensor plate has 34 teeth and is installed on the crankshaft. The pick–up coil is made of an iron core and magnet. The sensor plate rotates and as each tooth passes through the pick–up coil, a pulse signal is created. The pick–up coil generates 34 signals for each engine revolution. Based on these signals, the engine control ECU calculates the crankshaft position and engine RPM. Using these calculations, the fuel injection time and ignition timing are controlled.

DTC No.	DTC Detecting Condition	Trouble Area
P0335/12/13	No crankshaft position sensor signal to engine control ECU during cranking (2 trip detection logic)	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Signal plate • Engine control ECU
	No crankshaft position sensor signal to engine control ECU with engine speed 600 rpm or more (2 trip detection logic)	
P0339/13	In condition (a), (b) and (c), when no crankshaft position sensor (NE) signal is input for 0.05 sec. or more. : (1 trip detection logic) (f) Engine revolution 1000 rpm or more (g) STA signal is OFF (h) 3 sec. or more has lapsed after STA signal is switched from ON to OFF.	



Reference: Inspection using the oscilloscope.

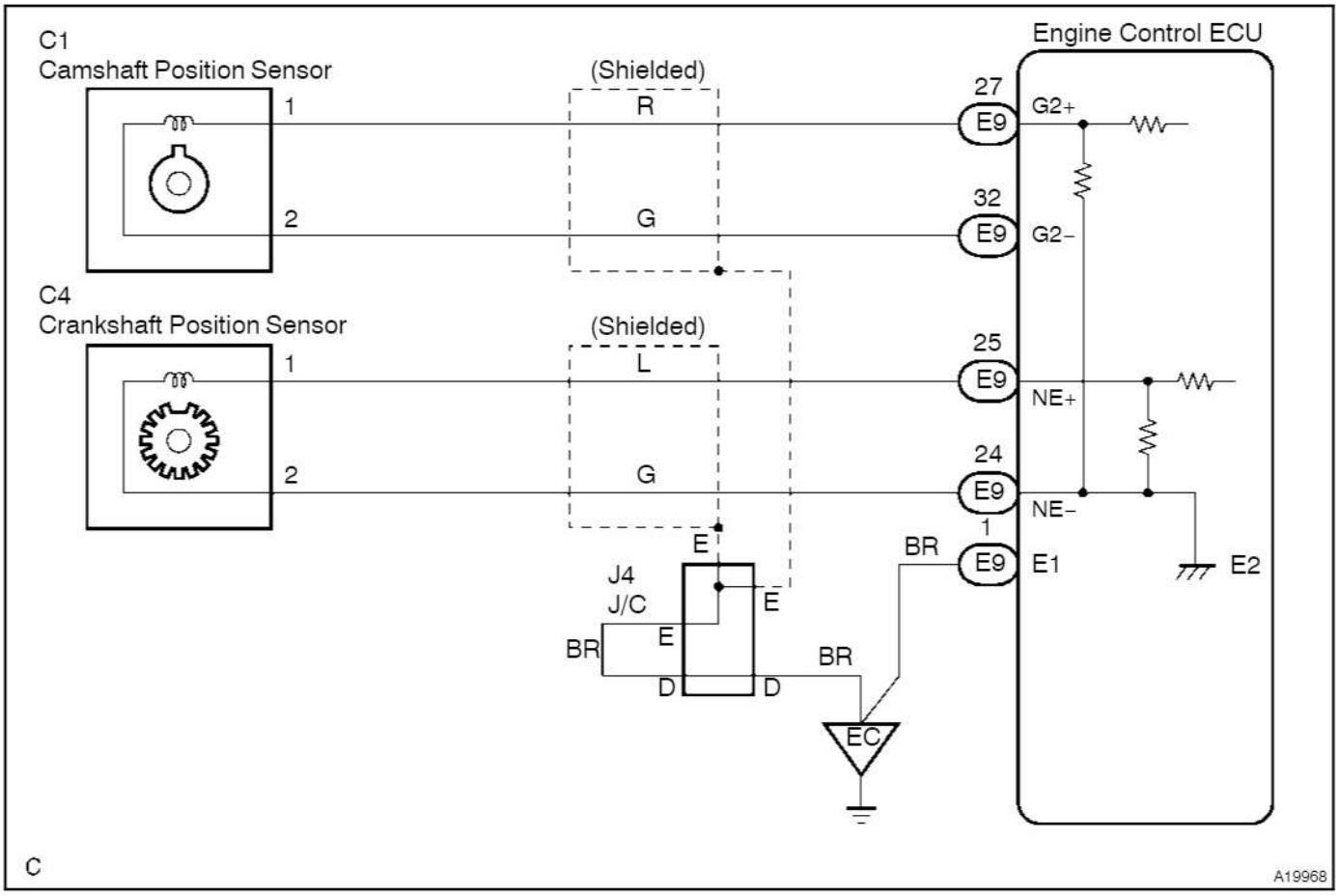
The correct waveform is as shown.

Tester Connection	Specified Condition
G2+ (E7–27) – G2– (E7–32)	Correct waveform is as shown
NE+ (E7–25) – NE– (E7–24)	

MONITOR DESCRIPTION

If there is no signal from the crankshaft sensor even though the engine is revolving, the engine control ECU interprets this as a malfunction of the sensor.
This monitor runs for 10 seconds (the first 10 seconds of engine idle) after the engine is started.

WIRING DIAGRAM



INSPECTION PROCEDURE

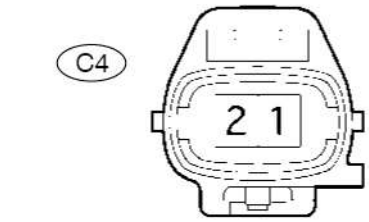
HINT:

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a 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 lean or rich, etc. at the time of the malfunction.
- READ VALUE OF HAND–HELD TESTER OR OBD II SCAN TOOL

(a) Connect the hand–held tester to the DLC3.
(b) Start the engine and push the hand–held tester or the OBD II scan tool main switch ON.
(c) Select the item "DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / ENGINE SPD".

- The engine speed can be confirmed in DATA LIST using the hand–held tester. If there is no NE signals from the crankshaft position sensor despite the engine revolving, the engine speed will be indicated as zero. If voltage output of the crankshaft position sensor is insufficient, the engine speed will be indicated as lower RPM (than the actual RPM).

1	**Check resistance of crankshaft position sensor.**



PREPARATION:

Disconnect the C4 crankshaft position sensor connector.

CHECK:

Measure the resistance between terminals 1 and 2.

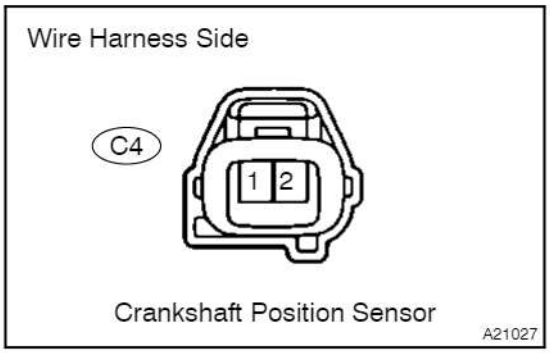
OK:

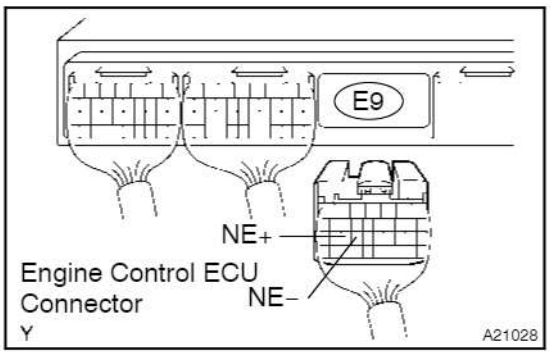
Tester Connection	Specified Condition
1 – 2	1,850 to 2,450 Ω (at 20°C (68°F))

NG → **Replace crankshaft position sensor.**

OK →

2	**Check for open and short in harness and connector between engine control ECU and crankshaft position sensor.**





PREPARATION:

(a) Disconnect the C4 crankshaft position sensor connector.

(b) Disconnect the E9 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
Crankshaft position sensor (C4–1) – NE+ (E9–25)	Below 1 Ω
Crankshaft position sensor (C4–2) – NE– (E9–24)	Below 1 Ω
Crankshaft position sensor (C4–1) or NE+ (E9–25) – Body ground	10 kΩ or higher
Crankshaft position sensor (C4–2) or NE– (E9–24) – Body ground	10 kΩ or higher

NG	**Repair or replace harness or connector.**

OK

3	**Check sensor installation (crankshaft position sensor).**

CHECK:

Check the crankshaft position sensor installation.

NG	**Tighten sensor.**

OK

4	**Inspect teeth of sensor plate.**

PREPARATION:
Remove the crankshaft angle sensor plate (See Pub. No. RM630E, page EM–14).
CHECK:
Check the teeth of sensor plate.

NG → **Replace sensor plate.**

OK

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

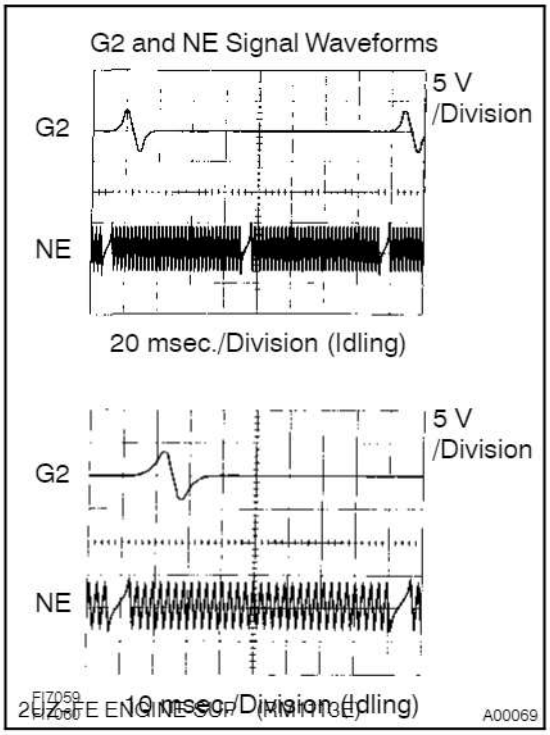
DTC	P0340/12	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)

DTC	P0341/12	Camshaft Position Sensor "A" Circuit Range/Performance (Single Sensor)

CIRCUIT DESCRIPTION

The camshaft position sensor (G signal) consists of a magnet iron core and pickup coil.
The G signal plate has 1 tooth on its outer circumference and is installed on the LH camshaft timing pulley. When the camshafts rotate, protrusion on the signal plate and air gap on the pickup coil change, causing fluctuations in the magnetic field and generating a voltage in the pickup coil.
The NE signal plate has 34 teeth and is mounted on the crankshaft. The NE signal sensor generates 34 signals at every engine revolution. The engine control ECU detects the crankshaft angle and the engine revolution based on the NE signals, and the cylinder and the angle of the G2 based on the combination of the G and NE signals.

DTC No.	DTC Detection Condition	Trouble Area
P0340/12	No camshaft position sensor signal to engine control ECU during cranking (2 trip detection logic)	• Open or short in camshaft position sensor circuit • Camshaft position sensor • LH camshaft timing pulley • Jumping teeth of timing belt • Engine control ECU
	No camshaft position sensor signal to engine control ECU with engine speed 600 rpm or more (1 trip detection logic)	
P0341/12	While crankshaft rotates twice, camshaft position sensor signal will be input to engine control ECU 12 times or more (1 trip detection logic) • Hint: Under normal condition, the camshaft position signal is input into the engine control ECU 1 times per 2 engine revolutions	



Reference: Inspection using the oscilloscope.
The correct waveform is as shown.

Tester Connection	Specified Condition
G2+ (E7–27) – G2– (E7–32)	Correct waveform is as shown
NE+ (E7–25) – NE– (E7–24)	

MONITOR DESCRIPTION

If there is no signal from the camshaft position sensor even though the engine is turning, or if the rotation of the camshaft and the crankshaft is not synchronized, the engine control ECU interprets this as a malfunction of the sensor.
This monitor runs for 10 seconds (the first 10 seconds of engine idle) after the engine is started.

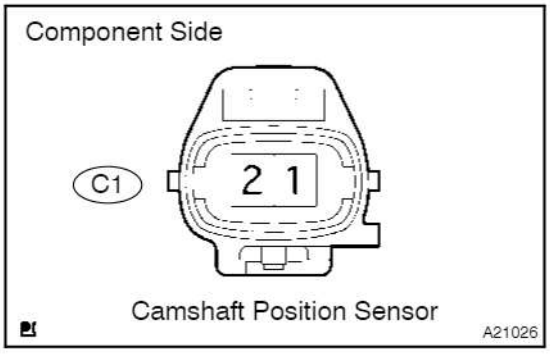
WIRING DIAGRAM

Refer to DTC P0335 on page DI–152.

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Check resistance of camshaft position sensor.**



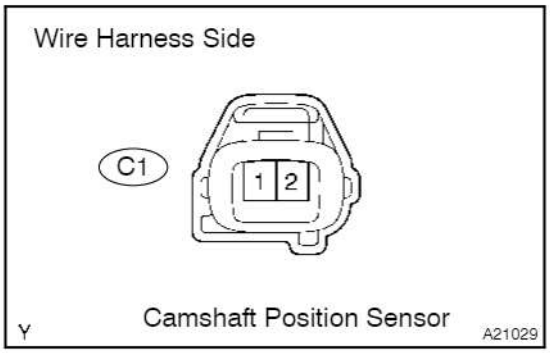
PREPARATION:
Disconnect the C1 camshaft position sensor connector.
CHECK:
Measure the resistance between terminals 1 and 2.
OK:

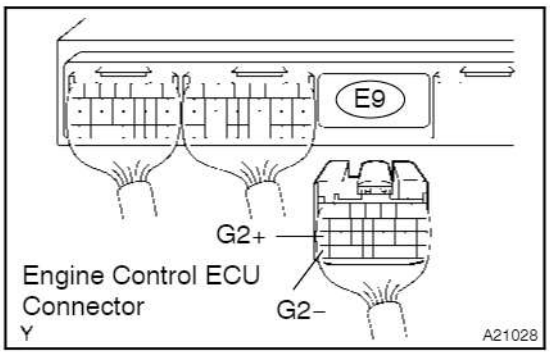
Tester Connection	Specified Condition
1 – 2	950 to 1,250 Ω (at 20°C (68°F))

NG → **Replace camshaft position sensor.**

OK

2	**Check for open and short in harness and connector between engine control ECU and camshaft position sensor.**





PREPARATION:

(a) Disconnect the C1 camshaft position sensor connector.

(b) Disconnect the E9 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
Camshaft position sensor (C1–1) – G2+ (E9–27)	Below 1 Ω
Camshaft position sensor (C1–2) – G2– (E9–32)	Below 1 Ω
Camshaft position sensor (C1–1) or G2+ (E9–27) – Body ground	10 kΩ or higher
Camshaft position sensor (C1–2) or G2– (E9–32) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK

3	**Check sensor installation (Camshaft position sensor).**

CHECK:

Check the camshaft position sensor installation.

NG → **Tighten sensor.**

OK

4	**Inspect teeth of LH camshaft timing belt pulley.**

PREPARATION:
Remove the LH camshaft timing belt pulley (See Pub. No. RM630E, page EM–14).
CHECK:
Check the LH camshaft timing belt pulley.

NG → **Replace LH camshaft timing pulley.**

OK

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DICTH–01

DTC	P0351/14	Igniter Coil "A" Primary/Secondary Circuit

DTC	P0352/14	Igniter Coil "B" Primary/Secondary Circuit

DTC	P0353/15	Igniter Coil "C" Primary/Secondary Circuit

DTC	P0354/15	Igniter Coil "D" Primary/Secondary Circuit

DTC	P0355/14	Igniter Coil "E" Primary/Secondary Circuit

DTC	P0356/14	Igniter Coil "F" Primary/Secondary Circuit

DTC	P0357/15	Igniter Coil "G" Primary/Secondary Circuit

DTC	P0358/15	Igniter Coil "H" Primary/Secondary Circuit

HINT:

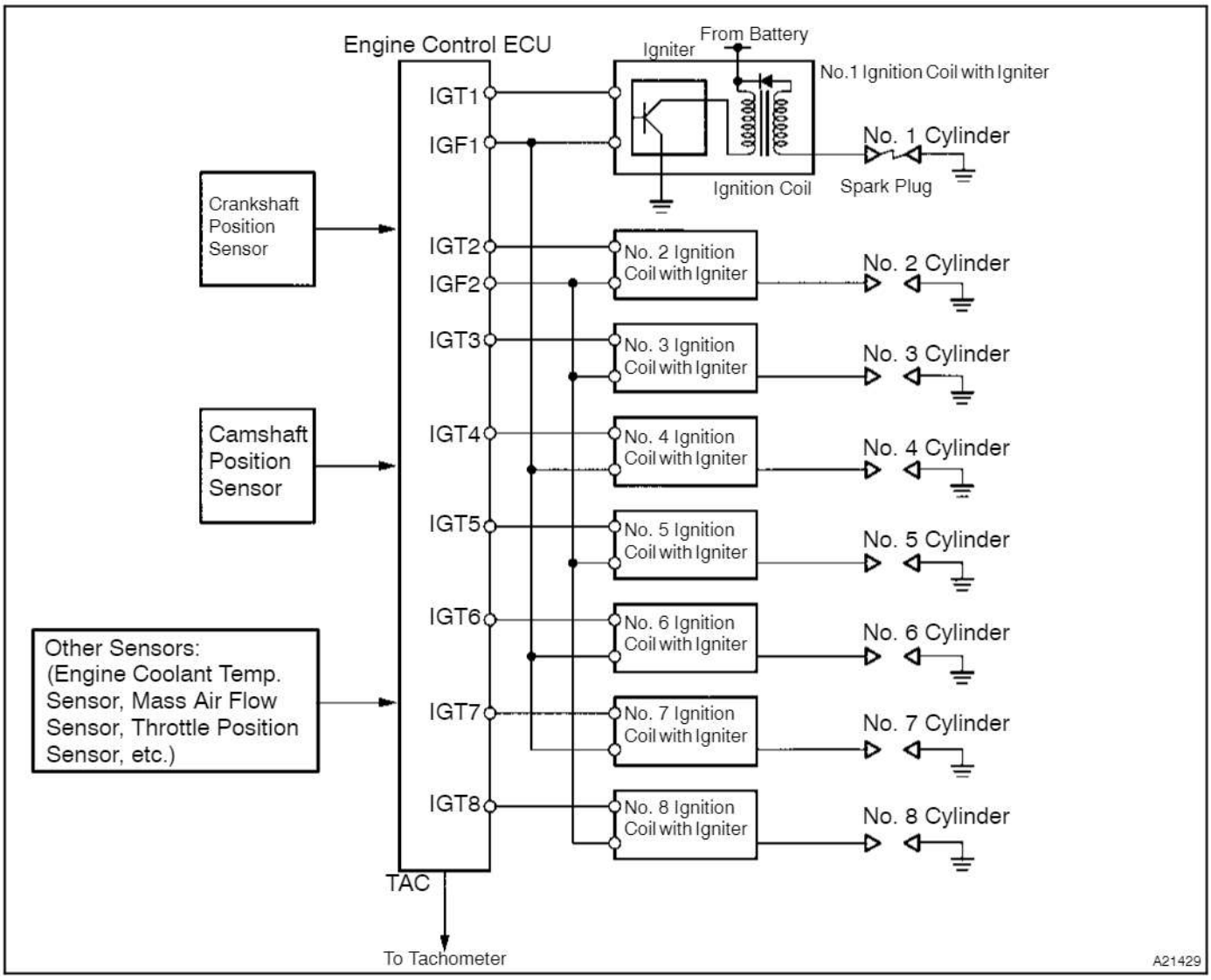
- These DTCs indicate a malfunction related to primary circuit.
- If DTC P0351/14 is displayed, check No. 1 ignition coil with igniter circuit.
- If DTC P0352/14 is displayed, check No. 2 ignition coil with igniter circuit.
- If DTC P0353/15 is displayed, check No. 3 ignition coil with igniter circuit.
- If DTC P0354/15 is displayed, check No. 4 ignition coil with igniter circuit.
- If DTC P0355/14 is displayed, check No. 5 ignition coil with igniter circuit.
- If DTC P0356/14 is displayed, check No. 6 ignition coil with igniter circuit.
- If DTC P0357/15 is displayed, check No. 7 ignition coil with igniter circuit.
- If DTC P0358/15 is displayed, check No. 8 ignition coil with igniter circuit.

CIRCUIT DESCRIPTION

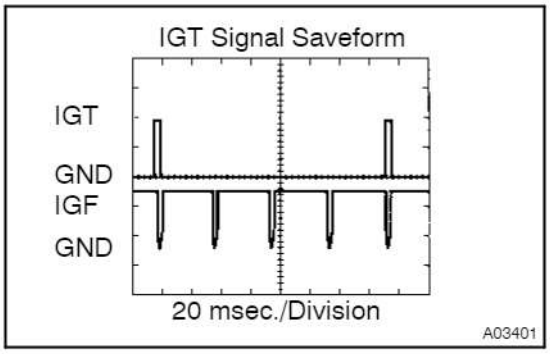
These DTCs indicate a malfunction related to primary circuit.

The DIS is a 1–cylinder ignition system which ignites one cylinder with one ignition coil. In the 1–cylinder ignition system, the one spark plug is connected to the end of the secondary winding. High voltage generated in the secondary winding is applied directly to the spark plug. The spark of the spark plug passes from the center electrode to the ground electrode.

The engine control ECU determines the ignition timing and outputs the ignition signals (IGTs) for each cylinder. Using the IGT, the engine control ECU turns on and off the power transistor inside the igniter and this switches on and off the current to the primary coil. When current to the primary coil is cut off, high–voltage is generated in the secondary coil and this voltage is applied to the spark plugs to create sparks inside the cylinders. As the engine control ECU cuts the current to the primary coil, the igniter sends back the ignition confirmation signal (IGF) for each cylinder ignition to the engine control ECU.

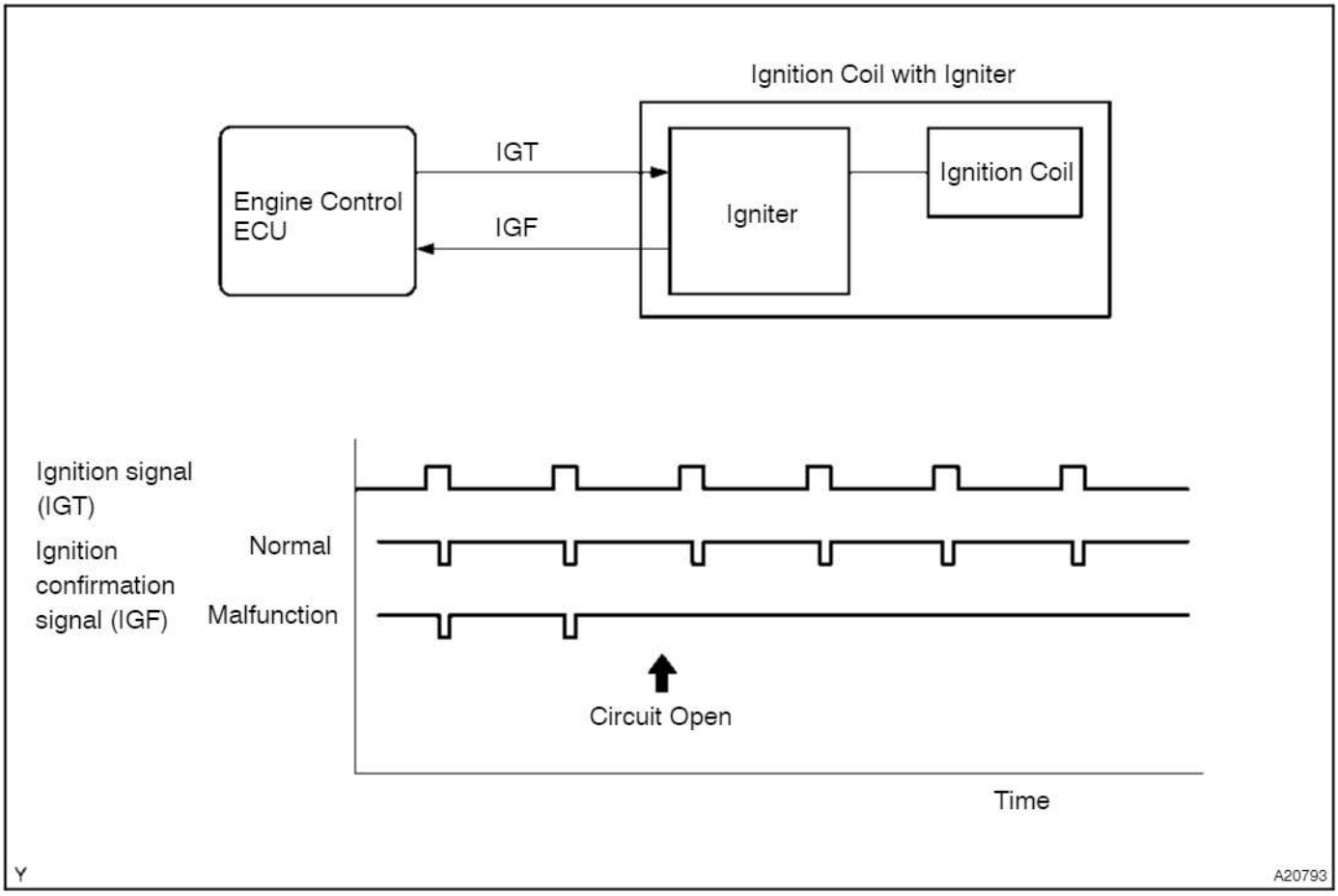


DTC No.	DTC Detecting Condition	Trouble Area
P0351/14 P0352/14 P0353/15 P0354/15 P0355/14 P0356/14 P0357/15 P0358/15	No IGF signal to engine control ECU while engine is running (1 trip detection logic)	• Open or short in IGF1 or IGF2 and IGT1 to IGT8 circuit from ignition coil with igniter to engine control ECU • No. 1 to No. 8 ignition coil with igniter • Ignition system • Engine control ECU



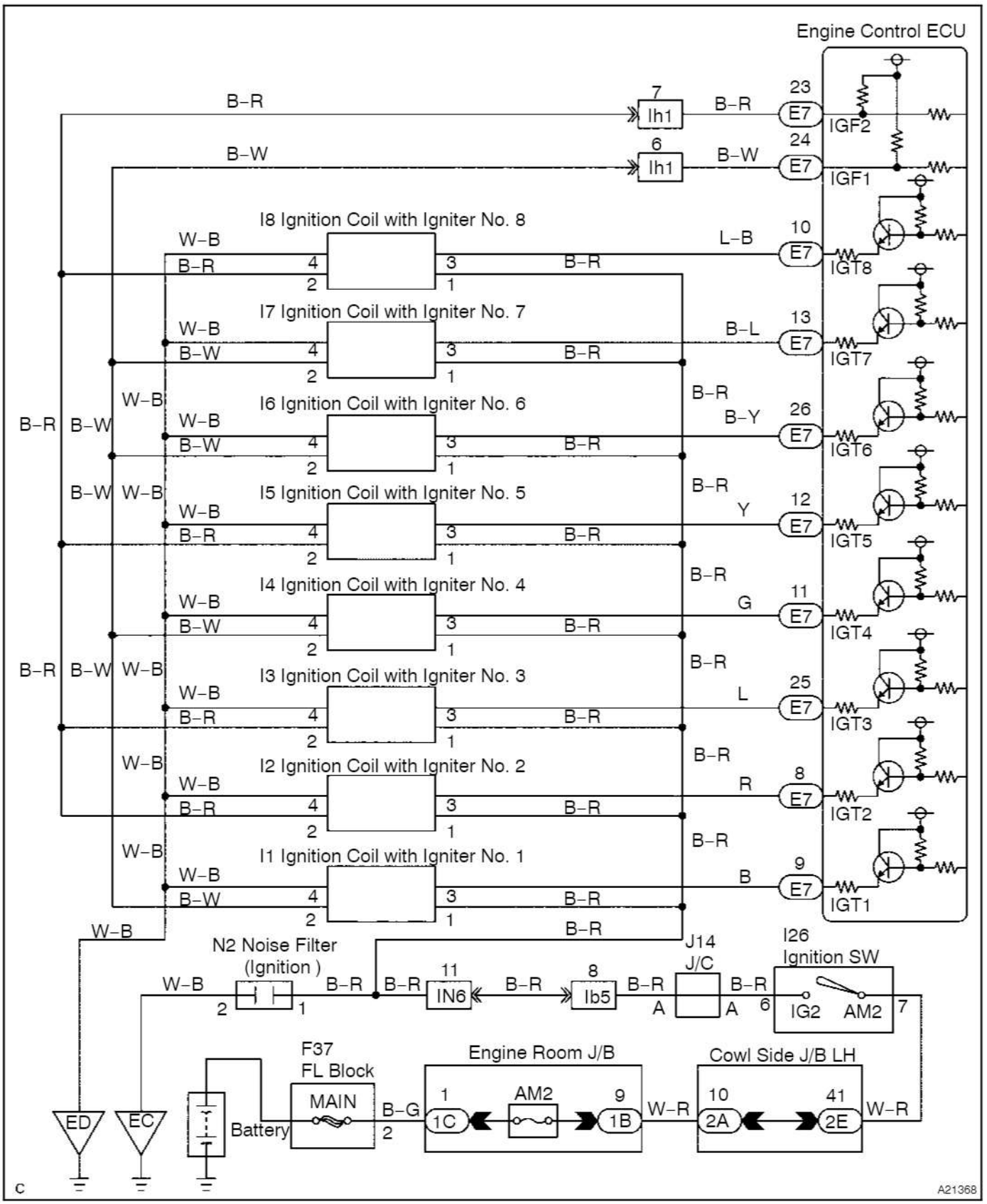
Reference: Inspection using the oscilloscope.
During cranking or idling, check the waveform between terminals IG1 to IG8 and E1, and IGF1, IGF2 and E1 of the E5 and E7 engine control ECU connectors.

MONITOR DESCRIPTION



If the engine control ECU does not receive the IGF after sending the IGT it interprets this as a fault in the igniter and sets a DTC.
The monitor runs for 1 second (the first second of engine idle) after the engine is started.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

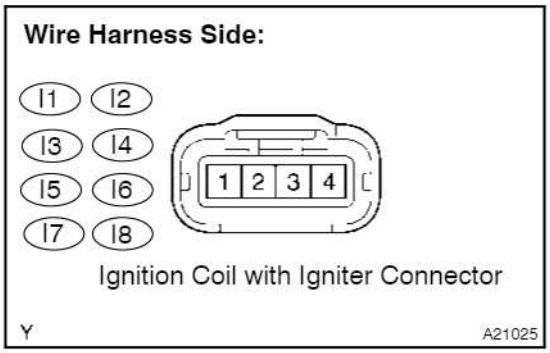
- If DTCs P0351/14, P0354/15, P0356/14 and P0357/15 are output simultaneously, IGF1 circuit may be open or short.
- If DTCs P0352/14, P0353/15, P0355/14 and P0358/15 are output simultaneously, IGF2 circuit may be open or short.
- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

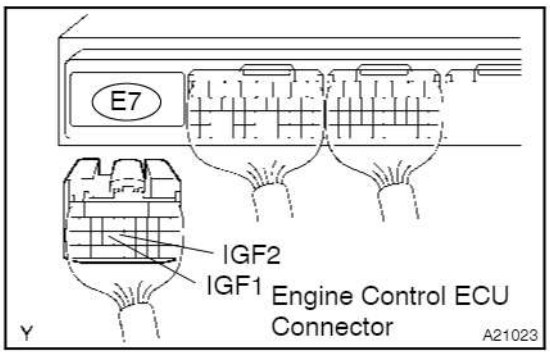
1	**Check spark plug and spark (See Pub. No. RM630E, page IG–1).**

NG → **Go to step 4.**

OK

2	**Check for open and short in harness and connector in IGF signal circuits between engine control ECU and ignition coil with igniter.**





PREPARATION:

(a) Disconnect the I1, I2, I3, I4, I5, I6, I7 or I8 ignition coil will igniter connector.

(b) Disconnect the E7 engine control ECU connector.

CHECK:

Check the resistance between the wire harness side connectors.

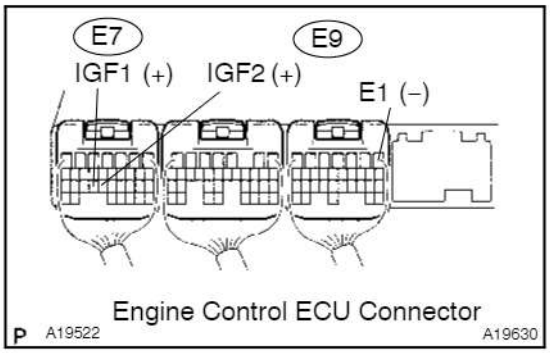
OK:

Tester Connection	Specified Condition
Ignition coil (I1–2) – IGF1 (E7–24)	Below 1 Ω
Ignition coil (I2–2) – IGF2 (E7–23)	Below 1 Ω
Ignition coil (I3–2) – IGF1 (E7–24)	Below 1 Ω
Ignition coil (I4–2) – IGF2 (E7–23)	Below 1 Ω
Ignition coil (I5–2) – IGF1 (E7–24)	Below 1 Ω
Ignition coil (I6–2) – IGF2 (E7–23)	Below 1 Ω
Ignition coil (I7–2) – IGF1 (E7–24)	Below 1 Ω
Ignition coil (I8–2) – IGF2 (E7–23)	Below 1 Ω
Ignition coil (I1–2) or IGF1 (E7–24) – Body ground	10 kΩ or higher
Ignition coil (I2–2) or IGF2 (E7–23) – Body ground	10 kΩ or higher
Ignition coil (I3–2) or IGF1 (E7–24) – Body ground	10 kΩ or higher
Ignition coil (I4–2) or IGF2 (E7–23) – Body ground	10 kΩ or higher
Ignition coil (I5–2) or IGF1 (E7–24) – Body ground	10 kΩ or higher
Ignition coil (I6–2) or IGF2 (E7–23) – Body ground	10 kΩ or higher
Ignition coil (I7–2) or IGF1 (E7–24) – Body ground	10 kΩ or higher
Ignition coil (I8–2) or IGF2 (E7–23) – Body ground	10 kΩ or higher

NG	**Repair or replace harness or connector.**

OK

3	**Disconnect ignition coil with igniter connector, and check voltage between terminals IGF1, IGF2 and E1 of engine control ECU connector.**



PREPARATION:

(a) Disconnect the I1, I2, I3, I4, I5, I6, I7 or I8 ignition coil with igniter connector.

(b) Turn the ignition switch ON.

CHECK:

Measure the voltage between the E7 and E9 engine control ECU connectors.

OK:

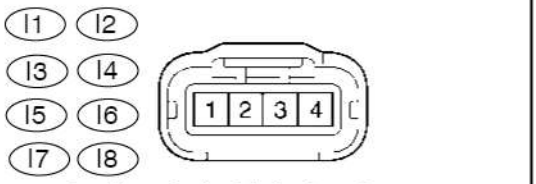
Tester Connection	Specified Condition
IGF1 (E7–24) – E1 (E9–1)	4.5 to 5.5 V
IGF2 (E7–23) – E1 (E9–1)	4.5 to 5.5 V

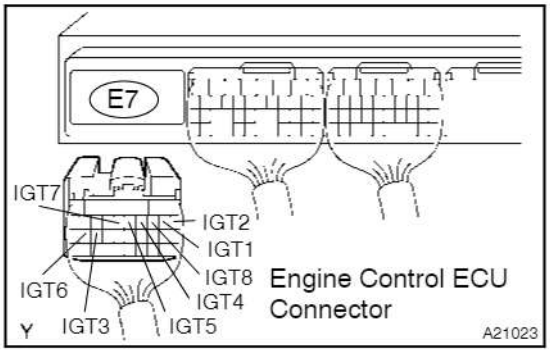
NG → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

OK →

Replace ignition coil with igniter.

4	**Check for open and short in harness and connector in IGT signal circuit between engine control ECU and ignition coil with igniter.**





PREPARATION:

(a) Disconnect the I1, I2, I3, I4, I5, I6, I7 or I8 ignition coil connector.

(b) Disconnect the E7 engine control ECU connector.

CHECK:

Check the resistance between the wire harness side connectors.

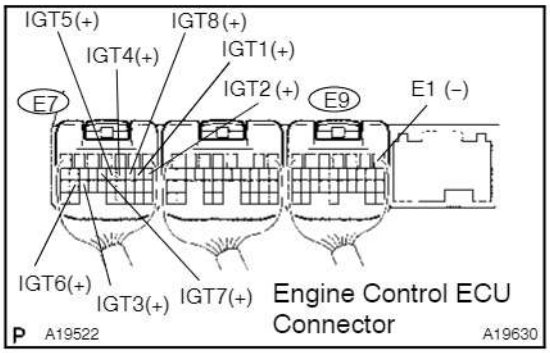
OK:

Tester Connection	Specified Condition
Ignition coil (I1–2) – IGT1 (E7–9)	Below 1 Ω
Ignition coil (I2–2) – IGT2 (E7–8)	Below 1 Ω
Ignition coil (I3–2) – IGT3 (E7–25)	Below 1 Ω
Ignition coil (I4–2) – IGT4 (E7–11)	Below 1 Ω
Ignition coil (I5–2) – IGT5 (E7–12)	Below 1 Ω
Ignition coil (I6–2) – IGT6 (E7–26)	Below 1 Ω
Ignition coil (I7–2) – IGT7 (E7–13)	Below 1 Ω
Ignition coil (I8–2) – IGT8 (E7–10)	Below 1 Ω
Ignition coil (I1–2) or IGT1 (E7–9) – Body ground	10 kΩ or higher
Ignition coil (I2–2) or IGT2 (E7–8) – Body ground	10 kΩ or higher
Ignition coil (I3–2) or IGT3 (E7–25) – Body ground	10 kΩ or higher
Ignition coil (I4–2) or IGT4 (E7–11) – Body ground	10 kΩ or higher
Ignition coil (I5–2) or IGT5 (E7–12) – Body ground	10 kΩ or higher
Ignition coil (I6–2) or IGT6 (E7–26) – Body ground	10 kΩ or higher
Ignition coil (I7–2) or IGT7 (E7–13) – Body ground	10 kΩ or higher
Ignition coil (I8–2) or IGT8 (E7–10) – Body ground	10 kΩ or higher

NG	**Repair or replace harness or connector.**

OK

5	**Check voltage between terminals IGT1 – IGT8 and E1 of engine control ECU connector.**



CHECK:

Measure the voltage between terminals the E7 and E9 engine control ECU connectors when the engine is cranked.

OK:

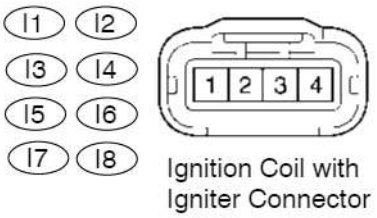
Tester Connection	Specified Condition
IGT1 (E7–9) – E1 (E9–1)	More than 0.1 V or less than 4.5 V
IGT2 (E7–8) – E1 (E9–1)	
IGT3 (E7–25) – E1 (E9–1)	
IGT4 (E7–11) – E1 (E9–1)	
IGT5 (E7–12) – E1 (E9–1)	
IGT6 (E7–26) – E1 (E9–1)	
IGT7 (E7–13) – E1 (E9–1)	
IGT8 (E7–10) – E1 (E9–1)	

NG → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

OK

6	Check ignition coil with igniter power source circuit.

Wire Harness Side:



Ignition Coil with Igniter Connector

Y A21025

PREPARATION:

Disconnect the I1, I2, I3, I4, I5, I6, I7 or I8 ignition coil with igniter connector.

CHECK:

(a) Turn the ignition switch ON and to the START position.

(b) Measure the voltage between the terminal of the wire harness side connector and body ground.

OK:

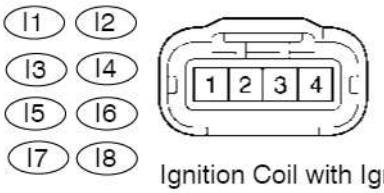
Tester Connection	Specified Condition
I1–1 – Body ground	9 to 14 V
I2–1 – Body ground	
I3–1 – Body ground	
I4–1 – Body ground	
I5–1 – Body ground	
I6–1 – Body ground	
I7–1 – Body ground	
I8–1 – Body ground	

OK → **Repair ignition coil with igniter.**

NG

7	**Check for open and short in harness and connector between ignition switch and ignition coil with igniter.**

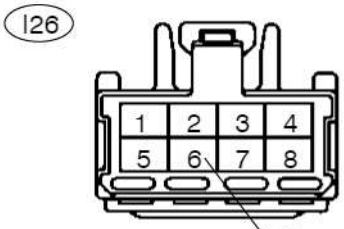
Wire Harness Side:



Ignition Coil with Igniter

Y A21025

Wire Harness Side:



Ignition Switch

A21030

PREPARATION:

(a) Disconnect the I1, 2, I3, I4, I5, I6, I7 or I8 ignition coil with igniter connector.

(b) Disconnect the I26 ignition switch connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
Ignition coil (I1–1) – IG2 (I26–6)	Below 1 Ω
Ignition coil (I2–1) – IG2 (I26–6)	Below 1 Ω
Ignition coil (I3–1) – IG2 (I26–6)	Below 1 Ω
Ignition coil (I4–1) – IG2 (I26–6)	Below 1 Ω
Ignition coil (I5–1) – IG2 (I26–6)	Below 1 Ω
Ignition coil (I6–1) – IG2 (I26–6)	Below 1 Ω
Ignition coil (I7–1) – IG2 (I26–6)	Below 1 Ω
Ignition coil (I8–1) – IG2 (I26–6)	Below 1 Ω
Ignition coil (I1–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Ignition coil (I2–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Ignition coil (I3–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Ignition coil (I4–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Ignition coil (I5–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Ignition coil (I6–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Ignition coil (I7–1) or IG2 (I26–6) – Body ground	10 kΩ or higher
Ignition coil (I8–1) or IG2 (I26–6) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK →

Replace ignition coil with igniter.

DIC2G–02

DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

DTC	P0430	Catalyst System Efficiency Below Threshold (Bank 2)

HINT:

- If DTC P0420 is displayed, check the bank 1 catalyst.
- If DTC P0430 is displayed, check the bank 2 catalyst.
- Bank 1 includes cylinder No. 1, but bank 2 does not. Cylinder No. 1 is located in the front part of the engine, opposite the transmission.

CIRCUIT DESCRIPTION

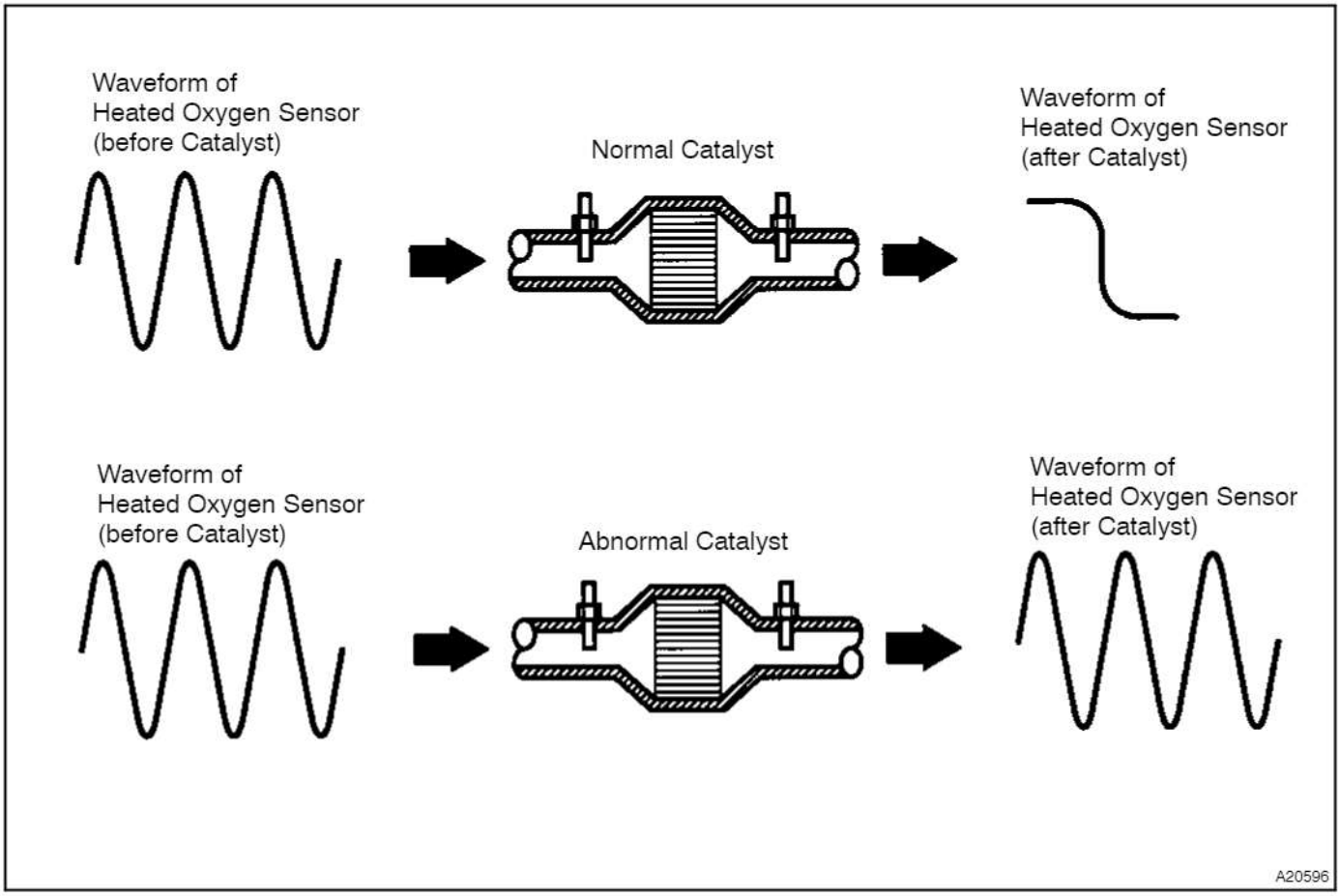
The ECM uses Heated Oxygen Sensors (HO2Ss) mounted before and after the three–way catalyst (TWC) to monitor its' efficiency. The front sensor sends pre–catalyst air–fuel information to the ECM. The rear sensor sends post–catalyst information to the ECM. The ECM compares these two signals to judge the efficiency of the catalyst and the catalyst's ability to store oxygen. During normal operation, the TWC stores and releases oxygen as needed. The capacity to store oxygen results in a low variation in the post–TWC exhaust stream as shown on the next page.

If the catalyst is functioning normally, the waveform of the HO2S (sensor 2) slowly switches between RICH and LEAN. If the catalyst is deteriorated, the waveform will alternate frequently between RICH and LEAN. As the catalyst efficiency degrades, its ability to store oxygen is reduced and the catalyst output becomes more variable.

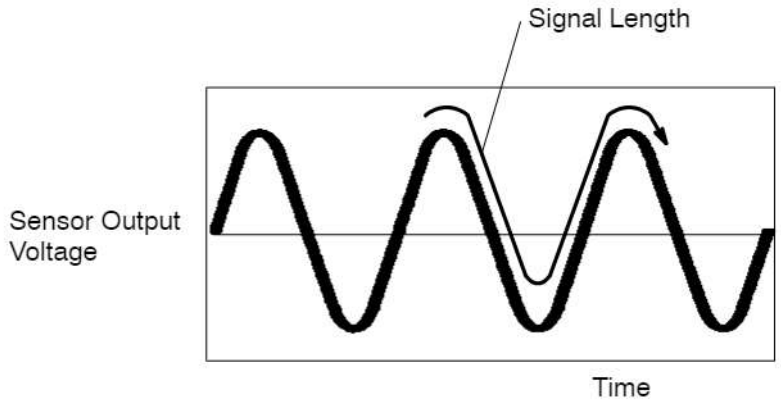
When running the catalyst monitor, the ECM begins to measure the signal length of the HO2S (sensor 1) and HO2S (sensor 2). The ECM calculates the rate of signal length of the HO2S (sensor 1) and HO2S (sensor 2) (catalyst deterioration level). If the catalyst deterioration level exceeds the threshold, the ECM interprets this as a catalyst malfunction. The ECM illuminates the MIL (2 trip detection logic) and sets a DTC.

The monitor runs after:

- The engine is warmed up (Engine Coolant Temperature (ECT) is 75°C (167°F) or more).
- The vehicle is driven at approximately 60 to 100 km/h (37 to 63 mph) for 15 minutes.



Heated Oxygen Sensor Signal Length

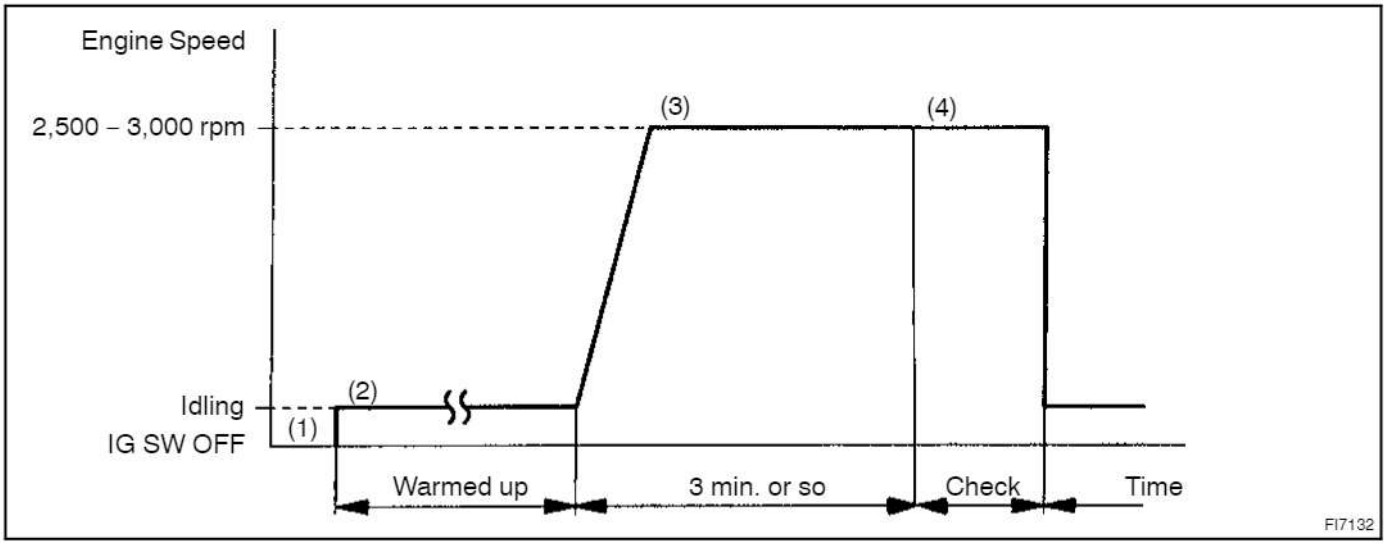


DTC No.	DTC Detecting Condition	Trouble Area
P0420 P0430	After engine and catalyst are warmed up, and while vehicle is driven within set vehicle and engine speed range; Waveforms of rear HO2S alternates frequency between Rich and Lean (2 trip detection logic)	• Gas leakage on exhaust system • Heated oxygen sensor (bank 1, 2 sensor 1, 2) • Three–way catalytic converter

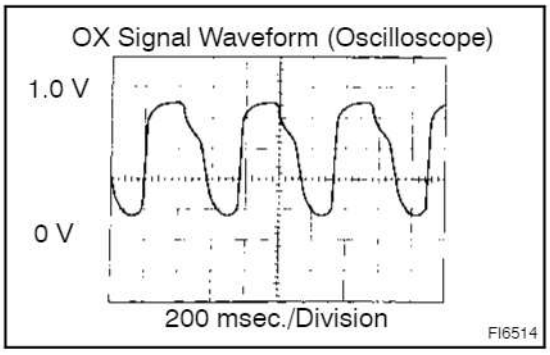
HINT:

- Bank 1 refers to the bank that includes cylinder No.1.
- Bank 2 refers to the bank that does not include cylinder No.1.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

CONFIRMATION ENGINE RACING PATTERN



(a) Connect the hand–held tester to the DLC3, or connect the probe of the oscilloscope between terminals OXL1, OXL2, OXR1, OXR2 and E1 of the engine control ECU connector.
(b) Start the engine and warm it up with all accessories switched OFF until engine coolant temperature is stable.
(c) Race the engine at 2,500 – 3,000 rpm for about 3 minutes.
(d) After confirming that the waveform of the heated oxygen sensor (bank 1, 2 sensor 1 (OX1A, OX2A)), oscillate around 0.5 V during feedback to the engine control ECU, check the waveform of the heated oxygen sensor (bank 1, 2 sensor 2 (OX1B, OX2B)).



HINT:
If there is a malfunction in the system, the waveform of the heated oxygen sensor (bank 1, 2 sensor 2 (OX1B, OX2B)) is almost the same as that of the heated oxygen sensor (bank 1, 2 sensor 1 (OX1A, OX2A)) on the left.
There are some cases where, even though a malfunction exists, the MIL may either light up or not light up.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Are there any other codes (besides DTC P0420 or P0430) being output?**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES.

CHECK:

Read the DTC using the hand–held tester.

RESULT:

Display (DTC Output)	Proceed to
"P0420 and/or P0430"	A
"P0420 or P0430" and other DTCs	B

HINT:

If any other codes besides "P0420 and/or P0430" are output, perform the troubleshooting for those DTCs first.

B → **Go to relevant DTC chart (See page DI–19).**

A

2	**Check gas leakage on exhaust system.**

NG → **Repair or replace exhaust gas leakage point.**

OK

3	**Check heated oxygen sensor (bank 1, 2 sensor 1).**

HINT:

Refer to the hint following the end of this flowchart.

NG → **Replace heated oxygen sensor.**

OK

4	**Check heated oxygen sensor (bank 1, 2 sensor 2).**

HINT:
Refer to the hint following the end of this flowchart.

NG → **Replace heated oxygen sensor.**

OK

Replace the front and rear three–way catalytic converter in the bank a malfunction is detected.

HINT:
Hand–held tester only:
The narrowing down the trouble area is possible by performing ACTIVE TEST of the following "A/F CONTROL" (Heated oxygen sensor or another can be distinguished).
(a) Perform ACTIVE TEST by hand–held tester (A/F CONTROL).
HINT:
"A/F CONTROL" is the ACTIVE TEST which changes the injection volume to –12.5 % or +25 %.
(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine with the engine speed at 2,500 rpm for approximately 90 seconds.
(4) Select the item "DIAGNOSIS / OBD/MOBD / ACTIVE TEST / A/F CONTROL".
(5) Perform "A/F CONTROL" with the engine in an idle condition (press the right or left button).

RESULT:

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume
+25 % → rich output: More than 0.55 V
–12.5 % → lean output: Less than 0.4 V

NOTICE:

However, there is a few second delay in the sensor 1 (front sensor) output. And there is a maximum 20 seconds delay in the sensor 2 (rear sensor).

	Output voltage of heated oxygen sensor (sensor 1: front sensor)	Output voltage of heated oxygen sensor (sensor 2: rear sensor)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 % Output voltage More than 0.55 V Less than 0.4 V **OK**	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	—
Case 2	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	Sensor 1: front sensor (sensor 1, heater, sensor 1 circuit)
Case 3	Injection volume +25 % –12.5 % Output voltage More than 0.55 V Less than 0.4 V **OK**	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Injection volume +25 % –12.5 % Output voltage Almost no reaction **NG**	Extremely rich or lean of the actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of the heated oxygen sensors (sensor 1 and 2).

For displaying the graph indication, enter "ACTIVE TEST / A/F CONTROL / USER DATA" then select "O2S B1S1 and O2S B1S2" by pressing "YES" button and push "ENTER" button before pressing "F4" button.

NOTICE:

If the vehicle is short of fuel, the air–fuel ratio becomes LEAN and DTCs P0133 and/or P0153 will be recorded, and the MIL then comes on.

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a 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.
- A high heated oxygen sensor (sensor 1) voltage (0.55 V or more) could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.

- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

DIBY8–04

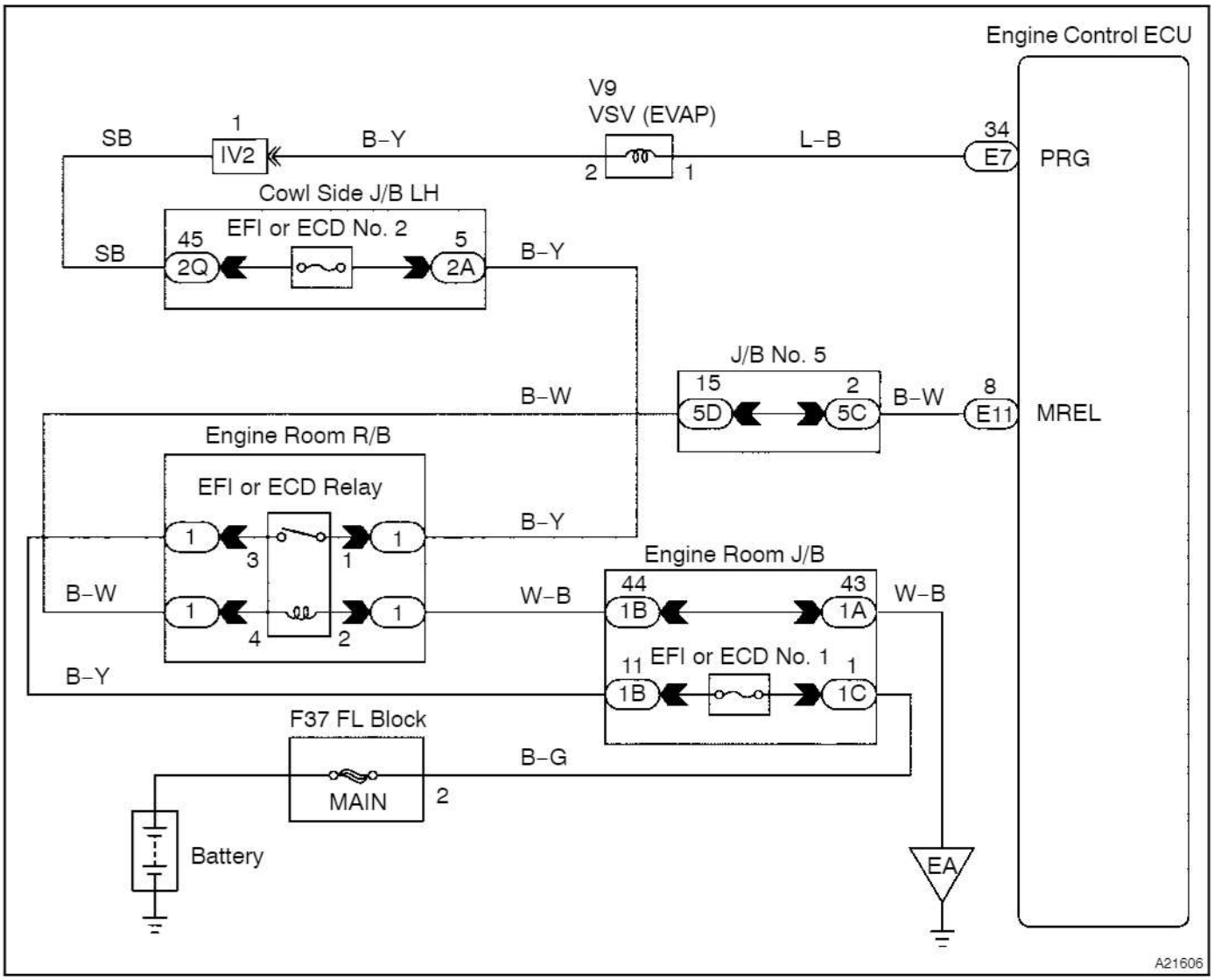
DTC	P0443	Evaporative Emission Control System Purge Control Valve Circuit

CIRCUIT DESCRIPTION

In order to reduce HC emissions, evaporated fuel from the fuel tank is routed through the charcoal canister to the intake manifold for combustion in the cylinders. The engine ECU changes the duty signal to the EVAP VSV. After the engine is warmed up, the intake quantity of HC emissions are appropriate for driving in terms of engine load, engine speed, vehicle speed, and other parameters.
This monitor runs for 1 second when EVAP purge VSV is activated.

DTC No.	DTC Detection Condition	Trouble Area
P0443	EVAP VSV proper response to engine ECU command does not occur (No dury signal from ECM for 10 seconds when commanded duty ratio is 5 to 95 %, 1 trip detection logic)	• EVAP VSV • Open or short in VSV circuit for EVAP • Engine control ECU

WIRING DIAGRAM

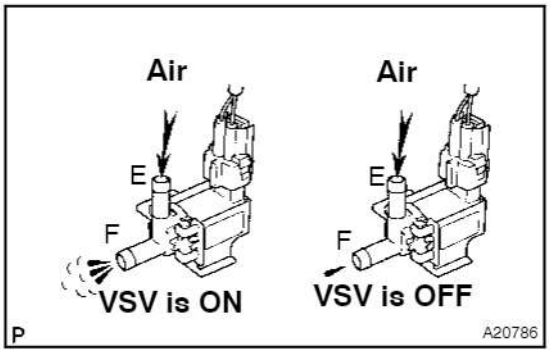


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	**Check operation of EVAP VSV.**



PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn ON the ignition switch and the hand–held tester main switch.
(c) Select the item "DIAGNOSIS / OBD/MOBD / ACTIVE TEST / EVAP VSV" (press the right or left button).

CHECK:

Check operation of the VSV when the VSV is operated by the hand–held tester.

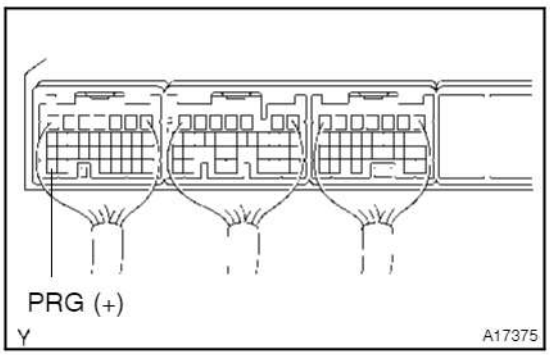
OK:

VSV is ON:
There is no air from port E flows out through port F.
VSV is OFF:
Air from port E flows out through port F.

OK	**Check for intermittent problems (See page DI–3).**

NG

2	**Check voltage between terminal PRG of engine control ECU connector and body ground.**



PREPARATION:

(a) Remove the glove compartment.
(b) Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals PRG of the ECU connector and body ground.

OK:

Voltage: 9 to 14 V.

OK	**Repair or replace engine control ECU (See Pub. No. RM630E, page FI–74).**

NG

3	Check EVAP VSV (See Pub. No. RM630E, page FI–61).

NG → Replace EVAP VSV.

OK

4	Check for open and short in wire harness between EVAP VSV and engine control ECU.

NG → Repair or replace harness and connector.

OK

5	Check for open and short in wire harness between EFI MAIN relay and EVAP VSV.

NG → Repair or replace harness and connector.

OK

Check engine control ECU power source circuit (See page DI–237)

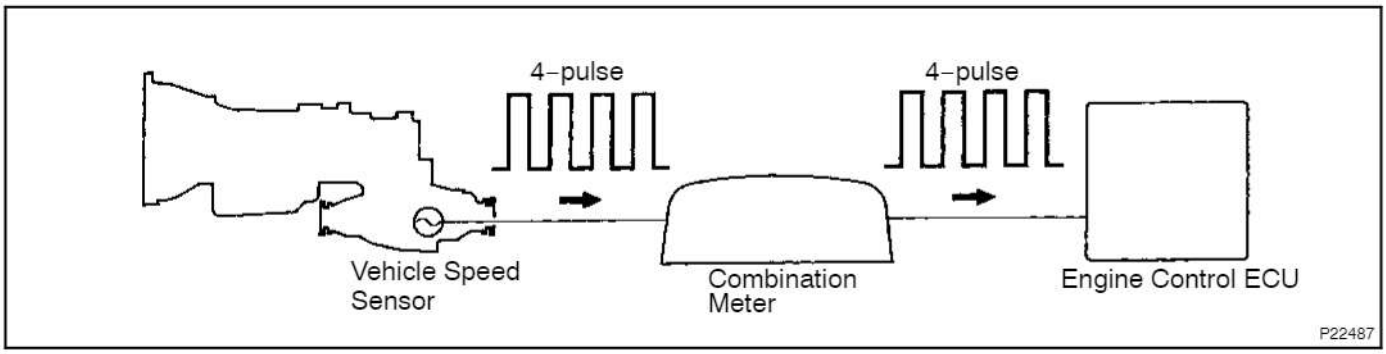
DI3CQ–16

DTC	P0500/42	Vehicle Speed Sensor "A"

DTC	P0503	Vehicle Speed Sensor "A" Intermittent/ Erratic/High

CIRCUIT DESCRIPTION

The No.1 vehicle speed sensor outputs a 4–pulse signal for every revolution of the rotor shaft, which is rotated by the transmission output shaft via the driven gear. After this signal is converted into a more precise rectangular waveform by the waveform shaping circuit inside the combination meter, it is then transmitted to the engine control ECU. The engine control ECU determines the vehicle speed based on the frequency of these pulse signals.



DTC No.	Proceed to	DTC Detection Condition	Trouble Area
P0500/42	Step 1	No vehicle speed sensor signal to engine control ECU under following conditions (a) and (b): (1 trip detection logic) (a) Park/neutral position switch is OFF (b) Vehicle is being driven	• Combination meter • Open or short in vehicle speed sensor circuit • Vehicle speed sensor • Engine control ECU
P0503	DI–3	Intermittent problem in the vehicle speed sensor circuit	

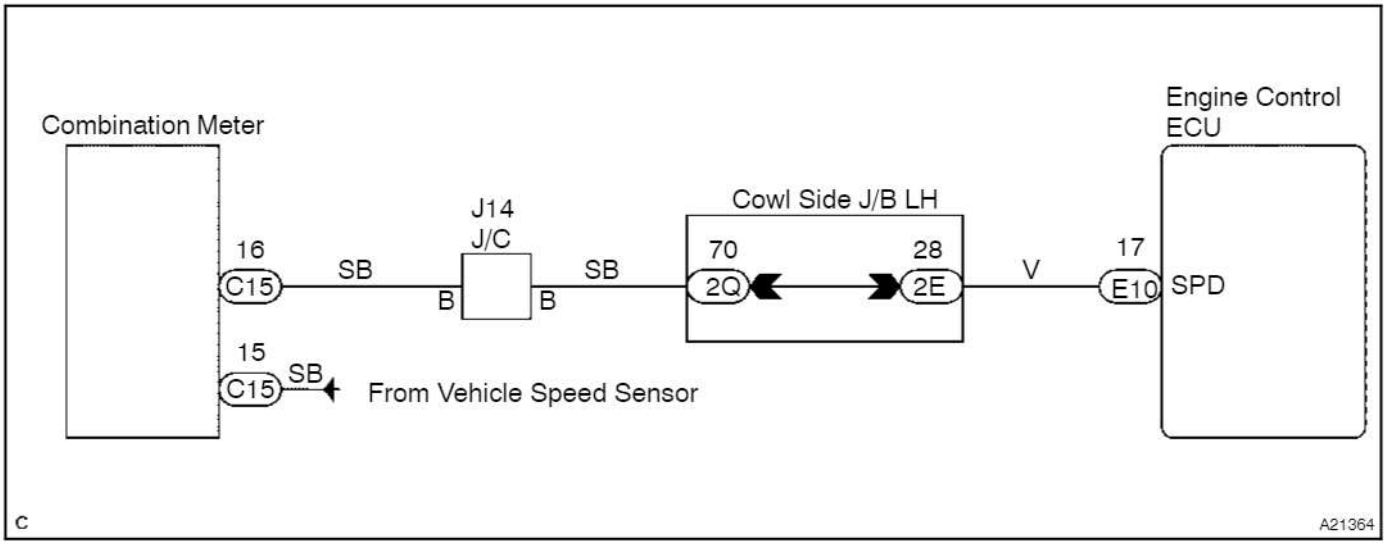
MONITOR DESCRIPTION

The engine control ECU assumes that the vehicle is being driven when the engine RPM is more than 2,000 rpm and the Park/Neutral Position (PNP) switch was turned OFF (for 10 seconds). If there is no signal from the VSS when the vehicle is being driven, the engine control ECU interprets this as a malfunction in the VSS. The engine control ECU illuminates the MIL and sets a DTC.

This monitor runs when all of following conditions are met for 10 seconds or more.

- Engine is warmed–up (Engine coolant temperature is 20 °C (68 °F) or more)
- Engine RPM is 2,000 rpm or more
- D shift position

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

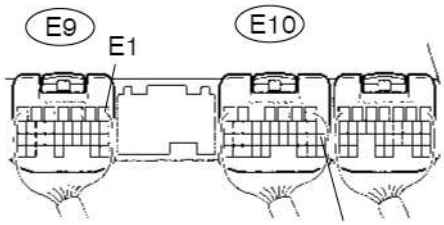
1	**Check operation of speedometer.**

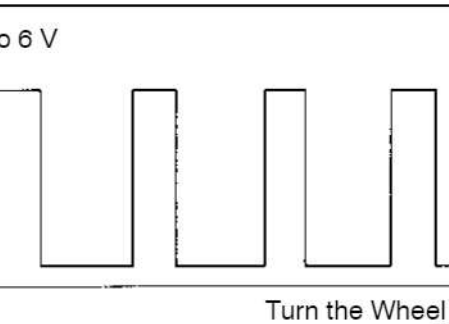
CHECK:
Drive the vehicle and check if the operation of the speedometer in the combination meter is normal.
HINT:
The vehicle speed is operating normally if the speedometer display is normal.

NG → **Check speedometer circuit. See combination meter troubleshooting.**

OK

2	Check voltage between terminal SPD and E1 of engine control ECU connector.





PREPARATION:

(a) Shift the shift lever to neutral.
(b) Jack up the rear wheel on one side.
(c) Turn the ignition switch ON.

CHECK:

Measure the voltage between the specified terminal of the E9 and E10 engine control ECU connector when the wheel is turned slowly.

OK:

Tester Connection	Specified Condition
SPD (E10–17) – E1 (E9–1)	Generated intermittently

HINT:

The output voltage should fluctuate up and down similarly to the diagram on the left when the wheel is turned slowly.

NG → **Check and repair harness and connector between combination meter and engine control ECU.**

OK →

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DIC2K–03

DTC	P0504/51	Brake Switch "A"/"B" Correlation

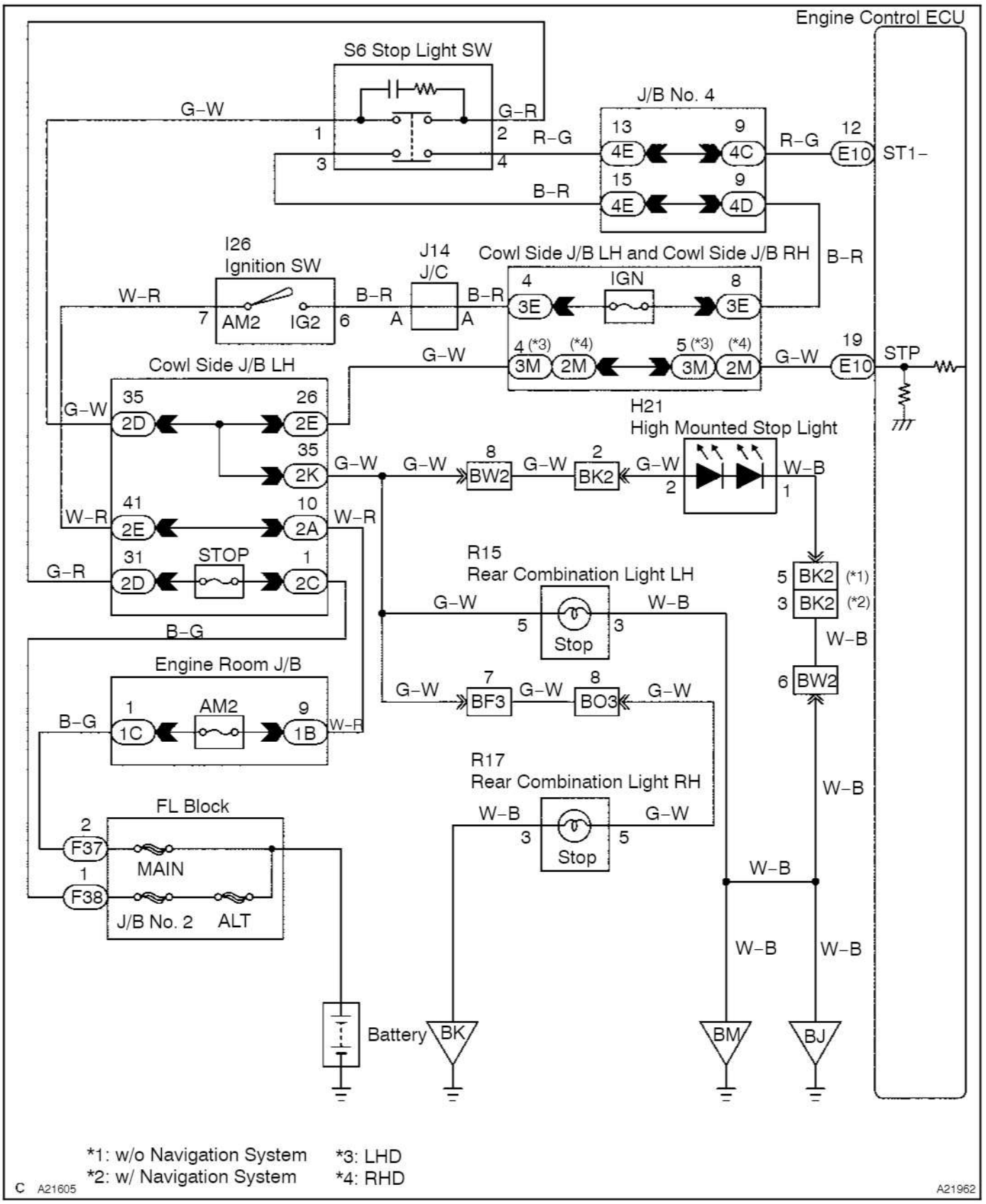
CIRCUIT DESCRIPTION

In addition to turning on the stop lamps, the stop lamp switch signals are used for a variety of engine, transmission, and suspension functions as well as being an input for diagnostic checks. It is important that the switch operates properly, therefore this switch is designed with two complementary signal outputs: STP and ST1–. The engine control ECU analyzes these signal outputs to detect malfunctions in the stop lamp switch.
HINT:
Normal condition is as shown in the table.

Signal	Brake pedal released	In transition	Brake pedal depressed
STP	OFF	ON	ON
ST1–	ON	ON	OFF

DTC No.	DTC Detection Condition	Trouble Area
P0504/51	Conditions (a), (b) and (c) continue for 0.5 sec. or more: (a) Ignition switch ON (b) Brake pedal released (c) STP signal is OFF when the ST1– signal is OFF	• Short in stop lamp switch signal circuit • Stop lamp fuse • Stop lamp switch • Engine control ECU

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

Hand–held tester:

1	**Check operation of stop light.**

CHECK:

Check if the stop lights come on and go off normally when the brake pedal is operated and released.

NG → **Check and repair stop light circuit.**

OK ↓

2	**Check STOP fuse.**

PREPARATION:

Remove the STOP fuse from the cowl side J/B LH.

CHECK:

Check the continuity of the STOP fuse.

OK:

Continuity

NG → **Check for short in all harness and components connected to STOP fuse.**

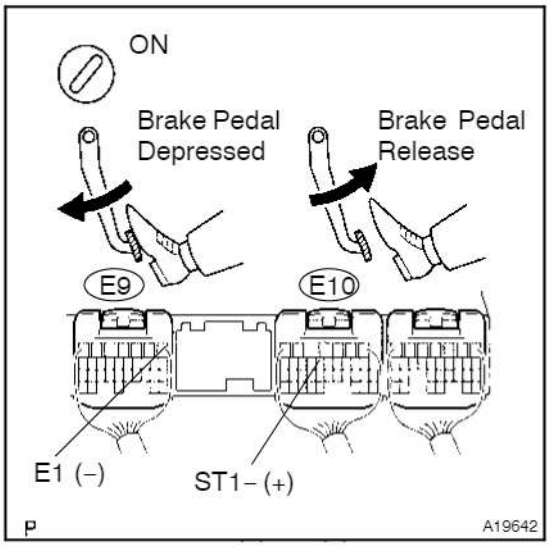
OK ↓

3	**Check stop light switch (See Pub. No. RM616E, page BE–56).**

NG → **Replace stop light switch.**

OK ↓

4	**Check STP signal and ST1– voltage.**



PREPARATION:

(a) Turn the ignition switch ON.

(b) Select the item "DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / STOP LIGHT SW".

CHECK:

Read the signal displayed on the hand–held tester.

OK:

Brake Pedal	Specified Condition
Depressed	STP Signal ON
Released	STP Signal OFF

CHECK:

Measure the voltage between the specified terminals of the E9 and E10 engine control ECU connectors.

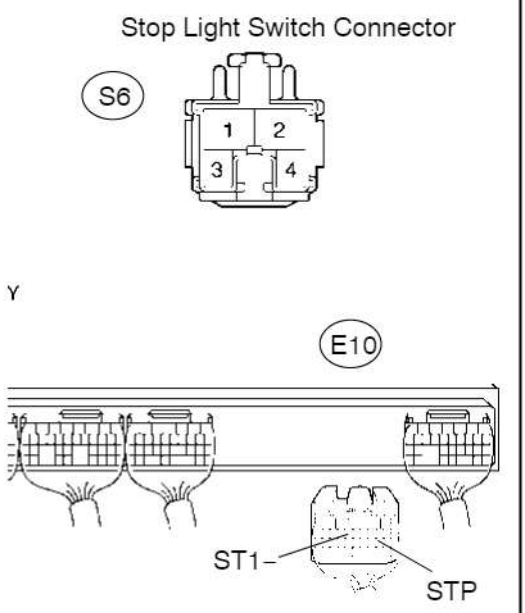
OK:

Tester Connection	Brake Pedal	Specified Condition
ST1– (E10–12) – E1 (E9–1)	Depressed	Below 1.5 V
	Released	7.5 to 14 V

OK → **Check for intermittent problems (See page DI–3).**

NG

5	**Check harness and connector between engine control ECU and stop light switch.**



PREPARATION:

(a) Disconnect the S6 stop light switch connector.

(b) Disconnect the E10 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
Stop light switch (S6–1) – STP (E10–19)	Below 1 Ω
Stop light switch (S6–4) – ST1– (E10–12)	Below 1 Ω
Stop light switch (S6–1) or STP (E10–19) – Body ground	10 kΩ or higher
Stop light switch (S6–4) or ST1– (E10–12) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

When not using hand–held tester:

1	**Check operation of stop light.**

CHECK:
Check if the stop lights come on and go off normally when the brake pedal is operated and released.

NG → **Check and repair stop light circuit.**

OK

2	**Check STOP fuse.**

PREPARATION:
Remove the STOP fuse from the cowl side J/B LH.
CHECK:
Check the continuity of the STOP fuse.
OK:
Continuity

NG → **Check for short in all harness and components connected to STOP fuse.**

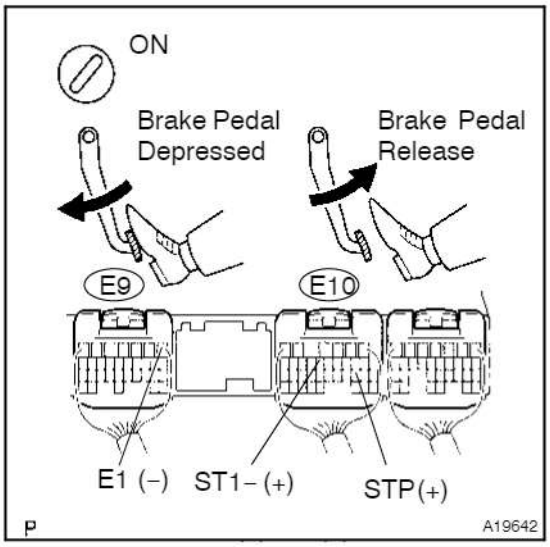
OK

3	**Check stop light switch (See Pub. No. RM616E, page BE–56).**

NG → **Replace stop light switch.**

OK

4	**Check STP signal.**



PREPARATION:

Turn the ignition switch ON.

CHECK:

Measure the voltage between the specified terminals of the E9 and E10 engine control ECU connectors.

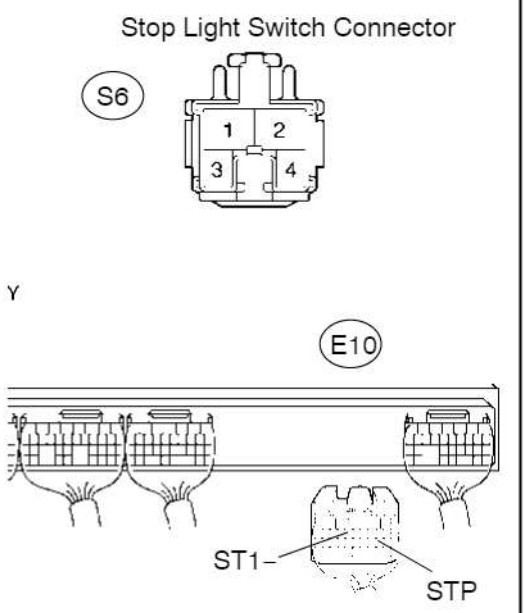
OK:

Tester Connection	Brake Pedal Position	Specified Condition
STP (E10–19) – E1 (E9–1)	Depressed	7.5 to 14 V
	Released	Below 1.5 V
ST1– (E10–12) – E1 (E9–1)	Depressed	Below 1.5 V
	Released	7.5 to 14 V

OK → **Check for intermittent problems (See page DI–3).**

NG

5	**Check harness and connector between engine control ECU and stop light switch.**



PREPARATION:

(a) Disconnect the S6 stop light switch connector.

(b) Disconnect the E10 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
Stop light switch (S6–1) – STP (E10–19)	Below 1 Ω
Stop light switch (S6–4) – ST1– (E10–12)	Below 1 Ω
Stop light switch (S6–1) or STP (E10–19) – Body ground	10 kΩ or higher
Stop light switch (S6–4) or ST1– (E10–12) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK

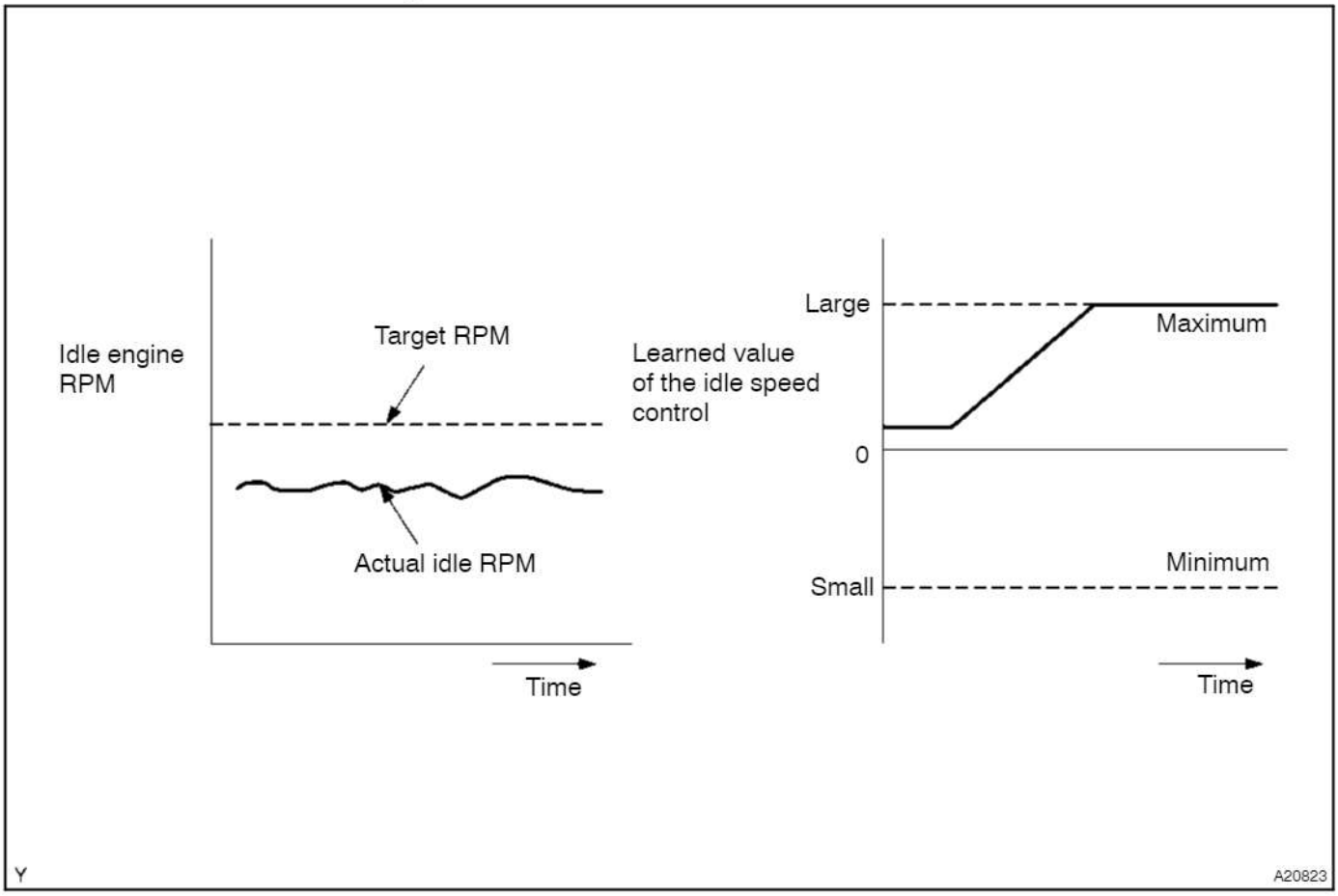
Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DIC2L–02

DTC	P0505	Idle Air Control System

CIRCUIT DESCRIPTION

The engine control ECU regulates the idle speed by opening and closing the throttle valve using the Electronic Throttle Control System (ETCS). If the actual idle RPM varies more than a specified value of the idle speed control five times. And idle speed control learned value remains at the maximum or remains at minimum five times or more during a trip, the engine control ECU concludes that there is a problem with the idle speed control function. The engine control ECU will turn on the check engine warning light and a DTC is set.
Example:
If the actual idle RPM varies from the target idle RPM by more than 200 rpm* five times during a drive cycle, the engine control ECU will turn on the check engine warning light and a DTC is set.
*: RPM threshold varies with engine load.



DTC No.	DTC Detecting Condition	Trouble Area
P0505	Idle speed continues to vary greatly from target speed (2 trip detection logic)	• Electric throttle control system • Air induction system • PCV hose connection

INSPECTION PROCEDURE

HINT:

- When the throttle position is slightly opened (the accelerator pedal is slightly depressed) because a floor carpet is overlapped on the accelerator pedal, or if not fully releasing the accelerator pedal, etc., DTC P0505 will possibly be detected.
- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Are there any other codes (besides P0505) being output?**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES.

CHECK:

Read the DTC using the hand–held tester.

RESULT:

Display (DTC Output)	Proceed to
P0505	A
"P0505" and other DTCs	B

HINT:

If any other codes besides P0505 are output, perform the troubleshooting for those DTCs first.

B → **Go to relevant DTC chart (See page DI–19).**

A

2	**Check connection of PCV piping.**

NG → **Repair or replace PCV piping.**

OK

3	**Check air induction system (See Pub. No. RM630E, page FI–1).**

CHECK:

Check for vacuum leaks in air induction system.

NG → **Repair or replace air induction system.**

OK

Check electric throttle control system (See Pub. No. RM630E, page FI–40).

DIC2M–05

DTC	P0560	System Voltage

CIRCUIT DESCRIPTION

The battery supplies electricity to the engine control ECU even when the ignition switch is OFF. This electricity allows the engine control ECU store data such as DTC history, freeze frame data, fuel trim values, and other data.

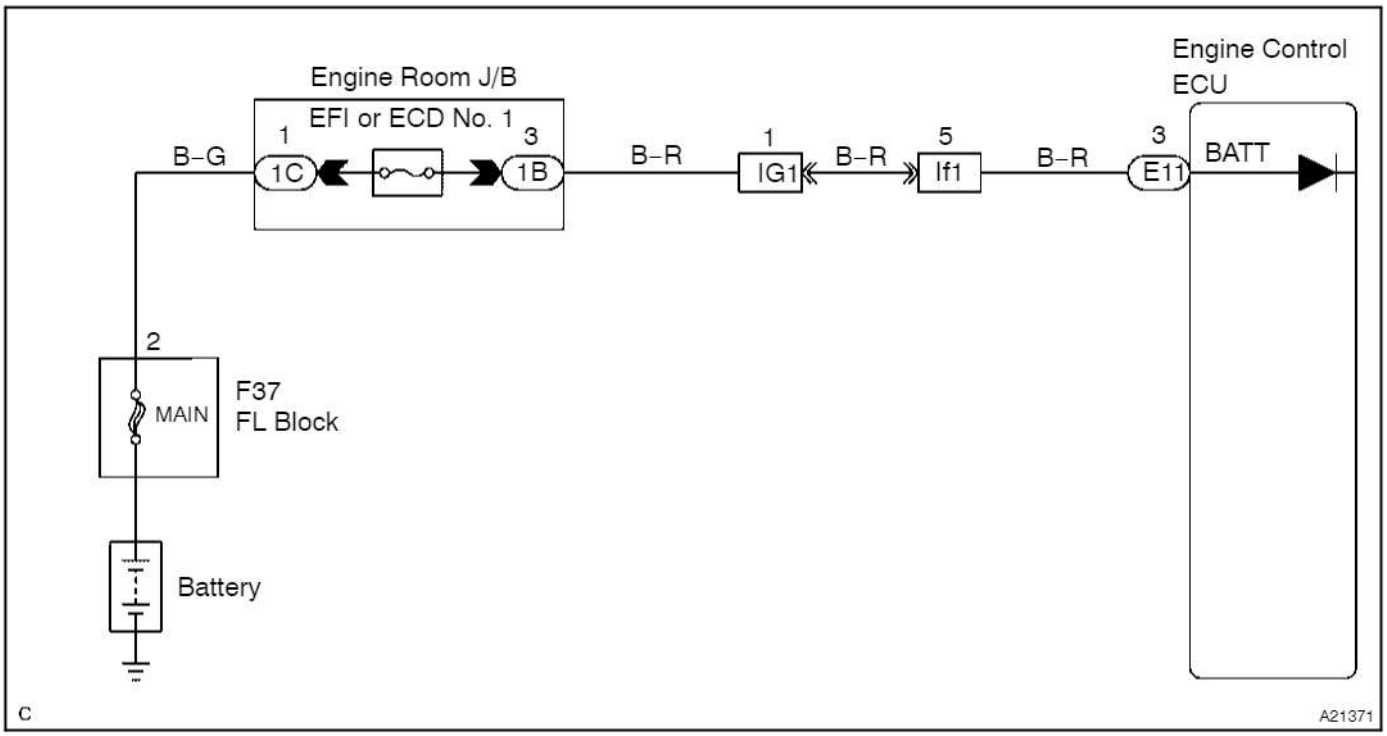
If the battery voltage falls below a minimum level, the engine control ECU will conclude that there is a fault in the power supply circuit. The next time the engine starts, the engine control ECU will turn on the MIL and a DTC will be set.

DTC No.	DTC Detecting Condition	Trouble Area
P0560	Open in back up power source circuit BATT is less than 3.5 V	• Open in back–up power source circuit • EFI or ECD No.1 fuse • Engine control ECU

HINT:

If DTC P0560 present, the engine control ECU will not store another DTC.

WIRING DIAGRAM

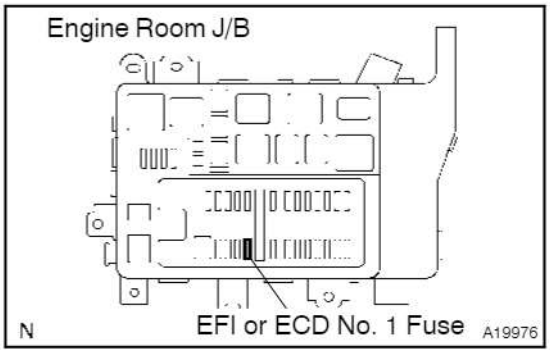


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Check EFI or ECD No. 1 fuse of engine room J/B.**



PREPARATION:

Remove the EFI or ECD No. 1 fuse from the engine room J/B.

CHECK:

Check the continuity of the EFI or ECD No. 1 fuse.

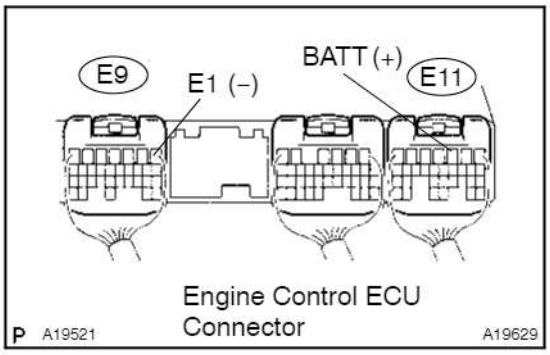
OK:

Continuity

NG → **Check for short in all harness and components connected to EFI or ECD No. 1 fuse.**

OK ↓

2	**Check voltage between terminal BATT and E1 of engine control ECU connector.**



CHECK:

Measure the voltage between terminals of the E9 and E11 engine control ECU connector.

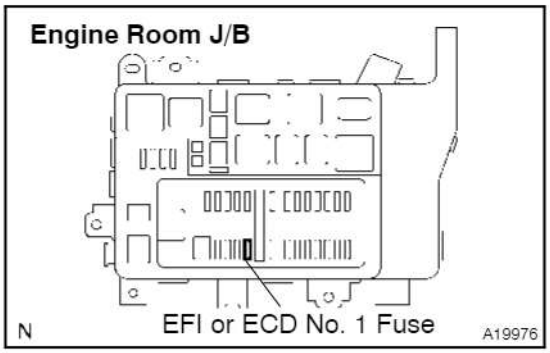
OK:

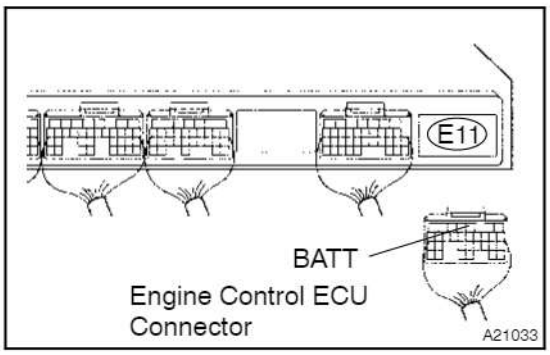
Tester Connection	Specified Condition
BATT (E11–3) – E1 (E9–1)	9 to 14 V

OK → **Check for intermittent problems (See page DI–3).**

NG ↓

3	**Check for open and short in harness and connector between engine control ECU and EFI or ECD No. 1 fuse, EFI or ECD No. 1 fuse and battery.**





Check the harness and the connector between the EFI or ECD No. 1 fuse and the engine control ECU:

PREPARATION:

(a) Remove the EFI or ECD No. 1 fuse from the engine room J/B.

(b) Disconnect the E11 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connector.

OK:

Tester Connection	Specified Condition
Engine Room J/B (EFI or ECD No. 1 fuse terminal 2) – BATT (E11–3)	Below 1 Ω
Engine Room J/B (EFI or ECD No. 1 fuse terminal 2) or BATT (E11–3) – Body ground	10 kΩ or higher

Check the harness and connector between the EFI or ECD No. 1 fuse and the battery:

PREPARATION:

(a) Remove the EFI or ECD No. 1 fuse from the engine room J/B.

(b) Disconnect the battery positive terminal.

CHECK:

Measure the resistance between the wire harness side connector.

OK:

Tester Connection	Specified Condition
Engine Room J/B (EFI or ECD No. 1 fuse terminal 1) – Battery positive terminal	Below 1 Ω
Engine Room J/B (EFI or ECD No. 1 fuse terminal 1) or Battery positive terminal – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK

Check and replace engine room J/B.

DTC	P0604/89*1	Internal Control Module Random Access Memory (RAM) Error

DTC	P0606/89*2	Engine Control ECU/PCM Processor

DTC	P0607/89*3	Control Module Performance

DTC	P0657/89*1	Actuator Supply Voltage Circuit / Open

*1: ETCS trouble code No. is 33
*2: ETCS trouble code No. is 33 or 36
*3: ETCS trouble code No. is 34 or 35

CIRCUIT DESCRIPTION

The engine control ECU continuously monitors its internal memory status, internal circuits, and output signals to the throttle actuator. This self–check insures that the engine control ECU is functioning properly. If any malfunction is detected, the engine control ECU will set the appropriate DTC and illuminate the MIL.
The engine control ECU memory status is diagnosed by internal "mirroring" of the main CPU and the sub CPU to detect RAM (Random Access Memory) errors. The two CPUs also perform continuous mutual monitoring.
The engine control ECU sets a DTC if: 1) outputs from the 2 CPUs are different and deviate from the standards, 2) the signals to the throttle actuator deviate from the standards, 3) a malfunction is found in the throttle actuator supply voltage, and 4) any other engine control ECU malfunction is found.

DTC No.	DTC Detecting Condition	Trouble Area
P0604/89 P0606/89 P0607/89 P0657/89	Engine control ECU malfunction	• Engine control ECU

INSPECTION PROCEDURE

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DIC2N–03

DTC	P0617	Starter Relay Circuit High

CIRCUIT DESCRIPTION

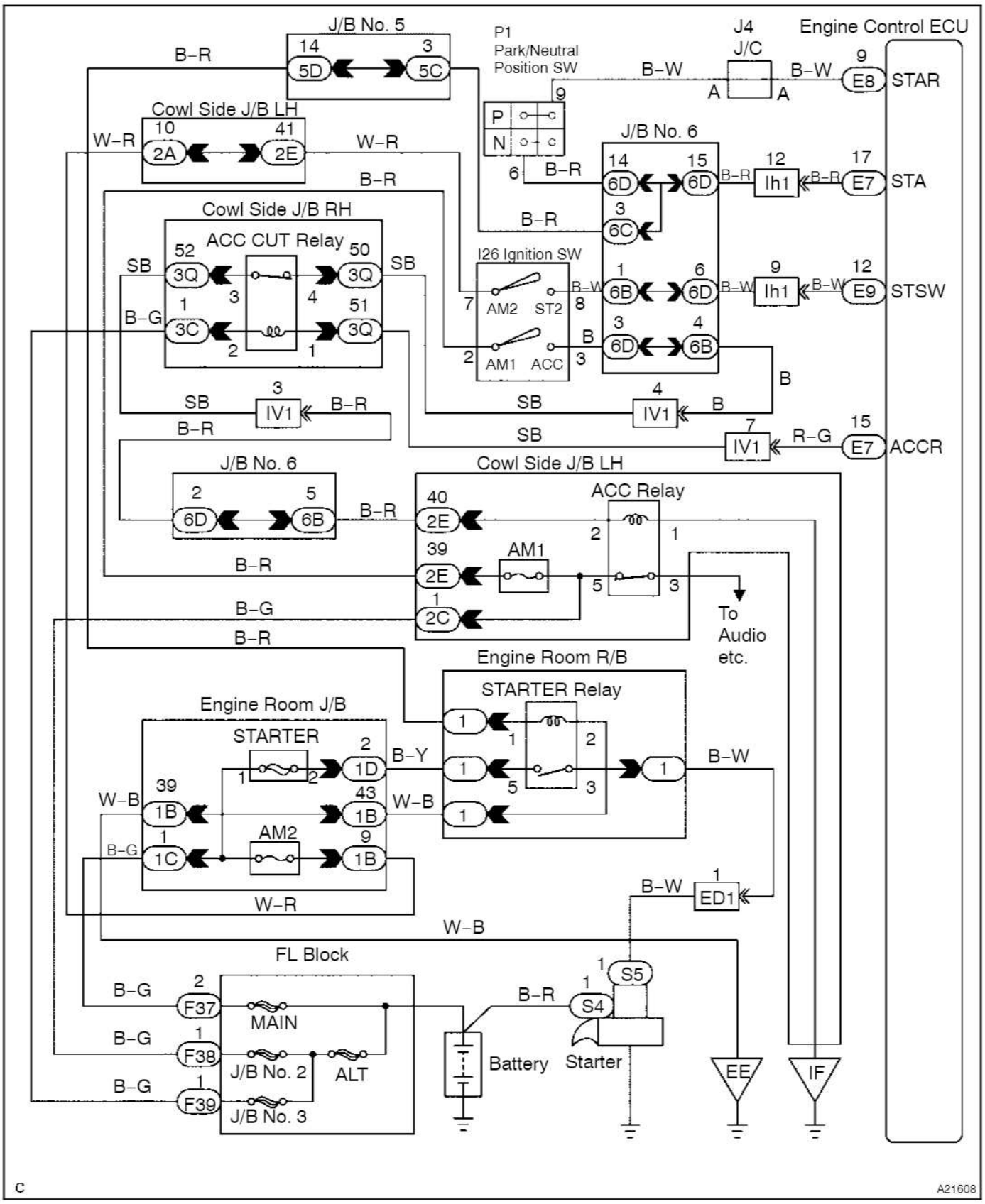
While the engine is being cranked, the battery positive voltage is applied to terminal STA of the engine control ECU.

If the vehicle is being driven and the engine control ECU detects the starter control signal (STA), the engine control ECU concludes that the starter control circuit is malfunctioning. The engine control ECU will turn on the MIL and a DTC is set.

This monitor runs when the vehicle is driven at 20 km/h (12 mph) for over 20 seconds.

DTC No.	DTC Detection Condition	Trouble Area
P0617	When all conditions (a), (b) and (c) are satisfied for 20 seconds with battery (+B) voltage 10.5 V or more (1 trip detection logic) (a) Vehicle speed ≧ 20 km/h (12.4 mph) (b) Engine revolution ≧ 1,000 rpm (c) STA signal ON	• Park/neutral position switch • Starter relay circuit • Ignition switch • Engine control ECU

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

When using hand–held tester:

1	**Connect hand–held tester, and check STA signal.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON, and push the hand–held tester main switch ON.
(c) Enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / STARTER SIG.

CHECK:

Read the STA signal on the hand–held tester while the starter operates.

OK:

Ignition Switch Position	ON	START
STA Signal	OFF	ON

OK → **Go to step 5.**

NG

2	**Check park/neutral position switch (See Pub. No. RM970E, page DI–32).**

NG → **Repair or replace park/neutral position switch. Go to next step 3 after the replacement.**

OK

3	**Check ignition switch (See Pub. No. RM616E, page BE–20).**

NG → **Replace ignition switch. Go the next step 4 after the replacement.**

OK

4	**Connect hand–held tester, and check STA signal.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON, and push the hand–held tester main switch ON.
(c) Enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / STARTER SIG.

CHECK:

Read the STA signal on the hand–held tester while the starter operates.

OK:

Ignition Switch Position	ON	START
STA Signal	OFF	ON

NG → **Repair or replace harness or connector.**

OK

5	**Check DTC reoccur.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and hand–held tester main switch ON.
(c) Clear DTC (See page DI–3).
(d) Drive the vehicle more than 40 km/h (25 mph) for 20 seconds or more.

CHECK:

Check DTC reoccur.

RESULT:

Display (DTC output)	Proceed to
P0617	A
No DTC output	B

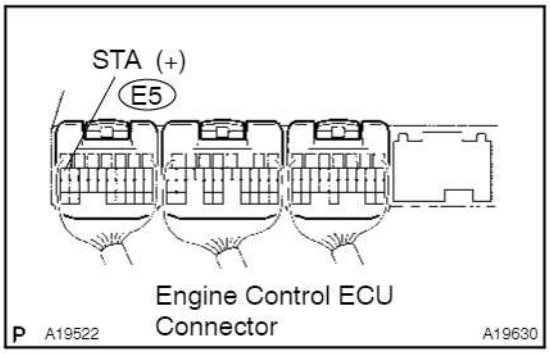
A → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

B

Check for intermittent problems (See page DI–3).

When not using hand–held tester:

1	**Check voltage between terminal STA of engine control ECU connector and body ground.**



PREPARATION:
Turn the ignition switch ON.
CHECK:
Measure the voltage between terminal STA of the engine control ECU connector and the body ground, while cranking the engine (ignition switch START position) and while not engine cranking the engine (ignition switch position ON).
OK:

Voltage:
6 V or more (ignition switch START position)
0 V (ignition switch ON position)

OK	**Go to step 5.**

NG

2	**Check park/neutral position switch (See Pub. No. RM970E, page DI–32).**

NG	**Replace park/neutral position switch. Go to next step 5 after the replacement.**

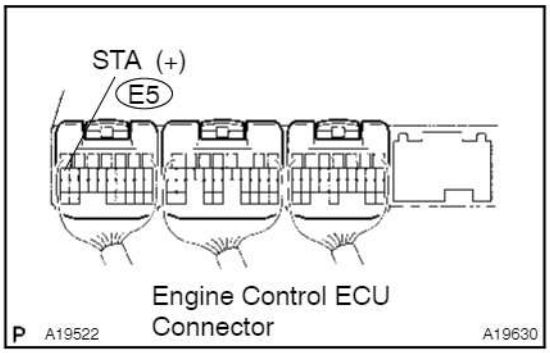
OK

3	**Check ignition switch (See Pub. No. RM616E, page BE–20).**

NG	**Replace ignition switch. Go to next step 5 after the replacement.**

OK

4	Check voltage between terminal STA of engine control ECU connector and body ground.



PREPARATION:
Turn the ignition switch ON.
CHECK:
Measure the voltage between terminal STA of the engine control ECU connector and the body ground, while cranking the engine (ignition switch START position) and while not engine cranking the engine (ignition switch position ON).
OK:

Voltage:
6 V or more (ignition switch START position)
0 V (ignition switch ON position)

NG → **Repair or replace harness or connector.**

OK

5	Check DTC reoccur.

PREPARATION:
(a) Clear DTC (See page DI–3).
(b) Drive the vehicle more than 40 km/h (25 mph) for 20 seconds or more.
CHECK:
Check DTC reoccur.
RESULT:

Display (DTC output)	Proceed to
P0617/89	A
No DTC output	B

A → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

B

Check for intermittent problems (See page DI–3).

DIC2O–03

DTC	P2102/41*1	Throttle Actuator Control Motor Circuit Low

DTC	P2103/41*2	Throttle Actuator Control Motor Circuit High

*1: ETCS trouble code No. is 21.
*2: ETCS trouble code No. is 24.

CIRCUIT DESCRIPTION

The throttle motor is operated by the engine control ECU and it opens and closes the throttle valve.
The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. The throttle position sensor provides feedback to the engine control ECU. This feedback allows the engine control ECU to control the throttle motor and monitor the throttle opening angle as the engine control ECU responds to driver inputs.
HINT:
This Electrical Throttle Control System (ETCS) does not use a throttle cable.

DTC No.	DTC Detection Condition	Trouble Area
P2102/41	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) Throttle control motor output duty 80 % or more (b) Throttle control motor current 0.5 A or less	• Open in throttle control motor and sensor circuit • Throttle control motor and sensor • Engine control ECU
P2103/41	Either of following conditions is met (1 trip detection logic). (a) Throttle control motor current 10 A or more (0.1 sec) (b) Throttle control motor current 7 A or more (0.6 sec.)	• Short in throttle control motor and sensor circuit • Throttle control motor and sensor • Throttle valve • Throttle body • Engine control ECU

MONITOR DESCRIPTION

The engine control ECU monitors the current through the electronic throttle motor and detects malfunctions or open circuit in the throttle motor based on the value of the current. When the current deviates from the standard, the engine control ECU concludes that there is a fault in the throttle motor.
Or, if the throttle valve is not functioning properly (for example, stuck ON) the engine control ECU concludes that there is a fault and turns on the MIL and a DTC is set.
Example:
When the current is more than 10 A. Or the current is less than 0.5 A when the motor driving duty ratio is exceeding 80%. The engine control ECU concludes that the current is out of range, turns on the MIL and a DTC is set.

FAIL SAFE

If the ETCS (Electronic Throttle Control System) has a malfunction, the engine control ECU cuts off current to the throttle control motor. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of the return spring. The engine control ECU then adjusts the engine output by controlling the fuel infection (intermittent fuel–cut) and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue at a minimum speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM

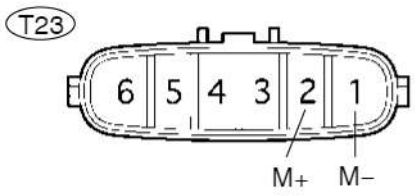
Refer to DTC P0120 on page DI–63.

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Check throttle control motor.**

Component Side:
Throttle Control Motor and Sensor



PREPARATION:
Disconnect the throttle control motor and sensor connector.
CHECK:
Measure the resistance between terminals of the throttle control motor.
OK:

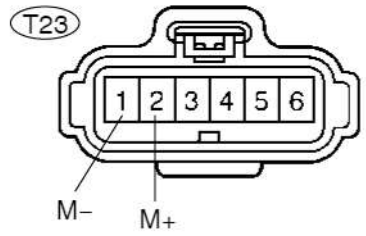
Tester Connection	Specified Condition
M+ (T23–2) – M– (T23–1)	0.3 to100 Ω (20°C (68°F))

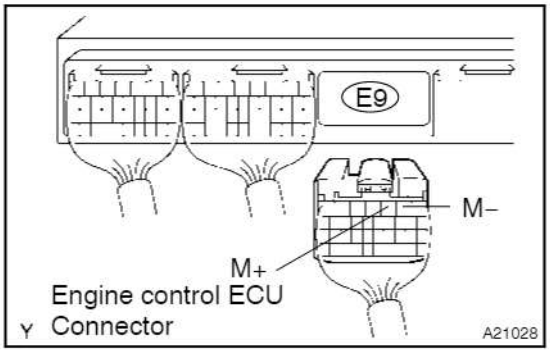
NG → **Replace throttle body (See Pub. No. RM630E, page FI–42).**

OK

2	**Check for open and short in harness and connector between throttle control motor and engine control ECU.**

Wire Harness Side:
Throttle Control Motor and Sensor





PREPARATION:

(a) Disconnect the T23 throttle control motor and sensor connector.

(b) Disconnect the E9 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
M+ (T23–2) – M+ (E9–3)	Below 1 Ω
M– (T23–1) – M– (E9–2)	Below 1 Ω
M+ (T23–2) or M+ (E9–3) – Body ground	10 kΩ or higher
M– (T23–1) or M– (E9–2) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK

3	**Visually check throttle valve.**

CHECK:

Check between the throttle valve and the housing for foreign objects.
Also, check if the valve can open and close smoothly.

NG → **Remove foreign object and clean throttle body.**

OK

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DTC	P2111/41*	Throttle Actuator Control System –Stuck Open

DTC	P2112/41*	Throttle Actuator Control System –Stuck Closed

*: ETCS trouble code No. is 31.

CIRCUIT DESCRIPTION

The throttle motor is operated by the engine control ECU and it opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the throttle position sensor, which is mounted on the throttle body. The throttle position sensor provides feedback to the engine control ECU to control the throttle motor and set the throttle valve angle in response to driver input.
HINT:
This Electrical Throttle Control System (ETCS) does not use a throttle cable.

DTC No.	DTC Detection Condition	Trouble Area
P2111/41	Throttle motor locked during engine control ECU order to close. (1 trip detection logic)	• Throttle control motor and sensor circuit • Throttle control motor and sensor • Throttle body • Throttle valve
P2112/41	Throttle motor locked during engine control ECU order to open. (1 trip detection logic)	

MONITOR DESCRIPTION

The engine control ECU concludes that there is a malfunction of the ETCS (Electronic Throttle Control System) when the throttle valve remains at a fixed angle despite high drive current from the engine control ECU. The engine control ECU will turn on the MIL and a DTC is set.
This monitor runs after the engine is started, and then the accelerator pedal is fully depressed and fully released quickly.

FAIL SAFE

If the ETCS (Electronic Throttle Control System) has a malfunction, the engine control ECU cuts off current to the throttle control motor. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of the return spring. The engine control ECU then adjusts the engine output by controlling the fuel infection (intermittent fuel–cut) and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue at a minimum speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM

Refer to DTC P0120 on page DI–63.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Check other DTC output**

Display (DTC output)	Proceed to
P2111 or P2112	A
P2111 or P2112 and other DTCs	B

B → **Go to relevant DTC chart (See page DI–19)**

A

2	**Check throttle body assy (Visually check throttle valve)**

Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. Also, check that the throttle valve moves smoothly.

NG → **Replace throttle body assy (See Pub. No. RM630E, page FI–42)**

OK

3	Check DTC output

(a) Clear the DTC.
(b) Start the engine and fully depress/fully release the accelerator pedal quickly (fully open/fullyclose the throttle valve).
(c) Read DTC.

Display (DTC output)	Proceed to
No DTC	A
P2111 or P2112	B

B → **Replace engine control ECU (See Pub. No. RM630E, page FI–74)**

OK →

Check for intermittent problem (See page DI–3)

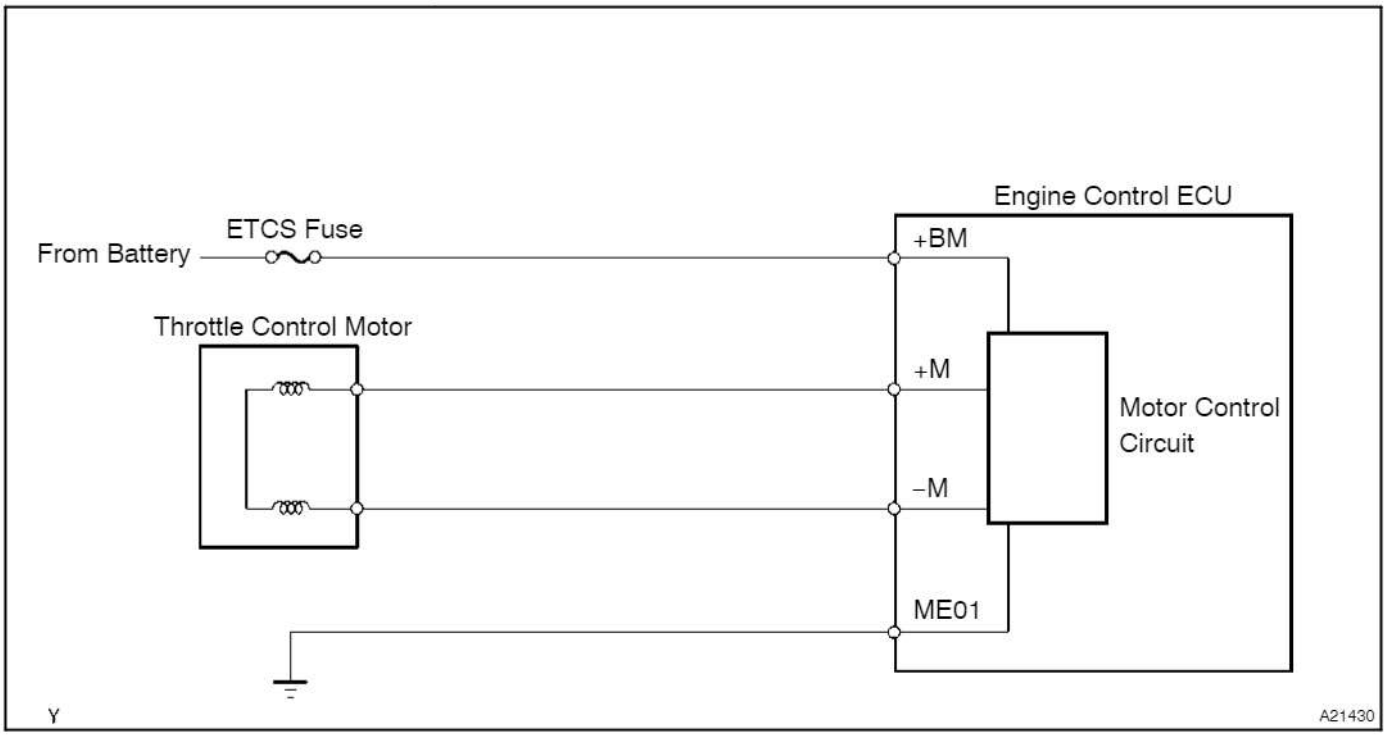
DIC2Q–03

DTC	P2118/89*	Throttle Actuator Control Motor Current Range/Performance

*: ETCS trouble code No. is 13.

CIRCUIT DESCRIPTION

The Electronic Throttle Control System (ETCS) has a dedicated power supply circuit. The voltage (+BM) is monitored and when the voltage is low (less than 4V), the engine control ECU concludes that the ETCS has a fault and current to the throttle control motor is cut.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the motor is cut. If repairs are made and the system has returned to normal, turn the ignition switch to OFF. The engine control ECU then allows current to flow to the motor and the motor can be restarted.
HINT:
This Electrical Throttle Control System (ETCS) does not use a throttle cable.



DTC No.	DTC Detection Condition	Trouble Area
P2118/89	Open in ETCS power source (+BM) circuit (1 trip detection logic)	• Open in ETCS power source circuit • ETCS fuse • Engine control ECU

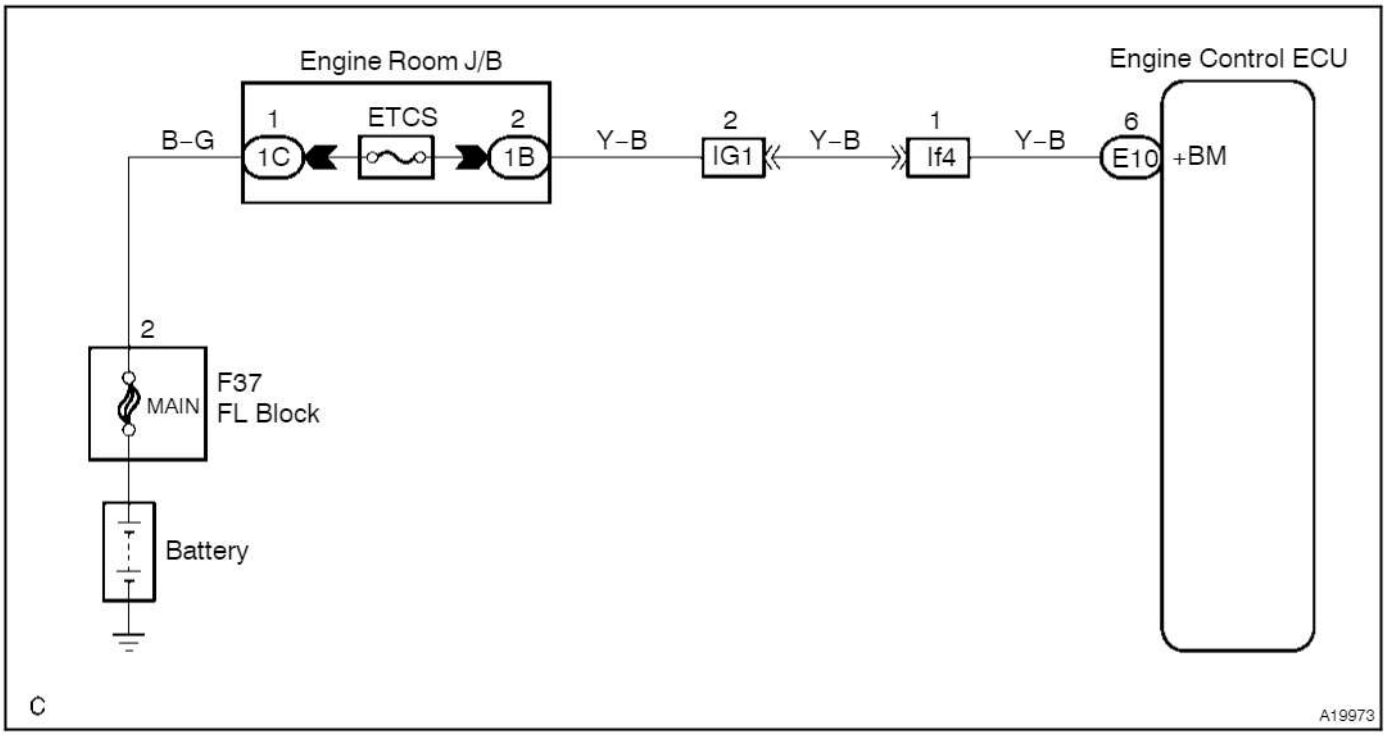
MONITOR DESCRIPTION

The engine control ECU monitors the battery supply voltage applied to the electronic throttle motor. When the power supply voltage drops below the threshold, the engine control ECU concludes that the power supply has an open circuit. A DTC is set and the MIL is turned on.

FAIL SAFE

If the ETCS (Electronic Throttle Control System) has a malfunction, the engine control ECU cuts off current to the throttle control motor. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of the return spring. The engine control ECU then adjusts the engine output by controlling the fuel infection (intermittent fuel–cut) and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue at a minimum speed.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM

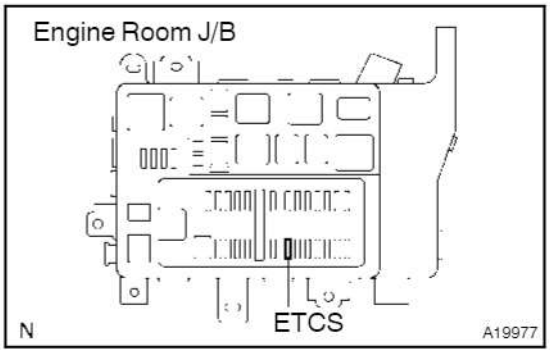


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Check ETCS fuse.**



PREPARATION:

Remove the ETCS fuse from the engine room J/B.

CHECK:

Check the continuity of the ETCS fuse.

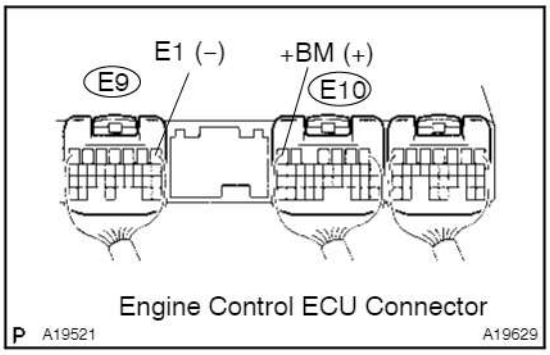
OK:

Continuity

NG → **Check for short in all harness and components connected to ETCS fuse.**

OK

2	**Check voltage between terminal +BM and E1 of engine control ECU connector.**



CHECK:

Measure the voltage between the specified terminals of the E9 and E10 engine control ECU connector.

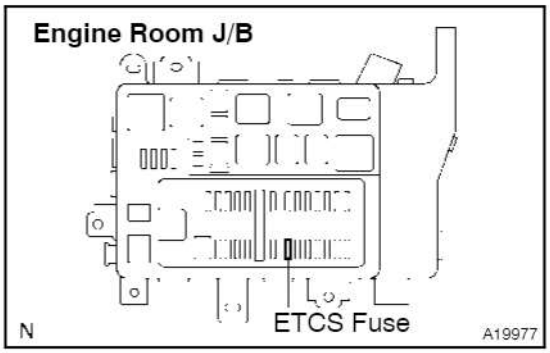
OK:

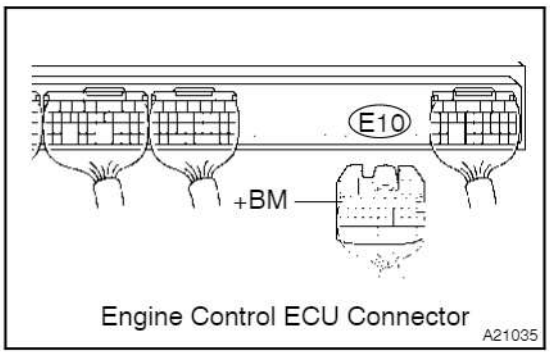
Tester Connection	Specified Condition
+BM (E10–6) – E7 (E9–1)	9 to 14 V

OK → **Check for intermittent problems (See page DI–3).**

NG

3	**Check for open or short in harness or connector between battery and ETCS fuse, ETCS fuse and engine control ECU.**





Check the harness and the connector between the ETCS fuse and the engine control ECU:

PREPARATION:

(a) Remove the ETCS fuse from the engine room J/B.

(b) Disconnect the E10 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connector.

OK:

Tester Connection	Specified Condition
Engine Room J/B (ETCS fuse terminal 2) – +BM (E10–6)	Below 1 Ω
Engine Room J/B (ETCS fuse terminal 2) or +BM (E10–6) – Body ground	10 kΩ or higher

Check the harness and connector between the ETCS fuse and the battery:

PREPARATION:

(a) Remove the ETCS fuse from the engine room J/B.

(b) Disconnect the battery positive terminal.

CHECK:

Measure the resistance between the wire harness side connector.

OK:

Tester Connection	Specified Condition
Engine Room J/B (ETCS fuse terminal 1) – Battery positive terminal	Below 1 Ω
Engine Room J/B (ETCS fuse terminal 1) or Battery positive terminal – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK →

Check engine room J/B.

DICTJ–01

DTC	P2119/89*	Throttle Actuator Control Throttle Body Range/Performance

*: ETCS trouble code No. is 32, 38 or 39.

CIRCUIT DESCRIPTION

The Electric Throttle Control System (ETCS) is composed of a throttle motor that operates the throttle valve, a throttle position sensor that detects the opening angle of the throttle valve, an accelerator pedal position sensor that detects the accelerator pedal position, and the engine control ECU that controls the ETCS system.

The engine control ECU operates the throttle motor to position the throttle valve for proper response to driver inputs. The throttle position sensor, mounted on the throttle body, detects the opening angle of the throttle valve and provides this signal to the engine control ECU so that the engine control ECU can regulate the throttle motor.

DTC No.	DTC Detection Condition	Trouble Area
P2119/89	Throttle opening angle continues to vary greatly from target throttle opening angle (1 trip detection logic)	• Electric throttle control system • Throttle body

MONITOR DESCRIPTION

The engine control ECU determines the "actual" throttle angle based on the throttle position sensor signal. The "actual" throttle position is compared to the "target" throttle position commanded by the engine control ECU. If the difference of these two values exceeds a specified limit, the engine control ECU interprets this as a fault in the ETCS (Electronic Throttle Control System). The engine control ECU turns on the MIL and a DTC is set.

The monitor runs after the engine is started, and the accelerator pedal is fully depressed to 5,000 rpm and fully released quickly.

FAIL SAFE

If the ETCS (Electronic Throttle Control System) has a malfunction, the engine control ECU cuts off current to the throttle control motor. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of the return spring. The engine control ECU then adjusts the engine output by controlling the fuel infection (intermittent fuel–cut) and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue at a minimum speed.

If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

If a "pass" condition is detected and then the ignition switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM

Refer to DTC P2102 and P2103 on page DI–206.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	Are there any other codes (besides DTC P2119) being output?

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) When using hand–held tester, enter the following menus: DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES.

CHECK:

Read the DTC using the hand–held tester.

RESULT:

Display (DTC Output)	Proceed to
P2119	A
"P2119" and other DTC	B

HINT:

If any other codes besides P2119 are output, perform the troubleshooting for those DTCs first.

B → **Go to relevant DTC chart (See page DI–19).**

A

2	Check if DTC output reoccur

(a) Clear the DTC.
(b) Allow the engine to idle for 15 seconds.
(c) Pull up the hand brake and move the shift lever to the D position.
(d) Fully depress the brake pedal and the accelerator pedal for 5 seconds.
(e) Read the DTC.

HINT:

Actual throttle position sensor voltage can be confirmed using with the hand–held tester.

OK: No DTC output.

NG → **Replace throttle body assy (See Pub. No. RM630E, page FI–42)**

OK

Normal

DICTK–01

DTC	P2120/19	Throttle/Pedal Position Sensor/Switch "D" Circuit

DTC	P2122/19	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

DTC	P2123/19	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input

DTC	P2125/19	Throttle/Pedal Position Sensor/Switch "E" Circuit

DTC	P2127/19	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

DTC	P2128/19	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input

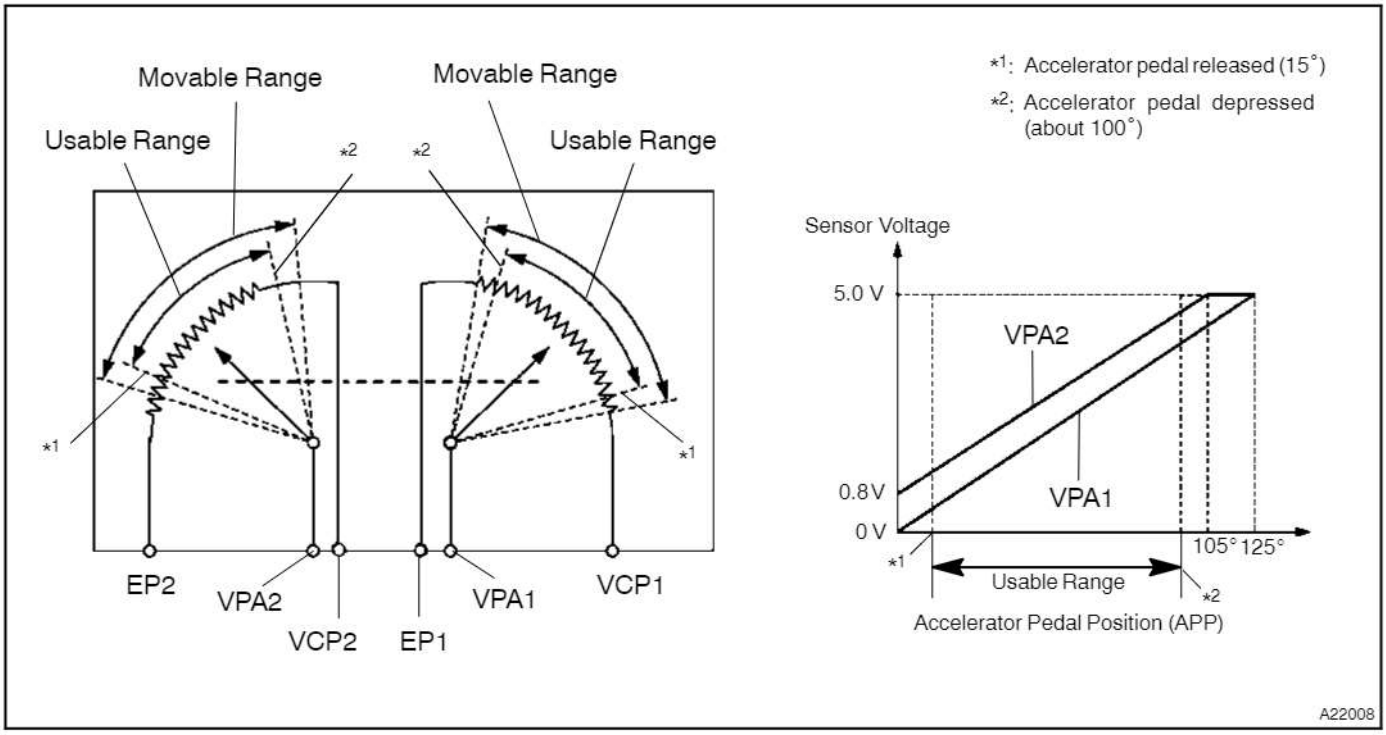
DTC	P2138/19	Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation

HINT:
This is the repair procedure for the "accelerator pedal position sensor".

CIRCUIT DESCRIPTION

A vehicle that is equipped with an Electronic Throttle Control System (ETCS) does not have a throttle cable. The APP sensor is mounted on the accelerator pedal bracket. The APP sensor has 2 sensor elements/signal outputs: VPA1 and VPA2. VPA1 is used to detect the actual accelerator pedal angle (used for engine control) and VPA2 is used to detect malfunctions in VPA1. Voltage applied to VPA1 and VPA2 changes between 0.2 V and 5 V in proportion to the accelerator pedal angle.

The engine control ECU monitors the accelerator pedal angle from VPA1 and VPA2 signal outputs, and controls the throttle actuator based on these signals.



DTC No.	DTC Detection Condition (Open or short in accelerator pedal position sensor circuit)	Main trouble Area
P2120/19	Condition (a) continues for 0.5 seconds or more: (1 trip detection logic) (a) VPA ≦ 0.2 V and VPA2 ≧ 0.97 deg, or VPA ≧ 4.8 V	• Accelerator pedal position sensor • Engine control ECU
P2122/19	Condition (a) and (b) continues for 0.5 seconds or more: (1 trip detection logic) (a) VPA ≦ 0.2 V (b) VPA2 ≧ 0.97 deg	• Accelerator pedal position sensor • VCPA circuit open • VPA circuit open or ground short • Engine control ECU
P2123/19	Condition (a) continues for 2.0 seconds or more: (1 trip detection logic) (a) VPA ≧ 4.8 V	• Accelerator pedal position sensor • EPA circuit open • Engine control ECU
P2125/19	Condition (a) continues for 0.5 seconds or more: (1 trip detection logic) (a) VPA2 ≦ 0.5 V and VPA ≧ 0.97 deg, or VPA2 ≧ 4.8 V and 0.2 V ≦ VPA ≦ 3.45 V	• Accelerator pedal position sensor • Engine control ECU
P2127/19	Condition (a) and (b) continues for 0.5 seconds or more: (1 trip detection logic) (a) VPA2 ≦ 0.5 V (b) VPA ≧ 0.97 deg	• Accelerator pedal position sensor • VCP2 circuit open • VPA2 circuit open or ground short • Engine control ECU

P2128/19	Condition (a) and (b) continues for 2.0 seconds or more: (1 trip detection logic) (a) VPA2 ≧ 4.8 V (a) 0.2 V ≦ VPA ≦ 3.45 V	• Accelerator pedal position sensor • EPA circuit open • Engine control ECU
P2138/19	Condition (a) or (b) continues for 2.0 seconds or more: (1 trip detection logic) (a) |VPA – VPA2| ≦ 0.02 V (b) VPA ≦ 0.2 V and VPA2 ≦ 0.5 V	• VPA and VPA2 circuit are short circuited • Accelerator pedal position sensor • Engine control ECU

HINT:
After confirming DTC P2120, P2122, P2123, P2125, P2127, P2128 and P2138 use the hand–held tester to confirm the accelerator pedal opening percentage.

Trouble area	Accelerator pedal position expressed as voltage			
	Accelerator pedal completely released		Accelerator pedal fully depressed	
	ACCEL POS #1	ACCEL POS #2	ACCEL POS #1	ACCEL POS #2
VC circuit open	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
VPA circuit open or ground short	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.3 V
VPA2 circuit open or ground short	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
E2 circuit open	4.5 to 5.5 V	4.5 to 5.5 V	4.5 to 5.5 V	4.5 to 5.5 V

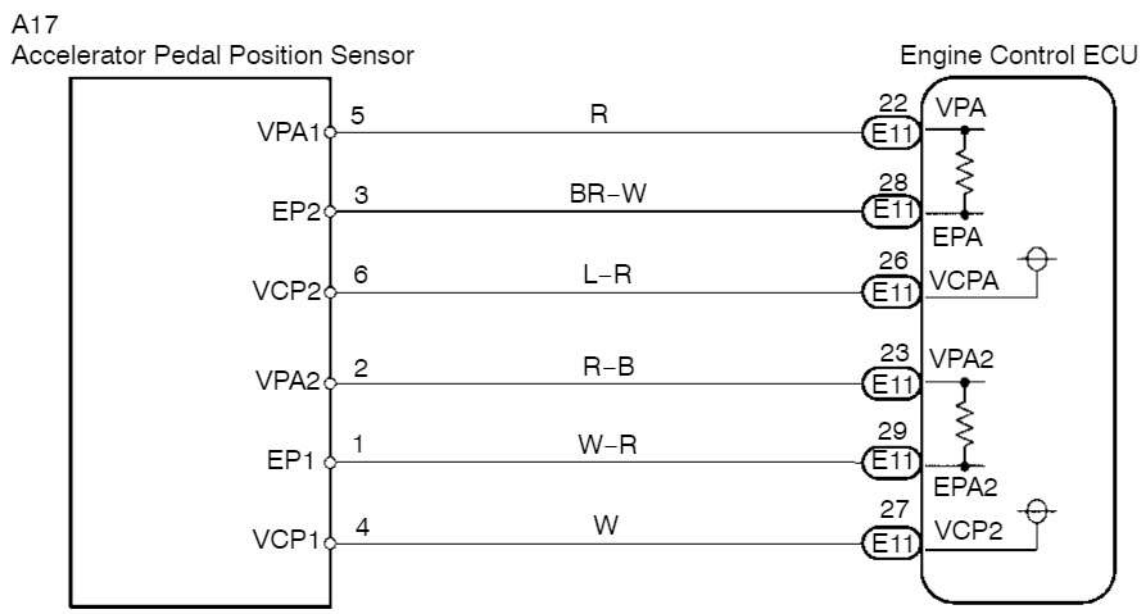
MONITOR DESCRIPTION

When VPA or VPA2, deviates from the standard, or the difference between the voltage outputs of the two sensors is less than threshold, the engine control ECU concludes that there is a defect in the accelerator pedal position sensor. The engine control ECU turns on the MIL and a DTC is set.
Example:
When the voltage output of the VPA below 0.2 V or exceeds 4.8 V.
The monitor runs for 2 seconds (the first 2 seconds for engine idle) after the engine is started.

FAIL SAFE

The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the engine control ECU detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the remaining circuit is used to calculate the accelerator pedal opening to allow the vehicle to continue driving.
If both circuits malfunction, the engine control ECU regards the opening angle of the accelerator pedal to be fully closed.
In this case, the throttle valve will remain closed as if the engine is idling.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM

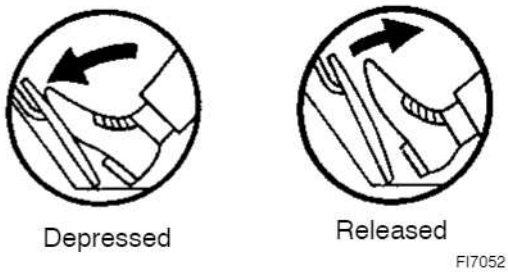


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Connect hand–held tester, and read the voltage for accelerator pedal position sensor data.**



PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) Enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ETCS / ACCEL POS #1 and ACCEL POS #2.

CHECK:

Read the voltage for the accelerator pedal position sensor data.

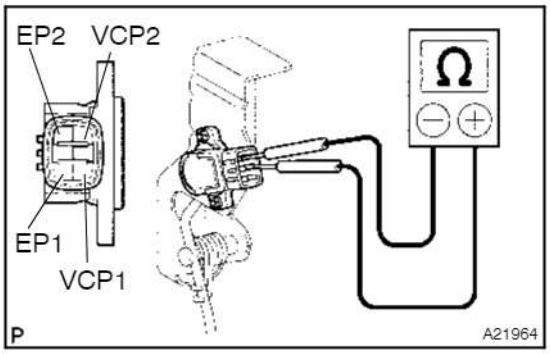
OK:

Accelerator pedal	ACCEL POS #1	ACCEL POS #2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.3 V

OK	**Go to step 5.**

NG

2	Check accelerator pedal position sensor.



(a) Disconnect the accelerator pedal position sensor connector.

CHECK:

(a) Measure the resistance between each terminal.

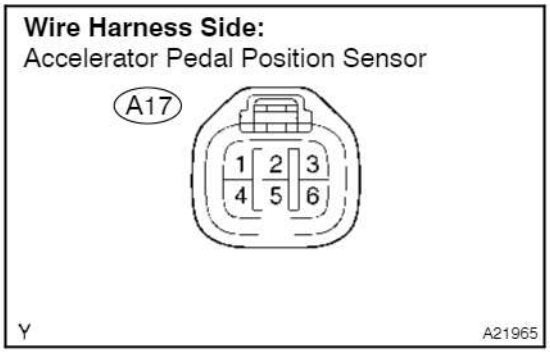
OK:

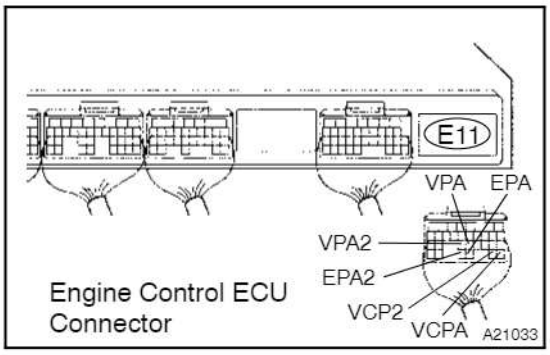
Tester Connection	Specified Condition
3 – 6	1.5 to 6.0 kΩ at 20°C (68°F)
1 – 4	1.5 to 6.0 kΩ at 20°C (68°F)

NG → **Replace accelerator pedal position sensor.**

OK

3	Check for open and short in harness and connector in VCPA, VCP2, VPA, VPA2 EPA and EPA2 circuit between engine control ECU and accelerator pedal position sensor.





PREPARATION:

(a) Disconnect the A17 accelerator pedal position sensor connector.

(b) Disconnect the E11 engine control ECU connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

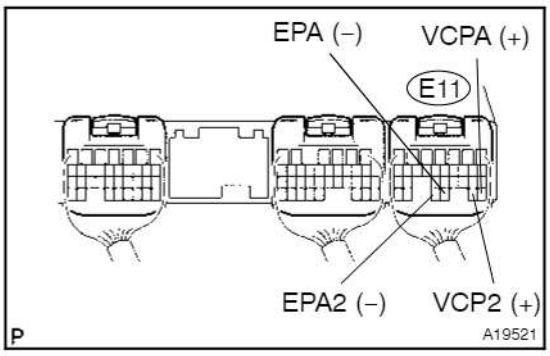
Tester Connection	Specified Condition
VPA1 (A17–5) – VPA (E11–22)	Below 1 Ω
EP1 (A17–3) – EPA (E11–28)	Below 1 Ω
VCP1 (A17–6) – VCPA (E11–26)	Below 1 Ω
VPA2 (A17–2) – VPA2 (E11–23)	Below 1 Ω
EP2 (A17–1) – EPA2 (E11–29)	Below 1 Ω
VCP2 (A17–4) – VCP2 (E11–27)	Below 1 Ω
VPA1 (A17–5) or VPA (E11–22) – Body ground	10 kΩ or higher
EP1 (A17–3) or EPA (E11–28) – Body ground	10 kΩ or higher
VCP1 (A17–6) or VCPA (E11–26) – Body ground	10 kΩ or higher
VPA2 (A17–2) or VPA2 (E11–23) – Body ground	10 kΩ or higher

EP2 (A17–1) or EPA2 (E11–29) – Body ground	10 kΩ or higher
VCP2 (A17–4) or VCP2 (E11–27) – Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**

OK

4	**Check voltage between terminals VCPA and EPA, and VCP2 and EPA2 of engine control ECU terminals.**



PREPARATION:

(a) Turn the ignition switch ON.

(b) Disconnect the A17 accelerator pedal position sensor connector.

CHECK:

Measure the voltage between the specified terminals of the E11 engine control ECU connector.

OK:

Tester Connection	Specified Condition
VCPA (E11–26) – EPA (E11–28)	4.5 to 5.5 V
VCP2 (E11–27) – EPA2 (E11–29)	4.5 to 5.5 V

NG → **Replace engine control ECU (See Pub. No. RM630, page FI–74).**

OK

5	**Check if DTC output recur?**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Disconnect the battery terminals or remove the EFI or ECD No. 1 fuse and ETCS fuse (Clear DTCs).
(c) Start the engine.
(d) Drive the engine at idle for 15 seconds or more.

CHECK:

Read the DTC output.

OK:

No DTC output.

OK → **System is OK.**

NG

Replace engine control ECU (See Pub. No. RM630E, page FI–74).

DTC	P2121/19	Throttle/Pedal Position Sensor/Switch "D" Circuit Range/Performance

HINT:
This is repair procedure for the "accelerator pedal position sensor".

CIRCUIT DESCRIPTION

Refer to DTC P2120 on page DI–218.

DTC No.	DTC Detecting Condition	Trouble Area
P2121/19	Conditions (a) and (b) continue for 0.5 seconds: (1 trip detection logic) (a) Difference between VPA and VPA2 exceeds the threshold (b) IDL is OFF	• Accelerator pedal position sensor circuit • Accelerator pedal position sensor • Engine control ECU

MONITOR DESCRIPTION

When the difference between voltage outputs of the VPA1 or VPA2 deviate from the standard range, the engine control ECU concludes that there is a defect in the APP sensor. The engine control ECU turns on the MIL and sets a DTC.
This monitor runs for 1 second (the first second of engine idle) after the engine is started.

FAIL SAFE

The APP sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the engine control ECU detects the abnormal signal voltage difference between the two sensor circuits and changes to limp mode. In limp mode, the remaining circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving.
If both circuits malfunction, the engine control ECU regards the opening angle of the accelerator pedal to be fully closed. In this case, the throttle valve will remain closed as if the engine is idling.
If a "pass" condition is detected and then the ignition switch is turned OFF, the fail–safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM

Refer to DTC P2120 on page DI–218.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air–fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

1	**Check DTC.**

RESULT:

Display (DTC Output)	Proceed to
"P2121" are output again	A
Other DTC output	B

B → **Go to prlevent DTD chart (See page DI–19).**

A

2	**Replace accelerator position sensor.**

GO

3	**Check DTC.**

PREPARATION:

(a) Clear the DTC (See page DI–3).
(b) Allow the engine to idle for a minute.
(c) Race the engine several time.

CHECK:

Read the DTC (See page DI–3).

RESULT:

Display (DTC Output)	Proceed to
"P2121" are output again	A
No DTC output	B

B → **System OK**

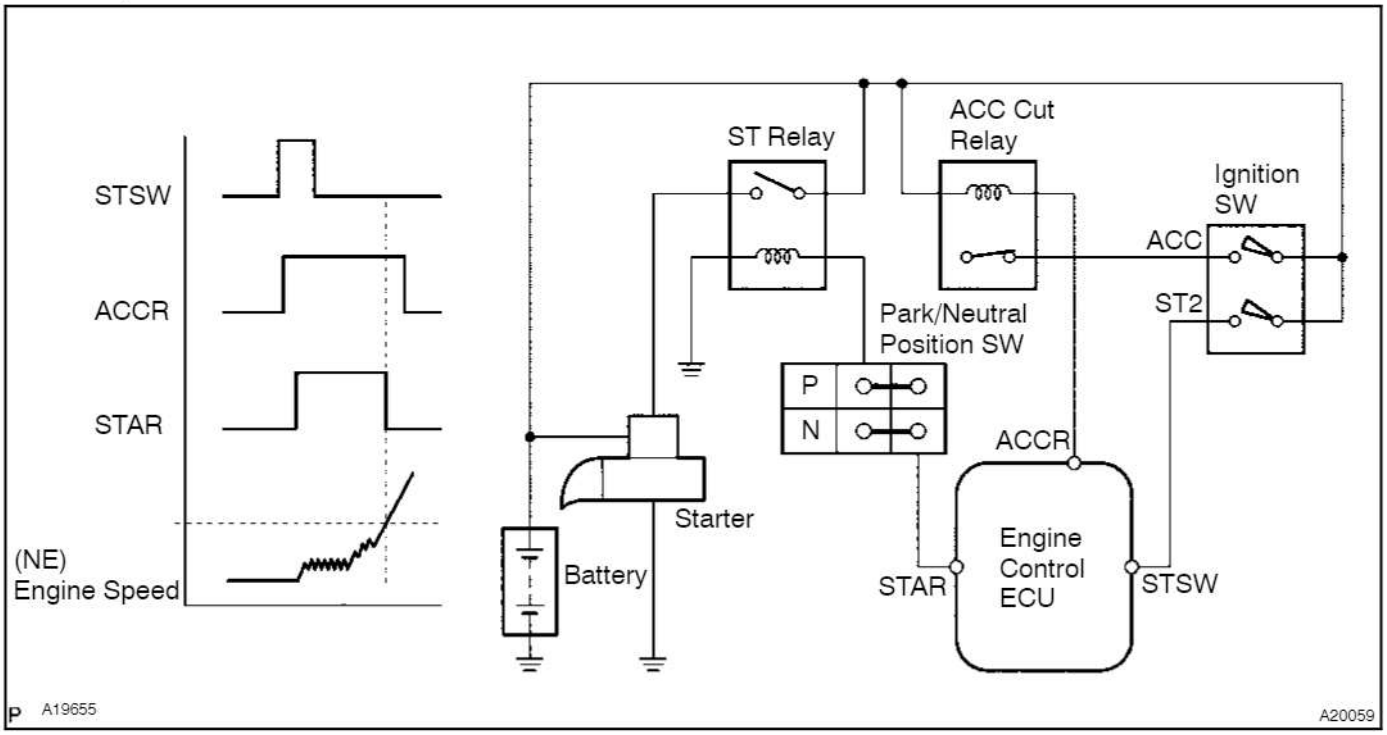
A → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

DIC2U–03

Cranking Hold Function Circuit

CIRCUIT DESCRIPTION

The starter is controlled by the engine control ECU, when the engine control ECU detects a start signal (STSW) from the ignition switch. This system monitors the engine speed (NE) and continues to operate the starter until it has determined that the engine has started (engine speed reaches approximately 500 rpm). If the engine is already running even when the ignition switch is turned to START, the engine control ECU will not operate the starter.



WIRING DIAGRAM

Refer to DTC P0617 on page DI–200.

INSPECTION PROCEDURE

When using hand–held tester:

1	**Check operation of engine cranking.**

CHECK:

When turning the ignition switch to the START position, check whether the starter motor starts.

OK:

Starter motor starts.

OK → **Check for intermittent problems (See page DI–3).**

NG

2	**Connect hand–held tester, and check STA signal.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON, and push the hand–held tester main switch ON.
(c) Enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / STARTER SIG.

CHECK:

Read the STA signal on the hand–held tester while the starter operates.

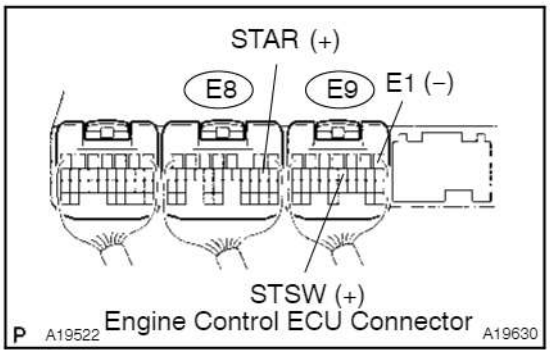
OK:

Ignition Switch Position	ON	START
STA Signal	OFF	ON

NG → **Go to step 5.**

OK

3	**Check voltage between terminal STAR, STSW and E1 of engine control ECU connector.**



CHECK:

Measure the voltage between the terminals of the E8 and E9 engine control ECU connectors, while cranking the engine (ignition switch START position).

OK:

Tester Connection	Specified Condition
STAR (E8–9) – E1 (E9–1)	9 to 14 V
STSW (E9–12) – E1 (E9–1)	9 to 14 V

RESULT:

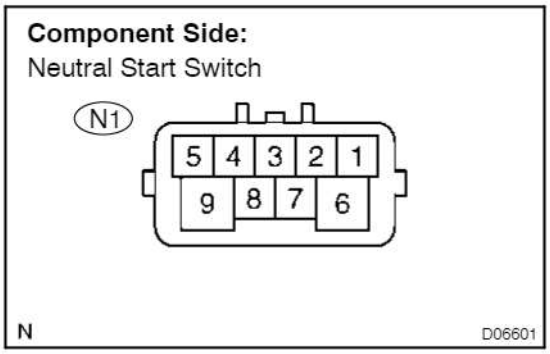
Terminal STAR	Terminal STSW	Proceed to
9 to 14 V	9 to 14 V	A
0 V	9 to 14 V	B
0 V	0 V	C

B → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

C → **Go to step 9.**

A

4	Check neutral start switch.



PREPARATION:
Remove the N1 neutral start switch connector.

CHECK:
Check continuity between each terminal shown below when the shift lever is moved to each range.

Shift range	Terminal No. to continuity	
P	1 – 3	6 – 9
R	2 – 3	–
N	3 – 5	6 – 9
D	3 – 7	–
2	3 – 4	–
L	3 – 8	–

OK:
There is continuity.

NG → **Replace the neutral start switch.**

OK ↓

Check and repair harness and connector between neutral start switch and engine control ECU (See page IN–20).

5	Check starter relay (See Pub. No. RM630E, page ST–16).

NG → **Replace starter relay.**

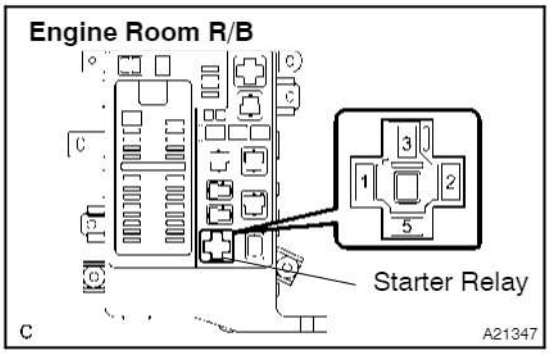
OK ↓

6	Check for open and short in harness and connector between neutral start switch and starter relay, starter relay and body ground (See page IN–20).

NG → **Repair or replace harness or connector.**

OK ↓

7	Check engine room R/B (Starter relay voltage).



PREPARATION:
Remove the starter relay from the engine room R/B.
CHECK:
Measure the voltage between the terminal of the engine room R/B and body ground.
OK:

Tester Connection	Specified Condition
Starter relay (5) – Body ground	9 to 14 V

NG → **Check and repair harness and connector between starter relay and battery.**

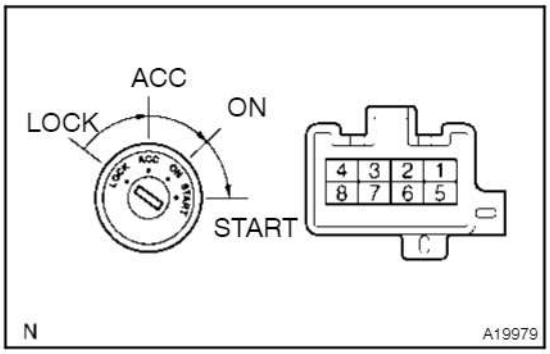
OK

8	Check starter (See Pub. No. RM630E, page ST–15).

NG → **Repair or replace starter.**

OK

9	Check ignition switch.



PREPARATION:

(a) Remove the lower finish panel.

(b) Disconnect the ignition switch connector.

CHECK:

Check continuity between terminals shown below.

OK:

Switch Position	Terminal No. to continuity	
LOCK	–	–
ACC	2–3	–
ON	2–3–4	6–7
START	1–2–4	6–7–8

NG → **Replace ignition switch.**

OK →

Check for open in harness and connector between engine control ECU and ignition switch, ignition switch and battery (See page IN–20).

When not using hand–held tester:

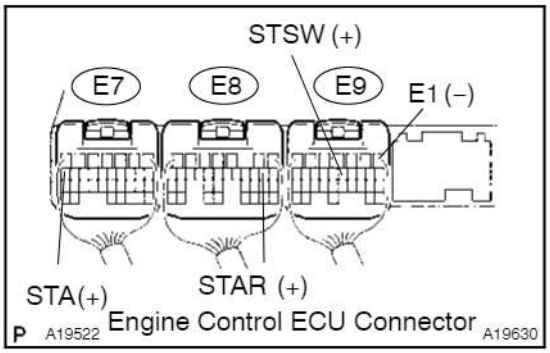
1	**Check operation of engine cranking.**

CHECK:
When turning the ignition switch to the ST position, check whether the starter motor starts.

OK → **Check for intermittent problems (See page DI–3).**

NG

2	**Check voltage between terminal STSW, STAR, STA and E1 of engine control ECU connector.**



CHECK:
Measure the voltage between the terminals of E7, E8 and E9 engine control ECU connectors, while cranking the engine (ignition switch START position).

OK:

Tester Connection	Specified Condition
STA (E7–17) – E1 (E9–1)	9 to 14 V
STAR (E8–9) – E1 (E9–1)	9 to 14 V
STSW (E9–12) – E1 (E9–1)	9 to 14 V

RESULT:

Terminal STA	Terminal STAR	Terminal STSW	Proceed to
9 to 14 V	9 to 14 V	9 to 14 V	A
0 V	9 to 14 V	9 to 14 V	B
0 V	0 V	9 to 14 V	C
0 V	0 V	0 V	D

B → **Go to step 7.**

C → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

D → **Go to step 8.**

A

3	**Check starter relay (See Pub. No. RM630E, page ST–16).**

NG → **Replace starter relay.**

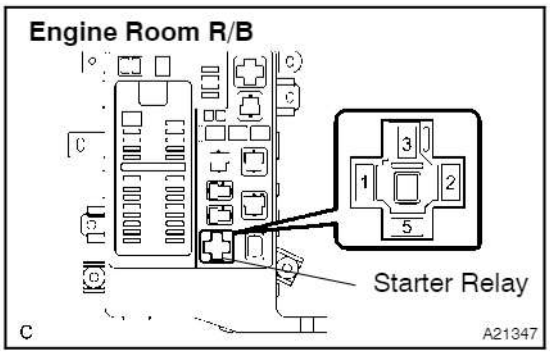
OK

4	**Check for open and short in harness and connector between neutral start switch and starter relay, starter relay and body ground (See page IN–20).**

NG → **Repair or replace harness or connector.**

OK

5	**Check engine room R/B (Starter relay voltage).**



PREPARATION:
Remove the starter relay from the engine room R/B.
CHECK:
Measure the voltage between the terminal of the engine room R/B and body ground.
OK:

Tester Connection	Specified Condition
Starter relay (5) – Body ground	9 to 14 V

NG → **Check and repair harness and connector between starter relay and battery (See page IN–20).**

OK

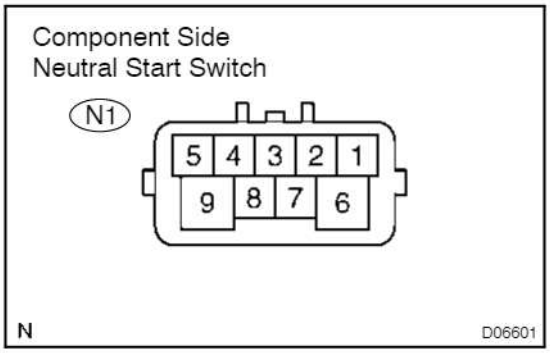
6	Check starter (See Pub. No. RM630E, page ST–15).

NG → Repair or replace starter.

OK

Check and repair harness and connector between starter relay and starter, starter and battery (See page IN–20).

7	Check neutral start switch.



PREPARATION:

Remove the N1 neutral start switch connector.

CHECK:

Check continuity between each terminal shown below when the shift lever is moved to each range.

Shift range	Terminal No. to continuity	
P	1 – 3	6 – 9
R	2 – 3	–
N	3 – 5	6 – 9
D	3 – 7	–
2	3 – 4	–
L	3 – 8	–

OK:

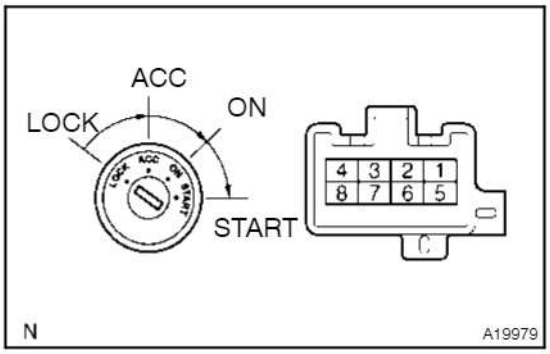
There is continuity.

NG → Replace the park/neutral position switch.

OK

Check and repair harness and connector between neutral start switch and engine control ECU (See page IN–20).

8	Check ignition switch.



PREPARATION:

(a) Remove the lower finish panel.

(b) Disconnect the ignition switch connector.

CHECK:

Check continuity between terminals shown below.

OK:

Switch Position	Terminal No. to continuity	
LOCK	–	–
ACC	2–3	–
ON	2–3–4	6–7
START	1–2–4	6–7–8

NG → **Replace ignition switch.**

OK

Check and replace harness and connector between engine control ECU and ignition switch, ignition switch and battery (See page IN–20).

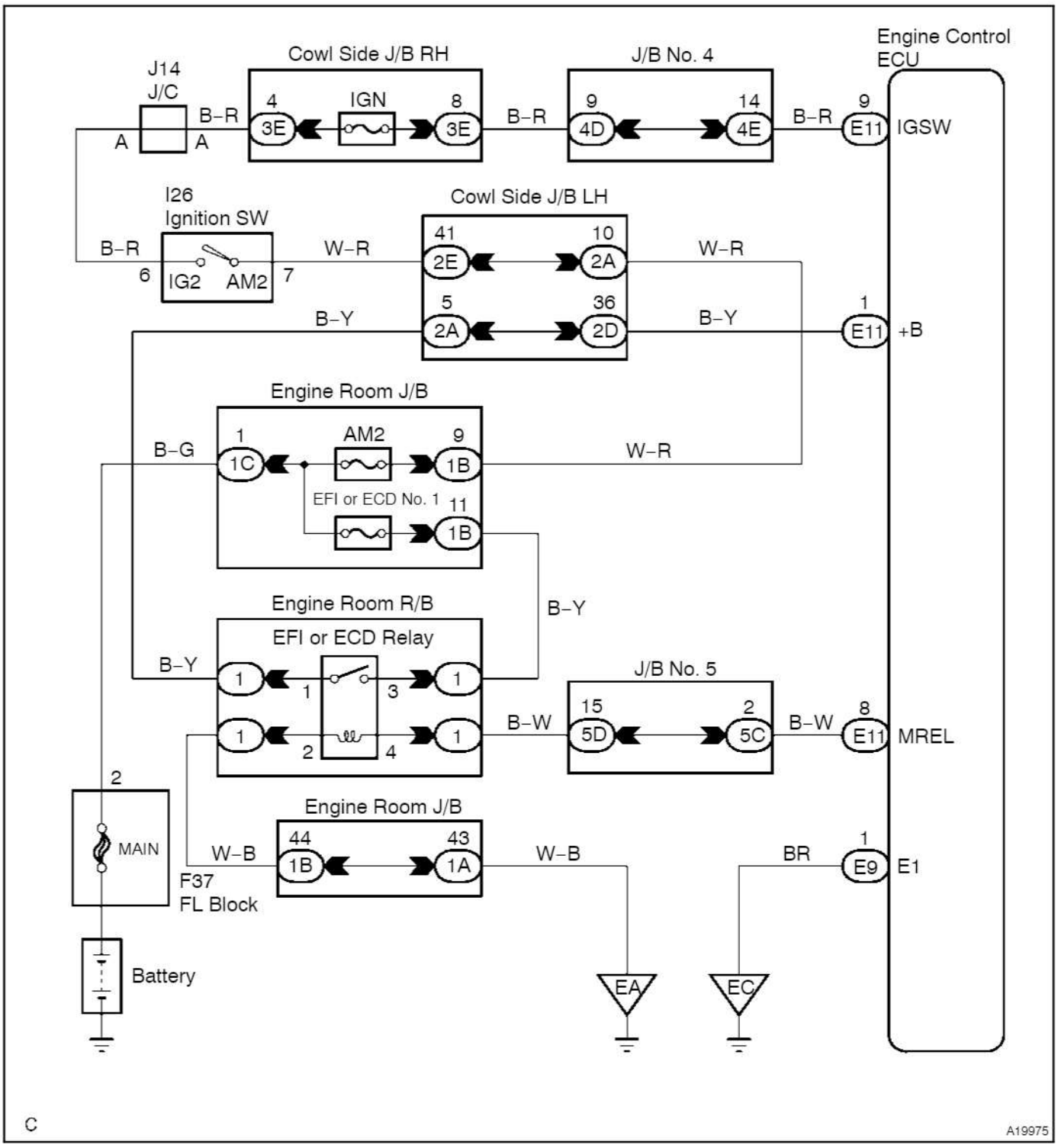
DIB2X–04

Engine Control ECU Power Source Circuit

CIRCUIT DESCRIPTION

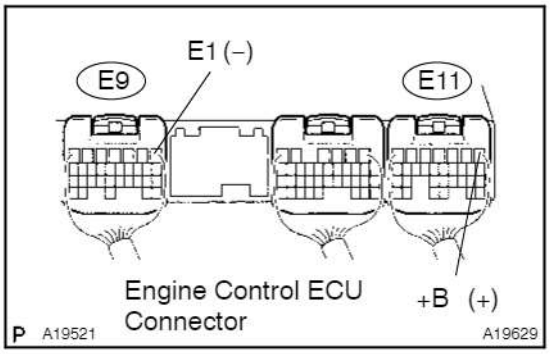
When the ignition switch is turned ON, battery positive voltage is applied to terminal IGSW of the engine control ECU and the EFI or ECD relay control circuit in the engine control ECU sends a signal to terminal MREL of the engine control ECU switching on the EFI or ECD relay.
This signal causes current to flow to the coil, closing the contacts of the EFI or ECD relay and supplying power to terminal +B of the engine control ECU.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	**Check voltage between terminals +B and E1 of engine control ECU connectors.**



PREPARATION:
Turn the ignition switch ON.
CHECK:
Measure the voltage between terminals +B and E1 of the engine control ECU connectors.
OK:
Voltage: 9 to 14 V

OK	**Proceed to next circuit inspection shown on problem symptoms table (See page DI–34).**

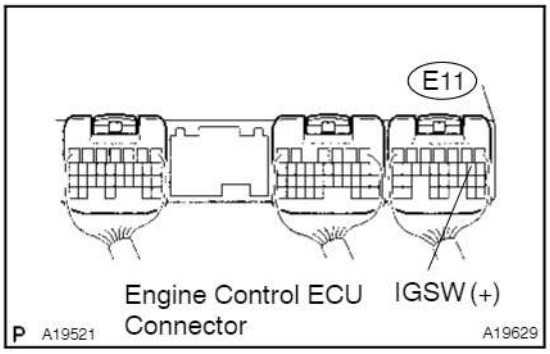
NG

2	**Check for open in harness and connector between terminal E1 of engine control ECU and body ground (See page IN–20).**

NG	**Repair or replace harness or connector.**

OK

3	**Check voltage between terminal IGSW of engine control ECU connector and body ground.**

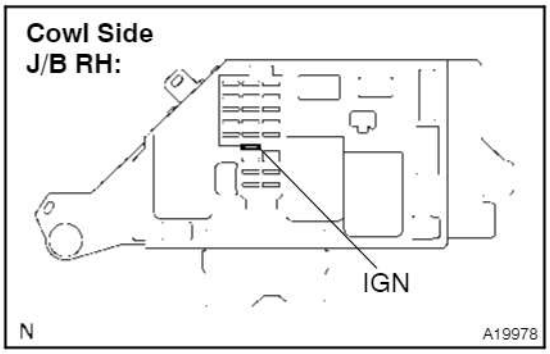


PREPARATION:
Turn the ignition switch ON.
CHECK:
Measure the voltage between terminal IGSW of the engine control ECU connector and body ground.
OK:
Voltage: 9 to 14 V

OK	**Go to step 6.**

NG

4	Check IGN fuse.



PREPARATION:
Remove the IGN fuse from the cowl side J/B RH.
CHECK:
Check the continuity of the IGN fuse.
OK:
Continuity

NG → **Check for short in all harness and components connected to IGN fuse.**

OK

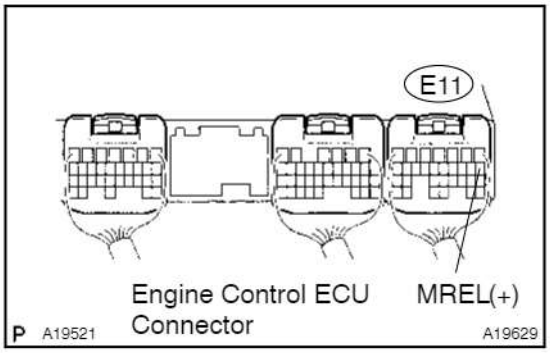
5	Check ignition switch (See Pub. No. RM616E, page BE–20).

NG → **Replace ignition switch.**

OK

Check and repair harness and connector between battery and ignition switch, and ignition switch and engine control ECU (See page IN–20).

6	Check voltage between terminal MREL of engine control ECU connector and body ground.



PREPARATION:
Turn the ignition switch ON.
CHECK:
Measure the voltage between terminal MREL of the engine control ECU connector and body ground.
OK:
Voltage: 9 to 14 V

NG → **Replace engine control ECU (See Pub. No. RM630E, FI–74).**

OK

7	Check EFI or ECD No. 1 fuse of engine room J/B.

Engine Room J/B:

PREPARATION:
Remove the EFI or ECD No. 1 fuse from the engine room J/B.
CHECK:
Check continuity of EFI or ECD No. 1 fuse.
OK:
Continuity

NG → **Check for short in all harness and components connected to EFI or ECD No. 1 fuse.**

OK

8	Check EFI or ECD relay (See Pub. No. RM630E, page FI–52).

NG → **Replace EFI or ECD relay.**

OK

9	Check for open and short in harness and connector between terminal MREL of engine control ECU and body ground (See page IN–20).

NG → **Repair or replace harness or connector.**

OK

Check and repair harness or connector between EFI or ECD No. 1 fuse and battery (See page IN–20).

DIB2Y–04

Fuel Pump Control Circuit

CIRCUIT DESCRIPTION

Refer to DTC P0230 on page DI–125.

WIRING DIAGRAM

Refer to DTC P0230 on page DI–125.

INSPECTION PROCEDURE

When using hand–held tester:

1	**Check fuel pump operation (See Pub. No. RM630E, page FI–7).**

OK → **Go to step 8.**

NG

2	**Connect hand–held tester, and check operation of fuel pump relay.**

PREPARATION:

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) Enter the following menus: DIAGNOSIS / OBD/MOBD / ACTIVE TEST / FUEL PUMP / SPD.

CHECK:

Check the operation of the fuel pump relay when it is switched ON and OFF by the hand–held tester.

OK:

Operating noise can be heard from the relay.

OK → **Go to step 4.**

NG

3	**Check operation of fuel pump relay (See Pub. No. RM630E, page FI–54).**

NG → **Replace fuel pump relay.**

OK

4	Check fuel pump (See Pub. No. RM630E, page FI–7).

NG → Repair or replace fuel pump.

OK

5	Check circuit opening relay (See Pub. No. RM630E, page FI–53).

NG → Replace circuit opening relay.

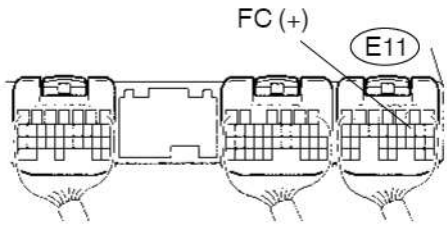
OK

6	Check for open in harness and connector between EFI or ECD relay and fuel pump, and fuel pump and body ground (See page IN–20).

NG → Repair or replace harness or connector.

OK

7	Check voltage between terminal FC and E1 of engine control ECU connector.



Engine Control ECU Connector

P A19521 A19629

PREPARATION:

Turn the ignition switch ON.

CHECK:

Measure the voltage between terminal FC of the engine control ECU connector and body ground.

OK:

Voltage: 9 to 14 V

NG → **Check for open in harness and connector between battery and FC terminal of engine control ECU (See page IN–20).**

OK →

Proceed to problem symptoms table (See page DI–34).

8	Check fuel pump resistor (See Pub. No. RM630E, page FI–59).

NG → **Replace fuel pump resistor.**

OK →

Check for open in harness and connector between circuit opening relay and fuel pump resistor, and fuel pump resistor and fuel pump (See page IN–20).

When not using hand–held tester:

1	Check operation of fuel pump (See Pub. No. RM630E, page FI–7).

OK → Go to step 7.

NG

2	Check operation of fuel pump relay (See Pub. No. RM630E, page FI–54).

NG → Replace fuel pump relay.

OK

3	Check fuel pump (See Pub. No. RM630E, page FI–7).

NG → Repair or replace fuel pump.

OK

4	Check circuit opening relay (See Pub. No. RM630E, page FI–53).

NG → Replace circuit opening relay.

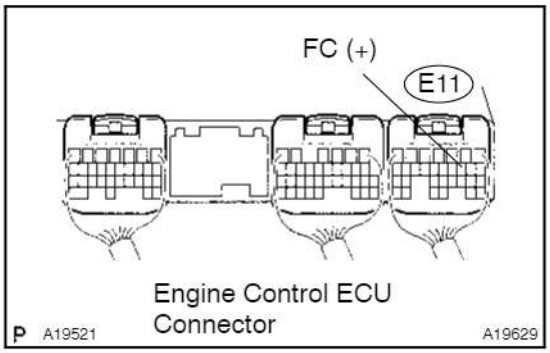
OK

5	Check for open in harness and connector between EFI or ECD relay and fuel pump, and fuel pump and body ground (See page IN–20).

NG → Repair or replace harness or connector.

OK

6	Check voltage between terminal FC of engine control ECU connector and body ground.



PREPARATION:
Turn the ignition switch ON.
CHECK:
Measure the voltage between terminal FC of the engine control ECU connector and body ground.
OK:
Voltage: 9 to 14 V

NG → **Check for open in harness and connector between battery and FC terminal of engine control ECU (See page IN–20).**

OK →

Proceed to problem symptoms table (See page DI–34).

7	Check fuel pump resistor (See Pub. No. RM630E, page FI–59).

NG → **Replace fuel pump resistor.**

OK →

Check for open in harness and connector between circuit opening relay and fuel pump resistor, fuel pump resistor and fuel pump (See page IN–20).

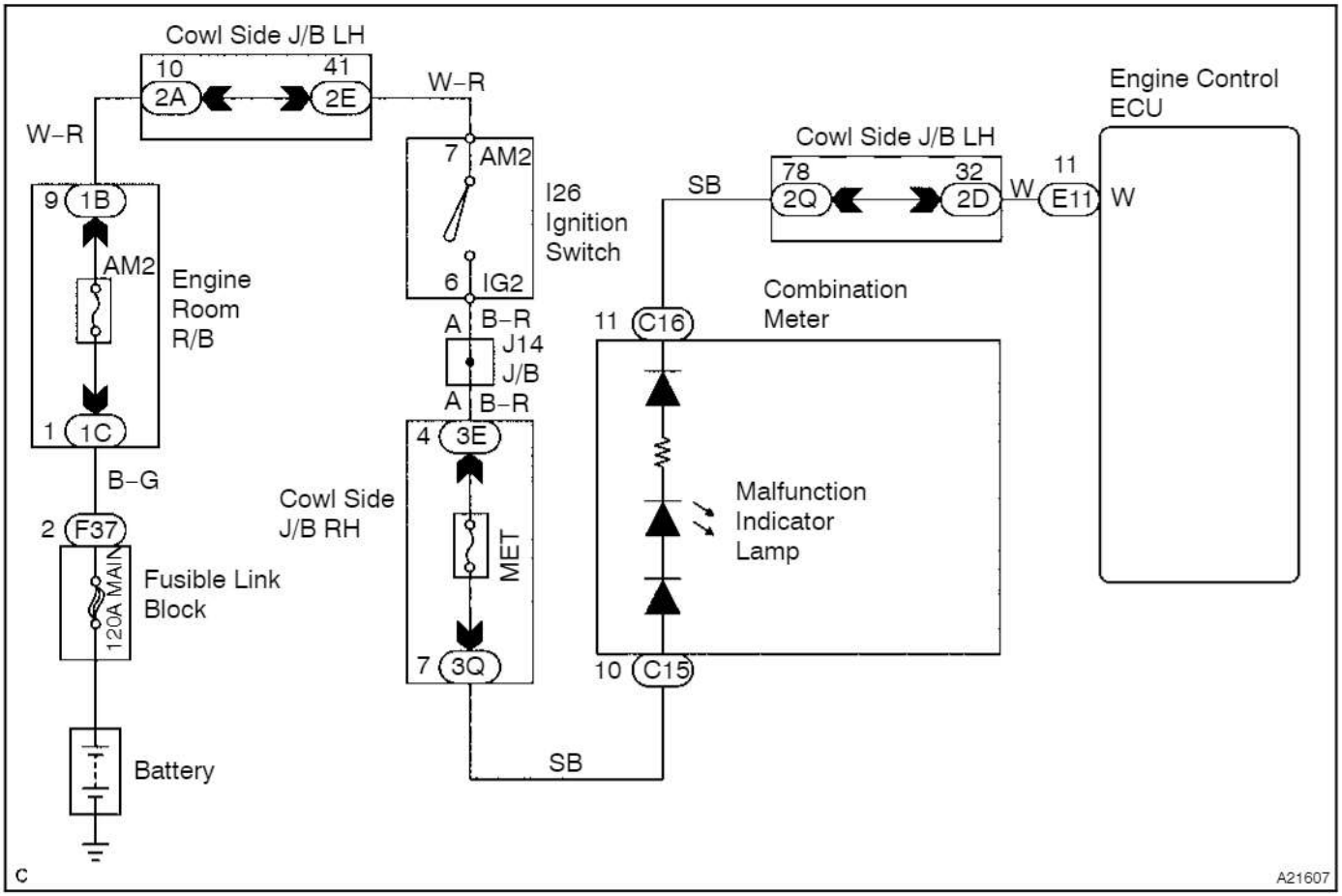
DIC2V–03

Check engine warning light circuit

CIRCUIT DESCRIPTION

If the engine control ECU detects a trouble, the check engine warning light lights up. At this time, the engine control ECU records a DTC in the memory.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Troubleshoot each trouble symptom in accordance with the chart below .

Check engine warning light remains on	Start inspection from step 1
Check engine warning light does not light up	Start inspection from step 3

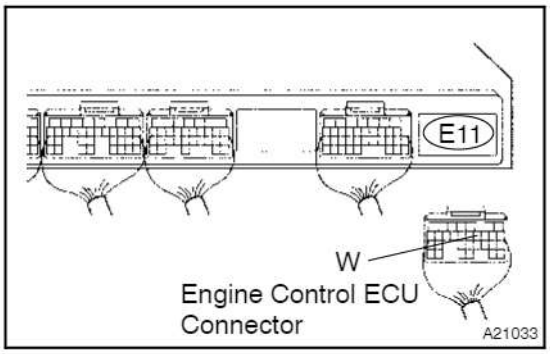
1 Clear DTC.

(a) Connect the hand–held tester to the DLC3.
(b) Turn the ignition switch ON and push the hand–held tester main switch ON.
(c) Read the DTC (See page DI–3).
(d) Clear the DTC (See page DI–3).
(e) Check that check engine warning light does not light up.
Standard: Check engine warning light does not light up

OK → **Repair circuit indicated by output code (See page DI–19).**

NG

2 Check harness and connector (Check for short in wire harness).



(a) Disconnect the E11 engine control ECU connector.
(b) Turn the ignition switch ON.
(c) Check that Check engine warning light does not light up.
Standard: Check engine warning light does not light up

OK → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

NG

Check and repair harness and connector between combination meter and engine control ECU (See page IN–20).

3	**Check that check engine warning light lights up.**

Check that check engine warning light lights up when turning the ignition switch ON.

Standard: Check engine warning light lights up

OK → **System OK.**

NG

4	**Inspect combination meter assy (Check engine warning light circuit).**

See the combination meter troubleshooting on Pub. No. RM970E, page BE–31.

NG → **Repair or replace bulb or combination meter assembly.**

OK

Check and repair harness and connector between combination meter and engine control ECU (See page IN–20).

HOW TO USE THIS MANUAL

IN00U–94

GENERAL INFORMATION

1. INDEX

An INDEX is provided on the first page of each section to guide you to the item to be repaired. To assist you in finding your way through the manual, the section title and major heading are given at the top of every page.

2. PRECAUTION

At the beginning of each section, a PRECAUTIONs is that pertains to repair operations contained in that section. are given.

Read these precautions before starting any repair work.

3. TROUBLESHOOTING

The TROUBLESHOOTING tables are included for each system. Be sure to read the fundamentals of how to proceed with troubleshooting on page IN–9.

Be sure to read this before performing troubleshooting.

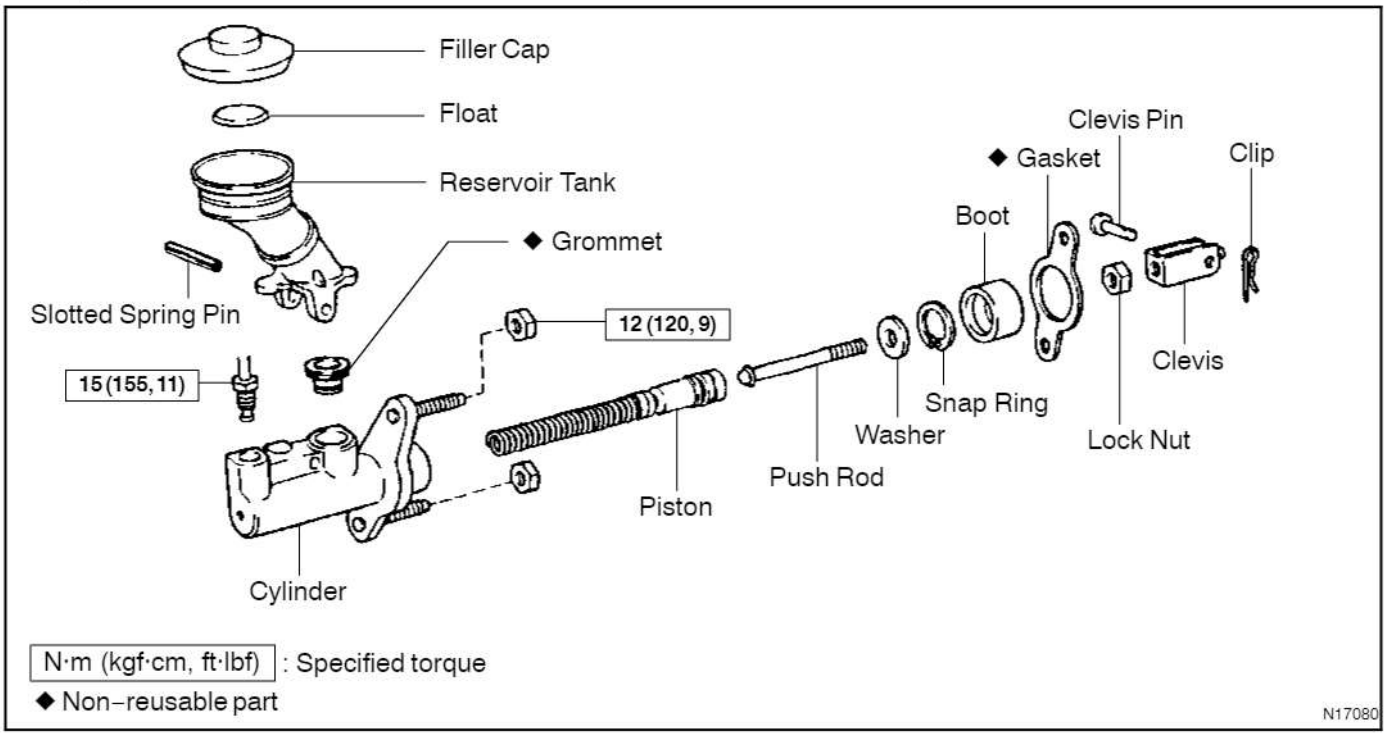
4. PREPARATION

The Preparation section lists the Special Service Tools (SST), recommended tools, equipment, lubricants and Special Service Materials (SSM) that should be prepared before beginning. It also explains the purpose of each one.

5. REPAIR PROCEDURES

Most repair operations begin with an overview illustration. It identifies the components and shows how the parts fit together.

Example:



The procedures are presented in a step–by–step format:

- The illustration shows what to do and where to do it.
- The task heading briefly describes what you will be doing.
- The detailed text shows step by step how to perform the task. It also gives information, such as specifications and warnings.

Example:

Task heading : what you will be doing

21. CHECK PISTON STROKE OF OVERDRIVE BRAKE

(a) Place SST and a dial indicator onto the overdrive brake piston as shown in the illustration.

SST 09350–30020 (09350–06120)

Set part No. *Component part No.*

Detailed text : how to perform task

(b) Measure the stroke applying and releasing the compressed air (392 — 785 kPa, 4 — 8 kgf/cm^2 or 57 — 114 psi) as shown in the illustration.

Piston stroke: 1.40 — 1.70 mm (0.0551 — 0.0669 in.)

Specification

This format provides the experienced technician with a FAST TRACK to the information needed. The upper case task heading are easy to read and the text below it provides detailed information. Important specifications and warnings are always written in bold–faced text.

6. REFERENCES

REFERENCES are instances where you are given a page to refer to for more infomation. They have been kept to a minimum.

7. SPECIFICATIONS

SPECIFICATIONS are printed in bold–faced text throughout the text where needed. They are also found in Service Specifications section for quick reference.

8. CAUTIONS, NOTICES, HINTS:

- CAUTIONS are in bold–faced text, and indicate there is a possibility of injury to you or other people.
- NOTICES are also in bold faced text, and indicate the possibility of damage to the components being repaired.
- HINTS are separated from the detailed text but are not in bold–faced text. HINTS provide additional information to help you perform repairs.

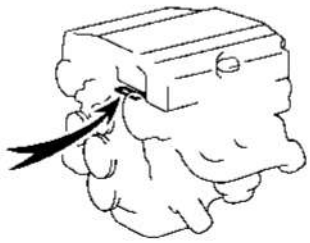
9. SI UNIT

The UNITS used in this manual comply with the the SI UNITS (International System of Unit) standard. For your convenience, we also provide units from the metric system and the English system.

Example:

Torque: 30 N·m (310 kgf·cm, 22 ft·lbf)

2UZ–FE Engine:



B04198

IDENTIFICATION INFORMATION

IN0KI–01

ENGINE SERIAL NUMBER

The engine serial number is stamped on the engine block, as shown in the illustration.

REPAIR INSTRUCTIONS

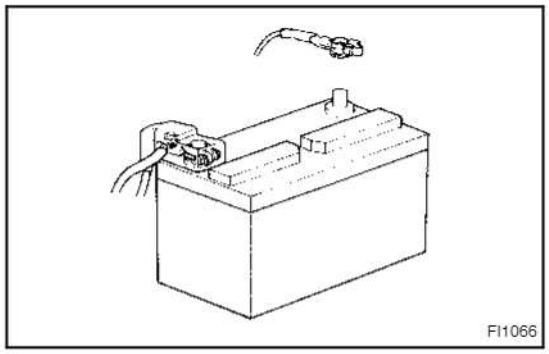
GENERAL INFORMATION

IN07M–09

BASIC REPAIR HINT

(a) Prevent damage and maintain vehicle cleanliness by using protective covering on the fender, seat and floor.

(b) During disassembly, line up parts in the order they were removed to facilitate reassembly.


FI1066

(c) Observe the following:

(1) Before performing electrical work, disconnect the negative (–) terminal cable from the battery.

(2) If it is necessary to disconnect the battery for inspection or repair, first disconnect the negative (–) terminal cable.

(3) To prevent damage to the battery terminal when disconnecting the terminal cable, loosen the cable nut and raise the cable straight up. Do not twist or pry the cable off.

(4) Clean the battery terminals and cable ends with a clean shop rag. Do not scrape them with a file or other abrasive objects.

(5) Install the cable ends to the battery terminals after loosening the nut and tighten the nut after installation. Do not hammer the cable ends onto the terminals.

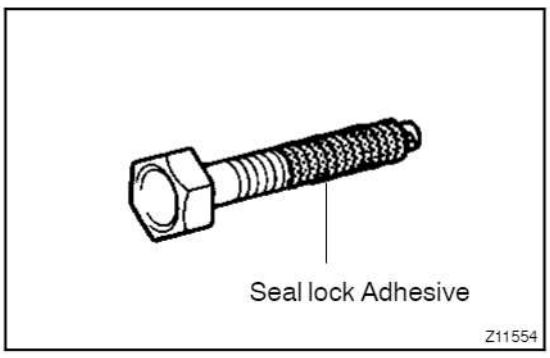
(6) Be sure the cover for the positive (+) terminal is properly in place.

(d) Check hose and wiring connectors to make sure that they are secure and correct.

(e) Non–reusable parts

(1) Always replace cotter pins, gaskets, O–rings and oil seals etc. with new ones.

(2) In component illustrations, non–reusable parts are indicated with "◆" symbols.



Z11554

(f) Precoated parts

Precoated parts are bolts, nuts, etc. that are coated with a seal lock adhesive at the factory.

(1) If a precoated part is retightened, loosened or moved in any way, it must be recoated with the specified adhesive.

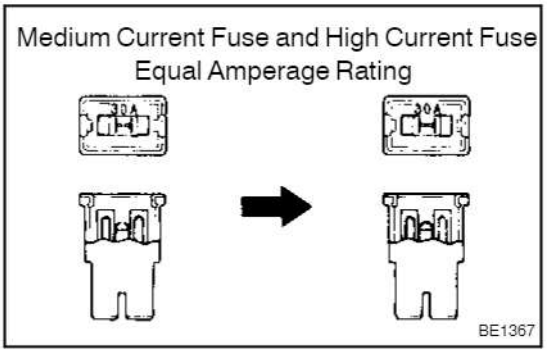
(2) When reusing precoated parts, clean off the old adhesive and dry with compressed air. Then apply the new seal lock adhesive appropriate to that bolt, nut, etc.

(3) In component illustrations precoated parts are indicated with "★" symbol.

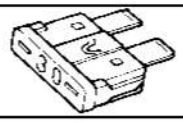
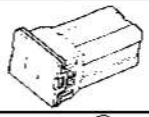
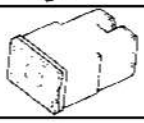
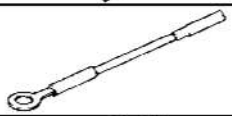
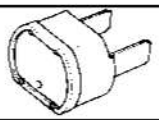
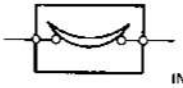
(g) When necessary, use a sealer on gaskets to prevent leaks.

(h) Carefully observe all specifications for bolt tightening torques. Always use a torque wrench.

(i) Use of special service tools (SST) and special service materials (SSM) may be required depending on the nature of the repair. Be sure to use SST and SSM where specified and follow the proper procedures. A list of SST and SSM can be found in Preparation section in this manual.



(j) When replacing fuses, be sure the new fuse has the correct amperage rating. DO NOT exceed the rating or use one with a lower rating.

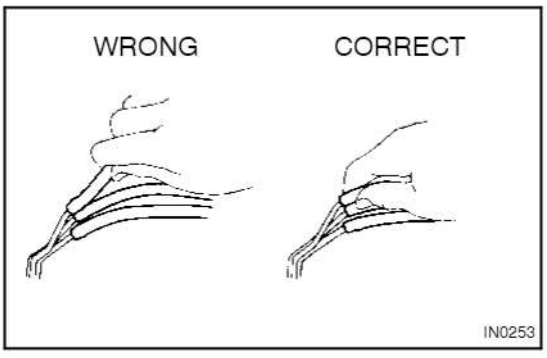
Illustration	Symbol	Part Name	Abbreviation
 BE5594	 IN0365	FUSE	FUSE
 BE5595	 IN0366	MEDIUM CURRENT FUSE	M–FUSE
 BE5596	 IN0367	HIGH CURRENT FUSE	H–FUSE
 BE5597	 IN0367	FUSIBLE LINK	FL
 BE5598	 IN0368	CIRCUIT BREAKER	CB

V00076

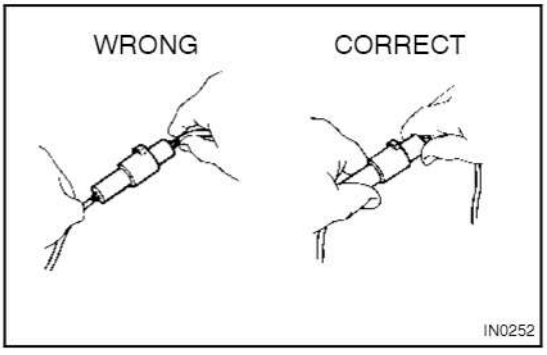
(k) Care must be taken when jacking up and supporting the vehicle. Be sure to lift and support the vehicle at the proper locations (As for vehicle lift and support location, please refer to Chassis & Body Repair Manual for each vehicle).
- Release the parking brake on a level surface and shift to Neutral (or N position).
- When jacking up the front wheels of the vehicle, place stoppers behind the rear wheels.
- When jacking up the rear wheels of the vehicle at first place stoppers in front of the front wheels.
- When jacking up only the front or rear wheels, set rigid racks and place stoppers in front and behind the wheels in contact with the ground.
- After the vehicle is jacked up, be sure to support it on rigid racks. It is extremely dangerous to do any work on a vehicle raised on a jack alone, even for a small job that can be finished quickly.

(l) Observe the following precautions to avoid damage to the following parts:

(1) Do not open the cover or case of the ECU unless absolutely necessary. (Static electricity transmitted through human touch may destroy the IC).



(2) To disconnect vacuum hoses, pull on the end of the hose, not the middle.



(3) To pull apart electrical connectors, pull on the connector itself, not the wires.

(4) Be careful not to drop electrical components, such as sensors or relays. If they are dropped on a hard floor, they should be replaced and not reused.

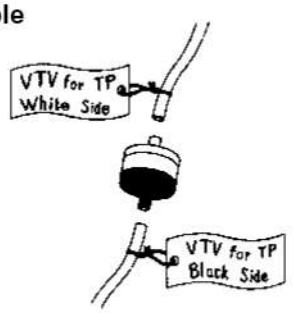
(5) When steam cleaning an engine, protect the electronic components, air filter and emissions–related components from water.

(6) Never use an impact wrench to remove or install temperature switches or temperature sensors.

(7) When checking continuity at the wire connector, insert the tester probe carefully to prevent terminals from bending.

(8) When using a vacuum gauge, never force the hose onto a connector that is too large. Use a step–down adapter for adjustment. Once the hose has been stretched, it may leak.

Example



IN0002

(m) Tag hoses before disconnecting them:

(1) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.

(2) After completing a job, double check that the vacuum hoses are properly connected. A label under the hood shows the proper layout.

(n) Unless otherwise stated, all resistance should be measured at an ambient temperature of 20°C (68°F). Measurement should be made after the engine has cooled down. If measured at high temperature immediately after the vehicle has been running, resistance may be outside specifications.

FOR ALL OF VEHICLES

PRECAUTION

IN0KJ–01

1. FOR VEHICLES EQUIPPED WITH A CATALYTIC CONVERTER

CAUTION:

If large amounts of unburned gasoline flow into the converter, it may overheat and create a fire hazard. To prevent this, observe the following precautions and explain them to your customer.

(a) Use only unleaded gasoline.

(b) Avoid prolonged idling.
Avoid idling the engine for more than 20 minutes.

(c) Avoid spark jump test.
(1) Perform spark jump tests only when absolutely necessary. Perform this test as rapidly as possible.
(2) While testing, never race the engine.

(d) Avoid prolonged engine compression measurement.
Engine compression tests must be done as rapidly as possible.

(e) Do not run engine when fuel tank is nearly empty.
This may cause the engine to misfire and create an extra load on the converter.

(f) Avoid coasting with ignition turned off and prolonged braking.

(g) Do not dispose of used catalyst with gasoline or oil contaminated parts.

2. IF VEHICLE IS EQUIPPED WITH MOBILE COMMUNICATION SYSTEM

For vehicles with mobile communication systems such as two–way radios and cellular telephones, observe the following precautions.

(1) Install the antenna as far away as possible from the ECU and sensors of the vehicle's electronic system.
(2) Install the antenna feeder at least 20 cm (7.87 in.) away from the ECU and sensors of the vehicle's electronics systems. For details about ECU and sensors locations, refer to the applicable component's section .
(3) Avoid winding the antenna feeder together with the other wiring, as much as possible, and also avoid running the antenna feeder parallel with other wire harnesses.
(4) Check that the antenna and feeder are correctly adjusted.
(5) Do not install powerful mobile communications system.

3. FOR USING HAND–HELD TESTER

CAUTION:

Observe the following for safety reasons:

- **Before using the hand–held tester, read its user manual throughly.**
- **Be sure to route all cables securely when driving with the hand–held tester connected to the vehicle. (I.e., keep cables away from feet, pedals, steering wheel and shift lever.)**
- **Two persons are required when test–driving with the hand–held tester: one person to drive the vehicle and another to operate the hand–held tester.**

HOW TO TROUBLESHOOT ECU CONTROLLED SYSTEMS

IN04S–49

GENERAL INFORMATION

A large number of ECU controlled systems are used in the LAND CRUISER. In general, the ECU controlled system is considered to be a very intricate system requiring a high level of technical knowledge and expert skill to troubleshoot. However, the fact is that if you proceed to inspect the circuits one by one, troubleshooting of these systems is not complex. If you have adequate understanding of the system and a basic knowledge of electricity, accurate diagnosis and necessary repair can be performed to locate and fix the problem. This manual is designed through emphasis of the above standpoint to help service technicians perform accurate and effective troubleshooting, and is compiled for the following major ECU controlled systems:
The troubleshooting procedure and how to make use of it are described on the following pages.

System	Page
1. Engine	DI–1

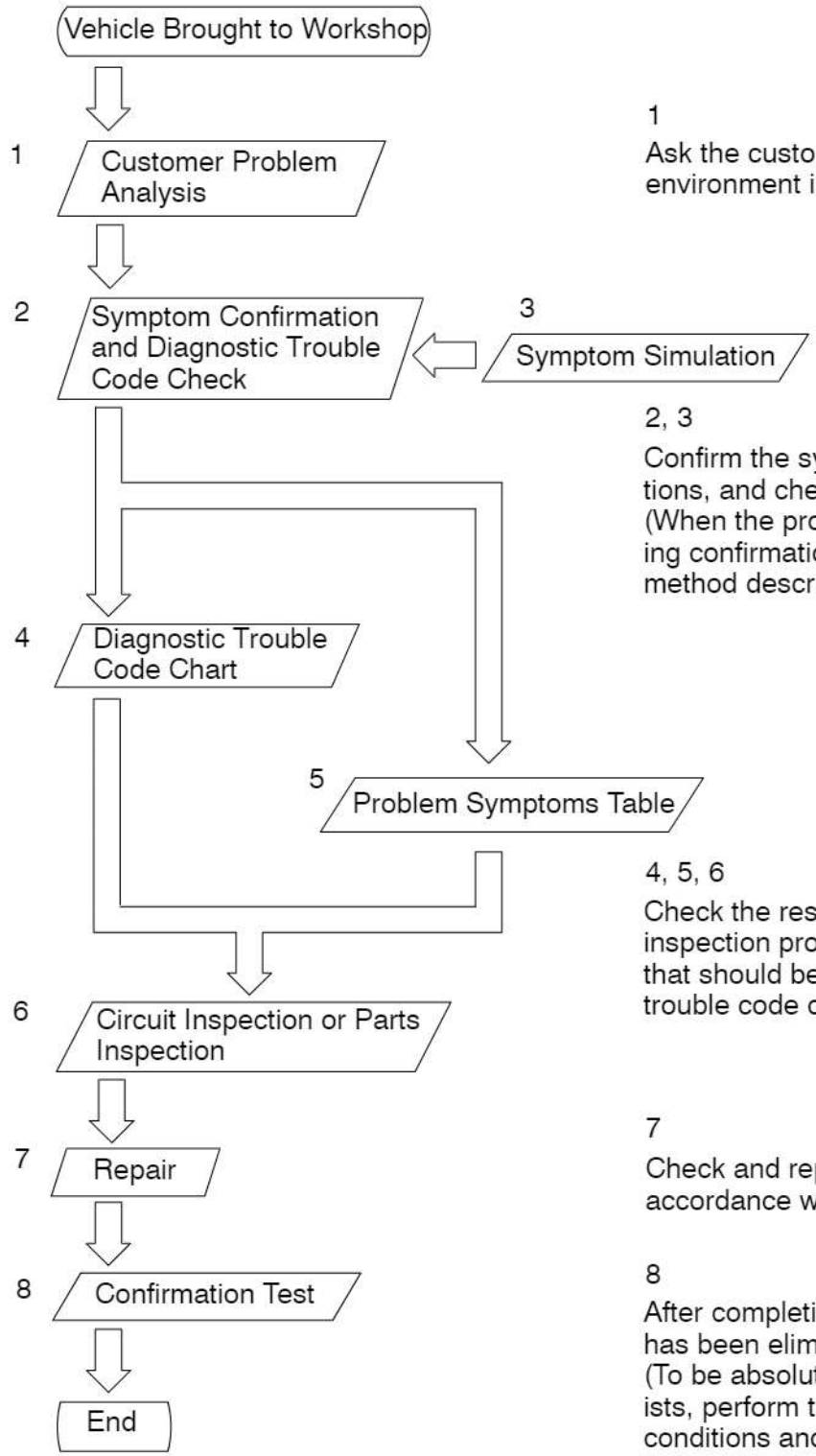
FOR USING HAND–HELD TESTER

- Before using the tester, read its operator manual thoroughly.
- Connected the cable of the tester to DLC3, turn the ignition switch ON and operated the tester. If the tester cannot communicate with the ECU controlled system, there is a problem on the vehicle side or tester side.
  (1) If communication is normal when the tester is connected to another vehicle, inspect the diagnosis data link line (Bus⊕line) or ECU power circuit of the vehicle.
  (2) If communication is still not possible when the tester is connected to another vehicle, the problem lies in the tester. Perform the Self Test procedures outlined in the Tester Operator's Manual.

IN04T-25

HOW TO PROCEED WITH TROUBLESHOOTING

Carry out troubleshooting in accordance with the procedure below. Only a basic procedure is shown. Details in the diagnostics Section show the most effective methods for each circuit. Confirm troubleshooting procedures first for the relevant circuit before beginning troubleshooting of that circuit.



1

Ask the customer about the conditions and the environment in which the problem occurred.

2, 3

Confirm the symptoms and the problem conditions, and check the diagnostic trouble codes. (When the problem symptoms do not appear during confirmation, use the symptom simulation method described later on.)

4, 5, 6

Check the results obtained in Step 2. Confirm the inspection procedure for the system or the part that should be checked using the diagnostic trouble code chart or the problem symptoms table.

7

Check and repair the affected system or part in accordance with the instructions in Step 6.

8

After completing repairs, confirm that the problem has been eliminated.
(To be absolutely sure the problem no longer exists, perform the confirmation test under the same conditions and environment as when it occurred the first time.)

1. CUSTOMER PROBLEM ANALYSIS

- The 5 items in the table below are important points in the problem analysis:
- In troubleshooting, the problem symptoms must be confirmed accurately. Preconceptions should be discarded in order to give an accurate judgement. To ascertain what the problem symptoms are, it is extremely important to ask the customer about the problem and the conditions at the time it occurred.

Important Points in the Customer Problem Analysis

- What ––––– Vehicle model, system name
- When ––––– Date, time, occurrence frequency
- Where ––––– Road conditions
- Under what conditions? ––––– Running conditions, driving conditions, weather conditions
- How did it happen? ––––– Problem symptoms

(Sample) Supplemental restraint system check sheet.

CUSTOMER PROBLEM ANALYSIS CHECK

Supplemental Restraint System Check Sheet Inspector's Name

Customer's Name		VIN	
		Production Date	/ /
		Licence No.	
Date Vehicle Brought In	/ /	Odometer Reading	km miles

Date Problem First Occurred	/ /
Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Other
Temperature	Approx.

Vehicle Operation	☐ Starting ☐ Idling ☐ Driving [☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ Other]

2. SYMPTOM CONFIRMATION AND DIAGNOSTIC TROUBLE CODE CHECK

The diagnostic system in the LAND CRUISER fulfills various functions.

- The first function is the Diagnostic Trouble Code Check (DTC) Check, In a DTC Check, a previous malfunction's DTC can be checked by a technician during troubleshooting. (A DTC is a code stored in the ECU memory whenever a malfunction in the signal circuits to the ECU occurs.)
- Another function is the Input Signal Check, which checks if the signals from various switches are sent to the ECU correctly. By using these check functions, the problem areas can be narrowed down and troubleshooting is more effective. Diagnostic functions are incorporated in the following systems in the LAND CRUISER:

System	Diagnostic Trouble Code Check	Input Signal Check (Sensor Check)	Other Diagnosis Function
Engine	○ (with Check Mode)	○	Diagnostic Test Mode

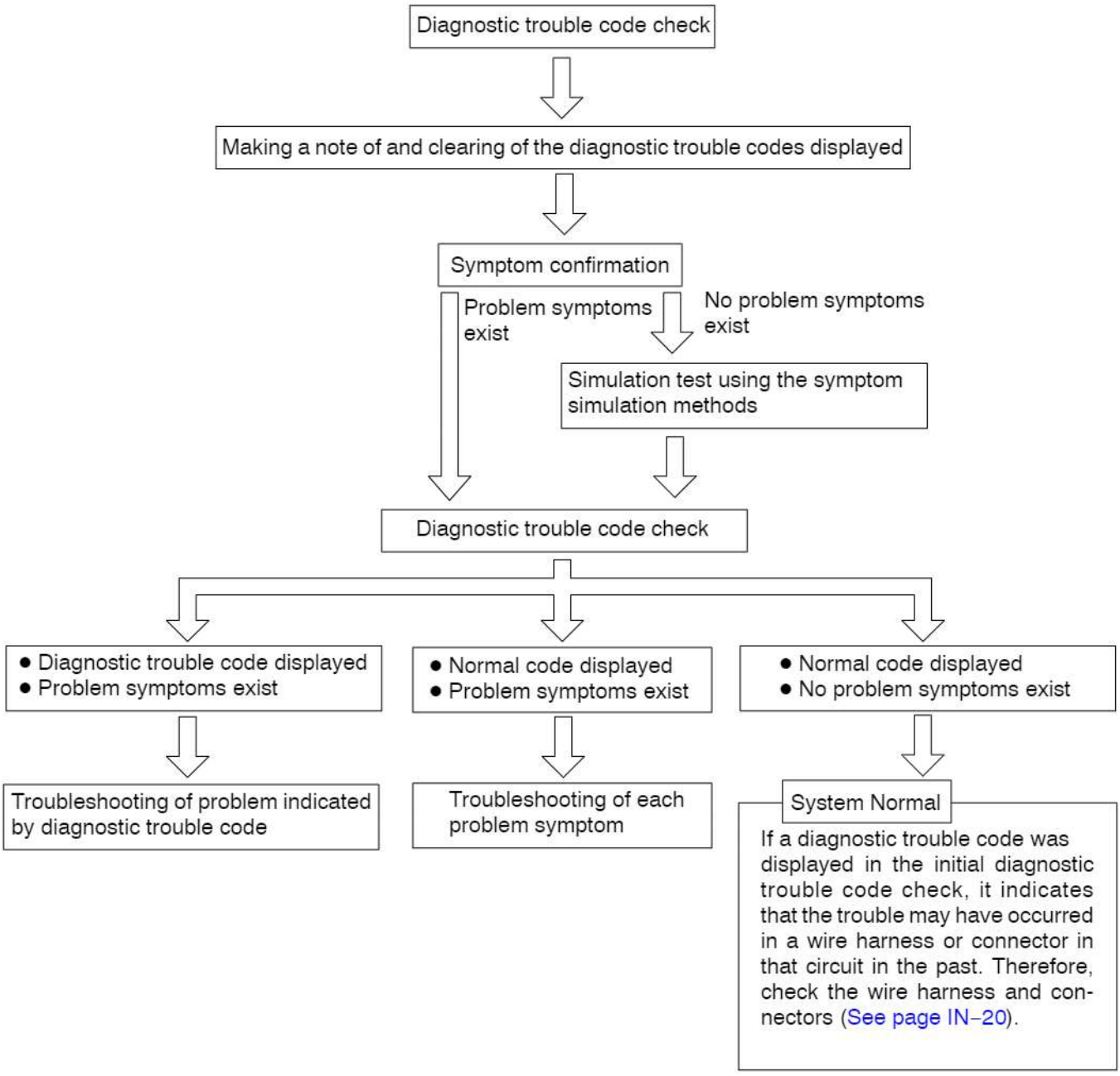
In the DTC Check, it is very important to determine whether the problem indicated by theDTC is: 1) still occurring, or 2) occurred in the past but has since returned to normal. In addition, the DTC should be compared to the problem symptom to see if they are related. For this reason, DTCs should be checked before and after confirmation of symptoms (i.e., whether or not problem symptoms exist) to determine current conditions, as shown in the table below.

Never skip the DTC Check. Failure to check DTCs may, depending on the case, result in unnecessary troubleshooting for systems operating normally or lead to repairs not pertinent to the problem. Follow the procedures listed above in the correct order.

DIAGNOSTIC TROUBLE CODE CHECK PROCEDURE

Diagnostic Trouble Code Check (Make a note of and then clear)	**Confirmation of Symptoms**	**Diagnostic Trouble Code Check**	**Problem Condition**
Diagnostic Trouble Code Display	Problem symptoms exist	Same diagnostic trouble code is displayed	Problem is still occurring in the diagnostic circuit
⇨	⇨	Normal code is displayed	The problem is still occurring in a place other than in the diagnostic circuit (The diagnostic trouble code displayed first is either for a past problem or it is a secondary problem)
⇨	No problem symptoms exist	⇨	The problem occurred in the diagnostic circuit in the past
Normal Code Display	Problem symptoms exist	Normal code is displayed	The problem is still occurring in a place other than in the diagnostic circuit
⇨	No problem symptoms exist	Normal code is displayed	The problem occurred in a place other than in the diagnostic circuit in the past

Taking into account the points on the previous page, a flow chart showing how to proceed with troubleshooting using the DTC check is shown below. Directions from the flow chart will indicate how to proceed to DTC troubleshooting or to the troubleshooting of problem symptoms table.



3. SYMPTOM SIMULATION

The most difficult case in troubleshooting is when no problem symptoms occurring. In such cases, a thorough customer problem analysis must be carried out. then simulate A simulation of the same or similar conditions and environment in which the problem occurred in the customer's vehicle should be carried out. No matter how much skill or experience a technician has, troubleshooting without confirming the problem symptoms will lead to something important in the repair operation being overlooked and lead to mistakes or delays in repairs.

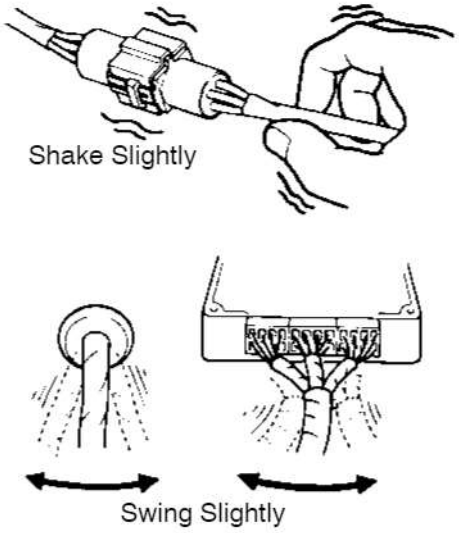
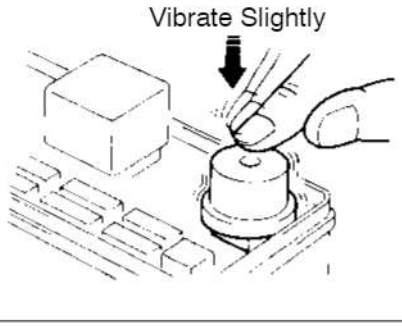
For example:

With a problem that only occurs when the engine is cold, or occurs as a result of vibration caused by the road during driving, the problem can never be determined as long as the symptoms are being checked on a stationary vehicle or a vehicle with a warmed–up engine.

Vibration, heat or water penetration (moisture) is difficult to reproduce. The symptom simulation tests below are effected substitutes for the conditions and can be applied on a stationary vehicle.

Important Points in the Symptom Simulation Test:

In the symptom simulation test, the problem symptoms as well as the problem area or parts must be confirmed. First, narrow down the possible problem circuits according to the symptoms. Then, connect the tester and carry out the symptom simulation test, judging whether the circuit being tested is defective or normal, and also confirming the problem symptoms at the same time. Refer to the problem symptoms table for each system to narrow down the possible causes of the symptom.

1	**VIBRATION METHOD: When vibration seems to be the major cause.**
CONNECTORS Slightly shake the connector vertically and horizontally. **WIRE HARNESS** Slightly shake the wire harness vertically and horizontally. The connector joint, fulcrum of the vibration, and body through portion are the major areas that should be checked thoroughly.	
PARTS AND SENSOR Apply slight vibration with a finger to the part of the sensor considered to be the cause of the problem and check whether or not the malfunction occurs. HINT: Applying strong vibration to relays may result in open relays.	

V07268

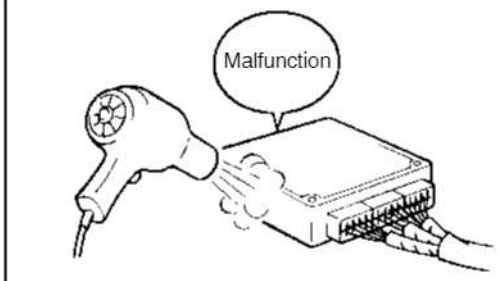
2	**HEAT METHOD: When the problem seems to occur when the suspect area is heated.**

Heat the component that is the likely cause of the malfunction with a hair dryer or similar device. Check wether or not the malfunction occurs.

NOTICE:

(1) Do not heat to more than 60 °C (140 °F). (Exceeding this temperature may damage components.)

(2) Do not apply heat directly to parts in the ECU.



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3	**WATER SPRINKLING METHOD: When the malfunction seems to occur on a rainy day or in a high–humidity condition.**

Sprinkle water onto the vehicle and check whether or not the malfunction occurs.

NOTICE:

(1) Never sprinkle water directly into the engine compartment. Indirectly change the temperature and humidity by applying water spray onto the front of the radiator. Never apply water directly onto electronic components.

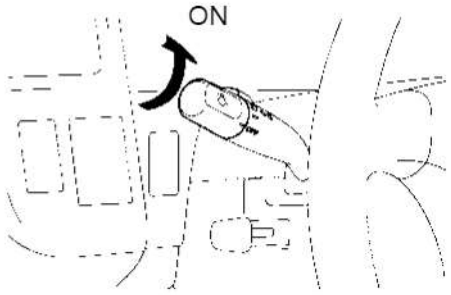
(2)

HINT:
If a vehicle is subject to water leakage, the leaked water may damage the ECU. When testing a vehicle with a water leakage problem, special caution must be taken.

FI6649

4	**OTHER: When a malfunction seems to occur when electrical load is excessive.**

Turn on all electrical loads including the heater blower, head lights, rear window defogger, etc. and check to see if the malfunction occurs.



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B02390

4. DIAGNOSTIC TROUBLE CODE CHART

Use Diagnostic Trouble Codes (DTCs) (from the DTC checks) in the table below to determine the trouble area and proper inspection procedure. The Supplemental Restraint System (SRS) diagnostic trouble code chart is shown below as an example.

- DTC No.
  Indicates the diagnostic trouble code.
- Page or Instructions
  Indicates the page where the inspection procedure for each circuit is to be found, or gives instructions for checking and repairs.

- Trouble Area
  Indicates the suspect area of the problem.

- Detection Item
  Indicates the system of the problem or contents of the problem.

DIAGNOSTIC TROUBLE CODE CHART

If a malfunction code is displayed during the DTC check, check the circuit for that code listed in the table below. (Proceed to the page given for that circuit).

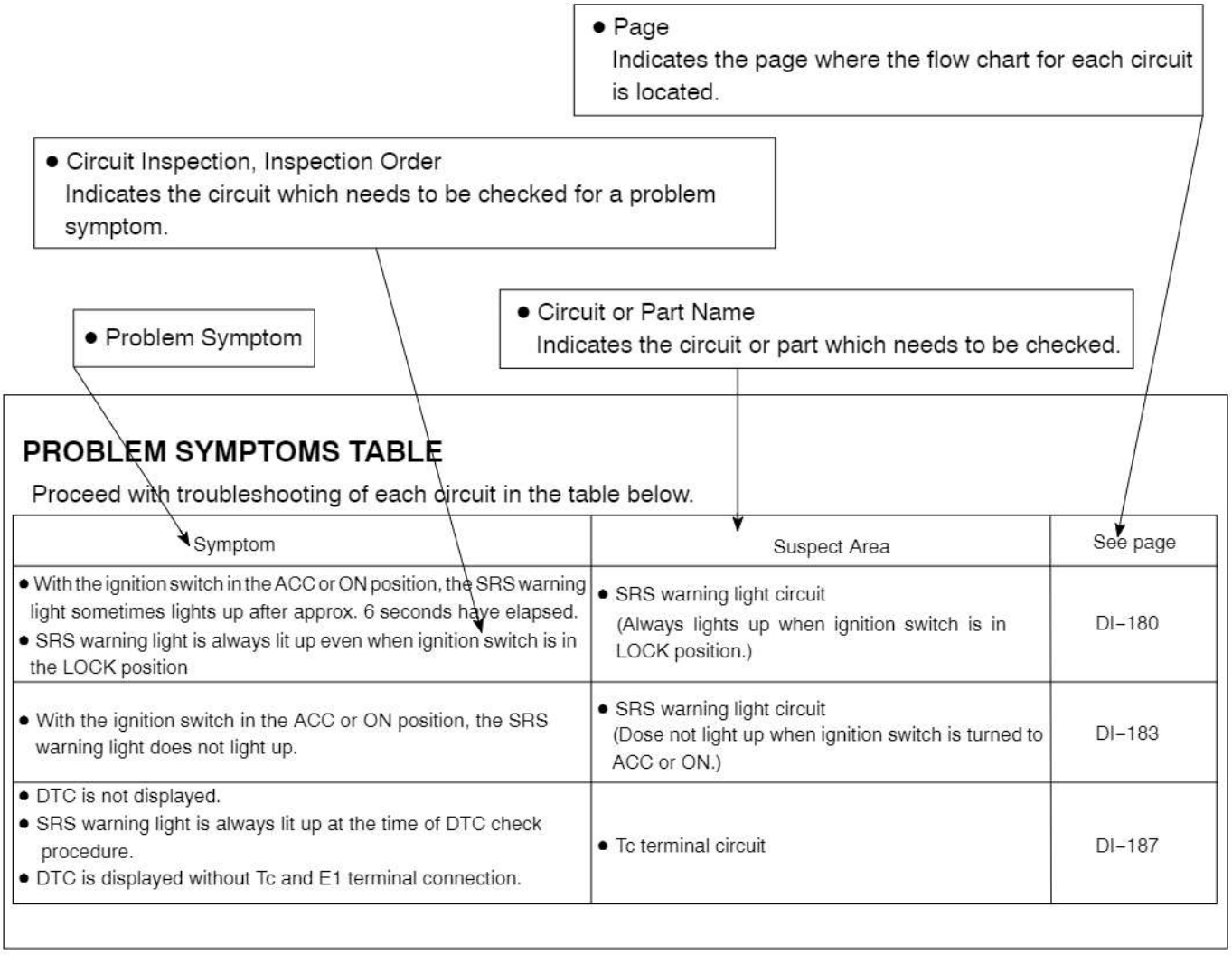
DTC No. (See page)	Detection Item	Trouble Area	SRS Warming Light
B0100/13 (DI–119)	• Short in D squib circuit	• Steering wheel pad (squib) • Spiral cable • Airbag sensor assembly • Wire harness	ON
B0101/14 (DI–124)	• Open in D squib circuit	• Steering wheel pad (squib) • Spiral cable • Airbag sensor assembly • Wire harness	ON
B0102/11 (DI–128)	• Short in D squib circuit (to ground)	• Steering wheel pad (squib) • Spiral cable • Airbag sensor assembly • Wire harness	ON
B0103/12 (DI–132)	• Short in D squib circuit (to B+)	• Steering wheel pad (squib) • Spiral cable • Airbag sensor assembly • Wire harness	ON
B0105/53 (DI–136)	• Short in P squib circuit	• Front Passenger airbag assembly (squib) • Airbag sensor assembly • Wire harness	ON
B0106/54	• Open in P squib circuit	• Front Passenger airbag assembly (squib) • Airbag sensor assembly • Wire harness	
	b circuit (to Ground)	• Front Passenger airbag assembly (squib) • Airbag sensor assembly • Wire harness	

5. PROBLEM SYMPTOMS TABLE

The suspected circuits or parts for each problem symptom are shown in the table below. Use this table to troubleshoot when, during a DTC check, a "Normal" code is displayed in the diagnostic trouble code check but the problem is still occurring. Numbers in the table show the inspection order in which the circuits or parts should be checked.

HINT:

In some cases, a problem is not detected by the diagnostic system even though a problem symptom is present. It is possible that the problem is occurring outside the detection range of the diagnostic system, or that the problem is occurring in a completely different.



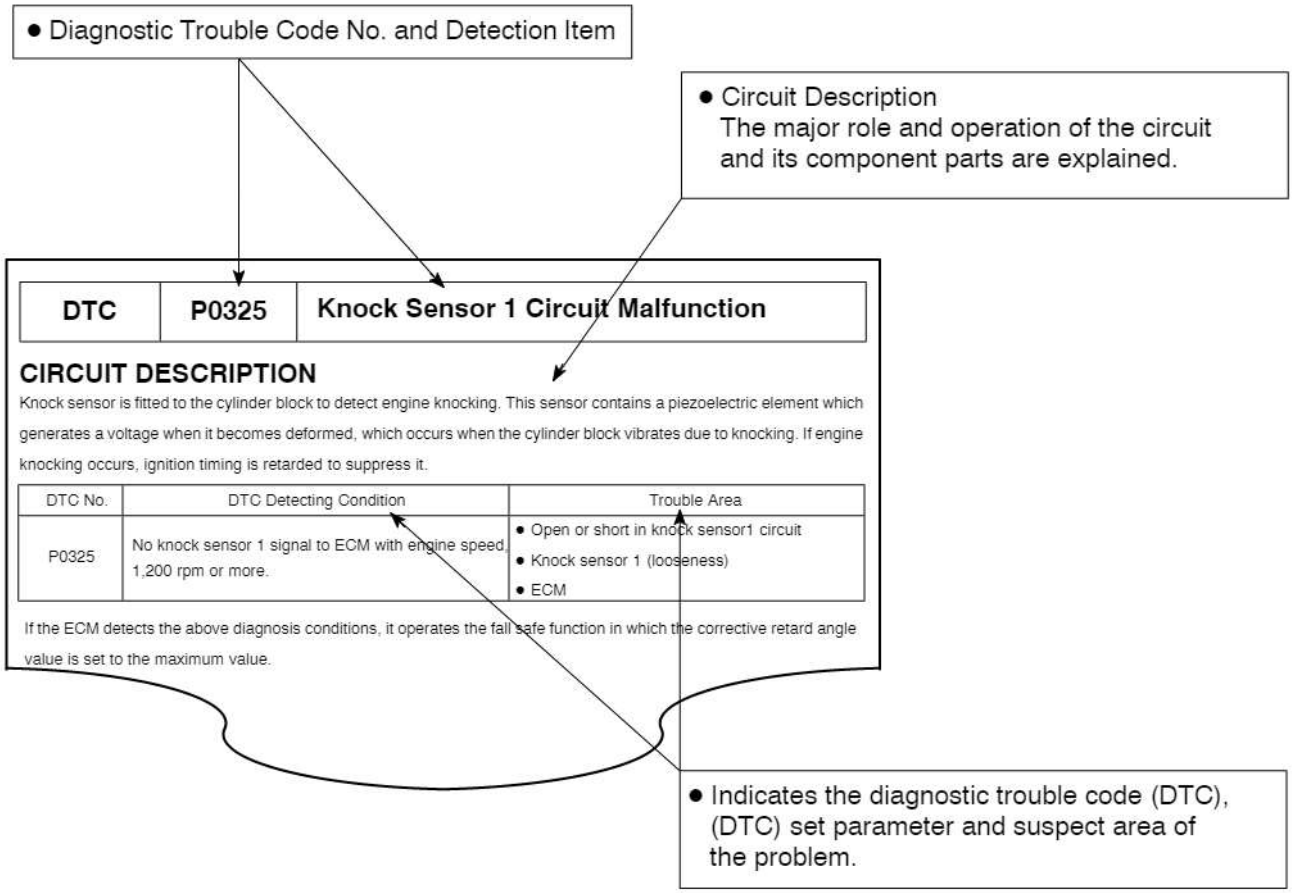
PROBLEM SYMPTOMS TABLE

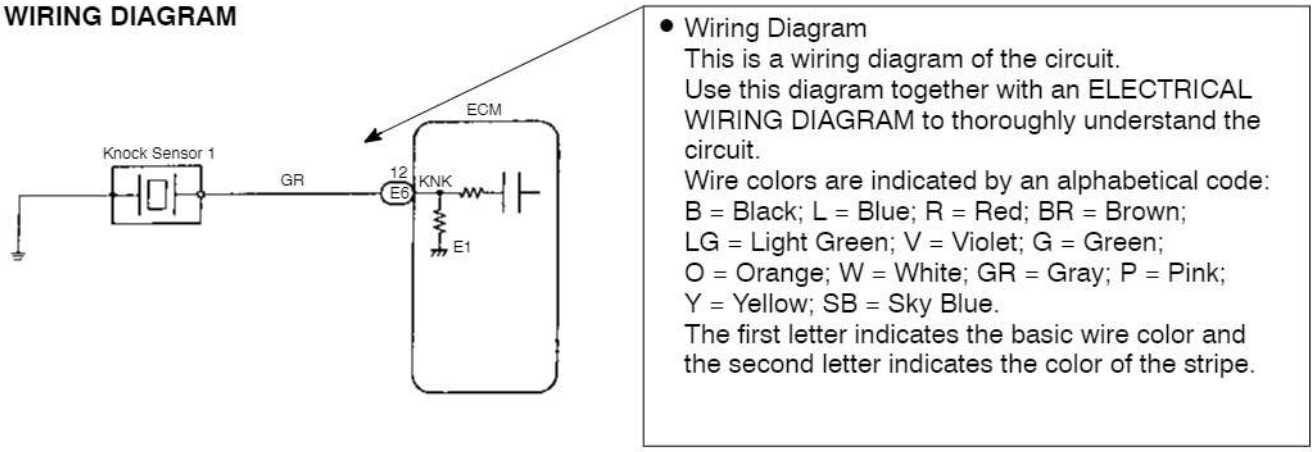
Proceed with troubleshooting of each circuit in the table below.

Symptom	Suspect Area	See page
• With the ignition switch in the ACC or ON position, the SRS warning light sometimes lights up after approx. 6 seconds have elapsed. • SRS warning light is always lit up even when ignition switch is in the LOCK position	• SRS warning light circuit (Always lights up when ignition switch is in LOCK position.)	DI–180
• With the ignition switch in the ACC or ON position, the SRS warning light does not light up.	• SRS warning light circuit (Dose not light up when ignition switch is turned to ACC or ON.)	DI–183
• DTC is not displayed. • SRS warning light is always lit up at the time of DTC check procedure. • DTC is displayed without Tc and E1 terminal connection.	• Tc terminal circuit	DI–187

6. CIRCUIT INSPECTION

How to read and use each page is shown below.





V08423

● Indicates the position of the ignition switch during the check.

LOCK
Ignition Switch LOCK (OFF)

ON
Ignition Switch ON

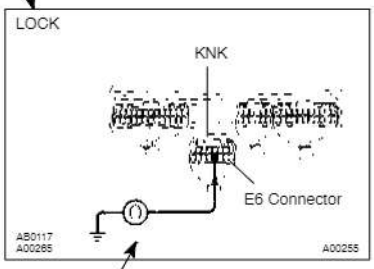
START
Ignition Switch START

ACC
Ignition Switch ACC

● Inspection Procedure
Use the inspection procedure to determine if the circuit is normal or abnormal. If it is abnormal, use it to determine whether the problem is located in the sensors, actuators, wire harness or ECU.

INSPECTION PROCEDURE

1	**Check continuity between terminal KNK of ECM connector and body ground.**



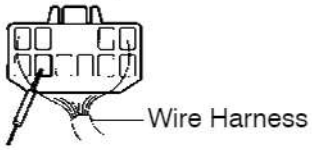
PREPARATION:
(a) Remove the glove compartment (See page SF–68).
(b) Disconnect the E6 connector of ECM.

CHECK:
Measure resistance between terminal KNK of ECM connector and body ground.

OK:
Resistance: 1 MΩ or higher

OK	**Go to step 3.**
NG	
2	**Check knock sensor (See page SF–61).**
OK	**Replace knock sensor.**

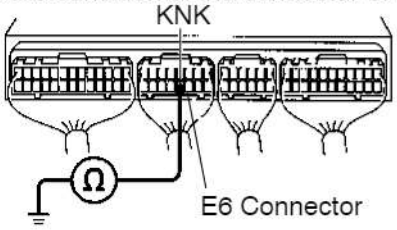
● Indicates the place to check the voltage or resistance.
● Indicates the connector position to checked (from the front or back side).



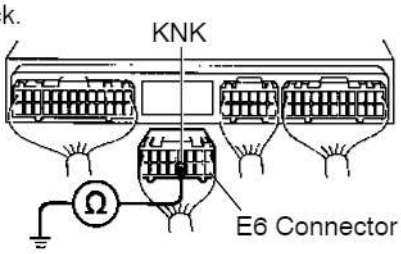
Check from the connector back side (with harness).

Check from the connector front side (without harness).
In this case, care must be taken not to bend the terminals.

● Indicates the condition of the connector of ECU during the check.

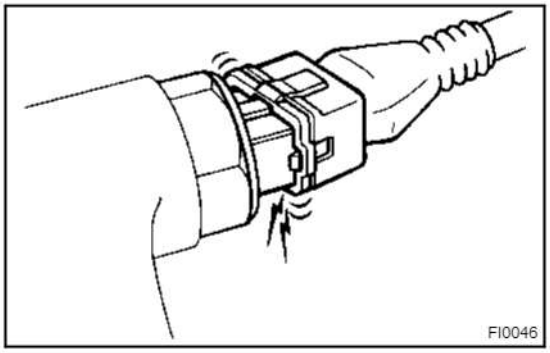


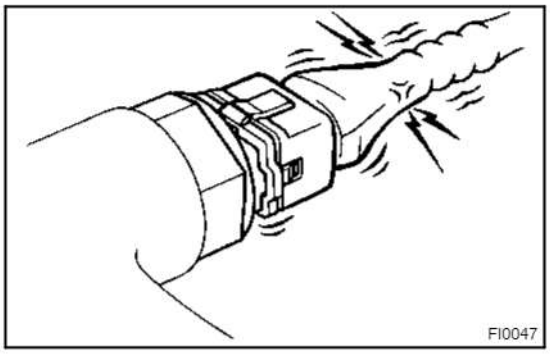
Connector being checked is connected.

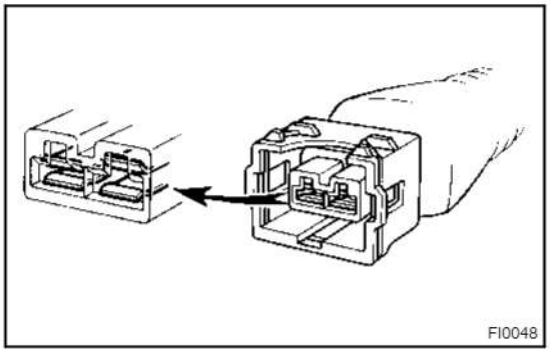


Connector being checked is disconnected.

V08425


FI0046


FI0047


FI0048

IN011-58

HOW TO USE THE DIAGNOSTIC CHART AND INSPECTION PROCEDURE

1. CONNECTOR CONNECTION AND TERMINAL INSPECTION

- For troubleshooting, diagnostic trouble code (DTC) charts or problem symptom charts are provided for each circuit with detailed inspection procedures on the following pages.
- When all the component parts, wire harnesses and connectors of each circuit except the ECU are found to be normal in troubleshooting, then it is determined that the problem is in the ECU. Accordingly, if diagnosis is performed without the problem symptoms occurring, refer to Step 8 to replace the ECU. So always confirm that the problem symptoms are occurring, or proceed with inspection while using the symptom simulation method.
- The instructions "Check wire harness and connector" and "Check and replace ECU" which appear in the inspection procedure, are common and applicable to all diagnostic trouble codes. Follow the procedure outlined below whenever these instructions appear.

OPEN CIRCUIT:

This could be due to a disconnected wire harness, faulty contact in the connector, a connector terminal pulled out, etc.

HINT:

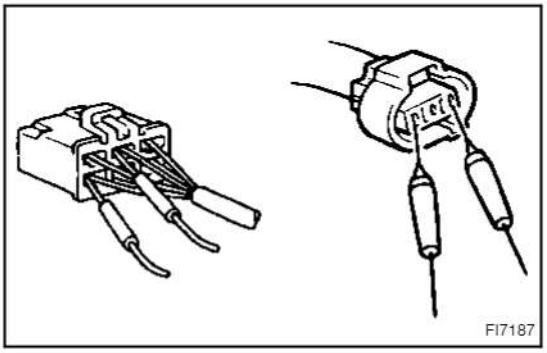
- It is rarely the case that a wire is broken in the middle of it. Most cases occur at the connector. In particular, carefully check the connectors of sensors and actuators.
- Faulty contact could be due to rusting of the connector terminals, to foreign materials entering terminals or a drop in contact pressure between the male and female terminals of the connector. Simply disconnecting and reconnecting the connectors once changes the condition of the connection and may result in a return to normal operation. Therefore, in troubleshooting, if no abnormality is found in the wire harness and connector check, but the problem disappears after the check, then the cause is considered to be in the wire harness or connectors.

SHORT CIRCUIT:

A short circuit be the result of contact between the wire harness and the body ground or a short circuiting switch.

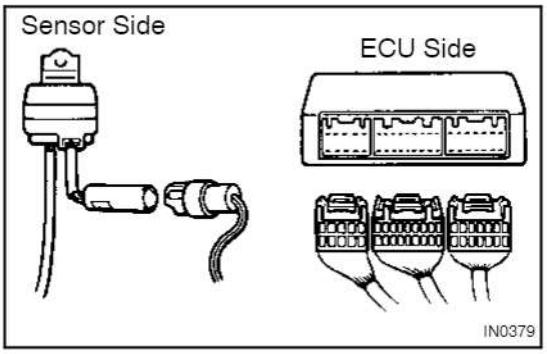
HINT:

When there is a short between the wire harness and body ground, check thoroughly it wire harness is caught in the body or is clamped properly.



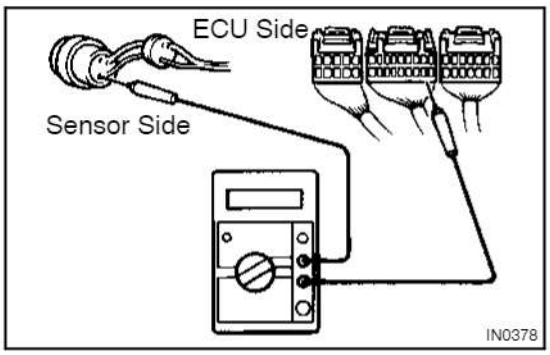
2. CONNECTOR HANDLING

When inserting tester probes into a connector, insert them from the rear of the connector. When necessary, use mini test leads. For water resistant connectors which cannot be accessed from behind, take good care not to deform the connector terminals.



3. CONTINUITY CHECK (OPEN CIRCUIT CHECK)

(a) Disconnect the connectors at both ECU and sensor sides.

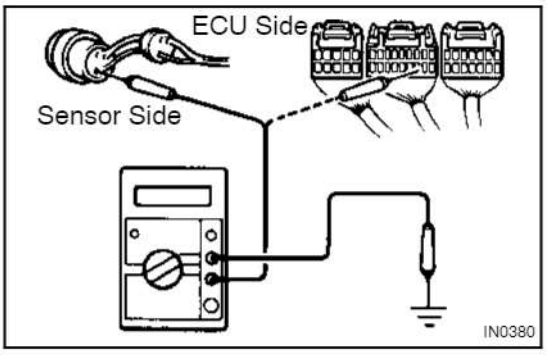


(b) Measure the resistance between the applicable terminals of the connectors.

Resistance: 1 Ω or less

HINT:

Measure the resistance while lightly shaking the wire harness vertically and horizontally.



4. RESISTANCE CHECK (SHORT CIRCUIT CHECK)

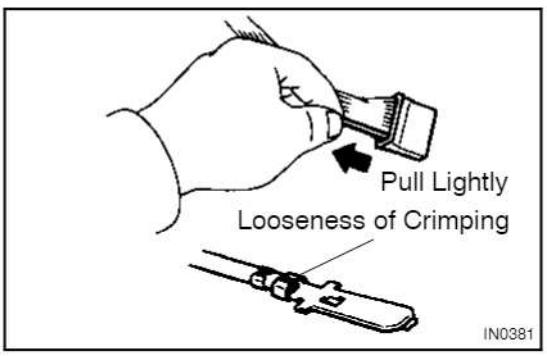
(a) Disconnect the connectors at both ends.

(b) Measure the resistance between the applicable terminals of the connectors and body ground. Be sure to carry out this check on the connectors on both ends.

Resistance: 1 MΩ or higher

HINT:

Measure the resistance while lightly shaking the wire harness vertically and horizontally.



5. VISUAL CHECK AND CONTACT PRESSURE CHECK

(a) Disconnect the connectors at both ends.

(b) Check for rust or foreign material, etc. in the terminals of the connectors.

(c) Check crimped portions for looseness or damage and check if the terminals are secured in the lock portion.

HINT:

The terminals should not come out when pulled lightly from the back.

(d) Prepare a test male terminal and insert it in the female terminal, then pull it out.

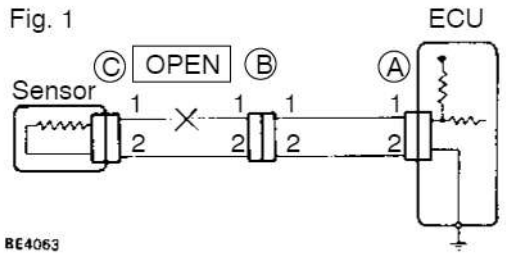
NOTICE:

When testing a gold–plated female terminal, always use a gold–plated male terminal.

HINT:

If a test terminal is easier to pull out than others, there may be poor contact in that section.

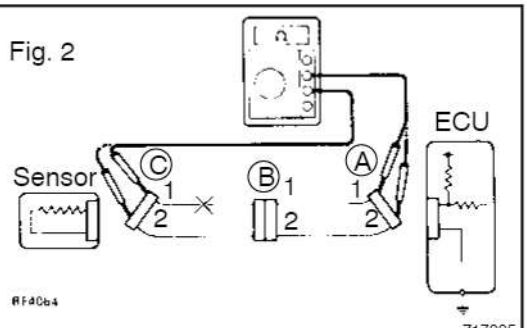
Fig. 1



6. CHECK OPEN CIRCUIT

For the open circuit in the wire harness in Fig. 1, performs a continuity check (step (a) below) or a voltage check (step (b) below).

Fig. 2



(a) Check the continuity.

(1) Disconnect connectors "A" and "C" and measure the resistance between them.

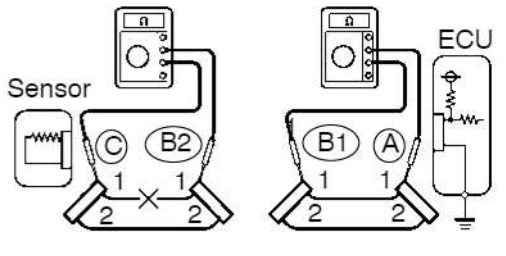
In the case of Fig. 2:

Between terminal 1 of connector "A" and terminal 1 of connector "C" → No continuity (open)

Between terminal 2 of connector "A" and terminal 2 of connector "C" → Continuity

An open circuit exists between terminal 1 of connector "A" and terminal 1 of connector "C".

Fig. 3



(2) Disconnect connector "B" and measure the resistance between the connectors.

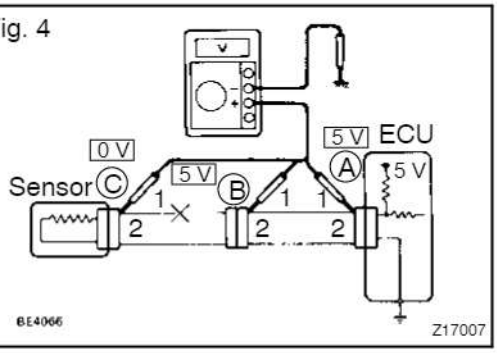
In the case of Fig. 3:

Between terminal 1 of connector "A" and terminal 1 of connector "B1" → Continuity

Between terminal 1 of connector "B2" and terminal 1 of connector "C" → No continuity (open)

An open circuit exists between terminal 1 of connector "B2" and terminal 1 of connector "C".

Fig. 4



(b) Check the voltage.

In a circuit in which voltage is applied to the ECU connector terminal, an open circuit can be checked for by conducting a voltage check.

As shown in Fig. 4, with each connector still connected, measure the voltage between body ground and terminal 1 of connector "A" at the ECU 5 V output terminal, terminal 1 of connector "B", and terminal 1 of connector "C" (in that order).

Example results:

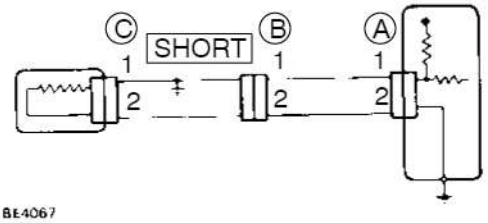
5 V: Between Terminal 1 of connector "A" and Body Ground

5 V: Between Terminal 1 of connector "B" and Body Ground

0 V: Between Terminal 1 of connector "C" and Body Ground

In the above example, an open circuit is in the wire harness between terminal 1 of "B" and terminal 1 of "C".

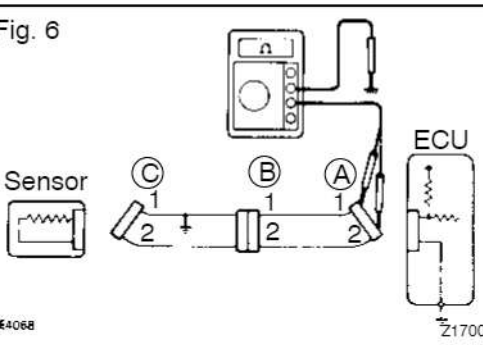
Fig. 5



7. CHECK SHORT CIRCUIT

If the wire harness is ground shorted (Fig. 5), locate the section by conducting a continuity check with ground below.

Fig. 6



Check the continuity with ground.

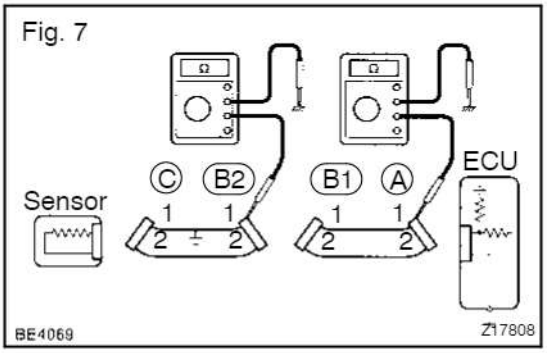
(1) Disconnect connectors "A" and "C" and measure the resistance between terminal 1 and 2 of connector "A" and body ground.

In the case of Fig. 6:

Between terminal 1 of connector "A" and body ground → Continuity (short)

Between terminal 2 of connector "A" and body ground → No continuity

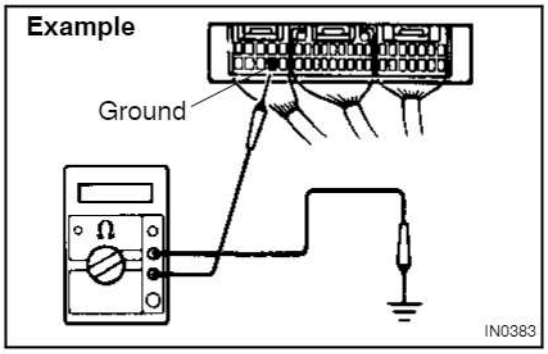
A short circuit is between terminal 1 of connector "A" and terminal 1 of connector "C".



(2) Disconnect connector "B" and measure the resistance between terminal 1 of connector "A" and body ground, and terminal 1 of connector "B2" and body ground.
In the case of Fig. 7:
Between terminal 1 of connector "A" and body ground → No continuity
Between terminal 1 of connector "B2" and body ground → Continuity (short)
A short circuit is between terminal 1 of connector "B2" and terminal 1 of connector "C".

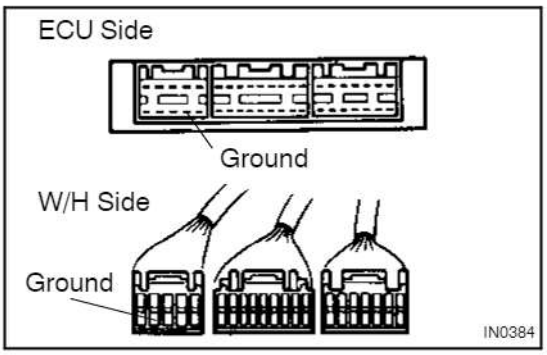
8. CHECK AND REPLACE ECU

First check the ECU ground circuit. If it is faulty, repair it. If it is normal, the ECU could be faulty. Replace the ECU with a normal good one and check that the symptoms appear.



(1) Measure the resistance between the ECU ground terminal and the body ground.

Resistance: 1 Ω or less



(2) Disconnect the ECU connector. Check for bent ground terminals (on the ECU side and the wire harness side). for Lastly, check the contact pressure.

TERMS

ABBREVIATIONS USED IN THIS MANUAL

IN04Q–26

Abbreviations	Meaning
A/C	Air Conditioning
AC	Alternating Current
ACC	Accessory
ACIS	Acoustic Control Induction System
ACSD	Automatic Cold Start Device
ALT	Alternator
AMP	Amplifier
APPROX.	Approximately
A/T	Automatic Transmission (Transaxle)
BACS	Boost Altitude Compensation System
BAT	Battery
BTDC	Before Top Dead Center
BVSV	Bimetallic Vacuum Switching Valve
CB	Circuit Breaker
CCO	Catalytic Converter for Oxidation
DC	Direct Current
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
ECD	Electronic Control Diesel
ECT	Electronic Control Transmission
ECU	Electronic Control Unit
EDU	Electronic Driving Unit
EFI	Electronic Fuel Injection
E/G	Engine
EGR	Exhaust Gas Recirculation
EVAP	Evaporative Emission Control
E–VRV	Electronic Vacuum Regulating Valve
EX	Exhaust
FIPG	Formed In Place Gasket
FL	Fusible Link
Fr	Front
GND	Ground
HAC	High Altitude Compensator
IG	Ignition
IIA	Integrated Ignition Assembly
IN	Intake
ISC	Idle Speed Control
J/B	Junction Block
J/C	Junction Connector
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LH	Left–Hand

LHD	Left–Hand Drive
LO	Low
MAP	Manifold Absolute Pressure
MAX.	Maximum
MIL	Malfunction Indicator Lamp
MIN.	Minimum
MP	Multipurpose
M/T	Manual Transmission
N	Neutral
O2S	Oxygen Sensor
O/D	Overdrive
O/S	Oversize
PKB	Parking Brake
PS	Power Steering
RAM	Random Access Memory
R/B	Relay Block
RH	Right–Hand
RHD	Right–Hand Drive
ROM	Read Only Memory
Rr	Rear
SICS	Starting Injection Control System
SPEC	Specification
SSM	Special Service Materials
SST	Special Service Tools
STD	Standard
SW	Switch
TACH	Tachometer
TDC	Top Dead Center
TEMP.	Temperature
TM	Transmission
TMC	TOYOTA Motor Corporation
TWC	Three–Way Catalyst
U/D	Underdrive
VCV	Vacuum Control Valve
VIN	Vehicle Identification Number
VSV	Vacuum Switching Valve
w/	With
W/H	Wire Harness
w/o	Without
WU–TWC	Warm Up Three–Way Catalytic Converter
2WD	Two Wheel Drive Vehicle (4x2)
4WD	For Wheel Drive Vehicle (4x4)