
DIAGNOSTICS

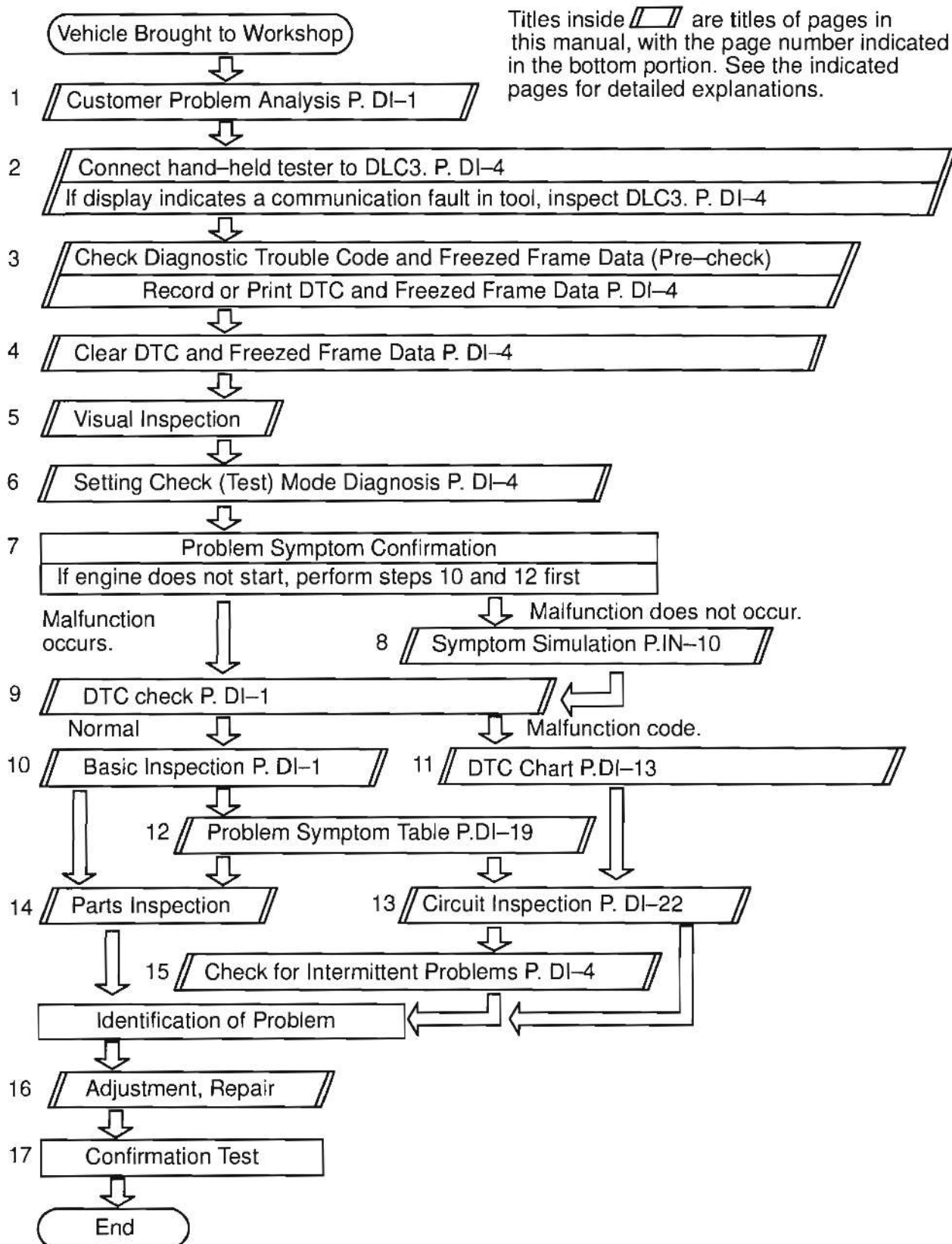
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ENGINE


HOW TO PROCEED WITH TROUBLESHOOTING

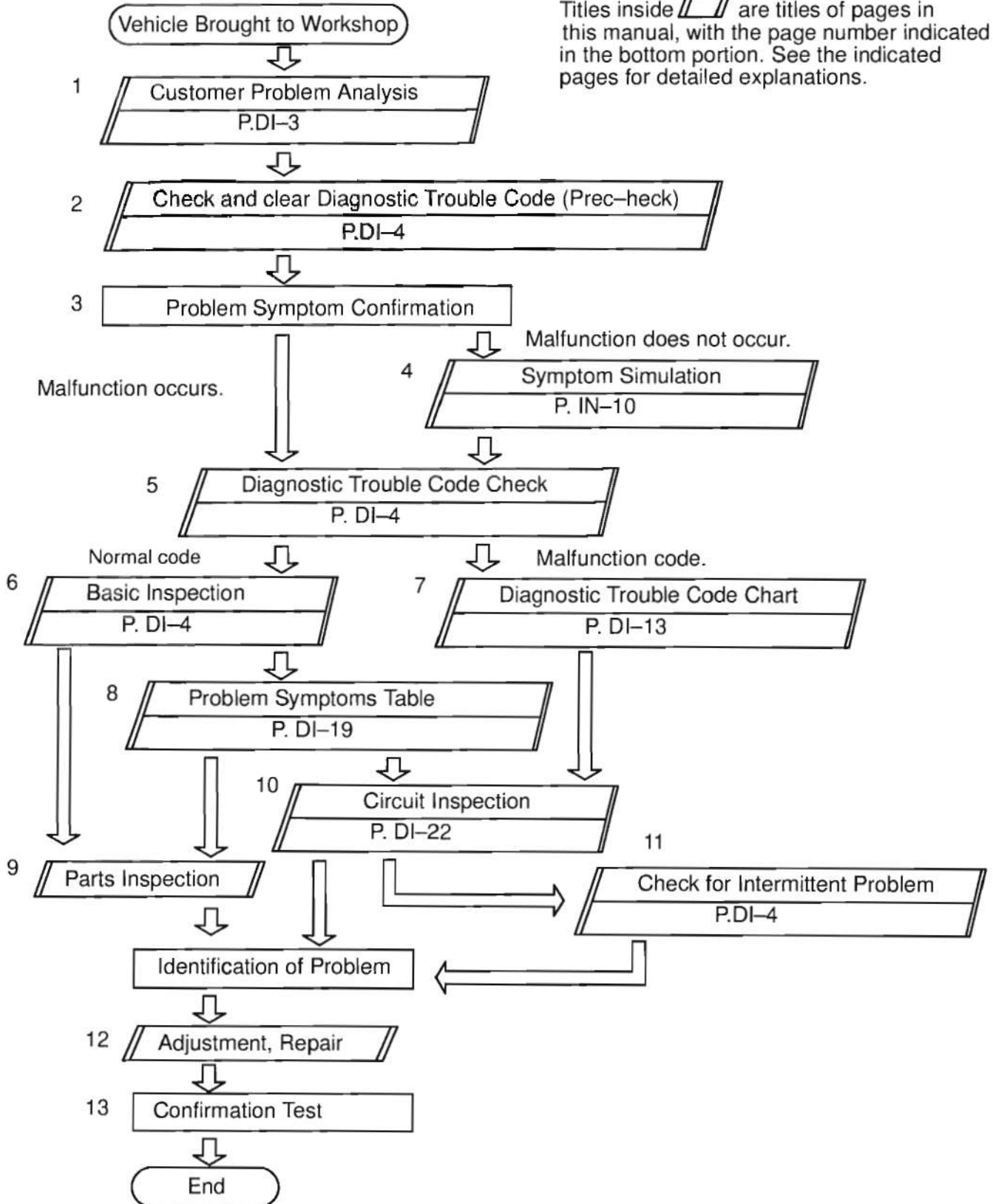
DI1H-03

When using hand-held tester, troubleshoot in accordance with the procedure on the following pages.



When not using hand-held tester, troubleshoot in accordance with the procedure on the following pages.

Titles inside  are titles of pages in this manual, with the page number indicated in the bottom portion. See the indicated pages for detailed explanations.



CUSTOMER PROBLEM ANALYSIS CHECK

ENGINE CONTROL SYSTEM Check Sheet

Inspector's Name _____

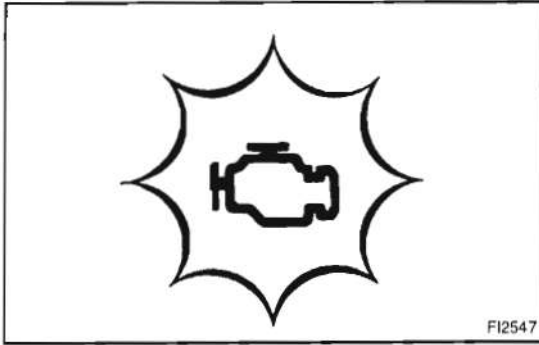
Customer's Name		Model and Model Year	
Driver's Name		Frame No.	
Date Vehicle Brought in		Engine Model	
License No.		Odometer Reading	km miles

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

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

Condition of Malfunction indicator Lamp		<input type="checkbox"/> Remains on <input type="checkbox"/> Sometimes lights up <input type="checkbox"/> Does not light up		
Diagnostic Trouble Code Inspection	Normal Mode (Precheck)	<input type="checkbox"/> Normal	<input type="checkbox"/> Malfunction code(s) (code) <input type="checkbox"/> Freezed frame data ()	
	Check Mode	<input type="checkbox"/> Normal	<input type="checkbox"/> Malfunction code(s) (code) <input type="checkbox"/> Freezed frame data ()	

DI



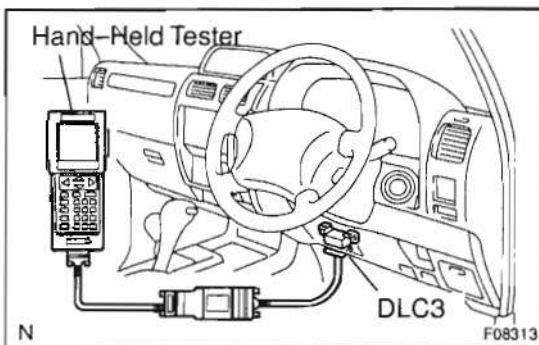
PRE-CHECK

1. DIAGNOSIS SYSTEM

(a) Description

- When troubleshooting Multiplex OBD (M-OBD) vehicles, the only difference from the usual troubleshooting procedure is that you connect the vehicle to the hand-held tester, and read off various data output from the vehicle's engine ECU.
- The vehicle's on-board computer lights up the check engine warning light on the instrument panel when the computer detects a malfunction in the computer itself or in drive system components. In addition to the check engine warning light lighting up when a malfunction is detected, the applicable diagnostic trouble codes are recorded in the engine ECU memory. (See page DI-13)

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



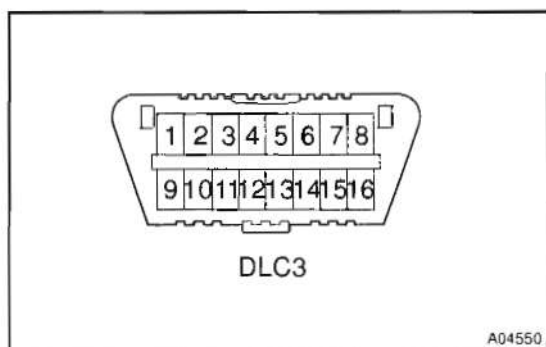
- To check the diagnostic trouble codes, connect the hand-held tester to Data Link Connector 3 (DLC3) on the vehicle or read the number of blinks of the check engine warning light when TC and CG terminals on the DLC3 are connected. The hand-held tester also enables you to erase the diagnostic trouble codes and activate the several actuators and check freeze frame date and various forms of engine data. (For operating instructions, see the hand-held tester instruction book.)
- The diagnosis system operates in normal mode during normal vehicle use. It also has a check (test) mode for technicians to simulate malfunction symptoms and troubleshoot. Some diagnostic trouble codes use 2 trip detection logic* to prevent erroneous detection and ensure thorough malfunction detection. By switching the engine ECU to check (test) mode using hand-held tester when troubleshooting, the technician can cause the check engine warning light to light up for a malfunction that is only detected once or momentarily. (hand-held tester only) (See page DI-13)

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

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

- Freeze frame data:
Freeze frame data records the engine condition when malfunction is detected. Because freeze frame data records the engine conditions (fuel system, calculator load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when the malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was lean or rich, etc. at the time of the malfunction.

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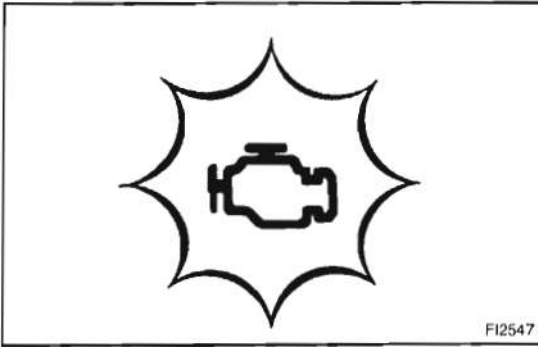
- (b) Check the DLC3.
The vehicle's engine ECU uses ISO 14230 for communication. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 14230 format.

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

HINT:

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

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



2. INSPECT DIAGNOSIS (Normal Mode)

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

HINT:

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

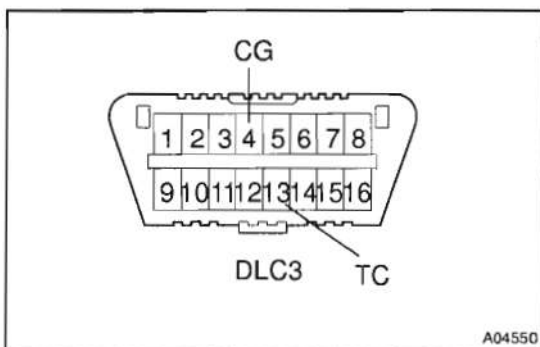
- (2) when the engine is started, the check engine warning light should go off. If the lamp remains on, the diagnosis system has detected a malfunction or abnormality in the system.

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

NOTICE:

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

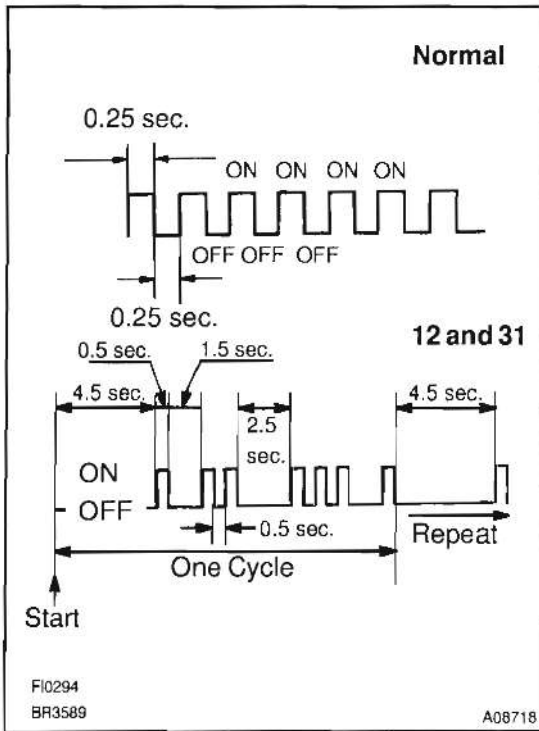
- (1) Prepare the hand-held tester.
- (2) Connect the hand-held tester to the DLC3.
- (3) Turn the ignition switch ON and switch the hand-held tester main switch ON.
- (4) Use the hand-held tester to check the DTCs and freeze frame data, note them down. (for operating instructions, see the hand-held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



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

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

SST 09843-18040



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

HINT:

If a DTC is not output, check the diagnostic connector (DLC3) circuit (See page DI-112).

- (4) Check the details of the malfunction using the DTC chart on page DI-13.
- (5) After completing the check, disconnect terminals 13 (TC) and 4 (CG) and turn off the display.

HINT:

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

NOTICE:

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

3. INSPECT DIAGNOSIS (Check (Test) Mode)

Hand-held tester only:

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

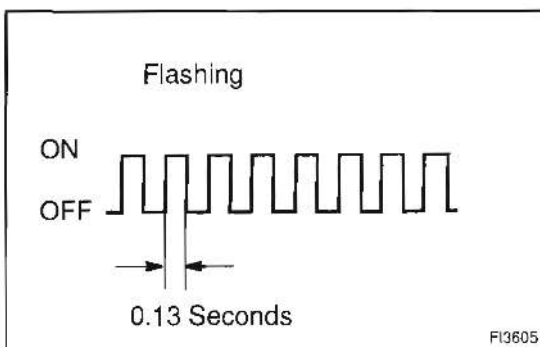
Furthermore, the same diagnostic items which are detected in the normal mode can also be detected in the check (test) mode.

- (a) Check the DTC.

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

NOTICE:

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



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

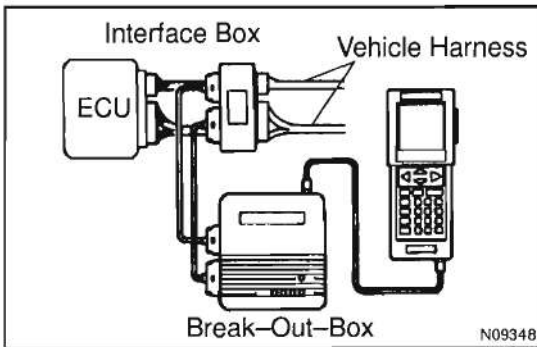
HINT:

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

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

NOTICE:

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



- (c) Measure the engine ECU terminal values using break-out box and hand-held tester.
- (1) Hook up the break-out-box and hand-held tester to the vehicle.
 - (2) Read the engine ECU input/output values by following the prompts on the tester screen.

HINT:

Hand-held tester has a "Snapshot" function.

This records the measured values and is effective in the diagnosis of intermittent problems.

Please refer to the hand-held tester/break-out-box operator's manual for further details.

4. FAIL-SAFE CHART

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

DTC No.	Fail-Safe Operation	Fail-Safe Deactivation Conditions
12	Out put limit	Return to normal condition
15	Out put limit	+B OFF
19 (1)	Out put limit	+B OFF
22	Engine coolant temp. is fixed at 107°C (224.6°F)	Return to normal condition
24	Intake air temp. is fixed at 170°C (338°F)	Return to normal condition
32	Compensation value is set at fixed value	Return to normal condition
34	Turbo charger control link fully open	+B OFF
35	Turbo pressure is set at fixed value	Return to normal condition
39	Fuel temp. is fixed at 40°C (104.0°F)	Return to normal condition
42	Vehicle speed is fixed at 0 km/h (0 mph)	Vehicle speed > 0 km/h (0 mph)
49	Out put limit	+B OFF
78 (1)	Fuel cut	+B OFF
78 (3)	Out put limit	+B OFF
97	Fuel cut	IG OFF→ON or Starter ON
	Out put limit	

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5. CHECK FOR INTERMITTENT PROBLEMS

Hand-held tester only:

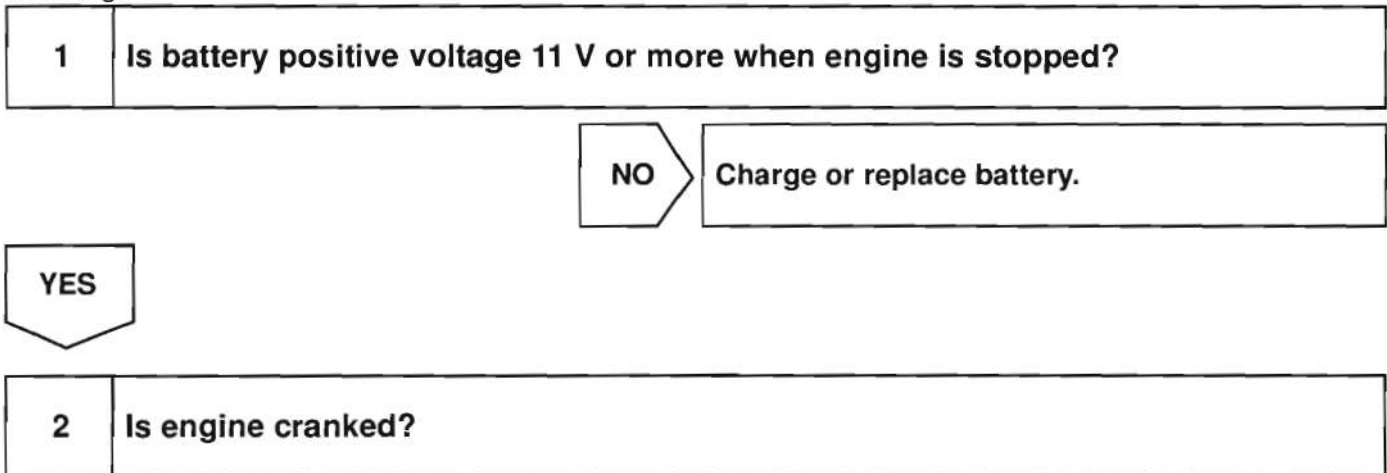
By putting the vehicle's engine ECU in the check (test) mode, 1 trip detection logic is possible instead of 2 trip detection logic and sensitivity to detect open circuits is increased. This makes it easier to detect intermittent problems.

- Clear the DTC (See step 3).
- Set the check (test) mode (See step 3).
- Perform a simulation test (See page IN-10).
- Check the connector and terminal (See page IN-20).
- Handle the connector (See page IN-20).

6. BASIC INSPECTION

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

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



NO

Proceed to problem symptoms table on page DI-19.

YES

3 Check air filter (See page EM-1).

NG

Repair or replace.

OK

4 Check fuel quality.**CHECK:**

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

NG

Replace fuel.

OK

5 Check engine oil (See page LU-1).

NG

Add or replace.

OK

6 Check coolant (See page CO-1).

NG

Replace coolant.

OK

7 Check diagnostic connector (DLC3) circuit (See page DI-112).

NG

Repair or replace.

OK

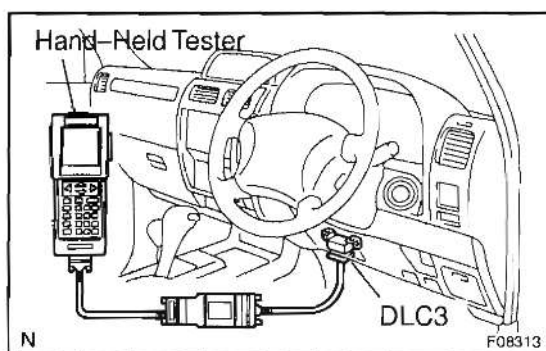
8 Check vacuum pump (See page EC-3).

NG

Repair or replace.

OK

Proceed to problem symptoms table on page DI-19.



7. REFERENCE VALUE OF ENGINE ECU DATA

NOTICE:

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

HINT:

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

- Connect the hand-held tester to the DLC3.
- Monitor engine ECU data by following the prompts on the tester screen.
Please refer to the hand-held tester operator's manual for further detail.
- Reference Value

Item	Inspection Condition	Reference Value
INJECTION VOLUME	Engine at idling*	3 – 10 mm ³ /st
	Engine racing at 2,000 rpm*	5 – 12 mm ³ /st
	Engine racing at 3,000 rpm*	7 – 14 mm ³ /st

INJECTION TIMING	Engine at idling*	-7°CA
	Engine racing at 2,000 rpm*	-7 – -4°CA
	Engine racing at 3,000 rpm*	2 – 5°CA
ENGINE SPD	RPM kept stable (Comparison with tachometer)	No great changes
PIM	Engine at idling*	90 – 100 kPa
	Engine racing at 2,000 rpm*	95 – 115 kPa
	Engine racing at 3,000 rpm*	100 – 120 kPa
ACCELE POSITION	Accelerator pedal fully closed	0 – 20 %
	Accelerator pedal fully opened	80 – 100 %
IDL SIG	Accelerator pedal full closed	650 – 750 rpm
STARTER SIG	During cranking	ON
A/C CUT SIG	A/C switch OFF	ON
EGR SYSTEM	Idling	ON
ACCEL CLOSE SW	Accelerator pedal fully closed	ON
AFM	Air Flow Rate Through Air Flow Meter at idling	5 – 10 g/sec
COMN RAIL PRESS	Engine at idling*	30 – 40 Mpa
M – INJ/PILOT ON	Engine at idling*	700 – 900 μs
M – INJ/PILOT OFF	Engine at idling*	0 μs
PILOT – INJ	Engine at idling*	500 – 600 μs
PUMP VCM ANGLE	Engine at idling*	70 – 90°CA

HINT:

*: Flat and level place, complete warning-up, shift lever to Nor P position, all accessories and A/C are switched OFF.

DIAGNOSTIC TROUBLE CODE CHART

HINT:

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

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

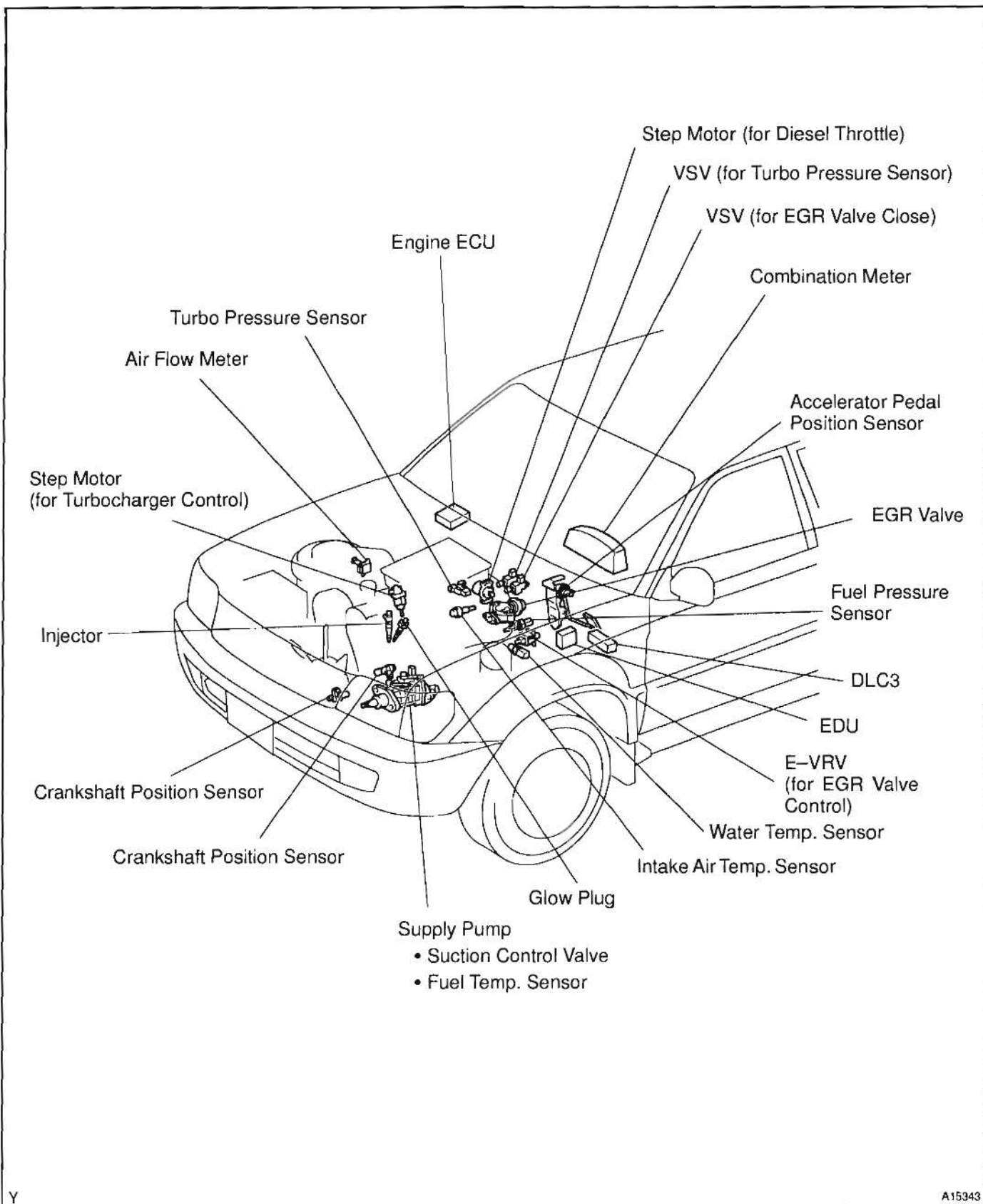
DTC No. (See page)	Detection Item	Trouble Area	*1 Check Engine Warning Light (NormalMode/ Test Mode)	*2 Memory
12 (DI-22)	Engine speed Sensor Circuit Malfunction (TDC or G1 circuit)	<ul style="list-style-type: none"> • Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing pulley • Engine ECU 	ON/ON	○
13 (DI-24)	Engine speed Sensor Circuit Malfunction (NE circuit)	<ul style="list-style-type: none"> • Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Crankshaft timing pulley • Engine ECU 	ON/ON	○
15 (DI-26)	Throttle Control Motor Circuit Malfunction	<ul style="list-style-type: none"> • Open or short in throttle control motor circuit • Throttle control motor • Throttle valve • Engine ECU 	ON/ON	○
19 (1) (DI-28)	Accelerator Pedal Position Sen- sor Circuit Malfunction (Open/ Short)	<ul style="list-style-type: none"> • Open or short in accelerator pedal position sensor circuit • Accelerator pedal position sensor • Engine ECU 	ON/ON	○
19 (2) (DI-34)	Accelerator Pedal Position Sen- sor Circuit Malfunction (IDL Switch/Range)	<ul style="list-style-type: none"> • Open or short in accelerator pedal position sensor circuit • Accelerator pedal position sensor • Engine ECU 	ON/ON	○
22 (DI-36)	Water Temp. Sensor Circuit Mal- function	<ul style="list-style-type: none"> • Open or short in water temp. sensor circuit • Water temp. sensor • Engine ECU 	ON/ON	○
24 (1) (DI-41)	Intake Air Temp. Sensor Circuit Malfunction	<ul style="list-style-type: none"> • Open or short in intake air temp. sensor circuit • Intake air temp. sensor • Engine ECU 	OFF/ON	○
24 (2) (DI-46)	Atmospheric Temp. Sensor Cir- cuit Malfunction	<ul style="list-style-type: none"> • Open or short in atmospheric temp. sensor circuit • Atmospheric air temp. sensor (built into air flow meter) • Engine ECU 	OFF/ON	○
31 (DI-51)	Air Flow Circuit Malfunction	<ul style="list-style-type: none"> • Open or short in air flow meter circuit • Air flow meter • Engine ECU 	ON/ON	○
32 (DI-56)	Injector Correction Resistance Malfunction	<ul style="list-style-type: none"> • Open or short in injector correction resistance cuicuit • Injector correction resistance • Engine ECU 	OFF/ON	○
34 (1) (DI-57)	Step motor for turbocharger con- trol circuit malfunction	<ul style="list-style-type: none"> • Step motor • Wire harness • Engine ECU 	ON/ON	○
34 (2) (DI-59)	Turbocharger system malfunc- tion	<ul style="list-style-type: none"> • Turbocharger • EGR valve • Air flow meter • Engine ECU 	ON/ON	○

34 (3) (DI-59)	Turbocharger stick detected (Close)	<ul style="list-style-type: none"> • Turbocharger • EGR valve • Air flow meter • Engine ECU 	ON/ON	○
35 (DI-61)	Turbo Pressure Sensor Circuit Malfunction	<ul style="list-style-type: none"> • Open or short in turbo pressure sensor circuit • Turbo pressure sensor • Open or short in VSV for turbo pressure sensor circuit • VSV for turbo pressure sensor • Vacuum hose disconnected or blocked • Turbocharger • EGR valve • Air flow meter • Engine ECU 	ON/ON	○
39 (DI-70)	Fuel Temp. Sensor Circuit Mal- function	<ul style="list-style-type: none"> • Open or short in fuel temp. sensor circuit • Fuel pressure sensor • Engine ECU 	ON/ON	○
42 (DI-75)	Vehicle Speed Sensor Signal Circuit Malfunction	<ul style="list-style-type: none"> • Open or short in vehicle speed sensor circuit • Vehicle speed sensor • Combination meter • Engine ECU 	ON/ON	○
49 (DI-77)	Common Rail Pressure Sensor Circuit Malfunction	<ul style="list-style-type: none"> • Open or short in fuel pressure sensor circuit for common rail • Fuel pressure sensor for common rail • Engine ECU 	ON/ON	○
78(1) (DI-79)	Fuel pump Circuit Malfunction (Fuel Leakage)	<ul style="list-style-type: none"> • Open or short in EDU circuit • EDU • Open or short in injector circuit • Injector • Open or short in common rail pressure sensor circuit • Common rail pressure sensor • Fuel line between supply pump and common rail • Fuel line between common rail and injector • Pressure limiter • Engine ECU 	ON/ON	○
78(2)(3) (DI-84)	Fuel pump Circuit Malfunction (Open Circuit) Fuel pump Circuit Malfunction (Over Force Feed)	<ul style="list-style-type: none"> • Open or short in SCV circuit • SCV • Supply pump • Engine ECU 	ON/ON	○
97 (DI-88)	EDU Circuit Malfunction	<ul style="list-style-type: none"> • Open or short in EDU circuit • EDU • Open or short in SCV circuit • SCV • Injector • Engine ecu. 	ON/ON	○
99	Engine Immobilizer System Mal- function	<ul style="list-style-type: none"> • Open or short in engine immobilizer system circuit • Transponder key amplifier • Transponder key computer • Transponder key coil • Engine ECU 	OFF/ON	○

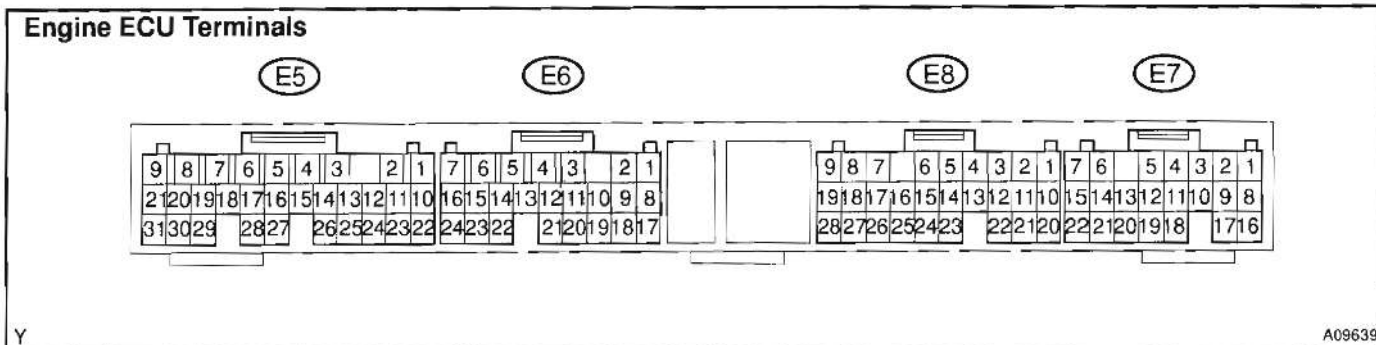
*1: "ON" displayed in the diagnosis mode column indicates that the check engine warning light is lighted up when a malfunction is detected.

*2: "○" in the memory column indicates that a DTC code is recorded in the engine ECU memory when a malfunction occurs. Accordingly, output of diagnostic results in the normal or test mode is done with the ignition switch ON.

PARTS LOCATION



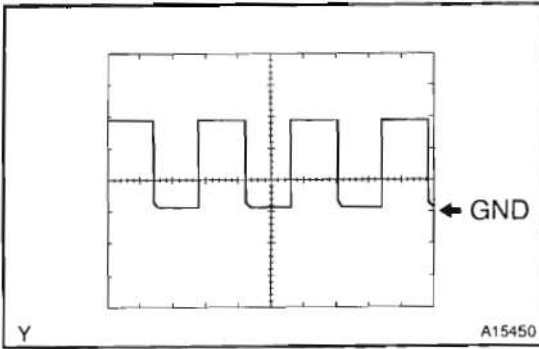
TERMINALS OF ECU



Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E7-2) – E1 (E5-22)	B-Y – BR	Always	9 – 14
+B (E7-1) – E1 (E5-22)	B-R – BR	IG switch ON	9 – 14
VC (E6-21) – E2 (E6-20)	B – BR	IG switch ON	4.5 – 5.5
VCC (E8-8) – E2C (E8-27)	G-Y – BR-W	IG switch ON	4.5 – 5.5
VCC2 (E8-13) – E2C (E8-27)	Y-B – BR-W	IG switch ON	4.5 – 5.5
VA (E8-19) – E2C (E8-27)	Y-R – BR-W	Accelerator pedal fully closed	0.3 – 0.8
		Accelerator pedal fully opened	2.9 – 4.9
VAS (E8-28) – E2C2 (E8-24)	GR – BR	Accelerator pedal fully closed	0.3 – 0.8
		Accelerator pedal fully opened	2.9 – 4.9
PCR (E6-23) – E2 (E6-20)	G-R – BR	IG switch ON	1.0 – 4.0
THAF (E6-13) – E2 (E6-20)	Y-B – BR	Atmospheric temp	0.5 – 3.8
PIM (E6-16) – E2 (E6-20)	B-Y – BR	Apply vacuum 40 kPa (300 mmHg, 11.8 in.Hg)	0.2 – 0.8
		Apply pressure 69 kPa (0.7 kg/cm ² , 9.96 lb/in ² .)	3.2 – 3.8
THA (E6-22) – E2 (E6-20)	L-Y – BR	Idling, air intake temp. 0°C (32°F) to 80°C (176°F)	0.5 – 3.4
THW (E6-14) – E2 (E6-20)	G – BR	Idling, engine coolant temp. 60°C (140°F) to 120°C (248°F)	0.2 – 1.0
THF (E6-24) – E2 (E6-20)	W – BR	IG switch ON (at engine cold)	0.5 – 3.8
VG (E6-19) – EVG (E6-11)	B – B	Idling, A/C switch OFF	0.5 – 3.0
IGSW (E7-9) – E1 (E5-22)	B-O – BR	IG switch ON	9 – 14
STA (E7-15) – E1 (E5-22)	R – BR	Cranking	6.0 or more
NE+ (E5-17) – NE- (E5-28)	B – W	Idling	Pulse generation (See page DI-24)
G+ (E5-16) – G- (E5-27)	B – W	Idling	Pulse generation (See page DI-22)
SPD (E8-22) – E1 (E5-22)	V-W – BR	IG switch ON, Rotate driving wheel slowly	Pulse generation (See page DI-75)
EGR (E5-2) – E01 (E5-21)	G-B – W-B	IG switch ON	9 – 14
		EGR ON (Maintain engine speed at 1,500 rpm after warming up)	Pulse generation (See page DI-97)
PA (E6-17) – E01 (E5-21)	R-B – W-B	Starter ON	9 – 14
#1 (E5-15) – E01 (E5-21)	W-L – W-B	Idling	Pulse generation (See page DI-88)
#2 (E5-14) – E01 (E5-21)	W-R – W-B		
#3 (E5-13) – E01 (E5-21)	L-Y – W-B		
#4 (E5-12) – E01 (E5-21)	W-G – W-B		
INJF (E5-18) – E01 (E5-21)	W – W-B	Idling	Pulse generation (See page DI-88)
MREL (E7-7) – E01 (E5-21)	L-B – W-B	IG switch ON	9 – 14

DIAGNOSTICS - ENGINE

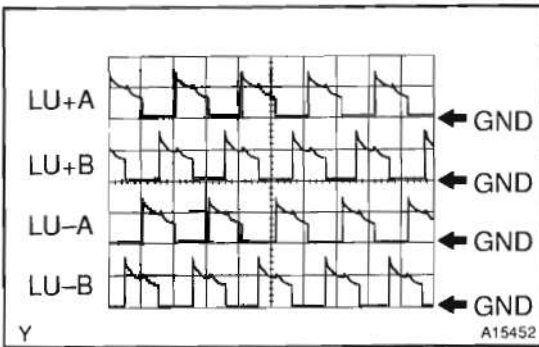
A/C (E8-6) - E1 (E5-22)	B-Y - BR	A/C switch ON (at idling)	0 - 1.5
		A/C switch OFF	9 - 14
TACH (E8-10) - E1 (E5-22)	B - BR	Idling	Pulse generation*1
SREL (E7-16) - E01 (E5-21)	G-R - W-B	IG switch ON	9 - 14
W (E7-12) - E1 (E5-22)	Y-R - BR	Check engine warning light lights up	0 - 3
		Except check engine warning light lights up	9 - 14
GIND (E7-3) - E1 (E5-22)	B-R - BR	Glow indicator light lights up	0 - 3.0
		Except glow indicator light lights up	9 - 14
ACT (E8-5) - E1 (E5-22)	L-B - BR	iG switch ON	9 - 14
		At A/C cut controlled (Driving below 30 km/h, accelerator pedal fully opened for 5 sec.)	0 - 3.0
LU+A (E5-20) - E1 (E5-22)	W - BR	IG switch ON	Pulse generation*2
LU-A (E5-30) - E1 (E5-22)	R - BR		
LU+B (E5-19) - E1 (E5-22)	G - BR		
LU-B (E5-29) - E1 (E5-22)	Y - BR		
TC (E7-18) - E1 (E5-22)	P-L - BR	IG switch ON	9 - 14
EGRC (E5-1) - E1 (E5-22)	R-W - BR	IG switch ON	0 - 3.0
		Maintain engine speed at 1500 rpm after warming up	9 - 14
SIL (E7-19) - E1 (E5-22)	V-W - BR	Connect hand-held tester to DLC3	Pulse generation*3
IMI (E7-14) - E1 (E5-22)	P-G - BR	Idling	Pulse generation*4
IMO (E7-21) - E1 (E5-22)	BR-R - BR	A few sec. after engine starting	Pulse generation*4
STP (E8-14) - E1 (E5-22)	G-W - BR	Brake pedal depressed	7.5 - 14
		Brake pedal released	0 - 1.5
ST1- (E8-23) - E1 (E5-22)	R-G - BR	Brake pedal depressed	0 - 1.5
		Brake pedal released	7.5 - 14
INJ1 (E5-26) - E1 (E5-22)	L-B - BR	Idling	0.5 - 4.5
INJ2 (E5-25) - E1 (E5-22)	L-R - BR		
INJ3 (E5-24) - E1 (E5-22)	L-W - BR		
INJ4 (E5-23) - E1 (E5-22)	R-G - BR		
VN+A (E5-6) - E1 (E5-22)	Y-B - BR	Idling	Pulse generation*5
VN-A (E5-5) - E1 (E5-22)	Y-R - BR		
VN+B (E5-4) - E1 (E5-22)	Y-G - BR		
VN-B (E5-3) - E1 (E5-22)	Y - BR		
PCV1 (E5-9) - E1 (E5-22)	B-Y - BR	Idling	Pulse generation (See page DI-84)
PCV2 (E5-8) - E1 (E5-22)	B-R - BR		
HSW (E8-25) - E1 (E5-22)	W - BR	Heater idle up switch ON	0 - 3.0
		Heater idle up switch OFF	9 - 14
VCH (E8-18) - E1 (E5-22)	G - BR	Power heater ON	0 - 1.5
		Power heater OFF	7.5 - 14
VCT (E8-15) - E1 (E5-22)	Y - BR	IG switch ON	9 - 14
		Power heater OFF operation	0 - 3.0



**REFERENCE:
INSPECTION USING OSCILLOSCOPE**

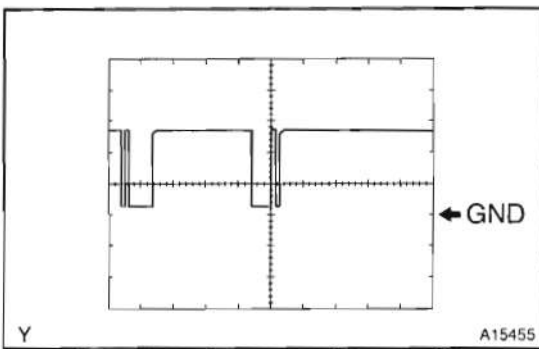
*1: TACH ↔ E1

Measure set: 5 V/DIV, 10 ms/DIV



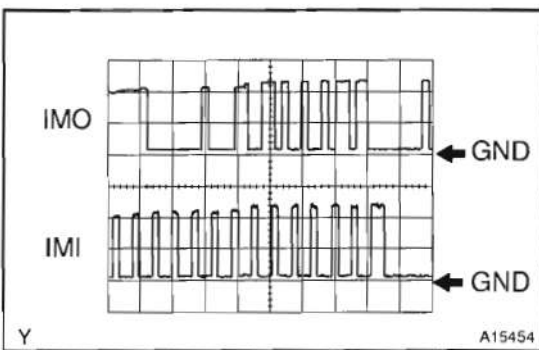
*2: LU+A, LU-A, LU+B, LU-B ↔ E1

Measure set: 20 V/DIV, 10 ms/DIV



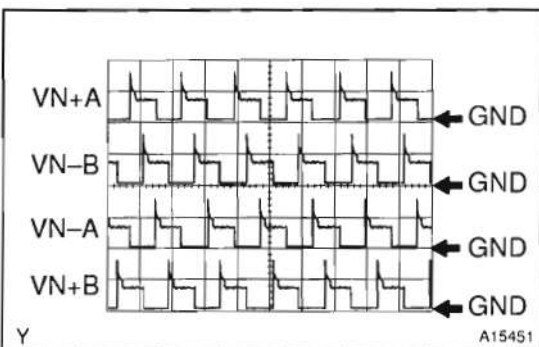
*3: SIL ↔ E1

Measure set: 5 V/DIV, 1 ms/DIV



*4: IMI, IMO ↔ E1

Measure set: 5 V/DIV, 100 ms/DIV



*5: VN+A, VN-A, VN+B, VN-B ↔ E1

Measure set: 20 V/DIV, 50 ms/DIV

PROBLEM SYMPTOMS TABLE

When the malfunction code is not confirmed the DTC check and the problem still can not be confirmed in the basic inspection, then proceed to this step and perform troubleshooting according to the numbered order given in the table below.

Symptom	Suspect Area	See page
Does not crank (Difficult to start)	<ol style="list-style-type: none"> 1. Starter 2. Starter relay 3. Water temp. sensor 	ST-19 ST-20 ED-11
Cold engine (Difficult to start)	<ol style="list-style-type: none"> 1. STA signal circuit 2. Injector 3. Fuel filter 4. Compression 5. Engine ECU 6. Supply pump 7. Fuel pressure sensor 8. Diesel throttle 9. Glow plug system 	DI-116 FU-4 FU-1 EM-2 ED-24 FU-13 ED-14 ED-6 ST-2
Hot engine (Difficult to start)	<ol style="list-style-type: none"> 1. STA signal circuit 2. Injector 3. Fuel filter 4. Compression 5. Engine ECU 6. Supply pump 7. Fuel pressure sensor 8. Diesel throttle 	DI-116 FU-4 FU-1 EM-2 ED-24 FU-13 ED-14 ED-6
Soon after starting (Engine stall)	<ol style="list-style-type: none"> 1. Fuel filter 2. Injector 3. ECU power source circuit 4. Engine ECU 5. Supply pump 6. Fuel pressure sensor 7. Diesel throttle 	FU-1 FU-4 DI-93 ED-24 FU-13 ED-14 ED-6
Others (Engine stall)	<ol style="list-style-type: none"> 1. ECU power source circuit 2. Injector 3. Engine ECU 4. Supply pump 5. Fuel pressure sensor 6. Diesel throttle 	DI-93 FU-4 ED-24 FU-13 ED-14 ED-6
Incorrect first idle (Poor idling)	<ol style="list-style-type: none"> 1. Fuel filter 2. Injector 3. Engine ECU 4. Supply pump 5. Fuel pressure sensor 	FU-1 FU-4 ED-24 FU-13 ED-14
High engine idle speed (Poor idling)	<ol style="list-style-type: none"> 1. A/C signal circuit 2. Injector 3. STA signal circuit 4. Engine ECU 5. Supply pump 6. Fuel pressure sensor 	DI-105 FU-4 DI-116 ED-24 FU-13 ED-14

Lower engine idle speed (Poor idling)	<ol style="list-style-type: none"> 1. A/C signal circuit 2. Injector 3. EGR control circuit 4. Compression 5. Valve clearance 6. Fuel line (Air bead) 7. Engine ECU 8. Supply pump 9. Fuel pressure sensor 10. Diesel throttle 	DI-105 FU-4 DI-97 EM-2 EM-5 - ED-24 FU-13 ED-14 ED-6
Rough idling (Poor idling)	<ol style="list-style-type: none"> 1. Injector 2. Fuel line (Air bead) 3. EGR control circuit 4. Compression 5. Valve clearance 6. Engine ECU 7. Supply pump 8. Fuel pressure sensor 9. Diesel throttle 	FU-4 - DI-97 EM-2 EM-5 ED-24 FU-13 ED-14 ED-6
Hunting at hot engine (Poor idling)	<ol style="list-style-type: none"> 1. Injector 2. ECU power source circuit 3. Compression 4. Fuel line (Air bead) 5. Valve clearance 6. Engine ECU 7. Supply pump 8. Fuel pressure sensor 9. Diesel throttle 	FU-4 DI-93 EM-2 - EM-5 ED-24 FU-13 ED-14 ED-6
Hunting at cold engine (Poor idling)	<ol style="list-style-type: none"> 1. Injector 2. ECU power source circuit 3. Compression 4. Fuel line (Air bead) 5. Valve clearance 6. Engine ECU 7. Supply pump 8. Fuel pressure sensor 9. Diesel throttle 	FU-4 DI-93 EM-2 - EM-5 ED-24 FU-13 ED-14 ED-6
Hesitation/ Poor acceleration (Poor driveability)	<ol style="list-style-type: none"> 1. Injector 2. Fuel filter 3. EGR control circuit 4. Compression 5. Engine ECU 6. Supply pump 7. Fuel pressure sensor 8. Diesel throttle 	FU-4 FU-1 DI-97 EM-2 ED-24 FU-13 ED-14 ED-6
Knocking (Poor driveability)	<ol style="list-style-type: none"> 1. Injector 2. EGR control circuit 3. Engine ECU 4. Supply pump 5. Fuel pressure sensor 	FU-4 DI-97 ED-24 FU-13 ED-14
Black smoke (Poor driveability)	<ol style="list-style-type: none"> 1. Injector 2. EGR control circuit 3. Engine ECU 4. Supply pump 5. Fuel pressure sensor 6. Diesel throttle 	FU-4 DI-97 ED-24 FU-13 ED-14 ED-6

DIAGNOSTICS - ENGINE

White smoke (Poor driveability)	<ol style="list-style-type: none">1. EGR control circuit2. Injector3. Fuel filter4. Engine ECU5. Supply pump6. Fuel pressure sensor7. Diesel throttle	<p>DI-97 FU-4 FU-1 ED-23 FU-13 ED-14 ED-6</p>
Surging/ Hunting (Poor driveability)	<ol style="list-style-type: none">1. Injector2. Engine ECU3. Supply pump4. Fuel pressure sensor	<p>FU-4 ED-24 FU-13 ED-14</p>

CIRCUIT INSPECTION

DTC	12	Engine Speed Sensor Circuit Malfunction 1 (TDC or G1 Circuit)
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CIRCUIT DESCRIPTION

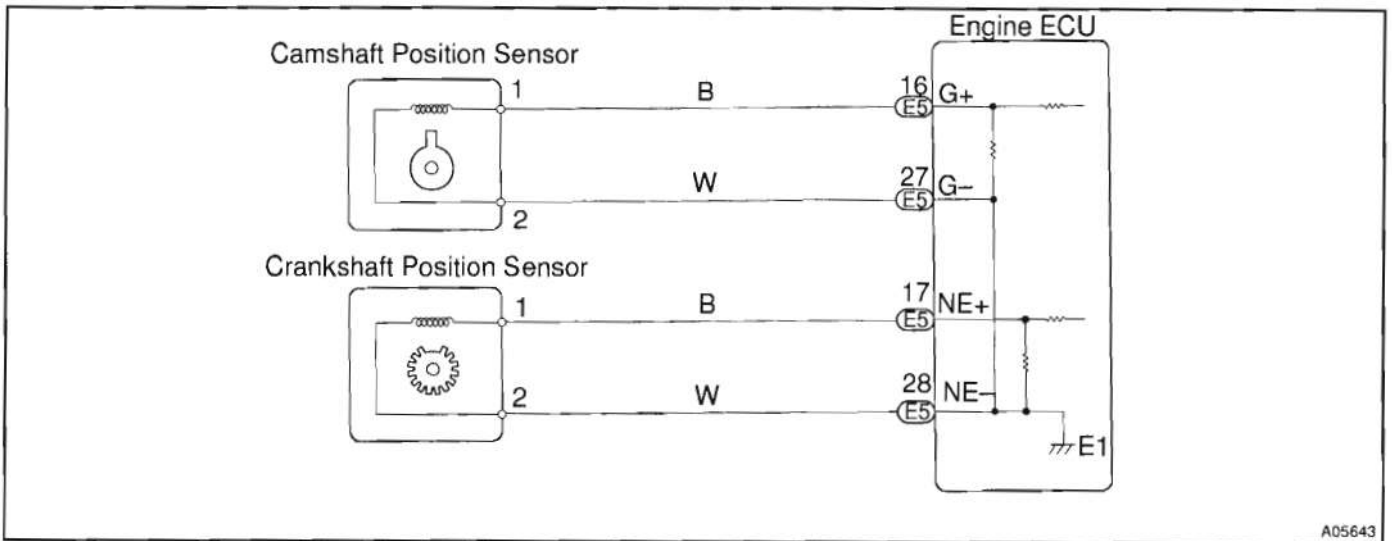
Camshaft position sensor (G1 signal) consists of a magnet, iron core and pickup coil.

The G1 signal plate has one tooth on its outer circumference and is installed the pump drive shaft pulley. When the camshafts rotate, the protrusion on the signal plate and the air gap on the pickup coil change, causing fluctuations in the magnetic field and generating an electromotive force in the pickup coil.

The NE signal plate has 34 teeth and is mounted on the crank angle sensor plate. The NE signal sensor generates 34 signals at every engine revolution. The engine ECU detects the standard crankshaft angle based on the G1 signal and the actual crankshaft angle and the engine speed by the NE signal.

DTC No.	DTC Detecting Condition	Trouble Area
12	No camshaft position sensor signal to ECU during cranking	<ul style="list-style-type: none"> • Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing pulley • Engine ECU
	No camshaft position sensor signal to ECU with engine speed 650 rpm or more	

WIRING DIAGRAM



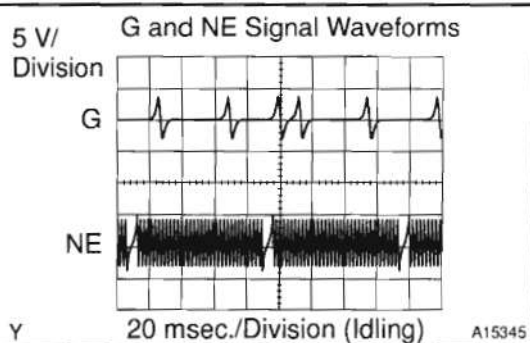
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INSPECTION PROCEDURE

HINT:

- Perform troubleshooting of DTC 12 first. If no trouble is found, troubleshoot the following mechanical system.
- 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 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 Check resistance of camshaft position sensor (See page ED-17).



Reference: INSPECTION USING OSCILLOSCOPE

During cranking or idling, check the waveforms between terminals G and G-, and NE and NE- of the ECU connector.

HINT:

The correct waveforms are as shown.

NG

Replace camshaft position sensor.

OK

2 Check for open and short in harness and connector between ECU and camshaft position sensor (See page IN-20).

NG

Repair or replace harness or connector.

OK

3 Inspect sensor installation and signal plate tooth of pump drive shaft pulley.

NG

Tighten sensor. Replace pump drive shaft pulley.

OK

Check and replace ECU (See page IN-20).

DTC	13	Engine Speed Sensor Circuit Malfunction 2 (NE Circuit)
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CIRCUIT DESCRIPTION

Crankshaft position sensor (NE signal) consists of a magnet, iron core and pickup coil. The NE signal plate has 34 teeth and is installed the crank angle sensor plate. The NE signal sensor generates 34 signals of every engine revolution. The ECU detects the standard crankshaft angle based on the G1 signal, and the actual crankshaft angle and the engine speed by the NE signal.

DTC No.	DTC Detecting Condition	Trouble Area
13	No crankshaft position sensor signal to engine ECU for 0.5 sec. or more at 650 rpm or more	<ul style="list-style-type: none"> • Open or short in crankshaft position sensor circuit • Crankshaft position sensor
	No crankshaft position sensor signal to engine ECU for 2.0 sec. or more during cranking	<ul style="list-style-type: none"> • Crank angle sensor plate • Engine ECU

WIRING DIAGRAM

Refer to DTC12 on page DI-22.

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 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	Check resistance of crankshaft position sensor (See page ED-18).
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Reference: INSPECTION USING OSCILLOSCOPE

Refer to DTC 12 on page DI-22.

NG	Replace crankshaft position sensor (See page ED-18).
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2	Check for open and short in harness and connector between engine ECU and crankshaft position sensor (See page IN-20).
----------	------------------------------------------------------------------------------------------------------------------------------

NG	Repair or replace harness or connector.
-----------	------------------------------------------------



3**Inspect sensor installation and signal plate teeth of crank angle sensor plate.****NG****Tighten sensor. Replace crank angle sensor plate.****OK****Check and replace engine ECU
(See page IN-20).**

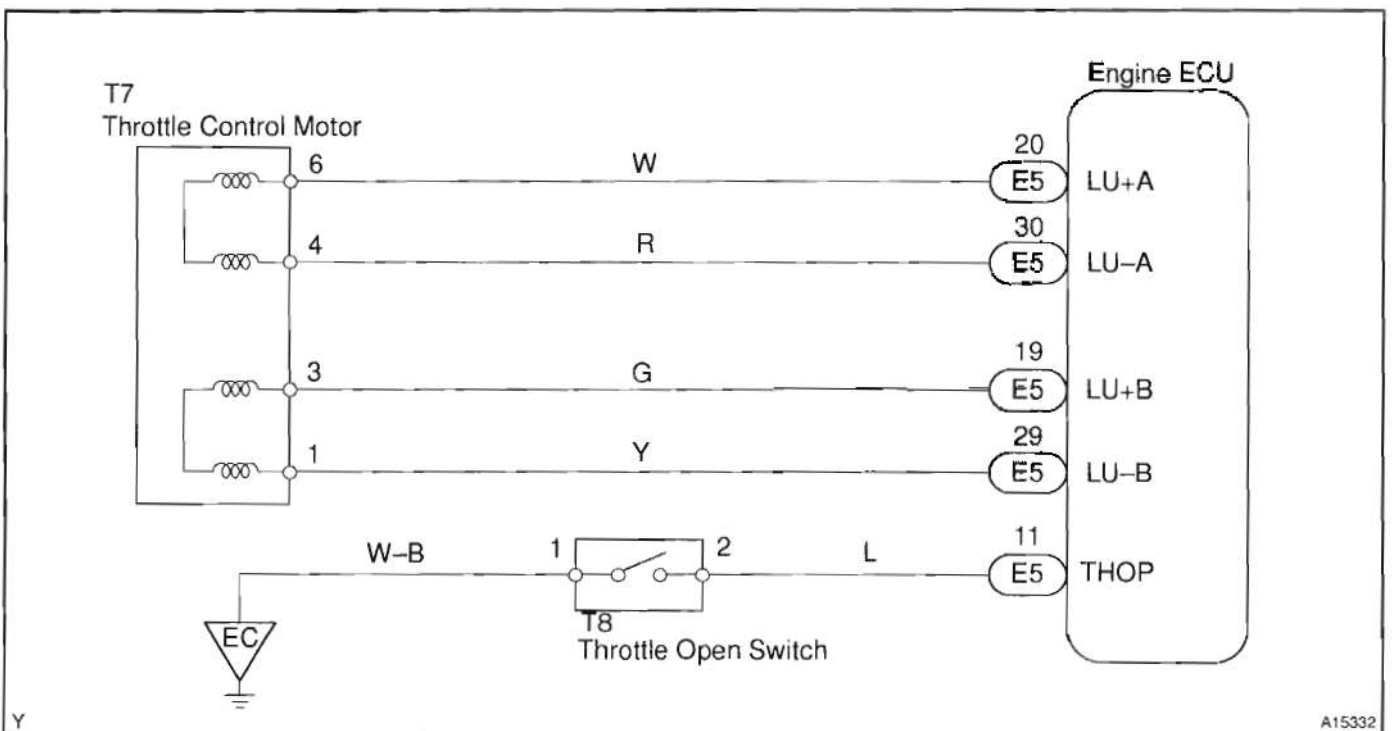
DTC**15****Throttle Control Motor Circuit Malfunction****CIRCUIT DESCRIPTION**

Throttle control motor is operated by the engine ECU and it opens and closes the throttle valve.

The fully opening of the throttle valve is detected by the throttle fully open position switch which is mounted on the throttle body.

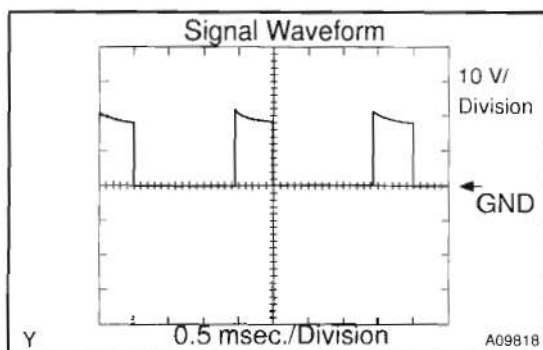
If this DTC is stored, the engine ECU shuts down the power for the throttle control motor.

DTC No.	DTC Detecting Condition	Trouble Area
15	Open or short in throttle control motor circuit	<ul style="list-style-type: none"> • Open or short in throttle control motor circuit • Throttle control motor • Throttle valve • Throttle drive gear
	Open or short in throttle full switch circuit	<ul style="list-style-type: none"> • Diesel throttle body • Engine ECU

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 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 Check throttle control motor circuit.



PREPARATION:

- Connect the oscilloscope between terminals LU+A/LU-A/LU+B/LU-B and E01 of the engine ECU.
- Start the engine.

CHECK:

Check the waveform between terminals LU+A/LU-A/LU+B/LU-B and E01 of the engine ECU when the engine is racing.

OK:

The correct waveforms are as shown.

OK

Check and replace engine ECU
(See page IN-20).

NG

2 Check throttle control motor (See page ED-6).

NG

Replace diesel throttle body assembly (See page ED-4).

OK

3 Check for open and short in harness and connector between throttle control motor and engine ECU (See page IN-20).

NG

Repair or replace.

OK

Check and replace engine ECU
(See page ED-23).

DTC	19 (1)	Accelerator Pedal Position Sensor Circuit Malfunction (Open/Short)
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CIRCUIT DESCRIPTION

The accelerator pedal position sensor is mounted at the accelerator pedal and detects the accelerator pedal opening angle. When the accelerator pedal is fully closed, a voltage of approximately 0.8 V is applied to terminals VA, VAS of the engine ECU. The voltage applied to terminals VA, VAS of the engine ECU increases in proportion to the opening angle of the accelerator pedal and becomes approximately 3.8 V when the accelerator pedal is fully opened. The engine ECU judges the vehicle driving conditions from these signals input from terminals VA, VAS and uses them as one of the conditions to control the injection volume and diesel throttle valve position.

This system has 2 way accelerator pedal position sensor and accelerator pedal closed position switch for fail safe.

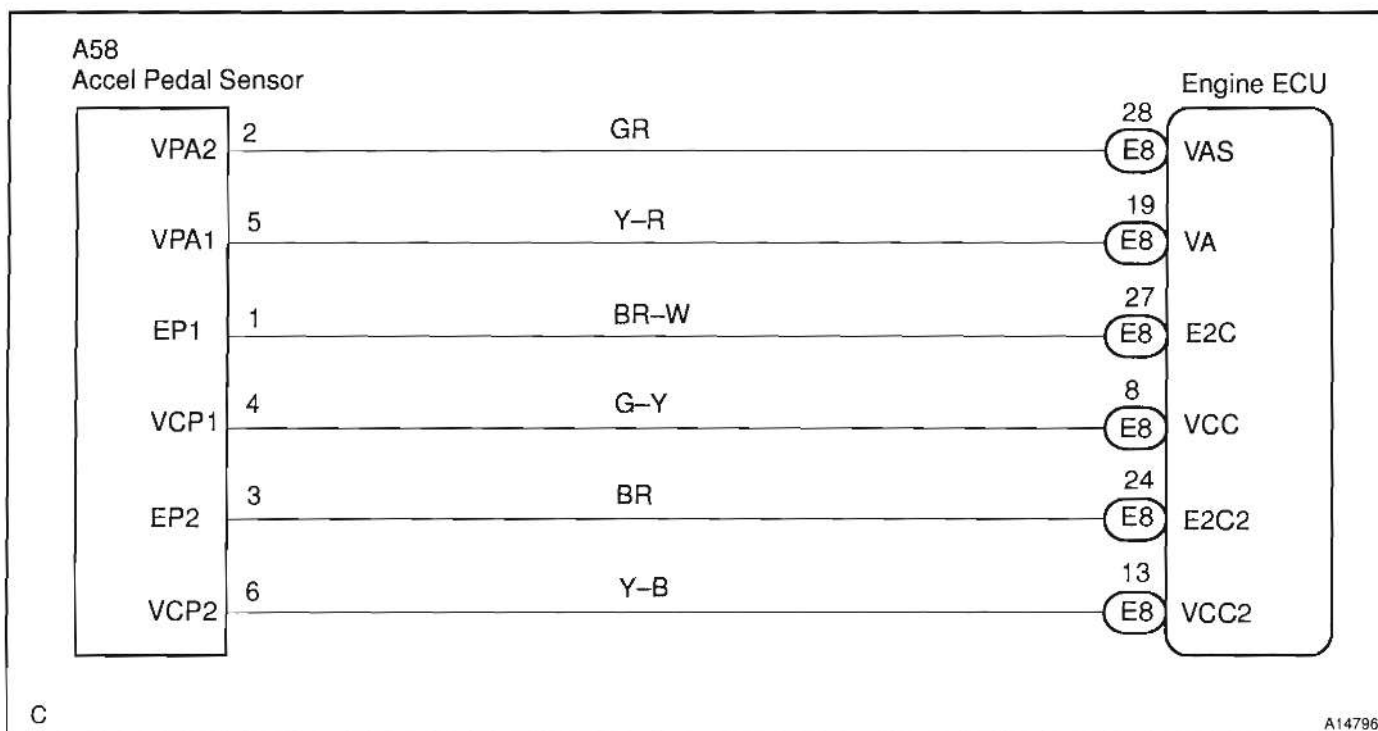
DTC No.	DTC Detecting Condition	Trouble Area
19(1)	Condition (a) or (b) continues 0.5 sec. or more: (a) VA < 0.2 V (b) VAS < 0.5 V	<ul style="list-style-type: none"> • Open or short in accelerator pedal position sensor circuit • Accelerator pedal position sensor • Engine ECU
	Conditions (a) and (b) continue 2.0 sec. or more: (a) VA > 4.8 V (b) 0.2 < VA < 3.45 V, VAS > 4.8 V	

HINT:

After confirming DTC 19 (1), use the hand-held tester to confirm the accelerator pedal opening percentage and accelerator pedal close position switch condition.

Accelerator pedal opening position expressed as percentage		Trouble area
Accelerator pedal fully closed	Accelerator pedal fully open	
0 %	0 %	<ul style="list-style-type: none"> • VCC circuit open • VA, VAS circuit open or short
Approx. 100 %	Approx. 100 %	<ul style="list-style-type: none"> • E2C circuit open

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 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.

When using hand-held tester:

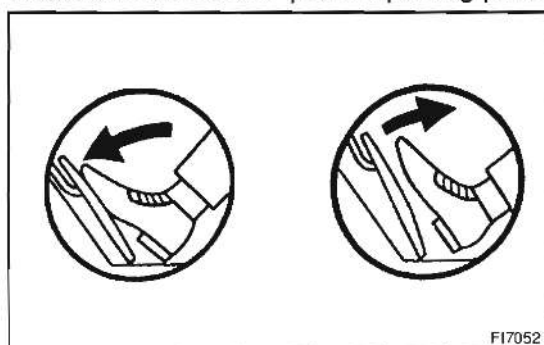
1	Connect the hand-held tester, read accelerator pedal opening percentage.
---	--------------------------------------------------------------------------

PREPARATION:

- Connect the hand-held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.

CHECK:

Read the accelerator pedal opening percentage.



OK:

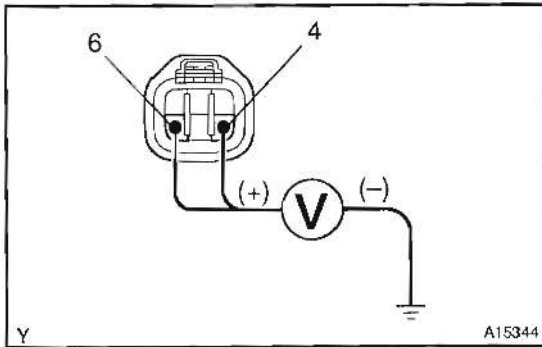
Accelerator pedal	Accelerator pedal opening position expressed as percentage
Fully open	Approx. 75 %
Fully closed	Approx. 16 %

OK

Check for intermittent problems
(See page DI-4).

NG

2 Check voltage between terminal 4, 6 of wire harness side connector and body ground.



PREPARATION:

- (a) Disconnect the accelerator pedal position sensor connector.
- (b) Turn the ignition switch ON.

CHECK:

Measure the voltage between terminal 4, 6 of the wire harness side connector and body ground.

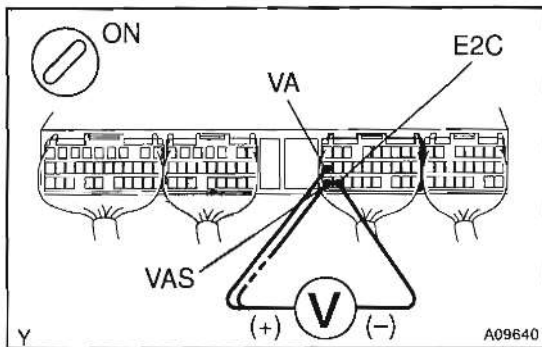
OK:

Voltage: 4.5 – 5.5 V

NG Go to step 5.

OK

3 Check voltage between terminals VA and E2C, and VAS and E2C2 of engine ECU connector.



PREPARATION:

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

CHECK:

Measure the voltage between terminals VA and E2C, and VAS and E2C2 of the engine ECU connector.

OK:

Accelerator pedal	Voltage (V)
Fully closed	VA: 0.5 – 1.1
	VAS: 0.9 – 2.3
Fully open	VA: 3.0 – 4.6
	VAS: 3.4 – 5.0

OK Check and replace engine ECU (See page IN-20).

NG

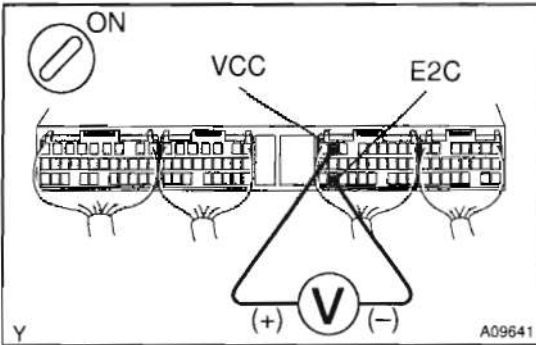
4 Check for open and short in harness and connector in VA and VAS circuits between engine ECU and accelerator pedal position sensor (See page IN-20).

NG Repair or replace harness or connector.

OK

Replace accelerator pedal assembly.

5 Check voltage between terminals VCC and E2C of engine ECU connector.

**PREPARATION:**

- Remove the glove compartment.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals VCC and E2C of the engine ECU connector.

OK:

Voltage: 4.5 – 5.5 V

NG

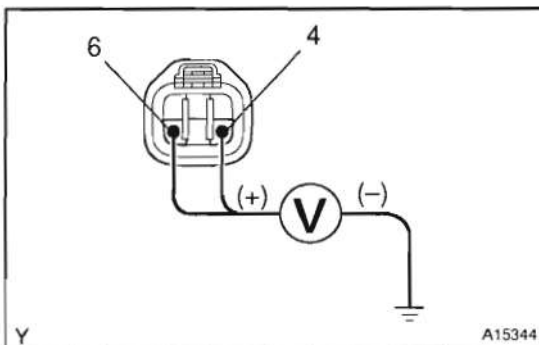
Check and replace engine ECU
(See page IN-20).

OK

Check for open in harness and connector in VCC circuit between engine ECU and accelerator pedal position sensor (See page IN-20).

When not using hand-held tester:

1 Check voltage between terminal 4, 6 of wire harness side connector and body ground.

**PREPARATION:**

- Disconnect the accelerator pedal position sensor connector.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminal 4, 6 of the wire harness side connector and body ground.

OK:

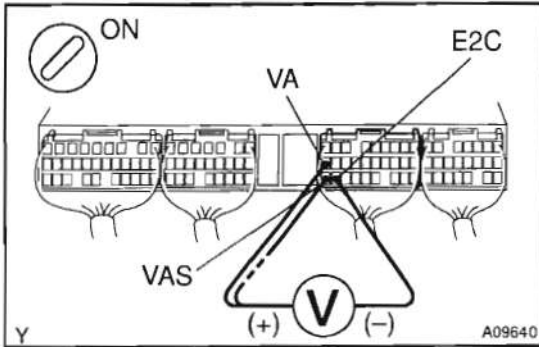
Voltage: 4.5 – 5.5 V

NG

Go to step 4.

OK

2 Check voltage between terminals VA and E2C, and VAS and E2C2 of engine ECU connector.



PREPARATION:

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

CHECK:

Measure the voltage between terminals VA and E2C, and VAS and E2C2 of the engine ECU connector.

OK:

Accelerator pedal	Voltage (V)
Fully closed	VA: 0.5 – 1.1 VAS: 0.9 – 2.3
Fully open	VA: 3.0 – 4.6 VAS: 3.4 – 5.0

OK Check and replace engine ECU (See page IN-20).

NG

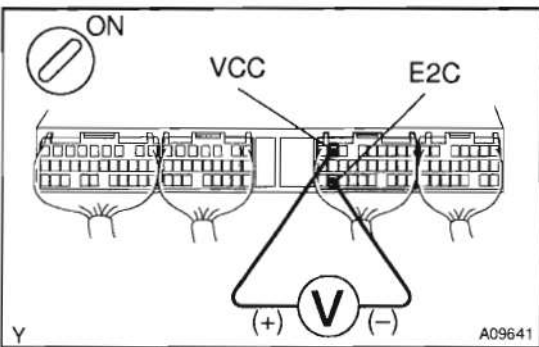
3 Check for open and short in harness and connector in VA and VAS circuits between engine ECU and accelerator pedal position sensor (See page IN-20).

NG Repair or replace harness or connector.

OK

Replace accelerator pedal assembly.

4 Check voltage between terminals VCC and E2C of engine ECU connector.



PREPARATION:

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

CHECK:

Measure the voltage between terminals VCC and E2C of the engine ECU connector.

OK:

Voltage: 4.5 – 5.5 V

NG**Check and replace engine ECU
(See page IN-20).****OK****Check for open in harness and connector in VCC circuit between engine ECU and accelerator pedal position sensor (See page IN-20).**

DTC	19 (2)	Accelerator Pedal Position Sensor Circuit Malfunction (IDL Switch/Range)
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CIRCUIT DESCRIPTION

Refer to DTC 19 (1) on page DI-28.

DTC No.	DTC Detecting Condition	Trouble Area
19 (2)	<p>With the ECU sensor completed learning and when the electric potential difference of No. 1 and No. 2 sensors has become more than 1.2 V or less than 0.4 V.</p> <p>Either one of the followings continues more than 2.0 seconds.</p> <p>(c) When the electrical potential difference of No. 1 and No. 2 sensors is beside the specified value.</p> <p>(d) $VPA2 \geq 4.9$ V</p> <p>(e) Accelerator idling criterion voltage of No. 1 and No. 2 in less than 0.04 V.</p>	<ul style="list-style-type: none"> • Open or short in accelerator pedal position sensor circuit • Accelerator pedal position sensor • Engine ECU

WIRING DIAGRAM

Refer to DTC 19 (1) on page DI-28.

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 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	Check voltage between terminal VCC and VCC2 of wire harness side connector and body ground (See page DI-28).
----------	---------------------------------------------------------------------------------------------------------------------

NG

Go to step 4.

OK

2	Check voltage between terminals VA and E2C, and VAS and E2C2 of engine ECU connector (See page DI-28).
----------	---------------------------------------------------------------------------------------------------------------

OK

Check and replace engine ECU (See page IN-20).

NG

- 3** Check for open and short in harness and connector in VA and VAS circuits between engine ECU and accelerator pedal position sensor (See page IN-20).

NG

Repair or replace harness or connector.

OK

Replace accelerator pedal.

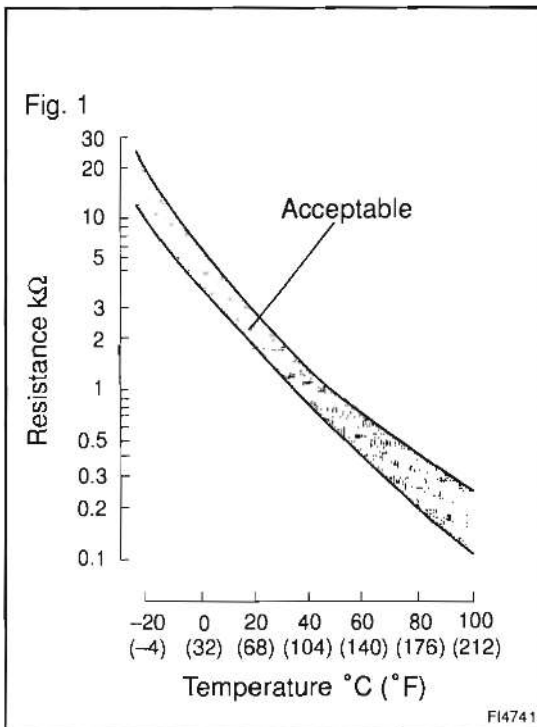
- 4** Check voltage between terminals VCC and E2C, VCC2 and E2C2 of engine ECU connector (See page DI-28, step 5).

NG

Check and replace engine ECU
(See page IN-20).

OK

Check for open in harness and connector in VCC circuit between engine ECU and accelerator pedal position sensor (See page IN-20).

DTC**22****Water Temp. Sensor Circuit Malfunction****CIRCUIT DESCRIPTION**

The water temperature sensor senses the coolant temperature. A thermistor built into the sensor changes the resistance value according to the coolant temperature. The lower the coolant temperature, the greater the thermistor resistance value, and the higher the coolant temperature, the lower the thermistor resistance value (See Fig. 1).

The water temperature sensor is connected to the engine ECU (See below). The 5 V power source voltage in the engine ECU is applied to the water temperature sensor from the terminal THW via a resistor R. That is, resistor R and the water temperature sensor are connected in series. When the resistance value of the water temperature sensor changes in accordance with changes in the coolant temperature, the potential at the terminal THW also changes. Based on this signal, the engine ECU increases the fuel injection volume to improve driveability during cold engine operation.

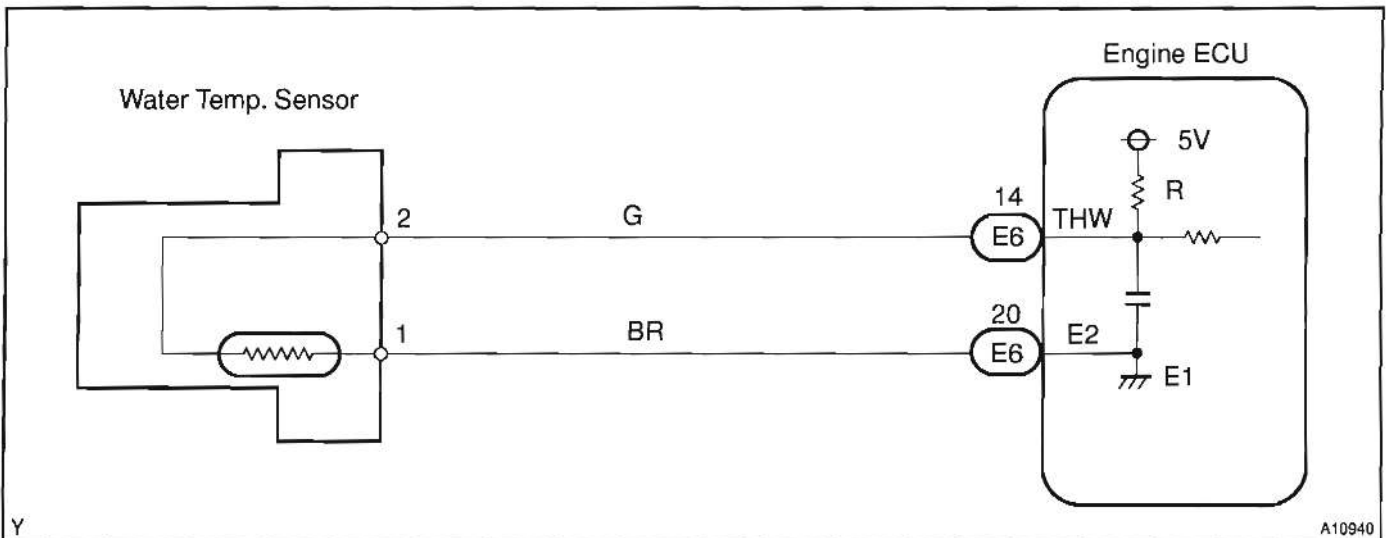
DTC No.	DTC Detecting Condition	Trouble Area
22	Open or short in water temp. sensor circuit for 0.5 sec. or more	<ul style="list-style-type: none"> • Open or short in water temp. sensor circuit • Water temp. sensor • Engine ECU

HINT:

After confirming DTC 22, use the hand-held tester to confirm the water temperature from the CURRENT DATA.

Temperature displayed	Malfunction
-40 $^{\circ}C$ (-40 $^{\circ}F$)	Open circuit
140 $^{\circ}C$ (284 $^{\circ}F$) or more	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- If DTCs 22, 24 and 39 are output simultaneously, E2 (sensor ground) may be open.
- 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 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.

When using hand-held tester:

1	Connect hand-held tester, and read value of water temperature.
---	-----------------------------------------------------------------------

PREPARATION:

- Connect the hand-held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

Same as actual water temperature.

HINT:

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

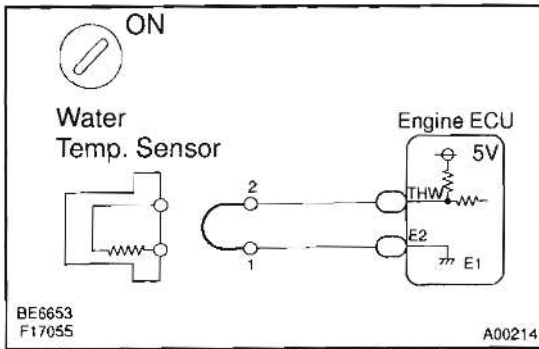
NG

-40°C (-40°F) ... Go to step 2.
 140°C (284°F) or more ... Go to step 4.

OK

Check for intermittent problems
 (See page DI-4).

2 Check for open in harness or engine ECU.



PREPARATION:

- Disconnect the water temperature sensor connector.
- Connect the sensor wire harness terminals together.
- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

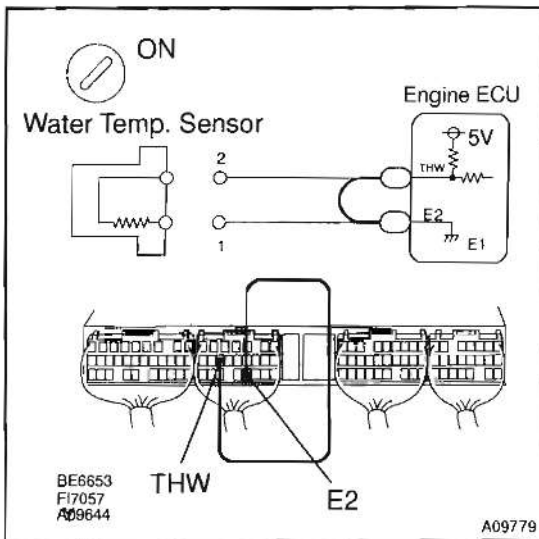
Temperature value: 140°C (284°F) or more

OK

Confirm good connection at sensor. If OK, replace water temperature sensor.

NG

3 Check for open in harness or engine ECU.



PREPARATION:

- Remove the glove compartment.
- Connect between terminals THW and E2 of the engine ECU connector.

HINT:

The water temperature sensor connector is disconnected. Before checking, do a visual and contact pressure check for the engine ECU connector (See page IN-20).

- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

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

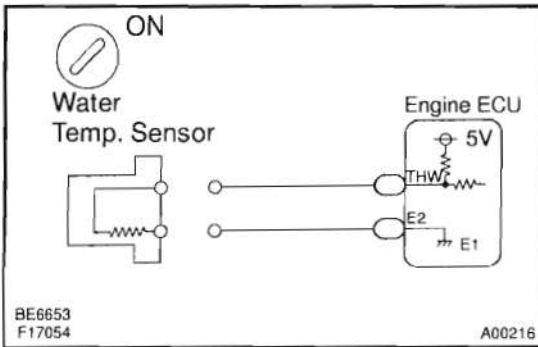
OK

Open in harness between terminal E2 or THW, repair or replace harness.

NG

Confirm good connection at engine ECU. If OK, replace engine ECU.

4 Check for short in harness and engine ECU.



PREPARATION:

- Disconnect the water temperature sensor connector.
- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

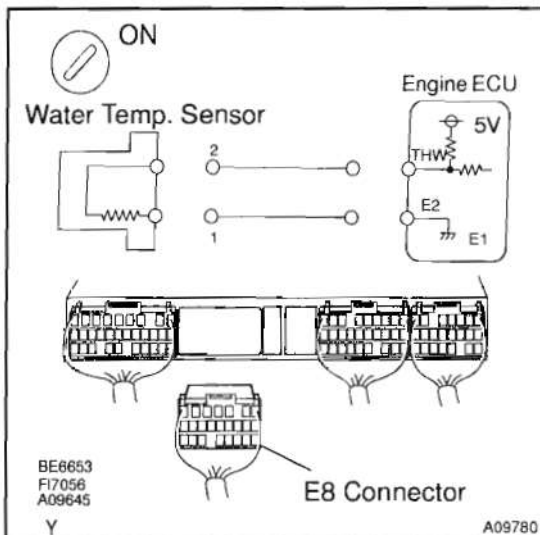
Temperature value: -40°C (-40°F)

OK

Replace water temperature sensor.

NG

5 Check for short in harness or engine ECU.



PREPARATION:

- Remove the glove compartment.
- Disconnect the E8 connector from the engine ECU.

HINT:

The water temperature sensor connector is disconnected.

- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

Temperature value: -40°C (-40°F)

OK

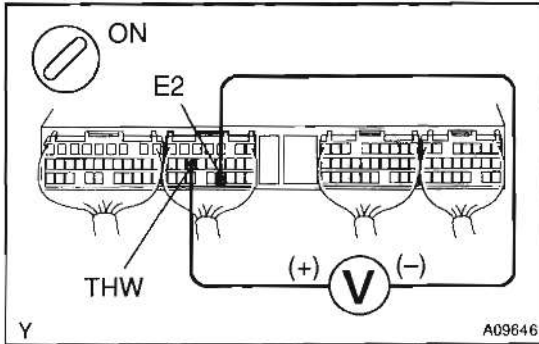
Repair or replace harness or connector.

NG

Check and replace engine ECU
(See page IN-20).

When not using hand-held tester:

1 Check voltage between terminals THW and E2 of engine ECU connector.

**PREPARATION:**

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

CHECK:

Measure the voltage between terminals THW and E2 of the engine ECU connector.

OK:

Water Temp. °C (°F)	Voltage
20 (68) (Engine is cool)	0.2 – 3.8 V
80 (176) (Engine is hot)	0.1 – 1.5 V

OK

**Check for intermittent problems
(See page DI-4).**

NG

2 Check water temperature sensor (See page ED-11).

NG

Replace water temperature sensor.

OK

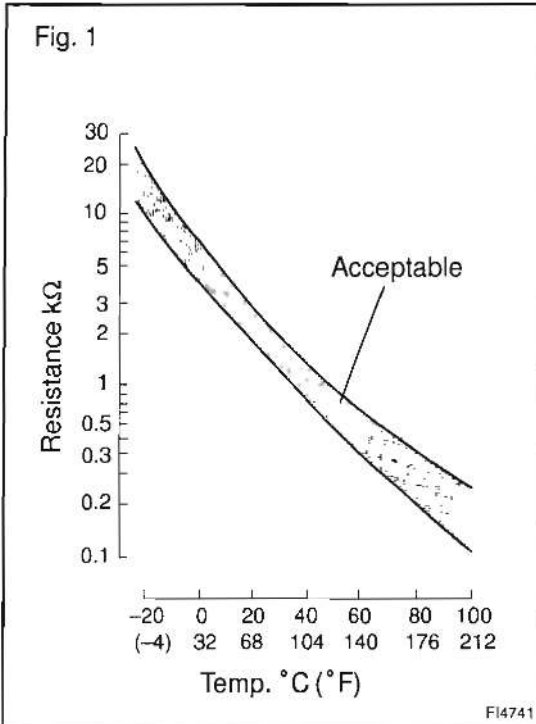
3 Check for open and short in harness and connector between engine ECU and water temperature sensor (See page IN-20).

NG

Repair or replace harness or connector.

OK

**Check and replace engine ECU
(See page IN-20).**

DTC**24 (1)****Intake Air Temp. Sensor Circuit Malfunction****CIRCUIT DESCRIPTION**

The intake air temperature sensor is built into the intake manifold and senses the intake air temperature. A thermistor built in the sensor changes the resistance value according to the intake air temperature. The lower the intake air temperature, the greater the thermistor resistance value, and the higher the intake air temperature, the lower the thermistor resistance value (See Fig. 1).

The intake air temperature sensor is connected to the engine ECU. The 5 V power source voltage in the engine ECU is applied to the intake air temperature sensor from terminal THA via a 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. Based on this signal, the engine ECU increases the fuel injection volume to improve drivability during cold engine operation.

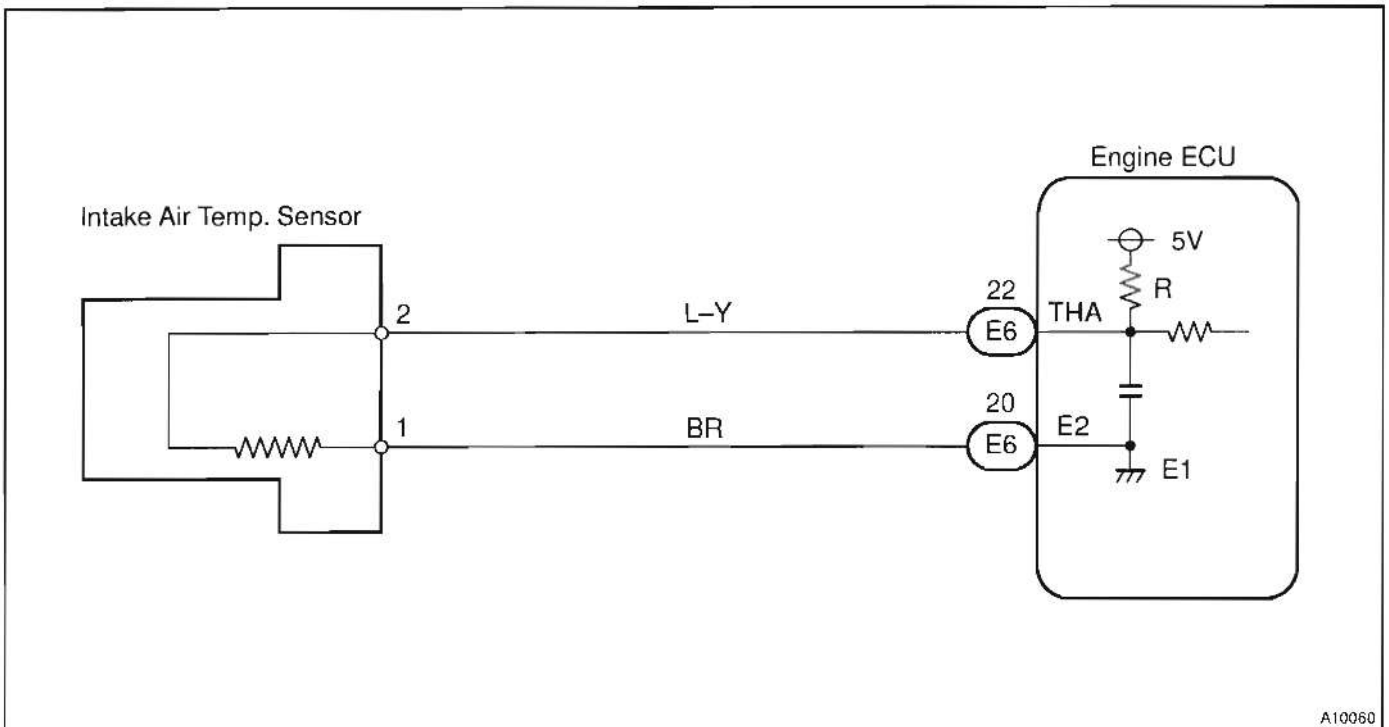
DTC No.	DTC Detecting Condition	Trouble Area
24 (1)	Open or short in intake air temp. sensor circuit for 0.5 sec. or more	<ul style="list-style-type: none"> • Open or short in intake air temp. sensor circuit • Intake air temp. sensor • Engine ECU

HINT:

After confirming DTC 24, use the hand-held tester to confirm the intake air temperature from the CURRENT DATA.

Temperature displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or more	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- If DTC 22, 24, 35 and 39, E2 (sensor ground) may be open.
- 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 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.

When using hand-held tester:

1	Connect hand-held tester, and read value of water temperature.
----------	-----------------------------------------------------------------------

PREPARATION:

- Connect the hand-held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

Same as actual intake air temperature.

HINT:

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

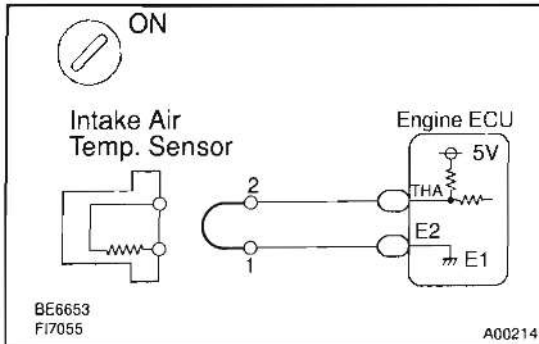
NG

-40°C (-40°F) ... Go to step 2.
 140°C (284°F) or more ... Go to step 4.

OK

Check for intermittent problems
(See page DI-4).

2 Check for open in harness or engine ECU.



PREPARATION:

- Disconnect the intake air temperature sensor connector.
- Connect the sensor wire harness terminals together.
- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

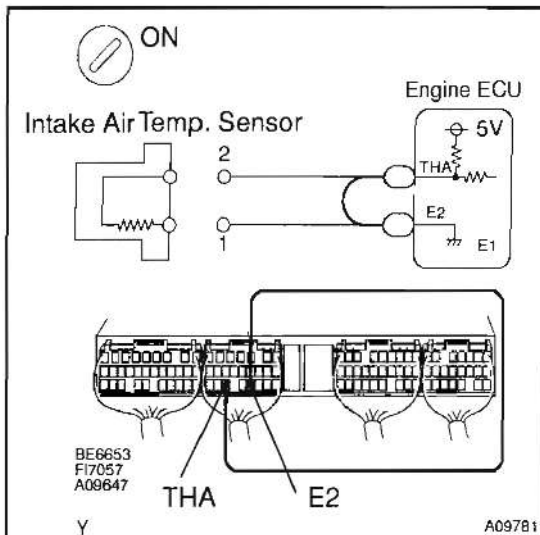
Temperature value: 140°C (284°F) or more

OK

Confirm good connection at sensor. If OK, replace intake air temperature sensor.

NG

3 Check for open in harness or engine ECU.



PREPARATION:

- Remove the glove compartment.
- Connect between terminals THA and E2 of the engine ECU connector.

HINT:

The intake air temperature sensor connector is disconnected. Before checking, do a visual and contact pressure check for the engine ECU connector (See page IN-20).

- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

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

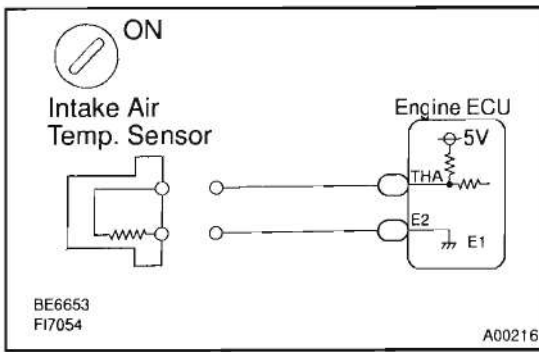
OK

Open in harness between terminal E2 or THA, repair or replace harness.

NG

Confirm good connection at engine ECU. If OK, replace engine ECU.

4 Check for short in harness and engine ECU.



PREPARATION:

- Disconnect the intake air temperature sensor connector.
- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

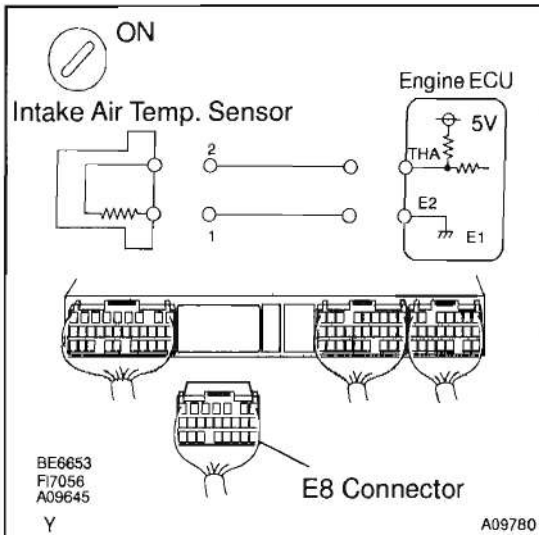
Temperature value: -40°C (-40°F)

OK

Replace intake air temperature sensor.

NG

5 Check for short in harness or engine ECU.



PREPARATION:

- Remove the glove compartment.
- Disconnect the E8 connector from the engine ECU.

HINT:

The intake air temperature sensor connector is disconnected.

- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

Temperature value: -40°C (-40°F)

OK

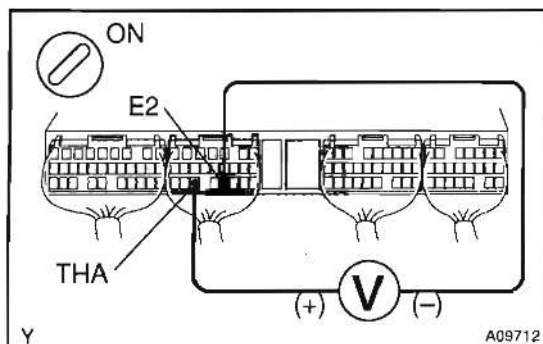
Repair or replace harness or connector.

NG

Check and replace engine ECU
(See page IN-20).

When not using hand-held tester:

- 1 Check voltage between terminals THA and E2 of engine ECU connector.**

**PREPARATION:**

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

CHECK:

Measure the voltage between terminals THA and E2 of the engine ECU connector.

OK:

Intake Air Temp. °C (°F)	Voltage
20 (68) (Engine is cool)	0.2 – 3.8 V
80 (176) (Engine is hot)	0.1 – 1.5 V

OK

**Check for intermittent problems
 (See page DI-4).**

NG

- 2 Check intake air temperature sensor (See page ED-13).**

NG

Replace intake air temperature sensor.

OK

- 3 Check for open and short in harness and connector between engine ECU and intake air temperature sensor (See page IN-20).**

NG

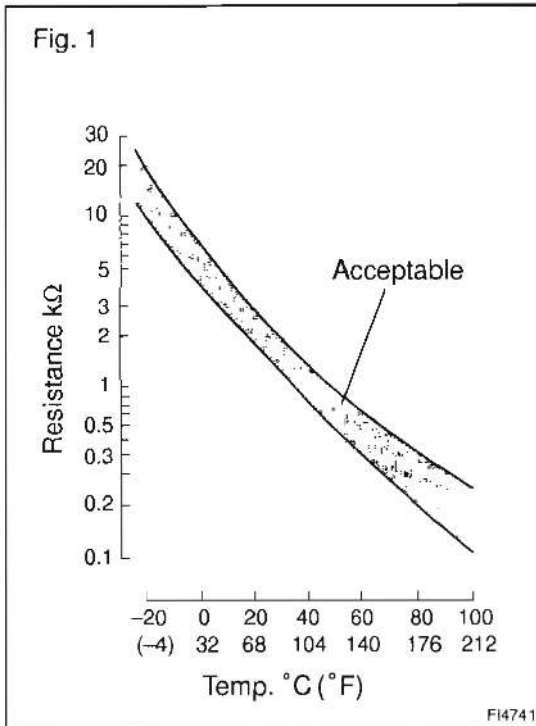
Repair or replace harness or connector.

OK

**Check and replace engine ECU
 (See page IN-20).**

DTC	24 (2)	Atmospheric Temp. Sensor Circuit Malfunction
------------	---------------	-----------------------------------------------------

CIRCUIT DESCRIPTION



The atmospheric temperature sensor is built into the air flow meter and senses the atmospheric temperature. A thermistor built in the sensor changes the resistance value according to the atmospheric temperature. The lower the atmospheric temperature, the greater the thermistor resistance value, and the higher the atmospheric temperature, the lower the thermistor resistance value (See Fig. 1).

The atmospheric temperature sensor is connected to the engine ECU. The 5 V power source voltage in the engine ECU is applied to the atmospheric temperature sensor from terminal THAF via a resistor R. That is resistor R and the atmospheric temperature sensor are connected in series. When the resistance value of the atmospheric temperature sensor changes. Based on this signal, the engine ECU increases the fuel injection volume to improve drivability during cold engine operation.

DTC No.	DTC Detecting Condition	Trouble Area
24	Open or short in atmospheric temp. sensor circuit for 0.5 sec. or more	<ul style="list-style-type: none"> • Open or short in atmospheric temp. sensor circuit • Atmospheric temp. sensor (built into air flow meter) • Engine ECU

HINT:

After confirming DTC 24, use the hand-held tester to confirm the atmospheric temperature from the CURRENT DATA.

Temperature displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or more	Short circuit

WIRING DIAGRAM

Refer to DTC 31 on page DI-51

INSPECTION PROCEDURE

HINT:

- If DTC 22, 24, 35 and 39, E2 (sensor ground) may be open.
- 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 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.

When using hand-held tester:

1 Connect hand-held tester, and read value of atmospheric 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.

CHECK:

Read the temperature value on the hand-held tester.

OK:

Same as actual atmospheric temperature.

HINT:

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

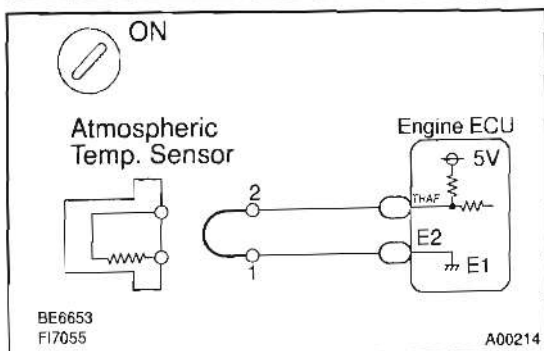
NG

-40°C (-40°F) ... Go to step 2.
 140°C (284°F) or more ... Go to step 4.

OK

Check for intermittent problems
 (See page DI-4).

2 Check for open in harness or engine ECU.

**PREPARATION:**

- (a) Disconnect the air flow meter connector.
 (b) Connect the sensor wire harness terminals together.
 (c) Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

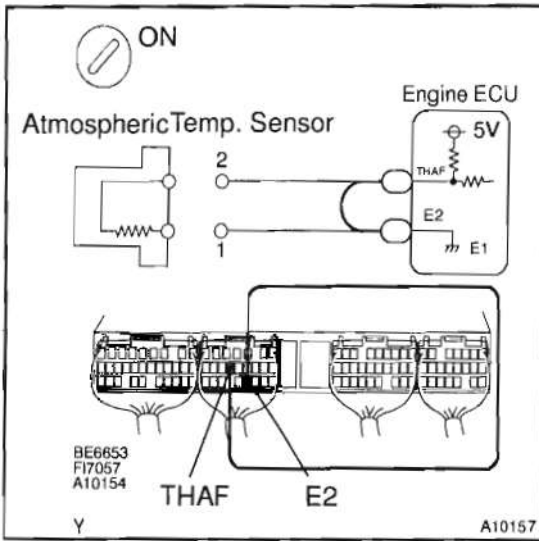
Temperature value: 140°C (284°F) or more

OK

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

NG

3 Check for open in harness or engine ECU.



PREPARATION:

- (a) Remove the glove compartment.
- (b) Connect between terminals THAF and E2 of the engine ECU connector.

HINT:

The air flow meter connector is disconnected. Before checking, do a visual and contact pressure check for the engine ECU connector (See page IN-20).

- (c) Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

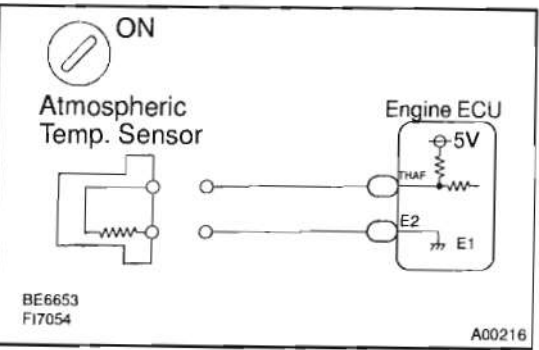
Temperature value: 140°C (284°F) or more

OK Open in harness between terminal E2 or THAF, repair or replace harness.

NG

Confirm good connection at engine ECU. If OK, replace engine ECU.

4 Check for short in harness and engine ECU.



PREPARATION:

- (a) Disconnect the air flow meter connector.
- (b) Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

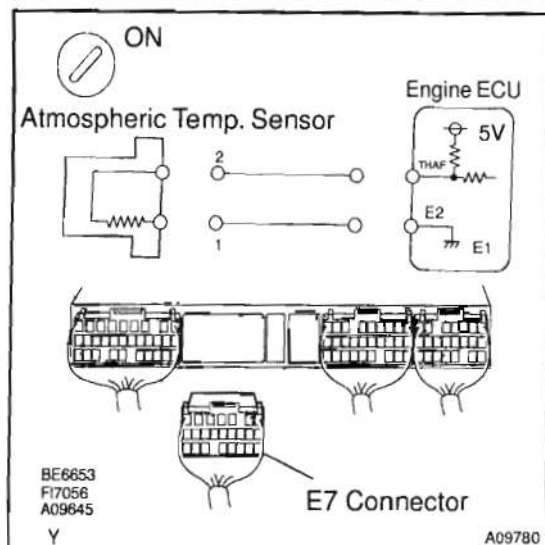
OK:

Temperature value: -40°C (-40°F)

OK Replace air flow meter.

NG

5 Check for short in harness or engine ECU.



PREPARATION:

- Remove the glove compartment.
- Disconnect the E7 connector from the engine ECU.

HINT:

The air flow meter connector is disconnected.

- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

Temperature value: -40°C (-40°F)

OK

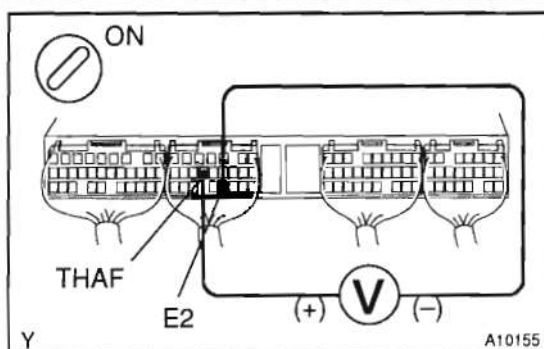
Repair or replace harness or connector.

NG

Check and replace engine ECU
(See page IN-20).

When not using hand-held tester:

1 Check voltage between terminals THAF and E2 of engine ECU connector.



PREPARATION:

- Remove the glove compartment.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals THAF and E2 of the engine ECU connector.

OK:

Atmospheric Temp. $^{\circ}\text{C}$ ($^{\circ}\text{F}$)	Voltage
20 (68) (Engine is cool)	0.2 - 3.8 V
80 (176) (Engine is hot)	0.1 - 1.5 V

OK

Check for intermittent problems
(See page DI-4).

NG

2	Check atmospheric temperature sensor (See page ED-13).
---	--------------------------------------------------------

NG	Replace air flow meter.
----	-------------------------

OK

3	Check for open and short in harness and connector between engine ECU and atmospheric temperature sensor (See page IN-20).
---	---------------------------------------------------------------------------------------------------------------------------

NG	Repair or replace harness or connector.
----	-----------------------------------------

OK

Check and replace engine ECU (See page IN-20).

DTC

31

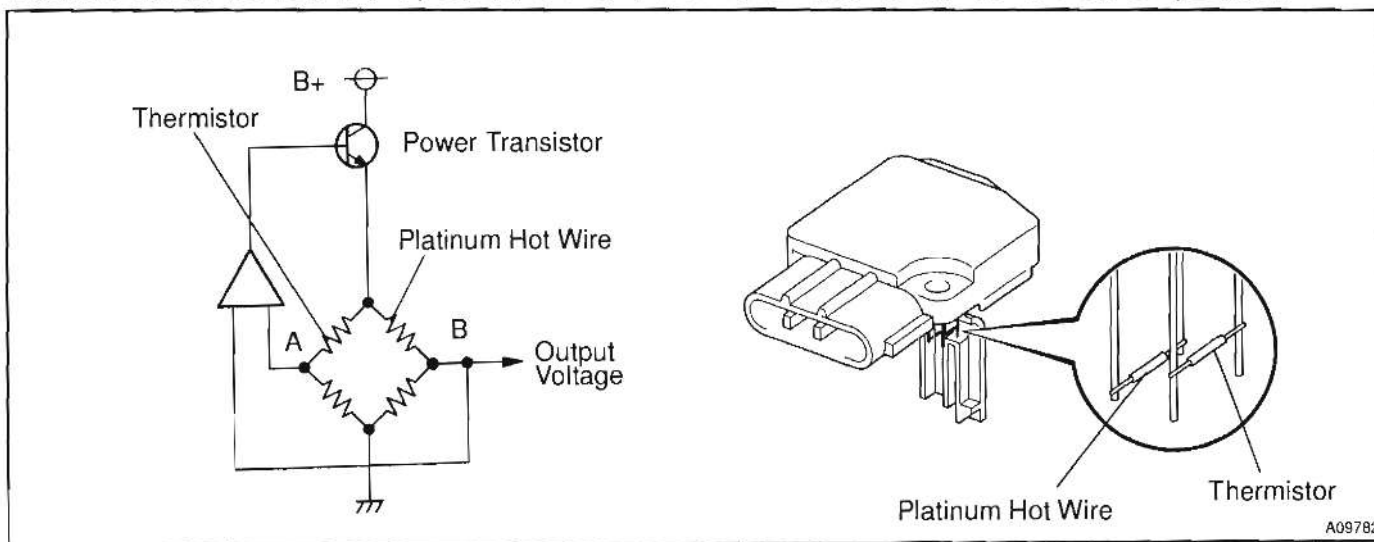
Air Flow Circuit Malfunction

CIRCUIT DESCRIPTION

The air flow meter uses a platinum hot wire. The hot wire air flow meter consists of a platinum hot wire, thermistor and a control circuit installed in a plastic housing. The hot wire air flow meter works on the principle that the hot wire and thermistor located in the intake air bypass of the housing detect any changes in the intake air temperature.

The hot wire is maintained at the set temperature by controlling the current flow through the hot wire. This current flow is then measured as the output voltage of the air flow meter.

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



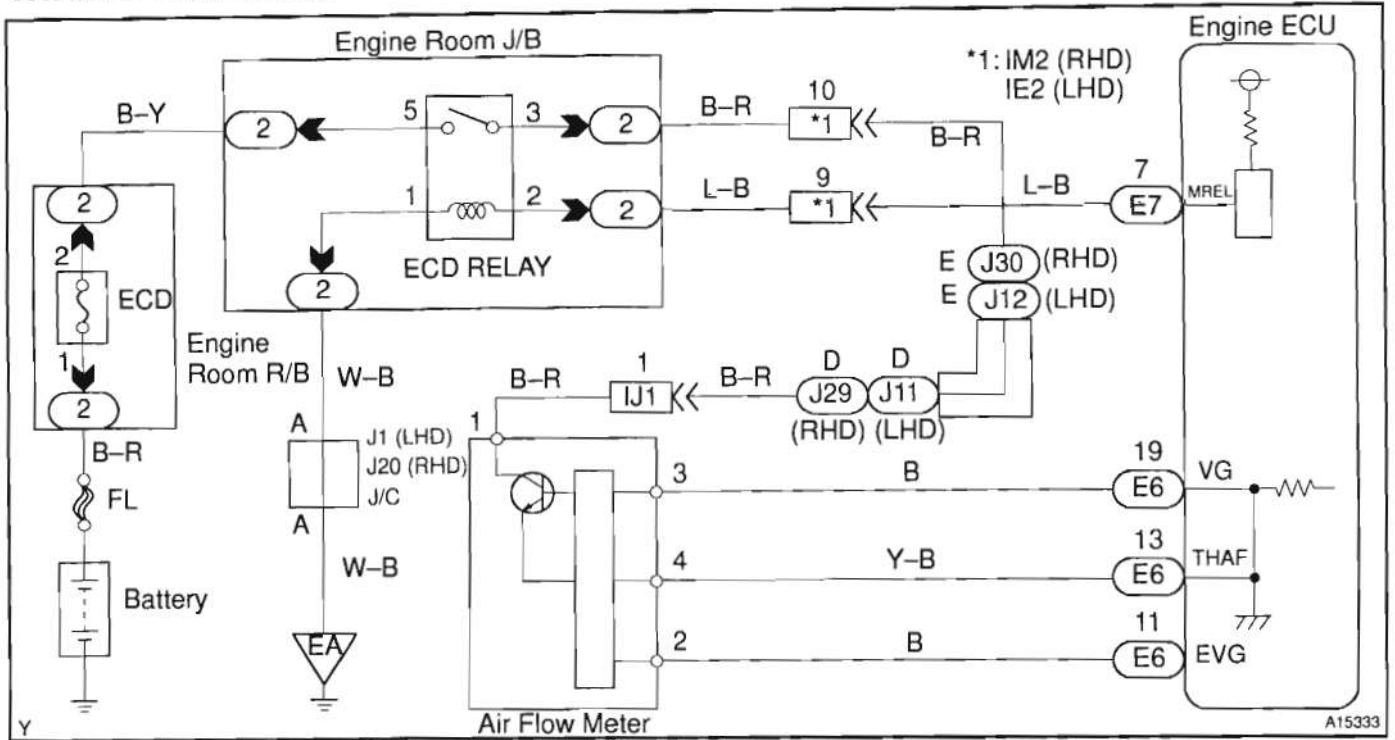
DTC No.	DTC Detecting Condition	Trouble Area
31	Open or short in air flow meter circuit with more than 3 sec.	<ul style="list-style-type: none"> • Open or short in air flow meter circuit • Air flow meter • Engine ECU

HINT:

After confirming DTC 31, use the hand-held tester to confirm the air flow ratio from the CURRENT DATA.

Air Flow Value (gm/sec.)	Malfunction
Approx. 0.0	<ul style="list-style-type: none"> • Air flow meter power source circuit open • VG circuit open or short
184.0 or more	<ul style="list-style-type: none"> • EVG circuit open

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 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.

When using hand-held tester:

1	Connect hand-held tester, and read value of 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.

CHECK:

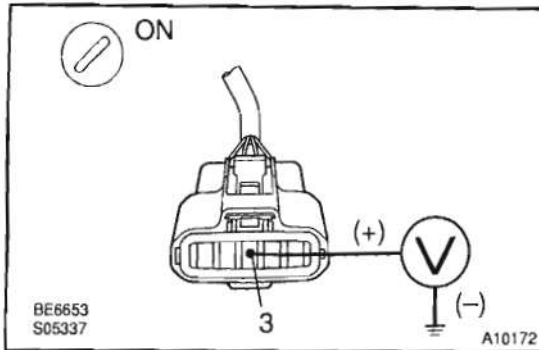
Read the air flow rate on the hand-held tester.

RESULT:

	Type I	Type II
Air Flow Rate (gm/sec.)	0.0	271.0 or more

Type I	Go to step 2.
Type II	Go to step 5.

2 Check voltage of air flow meter power source.



PREPARATION:

- Disconnect the air flow meter connector.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminal 3 of the air flow meter connector and body ground.

OK:

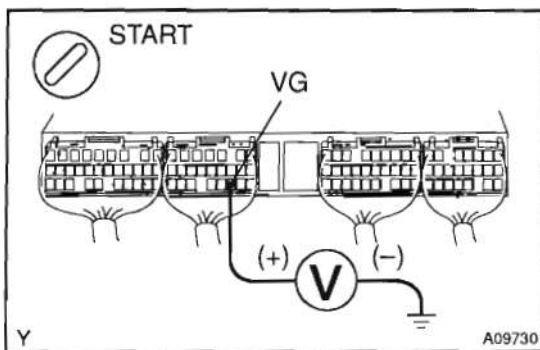
Voltage: 9 - 14 V

NG

Check for open in harness and connector between EFI main relay (Marking: EFI) and air flow meter (See page IN-20).

OK

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



PREPARATION:

- Remove the glove compartment door.
- Start the engine.

CHECK:

Measure the voltage between terminal VG of the engine ECU connector and body ground while the engine is idling.

OK:

Voltage:

0.5 - 3.0 V (P or N position and A/C switch OFF)

OK

Check and replace engine ECU (See page IN-20).

NG

4 Check for open and short in harness and connector between air flow meter and engine ECU (See page IN-20).

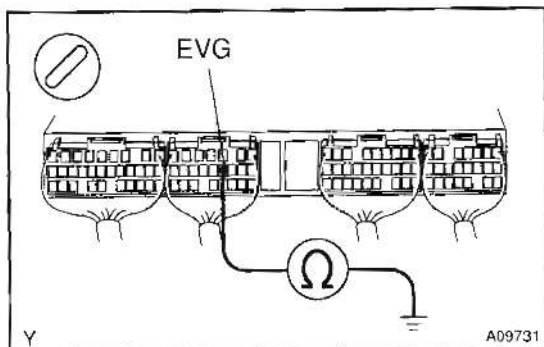
NG

Repair or replace harness or connector.

OK

Replace air flow meter.

- 5 Check continuity between terminal EVG of engine ECU connector and body ground.

**PREPARATION:**

Remove the glove compartment.

CHECK:

Check the continuity between terminal EVG of the engine ECU connector and body ground.

OK:

Continuity (1Ω or less)

NG

Check and replace engine ECU
(See page IN-20).

OK

- 6 Check for open in harness and connector between air flow meter and engine ECU (See page IN-20).

NG

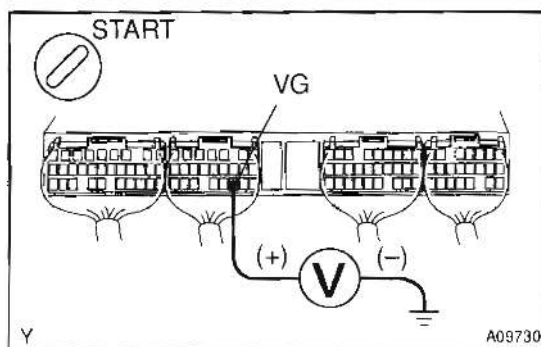
Repair or replace harness or connector.

OK

Replace air flow meter.

When not using hand-held tester:

- 1 Check voltage between terminals VG of engine ECU connector and body ground.

**PREPARATION:**

(a) Remove the glove compartment.

(b) Start the engine.

CHECK:

Measure the voltage between terminal VG of the engine ECU connector and body ground while the engine is idling.

OK:

Voltage:

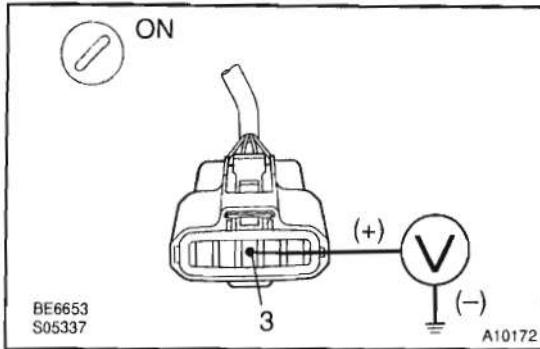
0.5 - 3.0 V (P or N position and A/C switch OFF)

OK

Check and replace engine ECU
(See page IN-20).

NG

2 Check voltage of air flow meter power source.



PREPARATION:

- (a) Disconnect the air flow meter connector.
- (b) Turn the ignition switch ON.

CHECK:

Measure the voltage between terminal 3 of the air flow meter connector and body ground.

OK:

Voltage: 9 – 14 V

NG

Check for open in harness and connector between EFI main relay (Marking: EFI) and air flow meter (See page IN-20).

OK

3 Check for open in harness and connector between air flow meter and engine ECU (See page IN-20).

NG

Repair or replace harness or connector.

OK

Replace air flow meter.

DTC	32	Injector Correction Resistance Malfunction
------------	-----------	---------------------------------------------------

CIRCUIT DESCRIPTION

The correction system is correcting a few vary between each injectors.

DTC No.	DTC Detecting Condition	Trouble Area
32	Open or short in circuit	<ul style="list-style-type: none"> • Injector correction resistance circuit • Injector correction resistance (built into injector) • Engine ECU

WIRING DIAGRAM

Refer to DTC 97 on page DI-88

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 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	Check resistance of ECU terminal for injector correction resistance and body ground.
----------	---------------------------------------------------------------------------------------------

OK	Check and replace engine ECU (See page ED-23).
-----------	-------------------------------------------------------

NG

2	Check resistance between terminals correction resistance of injector (See page FU-4).
----------	----------------------------------------------------------------------------------------------

NG	Replace the Injector.
-----------	------------------------------

OK

Repair harness or connector.

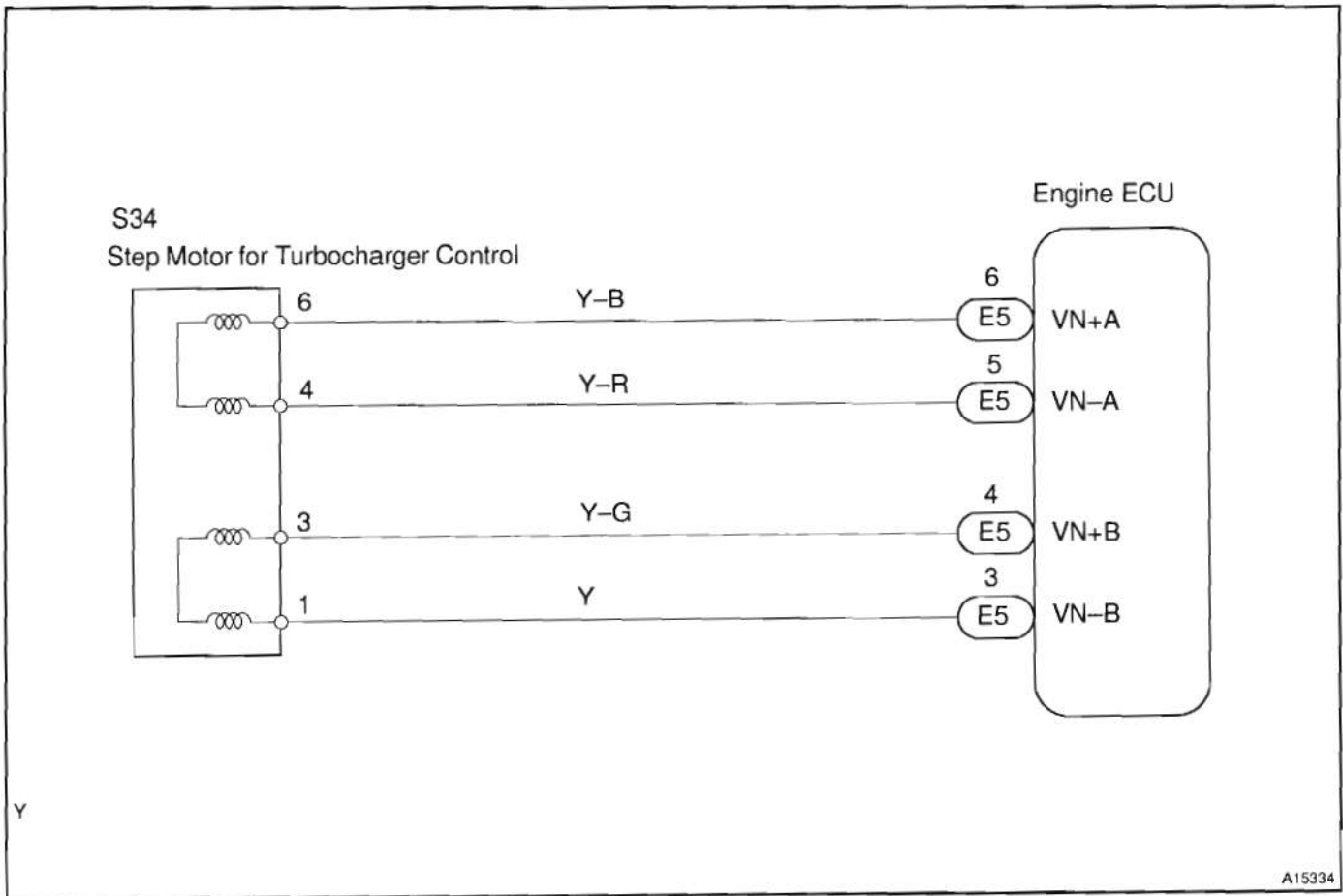
DTC	34 (1)	Step motor for turbocharger control circuit malfunction (Open/short)
------------	---------------	-----------------------------------------------------------------------------

CIRCUIT DESCRIPTION

DTC No.	DTC Detecting Condition	Trouble Area
34 (1)	When temporary error* is detected and , while the step motor control is kept, 31 errors are detected within 0.5 sec.	<ul style="list-style-type: none"> • Step motor • Wire harness • Engine ECU

*: When an error is detected from comparison between the current condition of the step motor and the monitor signal.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	Inspect step motor for turbocharger control (See page TC-3).
----------	---------------------------------------------------------------------

NG	Replace turbocharger assembly.
-----------	---------------------------------------

OK

2	Check for open and short in harness and connector between step motor and engine ECU (See page IN-20).
----------	--------------------------------------------------------------------------------------------------------------

NG	Repair or replace harness or connector.
-----------	------------------------------------------------

OK

Check and replace engine ECU (See page ED-23).

DTC	34 (2)	Turbocharger system malfunction
------------	---------------	----------------------------------------

DTC	34 (3)	Turbocharger stick detected (Close)
------------	---------------	--------------------------------------------

CIRCUIT DESCRIPTION

DTC No.	DTC Detecting Condition	Trouble Area
34 (2)	When the condition that the turbocharger pressure exceeds the standard value for 0.5 sec. or more is detected.	<ul style="list-style-type: none"> • Turbocharger • EGR valve • Air flow meter • Engine ECU
34 (3)	When the condition that for 60 sec. or more the turbocharger pressure is 20 kPa (0.2 kgf/cm ² , 1.4 psi) or more above the value that is set based on the engine revolution and the amount of fuel injection is detected.	

INSPECTION PROCEDURE

HINT:

If DTC 35 is output simultaneously, first troubleshoot DTC 35.

1	Check turbocharger assembly (See page TC-1).
----------	-----------------------------------------------------

NG

Replace turbocharger.

OK

2	Check EGR valve (See page EC-6)
----------	----------------------------------------

NG

Replace EGR valve.

OK

3	Check air flow meter (See page ED-3)
----------	---------------------------------------------

NG

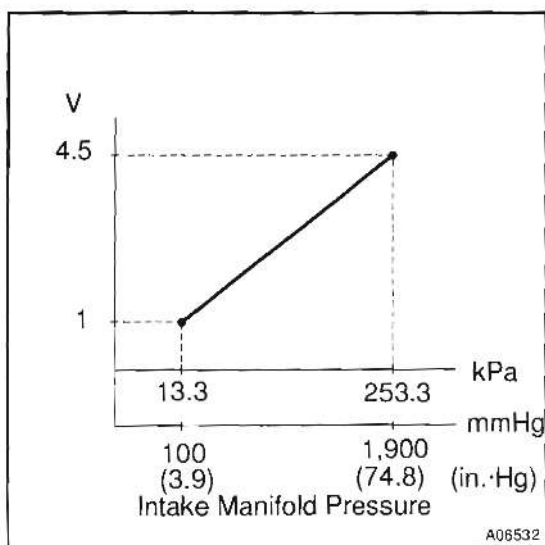
Replace air flow meter.

OK

**Check and replace engine ECU
(See page IN-20).**

DTC	35	Turbo Pressure Sensor Circuit Malfunction
------------	-----------	--------------------------------------------------

CIRCUIT DESCRIPTION



The turbo pressure sensor is connected to the intake manifold. The engine ECU detects the intake manifold pressure as a voltage by the sensor. The engine ECU uses the intake manifold pressure signal for correction of injection volume control and injection timing control.

The VSV for turbo pressure sensor switches the atmosphere applied to the turbo pressure sensor to the intake manifold pressure. The turbo pressure sensor monitors both the atmospheric pressure and intake manifold pressure and transmits the output voltage to the engine ECU, and the engine ECU uses this atmospheric pressure value for correcting the injection volume.

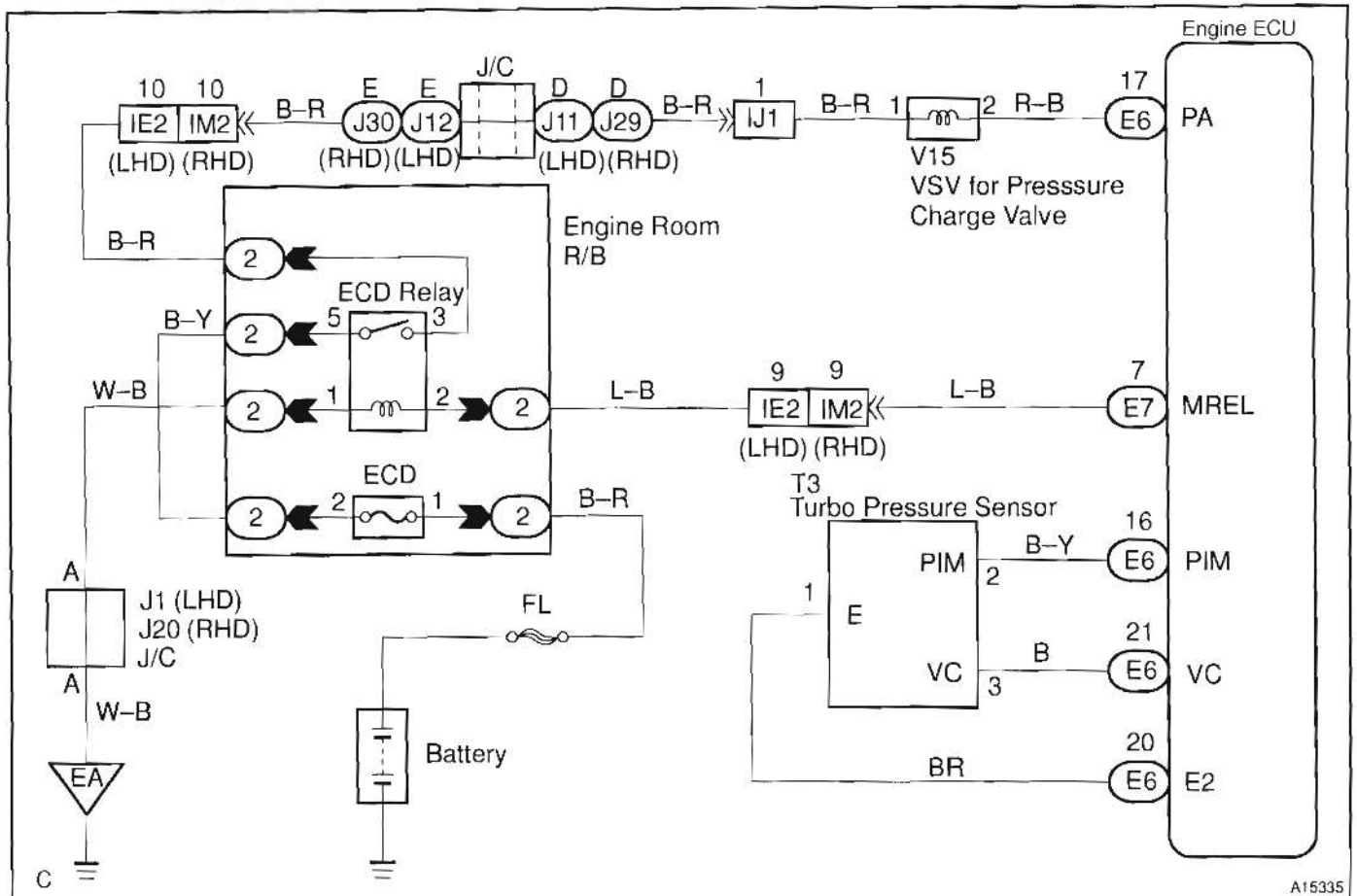
DTC No.	DTC Detecting Condition	Trouble Area
35	Open or short in turbo pressure sensor circuit for 2 sec. or more	<ul style="list-style-type: none"> • Open or short in turbo pressure sensor circuit • Turbo pressure sensor • Open or short in VSV for turbo pressure sensor circuit • VSV for turbo pressure sensor • Vacuum hose disconnected or blocked • Turbocharger • EGR valve • Air flow meter • Engine ECU

HINT:

After confirming DTC 35, use the hand-held tester to confirm the intake manifold pressure from the CURRENT DATA.

Intake Manifold Pressure (kPa)	Malfunction
Approx. 0	<ul style="list-style-type: none"> • PIM circuit short
250 or more	<ul style="list-style-type: none"> • VC circuit open or short • PIM circuit open • E2 circuit open

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- If DTC 22, 24, 35 and 39 are output simultaneously, E2 (sensor ground) may be open.
- 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 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.

When using hand-held tester:

- | | |
|---|---------------------------------------------------------------------------|
| 1 | Connect the hand-held tester, and read value of intake manifold pressure. |
|---|---------------------------------------------------------------------------|

PREPARATION:

- Connect the hand-held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.

CHECK:

Read the value of intake manifold pressure on the hand-held tester.

OK:

Same as atmospheric pressure.

OK

Go to step 5.

NG

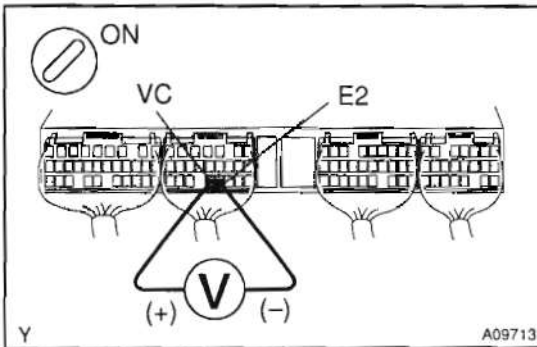
2 Check turbo pressure sensor (See page ED-15).

NG

Replace turbo pressure sensor.

OK

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

**PREPARATION:**

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

CHECK:

Measure the voltage between terminals VC and E2 of the engine ECU connector.

OK:

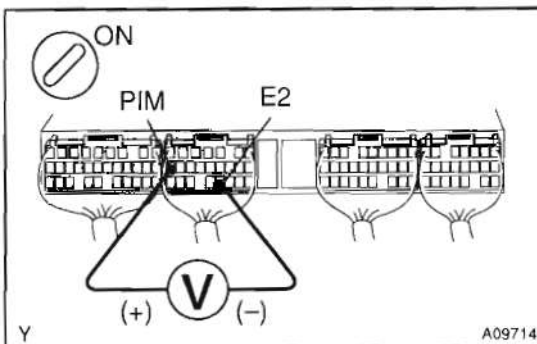
Voltage: 4.5 – 5.5 V

NG

Check and replace engine ECU
(See page IN-20).

OK

4 Check voltage between terminals PIM and E2 of engine ECU connector.

**PREPARATION:**

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

CHECK:

Measure the voltage between terminals PIM and E2 of the engine ECU connector.

OK:

Voltage: 1.7 – 2.9 V

OK

Check and replace engine ECU
(See page IN-20).

NG

Check for open and short in harness and connector between engine ECU and turbo pressure sensor (See page IN-20).

- 5 Check connection of vacuum hose between turbo pressure sensor and VSV for turbo pressure sensor, and VSV for turbo pressure sensor and intake manifold.

NG

Repair or replace.

OK

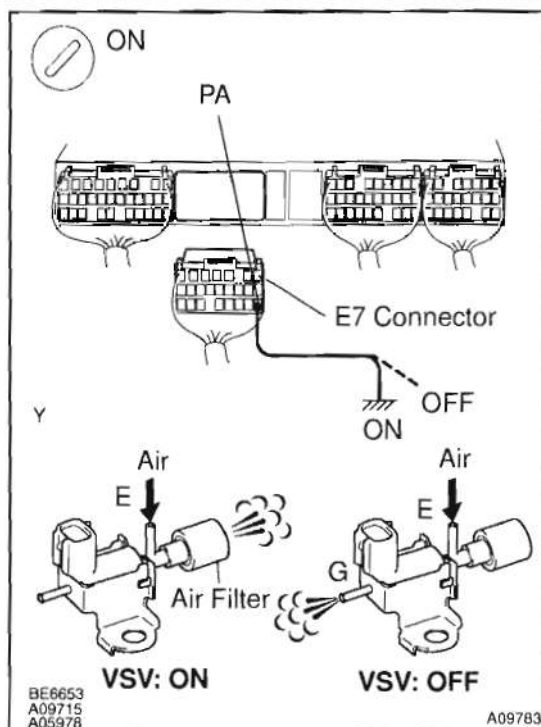
- 6 Check resistance of VSV for turbo pressure sensor (See page ED-15).

NG

Replace VSV for turbo pressure sensor.

OK

- 7 Check VSV for turbo pressure sensor.

**PREPARATION:**

- Remove the glove compartment.
- Disconnect the E7 connector from the engine ECU.
- Turn the ignition switch ON.

CHECK:

Check the VSV function.

- Connect between terminal PA of the engine ECU connector and body ground (VSV is ON).
- Disconnect between terminal PA of the engine ECU connector and body ground (VSV is OFF).

OK:

VSV is ON:

Air from port E flows out through the air filter.

VSV is OFF:

Air from port E flows out through port G.

OK

Go to step 9.

NG

- 8 Check for open and short in harness and connector between engine ECU and VSV for turbo pressure sensor, and VSV for turbo pressure sensor and EFI main relay (Marking: EFI) (See page IN-20).

NG

Repair harness or connector.

OK

Replace VSV for turbo pressure sensor.

- 9 Check turbocharger assembly (See page TC-1).

NG

Replace turbocharger.

OK

- 10 Check EGR valve (See page EC-6)

NG

Replace EGR valve.

OK

- 11 Check air flow meter (See page ED-3)

NG

Replace air flow meter.

OK

Check and replace engine ECU
(See page IN-20).

When not using hand-held tester:

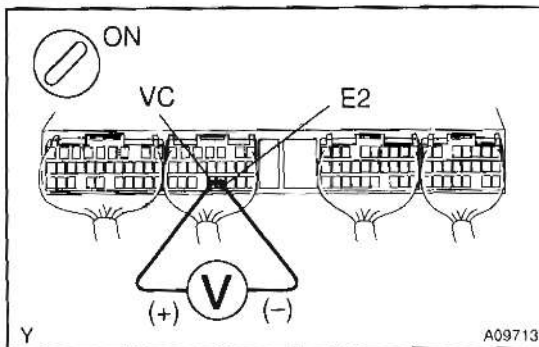
1 Check turbo pressure sensor (See page ED-15).

NG

Replace turbo pressure sensor.

OK

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



PREPARATION:

- Remove the glove compartment.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals VC and E2 of the engine ECU connector.

OK:

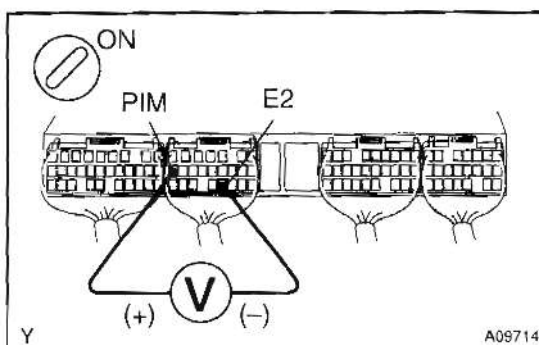
Voltage: 4.5 - 5.5 V

NG

Check and replace engine ECU
(See page IN-20).

OK

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



PREPARATION:

- Remove the glove compartment.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals PIM and E2 of the engine ECU connector.

OK:

Voltage: 1.7 - 2.9 V

OK

Check and replace engine ECU
(See page IN-20).

NG

- 4 Check for open and short in harness and connector between engine ECU and turbo pressure sensor (See page IN-20).

NG

Repair or replace harness or connector.

OK

- 5 Check connection of vacuum hose between turbo pressure sensor and VSV for turbo pressure sensor, and VSV for turbo pressure sensor and intake manifold.

NG

Repair or replace.

OK

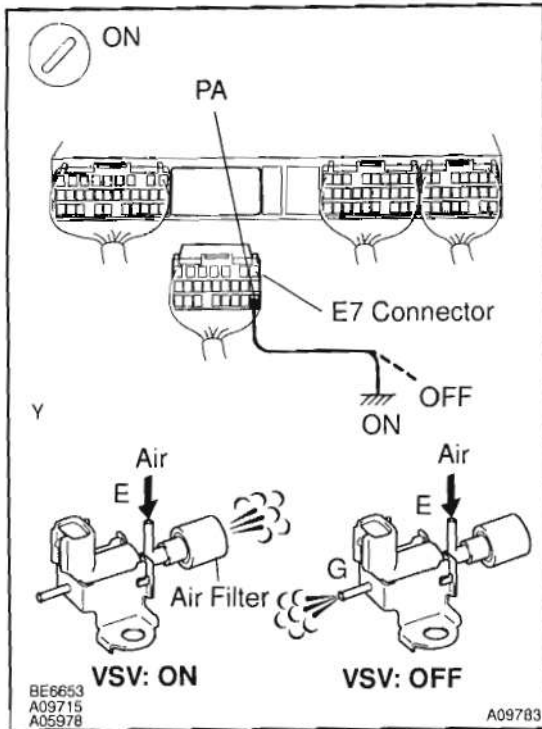
- 6 Check resistance of VSV for turbo pressure sensor (See page ED-15).

NG

Replace VSV for turbo pressure sensor.

OK

7 Check VSV for turbo pressure sensor.



PREPARATION:

- (a) Remove the glove compartment.
- (b) Disconnect the E7 connector from the engine ECU.
- (c) Turn the ignition switch ON.

CHECK:

Check the VSV function.

- (a) Connect between terminal PA of the engine ECU connector and body ground (VSV is ON).
- (b) Disconnect between terminal PA of the engine ECU connector and body ground (VSV is OFF).

OK:

VSV is ON:

Air from port E flows out through the air filter.

VSV is OFF:

Air from port E flows out through port G.

OK → Go to step 11.

NG

8 Check turbocharger assembly (See page TC-1).

NG → Replace turbocharger.

OK

9 Check EGR valve (See page EC-6)

NG → Replace EGR valve.

OK

10 Check air flow meter (See page ED-3)

NG → Replace air flow meter.

OK

Check and replace engine ECU
(See page IN-20).

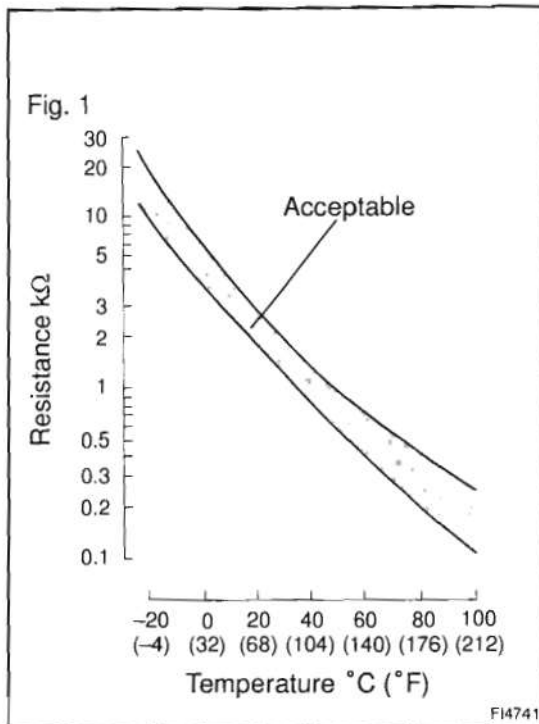
11	Check for open and short in harness and connector between engine ECU and VSV for turbo pressure sensor and ECD main relay (Marking: INJ) (See page IN-20).
----	---------------------------------------------------------------------------------------------------------------------------------------------------------------

NG

Repair harness or connector.

OK

Replace VSV for turbo pressure sensor.

DTC**39****Fuel Temp. Sensor Circuit Malfunction****CIRCUIT DESCRIPTION**

The fuel temperature sensor senses the fuel temperature. A thermistor built into the sensor changes the resistance value according to the fuel temperature. The lower the fuel temperature, the greater the thermistor resistance value, and the higher the fuel temperature, the lower the thermistor resistance value (See Fig. 1).

The fuel temperature sensor is connected to the engine ECU (See below). The 5 V power source voltage in the engine ECU is applied to the fuel temperature sensor from terminal THF via a resistor R. That is, resistor R and the fuel temperature sensor are connected in series. When the resistance value of the fuel temperature sensor changes in accordance with changes in the fuel temperature, the potential at terminal THF also changes. Based on this signal, the engine ECU performs the pressure control compensation of the supply pump and error detection compensation of the highly pressurized fuel system.

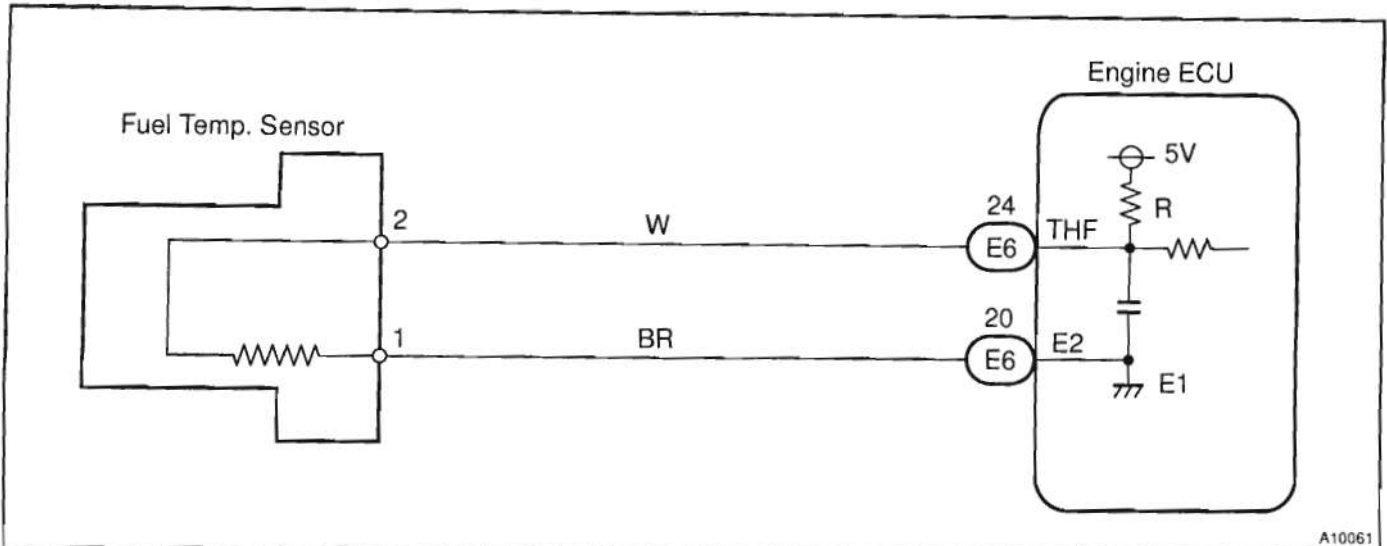
DTC No.	DTC Detecting Condition	Trouble Area
39	Open or short in fuel temp. sensor circuit for 0.5 sec. or more	<ul style="list-style-type: none"> • Open or short in fuel temp. sensor circuit • Fuel temp. sensor • Engine ECU

HINT:

After confirming DTC 39, use the hand-held tester to confirm the fuel temperature from the CURRENT DATA.

Temperature displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or more	Short circuit

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- If DTC 22, 24, 35 and 39 are output simultaneously, E2 (sensor ground) may be open.
- 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 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.

When using hand-held tester:

1	Connect hand-held tester, and read value of fuel temperature.
---	---------------------------------------------------------------

PREPARATION:

- Connect the hand-held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

Same as actual fuel temperature.

HINT:

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

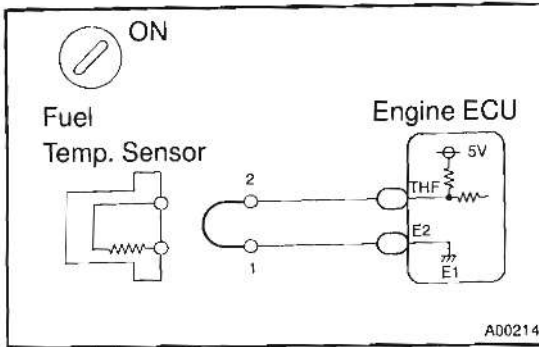
NG

-40°C (-40°F) ... Go to step 2.
 140°C (284°F) or more ... Go to step 4.

OK

Check for intermittent problems (See page DI-4).

2 Check for open in harness or engine ECU.



PREPARATION:

- Disconnect the fuel temperature sensor connector.
- Connect the sensor wire harness terminals together.
- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

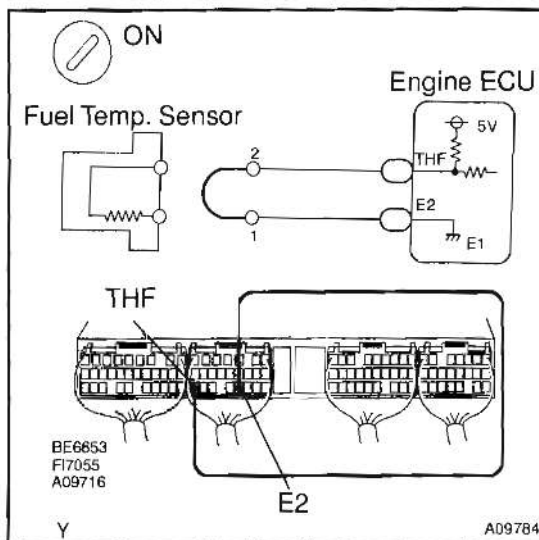
Temperature value: 140°C (284°F) or more

OK

Confirm good connection at sensor. If OK, replace fuel pump.

NG

3 Check for open in harness or engine ECU.



PREPARATION:

- Remove the glove compartment.
- Connect between terminals THF and E2 of the engine ECU connector.

HINT:

The fuel temperature sensor connector is disconnected. Before checking, do a visual and contact pressure check for the engine ECU connector (See page IN-20).

- Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

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

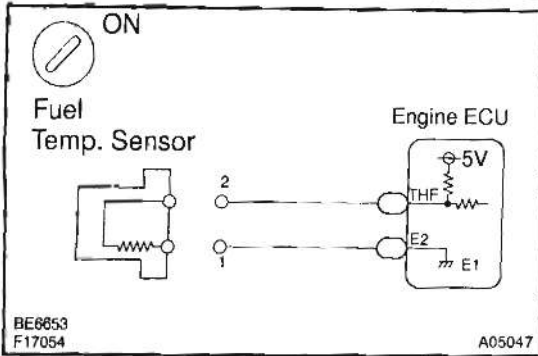
OK

Open in harness between terminal E2 or THF, repair or replace harness.

NG

Confirm good connection at engine ECU. If OK, replace engine ECU.

4 Check for short in harness or engine ECU.



PREPARATION:

- (a) Disconnect the fuel temperature sensor connector.
- (b) Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

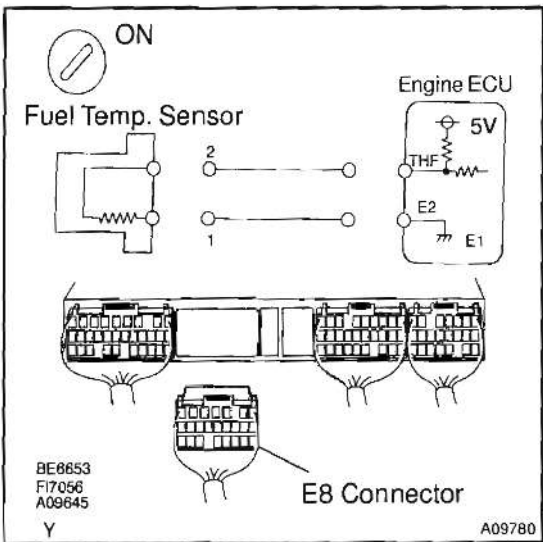
OK:

Temperature value: -40°C (-40°F)

OK Replace fuel temperature sensor.

NG

5 Check for short in harness or engine ECU.



PREPARATION:

- (a) Remove the glove compartment.
- (b) Disconnect the E8 connector from the engine ECU.

HINT:

The fuel temperature sensor connector is disconnected.

- (c) Turn the ignition switch ON.

CHECK:

Read the temperature value on the hand-held tester.

OK:

Temperature value: -40°C (-40°F)

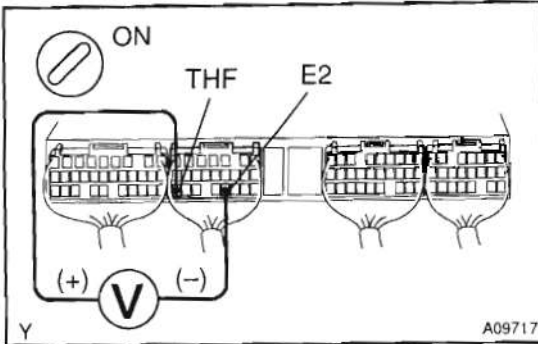
OK Repair or replace harness or connector.

NG

Check and replace engine ECU
(See page IN-20).

When not using hand-held tester:

1

Check voltage between terminals THF and E2 of engine ECU connector.**PREPARATION:**

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

CHECK:

Measure the voltage between terminals THF and E2 of the engine ECU connector.

OK:

Fuel Temp. °C (°F)	Voltage
20 (68) (Engine is cool)	0.2 - 3.8 V
80 (176) (Engine is hot)	0.1 - 1.5 V

OK

Check for intermittent problems
(See page DI-4).

NG

2

Check fuel temperature sensor (See page ED-12).

NG

Replace fuel temperature sensor.

OK

3

Check for open and short in harness and connector between engine ECU and fuel temperature sensor (See page IN-20).

NG

Repair or replace harness or connector.

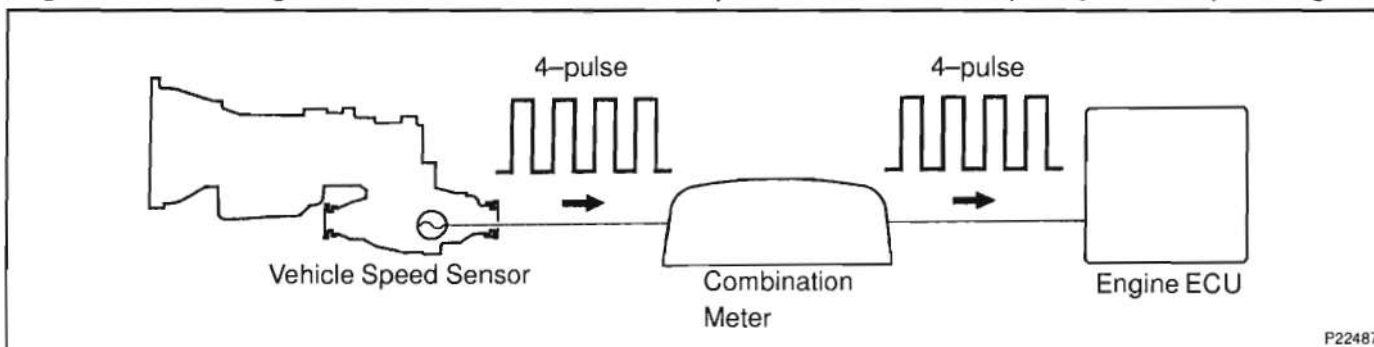
OK

Check and replace engine ECU
(See page IN-20).

DTC	42	Vehicle Speed Sensor Signal Circuit Malfunction
------------	-----------	--------------------------------------------------------

CIRCUIT DESCRIPTION

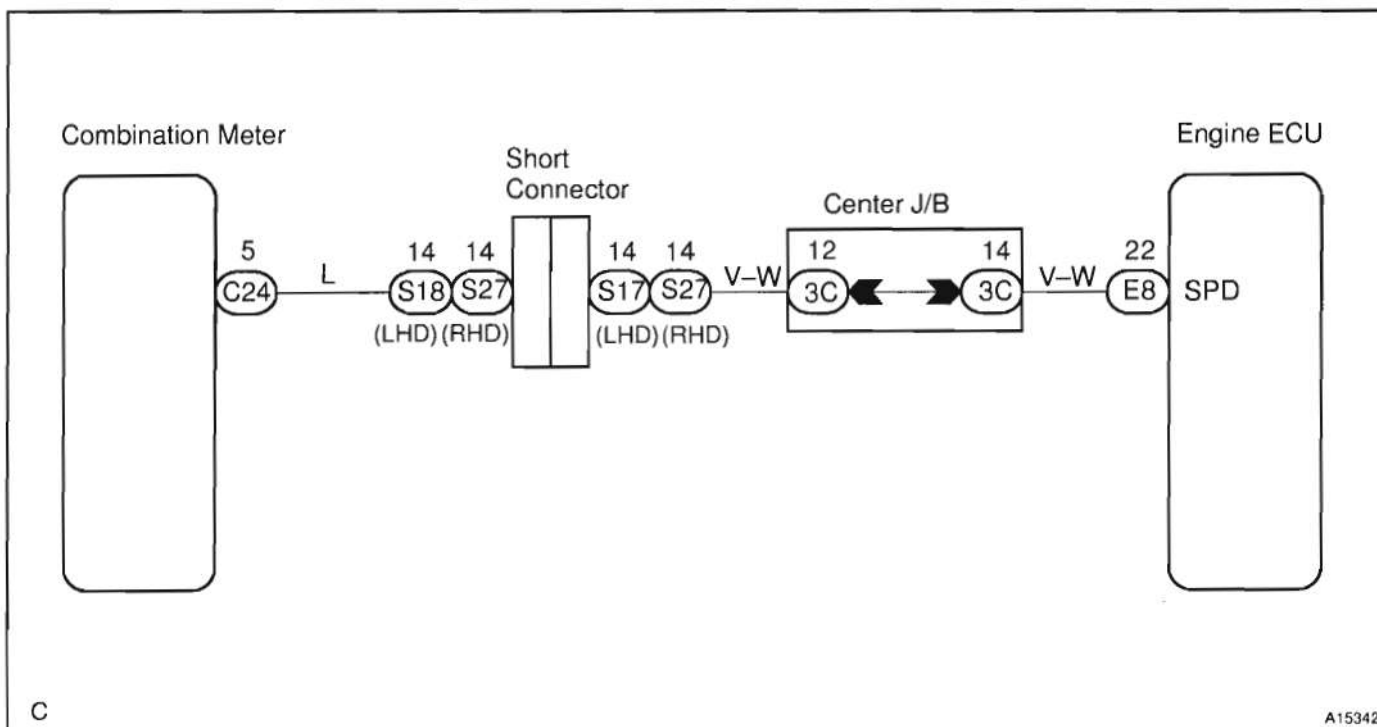
The vehicle speed sensor outputs a 4-pulse signal for every revolution of the rotor shaft, which is rotated by the transmission output shaft via the driven gear. After this signal is converted into a more precise rectangular waveform by the waveform shaping circuit inside the combination meter, it is then transmitted to the engine ECU. The engine ECU determines the vehicle speed based on the frequency of these pulse signals.



P22487

DTC No.	DTC Detecting Condition	Trouble Area
42	All conditions below are detected continuously for 8 sec. or more: (a) Vehicle speed signal: 0 km/h (0 mph) (b) Engine speed: 2,400 - 4,000 rpm (c) Engine coolant temp.: 60°C (176°F) or more (d) Accelerator pedal opening angle : 29 % or more	<ul style="list-style-type: none"> • Open or short in vehicle speed sensor circuit • Vehicle speed sensor • Combination meter • Engine ECU

WIRING DIAGRAM



C

A15342

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 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 Check operation of speedometer.

CHECK:

Drive the vehicle and check if the operation of the speedometer in the combination meter is normal.

HINT:

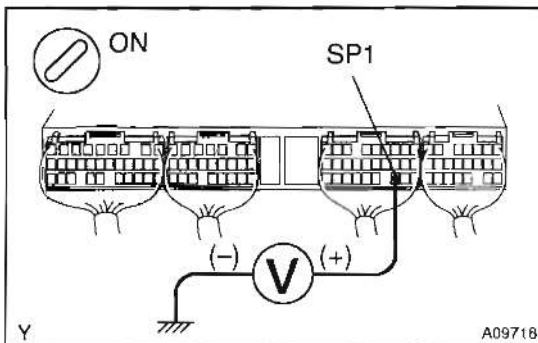
The vehicle speed sensor is operating normally if the speedometer display is normal.

NG

Check speedometer.

OK

2 Check voltage between terminal SP1 of engine ECU connector and body ground.

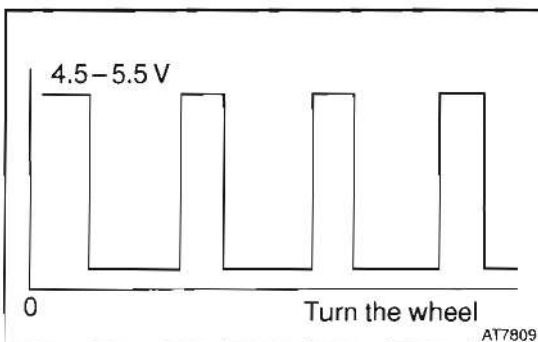


PREPARATION:

- Remove the glove compartment.
- Shift the shift lever to the neutral.
- Jack up one of the front wheels.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminal SP1 of the engine ECU connector and body ground when the wheel is turned slowly.



OK:

Voltage is generated intermittently.

NG

Check and repair harness and connector between combination meter and engine ECU (See page IN-20).

OK

Check and replace engine ECU
(See page IN-20).

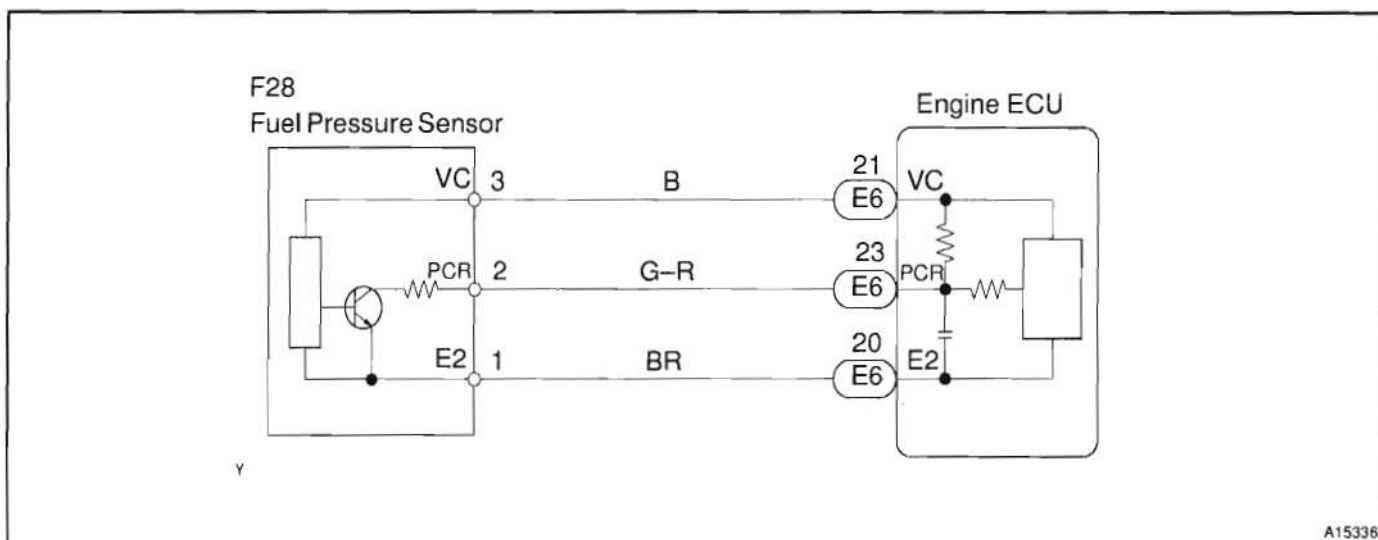
DTC**49****Fuel Pressure Circuit Malfunction****CIRCUIT DESCRIPTION**

Fuel pressure sensor installed on a Common Rail detects the fuel pressure and controls to feed back the pump discharge in order to keep the target pressure (20 – 135 Mpa) set by the engine control computer.

DTC No.	DTC Detecting Condition	Trouble Area
P49	Open or short in fuel pressure sensor circuit for common rail	<ul style="list-style-type: none"> • Open or short in fuel pressure sensor circuit for common rail • Fuel pressure sensor for common rail • ECU

HINT:

After confirming DTC 49, use the hand-held tester to confirm the fuel rail pressure from the CURRENT DATA.

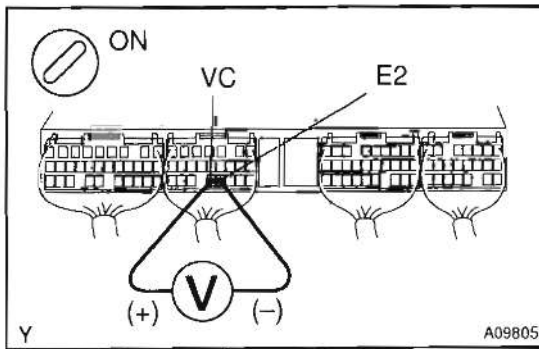
WIRING DIAGRAM

A15336

INSPECTION PROCEDURE**HINT:**

- If DTC 22, 24, 39 and 49 are output simultaneously, E2 (sensor ground) may be open.
- 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 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 Check voltage between terminals VC and E2 of ECM connector.



PREPARATION:

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

CHECK:

Measure the voltage between terminals VC and E2 of the ECU connector.

OK:

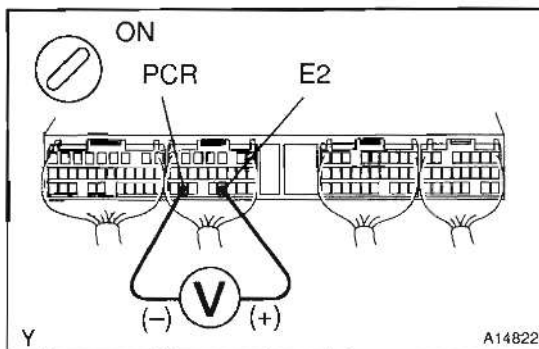
Voltage: 4.75 – 5.25 V

NG

**Check and replace engine ECU
(See page IN-20).**

OK

2 Check voltage between terminals PCR and E2 of ECU connector.



PREPARATION:

- (a) Remove the glove compartment.
- (b) Start the engine.

CHECK:

Measure the voltage between terminals PCR and E2 of the engine ECU connector.

OK:

Voltage: 1.7 V at 20°C (68°F)

OK

**Check and replace engine ECU
(See page IN-20).**

NG

3 Check for open and short in harness and connector between fuel pressure sensor for common rail and engine ECU (See page IN-20).

NG

Repair or replace harness or connector.

OK

**Replace common rail assembly
(See page FU-20).**

DTC	78 (1)	Fuel Pump Circuit Malfunction (Fuel Leakage)
------------	---------------	-----------------------------------------------------

CIRCUIT DESCRIPTION

Refer to DTC 49 on page DI-77.

Refer to DTC 97 on page DI-88.

DTC No.	DTC Detecting condition	Trouble Area
78 (1)	Pressure change of common rail is abnormal against injection quantify and supply quantify of supply pump	<ul style="list-style-type: none"> • Open or short in EDU circuit • EDU • Open or short in injector circuit • Injector • Open or short in common rail pressure sensor circuit • Common rail pressure sensor • Fuel line between supply pump and common rail • Fuel line between common rail and injector • Pressure limiter • Engine ECU

WIRING DIAGRAM

Refer to DTC 49 on page DI-77.

Refer to DTC 97 on page DI-88.

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 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.

When using hand-held tester:

1	Are there any other codes (besides DTC 39, DTC 49, DTC 78 (2), DTC 78 (3) or DTC 97) being output?
----------	-----------------------------------------------------------------------------------------------------------

YES

Go to relevant DTC chart
(See page DI-13).

NO

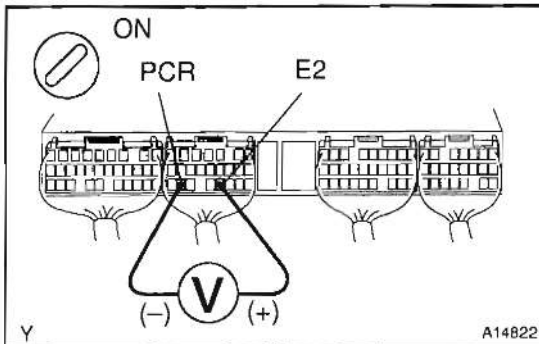
2	Open engine hood and check if there is any fuel leakage (See page FU-8).
----------	---------------------------------------------------------------------------------

NG

Check and replace.

OK

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

**PREPARATION:**

- Remove the glove compartment.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals PCR and E2 of the engine ECU connector.

OK:

Voltage: Approx. 1 V at 20°C (68°F)

OK

Go to step 5.

NG

4 Check for open and short in harness and connector between common rail pressure sensor and engine ECU (See page IN-20).

NG

Repair or replace harness or connector.

OK

Replace common rail assembly (See page FU-21).

5 Connect hand-held tester, and read value of compensation of injection quantify between cylinders.

PREPARATION:

- Connect the hand held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.

CHECK:

Read the compensation of the injection quantify between the cylinders on the hand-held tester.

OK:

STD: -3 – 3 mm³/st
Maximum: -4 – 4 mm³/st

NG

Replace corresponding cylinder injector.

OK

6 Check if any fuel is mixed with engine oil.

NG

Replace injector (See page FU-6).

OK

7 When you start engine, check that if any white smoke is coming out from exhaust pipe.

NG

Replace injector (See page FU-6).

OK

Replace injector (See page FU-6) and common rail assembly (See page FU-21).

When not using hand-held tester:

1 Are there any other codes (besides DTC 39, DTC 49, DTC 78 (2), DTC 78 (3) or DTC 97) being output?

YES

Go to relevant DTC chart (See page DI-13).

NO

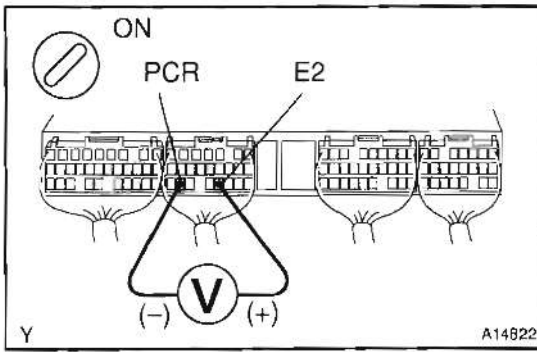
2 Open engine hood and check if there is any fuel leakage (See page FU-8).

NG

Check and replace leakage parts.

OK

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



PREPARATION:

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

CHECK:

Measure the voltage between terminals PCR and E2 of the engine ECU connector.

OK:

Voltage: Approx. 1 V at 20°C (68°F)

NG

Go to step 5.

OK

4 Check for open and short in harness and connector between common rail pressure sensor and engine ECU (See page IN-20).

NG

Repair or replace harness or connector.

OK

Replace common rail assembly (See page FU-21).

5 Check if any fuel is mixed with engine oil.

NG

Replace injector.

OK

6 When you start the engine, check that if any white smoke is coming out from exhaust pipe.

NG

Replace injector (See page FU-6).

OK

Go to step 1 in DTC 78 (2), DTC 78 (3).

DTC	78 (2)	Fuel Pump Circuit Malfunction (Open Circuit)
------------	---------------	-----------------------------------------------------

DTC	78 (3)	Fuel Pump Circuit Malfunction (Over Force Feed)
------------	---------------	--------------------------------------------------------

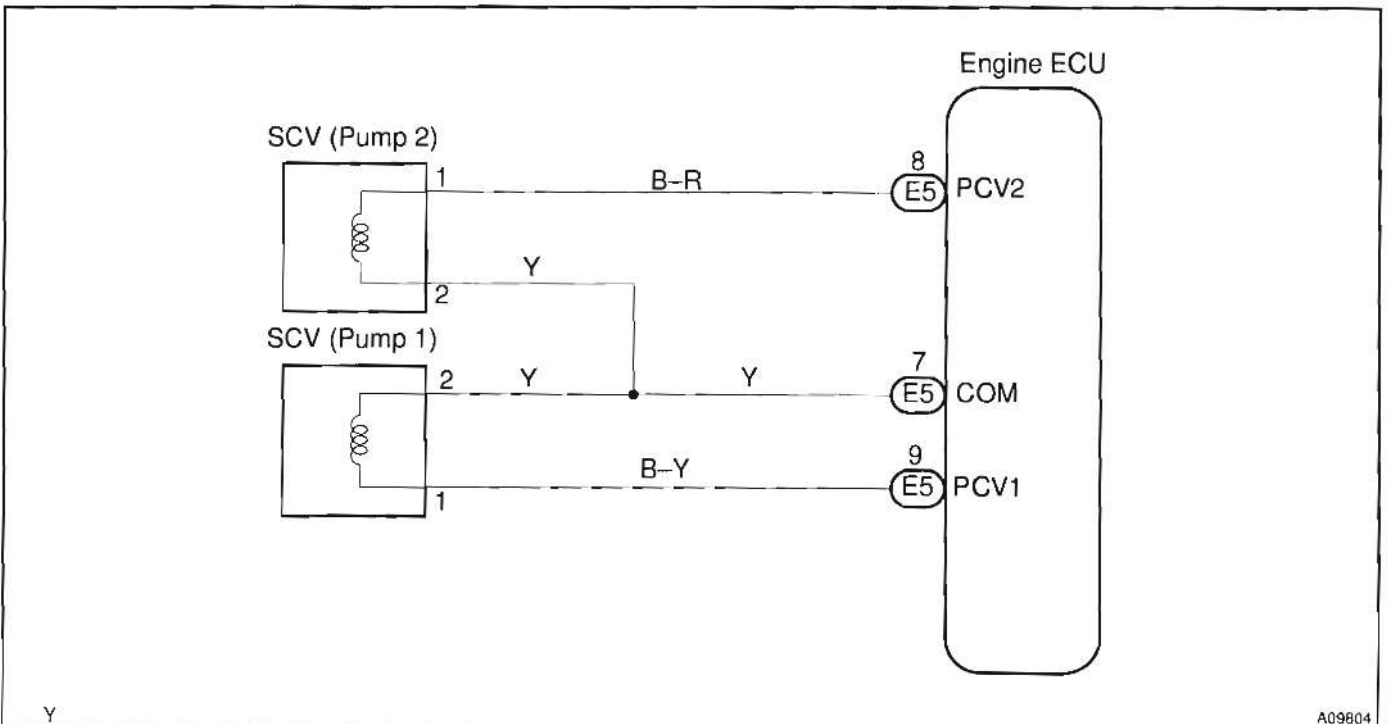
CIRCUIT DESCRIPTION

Supply pump is a tandem type and has two circuits of the fuel suction and force feed processes that achieve both high pressure force feed of fuel and reduction of driving torque.

In the suction process, it control SCV (Suction Control Valve) which suctions fuel by a plunger.

DTC No.	DTC Detecting condition	Trouble Area
78 (2) 78 (3)	Pressure change of common rail against supply quantity of supply pump is abnormal	<ul style="list-style-type: none"> • Open or short in SCV circuit • SCV • Supply pump • Engine ECU

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 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.

When using hand-held tester:

1 Are there any other codes (besides DTC 39, DTC 49 or DTC 97) being output?

YES Go to relevant DTC chart (See page DI-13).

NO

2 Check SCV (See page FU-13).

OK Replace supply pump (See page FU-16).

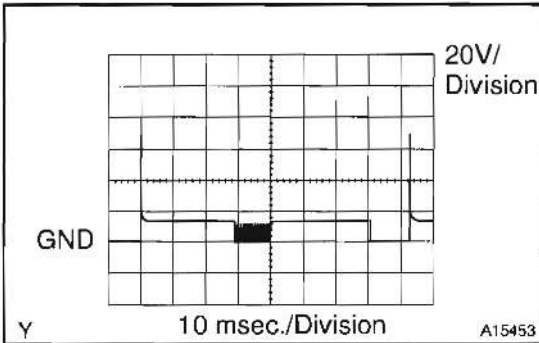
OK

3 Check for open and short in harness and connector between SCV and engine ECU (See page IN-20).

NG Repair or replace harness or connector.

OK

4 Check voltage between terminals PCV1 and COM, and PCV2 and COM of engine ECU connector.



Reference: INSPECTION USING OSCILLOSCOPE

During cranking or idling, check the waveforms between terminals PCV1 and COM, and PCV2 and COM of the engine ECU connector.

HINT:

The correct waveforms are as shown.

NG Check and replace engine ECU (See page ED-24).

OK

Replace supply pump (See page FU-16).

When not using hand-held tester:

1 Check SCV (See page FU-13).

NG

Replace supply pump (See page FU-16).

OK

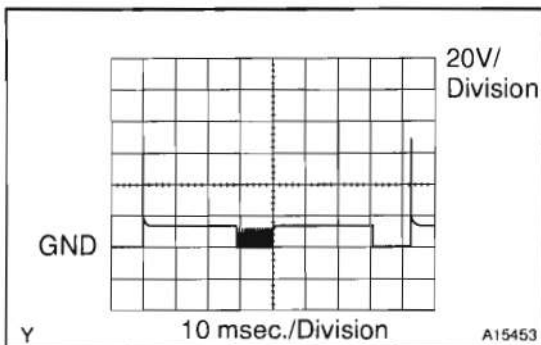
2 Check for open and short in harness and connector between SCV and engine ECU (See page IN-20).

NG

Repair or replace harness or connector.

OK

3 Check voltage between terminals PCV1 and COM, and PCV2 and COM of engine ECU connector.



Reference: INSPECTION USING OSCILLOSCOPE

During cranking or idling, check the waveforms between terminals PCV1 and COM, and PCV2 and COM of the engine ECU connector.

HINT:

The correct waveforms are as shown.

NG

Check and replace engine ECU (See page ED-24).

OK

4 Check if engine will start.

YES

Replace supply pump (See page FU-16).

NO

Peplace injector (See page FU-6) and common rail assembly (See page FU-21).

DTC	97	EDU Circuit Malfunction
------------	-----------	--------------------------------

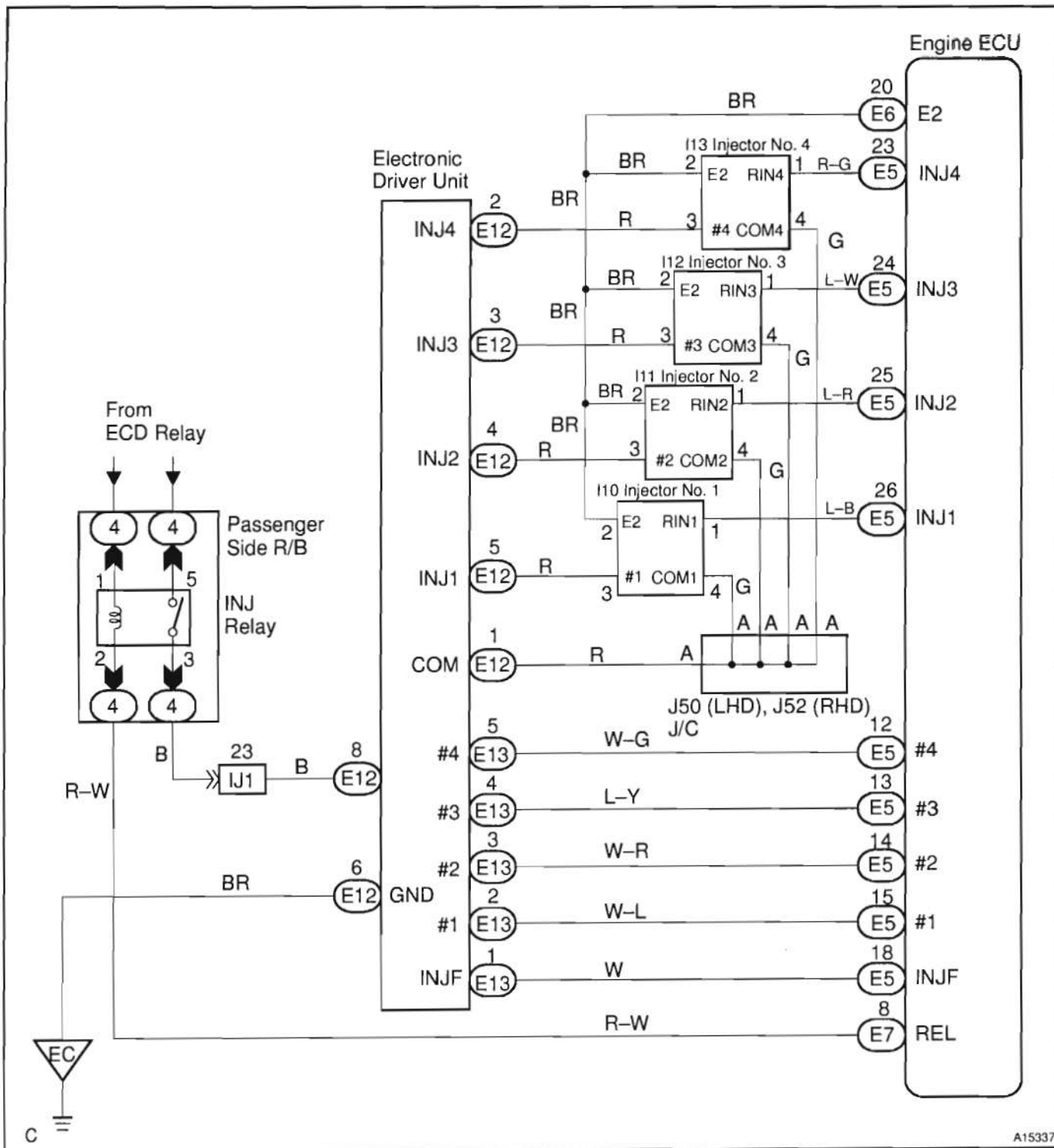
CIRCUIT DESCRIPTION

The ECU has been adopted to drive the injector at high speeds. The EDU has realized high-speed driving under high fuel pressure conditions through the use of a DC/DC converter that provides a high-voltage, quick-charging system.

The engine ECU constantly monitors the EDU and stops the engine in case an abnormal condition is detected.

DTC No.	DTC Detecting condition	Trouble Area
97	Open or short in EDU circuit	<ul style="list-style-type: none"> • Open or short in EDU circuit • EDU • Open or short in SCV circuit • SCV • Injector • Engine ECU

WIRING DIAGRAM

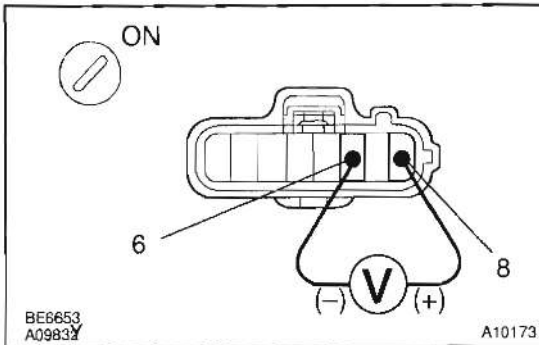


INSPECTION PROCEDURE

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 for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ration was lean or rich, etc. at the time of the malfunction.

1 Check voltage of EDU power source.



PREPARATION:

- Disconnect the EDU connector.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals 6 and 8 of the wire harness side connector.

OK:

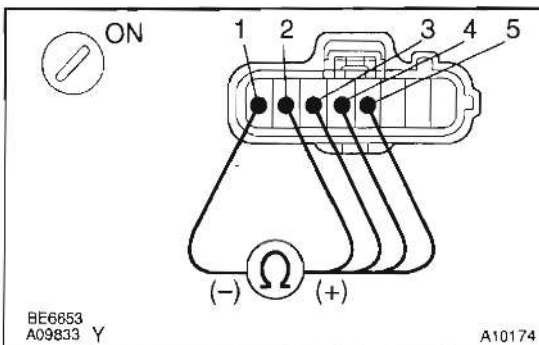
Voltage: 9 – 14 V

NG

Check EDU power source circuit
(See page DI-93).

OK

2 Check resistance between terminals 1 and 2 – 5 of wire harness side connector.



PREPARATION:

- Disconnect the EDU connector.
- Turn the ignition switch ON.

CHECK:

Measure the resistance between terminals 1 and 2 – 5 of the wire harness side connector.

OK:

Resistance: 2.5 – 3.1 Ω at 20°C (68°F)

OK

Go to step 4.

NG

3 Check injector (See page FU-4).

NG

Replace injector.

OK

Repair or replace harness or connector.

4 Check SCV (See page FU-13).

NG

Replace supply pump (See page FU-16).

OK

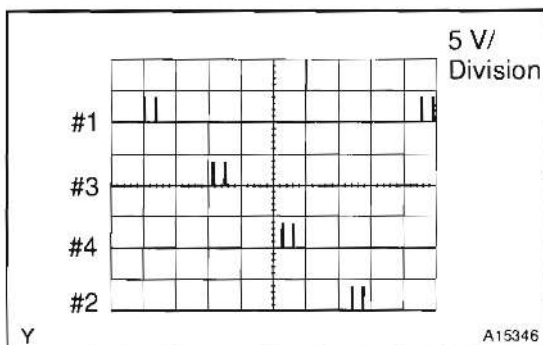
5 Check for open and short in harness and connector between SCV and ECU.

NG

Repair or replace harness or connector.

OK

6 Check voltage between terminals #1 – #4 and E01 of engine ECU connector.

**PREPARATION:**

Remove the glove compartment.

CHECK:

During cranking or idling, check the waveform between terminals #1 – #4 and E01 of the engine ECU connector with the oscilloscope.

OK:

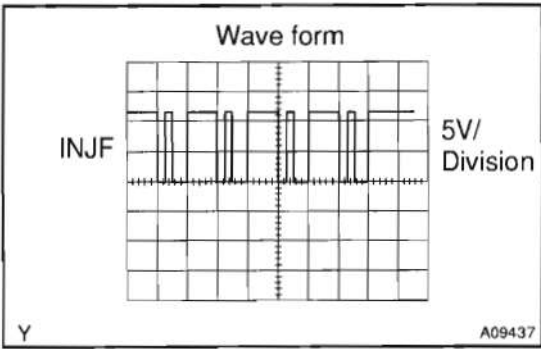
Voltage: The correct waveform are as shown.

NG

Check and replace ECU (See page IN-20).

OK

7 Check voltage between terminals INJF and E01 of engine ECU connector.



PREPARATION:

Remove the glove compartment.

CHECK:

During cranking or idling, check the wave form between terminals INJF and E01 of the engine ECU connector with the oscilloscope.

OK:

Voltage: The correct waveform are as shown.

NG Check and replace ECU (See page IN-20).

NG

8 Check for open and short in harness and connector between EDU and engine ECU (See page IN-20).

NG Repair or replace harness or connector.

OK

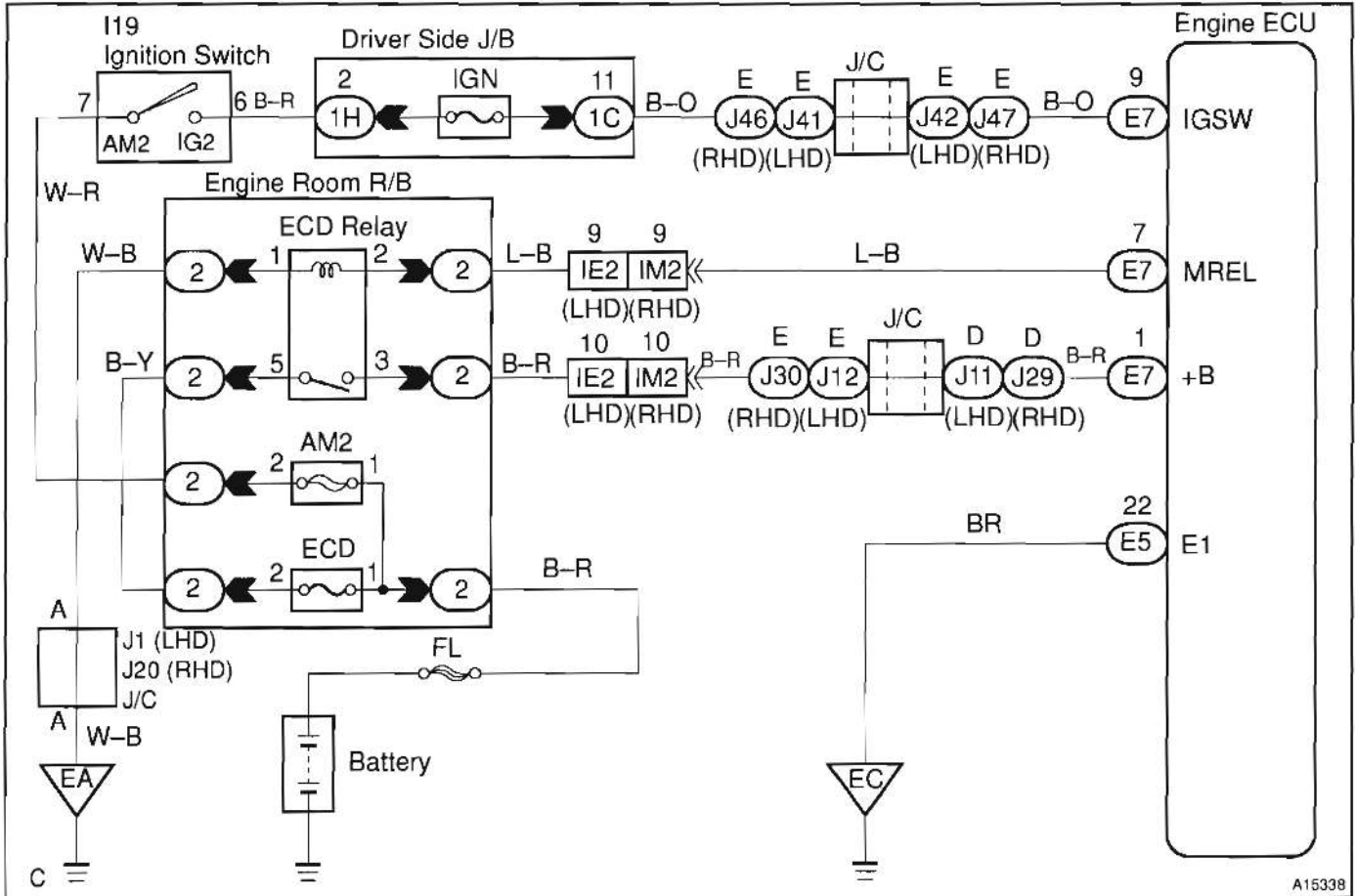
Replace EDU.

ECU Power Source Circuit

CIRCUIT DESCRIPTION

When the ignition switch is turned ON, battery positive voltage is applied to the coil, closing the contacts of the EFI relay (Marking: EFI) and supplying power to the terminal +B of the engine ECU.

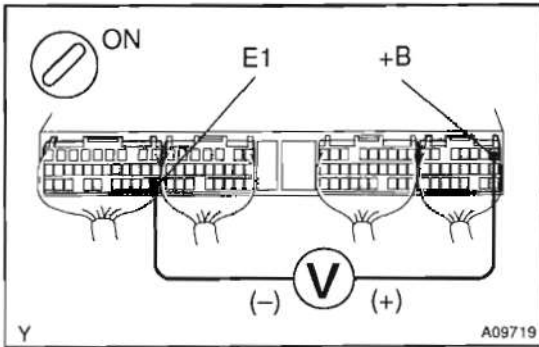
WIRING DIAGRAM



A15338

INSPECTION PROCEDURE

1 Check voltage between terminals +B and E1 of engine ECU connector.



PREPARATION:

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

CHECK:

Measure the voltage between terminals +B and E1 of the engine ECU connector.

OK:

Voltage: 9 – 14 V

OK → Proceed to next circuit inspection shown on problem symptoms table (See page DI-19).

NG

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

NG → Repair or replace harness or connector.

OK

3 Check EFI main relay (Marking: EFI) (See page ED-8).

NG → Replace EFI main relay.

OK

4 Check EFI fuse.

PREPARATION:

Remove the EFI fuse from the engine room J/B.

CHECK:

Check the continuity of the EFI fuse.

OK:

Continuity

NG

Check for short in all harness and components connected to EFI fuse.

OK

5 Check for open in harness and connector between engine ECU and EFI main relay (Marking: EFI), and EFI main relay and battery (See page IN-20).

NG

Repair harness or connector.

OK

6 Check voltage between terminals IGSW and E1 of engine ECU connector.

PREPARATION:

- Remove the glove compartment door.
- Turn the ignition switch ON.

CHECK:

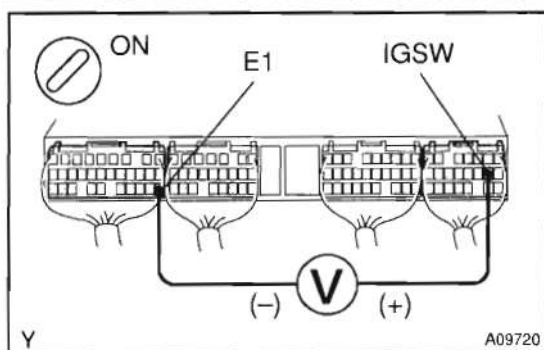
Measure the voltage between terminals IGSW and E1 of the engine ECU connector.

OK:

Voltage : 9 - 14 V

OK

Go to step 9.



NG

7 Check ignition switch (See Pub. No. RM517E BE section).

NG Replace ignition switch.

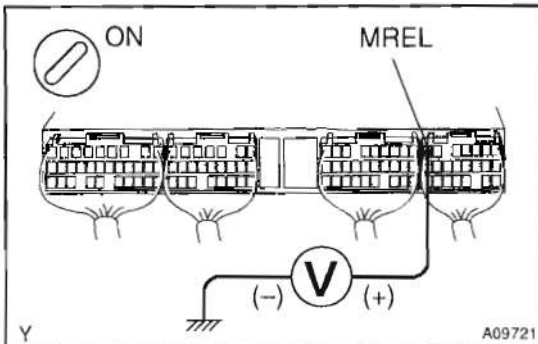
OK

8 Check for open in harness and connector between ignition switch and engine ECU (See page IN-20).

NG Repair or replace harness or connector.

OK

9 Check voltage between terminal MREL of engine ECU connector and body ground.



PREPARATION:

- Remove the glove compartment door.
- Turn the ignition switch ON.

CHECK:

Measure the voltage between terminal MREL of the engine ECU connector and body ground.

OK:

Voltage: 9 – 14 V

OK Check and replace engine ECU (See page IN-20).

NG

Check for open in harness and connector between engine ECU and EFI main relay (Marking: EFI), and EFI main relay and body ground (See page IN-20).

EGR Control Circuit

CIRCUIT DESCRIPTION

The EGR system recirculates exhaust gas, which is controlled to the proper quantity to suit the driving conditions into the intake air mixture to slow down combustion, reduce the combustion temperature and reduce NOx emissions,

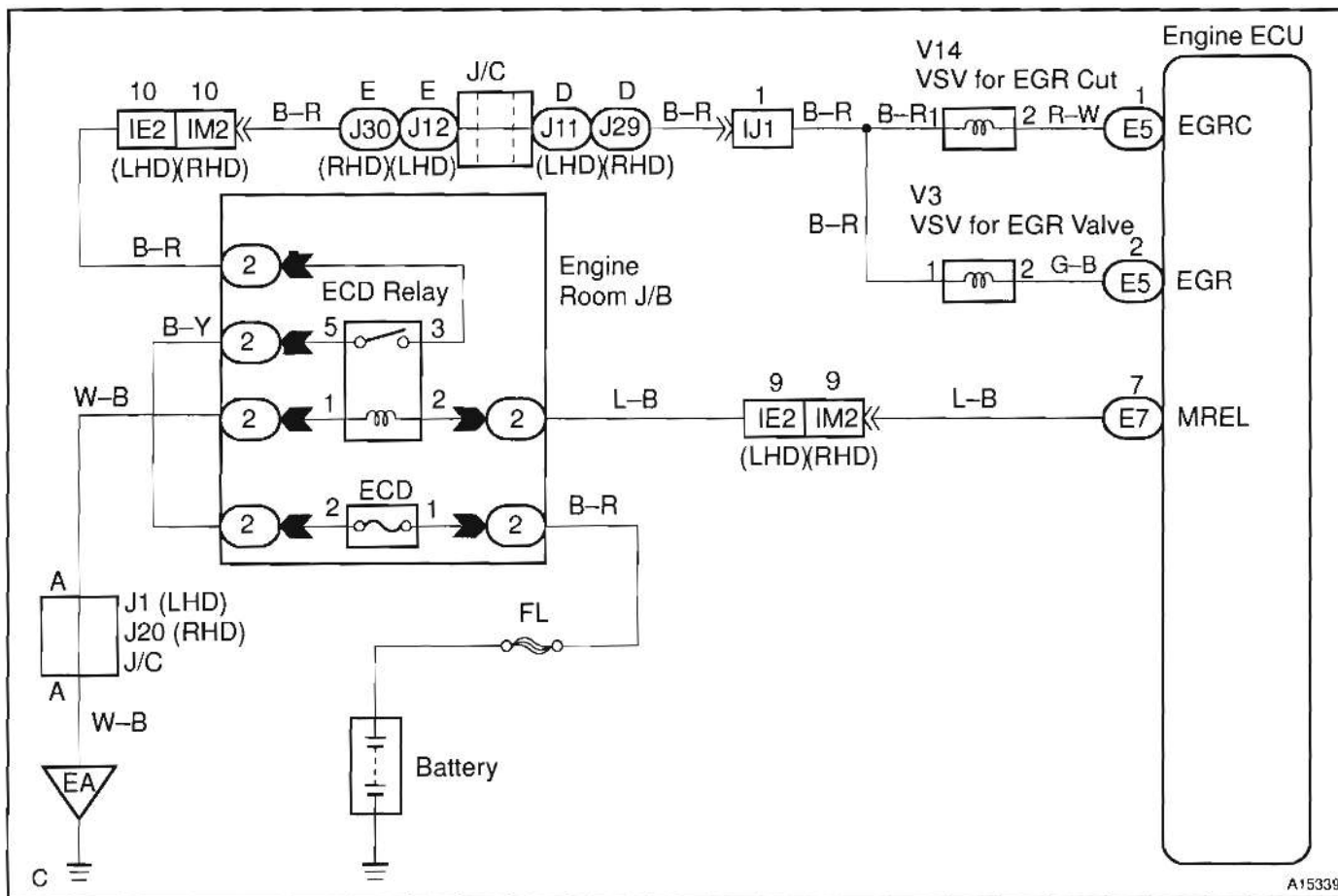
The lift amount of EGR valve is controlled by the vacuum which is regulated by the E-VRV operated by the engine ECU.

If even one of the following conditions is fulfilled, the VSV is turned ON by a signal from the ECU. This results in atmospheric air acting on the EGR valve, closing the EGR valve and shutting off the exhaust gas (EGR cut-off).

Under the following conditions, EGR is cut to maintain driveability.

- Before the engine is warmed up
- Engine speed over 4,000 rpm

WIRING DIAGRAM



INSPECTION PROCEDURE

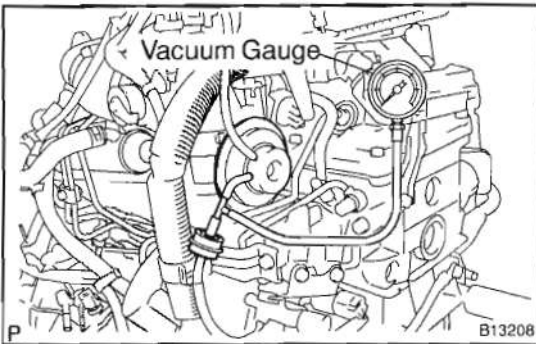
When using hand-held tester:

1	Check connection of vacuum hose.
---	----------------------------------

NG	Repair or replace.
----	--------------------

OK

2	Check vacuum between EGR valve and VSV for EGR at 1,500 rpm.
---	--------------------------------------------------------------

**PREPARATION:**

- (a) Using a 3-way connector, connect a vacuum gauge to the hose between the VSV and EGR valve.
- (b) Warm up the engine to above 80°C (176°F).

CHECK:

Check the vacuum at 1,500 rpm.

RESULT:

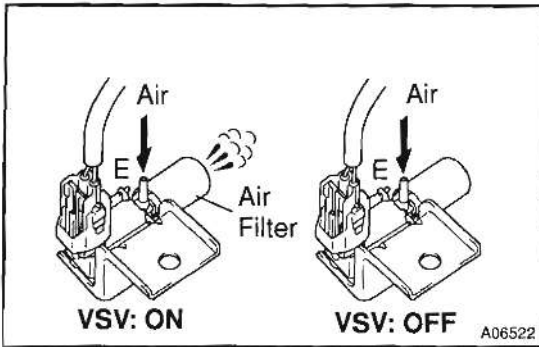
Type	Vacuum
I	0 kPa (0 mmHg, 0 in. Hg)
II	0 kPa (0 mmHg, in. Hg) – 28 kPa (210 mmHg, 8.3 in. Hg)
III	Above 28 kPa (210 mmHg, 8.3 in. Hg)

Type I	Go to step 7.
--------	---------------

Type III	Go to step 10
----------	---------------

Type II

3 Check VSV circuit for EGR.



PREPARATION:

- Disconnect the vacuum hose from the VSV for the EGR.
- Connect the hand-held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.
- Select the ACTIVE TEST mode on the hand-held tester.

CHECK:

Check the operation of VSV for EGR when it is operated by the hand-held tester.

OK:

VSV is ON:

Air from port E flows out through air filter.

VSV is OFF:

Air does not flow from port E to air filter.

OK

Check connection, damage and blockage of vacuum hose.

NG

4 Check VSV for EGR (See page EC-6).

NG

Replace VSV for EGR.

OK

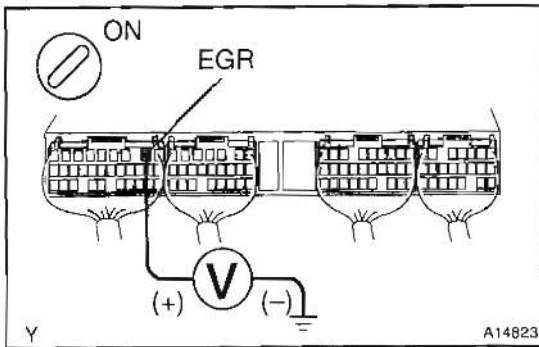
5 Check for open and short in harness and connector between VSV for EGR and engine ECU (See page IN-20).

NG

Repair or replace harness or connector.

OK

6 Check voltage between terminal EGR of engine ECU connector and body ground.



PREPARATION:

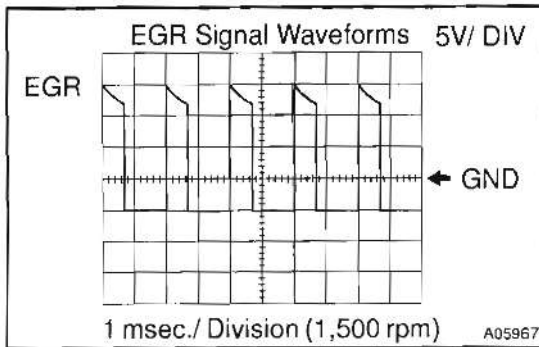
- (a) Remove the glove compartment door.
- (b) Turn the ignition switch ON.

CHECK:

Measure the voltage between terminal EGR of the engine ECU connector and body ground.

OK:

Voltage: 9 – 14 V



Reference: INSPECTION USING OSCILLOSCOPE

During EGR system is ON (engine speed 1,500 rpm), check the waveform between terminals EGR and E1 of engine ECU connector.

HINT:

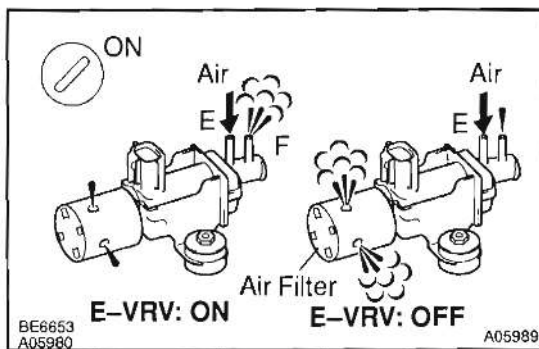
The correct waveform is as shown.

NG

Go to step 8.

OK

7 Check operation of E-VRV.



PREPARATION:

- (a) Disconnect the vacuum hoses from the E-VRV.
- (b) Connect the hand-held tester to the DLC3.
- (c) Turn the ignition switch ON and the push hand-held tester main switch ON.
- (d) Select the ACTIVE TEST mode on the hand-held tester.

CHECK:

Check the operation of the E-VRV when it is operated by the hand-held tester.

OK:

E-VRV ON:

Air from port E flows out through port F.

E-VRV OFF:

Air from port E flows out through air filter.

OK

Go to step 10.

NG

8 Check E-VRV for EGR (See page EC-6).

NG

Replace E-VRV.

OK

9 Check for open and short in harness and connector between E-VRV and engine ECU, and E-VRV and EFI main relay (Marking : EFI) (See page IN-20).

NG

Repair or replace harness or connector.

OK

10 Check EGR valve (See page EC-6).

NG

Replace the EGR valve.

OK

Check and replace engine ECU (See page IN-20).

When not using hand-held tester:

1 Check the connection of vacuum hose.

NG

Repair or replace.

OK

2 Check vacuum between EGR valve and VSV for EGR at 1,500 rpm (See page DI-97, step 2).

Type I Go to step 6.

Type III Go to step 9.

Type II

3 Check VSV for EGR (See page EC-6).

NG Replace VSV for EGR.

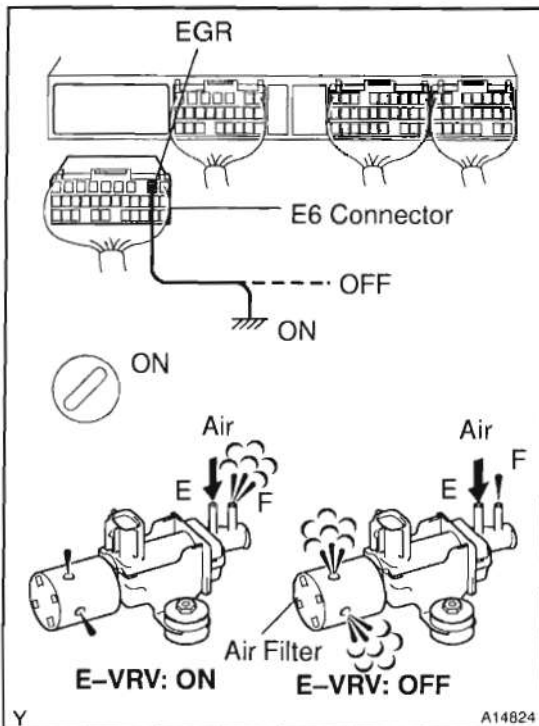
OK

4 Check for open and short in harness and connector between VSV for EGR and engine ECU (See page IN-20).

NG Repair or replace harness or connector.

OK

5 Check operation of E-VRV.



PREPARATION:

- Remove the glove compartment door.
- Disconnect the E6 connector from the engine ECU.
- Turn the ignition switch ON.

CHECK:

Check the E-VRV operation.

- Connect between terminal EGR of the engine ECU connector and body ground (ON).
- Disconnect between terminal EGR of the engine ECU connector and body ground (OFF).

OK:

E-VRV ON:

Air from port E flows out through port F.

E-VRV OFF:

Air from port E flows out through air filter.

OK

Go to step 9.

NG

6 Check E-VRV (See page EC-6).

NG

Replace E-VRV.

OK

7 Check for open and short in harness and connector between E-VRV and engine ECU, and E-VRV and EFI main relay (Marking : EFI) (See page IN-20).

NG

Repair or replace harness or connector.

OK

8	Check EGR valve (See page EC-6).
---	----------------------------------

NG	Replace EGR valve.
----	--------------------

OK

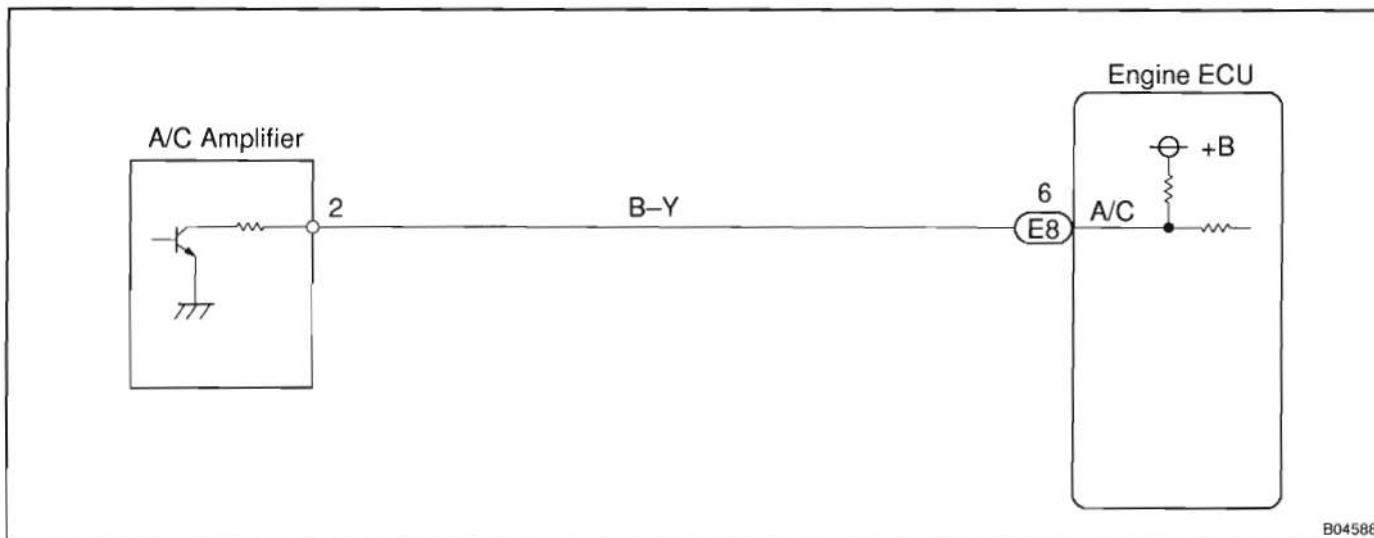
Check and replace engine ECU (See page IN-20).

A/C Signal Circuit

CIRCUIT DESCRIPTION

When the A/C compressor is ON, the A/C amplifier sends the A/C signal to the engine ECU, then engine ECU increases the fuel injection volume to improve driveability during engine idling.

WIRING DIAGRAM



INSPECTION PROCEDURE

When using hand-held tester:

- 1 Connect hand-held tester, and check A/C signal.

PREPARATION:

- Connect the hand-held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.

CHECK:

Read the A/C signal on the hand-held tester while the A/C compressor is ON.

OK:

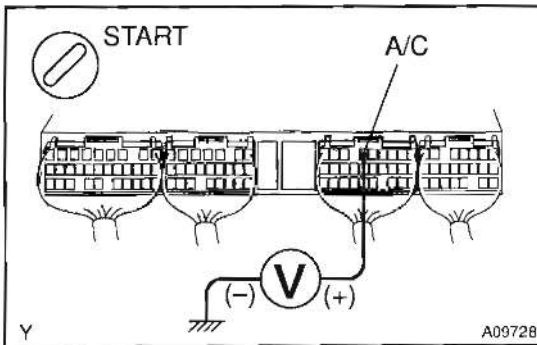
A/C Switch Condition	OFF	ON
A/C Signal	OFF	ON

OK

Proceed to next circuit inspection shown on problem symptoms table (See page DI-19).

NG

2 Check voltage between terminal A/C of engine ECU connector and body ground.



PREPARATION:

- (a) Remove the glove compartment door.
- (b) Start the engine.

CHECK:

Measure the voltage between terminal A/C of the engine ECU connector and body ground when the A/C switch is turned to ON and OFF.

OK:

A/C Switch Condition	Voltage
ON	Below 1.5 V
OFF	9 - 14 V

OK

**Check and replace engine ECU
(See page IN-20).**

NG

3 Check for open and short in harness and connector between engine ECU and A/C amplifier (See page IN-20).

NG

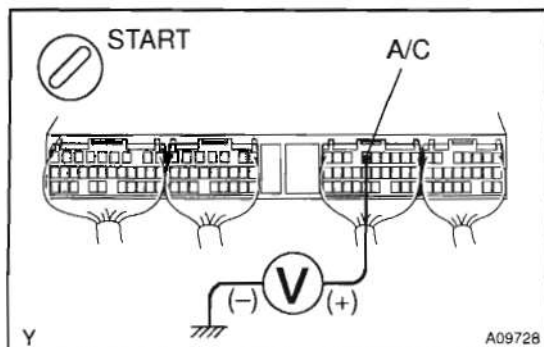
Repair or replace harness or connector.

OK

Check and replace A/C amplifier.

When not using hand-held tester:

1 Check voltage between terminal A/C of engine ECU connector and body ground.

**PREPARATION:**

- (a) Remove the glove compartment door.
- (b) Start the engine.

CHECK:

Measure the voltage between terminal A/C of the engine ECU connector and body ground when the A/C switch is turned to ON and OFF.

OK:

A/C Switch Condition	Voltage
ON	Below 1.5 V
OFF	9 – 14 V

OK

Proceed to next circuit inspection shown on problem symptoms table (See page DI-19).

NG

2 Check for open and short in harness and connector between engine ECU and A/C amplifier (See page IN-20).

NG

Repair or replace harness or connector.

OK

Check and replace A/C amplifier.

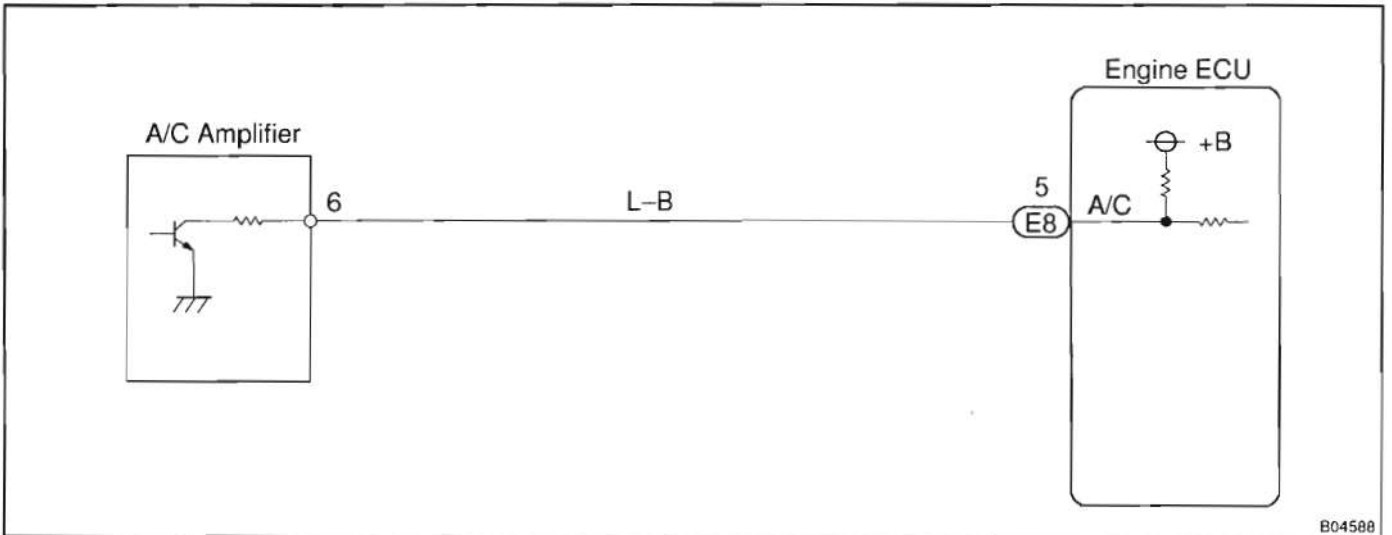
A/C Cut Control Circuit

CIRCUIT DESCRIPTION

This circuit cuts air conditioning operation during vehicle acceleration in order to increase acceleration performance. During acceleration with the vehicle speed at 30 km/h (19 mph) or less and accelerator pedal opening angle at 45° or more, the A/C magnetic switch is turned OFF for several seconds.

The air conditioning is also controlled by the ECU outputting the engine coolant temperature to A/C amplifier.

WIRING DIAGRAM



INSPECTION PROCEDURE**When using hand-held tester**

1	Connect the hand-held tester and check operation of air conditioning cut control.
----------	------------------------------------------------------------------------------------------

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 and air conditioning switch ON.

HINT:

A/C magnetic clutch is turned ON.

- (d) Select the ACTIVE TEST mode on the hand-held tester.

CHECK:

Check operation of A/C magnetic clutch cut when air conditioning cut control is operated by the hand-held tester.

OK:

A/C magnet clutch is turned OFF.



OK

Proceed to next circuit inspection shown on problem symptoms table (See page DI-19).



NG

2	Check for open and short in harness and connector between engine ECU and A/C amplifier (See page IN-20).
----------	-----------------------------------------------------------------------------------------------------------------



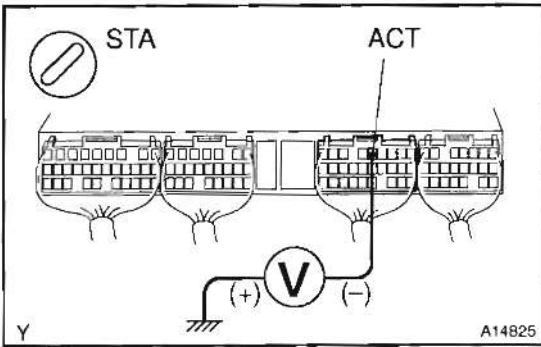
NG

Repair or replace harness or connector.



OK

3 Check voltage between terminal ACT of engine ECU and body ground.



PREPARATION:

- (a) Remove the glove compartment door.
- (b) Start the engine.

CHECK:

Measure voltage between terminal ACT of engine ECU connector and body ground when A/C switch is turned to ON and OFF.

OK:

A/C switch condition	Voltage
Engine at idling	9 – 14 V
IG ON Engine stop	0 – 3 V

OK → Check and replace A/C amplifier.

NG

4 Check for open and short in harness and connector between engine ECU and Combination meter (See page IN-20).

NG → Repair or replace harness or connector.

OK

Check and replace engine ECU (See page IN-20).

When not using hand-held tester

1 Check voltage between terminal ACT of engine ECU and body ground (See page DI-108).

OK → Check and replace A/C amplifier.

NG

- 2** Check voltage between terminal THWO of engine ECU and body ground
(See page DI-108).

OK

Check and replace A/C amplifier.

NG

- 3** Check for open and short in harness and connector between engine ECU and
A/C amplifier (See page IN-20).

NG

Repair or replace harness or connector.

OK

Check and replace engine ECU.

Diagnostic Connector (DLC3) Circuit

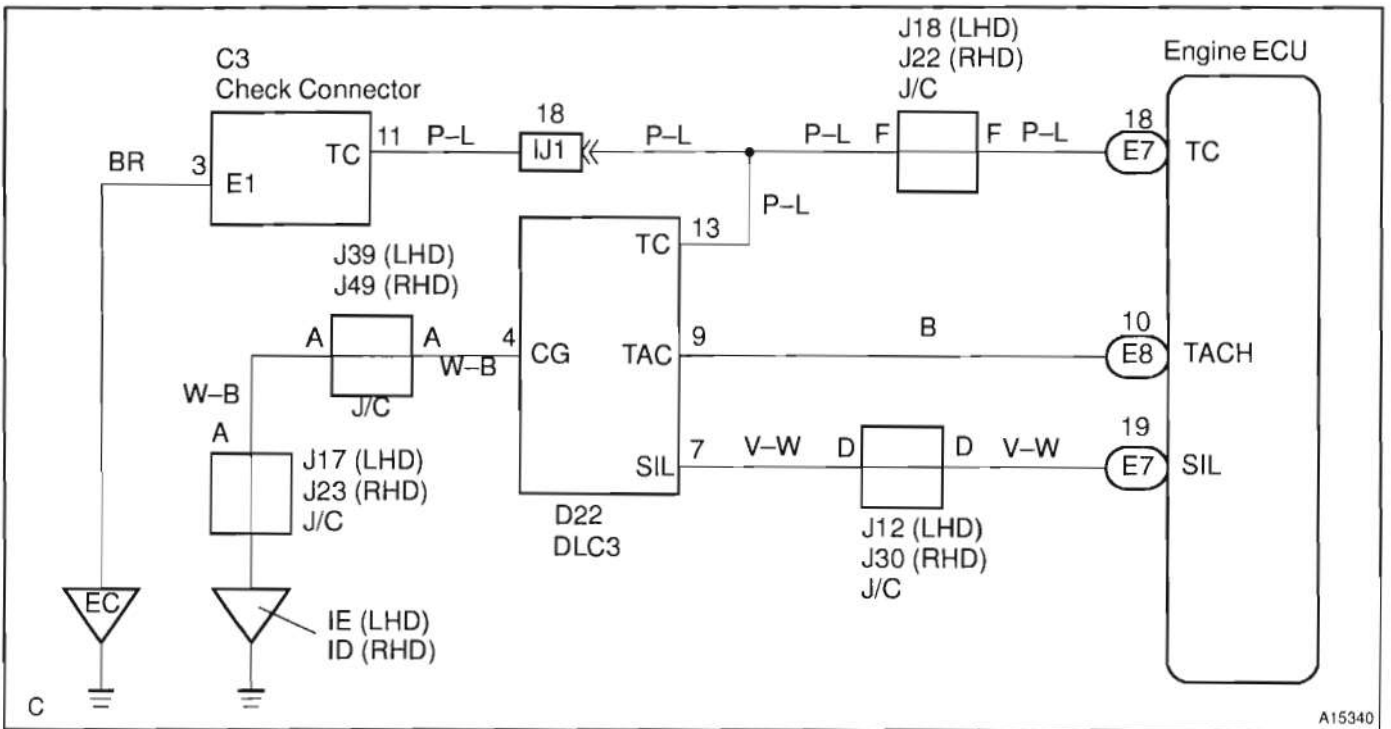
CIRCUIT DESCRIPTION

Terminals TC and CG are located in the DLC3.

The DLC3 is located under the finish lower panel. When terminals TC and CG are connected, DTC in normal mode or test mode can be read from the check engine warning light in the combination meter.

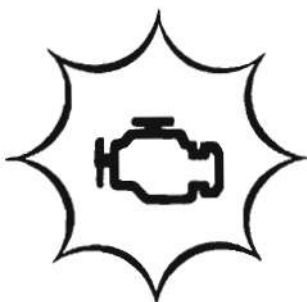
Also, terminal SIL is located in the DLC3. This terminal is used by the M-OB D communication with hand-held tester.

WIRING DIAGRAM



INSPECTION PROCEDURE

1 Check check engine warning light condition.



F12547

PREPARATION:

- (a) Turn the ignition switch ON.
- (b) Using SST, connect terminals TC and CG of the DLC3.
SST 09843-18040

CHECK:

Check the check engine warning light condition.

OK:

Check engine warning light : Blinking

HINT:

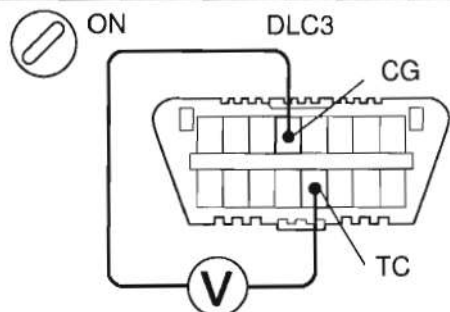
If this inspection OK and there is no hand-held tester, do not need to do the following steps and this circuit is OK. Proceed to next circuit inspection shown on problem symptom table (See page DI-19).

OK

Go to step 7.

NG

2 Check voltage between terminals TC and CG of DLC3.



Y

A10152

PREPARATION:

Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals TC and CG of the DLC3.

OK:

Voltage : 9 - 14 V

OK

Go to step 5.

NG

3 Check continuity terminal CG of DLC3 and body ground.

NG

Repair or replace harness or connector.

OK

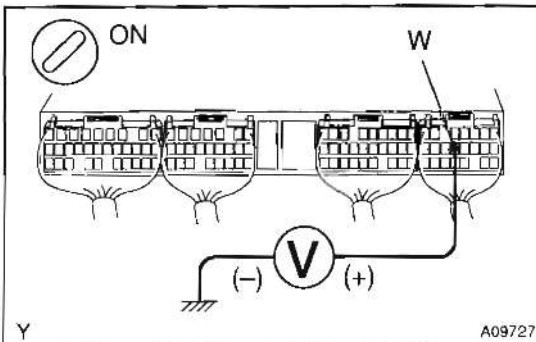
- 4** Check for open and short in harness and connector between terminal TC of DLC3 and terminal TC of engine ECU (See page IN-20).

NG

Repair or replace harness or connector.

OK

- 5** Check voltage between terminal W of engine ECU connector and body ground.



PREPARATION:

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

CHECK:

Measure the voltage between terminal W of the engine ECU connector and body ground.

OK:

Voltage: 9 – 14 V

OK

Check and replace engine ECU
 (See page IN-20).

NG

- 6** Check bulb of check engine warning light.

NG

Replace bulb.

OK

Check for open in harness and connector between terminal W of engine ECU and combination meter (See page IN-20).

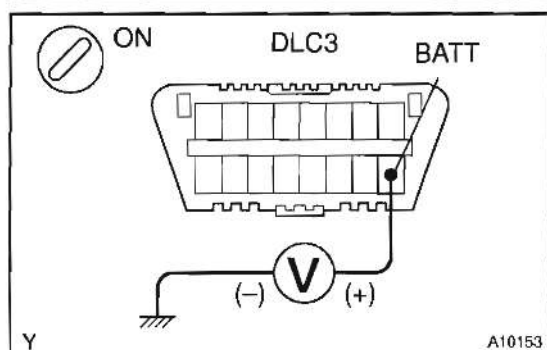
7 Can you read the DTC (including normal DTC) using hand-held tester?

YES

Proceed to next circuit inspection shown on problem symptom table (See page DI-19).

NO

8 Check voltage between terminal BATT of DLC3 and body ground.



CHECK:

Measure the voltage between terminal BATT of the DLC3 and body ground.

OK:

Voltage: 9 - 14 V

NG

Check for open and short in harness and connector between terminal BATT of DLC3 and fusible link block (See page IN-20).

OK

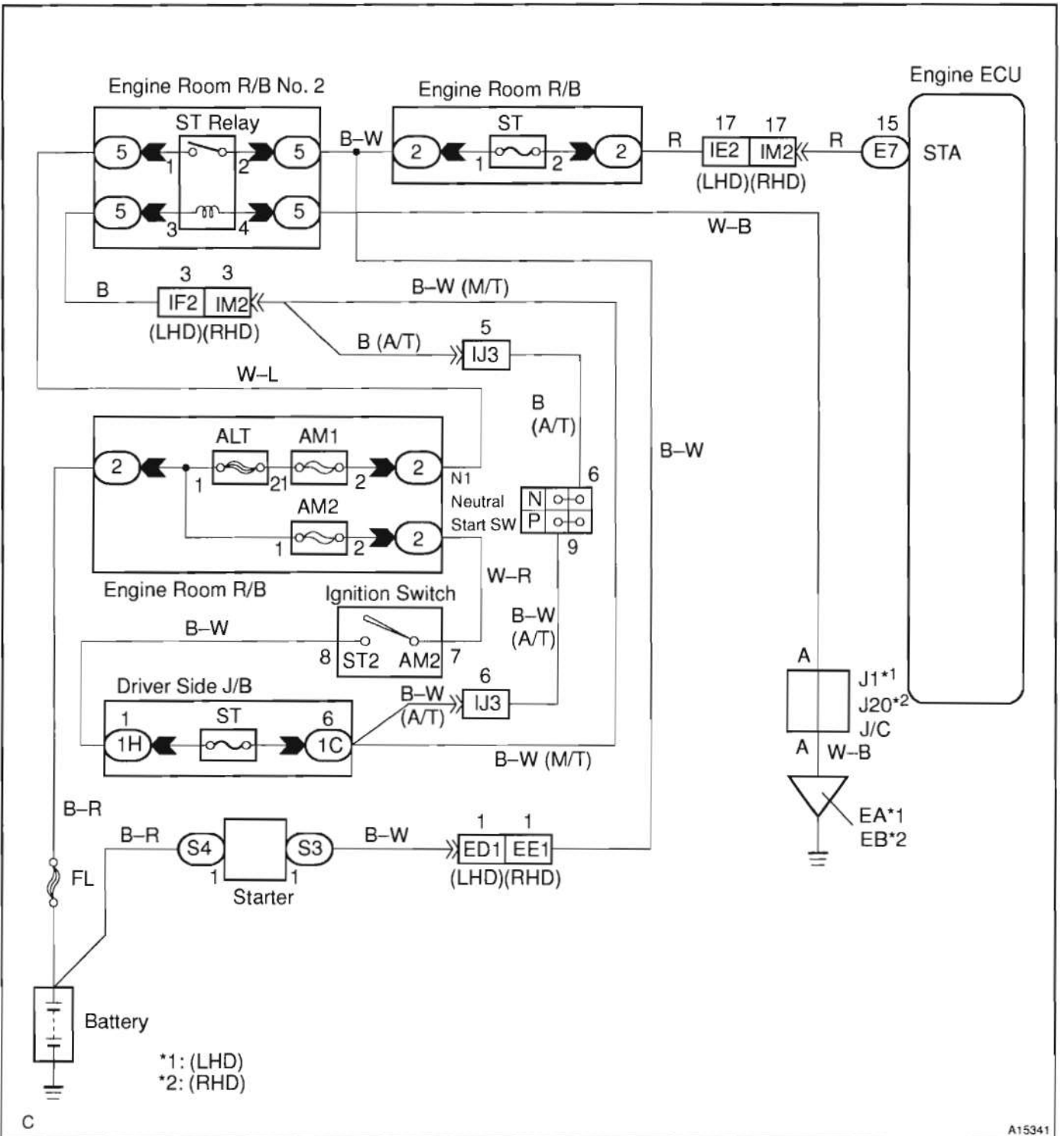
Check for open and short in harness and connector between terminal SIL of DLC3 and terminal SIL of engine ECU (See page IN-20).

Starter Signal Circuit

CIRCUIT DESCRIPTION

When the engine is being cranked, the intake air flow is slow, so fuel vaporization is poor. A rich mixture is therefore necessary in order to achieve good start ability. While the engine is being cranked, the battery positive voltage is applied to terminal STA of the engine ECU. The starter signal is mainly used to increase the fuel injection volume for the starting injection control and after-start injection control.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

This diagnostic chart is based on the premise that the engine is being cranked under normal conditions. If the engine does not crank, proceed to the problem symptoms table on page DI-19.

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.

CHECK:

Read the STA signal on the hand-held tester while the starter operates.

OK:

Ignition Switch Position	ON	STA
STA Signal	OFF	ON

OK

Proceed to next circuit inspection shown on problem symptoms table (See page DI-19).

NG

2	Check for open in harness and connector between engine ECU and starter relay (See page IN-20).
----------	-------------------------------------------------------------------------------------------------------

NG

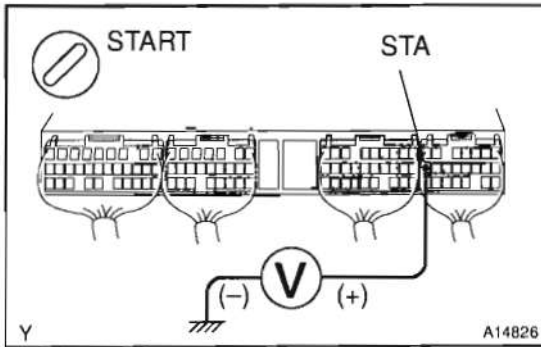
Repair or replace harness or connector.

OK

Check and replace engine ECU
(See page IN-20).

When not using hand-held tester:

1 Check starter signal.



PREPARATION:

- (a) Remove the glove compartment door.
- (b) Turn the ignition switch START.

CHECK:

Measure the voltage between terminal STA of the engine ECU connector and body ground during cranking.

OK:

Voltage: 6.0 V or more

OK Proceed to next circuit inspection shown on problem symptoms table (See page DI-19).

NG

2 Check for open in harness and connector between engine ECU and starter relay (See page IN-20).

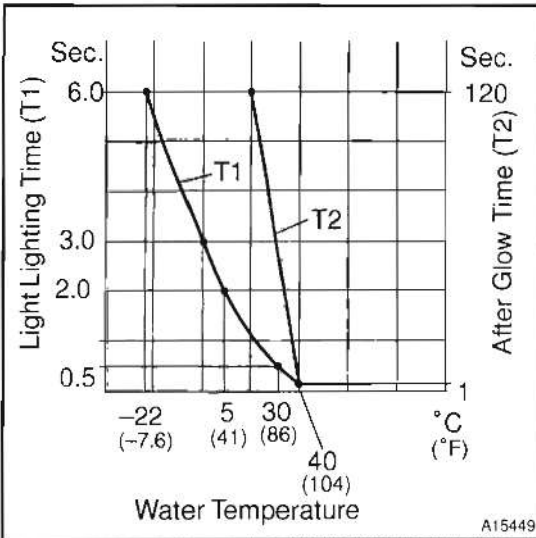
NG Repair or replace harness or connector.

OK

Check and replace engine ECU (See page IN-20).

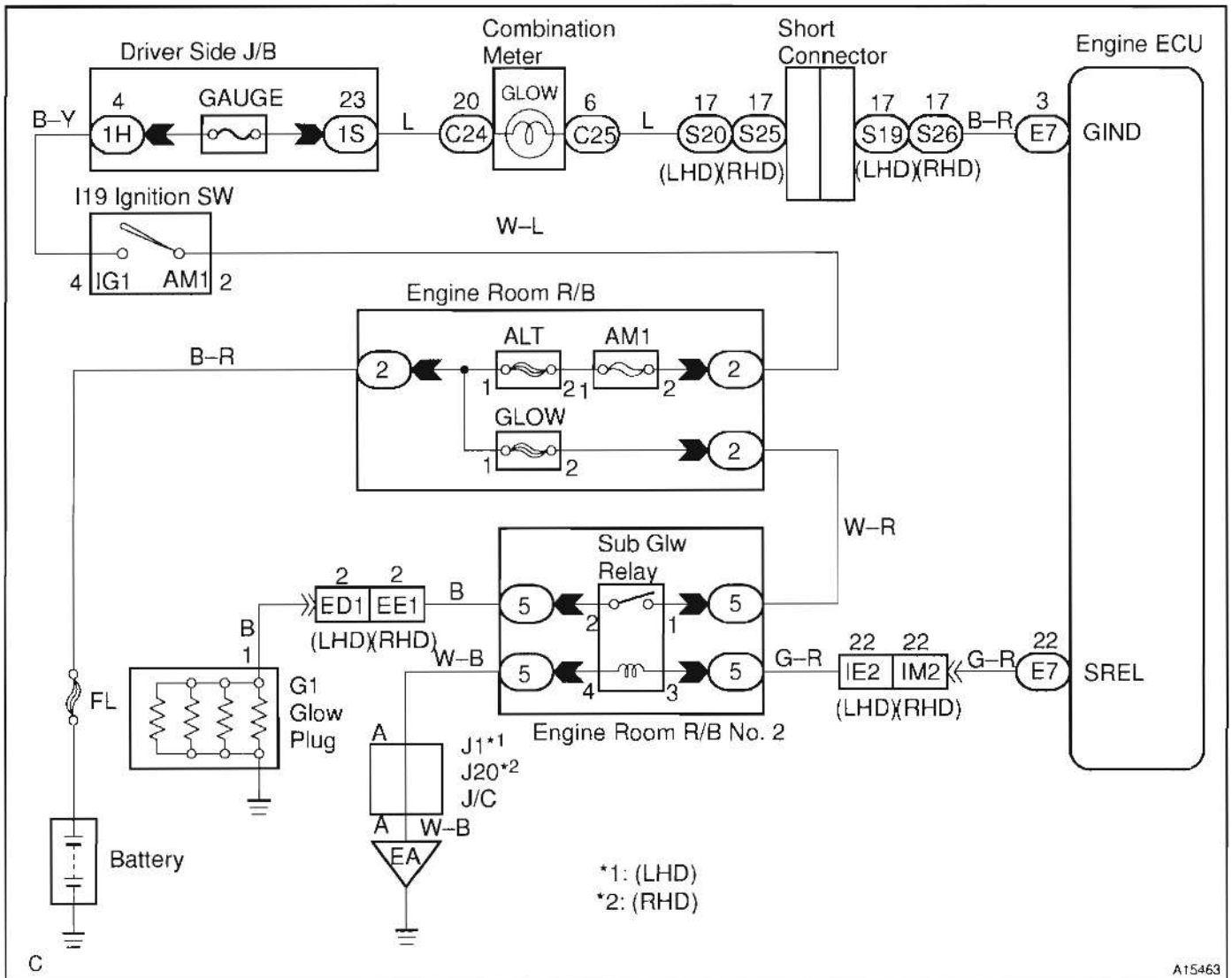
Pre-Heating Control Circuit

CIRCUIT DESCRIPTION



When the ignition switch turns ON, the engine ECU calculates the glow indicator lighting time/heating corresponding to the coolant temperature at that time and turns ON the glow indicator light/glow plug relay. As the ceramics is used for a glow plug material, the current control is not performed.

WIRING DIAGRAM



INSPECTION PROCEDURE

1 Does glow indicator light up?

PREPARATION:

Turn the ignition switch ON.

CHECK:

Does the glow indicator light up?

OK:

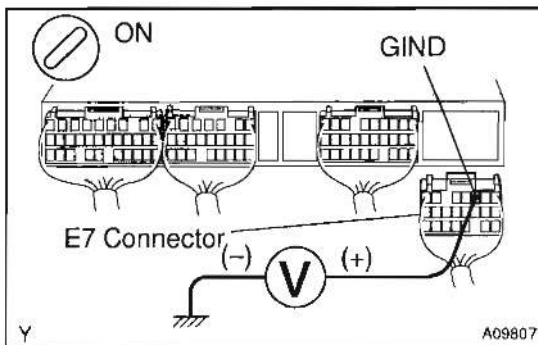
The glow indicator lights up for 0.5 sec. or more.

OK

Go to step 5.

NG

2 Check voltage between terminal GIND of engine ECU connector and body ground.



PREPARATION:

- Remove the glove compartment door.
- Disconnect the E7 connector from the engine ECU.
- Turn ignition switch ON.

CHECK:

Measure the voltage between terminal GIND of the engine ECU connector and body ground.

OK:

Voltage: 9 – 14 V

OK

Check and replace engine ECU
(See page IN-20).

NG

3 Check GAUGE fuse.**PREPARATION:**

Remove the GAUGE fuse.

CHECK:

Measure the continuity of the GAUGE fuse.

OK:

Continuity

NG

Check for short in all harness and components connected to GAUGE fuse.

OK

4 Check glow indicator light bulb.

NG

Replace bulb.

OK

Check for open in harness and connector between combination meter and engine ECU, and combination meter and GAUGE fuse (See page IN-20).

5 Check glow indicator lighting time (See page ST-2).

NG

Check and replace engine ECU (See page IN-20).

OK

6 Are there any DTC being output?

YES

Go to relevant DTC chart.

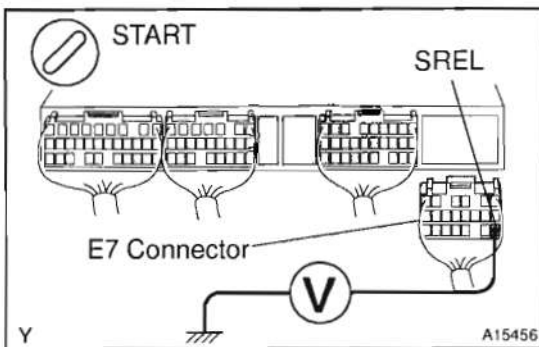
NO

7 Check glow plug relay (See page ST-2).

NG Replace glow plug relay.

OK

8 Check voltage between terminal SREL of engine ECU connector and body ground at cranking.



PREPARATION:

- Remove the glove compartment door.
- Disconnect the E7 connector from the engine ECU.
- Turn the ignition switch START.

CHECK:

Measure the voltage between terminal SREL of the engine ECU connector and body ground at cranking.

OK:

Voltage: 9 – 14 V

NG Check and replace engine ECU (See page IN-20).

OK

9 Check for open and short in harness and connector between glow plug relay and engine ECU, and glow plug relay and body ground (See page IN-20).

NG Repair harness or connector.

OK

10 Check resistance of glow plug (See page ST-2).

NG Replace glow plug.

OK

11 Inspect glow plug installation.

NG

Tighten glow plug.

OK

12 Check for open in harness and connector between glow plug relay and glow plug (See page IN-20).

NG

Repair harness or connector.

OK

Proceed to next circuit inspection shown on problem symptoms table (See page DI-19).

