DIC2A–02

DTC	P0171	System too Lean (Bank 1)

DTC	P0172	System too Rich (Bank 1)

DTC	P0174	System too Lean (Bank 2)

DTC	P0175	System too Rich (Bank 2)

CIRCUIT DESCRIPTION

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

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

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

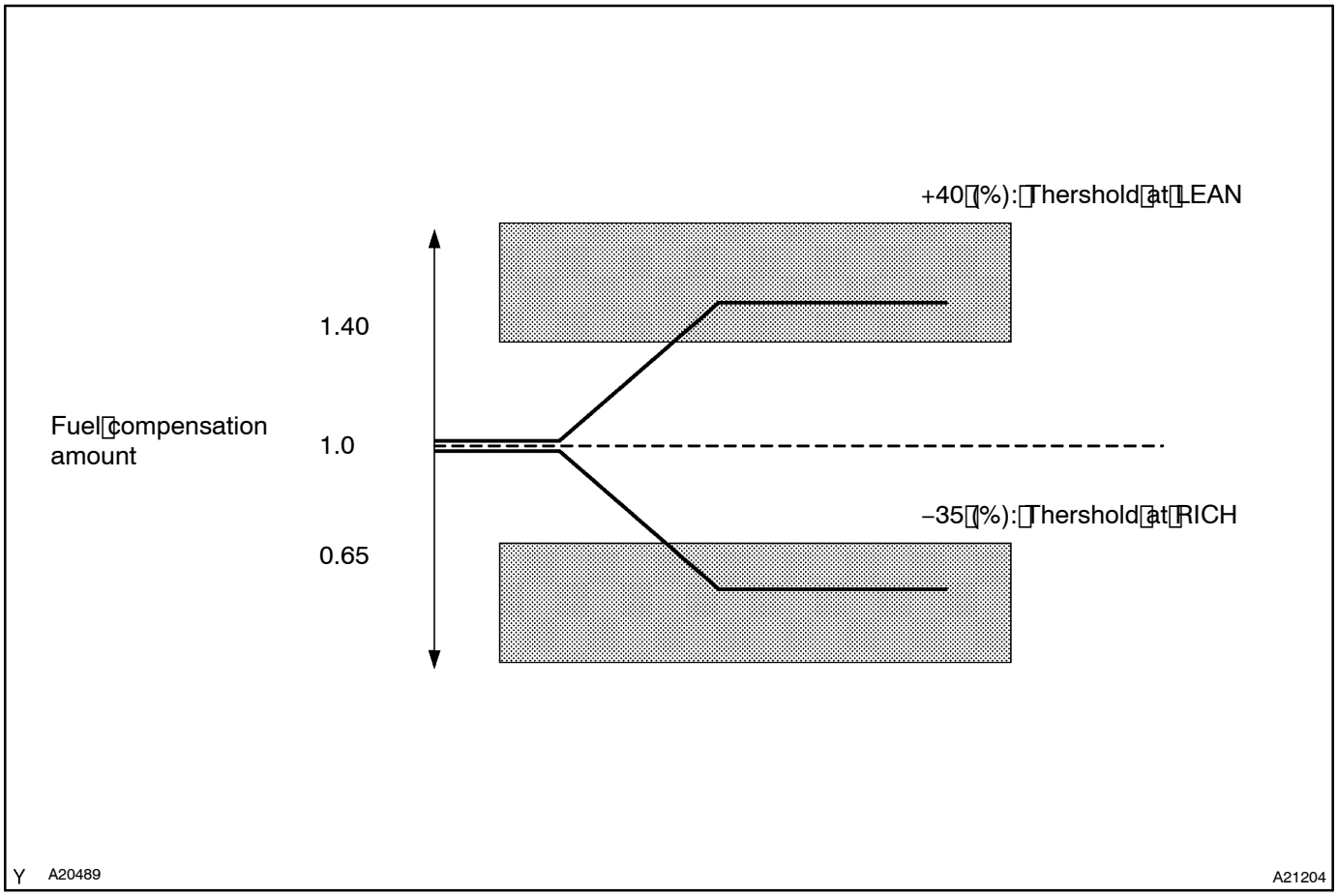
If both the short–term fuel trim and the long–term fuel trim are LEAN or RICH beyond a certain value, it is detected as a malfunction and the MIL is illuminated and a DTC is set.

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

HINT:

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

MONITOR DESCRIPTION



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

Example:

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

WIRING DIAGRAM

Refer to DTC P0031 on page DI–35.

INSPECTION PROCEDURE

HINT:

Hand–held tester only:

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

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

HINT:

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

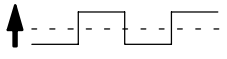
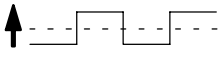
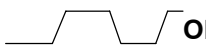
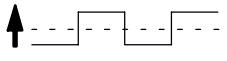
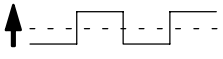
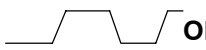
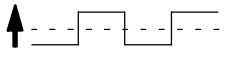
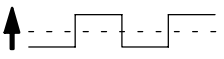
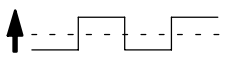
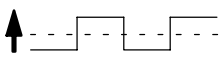
(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine with the engine speed at 2,500 rpm for approximately 90 seconds.
(4) Select the item ”DIAGNOSIS / OBD/MOBD / ACTIVE TEST / A/F CONTROL”.
(5) Perform ”A/F CONTROL” with the engine in an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

RESULT:

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

NOTICE:

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

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

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

- Read freeze frame data using the hand–held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.
- A high heated oxygen sensor (sensor 1) voltage (0.5 V or more) could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

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

CHECK:
Check the air induction system for vacuum leaks.

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

OK

2	**Check connection of PCV piping.**

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

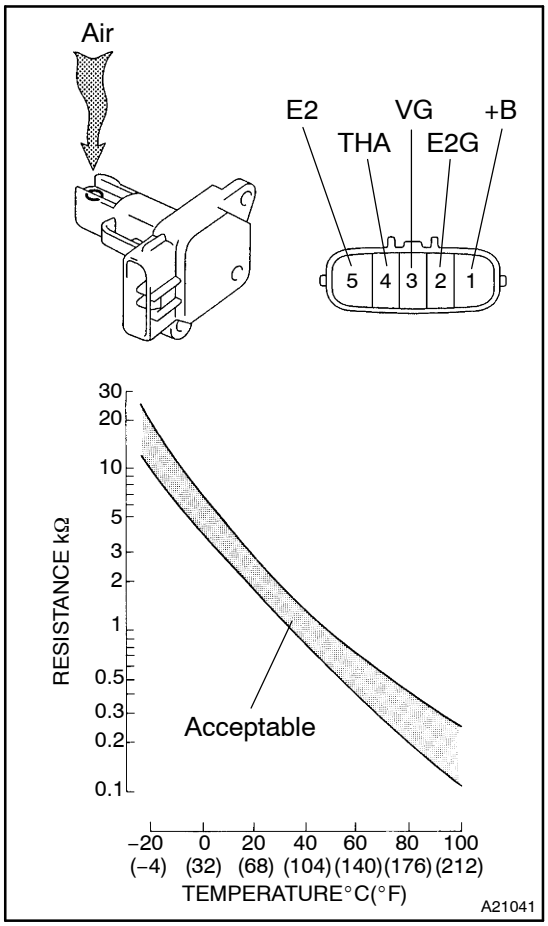
OK

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

NG → **Replace injector.**

OK

4	Check air flow meter.



PREPARATION:

Remove the air flow meter.

CHECK:

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

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

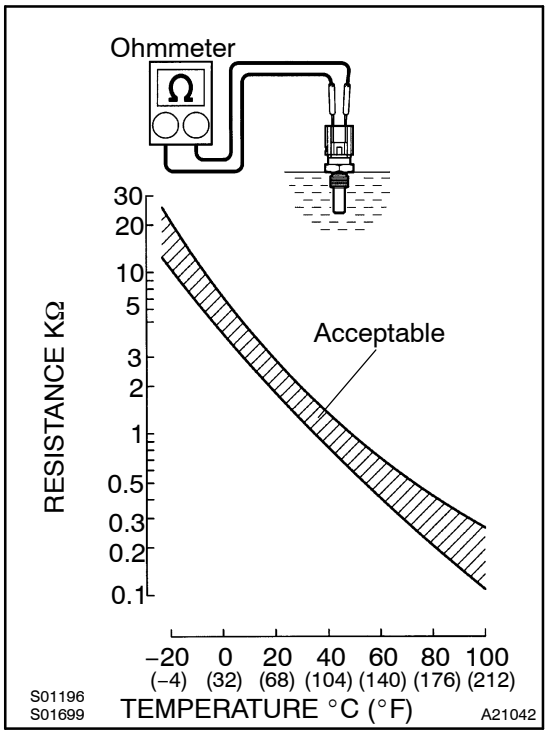
Resistance:

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

NG → **Replace air flow meter.**

OK

5	Check engine coolant temperature sensor.



PREPARATION:

Remove the engine coolant temperature sensor.

CHECK:

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

Resistance:

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

NOTICE:

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

HINT:

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

(b) Reinstall the engine coolant temperature sensor.

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

OK

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

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

OK

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

CHECK:

Check the fuel pressure (high or low pressure).

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

OK

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

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

OK

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

PREPARATION:

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

CHECK:

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

OK:

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

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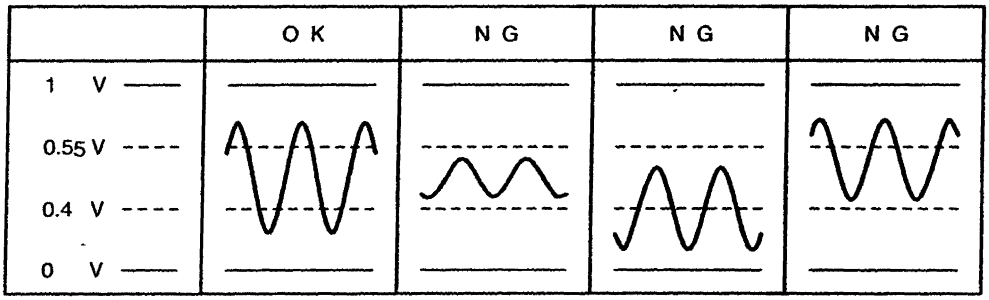

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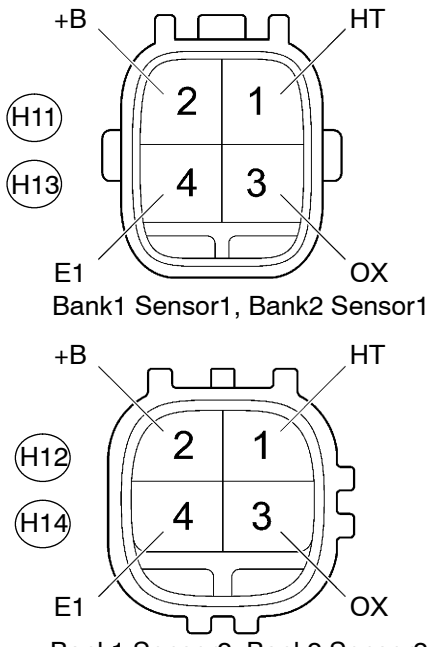
OK	**Go to step 17.**

NG

10	Check resistance of heated oxygen sensor heater.

Components Side:



PREPARATION:

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

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

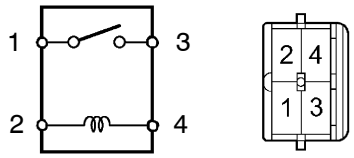
Tester Connection	Specified Condition
HT (H11–1) – +B (H11–2)	11.7 to 14.3 Ω (20°C)
HT (H12–1) – +B (H12–2)	11.7 to 14.3 Ω (20°C)
HT (H13–1) – +B (H13–2)	11.7 to 14.3 Ω (20°C)
HT (H14–1) – +B (H14–2)	11.7 to 14.3 Ω (20°C)

NG → **Replace heated oxygen sensor.**

OK

11	Check EFI or ECD relay.

EFI or ECD Relay



PREPARATION:

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

CHECK:

Inspect the EFI or ECD relay.

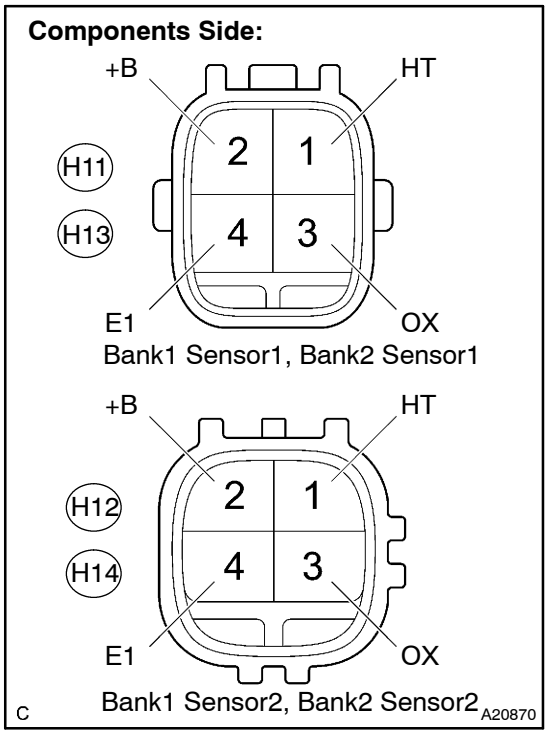
OK:

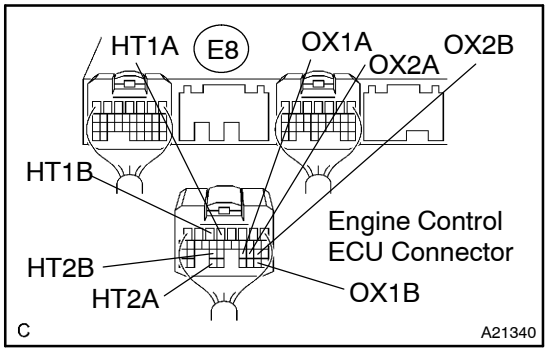
Terminal No.	Condition	Specified Condition
1 – 3	Usually	10 kΩ or higher
	Apply B+ between terminals 2 and 4	Below 1 Ω

NG → **Replace EFI or ECD relay.**

OK

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





PREPARATION:

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

(b) Disconnect the E8 engine control ECU connector.

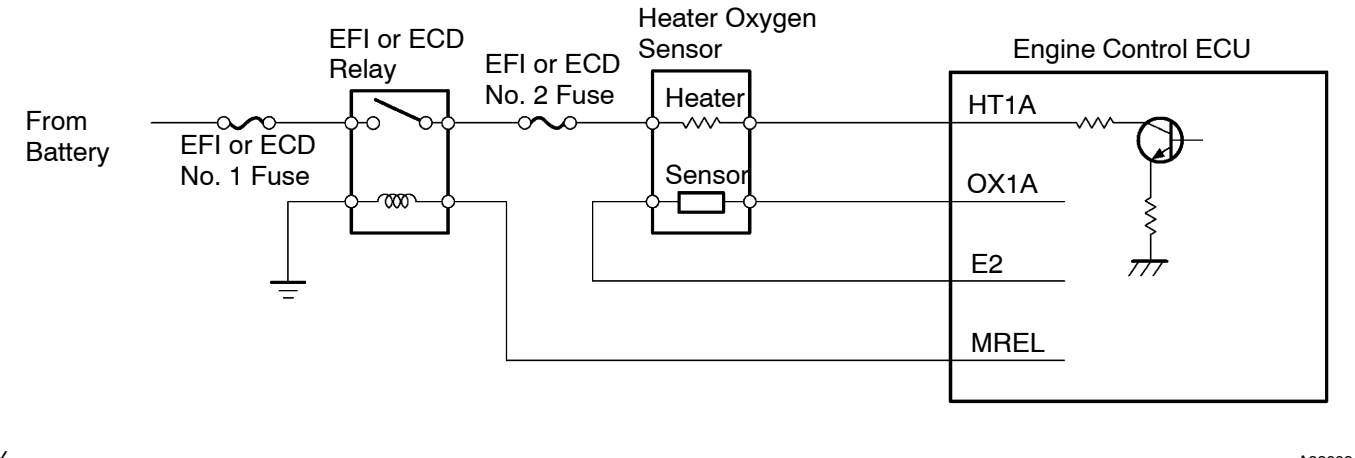
CHECK:

Measure the resistance between the wire harness side connectors.

OK:

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

Reference (Bank 1 Sensor 1 System Drawing)



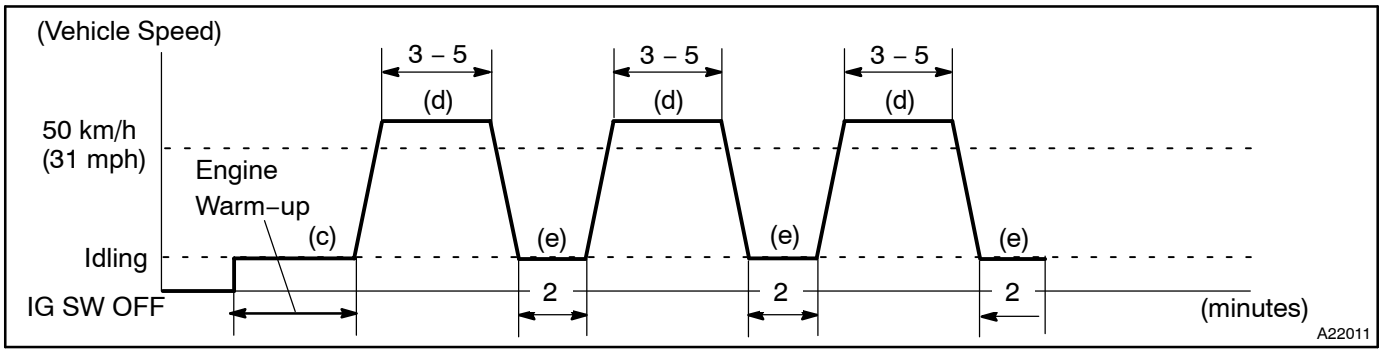
NG	**Replace or replace harness or connector.**

OK

13	**Replace heated oxygen sensor.**

Go

14	Perform confirmation driving pattern.



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

GO

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

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

NO

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

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

YES

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

17	Perform confirmation driving pattern.

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

Go

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

NO → Go to step 22.

YES

19	Replace heated oxygen sensor.

Go

20	Perform confirmation driving pattern.

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

Go

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

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

No

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

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

YES

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