

DTC	P0130	OXYGEN SENSOR CIRCUIT (BANK 1 SENSOR 1)
DTC	P0150	OXYGEN SENSOR CIRCUIT (BANK 2 SENSOR 1)
DTC	P2195	OXYGEN SENSOR SIGNAL STUCK LEAN (BANK 1 SENSOR 1)
DTC	P2196	OXYGEN SENSOR SIGNAL STUCK RICH (BANK 1 SENSOR 1)
DTC	P2197	OXYGEN SENSOR SIGNAL STUCK LEAN (BANK 2 SENSOR 1)
DTC	P2198	OXYGEN SENSOR SIGNAL STUCK RICH (BANK 2 SENSOR 1)

CIRCUIT DESCRIPTION

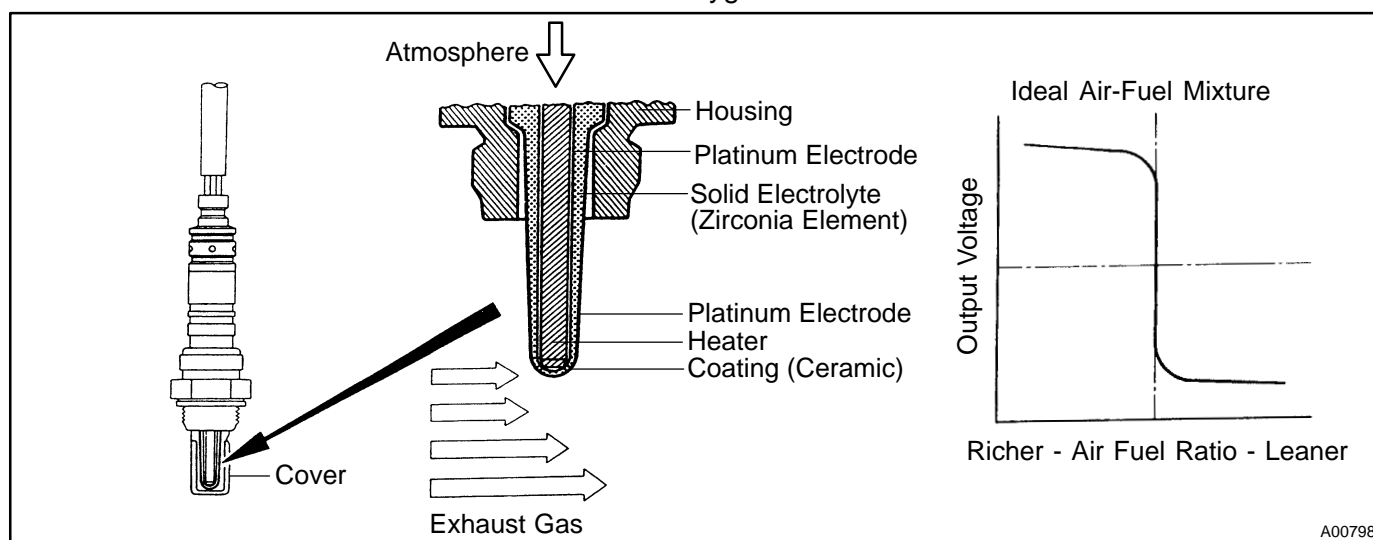
To obtain a high purification rate for the CO, HC and NO_x components of the exhaust gas, a three-way catalytic converter is used. But for the most efficient use of the three-way catalytic converter, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel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

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

When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust gas increases. And the heated oxygen sensor informs the ECM of the LEAN condition (small electromotive force: < 0.45 V).

When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio, the oxygen concentration in the exhaust gas is reduced. And the heated oxygen sensor informs the ECM of the RICH condition (large electromotive force: > 0.45 V). The ECM judges by the electromotive force from the heated oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if the malfunction of the heated oxygen sensor causes an output of abnormal electromotive force, the ECM becomes unable to perform the accurate air-fuel ratio control.

The heated oxygen sensors include a heater which heats the zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater in order to heat the sensor for the accurate oxygen concentration detection.



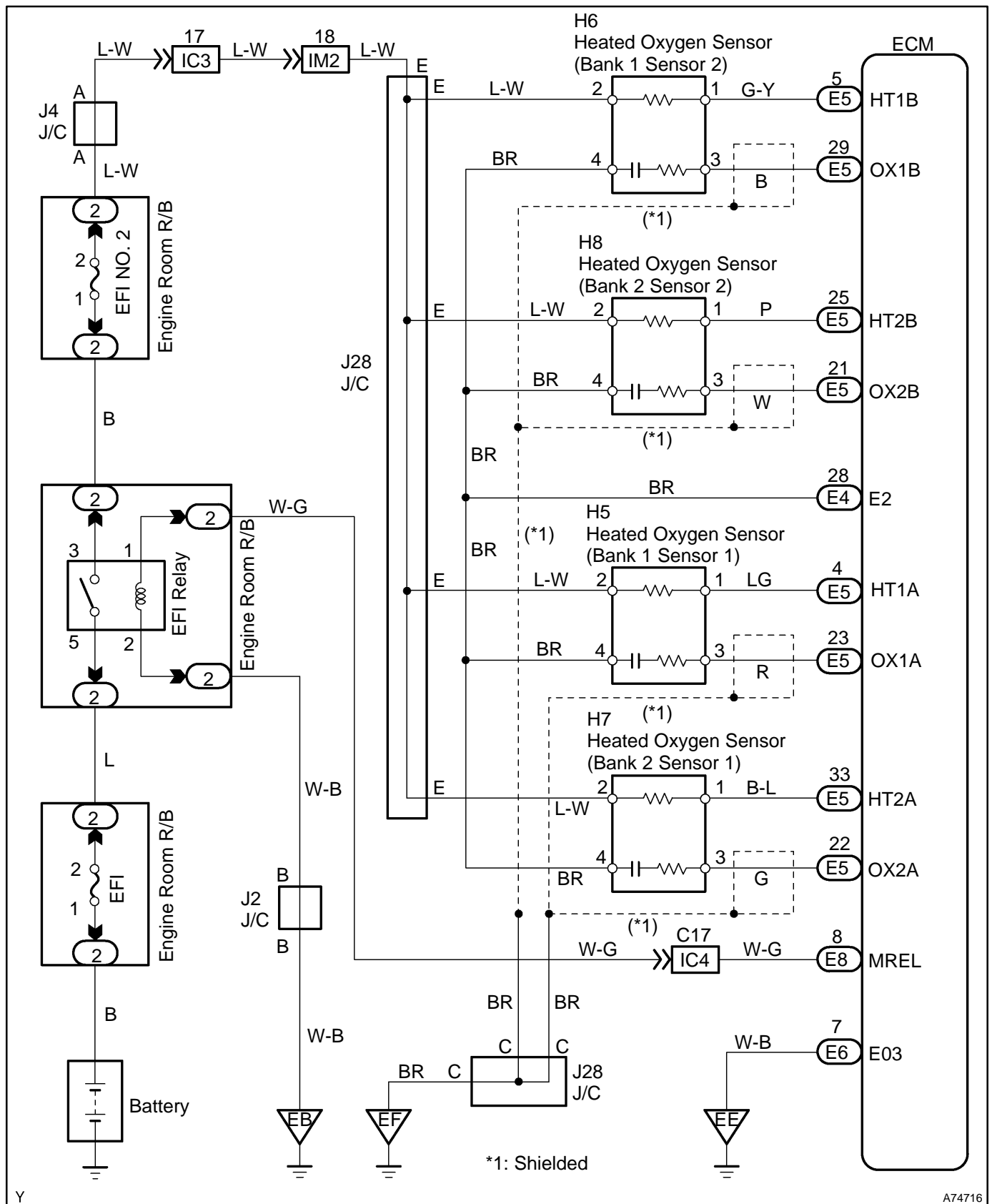
A00798

DTC No.	DTC Detection Condition	Trouble Area
P0130 P0150	Output voltage of heated oxygen sensor remains at 0.4 V or more, or 0.55 V or less, during idling after engine is warmed up (2 trip detection logic)	<ul style="list-style-type: none"> • Open or short in heated oxygen sensor (bank 1, 2 sensor 1) circuit • Heated oxygen sensor (bank 1, 2 sensor 1)
P2195 P2196	Output voltage of heated oxygen sensor remains at 0.55 V or less, during idling after engine is warmed up (2 trip detection logic)	<ul style="list-style-type: none"> • Heated oxygen sensor heater (bank 1, 2 sensor 1) • EFI relay • Air induction system
P2197 P2198	Output voltage of heated oxygen sensor remains at 0.4 V or more, during idling after engine is warmed up (2 trip detection logic)	<ul style="list-style-type: none"> • Fuel pressure • Injector • ECM

HINT:

- Bank 1 refers to the bank that includes cylinder No.1.
- Bank 2 refers to the bank that does not include cylinder No.1.
- Sensor 1 refers to the sensor closest to the engine body.
- The output voltage of the heated oxygen sensor and the short-term fuel trim value can be read using the hand-held tester or the OBD II scan tool.

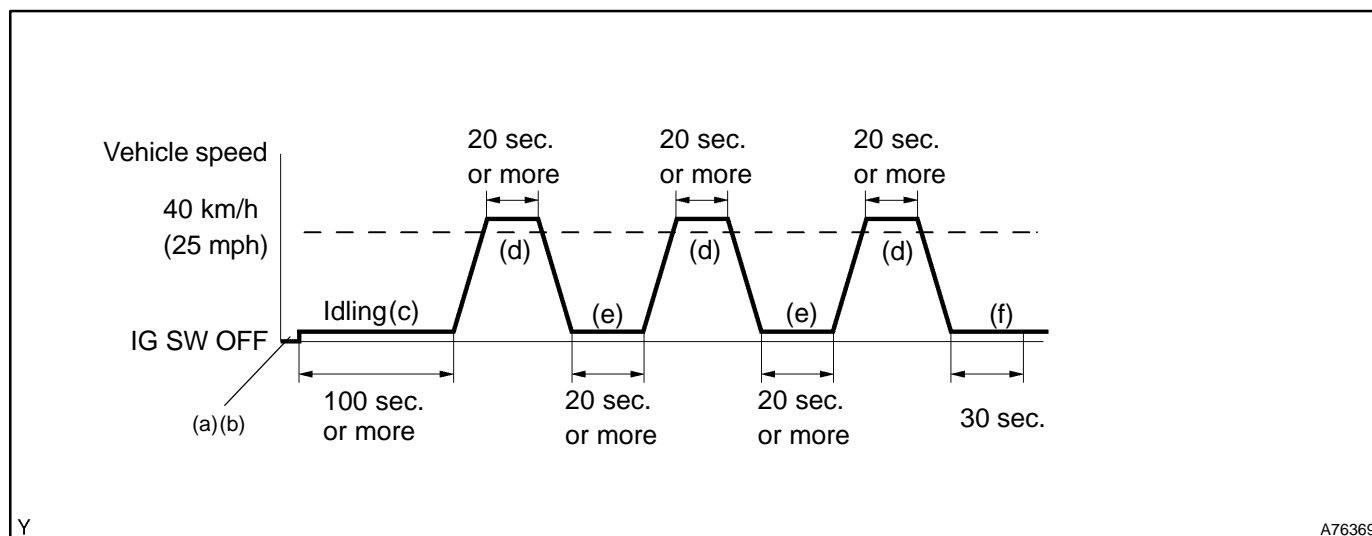
WIRING DIAGRAM



Y

A74716

CONFIRMATION DRIVING PATTERN



- (a) Connect the hand-held tester to the DLC3.
- (b) Switch the hand-held tester from the "normal mode" to "check mode" (See page 05-5).
- (c) Start the engine and let the engine idle for 100 seconds or more.
- (d) Drive the vehicle at 40 km/h (25 mph) or more for 20 seconds or more.
- (e) Let the engine idle for 20 seconds or more.
- (f) Let the engine idle for 30 seconds.

HINT:

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

NOTICE:

If the conditions in this test are not strictly followed, detection of the malfunction will be impossible.
If you do not have the hand-held tester, turn the ignition switch OFF after performing steps (c) to (f), then perform steps (c) to (f) again.

INSPECTION PROCEDURE

HINT:

Hand-held tester only:

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

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

HINT:

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

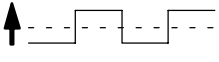

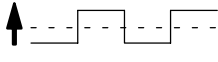
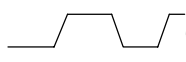
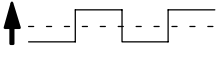
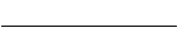
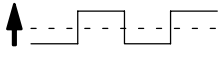

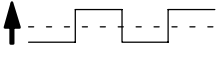

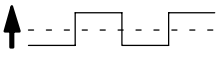
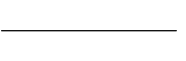
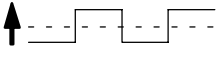
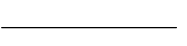
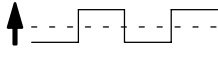
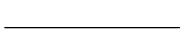
- (1) Connect the hand-held tester to the DLC3 on the vehicle.
- (2) Turn the ignition switch ON.
- (3) Warm up the engine with the engine speed at 2,500 rpm for approx. 90 sec.
- (4) Select the item "DIAGNOSIS/ENHANCED OBD II/ACTIVE TEST/ A/F CONTROL".
- (5) Perform "A/F CONTROL" when idle condition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

Result:

Heated oxygen sensor reacts in synchronizing with increase and decrease of injection volume (+25 % → rich output: More than 0.55 V, -12.5 % → lean output: Less than 0.4 V)

NOTICE:

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

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

The following procedure of A/F CONTROL enable that to check its output (show its graph indication) of heated oxygen sensor.

To display the graph indication. Select and push the "YES or NO" button 2 data "O2S B1S1 and O2S B1S2" or "O2S B2S1 and O2S B2S2" and press button "4" after selecting "ACTIVE TEST/ A/F CONTROL/USER DATA".

NOTICE:

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

HINT:

- If different DTCs that are related to different system are output simultaneously while terminal E2 is used as a ground terminal, terminal E2 may be open.
- Read freeze frame data using the hand-held tester or the OBD II scan tool, as freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was lean or rich, etc. at the time of the malfunction.
- A high heated oxygen sensor (sensor 1) voltage (0.55 V or more) could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1 CHECK OTHER DTC OUTPUT(BESIDES HEATED OXYGEN SENSOR DTCS)

- (a) Read the DTC using the hand-held tester or the OBD II scan tool.

Result:

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

HINT:

If any other codes besides "P0130, P0150, P2195, P2196, P2197 and/or P2198" are output, perform the troubleshoot on that DTC before.

B

GO TO RELEVANT DTC CHART
(See page 05-18)

A

2 READ VALUE OF HAND-HELD TESTER OR OBD II SCAN TOOL(OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

- (a) Warm up the heated oxygen sensor with the engine speed at 2,500 rpm for approximately 90 seconds.
(b) Read the output voltage of the heated oxygen sensor during idling.

Heated oxygen sensor output voltage:

Alternates repeatedly between less than 0.4 V and more than 0.55 V (See the following table).

	O K	N G	N G	N G
1 V ———				
0.55 V - - -				
0.4 V - - -				
0 V ———				

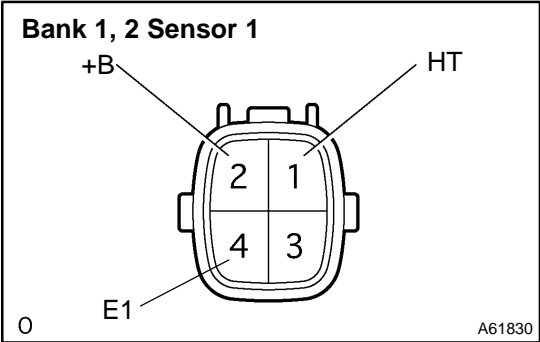
OK

Go to step 9

NG

3

INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)



- (a) Measure the resistance between the terminals of the heated oxygen sensor connector.

Standard (Bank 1, 2 sensor 1):

Terminal No.	Resistance
1 (HT) ⇔ 2 (+B)	11 - 16 Ω at 20 °C (68 °F)
1 (HT) ⇔ 4 (E1)	No Continuity

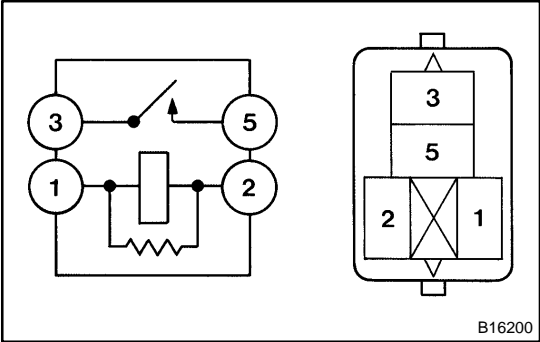
NG

REPLACE HEATED OXYGEN SENSOR

OK

4

INSPECT EFI RELAY



- (a) Remove the EFI relay from the engine room R/B.
- (b) Inspect the EFI relay.

Standard:

Terminal No.	Condition	Specified condition
1 ⇔ 2	Constant	Continuity
3 ⇔ 5	Usually	No Continuity
	Apply B+ between Terminals 1 and 2	Continuity

NG

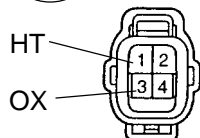
REPLACE EFI RELAY

OK

5 CHECK HARNESS AND CONNECTOR(HEATED OXYGEN SENSOR - ECM)

Wire Harness Side

- (H5) Bank 1 Sensor 1
(H7) Bank 2 Sensor 1



Heated Oxygen Sensor Connector

A67392

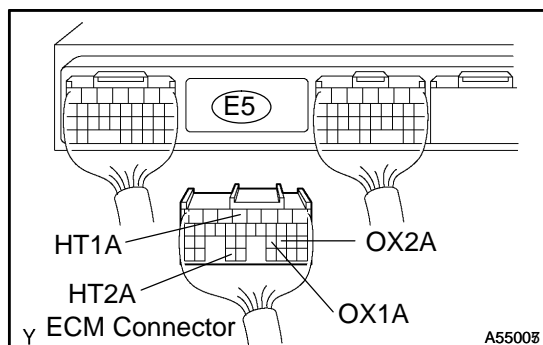
- Disconnect the H5 or H7 heated oxygen sensor connector.
- Disconnect the E5 ECM connector.
- Check the continuity between the wire harness side connectors.

Standard (Check for open):

Symbols (Terminal No.)	Specified condition
OX (H5-3) ⇔ OX1A (E5-23)	Continuity
HT (H5-1) ⇔ HT1A (E5-4)	
OX (H7-3) ⇔ OX2A (E5-22)	
HT (H7-1) ⇔ HT2A (E5-33)	

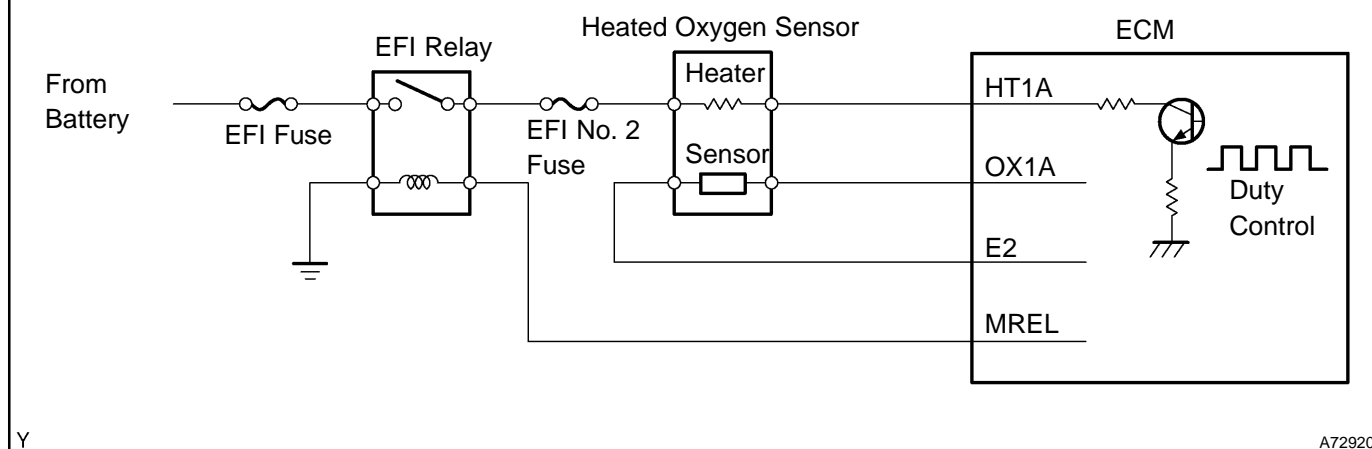
Standard (Check for short):

Symbols (Terminal No.)	Specified condition
OX (H5-3) or OX1A (E5-23) ⇔ Body ground	No continuity
HT (H5-1) or HT1A (E5-4) ⇔ Body ground	
OX (H7-3) or OX2A (E5-22) ⇔ Body ground	
HT (H7-1) or HT2A (E5-33) ⇔ Body ground	



A55003

Reference (Bank 1 Sensor 1 System Drawing)



A72920

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6 CHECK AIR INDUCTION SYSTEM

- Check the vacuum leaks in air induction system.

NG

REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

7 CHECK FUEL PRESSURE (See page 11-5)

(a) Check the fuel pressure (high or low pressure).

NG

REPAIR OR REPLACE FUEL SYSTEM

OK

8 INSPECT FUEL INJECTOR ASSY(INJECTION AND VOLUME) (See page 11-7)

NG

REPLACE FUEL INJECTOR ASSY

OK

REPLACE HEATED OXYGEN SENSOR

9 PERFORM CONFIRMATION DRIVING PATTERN

GO

10 READ OUTPUT DTC(HEATED OXYGEN SENSOR DTCS ARE OUTPUT AGAIN)

(a) Read the DTC using the hand-held tester or the OBD II scan tool.

Result:

Display (DTC output)	Proceed to
"P0130, P0150, P2195, P2196, P2197 and/or P2198" are output again	A
"P0130, P0150, P2195, P2196, P2197 and/or P2198" are not output again	B

B

**CHECK FOR INTERMITTENT PROBLEMS
(See page 05-5)**

A

REPLACE HEATED OXYGEN SENSOR