

DTC	P0130	OXYGEN SENSOR CIRCUIT (BANK 1 SENSOR 1)
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DTC	P2195	OXYGEN SENSOR SIGNAL STUCK LEAN (BANK 1 SENSOR 1)
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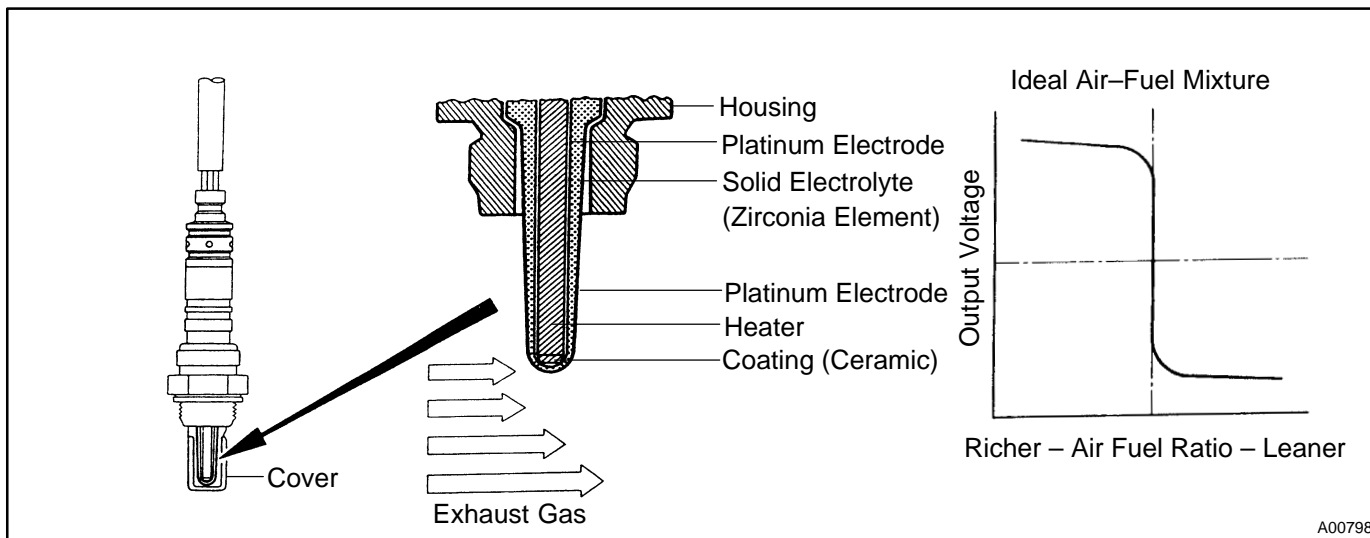
DTC	P2196	OXYGEN SENSOR SIGNAL STUCK RICH (BANK 1 SENSOR 1)
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CIRCUIT DESCRIPTION

The front oxygen sensor is used to monitor oxygen concentration in the exhaust. For optimum catalytic converter operation, the air fuel mixture must be maintained near the ideal "stoichiometric" ratio. The heated oxygen sensor output voltage changes suddenly at the stoichiometric ratio. The ECM adjusts the fuel injection time so that the air-fuel ratio is nearly stoichiometric.

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 (low voltage, i.e. less than 0.45 V).

When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio, the oxygen will be vanished from the exhaust gas. And the heated oxygen sensor informs the ECM of the RICH condition (high voltage, i.e. more than 0.45 V).



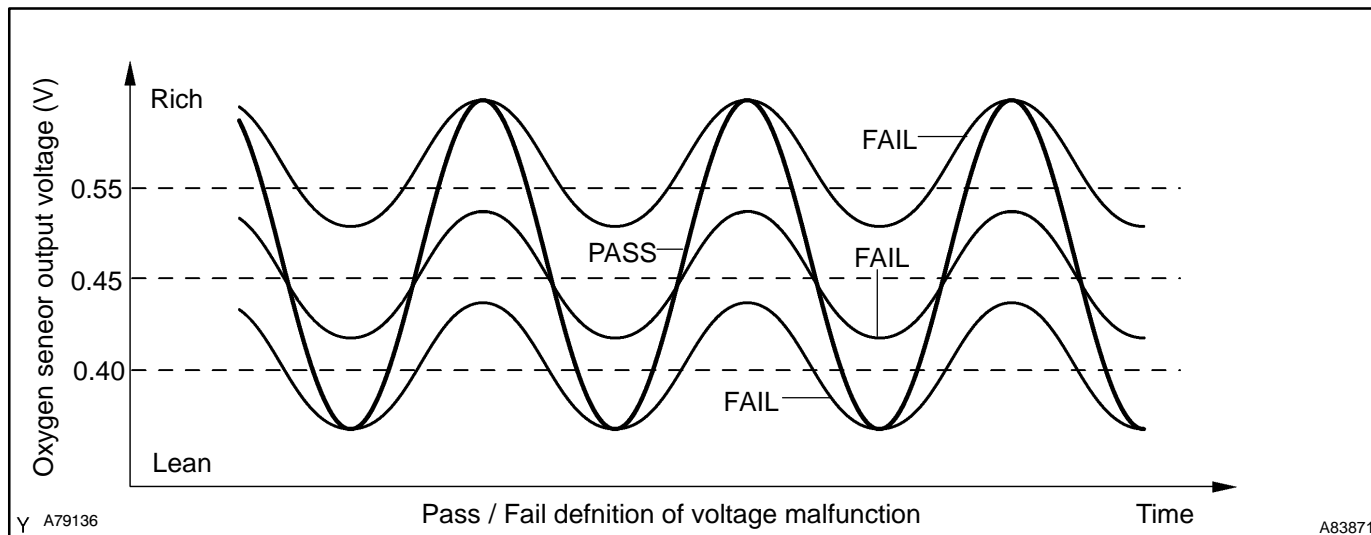
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DTC No.	DTC Detection Condition	Trouble Area
P0130	Output voltage of heated oxygen sensor remains at 0.4 V or more, or 0.55 V or less, during idling after engine is warmed up (2 trip detection logic)	<ul style="list-style-type: none"> • Open or short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

HINT:

- 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.

MONITOR DESCRIPTION



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

The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to the exhaust gases. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The heated oxygen sensor has the characteristic whereby its output voltage change suddenly in the vicinity of the stoichiometric air-fuel ratio. The heated oxygen sensor generates output voltage between 0 V and 1.0 V in response to the oxygen concentration in exhaust gas. When the output voltage of the sensor is 0.55 V or more, the ECM judges that the air-fuel ratio is RICH. When it is 0.40 V or less, the ECM judges that the air-fuel ratio is LEAN.

In the normal condition, the heated oxygen sensor indicates RICH and LEAN alternately with a regular cycle under the air-fuel ratio feedback control. If the sensor voltage output remains at RICH, or at LEAN, the ECM interprets this as malfunction of the sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0130	Front heated oxygen sensor voltage is constant at lean side or rich side
	P2195	Front heated oxygen sensor voltage is constant at lean side
	P2196	Front heated oxygen sensor voltage is constant at rich side
Required sensors/components	Main sensors	Front heated oxygen sensor
	Related sensors	Crank position sensor, vehicle speed sensor
Frequency of operation	Once per drive cycles	
Duration	25 to 36 sec (2 times)	
MIL operation	2 driving cycles	
Sequence of operation	None	

TYPICAL ENABLING CONDITION

Item	Specification	
	Minimum	Maximum
The monitor will run whenever the following DTCs are not present	See "List of Disable a Monitor" table (On page 05-24)	
There is history that the following conditions were met for 27 seconds	(a) and (b)	
(a) Vehicle speed	40 km/h (25 mph)	–
(b) Engine speed	900 rpm	–
Time after engine start	120 sec	–
Idle	ON	
Fuel system status	Closed loop	

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
P0130:	
Either the following condition (a) or (b) is met:	More than 2 times
(a) Front oxygen sensor voltage is 0.55 V or less	For more than 25 seconds
(b) Front oxygen sensor voltage is 0.40 V or more	For more than 25 seconds
P2195:	
Front oxygen sensor voltage is 0.55 V or less	For more than 25 seconds (3 times)
P2196:	
Front oxygen sensor voltage is 0.4 V or more	For more than 25 seconds (3 times)

COMPONENT OPERATING RANGE

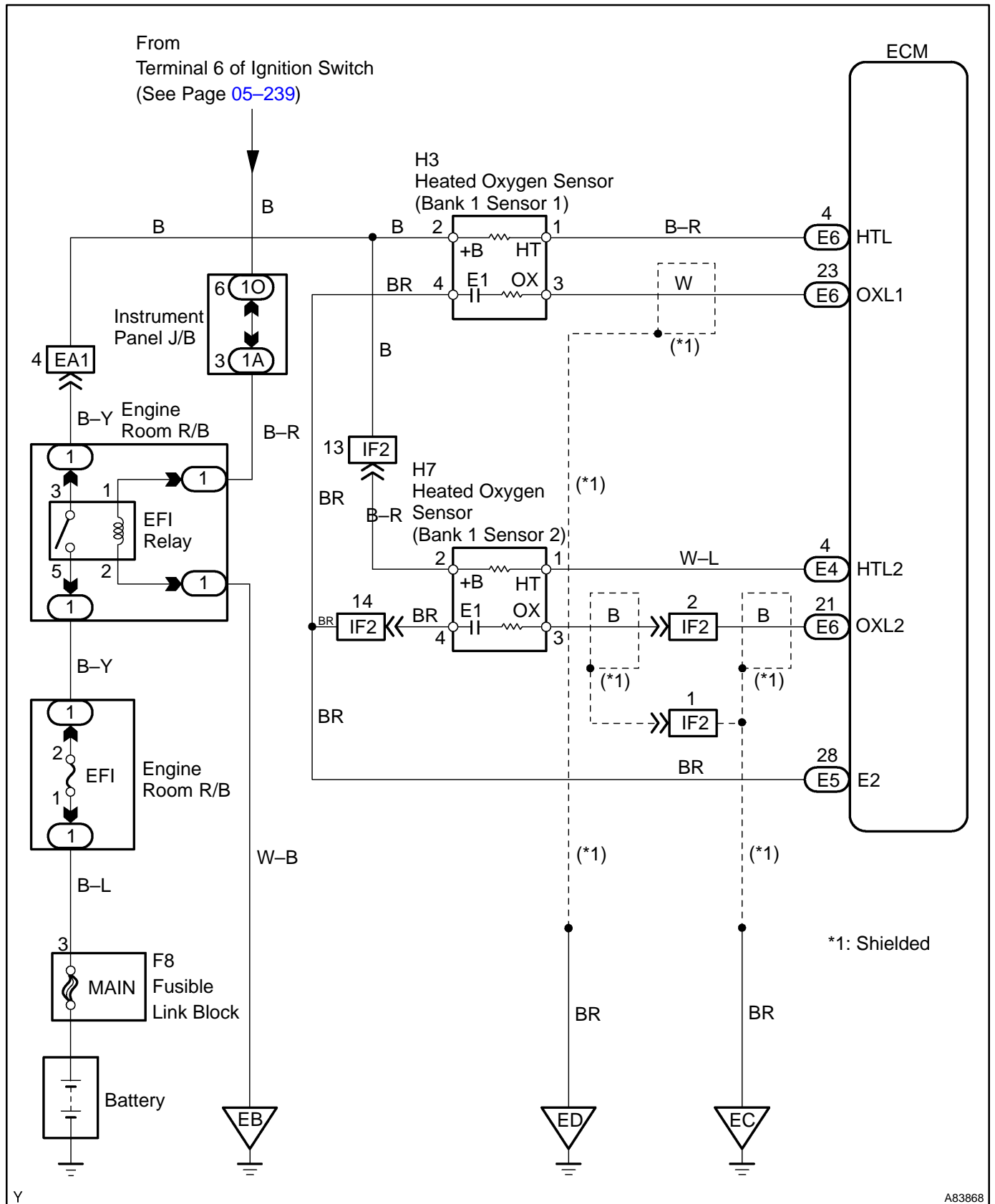
Parameter	Standard Value
Sensor voltage	0 to 1 V

MONITOR RESULT (MODE 06 DATA)

Test ID	Comp ID	Description of test data	Description of test limit	Unit	Conversion factor
\$03	–	Not supported by mode \$06, but by mode \$05	–	–	–

Refer to page 05-26 for detailed information on CHECKING MONITOR STATUS.

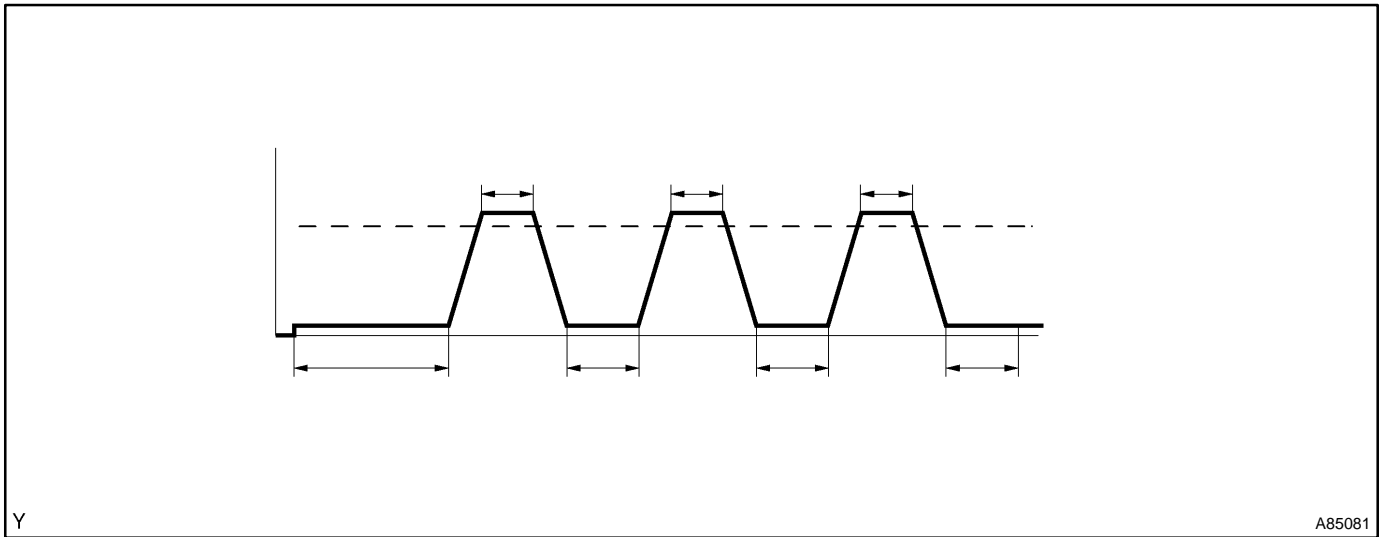
WIRING DIAGRAM



Y

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CONFIRMATION DRIVING PATTERN



- (a) Connect the hand-held tester to the DLC3.
- (b) Switch the hand-held tester from the "normal mode" to the "check mode" (See page 05-11).
- (c) Start the engine and let the engine idle for 120 seconds or more.
- (d) Drive the vehicle at 40 km/h (25 mph) or more for 40 seconds or more.
- (e) Let the engine idle for 20 seconds or more. Perform steps (d) and (e) at least 3 times.
- (f) Let the engine idle for 30 seconds.

HINT:

If a malfunction exists, the MIL will be illuminated on the multi-information display during step (f).

NOTICE:

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

INSPECTION PROCEDURE

HINT:

Hand-held tester only:

Narrowing down the trouble area is possible by performing the "A/F CONTROL" ACTIVE TEST (heated oxygen sensor or other trouble areas can be distinguished).

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

HINT:

"A/F CONTROL" is ACTIVE TEST which changes the injection volume -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 by running the engine at 2,500 rpm for approximately 3 minutes.
- (4) Select the item "DIAGNOSIS/ENHANCED OBD II/ACTIVE TEST/ A/F CONTROL".
- (5) Perform "A/F CONTROL" with the engine in an idle condition (press the right or left button).

Result:

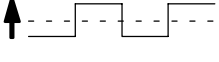

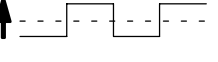
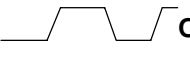
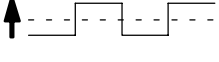
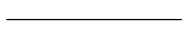
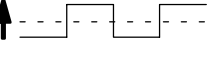
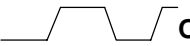
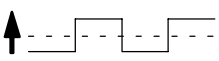

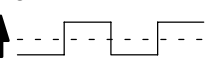

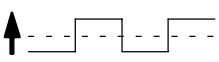

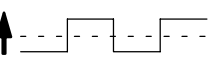

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

$+25\%$ → rich output: More than 0.5 V

-12.5% → lean output: Less than 0.4 V

NOTICE:

There is a delay of few seconds in the sensor 1 (front sensor) output, and there is about 20 seconds delay at maximum 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 0.4V  OK	Injection volume $+25\%$ ↑ -12.5% ↓  Output voltage More than 0.5 V Less than 0.4V  OK	—
Case 2	Injection volume $+25\%$ ↑ -12.5% ↓  Output voltage No reaction  NG	Injection volume $+25\%$ ↑ -12.5% ↓  Output voltage More than 0.5 V Less than 0.4V  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 0.4V  OK	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 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 outputs of both the heated oxygen sensors.

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

NOTICE:

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

HINT:

- If different DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may be open.
- Read freeze frame data using the hand-held tester or the OBD II scan tool. 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 DTCS OUTPUT(IN ADDITION TO HEATED OXYGEN SENSOR DTCS)
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- Connect the hand-held tester or the OBD II scan tool to the DLC3.
- Turn the ignition switch ON and push the hand-held tester or the OBD II scan tool main switch ON.
- Select the item "DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES".
- Read the DTC using the hand-held tester or the OBD II scan tool.

Result:

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

HINT:

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

B

GO TO RELEVANT DTC CHART
(See page [05-34](#))

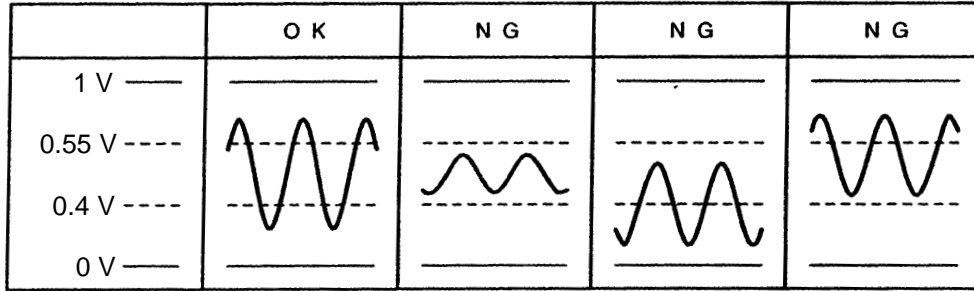
A

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

- (a) Connect the hand-held tester or the OBD II scan tool to the DLC3.
- (b) Start the engine and push the hand-held tester or the OBD II scan tool main switch ON.
- (c) Select the item "DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1S1".
- (d) Warm up the heated oxygen sensor with the engine speed at 2,500 rpm for approximately 90 seconds.
- (e) Read the output voltage of the heated oxygen sensor during idling.

Heated oxygen sensor output voltage:

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

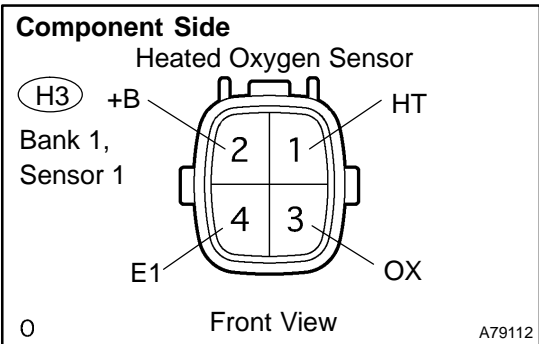


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OK → Go to step 9

NG

3 INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)



- (a) Disconnect the H3 heated oxygen sensor connector.
- (b) Measure the resistance between the terminals of the heated oxygen sensor connector.

Standard:

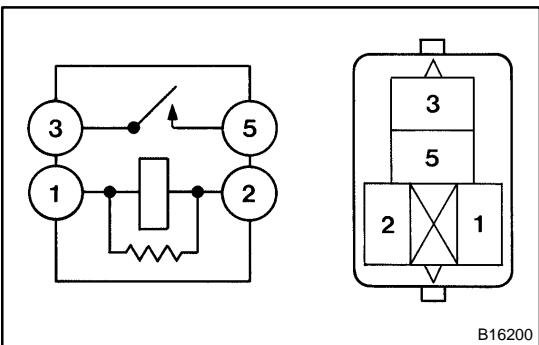
Tester Connection	Specified Condition
HT (H3-1) - +B (H3-2)	11 to 16 Ω at 20 °C (68 °F)
HT (H3-1) - E1 (H3-4)	10 kΩ or higher

- (c) Reconnect the heated oxygen sensor connector.

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:

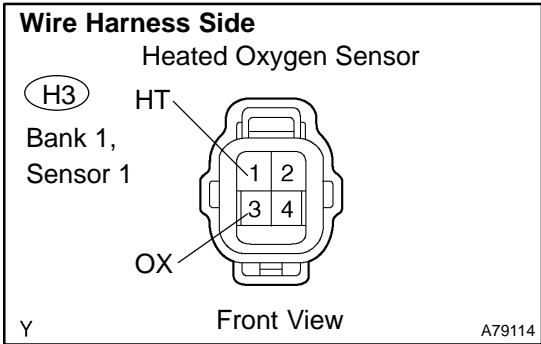
Tester Connection	Specified Condition
1 - 2	Continuity
3 - 5	No continuity
	Continuity (Apply battery voltage to terminals 1 and 2)

- (c) Reinstall the EFI relay.

NG → REPLACE EFI RELAY

OK

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



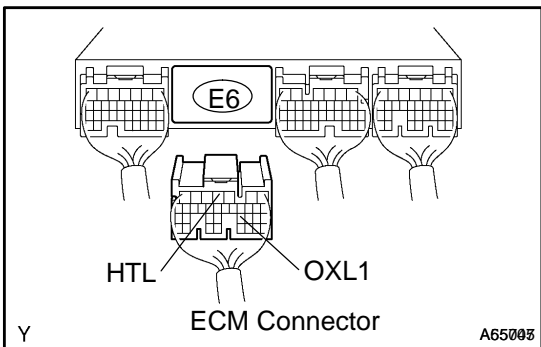
- (a) Disconnect the H3 heated oxygen sensor connector.
- (b) Disconnect the E6 ECM connector.
- (c) Measure the resistance between the wire harness side connectors.

Standard (Check for open):

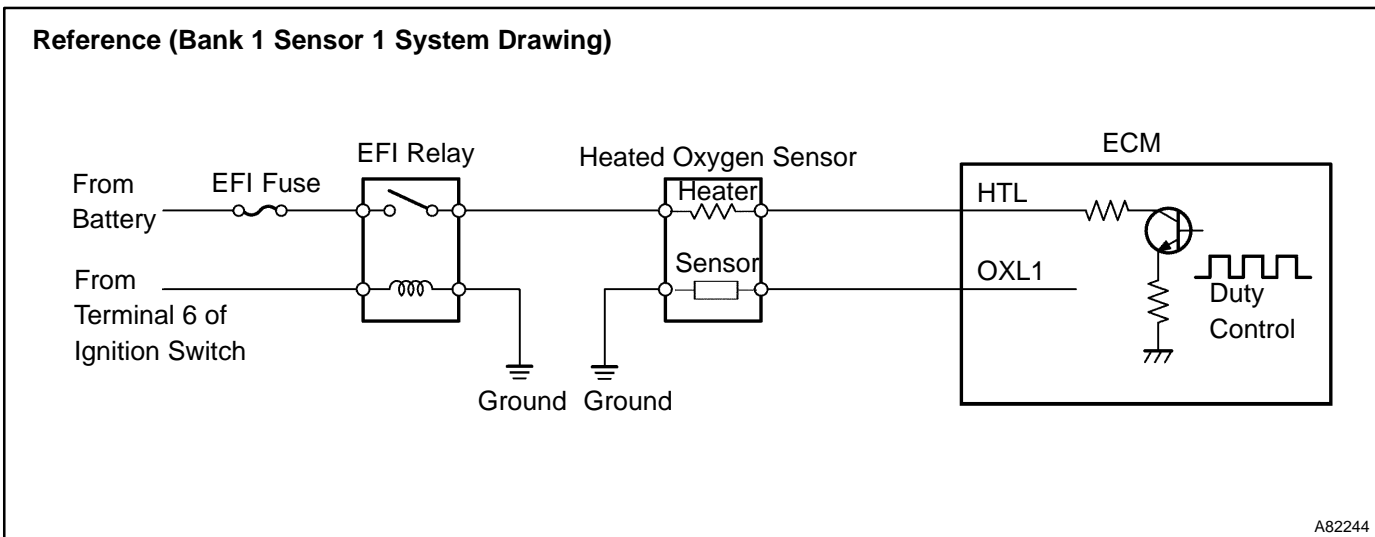
Tester Connection	Specified Condition
HT (H3-1) – HTL (E6-4)	Below 1 Ω
OX (H3-3) – OXL1 (E6-23)	

Standard (Check for short):

Tester Connection	Specified Condition
HT (H3-1) or HTL (E6-4) – Body ground	10 kΩ or higher
OX (H3-3) or OXL1 (E6-23) – Body ground	



- (d) Reconnect the heated oxygen sensor connector.
- (e) Reconnect the ECM connector.



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6 CHECK AIR INDUCTION SYSTEM

(a) Check the air induction system for vacuum leaks.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

7 CHECK FUEL PRESSURE (See page 11-4)

(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

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

GO

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

- (a) Connect the hand-held tester or the OBD II scan tool to the DLC3.
- (b) Turn the ignition switch ON and push the hand-held tester or the OBD II scan tool main switch ON.
- (c) Select the item "DIAGNOSIS / OBD/MOBD / DTC INFO / CURRENT CODES".
- (d) Read the DTCs using the hand-held tester or the OBD II scan tool.

Result:

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

B → **CHECK FOR INTERMITTENT PROBLEMS (See apge 05-41)**

A

REPLACE HEATED OXYGEN SENSOR