DTC	P0130	OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 1)

DTC	P2195	OXYGEN SENSOR SIGNAL STUCK LEAN (BANK 1 SENSOR 1)

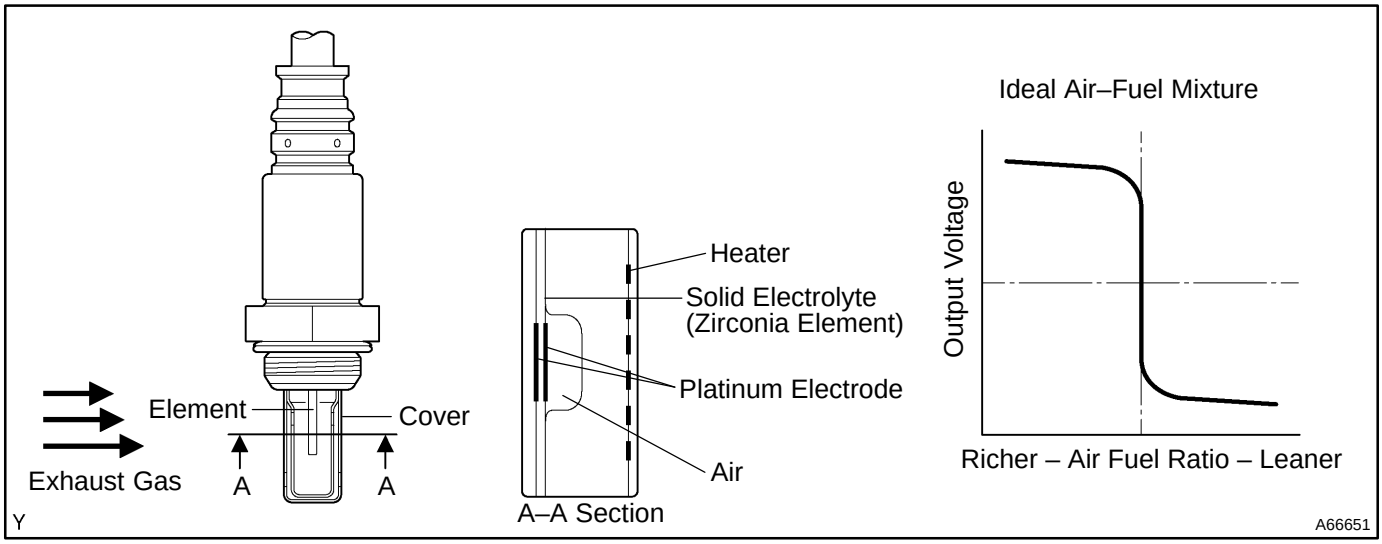
DTC	P2196	OXYGEN SENSOR SIGNAL STUCK RICH (BANK 1 SENSOR 1)

CIRCUIT DESCRIPTION

The rear heated oxygen sensor is used to monitor oxygen concentration in the exhaust gas. 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 in the vicinity of 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).

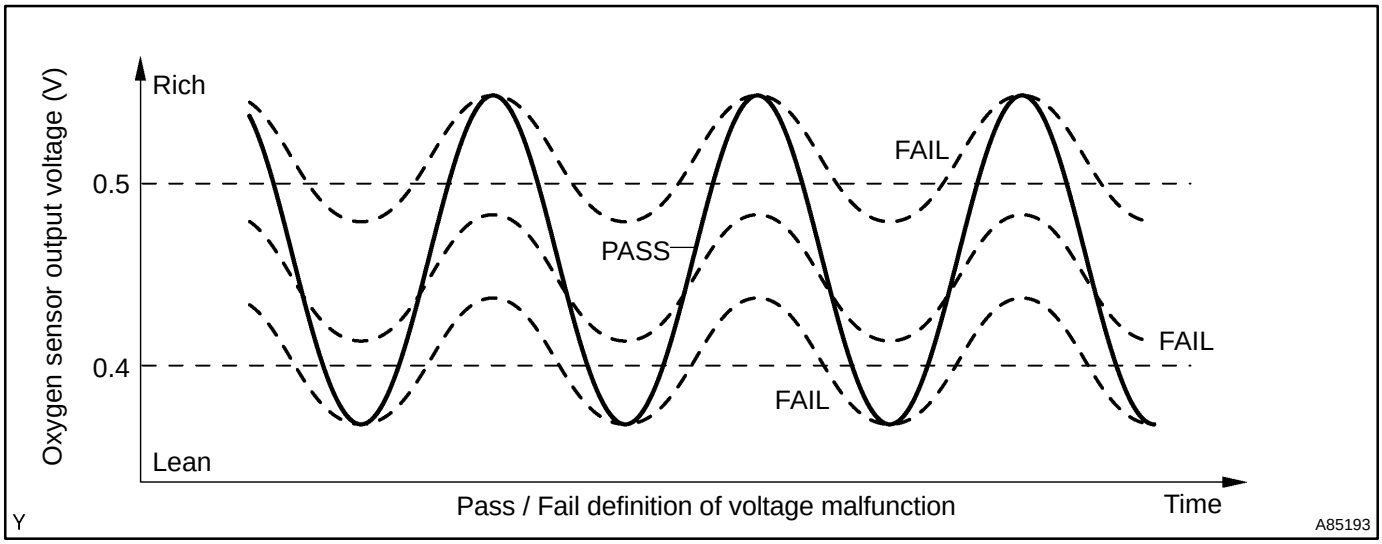


DTC No.	DTC Detection Condition	Trouble Area
P0130	Output voltage of heated oxygen sensor remains at 0.4 V or more, or 0.5 V or less, during idling after engine is warmed up (2 trip detection logic)	• Open or short in heated oxygen sensor (bank 1 sensor 1) circuit • Heated oxygen sensor (bank 1 sensor 1) • Heated oxygen sensor heater (bank 1 sensor 1) • EFI relay • Air induction system • Fuel pressure • Injector • ECM
P2195	Output voltage of heated oxygen sensor remains at 0.5 V or less, during idling after engine is warmed up (2 trip detection logic)	
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)	

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- 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 heated oxygen sensor information to regulate the air–fuel ratio near to the stoichiometric air–fuel ratio. The sensor detects oxygen levels in the exhaust gases and sends this signal to the ECM. This maximizes the catalytic converter's ability to purify the exhaust gases.
The heated oxygen sensor element consists of the platinum coated zirconia and heating element. The inner surface of sensor element is exposed to the outside air, and the outer surface of sensor element is exposed to the exhaust gases. The sensor generates between 0 V and 1 V of the voltage output in response to the oxygen concentration in the exhaust gases. The sensor's output voltage varies suddenly in the vicinity of the stoichiometric air–fuel ratio.
Under normal condition, the output voltage from the heated oxygen sensor alternates between RICH and LEAN sides periodically. When it is 0.4 V or less, the air–fuel ratio is judged as LEAN.
If the heated oxygen sensor outputs RICH signal (or LEAN signal) constantly, or if the heated oxygen sensor cannot output enough voltage to reach the minimum specification, the ECM interprets this as a malfunction in the heated oxygen sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0130	Front heated oxygen sensor voltage is constant
	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 senor
	Related sensors	Crank shaft position sensor, vehicle speed sensor
Frequency of operation	Once per drive cycles	
Duration	18 to 36 seconds x 3	
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" (On page 05–25)	
There is history of following condition (a) and (b) a met:	20 seconds (Continuously)	–
(a) Vehicle speed	25 mph (40 km/h)	–
(b) Engine speed	900 rpm	–
Time after engine start	120 seconds	–
Idle	ON	
Fuel system status	Closed loop	

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
P0130:	
Sensor voltage is 0.5 V or less for 18 seconds or more	3 times or more
Sensor voltage is 0.4 V or more for 18 seconds or more	
P2195:	
Front heated oxygen sensor voltage is 0.5 V or less for 18 seconds or more	3 times or more
P2196:	
Front heated oxygen sensor voltage is 0.4 V or more for 18 seconds or more	3 times or more

COMPONENT OPERATING RANGE

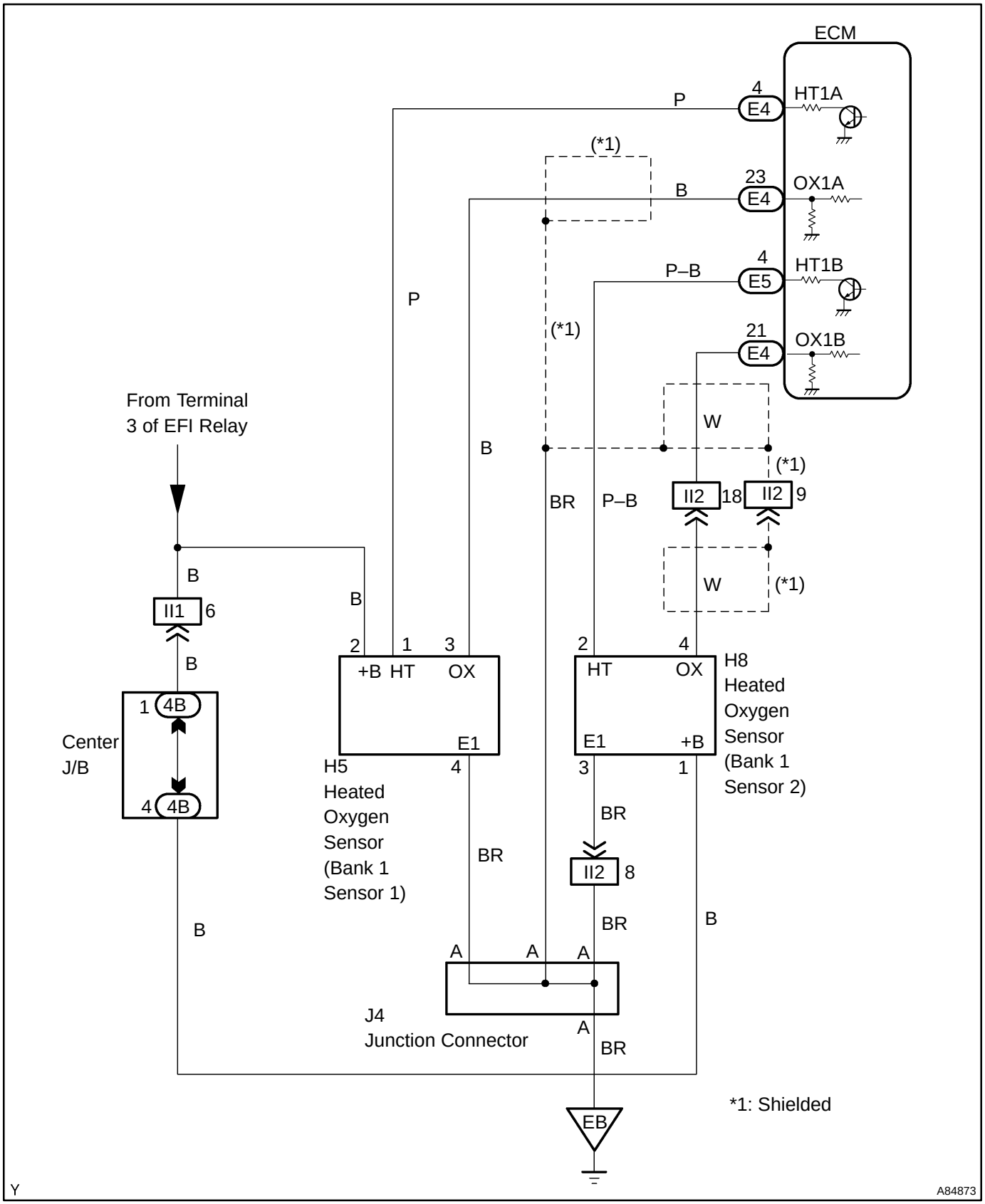
Parameter	Standard Value
In the normal condition, the heated oxygen sensor voltage	0 to 1 V

MONITOR RESULT (MODE 06 DATA)

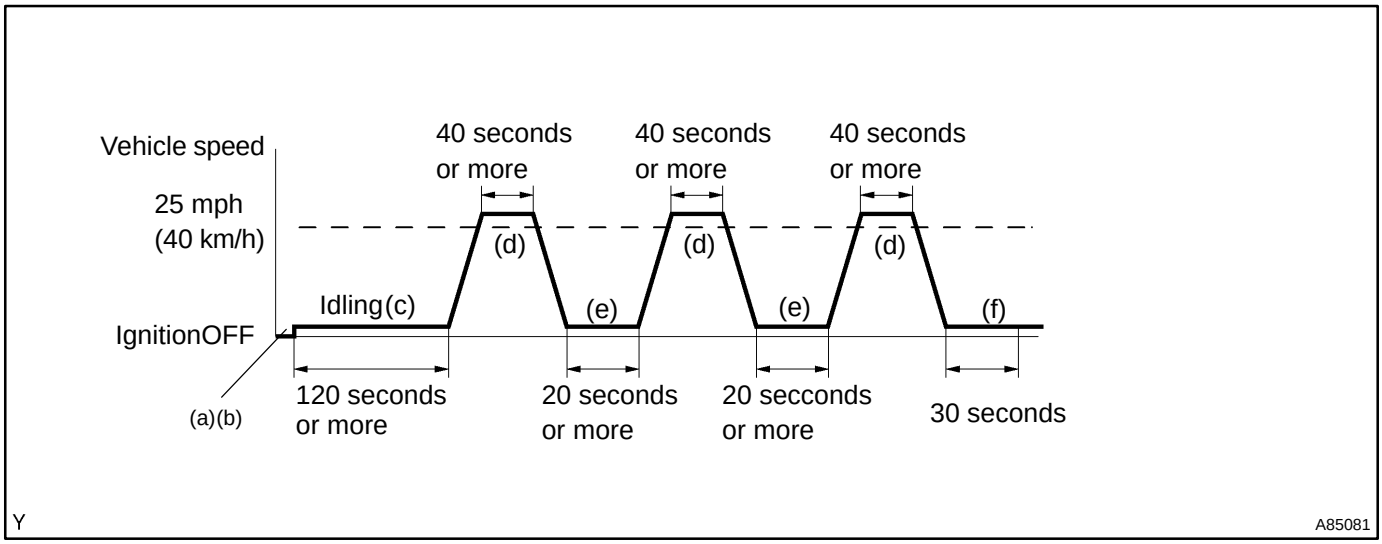
Test ID	Comp ID	Description of test data	Description of test limit	Unit	Conversion factor
$03	–	Not supported by mode $06, but by mode $05	–	–	–

Refer to page 05–27 for detailed information on Checking Monitor Status.

WIRING DIAGRAM



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 25 mph (40 km/h) 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 the 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 ”A/F CONTROL” ACTIVE TEST (heated oxygen sensor or other trouble areas can be distinguished).

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

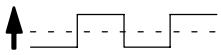
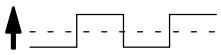
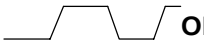
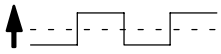
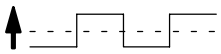
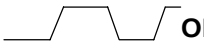
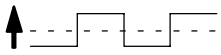
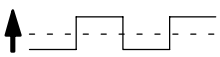
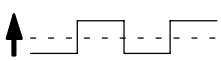
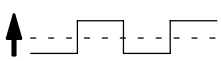
HINT:
”A/F CONTROL” is the ACTIVE TEST which changes the injection volume to –12.5 % or +25 %.

(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine by running the engine speed at 2,500 rpm for approximately 90 seconds.
(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 0.4 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 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 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 of 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 (0.5 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 OTHER DTC OUTPUT(IN ADDITION TO HEATED OXYGEN SENSOR DTCS)

(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 / ENHANCED OBD II / DTC INFO / CURRENT CODES”.
(d) Read the DTCs.
Result:

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

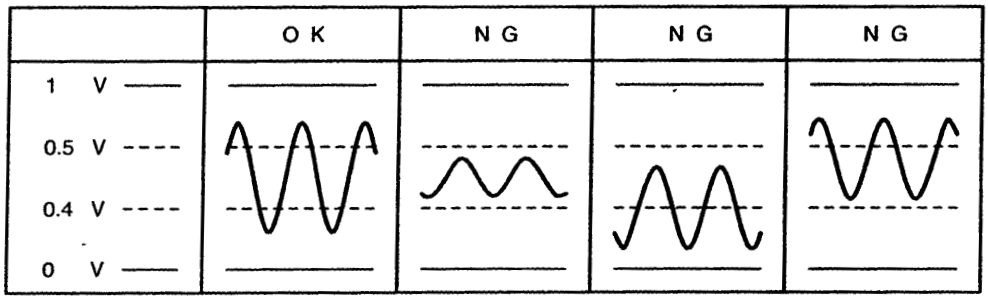
HINT:
If any other codes besides P0130, P2195 and/or P2196 are output, perform the troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–35)**

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 repeatedly between less than 0.4 V and more than 0.5 V (See the following table).

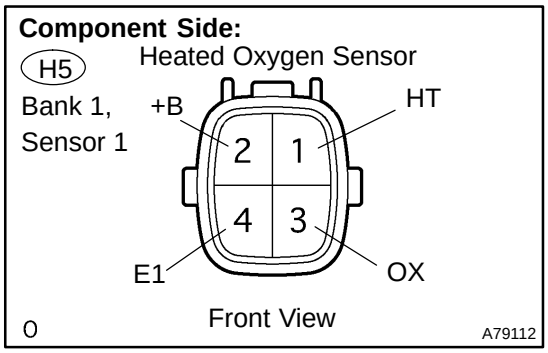


A85076

OK → **Go to step 9**

NG

3 INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)



(a) Disconnect the H5 heated oxygen sensor connector.

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

Standard:

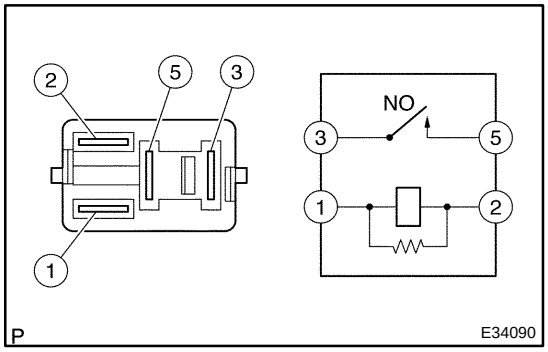
Tester Connection	Specified Condition
HT (H5–1) – +B (H5–2)	5 to 10 Ω at 20 °C (68 °F)
HT (H5–1) – E1 (H5–4)	10 kΩ or higher

(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) Check for continuity in the EFI relay.

Standard:

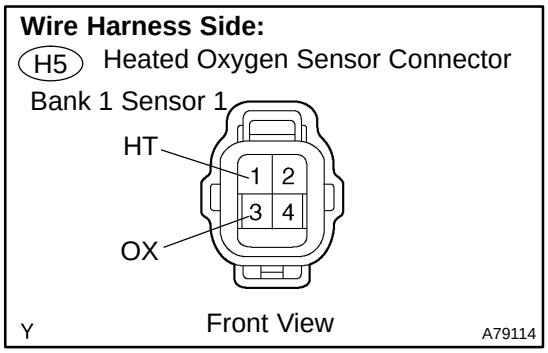
Tester Connection	Specified Condition
1 – 2	Continuity
3 – 5	No continuity
	Continuity (Apply battery voltage to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → **REPLACE EFI RELAY**

OK

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



(a) Disconnect the H5 heated oxygen sensor connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance between the wire harness side connectors.

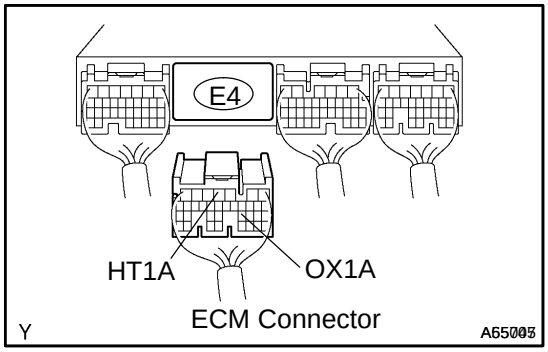
Standard (Check for open):

Tester Connection	Specified Condition
HT (H5–1) – HT1A (E4–4)	Below 1 Ω
OX (H5–3) – OX1A (E4–23)	

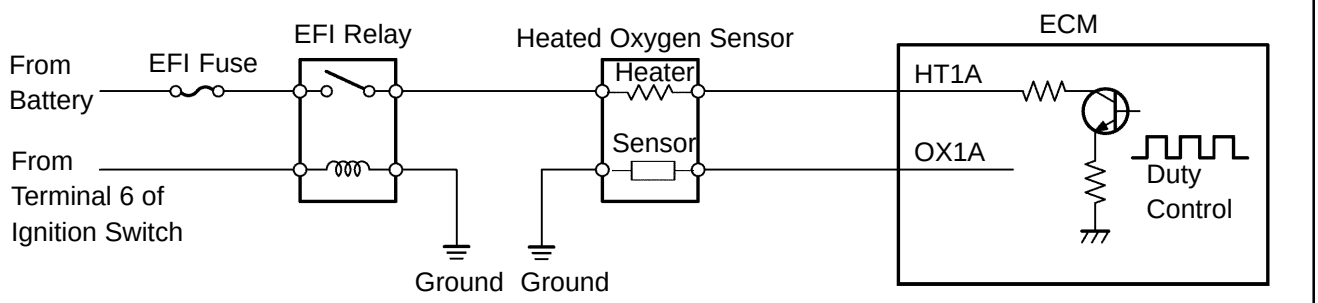
Standard (Check for short):

Tester Connection	Specified Condition
HT (H5–1) or HT1A (E4–4) – Body ground	10 kΩ or higher
OX (H5–3) or OX1A (E4–23) – Body ground	

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



Reference (Bank 1 Sensor 1 System Drawing)



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 11–5)

(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

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) Read the DTC using the hand–held tester or the OBD II scan tool.
Result:

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

B → CHECK FOR INTERMITTENT PROBLEMS (See page 05–41)

A

REPLACE HEATED OXYGEN SENSOR