

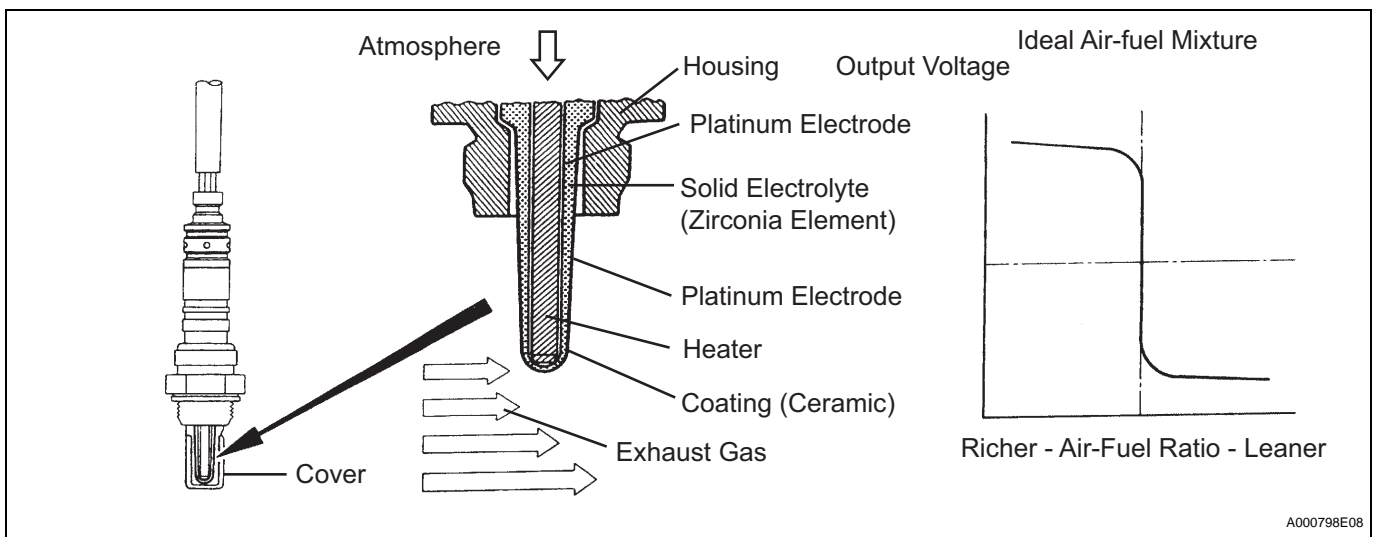
DTC	P0130	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 1)
DTC	P2195	Oxygen Sensor Signal Stuck Lean (Bank 1 Sensor 1)
DTC	P2196	Oxygen Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DESCRIPTION

The Heated Oxygen (HO2) sensor (bank 1 sensor 1) monitors the oxygen concentration in the exhaust gas. For optimum TWC operation, the air-fuel mixture must be maintained as close as possible to the stoichiometric ratio. The HO2 sensor output voltage changes dramatically in the vicinity of the stoichiometric ratio. By making adjustments in accordance with these signal voltages, the ECM adjusts the fuel injection time so that the air-fuel ratio remains close to stoichiometric levels.

If the oxygen concentration in the exhaust gas increases, the air-fuel ratio is lean and the HO2 sensor output voltage to the ECM drops below 0.45 V. If the oxygen concentration in the exhaust gas decreases, the air-fuel ratio is rich and the HO2 sensor output voltage to the ECM increases to above 0.45 V.

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DTC No.	DTC Detection Condition	Trouble Area
P0130	Output voltage of Heated Oxygen (HO2) 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 HO2 sensor (bank 1 sensor 1) circuit • HO2 sensor (bank 1 sensor 1) • HO2 sensor heater (bank 1 sensor 1) • EFI relay • Air induction system • Fuel pressure • Injector • ECM
P2195	Output voltage of HO2 sensor remains at 0.55 V or less during idling with warm engine (2 trip detection logic)	<ul style="list-style-type: none"> • Open or short in HO2 sensor (bank 1 sensor 1) circuit • HO2 sensor (bank 1 sensor 1) • HO2 sensor heater (bank 1 sensor 1) • EFI relay • Air induction system • Fuel pressure • Injector • ECM

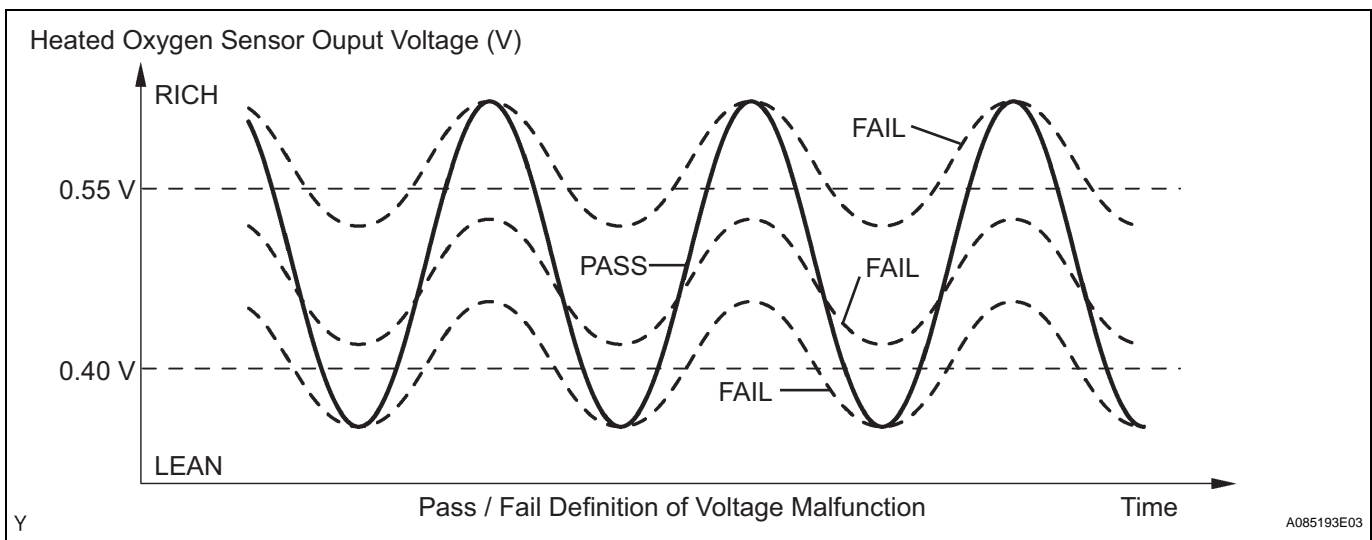
DTC No.	DTC Detection Condition	Trouble Area
P2196	Output voltage of HO2 sensor remains at 0.4 V or more during idling with warm engine (2 trip detection logic)	<ul style="list-style-type: none"> • Open or short in HO2 sensor (bank 1 sensor 1) circuit • HO2 sensor (bank 1 sensor 1) • HO2 sensor heater (bank 1 sensor 1) • EFI relay • Air induction system • Fuel pressure • Injector • ECM

HINT:

- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC), and located near the engine assembly.
- The output voltage of the HO2 sensor and the short-term fuel trim value can be read using the intelligent tester.

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MONITOR DESCRIPTION



MONITOR STRATEGY

Related DTCs	P0130: Heated Oxygen (HO2) sensor (bank 1 sensor 1) voltage P2195: Heated Oxygen (HO2) sensor (bank 1 sensor 1) voltage stuck Lean P2196: Heated Oxygen (HO2) sensor (bank 1 sensor 1) voltage stuck Rich
Required Sensors/Components (Main)	Front HO2 sensor (sensor 1)
Required Sensors/Components (Related)	Crankshaft Position (CKP) sensor, Vehicle Speed Sensor (VSS)
Frequency of Operation	Once per driving cycle
Duration	20 to 36 seconds (3 times)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever these DTCs not present	P0031, P0032 (heated oxygen sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0123 (TP sensor) P0125 (insufficient ECT for closed loop) P0134 (heated oxygen sensor 1) P0171, P0172 (fuel system) P0300 - P0304 (misfire) P0335 (crankshaft position sensor) P0340 (camshaft position sensor) P0441 - P0456 (EVAP system) P0500 (VSS)
Time after engine start	120 seconds
Idling	ON
Fuel system status	Closed Loop
Vehicle speed	Less than 5 km/h (3.125 mph)
Driving record for 20 seconds or more	40 km/h (25 mph) or more and 900 rpm or more

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TYPICAL MALFUNCTION THRESHOLDS**Heated oxygen sensor voltage (P0130):**

Occurrences either of following conditions is met	More than 2 times
Minimum HO2 sensor voltage	0.4 V or more for 25 seconds or more
Maximum HO2 sensor voltage	0.55 V or less for 25 seconds or more

Heated oxygen sensor voltage stuck Lean (P2195):

Occurrences following condition is met	2 times
Maximum heated oxygen sensor voltage	0.55 V or less for 25 seconds or more

Heated oxygen sensor voltage stuck Rich (P2196):

Occurrences following condition is met	2 times
Minimum heated oxygen sensor voltage	0.4 V or more for 25 seconds or more

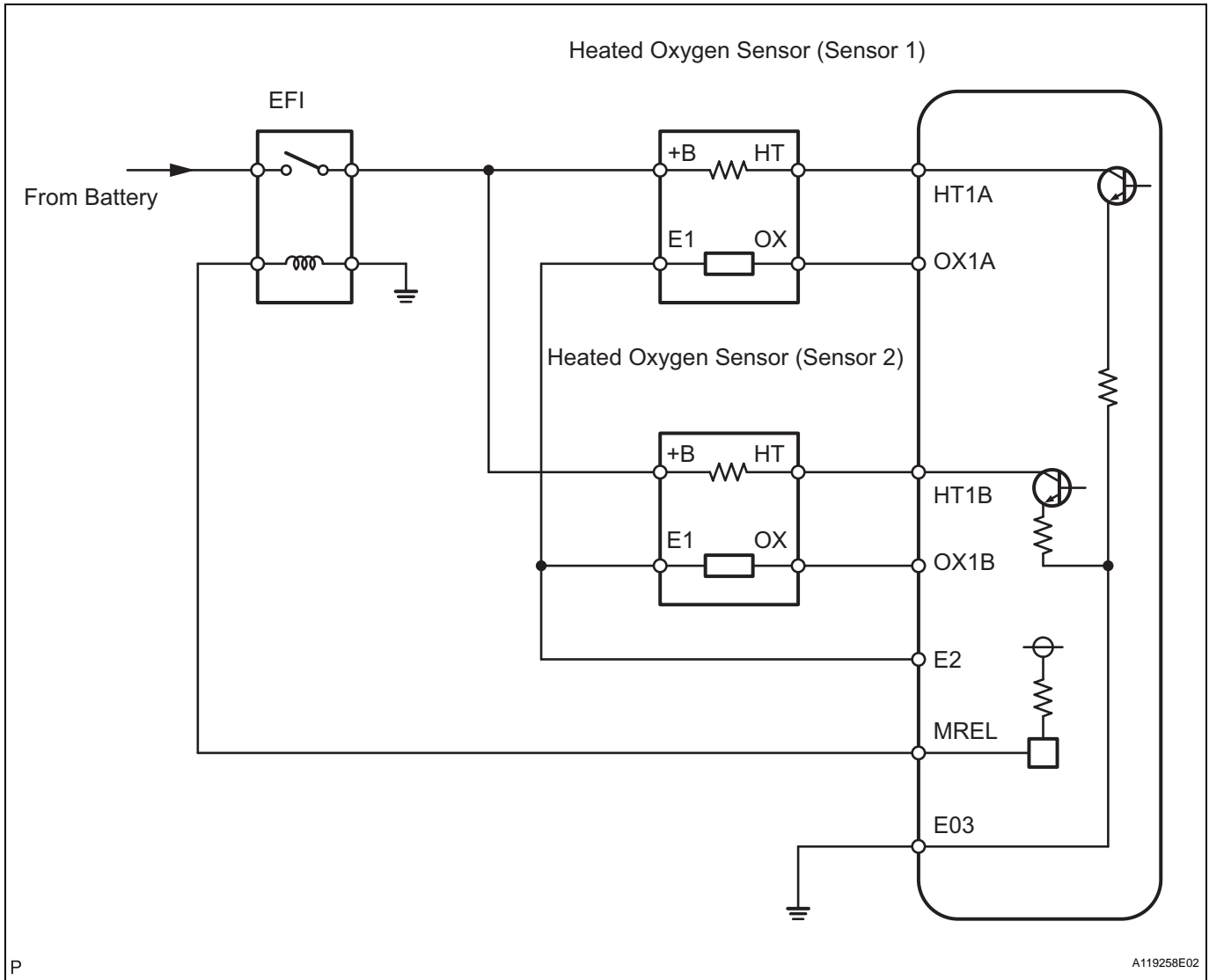
COMPONENT OPERATING RANGE

Heated Oxygen (HO2) sensor voltage	Fluctuates for a second
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MONITOR RESULT

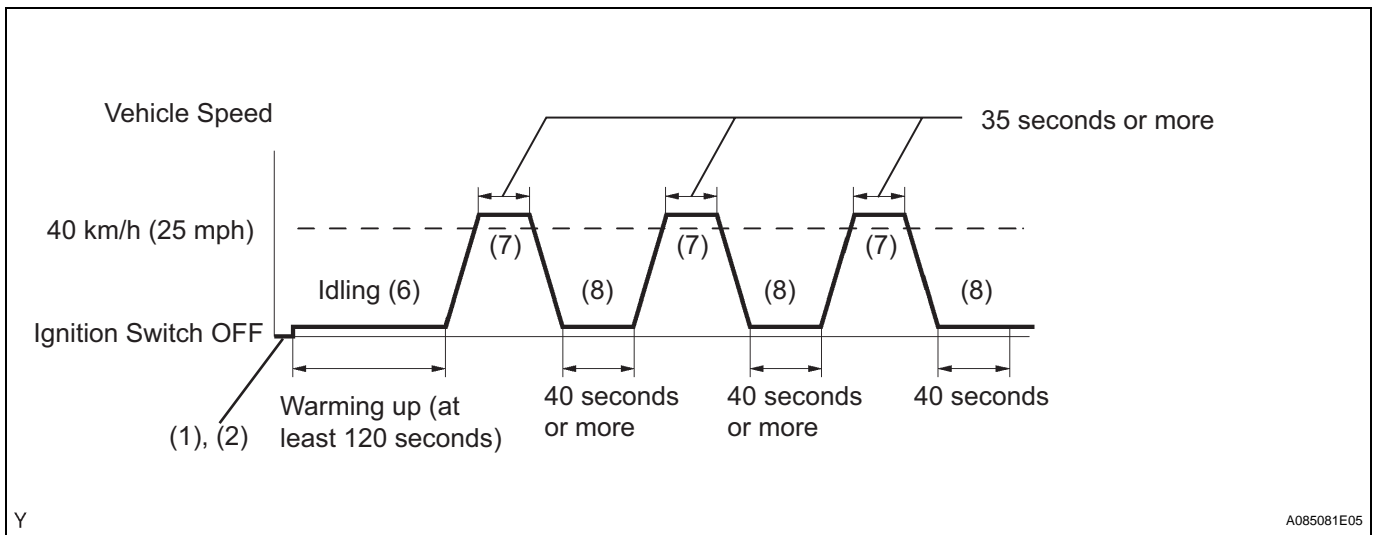
Refer to CHECKING MONITOR STATUS (see page [ES-19](#)).

WIRING DIAGRAM



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CONFIRMATION DRIVING PATTERN



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HINT:

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.

- (1) Connect the intelligent tester to the DLC3.
- (2) Turn the ignition switch ON and turn the tester ON.
- (3) Clear DTCs (see page [ES-37](#)).
- (4) If using the intelligent tester, switch the ECM from normal mode to check mode (see page [ES-41](#)).
- (5) Start the engine.
- (6) Allow the engine to idle until the engine coolant temperature reaches 75°C (167°F).
- (7) Drive the vehicle at an engine speed of more than 40 km/h (25 mph) for 35 seconds or more.
- (8) Allow the engine to idle for 40 seconds or more.
- (9) Repeat steps (6) and (7) described above at least 3 times.
- (10) Allow the engine to idle for 40 seconds or more.

HINT:

When using the intelligent tester: The MIL will be illuminated during step (10) if a malfunction still exists.

CAUTION:

If the conditions in this test are not strictly followed, malfunctions may not be detected.

HINT:

Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Heated Oxygen (HO2) sensors and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the A/F CONTROL operation using the intelligent tester.

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
4. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage outputs of the HO2 sensors (O2S B1S1 and O2S B1S2) displayed on the tester.

HINT:

- The A/F CONTROL operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

Tester Display (Sensor)	Injection Volume	Status	Voltage
O2S B1S1 (Front HO2 Sensor)	+25%	Rich	More than 0.55
O2S B1S1 (Front HO2 Sensor)	-12.5%	Lean	Less than 0.4
O2S B1S2 (Rear HO2 Sensor)	+25%	Rich	More than 0.5
O2S B1S2 (Rear HO2 Sensor)	-12.5%	Lean	Less than 0.4

NOTICE:

The front HO2 sensor has an output delay of a few seconds and the rear HO2 sensor has a maximum output delay of approximately 20 seconds.

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Case	Front HO2 Sensor (Sensor 1) Output Voltage		Rear HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		
	Output Voltage More than 0.55 V Less than 0.4 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		<ul style="list-style-type: none"> • Front HO2 sensor • Front HO2 sensor heater • Front HO2 sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		<ul style="list-style-type: none"> • Rear HO2 sensor • Rear HO2 sensor heater • Rear HO2 sensor circuit
	Output Voltage More than 0.55 V Less than 0.4 V		Output Voltage Almost no reaction		
4	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		<ul style="list-style-type: none"> • Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the front and rear HO2 sensors.
- To display the graph, enter the following menus on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST/ A/F CONTROL / USER DATA / O2S B1S1 and O2S B1S2; the press the YES button and then the ENTER button followed by the F4 button.

NOTICE:

If the vehicle is short of fuel, the air-fuel ratio becomes lean, HO2 sensor DTCs are recorded, and the ECM illuminates the MIL.

HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high HO2 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 HO2 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 ANY OTHER DTCs OUTPUT (IN ADDITION TO HEATED OXYGEN SENSOR DTCs)
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- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.

- (c) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (d) Read 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 DTCs other than P0130, P2195 and/or P2196 are output, troubleshoot those DTCs first.

B **GO TO DTC CHART**

A

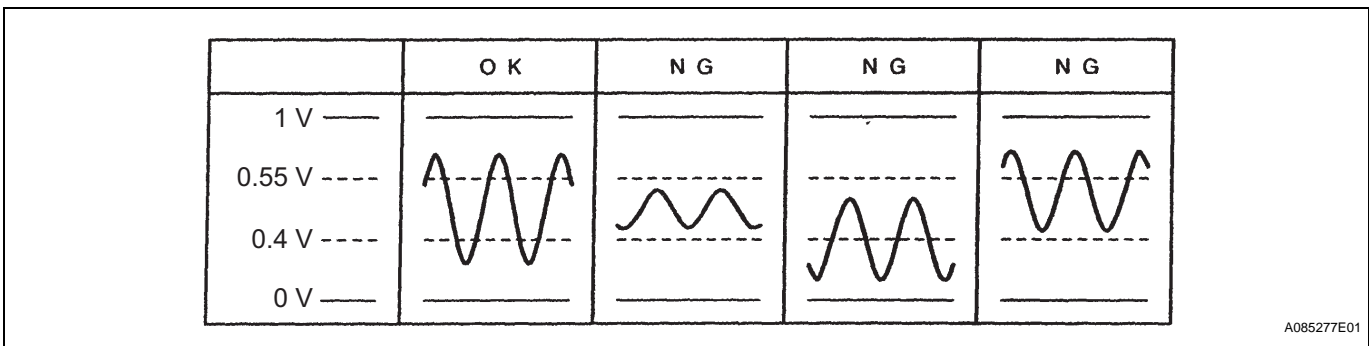
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2 READ VALUE OF INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Start the engine.
- (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / O2S B1S1.
- (e) Warm up the Heated Oxygen (HO2) sensor at an engine speed of 2,500 rpm for approximately 90 seconds.
- (f) Read the voltage output of the front HO2 sensor displayed on the tester while the engine is idling.

Standard voltage:

Fluctuates between less than 0.4 V and more than 0.55 V (refer to table below).

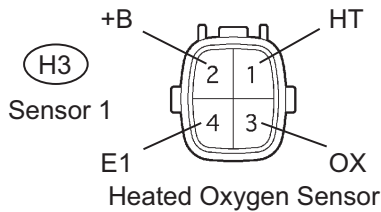


OK **Go to step 9**

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3 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

Component Side



- (a) Disconnect the H3 HO2 sensor connector.
- (b) Measure the resistance of the HO2 sensor connector.

Standard resistance

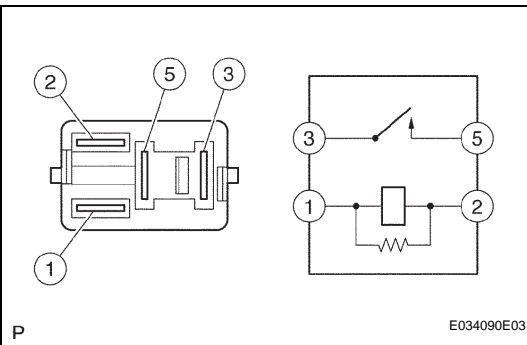
Tester Connection	Specified Condition
HT (H3-1) - +B (H3-2)	11 to 16 Ω at 20°C (68°F)
HT (H3-1) - E1 (H3-4)	10 k Ω or higher

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REPLACE HEATED OXYGEN SENSOR

OK

4 INSPECT EFI RELAY (Marking: EFI)



- (a) Remove the EFI relay from the engine room relay block.
- (b) Measure the resistance of the EFI relay.

Standard resistance

Tester Connection	Specified Condition
3 - 5	10 k Ω or higher
3 - 5	Below 1 Ω (When battery voltage is applied to terminals 1 and 2)

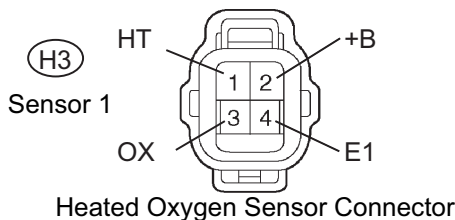
NG

REPLACE EFI RELAY

OK

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

Wire Harness Side



- (a) Disconnect the H3 HO2 sensor connector.
- (b) Turn the ignition switch ON.
- (c) Measure the voltage between the +B terminal of the H3 HO2 sensor connector and body ground.

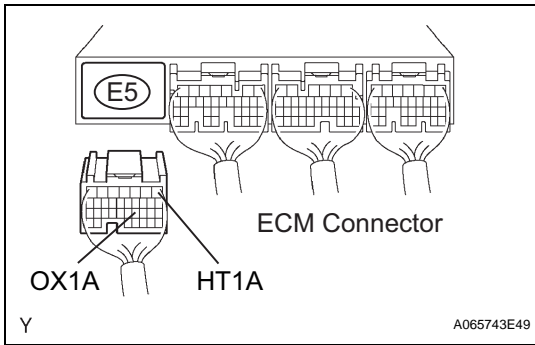
Standard voltage

Tester Connection	Specified Condition
+B (H3-2) - Body ground	9 to 14 V

- (d) Turn the ignition switch OFF.
- (e) Disconnect the E5 ECM connector.

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Y



(f) Measure the resistance of the wire harness side connectors.

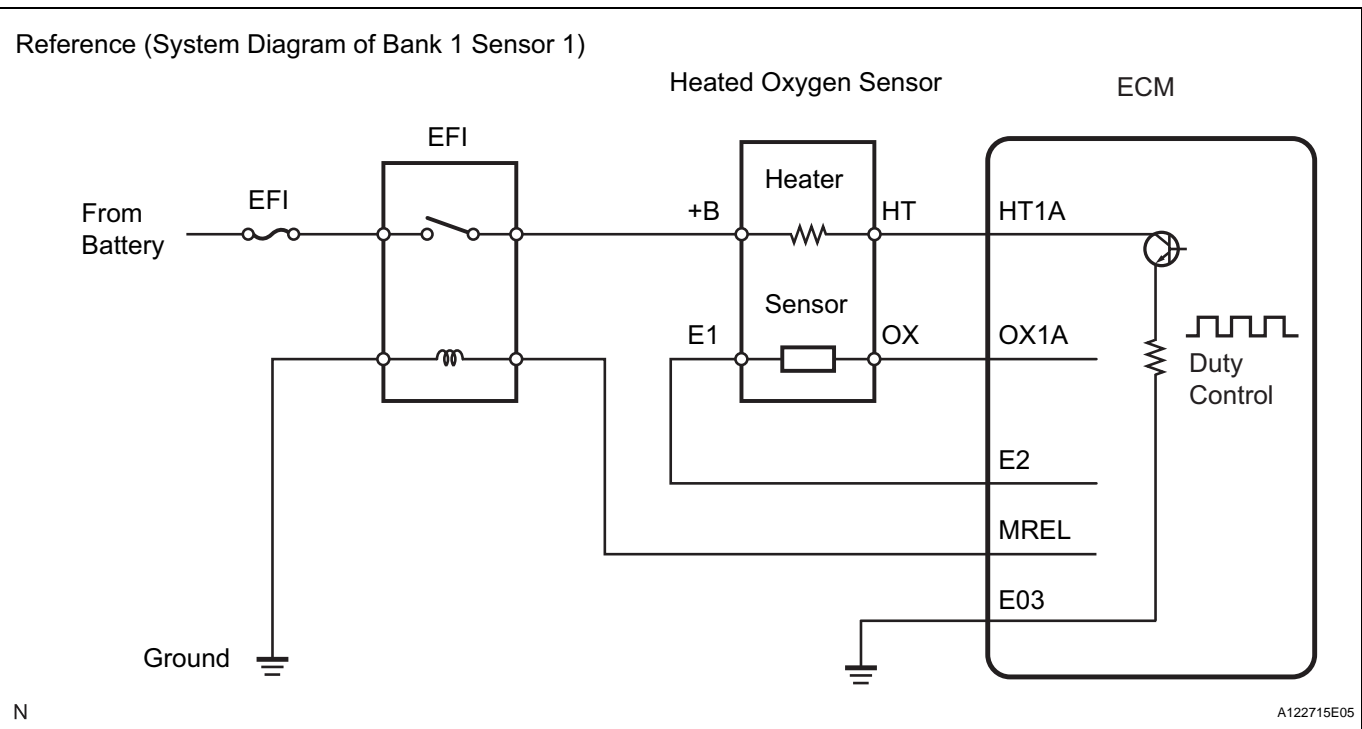
Standard resistance (Check for open)

Tester Connection	Specified Condition
HT (H3-1) - HT1A (E5-1)	Below 1 Ω
OX (H3-3) - OX1A (E5-21)	Below 1 Ω
E1 (H3-4) - Body ground	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
HT (H3-1) or HT1A (E5-1) - Body ground	10 kΩ or higher
OX (H3-3) or OX1A (E5-21) - Body ground	10 kΩ or higher

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NG REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6 CHECK AIR INDUCTION SYSTEM

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

OK:

No leakage from air induction system.

NG REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

7 CHECK FUEL PRESSURE

(a) Check the fuel pressure (high or low pressure) (see page [FU-7](#)).

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8 INSPECT FUEL INJECTOR

(a) Check the injector injection and volume (see page [FU-13](#)).

NG → **REPLACE FUEL INJECTOR**

OK

REPLACE HEATED OXYGEN SENSOR

9 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

10 CHECK WHETHER DTC OUTPUT RECURS (HEATED OXYGEN SENSOR DTCS)

- (a) Read DTCs using the intelligent tester.
- (b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

Result

Display (DTC output)	Proceed to
P0130, P2195 and/or P2196	A
No output	B

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

REPLACE HEATED OXYGEN SENSOR