

<b>DTC</b>	<b>P0136</b>	<b>OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2)</b>
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<b>DTC</b>	<b>P0156</b>	<b>OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 2 SENSOR 2)</b>
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## CIRCUIT DESCRIPTION

Refer to DTC P0130 on page 05-102.

DTC No.	DTC Detection Condition	Trouble Area
P0136 P0156	The following condition (a) or (b) continues for 500 seconds or more: (a) During driving with the engine warmed up, heated oxygen sensor output does not change (b) Heated oxygen sensor output is very low most of the time	<ul style="list-style-type: none"> <li>• Open or short in heated oxygen sensor circuit</li> <li>• Heated oxygen sensor (Bank 1, 2 Sensor 2)</li> <li>• Heated oxygen sensor heater (Bank 1, 2 Sensor 2)</li> <li>• EFI relay</li> </ul>

### 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 2 refers to the sensor farthest away from the engine body.

## MONITOR DESCRIPTION

The heated oxygen sensor generates waveform of the voltage between 0 V and 1 V in response to the oxygen concentration in the exhaust gases. When the output voltage of the heated oxygen 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.

If the rear heated oxygen sensor output does not change between RICH and LEAN during "Stop and GO" driving, the ECM interprets this as malfunction in the sensor and sets a DTC. Also, if the sensor output remains at less than 0.05 V for more than 126 seconds (when ECM monitored the sensor for 210 seconds while the air-fuel feedback is being performed), the ECM will interpret this as a fault. In either case, the ECM will turn on the MIL and set a DTC.

## MONITOR STRATEGY

Related DTCs	P0136: Heated oxygen sensor (Bank 1 Sensor 2) output voltage (Crack) P0136: Heated oxygen sensor (Bank 1 Sensor 2) output voltage P0156: Heated oxygen sensor (Bank 2 Sensor 2) output voltage (Crack) P0156: Heated oxygen sensor (Bank 2 Sensor 2) output voltage
Required sensors/ components (Main)	Heated oxygen sensor (Sensor 2)
Required sensors/ components (Related)	Mass air flow meter, vehicle speed sensor
Frequency of operation	Once per drive cycles
Duration	300 seconds
MIL operation	2 driving cycles
Sequence operation	None

## TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05-13
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### Case 1 (Output voltage (crack)):

Vehicle speed	2 mph (3 km/h) or more
Idle	OFF
Fuel cut	OFF
Time after fuel cut from ON to OFF	20 seconds
Intake air amount per revolution	0.7 g/rev or more

### Case 2 (Output voltage):

All of the following conditions are met:	A, B, C and D
A. Pass/fail detection in this driving cycle	Not detected
B. Engine	Running
C. Time after engine start	0 second or more
D. Either of the following conditions is met:	(a) or (b)
(a) Cumulative time while heated oxygen sensor heater is ON	22 seconds or more
(b) At once more heated oxygen sensor voltage	0.2 V or more

## TYPICAL MALFUNCTION THRESHOLDS

### Case 1 (Output voltage (crack)):

Following conditions are met:	A, B and C
A. Cumulative heated oxygen sensor monitor time	300 seconds or more
B. Time while heated oxygen sensor voltage is less than 0.05V	180 seconds or more
C. Maximum heated oxygen sensor rich time (0.45V or more)	Less than 20 seconds

### Case 2 (Output voltage):

Number of heated oxygen sensor voltage "switching"	0 times or less
"Switching" is counted when the sensor signal alternates the minimum or maximum voltage	-
Minimum voltage	Less than 0.4 V
Maximum voltage	0.5 V or more

## COMPONENT OPERATING RANGE

Heated oxygen sensor voltage	0 to 1 V
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## O2S TEST RESULT

Refer to page 05-19 for detailed information.

### Rear O2S voltage monitor

If the O2S sensor voltage is out of the standard value, the ECM interprets this as a malfunction.

TEST ID	Description of TEST DATA	Conversion Factor	Unit
\$07	The minimum voltage	N/A	V
\$08	The maximum voltage	N/A	V
\$31	Time to change from Lean (less than 0.4 V) to Rich (0.5 V or more)	N/A	second
\$32	Time to change from Rich (0.5 V or more) to Lean (less than 0.4 V)	N/A	second
\$37	Time from fuel cut occurs to sensor output drops to 0.2 V	N/A	second

**Rear O2S element monitor**

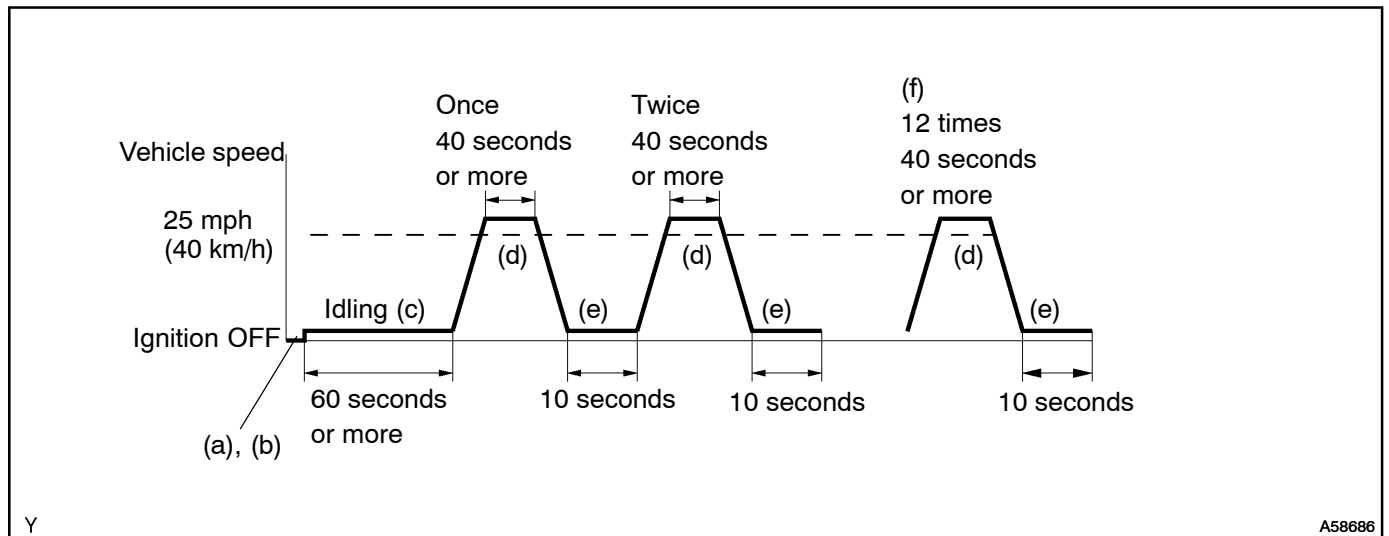
If all the values (\$81, \$84 \$85 and \$87) are out of the standard values, the ECM interprets this as a malfunction.

TEST ID	Description of TEST DATA	Conversion Factor	Unit
\$81	Percentage of monitoring time when the HO2S voltage is less than 0.05V	Multiply 0.3906	%
\$84	Percentage of monitoring time when the HO2S voltage is more than 0.7V	Multiply 0.3906	%
\$85	Time when the HO2S voltage is 0.45V or more	Multiply 0.2621	second
\$87	Percentage of monitoring time when the HO2S voltage is more than 0.45V	Multiply 0.3906	%

**WIRING DIAGRAM**

Refer to DTC P0130 on page 05-102.

**CONFIRMATION DRIVING PATTERN**



- (a) Connect the hand-held tester to the DLC3.
- (b) Switch the hand-held tester from normal mode to the check mode (see page 05-38).
- (c) Start the engine and let it idle for 60 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 10 seconds or more.
- (f) Perform steps (d) and (e) 12 times.

**HINT:**

If a malfunction exists, the MIL will be illuminated during step (f).

**NOTICE:**

**If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have a hand-held tester, turn the ignition switch to OFF after performing steps from (c) to (f), then perform steps (c) to (f) again.**

## INSPECTION PROCEDURE

HINT:

Hand-held tester only:

It is possible the malfunctioning area can be found using the ACTIVE TEST A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble areas are malfunctioning or not.

(a) Perform the ACTIVE TEST A/F CONTROL operation.

HINT:

The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.

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

**Result:**

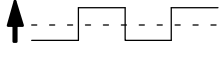
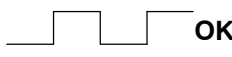
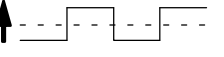

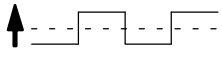
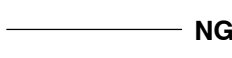
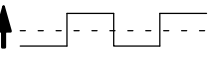
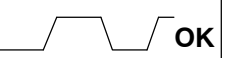
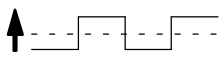

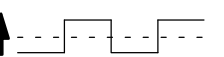

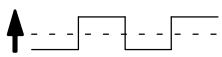
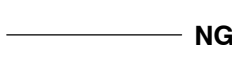
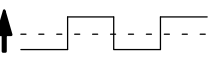
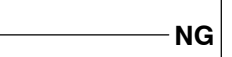
**Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:**

**+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)	Main suspect trouble area
Case 1	Injection volume +25 % ↑  -12.5 % Output voltage More than 0.5 V  <b>OK</b> Less than 0.4V	Injection volume +25 % ↑  -12.5 % Output voltage More than 0.5 V  <b>OK</b> Less than 0.4V	—
Case 2	Injection volume +25 % ↑  -12.5 % Output voltage Almost no reaction  <b>NG</b>	Injection volume +25 % ↑  -12.5 % Output voltage More than 0.5 V  <b>OK</b> 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 0.5 V  <b>OK</b> Less than 0.4V	Injection volume +25 % ↑  -12.5 % Output voltage Almost no reaction  <b>NG</b>	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 % ↑  -12.5 % Output voltage Almost no reaction  <b>NG</b>	Injection volume +25 % ↑  -12.5 % Output voltage Almost no reaction  <b>NG</b>	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 sensor.

To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, then select "O2S B1S1 and O2S B1S2" or "O2S B2S1 and O2S B2S2" by pressing the "YES" button followed by the "ENTER" button and then the "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 illuminates.**

**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, freeze frame data can help determine if the vehicle was running or stopped, 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 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.

<b>1</b>	<b>CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P0136 AND/OR P0156)</b>
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- Connect the hand-held tester or the OBD II scan tool to the DLC3.
- Turn the ignition switch to ON and turn the hand-held tester or the OBD II scan tool ON.
- Select the item: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read the DTCs.

**Result:**

Display (DTC output)	Proceed to
P0136 and/or P0156	A
P0136 or P0156 and other DTCs	B

**HINT:**

If any other codes besides P0136 and/or P0156 are output, perform troubleshooting for those DTCs first.

**B**

**GO TO RELEVANT DTC CHART**  
(See page 05-47)

**A**

<b>2</b>	<b>READ VALUE OF HAND-HELD TESTER OR OBD II SCAN TOOL(OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)</b>
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- Connect the hand-held tester or the OBD II scan tool to the DLC3.
- Start the engine and turn the hand-held tester or the OBD II scan tool ON.
- Select the item: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- After warming up the engine, run the engine at 2,500 rpm for 3 minutes.
- Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

**HINT:**

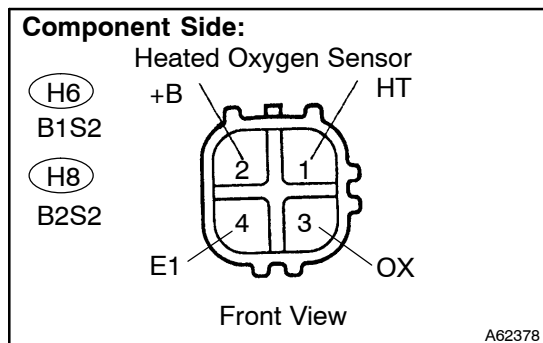
Quickly accelerate the engine to 4,000 rpm 3 times by using the accelerator pedal.

**Heated oxygen sensor output voltage: Alternates from 0.4 V or less to 0.5 V or more.**

OK

Go to step 6

NG

**3 INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)**

- Disconnect the H6 or H8 heated oxygen sensor connector.
- Measure the resistance between the terminals of the heated oxygen sensor connector.

**Standard (Bank 1, 2 sensor 2):**

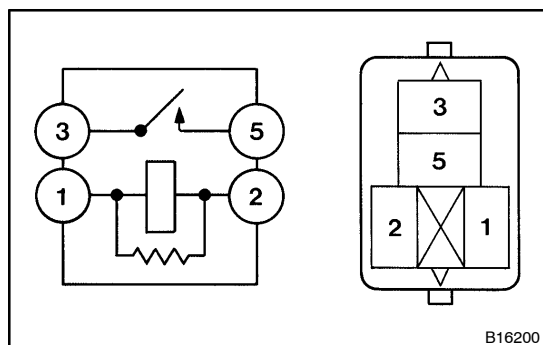
Tester Connection	Specified Condition
1 (HT) - 2 (+B)	11 to 16 $\Omega$ at 20 °C (68 °F)
1 (HT) - 4 (E1)	10 k $\Omega$ or higher

- Reconnect the heated oxygen sensor connector.

NG

**REPLACE HEATED OXYGEN SENSOR**

OK

**4 INSPECT EFI RELAY**

- Remove the EFI relay from the engine room R/B.
- Check for continuity in the EFI relay.

**Standard:**

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

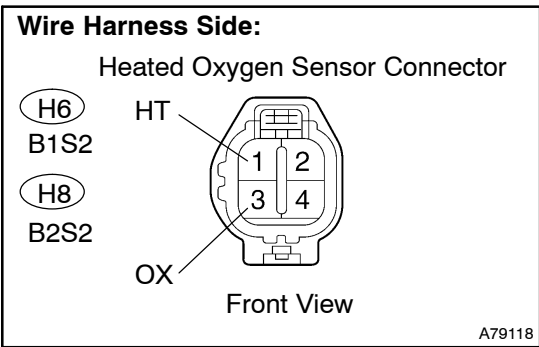
- Reinstall the EFI relay.

NG

**REPLACE EFI RELAY**

OK

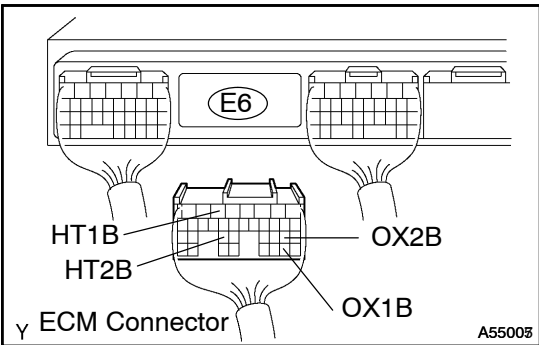
**5 CHECK HARNESS AND CONNECTOR(HEATED OXYGEN SENSOR - ECM)**



- (a) Disconnect the H6 or H8 heated oxygen sensor connector.
- (b) Disconnect the E6 ECM connector.
- (c) Check the resistance between the wire harness side connectors.

**Standard (Check for open):**

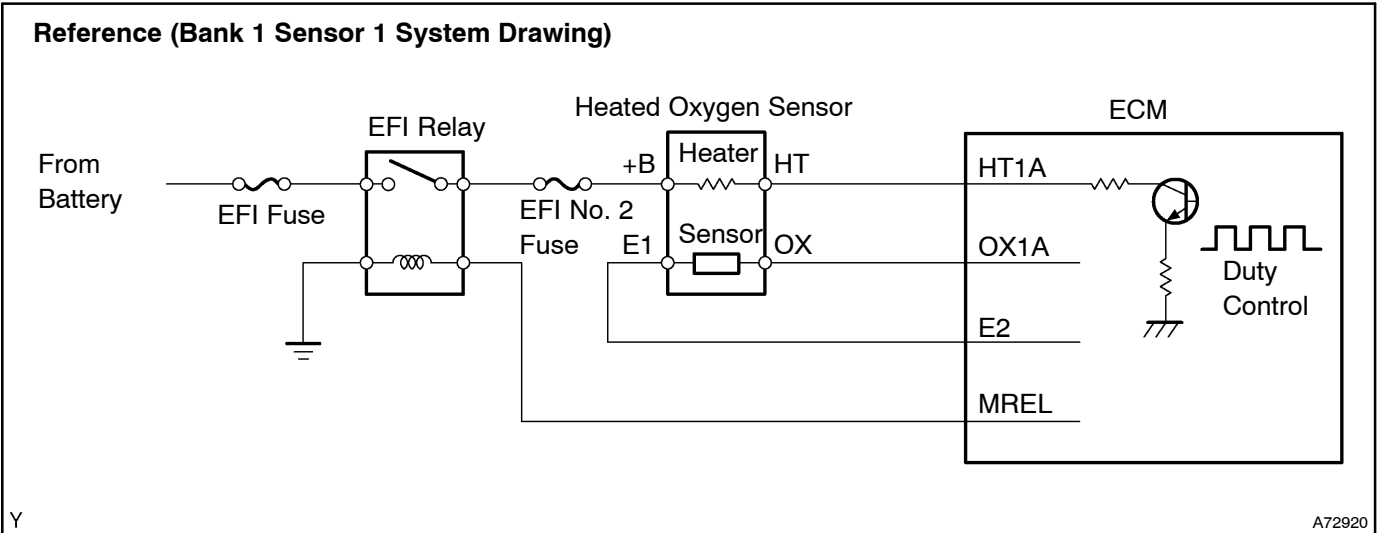
Tester Connection	Specified Condition
OX (H6-3) - OX1B (E6-29)	Below 1 Ω
HT (H6-1) - HT1B (E6-5)	
OX (H8-3) - OX2B (E6-21)	
HT (H8-1) - HT2B (E6-25)	



**Standard (Check for short):**

Tester Connection	Specified Condition
OX (H6-3) or OX1B (E6-29) - Body ground	10 kΩ or higher
HT (H6-1) or HT1B (E6-5) - Body ground	
OX (H8-3) or OX2B (E6-21) - Body ground	
HT (H8-1) or HT2B (E6-25) - Body ground	

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



**NG** → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

**OK**

**REPLACE HEATED OXYGEN SENSOR**

**6 PERFORM CONFIRMATION DRIVING PATTERN**

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

**GO**

**7 | READ OUTPUT DTC(SEE IF DTC P0136 AND/OR P0156 ARE OUTPUT AGAIN)**

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

**Result:**

Display (DTC output)	Proceed to
No output	A
P0136 and/or P0156	B

**B** → **REPLACE HEATED OXYGEN SENSOR**

**A**

**CHECK FOR INTERMITTENT PROBLEMS (See page 05-10)**