

<b>DTC</b>	<b>P0133</b>	<b>OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 1)</b>
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### CIRCUIT DESCRIPTION

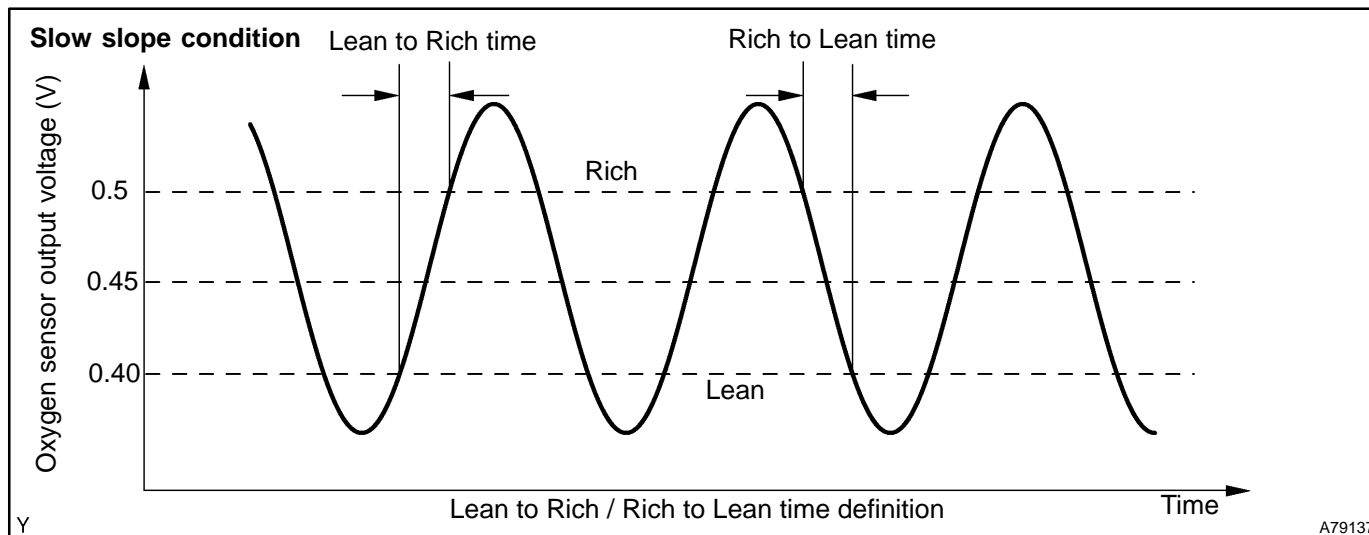
Refer to DTC P0130 on page 05-96.

DTC No.	DTC Detection Condition	Trouble Area
P0133	After engine has been warmed up, if response time that heated oxygen sensor's output voltage reaches from RICH to LEAN, or from LEAN to RICH, is 0.6 sec or more during idling (2 trip detection logic)	<ul style="list-style-type: none"> <li>• Open or short in heated oxygen sensor (bank 1 sensor 1) circuit</li> <li>• Heated oxygen sensor (bank 1 sensor 1)</li> <li>• Heated oxygen sensor heater (bank 1 sensor 1)</li> <li>• EFI relay</li> <li>• Air induction system</li> <li>• Fuel pressure</li> <li>• Injector</li> <li>• ECM</li> </ul>
	If response time of heated oxygen sensor's output voltage in one RICH-LEAN cycle is 9 sec or more (M/T vehicle: 5.5 sec or more) during idling (2 trip detection logic)	

**HINT:**

Sensor 1 refers to the sensor closest to the engine body.

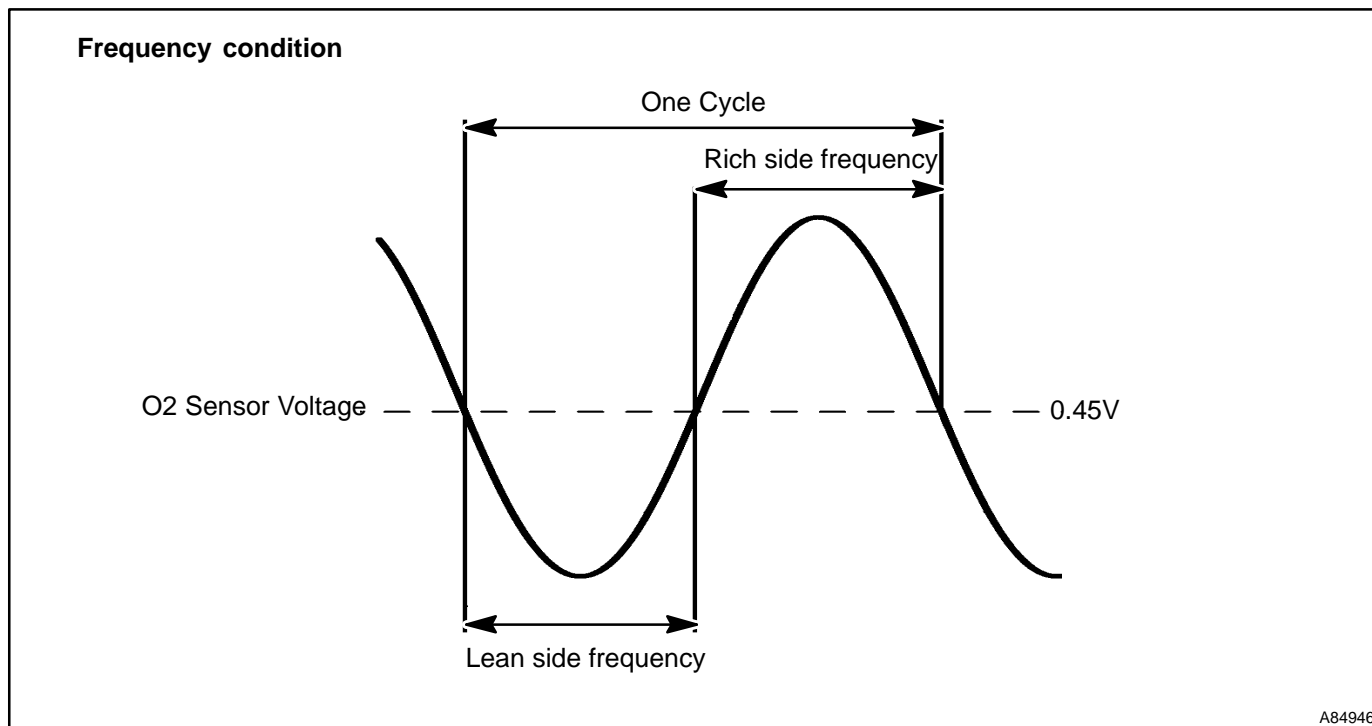
### MONITOR DESCRIPTION



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 waveforms of a voltage between 0 V and 1 V in response to the oxygen concentration in the 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.

The ECM monitors the response feature of the heated oxygen sensor. If the response time of the sensor output status change from RICH to LEAN or vice versa becomes longer, the ECM interprets this as malfunction in the heated oxygen sensor and sets a DTC.



## MONITOR STRATEGY

Related DTCs	P0133	Front heated oxygen sensor response monitor
Required sensors/components	Main sensors	Front heated oxygen sensor
	Related sensors	Crank position sensor, vehicle speed sensor, mass air flow meter
Frequency of operation	Once per drive cycles	
Duration	Within 60 sec.	
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)	
<b>Frequency idle condition:</b>		
There is history that the following conditions were met for 20 seconds	(a) and (b)	
(a) Vehicle speed	25 mph (40 km/h)	—
(b) Engine speed	900 rpm	—
Time after engine start	120 seconds	—
Idle	ON	
Vehicle speed		5 km/h (3 mph)
Fuel system status	Closed loop	
Engine coolant temperature	40 °C (104 °F)	—
Secondary air system	Not operating	
<b>Frequency cruise condition:</b>		
There is history that the following conditions were met for 20 seconds	(a) and (b)	
(a) Vehicle speed	25 mph (40 km/h)	—
(b) Engine speed	900 rpm	—
Time after engine start	120 sec	—

Idle	OFF	
Intake air amount	4.2 g/s	20 g/s
Fuel system status	Closed loop	
Engine speed	1000 rpm	3500 rpm
Engine coolant temperature	70 °C (158 °F)	–
Secondary air system	Not operating	
<b>Slow slope condition:</b>		
There is history that the following conditions were met for 20 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	
Vehicle speed		5 km/h (3 mph)
Fuel system status	Closed loop	
Engine coolant temperature	40 °C (104 °F)	–

## TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
<b>Frequency idle condition:</b>	
Time required by the sensor's output voltage to change in one RICH–LEAN cycle	9 sec or more
<b>Frequency cruise condition:</b>	
Time required by the sensor's output voltage to change in one RICH–LEAN cycle	a specific time or more
<b>Slow slope condition:</b>	
Time that sensor's output voltage changes from 0.4 to 0.55 V, or from 0.55 to 0.4 V	0.9 sec or more

## COMPONENT OPERATING RANGE

Parameter	Standard Value
Voltage output from heated oxygen sensor	Quickly fluctuates between 0.4 and 0.55 V

## WIRING DIAGRAM

Refer to DTC P0130 on page [05–96](#).

## 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:**

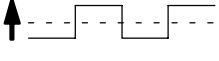

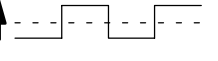
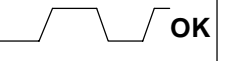
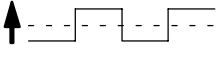

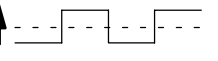
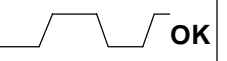
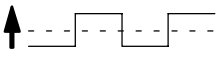

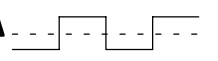

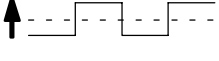
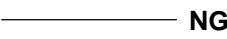
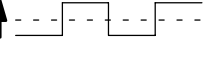
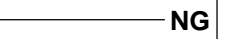
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

+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  <b>OK</b>	Injection volume +25 % ↑ -12.5 %  Output voltage More than 0.5 V Less than 0.4V  <b>OK</b>	—
Case 2	Injection volume +25 % ↑ -12.5 %  Output voltage No reaction  <b>NG</b>	Injection volume +25 % ↑ -12.5 %  Output voltage More than 0.5 V Less than 0.4V  <b>OK</b>	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  <b>OK</b>	Injection volume +25 % ↑ -12.5 %  Output voltage No reaction  <b>NG</b>	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 % ↑ -12.5 %  Output voltage No reaction  <b>NG</b>	Injection volume +25 % ↑ -12.5 %  Output voltage 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 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 DTC P0133 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 DTC P0133)**

- 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 DTCs using the hand-held tester or the OBD II scan tool.

**Result:**

Display (DTC output)	Proceed to
Only "P0133" is output	A
"P0133" and other DTCs are output	B

**HINT:**

If any other codes besides "P0133" is output, perform the troubleshooting for those DTCs first.

**B** **GO TO RELEVANT DTC CHART**  
(See page 05-34)

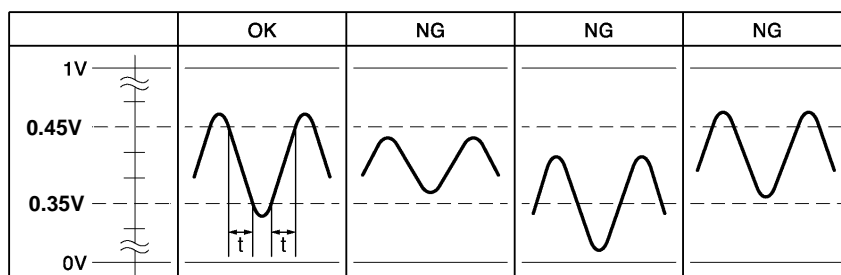
**A**

**2 READ VALUE OF HAND-HELD TESTER OR OBD II SCAN TOOL(HEATED OXYGEN SENSOR DURING IDLING)**

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

**Heated oxygen sensor output voltage:**

**Alternates between less than 0.35 V and more than 0.45 V, and period of "t" must exist less than 0.9 seconds (See the following table).**



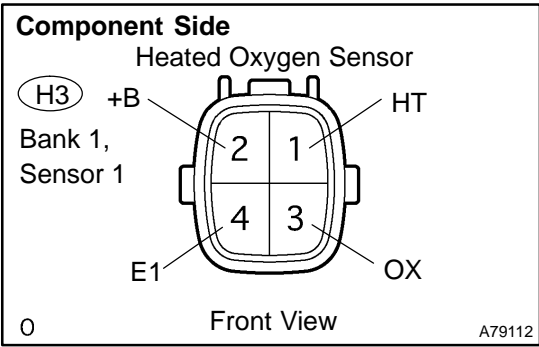
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**OK** **Go to step 9**

**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:**

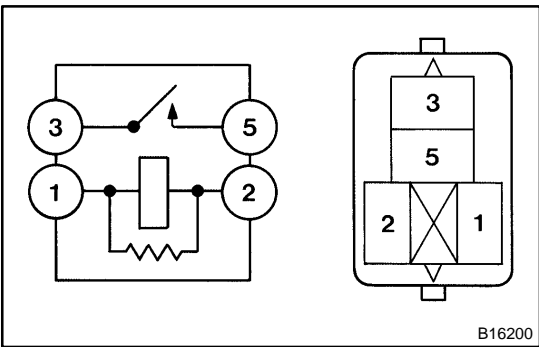
Tester Connection	Specified Condition
HT (H3-1) - +B (H3-2)	11 to 16 Ω at 20 °C (68 °F)
HT (H3-1) - E1 (H3-4)	10 kΩ or higher

- (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:**

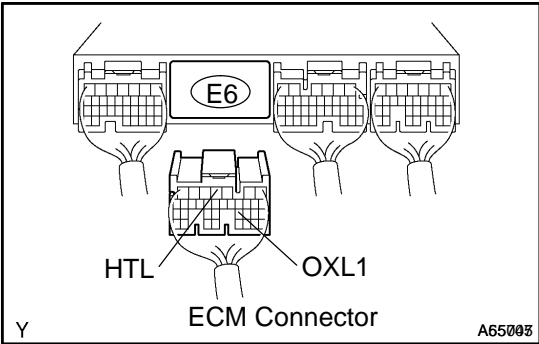
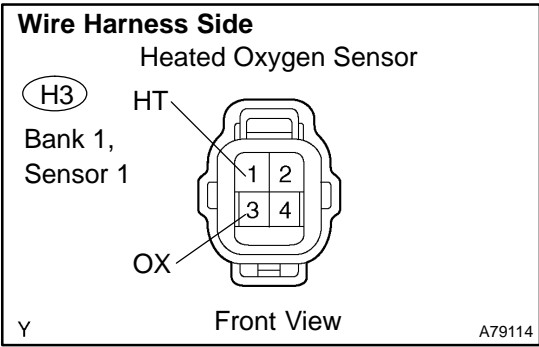
Tester Connection	Specified Condition
1 - 2	Continuity
3 - 5	No continuity
	Continuity (Apply battery voltage to terminals 1 and 2)

- (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.

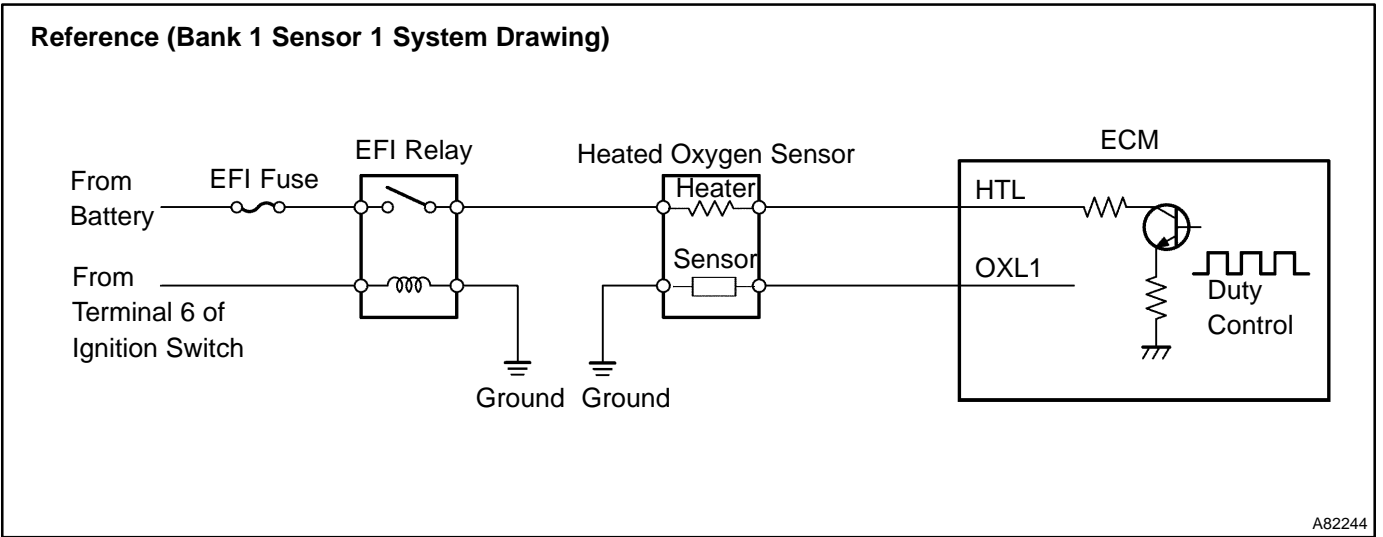
**Standard (Check for open):**

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 pae 11-7)**

**NG** → **REPLACE FUEL INJECTOR ASSY**

**OK**

**REPLACE HEATED OXYGEN SENSOR**

**9 PERFORM CONFIRMATION DRIVING PATTERN (See page 05-96)**

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

**GO**

**10 READ OUTPUT DTC(DTC P0133 IS 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
"P0133" is output again	A
"P0133" is not output again	B

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

**A**

**REPLACE HEATED OXYGEN SENSOR**