DTC	P0133	OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 1)

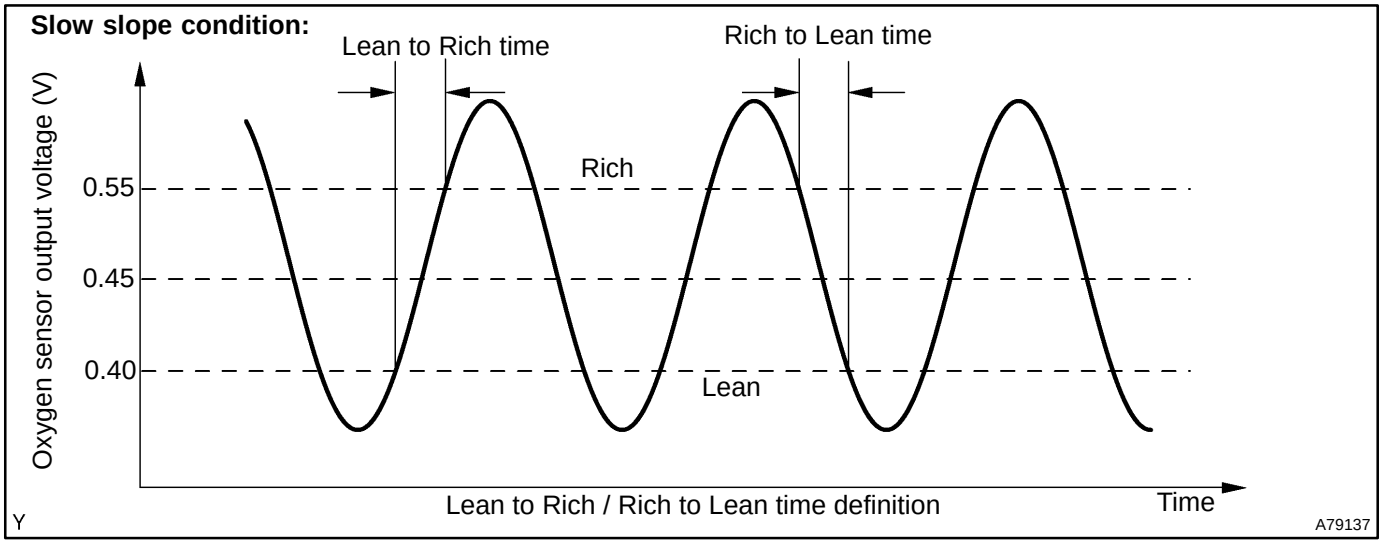
CIRCUIT DESCRIPTION

Refer to DTC P0130 on page 05–101.

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 second or more during idling. (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 •
	If response time of heated oxygen sensor's output voltage in one RICH–LEAN cycle is 6 seconds or more during idling. (2 trip detection logic)	

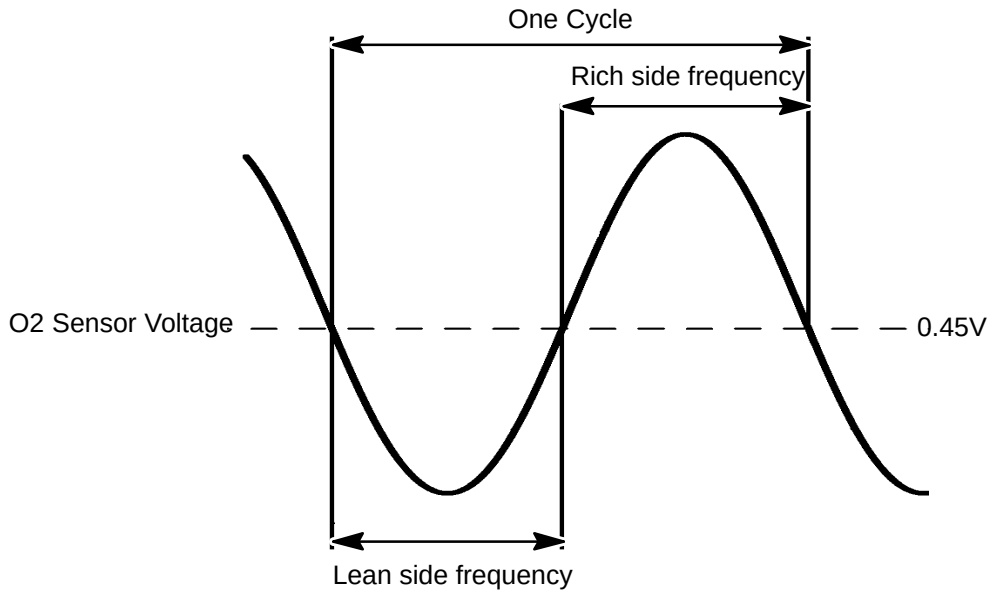
HINT:
Sensor 1 refers to the sensor closest to the engine assembly.

MONITOR DESCRIPTION



The engine control module (ECM) uses the heated 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 the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of the 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 waveform of a voltage between 0 V and 1 V in response to the oxygen concentration in exhaust gas. 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.
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 a malfunction in the heated oxygen sensor and sets a DTC.

Frequency condition:



MONITOR STRATEGY

Related DTCs	P0133	Front heated oxygen sensor response monitor
Required sensors/components	Main sensors	Front heated oxygen sensor
	Related sensors	Crank shaft position sensor, vehicle speed sensor, mass air flow sensor
Frequency of operation	Once per drive cycles	
Duration	Within 60 seconds	
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)	
Frequency idle condition:		
There is a history that the following condition (a) and (b) were met for 20seconds		
(a) Vehicle speed	25 mph (40 km/h)	–
(b) Engine speed	900 rpm	–
Time after engine start	120 seconds	–
Idle	ON	
Vehicle speed	–	3 mph (5 km/h)
Fuel system status	Closed loop	
Engine coolant temperature	40°C (104°F)	–
Frequency cruise condition:		
There is a history that the following condition (a) and (b) were met for 20seconds		
(a) Vehicle speed	25 mph (40 km/h)	–
(b) Engine speed	900 rpm	–
Intake air amount	5 g/s	14.5 g/s
Time after engine start	120 sec	–
Idle	OFF	
Fuel system status	Closed loop	

Engine speed	1,000 rpm	3,500 rpm
Engine coolant temperature	70°C (104°F)	–
Slow slope condition:		
There is a history that the following condition (a) and (b) were met for 20seconds		
(a) Vehicle speed	25 mph (40 km/h)	–
(b) Engine speed	900 rpm	–
Time after engine start	120 seconds	–
Idle	ON	
Vehicle speed	–	3 mph (5 km/h)
Fuel system status	Closed loop	
Engine coolant temperature	40°C (104°F)	–

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
Frequency idle condition	
Time required by the voltage output to change in one cycle	w/ AT: 6 sec or more w/ MT: 5.5 sec or more
Frequency cruise condition	
Time required by the voltage output to change in one cycle	a specific time or more
Slow slope condition	
Time that output voltage of front heated oxygen sensor increase from 0.4V to 0.55V and drops from 0.55V to 0.4V	0.6 seconds or more

COMPONENT OPERATING RANGE

Parameter	Standard Value
Voltage output of the front heated oxygen sensor fluctuates between 0.40 V and 0.5 V in an instant.	

WIRING DIAGRAM

Refer to DTC P0130 on page 05–101.

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

(a) Perform ACTIVE TEST using the 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 0.4V **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 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 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 (0.5 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 DTC P0133)

(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 DTCs using the hand–held tester or the OBD II scan tool.
Result:

Display (DTC output)	Proceed to
P0133	A
P0133 and other DTCs	B

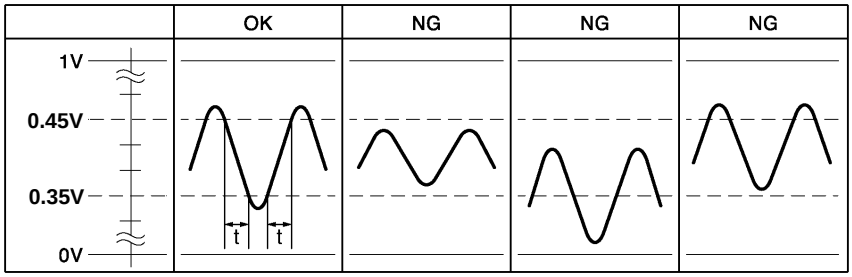
HINT:
If any other codes besides P0133 are output, perform the troubleshooting for those DTCs first.

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

A

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

(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 0.35 V and more than 0.45 V, and period of ”t” must exist less than 0.6 sec. (See the following table).



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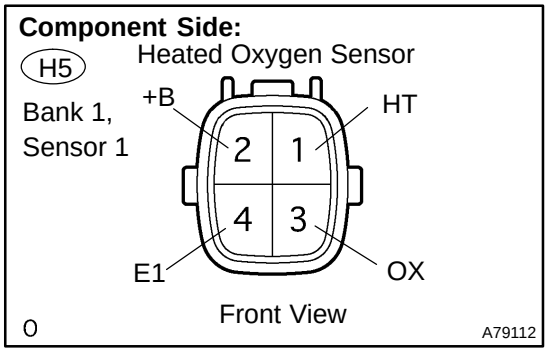
OK → **Go to step 9**

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:

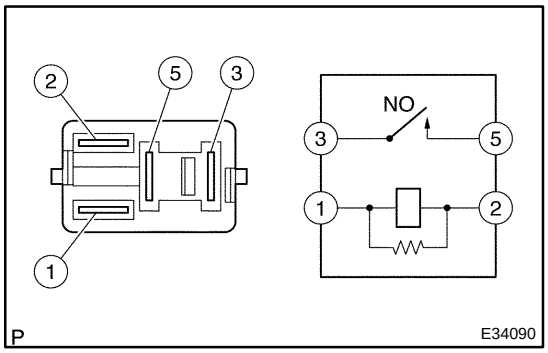
Tester Connection	Specified Condition
HT (H5–1) – +B (H5–2)	5 to 10 Ω at 20 °C (68 °F)
HT (H5–1) – E1 (H5–4)	10 kΩ or higher

(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.

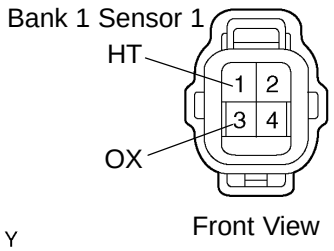
NG → **REPLACE EFI RELAY**

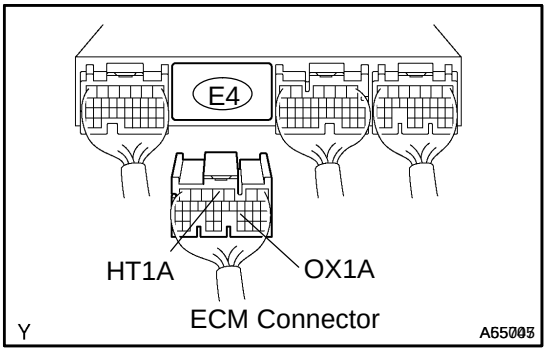
OK

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

Wire Harness Side:

H5 Heated Oxygen Sensor Connector





(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)	

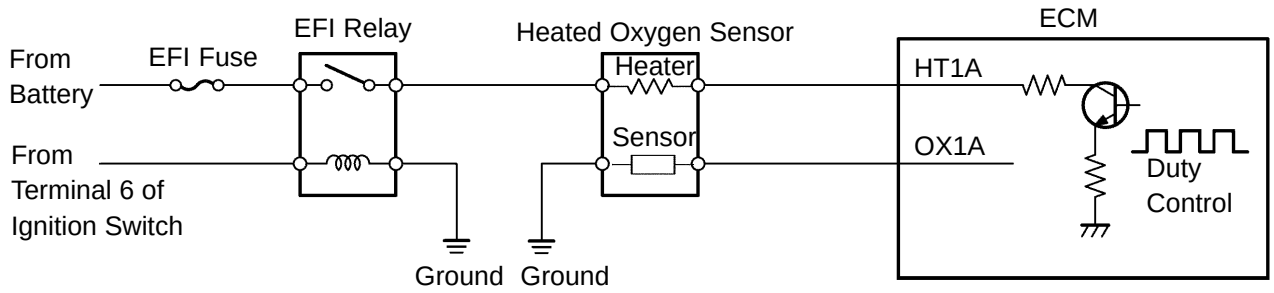
Standard (Check for short):

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 (See page 05–101)

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

Display (DTC output)	Proceed to
P0133	A
No output	B

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

A

REPLACE HEATED OXYGEN SENSOR