

DTC	P0133	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 1)
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DTC	P0153	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 1)
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CIRCUIT DESCRIPTION

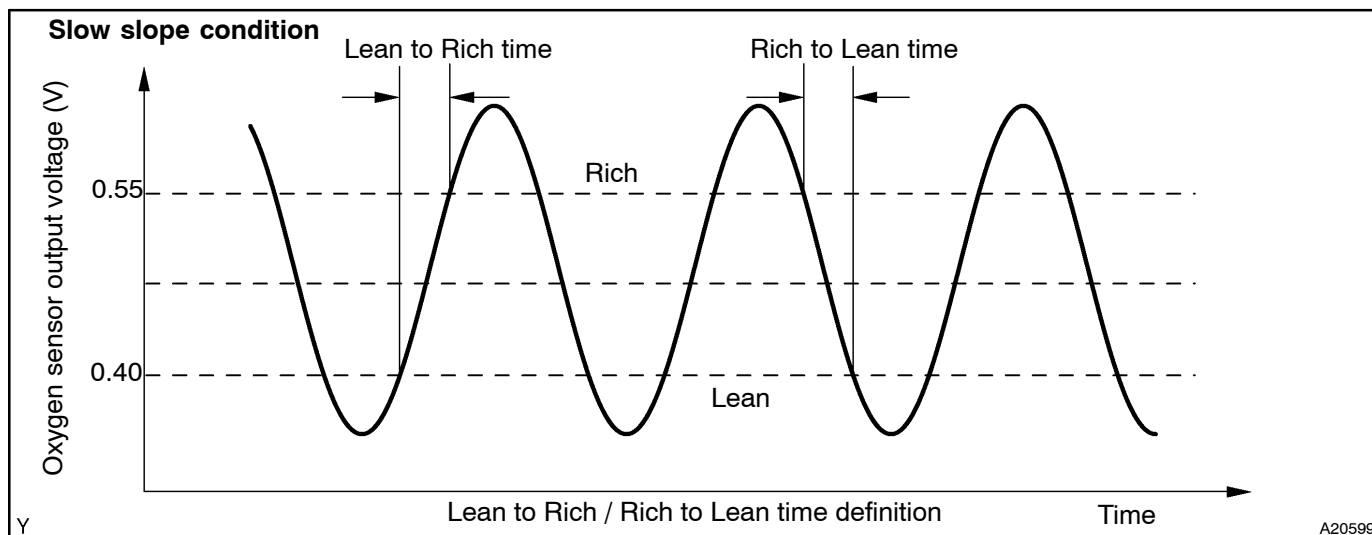
Refer to DTC P0031 on page [DI-49](#).

DTC No.	DTC Detecting Condition	Trouble Area
P0133 P0153	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 seconds or more during idling. (2 trip detection logic)	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Air induction system • Fuel pressure • Injector • ECM
	If response time of heated oxygen sensor's output voltage in one RICH-LEAN cycle is 5.6 seconds or more during idling. (2 trip detection logic)	

HINT:

- Bank 1 refers to bank that includes cylinder No. 1.
- Bank 2 refers to bank that does not includes cylinder No. 1.
- Sensor 1 refers to the sensor closer to the engine assembly.

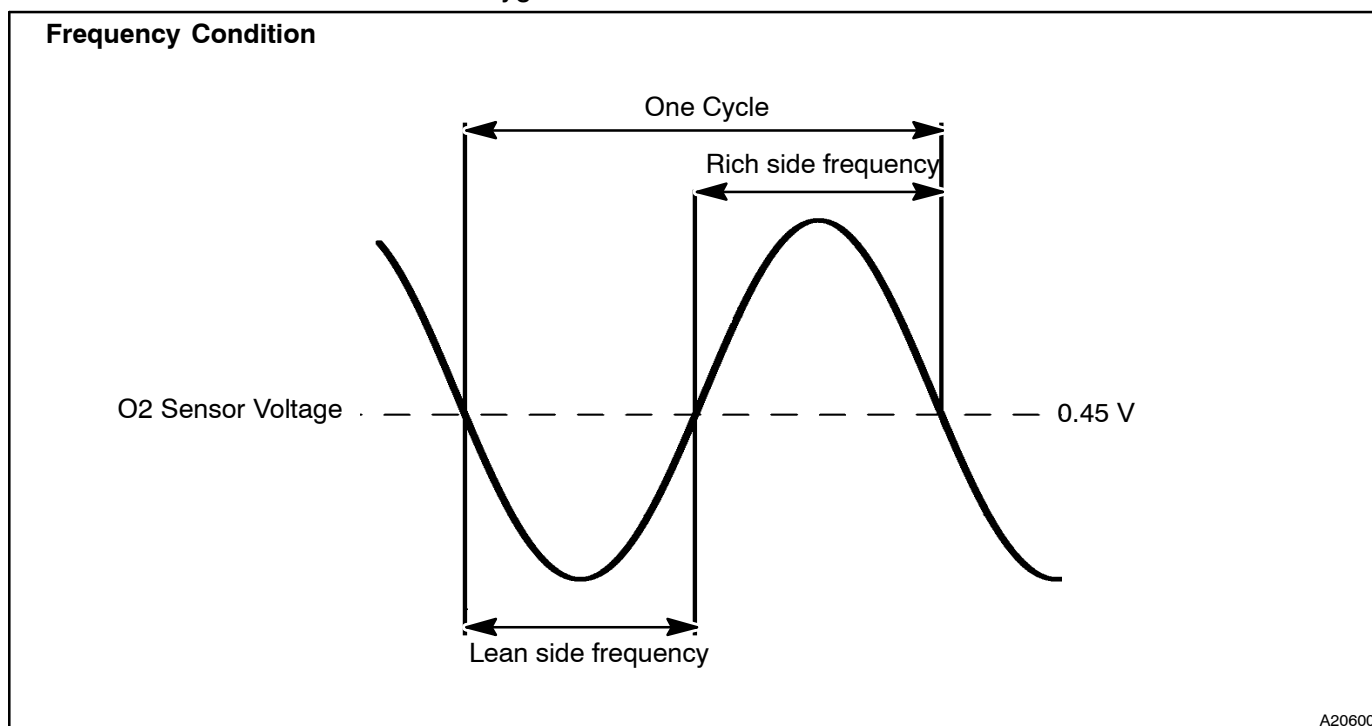
MONITOR DESCRIPTION



The 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 outside air. The outer surface of the sensor element is exposed to exhaust gas. 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 changes 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 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 heated oxygen 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.



MONITOR STRATEGY

Related DTCs	P0133	Front heated oxygen sensor response monitor (Bank 1)
	P0153	Front heated oxygen sensor response monitor (Bank 2)
Required sensors/components	Main sensors/components	Front heated oxygen sensor
	Related sensors/components	Crank position sensor, Vehicle speed sensor, Mass air flow meter
Frequency of operation	Once per drive cycle	
Duration	Within 60 sec.	
MIL operation	2 driving cycles	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever the following DTCs are not present	See "List of disable a monitor" (on page DI-3)	
Frequency idle condition:		
There is history that the following conditions were met for 20 sec.	A and B	
A. Vehicle speed	40 km/h (25 mph)	–
B. Engine speed	900 rpm	–
Idle	ON	
Vehicle speed	–	5 km/h (3 mph)
Fuel system status	Closed loop	
Time after engine start	120 sec.	–
Engine coolant temperature	40°C (104°F)	–
Frequency cruise condition:		
There is history that the following conditions were met for 20 sec.	A and B	
A. Vehicle speed	40 km/h (25 mph)	–
B. Engine speed	900 rpm	–
Intake air amount	3 g/sec.	13 g/sec.
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 (158°F)	–
Slow slope condition:		
Both of the following condition were met for 20 sec.	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
Frequency idle condition	
Time required by the sensor's output voltage to change in one RICH–LEAN cycle	5.6 sec. or more
Frequency cruise condition	
Time required by the sensor's output voltage to change in one RICH–LEAN cycle	a specific time or more
Slow slope condition	
Both of the following conditions were met	A and B
A. Number of judgment made	3 times
B. Following conditions were met	(a) or (b)
(a) Average lean to rich response time	0.9 sec. or more
(b) Average rich to lean response time	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

O2S TEST RESULT

Refer to page [DI-3](#) for detailed information.

Front HO2S slow slope monitor

If the HO2S sensor voltage is out of the standard value, the ECM interprets this as a malfunction.

TEST ID	Description of TEST DATA	Conversion Factor	Unit
\$03	(Test constant) Low sensor voltage for response time calculation	N/A	V
\$04	(Test constant) High sensor voltage for response time calculation	N/A	V

If the time required to change is out of the standard value, the ECM interprets this as a malfunction.

TEST ID	Description of TEST DATA	Conversion Factor	Unit
\$31	Time to change from Lean (≤ 0.4 V) to Rich (≥ 0.55 V)	N/A	sec.
\$32	Time to change from Rich (≥ 0.55 V) to Lean (≤ 0.4 V)	N/A	sec.

Front HO2S frequency monitor (idling)

If the \$38 is out of the standard value, the ECM interprets this as a malfunction.

TEST ID	Description of TEST DATA	Conversion Factor	Unit
\$38	Response time of heated oxygen sensor's output voltage in one RICH–LEAN cycle	N/A	sec.

Front HO2S frequency monitor (cruse)

If the \$90 is out of the standard value, the ECM interprets this as a malfunction.

TEST ID	Description of TEST DATA	Conversion Factor	Unit
\$90	Remained value of that average of switching frequency is subtracted from average of switching frequency threshold	Multiply by 0.04096 plus 5.2	sec.

WIRING DIAGRAM

Refer to DTC P0031 on page [DI-49](#).

INSPECTION PROCEDURE

HINT:

Hand-held tester only:

The narrowing down the trouble area is possible by performing ACTIVE TEST of the following "A/F CONTROL" (Heated oxygen sensor or another can be distinguished).

(a) Perform ACTIVE TEST by 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 with 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:

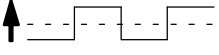
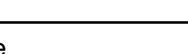
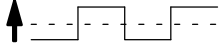
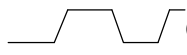
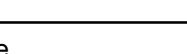
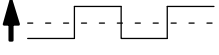
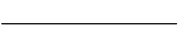
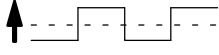
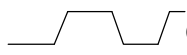
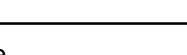
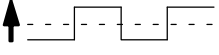
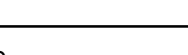
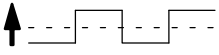
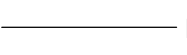
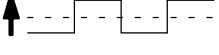
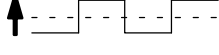
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume

+25 % → rich output: More than 0.5 V

-12.5 % → lean output: Less than 0.4 V

NOTICE:

However, there is a few second delay in the sensor 1 (front sensor) output. And there is about 20 seconds delay 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 Almost 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 Almost no reaction  NG	Sensor 2: rear sensor (sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 %  -12.5 %  Output voltage Almost no reaction  NG	Injection volume +25 %  -12.5 %  Output voltage Almost no reaction  NG	Extremely rich or lean of the 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 output of the heated oxygen sensors (sensor 1 and 2).

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 DTCs P0133 and/or P0153 will be recorded, and the MIL then comes on.

- If different DTCs related to different systems while terminal E2 as 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	Are there any other codes (besides DTC P0133 or P0153) being output?
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PREPARATION:

- (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 OBD II scan tool main switch ON.
- (c) When using hand-held tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

CHECK:

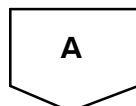
Read the DTC using the hand-held tester or the OBD II scan tool.

RESULT:

Display (DTC Output)	Proceed to
"P0133 and/or P0153"	A
"P0133 or P0153" and other DTCs	B

HINT:

If any other codes besides "P0133 and/or P0153" are output, perform the troubleshooting for those DTCs first.



2	Check output voltage of heated oxygen sensor during idling.
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PREPARATION:

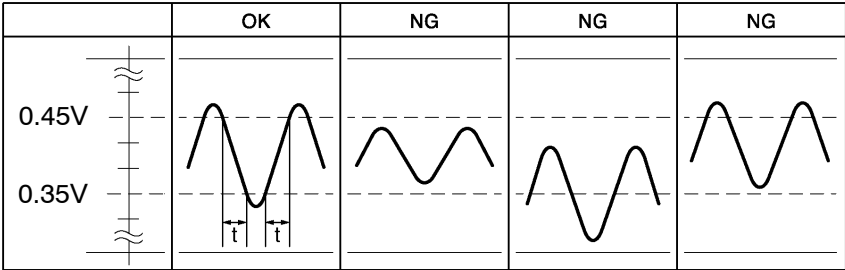
- (a) Warm up the heated oxygen sensor with the engine speed at 2,500 rpm for approximately 90 seconds.
- (b) Connect the hand-held tester or OBD II scan tool to the DLC3.
- (c) When using hand-held tester, enter the following menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1 S1 or B2 S1.

CHECK:

Check the output voltage of the heated oxygen sensor while idling the OBD II scan tool or hand-held tester.

OK:

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 seconds (See the following table).



A20315

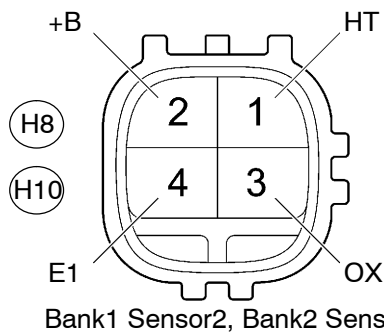
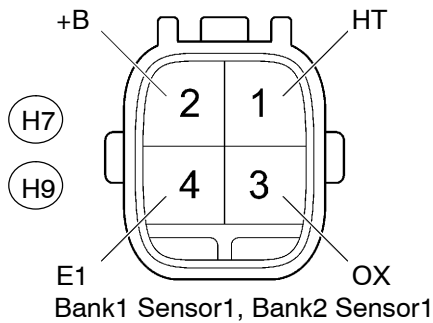
OK

Go to step 9.

NG

3 Check resistance of heated oxygen sensor heater.

Components Side:



C

A20870

PREPARATION:

Disconnect the H7, H8, H9 or H10 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

Tester Connection	Specified Condition
HT (H7-1) - +B (H7-2)	11 to 16 Ω (20°C)
HT (H8-1) - +B (H8-2)	11 to 16 Ω (20°C)
HT (H9-1) - +B (H9-2)	11 to 16 Ω (20°C)
HT (H10-1) - +B (H10-2)	11 to 16 Ω (20°C)

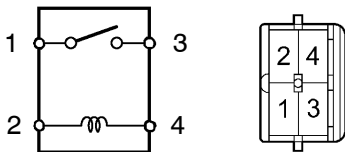
NG

Replace heated oxygen sensor.

OK

4 Check EFI or ECD relay.

EFI or ECD Relay



A21543

PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Inspect the EFI or ECD relay.

OK:

Terminal No.	Condition	Specified Condition
2 - 4	Constant	Continuity
1 - 3	Usually	No Continuity
	Apply B+ between terminals 2 and 4	Continuity

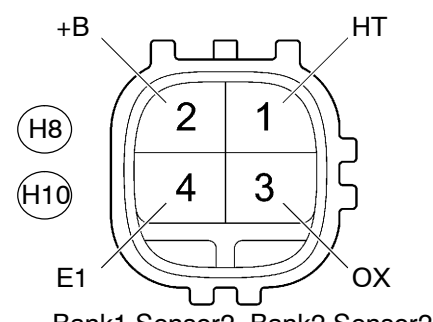
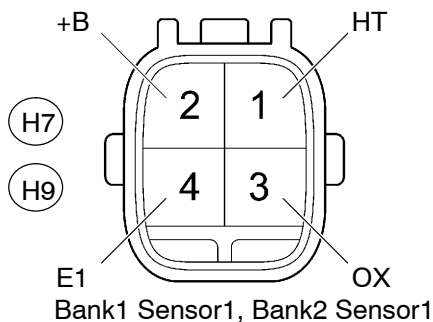
NG

Replace EFI or ECD relay.

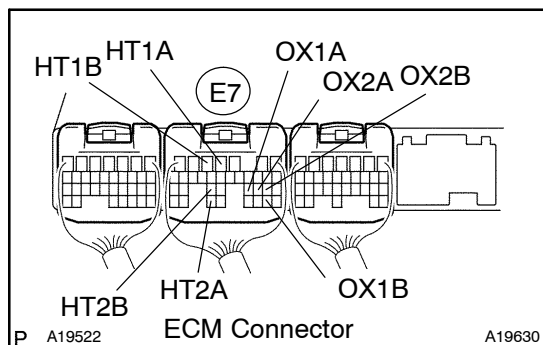
OK

5 Check for open and short in harness and connector between ECM and heated oxygen sensor.

Components Side:



C A20870



P A19522

A19630

PREPARATION:

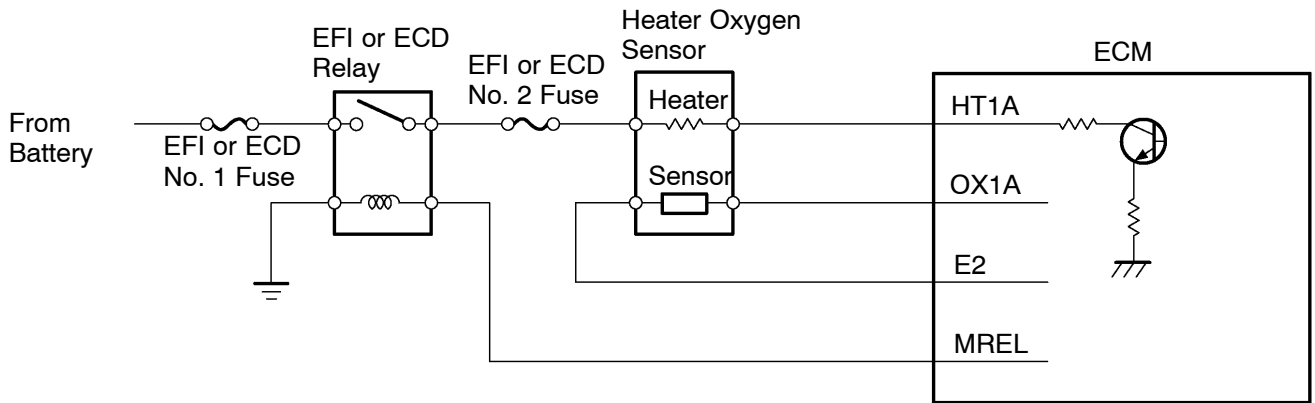
- Disconnect the H7, H8, H9 or H10 heated oxygen sensor connector.
- Disconnect the E7 ECM connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Tester Connection	Specified Condition
OX (H7-3) - OX1A (E7-23)	Below 1 Ω
HT (H7-1) - HT1A (E7-4)	Below 1 Ω
OX (H8-3) - OX1B (E7-29)	Below 1 Ω
HT (H8-1) - HT1B (E7-5)	Below 1 Ω
OX (H9-3) - OX2A (E7-22)	Below 1 Ω
HT (H9-1) - HT2A (E7-33)	Below 1 Ω
OX (H10-3) - OX2B (E7-21)	Below 1 Ω
HT (H10-1) - HT2B (E7-25)	Below 1 Ω
OX (H7-3) or OX1A (E7-23) - Body ground	10 k Ω or higher
HT (H7-1) or HT1A (E7-4) - Body ground	10 k Ω or higher
OX (H8-3) or OX1B (E7-29) - Body ground	10 k Ω or higher
HT (H8-1) or HT1B (E7-5) - Body ground	10 k Ω or higher
OX (H9-3) or OX2A (E7-22) - Body ground	10 k Ω or higher
HT (H9-1) or HT2A (E7-33) - Body ground	10 k Ω or higher
OX (H10-3) or OX2B (E7-21) - Body ground	10 k Ω or higher
HT (H10-1) or HT2B (E7-25) - Body ground	10 k Ω or higher

Reference (Bank 1 Sensor 1 System Drawing)

Y

A21040

NG**Repair or replace harness or connector.****OK****6****Check air induction system (See page [SF-1](#)).****CHECK:**

Check the air induction system for vacuum leaks.

NG**Repair or replace air induction system.****OK****7****Check fuel pressure (See page [SF-7](#)).****CHECK:**

Check the fuel pressure (high or low pressure).

NG**Check and repair fuel pump, pressure regulator, fuel pipe line and filter (See page [SF-1](#)).****OK**

8	Check injector injection (See page SF-24).
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NG

Replace injector.

OK

Replace heated oxygen sensor.

9	Perform confirmation driving pattern (See page DI-106).
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HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

Go

10	Is there DTC P0133 or P0153 being output again?
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NO

Check for intermittent problems
(See page [DI-3](#)).

YES

Replace heated oxygen sensor.