DTC	P0133	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 1)

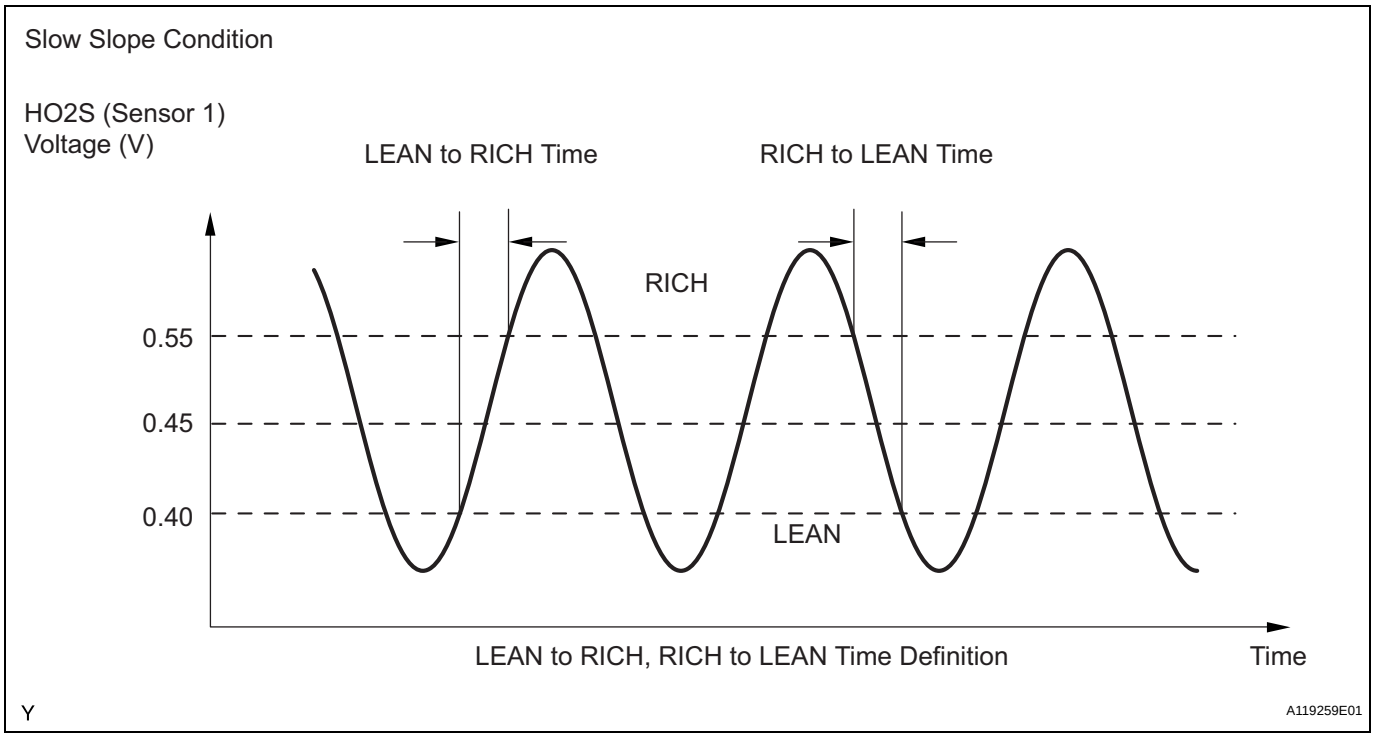
DESCRIPTION

HINT:
Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.
Refer to DTC P0130 (see page ES-110).

DTC No.	DTC Detection Condition	Trouble Area
P0133	• While idling with warm engine, response time for voltage output of Heated Oxygen (HO2) sensor to change from rich to lean or from lean to rich is 0.9 seconds or more (2 trip detection logic) • While idling, response time of HO2 sensor output voltage in 1 rich-lean cycle is 9 seconds or more (2 trip detection logic)	• Open or short in Heated Oxygen (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

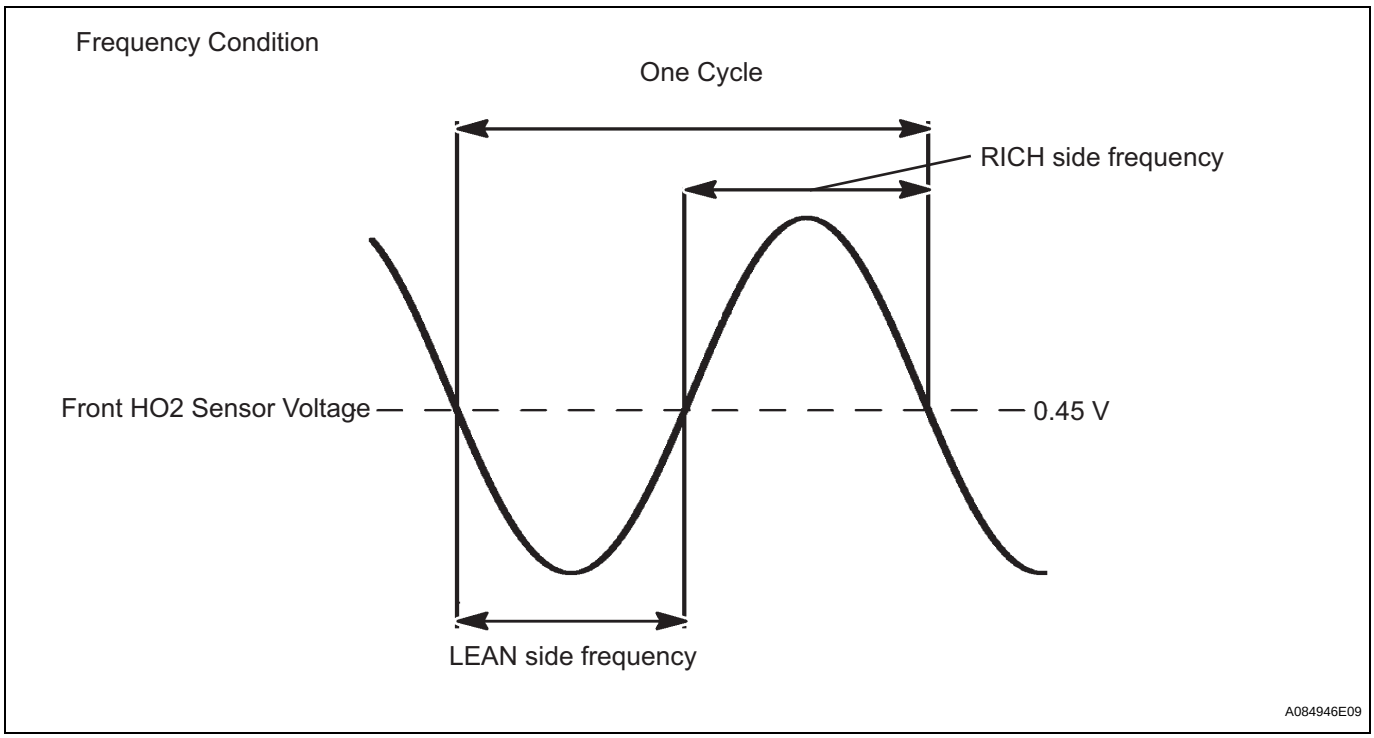
ES

MONITOR DESCRIPTION



The Heated Oxygen (HO2) sensor detects the oxygen levels in the exhaust gas and transmits this information to the ECM, which uses it to maintain the air-fuel ratio as close as possible to stoichiometric levels. This optimizes the three-way catalytic converter's ability to purify the exhaust gases.
The sensor element is made of platinum electrode and solid electrolyte (zirconia element), and includes an integrated heating element. The inner surface of the sensor element is exposed to the outside air and the outer surface is exposed to the exhaust gases.
The HO2 sensor generates a waveform voltage signal that oscillates between 0.1 V and 0.9 V in accordance with the oxygen concentration in the exhaust gas. The HO2 sensor has a characteristic whereby this output voltage changes dramatically in the vicinity of the stoichiometric air-fuel ratio.
When the output voltage of the HO2 sensor is 0.55 V or more, the ECM determines that the air-fuel ratio is rich. When it is 0.40 V or less, the ECM determines that the air-fuel ratio is lean.

The ECM also monitors the response of the HO2 sensor. If the response time of the output changes from rich to lean or vice versa becomes longer than preset thresholds, the ECM interprets this as a malfunction in the HO2 sensor, illuminates the MIL and sets the DTC (2 trip detection logic).



MONITOR STRATEGY

Related DTCs	P0133: Heated Oxygen (HO2) sensor (bank 1 sensor 1) responsibility P0133: HO2 sensor (bank 1 sensor 1) frequency at idle P0133: HO2 sensor (bank 1 sensor 1) frequency at driving
Required Sensors/Components (Main)	HO2 sensor (sensor 1)
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	60 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

HO2 sensor bank 1 sensor 1 responsibility

This monitor will run whenever these DTCs are 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)
Driving record for 20 seconds or more	40 km/h (25 mph) or more and 900 rpm or more
Time after engine start	120 seconds or more
Idle	ON
Fuel system	Closed loop

Vehicle speed	Less than 5 km/h (3 mph)
ECT	40°C (104°F) or more

HO2 sensor bank 1 sensor 1 frequency at idle

This monitor will run whenever these DTCs are 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)
Driving record for 20 seconds or more	40 km/h (25 mph) or more and 900 rpm or more
Time after engine start	120 seconds or more
Idle	ON
Fuel system	Closed loop
Vehicle speed	Less than 5 km/h (3 mph)
ECT	40°C (104°F) or more

HO2 sensor bank 1 sensor 1 frequency at driving

This monitor will run whenever these DTCs are 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)
Driving record for 20 seconds or more	40 km/h (25 mph) or more and 900 rpm or more
Time after engine start	120 seconds or more
Idle	OFF
MAF	4.2 to 20 g/sec.
Fuel system	Closed loop
Engine rpm	1,000 to 3,500 rpm
Fuel cut	OFF
ECT	70°C (158°F) or more

TYPICAL MALFUNCTION THRESHOLDS

HO2 sensor (bank 1 sensor 1) responsibility

Rich (0.55 V) to Lean (0.4 V) switch time	0.9 seconds or more
Lean (0.4 V) to Rich (0.55 V) switch time	0.9 seconds or more

HO2 sensor (bank 1 sensor 1) frequency at idle

HO2 sensor frequency in 1 period	9 seconds or more

HO2 sensor (bank 1 sensor 1) frequency at driving

HO2 sensor frequency in 1 period	Malfunction threshold or more

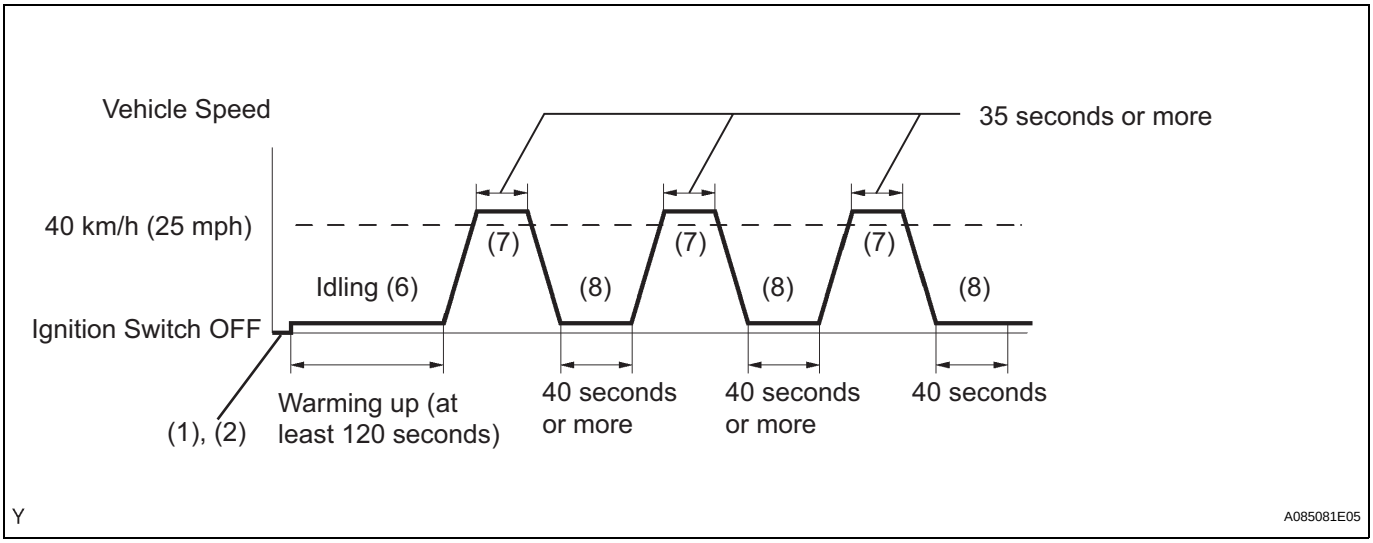
COMPONENT OPERATING RANGE

HO2 sensor voltage	Fluctuates for a second

MONITOR RESULT

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

CONFIRMATION DRIVING PATTERN



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).
(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.

WIRING DIAGRAM

Refer to DTC P0130 (see page ES-113).

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.

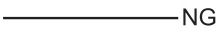
3. Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
4. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage output 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 Volumes	Status	Voltages
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

ES

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.

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%		• 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%		• 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%		• 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; then press the YES button and ENTER button followed by the F4 button.

NOTICE:

If the vehicle is short of fuel, the air-fuel ratio becomes lean and 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.

ES

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0133)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read DTCs.

Result

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

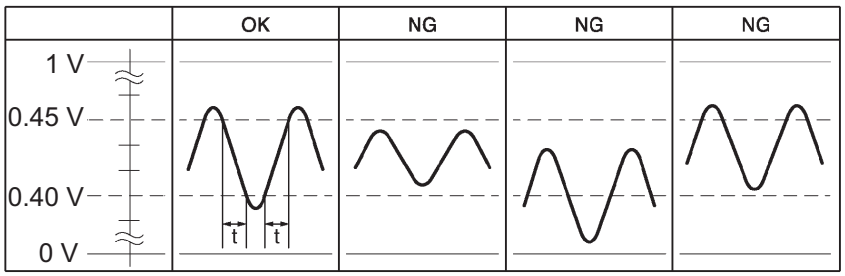
HINT:
If any DTCs other than P0133 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2	READ VALUE OF INTELLIGENT TESTER (HEATED OXYGEN SENSOR DURING IDLING)

(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:
Fluctuates between less than 0.40 V and more than 0.45 V, and period "t" must be less than 0.6 seconds (refer to table below).

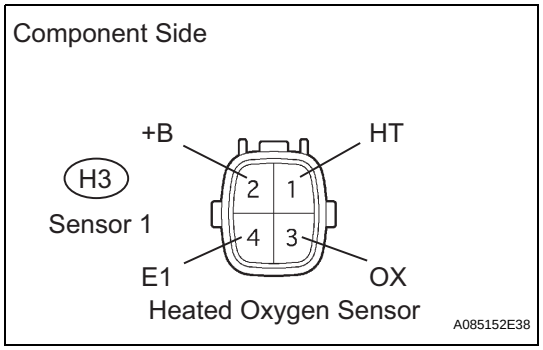


OK → **Go to step 9**

NG

ES

3 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H3 HO2 sensor connector.
(b) Measure the resistance between the terminals of the HO2 sensor connector.
Standard resistance

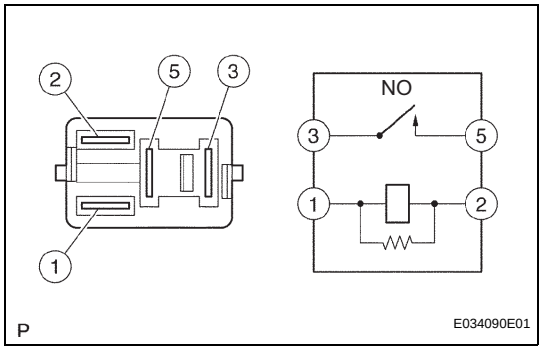
Tester Connection	Specified Condition
HT (H3-1) - +B (H3-2)	11 to 16 Ω at 20°C (68°F)
HT (H3-1) - E1 (H3-4)	10 kΩ or higher

(c) Reconnect the HO2 sensor connector.

NG → **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

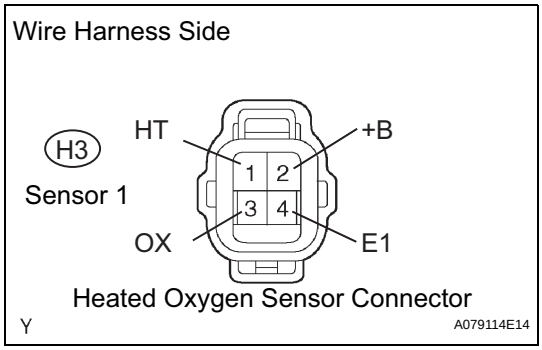
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (When battery voltage applied to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → **REPLACE EFI RELAY**

OK

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

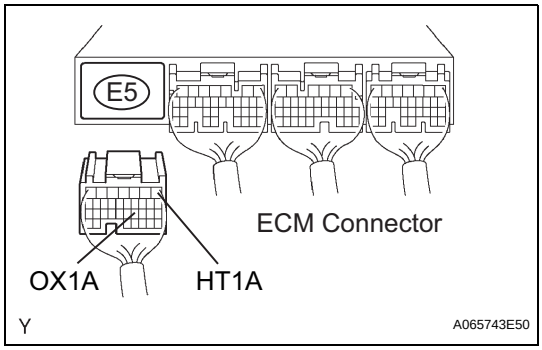


(a) Disconnect the H3 HO2 sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the +B terminal of the H3 HO2 sensor connector and body ground.

Standard voltage

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

(d) Turn the ignition switch OFF.



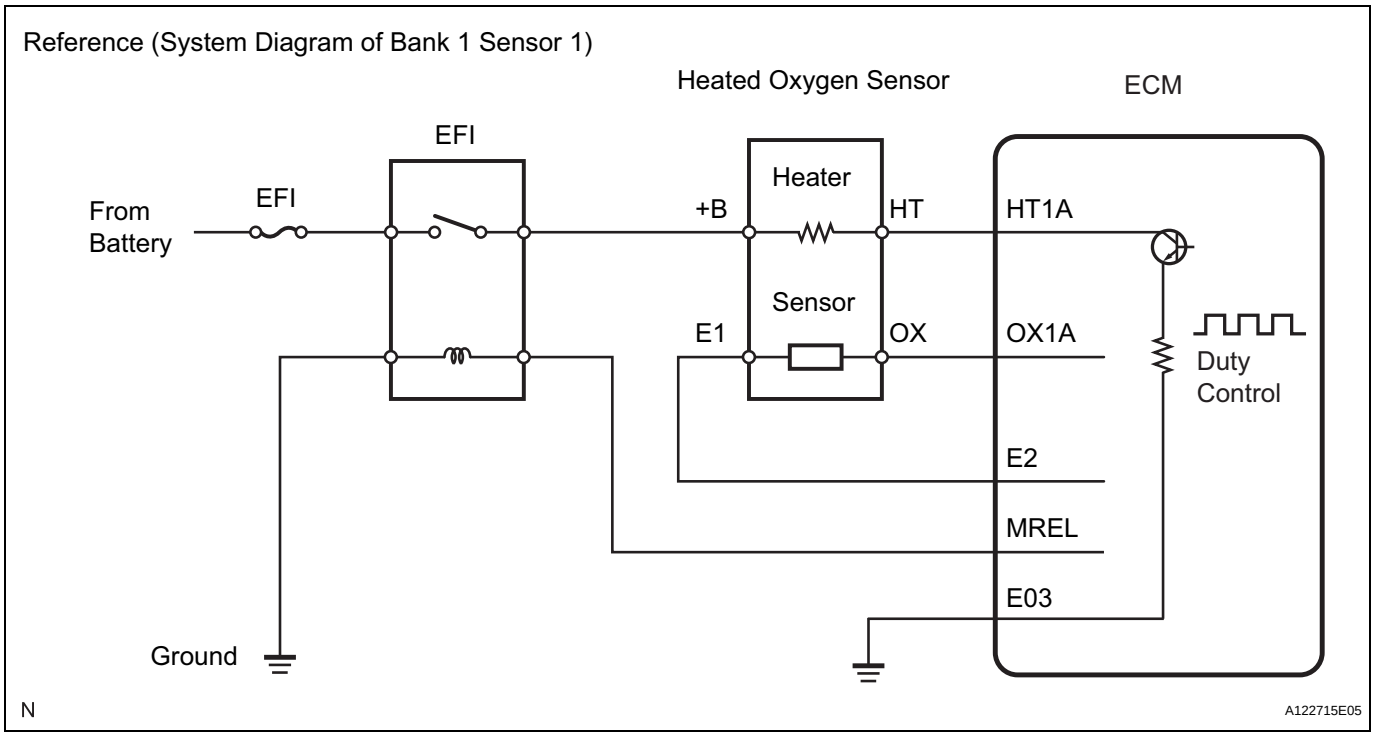
(e) Disconnect the E5 ECM connector.
(f) Measure the resistance of the wire harness side connectors.

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



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 (INJECTION AND VOLUME)

(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 (DTC P0133)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the intelligent tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read DTCs.

Result

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

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE HEATED OXYGEN SENSOR