

<b>DTC</b>	<b>P0136</b>	<b>Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)</b>
<b>DTC</b>	<b>P0138</b>	<b>Heated Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)</b>
<b>DTC</b>	<b>P0139</b>	<b>Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)</b>

## DESCRIPTION

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The rear Heated Oxygen (HO2) sensor (bank 1 sensor 2) is located behind the Three-Way Catalytic Converter (TWC), and detects the oxygen concentration in the exhaust gas. For optimum TWC operation, the air fuel mixture must be maintained as close as possible to the stoichiometric ratio. The HO2 sensor output voltage changes dramatically in the vicinity of the stoichiometric ratio. By making adjustments in accordance with these signal voltage changes, the ECM adjusts the fuel injection time so that the air-fuel ratio remains as close as possible to stoichiometric levels.

The rear HO2 sensor generates a voltage that ranges from 0.1 V to 0.9 V according to the oxygen concentration in the exhaust gas. When the oxygen concentration in the exhaust gas increases, the HO2 sensor voltage drops below 0.45 V. The ECM interprets this as the air-fuel ratio being lean. Alternatively, the sensor voltage rises to more than 0.45 V when there is no oxygen in the exhaust gas. The ECM interprets this as the air-fuel ratio being rich.

DTC No	DTC Detection Condition	Trouble Area
P0136	Either of following conditions (a) or (b) met: (a) Rear Heated Oxygen (HO2) sensor voltage remains below 0.4 V (lean) or above 0.5 V (rich) while vehicle repeatedly accelerated and decelerated for 5 minutes or more (b) Rear HO2 sensor voltage remains below 0.05 V for long time period	<ul style="list-style-type: none"> <li>Open or short in Heated Oxygen (HO2) sensor (sensor 2) circuit</li> <li>HO2 sensor (sensor 2)</li> <li>HO2 sensor (sensor 2) heater</li> <li>EFI relay</li> </ul>
P0138	Rear HO2 sensor output voltage 1.2 V or more for 10 seconds	<ul style="list-style-type: none"> <li>HO2 sensor (sensor 2)</li> <li>Short in HO2 sensor (sensor 2) circuit</li> </ul>
P0139	When either condition below is met: <ul style="list-style-type: none"> <li>After fuel cut starting, time until rear HO2 sensor (sensor 2) voltage drops to below 0.2 V is 7 seconds or more</li> <li>During fuel cut, duration that rear oxygen sensor voltage drops from 0.35 V to 0.2 V is 1 second or more</li> </ul>	<ul style="list-style-type: none"> <li>HO2 sensor (sensor 2)</li> <li>Short in HO2 sensor (sensor 2) circuit</li> </ul>

## MONITOR DESCRIPTION

The ECM monitors the HO2 sensor (bank 1 sensor 2) to check for the following malfunctions. If any one of the malfunctions is detected, the ECM illuminates the MIL and sets a DTC:

- The HO2 sensor output voltage remains above 0.5 V (rich) or below 0.4 V (lean) while the vehicle is accelerated and decelerated for 4 to 8 minutes.
- The HO2 sensor output voltage remains extremely low, below 0.05 V for a long time period of time while the vehicle is driven.
- The HO2 sensor output voltage remains extremely low, below 0.2 V (extremely lean condition) soon after fuel cut is performed while the vehicle is decelerated. The ECM interprets this as the sensor response having deteriorated.
- The HO2 sensor output voltage exceeds more than 1.2 V for 10 seconds.

## MONITOR STRATEGY

Related DTCs	P0136: HO2 sensor (bank 1 sensor 2) voltage P0138: HO2 sensor (bank 1 sensor 2) voltage high P0139: HO2 sensor (bank 1 sensor 2) fuel cut
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Required Sensors/Components (Main)	HO2 sensor (sensor 2)
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Mass Air Flow (MAF) meter, Vehicle speed sensor (VSS)
Frequency of Operation	Continuous
Duration	Within 6 minutes: P0136 10 seconds: P0138 7 seconds: P0139
MIL Operation	2 driving cycles
Sequence of Operation	None

## TYPICAL ENABLING CONDITIONS

### All:

Monitor runs whenever these DTCs not present	P0031, P0032 (heated oxygen sensor 1) P0037, P0038 (heated oxygen sensor 2) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0123 (TP sensor) P0125 (insufficient ECT for closed loop) P0130 (heated oxygen sensor 1) 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)
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### P0136 HO2 sensor voltage:

Engine	Running
Fuel system status	Closed loop
Idle	OFF
Cumulative time while oxygen sensor heater is operating	22 seconds or more

### P0136 HO2 sensor element:

Engine	Running
Vehicle speed	3 km/h (2 mph) or more
Idle	OFF
Fuel cut	OFF
Intake air amount per revolution	0.16 g/rev or more

### P0138 HO2 sensor voltage:

Engine	Running
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### P0139 HO2 sensor voltage (during fuel cut):

HO2 sensor (sensor 2) voltage before fuel cut	0.2 V or more
Three-way catalytic converter condition	400°C (752°F) or more
ECT	70°C (158°F) or more
Fuel cut	Operating

## TYPICAL MALFUNCTION THRESHOLDS

### P0136 HO2 sensor voltage:

Lean/Rich switching count	None
Lean	Heated Oxygen (HO2) sensor (sensor 2) voltage less than 0.4 V
Rich	HO2 sensor (sensor 2) voltage 0.5 V or more
Cumulative rear oxygen sensor monitor time	300 seconds or more

**P0136 HO2 sensor element:**

Cumulative rear HO2 sensor (sensor 2) monitor time	210 seconds or more
Cumulative time when HO2 sensor (sensor 2) voltage less than 0.05 V	126 seconds or more
Cumulative time when HO2 sensor (sensor 2) voltage 0.70 V or more	Less than 42 seconds
Cumulative time when HO2 sensor (sensor 2) voltage more than 0.45 V	Less than 84 seconds
Maximum rear HO2 sensor (sensor 2) rich time: Rear HO2 sensor voltage 0.45 V or more	Less than 20 seconds

**P0138 HO2 sensor voltage:**

Time while HO2 sensor output voltage 1.2 V or more	10 seconds or more
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**ES****P0139 HO2 sensor voltage (during fuel cut):**

Time until HO2 sensor (sensor 2) voltage drops to below 0.2 V after fuel cut starting	7 seconds or more
Duration that rear oxygen sensor voltage drops from 0.35 V to 0.2 V during fuel cut	1 second or more

**COMPONENT OPERATING RANGE**

HO2 sensor (sensor 2) voltage	Alternates between 0 V and 1 V
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**MONITOR RESULT**

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

**WIRING DIAGRAM**

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

**CONFIRMATION DRIVING PATTERN**

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.

**CAUTION:**

**Strictly observe posted speed limits, traffic laws, and road conditions when performing the driving pattern below.**

**1. Preconditions**

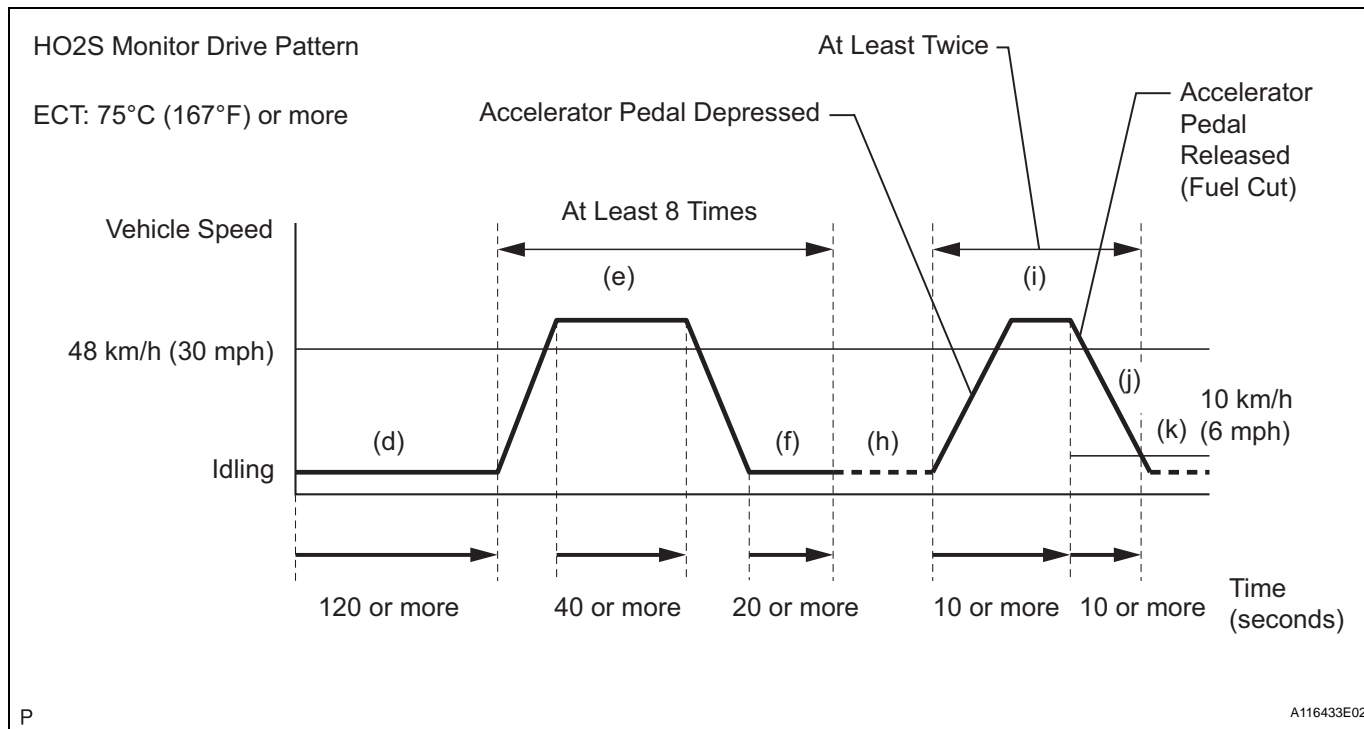
The Heated Oxygen (HO2) sensor monitor will not run unless:

- 2 minutes or more have elapsed since the engine was started.
- The Engine Coolant Temperature (ETC) is 75°C (167°F) or more.
- Cumulative driving time at a vehicle speed of 48 km/h (30 mph) or more exceeds 6 minutes.
- Air-fuel ratio feedback control is performed.
- Fuel cut control is performed for 8 seconds or more (for the rear HO2 sensor).

**2. Driving Patterns**

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Clear DTCs (see page [ES-37](#)).
- (d) Start the engine and warm it up until the ETC reaches 75°C (167°F) or higher.
- (e) Drive the vehicle at 48 km/h (30 mph) or more for at least 40 seconds.
- (f) Allow the engine to idle for 20 seconds or more.
- (g) Repeat steps (e) and (f) described above at least 8 times in 1 driving cycle.
- (h) Change the transmission to 2nd gear.
- (i) Accelerate the vehicle to 48 km/h (30 mph) or more by depressing the accelerator pedal for at least 10 seconds.

- (j) Soon after performing step (i) above, release the accelerator pedal for at least 10 seconds without depressing the brake pedal in order to execute fuel cut control.
- (k) Allow the vehicle to decelerate to less than 10 km/h (6 mph).
- (l) Repeat steps from (i) through (k) described above at least twice in 1 driving cycle.



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**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

**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%		<ul style="list-style-type: none"> <li>• Front HO2 sensor</li> <li>• Front HO2 sensor heater</li> <li>• Front HO2 sensor circuit</li> </ul>
	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%		<ul style="list-style-type: none"> <li>• Rear HO2 sensor</li> <li>• Rear HO2 sensor heater</li> <li>• Rear HO2 sensor circuit</li> </ul>
	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%		<ul style="list-style-type: none"> <li>• Injector</li> <li>• Fuel pressure</li> <li>• Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)</li> </ul>
	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, 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.

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**1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0136, P0138 AND/OR P0139)**

- (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
P0136, P0138 and/or P0139	A
P0136, P0138 and/or P0139, and other DTCs	B

**HINT:**

If any DTCs other than P0136, P0138 and/or P0139 are output, troubleshoot those DTCs first.

**B**  **GO TO DTC CHART**

**ES**

**A** 

**2 READ VALUE OF INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**

- (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 B1S2 and ENGINE SPD.
- (e) Warm up the engine.
- (f) Run the engine at an engine speed of 2,500 rpm for 3 minutes.
- (g) Rev the engine up to 4,000 rpm 3 times using the accelerator pedal.
- (h) Read the output voltage of the rear Heated Oxygen (HO2) sensor displayed on the tester when the engine speed is suddenly increased.

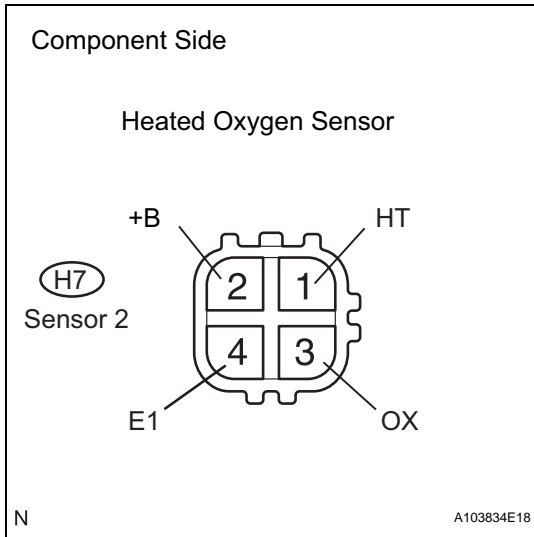
**Standard voltage:**

**Rear HO2 sensor voltage output fluctuates between less than 0.4 V and more than 0.55 V.**

**OK**  **Go to step 6**

**NG** 

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



- (a) Disconnect the H7 HO2 sensor connector.
- (b) Measure the resistance of the HO2 sensor connector.

**Standard resistance**

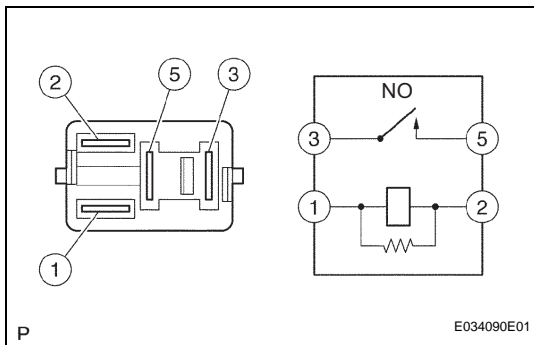
Tester Connection	Specified Condition
HT (H7-1) - +B (H7-2)	11 to 16 $\Omega$ at 20 °C (68 °F)
HT (H7-1) - E1 (H7-4)	10 k $\Omega$ or higher

**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**

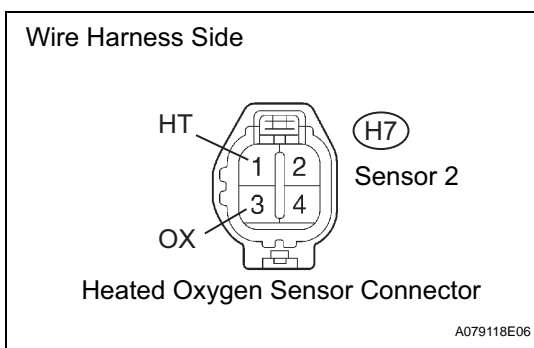
Tester Connection	Specified Condition
3 - 5	10 k $\Omega$ or higher
3 - 5	Below 1 $\Omega$ (When battery voltage is applied to terminals 1 and 2)

**NG**

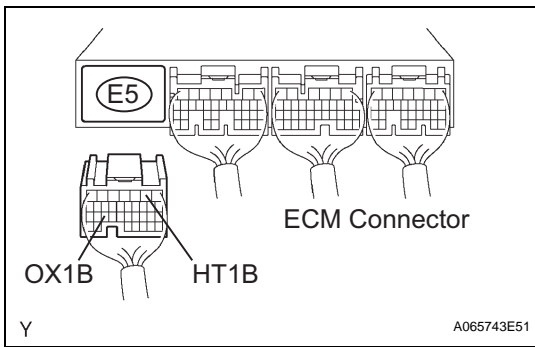
**REPLACE EFI RELAY**

**OK**

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



- (a) Disconnect the H7 HO2 sensor connector.



- (b) Disconnect the E5 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

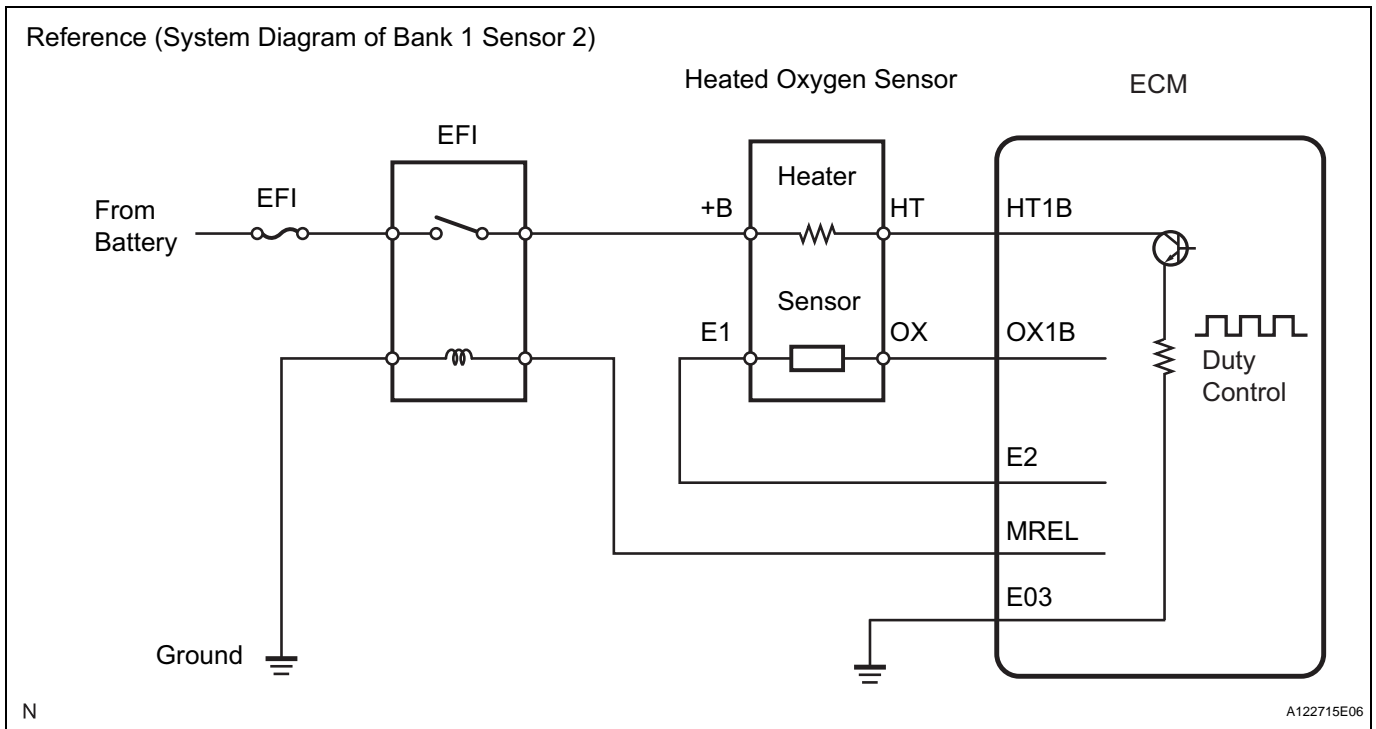
**Standard resistance (Check for open)**

Tester Connection	Specified Condition
HT (H7-1) - HT1B (E5-2)	Below 1 Ω
OX (H7-3) - OX1B (E5-25)	Below 1 Ω

**Standard resistance (Check for short)**

Tester Connection	Specified Condition
HT (H7-1) or HT1B (E5-2) - Body ground	10 kΩ or higher
OX (H7-3) or OX1B (E5-25) - Body ground	10 kΩ or higher

**ES**



**NG**

**REPAIR OR REPLACE HARNESS OR CONNECTOR**

**OK**

**REPLACE HEATED OXYGEN SENSOR**

**6 PERFORM CONFIRMATION DRIVING PATTERN**

**NEXT**

**7 CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0138 AND/OR P0139)**

- (a) Read DTCs using the intelligent tester.



- (b) If using the intelligent tester, enter the following menus:  
 DIAGNOSIS / ENHANCED OBD II / DTC INFO /  
 CURRENT CODES.

**Result**

Display (DTC output)	Proceed to
P0136, P0138 and/or P0139	A
No output	B

**B**  **CHECK FOR INTERMITTENT PROBLEMS**

**A** 

**ES**

**REPLACE HEATED OXYGEN SENSOR**