DTC	P0136	OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2)

DTC	P0137	HEATED OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2)

DTC	P0138	HEATED OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2)

CIRCUIT DESCRIPTION

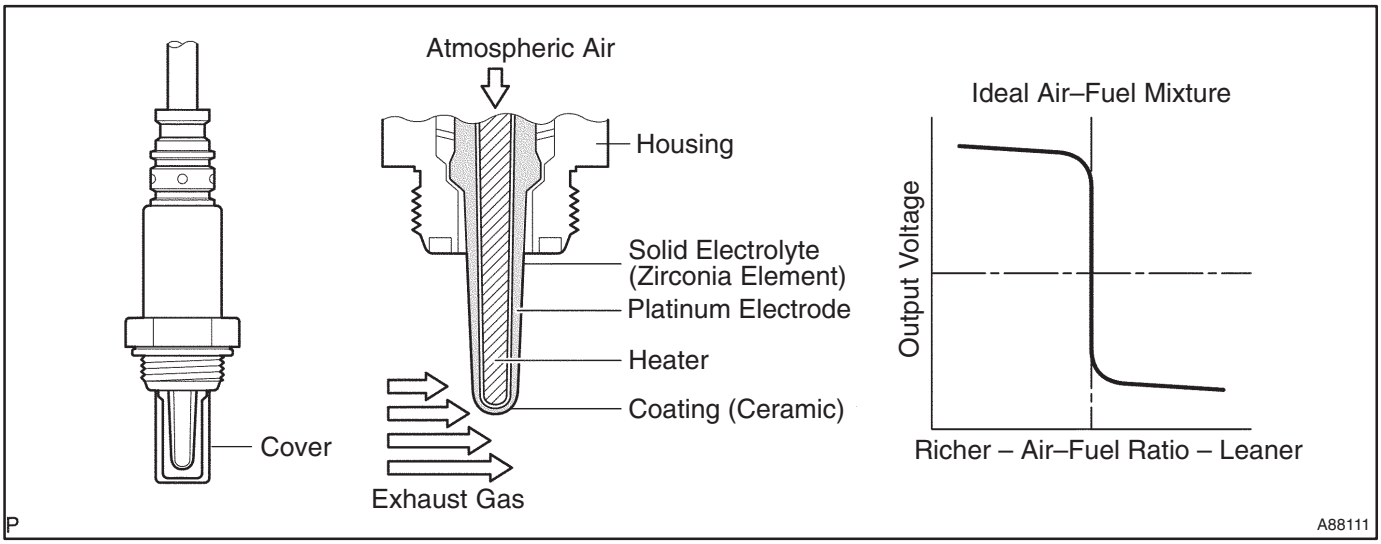
In order to obtain a high purification rate for the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a Three–Way Catalytic Converter (TWC) is used. For the most efficient use of the TWC, the air–fuel ratio must be precisely controlled so that it is always close to the stoichiometric air–fuel ratio.

The heated oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air–fuel ratio. This is used to detect the oxygen concentration in the exhaust gas and provide the ECM with feedback to control the air–fuel ratio.

When the air–fuel ratio becomes lean, the oxygen concentration in the exhaust gas increases. The heated oxygen sensor informs the ECM of the lean condition (low voltage, i.e. less than 0.45 V).

When the air–fuel ratio is richer than the stoichiometric air–fuel level, the oxygen concentration in the exhaust gas is reduced. And the heated oxygen sensor informs the ECM of the rich condition (high voltage, i.e. more than 0.45 V). The ECM judges by the voltage output of the heated oxygen sensor whether the air–fuel ratio is rich or lean and controls the injection time accordingly. If a malfunction of the heated oxygen sensor causes an output of abnormal voltage, the ECM is unable to perform accurate air–fuel ratio control.

The heated oxygen sensor includes a heater which heats the zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), a current flows to the heater in order to heat the sensor for accurate oxygen concentration detection.



DTC No	DTC Detection Condition	Trouble Area
P0136	During active control, heated oxygen sensor output voltage 0.2 to 0.6 V.	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor (sensor 2) • Heated oxygen sensor heater (sensor 2) • EFI relay
P0136	(a) and (b) are met for more than 90 seconds. (a) Estimated rear oxygen sensor temperature is less than 800 °C (1472 °F). (b) Rear oxygen sensor impedance is less than 5 Ω.	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor (sensor 2) • Heated oxygen sensor heater (sensor 2) • EFI relay
P0137	During active control, heated oxygen sensor output voltage less than 0.2 V.	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor (sensor 2) • Heated oxygen sensor heater (sensor 2) • EFI relay
P0137	(a) and (b) are met for more than 90 seconds. (a) Estimated rear oxygen sensor temperature is less than 450 °C (842 °F). (b) Rear oxygen sensor impedance is more than 15 kΩ.	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor (sensor 2) • Heated oxygen sensor heater (sensor 2) • EFI relay
P0138	During active control, heated oxygen sensor output voltage more than 0.6 V.	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor (sensor 2) • Heated oxygen sensor heater (sensor 2) • EFI relay
P0138	Rear oxygen sensor output voltage is 1.2 V or higher for more than 30 seconds.	• Open or short in heated oxygen sensor circuit • Heated oxygen sensor (sensor 2) • Heated oxygen sensor heater (sensor 2) • EFI relay

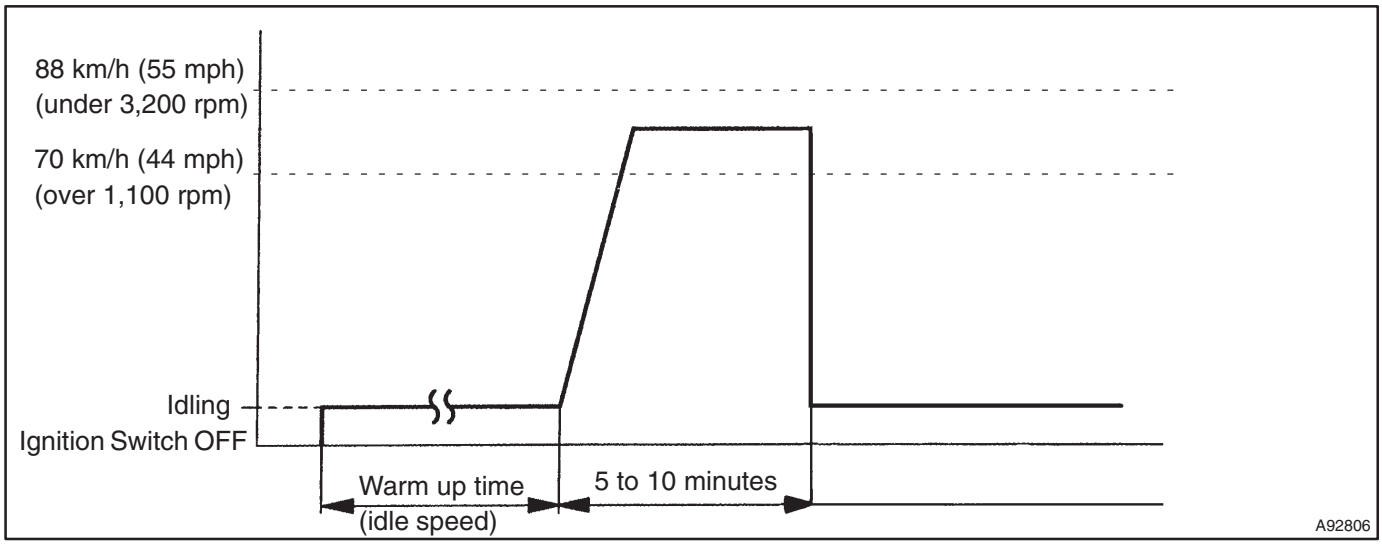
HINT:
Sensor 2 refers to the sensor mounted behind the Three–Way Catalytic Converter and located far from the engine assembly.

WIRING DIAGRAM

Refer to DTC P0037 on page 05–53.

CONFIRMATION DRIVING PATTERN

HINT:
Performing this confirmation pattern will activate the DTC detection (P0136) of the ECM. This is very useful for verifying the completion of a repair.



(a) Clear the DTCs (see page 05–18).
(b) Activate the check mode (see page 05–21).
(c) Start the engine and warm it up with all the accessory switches OFF.
(d) Deactivate the check mode and drive the vehicle at 70 to 88 km/h (44 to 55 mph) for 5 to 10 minutes.
(e) Read DTCs.

NOTICE:

- **If the conditions in this test are not strictly followed, no malfunction will be detected.**
- **Do not drive the vehicle without deactivating check mode, otherwise damaging the transaxle may result.**

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be found using the Active Test / A/F Control operation. The A/F Control operation can help to determine whether the heated oxygen sensor and other potential trouble areas are malfunctioning.

(a) Perform the Active Test using the intelligent tester II.

HINT:

The A/F Control operation lowers the injection volume by 12.5 % or increases the injection volume by 25 %.

(1) Connect the intelligent tester II to the DLC3.
(2) Start the engine and turn the intelligent tester II ON.
(3) Warm up the engine by running the engine at 2,500 rpm for approximately 3 minutes.
(4) On the intelligent tester II, select the following menu items: Powertrain / Engine and ECT / Active Test / A/F Control.
(5) Select the following monitor items: AFS B1 S1 and O2S B1 S2.
(6) Perform the A/F Control operation with the engine in an idling condition (press the right or left button).

Result:

A/F sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: Less than 3.0 V
–12.5% → lean output: More than 3.35 V
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: More than 0.55 V
–12.5% → lean output: Less than 0.4 V

NOTICE:
There is a few seconds delay in the A/F sensor output and there is about 20 seconds delay in the heated oxygen sensor output.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Mainly suspect trouble area
Case 1	Injection volume +25% –12.5% Output voltage More than 3.35 V Less than 3.0 V **OK**	Injection volume +25% –12.5% Output voltage More than 0.55 V Less than 0.4 V **OK**	—
Case 2	Injection volume +25% –12.5% Output voltage No reaction **NG**	Injection volume +25% –12.5% Output voltage More than 0.55 V Less than 0.4 V **OK**	A/F sensor (A/F sensor, heater, A/F sensor circuit)
Case 3	Injection volume +25% –12.5% Output voltage More than 3.35 V Less than 3.0 V **OK**	Injection volume +25% –12.5% Output voltage No reaction **NG**	Heated oxygen sensor (heated oxygen sensor, heater, heated oxygen sensor 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 A/F Control procedure enables the technician to check and graph the voltage output of both the sensors.

NOTICE:
If the vehicle is short of fuel, the air–fuel ratio becomes lean and the heated oxygen sensor DTCs are recorded, and the MIL then illuminates.

HINT:

- If different DTCs related 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 II. Freeze frame data record 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 low A/F sensor voltage could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage 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 P0136, P0137 AND P0138)

(a) Connect the intelligent tester II to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester II ON.
(c) Select the following menu items: Powertrain / Engine and ECT / DTC.
(d) Read DTCs.

Result:

Display (DTC Output)	Proceed To
Only "P0136, P0137 and/or P0138" are output	A
"P0136, P0137 and/or P0138" and other DTCs	B

HINT:
If any DTCs other than P0136, P0137 and/or P0138 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART** (See page 05–29)

A

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

(a) Connect the intelligent tester II to the DLC3.
(b) Start the engine and turn the intelligent tester II ON.
(c) Select the following menu items: Powertrain / Engine and ECT / DTC.
(d) After warming up the engine, run the engine at 2,500 rpm for 3 minutes.
(e) Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:
Quickly accelerate the engine to 4,000 rpm 3 times by using the accelerator pedal.

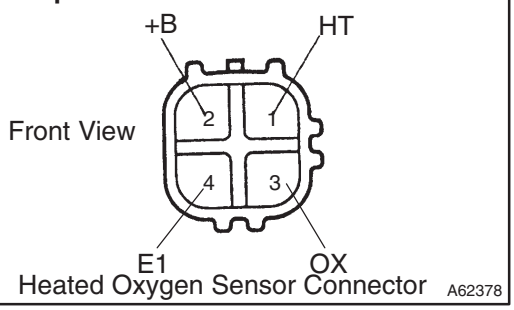
Standard: Fluctuates between 0.4 V or less and 0.5 V or more.

OK → **Go to step 6**

NG

3	INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)

Component Side:



(a) Disconnect the H20 heated oxygen sensor connector.
(b) Measure the resistance between the terminals of the heated oxygen sensor connector.

Standard:

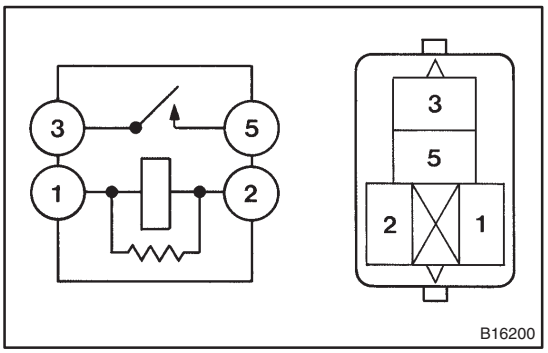
Tester Connection	Specified Condition
1 (HT) – 2 (+B)	11 to 16 Ω at 20°C (68°F)
1 (HT) – 4 (E1)	10 kΩ or higher

(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 the EFI relay resistance.

Standard:

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

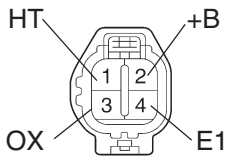
(c) Reinstall the EFI relay.

NG → **REPLACE EFI RELAY**

OK

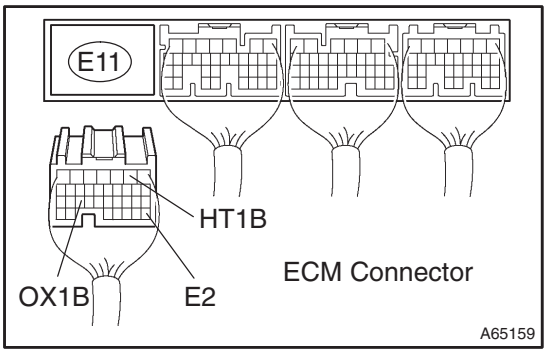
5 CHECK HARNESS AND CONNECTOR(HEATED OXYGEN SENSOR – ECM)

Wire Harness Side:
(H20) Heated Oxygen Sensor Connector



Front View

A72895



(a) Disconnect the H20 heated oxygen sensor connector.
(b) Disconnect the E11 ECM connector.
(c) Check the resistance.

Standard (Check for open):

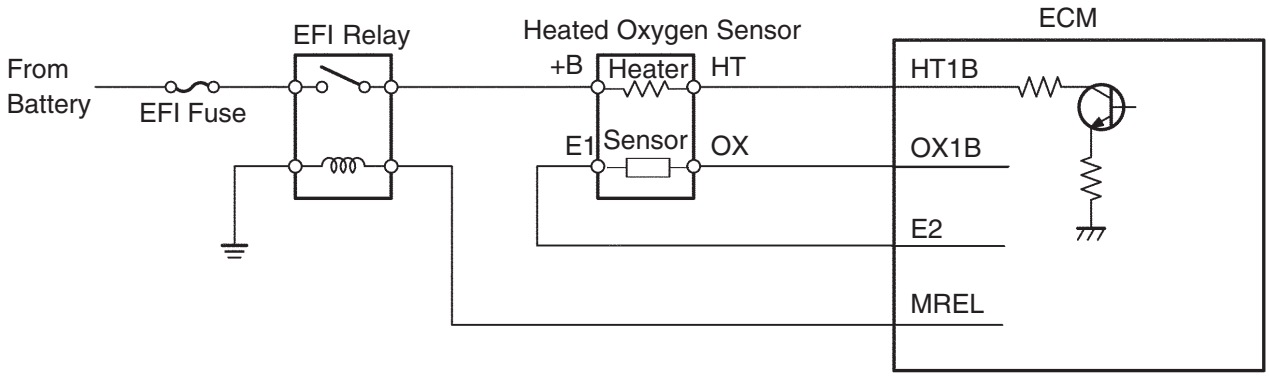
Tester Connection	Specified Condition
OX (H20–3) – OX1B (E11–25)	Below 1 Ω
HT (H20–1) – HT1B (E11–2)	Below 1 Ω
E1 (H20–4) – E2 (E11–28)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
OX (H20–3) or OX1B (E11–25) – Body ground	10 kΩ or higher
HT (H20–1) or HT1B (E11–2) – Body ground	10 kΩ or higher

(d) Reconnect the heated oxygen sensor connector.
(e) Reconnect the ECM connectors.

Reference (Sensor 2 System Diagram):



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR

6	PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

NEXT

7	CHECK IF DTC OUTPUT RECURS(DTC P0136, P0137 and/or P0138)

(a) Connect the intelligent tester II to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester II ON.
(c) Select the following menu items: Powertrain / Engine and ECT / DTC.
(d) Read DTCs.

Result:

Display (DTC Output)	Proceed To
No output	A
P0136, P0137 and/or P0138	B

B → REPLACE HEATED OXYGEN SENSOR

A

CHECK FOR INTERMITTENT PROBLEMS (See page 05–8)