DTC	P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)
DTC	P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)
DTC	P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)
DTC	P102D	O2 Sensor Heater Circuit Performance Bank 1 Sensor 2 Stuck ON

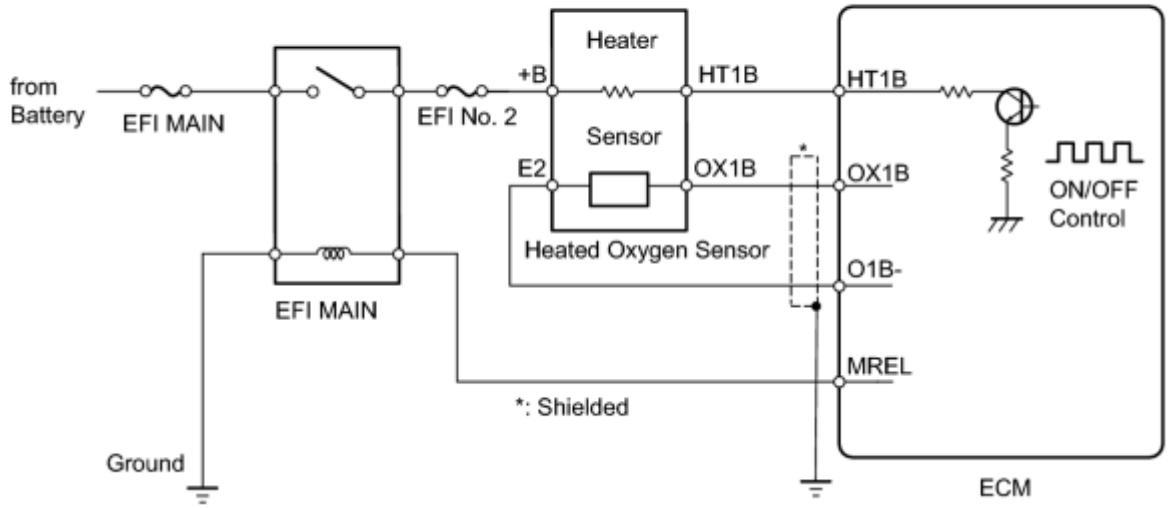
DESCRIPTION

Refer to DTC P0136 INFO.

HINT:

- Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.
- When any of these DTCs are set, the ECM enters fail-safe mode. The ECM turns off the heated oxygen sensor heater in fail-safe mode. Fail-safe mode continues until the power switch is turned off.
- The ECM uses pulse width modulation to adjust the current through the heater. The heated oxygen sensor heater circuit uses a relay on the +B side of the circuit.

Reference (System Diagram of Sensor 2):



DTC No.	DTC Detection Condition	Trouble Area
P0037	The heater current less than the specified value while the heater is operating (1 trip detection logic).	• Open in heated oxygen sensor (sensor 2) heater circuit • Heated oxygen sensor (sensor 2) heater • ECM
P0038	The heater current is higher than the specified value while the heater is operating (1 trip detection logic).	• Short in heated oxygen sensor (sensor 2) heater circuit • Heated oxygen sensor (sensor 2) heater

DTC No.	DTC Detection Condition	Trouble Area
		• ECM
P0141	The cumulative heater resistance correction value exceeds the threshold (2 trip detection logic).	• Open or short in heated oxygen sensor (sensor 2) heater circuit • Heated oxygen sensor (sensor 2) heater • ECM
P102D	The heater current is higher than the specified value while the heater is not operating (1 trip detection logic).	ECM

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR DESCRIPTION

The sensing portion of the heated oxygen sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated Oxygen Sensor Heater Range Check (P0037, P0038 and P102D):

- The ECM monitors the current applied to the heated oxygen sensor heater to check the heater for malfunctions.

If the heater current is outside the normal range, the signal transmitted by the heated oxygen sensor becomes inaccurate. When the current in the heated oxygen sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

Heated Oxygen Sensor Heater Performance (P0141):

- After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM determines that there is a malfunction in the heated oxygen sensor heater and stores DTC P0141.

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater (sensor 2) open/short (Low

	electrical current) P0038: Heated oxygen sensor heater (sensor 2) open/short (High electrical current) P0141: Heated oxygen sensor heater performance (sensor 2) P102D: Heated oxygen sensor heater ON stuck (sensor 2)
Required sensors/Components (Main)	Heated oxygen sensor heater (sensor 2)
Required sensors/Components (Related)	-
Frequency of operation	Continuous: P0037, P0038, P102D Once per driving cycle: P0141
Duration	0.5 seconds: P0037, P102D 1 second: P0038 10 seconds: P0141
MIL operation	Immediately: P0037, P0038, P102D 2 driving cycles: P0141
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All

Monitor runs whenever following DTCs are not present	None

P0037 (Case 1)

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF
Catalyst active air fuel ratio control	Not operating
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete
Heater OFF current learned value	Acquired
Heated oxygen sensor heater high current fail (P0038)	Not detected

P0037 (Case 2)

Battery voltage	10.5 V or more

Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete
Heated oxygen sensor heater OFF current	More than 3.5 A
Hybrid IC high current limiter port	Fail
Heated oxygen sensor heater high current fail (P0038)	Not detected

P0038

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF
Catalyst active air fuel ratio control	Not operating
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete

P0141 (Case 1)

Heated oxygen sensor heater circuit fail (P0037 and P0038)	Not detected
Battery voltage	10.5 V or more
Fuel cut	OFF
Time after fuel cut ON to OFF	30 seconds or more
Accumulated heater ON time	100 seconds or more
Learned heater OFF current operation	Complete

P0141 (Case 2)

Duration that rear heated oxygen sensor impedance is less than 15 kΩ	2 seconds or more

P102D

Battery voltage	10.5 V or more
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete
Heated oxygen sensor heater OFF current	More than 3.5 A
Hybrid IC high current limiter port	Fail
Heated oxygen sensor heater high current fail (P0038)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

P0037 (Case 1)

Heater ON current - Learned heater OFF current	0.3 A or less

P0037 (Case 2)

Heated oxygen sensor heater ON current	1 A or less

P0038

Hybrid IC high current limiter port	Fail
Heated oxygen sensor heater output	ON

P0141

Accumulated heater resistance	Varies with sensor element temperature (Example: Higher than 23 Ω)

P102D

Heated oxygen sensor heater ON current	Higher than 1 A

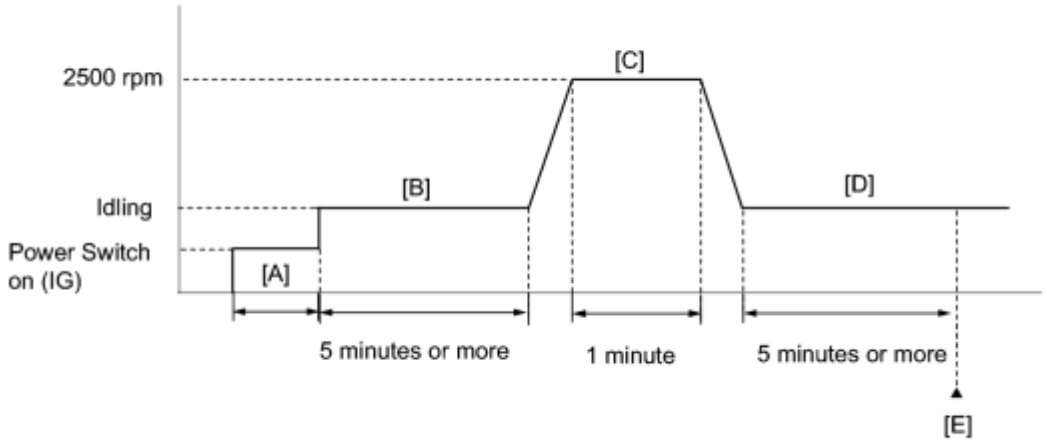
COMPONENT OPERATING RANGE

Heated oxygen sensor heater current	0.4 to 1 A (when engine idles, heated oxygen sensor warmed up and battery voltage 11 to 14 V)

MONITOR RESULT

- Refer to Checking Monitor Status INFO.

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the power switch on (IG) and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure) INFO.
4. Turn the power switch off and wait for 30 seconds.
5. Turn the power switch on (IG) and turn the Techstream on [A].
6. Put the engine in inspection mode INFO.
7. Start the engine and idle it for 5 minutes or more [B].
8. With the vehicle stationary, depress the accelerator pedal and maintain an engine speed of 2500 rpm for 1 minute [C].
9. Idle the engine for 5 minutes or more [D].
10. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
11. Read the pending DTC [E].
12. If a pending DTC is output, the system is malfunctioning.

HINT:

If a pending DTC is not output, perform the following procedure.

13. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
14. Input the DTC: P0037, P0038, P0141, or P102D.
15. Check the DTC judgment result.

Techstream Display	Description
NORMAL	○ DTC judgment completed ○ System normal
ABNORMAL	○ DTC judgment completed ○ System abnormal
INCOMPLETE	○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows NORMAL, the system is normal.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform step [B] through [D] again.

16. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
17. Check the judgment result.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows NORMAL, the system is normal.

18. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO.

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0136 INFO.

INSPECTION PROCEDURE

NOTICE:

Inspect the fuses for circuits related to this system before performing the following inspection procedure.

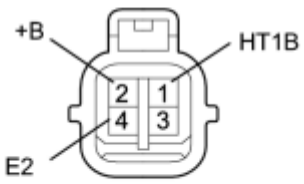
HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

PROCEDURE

1.	INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

*1



(a) Disconnect the heated oxygen sensor connector.

(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 Ω
1 (HT1B) - 4 (E2)	Always	10 kΩ or higher

Text in Illustration

*1	Component without harness connected (Heated Oxygen Sensor (Sensor 2))

(c) Reconnect the heated oxygen sensor connector.

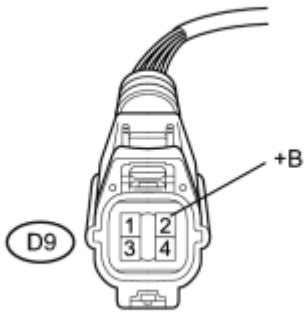
NG ▶ REPLACE HEATED OXYGEN SENSOR

OK

▼

2.	CHECK TERMINAL VOLTAGE (POWER SOURCE)

*1



(a) Disconnect the heated oxygen sensor connector.

(b) Turn the power switch on (IG).

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Switch Condition	Specified Condition
D9-2 (+B) - Body ground	Power switch on (IG)	11 to 14 V

Text in Illustration

*1	Front view of harness connector (to Heated Oxygen Sensor (Sensor 2))

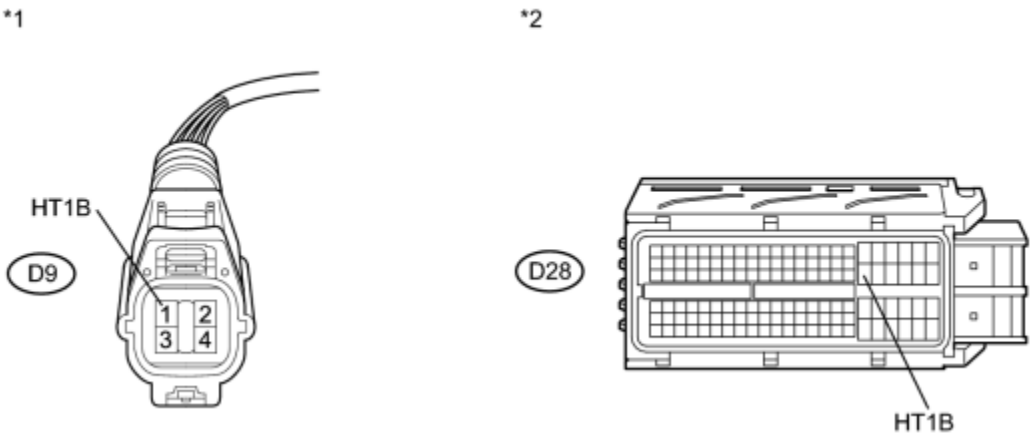
(d) Reconnect the heated oxygen sensor connector.

NG ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR (HEATED OXYGEN SENSOR - EFI MAIN RELAY)

OK ▼

3.	CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

(a) Disconnect the heated oxygen sensor connector.



(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
D9-1 (HT1B) - D28-41 (HT1B)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
D9-1 (HT1B) or D28-41 (HT1B) - Body ground	Always	10 kΩ or higher

Text in Illustration

*1	Front view of harness connector (to Heated Oxygen Sensor (Sensor 2))	*2	Front view of harness connector (to ECM)

(d) Reconnect the heated oxygen sensor connector.

(e) Reconnect the ECM connector.

NG ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR (HEATED OXYGEN SENSOR - ECM)

OK

4.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0037, P0038, P0141 OR P0101D)

(a) Connect the Techstream to the DLC3.

(b) Turn the power switch on (IG).

(c) Turn the Techstream on.

(d) Clear the DTCs INFO.

(e) Put the engine in inspection mode INFO.

(f) Start the engine.

(g) Drive the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.

(h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

(i) Read the pending DTCs.

Result:

Result	Proceed to
DTC is not output	A
DTC P0037, P0038, P0141 or P102D is output	B

B ▶ REPLACE ECM

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**