DESCRIPTION
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a 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 level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. less than 0.45 V).

Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. more than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.

<table>
<thead>
<tr>
<th>DTC</th>
<th>P0136</th>
<th>Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTC</td>
<td>P0137</td>
<td>Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)</td>
</tr>
<tr>
<td>DTC</td>
<td>P0138</td>
<td>Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)</td>
</tr>
</tbody>
</table>

**Atmospheric Air Housing**

**Platinum Electrode**

**Solid Electrolyte (Zirconia Element)**

**Heater**

**Coating (Ceramic)**

**Exhaust Gas**

**Output Voltage**

**Ideal Air-fuel Mixture**

**Richer - Air-fuel Ratio - Leaner**
MONITOR DESCRIPTION

Active Air-Fuel Ratio Control
The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, one of the following DTCs is set: DTC P0136 (abnormal voltage output), P0137 (open circuit) and P0138 (short circuit).

Abnormal Voltage Output of HO2 Sensor (DTC P0136)
While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to less than 0.21 V and does not increase to more than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and sets DTC P0136.

### DTC No. P0136
- Abnormal voltage output:
  - During active air-fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic):
    - (a) Heated Oxygen (HO2) sensor voltage does not decrease to less than 0.59 V
    - (b) HO2 sensor voltage does not increase to more than 0.21 V
  - Low impedance:
    - Sensor impedance less than 5 Ω for more than 30 seconds when ECM presumes sensor to be warmed up and operating normally (2 trip detection logic)
- Trouble Areas:
  - Open or short in HO2 sensor (sensor 2) circuit
  - HO2 sensor (sensor 2)
  - HO2 sensor heater (sensor 2)
  - Air-fuel Ratio (A/F) sensor (sensor 1)
  - Integration relay (EFI MAIN relay)
  - Gas leakage from exhaust system

### DTC No. P0137
- Low voltage (open):
  - During active air-fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic):
    - (a) HO2 sensor voltage output less than 0.21 V
    - (b) Target air-fuel ratio rich
  - High impedance:
    - Sensor impedance 15 kΩ or more for more than 90 seconds when ECM presumes sensor to be warmed up and operating normally (2 trip detection logic)
- Trouble Areas:
  - Open in HO2 sensor (sensor 2) circuit
  - HO2 sensor (sensor 2)
  - HO2 sensor heater (sensor 2)
  - Integration relay (EFI MAIN relay)
  - Gas leakage from exhaust system

### DTC No. P0138
- High voltage (short):
  - During active air-fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic):
    - (a) HO2 sensor voltage output more than 0.59 V
    - (b) Target air-fuel ratio lean
  - Extremely high voltage (short):
    - HO2 sensor voltage output exceeds 1.2 V for more than 10 seconds (2 trip detection logic)
- Trouble Areas:
  - Short in HO2 sensor (sensor 2) circuit
  - HO2 sensor (sensor 2)
  - ECM internal circuit malfunction
Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 or P0138)

During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor decreases significantly, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and sets DTC P0137. When the target air-fuel ratio is lean and the voltage output is 0.59 V or more (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and sets DTC P0138.

HINT:
DTC P0138 is also set if the HO2 sensor voltage output is more than 1.2 V for 10 seconds or more.

*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated based on the calculated OSC value (see page ES-191).
HO2 SENSOR CIRCUIT LOW VOLTAGE
(P0137: OPEN)

Active air-fuel ratio control
Off

Target air-fuel ratio
Stoichiometric Air-Fuel Level

HO2 sensor voltage
0.21 V

15 to 20 seconds

HO2 SENSOR CIRCUIT HIGH VOLTAGE
(P0138: SHORT)

Active air-fuel ratio control
Off

Target air-fuel ratio
Stoichiometric Air-Fuel Level

HO2 sensor voltage
0.59 V

Operation
Lean

Abnormal

Normal
High or Low Impedance of Heated Oxygen (HO2) Sensor (DTC P0136 or P0137)

During normal air-fuel ratio feedback control, there are small variations in the exhaust gas oxygen concentration. In order to continuously monitor the slight variations in the HO2 sensor signal while the engine is running, the impedance* of the sensor is measured by the ECM. The ECM determines that there is a malfunction in the sensor when the measured impedance deviates from the standard range.

*: The effective resistance in an alternating current electrical circuit.

HINT:
• The impedance cannot be measured using an ohmmeter.
• DTC P0136 indicates the deterioration of the HO2 sensor. The ECM sets this DTC by calculating the impedance of the sensor when the typical enabling conditions are satisfied (2 driving cycles).
• DTC P0137 indicates an open or short circuit in the HO2 sensor (2 driving cycles). The ECM sets this DTC when the impedance of the sensor exceeds the threshold 15 kΩ.

MONITOR STRATEGY

| Related DTCs | P0136: Heated oxygen sensor output voltage (Abnormal voltage output)  
P0136: Heated oxygen sensor impedance (Low)  
P0137: Heated oxygen sensor output voltage (Low voltage)  
P0137: Heated oxygen sensor impedance (High)  
P0138: Heated oxygen sensor output voltage (High voltage)  
P0138: Heated oxygen sensor output voltage (Extremely high) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Sensors/Components (Main)</td>
<td>Heated oxygen sensor</td>
</tr>
<tr>
<td>Required Sensors/Components (Related)</td>
<td>Crankshaft position sensor, engine coolant temperature sensor, mass air flow meter and throttle position sensor</td>
</tr>
</tbody>
</table>
| Frequency of Operation | Once per driving cycle: Active air-fuel ratio control detection  
Continuous: Other |
| Duration | 20 seconds: Active air-fuel ratio control detection  
90 seconds: Heated oxygen sensor impedance (High)  
30 seconds: Heated oxygen sensor impedance (Low)  
10 seconds: Output voltage (Stuck high) |
| MIL Operation | 2 driving cycles |
| Sequence of Operation | None |
TYPICAL ENABLING CONDITIONS

All:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heated Oxygen Sensor Output Voltage (Abnormal Voltage Output, High Voltage and Low Voltage):</td>
<td></td>
</tr>
<tr>
<td>Active air-fuel ratio control</td>
<td>Executing</td>
</tr>
<tr>
<td>Active air-fuel ratio control begins when all of following conditions met:</td>
<td>-</td>
</tr>
<tr>
<td>Battery voltage</td>
<td>11 V or more</td>
</tr>
<tr>
<td>Engine coolant temperature</td>
<td>75°C (167°F) or more</td>
</tr>
<tr>
<td>Idling</td>
<td>OFF</td>
</tr>
<tr>
<td>Engine RPM</td>
<td>Less than 4,000 rpm</td>
</tr>
<tr>
<td>A/F sensor status</td>
<td>Activated</td>
</tr>
<tr>
<td>Fuel system status</td>
<td>Closed loop</td>
</tr>
<tr>
<td>Fuel cut</td>
<td>OFF</td>
</tr>
<tr>
<td>Engine load</td>
<td>10 to 80 %</td>
</tr>
<tr>
<td>Shift position</td>
<td>4th</td>
</tr>
</tbody>
</table>

Heated Oxygen Sensor Impedance (Low):

<table>
<thead>
<tr>
<th>Condition</th>
<th>Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery voltage</td>
<td>11 V or more</td>
</tr>
<tr>
<td>Estimated rear HO2 sensor temperature</td>
<td>Less than 700°C (1,292°F)</td>
</tr>
<tr>
<td>ECM monitor</td>
<td>Completed</td>
</tr>
<tr>
<td>DTC P0606</td>
<td>Not set</td>
</tr>
</tbody>
</table>

Heated Oxygen Sensor Impedance (High):

<table>
<thead>
<tr>
<th>Condition</th>
<th>Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery voltage</td>
<td>11 V or more</td>
</tr>
<tr>
<td>Estimated rear HO2 sensor temperature</td>
<td>450°C (842°F) or more</td>
</tr>
<tr>
<td>ECM monitor</td>
<td>Completed</td>
</tr>
<tr>
<td>DTC P0606</td>
<td>Not set</td>
</tr>
</tbody>
</table>

Heated Oxygen Sensor Output Voltage (Extremely High):

<table>
<thead>
<tr>
<th>Condition</th>
<th>Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery voltage</td>
<td>11 V or more</td>
</tr>
<tr>
<td>Time after engine start</td>
<td>2 seconds or more</td>
</tr>
</tbody>
</table>

TYPICAL MALFUNCTION THRESHOLDS

Heated Oxygen Sensor Output Voltage (Abnormal Voltage Output):

<table>
<thead>
<tr>
<th>Condition</th>
<th>Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either of following conditions met:</td>
<td>1 or 2</td>
</tr>
<tr>
<td>1. All of following conditions (a), (b) and (c) met</td>
<td>-</td>
</tr>
<tr>
<td>(a) Commanded air-fuel ratio</td>
<td>14.3 or less</td>
</tr>
<tr>
<td>(b) Rear HO2 sensor voltage</td>
<td>0.21 to 0.59 V</td>
</tr>
<tr>
<td>(c) OSC (Oxygen Storage Capacity of Catalyst)</td>
<td>2 g or more</td>
</tr>
<tr>
<td>2. All of following conditions (d), (e) and (f) met</td>
<td>-</td>
</tr>
<tr>
<td>(d) Commanded air-fuel ratio</td>
<td>14.9 or more</td>
</tr>
</tbody>
</table>
(e) Rear HO2 sensor voltage 0.21 to 0.59 V
(f) OSC 2 g or more

Heated Oxygen Sensor Output Voltage (Low):
All of following conditions (a), (b) and (c) met -
(a) Commanded air-fuel ratio 14.3 or less
(b) Rear HO2 sensor voltage Less than 0.21 V
(c) OSC 2 g or more

Heated Oxygen Sensor Output Voltage (High):
All of following conditions (a), (b) and (c) met -
(a) Commanded air-fuel ratio 14.9 or more
(b) Rear HO2 sensor voltage More than 0.59 V
(c) OSC 2 g or more

Heated Oxygen Sensor Impedance (Low):
Duration of following condition met 30 seconds or more
Heated oxygen sensor impedance Less than 5 Ω

Heated Oxygen Sensor Impedance (High):
Duration of following condition met 90 seconds or more
Heated oxygen sensor impedance 15 kΩ or more

Heated Oxygen Sensor Output Voltage (Extremely High):
Duration of following condition met 10 seconds or more
Heated oxygen sensor voltage 1.2 V or more

COMPONENT OPERATING RANGE
Duration of following condition met 30 seconds or more
Heated oxygen sensor voltage Varies between 0.1 and 0.9 V

MONITOR RESULT
Refer to CHECKING MONITOR STATUS (see page ES-17).
WIRING DIAGRAM

CONFIRMATION DRIVING PATTERN

HINT:
- This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.
- Performing this confirmation pattern will activate the Heated Oxygen (HO2) sensor monitor. (The catalyst monitor is performed simultaneously.) This is very useful for verifying the completion of a repair.
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Clear DTCs (if set) (see page ES-35).
(e) Select the following menu items: DIAGNOSIS / CARB OBD II / READINESS TESTS.
(f) Check that O2S EVAL is INCMPL (incomplete).
(g) Start the engine and warm it up.
(h) Drive the vehicle at between 64 km/h and 113 km/h (40 mph and 70 mph) for at least 10 minutes.
(i) Note the state of the Readiness Tests items. Those items will change to COMPL (complete) as the O2S EVAL monitor operates.
(j) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES and check if any DTCs (any pending DTCs) are set.

**HINT:**
If O2S EVAL does not change to COMPL, and any pending DTCs fail to set, extend the driving time.

### INSPECTION PROCEDURE

**HINT:**
Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.

**HINT:**
Intelligent tester only:
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 Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the A/F CONTROL operation using the intelligent tester.

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester ON.
(c) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(e) Perform the A/F CONTROL operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).

(f) Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2) 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 %.
- The sensors react in accordance with increases and decreases in the fuel injection volume.

**Standard**

<table>
<thead>
<tr>
<th>Tester Display (Sensor)</th>
<th>Injection Volumes</th>
<th>Status</th>
<th>Voltages</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFS B1 S1 (A/F)</td>
<td>+25 %</td>
<td>Rich</td>
<td>Less than 3.0</td>
</tr>
<tr>
<td></td>
<td>-12.5 %</td>
<td>Lean</td>
<td>More than 3.35</td>
</tr>
<tr>
<td>O2S B1 S2 (HO2)</td>
<td>+25 %</td>
<td>Rich</td>
<td>More than 0.5</td>
</tr>
<tr>
<td></td>
<td>-12.5 %</td>
<td>Lean</td>
<td>Less than 0.4</td>
</tr>
</tbody>
</table>

**NOTICE:**
The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

<table>
<thead>
<tr>
<th>Case</th>
<th>A/F Sensor (Sensor 1) Output Voltage</th>
<th>HO2 Sensor (Sensor 2) Output Voltage</th>
<th>Main Suspected Trouble Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Injection Volume +25 % -12.5 %</td>
<td>Injection Volume +25 % -12.5 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output Voltage More than 3.35 V</td>
<td>Output Voltage More than 0.5 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less than 3.0 V</td>
<td>Less than 0.4 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OK</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Injection Volume +25 % -12.5 %</td>
<td>Injection Volume +25 % -12.5 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output Voltage Almost no reaction</td>
<td>Output Voltage More than 0.5 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less than 0.4 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A/F sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A/F sensor heater</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A/F sensor circuit</td>
</tr>
<tr>
<td>3</td>
<td>Injection Volume +25 % -12.5 %</td>
<td>Injection Volume +25 % -12.5 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output Voltage More than 3.35 V</td>
<td>Output Voltage Almost no reaction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less than 3.0 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HO2 sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HO2 sensor heater</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HO2 sensor circuit</td>
</tr>
</tbody>
</table>
Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.

To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1 S1 and O2S B1 S2; then press the YES button and then the ENTER button followed by the F4 button.

**HINT:**
- 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.
- If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0138 will be set.

### 1 READ OUTPUT DTC

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

**Result**

<table>
<thead>
<tr>
<th>DTC</th>
<th>Proceed To</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0138</td>
<td>A</td>
</tr>
<tr>
<td>P0137</td>
<td>B</td>
</tr>
<tr>
<td>P0136</td>
<td>C</td>
</tr>
</tbody>
</table>

- **B** Go to step 14
- **C** Go to step 7

### 2 READ VALUE USING 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) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / O2S B1 S2.
(d) Allow the engine to idle.
(e) Read the Heated Oxygen (HO2) sensor output voltage while idling.
Result

<table>
<thead>
<tr>
<th>HO2 Sensor Output Voltages</th>
<th>Proceed To</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 1.2 V</td>
<td>A</td>
</tr>
<tr>
<td>Less than 1.0 V</td>
<td>B</td>
</tr>
</tbody>
</table>

B  Go to step 5

3 CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

(a) Turn the ignition switch OFF and wait for 5 minutes.
(b) Disconnect the B30 ECM connector.
(c) Measure the resistance.

Standard resistance

<table>
<thead>
<tr>
<th>Tester Connections</th>
<th>Specified Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>B30-47 (HT1B) - B30-64 (OX1B)</td>
<td>10 kΩ or higher</td>
</tr>
</tbody>
</table>

(d) Reconnect the ECM connector.

OK  REPLACE ECM

NG

4 INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)

(a) Disconnect the B19 HO2 sensor connector.
(b) Measure the resistance.

Standard resistance

<table>
<thead>
<tr>
<th>Tester Connections</th>
<th>Specified Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (+B) - 4 (E2)</td>
<td>10 kΩ or higher</td>
</tr>
<tr>
<td>2 (+B) - 3 (OX1B)</td>
<td>10 kΩ or higher</td>
</tr>
</tbody>
</table>

(c) Reconnect the HO2 sensor connector.

NG  REPLACE HEATED OXYGEN SENSOR

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR
5 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

6 CHECK WHETHER DTC OUTPUT RECURS (DTC P0138)

(a) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(b) Read DTCs.

Result

<table>
<thead>
<tr>
<th>Display (DTC Output)</th>
<th>Proceed To</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0138</td>
<td>A</td>
</tr>
<tr>
<td>No output</td>
<td>B</td>
</tr>
</tbody>
</table>

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE HEATED OXYGEN SENSOR

7 READ VALUE USING 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) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / O2S B1 S2
(e) After warming up the engine, run the engine at an engine speed of 2,500 rpm for 3 minutes.
(f) Read the output voltage of the HO2 sensor when the engine rpm is suddenly increased.
   HINT:
   Quickly accelerate the engine to 4,000 rpm 3 times using the accelerator pedal.
   Standard voltage:
   Fluctuates between 0.4 V or less and 0.5 V or more.

NG → Go to step 14

OK

8 PERFORM CONFIRMATION DRIVING PATTERN

NEXT
9 CHECK WHETHER DTC OUTPUT RECURS (DTC P0136)

(a) On the intelligent tester, select the following menu items:
DIAGNOSIS / ENHANCED OBD II / DTC INFO /
CURRENT CODES.
(b) Read DTCs.

Result

<table>
<thead>
<tr>
<th>Display (DTC Output)</th>
<th>Proceed To</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0136</td>
<td>A</td>
</tr>
<tr>
<td>No output</td>
<td>B</td>
</tr>
</tbody>
</table>

A

B CHECK FOR INTERMITTENT PROBLEMS

10 REPLACE HEATED OXYGEN SENSOR

NEXT

11 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

12 CHECK WHETHER DTC OUTPUT RECURS (DTC P0136)

(a) On the intelligent tester, select the following menu items:
DIAGNOSIS / ENHANCED OBD II / DTC INFO /
CURRENT CODES.
(b) Read DTCs.

Result

<table>
<thead>
<tr>
<th>Display (DTC Output)</th>
<th>Proceed To</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0136</td>
<td>A</td>
</tr>
<tr>
<td>No output</td>
<td>B</td>
</tr>
</tbody>
</table>

B REPAIR COMPLETE

A
(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester ON.
(c) Warm up the engine.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INJ VOL.
(e) Change the fuel injection volume using the tester, monitoring the voltage output of Air-Fuel Ratio (A/F) and HO2 sensors displayed on the tester.

HINT:
- Change the fuel injection volume within the range of -12 % and +12 %. The injection volume can be changed in 1 % graduations within the range.
- The A/F sensor is displayed as AFS B1 S1, and the HO2 sensor is displayed as O2S B1 S2, on the intelligent tester.

**Result**

<table>
<thead>
<tr>
<th>Tester Display (Sensor)</th>
<th>Voltage Variations</th>
<th>Proceed To</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFS B1 S1 (A/F)</td>
<td>Alternates between more and less than 3.3 V</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>Remains at more than 3.3 V</td>
<td>NG</td>
</tr>
<tr>
<td></td>
<td>Remains at less than 3.3 V</td>
<td>NG</td>
</tr>
</tbody>
</table>

HINT:
A normal HO2 sensor voltage (O2S B1 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either less or more than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

**NG** REPLACE AIR-FUEL RATIO SENSOR
CHECK AND REPAIR EXTREMELY RICH OR LEAN ACTUAL AIR-FUEL RATIO (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

14 CHECK FOR EXHAUST GAS LEAK

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

15 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE) (See page ES-89)

NG → REPLACE HEATED OXYGEN SENSOR

16 INSPECT INTEGRATION RELAY (EFI RELAY) (See page ES-84)

NG → REPLACE INTEGRATION RELAY (EFI RELAY)

OK
(a) Disconnect the B19 HO2 sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the +B terminal of the HO2 sensor connector and body ground.

**Standard voltage**

<table>
<thead>
<tr>
<th>Tester Connections</th>
<th>Specified Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>B19-2 (+B) - Body ground</td>
<td>9 to 14 V</td>
</tr>
</tbody>
</table>

(d) Turn the ignition switch OFF.
(e) Disconnect the B30 ECM connector.
(f) Measure the resistance.

**Standard resistance (Check for open)**

<table>
<thead>
<tr>
<th>Tester Connections</th>
<th>Specified Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>B19-1 (HT1B) - B30-47 (HT1B)</td>
<td>Below 1 Ω</td>
</tr>
<tr>
<td>B19-3 (OX1B) - B30-64 (OX1B)</td>
<td>Below 1 Ω</td>
</tr>
<tr>
<td>B19-4 (E2) - B30-87 (EX1B)</td>
<td>Below 1 Ω</td>
</tr>
</tbody>
</table>

(g) Reconnect the HO2 sensor connector.
(h) Reconnect the ECM connector.

Reference (System Diagram of Sensor 2):
NG
REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR