Last Modified: 2-3-2017	6.6 C	**Doc ID:** RM000000PFA02FX
Model Year Start: 2007	**Model:** IS250	**Prod Date Range:** [07/2006 -]
Title: 4GR-FSE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0037,P0038,P0057,P0058,P0141,P0161; Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2); 2007 MY IS250 [07/2006 -]		

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	**P0057**	**Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)**
DTC	**P0058**	**Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)**
DTC	**P0141**	**Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)**
DTC	**P0161**	**Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)**

DESCRIPTION

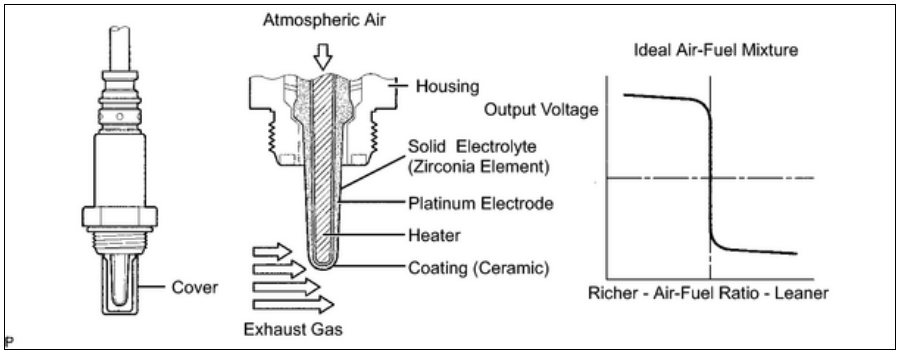
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC (Three-Way Catalytic Converter) is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always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

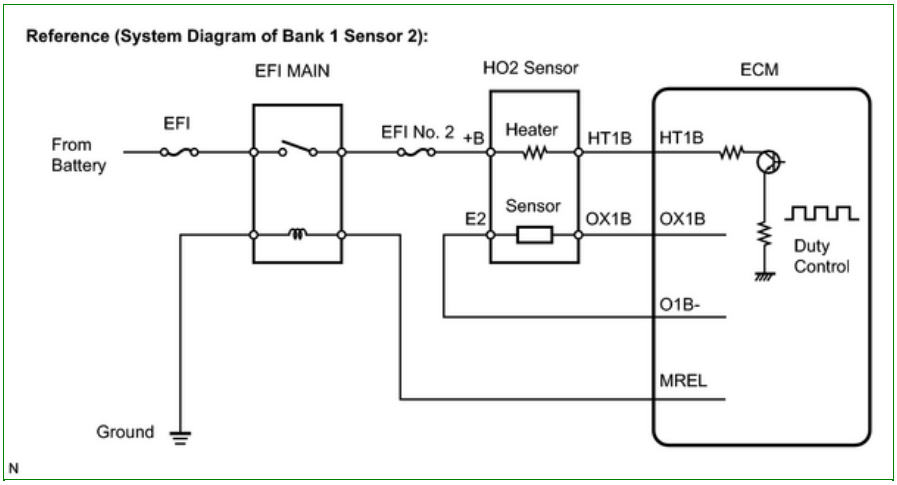
The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations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



HINT:

- Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) 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 (HO2) Sensor heater in fail-safe mode. Fail-safe mode continues until the engine switch is turned off.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the B+ side of the circuit.



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0037 P0057	Heated Oxygen (HO2) sensor heater current less than 0.3 A (1 trip detection logic)	• Open in HO2 sensor heater circuit • HO2 sensor heater • Integration relay • ECM
P0038 P0058	Heated Oxygen (HO2) sensor heater current more than 2 A (1 trip detection logic)	• Short in HO2 sensor heater circuit • HO2 sensor heater • Integration relay • ECM
P0141 P0161	Cumulative heater resistance correction value exceeds the acceptable threshold (1 trip detection logic)	• Open or short in HO2 sensor heater • HO2 sensor heater • ECM

HINT:

- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- 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 position of the Heated Oxygen (HO2) 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, P0057 and P0058):

The ECM monitors the current applied to the O2 sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

Example:

The ECM sets DTC P0038 or P0058 when the current in the HO2 sensor heater is more than 2 A. Conversely, when the heater current is less than 0.3 A, DTC P0037 or P0057 is set.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the HO2S heater and set DTC P0141 and P0161.

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater (bank 1 sensor 2) open/short (Low electrical current) P0038: Heated oxygen sensor heater (bank 1 sensor 2) open/short (High electrical current) P0057: Heated oxygen sensor heater (bank 2 sensor 2) open/short (Low electrical current) P0058: Heated oxygen sensor heater (bank 2 sensor 2) open/short (High electrical current) P0141: Heated oxygen sensor heater performance (bank 1 sensor 2) P0161: Heated oxygen sensor heater performance (bank 2 sensor 2)
Required sensors / components (Main)	Heated oxygen sensor heater (bank 1 sensor 2) Heated oxygen sensor heater (bank 2 sensor 2)
Required sensors / components (Sub)	-
Frequency of operation	Continuous: P0037, P0038, P0057 and P0058 Once per driving cycle: P0141 and P0161
Duration	0.5 seconds: P0037 and P0038 Within: 1 second: P0037, P0038, P0057 and P0058 10 seconds: P0141 and P0161
MIL operation	Immediate: P0037, P0038, P0057 and P0058 2 driving cycles: P0141 and P0161
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	None

P0037 and P0057:

Battery voltage	10.5 to 20 V

P0038 and P0058 (Case 1):

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF

P0038 and P0058 (Case 2):

Battery voltage	10.5 to 20 V

P0141 and P0161 (Heater performance monitor check):

Monitor runs whenever following DTCs not present	None
One of the following conditions is met:	Condition A or B
A. All of the following conditions are met:	Conditions 1, 2, 3, 4 and 5
1. Battery voltage	10.5 V or more
2. Fuel cut	OFF
3. Time after fuel cut ON to OFF	30 seconds or more
4. Accumulated heater ON time	100 seconds or more
5. Learned heater OFF current operation	Completed
B. Duration that rear heated oxygen sensor impedance is less than 15 kΩ	2 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0037 and P0057:

Heater current	Less than 0.3 A

P0038 and P0058:

One of the following conditions is met:	Condition A or B
A. Learned heater OFF current	More than 2 A
B. Heater current	2 A or more

P0141 and P0161 (Heater performance monitor check):

Accumulated heater resistance	Varies with sensor element temperature (Example: More than 23 ohm)

COMPONENT OPERATING RANGE

Heated oxygen (HO2) sensor heater current	0.4 to 1 A (when engine idles, HO2 sensor warmed up and battery voltage 11 to 14 V)

MONITOR RESULT

Refer to CHECKING MONITOR STATUS INFO .

WIRING DIAGRAM

Refer to DTC P0136 INFO .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. 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 INFO .

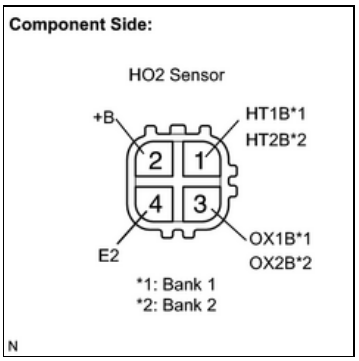
PROCEDURE

1.	**INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)**

(a) Disconnect the J68*1 or J40*2, Q4*3 heated oxygen (HO2) sensor connectors.

HINT:

- *1: Bank 1 Sensor 2
- *2: Bank 2 Sensor 2 (2WD)
- *3: Bank 2 Sensor 2 (4WD)



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

Standard resistance (Bank 1 sensor 2):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
HT1B (1) - +B (2)	20°C (68°F)	11 to 16 Ω
HT1B (1) - E2 (4)	-	10 kΩ or higher

Standard resistance (Bank 2 sensor 2):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION

HT2B (1) - +B (2)	20°C (68°F)	11 to 16 Ω
HT2B (1) - E2 (4)	-	10 kΩ or higher

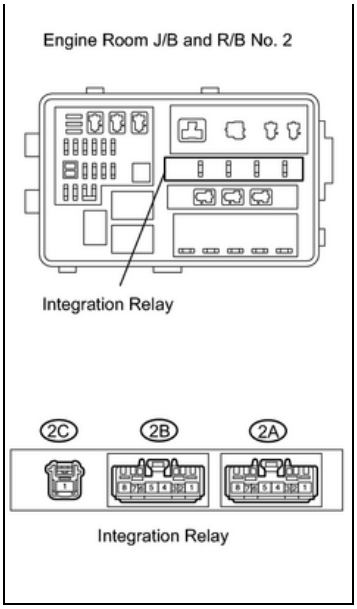
(c) Reconnect the HO2 sensor connector.

NG ▶ **REPLACE HEATED OXYGEN SENSOR**

OK ▼

2.	**INSPECT INTEGRATION NO.1 RELAY (EFI MAIN RELAY)**

(a) Remove the integration relay from the engine room J/B and R/B No. 2.



(b) Inspect the EFI MAIN relay.

Standard resistance:

TERMINAL CONNECTION	SPECIFIED CONDITION
2A-8 - 2A-5	10 kΩ or higher
2A-8 - 2A-5	Below 1 Ω (when battery voltage applied to terminals 2A-7 and 2A-6)

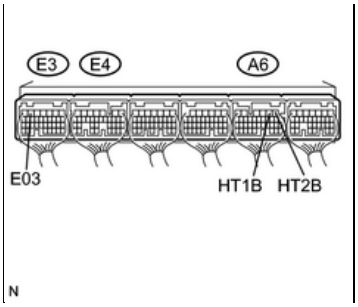
(c) Reinstall the integration relay.

NG ▶ **REPLACE INTEGRATION NO.1 RELAY**

OK ▼

3.	**INSPECT ECM (HT1B OR HT2B VOLTAGE)**

(a) Turn the engine switch on (IG).



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

Standard voltage:

TERMINAL CONNECTION	SPECIFIED CONDITION
HT1B (A6-2) - E03 (E8-6)	9 to 14 V
HT2B (A6-1) - E03 (E8-6)	9 to 14 V

HINT:

- The HT1B means the heated oxygen sensor bank 1 sensor 2.
- The HT2B means the heated oxygen sensor bank 2 sensor 2.

OK ▶ **REPLACE ECM**

NG ▼

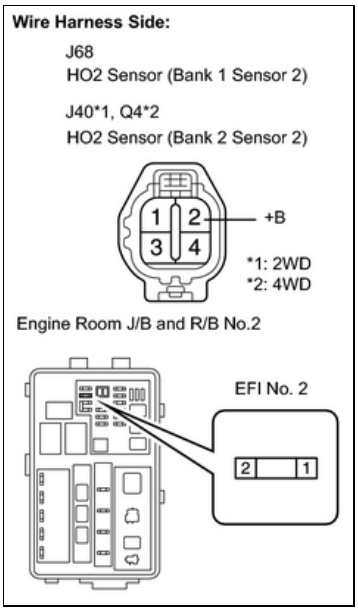
4.	**CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - EFI NO. 2 FUSE)**

(a) Check the harness and connector between the HO2 sensor and EFI No. 2 fuse.

(1) Disconnect the J68*1 or J40*2 or Q4*3 HO2 sensor connector.

HINT:

- *1: Bank 1 Sensor 2
- *2: Bank 2 Sensor 2 (2WD)
- *3: Bank 2 Sensor 2 (4WD)



(2) Remove the EFI No. 2 fuse from the engine room J/B and R/B No. 2.

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

Standard resistance (Check for open):

TERMINAL CONNECTION	SPECIFIED CONDITION
+B (J68-2) - EFI No. 2 fuse (2)	Below 1 Ω
+B (J40-2) - EFI No. 2 fuse (2)	Below 1 Ω
+B (Q4-2) - EFI No. 2 fuse (2)	Below 1 Ω

Standard resistance (Check for short):

TERMINAL CONNECTION	SPECIFIED CONDITION
+B (J68-2) or EFI No .2 fuse (2) - Body ground	10 kΩ or higher
+B (J40-2) or EFI No. 2 fuse (2) - Body ground	10 kΩ or higher
+B (Q4-2) or EFI No. 2 fuse (2) - Body ground	10 kΩ or higher

(4) Reconnect the HO2 sensor connector.

(5) Reconnect the EFI No. 2 fuse.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▼

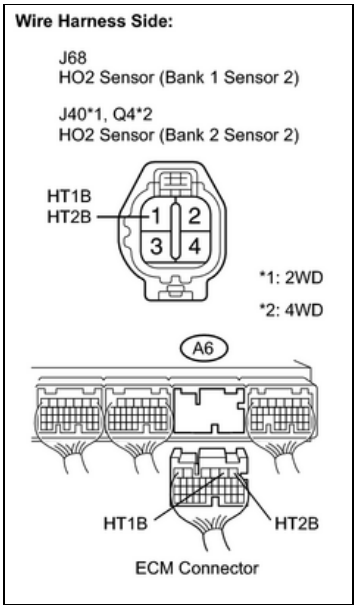
5.	CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)

(a) Check the harness and connector between the ECM and HO2 sensor.

(1) Disconnect the J68*1 or J40*2 or Q4*3 HO2 sensor connector.

HINT:

- *1: Bank 1 Sensor 2
- *2: Bank 2 Sensor 2 (2WD)
- *3: Bank 2 Sensor 2 (4WD)



(2) Disconnect the A6 ECM connector.

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

Standard resistance (Check for open):

TERMINAL CONNECTION	SPECIFIED CONDITION
HT1B (J68-1) - HT1B (A6-2)	Below 1 Ω
HT2B (J40-1) - HT2B (A6-1)	Below 1 Ω
HT2B (Q4-1) - HT2B (A6-1)	Below 1 Ω

Standard resistance (Check for short):

TERMINAL CONNECTION	SPECIFIED CONDITION
HT1B (J68-1) or HT1B (A6-2) - Body ground	10 kΩ or higher
HT2B (J40-1) or HT2B (A6-1) - Body ground	10 kΩ or higher
HT2B (Q4-1) or HT2B (A6-1) - Body ground	10 kΩ or higher

(4) Reconnect the HO2 sensor connector.

(5) Reconnect the ECM connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK ▶ **REPLACE ECM**