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Model Year Start: 2010	**Model:** GX460	**Prod Date Range:** [11/2009 -]
Title: 1UR-FE ENGINE CONTROL: SFI SYSTEM: P0031,P0032,P0051,P0052,P101D,P103D; Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1); 2010 MY GX460 [11/2009 -]		

DTC	**P0031**	**Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)**

DTC	**P0032**	**Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)**

DTC	**P0051**	**Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)**

DTC	**P0052**	**Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)**

DTC	**P101D**	**A/F Sensor Heater Circuit Performance Bank 1 Sensor 1 Stuck ON**

DTC	**P103D**	**A/F Sensor Heater Circuit Performance Bank 2 Sensor 1 Stuck ON**

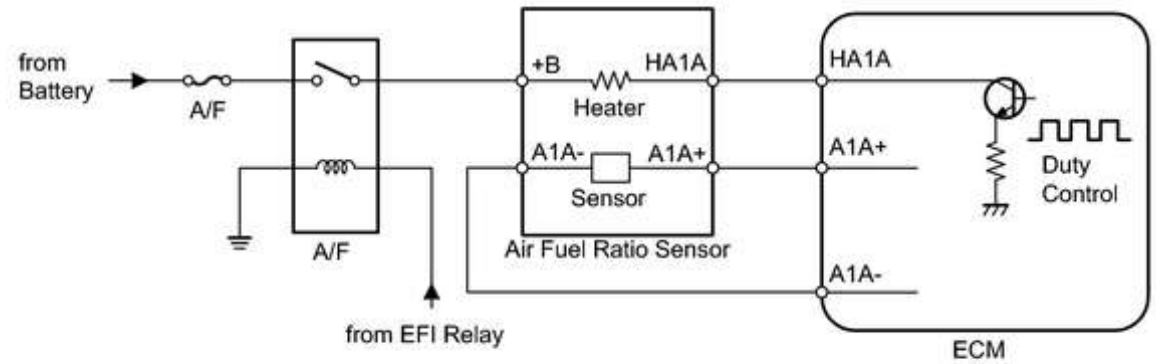
DESCRIPTION

Refer to DTC P2195 INFO .

HINT:

- Although the DTC titles say oxygen sensor, these DTCs relate to the air fuel ratio sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-way Catalytic Converter (TWC) and located near the engine assembly.
- When one of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the air fuel ratio sensor heater in fail-safe mode. The ECM continues operating in fail-safe mode until the engine switch is turned off.
- The ECM provides a pulse-width modulated control circuit to adjust the current through the heater. The air fuel ratio sensor heater circuit uses a relay on the +B side of the circuit.

Reference (System Diagram):



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0031 P0051	Air fuel ratio sensor heater current is below 0.8 A, even when the air fuel ratio sensor heater duty cycle is 50% or more (1 trip detection logic).	• Open in air fuel ratio sensor heater circuit • Air fuel ratio sensor heater (for Sensor 1) • No. 1 integration relay • ECM
P0032 P0052	Air fuel ratio sensor heater current reaches the high limit (Hybrid IC high current limiter port "Fail") (1 trip detection logic).	• Short in air fuel ratio sensor heater circuit • Air fuel ratio sensor heater (for Sensor 1) • No. 1 integration relay • ECM
P101D P103D	The heater current is higher than the specified value while the heater is not operating (1 trip detection logic).	ECM

MONITOR DESCRIPTION

The ECM uses information from the air fuel ratio sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-way Catalytic Converter (TWC) to purify the exhaust gases.

The air fuel ratio sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.

The air fuel ratio sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the air fuel ratio sensor becomes inaccurate. As a result, the ECM is unable to regulate the air-fuel ratio properly.

When the current in the air fuel ratio sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

MONITOR STRATEGY

Related DTCs	P0031: Air fuel ratio sensor heater (for Bank 1) open/short (Low electrical current) P0032: Air fuel ratio sensor heater (for Bank 1) open/short (High electrical current) P0051: Air fuel ratio sensor heater (for Bank 2) open/short (Low electrical current) P0052: Air fuel ratio sensor heater (for Bank 2) open/short (High electrical current) P101D: Air fuel ratio sensor heater (for Bank 1) performance P103D: Air fuel ratio sensor heater (for Bank 2) performance
Required Sensors/Components (Main)	Air fuel ratio sensor heater
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	11 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0031 and P0051

Monitor runs whenever following DTCs not stored	P101D, P103D (Air fuel ratio sensor heater)
Battery voltage	10.5 V or higher
Time after engine start	10 seconds or more
Air fuel ratio sensor heater duty cycle	50% or more

P0032 and P0052

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Time after engine start	10 seconds or more
Air fuel ratio sensor heater duty cycle	More than 0%

P101D and P103D

Monitor runs whenever following DTCs not stored	P0031, P0051 (Air fuel ratio sensor heater)
Battery voltage	10.5 V or higher
Time after engine start	10 seconds or more
Air fuel ratio sensor heater duty cycle	10 to 60%
Air fuel ratio sensor heater ON current	0.8 A or higher

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0051

Air fuel ratio sensor heater current	Below 0.8 A

P0032 and P0052

Hybrid IC high current limiter port	Fail

P101D and P103D

Hybrid IC high current limiter port	Fail

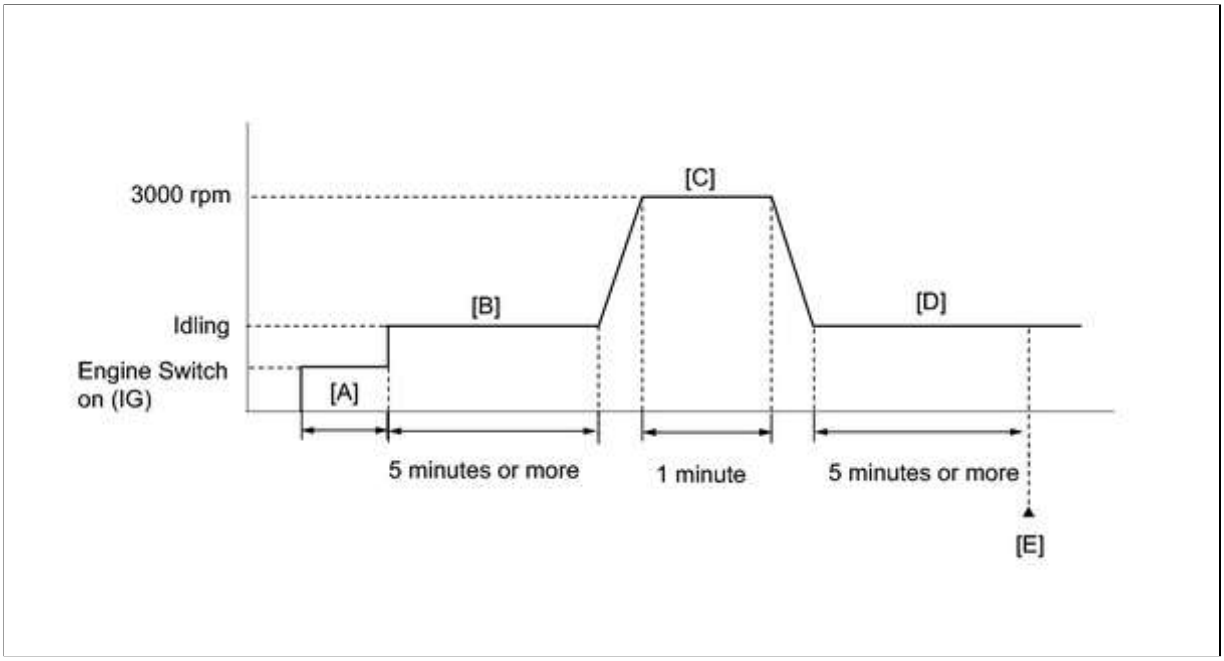
COMPONENT OPERATING RANGE

Air fuel ratio sensor heater current	0.8 A or higher

HINT:

Refer to "Data List / Active Test" [A/F Heater Duty #1, A/F Heater Duty #2] INFO .

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the engine switch on (IG) and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).
4. Turn the engine switch off and wait for at least 30 seconds.
5. Turn the engine switch on (IG) and turn the Techstream on [A].
6. Start the engine and idle it for 5 minutes or more [B].

7. With the vehicle stationary, depress the accelerator pedal and maintain an engine speed of 3000 rpm for 1 minute [C].
8. Idle the engine for 5 minutes or more [D].
9. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes [E].
10. Read the pending DTCs.

HINT:

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

11. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
12. Input the DTC: P0031, P0032, P0051, P0052, P101D or P103D.
13. 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 NORMAL, the system is normal.
- If the judgment result shows ABNORMAL, the system has a malfunction.

14. If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [E] again.
15. If 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 P2195 INFO .

INSPECTION PROCEDURE

NOTICE:

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

HINT:

- Read freeze frame data using the Techstream. 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.
- Bank 1 refers to the bank that includes the No. 1 cylinder*.

  *: The No. 1 cylinder is the cylinder which is farthest from the transmission.
- Bank 2 refers to the bank that does not include the No. 1 cylinder.

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

PROCEDURE

1.	**INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)**

(a) Inspect the air fuel ratio sensor INFO .

NG ▶ **REPLACE AIR FUEL RATIO SENSOR**

OK ▼

2.	**CHECK TERMINAL VOLTAGE (+B OF AIR FUEL RATIO SENSOR)**

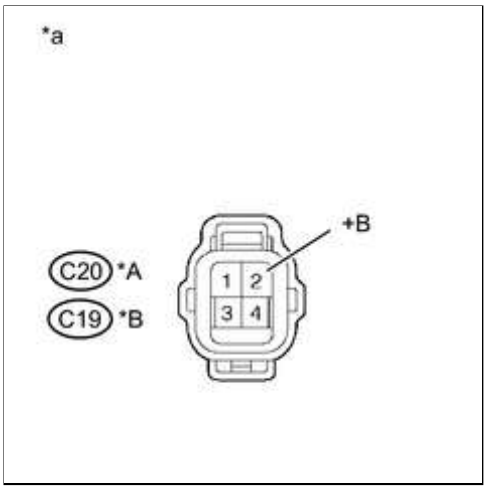
(a) Disconnect the air fuel ratio sensor connector.

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

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

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
C20-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V
C19-2 (+B) - Body ground	Engine switch on (IG)	11 to 14 V



Text in Illustration

*A	Bank 1
*B	Bank 2
*a	Front view of wire harness connector (to Air Fuel Ratio Sensor)

NG ▶ **GO TO STEP 5**

OK ▼

3.	**CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)**

(a) Disconnect the air fuel ratio sensor connector.

(b) Disconnect the ECM connector.

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

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
C20-1 (HA1A) - C31-17 (HA1A)	Always	Below 1 Ω
C19-1 (HA2A) - C31-19 (HA2A)	Always	Below 1 Ω
C20-1 (HA1A) or C31-17 (HA1A) - Body ground	Always	10 kΩ or higher
C19-1 (HA2A) or C31-19 (HA2A) - Body ground	Always	10 kΩ or higher

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

OK ▼

4.	**CHECK WHETHER DTC OUTPUT RECURS**

(a) Connect the Techstream to the DLC3.

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

(c) Turn the Techstream on.

(d) Clear DTCs INFO .

(e) Start the engine.

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

(g) Read the output pending DTCs using the Techstream.

Result

RESULT	PROCEED TO
No pending DTC is output	A
Pending DTC P0031, P0032, P0051, P0052, P101D or P103D is output	B

B ▶ **REPLACE ECM**

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

5.	**INSPECT NO. 1 INTEGRATION RELAY (A/F)**

(a) Inspect the No. 1 integration relay (A/F) INFO .

NG ▶ REPLACE NO. 1 INTEGRATION RELAY (A/F)

OK ▼

6.	**CHECK HARNESS AND CONNECTOR (NO. 1 INTEGRATION RELAY - AIR FUEL RATIO SENSOR AND BODY GROUND)**

(a) Disconnect the air fuel ratio sensor connector.

(b) Remove the No. 1 integration relay from the engine room relay block.

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

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
C20-2 (+B) - 1B-8	Always	Below 1 Ω
C19-2 (+B) - 1B-8	Always	Below 1 Ω
1B-7 - Body ground	Always	Below 1 Ω
C20-2 (+B) or 1B-8 - Body ground	Always	10 kΩ or higher
C19-2 (+B) or 1B-8 - Body ground	Always	10 kΩ or higher

NG ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR

OK ▶ CHECK ECM POWER SOURCE CIRCUIT