DTC	P2A00	A/F SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 1)

DTC	P2A03	A/F SENSOR CIRCUIT SLOW RESPONSE (BANK 2 SENSOR 1)

HINT:

- DTC P2A00 is a malfunction related to the bank 1 A/F sensor.
- DTC P2A03 is a malfunction related to the bank 2 A/F sensor.

CIRCUIT DESCRIPTION

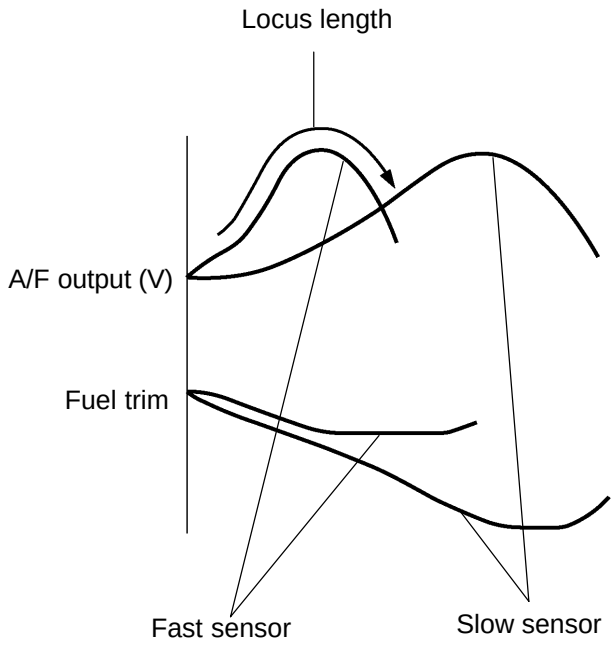
Refer to DTC P2195 on page 05−771.

DTC No.	DTC Detecting Condition	Trouble Area
P2A00 P2A03	When A/F sensor output voltage change is below expected compared to fuel trim change, ECM judges that A/F sensor circuit has slow response if conditions (a), (b) and (c) are met: (2 trip detection logic) (a) After engine is warmed up (b) During vehicle driving with engine speed 1,400 rpm or more (c) Vehicle speed 25 mph (40 km/h) or more	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater • A/F HTR relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM

HINT:

- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.
- Sensor 1 refers to the sensor closest to the engine assembly.

MONITOR DESCRIPTION



The air fuel ratio (A/F) sensor varies its output voltage in proportion to the air−fuel ratio. Based on the output voltage, the ECM determines if the air−fuel ratio is RICH or LEAN and adjusts the stoichiometric air−fuel ratio. The ECM also checks the fuel injection volume compensation value to check if the A/F sensor is deteriorating or not. The output voltage variation, known as locus length, should be high when the air−fuel ratio fluctuates. When the A/F sensor response rate has deteriorated, the locus length should be short.
The ECM concludes that there is a malfunction in the ratio of the A/F sensor when the locus length is short and the response rate has deteriorated.

MONITOR STRATEGY

Related DTCs	P2A00: A/F sensor (Bank 1) Slow Response P2A03: A/F sensor (Bank 2) Slow Response
Required sensors / components (Main)	A/F sensor
Required sensors / components (Related)	Vehicle speed sensor, Crankshaft position sensor
Frequency of operation	Once per driving cycle
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	See page 05−507
Engine condition	Running
Time after engine start	120 seconds or more
Fuel system status	Closed Loop
A/F sensor status	Activated
Idle	OFF

Time after idle OFF	2 seconds or more
Engine RPM	1,400 to 3,200 rpm
Vehicle speed	37.5 to 75 mph (60 to 120 km/h)
Time after fuel cut is OFF	2 seconds or more
Driving for 20 seconds or more	25 mph(40 km/h) or more and 900 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	6.0 or more

MONITOR RESULT

Refer to page 05−516 for detailed information.

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (see page 05−518).

- TID (Test Identification Data) is assigned to each emissions−related component.
- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID $06: A/F sensor

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
0	$01	Multiply by 0.000244 (no dimension)	Parameter for identify A/F sensor response rate (Bank 1)	Malfunction threshold for A/F sensor deterioration
0	$11	Multiply by 0.000244 (no dimension)	Parameter for identify A/F sensor response rate (Bank 2)	Malfunction threshold for A/F sensor deterioration

WIRING DIAGRAM

Refer to DTC P2195 on page 05−771.

INSPECTION PROCEDURE

HINT:

Hand−held tester only:

It is possible the malfunctioning area can be found using the ACTIVE TEST A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble areas are malfunctioning or not.

(a) Perform the ACTIVE TEST A/F CONTROL operation.

HINT:

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

(1) Connect the hand−held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
(4) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(5) Perform the A/F CONTROL operation with the engine idle (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:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Mainly suspected 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 0.4V **OK**	—
Case 2	Injection volume +25 % −12.5 % Output voltage Almost No reaction **NG**	Injection volume +25 % −12.5 % Output voltage More than 0.55 V Less than 0.4V **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 3.0V **OK**	Injection volume +25 % −12.5 % Output voltage Almost No reaction **NG**	Heated oxygen sensor (heated oxygen sensor, heater, heated oxygen sensor circuit)
Case 4	Injection volume +25 % −12.5 % Output voltage Almost No reaction **NG**	Injection volume +25 % −12.5 % Output voltage Almost 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 outputs of both the A/F sensor and the heated oxygen sensor.
For displaying the graph, enter ”ACTIVE TEST / A/F CONTROL / USER DATA”, select ”AFS B1S1 and O2S B1S2” by pressing ”YES” and push ”ENTER”. Then press ”F4”.
HINT:

- DTC P2A00 or P2A03 may be also detected, when the air fuel ratio is stuck rich or lean.
- 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 with a RICH air−fuel mixture.
- 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 with a LEAN air−fuel mixture.
- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO A/F SENSOR DTC)

(a) Read the DTC using the hand−held tester or the OBD II scan tool.

Result :

Display	Proceed to
DTC P2A00 and/or P2A03 are output.	A
DTC P2A00 and/or P2A03 and other codes are output.	B

HINT:

If any other code besides P2A00 and/or P2A03 are output, perform the troubleshooting for those codes first.

B → **GO TO RELEVANT DTC CHART (See page 05−543)**

A

2	READ VALUE OF HAND−HELD TESTER OR OBD II SCAN TOOL (OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the hand−held tester or the OBD II scan tool to the DLC3.

(b) Warm up the A/F sensors (bank 1 sensor1 and bank 2 sensor 1) by running the engine at 2,500 rpm for approximately 90 seconds.

(c) Read A/F sensor voltage output on the hand−held tester or the OBD II scan tool.

(d) Hand−held tester only:
On the hand−held tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA. Read the values.

(e) Select ”AFS B1 S1 or AFS B2 S1 / ENGINE SPD” and press YES.

(f) Monitor the A/F sensor voltage carefully.

(g) Check the A/F sensor voltage output under the following conditions:

(1) Allow the engine to idle for 30 seconds.

(2) Run the engine at approximately 2,500 rpm. Do not suddenly change the rpm.

(3) Raise the engine speed to 4,000 rpm and quickly release the accelerator pedal so that the throttle is fully closed.

Standard:

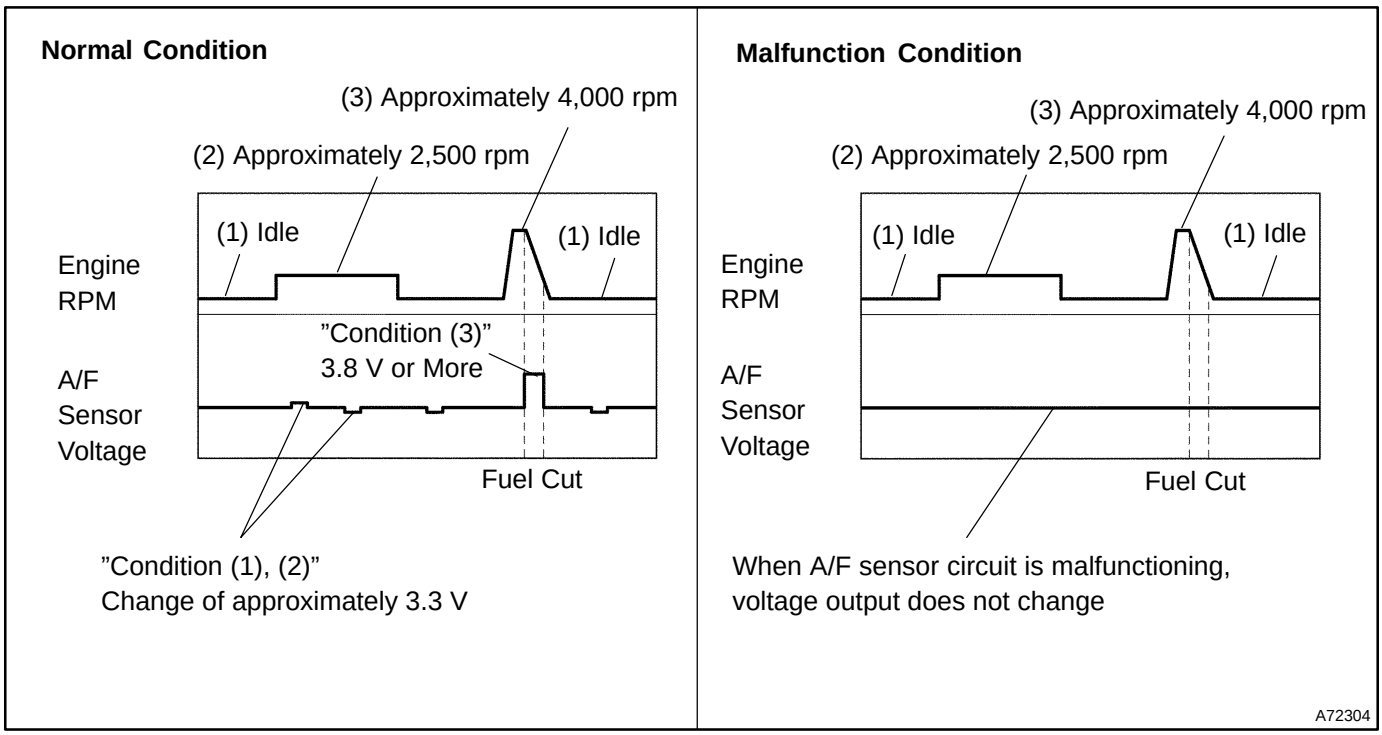
Condition (1) and (2)

Voltage change of 3.3 V (0.66 V)* (between approximately 3.1 to 3.5 V) as shown in the illustration.

Condition (3)

A/F sensor voltage increases to 3.8 V (0.76 V)* or more when fuel is cut during engine deceleration as shown in the illustration.

***: Voltage when using the OBD II scan tool.**



HINT:

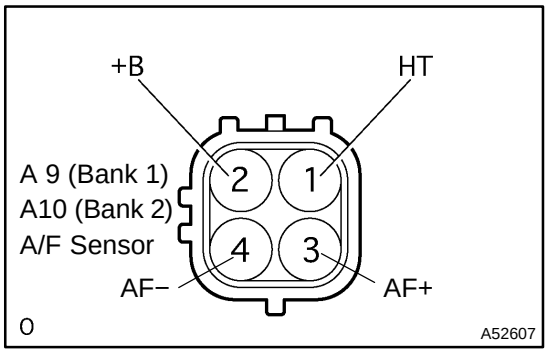
- Whenever the A/F sensor output voltage remains at approximately 3.3 V (0.660 V)* (see "Malfunction Condition" graphic) under any condition as well as the above conditions, the A/F sensor may have an open circuit. This will happen also when the A/F sensor heater has an open circuit.
- Whenever the A/F sensor output voltage remains at a certain value of approximately 3.8 V (0.76 V)* or more, or 2.8 V (0.56 V)* or less (see "Malfunction Condition" graphic) under any condition as well as the above conditions, the A/F sensor may have a short circuit.
- The ECM will stop fuel injection (fuel is cut) during engine deceleration. This will cause a LEAN condition and should result in a momentary increase in A/F sensor output voltage.
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal has been disconnected, the vehicle must be driven over 10 mph to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V (0.76 V)* during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F sensor or ECM, you will observe a constant voltage.

*: Voltage when using the OBD II scan tool.

OK	**Go to step 14**

NG

3 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



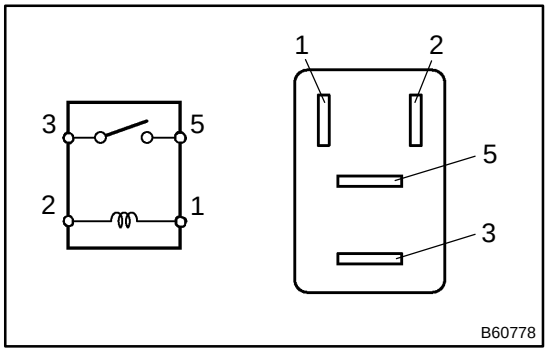
(a) Disconnect the A9 or A10 A/F sensor connector.
(b) Check the resistance of the A/F sensor terminals.
Standard:

Tester Connection	Condition	Specified Condition
1 (HT) − 2 (+B)	20°C (68°F)	0.8 to 1.4 Ω
1 (HT) − 2 (+B)	800°C (1,472°F)	1.8 to 3.4 Ω

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

4 INSPECT RELAY (A/F HTR)



(a) Remove the A/F HTR relay from the engine room R/B.
(b) Check the resistance of the A/F HTR relay.
Standard:

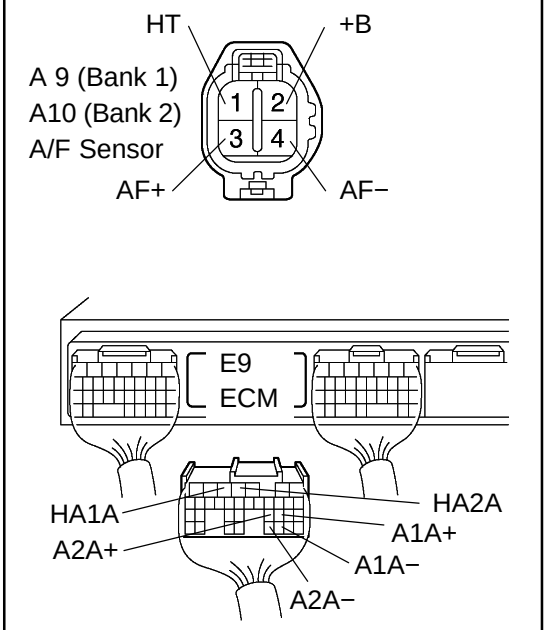
Tester Connection	Specified Condition
3 − 5	10 kΩ or higher
3 − 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE RELAY**

OK

5 CHECK WIRE HARNESS (A/F SENSOR − ECM)

Wire Harness Side

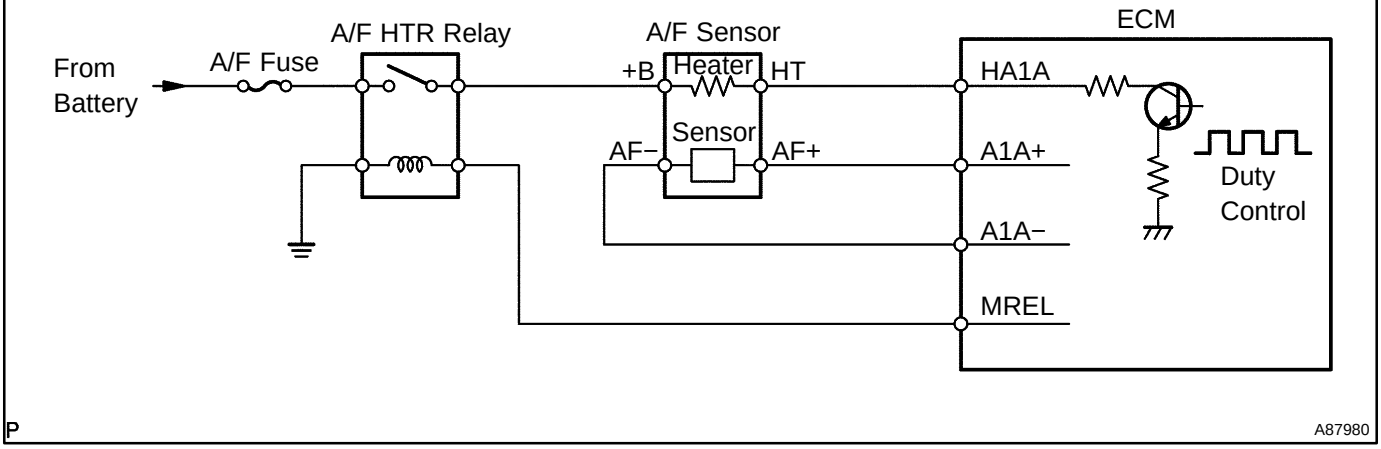


(a) Disconnect the A9 or A10 A/F sensor connector.
(b) Disconnect the E9 ECM connector.
(c) Check the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
A9−3 (AF+) − E9−22 (A1A+) A9−4 (AF−) − E9−30 (A1A−) A9−1 (HT) − E9−5 (HA1A) A10−3 (AF+) − E9−23 (A2A+) A10−4 (AF−) − E9−31 (A2A−) A10−1 (HT) − E9−4 (HA2A)	Below 1 Ω
A9−3 (AF+) or E9−22 (A1A+) − Body ground A9−4 (AF−) or E9−30 (A1A−) − Body ground A9−1 (HT) or E9−5 (HA1A) − Body ground A10−3 (AF+) or E9−23 (A2A+) − Body ground A10−4 (AF−) or E9−31 (A2A−) − Body ground A10−1 (HT) or E9−4 (HA2A) − Body ground	10 kΩ or higher

Reference (Bank 1 Sensor 1 System Drawing)



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

6	CHECK AIR INDUCTION SYSTEM

(a) Check for vacuum leaks in the air induction system.

OK: There is no leak in air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

7	CHECK CONNECTION OF PCV HOSE

OK: PCV hose is connected correctly. And PCV hose has no damage.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

8	CHECK FUEL PRESSURE (See page 11−29)

(a) Check fuel pressure (high or low fuel pressure).

Standard:

Fuel pressure: 304 to 343 kPA (3.1 to 3.5 kgf/cm^2, 44 to 55 psi).

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

9	INSPECT FUEL INJECTOR ASSY (See page 11−32)

(a) Check injector injection (high or low fuel injection quantity or poor injection pattern).

Standard:

Injection volume	Difference between each injector
60 to 73 cm^3 (3.7 to 4.5 cu in.) per 15 seconds	13 cm^3 (0.8 cu in.) or less

NG → **REPLACE FUEL INJECTOR ASSY (See page 11−38)**

OK

10	REPLACE AIR FUEL RATIO SENSOR

GO

11	PERFORM CONFIRMATION DRIVING PATTERN (See page 05−771)

HINT:

Clear all DTCs prior to performing the confirmation driving pattern (see page 05−771).

GO

12	READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the hand−held tester or the OBD II scan tool.

Result :

Display	Proceed to
DTC P2A00 and/or P2A03 are not output	A
DTC P2A00 and/or P2A03 are output again	B

B → **REPLACE ECM (See page 10−25) AND PERFORM CONFIRMATION DRIVING PATTERN (See page 05−771)**

A

13	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05−500)**

YES

DTC IS CAUSED BY RUNNING OUT OF FUEL

14	PERFORM CONFIRMATION DRIVING PATTERN (See page 05−771)

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (see page 05−771).

GO

15	READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the hand−held tester or the OBD II scan tool.

Result :

Display	Proceed to
DTC P2A00 and/or P2A03 are not output	A
DTC P2A00 and/or P2A03 are output	B

B → **Go to step 19**

A

16	REPLACE AIR FUEL RATIO SENSOR

GO

17	PERFORM CONFIRMATION DRIVING PATTERN (See page 05−771)

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (see page 05−771).

GO

18	READ OUTPUT DTC (A/F SENSOR DTC OUTPUT AGAIN)

(a) Read the DTC using the hand−held tester or the OBD II scan tool.
Result:

Display	Proceed to
DTC P2A00 and/or P2A03 are output	A
DTC P2A00 and/or P2A03 are not output	B

B → **REPLACE ECM (See page 10−25) AND PERFORM CONFIRMATION DRIVING PATTERN (See page 05−771)**

A

19	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK: Vehicle has run out of fuel in past.

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05−500)**

YES

DTC IS CAUSED BY RUNNING OUT OF FUEL