DIDUI−01

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)

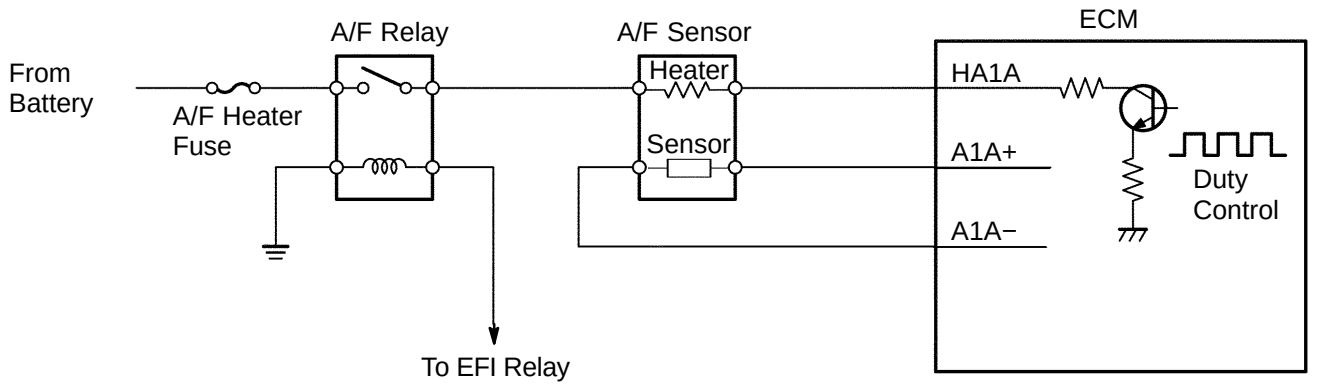
HINT:
Although each DTC title (DTC description) says ”oxygen sensor”, these DTCs are related to the ”A/F sensor”.

CIRCUIT DESCRIPTION

Refer to DTC P2195 on page DI−312.

HINT:
The ECM provides a pulse width modulated control circuit to adjust current through the heater. The A/F sensor heater circuit uses a relay on the B+ side of the circuit.

Reference (Bank 1 Sensor 1 System Drawing):



DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Heated current is 0.8 A or less when heater operates (1 trip detection logic)	• Open or short in heater circuit of A/F sensor • A/F sensor heater • A/F sensor heater relay • ECM
P0032 P0052	Hybrid IC high current limiter port is fail (1 trip detection logic)	

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 ECM uses the Air−Fuel Ratio sensor (A/F sensor) information to regulate the air−fuel ratio close to the stoichiomentric ratio. This maximizes the catalytic converter's ability to purify exhaust gases. The sensor detects oxygen levels in the exhaust gas and sends this signal to the ECM.

The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to 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 of the exhaust and the outside air. The platinum coating amplifies the voltage generation. When heated, the sensor becomes very efficient. If the temperature of the exhaust is low, the sensor will not generate useful voltage signals without supplemental heating. The ECM regulates the supplemental heating using a duty−cycle approach to regulate the average current in the heater element. If the heater current is out of the normal range, the sensor's output signals will be inaccurate and the ECM can not regulate the air−fuel ratio properly.

When the heater current is out of the normal operating range, the ECM interprets this as a malfunction and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0031	A/F sensor heater (Bank 1) range check (Low current)
	P0032	A/F sensor heater (Bank 1) range check (High current)
	P0051	A/F sensor heater (Bank 2) range check (Low current)
	P0052	A/F sensor heater (Bank 2) range check (High current)
Required sensors/components	Main sensors/components	A/F sensor heater
	Related sensors/components	−
Frequency of operation	Continuous	
Duration	10 sec.	
MIL operation	Immediate	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever these DTCs are not present	See page DI−18	
P0031, P0051 (Low current):		
Battery voltage	10.5 V	−
A/F sensor heater duty ratio	50%	−
Time after engine start	10 sec.	−
P0032, P0052 (High current):		
Time after engine start	10 sec.	−

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
P0031, P0051 (Low current):	
A/F sensor heater current	Less than 0.8 A
P0032, P0052 (High current):	
A/F sensor heater current	More than 10 A

COMPONENT OPERATING RANGE

Parameter	Standard Value
A/F sensor heater current	1.8 to 3.4 A at 20°C (68°F)

MONITOR RESULT

Refer to page DI−26 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 DI−27).

- 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.

TID $07: A/F sensor heater

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	$01	Multiply by 0.00017 (A)	Maximum heater current (Bank 1)	Malfunction criteria for A/F sensor heater
1	$10	Multiply by 0.00017 (A)	Maximum heater current (Bank 2)	Malfunction criteria for A/F sensor heater

WIRING DIAGRAM

Refer to DTC P2195 on page DI−312.

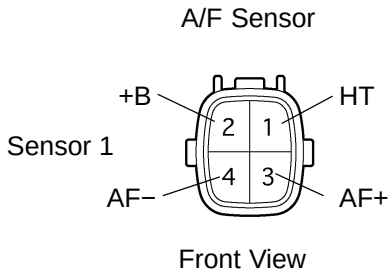
INSPECTION PROCEDURE

HINT:

Read freeze frame data using a hand−held tester. Freeze frame data record 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.

1	**Check resistance of air−fuel ratio (A/F) sensor heater.**

Component Side:



PREPARATION:

Disconnect the air−fuel ratio (A/F) sensor connector.

CHECK:

Measure resistance between the terminals of the A/F sensor connector.

OK:

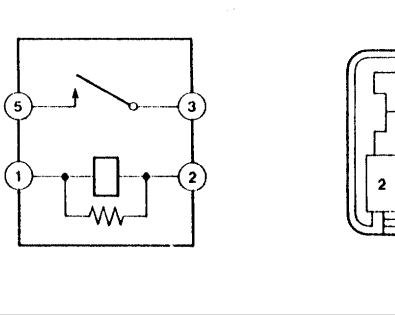
Standard:

Tester Connection	Specified Condition
HT (1) − +B (2)	1.8 Ω to 3.4 Ω at 20°C (68°F)
HT (1) − AF− (4)	10 kΩ or higher

NG	**Replace air−fuel ratio (A/F) sensor.**

OK

2	**Check A/F relay.**



PREPARATION:

Remove the A/F relay from the engine room J/B.

CHECK:

Inspect the A/F relay.

OK:

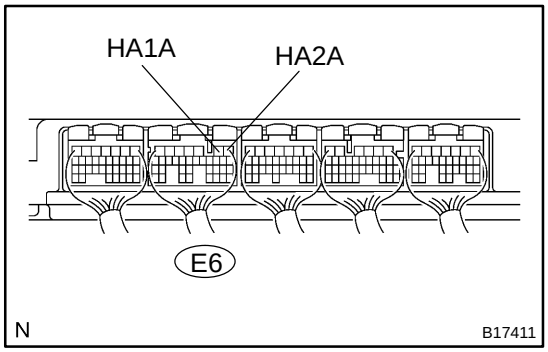
Standard:

Terminal No.	Condition	Specified Condition
3 − 5	Usually	10 KΩ or higher
3 − 5	Apply B+ between terminals 2 and 4	Below 1 Ω

NG	**Replace A/F relay.**

OK

3	**Check voltage between terminals HA1A, HA2A of ECM connectors and body ground.**



PREPARATION:

Turn the ignition switch to ON.

CHECK:

Measure the voltage between terminals of the ECM connectors and body ground.

HINT:

- Connect terminal HA1A to the bank 1 sensor 1.
- Connect terminal HA2A to the bank 2 sensor 1.

OK:

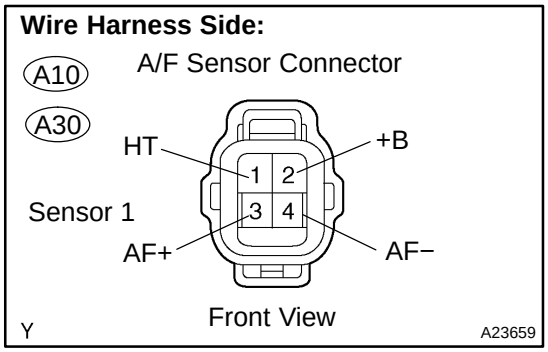
Standard:

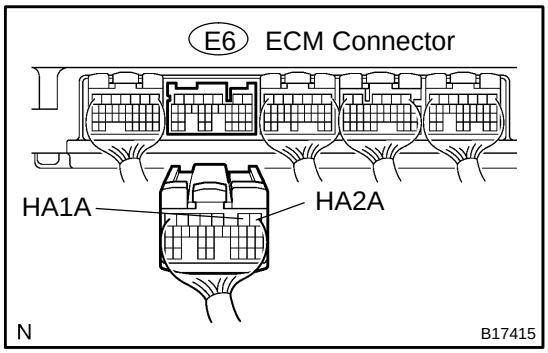
Tester Connection	Specified Condition
HA1A (E6−2) − Body ground	9 V to 14 V
HA2A (E6−1) − Body ground	9 V to 14 V

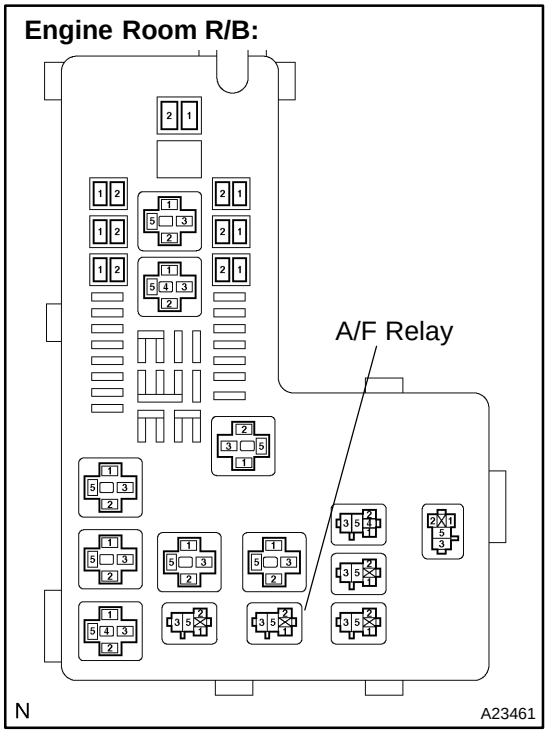
NG → **Replace ECM (See page SF−66).**

NG

4	**Check for open and short circuit in harness and connector between A/F sensor and ECM, A/F sensor and A/F relay.**







OK

Replace ECM (See page SF−66).

PREPARATION:

(a) Disconnect the A10 or A30 A/F sensor connector.

(b) Disconnect the E6 ECM connector.

CHECK:

Check for resistance between the wire harness side connectors.

OK:

Standard (Check for open):

Symbols (Terminal No.)	Specified condition
HT (A10−1) − HA1A (E6−2)	Below 1 Ω
HT (A30−1) − HA2A (E6−1)	Below 1 Ω

Standard (Check for short):

Symbols (Terminal No.)	Specified condition
HT (A10−1) or HA1A (E6−2) − Body ground	10 kΩ or higher
HT (A30−1) or HA2A (E6−1) − Body ground	10 kΩ or higher

PREPARATION:

(a) Disconnect the A10 or A30 A/F sensor connector.

(b) Remove the A/F sensor heater relay from the engine room R/B.

CHECK:

Check for resistance between the wire harness side connectors.

OK:

Standard (Check for open):

Symbols (Terminal No.)	Specified condition
+B (A10−2) − A/F sensor heater relay (3)	Below 1 Ω
+B (A47−2) − A/F sensor heater relay (3)	Below 1 Ω

Standard (Check for short):

Symbols (Terminal No.)	Specified condition
+B (A10−2) or A/F sensor heater relay (3) − Body ground	10 kΩ or higher
+B (A30−2) or A/F sensor heater relay (3) − Body ground	10 kΩ or higher

NG → **Repair or replace harness or connector.**