Last Modified: 12-04-2024	6.11:8.1.0	**Doc ID:** RM100000002BM1E
Model Year Start: 2023	**Model:** Prius Prime	**Prod Date Range:** [03/2023 -]
Title: M20A-FXS (ENGINE CONTROL): SFI SYSTEM: P223711,P223712,P223713,P223716,P223717,P22371B,P225111,P225112; A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Short to Ground; 2023 - 2024 MY Prius Prius Prime [03/2023 -]		

DTC	**P223711**	**A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Short to Ground**

DTC	**P223712**	**A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Short to Battery**

DTC	**P223713**	**A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Open**

DTC	**P223716**	**A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Voltage Below Threshold**

DTC	**P223717**	**A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Voltage Above Threshold**

DTC	**P22371B**	**A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Resistance Above Threshold**

DTC	**P225111**	**O2 Sensor Negative Current Control Bank 1 Sensor 1 Circuit Short to Ground**

DTC	**P225112**	**O2 Sensor Negative Current Control Bank 1 Sensor 1 Circuit Short to Battery**

DESCRIPTION

Refer to DTC P003012.

Click here INFO

HINT:

Although the DTC titles say O2 sensor, these DTCs relate to the air fuel ratio sensor (sensor 1).

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
P223711	A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Short to Ground	The A1A+ voltage is 1.26 V or less for 5 seconds or more (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • ECM	Comes on	Engine	A	SAE Code: P2238
P223712	A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Short to Battery	The A1A+ voltage is higher than 4.47 V for 5 seconds or more (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • ECM	Comes on	Engine	A	SAE Code: P2239
P223713	A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Open	An open or ground short in the circuit between terminals A1A+ and A1A- of the air fuel ratio sensor (sensor 1) while the engine is running (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • ECM	Comes on	Engine	A	SAE Code: P2237
P223716	A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Voltage Below Threshold	The difference between terminals A1A+ and A1A- is 0.2 V or less for 5 seconds or more (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • ECM	Comes on	Engine	A	SAE Code: P2238

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
P223717	A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Voltage Above Threshold	The difference between terminals A1A+ and A1A- is higher than 1.04 V for 5 seconds or more (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • ECM	Comes on	Engine	A	SAE Code: P2239
P22371B	A/F (O2) Sensor Positive Current Control Bank 1 Sensor 1 Circuit Resistance Above Threshold	The air fuel ratio sensor (sensor 1) impedance is higher than 63 Ω (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • ECM	Comes on	Engine	A	SAE Code: P2238
P225111	O2 Sensor Negative Current Control Bank 1 Sensor 1 Circuit Short to Ground	The A1A- voltage is 1.07 V or less for 5 seconds or more (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • ECM	Comes on	Engine	A	SAE Code: P2252
P225112	O2 Sensor Negative Current Control Bank 1 Sensor 1 Circuit Short to Battery	The A1A- voltage is higher than 3.93 V for 5 seconds or more (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • ECM	Comes on	Engine	A	SAE Code: P2253

MONITOR DESCRIPTION

These DTCs are stored when there is an open or short in the air fuel ratio sensor (sensor 1) circuit, or the air fuel ratio sensor (sensor 1) output value is abnormal. The voltage of the air fuel ratio sensor (sensor 1) is monitored while the ignition switch is ON, and the impedance (impedance is an electrical term that indicates the difficulty of flow of current) is checked while the engine is running. If the voltage of the air fuel ratio sensor (sensor 1) is outside the normal range, or the impedance is outside the normal range, the ECM illuminates the MIL and stores a DTC.

MONITOR STRATEGY

Related DTCs	P2237: Air fuel ratio sensor (sensor 1) circuit continuity check (circuit open) P2238: Air fuel ratio sensor (sensor 1) impedance check (high impedance) P2238: Air fuel ratio sensor (sensor 1) range check (A1A+ low voltage) P2238: Air fuel ratio sensor (sensor 1) correlation (A1A+ and A1A-) P2239: Air fuel ratio sensor (sensor 1) range check (A1A+ high voltage) P2239: Air fuel ratio sensor (sensor 1) correlation (A1A+ and A1A-) P2252: Air fuel ratio sensor (sensor 1) range check (A1A- low voltage) P2253: Air fuel ratio sensor (sensor 1) range check (A1A- high voltage)
Required Sensors/Components (Main)	Air fuel ratio sensor (sensor 1)
Required Sensors/Components (Related)	Engine coolant temperature sensor Crankshaft position sensor
Frequency of Operation	Continuous
Duration	10 seconds: P2237, P2238 (air fuel ratio sensor (sensor 1) high impedance) 5 seconds: Others
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P2237 and P2238

Monitor runs whenever the following DTCs are not stored	P0010, P1360, P1362, P1364, P1366, P2614 (Motor drive VVT system control module) P0011 (VVT system - advance) P0012 (VVT system - retard) P0013 (Exhaust VVT oil control solenoid) P0014 (Exhaust VVT system - advance) P0015 (Exhaust VVT system - retard) P0016 (VVT system - misalignment) P0017 (Exhaust VVT system - misalignment) P0031, P0032, P101D (Air fuel ratio sensor (sensor 1) heater) P0037, P0038, P102D (Air fuel ratio sensor (sensor 2) heater) P0087, P0088, P0191, P0192, P0193 (Fuel pressure sensor (for high pressure side)) P0101, P0102, P0103 (Mass air flow meter) P0106, P0107, P0108 (Manifold absolute pressure)

	P0112, P0113 (Intake air temperature sensor) P0116, P0117, P0118 (Engine coolant temperature sensor) P0121, P0122, P0123, P0222, P0223, P2135 (Throttle position sensor) P0125 (Insufficient coolant temperature for closed loop fuel control) P0128 (Thermostat) P0136, P013A, P2270, P2271, P22AB, P22AC, P22AD, P22B3, P22B4 (Air fuel ratio sensor (sensor 2)) P0171, P0172 (Fuel system) P0201, P0202, P0203, P0204, P062D, P21CF, P21D0, P21D1, P21D2 (Fuel injector) P0300, P0301, P0302, P0303, P0304 (Misfire) P0327, P0328 (Knock control sensor) P0335, P0337, P0338 (Crankshaft position sensor) P0340, P0342, P0343 (Camshaft position sensor) P0365, P0367, P0368 (Exhaust camshaft position sensor) P0401 (EGR system (closed)) P0441 (EVAP system) P0489, P0490 (EGR control circuit) P0657, P0658, P2102, P2103, P2111, P2112, P2119 (Throttle actuator) P107B, P107C, P107D (Fuel pressure sensor (for low pressure side)) P11EA, P11EC, P11ED, P11EE, P11EF, P219A, P219C, P219D, P219E, P219F (Air-fuel ratio imbalance) P1235 (High pressure fuel pump circuit) P2228, P2229 (Atmospheric pressure sensor)

P2239, P2252 and P2253

Monitor runs whenever the following DTCs are not stored	None

P2237: Air Fuel Ratio Sensor (Sensor 1) Circuit Continuity Check (Circuit Open)

Engine	Running
Auxiliary battery voltage	11 V or higher
Ignition switch	ON
Time after ignition switch is off to ON	5 seconds or more

P2238: Air Fuel Ratio Sensor (Sensor 1) Impedance Check (High Impedance)

Fuel cut	Not executed

P2238 and P2239: Air Fuel Ratio Sensor (Sensor 1) Range Check (A1A+ Low Voltage, A1A+ High Voltage)

Auxiliary battery voltage	10.5 V or higher
Ignition switch	ON
Time after ignition switch is off to ON	0.5 seconds or more
Air fuel ratio sensor (sensor 1) circuit fail (P2237)	Not detected

Air fuel ratio sensor (sensor 1) positive/negative current control circuit correlation fail (P2238, P2239)	Not detected
Air fuel ratio sensor (sensor 1) negative current control circuit range check fail (P2252, P2253)	Not detected

P2238 and P2239: Air Fuel Ratio Sensor (Sensor 1) Correlation (A1A+ and A1A-)

Auxiliary battery voltage	10.5 V or higher
Ignition switch	ON
Time after ignition switch is off to ON	0.5 seconds or more
Air fuel ratio sensor (sensor 1) circuit fail (P2237)	Not detected
Air fuel ratio sensor (sensor 1) positive current control circuit range check fail (P2238, P2239)	Not detected
Air fuel ratio sensor (sensor 1) negative current control circuit range check fail (P2252, P2253)	Not detected

P2252 and P2253: Air Fuel Ratio Sensor (Sensor 1) Range Check (A1A- Low Voltage, A1A- High Voltage)

Auxiliary battery voltage	10.5 V or higher
Ignition switch	ON
Time after ignition switch is off to ON	0.5 seconds or more
Air fuel ratio sensor (sensor 1) circuit fail (P2237)	Not detected
Air fuel ratio sensor (sensor 1) positive/negative current control circuit correlation fail (P2238, P2239)	Not detected
Air fuel ratio sensor (sensor 1) positive current control circuit range check fail (P2238, P2239)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

P2237: Air Fuel Ratio Sensor (Sensor 1) Circuit Continuity Check (Circuit Open)

Air fuel ratio sensor (sensor 1) impedance	Higher than 440 Ω

P2238: Air Fuel Ratio Sensor (Sensor 1) Impedance Check (High Impedance)

Air fuel ratio sensor (sensor 1) impedance	Higher than 63 Ω

P2238: Air Fuel Ratio Sensor (Sensor 1) Range Check (A1A+ Low Voltage)

A1A+ terminal voltage	1.26 V or less

P2238: Air Fuel Ratio Sensor (Sensor 1) Correlation (A1A+ and A1A-)

Difference between A1A+ terminal and A1A- terminal voltage	0.2 V or less

P2239: Air Fuel Ratio Sensor (Sensor 1) Range Check (A1A+ High Voltage)

A1A+ terminal voltage	Higher than 4.47 V

P2239: Air Fuel Ratio Sensor (Sensor 1) Correlation (A1A+ and A1A-)

Difference between A1A+ terminal and A1A- terminal voltage	Higher than 1.04 V

P2252: Air Fuel Ratio Sensor (Sensor 1) Range Check (A1A- Low Voltage)

A1A- terminal voltage	1.07 V or less

P2253: Air Fuel Ratio Sensor (Sensor 1) Range Check (A1A- High Voltage)

A1A- terminal voltage	Higher than 3.93 V

CONFIRMATION DRIVING PATTERN

HINT:

- After repair has been completed, clear the DTC and then check that the vehicle has returned to normal by performing the following All Readiness check procedure.

  Click here INFO
- When clearing the permanent DTCs, refer to the "CLEAR PERMANENT DTC" procedure.

  Click here INFO

1. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
2. Turn the ignition switch off and wait for at least 30 seconds.
3. Put the engine in Inspection Mode (Maintenance Mode).

   Click here INFO
4. Start the engine and wait 5 minutes or more [A].
5. Enter the following menus: Powertrain / Engine / Trouble Codes [B].
6. 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.
7. Enter the following menus: Powertrain / Engine / Utility / All Readiness.
8. Input the DTC: P223711, P223712, P223713, P223716, P223717, P22371B, P225111 or P225112.
9. Check the DTC judgment result.

   HINT:

   - If the judgment result is NORMAL, the system is normal.
   - If the judgment result is ABNORMAL, the system has a malfunction.
   - If the judgment result is INCOMPLETE, idle the engine for 5 minutes and check the DTC judgment result again.
   - [A] to [B]: Normal judgment procedure.

     The normal judgment procedure is used to complete DTC judgment and also used when clearing permanent DTCs.
   - When clearing the permanent DTCs, do not disconnect the cable from the auxiliary battery terminal or attempt to clear the DTCs during this procedure, as doing so will clear the universal trip and normal judgment histories.

WIRING DIAGRAM

Refer to DTC P003012.

Click here INFO

CAUTION / NOTICE / HINT

NOTICE:

- Inspect the fuses for circuits related to this system before performing the following procedure.
- Vehicle Control History may be stored in the hybrid vehicle control ECU if the engine is malfunctioning. Certain vehicle condition information is recorded when Vehicle Control History is stored. Reading the vehicle conditions recorded in both the freeze frame data and Vehicle Control History can be useful for troubleshooting.

  for HEV Model: Click here INFO

  for PHEV Model: Click here INFO

  (Select Powertrain in Health Check and then check the time stamp data.)
- If any "Engine Malfunction" Vehicle Control History item has been stored in the hybrid vehicle control ECU, make sure to clear it. However, as all Vehicle Control History items are cleared simultaneously, if any Vehicle Control History items other than "Engine Malfunction" are stored, make sure to perform any troubleshooting for them before clearing Vehicle Control History.

  for HEV Model: Click here INFO

  for PHEV Model: Click here INFO

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.
- Refer to "Data List / Active Test" [A/F (O2) Sensor Current B1S1].

  Click here INFO

PROCEDURE

1.	**CHECK TERMINAL VOLTAGE (AIR FUEL RATIO SENSOR (SENSOR 1) VOLTAGE)**

HINT:

Make sure that the connector is properly connected. If it is not, securely connect it and check for DTCs again.

Pre-procedure1

(a) Disconnect the air fuel ratio sensor (sensor 1) connector.

(b) Turn the ignition switch to ON.

Procedure1

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

Standard Voltage:

EWD INFO

Click Location & Routing(C44)
Click Connector(C44)

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	RESULT
C44-3 (A1A+) - Body ground	Ignition switch ON	2.8 to 3.0 V	V
C44-4 (A1A-) - Body ground	Ignition switch ON	2.3 to 2.7 V	V
C44-3 (A1A+) - C44-4 (A1A-)	Ignition switch ON	0.1 to 0.7 V	V

Post-procedure1

(d) None.

OK ▶ **REPLACE AIR FUEL RATIO SENSOR (SENSOR 1)**

NG ▼

2.	**CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR (SENSOR 1) - ECM)**

Pre-procedure1

(a) Disconnect the air fuel ratio sensor (sensor 1) connector.

(b) Disconnect the ECM connector.

Procedure1

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

Standard Resistance:

EWD INFO

Click Location & Routing(C44,C52)
Click Connector(C44)
Click Connector(C52)

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	RESULT
C44-1 (HA1A) - C52-9 (HA1A)	Always	Below 1 Ω	Ω
C44-3 (A1A+) - C52-95 (A1A+)	Always	Below 1 Ω	Ω
C44-4 (A1A-) - C52-94 (A1A-)	Always	Below 1 Ω	Ω
C44-1 (HA1A) or C52-9 (HA1A) - Body ground and other terminals	Always	10 kΩ or higher	kΩ
C44-3 (A1A+) or C52-95 (A1A+) - Body ground and other terminals	Always	10 kΩ or higher	kΩ
C44-4 (A1A-) or C52-94 (A1A-) - Body ground and other terminals	Always	10 kΩ or higher	kΩ

Post-procedure1

(d) None.

OK ▶ **REPLACE ECM**

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