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<b>Model Year Start:</b> 2023	<b>Model:</b> Prius Prime	<b>Prod Date Range:</b> [03/2023 - ]
<b>Title:</b> M20A-FXS (ENGINE CONTROL): SFI SYSTEM: P010012,P010014; Mass or Volume Air Flow Sensor "A" Circuit Short to Battery; 2023 - 2024 MY Prius Prius Prime [03/2023 - ]		

<b>DTC</b>	<b>P010012</b>	<b>Mass or Volume Air Flow Sensor "A" Circuit Short to Battery</b>
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<b>DTC</b>	<b>P010014</b>	<b>Mass or Volume Air Flow Sensor "A" Circuit Short to Ground or Open</b>
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## DESCRIPTION

The mass air flow meter sub-assembly is a sensor that measures the intake air volume using the following built-in components:

- By-pass duct (allows some of the intake air to flow past a silicon chip sensor)
- Silicon chip sensor (uses a heater control bridge circuit and temperature sensor bridge circuit to detect the difference in the temperature of the intake air that passes the sensors positioned before and after the heater).
- Control circuit (converts the difference in temperature into a pulse signal and performs correction)

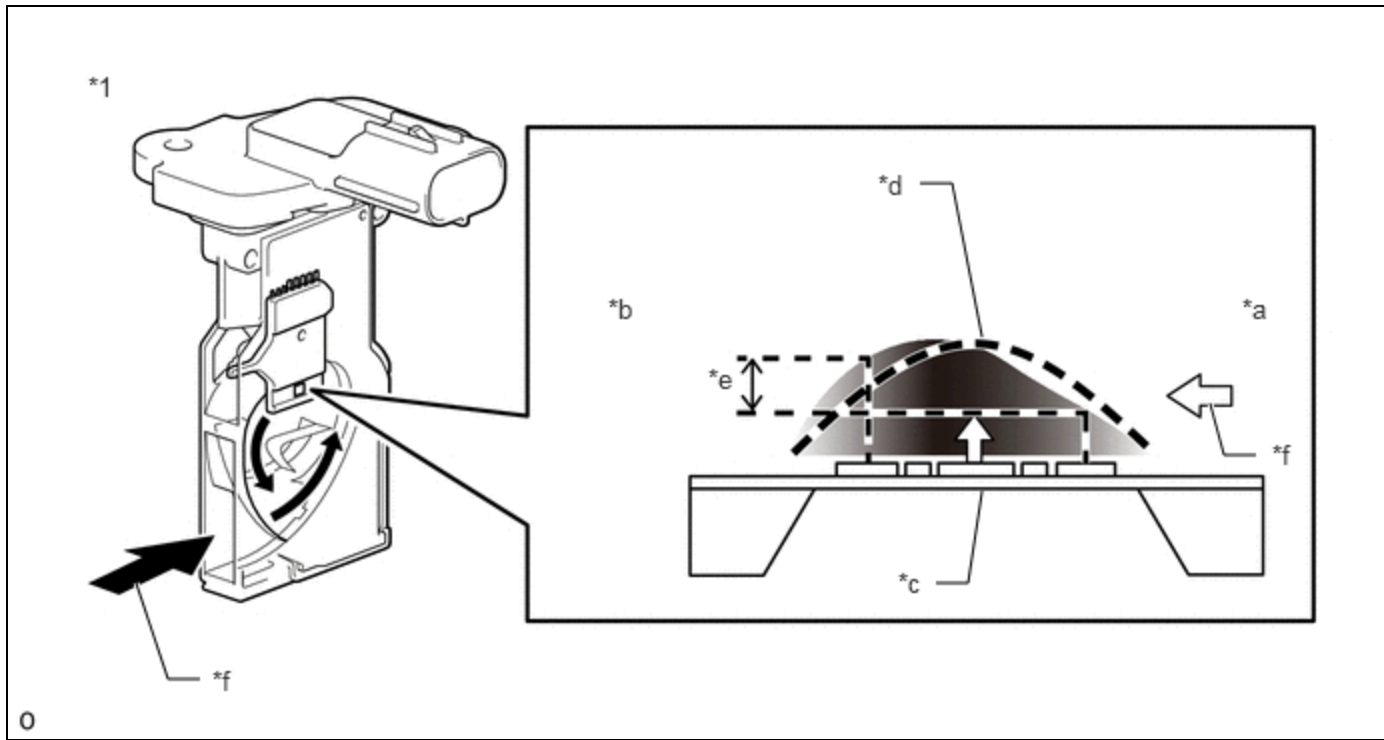
Intake air flows past the temperature sensor (before heater), the heater, and then the temperature sensor (after heater) of the silicon chip sensor in the by-pass duct. As the intake air is warmed up when it is exposed to the heater, the temperature of the intake air as it flows past the temperature sensor (after heater) is higher than when it flows past the temperature sensor (before heater). The difference in temperature of the intake air at each temperature sensor varies depending on the velocity of the intake air that flows past the silicon chip sensor. The temperature sensor bridge circuit detects the difference in temperature and the control circuit converts it into a pulse signal and outputs it to the ECM. When the temperature detected by the temperature sensor (before heater) is higher than that detected by the temperature sensor (after heater), backflow of the intake air is detected.

The ECM calculates the intake air volume based on the pulse signal received from the mass air flow meter sub-assembly, and uses it to determine the fuel injection duration necessary for an optimal air-fuel ratio.

The heater control bridge circuit has a temperature sensor and power transistor, and maintains the temperature differential between the heater temperature and intake air temperature at a specific level.

### **HINT:**

When DTCs are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM calculates the fuel injection duration based on the engine speed and throttle valve angle. Fail-safe mode continues until a pass condition is detected.



*1	Mass Air Flow Meter Sub-assembly	-	-
*a	Upstream Side	*b	Downstream Side
*c	Heater	*d	Temperature Distribution Without Airflow
*e	Flow Rate Detection by Temperature Differential	*f	Intake Air

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
P010012	Mass or Volume Air Flow Sensor "A" Circuit Short to Battery	The mass air flow meter sub-assembly output frequency is higher than 9.8 kHz for 3 seconds or more (1 trip detection logic).	<ul style="list-style-type: none"> <li>Open or short in mass air flow meter sub-assembly circuit</li> <li>Mass air flow meter sub-assembly</li> <li>ECM</li> </ul>	Comes on	Engine	A	SAE Code: P0103
P010014	Mass or Volume Air Flow Sensor "A" Circuit Short to Ground or Open	The mass air flow meter sub-assembly output frequency is less than 0.1 kHz for 3 seconds or more (1 trip detection logic).	<ul style="list-style-type: none"> <li>Open or short in mass air flow meter sub-assembly circuit</li> <li>Mass air flow meter sub-assembly</li> <li>ECM</li> </ul>	Comes on	Engine	A	SAE Code: P0102

## MONITOR DESCRIPTION

If there is a defect or an open or short circuit in the mass air flow meter sub-assembly, the frequency level deviates from the normal operating range. The ECM interprets this deviation as a malfunction in the mass air flow meter sub-assembly circuit and stores a DTC.

Example:

When the sensor output frequency remains less than 0.1 kHz, or higher than 9.8 kHz for 3 seconds, the ECM stores a DTC.

## MONITOR STRATEGY

Related DTCs	P0102: Mass air flow meter range check (low frequency) P0103: Mass air flow meter range check (high frequency)
Required Sensors/Components (Main)	Mass air flow meter sub-assembly
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	3 seconds
MIL Operation	Immediate
Sequence of Operation	None

## TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not stored	None
Both of the following conditions are met	-
Auxiliary battery voltage	8 V or higher
Ignition switch	ON

## TYPICAL MALFUNCTION THRESHOLDS

### **P0102**

Mass air flow meter output frequency	Less than 0.1 kHz
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### **P0103**

Mass air flow meter output frequency	Higher than 9.8 kHz
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## 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](#) 

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

[Click here](#) 

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. Turn the ignition switch to ON.
4. Wait 5 seconds 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: P010012 or P010014.
9. Check the DTC judgment result.

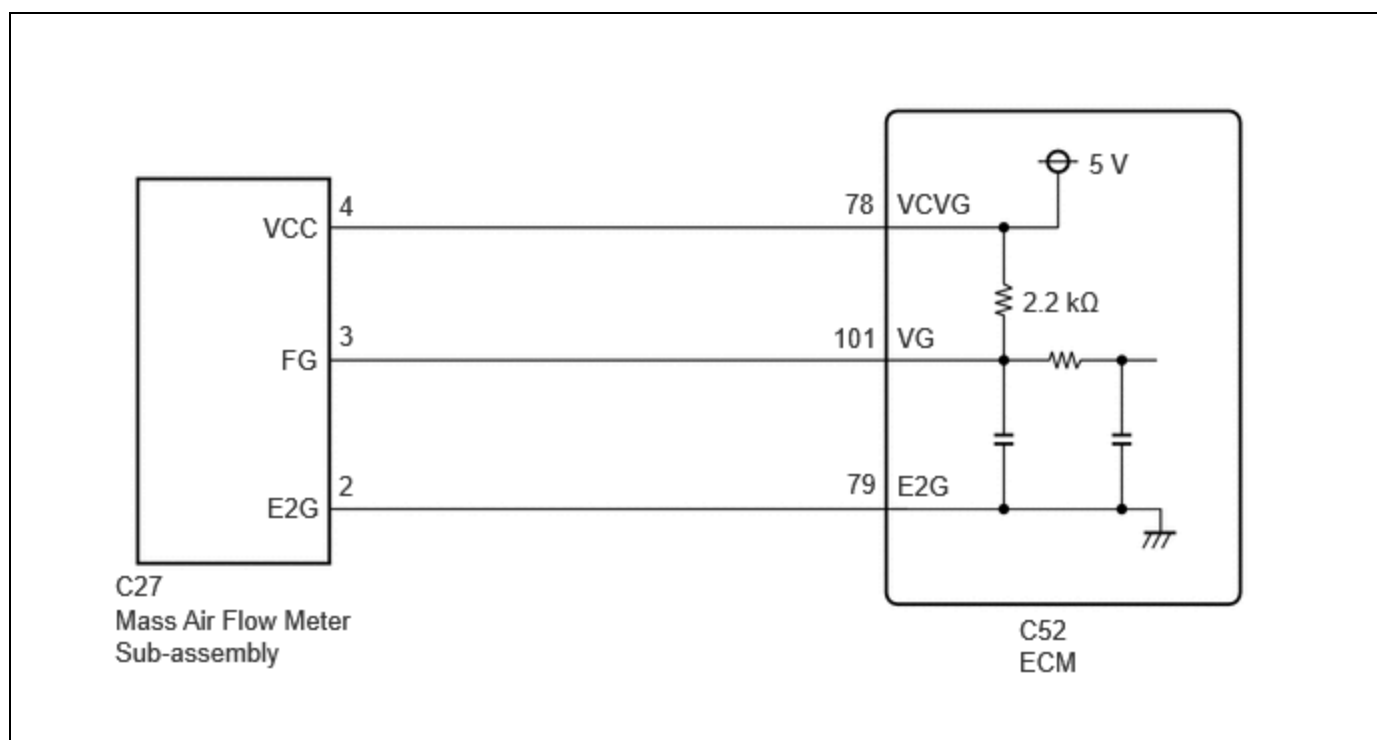
**HINT:**

- 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, perform steps [A] through [B] 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



## CAUTION / NOTICE / HINT

**NOTICE:**

- 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

## PROCEDURE

<b>1.</b>	<b>CHECK TERMINAL VOLTAGE (POWER SOURCE OF MASS AIR FLOW METER SUB-ASSEMBLY)</b>
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Pre-procedure1

- (a) Disconnect the mass air flow meter sub-assembly connector.
- (b) Turn the ignition switch to ON.

Procedure1

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

Standard Voltage:



[Click Location & Routing\(C27\)](#)

[Click Connector\(C27\)](#)

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	RESULT
C27-4 (VCC) - C27-2 (E2G)	Ignition switch ON	4.8 to 5.2 V	V
C27-3 (FG) - C27-2 (E2G)	Ignition switch ON	4.8 to 5.2 V	V

Post-procedure1

- (d) Turn the ignition switch off and wait for at least 30 seconds.

Pre-procedure2

- (e) None

Procedure2

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

Standard Resistance:



[Click Location & Routing\(C27\)](#)

[Click Connector\(C27\)](#)

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	RESULT
C27-4 (VCC) - C27-3 (FG)	Ignition switch off	2.09 to 2.31 k $\Omega$	k $\Omega$
C27-2 (E2G) - Body ground	Always	Below 1 $\Omega$	$\Omega$

Post-procedure2

(g) None

**NG**  **GO TO STEP 5****OK****2. INSPECT MASS AIR FLOW METER SUB-ASSEMBLY**Click here **NEXT****3. CLEAR DTC**

Pre-procedure1

(a) None

Procedure1

(b) Clear the DTCs.

**Powertrain > Engine > Clear DTCs**

Post-procedure1

(c) Turn the ignition switch off and wait for at least 30 seconds.

**NEXT****4. CHECK WHETHER DTC OUTPUT RECURS (DTC P010012 OR P010014)**

Pre-procedure1

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

Procedure1

(b) Read the DTCs.

**Powertrain > Engine > Trouble Codes**

RESULT	PROCEED TO
DTCs are not output	A
P010012 or P010014 is output	B

Post-procedure1

(c) None

**A** ► END

**B** ► REPLACE ECM

<b>5.</b>	<b>CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM)</b>
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Pre-procedure1

(a) Disconnect the mass air flow meter sub-assembly connector.

(b) Disconnect the ECM connector.

Procedure1

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

Standard Resistance:



[Click Location & Routing\(C27,C52\).](#)

[Click Connector\(C27\).](#)

[Click Connector\(C52\).](#)

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION	RESULT
C27-4 (VCC) - C52-78 (VCGV)	Always	Below 1 Ω	Ω
C27-3 (FG) - C52-101 (VG)	Always	Below 1 Ω	Ω
C27-2 (E2G) - C52-79 (E2G)	Always	Below 1 Ω	Ω
C27-4 (VCC) or C52-78 (VCGV) - Body ground and other terminals	Always	10 kΩ or higher	kΩ
C27-3 (FG) or C52-101 (VG) - Body ground and other terminals	Always	10 kΩ or higher	kΩ
C27-2 (E2G) or C52-79 (E2G) - 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**

