Last Modified: 12-04-2024	6.11:8.1.0	**Doc ID:** RM100000002BLU6
Model Year Start: 2023	**Model:** Prius Prime	**Prod Date Range:** [03/2023 -]
Title: M20A-FXS (ENGINE CONTROL): SFI SYSTEM: P001400,P001500; Camshaft Position "B" - Timing Over-Advanced or System Performance Bank 1; 2023 - 2024 MY Prius Prius Prime [03/2023 -]		

DTC	**P001400**	**Camshaft Position "B" - Timing Over-Advanced or System Performance Bank 1**

DTC	**P001500**	**Camshaft Position "B" - Timing Over-Retarded Bank 1**

DESCRIPTION

Refer to DTC P001313.

Click here INFO

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
P001400	Camshaft Position "B" - Timing Over-Advanced or System Performance Bank 1	Exhaust valve timing is stuck at a certain value when in the advance range (2 trip detection logic).	• Valve timing • Cam timing oil control solenoid assembly • Camshaft timing oil control valve assembly (exhaust camshaft timing gear bolt assembly) • Camshaft timing exhaust gear assembly • ECM	Comes on	Engine	B	SAE Code: P0014
P001500	Camshaft Position "B" - Timing Over-Retarded Bank 1	Exhaust valve timing is stuck at a certain value when in the retard range (1 trip detection logic).	• Valve timing • Cam timing oil control solenoid assembly • Camshaft timing oil control valve assembly (exhaust camshaft timing gear bolt assembly) • Camshaft timing exhaust gear assembly	Comes on	Engine	B	SAE Code: P0015

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
			• ECM				

MONITOR DESCRIPTION

The ECM optimizes the exhaust valve timing using the Variable Valve Timing (VVT) system to control the exhaust camshaft. The VVT system includes the ECM, cam timing oil control solenoid assembly, camshaft timing oil control valve assembly (exhaust camshaft timing gear bolt assembly) and camshaft timing exhaust gear assembly. The ECM sends a target duty-cycle control signal to the cam timing oil control solenoid assembly. The camshaft timing oil control valve assembly (exhaust camshaft timing gear bolt assembly) is operated to control the oil pressure supplied to the camshaft timing exhaust gear assembly based on this signal. The camshaft timing gear assembly can advance or retard the exhaust camshaft.

If the difference between the target and actual exhaust valve timing is large, and changes in the actual exhaust valve timing are small, the ECM interprets this as the camshaft timing exhaust gear assembly stuck malfunction and stores a DTC.

Example:
DTC P001400 is stored when the following conditions "A" and "B" are met:

a. It takes 5 seconds or more to change the valve timing by 5°CA (Condition "A").
b. After the above condition is met, the cam timing oil control solenoid assembly is forcibly activated for 60 seconds or more (Condition "B").

DTC P001500 is stored when the following conditions "C" and "D" are met:

a. It takes 5 seconds or more to change the valve timing by 5°CA (Condition "C").
b. After the above condition is met, the cam timing oil control solenoid assembly is forcibly activated for 9.5 seconds or more (Condition "D").

These DTCs indicate that the camshaft timing exhaust gear assembly cannot operate properly due to a camshaft timing oil control valve assembly (exhaust camshaft timing gear bolt assembly) malfunction or the presence of foreign matter in the camshaft timing oil control valve assembly (exhaust camshaft timing gear bolt assembly).

MONITOR STRATEGY

Related DTCs	P0014: Advanced camshaft timing (for exhaust camshaft) P0015: Retarded camshaft timing (for exhaust camshaft)
Required Sensors/Components (Main)	Cam timing oil control solenoid assembly Camshaft timing oil control valve assembly (exhaust camshaft timing gear bolt assembly) Camshaft timing exhaust gear assembly
Required Sensors/Components (Related)	Crankshaft position sensor Camshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: 2 driving cycles Retarded camshaft timing: Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not stored	P0013 (Exhaust VVT oil control solenoid) P0017 (Exhaust VVT system - misalignment) P0101, P0102, P0103 (Mass air flow meter) P0107, P0108 (Manifold absolute pressure) P0117, P0118 (Engine coolant temperature sensor) P0125 (Insufficient coolant temperature for closed loop fuel control) P0335, P0337, P0338 (Crankshaft position sensor) P0340, P0342, P0343 (Camshaft position sensor) P0365, P0367, P0368 (Exhaust camshaft position sensor)
Auxiliary battery voltage	11 V or higher
Engine speed	500 to 4000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

P0014: Advanced Camshaft Timing

Both of the following conditions are met	-
Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft Angle) for 5 seconds or more after the VVT hold duty ratio learned value reaches the upper or lower limit
Valve timing	No change at advanced valve timing

P0015: Retarded Camshaft Timing

Both of the following conditions are met	-
Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft Angle) for 5 seconds or more after the VVT hold duty ratio learned value reaches the upper or lower limit
Valve timing	No change at retarded valve timing

If the difference between the target and actual camshaft timing is greater than the specified value, the ECM operates the VVT actuator for 10 seconds by applying and releasing oil pressure. Then, the ECM monitors the camshaft timing change for 10 seconds.

MONITOR RESULT

Refer to detailed information in Checking Monitor Status.

Click here INFO

P0014, P0015: Exhaust Gas Recirculation/VVT / EX VVT STUCK B1

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$35	$85	Multiply by 0.01	Second	Forced movement of cam timing control actuator time

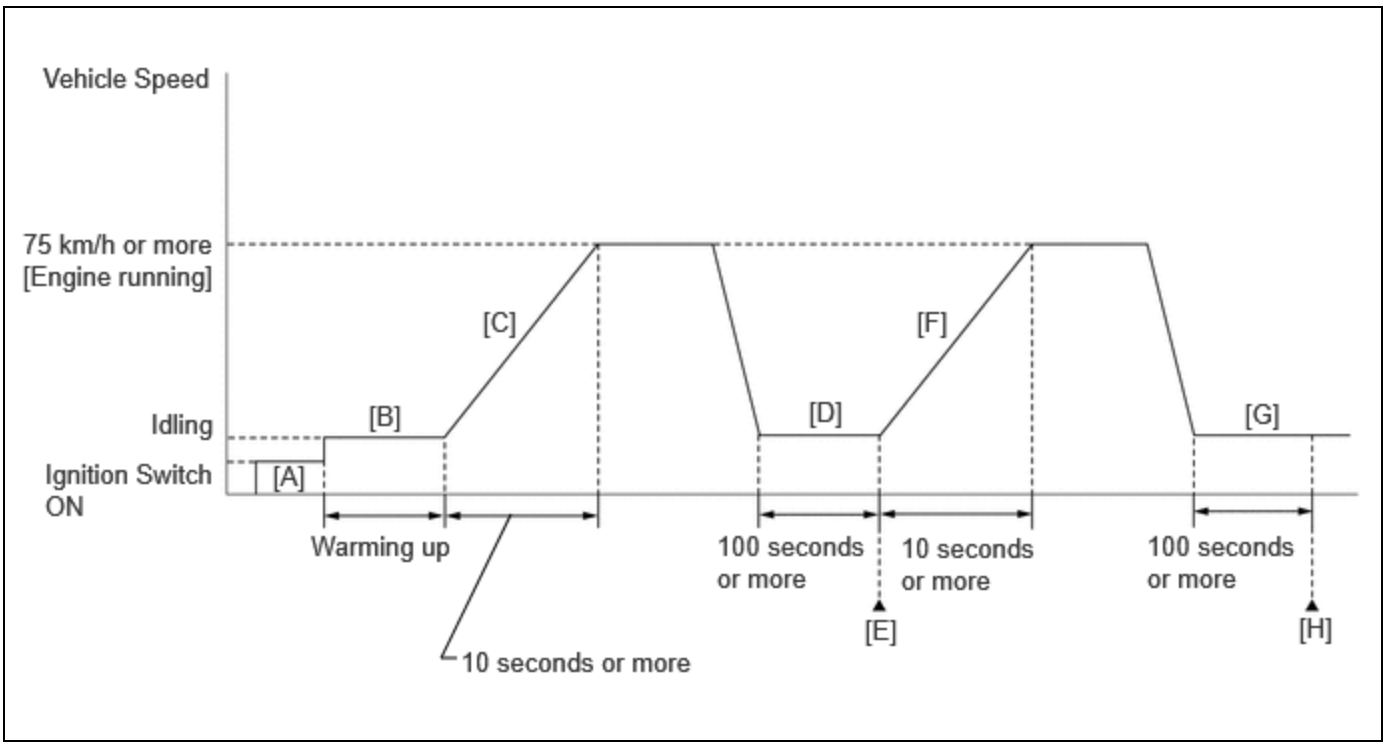
CONFIRMATION DRIVING PATTERN

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).

   HINT:

   - P001400 is output:

     Clear the DTC not using the GTS.
   - P001500 is output:

     Clear the DTC using the GTS.
2. Turn the ignition switch off and wait for at least 30 seconds.
3. Turn the ignition switch to ON [A].
4. Put the engine in Inspection Mode (Maintenance Mode).

   Click here INFO
5. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [B].
6. Press the EV/HV mode selection switch to select HV mode. (for PHEV Model)
7. With the engine running, accelerate the vehicle to 75 km/h (46 mph) or more by depressing the accelerator pedal for 10 seconds or more [C].

   CAUTION:

   When performing the confirmation driving pattern, obey all speed limits and traffic laws.

   HINT:

   If the engine stops, further depress the accelerator pedal to restart the engine.

8. Idle the engine for 100 seconds or more [D].

HINT:

- P001400 is output:

  With the shift lever in P.
- P001500 is output:

  With the shift lever in D.

9. Enter the following menus: Powertrain / Engine / 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 / Utility / All Readiness.
12. Input the DTC: P001400 or P001500.
13. 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 [F] through [H].
- [A] to [E]: 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.

14. With the engine running, accelerate the vehicle to 75 km/h (46 mph) or more by depressing the accelerator pedal for 10 seconds or more [F].

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the engine stops, further depress the accelerator pedal to restart the engine.

15. Idle the engine for 100 seconds or more [G].

HINT:

- P001400 is output:

  With the shift lever in P.
- P001500 is output:

  With the shift lever in D.

16. Enter the following menus: Powertrain / Engine / Trouble Codes [H].
17. 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.

18. Check the DTC judgment result again.

HINT:

- If the judgment result is NORMAL, the system is normal.
- If the judgment result is ABNORMAL, the system has a malfunction.

- [A] to [H]: 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.

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

HINT:

DTC P001400 or P001500 may be stored when foreign matter in the engine oil is caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. This foreign matter may then be captured by the oil filter.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P001400 OR P001500)**

(a) Read the DTCs.

Powertrain > Engine > Trouble Codes

RESULT	PROCEED TO
P001400 or P001500 and other DTCs are output	A
P001400 or P001500 is output	B

HINT:

If any DTCs other than P001400 or P001500 are output, troubleshoot those DTCs first.

A ▶ GO TO DTC CHART

B

2.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE EXHAUST VVT OCV DUTY RATIO BANK 1)**

Pre-procedure1

(a) Put the engine in Inspection Mode (Maintenance Mode).

Powertrain > Hybrid Control > Utility

TESTER DISPLAY
Inspection Mode

(b) Start the engine.

Procedure1

(c) Check the engine speed while operating the cam timing oil control solenoid assembly using the GTS.

Powertrain > Engine > Active Test

TESTER DISPLAY
Control the Exhaust VVT OCV Duty Ratio Bank 1

OK:

GTS OPERATION	ENGINE CONDITION
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

- Refer to "Data List / Active Test" [Exhaust VVT Hold Learn Value Bank 1, Exhaust VVT Change Angle Bank 1, Exhaust VVT OCV Control Duty Ratio Bank 1 and Exhaust VVT Target Angle Bank 1].

  Click here INFO
- Test not possible with the shift lever in P during charge control. Move the shift lever to N to perform test.
- If the DTCs are stored after the Active Test, clear the DTCs.

Post-procedure1

(d) None

NG ▶ **GO TO STEP 5**

OK

3.	**CLEAR DTC**

Pre-procedure1

(a) None

Procedure1

(b) Clear the DTCs.

Powertrain > Engine > Clear DTCs

HINT:

- P001400 is output:

  Clear the DTC not using the GTS.
- P001500 is output:

  Clear the DTC using the GTS.

Post-procedure1

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

NEXT

4.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P001400 OR P001500)**

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
P001400 or P001500 is output	B

HINT:

DTC P001400 or P001500 may be stored when foreign matter in the engine oil is caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. That foreign matter may then be captured by the oil filter.

Post-procedure1

(c) None

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

B

▼

5.	**INSPECT CAM TIMING OIL CONTROL SOLENOID ASSEMBLY**

Click here INFO

NG ▶ **GO TO STEP 11**

OK

▼

6.	**INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (EXHAUST CAMSHAFT TIMING GEAR BOLT ASSEMBLY)**

Click here INFO

NG ▶ **GO TO STEP 13**

OK

▼

7.	**CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)**

Pre-procedure1

(a) Remove the cylinder head cover sub-assembly.

HINT:

for HEV Model: Click here INFO

for PHEV Model: Click here INFO

(b) Turn the crankshaft pulley and align its groove with the TDC timing mark of the timing chain cover.

Procedure1

(c) Check that the timing marks of the camshaft timing gear assembly and camshaft timing exhaust

gear assembly are at the positions shown in the illustration.

HINT:

If the timing marks are not as shown, turn the crankshaft one revolution clockwise.

OK:

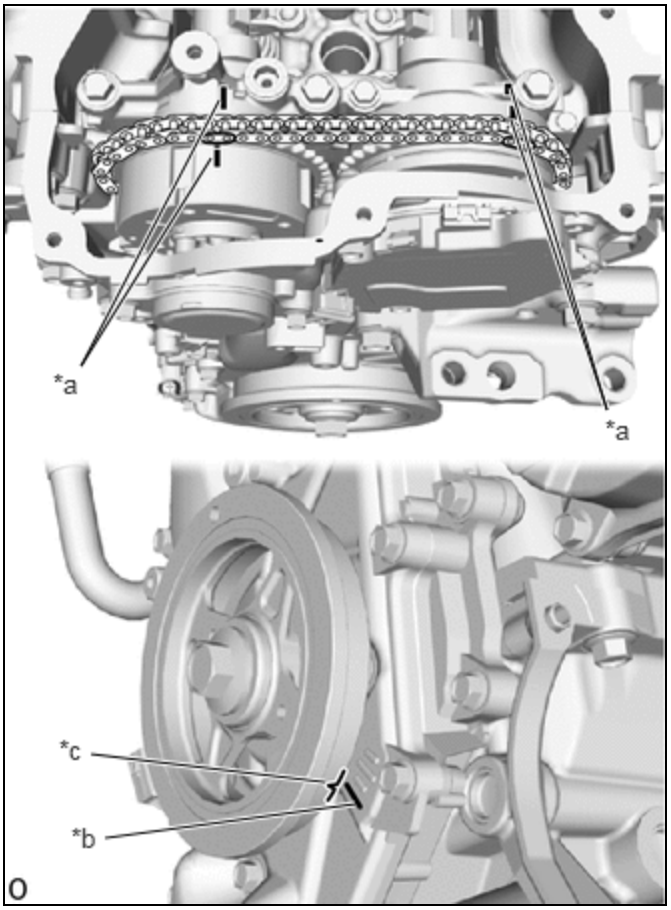
Timing marks on camshaft timing gear assembly and camshaft timing exhaust gear assembly are at the positions shown in the illustration.

HINT:

If the result is not as specified, check for mechanical malfunctions that may have affected the valve timing, such as a jumped tooth or stretching of the timing chain.

Result:

PROCEED TO
OK
NG



*a	Timing Mark
*b	TDC Timing Mark
*c	Groove

Post-procedure1

(d) None

OK ▶ **GO TO STEP 15**

NG ▼

8.	**CHECK ENGINE MECHANICAL SYSTEM**

(a) Check for mechanical malfunctions that affect the valve timing, such as a jumped tooth or stretching of the timing chain.

HINT:

Perform "Inspection After Repair" after repairing or replacing the engine mechanical system.

Click here INFO

NG ▶ **REPAIR OR REPLACE MALFUNCTIONING PARTS, COMPONENT AND AREA**

OK ▼

9.	**CLEAR DTC**

Pre-procedure1

(a) None

Procedure1

(b) Clear the DTCs.

Powertrain > Engine > Clear DTCs

HINT:

- P001400 is output:

  Clear the DTC not using the GTS.
- P001500 is output:

  Clear the DTC using the GTS.

Post-procedure1

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

NEXT ▼

10.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P001400 OR P001500)**

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

RESULT	PROCEED TO
P001400 or P001500 is output	B

Post-procedure1

(c) None

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

B ▶ **REPLACE ECM**

11.	**REPLACE CAM TIMING OIL CONTROL SOLENOID ASSEMBLY**

HINT:

Click here INFO

NEXT

▼

12.	**INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (EXHAUST CAMSHAFT TIMING GEAR BOLT ASSEMBLY)**

Click here INFO

OK ▶ **GO TO STEP 14**

NG

▼

13.	**REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (EXHAUST CAMSHAFT TIMING GEAR BOLT ASSEMBLY)**

HINT:

Click here INFO

NEXT

▼

14.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE EXHAUST VVT OCV DUTY RATIO BANK 1)**

Pre-procedure1

(a) Put the engine in Inspection Mode (Maintenance Mode).

Powertrain > Hybrid Control > Utility

TESTER DISPLAY
Inspection Mode

(b) Start the engine.

Procedure1

(c) Check the engine speed while operating the cam timing oil control solenoid assembly using the GTS.

Powertrain > Engine > Active Test

TESTER DISPLAY
Control the Exhaust VVT OCV Duty Ratio Bank 1

OK:

GTS OPERATION	ENGINE CONDITION
0%	Normal engine speed
100%	Engine idles roughly or stalls

HINT:

- Refer to "Data List / Active Test" [Exhaust VVT Hold Learn Value Bank 1, Exhaust VVT Change Angle Bank 1, Exhaust VVT OCV Control Duty Ratio Bank 1 and Exhaust VVT Target Angle Bank 1].

  Click here INFO
- Test not possible with the shift lever in P during charge control. Move the shift lever to N to perform test.
- If the DTCs are stored after the Active Test, clear the DTCs.

Post-procedure1

(d) None

OK ▶ **END**

NG ▼

15.	**REPLACE CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY**

HINT:

for HEV Model: Click here INFO

for PHEV Model: Click here INFO

NEXT

16.	**CLEAR DTC**

Pre-procedure1

(a) None

Procedure1

(b) Clear the DTCs.

Powertrain > Engine > Clear DTCs

HINT:

- P001400 is output:

  Clear the DTC not using the GTS.
- P001500 is output:

  Clear the DTC using the GTS.

Post-procedure1

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

NEXT

17.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P001400 OR P001500)**

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
P001400 or P001500 is output	B

Post-procedure1

(c) None

A ▶ **END**

B ▶ **REPLACE ECM**