Last Modified: 12-04-2024	6.11:8.1.0	**Doc ID:** RM100000002BM2F
Model Year Start: 2023	**Model:** Prius Prime	**Prod Date Range:** [03/2023 -]
Title: M20A-FXS (ENGINE CONTROL): SFI SYSTEM: P227019,P227118; A/F (O2) Sensor Signal Biased/Stuck Lean Bank 1 Sensor 2 Circuit Current Above Threshold; 2023 - 2024 MY Prius Prius Prime [03/2023 -]		

DTC	**P227019**	**A/F (O2) Sensor Signal Biased/Stuck Lean Bank 1 Sensor 2 Circuit Current Above Threshold**

DTC	**P227118**	**A/F (O2) Sensor Signal Biased/Stuck Rich Bank 1 Sensor 2 Circuit Current Below Threshold**

DESCRIPTION

Refer to DTC P003612.

Click here INFO

HINT:

Although the DTC title say O2 sensor, these DTCs relate to the air fuel ratio sensor (sensor 2).

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
P227019	A/F (O2) Sensor Signal Biased/Stuck Lean Bank 1 Sensor 2 Circuit Current Above Threshold	While the fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio sensor (sensor 2) current is 33.13 mA or more for 0.5 seconds or more (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 2) circuit • Air fuel ratio sensor (sensor 2) • Intake system • Gas leak from exhaust system • Fuel pressure (for high pressure side) • Fuel pressure (for low pressure side)	Comes on	Engine	B	SAE Code: P2270

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
			• Port fuel injector assembly • Direct fuel injector assembly • Fuel system • EGR valve assembly • ECM				
P227118	A/F (O2) Sensor Signal Biased/Stuck Rich Bank 1 Sensor 2 Circuit Current Below Threshold	While the fuel-cut operation is performed (during vehicle deceleration), the air fuel ratio sensor (sensor 2) current is less than 7.5 mA for 0.5 seconds or more (2 trip detection logic).	• Open or short in air fuel ratio sensor (sensor 2) circuit • Air fuel ratio sensor (sensor 2) • Intake system • Gas leak from exhaust system • Fuel pressure (for high pressure side) • Fuel pressure (for low pressure side) • Port fuel injector assembly • Direct fuel injector assembly • Fuel system • EGR valve assembly • ECM	Comes on	Engine	B	SAE Code: P2271

HINT:

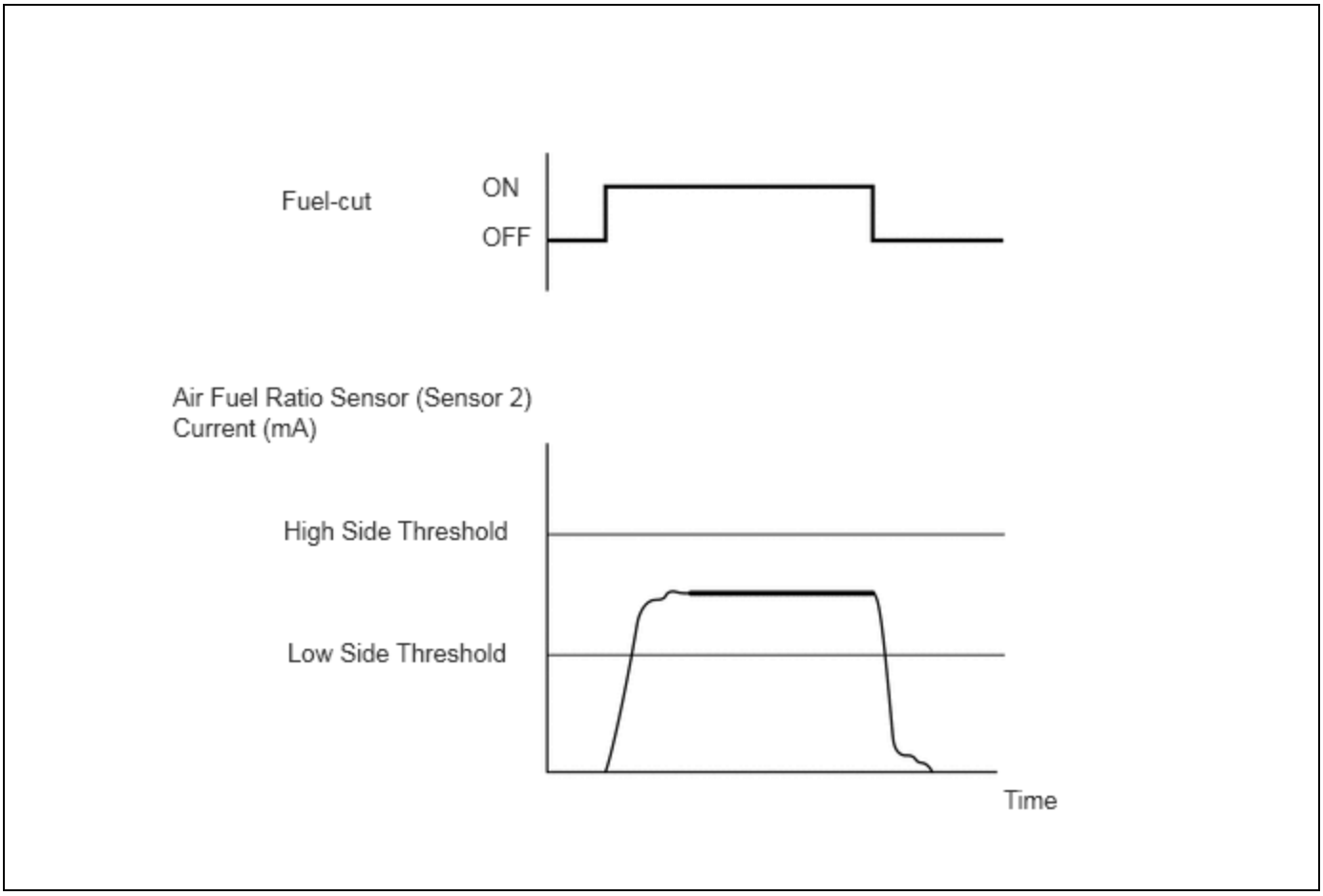
- When any of these DTCs are stored, check the air fuel ratio sensor (sensor 2) current output by entering the following menus on the GTS: Powertrain / Engine / Data List / A/F (O2) Sensor Current B1S2.

- Short-term fuel trim values can also be read using the GTS.
- If an air fuel ratio sensor (sensor 2) malfunction is detected, the ECM will store a DTC.

MONITOR DESCRIPTION

A rich air fuel mixture causes a low air fuel ratio sensor (sensor 2) current, and a lean air fuel mixture causes a high air fuel ratio sensor (sensor 2) current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the air fuel ratio sensor (sensor 2) current during fuel-cut and detects any abnormal current values.

If the air fuel ratio sensor (sensor 2) output is 33.13 mA or more for 0.5 seconds or more of cumulative time, the ECM interprets this as a malfunction of the air fuel ratio sensor (sensor 2) and stores DTC P227019 (stuck on high side). If the air fuel ratio sensor (sensor 2) output is less than 7.5 mA for 0.5 seconds or more of cumulative time, the ECM stores DTC P227118 (stuck on low side).



MONITOR STRATEGY

Related DTCs	P2270: Air fuel ratio sensor (sensor 2) signal stuck lean P2271: Air fuel ratio sensor (sensor 2) signal stuck rich
Required Sensors/Components (Main)	Air fuel ratio sensor (sensor 2)
Required Sensors/Components (Related)	Crankshaft position sensor Engine coolant temperature sensor Throttle position sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds

MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Auxiliary battery voltage	11 V or higher
Engine coolant temperature	75°C (167°F) or higher
Atmospheric pressure	76 kPa(abs) [11 psi(abs)] or higher
Time after engine start	3 seconds or more
Air fuel ratio sensor (sensor 2) malfunction (P22AB, P22AC, P22AD, P22B3, P22B4)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

P2270: Air Fuel Ratio Sensor (Sensor 2) Limit Current (High Side Malfunction)

Duration of following condition	0.5 seconds or more
Air fuel ratio sensor (sensor 2) current	33.13 mA or more

P2271: Air Fuel Ratio Sensor (Sensor 2) Limit Current (Low Side Malfunction)

Duration of following condition	0.5 seconds or more
Air fuel ratio sensor (sensor 2) current	Less than 7.5 mA

MONITOR RESULT

Refer to detailed information in Checking Monitor Status.

Click here INFO

P2270, P2271: O2 Sensor / OUTPUT RATE B1S2

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$02	$91	Multiply by 0.004	mA	Output rate bank 1 sensor 2

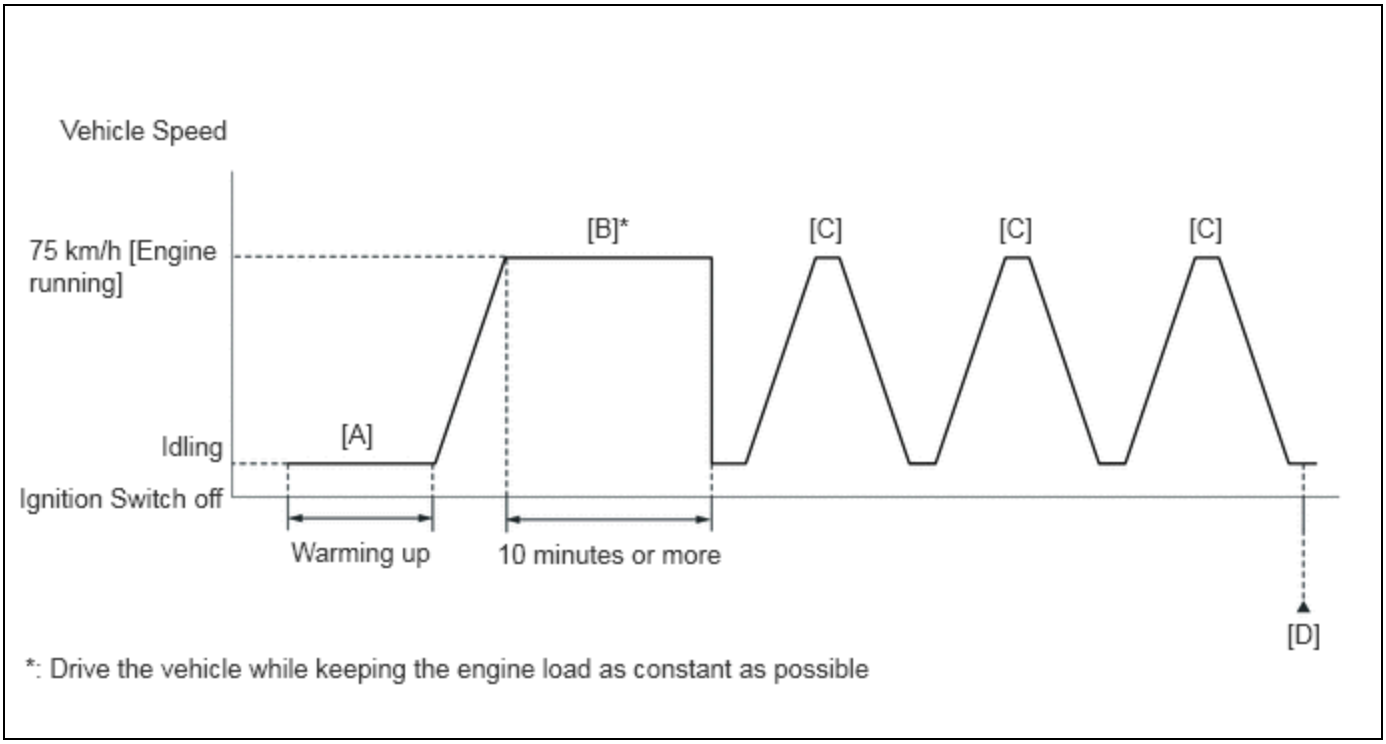
CONFIRMATION DRIVING PATTERN

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. Enter the following menus: Powertrain / Engine / Monitor / Current Monitor.
4. Check that Catalyst Efficiency / Current is Incomplete.
5. Put the engine in Inspection Mode (Maintenance Mode).

   Click here INFO
6. Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher with P selected [A].

   HINT:

   In order to keep the idle stable, turn off the A/C and all other electric loads and do not perform any shift operations.
7. Press the EV/HV mode selection switch to select HV mode. (for PHEV Model)
8. With the engine running, drive the vehicle at approximately 75 km/h (46 mph) for 10 minutes or more [B].

   CAUTION:

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

   HINT:

   - Drive the vehicle while keeping the engine load as constant as possible.
   - If the engine stops, further depress the accelerator pedal to restart the engine.
9. With the shift lever in B and the engine running, drive the vehicle at 75 km/h (46 mph), and then decelerate the vehicle by releasing the accelerator pedal for 10 seconds or more to perform the fuel-cut [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.
10. Repeat step [C] 2 times or more in one driving cycle.

11. Enter the following menus: Powertrain / Engine / Trouble Codes / Pending [D].
12. 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.

13. Enter the following menus: Powertrain / Engine / Utility / All Readiness.
14. Input the DTC: P227019 or P227118.
15. Check the DTC judgment result.

HINT:

- If the judgment result is NORMAL, the system is normal.
- If the judgment result is ABNORMAL, the system is malfunctioning.
- If the judgment result is INCOMPLETE, drive the vehicle with the shift lever in B, and then perform step [C] again.
- [A] to [D] : 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 P003612.

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.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P227019 OR P227118)**

(a) Read the DTCs.

Powertrain > Engine > Trouble Codes

RESULT	PROCEED TO
P227019 and P00D562 are output	A
P227118 and P00D562 are output	B
P227019 and P013A7C are output	C
P227118 and P013A7C are output	D
P227019 or P227118 and other DTCs are output	E
P227019 or P227118 is output	F

HINT:

If any DTCs other than P227019 or P227118 are output, troubleshoot those DTCs first.

A ▶ **GO TO STEP 2**

B ▶ **GO TO STEP 2**

C ▶ **GO TO STEP 2**

D ▶ **GO TO STEP 2**

E ▶ **GO TO DTC CHART**

F

▼

2.	**CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST**

(a) Has the vehicle run out of fuel in the past?

NO ▶ **GO TO STEP 5**

YES

▼

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 P227019 OR P227118)**

Pre-procedure1

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

Procedure1

(b) Check the DTC judgment result.

Powertrain > Engine > Utility

TESTER DISPLAY
All Readiness

(c) Input the DTC: P227019 or P227118.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P227019 or P227118 is output)	B

Post-procedure1

(d) None.

A **DTC CAUSED BY RUNNING OUT OF FUEL**

B GO TO STEP 5

5.	**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

6.	**READ VALUE USING GTS (TEST VALUE OF AIR FUEL RATIO SENSOR (SENSOR 2))**

Pre-procedure1

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

(b) Enter the following menus: Powertrain / Engine / Monitor / Current Monitor / O2 Sensor / Current.

Powertrain > Engine > Monitor

(c) Check that the status of O2 Sensor is Complete. If the status is still Incomplete, drive the vehicle according to the driving pattern again.

(d) Enter the following menus: Powertrain / Engine / Monitor / Current Monitor / O2 Sensor / Details / OUTPUT RATE B1S2.

Powertrain > Engine > Monitor

Procedure1

(e) Check the test value of the air fuel ratio sensor (sensor 2) output current during fuel-cut.

TEST VALUE	PROCEED TO
Within normal range (7.5 mA or more, and less than 33.13 mA)	A
Outside normal range (Less than 7.5 mA, or 33.13 mA or more)	B

Post-procedure1

(f) None.

B GO TO STEP 19

A

7.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE INJECTION VOLUME FOR A/F SENSOR)**

Pre-procedure1

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

Powertrain > Hybrid Control > Utility

TESTER DISPLAY
Inspection Mode

(b) Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher.

Powertrain > Engine > Data List

TESTER DISPLAY
Coolant Temperature

(c) Idle the engine for 5 minutes or more with P selected.

Procedure1

(d) Perform the Control the Injection Volume for A/F Sensor operation with the engine idling.

Powertrain > Engine > Active Test

ACTIVE TEST DISPLAY
Control the Injection Volume for A/F Sensor

DATA LIST DISPLAY
A/F (O2) Sensor Current B1S1
A/F (O2) Sensor Current B1S2

(e) Monitor the output values of the air fuel ratio sensor (sensor 1) and air fuel ratio sensor (sensor 2) (A/F (O2) Sensor Current B1S1 and A/F (O2) Sensor Current B1S2) displayed on the GTS.

HINT:

- The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 12.5%.
- The air fuel ratio sensor (sensor 1) has an output delay of a few seconds and the air fuel ratio sensor (sensor 2) has a maximum output delay of approximately 20 seconds.
- If the sensor output value does not change (almost no reaction) while performing the Active Test, the sensor may be malfunctioning.

Standard

GTS DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	CURRENT
A/F (O2) Sensor Current B1S1 (Air fuel ratio (sensor 1))	12.5%	Rich	Below -0.075 mA
	-12.5%	Lean	More than 0.037 mA
A/F (O2) Sensor Current B1S2 (Air fuel ratio (sensor 2))	12.5%	Rich	Below -0.86 mA
	-12.5%	Lean	More than 0.33 mA

STATUS OF A/F (O2) SENSOR CURRENT B1S1	STATUS OF A/F (O2) SENSOR CURRENT B1S2	AIR FUEL RATIO CONDITION AND AIR FUEL RATIO SENSOR (SENSOR 2) CONDITION	PROCEED TO
Lean	Lean	Actual air fuel ratio lean	A
Rich	Rich	Actual air fuel ratio rich	
Lean/Rich	Lean	Air fuel ratio sensor (sensor 2) malfunction	B
Lean/Rich	Rich	Air fuel ratio sensor (sensor 2) malfunction	
Lean/Rich	Lean/Rich	Normal	

Lean: During the Control the Injection Volume for A/F Sensor Active Test, the air fuel ratio sensor (sensor 1) output current (A/F (O2) Sensor Current B1S1) is consistently more than 0.037 mA, and the air fuel ratio sensor (sensor 2) output current (A/F (O2) Sensor Current B1S2) is consistently more than 0.33 mA.
Rich: During the Control the Injection Volume for A/F Sensor Active Test, the air fuel ratio sensor (sensor 1) output current (A/F (O2) Sensor Current B1S1) is consistently below -0.075 mA, and the air fuel ratio sensor (sensor 2) output current (A/F (O2) Sensor Current B1S2) is consistently below -0.86 mA.
Lean/Rich: During the Control the Injection Volume for A/F Sensor Active Test, the output current of the air fuel ratio sensor (sensor 1) or air fuel ratio sensor (sensor 2) alternate correctly.

HINT:

Refer to "Data List / Active Test" [A/F (O2) Sensor Current B1S1, A/F (O2) Sensor Current B1S2].

Click here INFO

Post-procedure1

(f) None.

B ▶ **GO TO STEP 19**

A

8.	**CHECK INTAKE SYSTEM**

(a) Check the intake system for vacuum leaks.

Click here INFO

OK:

No leaks in the intake system.

HINT:

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

Click here INFO

NG ▶ **REPAIR OR REPLACE INTAKE SYSTEM**

OK ▼

9.	**CHECK FOR EXHAUST GAS LEAK**

OK:

No gas leaks in exhaust system.

HINT:

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

Click here INFO

NG ▶ **REPAIR OR REPLACE EXHAUST SYSTEM**

OK ▼

10.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE EGR STEP POSITION)**

Pre-procedure1

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

Powertrain > Hybrid Control > Utility

TESTER DISPLAY
Inspection Mode

(b) Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher.

Powertrain > Engine > Data List

TESTER DISPLAY
Coolant Temperature

HINT:

The A/C switch and all accessories should be off.

Procedure1

(c) Confirm that the value of Data List item Engine Independent is "Operate" then check the value of Intake Manifold Absolute Pressure while performing the Active Test.

Powertrain > Engine > Active Test

ACTIVE TEST DISPLAY
Control the EGR Step Position

DATA LIST DISPLAY
Intake Manifold Absolute Pressure
Engine Independent

NOTICE:

- Make sure that the value of Data List item Engine Independent is "Operate" while performing the Active Test.
- Do not leave the EGR valve open for 10 seconds or more during the Active Test.
- Be sure to return the EGR valve to step 0 when the Active Test is completed.
- Do not open the EGR valve 30 steps or more during the Active Test.

OK:

The value of Intake Manifold Absolute Pressure changes in response to the EGR step position when the value of Engine Independent is "Operate".

Standard:

-	EGR STEP POSITION (ACTIVE TEST)	
	0 STEPS	0 TO 30 STEPS
Intake Manifold Absolute Pressure (Data List)	(EGR valve is fully closed)	Intake Manifold Absolute Pressure value is at least +10 kPa (1.45 psi) higher than when EGR valve is fully closed

HINT:

- If the value of Data List item Engine Independent is "Not Opr" when the engine is idling, charge control is being performed. Perform the Active Test after charge control is complete ("Operate" is displayed).
- While performing the Active Test, if the increase in the value of Intake Manifold Absolute Pressure is small, the EGR valve assembly may be malfunctioning.
- Even if the EGR valve assembly is malfunctioning, rough idling or an increase in the value of Intake Manifold Absolute Pressure may occur while performing the Active Test. However, the amount that the value of Intake Manifold Absolute Pressure increases will be smaller than normal.

RESULT	PROCEED TO
Intake Manifold Absolute Pressure value is at least +10 kPa (1.45 psi) higher than when EGR valve is fully closed	A
None of the above conditions are met	B

Post-procedure1

(d) None.

A ▶ **GO TO STEP 12**

B ▼

11.	INSPECT EGR VALVE ASSEMBLY

Pre-procedure1

(a) Remove the EGR valve assembly.

HINT:

Click here INFO

Procedure1

(b) Check if the EGR valve is stuck open.

OK:

EGR valve is tightly closed.

Post-procedure1

(c) None.

NG ▶ **REPLACE EGR VALVE ASSEMBLY**

OK ▼

12.	CHECK FUEL PRESSURE (FOR LOW PRESSURE SIDE)

Click here INFO

NG ▶ **GO TO STEP 22**

OK

13.	**INSPECT PORT FUEL INJECTOR ASSEMBLY**

(a) Inspect the port fuel injector assembly (whether fuel volume is high or low, and whether injection pattern is poor).

Click here INFO

NG ▶ **REPLACE PORT FUEL INJECTOR ASSEMBLY**

OK

14.	**READ VALUE USING GTS (FUEL PRESSURE (HIGH))**

Pre-procedure1

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

Powertrain > Hybrid Control > Utility

TESTER DISPLAY
Inspection Mode

(b) Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher with all the accessories switched off.

Powertrain > Engine > Data List

TESTER DISPLAY
Coolant Temperature

Procedure1

(c) According to the display on the GTS, read the Data List.

Powertrain > Engine > Data List

TESTER DISPLAY
Engine Speed

TESTER DISPLAY
Fuel Pressure (High)
Injection Mode

HINT:

During charge control, the engine speed is set at idle. Therefore, the engine speed will not increase when the accelerator pedal is depressed. In this case, read the Data List after charge control has completed.

Standard:

GTS DISPLAY	CONDITION	SPECIFIED CONDITION
Fuel Pressure (High)	• Shift position: P • A/C: Off • Engine warmed up • Engine Speed: 2500 rpm • Injection Mode: Direct	3000 to 25000 kPag

RESULT	PROCEED TO
The value of Fuel Pressure (High) is between 3000 and 25000 kPag	A
None of the above conditions are met	B

Post-procedure1

(d) None.

B ▶ **REPAIR OR REPLACE FUEL SYSTEM (FOR HIGH PRESSURE SIDE)**

A

▼

15.	INSPECT DIRECT FUEL INJECTOR ASSEMBLY

Click here INFO

NG ▶ **REPLACE DIRECT FUEL INJECTOR ASSEMBLY**

OK

▼

16.	**REPLACE AIR FUEL RATIO SENSOR (SENSOR 2)**

HINT:

Click here INFO

NEXT

17.	**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

18.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P227019 OR P227118)**

Pre-procedure1

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

Procedure1

(b) Check the DTC judgment result.

Powertrain > Engine > Utility

TESTER DISPLAY
All Readiness

(c) Input the DTC: P227019 or P227118.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P227019 or P227118 is output)	B

Post-procedure1

(d) None.

A ▶ **END**

B ▶ **REPLACE ECM**

19.	REPLACE AIR FUEL RATIO SENSOR (SENSOR 2)

HINT:

Click here INFO

NEXT

20.	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

21.	CHECK WHETHER DTC OUTPUT RECURS (DTC P227019 OR P227118)

Pre-procedure1

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

Procedure1

(b) Check the DTC judgment result.

Powertrain > Engine > Utility

TESTER DISPLAY
All Readiness

(c) Input the DTC: P227019 or P227118.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P227019 or P227118 is output)	B

Post-procedure1

(d) None.

A ▶ **END**

B ▶ **REPLACE ECM**

22.	CHECK FUEL LINE

(a) Check the fuel lines for leaks or blockage.

OK ▶ **REPLACE FUEL PUMP (FOR LOW PRESSURE SIDE)**

for HEV Model: Click here INFO

for PHEV Model: Click here INFO

NG ▶ **REPAIR OR REPLACE FUEL SYSTEM**