DTC	P0011	CAMSHAFT POSITION ”A” −TIMING OVER−ADVANCED OR SYSTEM PERFORMANCE (BANK 1)

DTC	P0012	CAMSHAFT POSITION ”A” −TIMING OVER−RETARDED (BANK 1)

DTC	P0021	CAMSHAFT POSITION ”A” − TIMING OVER−ADVANCED OR SYSTEM PERFORMANCE (BANK 2)

DTC	P0022	CAMSHAFT POSITION ”A” − TIMING OVER−RETARDED (BANK2)

CIRCUIT DESCRIPTION

Refer to DTC P0010 on page 05−553.

DTC No.	DTC Detection Condition	Trouble Area
P0011 P0021	After engine is warmed up and engine speed is at 500 to 4,000 rpm condition (a) continues (1 trip detection logic) (a) Valve timing does not change from current valve timing (Problem of advanced valve timing)	• Valve timing • OCV • Camshaft timing gear assy • ECM
P0012 P0022	After engine is warmed up and engine speed is at 500 to 4,000 rpm condition (a) continues (2 trip detection logic) (a) Valve timing does not change from current valve timing (Problem of retarded valve timing)	• Valve timing • OCV • Camshaft timing gear assy • ECM

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the Variable Valve Timing (VVT) system to control the intake valve camshaft. The VVT system includes the ECM, the Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty−cycle control signal to the OCV. This control signal, applied to the OCV, regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake valve camshaft.

Example:

A DTC will set if: 1) the difference between the target and actual valve timing is more than 5 degrees of the camshaft angle (CA) and the condition continues for more than 4.5 seconds; or 2) the OCV is forcibly activated 63 times or more.

Advanced cam DTCs are subject to ”1 trip” detection logic.

Retarded cam DTCs are subject to ”2 trip” detection logic.

MONITOR STRATEGY

Related DTCs	P0011: Advanced Camshaft Timing (Bank 1) P0012: Retarded Camshaft Timing (Bank 1) P0021: Advanced Camshaft Timing (Bank 2) P0022: Retarded Camshaft Timing (Bank 2)
Required sensors / components (Main)	VVT OCV, VVT Actuator
Required sensors / components (Related)	Crankshaft position sensor, Camshaft position sensor, ECT sensors
Frequency of operation	Once per driving cycles
Duration	Within 10 seconds
MIL operation	P0011 and P0021: Immediate P0012 and P0022: 2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	See page 05−507
Battery voltage	11 V or more
Engine RPM	500 to 4,000 rpm
ECT	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

P0011 and P0021:

Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft Angle)
Valve timing	No change at advanced valve timing

P0012 and P0022:

Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft Angle)
Valve timing	No change at retarded valve timing

If the difference between ”target” and ”actual”camshaft timing is larger than the specified value, the ECM operates the VVT actuator.
Then, the ECM monitors the camshaft timing change for 5 seconds.

WIRING DIAGRAM

Refer to DTC P0010 on page 05−553.

INSPECTION PROCEDURE

HINT:

Abnormal bank	Problem of advanced OCV	Problem of retarded OCV
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- If DTC P0011, P0012 is displayed, check the right bank VVT system.
- If DTC P0021, P0022 is displayed, check the left bank VVT system.

Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

Hand−held tester:

1	**CHECK VALVE TIMING (CHECK FOR LOOSE OR JUMPED TOOTH OF TIMING BELT) (See page 14−7)**

OK: The matchmarks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING (See page 14−7)**

OK

2	**PERFORM ACTIVE TEST BY HAND−HELD TESTER (OCV OPERATION)**

(a) Connect the hand−held tester to the DLC3.
(b) Start the engine and warm it up.
(c) Turn the ignition switch ON and push the hand−held tester main switch ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
(e) Using the hand−held tester, operate the OCV and check the engine speed.
Standard:

Tester Operation	Specified Condition
OCV is OFF	Normal engine speed
OCV is ON	Rough idle or engine stall

NG → **Go to step 4**

OK

3	**CHECK IF DTC OUTPUTS REOCCUR**

(a) Clear the DTCs.
(1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:
After disconnecting the battery cable, perform the ”INITIALIZE” procedure (see page 05−1251).

(b) Start and warm up the engine.
(c) Drive the vehicle for 10 minutes or more.
(d) Read output DTC using the hand−held tester.

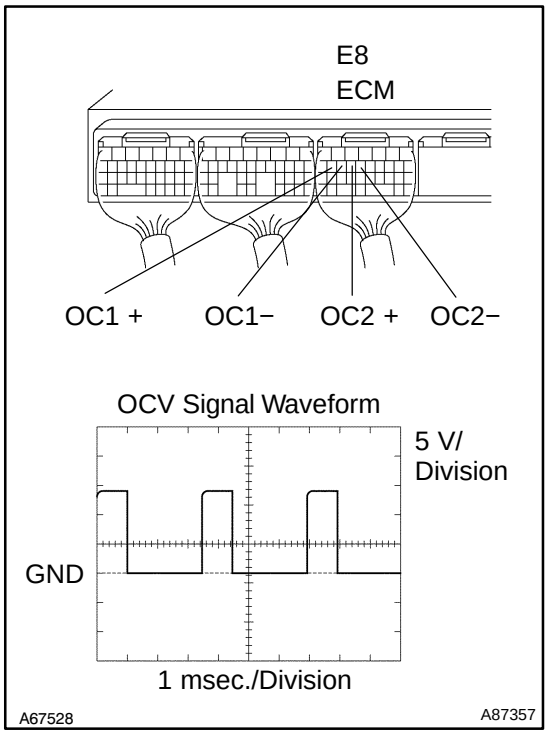
OK: No DTC output.

OK → **VVT SYSTEM OK***

HINT:
*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object in the engine oil enters the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

NG

4	CHECK ECM (OCV SIGNAL)



(a) During idling, check the waveform of the ECM connector using the oscilloscope.

Standard:

Tester Connection	Specified Condition
E8−16 (OC1+) − E8−15 (OC1−) E8−14 (OC2+) − E8−13 (OC2−)	Correct waveform is as shown

NG → **REPLACE ECM (See page 10−25)**

OK

5	CHECK OIL CONTROL VALVE FILTER

OK: The filter is not clogged.

NG → **REPLACE OIL CONTROL VALVE FILTER**

OK

6	CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSY (See page 10−2)

OK: OCV has no contamination and moves smoothly.

OK → **Go to step 8**

NG

7	REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSY

GO

8	CHECK CAMSHAFT TIMING GEAR ASSY (See page 14−224 or 14−234)

OK: Camshaft timing gear rotate smoothly when apply pressure.

OK	Go to step 10

NG

9	REPLACE CAMSHAFT TIMING GEAR ASSY

GO

10	CHECK FOR BLOCKAGE (OCV, OIL CHECK VALVE AND OIL HOLE)

OK: No blockage.

NG	REPAIR OR REPLACE

OK

11	CHECK IF DTC OUTPUTS REOCCUR

(a) Clear the DTCs.
  (1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:
After disconnecting the battery cable, perform the ”INITIALIZE” procedure (see page 05−1251).

(b) Start and warm up the engine.
(c) Drive the vehicle around for 10 minutes or more.
(d) Read output DTC using the hand−held tester.

OK: No DTC output.

OK	VVT SYSTEM OK*

HINT:
*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object in the engine oil enters the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

NG

REPLACE ECM (See page 10−25)

OBD II scan tool (excluding hand−held tester):

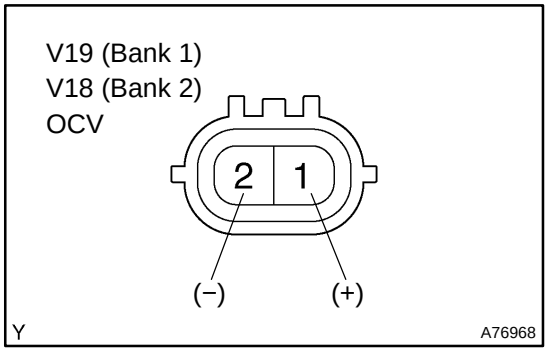
1	**CHECK VALVE TIMING (CHECK FOR LOOSE OR JUMPED TOOTH OF TIMING BELT) (See page 14−142)**

OK: The matchmarks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING (See page 14−142)**

OK

2	**INSPECT OPERATION OF OCV**



(a) Start the engine.
(b) Check the engine speed with (1) and (2).
  (1) Disconnect the V18 or V19 OCV connector.
  (2) Apply battery positive voltage between the terminals of the OCV.

Result:

Proceed to	Check (1)	Check (2)
A	Normal engine speed	Rough idle or engine stall
B	Conditions other than A	Conditions other than A

B → **Go to step 4**

A

3	**CHECK IF DTC OUTPUTS REOCCUR**

(a) Clear the DTCs.
  (1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:
After disconnecting the battery cable, perform the ”INITIALIZE” procedure (see page 05−1251).

(b) Start and warm up the engine.
(c) Drive the vehicle around for 10 minutes or more.
(d) Read output DTC using the OBD II scan tool.

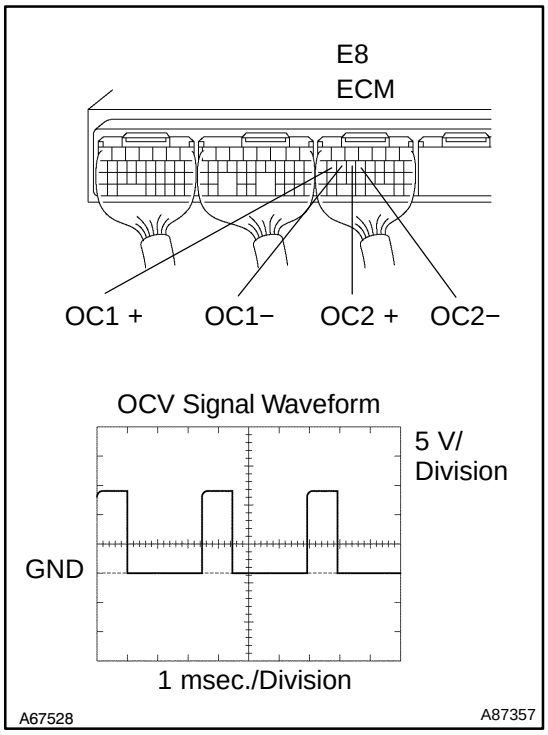
OK: No DTC output.

OK → **VVT SYSTEM OK***

HINT:
*: DTCs P0011, P0012, P0021 or P0022 is output when a foreign object in the engine oil enters the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

NG

4	CHECK ECM (OCV SIGNAL)



(a) During idling, check the waveform of the ECM connector using the oscilloscope.

Standard:

Tester Connection	Specified Condition
E8−16 (OC1+) − E8−15 (OC1−) E8−14 (OC2+) − E8−13 (OC2−)	Correct waveform is as shown

NG → **REPLACE ECM (See page 10−25)**

OK

5	CHECK OIL CONTROL VALVE FILTER

OK: The filter is not clogged.

NG → **REPLACE OIL CONTROL VALVE FILTER**

OK

6	CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSY (See page 10−2)

OK: OCV has no contamination and moves smoothly.

OK → **Go to step 8**

NG

7	REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSY

GO

8	CHECK CAMSHAFT TIMING GEAR ASSY (See page 14−224 or 14−234)

OK: Camshaft timing gear rotate smoothly when apply pressure.

OK	Go to step 10

NG

9	REPLACE CAMSHAFT TIMING GEAR ASSY

GO

10	CHECK FOR BLOCKAGE (OCV, OIL CHECK VALVE AND OIL HOLE)

OK: No blockage.

NG	REPAIR OR REPLACE

OK

11	CHECK IF DTC OUTPUTS REOCCUR

(a) Clear the DTCs.
  (1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.

HINT:
After disconnecting the battery cable, perform the ”INITIALIZE” procedure (see page 05−1251).

(b) Start and warm up the engine.
(c) Drive the vehicle around for 10 minutes or more.
(d) Read output DTC using the OBD II scan tool.

OK: No DTC output.

OK	VVT SYSTEM OK*

HINT:
*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object in the engine oil enters the system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

NG

REPLACE ECM (See page 10−25)