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)

ES

DTC	P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)

DESCRIPTION

Refer to DTC P0010 (See page ES-57).

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) (b) Valve timing does not change from current valve timing (Problem of advanced valve timing)	• Valve timing • OCV • Camshaft timing gear assembly • 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) (b) Valve timing does not change from current valve timing (Problem of retarded valve timing)	• Valve timing • OCV • Camshaft timing gear assembly • 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, sent to the OCV, regulates the oil pressure applied to the VVT controller. The VVT controller can advance or retard the intake valve camshaft.

Example:

A DTC will be 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: Retard camshaft timing (bank 1) P0021: Advanced camshaft timing (bank 2) P0022: Retard camshaft timing (bank 2)
Required sensors / components (Main)	VVT OCV and Camshaft timing gear
Required sensors / components (Related)	Crankshaft position sensor, camshaft position sensor and Engine coolant temperature sensor
Frequency of operation	Once per drive cycle

Duration	Within 10 seconds
MIL operation	P0011 and P0021: Immediate P0012 and P0022: 2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present.	P0100, P0101, P0102, P0103 (MAF sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0125 (Insufficient ECT for closed loop), P0335 (CKP sensor), P0340, P0341, P0345 (CMP sensor), P0351, P0352, P0353, P0354, P0355, P0356, (Igniter),
Battery voltage	11 V or more
Engine RPM	500 to 4,000 rpm
ECT	75°C (167°F) to 100°C (212°F)

ES

TYPICAL MALFUNCTION THRESHOLDS

P0011 and P0021:

All of the following conditions are met:	-
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:

All of the following conditions are met:	-
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 (See page ES-59).

HINT:

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

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

Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze data the moment a DTC is stored. 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.

1	**CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPING TEETH OF TIMING BELT)**

OK:

The matchmarks of crankshaft pulley and camshaft pulley are aligning.

NG	**ADJUST VALVE TIMING**

OK

2	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OCV OPERATION)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and warm it up.
(c) Turn the ignition switch ON and push the intelligent 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 intelligent 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 WHETHER DTC OUTPUTS REOCCUR

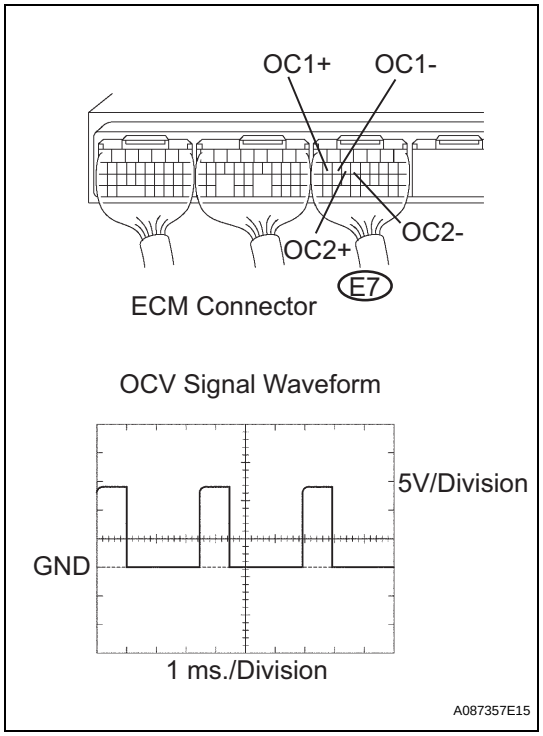
(a) Clear the DTCs.
(1) Erase the codes using one of the following methods: 1) use the intelligent tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.
HINT:
After disconnecting the battery cable, perform the "INITIALIZE" procedure.
(b) Start and warm up the engine.
(c) Drive the vehicle for 10 minutes or more.
(d) Read output DTC using the intelligent tester.
OK:
No DTC output.

HINT:
*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object enters in the engine oil 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.

OK → **VVT SYSTEM OK**

NG

4	CHECK ECM (OCV SIGNAL)



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

Tester Connection	Specified Condition
E7-16 (OC1+) - E7-15 (OC1-) E7-14 (OC2+) - E7-13 (OC2-)	Correct waveform is shown in the illustration

NG → **REPLACE ECM**

ES

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 ASSEMBLY (OCV)

OK:
OCV has no contamination and moves smoothly.

OK → **Go to step 8**

NG

7	REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

NEXT

8	CHECK CAMSHAFT TIMING GEAR ASSEMBLY

OK:
Camshaft timing gear assembly rotate smoothly when apply pressure.

OK → **Go to step 10**

NG

9	REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

ES

NEXT

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

OK:
No blockage.

NG → **REPAIR OR REPLACE MALFUNCTION PARTS**

OK

11	CHECK ANY OTHER DTCS OUTPUT

(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 NO. 1 and ETCS fuses for more than 60 seconds.
  HINT:
  After disconnecting the battery cable, perform the "INITIALIZE" procedure.
(b) Start and warm up the engine.
(c) Drive the vehicle around for 10 minutes or more.
(d) Read output DTC using the intelligent tester.
  OK:
  No DTC output.

HINT:
*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object enters in the engine oil 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.

OK → **VVT SYSTEM OK**

NG

REPLACE ECM

1	CHECK VALVE TIMING (CHECK FOR LOOSE OR JUMPING TEETH OF TIMING BELT)

OK:

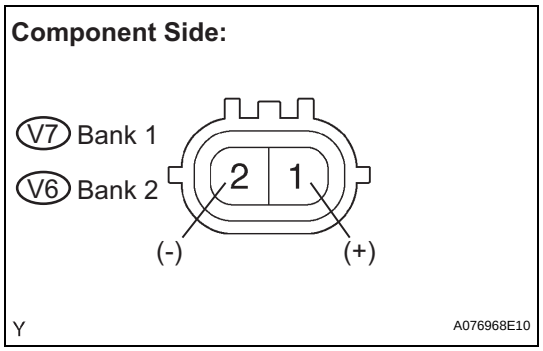
The matchmarks of crankshaft pulley and camshaft pulley are aligned.

NG → **ADJUST VALVE TIMING**

OK ↓

2	CHECK OPERATION OF OCV

Component Side:



(a) Start the engine.
(b) Check the engine speed with (*1) and (*2).
  (1) Disconnect the V6 or V7 OCV connector (*1).
  (2) Apply battery positive voltage between the terminals of the OCV (*2).
  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 WHETHER DTC OUTPUTS REOCCUR

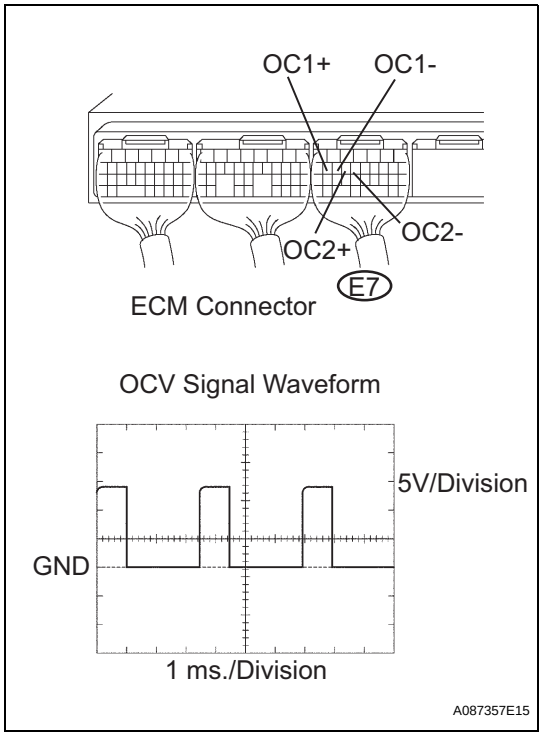
(a) Clear the DTCs.
  (1) Erase the codes using one of the following methods: 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI NO. 1 and ETCS fuses for more than 60 seconds.
  HINT:
  After disconnecting the battery cable, perform the "INITIALIZE" procedure.
(b) Start 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.

HINT:
*: DTCs P0011, P0012, P0021 or P0022 is output when a foreign object enters in the engine oil 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.

OK → **VVT SYSTEM OK**

NG ↓

4	CHECK ECM (OCV SIGNAL)



(a) During idling, check the waveform of the E7 ECM connector using an oscilloscope.
Standard

Tester Connection	Specified Condition
E7-16 (OC1+) - E7-15 (OC1-) E7-14 (OC2+) - E7-13 (OC2-)	Correct waveform is shown in the illustration

NG → REPLACE ECM

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 ASSEMBLY (OCV)

OK:
OCV has no contamination and moves smoothly.

OK → Go to step 8

NG

7	REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

NEXT

8	CHECK CAMSHAFT TIMING GEAR ASSEMBLY

OK:
Camshaft timing gear rotates smoothly when pressure is applied.

OK → **Go to step 10**

NG

9	REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

NEXT

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

OK:
No blockage.

NG → **REPAIR OR REPLACE MALFUNCTION PARTS**

OK

11	CHECK ANY OTHER DTCS OUTPUT

(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 NO. 1 and ETCS fuses for more than 60 seconds.
  HINT:
  After disconnecting the battery cable, perform the "INITIALIZE" procedure.
(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.

HINT:
*: DTCs P0011, P0012, P0021 or P0022 is output when a foreign object enters in the engine oil 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 → **VVT SYSTEM OK**

OK

REPLACE ECM