DIDT5−01

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 (Bank 2)

CIRCUIT DESCRIPTION

Refer to DTCs P0010 on page DI−70.

DTC No.	DTC Detecting Condition	Trouble Area
P0011 P0021	Advanced cam timing: After engine is warmed up and engine speed is at 400 to 4,000 rpm, condition (a) continues. (1 trip detection logic) (a) Valve timing does not change from current valve timing	• Valve timing • OCV • VVT controller assembly • ECM
P0012 P0022	Retarded cam timing: After engine is warmed up and engine speed is at 400 to 4,000 rpm, condition (a) continues. (2 trip detection logic) (a) Valve timing does not change from current valve timing	

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the VVT (Variable Valve Timing) system to control the intake valve camshaft. The VVT system includes the ECM, the OCV (Oil Control Valve) 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 crankshaft angle (CA) and the condition continues for more than 4.5 sec.; or 2) the OCV is forcibly activated 70 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	VVT system advance (Bank 1)
	P0012	VVT system retard (Bank 1)
	P0021	VVT system advance (Bank 2)
	P0022	VVT system retard (Bank 2)
Required sensors/components	Main sensors/components	Camshaft position sensor
	Related sensors/components	Engine coolant temperature sensor, Crankshaft position sensor
Frequency of operation	Once per drive cycle	
Duration	10 sec.	
MIL operation	P0011, P0021: Immediate P0012, P0022: 2 driving cycles	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever these DTCs are not present	See page DI−18	
Battery voltage	11 V	−
Engine RPM	500 rpm	4,000 rpm
ECT	75°C (167°F)	100°C (212°F)

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
P0011, P0021 (Advance):	
Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft angle)
Valve timing	No change at advanced valve timing
P0012, P0022 (Retard):	
Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft angle)
Valve timing	No change at retarded valve timing

WIRING DIAGRAM

Refer to DTCs P0010 on page DI−70.

INSPECTION PROCEDURE

HINT:

- Bank 1 refers to bank that includes cylinder No. 1.
- Bank 2 refers to bank that does not include cylinder No. 1.
- If DTC P0011, P0012 is displayed, check the bank 1 VVT system.
- If DTC P0021, P0022 is displayed, check the bank 2 VVT system.
- Read freeze frame data using the hand−held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air−fuel ratio was lean or rich, etc. at the time of the malfunction.

1	**Check operation of OCV.**

PREPARATION:

(a) Connect the hand−held tester to the DLC3.
(b) Start the engine and warm it up.
(c) Turn the ignition switch to ON and turn the hand−held tester ON.

CHECK:

(a) Select the item: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
(b) Using the hand−held tester, operate the OCV and check the engine speed.

OK:

Standard:

Tester operation	Specified condition
OCV is OFF	Normal engine speed
OCV is ON	Rough idle or engine stall

OK → **VVT system is OK.***

*: DTC P0011, P0012, P0021 or P0022 is also output when a foreign object is detected in some parts of the system in the engine oil, and then the system returns to normal in a short time. As ECM is controlled to eject a foreign object, there is no problem on the VVT. There is also no problem on the VVT as the oil filter should catch the foreign object in the engine oil.

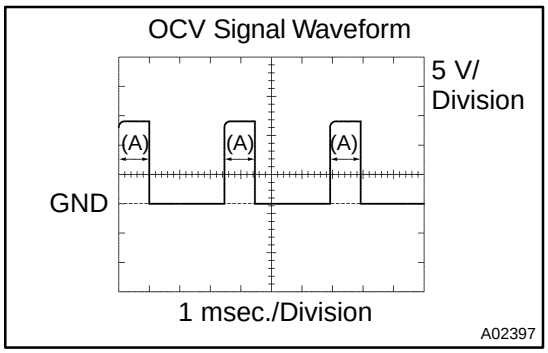
NG

2	**Check valve timing (See page EM−44).**

NG → **Adjust valve timing.**

OK

3	Check voltage between terminals OCV+ and OCV− of ECM connector.



CHECK:

(a) Inspection using the oscilloscope.

(b) During idling, check the waveform between the specified terminals of the E5 ECM connector.

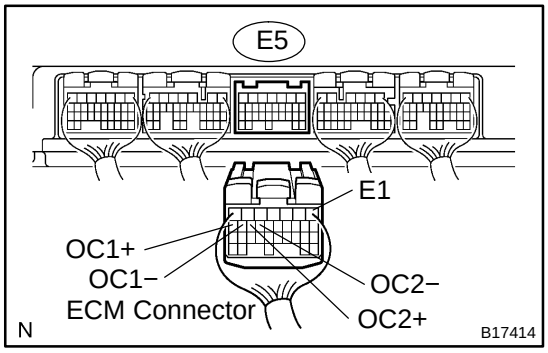
HINT:

The waveform frequency (A) is lengthened as the engine speed becomes higher.

OK:

Standard:

The correct waveform is as shown.



NG → **Replace ECM (See page SF−66).**

OK

4	Check OCV (See page EM−70).

NG → **Replace OCV, and then go to step 6.**

OK

5	Check camshaft timing gear assembly (See page EM−70).

NG → **Replace camshaft timing gear, and then go to step 7.**

OK

6	**Check oil control valve filter.**

NG → **Replace oil control valve filter.**

OK

7	**Check whether or not DTC P0010, P0012, P0021 or P0022 is stored.**

PREPARATION:

(a) Clear the DTC (See page DI−42).

(b) Perform simulation test.

CHECK:

Check whether or not DTC P0011, P0012, P0021 or P0022 is stored (See page DI−42).

OK:

Standard:

DTC P0011, P0012, P0021 or P0022 is not stored.

OK → **VVT system is OK.***

*: DTC P0011, P0012, P0021 or P0022 is also output when a foreign object is detected in some parts of the system in the engine oil, and then the system returns to normal in a short time. As ECM is controlled to eject a foreign object, there is no problem on the VVT. There is also no problem on the VVT as the oil filter should catch the foreign object in the engine oil.

NG

Replace ECM (See page SF−66).