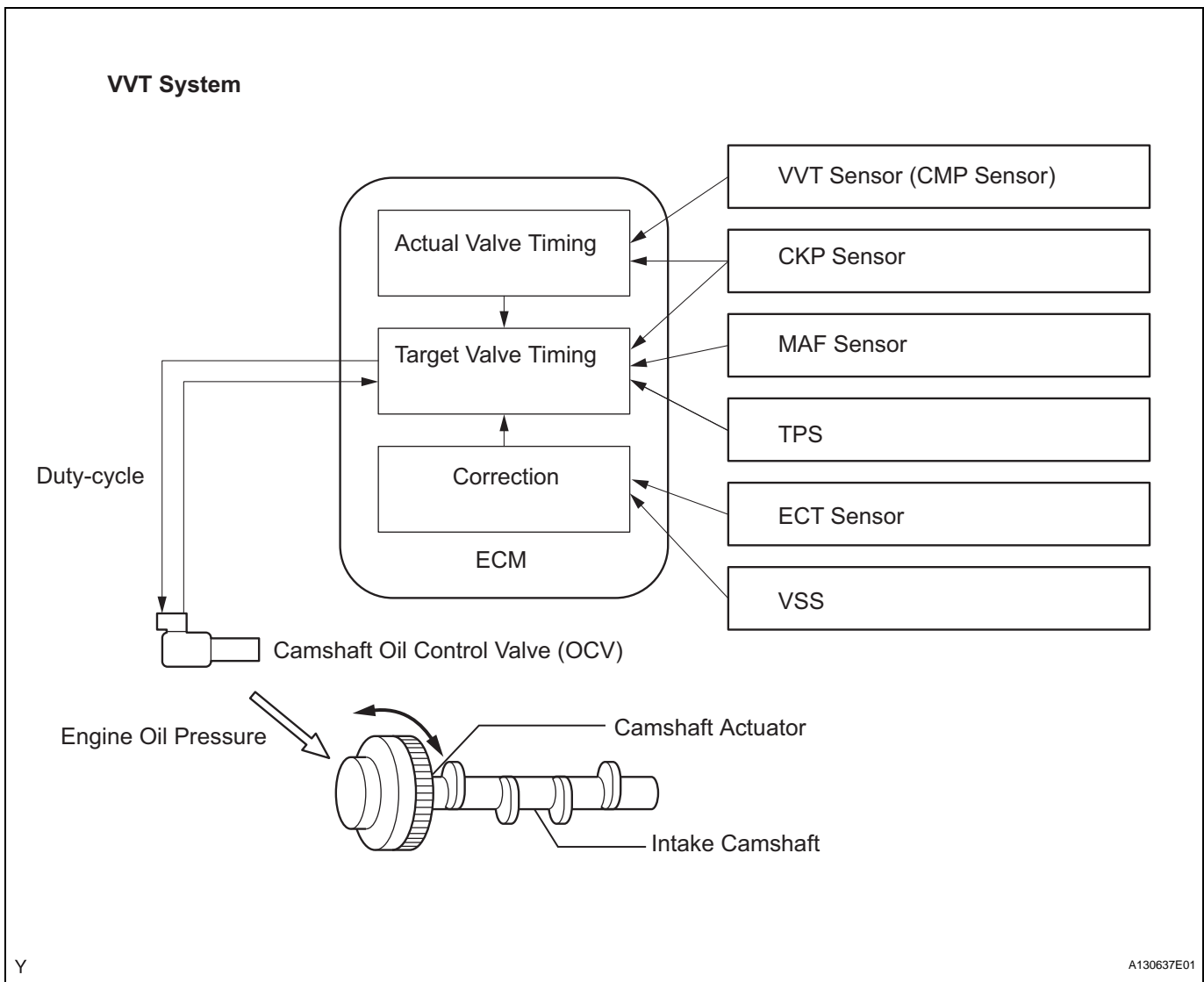


<b>DTC</b>	<b>P0011</b>	<b>Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)</b>
<b>DTC</b>	<b>P0012</b>	<b>Camshaft Position "A" - Timing Over-Retarded (Bank 1)</b>
<b>DTC</b>	<b>P0021</b>	<b>Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)</b>
<b>DTC</b>	<b>P0022</b>	<b>Camshaft Position "A" - Timing Over-Retarded (Bank 2)</b>

**ES****DESCRIPTION**

The VVT system includes the ECM, Oil Control Valve (OCV) and VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the OCV, based on the signals transmitted by several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.

ES



DTC No.	DTC Detection Condition	Trouble Area
P0011 P0021	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	<ul style="list-style-type: none"> <li>Valve timing</li> <li>OCV for intake camshaft</li> <li>OCV filter</li> <li>Intake camshaft timing gear assembly</li> <li>ECM</li> </ul>
P0012 P0022	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	<ul style="list-style-type: none"> <li>Valve timing</li> <li>OCV for intake camshaft</li> <li>OCV filter</li> <li>Intake camshaft timing gear assembly</li> <li>ECM</li> </ul>

### MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake 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 regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft. If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and sets a DTC.

Example:

A DTC is set when the following conditions 1, 2 and 3 are met:

1. The difference between the target and actual intake valve timing is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2. It takes 5 seconds or more to change the valve timing by 5°CA.
3. After above conditions 1 and 2 are met, the OCV is forcibly activated 63 times or more.

DTC P0011 and P0021 (Advanced Cam Timing) is subject to 1 trip detection logic.

DTC P0012 and P0022 (Retarded Cam Timing) is subject to 2 trip detection logic.

These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.

The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C [167°F] or more).
- The vehicle has been driven at more than 64 km/h (40 mph) for 3 minutes.
- The engine has idled for 3 minutes.

## 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 and VVT Actuator
Required Sensors/Components (Related)	Crankshaft position sensor, Camshaft position sensor and Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: Immediate Retarded camshaft timing: 2 driving cycles
Sequence of Operation	None

ES

## TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - 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)

## TYPICAL MALFUNCTION THRESHOLDS

### Advanced camshaft timing:

Valve timing	No change at advanced valve timing
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### Retard camshaft timing:

Valve timing	No change at retarded valve timing
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If the difference between the target and actual camshaft timings is greater 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-76](#)).

## INSPECTION PROCEDURE

**HINT:**

DTC P0011, P0012, P0021 or P0022 may be set when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain set even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

**HINT:**

Abnormal bank	Advanced timing over (Valve timing is out of specified range)	Retarded timing over (Valve timing is out of specified range)
Bank 1	P0011	P0021
Bank 2	P0012	P0022

- If DTC P0011 or P0012 is displayed, check the right bank VVT system for intake camshaft circuit (bank 1).
- Bank 1 refers to the bank that includes No. 1 cylinder.
- If DTC P0021 or P0022 is displayed, check the left bank VVT system for intake camshaft circuit (bank 2).
- Bank 2 refers to the bank that does not include No. 1 cylinder.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, 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.

**ES**

<b>1</b>	<b>CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)</b>
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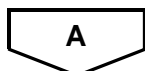
- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON and turn the tester ON.
- Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTCs.

**Result**

Display (DTC Output)	Proceed to
P0011, P0012, P0021 or P0022	<b>A</b>
P0011, P0012, P0021 or P0022 and other DTCs	<b>B</b>

**HINT:**

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.



<b>2</b>	<b>PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)</b>
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- Connect the intelligent tester to the DLC3.
- Start the engine and turn the tester ON.
- Warm up the engine.
- On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
- Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG

Go to step 4

OK

3

CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Clear DTCs (see page [ES-39](#)).
- (d) Start the engine and warm it up.
- (e) Switch the ECM from normal mode to check mode using the tester.
- (f) Drive the vehicle for more than 10 minutes.
- (g) Read DTCs using the tester.

OK:

No DTC output.

NG

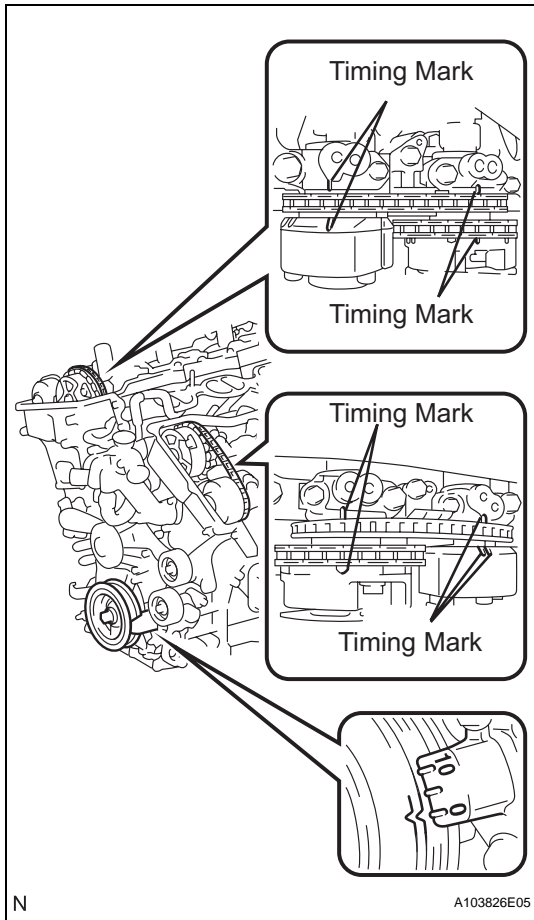
Go to step 4

OK

END

ES

#### 4 CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)



- Remove the cylinder head cover.
- Turn the crankshaft pulley, and align its groove with the timing mark "0" on the timing chain cover.
- Check that the timing marks on the camshaft timing sprocket and camshaft timing gear are facing upward as shown in the illustration.  
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

**OK:**

**Timing marks on camshaft timing gears are aligned as shown in the illustration.**

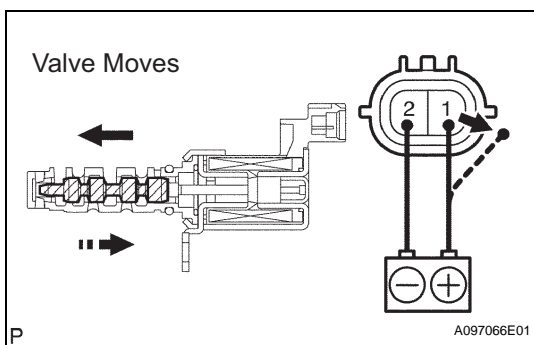
- Reinstall the cylinder head cover.

**NG**

**ADJUST VALVE TIMING**

**OK**

#### 5 INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)



- Remove the OCV.
- Measure the resistance between the terminals of the OCV.  
**Standard resistance:**  
**6.9 to 7.9  $\Omega$  at 20°C (68°F)**
- Apply the positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.

**OK:**

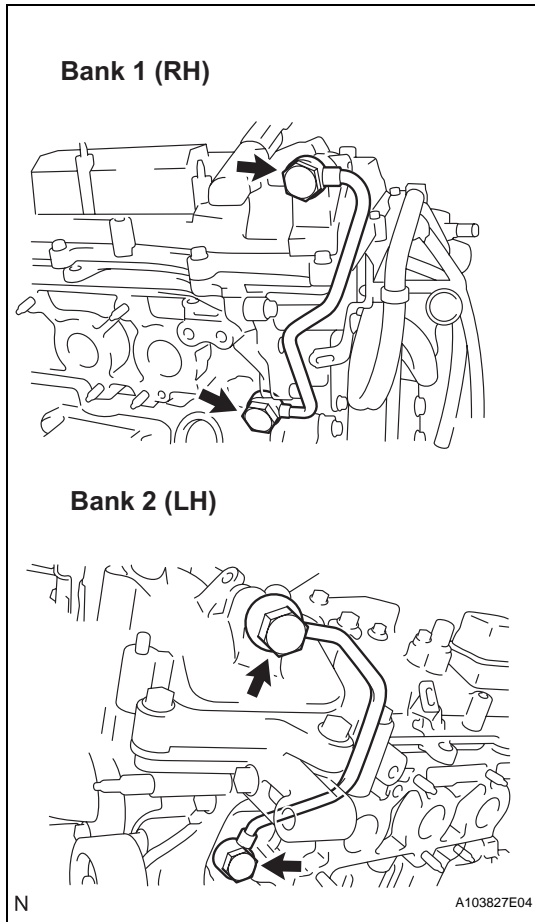
**Valve moves quickly.**

- Reinstall the OCV.

**NG**

**REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

**OK**

**6 INSPECT OIL CONTROL VALVE FILTER AND PIPE**

- (a) Remove the oil pipe No. 1 or No. 2.
- (b) Remove the OCV filter.
- (c) Check that the filter is not clogged.

**OK:****Filter is not clogged.**

- (d) Reinstall the OCV filter.
- (e) Reinstall the oil pipe No. 1 or No. 2.

**NG****CLEAN OIL CONTROL VALVE FILTER AND PIPE****OK****7 REPLACE CAMSHAFT TIMING GEAR ASSEMBLY****NEXT****8 CHECK WHETHER DTC OUTPUT RECURS**

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Clear DTCs (see page [ES-39](#)).
- (d) Start the engine and warm it up.
- (e) Switch the ECM from normal mode to check mode using the tester.
- (f) Drive the vehicle for more than 10 minutes.
- (g) Read output DTCs using the tester.

**Standard:****No DTC output.**

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay registered even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

