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)

HINT:
If DTC P0011, P0012, P0021 or P0022 is present, check the VVT (Variable Valve Timing) system.

DESCRIPTION

Refer to DTC P0010 (See page ES-75).

DTC No.	DTC Detection Condition	Trouble Area
P0011 P0021	Advanced cam timing: With warm engine and engine speed of between 500 rpm and 4000 rpm, all conditions (a), (b) and (c) are met (1 trip detection logic): (a) Difference between target and actual intake valve timings is more than 5° CA (Crankshaft Angle) for 4.5 seconds (b) Current intake valve timing is fixed (timing changes less than 5° CA in 5 seconds) (c) Variations in VVT controller timing are more than 19° CA of maximum delayed timing (advanced)	• Valve timing • OCV for intake camshaft • OCV filter • Intake camshaft (bank 1) timing gear assembly • ECM
P0012 P0022	Retarded cam timing: With warm engine and engine speed of between 500 rpm and 4000 rpm, all conditions (a), (b) and (c) are met (2 trip detection logic): (a) Difference between target and actual intake valve timings is more than 5° CA (Crankshaft Angle) for 4.5 seconds (b) Current intake valve timing is fixed (timing changes less than 5° CA in 5 seconds) (c) Variations in VVT controller timing is 19° CA or less of maximum delayed timing (retarded)	• Valve timing • OCV for intake camshaft • OCV filter • Intake camshaft (bank 2) timing gear assembly • ECM

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 applied 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 actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and sets a DTC.

Example:

A DTC will be set when the following conditions 1), 2) and 3) are met:

1) The difference between the target and actual intake valve timings 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.
DTCs P0011 and P0021 (Advanced Cam Timing) are detected with 1 trip detection logic.
DTCs P0012 and P0022 (Retarded Cam Timing) are detected with 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 not run unless 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 40 mph (64 km/h) for 3 minutes.
- The engine has idled for 3 minutes.

MONITOR STRATEGY

Related DTCs	P0011: Advanced intake camshaft timing (bank 1) P0012: Retarded intake camshaft timing (bank 1) P0021: Advanced intake camshaft timing (bank 2) P0022: Retarded intake camshaft timing (bank 2)
Required sensors / components (Main)	VVT OCV, VVT Actuator
Required sensors / components (Related)	Crankshaft position sensor, Camshaft position sensor, ECT sensor
Frequency of operation	Once per driving cycles
Duration	Less than 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	P0100, P0101, P0102, P0103 (MAF Sensor), P0115, P0116, P0117, P0118 (ECT Sensor), P0125 (Insufficient ECT for Closed Loop), P0335 (CKP Sensor), P0340 (CMP Sensor), P0351, P0352, P0353, P0354, P0355, P0356 (Ignitor)
Battery voltage	11 V or more
Engine RPM	500 to 4000 rpm
ECT	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

P0011, P0021:

Duration of actual valve timing and target valve timing	More than 5° CA (Crankshaft angle)
Valve timing	No change in advanced valve timing

P0012, P0022:

Duration of actual valve timing and target valve timing	More than 5° CA (Crankshaft angle)
Valve timing	No change in retarded valve timing

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-77).

INSPECTION PROCEDURE

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	P0012
Bank 2	P0021	P0022

HINT:
- If DTC P0011 or P0012 is displayed, check the bank 1 VVT system circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0021 or P0022 is displayed, check the bank 2 VVT system circuit.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

ES

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read the DTCs.

Result

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

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

B → **GO TO DTC CHART (See page ES-56)**

A

2	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE OCV)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine.
(d) Select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
(e) Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine idle 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 to the ON position and turn the tester on.
(c) Clear the DTCs (See page ES-39).
(d) Start the engine and warm it up.
(e) Select the check mode using the tester (See page ES-43).
(f) Drive the vehicle for more than 10 minutes.
(g) Read the DTCs using the tester.

OK:

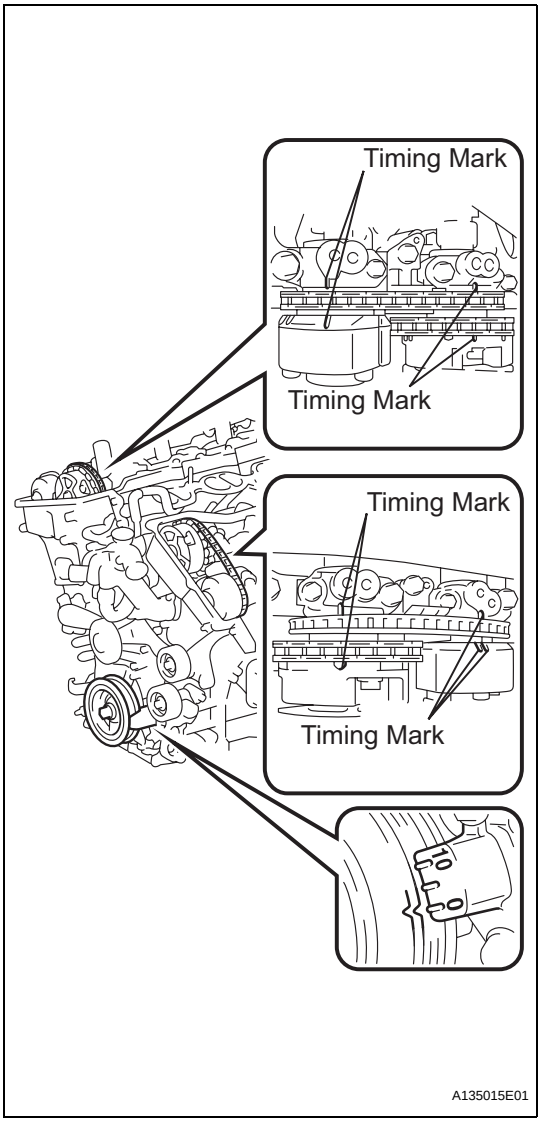
No DTC outputs.

NG → **Go to step 4**

OK ↓

SYSTEM IS OK

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



(a) Remove the cylinder head covers RH and LH.
(b) Turn the crankshaft to align the timing marks of the crankshaft.
(c) Align the notch of the crankshaft pulley to the "0" position.
(d) Check if the timing marks of the camshaft pulley and camshaft bearing cap align.
(e) Turn the crankshaft clockwise by 360° if the timing marks do not align. Check if they align once again.

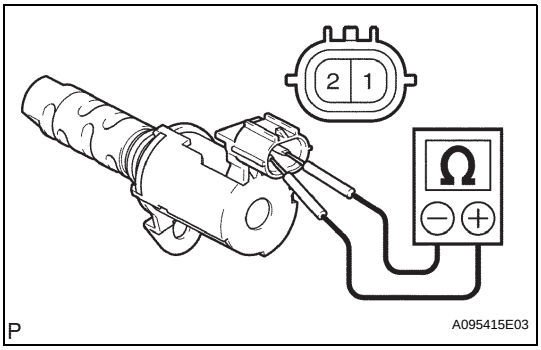
OK:

The timing marks of the camshaft pulley and the camshaft bearing cap align when the notch of the crankshaft pulley is in the "0" position.

NG → **ADJUST VALVE TIMING**

OK

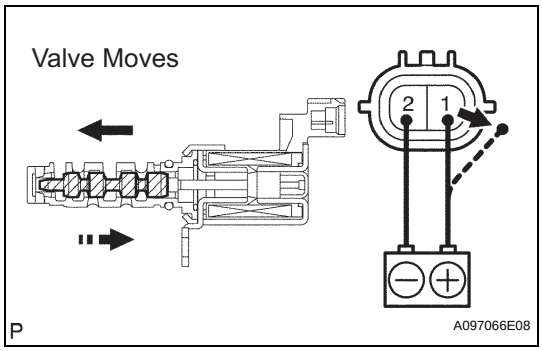
5	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)



(a) Remove the camshaft timing oil control valve (OCV).
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω



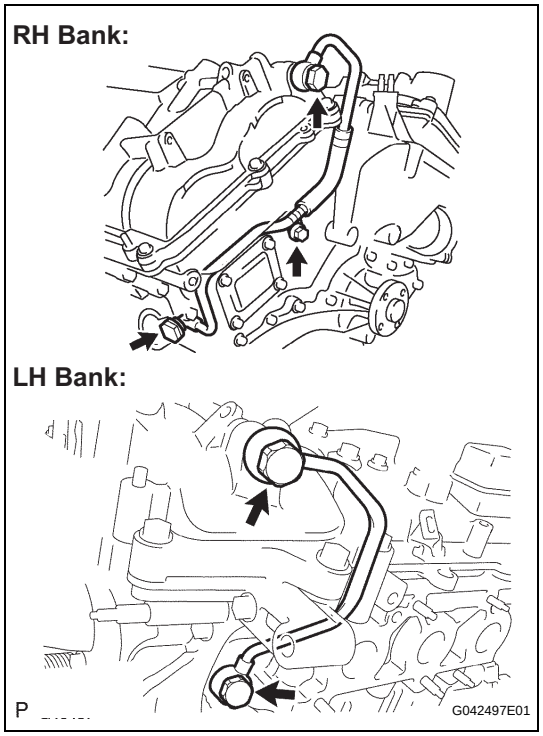
(c) Apply the positive battery voltage to terminal 1 and the negative battery voltage to terminal 2. Check the valve operation.
OK:
Valve moves quickly.
(d) Reinstall the OCV.

NG → **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (See page ES-486)**

OK

ES

6	CHECK OIL PIPE AND OIL CONTROL VALVE FILTER



(a) Remove the oil pipe No. 1 or oil pipe assembly.
(b) Remove the oil control valve filter.
(c) Check that the filter and pipe are not clogged.
OK:
The filter and pipe are not clogged.

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 to the ON position and turn the tester on.
(c) Clear the DTCs (See page ES-39).
(d) Start the engine and warm it up.
(e) Select the check mode using the tester (See page ES-43).

(f) Drive the vehicle for more than 10 minutes.
(g) Confirm that no DTC is set using the tester.
OK:
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 output 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.

NG → **REPLACE ECM (See page ES-498)**

ES

OK

SYSTEM IS OK