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)

HINT:

- If DTC P0011 or P0012 is displayed, check the bank 1 Variable Valve Timing (VVT) system circuit.
- If DTC P0021 or P0022 is displayed, check the bank 2 VVT system circuit.
- Bank 1 includes cylinder No. 1, but bank 2 does not. Cylinder No. 1 is located in the front part of the engine, opposite the transmission.

CIRCUIT DESCRIPTION

Refer to DTC P0010 on page 05–42.

DTC No.	DTC Detection 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) or (b) continues (1 trip detection logic): (a) Valve timing does not change from current valve timing (b) Current valve timing is fixed (difference between "target" and "actual" camshaft timing is more than 5° crankshaft angle (CA) for 4.5 seconds and camshaft timing change is less than 5°CA for 5 sec.)	• Valve timing • VVT Oil control valve (OCV) bank 1 • Camshaft timing gear assy • ECM
P0012 P0022	Retarded cam timing: After engine is warmed up and engine speed is at 400 to 4,000 rpm, condition (a) or (b) continues (2 trip detection logic): (a) Valve timing does not change from current valve timing (b) Current valve timing is fixed (difference between "target" and "actual" camshaft timing is more than 5°CA for 4.5 seconds and camshaft timing change is less than 5°CA for 5 sec.)	• Valve timing • VVT OCV bank 2 • Camshaft timing gear assy • ECM

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the VVT system to control the intake valve camshaft. The VVT system includes the ECM, the 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 Crankshaft 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.

The monitor runs if all the conditions below are met:

- After engine warm–up (engine coolant temperature 75°C (167°F) or more)
- After driving the vehicle over 40 km/h (64 mph) for 3 minutes.
- After idling the engine for 3 minutes.

WIRING DIAGRAM

Refer to DTC P0010 on page 05–42.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Intelligent Tester II. 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.

NOTICE:

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

1	PERFORM ACTIVE TEST (OCV OPERATION)

(a) Connect the Intelligent Tester II to the DLC3.

(b) Start the engine and warm it up.

(c) Select the item "Enter/ Diagnosis/ OBD·MOBD/ Power train/ Engine and ECT/ Active Test/ VVT CTRL B1 or VVT CTRL B2".

(d) Using the Intelligent Tester II, operate the OCV and check the engine RPM.

Standard:

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

B → **Go to step 4**

A

2	PERFORM ACTIVE TEST (OCV OPERATION)

(a) Enter the following menus: Active Test/ VVT B1 or VVT B2.
(b) Change the VVT B1 and VVT B2 values to a value between –100 % to 100 %.

HINT:

VVT B1 and VVT B2 values should be added to to the current OCV duty ratio.

(c) Confirm the current VVT angle by checking VVT CHNG ANGL#1 and VVT CHNG ANGL#2.
OK: Operation of VVT B1 or VVT B2 leads to an immediate, linear change in the VVT angle.

NOTICE:

- With the engine idling and with advanced camshaft timing (VVT B1 or VVT B2 has a value of 0 % to 100%), engine revolutions will be rough or the engine will stall.
- When the vehicle is being driven, if the engine is turned off or the throttle valve is open, this Active Test will automatically be canceled.

NG → **Go to step 4**

OK

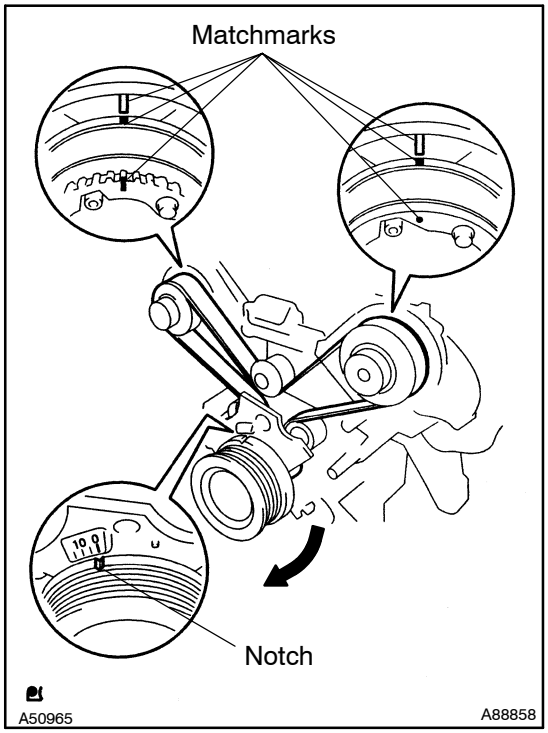
3	CHECK IF DTC OUTPUTS REOCCUR

(a) Select check mode.
(b) Start and warm up the engine.
(c) Drive the vehicle for 10 minutes or more.
(d) Read DTC.
OK: No DTC output.

OK → **END**

NG

4 CHECK VALVE TIMING



(a) Remove the engine cover.
(b) Remove the drive belt.
(c) Remove the timing belt cover LH and RH.
(d) Turn the crankshaft to align the matchmarks of the crankshaft.
(e) Align the notch of the crankshaft pulley to the "0" position.
(f) Confirm whether the camshaft pulley's matchmark and the matchmark of the cylinder head cover face each other.
(g) Turn the crankshaft clockwise by 360° if these do not face each other. Confirm whether or not these face each other once again.

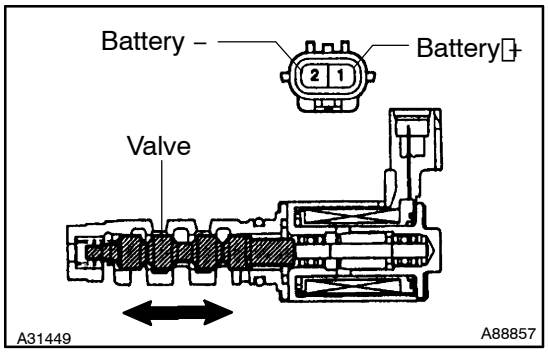
OK:

The matchmarks of the camshaft pulley and the cylinder head cover face each other when the notch of the crankshaft pulley is in the "0" position.

NG → **ADJUST VALVE TIMING (See page 14–71)**

OK

5 CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSY (OCV)

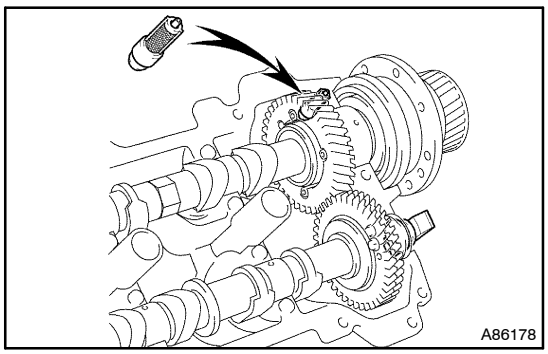


(a) Measure the resistance between the terminals of the OCV.
Standard: 6.9 to 7.9 Ω at 20°C (68°F)
(b) Remove the OCV.
(c) Apply battery positive voltage to terminal 1 and battery negative voltage to terminal 2. Check the valve operation.
OK: The valve moves quickly.

NG → **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSY (OCV)**

OK

6	CHECK OIL CONTROL VALVE FILTER



(a) Remove the cylinder head cover.
(b) Remove the camshaft bearing cap and the OCV filter.
(c) Check that the filter is not clogged.
OK: The filter is not clogged.

NG → **CLEAN OIL CONTROL VALVE FILTER**

OK

REPLACE CAMSHAFT TIMING GEAR ASSY (See page 14–81, 14–89)

After replacing the camshaft timing gear, check the DTC.
(a) Clear the DTC and select check mode (see page 05–27).
(b) Start and warm up the engine.
(c) Drive the vehicle for 10 minutes or more.
(d) Read DTC and check no DTC is set.