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Service Category: Engine/Hybrid System	Section: Engine Control	
Model Year: 2008	Model: LX570	Doc ID: RM000000PDU05LX
Title: 3UR-FE ENGINE CONTROL: SFI SYSTEM: DESCRIPTION (2008 LX570)		

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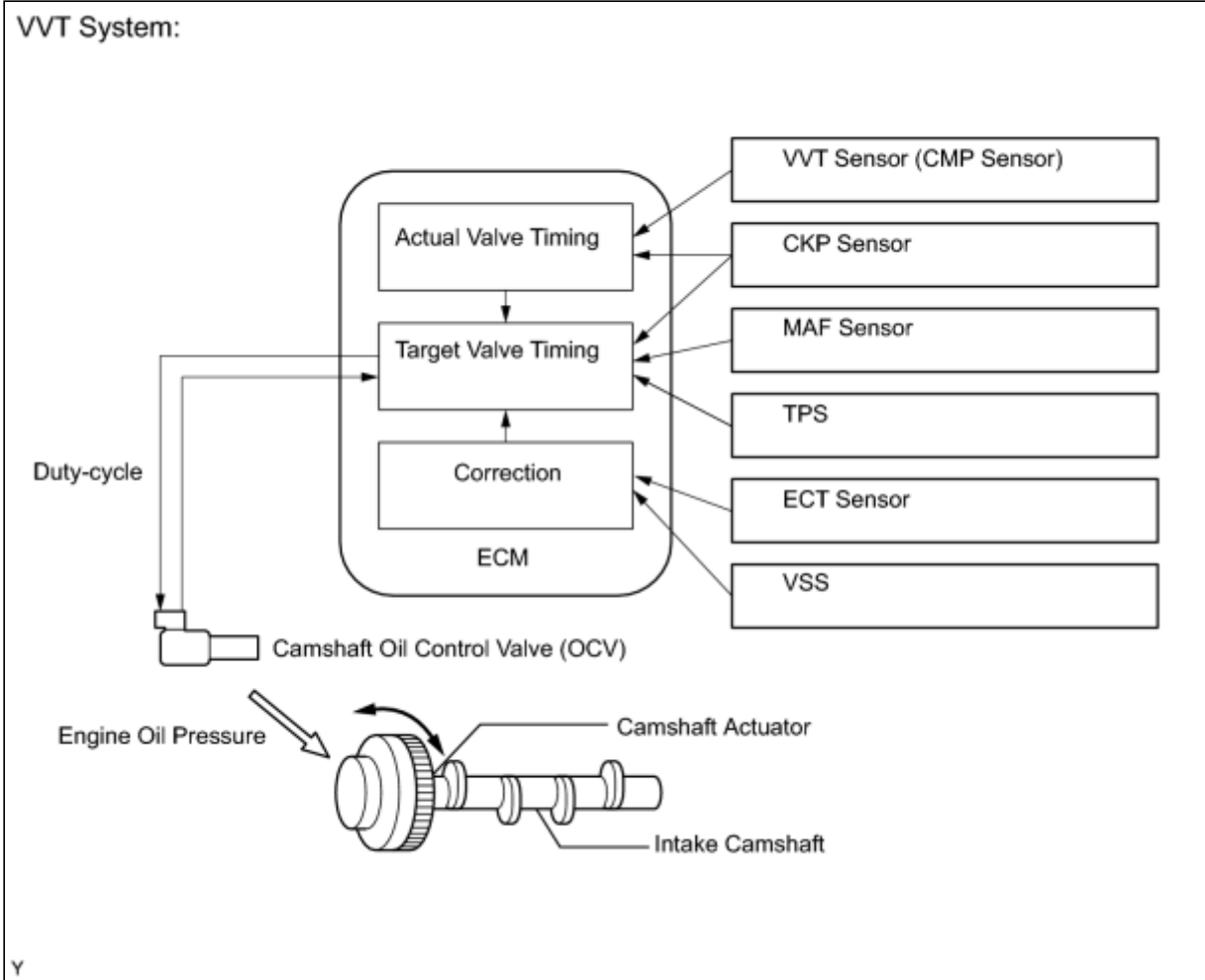
DTC	P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)
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DTC	P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)
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DTC	P0022	Camshaft Position "A" - Timing Over-Retarded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

The VVT system includes the ECM, Camshaft 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.



DTC CODE	DTC DETECTION CONDITION	TROUBLE AREA
P0011 P0021	The intake valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Camshaft Oil Control Valve (OCV) (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • ECM
P0012 P0022	The intake valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	• Valve timing • OCV (for intake side of Bank 1, 2) • OCV filter • Camshaft timing gear • 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, Camshaft 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. 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 stores DTC(s).

Example:

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

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

DTC P0012 and P0022 (Retarded Cam Timing) are 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:

MONITOR STRATEGY

Related DTCs	P0011: Advanced camshaft timing (for Bank 1) P0012: Retarded camshaft timing (for Bank 1) P0021: Advanced camshaft timing (for Bank 2) P0022: Retarded camshaft timing (for 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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not stored	P0102 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for Closed Loop) P0335 (CKP sensor) P0351 - P0358 (Igniter)
Battery voltage	11 V or higher
Engine speed	500 to 4,000 rpm
ECT	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Advanced camshaft timing:

Valve timing	No change at advanced valve timing
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Retarded 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 more than the specified value, the ECM operates the VVT actuator.

Then, the ECM monitors the camshaft timing change for 10 seconds.

WIRING DIAGRAM

INSPECTION PROCEDURE

HINT:

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

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

- If DTC P0011 or P0012 is output, check the left bank VVT system for intake side circuit (for Bank 1).
- Bank 1 refers to the bank that includes the No. 1 cylinder.
- If DTC P0021 or P0022 is output, check the right bank VVT system for intake side circuit (for Bank 2).
- Bank 2 refers to the bank that does not include the No. 1 cylinder.
- Read freeze frame data using the Techstream. 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.

PROCEDURE

1.	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)
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- (a) Connect the Techstream to the DLC3.
- (b) Turn the engine switch on (IG) and turn the Techstream on.
- (c) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
- (d) Read DTCs.

Result

RESULT	PROCEED TO
P0011, P0012, P0021 or P0022 is output	A
P0011, P0012, P0021 or P0022 and other DTCs are output	B

HINT:

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



2.	PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV)
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- (a) Connect the Techstream to the DLC3.
 - (b) Start the engine and turn the Techstream on.
 - (c) Warm up the engine.
 - (d) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1) or Control the VVT System (Bank 2).
 - (e) Check the engine speed while operating the Camshaft Oil Control Valve (OCV) using the Techstream.
- OK:

OPERATION	SPECIFIED CONDITION
OCV OFF	Normal engine speed
OCV ON	Soon after OCV switched from OFF to ON, engine idles roughly or stalls

OK

3.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)
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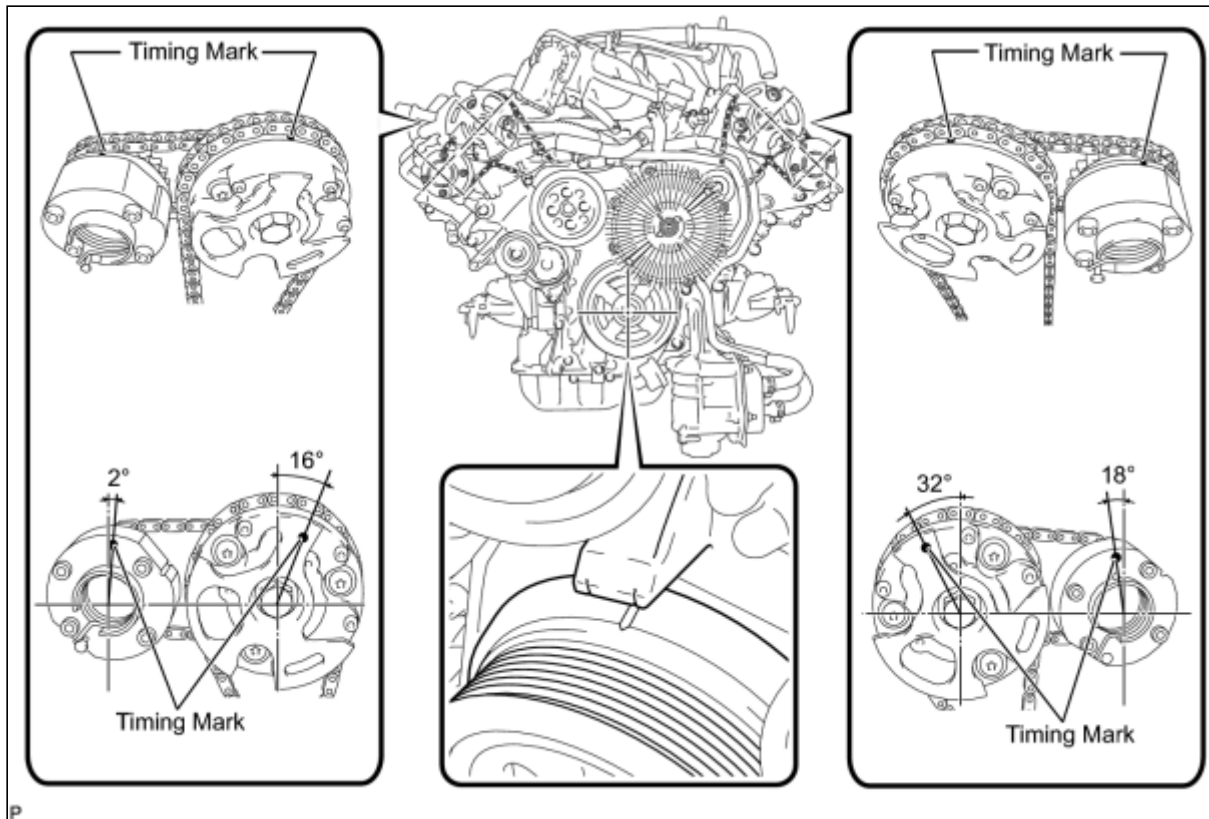
- (a) Connect the Techstream to the DLC3.
- (b) Turn the engine switch on (IG) and turn the Techstream on.
- (c) Clear the DTCs  .
- (d) Start the engine and warm it up.
- (e) Switch the ECM from normal mode to check mode using the Techstream.
- (f) Drive the vehicle for more than 10 minutes.
- (g) Read DTCs using the Techstream.

OK:

No DTC output.

OK

5.	CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TOOTH OF TIMING CHAIN)
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- (a) Remove the cylinder head cover LH and RH.
- (b) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.
- (c) Check that the timing marks of the camshaft timing gears and camshaft timing exhaust gears are at the positions shown in the illustration.

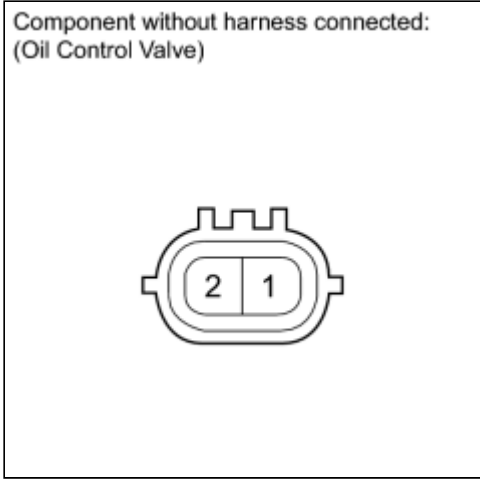
OK:

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

OK



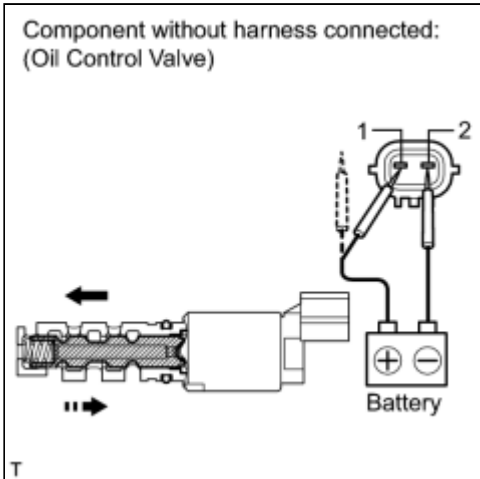
6.	INSPECT CAMSHAFT OIL CONTROL VALVE ASSEMBLY
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- (a) Remove the OCV.
- (b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
1 - 2	20°C (68°F)	6.9 to 7.9 Ω



- (c) Check the valve operation.
- OK:

MEASUREMENT CONDITION	SPECIFIED CONDITION
No battery voltage applied to terminals 1 and 2 → Battery voltage applied to terminals 1 and 2	Valve moves quickly

OK

7.	INSPECT OIL CONTROL VALVE FILTER
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(a) Remove the OCV filter  .

(b) Check that the filter is not clogged.

OK:

Filter is not clogged.

OK



8.	REPLACE INTAKE CAMSHAFT TIMING GEAR
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(a) Replace the intake camshaft timing gear  .

NEXT



13.	CHECK WHETHER DTC OUTPUT RECURS
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(a) Connect the Techstream to the DLC3.

(b) Turn the engine switch on (IG) and turn the Techstream on.

(c) Clear the DTCs  .

(d) Start the engine and warm it up.

(e) Switch the ECM from normal mode to check mode using the Techstream.

(f) Drive the vehicle for more than 10 minutes.

(g) Read the output DTCs using the Techstream.

OK:

No DTC is output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in the engine oil are caught in some parts of the system. These codes will stay stored 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.

OK

