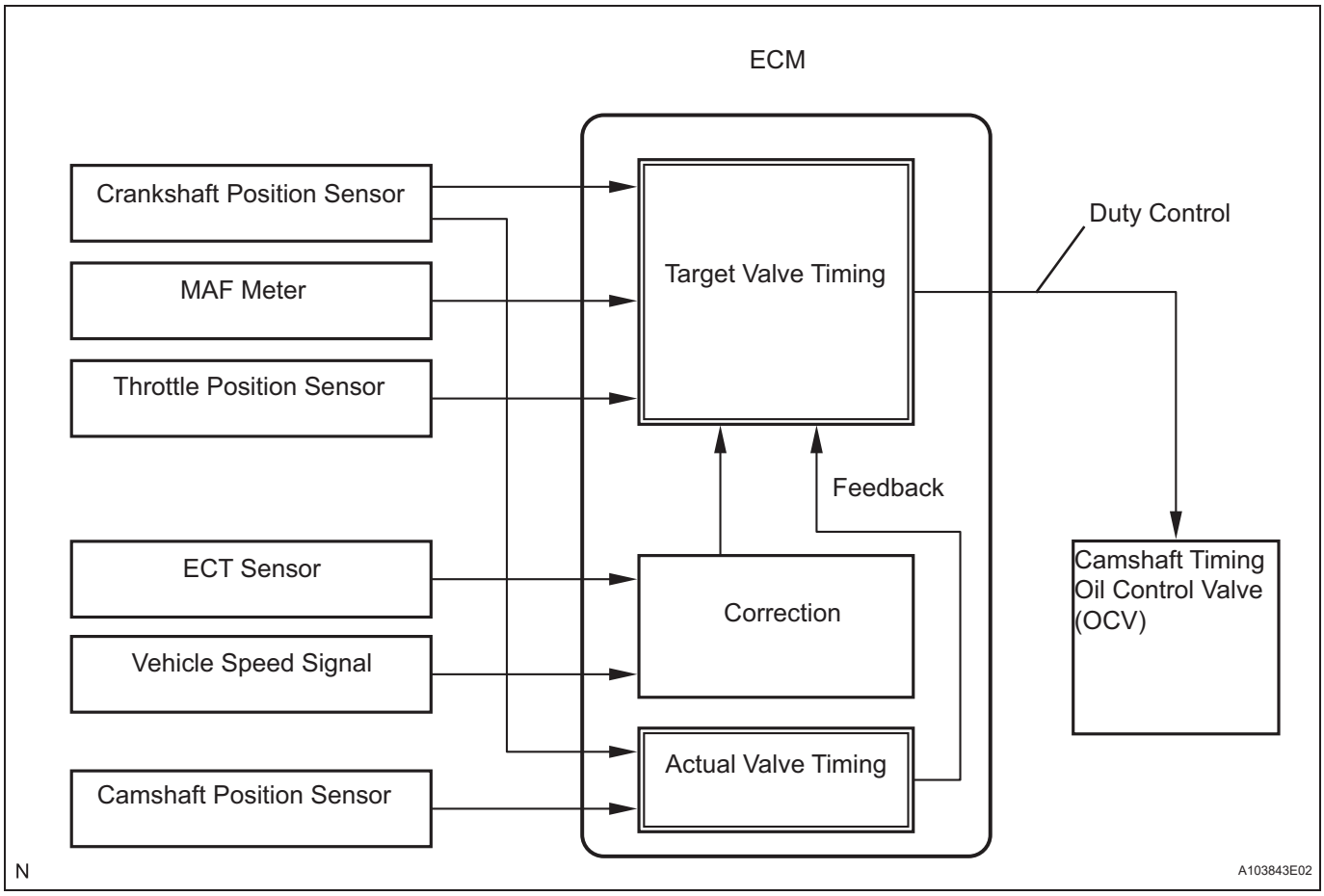
DTC	P0010	Camshaft Position "A" Actuator Circuit (Bank 1)

DESCRIPTION

The Variable Valve Timing (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, applied to the OCV, regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed based on engine operation condition such as intake air volume, throttle position and engine coolant temperature.

The ECM controls the OCV based on the signals from several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft is optimized, the engine torque and fuel economy improve, and exhaust emissions decrease. The ECM detects the actual valve timing using signals from the camshaft position sensor and the crankshaft position sensor. The ECM performs feedback control and verifies target valve timing.



DTC No.	DTC Detection Condition	Trouble Area
P0010	Open or short in oil control valve circuit	• Open or short in oil control valve circuit • Oil control valve • ECM

MONITOR DESCRIPTION

After the ECM sends the "target" duty-cycle signal to the OCV, the ECM monitors the OCV current to establish an "actual" duty-cycle. The ECM detects malfunction and sets a DTC when the actual duty-cycle ratio varies from the target duty-cycle ratio.

MONITOR STRATEGY

Related DTCs	P0010: VVT oil control valve range check
Required sensors/components	OCV
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Battery voltage	11 to 13 V
Target duty ratio	Less than 70%
Current cut status	Not cut

TYPICAL MALFUNCTION THRESHOLDS

Output signal duty for OCV	Output duty is 3% or less despite the ECM supplying the current to the OCV or Output duty is 100%

COMPONENT OPERATING RANGE

Output signal duty for OCV	More than 3% and less than 100%

WIRING DIAGRAM

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when 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.

1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE OCV)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Put the engine in inspection mode (see page ES-1).
(e) Start the engine and warm it up.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
(g) Using the intelligent tester, operate the OCV and check the engine speed.

OK

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

NOTICE:
Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

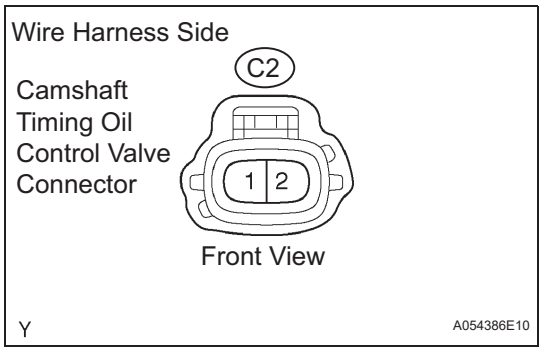
2	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

OK:
OCV has no contamination and moves smoothly.

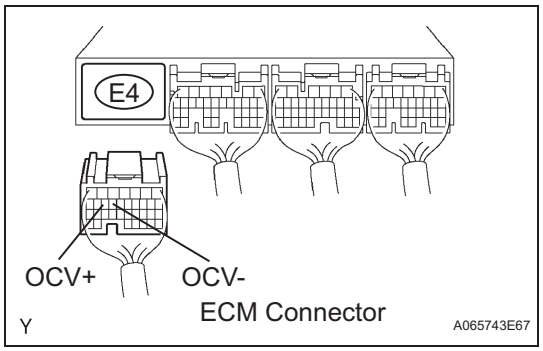
NG → **REPLACE CAMSHAFT TIMING CONTROL VALVE ASSEMBLY**

OK

3	CHECK HARNESS AND CONNECTOR (CAMSHAFT TIMING OIL CONTROL VALVE (OCV) - ECM)



(a) Disconnect the C2 camshaft timing oil control valve connector.



(b) Disconnect the E4 ECM connector.
(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
C2-1 - E4-15 (OCV+)	Below 1 Ω
C2-2 - E4-14 (OCV-)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
C2-1 or E4-15 (OCV+) - Body ground	10 kΩ or higher
C2-2 or E4-14 (OCV-) - Body ground	10 kΩ or higher

(d) Reconnect the camshaft timing oil control valve connector.
(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

ES

DTC	P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC	P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)

DESCRIPTION

Refer to DTC P0010 (see page ES-55).

DTC No.	DTC Detection Condition	Trouble Area
P0011	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	• Camshaft timing gear assembly • Oil control valve • Valve timing
P0012	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	• Camshaft timing gear assembly • Oil control valve • Valve timing

ES

MONITOR DESCRIPTION

To monitor the VVT components, the ECM (PCM) measures the valve timing that is calculated by the camshaft position and crankshaft position. The valve timing is usually adjusted in accordance with the driving condition. If the valve timing variation is less than the malfunction criterion, the ECM illuminates the MIL and set a DTC. P0011 is set when the valve timing is in the valve timing advance range. P0012 is set when the valve timing is in valve timing retard range.

MONITOR STRATEGY

Related DTCs	P0011: VVT system advance (bank) P0012: VVT system retard (bank 1)
Required sensors/components	Main sensors: Camshaft timing gear assembly Oil control valve Related sensors: Camshaft position sensor Engine coolant temperature sensor Crankshaft position sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	P0011: Immediately P0012: 2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351-P0354 (Igniter)
Battery voltage	11 V or more
Engine speed	900 to 5,000 rpm
Engine coolant temperature	75 to 100°C(167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Following conditions are met:	1 and 2
1. Deviation of valve timing (Target valve timing - Actual valve timing)	More than 5°CA
2. Response of valve timing	No change

WIRING DIAGRAM

Refer to DTC P0010 (see page ES-56).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when 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.

ES

1	CHECK VALVE TIMING (CHECK FOR LOOSE AND A JUMPED TOOTH OF TIMING CHAIN)

OK:

The match marks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING**

OK

2	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE OCV)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Put the engine in inspection mode (see page ES-1).
(e) Start the engine and warm it up.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
(g) Using the intelligent tester, operate the OCV and check the engine speed.

OK

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

NOTICE:

Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

NG → **Go to step 5**

OK

3	CHECK IF DTC OUTPUT RECURS

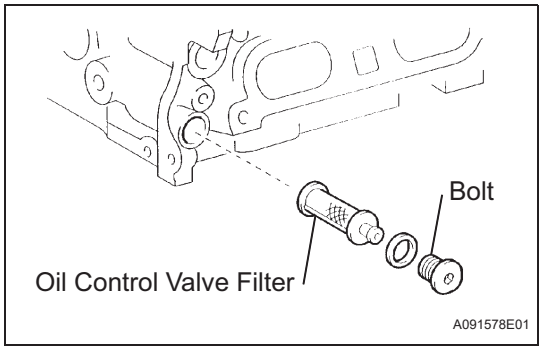
(a) Clear the DTCs (see page ES-29).
(b) Start the HV main system and warm the engine up.
(c) Drive the vehicle with the shift position in B at vehicle speed of more than 44 mph (70 km/h) approximately for 10 minutes or more.
(d) Read output DTCs using the intelligent tester.
OK:
No DTC output.

HINT:
*: DTC P0011 or P0012 is output when a foreign object in engine oil is caught in some part of the system.
These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

OK → **VVT SYSTEM OK***

NG

4	INSPECT OIL CONTROL VALVE FILTER



(a) Remove the air cleaner inlet, bolt and oil control valve filter.
(b) Check for blockages in the oil control valve filter.
(c) Reinstall the filter, bolt and air cleaner inlet.
NOTICE:
If necessary, clean the filter.
OK:
The filter has not clogged.

NG → **REPLACE OIL CONTROL VALVE FILTER**

OK

5	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

OK:
OCV has no contamination and moves smoothly.

NG → **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

OK

6	REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

NEXT

7	CHECK IF DTC OUTPUT RECURS

(a) Clear the DTCs (see page ES-29).
(b) Start the HV system, and warm the engine up.
(c) Drive the vehicle with the shift position in B at vehicle speed of more than 70 km/h (44 mph) approximately for 10 minutes or more.
(d) Read output DTCs using the intelligent tester.
OK:
No DTC output.

NG → **REPLACE ECM**

OK

END

DTC	P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)

DESCRIPTION

Refer to DTC P0335 (see page ES-159).

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and VVT sensor signal (2 trip detection logic)	• Mechanical system (timing chain has jumped a tooth, chain stretched) • ECM

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the Variable Valve Timing (VVT) system to control the intake valve 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, applied to the OCV, regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake valve camshaft. The ECM calibrates the valve timing of the VVT system by setting the camshaft to the maximum retard angle when the engine speed is idling. The ECM closes the OCV to retard the cam. The ECM stores this valve as "VVT learned value" (when the difference between the target valve timing and the actual valve timing is 5 degrees or less, the ECM stores this in its memory).
If the learned value meets both of the following conditions ("a" and "b"), the ECM interprets this as a defect in the VVT system and sets a DTC.
(a) VVT learning value is less than 30°CA (CA: Crankshaft Angle), or more than 46°CA.
(b) Above condition continues for more than 18 second.

MONITOR STRATEGY

Related DTCs	P0016: Deviation in crankshaft position sensor signal and VVT sensor signal
Required sensors/components	Crankshaft position sensor, camshaft position sensor
Frequency of operation	Once per driving cycle
Duration	60 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0115 - P0118 (ECT sensor)
Engine speed	900 to 5,000 rpm
Valve timing	Maximum valve timing retard

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	(a) or (b)
(a) VVT learned value	Less than 30°CA
(b) VVT learned value	More than 46°CA

WIRING DIAGRAM

Refer to DTC P0335 (see page ES-160).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when 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.

1	CHECK VALVE TIMING (CHECK FOR LOOSE AND A JUMPED TOOTH OF TIMING CHAIN)

OK:

The match marks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING (REPAIR OR REPLACE TIMING CHAIN)**

OK

REPLACE ECM