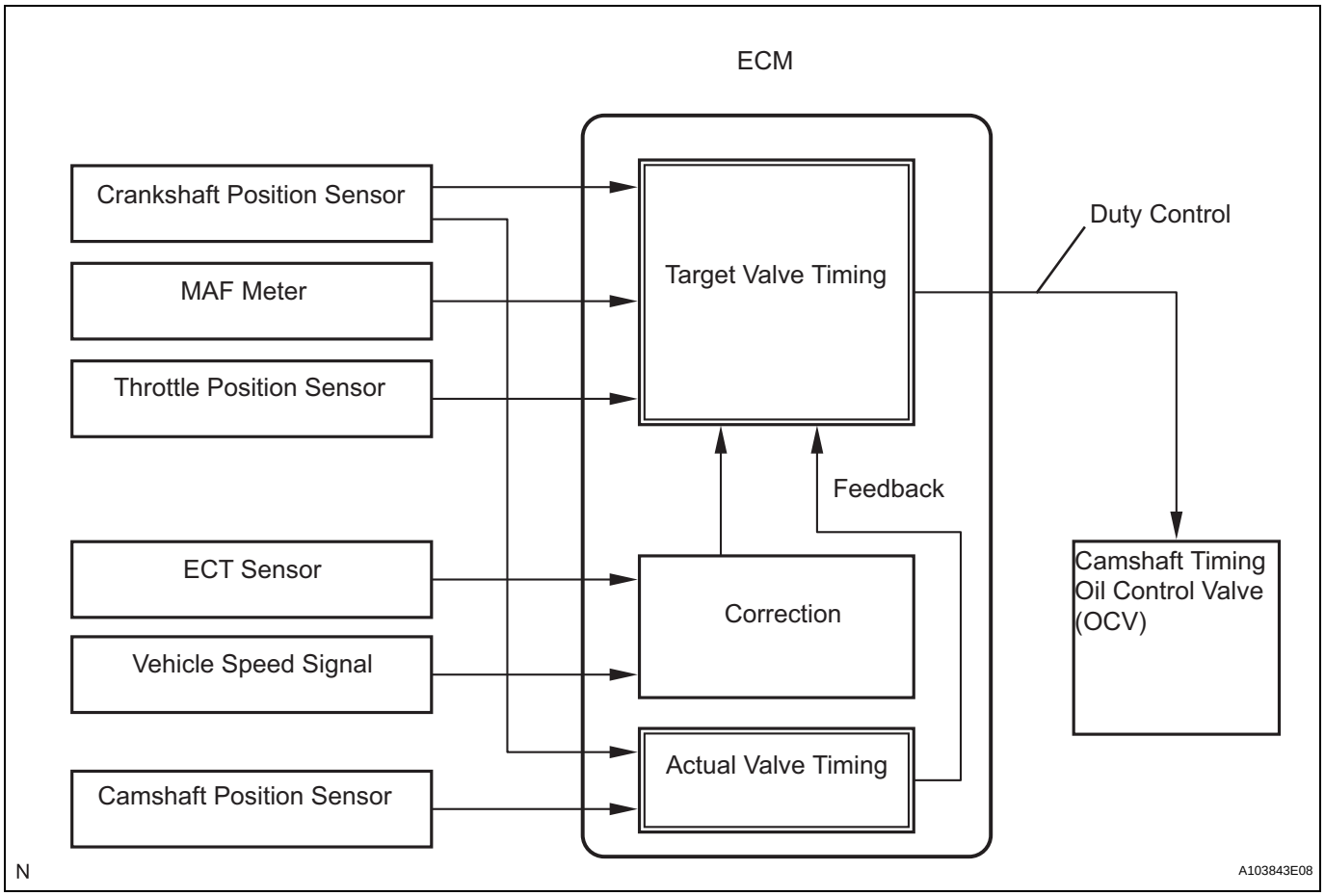
DTC	P0010	Camshaft Position "A" Actuator Circuit (Bank 1)

DTC	P0020	Camshaft Position "A" Actuator Circuit (Bank 2)

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, sent to the OCV, regulates the oil pressure applied to the VVT controller. Camshaft timing control is performed based on engine operation conditions such as intake air volume, throttle position and engine coolant temperature. The ECM controls the OCV based on the signals output from several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative position between the camshaft and the crankshaft is optimized. Also, 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 P0020	Open or short OCV circuit (1 trip detection logic)	• Open or short OCV circuit • OCV • 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 a malfunction and sets a DTC when the actual duty-cycle ratio varies from the target duty-cycle ratio.

MONITOR STRATEGY

Related DTCs	P0010: VVT OCV (bank 1) Range Check P0020: VVT OCV (bank 2) Range Check
Required sensors / components (Main)	VVT OCV (Variable Valve Timing oil control valve)
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	11 V or more
Target duty ratio for the OCV	Less than 70 %
Starter	OFF
Current cut status for the OCV	Not cut

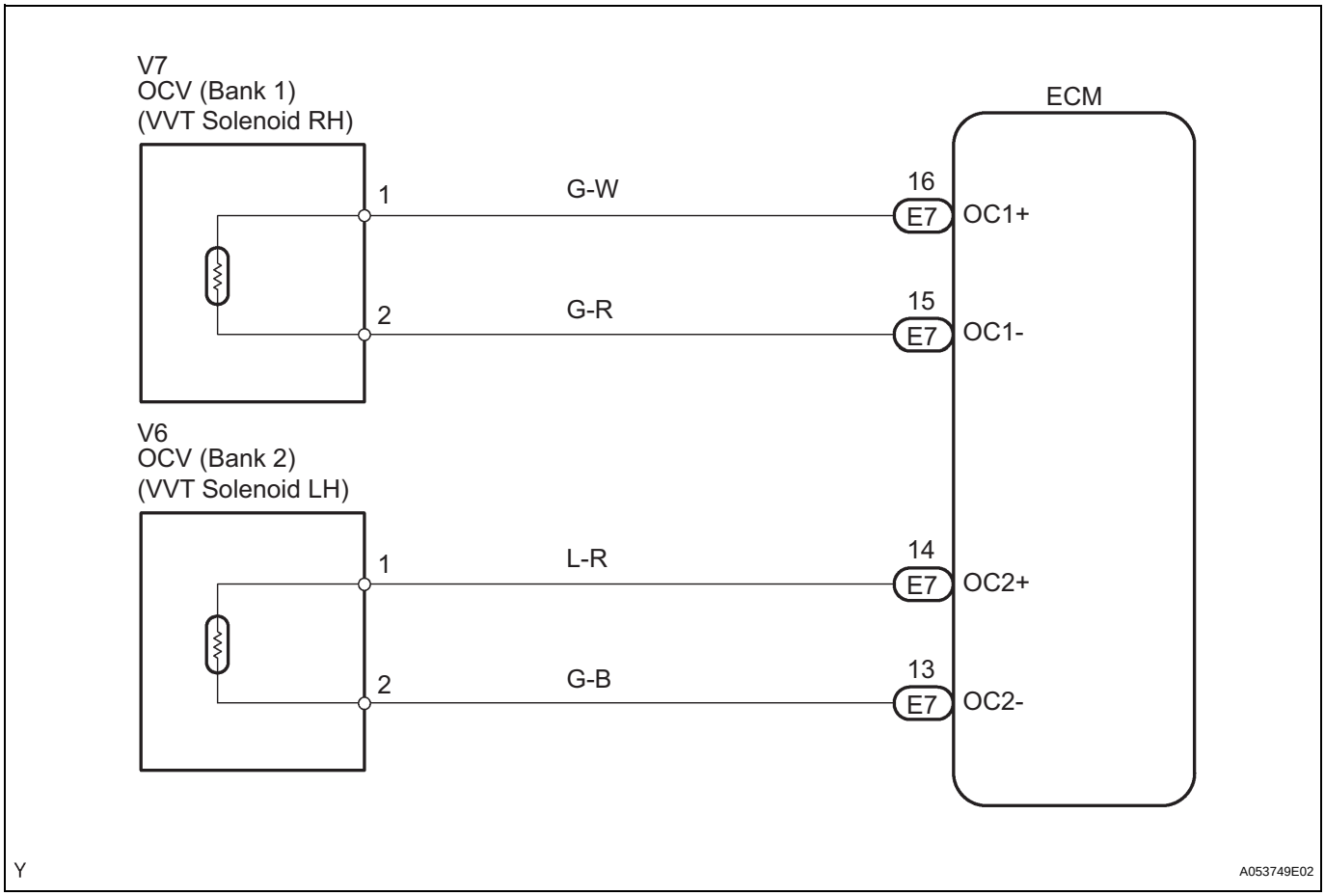
TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	Condition 1 or 2
1. OCV duty ratio	100 % (always ON) even though the target duty ratio is less than 70 %
2. OCV duty ratio when ECM supplies current to OCV	3 % or less despite the ECM supplying the current to the OCV

COMPONENT OPERATING RANGE

VVT OCV duty ratio	More than 3 %, and Less than 100 %

WIRING DIAGRAM



HINT:
- If DTC P0010 is displayed, check the right bank VVT system.
- Bank 1 refers to the bank that includes 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 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.

1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OCV OPERATION)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Warm up the engine.
(d) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
(e) Using the intelligent tester, operate the OCV and check the engine speed.

OK

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

OK → CHECK FOR INTERMITTENT PROBLEMS

NG

2 INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

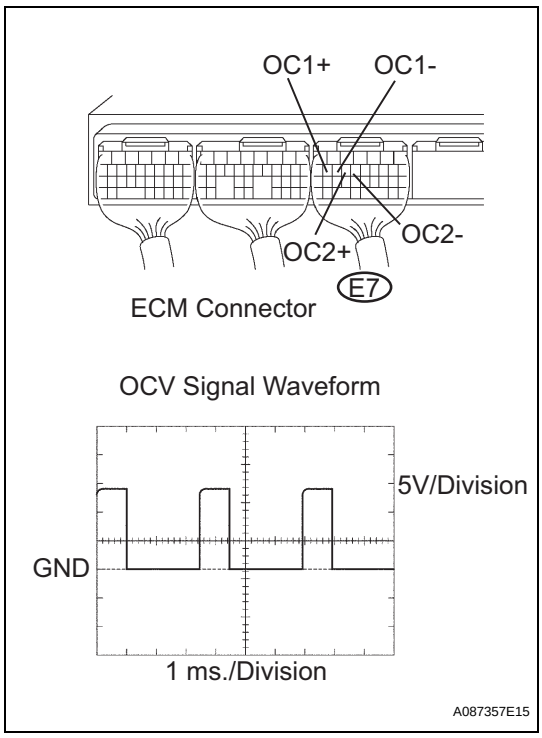
(a) Reconnect the OCV connector.
OK:
OCV has no contamination and moves smoothly.

NG → REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

ES

OK

3 INSPECT ECM (OCV SIGNAL)



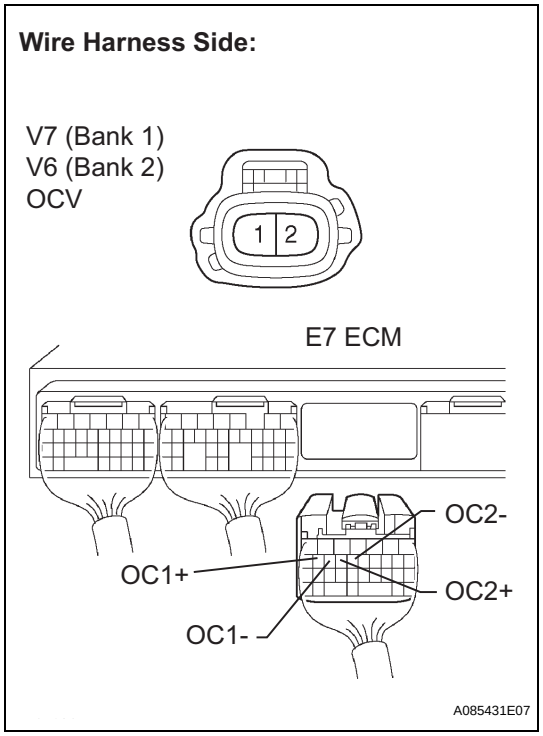
(a) During idling, check the waveform of the ECM connector using an oscilloscope.
Signal waveform

Tester Connection	Specified Condition
E7-16 (OC1+) - E7-15 (OC1-) E7-14 (OC2+) - E7-13 (OC2-)	Correct waveform is shown in the illustration.

NG → REPLACE ECM

OK

4 CHECK HARNESS AND CONNECTOR (OCV - ECM)



(a) Disconnect the V6 or V7 OCV connector.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Standard resistance

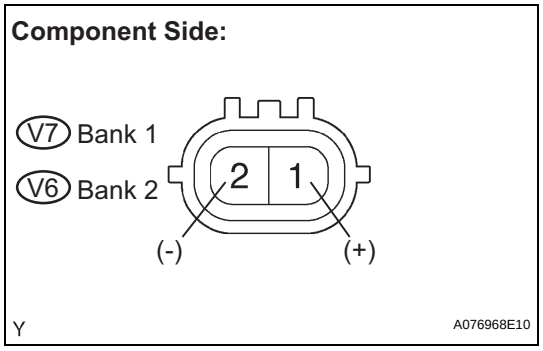
Tester Connection	Specified Condition
V7-1 (OCV) - E7-16 (OC1+) V7-2 (OCV) - E7-15 (OC1-) V6-1 (OCV) - E7-14 (OC2+) V6-2 (OCV) - E7-13 (OC2-)	Below 1 Ω
V7-1 (OCV) or E7-16 (OC1+) - Body ground V7-2 (OCV) or E7-15 (OC1-) - Body ground V6-1 (OCV) or E7-14 (OC2+) - Body ground V6-2 (OCV) or E7-13 (OC2-) - Body ground	10 kΩor higher

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

OK

CHECK FOR INTERMITTENT PROBLEMS

1 CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV OPERATION)



(a) Disconnect the V6 or V7 OCV connector.
(b) Apply positive battery voltage between the terminals of the OCV.
(c) Check the engine speed.

OK:

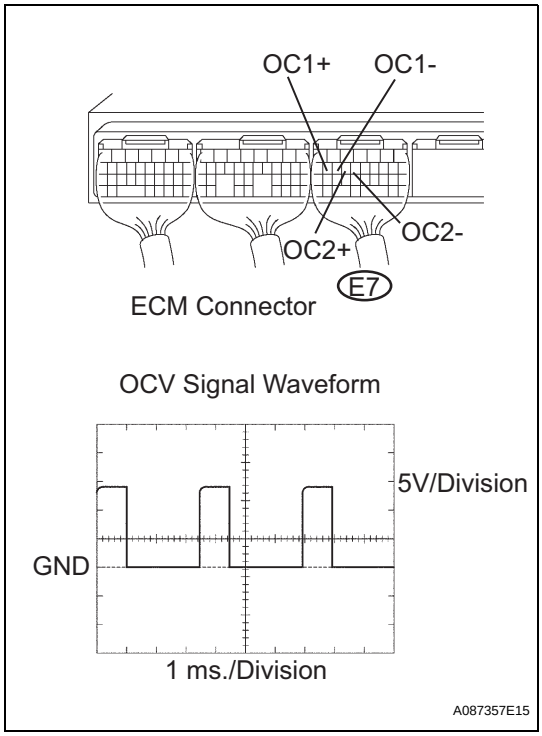
Engine speed is rough idle or engine is stalled.

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

OK

ES

2 CHECK ECM (OCV SIGNAL)



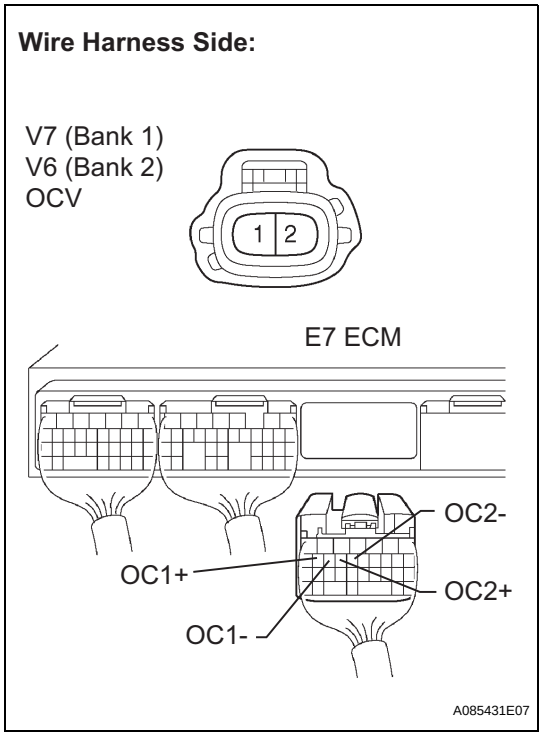
(a) During idling, check the waveform of the E7 ECM connector using an oscilloscope.
Signal waveform

Tester Connection	Specified Condition
E7-16 (OC1+) - E7-15 (OC1-) E7-14 (OC2+) - E7-13 (OC2-)	Correct waveform is shown in the illustration

NG → **REPLACE ECM**

OK

3 CHECK HARNESS AND CONNECTOR (OCV - ECM)



(a) Disconnect the V6 or V7 OCV connector.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Standard resistance

Tester Connection	Specified Condition
V7-1 (OCV) - E7-16 (OC1+) V7-2 (OCV) - E7-15 (OC1-) V6-1 (OCV) - E7-14 (OC2+) V6-2 (OCV) - E7-13 (OC2-)	Below 1 Ω
V7-1 (OCV) or E7-16 (OC1+) - Body ground V7-2 (OCV) or E7-15 (OC1-) - Body ground V6-1 (OCV) or E7-14 (OC2+) - Body ground V6-2 (OCV) or E7-13 (OC2-) - Body ground	10 kΩ or higher

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

OK

CHECK FOR INTERMITTENT PROBLEMS