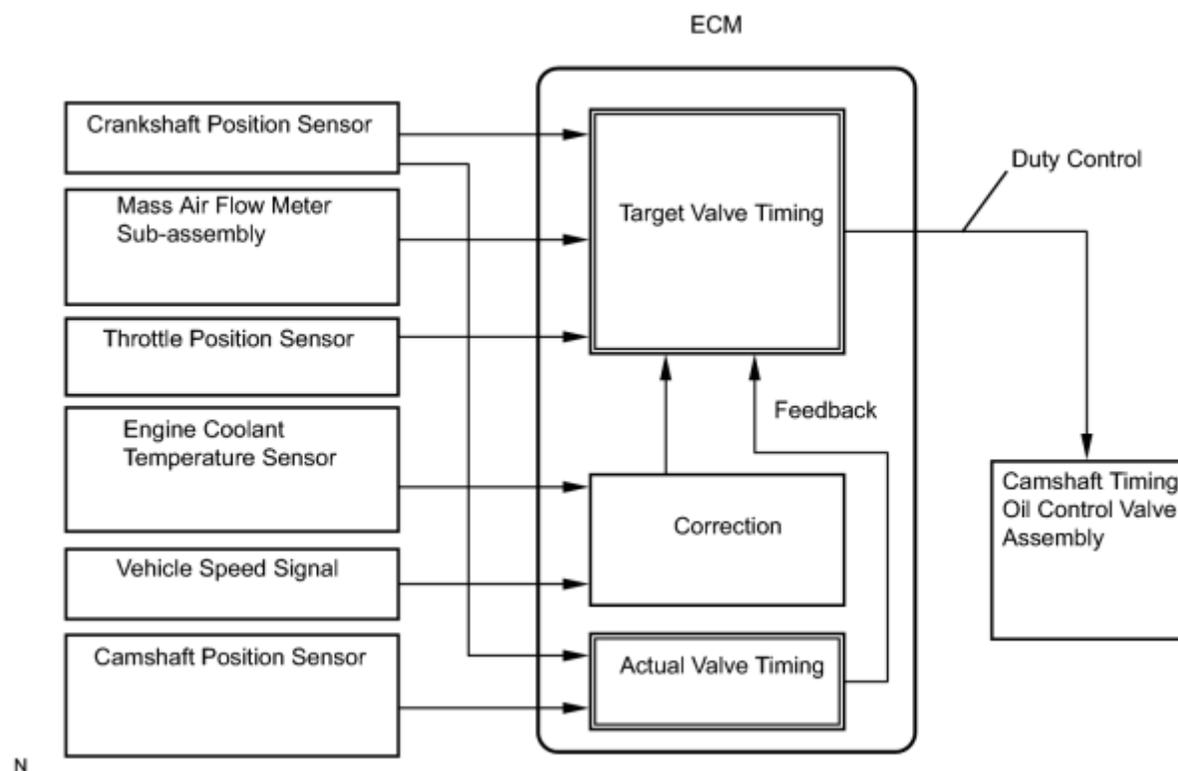


DESCRIPTION

The VVT (variable valve timing) system adjusts the intake valve timing to improve driveability. The engine oil pressure turns the VVT controller to adjust the valve timing.

The camshaft timing oil control valve assembly is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies the 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.



DTC No.	DTC Detection Condition	Trouble Area
P0010	Open or short in camshaft timing oil control valve assembly circuit (1 trip detection logic)	<ul style="list-style-type: none"> Open or short in camshaft timing oil control valve assembly circuit Camshaft timing oil control valve assembly ECM

MONITOR DESCRIPTION

This DTC is designed to detect open or short circuits in the camshaft timing oil control valve assembly circuit. If the camshaft timing oil control valve's duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and set the DTC.

MONITOR STRATEGY

Related DTCs	P0010: Camshaft timing oil control valve range check (bank 1)
Required Sensors/Components (Main)	Camshaft timing oil control valve assembly
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediately
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None
All of the following conditions are met	A, B, C and D
A. Starter	OFF
B. Power switch	On (IG)
C. Time after power switch off to on (IG)	0.5 seconds or more
D. Either of the following condition is met	(a) or (b)
(a) All of the following conditions are met	1, 2 and 3
1. Battery voltage	11 to 13 V
2. CPU commanded duty	Less than 70%
3. Current cut status	Not cut
(b) All of the following conditions are met	4, 5 and 6
4. Battery voltage	13 V or more
5. CPU commanded duty	Less than 80%
6. Current cut status	Not cut

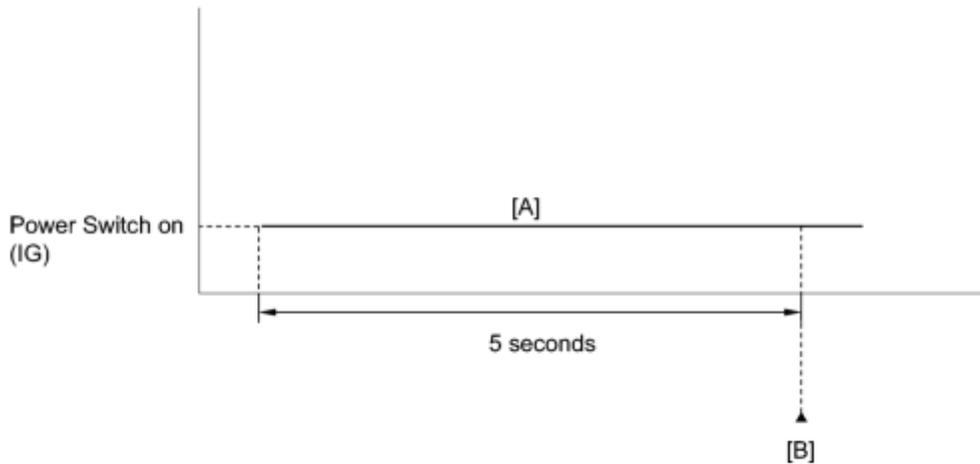
TYPICAL MALFUNCTION THRESHOLDS

VVT oil control valve condition	No operation record
---------------------------------	---------------------

COMPONENT OPERATING RANGE

VVT oil control valve condition	Operation record
---------------------------------	------------------

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the power switch on (IG) and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure) INFO.
4. Turn the power switch off and wait for 30 seconds.
5. Turn the power switch on (IG) and turn the Techstream on.
6. Wait 5 seconds [A].
7. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
8. Read the DTC [B].
9. If a DTC is output, the system is malfunctioning.

HINT:

If a DTC is not output, perform the following procedure.

10. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
11. Input the DTC: P0010.
12. Check the DTC judgment result.

Techstream Display	Description
NORMAL	<ul style="list-style-type: none"> ○ DTC judgment completed ○ System normal
ABNORMAL	<ul style="list-style-type: none"> ○ DTC judgment completed ○ System abnormal
INCOMPLETE	<ul style="list-style-type: none"> ○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	<ul style="list-style-type: none"> ○ Unable to perform DTC judgment

Techstream Display	Description
	<ul style="list-style-type: none"> ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows NORMAL, the system is normal.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform step [A] again.

13. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.

14. Check the judgment result.

HINT:

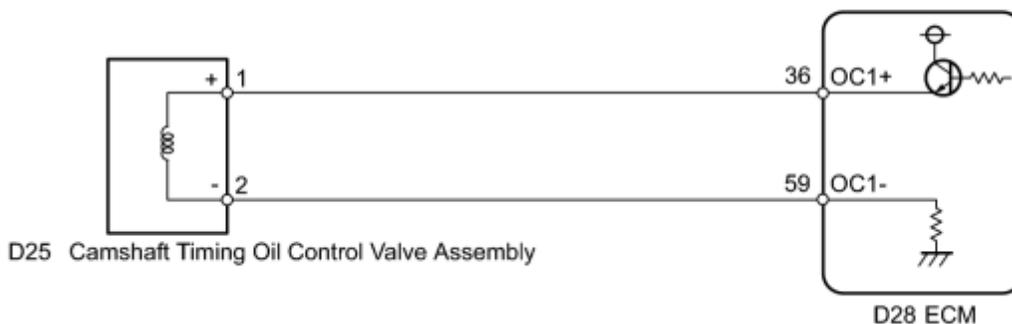
- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows NORMAL, the system is normal.

15. If the test result is INCOMPLETE or UNKNOWN and no DTC is output, perform a universal trip and check for permanent DTCs INFO.

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM



Y

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. 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.

PROCEDURE

1.	PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY)
----	---

- (a) Connect the Techstream to the DLC3.
- (b) Turn the power switch on (IG).
- (c) Turn the Techstream on.
- (d) Put the engine in inspection mode  .
- (e) Start the engine.
- (f) Warm up the engine.
- (g) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
- (h) Check the engine speed while operating the camshaft timing oil control valve assembly using the Techstream.

Result:

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

HINT:

If the result is not acceptable, cool the engine and perform the Active Test again.

- (i) Start the engine when the engine coolant temperature is 30°C (86°F) or less.
- (j) Turn the Techstream on.
- (k) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
- (l) Check the engine speed while operating the camshaft timing oil control valve assembly (for intake camshaft) using the Techstream with the engine coolant temperature is 50°C (122°F) or less.

Result:

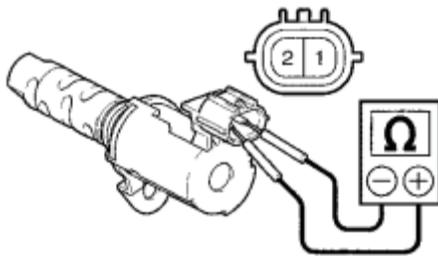
Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG ▶ [INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY](#)

OK ▶ **CHECK FOR INTERMITTENT PROBLEMS**

2.	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
----	--

*1



(a) Remove the camshaft timing oil control valve assembly.

(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

Text in Illustration

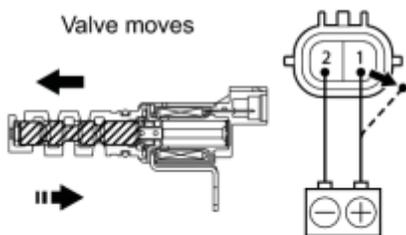
*1	Component without harness connected (Camshaft Timing Oil Control Valve Assembly)
----	---

(c) Connect the positive (+) battery terminal to terminal 1 and connect the negative (-) battery terminal to terminal 2. Check the valve operation.

OK:

Valve moves quickly.

Component without harness connected:
 (Camshaft Timing Oil Control Valve
 Assembly)



Y

(d) Reinstall the camshaft timing oil control valve assembly.

NG ▶ REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

OK

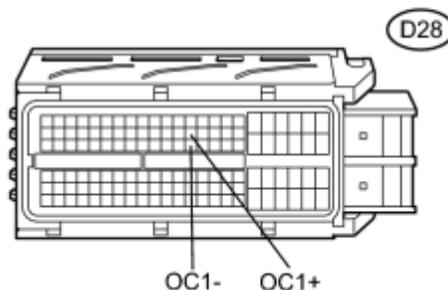
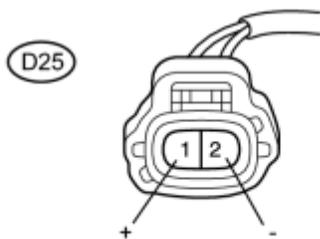


3.	CHECK HARNESS AND CONNECTOR (CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY - ECM)
----	--

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

*1

*2



N

(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
D25-1 (+) - D28-36 (OC1+)	Always	Below 1 Ω
D25-2 (-) - D28-59 (OC1-)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
D25-1 (+) or D28-36 (OC1+) - Body ground	Always	10 kΩ or higher
D25-2 (-) or D28-59 (OC1-) - Body ground	Always	10 kΩ or higher

Text in Illustration

*1 Front view of wire harness connector (to Camshaft Timing Oil Control Valve Assembly)	*2 Front view of wire harness connector (to ECM)
---	--

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

(e) Reconnect the ECM connector.

NG ► REPAIR OR REPLACE HARNESS OR CONNECTOR (CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY - ECM)

OK ► REPLACE ECM

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 .

DTC No.	DTC Detection Condition	Trouble Area
P0011	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	<ul style="list-style-type: none"> Valve timing Camshaft timing oil control valve assembly Oil control valve filter Camshaft timing gear assembly ECM
P0012	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	

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 camshaft timing oil control valve assembly and the VVT controller. The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve assembly. 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 timing is large, and changes in the actual intake valve timing are small, the ECM interprets this as a VVT controller stuck malfunction and sets a DTC.

- Example:
- A DTC is set when the following conditions "A" and "B" are met:
 - a. It takes 5 seconds or more to change the valve timing by 5°CA (Condition "A").
 - b. After the above condition is met, the camshaft timing oil control valve is forcibly activated for 10 seconds (Condition "B").
- The monitor will run if all of the following conditions are met:
- DTC P0011 (Advanced Cam Timing) is subject to 1 trip detection logic.
- DTC P0012 (Retarded Cam Timing) is subject to 2 trip detection logic.
- These DTCs indicate that the VVT controller cannot operate properly due to camshaft timing oil control valve assembly malfunctions or the presence of foreign objects in the camshaft timing oil control valve assembly.
 - The engine is warm (the engine coolant temperature is 75°C (167°F) or more).
 - The vehicle has been driven at 47 mph (75 km/h) or more.
 - The engine has idled for 30 seconds or more.

MONITOR STRATEGY

Related DTCs	P0011: Advanced camshaft timing P0012: Retarded camshaft timing
Required Sensors/Components (Main)	Camshaft timing oil control valve and VVT controller
Required Sensors/Components (Related)	Crankshaft position sensor Camshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: Immediately Retarded camshaft timing: 2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0010 (Camshaft timing oil control valve assembly Bank 1) P0016 (VVT System Bank 1 - Misalignment) P0102, P0103 (Mass Air Flow Meter sub-assembly) P0107, P0108 (Manifold Absolute Pressure) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Engine Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor)
Battery voltage	11 V or more
Engine RPM	500 to 4000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Advanced Camshaft Timing

All of the following conditions are met	-
Deviation of actual valve timing and target valve timing	More than 5°CA (crankshaft angle)
Valve timing	No change at advanced valve timing

Retarded Camshaft Timing

All of the following conditions are met	-
Deviation of actual valve timing and target valve timing	More than 5°CA (crankshaft angle)
Valve timing	No change at retarded valve timing

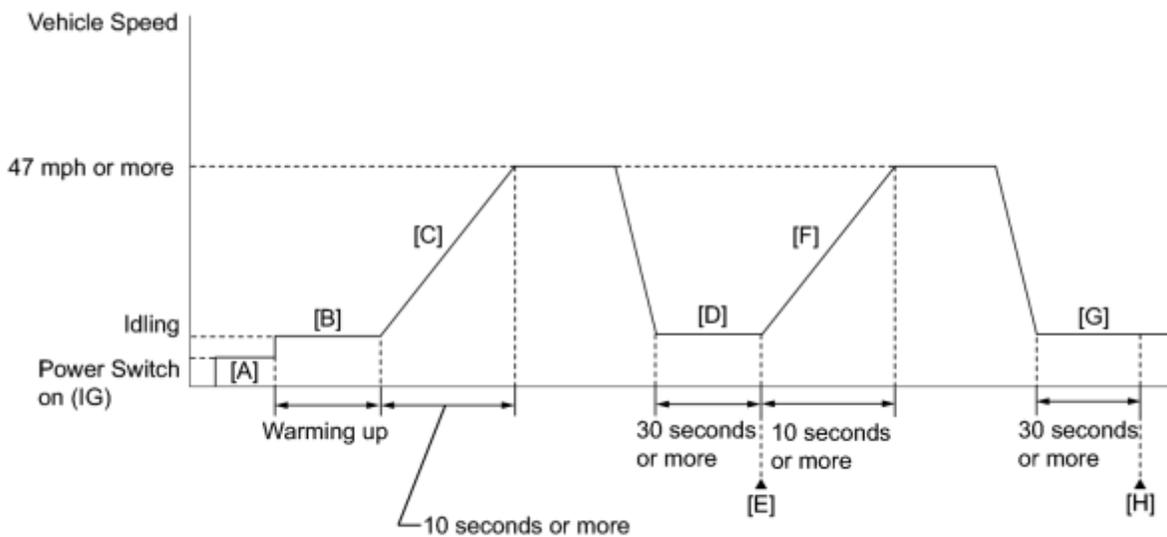
If the difference between the target and actual camshaft timing is greater than the specified value, the ECM operates the VVT actuator (camshaft timing oil control valve assembly).

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

MONITOR RESULT

Refer to Checking Monitor Status INFO.

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the power switch on (IG) and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure) INFO.

HINT:

- P0011 is output:
Clear the DTC without using the Techstream.
- P0012 is output:

Clear the DTC with using the Techstream.

4. Turn the power switch off and wait for 30 seconds.
5. Turn the power switch on (IG) and turn the Techstream on [A].
6. Put the engine in inspection mode .
7. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or more [B].
8. Accelerate the vehicle to 47 mph (75 km/h) or more for 10 seconds or more [C].
9. Idle the engine for 30 seconds or more [D].
10. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
11. Read the pending DTC [E].
12. If a pending DTC is output, the system is malfunctioning.

HINT:

If a pending DTC is not output, perform the following procedure.

13. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
14. Input the DTC: P0011 or P0012.
15. Check the DTC judgment result.

Techstream Display	Description
NORMAL	<ul style="list-style-type: none">○ DTC judgment completed○ System normal
ABNORMAL	<ul style="list-style-type: none">○ DTC judgment completed○ System abnormal
INCOMPLETE	<ul style="list-style-type: none">○ DTC judgment not completed○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	<ul style="list-style-type: none">○ Unable to perform DTC judgment○ Number of DTCs which do not fulfill DTC preconditions has reached ECU's memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
 - If the judgment result shows NORMAL, the system is normal.
 - If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [F] through [H].
16. Accelerate the vehicle to 47 mph (75 km/h) or more for 10 seconds or more [F].
 17. Idle the engine for 30 seconds or more [G].
 18. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
 19. Input the DTC: P0011 or P0012.

20. Check the DTC judgment result again [H].

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows NORMAL, the system is normal.

21. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs **INFO**.

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0010 **INFO**.

INSPECTION PROCEDURE

NOTICE:

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

HINT:

Read freeze frame data using the Techstream. 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.

PROCEDURE

1.	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011 OR P0012)
----	---

- Connect the Techstream to the DLC3.
- Turn the power switch on (IG).
- Turn the Techstream on.
- Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
- Read the DTCs.

Result:

Result	Proceed to
DTC P0011 or P0012 is output	A
DTC P0011 or P0012 and other DTCs are output	B

HINT:

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

B ▶ GO TO DTC CHART

A
▼

2.	PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY)
----	---

- (a) Connect the Techstream to the DLC3.
- (b) Turn the power switch on (IG).
- (c) Turn the Techstream on.
- (d) Put the engine in inspection mode .
- (e) Start the engine.
- (f) Warm up the engine.
- (g) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
- (h) Check the engine speed while operating the camshaft timing oil control valve assembly using the Techstream.

Result:

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

HINT:

If the result is not acceptable, cool the engine and perform the Active Test again.

- (i) Start the engine when the engine coolant temperature is 30°C (86°F) or less.
- (j) Turn the Techstream on.
- (k) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).

(l) Check the engine speed while operating the camshaft timing oil control valve assembly using the Techstream with the engine coolant temperature at 50°C (122°F) or less.

Result:

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG  [INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY](#)

OK



3.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0011 OR P0012)
----	--

- (a) Connect the Techstream to the DLC3.
- (b) Turn the power switch on (IG).
- (c) Turn the Techstream on.
- (d) Clear the DTCs .
- (e) Put the engine in inspection mode .
- (f) Start the engine and warm it up.
- (g) Driving the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.
- (h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
- (i) Read the pending DTCs.

Result:

Result	Proceed to
DTC is not output	A
DTC P0011 or P0012 is output	B

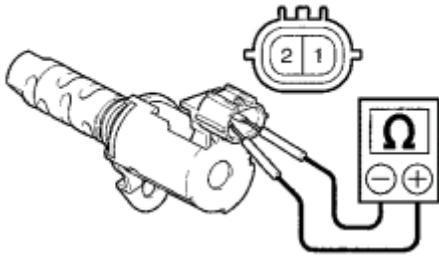
B  [ADJUST VALVE TIMING](#)

A  **CHECK FOR INTERMITTENT PROBLEMS**

4.	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
----	--

- (a) Remove the camshaft timing oil control valve assembly .

*1



(b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

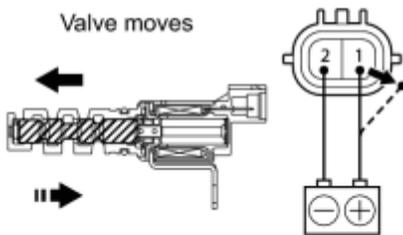
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

Text in Illustration

*1	Component without harness connected (Camshaft Timing Oil Control Valve Assembly)
----	---

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly)

(c) Connect the positive (+) battery terminal to terminal 1 and connect the negative (-) battery terminal to terminal 2. Check the valve operation.



OK:

Valve moves quickly.

Y

(d) Reinstall the camshaft timing oil control valve assembly NFC.

NG ▶ REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

OK

5.	INSPECT CAMSHAFT TIMING GEAR ASSEMBLY (FOR INTAKE CAMSHAFT)
----	---

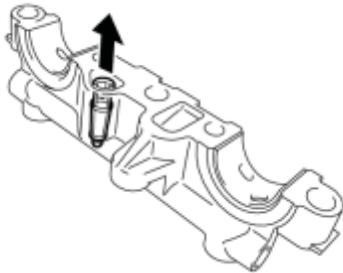
(a) Inspect the camshaft timing gear assembly (for intake camshaft) NFC.

NG ▶ REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (FOR INTAKE CAMSHAFT)

OK



6. INSPECT OIL CONTROL VALVE FILTER



(a) Remove the oil control valve filter **INFO**.

T

(b) Check that the filter is not clogged.

OK:

Filter is not clogged.

(c) Reinstall the oil control valve filter **INFO**.

NG ▶ REPLACE OIL CONTROL VALVE FILTER

OK



7. ADJUST VALVE TIMING

HINT:

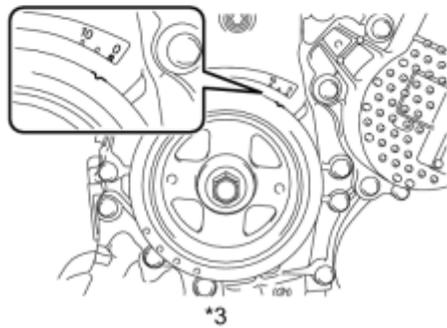
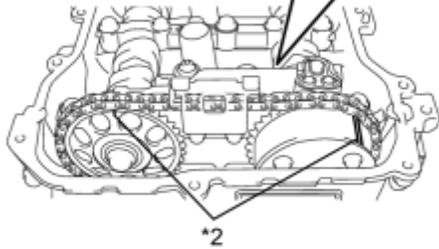
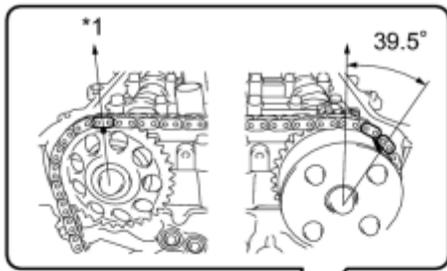
There are no marks on the cylinder head to match-up for the purpose of checking valve timing. Valve timing can only be inspected by lining up the colored plates on the timing chain with the marks on the pulleys. It may be necessary to remove and reinstall the chain to match-up the alignment marks **INFO**.

Text in Illustration

*1	Top
*2	Alignment Mark
*3	No. 1 Cylinder at TDC Compression

NEXT





c

8. CHECK WHETHER DTC OUTPUT RECURS (DTC P0011 OR P0012)

- (a) Connect the Techstream to the DLC3.
- (b) Turn the power switch on (IG).
- (c) Turn the Techstream on.
- (d) Clear the DTCs INFO.
- (e) Put the engine in inspection mode INFO.
- (f) Start the engine and warm it up.
- (g) Drive the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.
- (h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
- (i) Read the pending DTCs.

Result:

Result

Proceed to

Result	Proceed to
DTC is not output	A
DTC P0011 or P0012 is output	B

B ▶ REPLACE ECM

A ▶ END

DTC

P0016

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

DESCRIPTION

The ECM optimizes the valve timing by using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft timing oil control valve assembly and the VVT controller (camshaft timing gear assembly). The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve assembly.

This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.

DTC No.	Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and camshaft position sensor signal (2 trip detection logic)	<ul style="list-style-type: none"> • Valve timing • Camshaft timing oil control valve assembly • Oil control valve filter • Camshaft timing gear assembly (for intake camshaft) • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of specified range in consecutive driving cycles, the ECM illuminates the MIL and sets the DTC P0016.

This DTC indicates that the intake camshaft has been installed toward the crankshaft at an incorrect angle, caused by factors such as the timing chain having jumped a tooth.

This monitor begins to run after the engine has idled for 5 minutes.

MONITOR STRATEGY

Related DTCs	P0016: Camshaft Timing Misalignment at idling
Required Sensors/Components (Main)	VVT actuator
Required Sensors/Components (Related)	Camshaft position sensor Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	Within 60 seconds
MIL Operation	2 driving cycles

Sequence of Operation	None
-----------------------	------

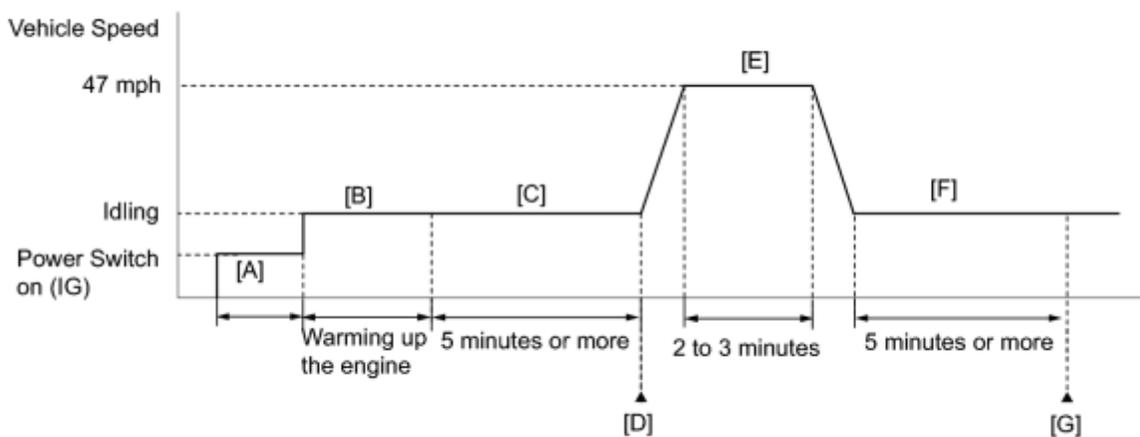
TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0010 (VVT Oil Control Valve Bank 1) P0102, P0103 (Mass Air Flow Meter Sub-assembly) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Engine Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor)
Engine RPM	900 to 1100 rpm

TYPICAL MALFUNCTION THRESHOLDS

One of the following conditions is met	-
VVT learning value at maximum retarded valve timing	Less than 22°CA (crankshaft angle)
VVT learning value at maximum retarded valve timing	More than 47°CA (crankshaft angle)

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the power switch on (IG) and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure) INFO.
4. Turn the power switch off and wait for 30 seconds.

5. Turn the power switch on (IG) and turn the Techstream on [A].
6. Put the engine in inspection mode INFO.
7. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [B].
8. Idle the engine for 5 minutes or more [C].
9. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
10. Read the pending DTC [D].
11. If a pending DTC is output, the system is malfunctioning.

HINT:

If a pending DTC is not output, perform the following procedure.

12. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
13. Input the DTC: P0016.
14. Check the DTC judgment result.

Techstream Display	Description
NORMAL	<ul style="list-style-type: none"> ○ DTC judgment completed ○ System normal
ABNORMAL	<ul style="list-style-type: none"> ○ DTC judgment completed ○ System abnormal
INCOMPLETE	<ul style="list-style-type: none"> ○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	<ul style="list-style-type: none"> ○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION:

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
 - If the judgment result shows NORMAL, the system is normal.
 - If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [E] through [G].
15. Drive the vehicle at 47 mph (75 km/h) for 2 to 3 minutes [E].
 16. Idle the engine for 5 minutes or more [F].
 17. Check the DTC judgment result [G].

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows NORMAL, the system is normal.

18. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs **INFC**.

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine conditions 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 P0016)

- Connect the Techstream to the DLC3.
- Turn the power switch on (IG).
- Turn the Techstream on.
- Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
- Read the DTCs.

Result:

Result	Proceed to
DTC P0016 is output	A
DTC P0016 and other DTCs are output	B

HINT:

If any DTCs other than P0016 are output, troubleshoot those DTCs first.

B ▶ GO TO DTC CHART

A
▼

2. PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY)

- Connect the Techstream to the DLC3.

- (b) Turn the power switch on (IG).
- (c) Turn the Techstream on.
- (d) Put the engine in inspection mode .
- (e) Start the engine.
- (f) Warm up the engine.
- (g) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
- (h) Check the engine speed while operating the camshaft timing oil control valve assembly using the Techstream.

Result:

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

HINT:

If the result is not acceptable, cool the engine and perform the Active Test again.

- (i) Start the engine when the engine coolant temperature is 30°C (86°F) or less.
- (j) Turn the Techstream on.
- (k) Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
- (l) Check the engine speed while operating the camshaft timing oil control valve assembly using the Techstream with the engine coolant temperature at 50°C (122°F) or less.

Result:

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG  [INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY](#)

OK



3.	CHECK WHETHER DTC OUTPUT RECURS (DTC P0016)
----	---

- (a) Connect the Techstream to the DLC3.
- (b) Turn the power switch on (IG).
- (c) Turn the Techstream on.
- (d) Clear the DTCs INFO.
- (e) Put the engine in inspection mode INFO.
- (f) Start the engine and warm it up.
- (g) Driving the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.
- (h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
- (i) Read the pending DTCs.

Result:

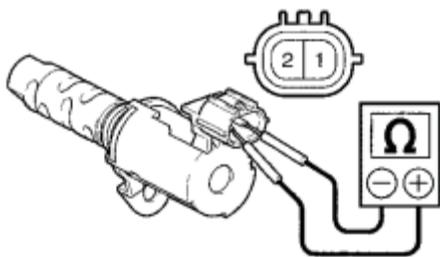
Result	Proceed to
DTC is not output	A
DTC P0016 is output	B

B ▶ ADJUST VALVE TIMING

A ▶ CHECK FOR INTERMITTENT PROBLEMS

4.	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
----	--

*1



- (a) Remove the camshaft timing oil control valve assembly INFO.

- (b) Measure the resistance according to the value(s) in the table below.

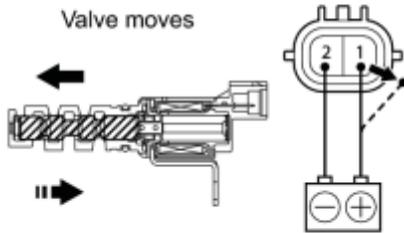
Standard Resistance:

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

Text in Illustration

*1	Component without harness connected (Camshaft Timing Oil Control Valve Assembly)
----	---

Component without harness connected:
(Camshaft Timing Oil Control Valve
Assembly)



(c) Connect the positive (+) battery terminal to terminal 1 and connect the negative (-) battery terminal to terminal 2. Check the valve operation.

OK:

Valve moves quickly.

Y

(d) Reinstall the camshaft timing oil control valve assembly INFO.

NG ▶ REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

OK



5.	INSPECT CAMSHAFT TIMING GEAR ASSEMBLY
----	---------------------------------------

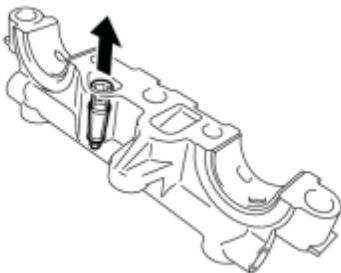
(a) Inspect the camshaft timing gear assembly (for intake camshaft) INFO.

NG ▶ REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

OK



6.	INSPECT OIL CONTROL VALVE FILTER
----	----------------------------------



(a) Remove the oil control valve filter INFO.

T

(b) Check that the filter is not clogged.

OK:

Filter is not clogged.

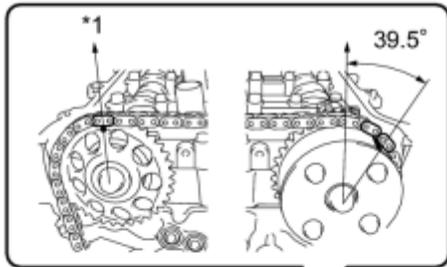
(c) Reinstall the oil control valve filter **INFO**.

NG ▶ REPLACE OIL CONTROL VALVE FILTER

OK

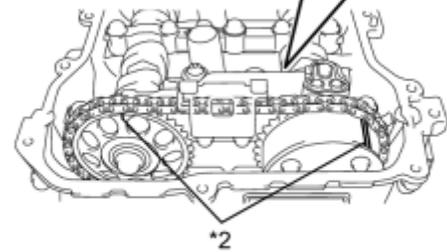


7. ADJUST VALVE TIMING



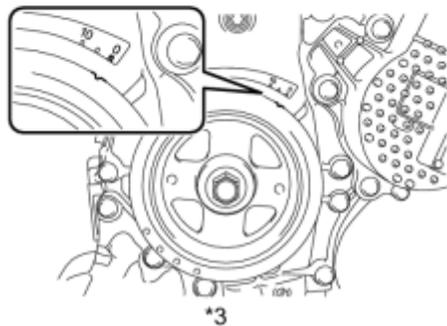
HINT:

There are no marks on the cylinder head to match-up for the purpose of checking valve timing. Valve timing can only be inspected by lining up the colored plates on the timing chain with the marks on the pulleys. It may be necessary to remove and reinstall the chain to match-up the alignment marks **INFO**.



Text in Illustration

*1	Top
*2	Alignment Mark
*3	No. 1 Cylinder at TDC Compression



NEXT



8. CHECK WHETHER DTC OUTPUT RECURS (DTC P0016)

(a) Connect the Techstream to the DLC3.

(b) Turn the power switch on (IG).

(c) Turn the Techstream on.

(d) Clear the DTCs **INFO**.

(e) Put the engine in inspection mode **INFO**.

(f) Start the engine and warm it up.

(g) Drive the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.

(h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

(i) Read the pending DTCs.

Result:

Result	Proceed to
DTC is not output	A
DTC P0016 is output	B

B ▶ REPLACE ECM

A ▶ END