

P0010, P0013, P0020, or P0023 Intake Camshaft Position (CMP) Actuator Solenoid Control Circuit

Circuit Description

The camshaft position (CMP) actuator system enables the engine control module (ECM) to change the timing of the camshafts while the engine is operating. The CMP actuator solenoid signal from the ECM is pulse width modulated (PWM). The ECM controls the CMP actuator solenoid duty cycle by controlling the amount of solenoid ON time. The CMP actuator solenoid controls the advance or the retard of each camshaft. The CMP actuator solenoid controls the oil flow that applies the pressure to advance or retard the camshafts. Ignition voltage is supplied directly to the CMP actuator solenoid. The ECM controls the solenoid by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. If the ECM detects the control circuit voltage is within a predetermined range when the circuit is commanded OFF, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P0010 Intake Camshaft Position (CMP) Actuator Solenoid Control Circuit Bank 1
- DTC P0013 Exhaust Camshaft Position (CMP) Actuator Solenoid Control Circuit Bank 1
- DTC P0020 Intake Camshaft Position (CMP) Actuator Solenoid Control Circuit Bank 2
- DTC P0023 Exhaust Camshaft Position (CMP) Actuator Solenoid Control Circuit Bank 2

Conditions for Running the DTC

- The engine speed is more than 80 RPM.
- The ignition 1 voltage is between 10–18 volts.
- The ECM has commanded the CMP actuator solenoid ON and OFF at least once during the ignition cycle.
- DTCs P0010, P0013, P0020, and P0023 run continuously once the above

conditions are met for more than 1 second.

Conditions for Setting the DTC

- The ECM detects an open in the CMP actuator solenoid circuits when the solenoid is commanded OFF.
- The condition exists for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Use the J 35616-C Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector.
- The lower connector of the ECM is connector C1 and the upper connector of the ECM is connector C2. Refer to Engine Controls Component Views
- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the circuit status for the component with a scan tool. The circuit status parameter changes from OK or Indeterminate to Fault if there is a condition with the circuit or a connection. The output driver module (ODM) information is in the ODM

data list.

- For an intermittent condition, refer to Intermittent Conditions

Test Description

The numbers below refer to the step numbers on the diagnostic table.

- This step determines if the condition exists. The engine speed must be increased to enable the CMP actuator solenoids. The DTC will not set unless the solenoid is commanded ON and OFF at least once during the ignition cycle.
- This step verifies that the ECM is providing a ground to the CMP actuator solenoid.
- This step determines if there is an internal condition with the ECM. The CMP actuator control circuit is pulled-up to a voltage within the ECM. The ECM uses this voltage as a feedback circuit. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. If the voltage is not within the specified range, there is a condition with the ECM.

DTC P0010, P0013, P0020, or P0023

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics on page 6-1196 Connector End View Reference: Engine Control Module (ECM) Connector End Views on page 6-1220 or Engine Controls Connector End Views on page 6-1223				
1	Did you perform the Diagnostic System Check—Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check—Engine Controls
2	1. Start the engine. 2. Allow the engine to reach operating temperature. 3. Increase the engine speed to the specified value for 10 seconds. 4. Observe the DTC information with a scan tool. Did DTC P0010, P0013, P0020, or P0023 fail this ignition?	2,000 RPM	Go to Step 4	Go to Step 3

Step	Action	Values	Yes	No
3	<p>1. Observe the Freeze Frame/Failure Records for this DTC.</p> <p>2. Turn OFF the ignition for 30 seconds.</p> <p>3. Start the engine.</p> <p>4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.</p> <p>Did the DTC fail this ignition?</p>	—	Go to Step 4	Go to Intermittent Conditions
4	<p>1. Turn OFF the ignition.</p> <p>2. Disconnect the camshaft position (CMP) actuator solenoid. Refer to the appropriate procedure:</p> <ul style="list-style-type: none"> • Camshaft Position (CMP) Actuator Solenoid Replacement -Bank 1 (Right) Intake • Camshaft Position (CMP) Actuator Solenoid Replacement -Bank 1 (Right) Exhaust • Camshaft Position (CMP) Actuator Solenoid Replacement -Bank 2 (Left) Intake • Camshaft Position (CMP) Actuator Solenoid Replacement -Bank 2 (Left) Exhaust <p>3. Turn ON the ignition, with the engine OFF.</p> <p>4. Probe the ignition 1 voltage circuit of the CMP actuator solenoid with a test lamp that is connected to the engine control module (ECM) housing.</p> <p>Does the test lamp illuminate?</p>	—	Go to Step 5	Go to Step 10

Step	Action	Values	Yes	No
5	<p>1. Connect a test lamp between the control circuit of the CMP actuator solenoid and the ignition 1 voltage circuit of the CMP actuator solenoid.</p> <p>2. Start the engine.</p> <p>3. Command the appropriate CMP actuator solenoid from 0 to 40 and back to 0 degrees with a scan tool.</p> <p>4. Exit the CMP Actuator Solenoid Control function.</p> <p>Important: The ignition must be turned OFF or the CMP actuator may not operate correctly after using the output control.</p> <p>5. Turn OFF the ignition.</p> <p>Does the test lamp turn ON when commanded with a scan tool?</p>	—	Go to Step 7	Go to Step 6
6	<p>Test the control circuit of the CMP actuator solenoid for an open. Refer to Circuit Testing on page 8-1184 and Wiring Repairs on page 8-1189 in Wiring Systems. Did you find and correct the condition?</p>	—	Go to Step 13	Go to Step 9
7	<p>Measure the voltage from the control circuit of the CMP actuator solenoid to the ECM housing with a DMM. Refer to Circuit Testing on page 8-1184 in Wiring Systems. Is the voltage within the specified range?</p>	2.0–3.0 V	Go to Step 8	Go to Step 12
8	<p>Test for an intermittent and for a poor connection at the CMP actuator solenoid. Refer to Testing for Intermittent and Poor Connections on page 8-1187 and Connector Repairs on page 8-1198 in Wiring Systems. Did you find and correct the condition?</p>	—	Go to Step 13	Go to Step 11

Step	Action	Values	Yes	No
9	Test for an intermittent and for a poor connection at the ECM. Refer to Testing for Intermittent and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
10	1. Repair the ignition voltage circuit of the CMP actuator solenoid for an open or for an intermittent short to ground. Refer to Wiring Repairs. 2. Replace the fuse if necessary. Did you complete the repair?	—	Go to Step 13	—
11	Replace the CMP actuator solenoid. Refer to the appropriate procedure: • Camshaft Position (CMP) Actuator Solenoid Replacement -Bank 1 (Right) Intake on page 6-1721 • Camshaft Position (CMP) Actuator Solenoid Replacement -Bank 1 (Right) Exhaust on page 6-1723 • Camshaft Position (CMP) Actuator Solenoid Replacement -Bank 2 (Left) Intake on page 6-1724 • Camshaft Position (CMP) Actuator Solenoid Replacement -Bank 2 (Left) Exhaust Did you complete thereplacement?	—	Go to Step 13	—
12	Replace the ECM. Refer to Engine Control Module (ECM) Replacement on page 6-1648. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Values	Yes	No
13	<ol style="list-style-type: none">1. Clear the DTCs with a scan tool.2. Turn OFF the ignition for 30 seconds.3. Start the engine.4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

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