

## 02 Jeep Wrangler CMP and CKP

### CMS description and testing.

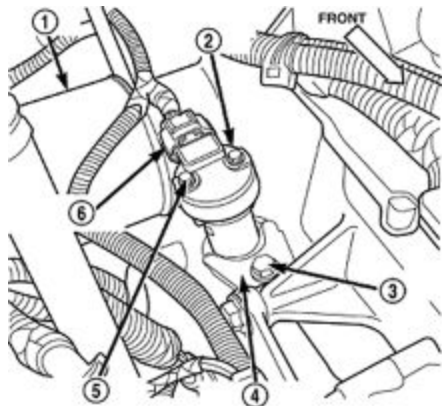
#### 4.0L

The Camshaft Position Sensor (CMP) on the 4.0L 6cylinder engine is bolted to the top of the oil pump drive shaft assembly. The sensor and drive shaft assembly is located on the right side of the engine near the oil filter.

The CMP sensor contains a Hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects a rotating pulse ring (shutter) on the oil pump drive shaft. The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.



Removal and Installation.

#### 4.0L

The Camshaft Position Sensor (CMP) on the 4.0L 6cylinder engine is bolted to the top of the oil pump drive shaft assembly. The sensor and drive shaft assembly is located on the right side of the engine near the oil filter. The rotational position of oil pump drive determines fuel synchronization only. It does not determine ignition timing.

#### WARNING

Do NOT attempt to rotate the oil pump drive to modify ignition timing.

1. Two different procedures are used for Removal & Installation. The first procedure will detail Removal & Installation of the sensor only. The second procedure will detail Removal & Installation of the sensor and oil pump drive shaft assembly. The second procedure is to be used if the engine has been disassembled.
2. An internal oil seal is used in the drive shaft housing that prevents engine oil at the bottom of the sensor. The seal is not serviceable.

### **Sensor Only**

1. Disconnect electrical connector at CMP sensor.
2. Remove 2 sensor mounting bolts.
3. Remove sensor from oil pump drive.

### **Oil Pump Drive & Sensor**

#### **WARNING**

If the CMP and oil pump drive are to be removed and installed, do NOT allow engine crankshaft or camshaft to rotate. CMP sensor relationship will be lost.

1. Disconnect electrical connector at CMP sensor.
2. Remove 2 sensor mounting bolts
3. Remove sensor from oil pump drive.
4. Before proceeding to next step, mark and note rotational position of oil pump drive in relationship to engine block. After installation:, the CMP sensor should face rear of engine 0.
5. Remove hold-down bolt and clamp.
6. While pulling assembly from engine, note direction and position of pulse ring. After Removal & Installation, look down into top of oil pump and note direction and position of slot at top of oil pump gear.
7. Remove and discard old oil pump drive-to-engine block gasket.

### **Sensor Only**

The Camshaft Position Sensor (CMP) on the 4.0L 6cylinder engine is bolted to the top of the oil pump drive shaft assembly. The sensor and drive shaft assembly is located on the right side of the engine near the oil filter.

1. Install sensor to oil pump drive.
2. Install 2 sensor mounting bolts and tighten to 2 Nm (15 inch lbs.) torque.
3. Connect electrical connector to CMP sensor.

### **Oil Pump Drive & Sensor**

1. Clean oil pump drive mounting hole area of engine block.
2. Install new oil pump drive-to-engine block gasket.

3. Temporarily install a toothpick or similar tool through access hole at side of oil pump drive housing. Align toothpick into mating hole on pulse ring.
4. Install oil pump drive into engine while aligning into slot on oil pump. Rotate oil pump drive back to its original position and install hold-down clamp and bolt. Finger-tighten bolt. Do NOT do a final tightening of bolt at this time.
5. If engine crankshaft or camshaft has been rotated, such as during engine tear-down, CMP sensor relationship must be reestablished.
6. Remove ignition coil rail assembly.
7. Remove cylinder number 1 spark plug.
8. Hold a finger over the open spark plug hole. Rotate engine at vibration dampener bolt until compression (pressure) is felt.
9. Slowly continue to rotate engine.

#### NOTE

Do this until timing index mark on vibration damper pulley aligns with top dead center (TDC) mark (0 degree) on timing degree scale. Always rotate engine in direction of normal rotation. Do NOT rotate engine backward to align timing marks.

10. Install oil pump drive into engine while aligning into slot on oil pump. If pump drive will not drop down flush to engine block, the oil pump slot is not aligned. Remove oil pump drive and align slot in oil pump to shaft at bottom of drive. Install into engine. Rotate oil pump drive back to its original position and install hold-down clamp and bolt. Finger-tighten the bolt. Do NOT do a final tightening of bolt at this time.
11. Remove toothpick from housing.
12. Install sensor to oil pump drive. After installation:, the CMP sensor should face rear of engine: 0.
13. Install 2 sensor mounting bolts and tighten to 2 Nm (15 inch lbs.) torque. Connect electrical connector to CMP sensor.
14. If removed, install spark plug and ignition coil rail.
15. To verify correct rotational position of oil pump drive, the DRB scan tool must be used.

#### CAUTION

**When performing the following test, the engine will be running. Be careful not to stand in line with the fan blades or fan belt. Do NOT wear loose clothing.**

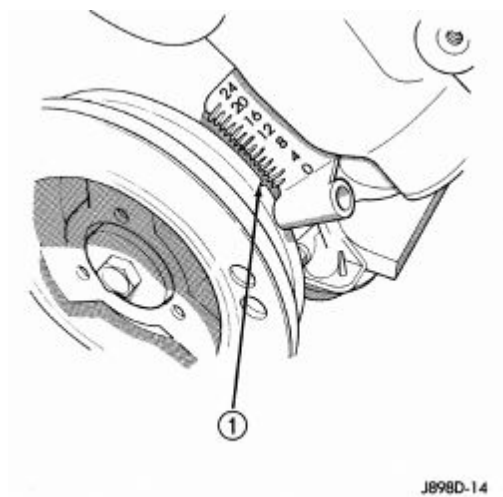
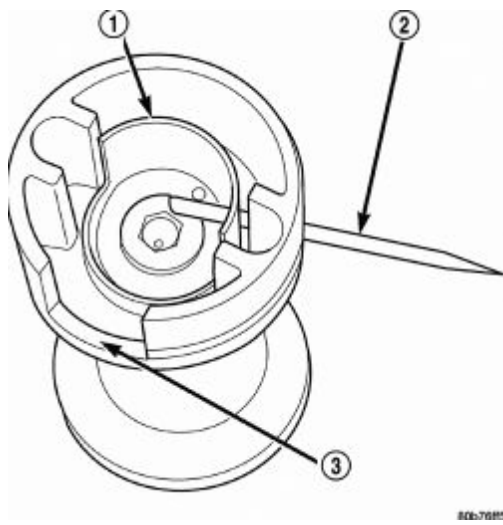
16. Connect the scan tool to data link connector. The data link connector is located in passenger compartment, below and to left of steering column.
17. Gain access to SET SYNC screen on the scan tool.
18. Follow the directions on the scan tool screen and start engine. Bring to operating temperature (engine must be in closed loop mode).
19. With engine running at idle speed, the words IN RANGE should appear on the scan tool screen along with 0. This indicates correct position of oil pump drive.
20. If a plus (+) or a minus (-) is displayed next to degree number, and/or the degree displayed is not zero, loosen, but do NOT remove hold-down clamp bolt. Rotate oil pump

drive until IN RANGE appears on screen. Continue to rotate oil pump drive until achieving as close to 0 as possible.

#### NOTE

The degree scale on SET SYNC screen of the scan tool is referring to fuel synchronization only. It is not referring to ignition timing. Because of this, do NOT attempt to adjust ignition timing using this method. Rotating oil pump drive will have no effect on ignition timing. All ignition timing values are controlled by powertrain control module (PCM).

21. Tighten hold-down clamp bolt to 23 Nm (17 ft. lbs.) torque.



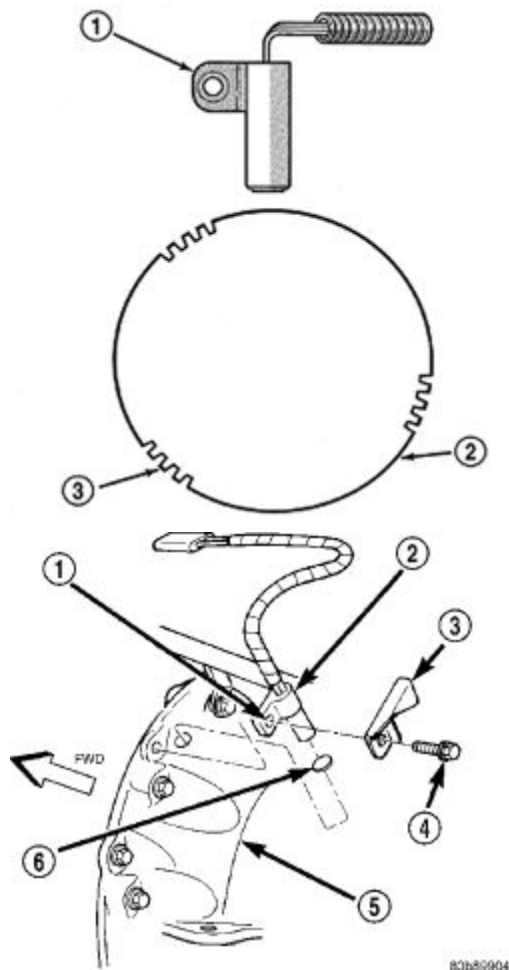
## CKP description and replacement

4.0L

The Crankshaft Position Sensor (CKP) is mounted to the transmission bellhousing at the left/rear side of the engine block. Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the powertrain control module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing. The sensor is a Hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

On 4.0L 6-cylinder engines, the flywheel/drive plate has 3 sets of four notches at its outer edge. The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution there are 3 sets of four pulses generated.

The trailing edge of the fourth notch, which causes the pulse, is four degrees before top dead center (TDC) of the corresponding piston. The engine will not operate if the PCM does not receive a crankshaft position sensor input.



4.0L

The Crankshaft Position (CKP) sensor is mounted to the transmission bellhousing at the left/rear side of the engine block. The sensor is adjustable and is attached with one bolt. A wire shield/router is attached to the sensor.

1. Disconnect sensor pigtail harness (3way connector) from main engine wiring harness.
2. Remove sensor mounting bolt.
3. Remove wire shield and sensor.

New replacement sensors will be equipped with a paper spacer glued to bottom of sensor. If installing (returning) a used sensor to vehicle, a new paper spacer must be installed to bottom of sensor. This spacer will be ground off the first time engine is started. If spacer is not used, sensor will be broken the first time engine is started.

**New Sensors:** Be sure paper spacer is installed to bottom of sensor. If not, obtain spacer PN05252229.

**Used Sensors:** Clean bottom of sensor and install spacer PN05252229.

1. Install sensor into transmission bellhousing hole.
2. Position sensor wire shield to sensor.
3. Push sensor against flywheel/drive plate. With sensor pushed against flywheel/drive plate, tighten mounting bolt to 7 Nm (60 inch lbs.) torque.
4. Route sensor wiring harness into wire shield.
5. Connect sensor pigtail harness electrical connector to main wiring harness

## **DTC P0340: NO CAM SIGNAL AT PCM**

### **NOTE:**

**For component location, see COMPONENT LOCATIONS . For connector identification, see CONNECTOR IDENTIFICATION . For circuit identification and wiring diagram, see WIRING DIAGRAMS article. After each repair procedure has been completed, reconnect all components. Perform POWERTRAIN VERIFICATION TEST VER-5 under VERIFICATION TESTS to ensure system is functioning properly.**

### **Monitored & Set Conditions**

Camshaft signal is monitored with engine cranking or running. DTC will set when at least 5 seconds have elapsed with Crankshaft Position (CKP) sensor signals present but no signal from Camshaft Position (CMP) sensor.

### **Possible Causes**

Crankshaft Position Sensor Signal

Intermittent CMP Sensor Signal

5-Volt Supply Circuit Shorted To Ground

5-Volt Supply Circuit Open

5-Volt Supply Circuit Shorted To Voltage

CMP Sensor Signal Circuit Shorted Ground

CMP Sensor Signal Circuit Open

CMP Sensor Signal Circuit Shorted To Voltage

CMP Sensor Signal Shorted To 5-Volt Supply Circuit

Camshaft Position Sensor Ground Circuit Open

PCM - 5-Volt Supply

PCM - CMP Sensor Signal

Camshaft Position Sensor

1. With the DRBIII(R), read the Current CMP State while cranking the engine. Does the DRBIII(R) display Current CMP State Present while cranking the engine? If yes, go to next step. If no, go to step 4 .

**NOTE:**

An intermittent failure with the Crankshaft Position Sensor may cause the DTC P0340 to set.

**WARNING:**

When the engine is operating, do not stand in a direct line with the fan. Do not put your hand near the pulleys, belts or fan. Do not wear loose clothing.

2. Turn ignition on, engine not running. Locate CKP Sensor. With the DRBIII(R) as a Dual Channel lab scope and the Miller Special Tool (6801), backprobe the CKP Sensor Signal circuit in the Crank Sensor connector and the PCM harness connector. Wiggle the related wire harness and connections. Monitor the lab scope screen. Start the engine. Lightly tap on the Crank Sensor and wiggle the CKP Sensor connector. Observe the lab scope screen. Look for any erratic pulses generated by the CKP Sensor. Did the CKP Sensor generate any erratic pulses? If yes, carefully inspect the wiring harness and connections, and repair as necessary. If okay, replace the Crankshaft Position Sensor. If no, go to next step.

**WARNING:**

When the engine is operating, do not stand in a direct line with the fan. Do not put your hands near the pulleys, belts or fan. Do not wear loose clothing.

3. The conditions that set the DTC are not present at this time. The following may help in identifying the intermittent condition. Turn the ignition off. With the DRBIII(R) lab scope probe, in the dual channel function, and the Miller Special Tool (6801), backprobe the CMP Sensor Signal circuit in the PCM harness connector and the CMP Sensor harness connector. Wiggle the related wire harness and connections. Look for any pulses generated by the CMP Sensor while wiggling the harness and connectors. Start the engine. Observe the lab scope screen. Wiggle the related wire harness and connections. Look for any erratic pulses generated by the CMP Sensor. Did the CMP Sensor generate any irregular pulses in either of the above tests? If yes, check the wiring and connections that may cause the intermittent condition. If okay, replace the Camshaft Position Sensor. If no, test is complete.
4. Turn the ignition off. Disconnect the CMP Sensor harness connector. Turn ignition on, engine not running. Measure the voltage on the 5-Volt Supply circuit at the CMP Sensor harness connector. Is the voltage between 4.8 and 5.2 volts? If yes, go to next step. If no, go to step 13 .
5. Measure the voltage on the CMP Sensor Signal circuit at the CMP Sensor harness connector. Is the voltage between 4.5 and 5.0 volts? If yes, go to next step. If no, go to step 8 .
6. Turn the ignition off. Ensure the CMP Sensor is disconnected. Disconnect the PCM harness connectors. Measure the resistance of the Sensor Ground circuit from the CMP Sensor harness connector and the PCM harness connector. Is the resistance below 5.0 ohms? If yes, go to next step. If no, repair the Sensor Ground circuit for an open.

**NOTE:**

Inspect the Camshaft sprocket for damage. If a problem is found, repair as necessary.

7. There are no possible causes remaining, replace the Camshaft Position Sensor.
8. 8.Ensure the ignition is off. Measure the resistance between ground and the CMP Sensor Signal circuit at the CMP Sensor harness connector. Is the resistance below 100 ohms? If yes, repair the CMP Sensor Signal circuit for a short to ground. If no, go to next step.
9. Ensure the ignition is off. Disconnect the PCM harness connectors. Measure the resistance of the CMP Sensor Signal circuit from the CMP Sensor harness connector to the PCM harness connector. Is the resistance below 5.0 ohms? If yes, go to next step. If no, repair the CMP Sensor Signal circuit for an open.
10. Ensure the ignition is off. Reconnect PCM connectors. Turn ignition on, engine not running. Measure the voltage of the CMP Sensor Signal circuit at the CMP Sensor harness connector. Is the voltage above 5.3 volts? If yes, repair the CMP Sensor Signal circuit for a short to battery voltage. If no, go to next step.

11. Ensure the ignition is off. Disconnect the PCM harness connectors. Measure the resistance between the CMP Sensor Signal circuit and the 5-Volt Supply circuit at the CMP Sensor harness connector. Is the resistance below 5.0 ohms? If yes, repair the CMP Sensor Signal circuit that is shorted to the 5-Volt Supply circuit. If no, go to next step.
12. There are no possible causes remaining, replace PCM. Program the new PCM. See PROGRAMMING .
13. Turn the ignition off. Disconnect the PCM harness connectors. Ensure the CMP Sensor is disconnected. Measure the resistance between ground and the 5-Volt Supply circuit at the CMP Sensor harness connector. Is the resistance below 100 ohms? If yes, repair the 5-Volt Supply circuit for a short to ground. If no, go to next step.
14. Measure the resistance of the 5-Volt Supply circuit from the CMP Sensor harness connector to the PCM harness connector. Is the resistance below 5.0 ohms? If yes, go to next step. If no, repair the 5-Volt Supply circuit for an open.
15. Ensure the ignition is off. Reconnect PCM connectors. Turn ignition on, engine not running. Measure the voltage of the 5-Volt Supply circuit at the CMP Sensor harness connector. Is the voltage above 5.3 volts? If yes, repair the 5-Volt Supply circuit for a short to battery voltage. If no, go to next step.
16. There are no possible causes remaining, replace PCM. Program the new PCM. See PROGRAMMING

## **DTC P0320: NO CRANK REFERENCE SIGNAL AT PCM**

### **NOTE:**

For component location, see COMPONENT LOCATIONS . For connector identification, see CONNECTOR IDENTIFICATION . For circuit identification and wiring diagram, see WIRING DIAGRAMS article. After each repair procedure has been completed, reconnect all components. Perform POWERTRAIN VERIFICATION TEST VER-5 under VERIFICATION TESTS to ensure system is functioning properly.

### Monitored & Set Conditions

Cam signal is monitored with ignition on. DTC will set when no signal from the Crankshaft Position Sensor is present during engine cranking, and at least 3 Camshaft Position Sensor signals have occurred.

## Possible Causes

Camshaft Position Sensor Signal

Intermittent CKP Sensor Signal

5-Volt Supply Circuit Shorted To Ground

5-Volt Supply Circuit Open

5-Volt Supply Circuit Shorted To Voltage

CKP Sensor Signal Circuit Shorted Ground

CKP Sensor Signal Circuit Open

CKP Sensor Signal Circuit Shorted To Voltage

CKP Sensor Signal Shorted To 5-Volt Supply Circuit

Crank Sensor Ground Circuit Open

Crankshaft Position Sensor PCM - CKP Sensor Signal

PCM - 5-Volt Supply

## Testing

1. With the DRBIII(R), read the Current CKP State while cranking the engine. Does the DRBIII(R) display Current CKP State Present while cranking the engine? If yes, go to next step. If no, go to step 4 .

### **NOTE:**

An intermittent failure with the Camshaft Position Sensor may cause DTC P0320 to set.

### **WARNING:**

When the engine is operating, do not stand in a direct line with the fan. Do not put your hands near the pulleys, belts or fan. Do not wear loose clothing.

2. Turn the ignition off. Locate CMP Sensor. With the DRBIII(R) as a Dual Channel Lab Scope and the Miller Special Tool (6801), backprobe the CMP Sensor Signal circuit in the CMP Sensor connector and the PCM harness connector. Turn ignition on, engine not running. Wiggle the related wire harness and gently tap on the Camshaft Position Sensor. Observe the lab scope screen. Look for any pulses generated by the CMP Sensor. Now start the

vehicle and wiggle the related wire harness. The Channel 1 and Channel 2 graphs should display the same readings on the DRBIII(R) screen. If they don't, you may have a bad connection or a wiring concern. Did the CMP Sensor generate any erratic pulses? If yes, replace the Camshaft Position Sensor. If no, go to next step.

**WARNING:**

When the engine is operating, do not stand in a direct line with the fan. Do not put your hands near the pulleys, belts or fan. Do not wear loose clothing.

3. The conditions that set the DTC are not present at this time. The following may help in identifying the intermittent condition. Turn the ignition off. With the DRBIII(R) lab scope probe, in the dual channel function, and the Miller Special Tool (6801), backprobe the CKP Sensor Signal circuit in the PCM harness connector and the CKP Sensor harness connector. Wiggle the related wire harness and connections. Look for any pulses generated by the CKP while wiggling the harness and connectors. Start the engine. Observe the lab scope screen. Wiggle the related wire harness and connections. Look for any erratic pulses generated by the CKP Sensor. Did the CKP Sensor generate any irregular pulses in either of the above tests? If yes, check the wiring and connections that may cause the intermittent condition. If okay, replace the Crankshaft Position Sensor. If no, test is complete.
4. Turn the ignition off. Disconnect the CKP Sensor harness connector. Turn ignition on, engine not running. Measure the voltage of the 5-Volt Supply circuit at the CKP Sensor harness connector. Is the voltage between 4.5 and 5.5 volts? If yes, go to next step. If no, go to step 13 .
5. Measure the voltage on the CKP Sensor Signal circuit at the CKP Sensor harness connector. Is the voltage between 4.5 and 5.0 volts? If yes, go to next step. If no, go to step 8 .
6. Turn the ignition off. Measure the resistance of the Sensor Ground circuit from the CKP Sensor harness connector to the PCM harness connector. Is the resistance below 5.0 ohms? If yes, go to next step. If no, repair the Sensor Ground circuit for an open.

**NOTE:**

Inspect the slots on the flywheel for damage. If a problem is found, repair as necessary.

7. There are no possible causes remaining, replace the Crankshaft Position Sensor.
8. Turn the ignition off. Ensure the CKP Sensor is disconnected. Measure the resistance between ground and the CKP Sensor Signal circuit at the CKP Sensor harness connector. Is

the resistance below 100 ohms? If yes, repair the CKP Sensor Signal circuit for a short to ground. If no, go to next step.

9. Ensure the ignition is off. Disconnect the PCM harness connectors. Measure the resistance of the CKP Sensor Signal circuit from the CKP Sensor harness connector to the PCM harness connector. Is the resistance below 5.0 ohms? If yes, go to next step. If no, repair the CKP Sensor Signal circuit for an open.
10. Ensure the ignition is off. Reconnect PCM connectors. Turn ignition on, engine not running. Measure the voltage of the CKP Sensor Signal circuit at the CKP Sensor harness connector. Is the voltage above 5.0 volts? If yes, repair the CKP Sensor Signal circuit for a short to battery voltage. If no, go to next step.
11. Turn the ignition off. Ensure the CKP Sensor is disconnected. Disconnect the PCM harness connectors. Measure the resistance between the CKP Sensor Signal circuit and the 5-Volt Supply circuit at the CKP Sensor harness connector. Is the resistance below 5.0 ohms? If yes, repair the CKP Sensor Signal circuit shorted to the 5-Volt Supply circuit. If no, go to next step.
12. There are no possible causes remaining, replace PCM. Program the new PCM. See PROGRAMMING .
13. Turn the ignition off. Disconnect the PCM harness connectors. Ensure the CKP Sensor is disconnected. Measure the resistance between ground and the 5-Volt Supply circuit at the CKP Sensor harness connector. Is the resistance below 100 ohms? If yes, repair the 5-Volt Supply circuit for a short to ground. If no, go to next step.
14. Measure the resistance of the 5-Volt Supply circuit from the CKP Sensor harness connector to the PCM harness connector. Is the resistance below 5.0 ohms? If yes, go to next step. If no, repair the 5-Volt Supply circuit for an open.
15. Turn the ignition off. Reconnect PCM connectors. Turn ignition on, engine not running. Measure the voltage of the 5-Volt Supply circuit at the CKP Sensor harness connector. Is the voltage above 5.3 volts? If yes, repair the 5-Volt Supply circuit for a short to battery voltage. If no, go to next step.
16. There are no possible causes remaining, replace PCM. Program the new PCM. See PROGRAMMING .