A Chain of Events

By Jesse Zacarias

A favorite story that helps explain how a chain of events can take place starts something like this: Because of a loose horseshoe the horse was not ready for battle. Because the horse was not ready for battle the soldier was not able to ride. Because the soldier was not able to ride, the battle was lost. Because the battle was lost the war was lost.

This is somewhat similar to the chain of events that took place in the following situation.

A 1997 Dodge Ram 2500 with a 5.9-liter diesel engine came to our shop. The customer had had two factory-rebuilt transmissions installed, the second under warranty to correct a concern of no upshift. The customer complained that there also was no tachometer or speedometer reading and that the air conditioner would not work at times. In addition, the battery had needed charging recently. The dealer wanted to replace the entire wiring harness at a cost of $2,700, so the customer wanted a second opinion.

When we hooked up the scan tool we found no communication. We started with the basics. We checked the battery and found it needed charging, so we charged it, started the engine and found the charging system not working. We also noticed that the "wait to start," "water in fuel," "transmission temperature" and "OD OFF" lights would not illuminate.

To check for voltage and ground at the PCM we disconnected the C1 connector and checked pins A2 and A22 for voltage. A2 had 12.6 volts with KOEO (key on, engine off), A22 had 12.6 volts (fused B+), and A31 and A32 had good grounds. We connected the C1 connector back to the PCM, and with KOEO we checked for reference voltage at A17 and B31. We noticed it had only 0.42 volt at A17 (see Figure 1) and 1.5 volts, not the normal 5.1, at B31.

By studying the factory wiring diagrams, we noticed that the PCM provided the ground through connector C1, pin A4 (circuit K4), for some, but not all, of the sensors involved in our problems. We also knew we were dealing with a problem in the reference voltage (circuit K6) or reference ground (circuit K4). Although the PCM provided the reference voltage to the K4 circuit, we have seen very few PCM failures, so rather than condemning the PCM ($500), we wanted to make sure everything else in the circuit checked out OK.

To check the system live, we decided to eliminate the K4 circuit (sensor ground) by removing the wire from connector C1 A4 at the

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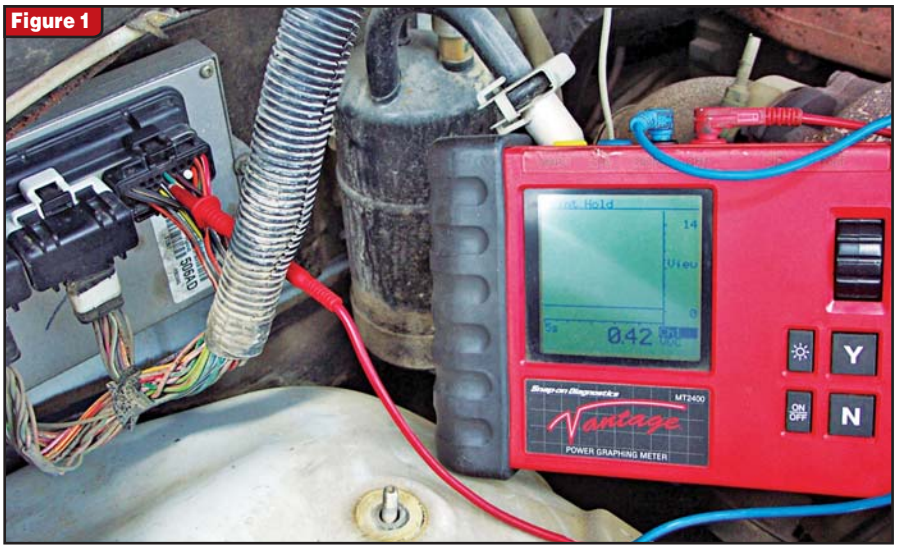

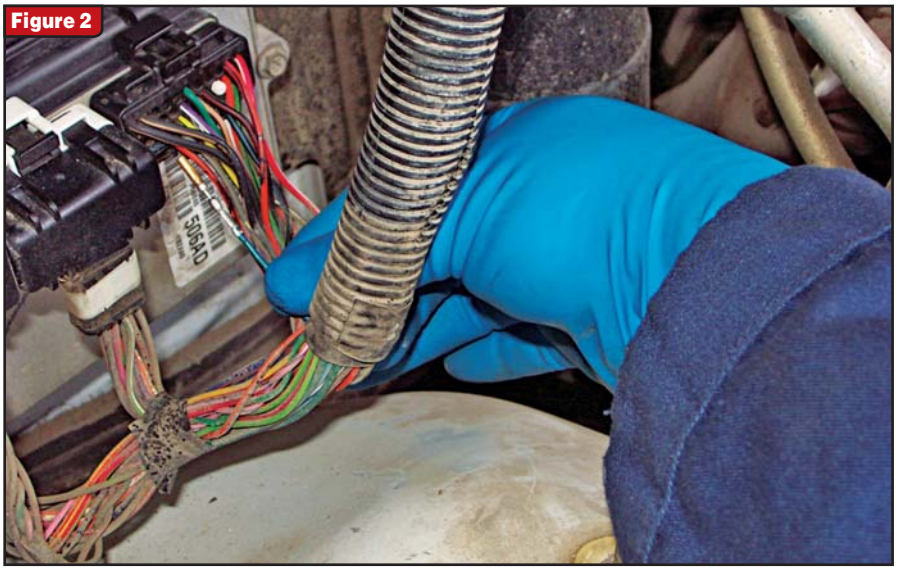

PCM (see Figure 2) so that we could control the ground manually.

When we disconnected the K4 circuit we immediately saw the scan tool come alive. We had communication and 5-volt reference at K6 circuit. When we externally grounded the K4 circuit back to ground, we lost communication and our 5-volt reference.

This told us we had a short to ground at circuit K6 (5-volt reference). We reconnected wire A4 at connector C1 to PCM K4 circuit and disconnected each sensor in the K6 (reference-voltage) circuit one by one, starting with the easiest to the most difficult.

When we got to the engine-speed (CKP) sensor (see Figure 3), our reference voltage returned to normal and communication with the scan tool was restored. We had found our short to ground.

We replaced the engine-speed sensor, and everything, including the air conditioner, was back to normal.

When we checked the resistance between pins 1 and 2 of the engine-speed sensor (see Figure 4), the reading was 0.6 ohm, as close as you can get to a direct short. The engine-speed sensor was shorted between pins 1 – reference voltage – and 2 – sensor ground (the loose horseshoe).

We came to the following conclusion:

The PCM has to see engine speed to start energizing the charging system. Therefore, when the engine-speed sensor was not working, the PCM generator field driver (connector C2, pin B10) would not pulse the generator and the charging system would not energize.

This same speed reading will cause generator output at connector C3, pin C25, to provide the battery voltage necessary to energize the transmission-control relay at pin 86. This relay, when grounded by the PCM, provides voltage to the transmission solenoid assembly at pin 1, via pin 87. Because the transmission-control relay depends on generator voltage to energize, the lack of speed signal also will prevent the transmission-control relay from energizing, and no power will be supplied to the solenoid block.

When the PCM reference voltage was shorted to ground, it affected the PCM's ability to communicate with the scan tool through the SCI transmit-and-receive circuit.

The air conditioner would not work because the PCM supplies ground to the coil side of the A/C-clutch relay through connector C3, pin C1 (C13 circuit). Without a speed reading, the PCM would not turn the A/C on.

The PCM supplies the ground to the message center, which illuminates the "wait to start," "water in fuel" and "transmission temperature" lights. As far as we can determine, the PCM turned this circuit off.

It's amazing how one simple sensor failure can cause so many problems for a PCM, and so the war was lost (at least for the dealer). TD

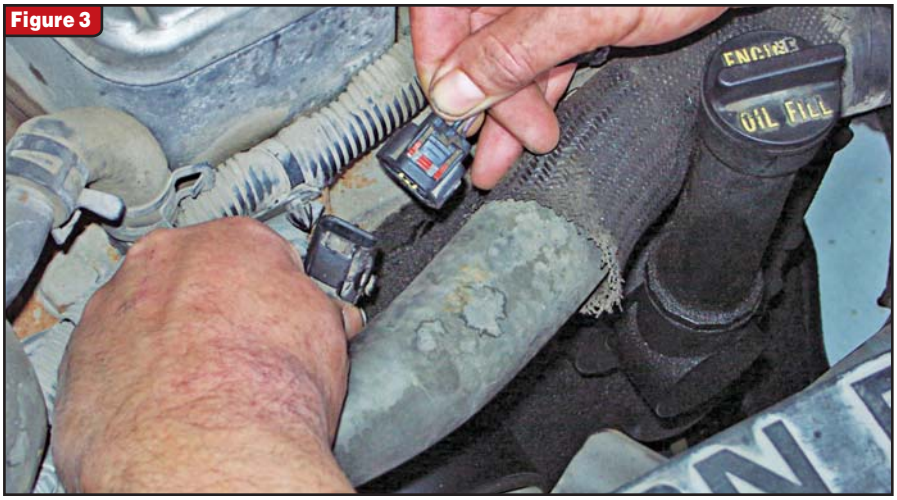

Figure 3

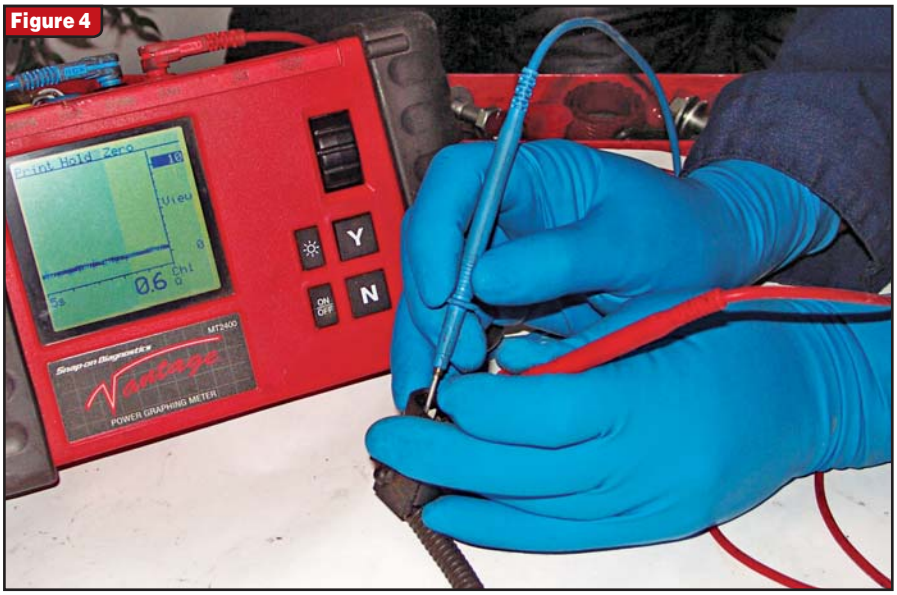

Figure 4

Jesse Zacarias is the owner of Elec-Tran Diagnostics, a transmission shop in Gilroy, Calif.
Roy Delfran of Snap-on Ask A Tech Community Bulletin Boards contributed to this article.