by Stevie Lavallee

Sensor Simulator Tester III

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Figure 1

"Does everybody know what time it is? Tool Time! That's right; Binford Tools is proud to present Tim 'the Tool Man' Taylor!" "Hello everyone. I'm Tim 'the Tool Man' Taylor, and you all know my assistant, Al 'Flannel' Borland."

Oops, that's Home Improvement. Wrong channel. Switching to the *GEARS Magazine* channel. Click... click... ahhh... that's it. Welcome to the first *GEARS Magazine Tool Time* column, presented by Stevie Lavallee. The purpose of *Tool Time* is to let you know about the many different tools and equipment available for effective and profit-making diagnostic and repair routines. In the coming months, this column will feature tools and equipment from both the aftermarket and OEM. When possible, we'll use actual diagnostic or repair routines, just like this article.

And if you're a tool or equipment manufacturer who wants your products considered for a Tool Time article, con-

tact Lance Wiggins, ATRA Technical Director, at (805) 604-2034, or email at lwiggins@atra.com.

This first column features the Sensor Simulator Tester III (SST III, figure 1), manufactured and distributed by Products Research, Inc. We first became aware of the SST III after a conversation with Larry Bloodworth of Certified Transmission & Driveline Clinic in Utah. Bloodworth sent us the SST III he had purchased for us to evaluate.

The SST III simulates suspect signals, to allow the user to determine whether there's a problem with a sensor, the sensor's wiring, or the on-board controller. It's a self-contained, handheld tester, powered by standard AA batteries. It has bidirectional control features, which allow the user to monitor and send various sensor signals. Some of the SST III features include:

- A digital display that shows actual signal output:
  - Variable Frequency from 20 to 4000 Hz
  - Variable Voltage from 0 to 16 volts
  - Variable Resistance from 75 to 200K
- AC Voltage output to simulate VSS, TSS, OSS, TISS, TOSS, and virtually any AC permanent magnet generators found in most applications, including ABS.
- A built-in continuity tester sounds a beeper and provides continuous graphic display so the user can perform a wiggle test to check for intermittent wiring problems.
- Oxygen sensor diagnostic LEDs — a handy way to monitor O_2 sensor output levels during actual operations. Using bidirectional control, it can vary the O_2 sensor's output, which will put the on-board controller into open or closed loop.
- Additional sensor simulation capabilities including CAM, CRANK, CTS, MAP, MAF, MAT and IAC.

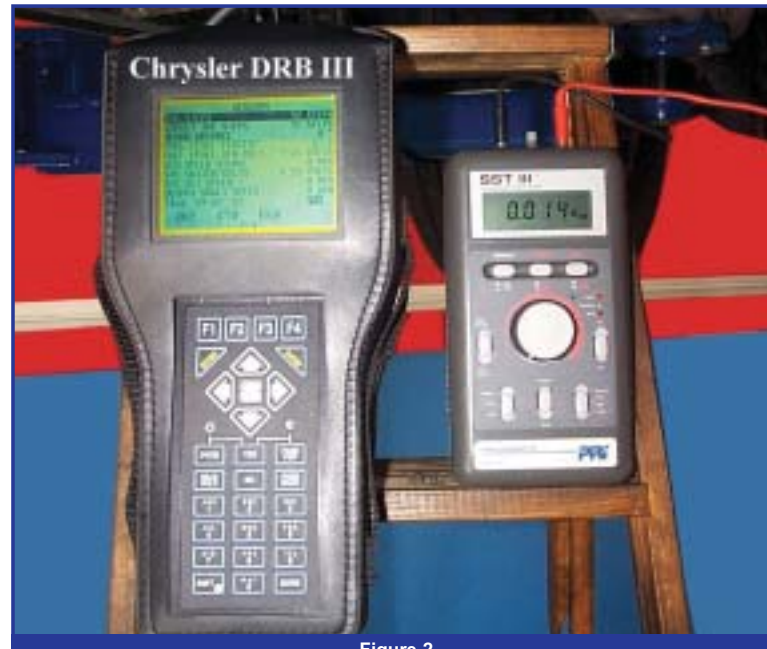

Figure 2

Now that we know what sensor signals the SST III can monitor and control, let's look at an actual diagnostic routine. A customer brought in his 1999 Jeep Grand Cherokee 4X2, equipped with a 4.0L engine and 42RE transmission, with a shift scheduling complaint. What began as an intermittent problem at about 50,000 miles had become a full-time problem at 58,000 miles. The initial test drive revealed a very late 1-2 upshift.

Using the Chrysler DRB III Scan Tool (figure 2), we retrieved DTC

Figure 3

Figure 4

P0720 from the computer's memory (figure 3). DTC P0720 is an SAE designated "Low Output Speed Sensor RPM Above 15 MPH." Mitchell 1 On-Demand for Transmissions Version 5.1 provides the following information for DTC P0720:

Circuit Description: Circuit is monitored continuously while key is on and gear selector is not in Park or Neutral. Code sets if vehicle speed is above 15 MPH and output shaft speed is below 60 RPM for 2.6 seconds as measured from vehicle speed sensor.

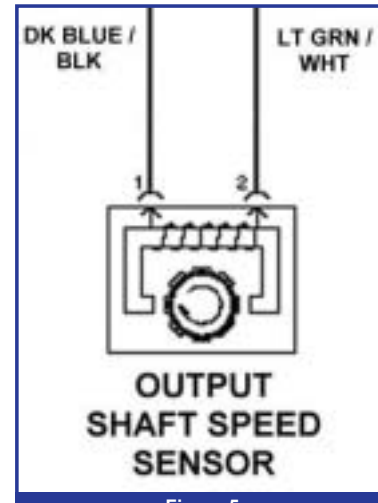

Figure 5

Possible Causes: Open output speed sensor (OSS) ground circuit, damaged ignition wiring, open OSS signal circuit, short to ground in OSS circuit, Park / Neutral switch DTC present, malfunctioning OSS, short to ground in OSS ground circuit, malfunctioning PCM, OSS harness intermittently defective.

OSS Sensor: The OSS sensor is located on the overdrive unit attached to the rear of the transmission. The OSS is mounted above the lugs on the park gear in the O/D unit. The OSS signal is generated when lugs on the park gear rotate past the face of the sensor. This input signal is delivered to the PCM, which uses the signal to control transmission operation. The VSS also serves as a backup to the OSS.

We raised the Jeep using a frame-contact lift, and selected the DRB III Sensors menu. An assistant started the engine, placed the gear selector in O/D range, and ran the wheel speed up so we could view the sensor PIDs (figure 4). Although the Vehicle Speed Signal reads 31 MPH, the Output Shaft Speed via the OSS reads *zero* RPM. With an OSS reading of zero RPM, there were three likely possibilities for the fault:

- A faulty OSS
- A wiring problem between the OSS and the PCM
- A faulty PCM

The OSS sends the signal to the

PCM via OSS pins 1 and 2 (figure 5). Pin 1 is the OSS ground signal and travels to PCM pin 25. Pin 2 is the OSS signal and travels to PCM pin 28. We probed the OSS signal wires with common pins (figure 6). With the OSS connector *still plugged in* to the OSS, we connected SST III test leads to the pins. Since the OSS outputs an AC voltage signal, we set the SST III in monitor mode with AC Hertz (Hz) selected.

With the wheels spinning at about 30 MPH, the SST III display read zero Hz. The DRB III also reported zero RPM. Gently shaking the OSS connector didn't change the reading.

With the wheels stopped, we unplugged the OSS connector. Then we set the SST III to the output mode. With the wheels spinning at about 30 MPH, we slowly turned the center knob clockwise, which sent an AC frequency signal to the PCM (figure 7).

We immediately received an OSS reading of 1520 RPM (figure 8). This proved that the OSS circuit, from the connector to the PCM, was in sound condition. We installed a replacement OSS, and cleared the stored trouble codes with the DRB III. On the lift as well as during the extended test drive, the OSS signal and the transmission both functioned properly.

NOTE: When sealing a wire puncture, *never* use RTV sealer! Use a dab of Liquid Tape‹, readily available at most parts stores, or nail polish (check with your receptionist).

How much time did we save by using the SST III to diagnose the OSS fault? Without using the SST III, we might have replaced the OSS first; on this particular vehicle, the problem would have been resolved. On the other hand, suppose the OSS *wasn't* the problem. The usual scenario would go something like this:

1. The OSS would have been replaced first.

2. In some shops, the wiring would have been checked for shorts or opens from the OSS to the PCM, which is time consuming, and not usually very easy to do.

3. In some shops, the wiring would have been replaced from the OSS to the PCM, which also takes a lot of time and isn't particularly easy to do.

Now look at the three steps above. Aside from replacing what may be a *suspected faulty* OSS, steps 2 and 3 are quite time consuming. By using the SST III for this particular vehicle diagnosis and repair, the diagnostic routine took only a few minutes. And in that time, we were able to confirm that the OSS wiring and the PCM were operating properly.

Here are some other specific fault applications we've used the SST III to check:

1. TP sensor circuits on Ford trucks and vans equipped with IDI diesel engines. It quickly isolates whether or not the TP sensor is faulty, or if the linkage systems are worn, causing erratic base idle and part-throttle fluctuations.

2. TP sensor circuits used in early Jeeps, early Chevy

These are only a few examples where we've used the SST III for computer system diagnoses. Stay tuned for more Tool Time column articles.

Figure 6

diesels, and other applications where it's common to suspect the TP sensor of causing erratic operation.

3. The APPS systems used in GM and Ford DI diesel applications.

4. Ford VSS and PSOM circuits.

5. Fixed and variable duty cycle controlled EPC and TCC circuits.

6. BARO, MAP, and MAF sensor circuit faults causing transmission performance concerns.

7. Transmission Range (TR) sensors that use analog voltage signals.

8. GM and Chrysler erratic input and output speed sensor signals.

9. Transmission Fluid Tempera-ture (TFT) sensors that can cause erratic shift and TCC scheduling.

These are only a few examples where we've used the SST III for computer system diagnoses. Stay tuned for more Tool Time column articles. As Tim "the Tool Man" Taylor likes to say: Ahrrr… Ahrrr… Ahrrr…

For more information on the SST III and similar test instruments, contact Products Research Inc., 1550A Fullerton Avenue, Addison, Illinois, 60101, 1-800-525-0093.

Figure 7

Figure 8