Ford F250 with *Late* and *Harsh* Upshifts

by Mike Van Dyke and Chris Ondersma

Getting past the distractions to diagnose a Ford PSOM problem.

Figure 1: A loose negative battery cable explained the slow cranking, but wasn't the source of our problem.

Figure 2: Original spark plug wires with 1992 year code were highly suspicious.

We received a call on the ATRA HotLine from Steve at Trans Care in Camarillo, California. Steve was working on a 1992 Ford F250 pickup with a 7.5L gas engine and an E4OD transmission, with 152,000 miles showing. The truck would intermittently upshift late and hard. We decided to bring it into the ATRA research facility to track down the source of the problem.

The First Steps

Once we had the truck, we followed the first rule of diagnosis: *Road test and scan the vehicle to verify the problem, and record any other problems or DTCs.* The first few things we noticed were slow cranking and the engine was running very poorly. The engine had an off-idle tip-in stumble, it would surge during acceleration and cruise, and its power was quite noticeably reduced. The loss of power made the 460's performance seem more like a 302; otherwise, the transmission shift timing and shift feel seemed normal. The shifts were smooth and appropriately timed at any given throttle opening. A scan test revealed no helpful DTCs. But it did reveal another diagnostic obstacle: There was no scan data available.

With no symptoms and no codes, this truck was already proving to be difficult to get a handle on. We finally got our break on the second road test; as soon as we pulled out of the

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driveway and started accelerating, we noticed there was no upshift. We ran it up to about 3000 RPM in first gear and let off the throttle a couple times, until it finally jolted into second gear. The 2-3 and 3-4 shifts were also very late and hard. After driving for a while, we could no longer get it to shift automatically; we had to resort to shifting to manual 2 just to get second gear and keep up with traffic on the side streets.

Before we went too much further, we needed to cover the basics: clean and check the grounds, and check the battery and charging system. We found a loose negative battery cable (figure 1), which explained the slow cranking. The battery was also discharged, having only 12.2 volts at the terminals even with a surface charge just after shutting the engine off. After going over all of the grounds and giving the battery and terminals the attention they needed, we verified the charging voltage and alternator output were good. But our shifting problems persisted.

With the engine still running poorly, we followed the second rule of transmission performance diagnosis: *Fix or rule out engine performance problems first.* A look around the engine compartment revealed other suspicious looking components: an original looking TPS and MAP sensor, and OEM Motorcraft spark plug wires with the 1992 year code (figure 2) printed on them!

With no available scan data, the next step was to unplug the PCM and connect a breakout box (figure 3). This way we could easily access all of the signals going to and from the PCM. The PCM power feeds checked okay, and the PCM grounds all checked good with a voltage drop test. We connected an oscilloscope to the TPS circuit and performed a static sweep; there was a little signal dropout right off idle.

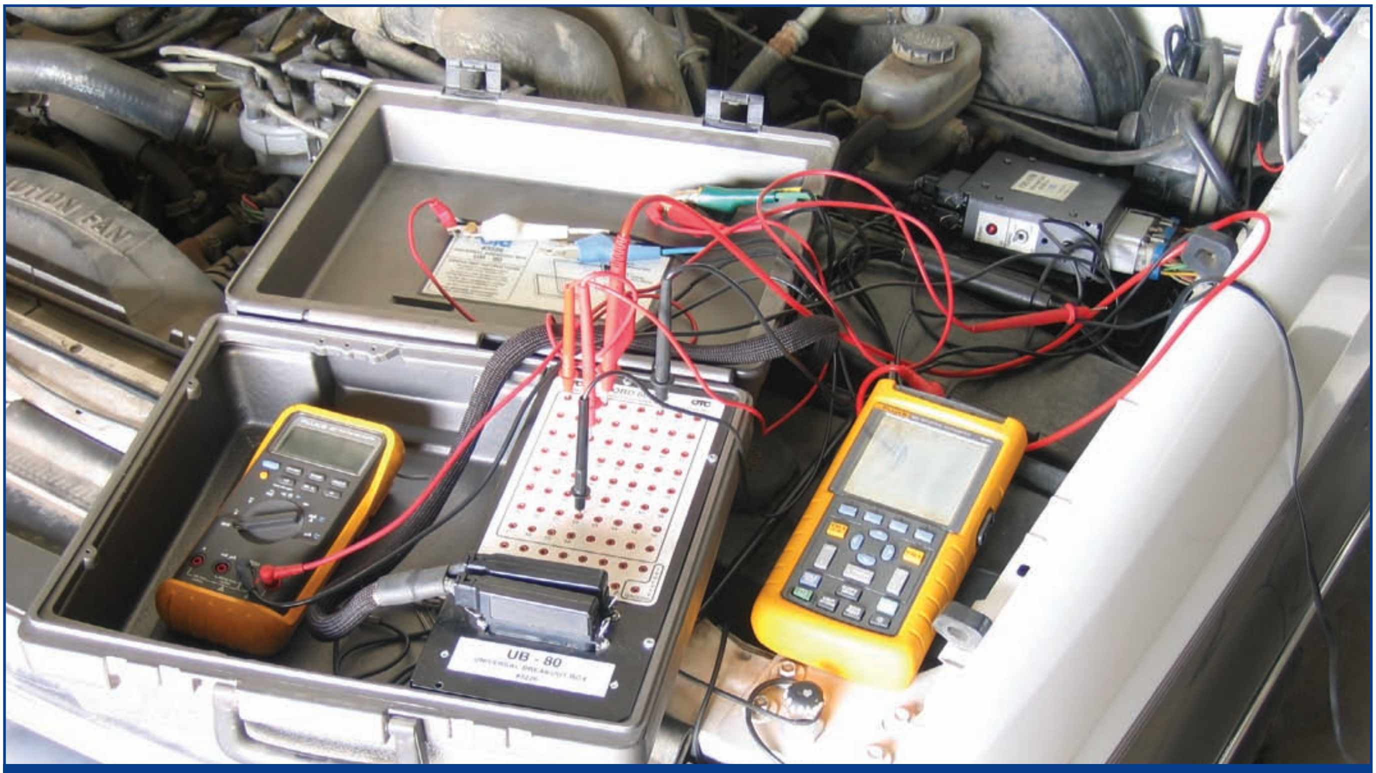

Figure 3: With no scan data available, you have to get down and dirty with a breakout box, oscilloscope and DMM.

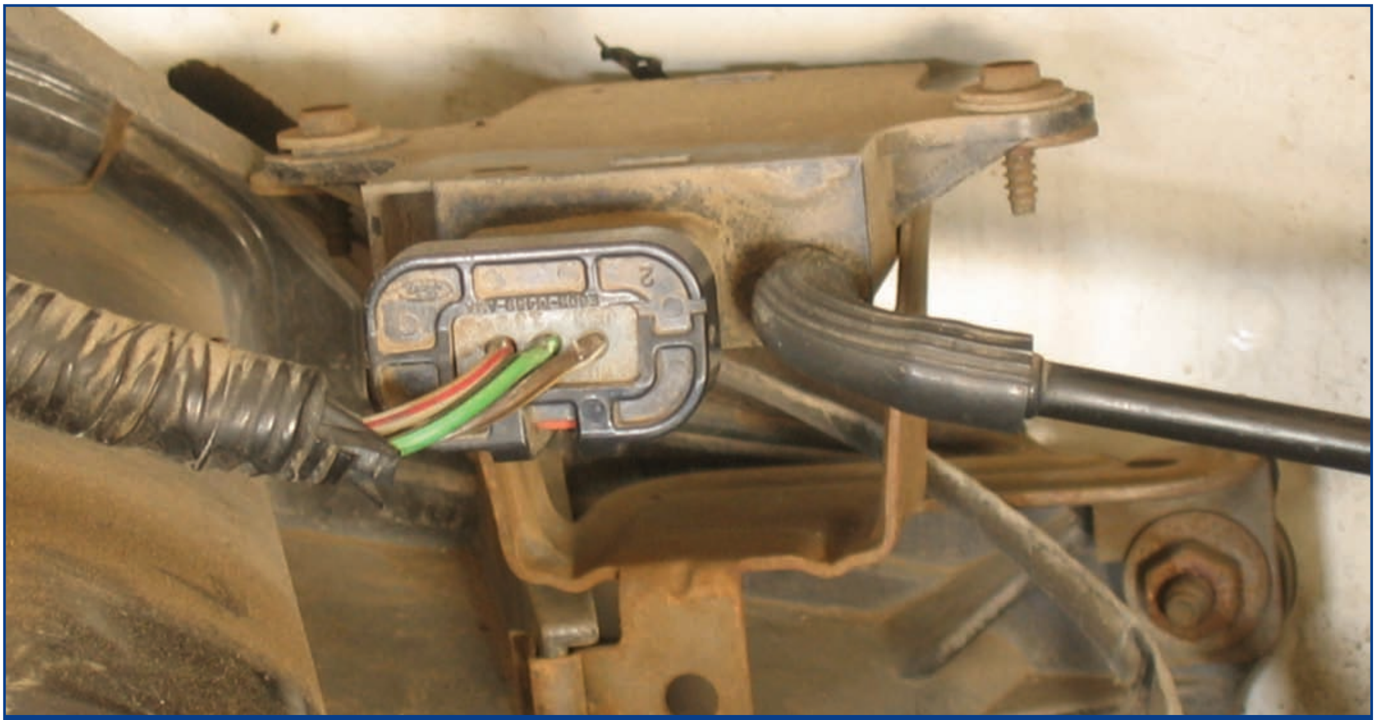

Figure 4: We eliminated our original-looking MAP sensor from the suspect list by simply unplugging it.

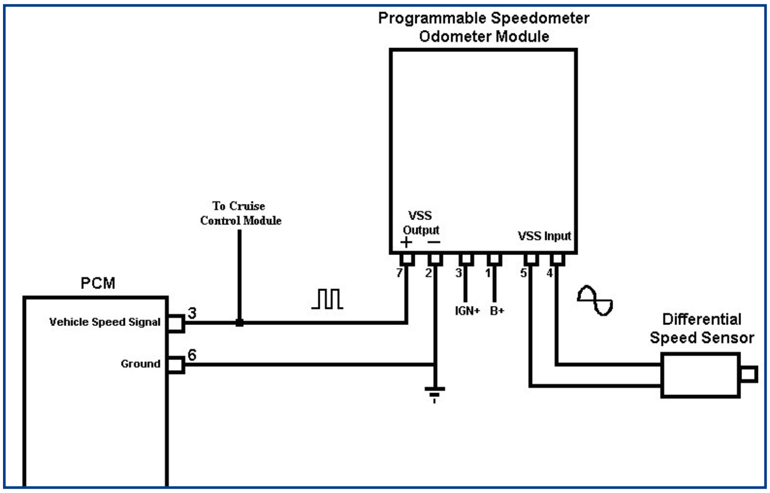

Figure 5: The PSOM (Programmable Speedometer Odometer Module) receives an AC signal from the differential speed sensor and sends out a square wave vehicle speed signal to the PCM.

Testing While the Problem Occurs

The third rule of diagnosis is to *verify whether the transmission is doing what it is told or commanded to do*. In other words, monitor the shift solenoid signals while the transmission won't upshift. We connected a signal monitor to Shift Solenoid A and Shift Solenoid B ground control circuits at the breakout box. Running the truck on the rack verified the PCM was commanding first gear consistently when the transmission wouldn't upshift.

So the transmission was operating exactly as it was being commanded.

An extension of our third diagnostic rule is to test or monitor signals when the problem is *actually occurring*. Since we could now duplicate the problem running the truck on the lift, we monitored the TPS signal while the transmission wouldn't upshift. We could see regular 1 volt spikes in the signal. We suspected these were being caused by EMI from high firing voltage and leaks in the secondary ignition, considering the old plug wires and all. To eliminate the TPS signal as the culprit, we simply unplugged it. Then we started the truck, verified the PCM set a TPS code, and ran the truck on the lift again. No change in the symptoms.

Unplugging a sensor is a handy trick, especially for the TPS, MAP or MAF sensors. Unplugging one of these engine sensors takes the signal away from the PCM and forces the PCM programming to use an alternate engine management and transmission control strategy by looking at the data from the remaining sensors. Keep in mind that the PCM may default to high line pressure and late shifts when you use this strategy and not give you very much useful information when diagnosing late or harsh shifts. Since our problem had progressed to no upshifts, we found it to be useful to eliminate the sensor signals.

We plugged the TPS back in, cleared the DTCs, and moved on to the next suspect: the MAP sensor (figure 4). The MAP sensor signal checked out okay on the scope, but we still unplugged it to take the signal out of the picture. As you probably already guessed, the problem was still there. The MLPS signal voltage was giving a correct Drive range voltage signal as well.

Getting to the Root of the Problem

Next we scoped the vehicle speed signal at PCM terminal 3. AH HA! As soon as we probed terminal 3 we could see the signal was faulty. The PCM


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Figure 6: Once we narrowed down the problem, we removed the instrument cluster for further testing.

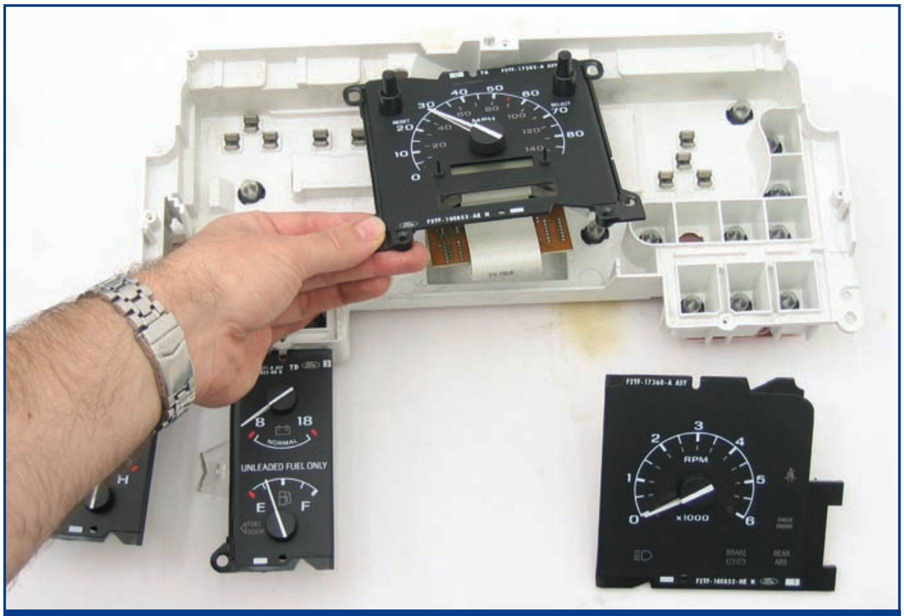

Figure 7: Plugging the speedometer module into the dash by itself offers more room for live circuit testing.

Tip: When replacing a PSOM (Programmable Speedometer Odometer Module), make sure to have it programmed properly for the tire size, differential ratio, and differential reluctor tooth count. ATRA TSB #425 covers calculating and setting the ratio constant on the PSOM. It's also a good idea to transfer the correct vehicle mileage to the replacement PSOM. Check with your local speedometer shop for this service, or type "speedometer repair" into your favorite internet search engine to find a repair shop with overnight shipping services.

receives the vehicle speed signal from the PSOM (Programmable Speedometer Odometer Module) between PCM terminals 3 (+) and 6 (-). The signal on this truck is supposed to be a square wave signal that varies in frequency with road speed. Lowering the voltage scale on the scope revealed the signal was only a tiny 300 mV square wave; its amplitude was much too low for the PCM to recognize.

Something to consider is when we checked the frequency of the vehicle speed signal at PCM terminal 3, it was tracking correctly with vehicle speed. Keep in mind the digital multimeter is a very sensitive instrument, capable of reading very small signals, so it was actually reading the frequency of this weak signal. This is where the oscilloscope proved its worth; we could see immediately the signal was bad when we probed the circuit.

Look at the wiring diagram in figure 5: The PSOM receives the AC signal from the differential speed sensor and sends out a square wave vehicle speed signal to the PCM. Because the speedometer maintained a good, steady reading, we knew the PSOM was getting a good signal from the differential speed sensor.

The cruise control module shares the vehicle speed signal with the PCM, and can short internally and pull the signal to ground. To eliminate a bad cruise control module, we unplugged the cruise control module and verified there was still no vehicle speed signal to the PCM.

Testing and Inspecting the PSOM

At this point we were left with one of two possibilities: either there was a problem with the vehicle speed signal circuit between the PSOM and the PCM, or we had a faulty PSOM that wasn't providing the proper signal.

In order to access the PSOM connector we removed the instrument cluster (figure 6) to check the signal right from the back of the PSOM (which is part the speedometer assembly), and test the circuit between the PSOM and the PCM. There was no short to ground, and the circuit checked out okay, with

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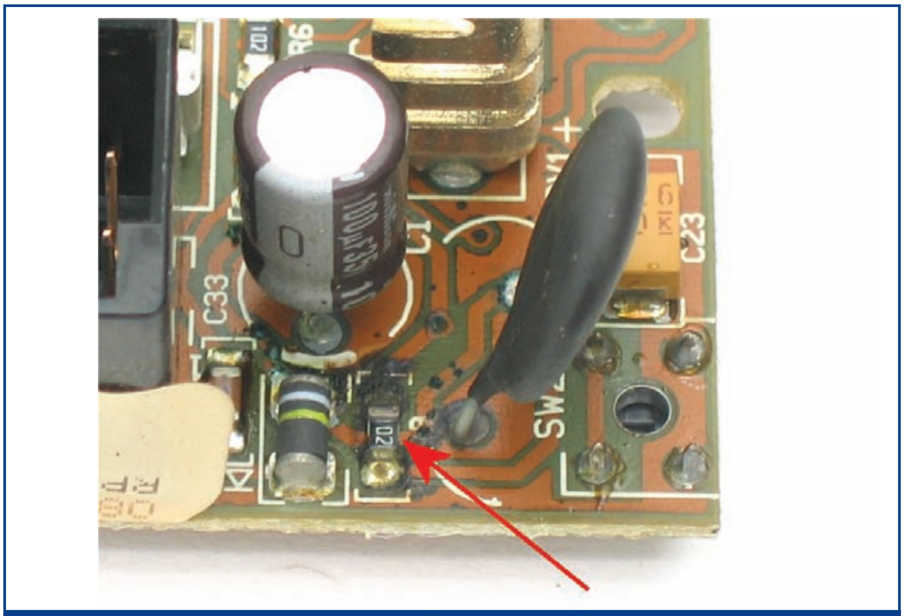


Figure 8: A leaking electrolytic capacitor on the PSOM circuit board also provided a visual indication of failure.

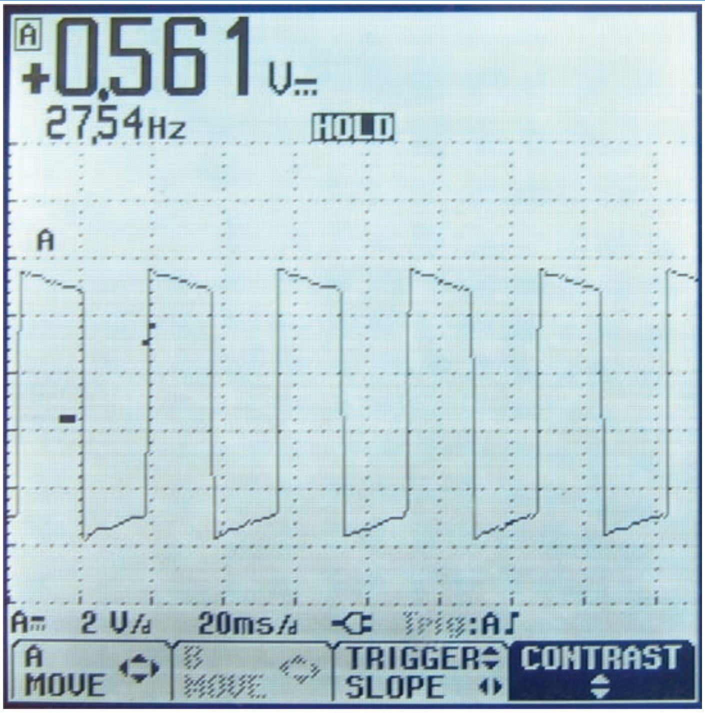


Figure 9: The correct PSOM vehicle speed signal to the PCM is an AC square wave that rises to 5 volts positive and drops back to 3 volts negative, with a frequency of about 120 Hz at 60 mph.

almost no resistance between the PSOM and PCM. With the PSOM plugged in, it had good power and ground under operating conditions, and the PCM had a good ground at terminal 6.

There isn't much slack in the harness, which can make it difficult to backprobe the PSOM to check the power, ground and signals. One thing that can make it easier to check is to remove the speedometer assembly from the instrument cluster (figure 7). You can accomplish this fairly quickly: Remove the lens from the instrument cluster, then carefully remove the gauges one by one, starting from the ends of the cluster. The PSOM/speedometer module has to be removed last.

With the speedometer removed from the cluster, you can carefully plug it into the harness connector in the dash and have plenty of room for power, ground and signal testing. Just be careful not to damage the speedometer needle or dial face. Also, be sure to plug in the fuel tank select switch if your truck has one in the instrument cluster trim panel; otherwise the fuel pump won't run, so the engine won't start.

With the PSOM/speedometer removed from the instrument cluster, we could also see signs of damage on the circuit board caused by a leaking capacitor (figure 8).

With the PSOM/speedometer removed from the instrument cluster, we could also see signs of damage on the circuit board caused by a leaking capacitor (figure 8). This gave us more evidence to suggest a problem with the PSOM.

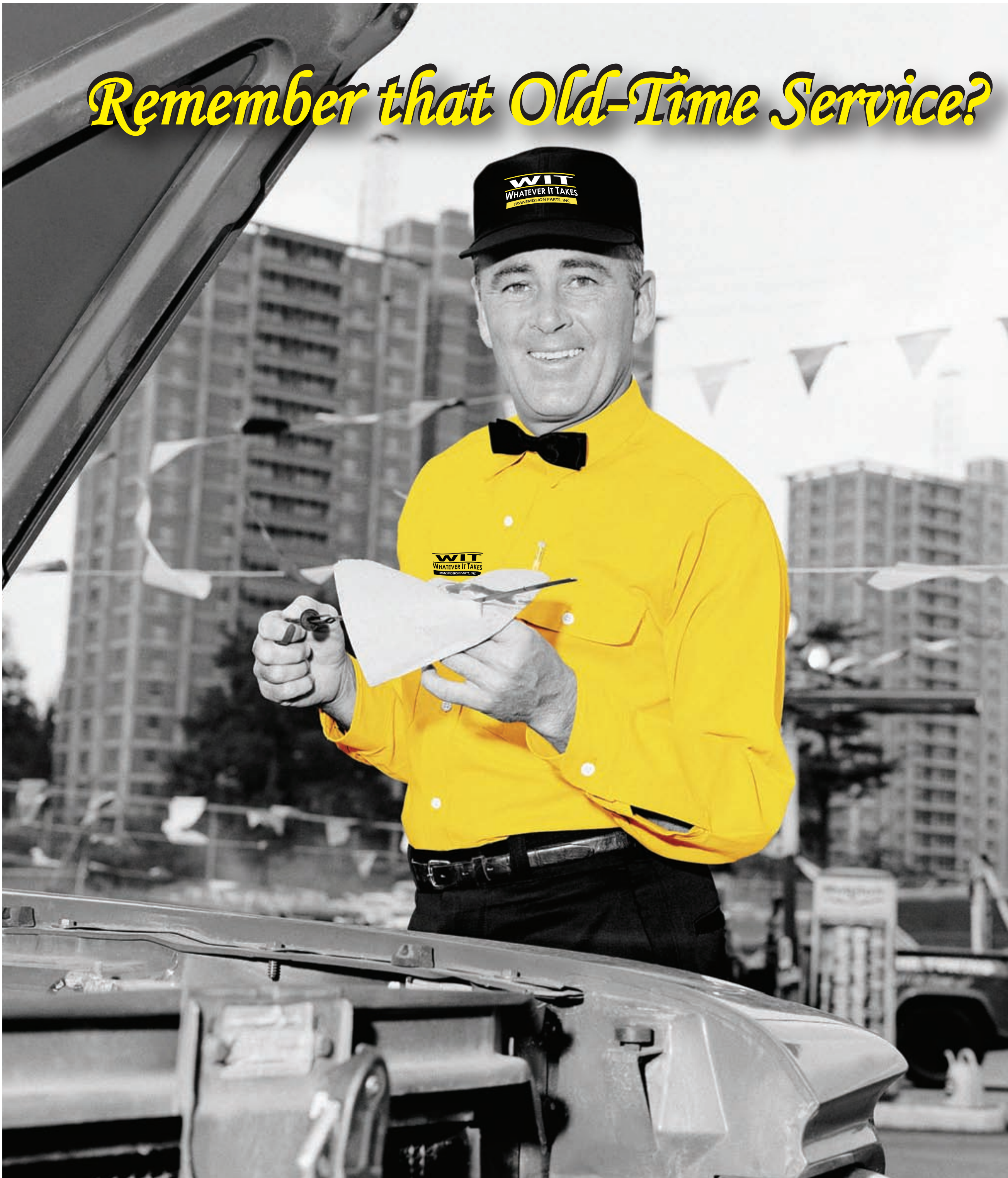
Once we verified the PSOM had everything it needed to work, but still wasn't providing the necessary signal to the PCM, we ordered and installed a replacement instrument cluster from the salvage yard. Just as we expected, we now had a good vehicle speed signal waveform between PCM terminals 3 and 6, and the transmission now shifted smoothly and on time.

Look at figure 9: Notice the correct vehicle speed signal to the PCM is an AC square wave that rises to about 5 volts positive and drops to about 3 volts negative. The sloping tops and bottoms on the waveform are normal, and don't indicate a problem in the circuit.

Conclusion

Even though it's considered a rule to diagnose and repair engine performance problems first, sometimes just going through the motions and checking all the signals will lead to the source of the problem. A poor running engine on this truck was a major distraction during the diagnostic process, but the transmission problem ended up being caused by a faulty vehicle speed signal from a bad PSOM. A special thanks to Steve and everyone at Trans Care in Camarillo, California for providing the vehicle and service background information.

Remember that Old-Time Service?



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