Another Mystery Solved:

Hocus Focus

The little Ford that couldn't

by John Anello

A shop called me in to investigate a 2002 Ford Focus with 2.0L that had poor power on a hard acceleration (**Figure 1**). The vehicle, which only had about 53,000 miles on it, idled fine with no misfires or codes stored in memory. It just didn't have the horsepower it should have had.

The shop had already replaced the fuel filter and performed a back-pressure check to rule out a clogged catalytic convertor. The owner was told by the garage that there was a possibility that the fuel pump was bad and it was suggested that he go to the new car dealership to have it changed under warranty. When the Ford dealer's tech checked the car, he had a different opinion of what was needed to fix the complaint. He recommended a new transmission because of the lack of torque and a concurrent condition of engine flare-up on acceleration. The torque multiplication at the wheels just did not seem to be adequate.

At this point, the customer called the garage owner to let him know about the outcome at the dealership, and the garage owner recommended a local transmission shop for a second opinion. The trans shop proved the dealer wrong, and now the vehicle was back at the garage for further investigation. This poor car was like a carnival ride -- everybody wanted to take a turn in the driver seat. There were too many opinions and no solid answers.

When I arrived at the shop, I drove the vehicle to get a feel for the problem the others had experienced. I warmed the car up and it seemed to rev fine with no hesitation problems. The engine idled smoothly with no misfires or apparent roughness. I placed the transmission in drive and accelerated normally from a dead stop, and it did not seem bad at all. Then, I tried hard acceleration. It seemed to accelerate fine without holding back, but it took too long to come out of first gear due to the amount of throttle needed to get the vehicle going. Holding the throttle down farther created an engine flare-up, which was followed by a bang into second gear. It felt like a bad transmission, but then again it seemed like the engine did not have the top-end torque it was designed to have.

At this point, I needed to run some tests to determine if the

Figure 1

engine was experiencing a fuel, air/exhaust flow, or timing problem. I started my diagnosis by checking for codes in memory, and there were none present (**Figure 2**). The EVAP monitor had not run yet, indicating that someone had erased prior codes and stored freeze frame information, but the vehicle did run all the other monitors proving out any fuel trim or misfire conditions.

When dealing with a low-power condition, it is important to know that most of the failures I have seen in the field fall into the common categories of lack of fuel, restricted air intake, clogged exhaust, miscalculation of volumetric efficiency, or an ignition/valve timing issue. It was easy to just watch data parameters on acceleration to determine if the problem was fuel-related, so I accelerated the engine again from a dead stop at wide open throttle while viewing some selected PIDs (**Figure 3**). You can quickly see that the PCM maintained fuel control during the whole time indicating that the power loss was not due to a fuel problem. Had it been a lack of fuel, I

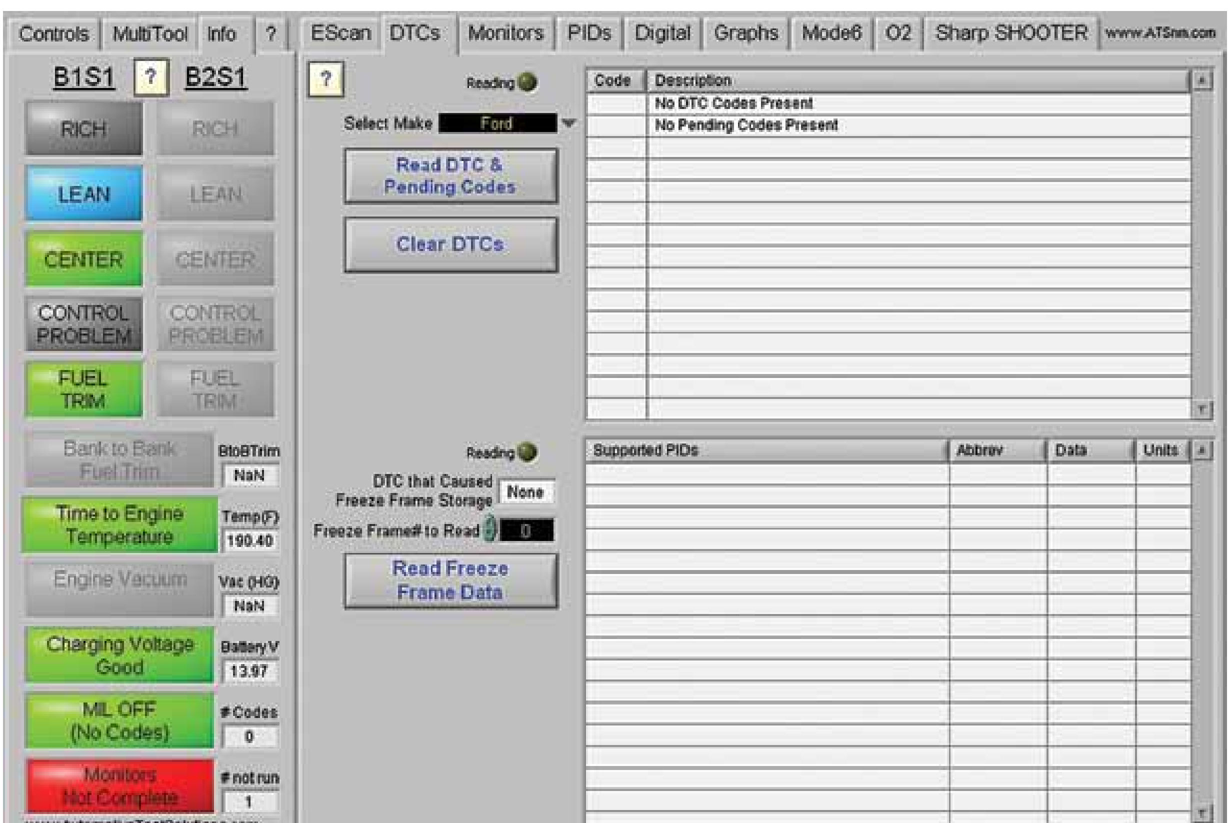

Figure 2

would have seen fuel trims maxed out with an O2 sensor value constantly below 500mV. Providing that the O2 is working properly, this quick test eliminates the need to get too intrusive by hooking up a fuel analyzer to check fuel pressure and volume.

Now that I had eliminated the possibility of a fuel delivery problem, my next step was to perform a volumetric efficiency test to check air flow through the engine. After all, the engine is nothing more than an air pump and the PCM will use the MAF calculation to determine the proper fuel and ignition timing mapping to keep the engine at peak performance. The correct air flow reading is dependant on the proper calibration of the MAF, the amount of restriction in the air inlet and exhaust system, and valve train integrity. To be accurate, this test has to be done at wide open throttle while driving. You also need to take into consideration the ambient air temp, altitude and engine size. This can be done by recording your captured scan data into a VE calculator, or by

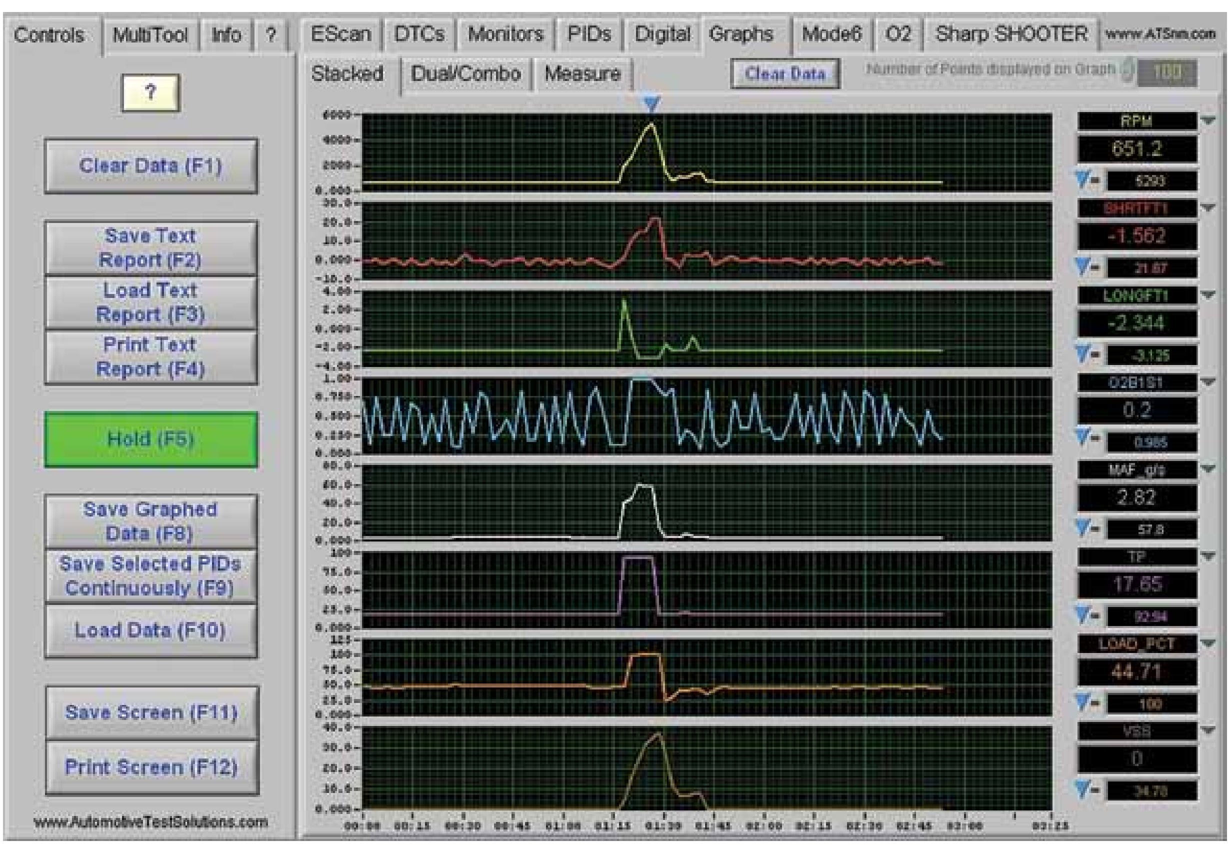

Figure 3

simply plugging your engine and ambient conditions into the Escan VE program and letting it do all the work for you while you concentrate on your driving skills to maintain a steady wide open throttle acceleration to capture the data you need.

Once the proper information was entered into the VE program, I put the pedal to the metal from a dead stop and captured the air flow data (**Figure 4**). The actual volume of air was 30% below the calculated specification. There were no fuel trim issues, which indicated that the MAF was correct in its findings. The exhaust back pressure had already been checked by the garage and found to be below three psi, and the air inlet and air filter were checked for restrictions and were okay. This problem was valve train related.

I next hooked up my scope and tagged the crank and cam sensors to perform a correlation check by viewing the signals in a superimposed format (**Figure 5**) to prove my suspicions. By pulling up a known-

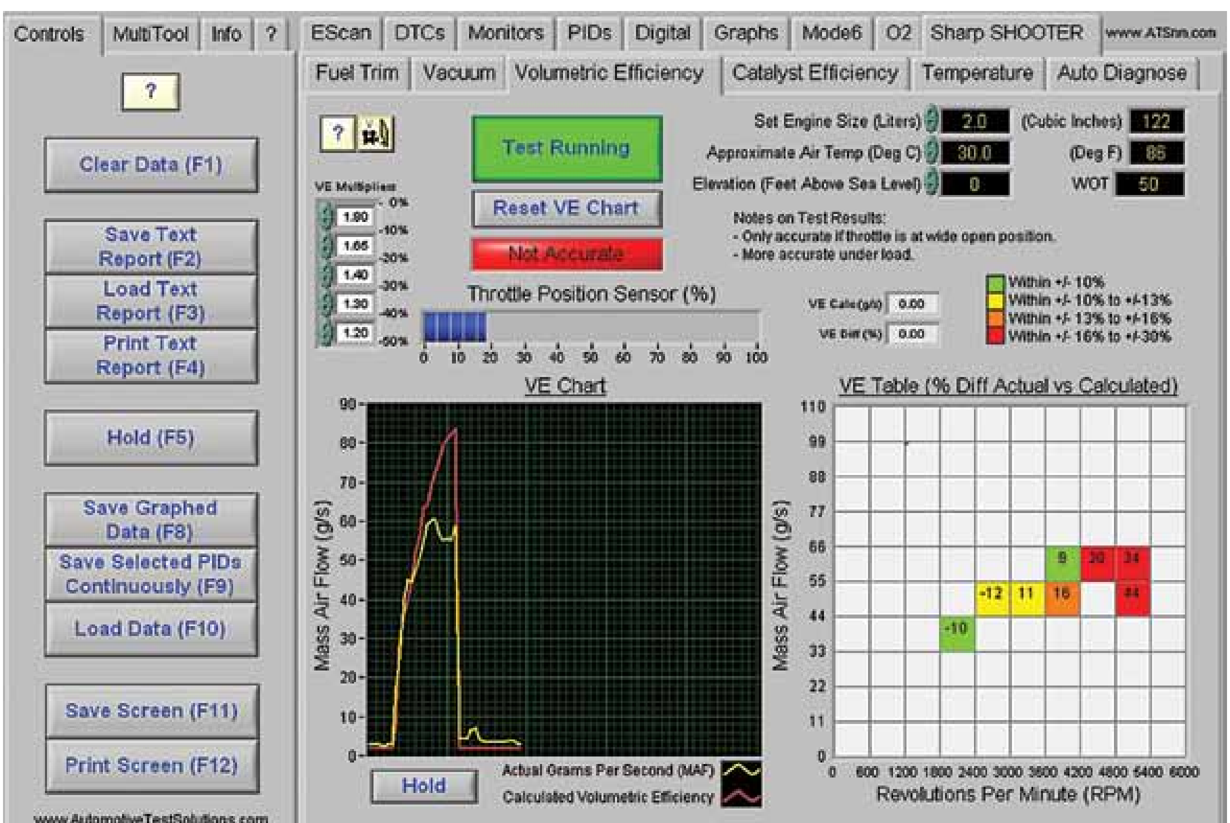

Figure 4

good pattern from my Ace Misfire database (**Figure 6**), I could see that the crank and cam correlation was off by about 60 degrees. This is a quick and easy check to validate mechanical timing issues with trigger points, but it alone still cannot prove out a jumped timing chain or belt. There have been too many situations where I have found loose trigger wheels that had lost their indexing, damaged flywheels, worn crank pulley keyways, or even sheared cam gear pins. The only true way for me to quickly prove out a valve train problem would be to use a 300 psi pressure transducer in a cylinder to get a true indication of piston and valve correlation.

I removed the spark plug and placed a spark tester on the wire. I next screwed the pressure transducer and adapter assembly into the cylinder and started the engine to capture a waveform. I shut down the engine and zoomed in on the pressure pattern to view the peak-to-peak pressure rises indicating one combustion event of 720 degrees. I placed the cursors on the peak-to-peak compression rises and then hit the Cam Timing

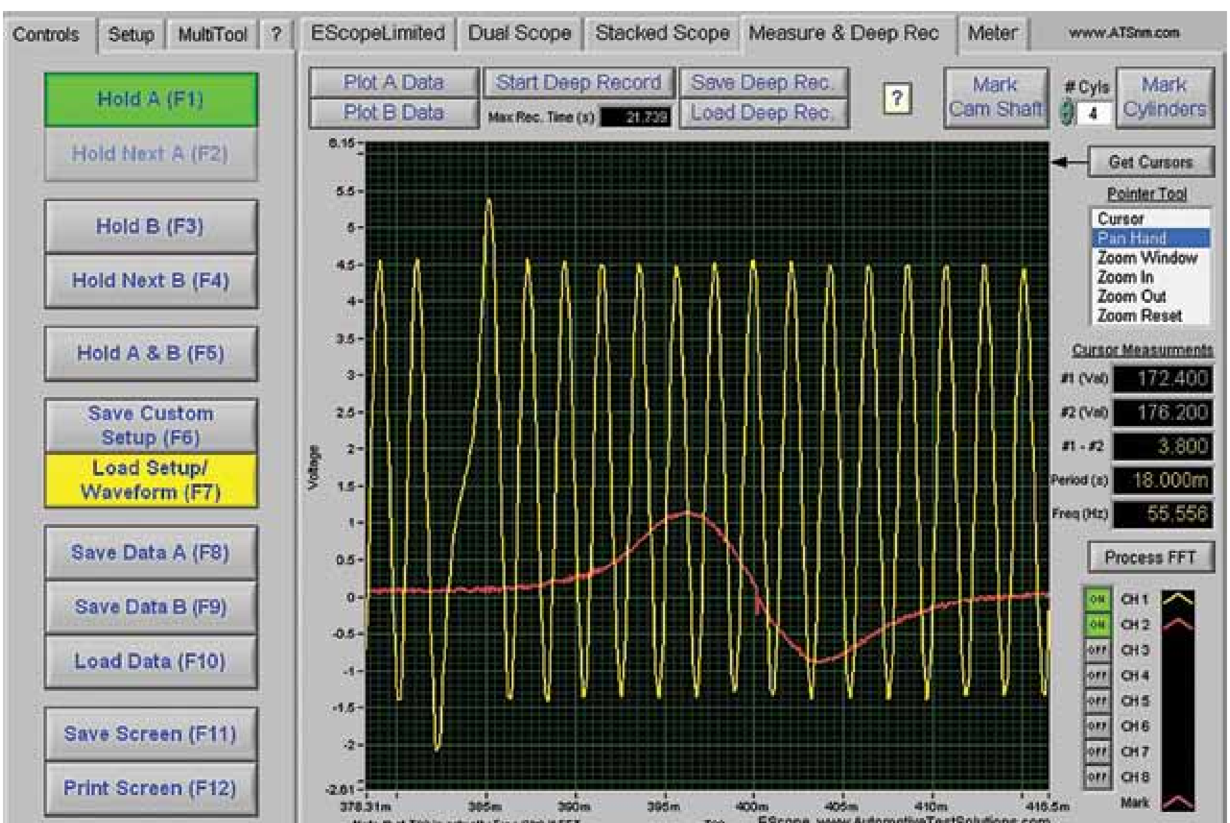

Figure 5

button within the EScope program (**Figure 7**). The program automatically placed five large purple cursors creating four divisions of 180 degree of crankshaft rotation and five smaller purple cursors creating six subdivisions of 30 degrees on the screen. You could now see that the exhaust valve was opening at about 75 degrees before BDC of the power stroke (note that the lowest fall after the compression rise is where the exhaust valve begins to open). Having seen many waveforms showing exhaust valve openings between 30-45 degrees before BDC of the power stroke, this engine's valve timing was definitely off by 30 degrees or better. It was now safe to instruct the garage to pull apart the front timing cover, which involved supporting the engine with a jack, removing an upper engine support and removing an upper metal timing housing cover -- all that just to expose the timing belt.

Once the timing belt cover was removed, I marked the sprockets with White Out (**Figure 8**). The cam gear was off by about two teeth. Also, the belt had some slop indicating that

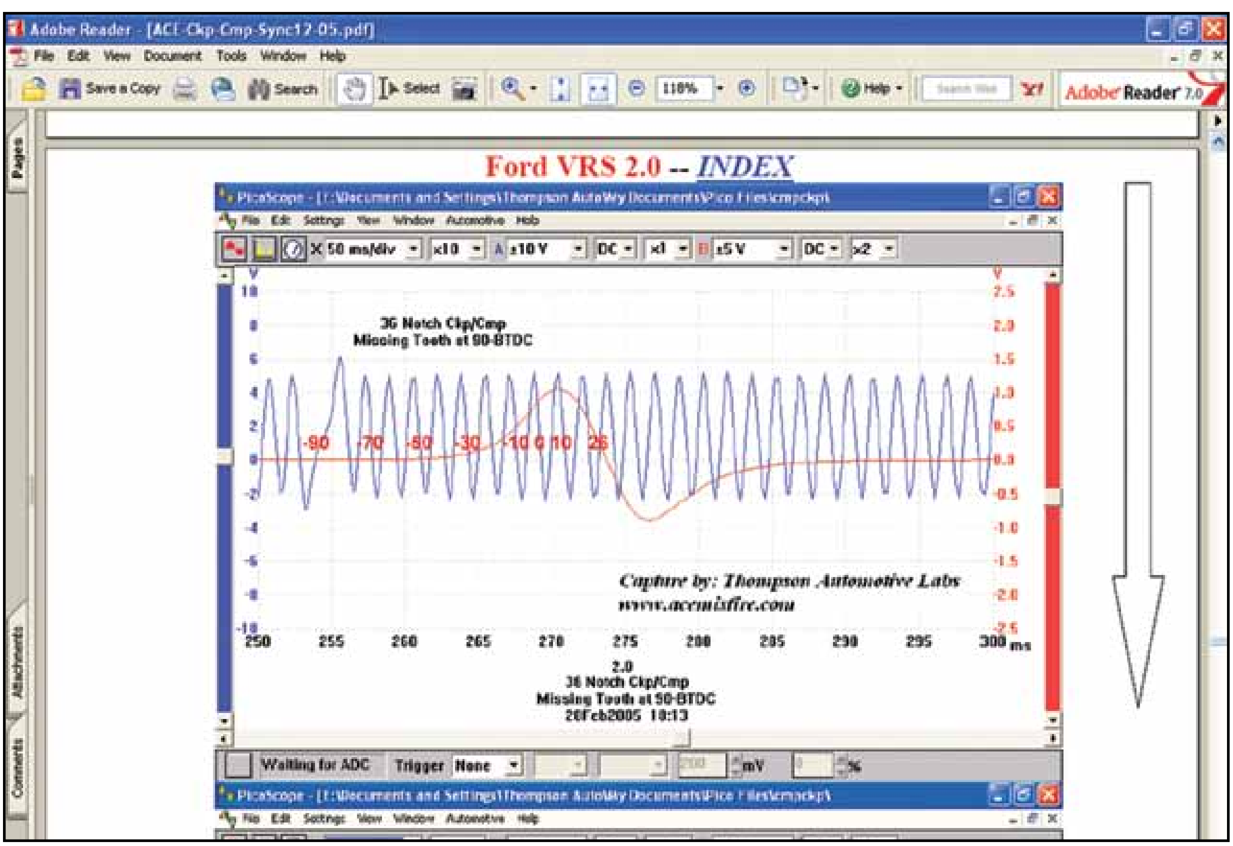

Figure 6

the self-adjuster was not doing its job of compensating for belt stretch. The fix here was to sell the customer a timing belt and a new belt tensionor. I also recommended replacing the water pump that ran off the belt as a preventative maintenance measure. Prior to being a mobile technician for the last 15 years, I worked in an engine rebuilding shop for five years and as a dealer technician for another 10 years, and I have seen so many guys in the field skimp on so many types of jobs to try to save a customer money by not replacing a component that may involve overlapping labor time. An experienced tech should understand that educating a customer is the best way to sell needed work on a vehicle. Doing this good deed will help to prevent a return visit of the vehicle on the hook. I find that whenever you try to save a customer money you always lose in the end.

It's amazing to me how this Focus timing belt went undetected by the PCM, or even by a dealer tech who knew Ford products well. On the other hand, I can see this happening to any

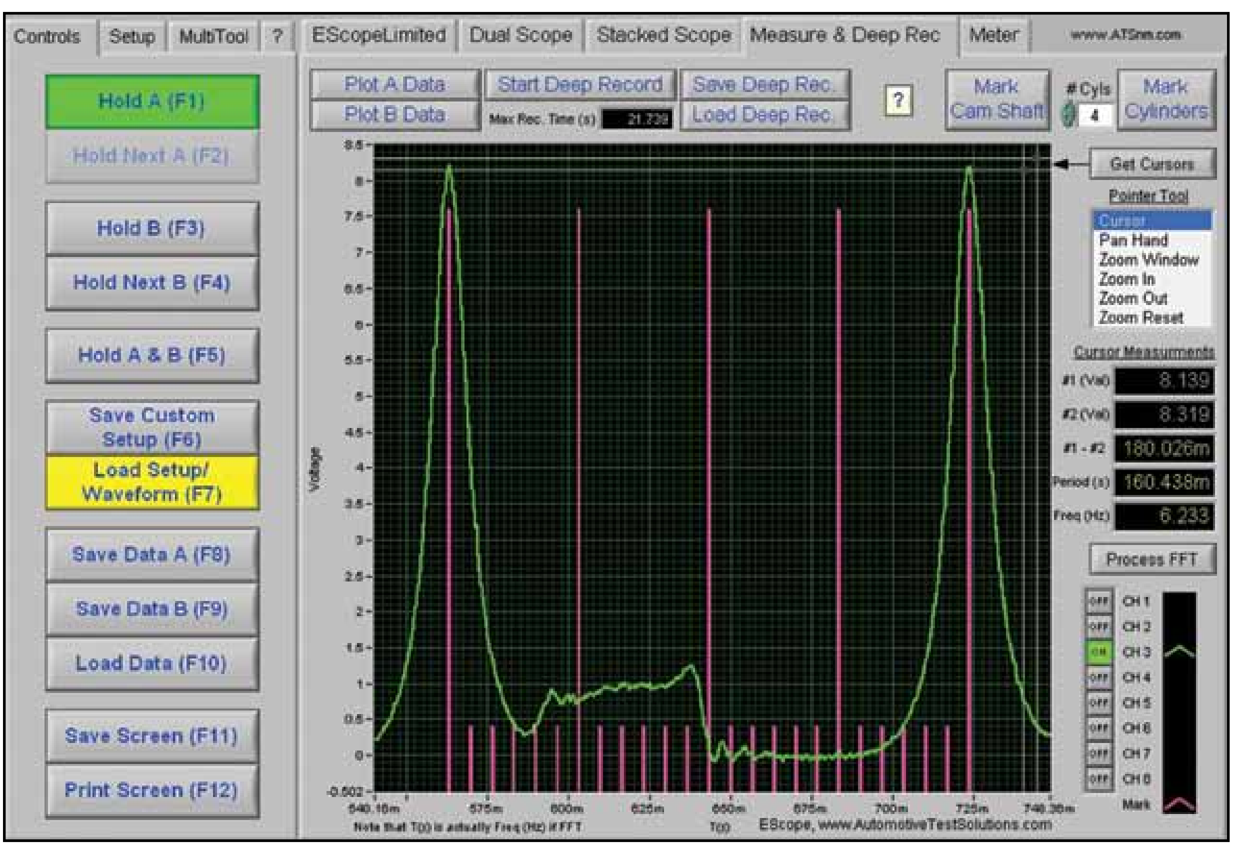

Figure 7

tech because there were no obvious signs that you would normally associate with a jumped timing belt, such as poor engine vacuum, rough idle, engine misfire, dramatic loss of power, erratic electronic spark operation, or even popping through the intake. This was a tricky Hocus Focus that deceived everyone into thinking that anything could be at fault except the timing belt. Even when I drove the car, I thought the engine was all right and I was leaning toward performing a transmission stall speed test because it did seem like a transmission problem.

Figure 8

I believe that the key to resolving power issues is to keep it simple by performing pinpoint tests to validate engine performance, which can have an effect on transmission performance. Using "feels like" or failure pattern tactics will only lead you down a dead end street where you won't find the resolution to the initial problem. I always strive to find new ways to fine-tune my diagnostics to cut down on labor-intensive intrusive tests and component removal. As the technology in equipment advances, it can only help us to achieve new levels of diagnostic strategies. I hope this story helps you choose the right path when you hit that diagnostic fork in the road.