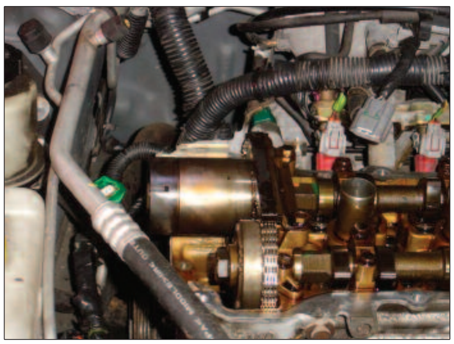
WELLS COUNTERPOINT
www.wellsVE.com
Volume 13 Issue 4, Fall 2010
THE ELECTRONIC, DIAGNOSTIC AND DRIVEABILITY RESOURCE.

Nissan Variable Valve Timing

Variable valve timing gives engine designers the best of both worlds — power with economy.



This issue's case studies were contributed by John Thornton.

It is common knowledge that it's easier to fix a broken vehicle if you have a clear understanding of how it works when it's not broken. When you have the time, it pays to connect your diagnostic equipment to known-good vehicles! This is especially true when an oscilloscope is involved. If you only pull out your oscilloscope when you are faced with really tough problems, you'll need to spend time familiarizing yourself with how your scope works before you can get down to business. But if you put the time into building your scope proficiency, you'll also become more familiar with how certain waveforms should look when a vehicle is running properly. So when the time comes, you'll have a much easier time spotting abnormal waveforms produced by a vehicle with a problem.

To illustrate this point, we'll begin with a vehicle that has no known problems and no stored DTCs. It's working the way it's supposed to. Our first case study concerns a 2001 Nissan Sentra GXE, equipped with a 1.8L engine (engine code QG18DE) and variable valve timing (also called Nissan Variable Cam Timing or N-VCT). Nissan first introduced this system in 1987 on the VG30DE, which was installed in the 300ZX in this country.

Variable valve timing allows engine designers to incorporate the best characteristics of different camshaft profiles into the same engine. In the past, designers needed to make compromises to achieve often contradictory emissions, power and economy goals. With variable valve timing, when the valves open, the relationship between intake and exhaust valve opening (overlap) can be changed by the PCM, depending upon engine speed and load inputs. At least on this Nissan Sentra system, valve lift and duration *are not* altered and the valve timing of the intake camshaft is controlled. The exhaust cam timing can't be changed by the PCM.

These systems can malfunction in a number of different ways. If the intake cam timing fails to change at higher engine RPM, the customer may notice a loss of engine performance. If the electric solenoid (cam phaser) on the end of the camshaft fails, or if the phaser's oil passages become clogged, the phaser may become stuck in the advanced position. The engine may run normally at higher RPM, but have a rough idle or other driveability issues at lower RPM.

We'll use this Sentra case study to demonstrate a known-good relationship between the crank sensor and cam sensor signals, both of which are used by the PCM to control the QG18DE engine's variable valve timing system.

The crankshaft position sensor (POS) is located at the rear of the cylinder block, facing the gear teeth of the signal plate at the end of the crankshaft. The sensor consists of a permanent magnet and Hall effect integrated circuit (IC). When the engine is running, the changing gap between the high and low gear teeth sections causes the magnetic field near the sensor to fluctuate. The Hall effect sensor converts the changing magnetic field into a digital voltage output to the PCM. The PCM uses the changes in the POS sensor signal to detect variations in engine speed.

On vehicles not equipped with the Nissan antitheft system (NAS), the POS sensor signal is accessed at PCM pin #75. One crank revolution could potentially produce 36 evenly spaced pulses. However, the signal plate has two missing teeth, so during one crank revolution the POS sensor is exposed to one missing tooth, then 17 teeth, then another missing tooth, then 17 teeth.

The camshaft position sensor (PHASE) senses gaps in the exhaust cam sprocket, which allows the PCM to identify the camshaft position for a particular cylinder. This sensor consists of a permanent magnet, core and coil. When the engine is running, the high and low sections of the sprocket teeth cause the sensor gap to change. The changing gap causes the magnetic field near the sensor to move. This causes the sensor's generated A/C voltage to vary.

The PHASE sensor signal is accessed at PCM pin #76 and/or pin #66 (without NATS). The exhaust camshaft turns at half crankshaft speed, so two crankshaft revolutions are

continued on page 3

Fine Tuning

Fine **Tuning** questions are answered by Mark Hicks, Technical Services Manager. Please send your questions to: **Mark Hicks c/o Wells Manufacturing, L.P., P.O. Box 70, Fond du Lac, WI 54936-0070** or e-mail him at **technical@wellsmfgcorp.com.** We'll send you a very nice Wells golf shirt if your question is published. So please include your shirt size with your question.

Q: I am working on a 1992 Pontiac with a 3.3L engine that has 120,000 miles on it. It will idle between 300 to 800 rpm for about 30 seconds, then stall. It had a DTC 26 (Transmission Quad Driver) stored in the ECM. I noticed on my scan tool that the transaxle position switch indicates that the transaxle is in Drive when the shifter is in the Park position. I installed a new neutral safety switch but nothing changed. What else could be causing this code and the engine idling problems?

Michael Johnson
Cars R Us
Fond du Lac, Wisconsin

A: The first step to diagnosing any code is to understand why the vehicle's computer or ECM has determined a problem exists. In the case of a code 26 setting, the ECM monitors the voltage potential of the supply as it grounds each circuit related to the 1 and 2 quad driver modules or QDM. This monitoring is accomplished by reading a voltage drop right before the switching part of the circuit. When the circuit is "on," the voltage drop will be low, because the current has an easier path through the circuit to ground. When the circuit is "off," the voltage drop is high, because the current can't pass through the circuit. If the ECM reads a high drop when it should be low or low when it should be high, the Check Engine light is illuminated and a code 26 is set.

Check the transmission electrical connections; in many cases this is unplugged or the wires have been cut due to transmission and torque converter problems. This vehicle also is equipped with a transaxle position switch inside the console. Check the power inputs to the ECM and from the transaxle position switch. Typically this is not an ECM problem. Remember, "on" equals a low voltage and "off" equals a high voltage.

Results: Mike found a low voltage input from the transaxle position switch because it was shorted due to debris and spilled soda drinks after years of use.

Q: I am working on a 2004 Nissan Altima with a 3.5L engine. A few weeks ago I replaced a headlight and flushed the cooling system. I also pushed open the throttle plate with my fingers and cleaned the plate and bore. The plate was very carboned up. This vehicle has an electronic throttle-by-wire system. Now the engine runs at 1050 RPM at idle and is setting a code P0507. After cleaning the plate and ports, I believe it is in a new position and allowing more air to flow through, causing the high idle. I am sure a relearn procedure is needed to correct the problem. Nissan told me I have to use the factory scan tool to perform the relearn process. Is there anything else I can try?

Tom Fritz
Garden City, Idaho

A: What you are experiencing is a common problem with this vehicle. If the engine speed is more than 200 rpm over the target value, code P0507 will set. The following procedure will work on most vehicles, but if it doesn't you will need the factory scan tool to complete the relearn procedure.

- Start out by driving the vehicle on the highway for at least 15 minutes. The engine and transmission must be at operating temperature.
- Make sure the charging system is functioning properly, the transmission is in Park or Neutral and the position switch on your scan tool should indicate ON. All electrical loads must be off and the steering wheel should be straight.
- Next, turn the key ON for two to three seconds, then OFF for ten seconds. Repeat this sequence three times in succession.
- Then turn the key ON, wait exactly three seconds and press the accelerator to the floor and release it five times within five seconds.
- Wait exactly seven seconds, then press the accelerator to the floor and hold it there. After about 10 seconds the MIL will begin to blink.
- If the light does not blink after about 20 seconds, restart the procedure. Repeat as often as necessary.
- The MIL will blink for about 10 seconds and then come ON steady. When it does, release the accelerator within three seconds and start the engine.

If the relearn was successful you will see a dramatic drop in RPM. In cases where the starting RPM is extremely high, it may be necessary to temporarily disconnect two injectors to bring it down.

Results: Tom followed the procedure and the engine is now idling around 750 RPM. Thank you to Identifix for help with this procedure.

In the last *CounterPoint*, John Huber and Phillip Flusche wrote about a problem on a 2002 Volkswagen Beetle with a 1.9L turbodiesel engine. It had a surging problem while driving and the idle speed was higher than normal. The engine RPM would surge up and down from the desired speed by 200 RPM or more. The customer was unable to drive the car as a result. John and Phillip have tested the mass airflow sensor, the fuel filter, fuel pressure, fuel integrity and timing belt, but the driveability symptoms remain.

A: A common driveability issue with this type of engine is a carbon or "coking" buildup in the air intake. The symptoms of this problem usually are a loss of power or a no-start. Either way, it's worth taking a quick look.

Results: After removing the air inlet tube to the intake manifold the cause was obvious. It was more than halfway closed with carbon and the manifold changeover (shutdown) valve was stuck half open. It is normal to have some carbon buildup in this area, but the factory spec states no more than 10mm of carbon accumulation. The purpose of the shutdown valve is to close when the engine is turned off to prevent "dieseling." If the valve sticks closed, it will cause a no-start situation and when the carbon becomes thicker than specs a loss of power will occur.

Tip: Don't try to clean the intake with any liquid spray with the manifold installed. Due to the diesel's high compression ratio, even a small amount of liquid on top of a piston could cause a hydraulic lock condition.

Diagnose The Problem Win A Shirt

I am working on a 1997 Ford Taurus LX with a 3.0L engine. The power steering works okay until the transmission is shifted into Reverse or Drive. Then it becomes very difficult to turn the steering wheel. Occasionally the radio and power windows will also stop working. I have no idea what to check; can you help?

Wayne Brown
Auto Tech Shop
Sylvan, Alabama

If you have the answer, contact us at:
E-mail: technical@wellsmfgcorp.com
Fax: (920) 922-3585
Postal: *CounterPoint* Editor
c/o Wells Manufacturing, L.P.
P.O. Box 70
Fond du Lac, WI 54936-0070

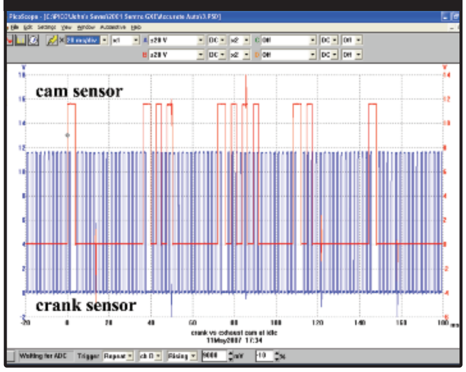
For certified (no fee) diagnostic assistance, call 1-800-558-9770 from 7:00 AM to 7:00 PM CST. WELLS

continued from page 1

Nissan Variable Valve Timing

required to produce four groups of pulses in the firing order sequence. On the scope, look for a single pulse, followed by three pulses, followed by four pulses, then two pulses before the sequence repeats. The numbering and sequencing of the pulses in this series is the same as the engine's firing order (1, 3, 4, 2). Refer to Figure 1 for an example of known-good POS and PHASE sensor waveforms.

Figure 1: *This screen capture illustrates known-good POS and PHASE sensor waveforms.*



The POS and PHASE sensor waveforms have been enlarged in Figure 2. We've overlayed the waveforms and further enlarged them for a better illustration of the relationship between the two in Figure 3.

Figure 2: *A view of the POS and PHASE waveforms, illustrating the distinctive pattern of each.*

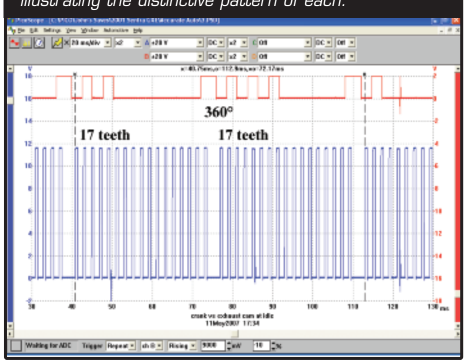
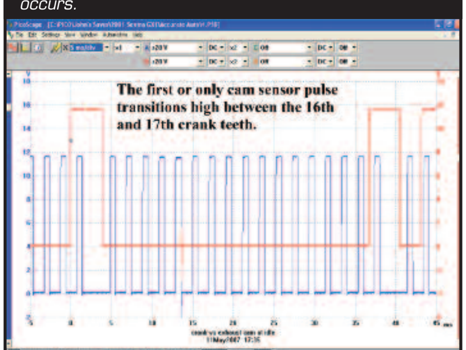


Figure 3: *The two waveforms have been enlarged and overlayed to illustrate when the cam sensor pulse occurs.*

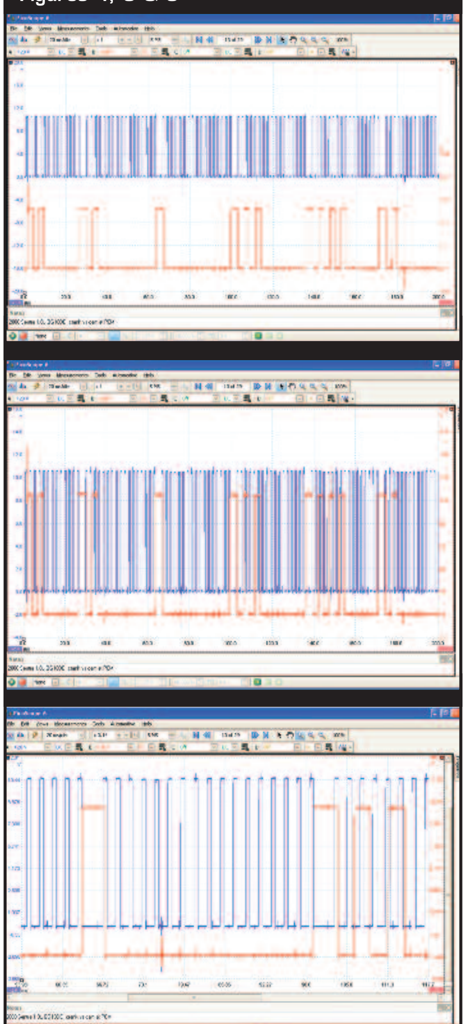


What did we learn? Each series of pulses in the PHASE sensor waveform begins between the 16th and 17th crank teeth pulses in the POS waveform. The first or only PHASE sensor pulse transitions low five crank degrees before the first POS sensor signal pulse. This is a normal relationship between the two sensor signals, and will be an important piece of information in our upcoming diagnosis. These waveforms were collected on a 2001 Nissan Sentra GXE 1.8L with 35,000 miles.

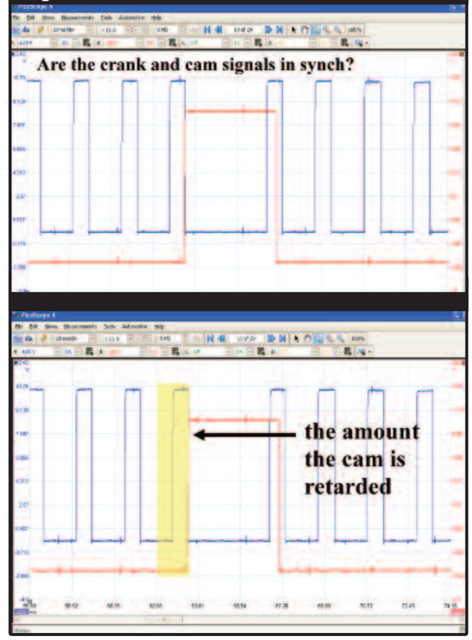
Our second case study involves a 2000 Nissan Sentra GXE, also equipped with a 1.8L QG18DE engine, but with 98,000 miles on the odometer. The customer's complaint is that the MIL is illuminated. We've checked for diagnostic trouble codes and DTC P0335 (crank sensor) was pulled. The crank (POS) and cam (PHASE) signals will be checked to see if a clue can be found regarding the P0335. The PCM has been removed from its case for easy signal access.

Refer to the series of waveforms in Figure 4 through 8. Are the crank and cam signals in sync? It looks like the cam timing is off. The crank-to-cam relationship is incorrect.

Figures 4, 5 & 6



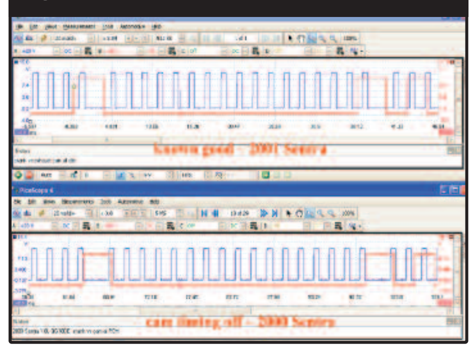
Figures 7 & 8



We've gradually zoomed in on the sensor waveforms in this series of screen captures, to illustrate the relationship between the two. In the last two screen captures, it's very apparent that the cam sensor's waveform is retarded.

Figure 9 shows the retarded cam timing when compared to a known-good vehicle. Further diagnosis will be required to determine the cause of the problem. Is the timing chain stretched? Has the chain jumped a tooth? At 98,000 miles, either of these defects is a distinct possibility.

Figure 9



We'll be back next time for a further look at Nissan's Variable Cam Timing. WELLS

This is the first of a two-part series of case studies provided by John Thornton. John is a respected driveability instructor who also operates an independent repair shop and is a regular contributor to several automotive trade magazines. Counter-Point looks forward to continued contributions from John, as well as other driveability instructors. Thanks, John for these great case studies.

WELLS

WELLS MANUFACTURING, L.P.
P.O. Box 70
Fond du Lac, WI 54936-0070

Hot off the Wire

Firing Order Info

When was the last time you needed the firing order for an OBD II vehicle? Maybe it was when you replaced an ignition coil or verified a timing chain installation. Whatever the reason, it can be a challenge to find the information you need.

This is why Wells has added firing order information to our website for nearly every vehicle from 1990 to 2007. That's not all we have done to our site lately. A total of 14 instructional and manufacturing process videos are also available. We've also added more instruction sheets, acronym definitions, coil testing specs, crank/cam sensor specs and pin-out diagrams, to name a few.

Our popular OBD II trouble code lookup feature now includes more codes, each with up to five of the most common code setting causes. OE manufacturers added more than 1700 new codes to the line-up during the 2008 model year. In response, we'll be adding even more trouble codes, descriptions and causes in the future.

Our site will receive a makeover, including user-friendly buttons which provide direct access to your favorite areas and a better search engine. We'll also be adding lots of great information, but we're not going to spill all the beans right now. Thank you for your continued patronage. WELLS

Publisher's Information

Wells President ....David Peace
V.P. Sales & Marketing.......Bill Nonnamaker
Technical Services Manager .... Mark Hicks
Newsletter Editor ....Karl Seyfert

CounterPoint is a quarterly publication of Wells Manufacturing, L.P., P.O. Box 70, Fond du Lac, WI 54936-0070. Letters and comments should be directed to: ***CounterPoint*** Editor, c/o Wells Manufacturing, L.P., P.O. Box 70, Fond du Lac, WI 54936-0070.

SUBSCRIPTION FORM: To receive a quarterly issue of CounterPoint, or to renew your existing subscription, please fill out the form below and mail or fax it to:

CounterPoint
c/o Wells Manufacturing, L.P.
P.O. Box 70, Fond du Lac, WI 54936-0070
FAX: (920) 922-3585
technical@wellsmfgcorp.com

You can also sign up for a CounterPoint digital subscription (PDF) by visiting our website at **www.wellsVE.com**.

☐ English ☐ Spanish ☐ Both (Check One)

NAME/TITLE

COMPANY

STREET ADDRESS

CITY, STATE, ZIP CODE

PHONE NUMBER