# derFiX®

November 2019

Technical Knowledge for Volkswagen®, Audi® and Porsche® Service Professionals


2005 Jetta 2.5L PCV/Vacuum Leak

2009 Tiguan 2.0L Fuel Pressure Error

2008 Audi A6 3.2L No Crank/No Start

Audi Diagnosis Bad Timing

Getting to Know Mr. Mezger, Part 2

VW and Audi Ignition Coils

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## In this issue

# This Audi Diagnosis Was Bad Timing for All

By: Gary Smith

From time to time, you may get that certain vehicle in your bay that has many small issues that need attention, but there's usually only one big driveability problem that prompted the customer to visit your shop. Often these vehicles are doing things that seemingly defy logic, and sometimes seem to defy physics as well.

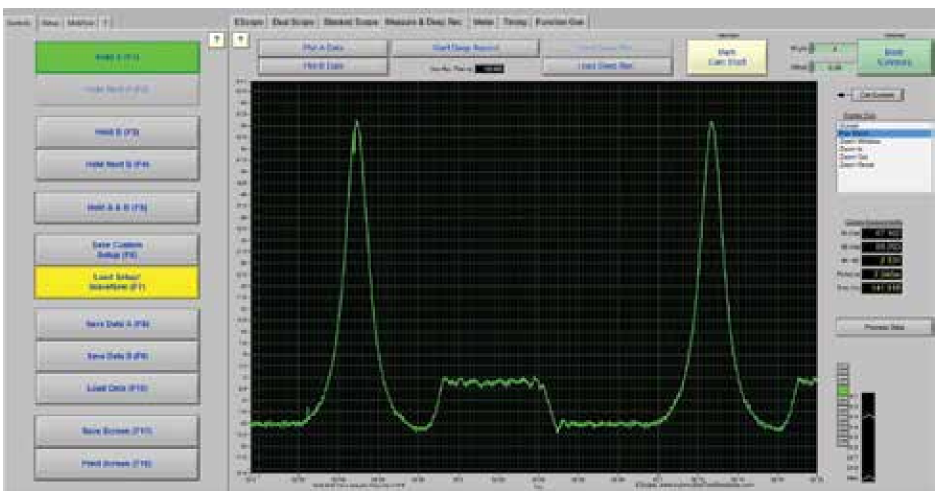
These are the vehicles that can make technicians lose sleep some nights.

Today, with the sheer onslaught of high technology in engine controls, management systems, software coding, rationality codes, plausibility algorithms, ADAS systems, and CAN packets that can't be easily decoded for quick diagnostics, automotive technicians are having to take in a ton of technical service information. It's so intense it has literally become like trying to drink water from a fire hose year over year.

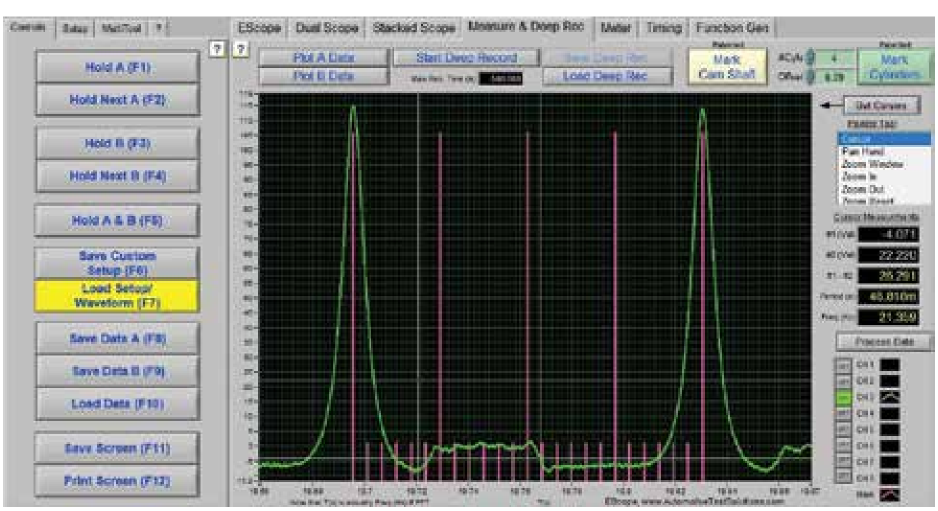
These vehicles are showing up in our bays with more and more complex issues every day. From ADAS systems, to GDI, CAN network issues to mechanical engine problems, as techs, we've got it all coming at us these days.

As such, in order to remain relevant now and into the near future and grow diagnostic skills as technicians, you must engage in constant study and experimentation and seriously accelerate your in-depth study of basic electrical principles and electrical system diagnosis. Scan tools and DTC charts can no longer be your only diagnostic option.

The failure to do so will likely render many of us irrelevant, seeking retirement or possibly even unemployed as techs in future years. How do we solve this dilemma and stay sharp on diagnostics?



*Here is an overview of the waveform and how to use it for checking cam timing, for example.*




## ENTER THE CONCEPT OF PHYSICAL TESTING

Using a lab scope, some out of the box diagnostic strategy, and leaning on basic electrical testing principles combined with some high-tech strategy, we can be far more accurate and productive in our diagnoses, especially on these tougher driveability issues in gasoline direct injected vehicles, which often present with no codes.

Combine lab scope physical testing with pressure transducers that allow you to evaluate the internal engine quickly and accurately without engine disassembly and you have a game-changer for diagnosing modern day vehicle platforms.

Here are a set of tests that, once learned, can be applied to any 4-stroke vehicle and used in several creative ways to get diagnostic answers without much concern at all for the technical complexity of the platform you are working on.

This testing method can be taken from vehicle to vehicle and it can be the same test method on each car being serviced. This greatly simplifies the diagnostic path and nearly ignores the complexity of the car.

Another huge benefit is that using this testing methodology, you can greatly reduce your computer research and schematic lookup time, and in fact, almost eliminate it in some cases.

This testing methodology does NOT seek to circumvent prudent research for DTC flow charts and TSBs in the diagnostic process, however. You still have reading, research and due diligence that go with any proper diagnostic procedure, but this research time can be greatly diminished in most cases.

Yet these techniques are often not being leveraged by OEMs, dealers or independent repair shops.

Why? Because the word is just getting out on the street, and mostly in the independent repair market. There are an increasing number of shop owners and techs now paying serious attention to this new diagnostic approach, and for very good reason.

With this waveform, you can determine running engine compression, camshaft timing and phaser operation, piston movement, piston ring health, valve leakage (huge in catching GDI engine misfires), vacuum, exhaust back pressure and much, much more.

## ALL ON ONE SCREEN, USING THE SAME SIMPLE TEST FOR EVERY CAR

Add to this a signal overlay strategy, and you now have a visual confirmation that the PCMs, electronic sensors and signals are in perfect time (or not) with the actual movement of the inside of the mechanical engine. In the past, this has been technicians' "great unknown."

And you can do these tests, even on the most complex engines, usually in ten minutes or less, without taking any of the engine apart.

For the first time, you now have a way to verify, quickly, whether or not the electrical and mechanical systems are working properly in sync.

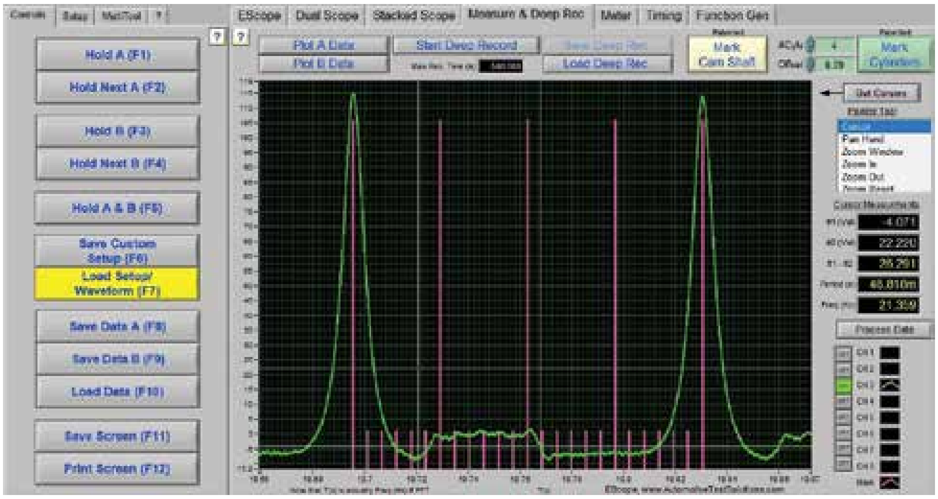
Once you learn how to leverage this waveform imagery and strategy in your diagnostics, rarely will you see a tech return to the "traditional" diagnostic methodology. Why, you ask? Because you can find and fix driveability issues using this method so quickly and accurately, you just never want to go back to the old ways.

Today, technicians need to be able to blend diagnostics into several broad subject areas, for example:

1. You need to be able to diagnose mechanical internal engine issues, transmission and powertrain issues.
2. You need to be fairly advanced today in your knowledge of electricity and electrical transport systems.
3. You need to understand telematics and ADAS systems that interface computers and programming to the actual mechanical operation of the vehicle and,
4. You need to be part psychic and soothsayer.

The reason we need to be all of this? All of these systems now fully interface and interact together in today's platforms. This new testing method accommodates all of that.

So how do you productively and, more importantly, accurately diagnose these multiple integrated platforms without expensive diagnostic mistakes?




*Bank 1 was measured for cam timing. The waveform proves a normal cam timing profile with the exhaust plateau appearing between the second and third large purple marks. Both intake and exhaust camshafts are within specification for proper cam timing.*

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You can apply these new testing strategies to your existing mix, and really improve your accuracy, and time to fix.

But what is meant by the term "physical testing?" Physical testing involves testing the electrical system's transport systems (wiring) between points to pinpoint the cause of a problem. It also involves mechanical testing of systems. These two areas are inextricably intertwined in modern diagnostics.

OK, so what can physical testing and a basic electrical testing focus do in such a high tech business, you ask? Everything. Literally, everything.

When you put your hands on the vehicle and perform lab scope tests, you can hook up multiple affected circuits, watch the behavior of electricity (this is the key) in the circuit and catch errant and intermittent electrical behavior.

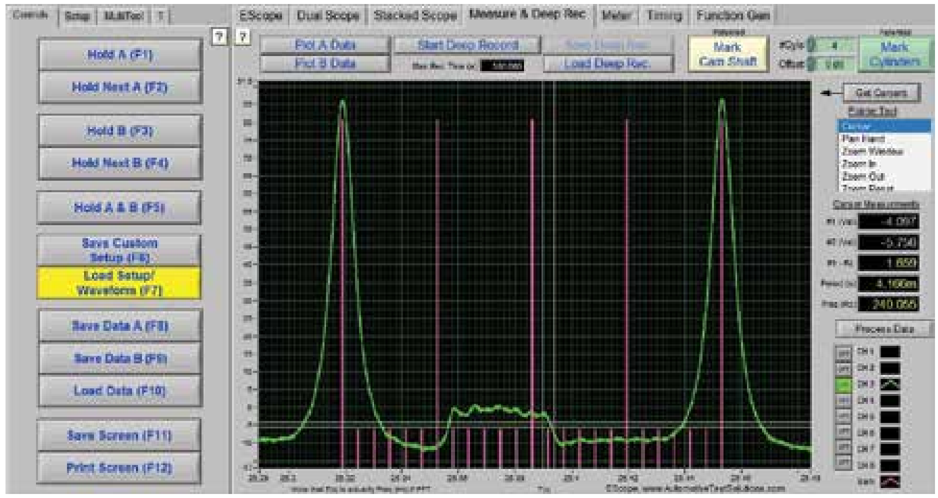
You can track down the problem quickly and accurately using this method, and once you learn what you are doing with these tools and methods, you can substantially cut down your research, schematic lookup and computer time and improve flat rate efficiency as well.

The best part? Good, accurate diagnostic calls, consistently. Consider this case study as an example:

A 2009 Audi A6 came into a shop with a distraught (and almost broke) customer. The car had an ugly history of diagnostic and repair work that had been done, but that had not yet resolved the customer's concern, and he was in deep (financially and frustration-wise) with this car.

Originally, the vehicle presented with multiple misfire DTCs, a MAF Plausibility code, a series of cam/crank correlation codes, and an Exhaust Camshaft Retard Set Point Not Reached code.

All of the possible external parts had been "tried" on this vehicle, and the result of several service visits and parts




*This image shows that the exhaust camshaft is off by approximately 60 degrees from its normal operating position, and the intake cam is off 30 degrees on Bank 2.*

replacements was that, while the misfire codes were "almost gone," the vehicle still had a power loss issue, and the car was still setting the Exhaust Camshaft Set Point Not Reached code.

It seemed that the variable valve timing camshaft phasers that were installed by the dealer had solved the other two timing-related DTCs. But the new MAF sensor did not cure the plausibility code. Hmmm.

The diagnostic approach was to drill into the history and look closely at the history of the case. The problem was apparently still in the mechanical timing due to the idle shake, loss of power, and Exhaust Cam Retard Set Point code that still existed.

Further diagnosis involved the installation of a pressure transducer, connecting the vehicle to a lab scope and studying a running compression test on Bank 1 of the engine. Measuring the camshaft timing showed that, though it was very close to spec, the intake camshaft was out slightly by a few degrees.

## TIME TO MEASURE BANK 2

The second image shows that the camshaft timing is WAY out. The intake cam is out by 30 degrees,


HOW DO YOU SEMA?
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and the exhaust cam timing measures out by 60 degrees. This explains the Exhaust Cam Retard Set Point Not Reached code, the loss of power, and the MAF plausibility code.

Because the timing chains on this engine are between the engine and transmission, it is essential to be accurate with the diagnosis because the customer had spent so much money already, and it was apparent that the engine needed to come out for repairs.

The scan tool, believe it or not, is just one tool used in this process. A scan tool generally would be used to provide data, codes, and clues as to where to look for the problem, or as a tool for actuation, measurement and maybe programming software too. This works well on average if the computer is telling us the truth. Yet we've been leaning on this as the primary diagnostic method for decades.

As an industry, we are beginning to see an evolution in diagnostics. With the costs of parts, modules, and labor going ever higher for the driver-consumer, this diagnostic gap is a serious issue for the sake of our customers' wallets, and our local reputations as quality repair shops.

Because most of us were trained in one way or another to track down a driveability or diagnostic problem using a scan tool, DVOM and a DTC chart, many technicians learned diagnosis via the "trial by fire" method ("Here kid, take this scanner, plug it in here, and do this procedure…").

"Old Uncle Joe" in the bay next to us also told us "how things were done" and showed us how he solved the problems of his day. Between that advice, and our own diagnostic growth path, most of us have kind of stumbled through learning diagnostics, learning more and getting smarter at diagnostics as we go along in our careers.

The concern beginning to show up in shops today, though, is that many of us, by virtue of how we learned our way into diagnostics, also bypassed basic electrical training, the kind that teaches us how electrons flow, the kind that teaches both AC and DC electrical principles and diagnosis.

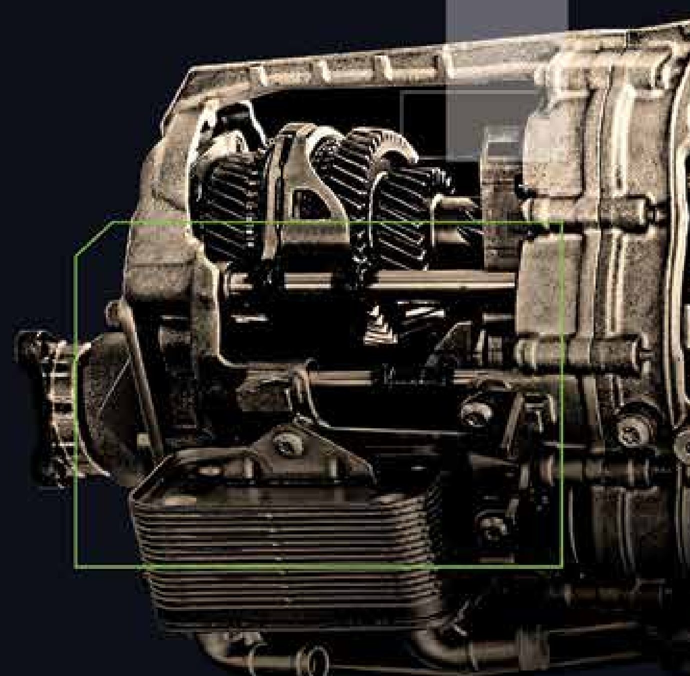
This (unknowingly) could be our industry's biggest weakness, servicing modern-day vehicles using 1980s diagnostic strategy and methods.

The moral of the story?

Don't be afraid to look at and try out new diagnostic ideas and, for goodness' sake, be enthusiastically willing to look at some of these emerging diagnostic technologies.

In the next article of this series, we will build on this technology and show how to utilize this waveform with a signal overlay strategy to complete the electrical/mechanical diagnostic relationship. ■





# 2.0L VW TFSI Automatic Transmission 4Motion

## The Magic Wand Continues (Part 2)

*By: Augie Ferron*


If there are any Star Trek fans out there, this article should be interesting.

The article is in addition to the earlier "magic wand" version that was experimented with, in the November 2018 article, Out-of-the-Box EVAP with a "Magic Wand." The beginning of the experiment was with a professional COP paddle. Multiple models, testing the different types of ignition coils and capturing the images, produced interesting results. That article tested a COP coil and EVAP solenoid with a wheel speed sensor.

Professional COP paddles are what's recommended but "we learn from experimentation and observations."

Part of the experiment was with a damaged wheel speed sensor harness from a Mercedes-Benz S550 4Matic and another one from a Kia Sorento. Each had different internal resistance readings. The Mercedes-Benz was about 1K ohms. The Sorento was about 445K ohms.

The first article used the Mercedes-Benz version and this article will use the Kia version with a professional paddle. Each version has slight variances when recording ignition coil signatures.

### YOU CAN SEE THE HUMOR RIGHT?

Yes, this is only an experiment but why not test a VW ignition coil with a Mercedes-Benz or Kia wheel speed sensor?

How about testing an ignition coil with a Tricorder, a Star Trek Tricorder on an Android tablet?

Why? Because the application was found and curiosity abounds as to how a "magnetic field" behaves and what its signature looks like with a magnetometer. Modern phones and tablets have a magnetometer built-in.

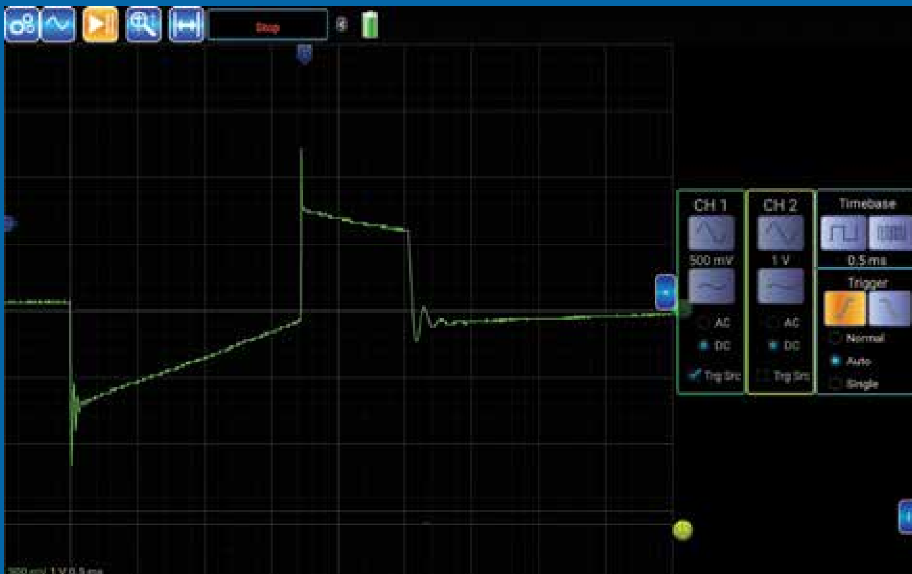
The Mercedes-Benz version looks like this version before it was "carved" and the Kia was different because of the "right angle." Before any "manipulation" of the original structure, they were tested with the oscilloscope.

### THE EASY BUTTON

There were two curiosities:

1. Can the speed sensor have another purpose;
2. Wondered what the signature looked like when testing an ignition coil(s).

As you may know, *derFix* went "all digital" this year, posting original content regularly to derFixTech.com. Here was one of our most popular articles we thought you shouldn't miss.




*Pro sensor*


*Speed sensor*

This quick test offers a view with the Kia speed sensor and tablet.

The screen capture is with a professional sensor. Notice the difference while testing the 2.0L Tiguan COP at idle.

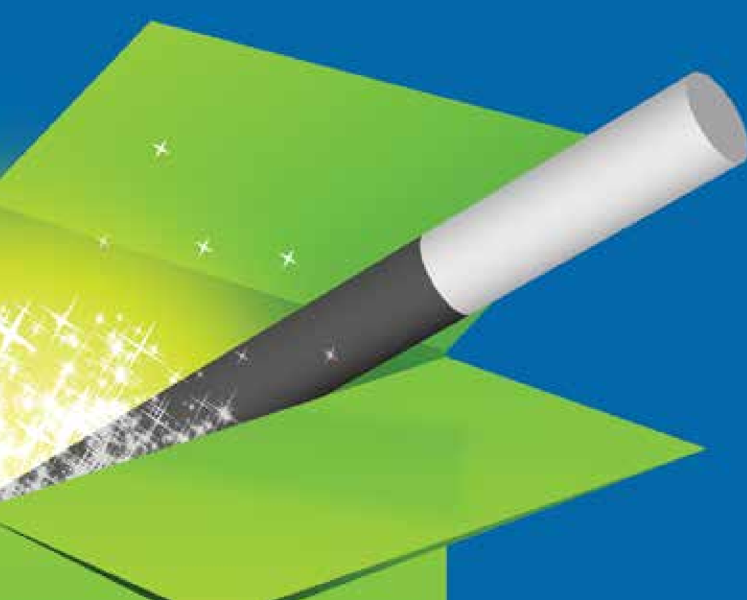
This test indicates a proper waveform signature of a COP ignition coil at idle. There are many versions of COP capacitance ignition coil testing equipment on the market and this version might work quite well on a "little scope." This same tool works identically on a 4 channel and an 8 channel oscilloscope.

The Pro sensor (left-top) version has 1000:1 attenuation.

The "Speed sensor" (left-bottom) is with a speed sensor that was captured and saved for a test.

**NOTE:** Use an attenuator with any hand made tool.

The difference is with the details of the image, but the idea works with a component destined for the garbage or landfill site. If there is no access to a Pro version, beg, borrow, or steal a speed sensor and try it. This image is not perfect by any...



# VW and Audi Ignition Coils
## The Magic Wand Continues (Part 3)

By: Augie Ferron

The reference for this article is a known good coil, with the engine at idle with no recorded faults. The result being: the ECM is in control of the magnetic collapse with sufficient current to drive the transformer.

When the VW/Audi models are being tested, the harness itself can be assembled in such a manner that it is difficult to back probe, to move and open. There are no winners in that operation so a "piggy back" set of harnesses was created as a "tool" to quickly test this four cylinder engine.

The earlier article describes the input signal from the ECM and a measurement of the coil ramp. This is one set of harnesses we made so as to not damage the original harness and gather the signals of interest.

### ANOTHER TOOL IN THE TOOL BOX

One choice of quality breakout harness is the BREMI brand 20113/40 and required a set of 4. With this setup, there is no damage or manipulation of the original harness and it represents a far better investment of shop/customer and learning time. The BREMI set is a harness repair solution but added perfectly fitting male blades to the original harness connections. This test is on a 2.0L Audi.

Another set of four can be attached to a V-8.

With the "piggy back" harness, the signals can be back probed and you can easily attach a current clamp for precision measurements.

### WHAT ABOUT THE PADDLE?

This is one choice and simple to use with any scope. The addition is the clip for systems that use secondary high tension wires. Note however that this is only a pickup and will offer enough detail as to how the COP is operating with ECM control. The choice in this instance was from AESWave and we acquired the BNC version for the scopes in use.

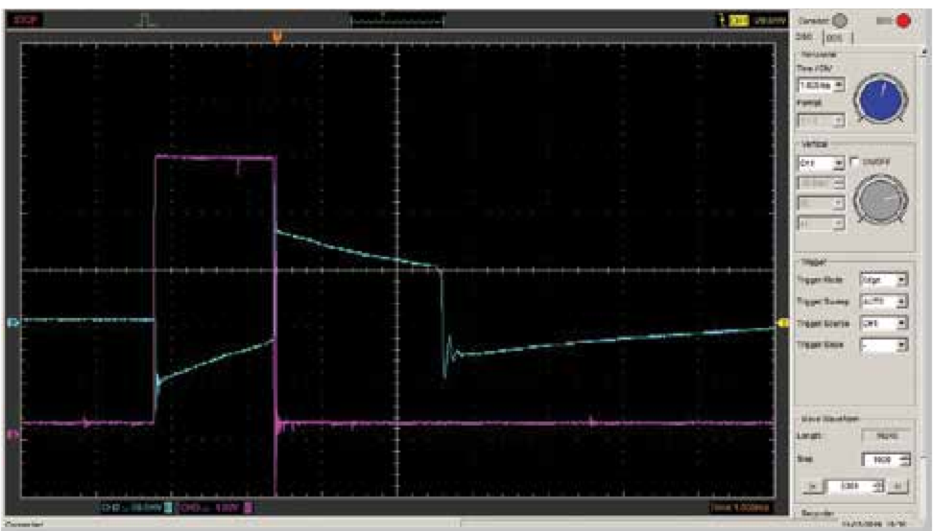
| PARTS REQUIRED |
| --- |
| Red female blade connector |
| Perfect fitting male connector removed from a damaged and stripped down GM under hood fuse box. (Never throw those out). |
| Wire, solder and shrink tubing |

*Homemade field harness*

| TOOLS AND TEST EQUIPMENT REQUIRED |
| --- |
| Ross-Tech VCDS and 90 amp power supply |
| 4 channel oscilloscope |
| Professional ignition paddle |
| BREMI harness repair or purpose built harness |
| Magic wand |
| Tablet with a Tricorder, camera and notes |

Test harness

Connected harness



ECM input and COP

Paddle 1000:1

*(Image Courtesy AESWave)*

## BACK TO THE HARNESS "PIGGY BACK" EXTENSION AND IT'S NEEDED NOW!

This should also mean that the COP coil can be removed/rotated and include a secondary wire from the COP to the spark plug. With the clip attachment, would the image look different? Can lean or rich conditions be measured? Is there more detail? What is the difference between the paddle on the COP and clip measurement at the secondary wire? (Clip it close to the spark plug.)

The preferred method is a professional paddle that should guide the learning technician as to how a COP works and is the simplest method by far. Details on the secondary side however, will offer far more valuable information.

The magic wand works but include attenuation 20:1 at the scope side, just to be sure.

Violet is the ECM input to the coil to trigger a firing event.

Blue is the COP pickup – From the previous article, the ECM input can be measured as the "coil saturation" in ms.

Yellow is the secondary output with a clip.

This is the reason for the breakout harness for the trigger event and with an amp clamp, measure the ramp.

What will the secondary look like with the clip on the secondary wire?

What is the relationship between the ECM input and the secondary output?

What is the relationship between the secondary output and a paddle?

So what is the difference between the paddle and a clip on the secondary wire between the coil and spark plug?

Is there a relationship between the secondary output and the COP with a paddle or magic wand? They both tell the truth, but this is deeper.

Ever wonder what a misfire or oiled intake valve looks like on a direct injected engine? It may be a good idea to measure before and after a cleaning.

As you've seen in previous installments of our "magic wand" series, we try to offer creative approaches to automotive diagnostics. You'll recall that, in previous experiments, wheel speed sensors were used as "magnetic wave sensors" to measure simple ON/OFF solenoids and analyze the COP ignition coil(s). The experiments were tested along side known automotive test tools with an oscilloscope.

With a wheel speed sensor, the reluctor spins at right a right angle to the mounted wheel speed sensor. The edges of the reluctor wheel (in part) create a magnetic waveform that the sensor absorbs over time. The faster the reluctor spins, the greater the attenuation and frequency of each rise and drop of the reluctor teeth across the sensor. Methods of measurement can be RPM via an ABS control unit or oscilloscope signal.

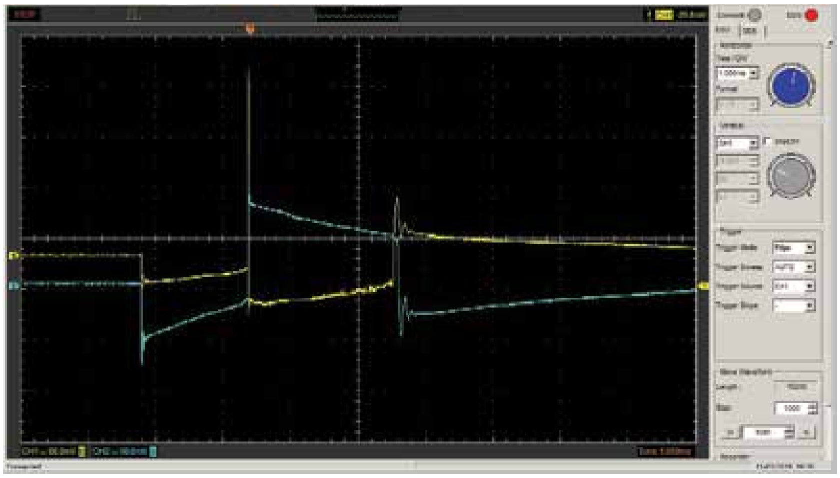
The experiments with the sensors were captured in parallel with an automotive device. I was surprised at how close the various waveforms resembled each other within the test. During the experiments, there was a conscious attempt to apply the cost of each device.

There will be a few more experiments with different sensors that were "scavenged" to measure their properties as opposed to an automotive device. These experiments measure and graph the physical force of a magnetic wave at a solenoid or ignition system.

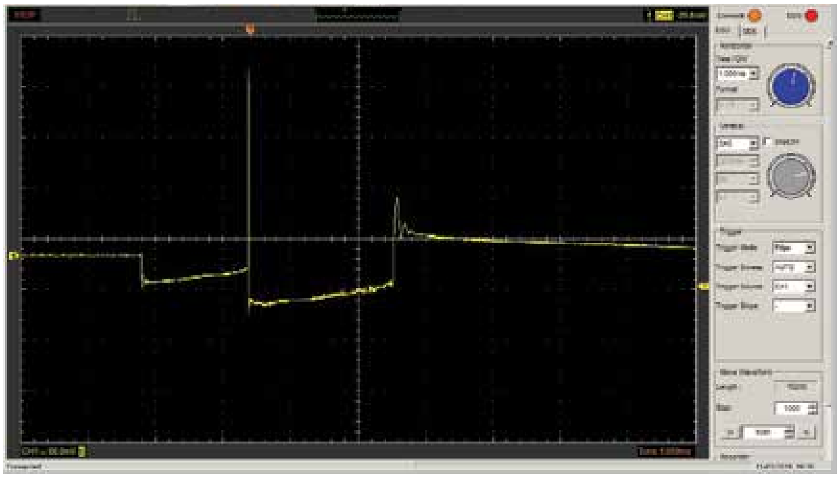
What about physical forces such as positive or negative pressures? Will these speed sensors offer any type of data that will correlated with the above noted pressures? I think not, but what about using an electrical device to measure a physical pressure in its simplest form? Can a device be re-purposed or created to measure pressures that are very low compared to the very high pressures of a direct injected engine?

The magic wand articles don't have a specific conclusion except for experimentation with devices and sensors that are re-purposed, or created, for use with a multimeter or oscilloscope. This includes simulation of inputs or outputs of a control unit.

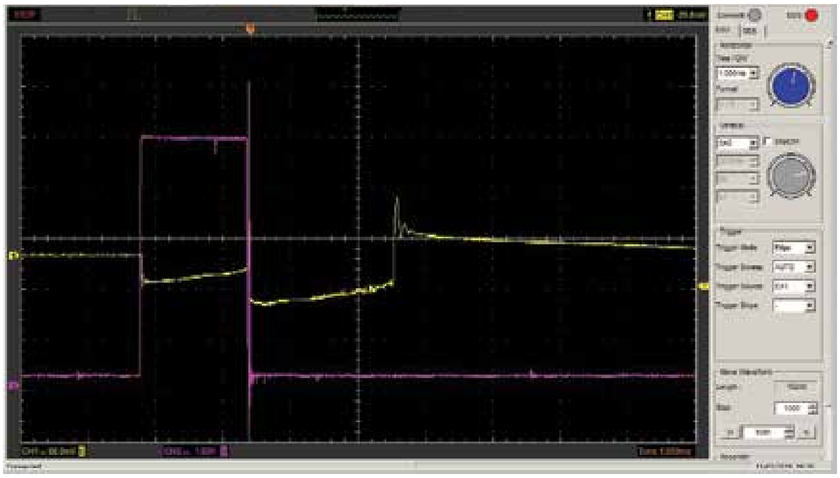
Thoughts and experiments are where an inquisitive mind can test theories and later apply what was learned towards a practical use. ■



*Secondary output and COP*



*Secondary output*

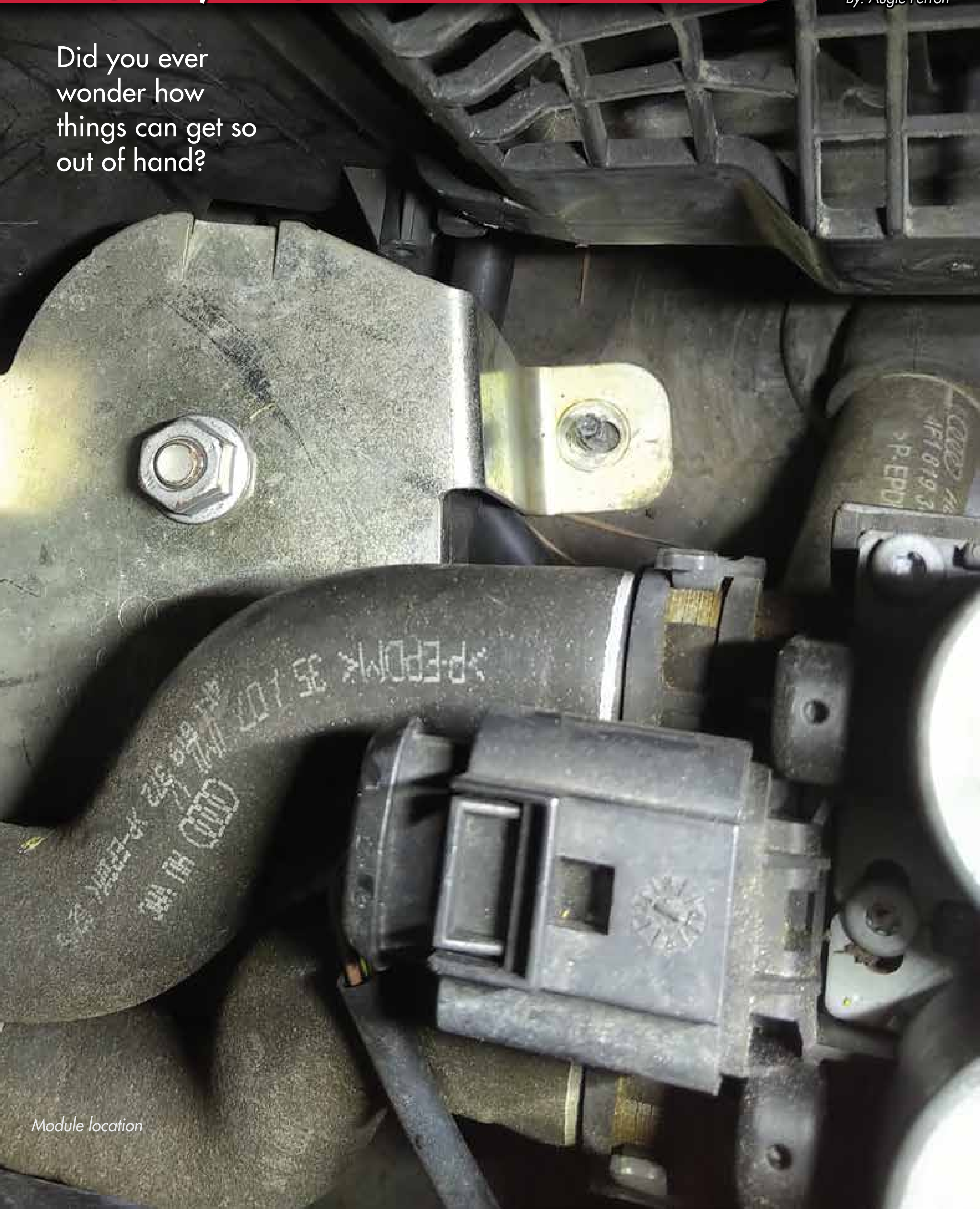


*ECM input and secondary output*

# Tips and Tricks with a 2008 Audi A6 3.2L No Crank/No Start

By: Augie Ferron

Did you ever wonder how things can get so out of hand?



*Module location*

## HINT 1

Never assume and keep it simple.

## HISTORY

An acquaintance asked for some technical help with this model Audi that experienced a no crank/no start. The comedy was sending a camera image of the Autologic screen with the ECM fault via email.

## REALITY

The correct method is to send/save the entire autoscan with the PR tag found in the trunk or within the owner's maintenance manual.

The autoscan was accessed and saved when arriving at the facility. It was quite interesting and lengthy as well.

| TOOLS USED |
|---|
| 90 amp clean and stable power supply |
| Ross-Tech VCDS |
| Multi-meter, jumper leads and schematics |
| Camera, pen, markers and note paper |


*PR Tag*

1. *4F2 5NH is the sales code for this model. If erWin is used, the value narrows the exact vehicle for schematics and service/repair information.*
2. *BKH is the engine code.*
3. *KSW is the transmission code.*
4. *The three digit codes are the options installed in this model.*

| ECM |
|---|
| 012371 - Starter Control; Returned Message |
| P3053 - 006 - 50 Short to Ground |
| 012424 - Starter Relay |
| P3088 - 006 - Electrical Malfunction |
| 012403 - Fuel Pump Circuit |
| P3073 - 007 - Electrical Malfunction |

| ABS |
|---|
| 01826 - Sensor for Steering Angle (G85); Supply Voltage Terminal 30 |
| 00532 - Supply Voltage B+ |
| 002 - Lower Limit Exceeded – Intermittent |
| **ACC/START AUTH.** |
| 00532 - Supply Voltage B+ |
| 002 - Lower Limit Exceeded – Intermittent |
| 00446 - Function Limitation due to Under-Voltage |
| 002 - Lower Limit Exceeded – Intermittent |

| CONTROL HEAD |
|---|
| 01964 - Control Module for Seat & Steering Column Memory (J136) |
| 004 - No Signal/Communication – Intermittent |

| CENT. ELECT. |
|---|
| 02382 - Sensor for Light Detection (G399) |
| 014 - Defective – Intermittent |
| 00924 - Relay for Headlamp Cleaning System (J39) |
| 014 - Defective – Intermittent |

| AIRBAG |
|---|
| 00532 - Supply Voltage B+ |
| 002 - Lower Limit Exceeded - Intermittent |
| 02095 - Component Protection Active |
| 000 – Intermittent |

| STEERING WHEEL |
|---|
| 00446 - Function Limitation due to Under-Voltage |
| 002 - Lower Limit Exceeded – Intermittent |
| 00532 - Supply Voltage B+ |
| 002 - Lower Limit Exceeded – Intermittent |

| NAVIGATION |
|---|
| 00446 - Function Limitation due to Under-Voltage |
| 002 - Lower Limit Exceeded – Intermittent |

| CENTRAL CONV. |
|---|
| 01134 - Alarm Horn (H12) |
| 012 - Electrical Fault in Circuit |
| **CENTR. ELECTR. II** |
| 00532 - Supply Voltage B+ |
| 002 - Lower Limit Exceeded – Intermittent |
| 00446 - Function Limitation due to Under-Voltage |
| 002 - Lower Limit Exceeded – Intermittent |

| HEADLIGHT RANGE |
|---|
| 00446 - Function Limitation due to Under-Voltage |
| 002 - Lower Limit Exceeded – Intermittent |

| BATTERY REGUL. |
|---|
| 02277 - Quiescent Current Stage 6 |
| 02272 - Quiescent Current Stage 1 |
| 02273 - Quiescent Current Stage 2 |
| 02276 - Quiescent Current Stage 5 |
| 02274 - Quiescent Current Stage 3 |

| TIRE PRESSURE |
|---|
| 00532 - Supply Voltage B+ |
| 002 - Lower Limit Exceeded - Intermittent - MIL ON |
| 01521 - Sensor for Tire Pressure |
| 004 - No Signal/Communication - MIL ON |

There are 30 main controllers (CAN) attached to this Audi with various sub-modules that are also attached to a LIN (Local Interconnect Network) and MOST. The remaining controllers not listed had no faults recorded.

## HINT 2

Autoscan the vehicle again after any repair or part replacement.

The shop that was attempting the repair took it upon themselves to replace the relays that may have been in question for "Start Authorization." Those relays were situated under the driver side dash and mounted at the firewall.

In this case, the relay assembly was easy to access, monitor and measure.

Noticed during the analysis and inspection of the A6 was the inner plenum area where leaves, twigs, seeds, and debris of all types accumulated and we wondered how long and how much moisture may have accumulated over time. That being said, how many rodents had a party in that area?

**Side note:** Cleaning the plenum and replacing/checking the dust and pollen filter should always be part of bi-yearly maintenance.

Imagine the removal of the wiper assembly and the effort to clean the area.

With the area cleaned and inspected, there were no signs of water or rodent intrusion. The best option is to ensure a clean and stable power supply at the battery (test it as well with a carbon pile). With a captured and saved primary autoscan, delete all the faults and save the latest recording with one or two key cycles. The majority of the B+ or Battery Supply faults did not return except for the repeated ECM, ABS, and Central Convenience faults.

## WHERE TO START

Why not eliminate the starter first? A high quality momentary push button attached to the solenoid proves the starter rotates. Additionally, remove the Starter Relay (Position 4) and apply B+ to Pin 8 (BLK/RED).

*Driver side electronics*

High quality schematics fitting the A6 can be found in erWin (only a personal choice) but many on-line subscriptions offer schematics that can be printed, cut, and taped together. Get your markers ready, attach the schematics to a board and note each step.

Quality relay breakout kits are available and do work well but, in this case, the entire relay station can be rotated (inverted/rotated) and back probed.

Back probing can also mean closing the relay with a ground connection or monitoring the B+ and controlled power supply. Monitoring can also mean the relay is being closed by the security system or control unit. Remember to use perfect fitting male PINs to simulate a relay leg.

There are three relays on this model that required testing (1, 4 and 6). Since the Audi woke up and was scanned, Power Supply Relay J329 now works.

## HINT 3

NEVER operate a power probe to activate or ground any computer controlled relay. Expect damaged internal components with the "but it ran before it came in the shop" expression.

For the sake of simplicity and if there's a desire to learn to read schematic diagrams, apply and prove this no start condition, then follow this style of thinking.

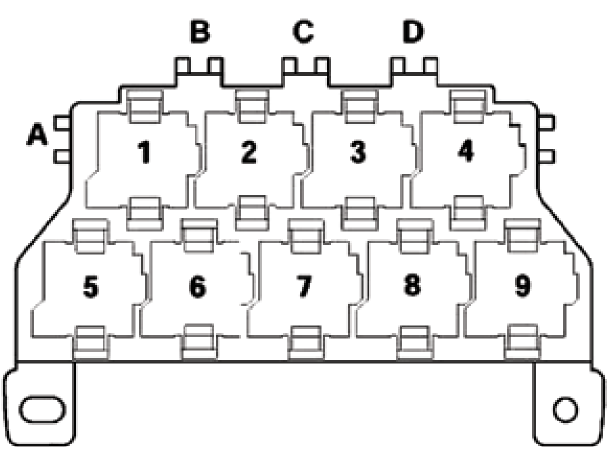
A) At the following link, the identical schematics have been provided.

**tinyurl.com/LINAlarm**

B) Download and print all schematics. Keep the sets separated. They are named in the subsequent order:

1. Access start 1, Access start 2
2. Alarm 1, Alarm 2
3. Engine 1, Engine 2, Engine 3, Engine 4
4. Starting

*Debris at brake booster*




*Relay panel positions 1 through 9 from 2007:*

1. *Power Supply Relay (Terminal 15) - J329*
2. *Headlamp Washer Relay - J39*
3. *Preheating Coolant, Low Heat OutputRelay - J359 "From June 2007"*
4. *Starter Relay - J53*
5. *Preheating Coolant, High Heat Output Relay - J360 "From June 2007"*
6. *Starter Relay 2 - J695*
7. *Dual Horn Relay - J4 OR Power Supply Relay (Terminal 75x) - J694*
8. *Special Purpose Vehicle*
9. *Not Occupied*

C) Trim the sets such as Access start 1 and Access start 2 so they fit together and attach the two schematics together with tape.

D) Beg borrow or steal some crayons or colored markers (red, blue & green).

E) Follow the instructions for Access start 1 and Access start 2.

1. **Access/Start Authorization** (Access 1 and 2)
2. **Power Supply Relay (Terminal 15)**
3. With red marker
4. Pin 2 (BLK) to Pin 18 Access/Start Control Module with (BLK) at Power Distribution System
5. **Starter Relay and Starter Relay 2**
6. With red marker
7. Power Distribution Pins 4, 8, 2 all (BLK)
8. With blue marker
9. Both relays, Pins 6 (BLK/BLU)

F) Follow the instructions for Alarm 1 and Alarm 2 (Alarm Horn).

1. With red marker
2. Pin 3 (RED/GRN changing to RED/GRAY) of alarm horn to Fuse 7 (5A)
3. With green marker
4. Pin 2 (BRN) to ground connection
5. With blue marker
6. Pin 1 (BLK/YEL) to Pin 18 Comfort Control System

G) Follow the instructions for Engine 1 through 4.

1. With red marker
2. Pin 32 (BLK/RED) Starting/ Charging System
3. With blue marker
4. Pin 46 (BLK/WHT) Starting/ Charging System and Pin 23 (BLK/BLU)

H) Follow the instructions for Starting.

1. With red marker
2. For both Starter Relay and Starter Relay 2
3. Pins 8, 4 and 2
4. At Starter Relay Pin 8 (BLK/RED) to Starter Pin 50 also connecting to ECM Pin 32
5. With blue marker
6. Pin 6 at Starter Relay to Pin 46 of ECM
7. Pin 6 at Starter Relay 2 to Pin 23 of ECM

View the colored pages now and notice the interrelationship between the control modules, starter and relays for this model.

## IN SIMPLE TERMS

The ECM controls the relays in the proper order if authorized by the Start/ Access Control Module.

The Start/Access Control Module and the ECM MUST recognize the ignition key(s).

The ECM controls the Starter Relay and Starter Relay 2 by enabling an internal ground circuit via Start/Access Control Module. Access is determined via CAN between these two controllers if the key(s) and associated controllers match.

If the B+ connections are stable from the Power Distribution System and the voltage drop is within reason, then determine what closes the relay(s).

Quality jumper wires were used to "ground" the control (Pin 6) of Starter Relay 2 and the current flow was measured towards the Starter Relay (Pin 2). If the Starter Relay Pin 6 was grounded then the starter should rotate.

## THAT IS ALL TRUE BUT...

The problem is still a no crank/no start with the ignition key(s). The next step will certainly create faults within multiple controllers and knowing that fact, we disconnected the battery and disconnected the ECM.

After re-connecting the power supply and ensuring both relays had a power source at Pins 2 and 4, the next step was to ground Pins 46 and 23 at the ECM. If the colored schematics were followed exactly, then the grounding of both ECM pins proves that both relays operate correctly and the two wires at the ECM are intact.

Disconnect the battery again, ensure the ECM connections are clean and re-connect both the ECM and battery. Scan once again and clear ALL faults with at least one ignition key cycle.

## IS THERE SOMETHING MISSING?

Yes there was, and we noticed what a co-worker had said, "Did you hear that? Did you feel that?" The car did start and ran quite well at that moment.

After testing clearing/all faults and re-setting the ECM and ABS adaptations, there were two more faults in one controller remaining...

| CENTRAL CONV. |
|---|
| 01134 - Alarm Horn (H12) |
| 012 - Electrical Fault in Circuit |

Remember the debris, the leaves, seeds, twigs etc. etc. etc.?

One would wonder with this module sitting at the bottom of the plenum and absorbing the "compost."

This brings us back to the old Volvo days when that type of module was bolted and riveted under the right front fender and that "tow in with no start" condition.

Fortunately for the customer, the local dealer found and ordered the new module for the next day. Of course the replacement had an updated part number and once it was installed, no faults returned. The last scan returned as perfectly clear.

Will the A6 start without the module?

*Yes it will.*

Was this exercise pointless?

*Not really, we all acquired great cutting, taping and coloring skills.*

How and why did this module fail to the point of a no start?

*Unfortunately the customer wanted the module and couldn't "open" it but, very confident when it was installed again, the same fault returned.*

The replacement was definitely the cure.

## BUT WHAT ABOUT THE ORIGINAL MODULE?

Once again, follow this path with this download. The text document provides very good links and images to repeated problems. The images and links appear to be identical part numbers but in different models.

**tinyurl.com/LINAlarm2**

Remember the story about the Volvo? Same problem, same battery deterioration on the circuit board, same no start. Welcome to the future.

## SIDE NOTE

Don't waste your time attempting some of what those links profess as a cure, repair or adaptation. The damage has been done and that part about the "guarantee" is no different than winning a lottery.

With the new module installed and no faults recorded, the Audi was returned to the customer.

## EXPLANATION AND OPERATION "IF – THEN – ELSE"

If for any reason the Alarm Module has a fault and is possibly active on the network, then expect the engine not to start with multiple faults.

What about this one controller that recorded "Battery Management Faults?"

| BATTERY REGUL. |
|---|
| 02277 - Quiescent Current Stage 6 |
| 02272 - Quiescent Current Stage 1 |
| 02273 - Quiescent Current Stage 2 |
| 02276 - Quiescent Current Stage 5 |
| 02274 - Quiescent Current Stage 3 |

## STAGE MEANINGS:

Stage 1. CAN Convenience loads are deactivated.
Stage 2. Additional CAN Convenience load with Infotainment System restrictions.
Stage 3. Initialization of KEY ON "closed circuit" current reduction.
Stage 4. Deactivation in this stage can only be performed by a VAG style scan tool. The J644 module can not independently initiate this program.
Stage 5. Deactivation of the auxiliary heater.

Stage 6. Reduction of Bus system wake-up.

As with all schematics, take them with a grain of salt and recognize that Central Convenience Controller and the alarm horn gave out one piece of information within the scan as to how they interconnect:

Subsystem 1 - Part No: 1K0 951 605 C

Component: **LIN** BACKUP HORN H03 1301

Some Audi models have an Interior Monitoring System with a parallel connection to the **LIN** BACKUP HORN output to Central Convenience.

Now imagine a LIN controlled alarm that has a backup battery and damaged circuit board screaming and yelling in silence and considered a parasitic load. ■

*Alarm module*

# VW Haldex 4Motion Generation IV

By: Augie Ferron

As you may know, *derFix* went "all digital" this year, posting original content regularly to derFixTech.com. Here was one of our most popular articles we thought you shouldn't miss.

## 2.0L TFSI Automatic Transmission AWD

| TOOLS USED: |
|---|
| Ross-Tech VCDS |
| 90 amp power supply |
| Oscilloscope with tablet |
| Multi-meter and amp clamp |
| Camera and note paper |

For the uninitiated technicians working with VW models, the data, images and observations for the vehicle being discussed here are real world including a personal vehicle. The vehicle does not have any issues or faults with the Haldex 4Motion, but the article offers observations, service procedures and undocumented output/live tests.

Hand in hand, associate this article with the previous "The DVOM and Signatures" article in the *derFix* November 2018 issue. This new article employs a few methods to test the Haldex system with various tools. Regard the data, images and illustrations as representative of a working faultless unit and a guide to future repairs.

Note: Remember to scan the entire vehicle and save it including all subsequent scans while performing any service or repairs.

## WHO USES HALDEX?

Over the years that the 4Motion Haldex system has been in service, many versions have been used, achieving great success. The system has been used with VW Group, Volvo, Saab, GM, Ford and Land Rover models.

In 2011, the Swedish Haldex Traction AB division was acquired by Borg Warner.

## WHAT DOES THIS GENERATION LOOK LIKE?

Before engaging in any type of work or diagnosis, the system(s) should be understood as to the design and how the system(s) are intended to work.

One simple way to know what systems are inter-connected is using VCDS to see the activity of the networks connected to the Haldex controller.

By accessing the VCDS at address 22 and function 08 measuring blocks, read and view groups 125 and 126.

| |
|---|
| Group 125, Field 0,CAN-Data Bus Communication |
| Group 125, Field 1,Engine *J623 Control |
| Group 125, Field 2,Transmission *J217 Control |
| Group 125, Field 3,ABS *J104 Control |
| Group 125, Field 4,Instruments *J285 |

| |
|---|
| Group 126, Field 0,CAN-Data Bus Communication |
| Group 126, Field 1,Steering Angle Sensor *G85 |
| Group 126, Field 2,CAN-Gateway *J533 Control |

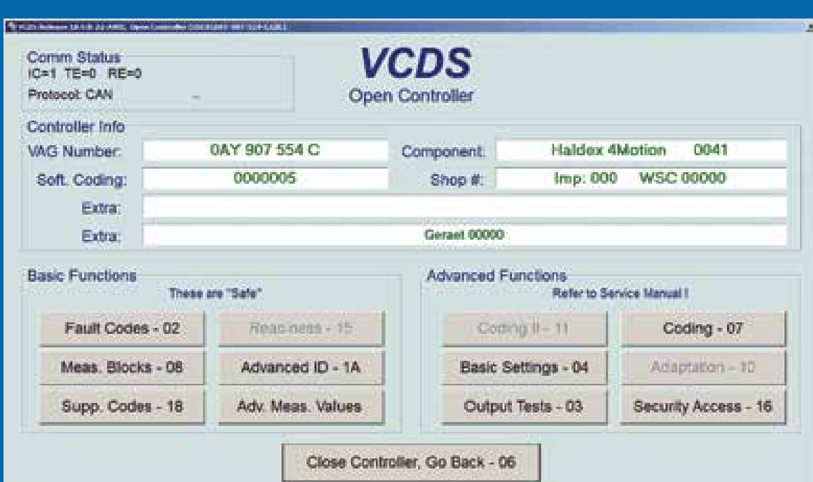
All groups should indicate 1 = Active on the network
Any group indicating 0 = Not active on the network

The image describes important data such as: Controller part number, Component and software version, Controller coding and the Work Shop Number that LAST coded the controller. A VW or Audi dealer that codes the controller will have its number within that field. VCDS will accomplish that task in "stealth mode."

Search for the "VW Coding Mysteries" article with an interesting explanation of "who LAST coded the controller."

## GENERATION IV ATTRIBUTES

Similar to earlier generations, the Haldex controller applies the driving force via a set of clutch plates. Compared to previous generations, a new feature added is building pressure via an electric pump while J492 determines the amount of torque transferred to the coupling opening control valve N373. This version no longer requires the speed differences between the front and rear axles to start the coupling in support of four wheel drive. The system is compatible with traction control systems within the ABS and ESP systems.




*Address 22*

This version uses an electric over hydraulic controlled clutch plate with an optimized and demand-regulated pump control. Drivers can now expect a seamless and instant engagement by means of pre-control. Consider pre-control as Engine Torque via throttle application.

## SERVICE BAY TESTS AND WHAT SHOULD BE IN VIEW

When the engine is started and reaches 400 RPM, the Haldex pump V81 is activated. Via the oil filter to the accumulator, V81 moves oil until a pressure of 30 bar, or about 435 psi, is reached. N373 (coupling opening control valve) is closed by J492 (Haldex) in order that the working pressure is applied to the working piston and pressing the clutch plates together.

On acceleration, the full rear axle torque is available immediately.

During Haldex activity, constant system pressure between the pump and valve is held at approximately 30 bar, or about 435 psi.

N373 (coupling opening control valve) controls the working pressure and sets the applied pressure as required.

Working pressure can be between 0 percent while braking and 100 percent during acceleration.

A raised hoist test is one way to determine if the Haldex system will engage. The issue can be wheel speed differences when one or more wheels drag slightly with either or both differentials active (spinning at different rates). It will happen on the hoist, so expect the ABS to intervene quickly...

# 2005 Jetta 2.5L PCV/Vacuum Leak

By: Augie Ferron

*Air drawn in and damaging the air filter through the damaged cover*

| |
|---|
| VIN: 3VWJM31K68Mxxxxxx |
| Mileage: 359,650 km - 223,476 mi |
| Part No SW: 07K 906 032 BJ |
| Component: 2,5l R5/4V |
| **3 FAULTS FOUND** |
| 008825 - Leak in Air Intake System<br>P2279 - 008 - Intermittent - MIL ON |
| 000369 - Fuel Trim; Bank 1<br>P0171 - 004 - System Too Lean - MIL ON |
| 001287 - Idle Control System RPM<br>P0507 - 001 - Higher than Expected. - Intermittent |

| TOOLS USED |
|---|
| 90 amp clean and stable power supply |
| Ross-Tech VCDS with screen capturing software |
| Vacuum gauge, camera and note paper |
| Banding/crimping tool |

*PR code*

## HISTORY

This particular Jetta owner asked that we look at this model because of a starting and idling anomaly that was repeated in the facility and had concerns in relation to idle quality.

Those concerns were immediately repeated and what was discovered was due to very poor service procedures and damage to the air box.

The damage also included the air filter and cover.

## HINT

Extra and detailed testing with the detached cover on this engine can be easily accomplished if the MAF is removed from the cover and attached to the air inlet. If these models are tested and are in service in the shop, keep a known good spare MAF for test purposes and that will save precious time.

As in every article, these examples help identify the exact model with the:

- Matching VIN and model
- Sales code: 1K2 7S3
- Engine code: CBT
- Transmission code: KBU
- With erWin, the exact service procedures, specifications and schematics can be accessed with locations.

This view of the air filter leads to the assumption that the previous service facility was a little "rough" with the cover that was housing the air filter.

An attempt was made to use a two part metal epoxy to repair the cover and minimize the damage to the air filter. The attempt included affixing the rubber grommet to the stays/pins on the valve cover.

Frankly, I was rather proud of myself that it fit and held the position of the main engine cover. The die grinder and multiple layers of epoxy over time created a work of art.

## SIDE NOTE 1

All the while when this air filter box was worked on, there was much "rodent left over" of material, seeds,


*Damaged cover*


*More epoxy layers*

*Damaged diaphragm*

*Redneck repair*

twigs, etc. etc. including material on the engine valve cover and coils – so much, it was saved for the vehicle owner.

The repair to the engine cover will not address the lean or improper idle condition. The lean/idle condition is attributed to a vacuum loss and has to be identified as either internal (engine mechanical components) or external (engine vacuum connections).

A sure way to test a theory on this engine is to disconnect the vacuum source at the PCV system and cap it. Measure (using a vacuum gauge) at the dipstick with or without the PCV hose attached.

As with anything, sometimes a replacement part is found that will solve the "torn diaphragm" syndrome. With some cleaning and re-assembly with a replacement, the fuel trims and faults were deleted and idle quality returned to normal. Note the replacement is an aftermarket part.

Be advised, when faults are deleted with VCDS, ALWAYS reset the throttle adaptations in basic settings group 060 and 063. Then proceed with live tests and logging. Measure the trims and see that the trims are now reasonable.

End of story right?

## WHAT WAS REPLACED?

The Jetta returned two weeks later with a similar problem but the plastic PCV cover failed due to heat distortion and, this time, we heard the external vacuum leak. The "work of art" failed because of heat as well and that's where Lewis Black's rants reminded us all of human frailty.


*Correct vacuum - very little movement of the gauge at idle.*

## TIME TO INSPECT

The redneck solution was to tie a large washer to "push" on the cover and keep the distortion minimized. It worked as a temporary solution until another replacement version arrived.

While this test was a success, the measurement was done again at the dipstick tube with the following result: Very little vacuum was introduced into the engine.

The next solution was mentioned during a conversation about the replacement cover "clip openings." The discussion was about how the manufacturing process lacked the correct dimensions. There was a difference (height) in the clip openings and the way the cap appeared weak. The difference being, how the cover's openings grabbed the tangs of the valve cover/PCV port.

## SIDE NOTE 2

The rodents returned again and left another mess on top of the engine valve cover and ignition coil area.

The solution: We found a kit that is used to "band" C-V boots to the axle shaft.

*Different covers*

*Cap and band*

*Banding kit*


*Band twist tool*

This kit offered a perfect solution to keep the replacement cap in place.

1. Calculate the length needed.
2. Use the correct clip to attach the length of band.
3. Push or have the cap tied firmly in place.
4. Use the correct tool to squeeze" the clamp onto the cap.

## WHY?

Cost effectiveness and at 359,650 km or 223,476 miles we could not justify the cost of a replacement valve cover if we can "patch it" with a little thought and finesse.

Another solution is with this tool that was purchased some time ago. Needed is one clamp that was difficult to find but not impossible.

## APPRECIATION

The customer returned a few days later with a big bag of cashews, tangerines, and a thank you to all with a great big smile.

## SIDE NOTE 3

The rodents returned again and this time they had a party at the dust and pollen filter. The customer complaint this time was the smell!

After the third attempt with the pesky rodents and a new filter, the battle raged and continued at the pharmacy.

## HOW TO GET RID OF PESKY RODENTS 101

1. Find some pill bottles and drill multiple holes into the side.
2. Find some moth balls and fill the bottles.
3. Cap the bottles with the mothballs.
4. Place the pill bottles with the mothballs in strategic locations around the engine bay and inlet to the dust and pollen filter.
5. Replenish the mothballs from time to time.

## EXPLANATION AND OPERATION "IF – THEN – ELSE"

If for any reason a vacuum gauge at the dipstick tube displays relative engine vacuum, then the PCV valve likely has a damaged diaphragm or the valve cover is mechanically damaged/cracked.

If the vacuum gauge reading is reading much lower than engine vacuum, there is a good chance the valve cover and diaphragm are intact. ■

# Porsche Oil Scavenging Systems

By: Mike Bavaro
Bodymotion, Inc.

As you may know, *derFix* went "all digital" this year, posting original content regularly to derFixTech.com. Here was one of our most popular articles we thought you shouldn't miss.

## Subtle differences mark improvements over the years

Many in the general driving public seem to regard problem diagnostics as just a matter of a free or inexpensive code reader sourced at any auto parts store. The repair shop or technician is sometimes questioned when quoting a price for diagnosis of a Check Engine light. At times it is understandable why customers feel that way but, in reality, old fashioned investigative work with the correct tools and equipment can dig deep and correctly identify the culprit or culprits far more quickly and accurately than guesswork.

For example, Porsche has updated the part numbers for ignition coils several times for both early and late model coil over plug applications. It may seem logical to sell a set of updated, new and improved coils to solve misfire codes and, while the coils are removed and for just a few bucks more, put a set of spark plugs in. How refreshing — an old fashioned "tune-up." While this approach may solve the misfire issue and send a customer on his or her way, it all too often is not a solution, at least not a permanent one.

Oil fouled spark plugs are a first tip-off. Excessive carbon buildup on intake valves and ports are also proof of oil burning as well as obvious tailpipe odor and blue smoke. Oil vapors are introduced into the intake air system to purge the crankcase of unburned blow-by gases. However if the quantity of oil being burned is excessive it can quickly foul those new plugs. The result may not be just a misfire warning, but now

*Air/oil separators — On the right is the 2002 up M96. In the center is the 1997-2000 Boxster. And on the left is the A/OS for the 2006 (and later) M97/01.*

*Left: Here we have the 997 GT3 tandem vacuum/scavenge pump.*

possible catalytic converter efficiency codes and maybe lean mixture codes. Visible smoke may also accompany the complaint or condition, giving the tech a suspicion that the engine is worn and needs overhaul. And, that may be true, but, if a complete diagnosis is not done, a less expensive alternative may be lost.

What, you say, does this have to do with oil scavenge pumps and crankcase ventilation? Well, plenty. Porsche uses air-oil separators on their water-cooled engines from 1997 on up.

Porsche also utilizes auxiliary pumps to evacuate oil and air from the crankcase, thus reducing the total emissions output from the engine. Previous articles on Porsche oil pumps provide insight into pressure supply or related problems and fixes, yet the "scavenged oil" generally gets ignored.

Because the Porsche engines use the lubricating oil for hydraulic control, the oil passes through screens and orifices that exacerbate the oil being diluted with air. The spray from rotating cams, chains and various cam elements produces what can be referred to best as a chocolate milkshake. Air must be separated from the oil because aerated oil doesn't do as good a job as clean, air-less oil.

Every oil manufacturer blends additives into their motor oil. Some of these additives help reduce bubbles and foaming in the oil. These dispersion additives break surface tension to achieve this goal. Racing or high RPM application lubricants contain a higher concentration of these additives. Extended oil change intervals combined with high oil operating temperatures negatively affect the concentration of the anti-foam additives. The longer the oil is in service and the hotter the oil temperature, the more the oil is susceptible to bubbles and foaming.

Scavenge pumps as shown in photos are powered by the camshafts. They are very efficient as they pump equal parts air and oil and evacuate the oil from the camshaft area back to the sump. Single stage pumps send air diluted oil back to the sump. The need for increased vacuum inside the crankcase (less air equals less aerated oil) exceeded the idling engine's ability to build high vacuum levels. Various methods of vacuum amplification and vacuum storage tanks were just not enough.

Enter the dual stage or tandem pumps. These pumps are "piggy-backed" with the gear...

Boxster / Cayman 987780/2012

Fault memory entry:
All fault memories were erased!

Overview | Extended identifications | **Fault memory** | Actual values input signals | Drive links checks | Maintenance repairs | Coding programming

| Control unit | - | Fault code | active | Description |
|---|---|---|---|---|
| DME (DFI) 987S 3.4 L USA | | P0300 | | Misfire totals fault (exceeds limit value) |
| | | P0301 | | Misfiring, cylinder 1 (exceeds limit value) |
| | | P0306 | | Cylinder 6 misfire detected (exceeds limit value) |

*Typical misfire fault codes*

*This shows the single stage M96 scavenge pump.*

# Getting to Know Mr. Mezger, Part 2
## Evolution into Water Cooling

By: Tim Pott

The air-cooled Porsche Mezger engine proved its worth for years. Water cooling extended its life even further.

*An M96 Porsche factory replacement block ready for installation. This was the early replacement for the air-cooled Mezger dry sump engine.*

Porsche continued the air-cooled Mezger engined 911s far longer than many car enthusiasts and aficionados had ever imagined possible. The continued development of this engine in air cooled form was driven by its now iconic status and popularity among "Porschephiles" everywhere. The air-cooled powerplant was limited in large part due to the fact that its cooling system, being air, was subject to changes in ambient temperatures. With increased emission standards the heat loading on the combustion process was limiting horsepower output, regardless of engine displacement.

It was inevitable that Porsche would have to abandon its air cooling for a conventional water cooling system.

Porsche had been turning to liquid cooling for its racing engines several years prior to using liquid cooling in its production cars. The 935/78 race car, nicknamed the "Moby Dick" due to its large whale tail, received water-cooled cylinder heads in order to stabilize combustion chamber temperatures. The limited production supercar 959 also received water-cooled cylinder heads while continuing to use air to cool the rest of the engine, including the cylinders and block. Porsche's 962 race car was the first flat six cylinder engine to be entirely water-cooled.

*This is an example of a large displacement, high-performance, water-cooled piston and cylinder assembly.*


*Picture of the housing where the water-cooled cylinder sleeve is housed*

When the Porsche 996 (still badged as a 911) debuted as a street legal sports car it had the first fully liquid-cooled flat six engine in the Porsche sports car lineup. The vast majority of the 996 models received a newly designed engine which was no longer technically a dry sump engine. The GT3 and Twin Turbo 996s, however, received a much different engine than the base model 996.

This "new" engine was a water-cooled copy of the early "Mezger" dry sump design as its air-cooled predecessor. In fact, the castings of the water-cooled engine block are so similar both internally and externally, that some of the components such as crankshafts, countershafts and oil pumps are interchangeable with some of the later models of air-cooled engines. Many folks in the Porsche community reserve the moniker "Mezger Engine" for only these water-cooled, dry sump engines first fitted into the high end (turbo and GT3) models, but that is not paying homage to the original air-cooled history of the design.

The normally aspirated, early Porsche 996/911 and Boxster lineup, which got the new, more cost-conscious designed engine, suffered from some significant and questionable engineering decisions.

Now legendary and most glaring among these was the use of a sealed ball bearing at the end of the intermediate shaft within the engine. The failure of this ball bearing meant almost certain instant and catastrophic death of the entire engine. While there are no official measures to quantify the number of engines affected, it had many disenchanted Porsche owners questioning their loyalty to the marque.

Several aftermarket businesses rushed to develop fixes, including; replacing the ball bearing with one that offers a longer service life and upgrading the ball style bearing to a more conventional plain, babbited engine bearing which is fed oil under pressure. Many of these aftermarket fixes are effective but none of them were approved or adopted by the manufacturer. The affected engines were in use in the Boxster, Cayman, and 911 lineup until 2008 when a newly designed engine replaced the flawed one.

The water-cooled Mezger designed engines, on the other hand are truly a magnificent design and rose to a high level of power and reliability. As previously mentioned, the engine case, crankshaft, connecting rods, intermediate shaft and oil pump all shared the same architecture and, in some cases, even part numbers of the 993 and 964 air cooled models. The liquid cooling did necessitate the redesign of many other internal components, however.

The pistons and cylinders are still individual units and are typically sold in balanced and matched sets similar to those of their air-cooled predecessors.

The difference is that the cylinder is now housed in an aluminum structure which allows coolant, in a conventional mixture of ethylene glycol and water, to circulate around this "wet sleeve."

O-rings at the top and bottom of each individual cylinder keep the coolant mixture away from the cylinder head and bottom end oil tight areas of the engine. Installation of the pistons and cylinders requires the use of very special tools as well as unique procedures to assure proper sealing.

The cylinder heads are no longer individual units but each is cast as a single head which covers each of the two banks of three cylinders of the horizontally opposed six cylinder engine.

Dual overhead camshafts are utilized in the head structure which now actuate four valves per cylinder. The camshafts are still driven by a chain off an intermediate shaft, which in turn is driven directly by a gear from the crankshaft at the required one-half speed of the crankshaft. A conventional style cam chain tensioner, with ramps and guides nearly identical to the air-cooled units used in the 993 and 964 models, keeps the proper tension on the now longer chain (longer due to the fact that it is driving two cams as opposed to one) throughout the heat cycling of the engine. Dual overhead camshafts receive timing variation through cam actuators on the inlet camshafts.

A labyrinth of external cooling passages is necessary to carry the liquid from the heat sources in the heads and cylinders away from the engine and to the radiators that live at the front end of the car.

*A cylinder head for a water-cooled Mezger engine. This is one piece, as opposed to individual heads on the air-cooled versions.*

*These are the external coolant manifolds for a 996 twin turbo Porsche engine.*

These external passages, or manifolds, became a failure point on this otherwise robust design. In order to attach rubber cooling hoses to the manifolds it was necessary to have a smoothly machined end with a flange to properly secure the hose to the manifold. These flanged tubes were glued into place on the coolant manifold. After several years of heat cycling the glue can fail and the engine will dump a huge amount of coolant almost immediately from the gaping hole left at the detached point on the manifold.

The nature of the failure rarely caused a severe overheating event because the dramatic plume of steaming coolant alerted the driver and the car was typically shut off immediately. The biggest problem this failure posed was the slippery coolant that coated the road, or worse, a track surface as these cars were often used at race track events.

Two approaches to fixing this coolant manifold issue have been developed and both require removal of the coolant manifolds. After the manifold has been removed, which also necessitates engine removal, the machined sleeves can be either welded or pinned to the cast portion of the manifold. Welding requires heating and removing the glued sleeve from the manifold and the old glue must be completely removed by the use of abrasives.

Once the two surfaces have been cleaned they can be welded using a TIG (Tungsten Inert Gas) welder. Because of the variation of the thickness of the two materials, an experienced hand at this task is required, and many welders are not comfortable taking this approach as a result. When done properly, it is the best solution as it is permanent and does not allow for any leakage whatsoever at the joint between the two pieces of aluminum.

*Example of a high-quality TIG welded connection of the coolant manifold to the flanged tube.*

The pinning approach has the benefit of not requiring excellent TIG welding skills. This procedure involves drilling a hole through the cast manifold into the machined, flanged tube. The hole is then threaded and a bolt secures the two components together. Care must be taken to completely clean all the metal chips that result from the drilling and tapping procedures or they can wind up finding their way to some critical component of the engine's cooling system such as a water pump or thermostat. Because of this, it is recommended that the coolant manifold be removed entirely from the engine as it is during the welding procedure.

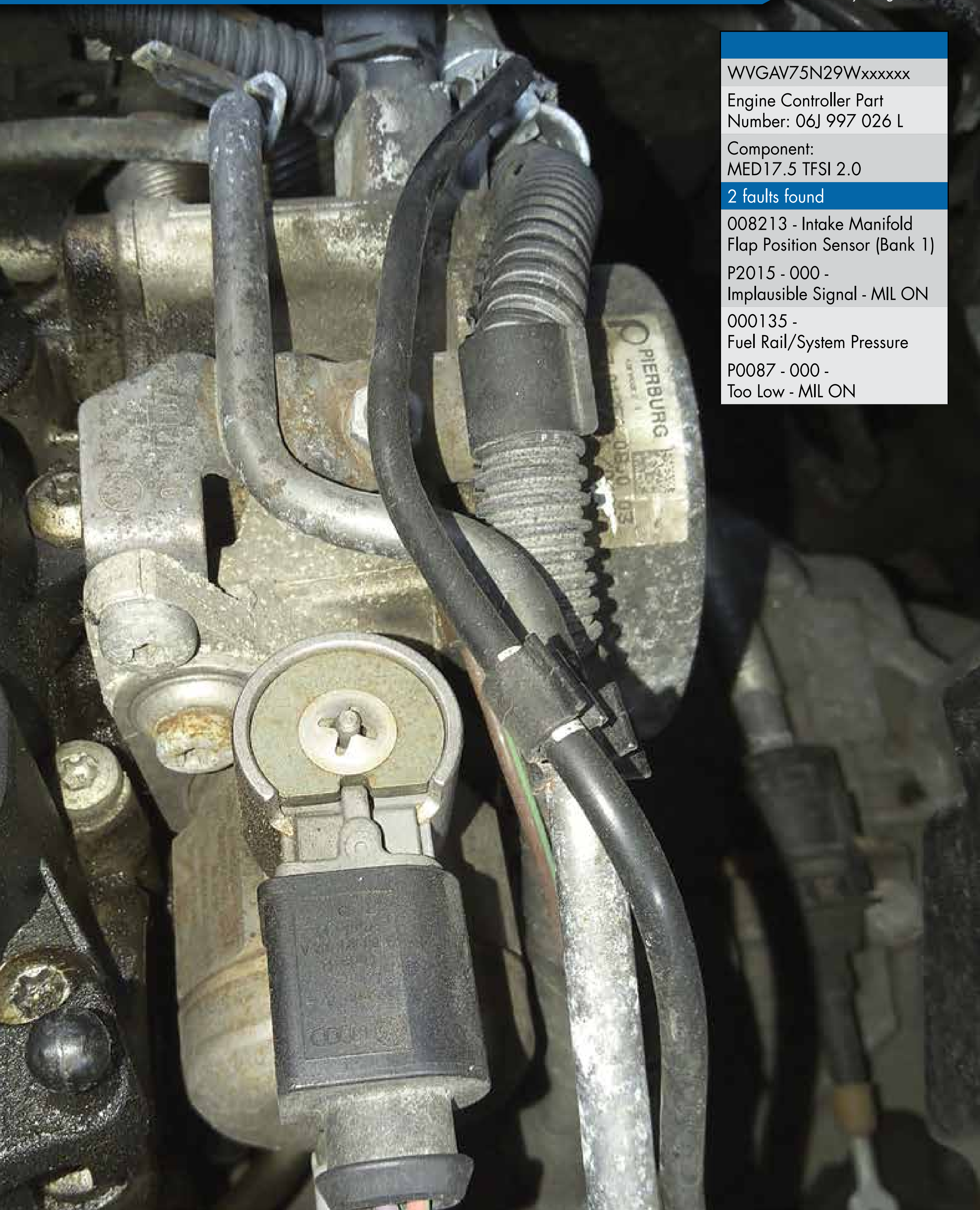
The other drawback to the pinning method of repair is that a small amount of seepage can still develop between the cast manifold and the attaching flanged pipe. Certainly pinning will prevent the more catastrophic pipe blowing from the manifold, but a smaller leak is still a possibility. As with any repair, consultation with the vehicle owner explaining pros and cons as well as costs involved is the key to success.

The extremely robust design of the Mezger engine from its earliest air-cooled form until its adaptation for use in the liquid-cooled GT3 and Turbo models is perhaps one of the biggest reasons for the Porsche 911 being arguably the most successful production sports car in history. This engine has evolved through experience gained from endurance racing as well as countless miles of street use and abuse. At the end of endurance races, some of them 24 hours long, these engines always seemed to be running at the end which gave way to an old racing saw – "To finish first, first you must first finish!" Due to economic and increasing emission standards, it is unlikely another engine will ever reach the bar set by the legendary Mezger engine in either its liquid or air-cooled form. ■

# 2009 Tiguan 2.0L Fuel Pressure Error

By: Augie Ferron

| |
|---|
| WVGAV75N29Wxxxxxx |
| Engine Controller Part Number: 06J 997 026 L |
| Component: MED17.5 TFSI 2.0 |
| 2 faults found |
| 008213 - Intake Manifold Flap Position Sensor (Bank 1) |
| P2015 - 000 - Implausible Signal - MIL ON |
| 000135 - Fuel Rail/System Pressure |
| P0087 - 000 - Too Low - MIL ON |



## HISTORY

The episode with the Audi A6 led to an unfortunate incident with a Tiguan at the same facility. After completing the autoscan, it was difficult to start, at times stalled, and by "feathering" the throttle had stable enough RPMs to acquire live running data for a few moments.

## GO BACKWARDS

The primary complaint was an oil leak at the high pressure fuel pump. The facility opted to repair the pump with a new seal. The engine was very difficult to start and often didn't or repeatedly stalled.

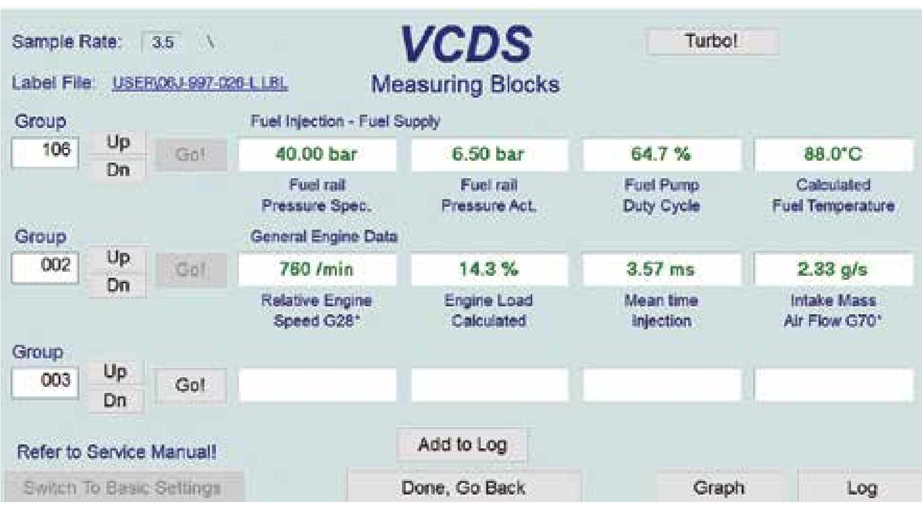
| TOOLS USED |
| --- |
| 90 amp clean and stable power supply |
| Ross-Tech VCDS with screen capturing software |

## STOP RIGHT HERE

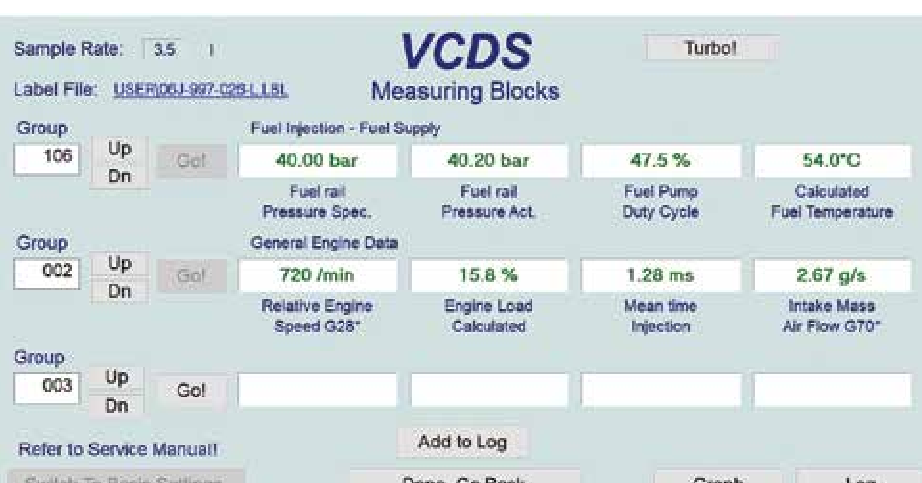
For the uninitiated technicians that work on any Direct Injection engine, **NEVER** open the fuel system running or not running.

## STEPS AND HOW TO

1. Find a wiring schematic (the VW in this case).
2. Find the **correct** fuse to disable the fuel pump control module at or near the fuel tank.
3. With the engine running, monitor the fuel pressure at group 140.
4. Wait until pressure is "approx 8 bar" and switch the ignition OFF.
5. Leave the fuse out until the repairs are completed.
   *(This will maintain fuel in the rail and not starve the high pressure pump.)*




*Defective pump*




*Cold run up*

## WHY DO YOU ASK??

Hot soak condition and fuel vaporizing 101.

Many vehicles in the market and especially FSI (Fuel Stratified Injection) models will energize the fuel pump control module, engaging the fuel pump when the driver's door is opened. Let's call it pre-prime.

An interesting fact (tested and proven) concerns engine coolant temperature.

The hotter the engine, the longer the fuel pump remains ON and vice versa.

So imagine an engine at operating temperature, inadvertently operating the fuel system. Imagine opening the driver's door with the fuel system opened to the environment. Therefore keeping the pressure up minimizes vapor lock on hot engines ie: hot soak.

## BACK TO THE TIGUAN

At idle and with the engine complaining (noisy as well), the images were captured at groups 106 and 002.

For this short running time and viewing the screen capture after the engine was shut down, there are some questions about the replacement high pressure fuel pump.

| | |
| --- | --- |
| Group 106 field 1 | The ECM is requesting 40.00 bar |
| Group 106 field 2 | Actual fuel rail pressure is far too low at 6.50 bar |
| Group 106 field 3 | The in tank fuel pump is commanded at 64.7 percent |
| Group 002 field 3 | Mean injection time is 3.57 ms |

*(This is looking more like a port injected model.)*

## WHAT WAS REPLACED?

Where is the original part and where was it purchased? The search was on and within a few minutes the original part was found. The original appeared to be defective where the seal resides, and we also found the original cam follower inside the original fuel pump. The follower or cap rides the camshaft, pushing on the spring loaded shaft that creates high pressure. The four lobe design reduces the piston stroke compared to the earlier three lobe design.

## TIME TO INSPECT

The technician was asked to remove the pump following the above instructions and we placed the replacement pump beside the original.

The follower or cap is missing from the replacement. No comment and keeping it clean! Reassemble again with the correct parts and measure.

| | |
|---|---|
| Group 106 field 2 | Is close to specification |
| Group 002 field 3 | Looks normal for a cool FSI engine |
| Group 106 field 4 | The warmer engine is demanding more in-tank ON time |
| Group 002 field 3 | Engine management requires less injection time (warm) |

There will be many interesting images of damaged cam followers and plunger shafts found with the "Google images" service. Have a look.

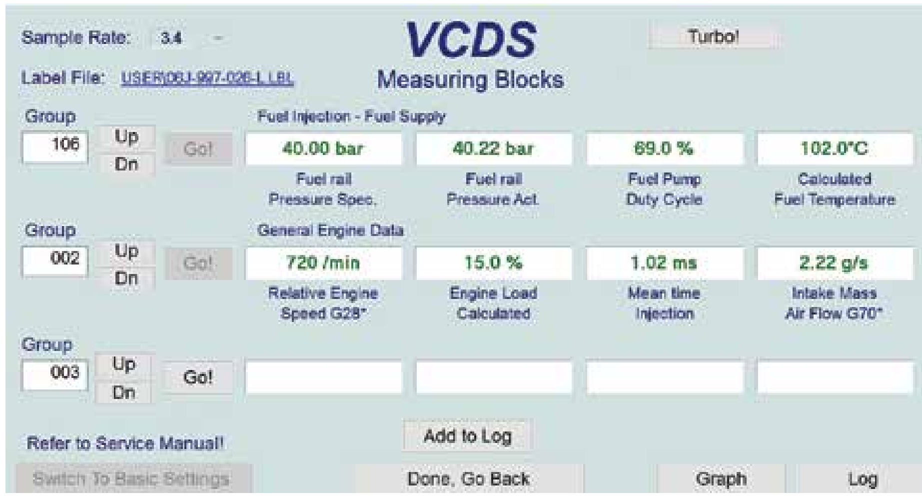
Fortunately, there was no camshaft damage found with this model and luckily, because the shop has such difficulty trying to start the engine.

Despite finding this problem quickly, use this article as a guide to narrow other possible FSI related problems or faults.

## EXPLANATION AND OPERATION "IF – THEN – ELSE"

If for any reason the ECM is recording fuel pressure faults, and injection pulse width is far too wide (fat), then expect the fuel tank control module to try to compensate for the difference between "specified and actual" values.

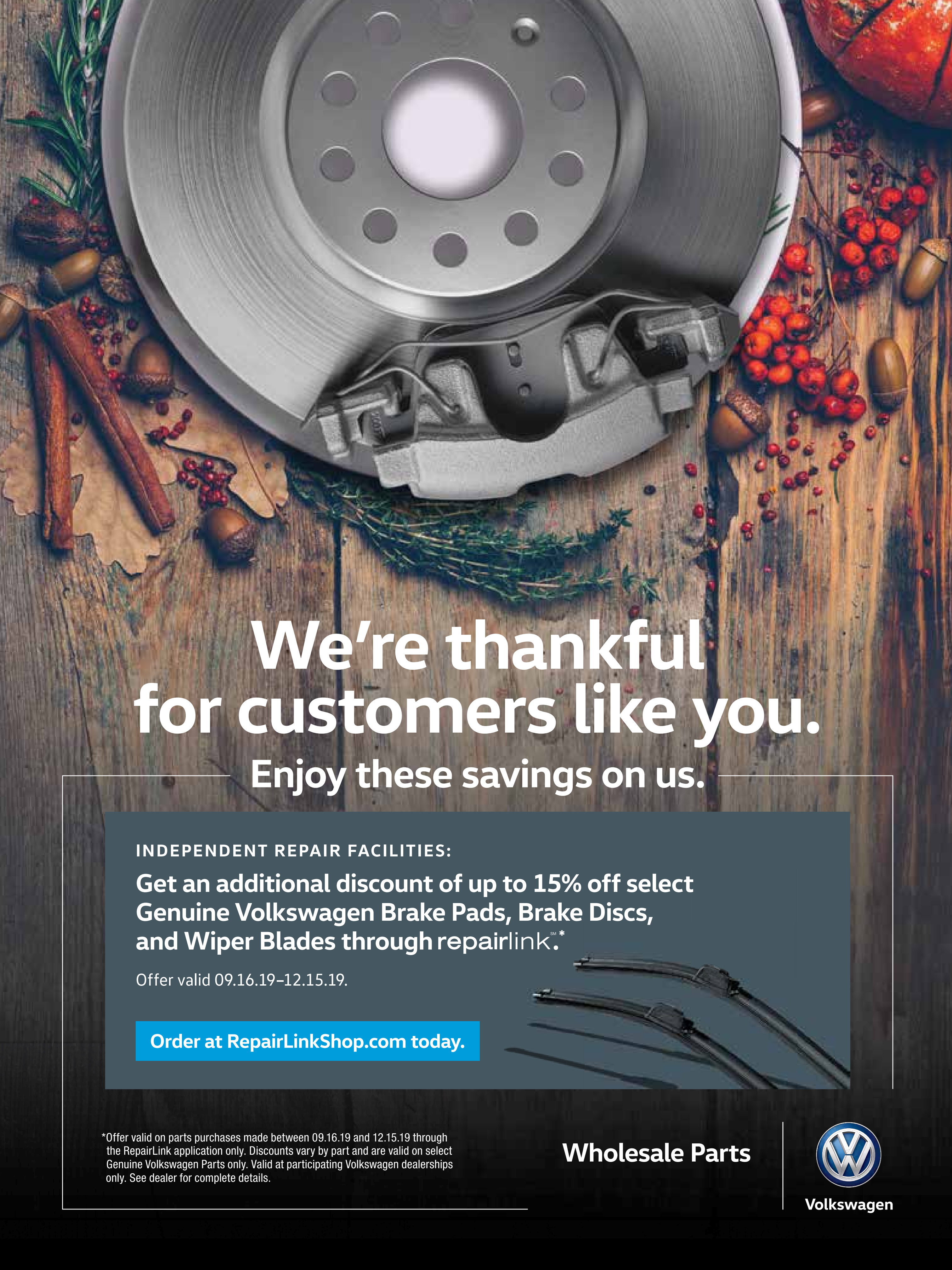
VCDS is the "**go to**" tool with many features comparable to a factory version, but one day I was experimenting with an Android device. 572.9 psi or 3880.0 kPa = **dangerous**, plus conversion from degrees C to degrees F. ■




*Warm engine*


*Android psi*


*Android kPa*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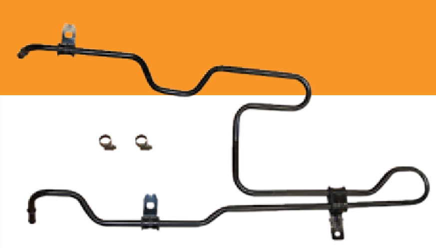

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