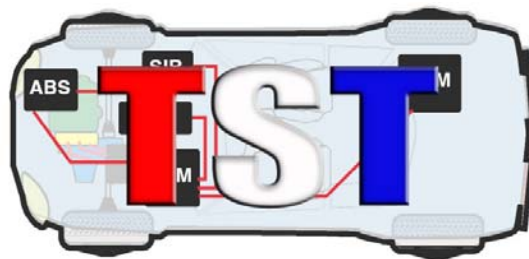


November 2018



Technicians Service Training

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"Alternative Diagnostics"

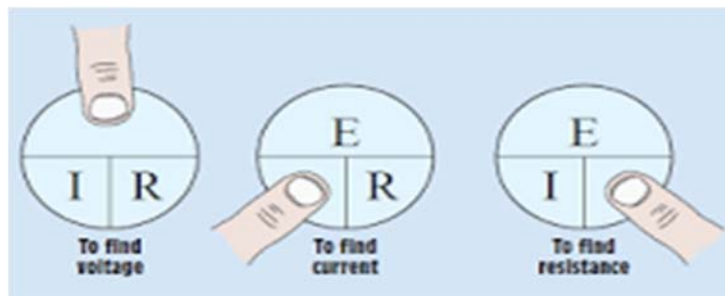
In this article we will discuss ways to use modern technology to diagnose BMWs. We will explore the use of scopes (DSO), scan tools and pressure transducers. The logical use of other shop tools to speed diagnosis will also be explored.



To use a scope you need a complete understanding of basic electricity.



We don't use I, E or R. Remember I is current - Amperage
R is Ohms - Resistance and E is Voltage



$$E=IXR$$

$$I=E/R$$

$$R=E/I$$

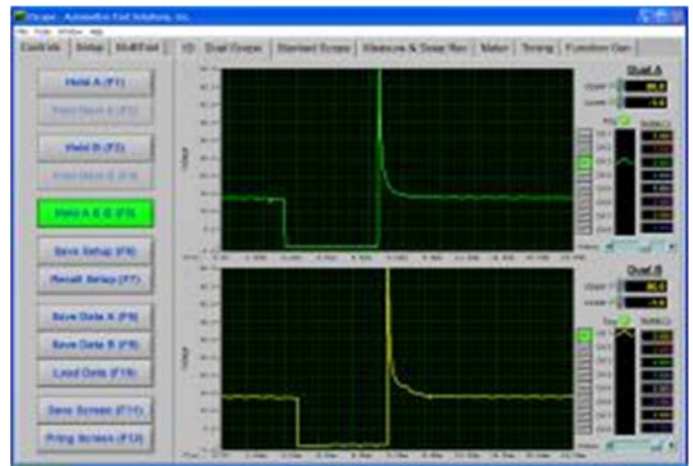
Volts = Amps x Ohms Amps = Volts/Ohms Ohms = Volts/Amps

(Con't on page 2)

"Alternative Diagnostics" (con't from p. 2)

A DVOM (digital volt ohm meter) samples the voltage thousands of times per second and averages it out to display a value. A scope samples the voltage millions or billions of times per second and plots the readings to display a graphic image of the various voltage values. The expression "a picture is worth a thousand words" applies here.

This is an injector waveform displayed on a PC based DSO.

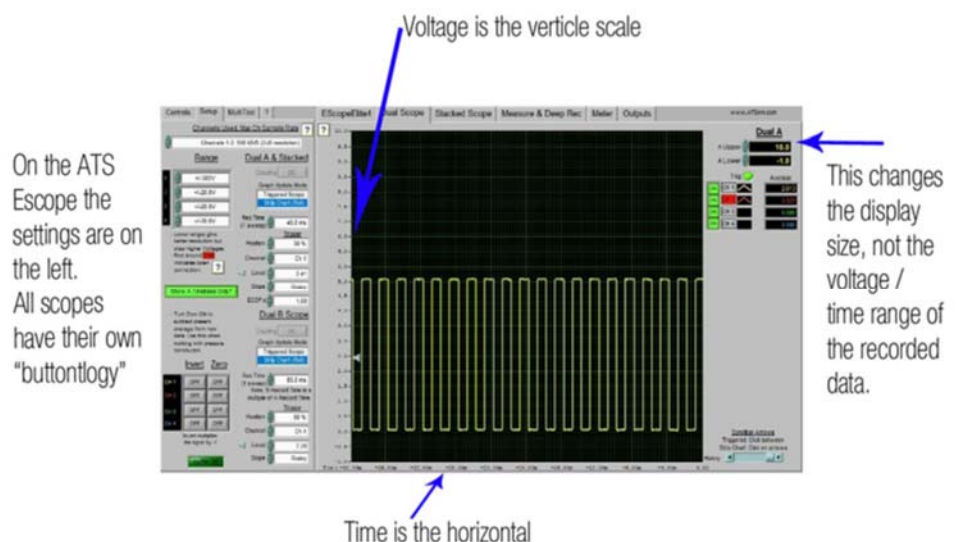


A scope can be used for any electrical test (battery, alternator, or any system / device including networking) The scope only tests voltage! When testing for amperage, pressure or any other value the value is converted to voltage so the scope can recognize and plot it on the screen.

All scopes measure time horizontally and voltage vertically.

If you want to measure the start/charging system of a BMW, you can use an amp clamp on the starter cable or battery ground cable.

Use another channel for measuring battery voltage. By disabling fuel, with one test you can evaluate battery health, motor resistance and starter condition. With fuel enabled you can test charging voltage and AC leakage.



(Con't on page 6)

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- ***Keep our fellow technicians up to date with the latest technology.***
- ***Provide training seminars for a reasonable price.***
- ***Deliver information that the technician can use now.***
- ***Keep technicians informed of information affecting our industry.***
- ***Increase consumer awareness of what a good technician is.***

Why join TST?

TST membership includes special pricing on weekday night seminars and the occasional full Saturday seminar. With a **\$75.00** yearly membership, the seminars are only **\$50.00**. **TST seminars are NOT sales or product seminars.** The instructors that TST brings in are all "hands-on" industry experts with up to date, cutting edge knowledge that you can use in your shop the next day. That's 75 dollars for a seminar in which you are able to learn something useful, for fixing those tough jobs that we all see on a regular basis. Our instructors are masters at making the complex understandable. Membership also includes a newsletter full of real world technical articles, diagnostic case studies, and solutions to the kinds of problems you see in your bays each week.

The following are some of TST's regular instructors:

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Wayne Colonna of ATSG

Jorge Menchu the "Labscope Guru," AES Wave

John Anello of Auto Tech On Wheels

Mark Warren of World Pac / Motor Magazine

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Currently there are **TST chapters in Connecticut, Massachusetts, New Jersey, New York** and membership continues to grow. For more information you can call **TST** headquarters at:

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"Alternative Diagnostics" (con't from p. 2)

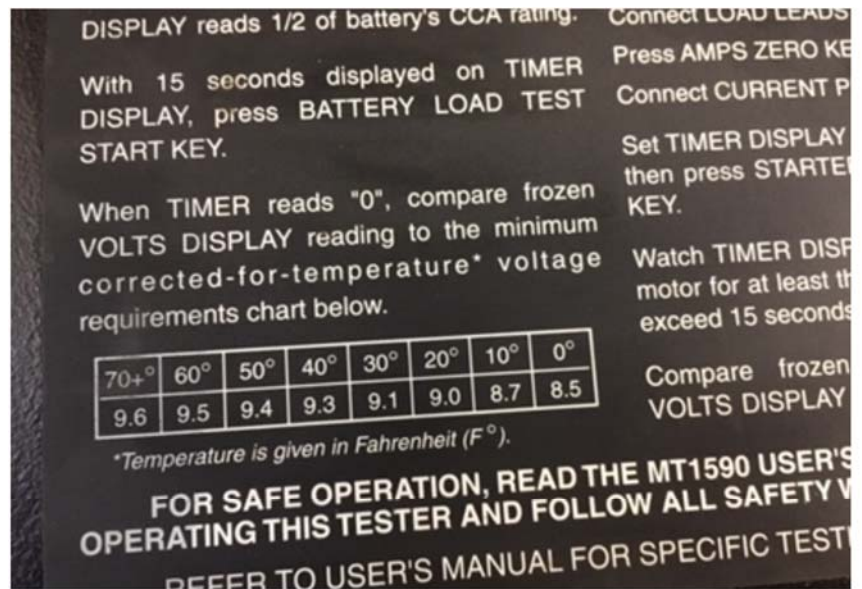
Battery testing;

1. Visual inspection, look for loose, corroded terminals, deposits, conductive deposits or any other damage

2. Open circuit voltage. This changes with temperature

BMW Tip; Always look at the cranking voltage drop for excessive "low voltage". If the voltage drops below 9V modules can drop below their "logic threshold" and either not boot or set voltage/network codes. This is also a possible cause of corrupted memory.

In-rush current will show the mechanical and electromotive resistance that has to be overcome to begin turning the motor. Excess amperage/ starter draw indicates either a starter motor problem or engine mechanical binding/ friction issue.

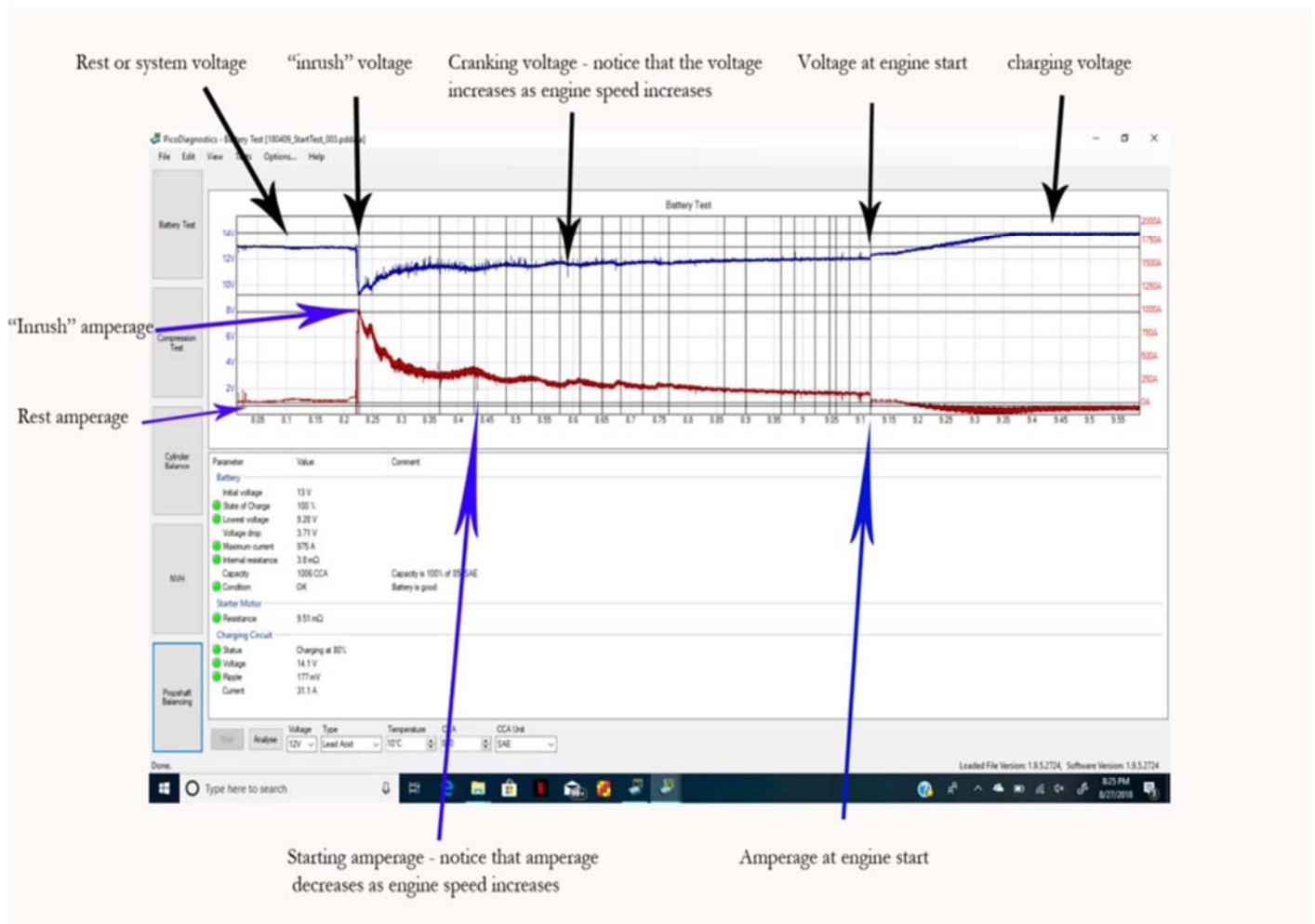


Voltage	State of Charge
12.6+	100%
12.5	90%
12.42	80%
12.32	70%
12.20	60%
12.06	50%
11.9	40%
11.75	30%
11.58	20%
11.31	10%
10.5	0%

(Con't on page 7)

"Alternative Diagnostics" (con't from p. 6)

The figure below shows the information available from 1 test



The charge system pattern on a DSO will show the fluctuations in both AC and DC charging voltage when you set one channel to AC and the other to DC. *See waveforms on page 10.*

Tip; On older BMWs 500mV was acceptable. As the electronics have advanced, the acceptable value has decreased. On modern BMWs, 100 - 150mV is the acceptable level.

(Con't on page 10)

GTC505

Engine Ignition Analyzer



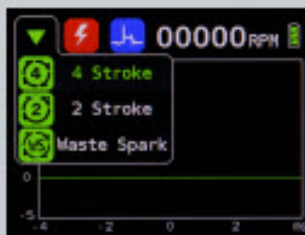
Quick, powerful and easy to use

- Plug the appropriate sensor pick-up into the flexible probe
- Select the engine's cycle (4-stroke, 2-stroke, or waste spark)
- Select the measurement type and display format
- Place the pick-up on top of the ignition module, or over the spark plug wire
- The GTC505 will automatically detect and adjust all parameters to provide accurate measurements and clear graphs

Useful for troubleshooting:

- Non-starts
- Misfires
- Intermittent problems
- Primary and secondary coil circuits faults
- Fouled or damaged spark plugs
- Damaged spark plug wires

Complete ignition system diagnostic:



Works on 2 and 4 cycle, and waste spark ignition systems engines.



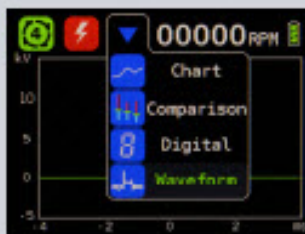
Displays secondary ignition waveforms.



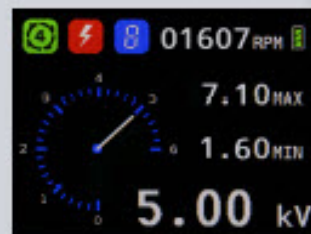
Displays and measures spark burn (firing) time, dwell time, current ramp time, RPM, and spark plug peak voltage.



Candle stick graph compares maximum, minimum and average measurements of several cylinders.



Selectable view of all measurements modes as chart, compare graph, analog gauge / digital readout and waveforms.



Analog gauge and digital readout with maximum and minimum.



Specially designed pick-ups for coil on plug ignition modules (left) and spark plug wires (right).



Chart mode used for detecting intermittent or infrequent failures and misfires.



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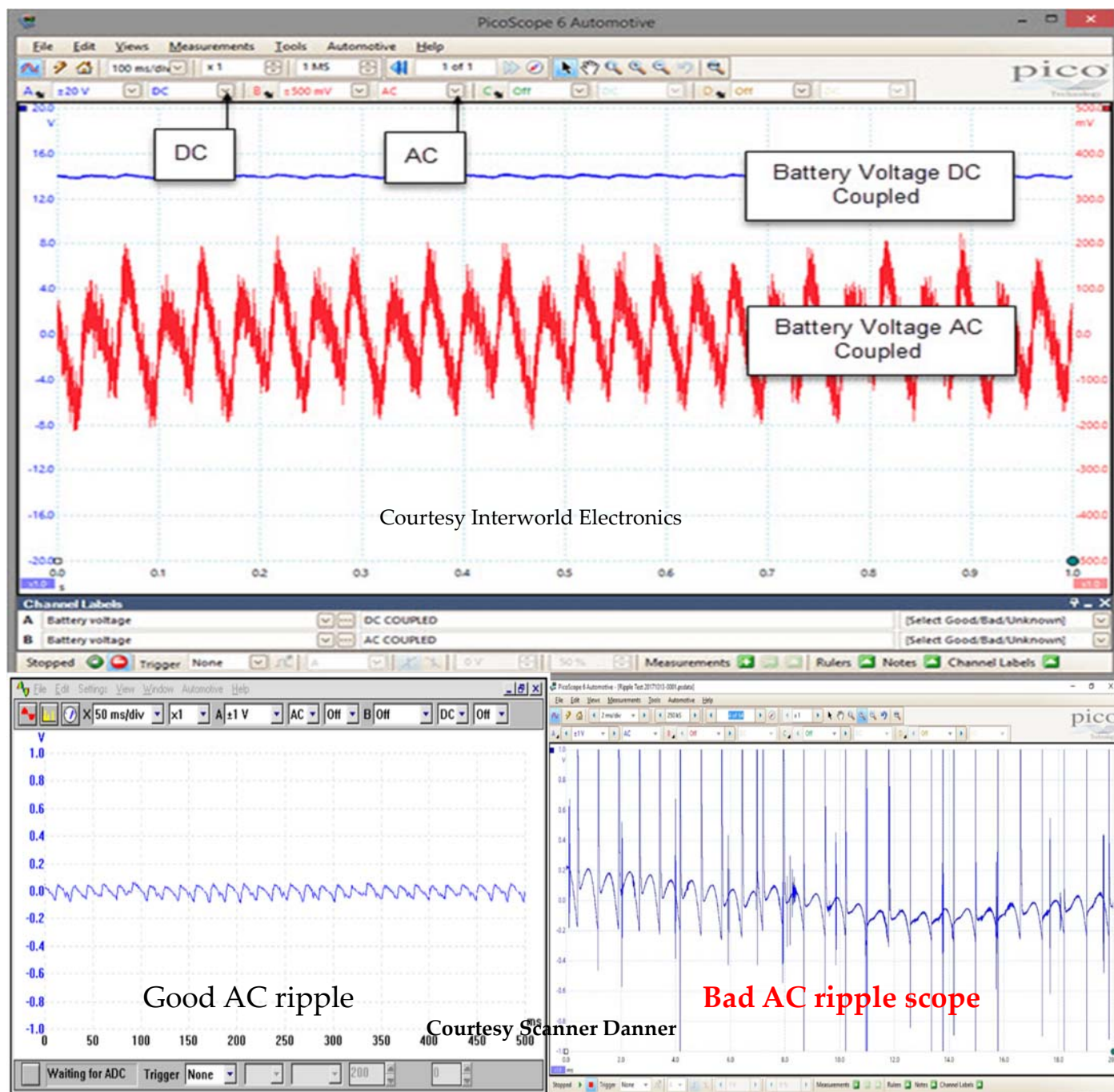
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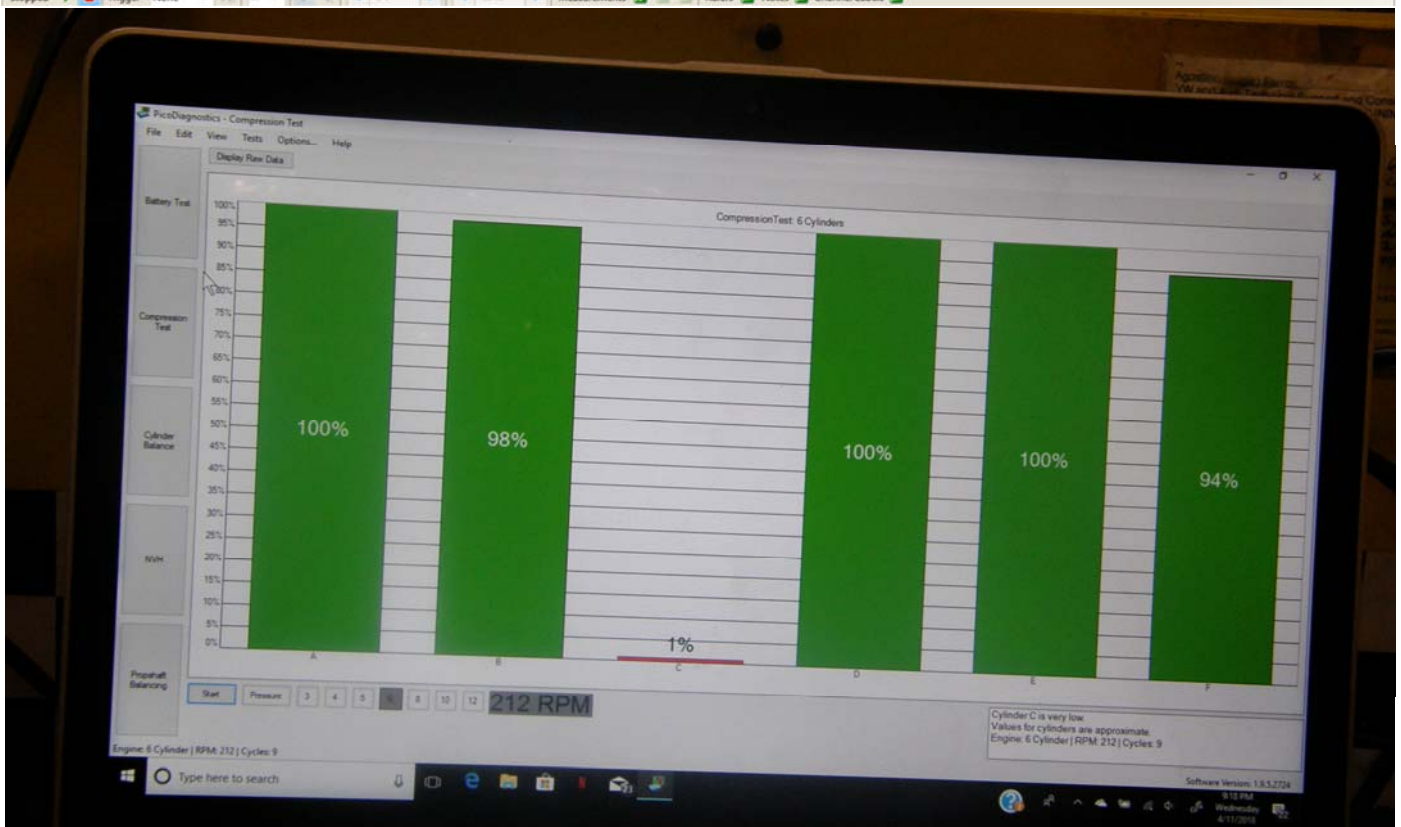
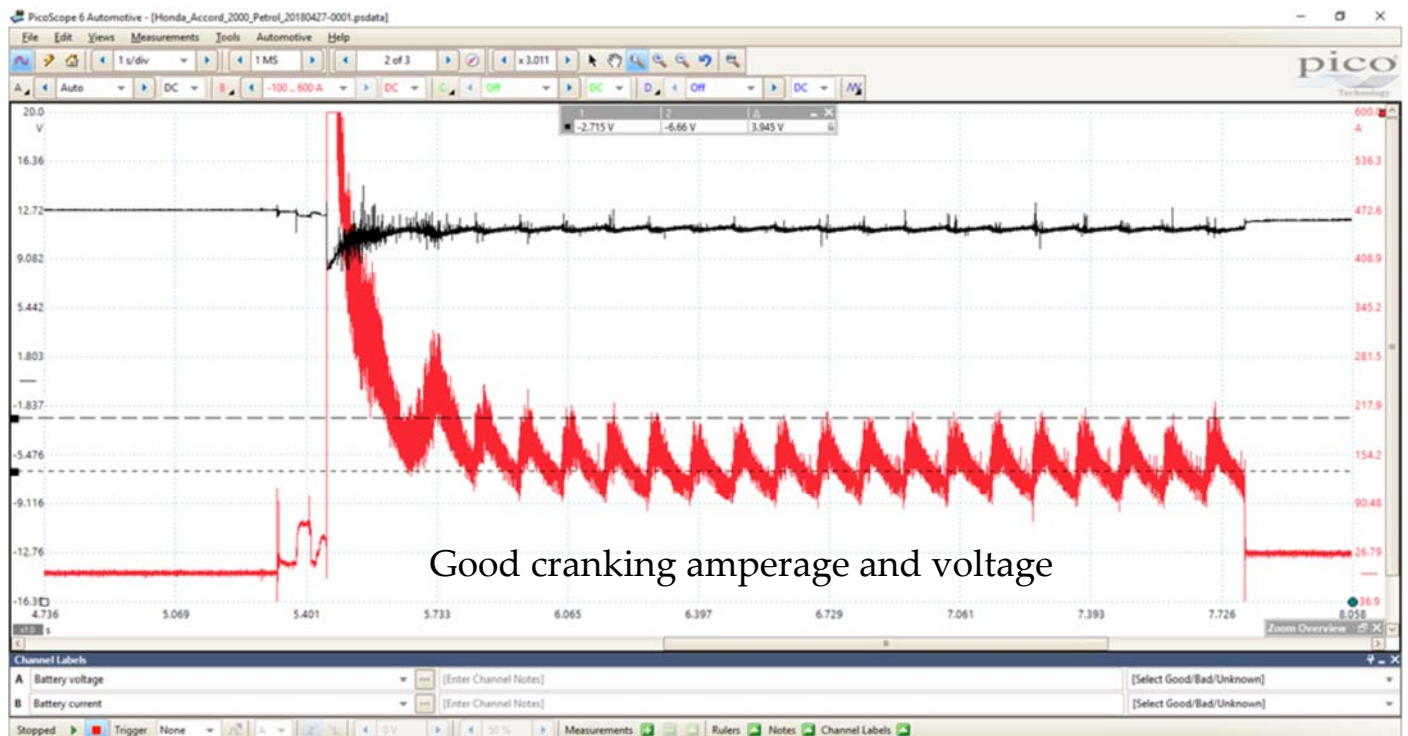
"Alternative Diagnostics" (con't from p. 7)



So what is a common BMW problem for which you need a quick diagnostic test? How about misfires? They can be caused by fuel, ignition or mechanical problems. A factory level scan tool is my first stop to "divide and conquer" decision making. Mechanical is the basis for all engine operations so that should be the area tested first. A quick test of engine health can be made with a scope and an amp clamp.

(Con't on page 11)

"Alternative Diagnostics" (con't from p. 10)



The above screen shot is an example of a non-contributing cylinder in a bar graph form of relative compression using the Pico software.

(Con't on page 14)

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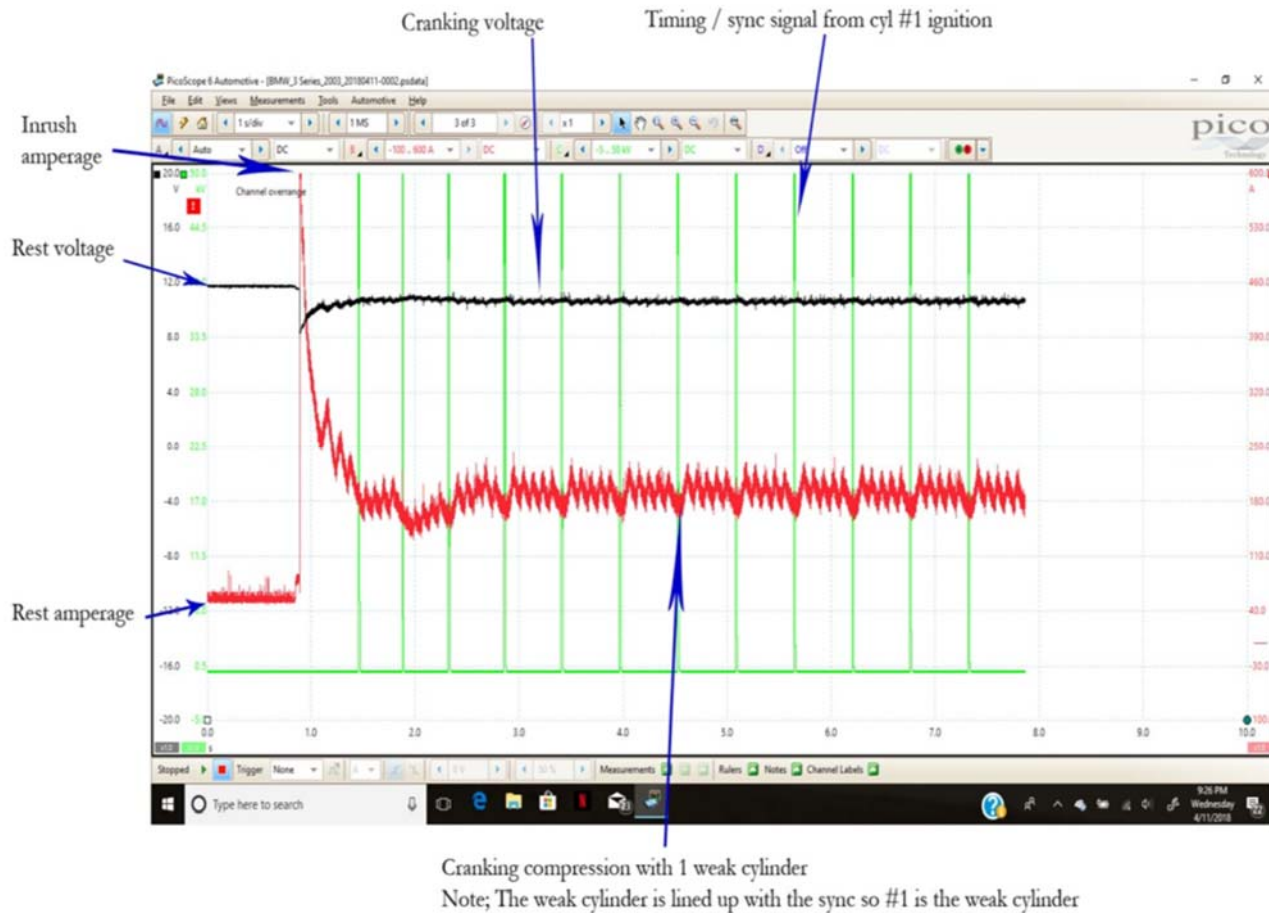
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"Alternative Diagnostics" (con't from p. 11)



The above is an example of a non-contributing cylinder in a raw scope form using the Pico scope.

Current is the red trace, Voltage is the black the trace and sync is green. This image shows a weak cylinder on a 6 cylinder engine. Cyl #1 was sync so #1 is the mechanically weak cylinder. Since this is a cranking only test, you would not look at fuel or spark in this case.

So what if the mechanical condition is good? Do you test fuel or ignition first? Usually I use and exhaust analyzer with a lambda calculator to give me a direction. If it's running 1.35 lambda (which means it is 35% lean), I am looking at mixture, not ignition. If, on the other hand, the lambda is 1.00, at all speeds, then ignition is my next area for testing.

(Con't on page 20)

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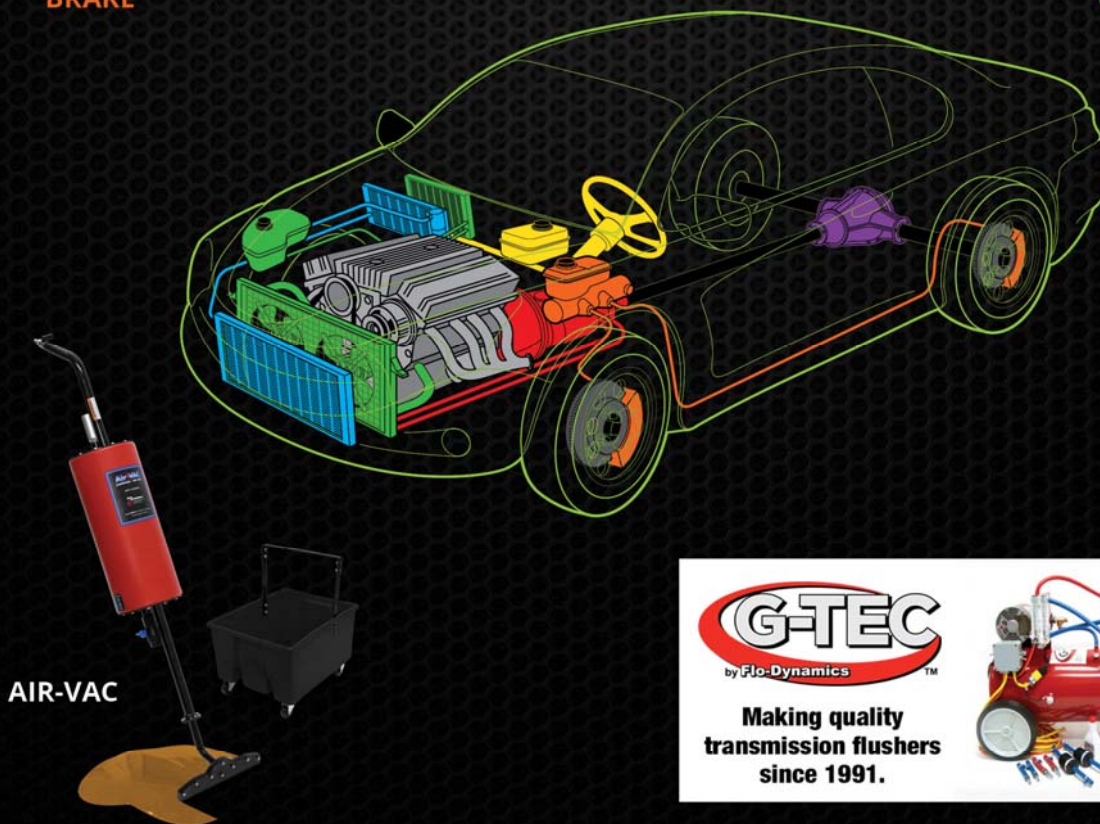
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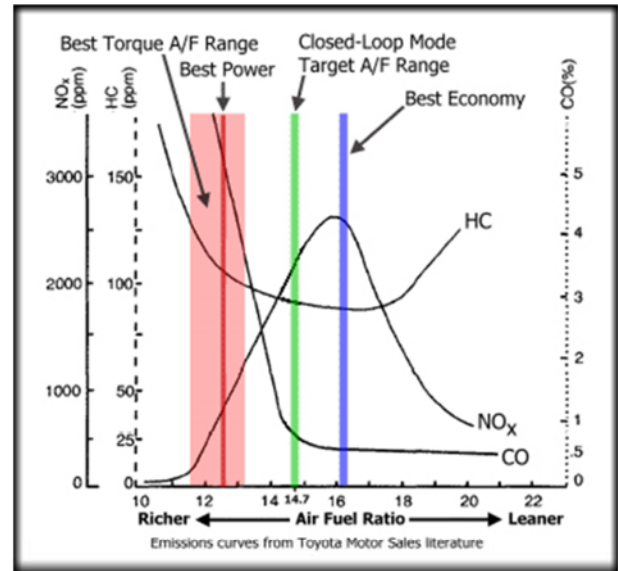


"Alternative Diagnostics" (con't from p. 14)

The chart to the right helps provide an understanding of fuel ratio issues.

Lean mixtures cause lean density misfires and extremely rich mixtures cause short burn times and carbon fouling.

The gas analyzer readings are from a '88 BMW 635CSi that shows a Lambda of 1.01 with low HC, CO and O₂ and good CO₂ at 14.22%.

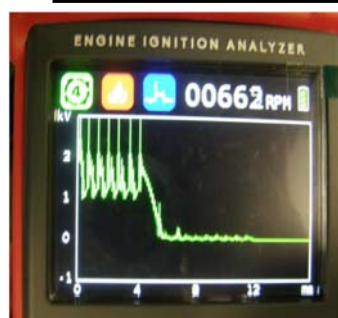


Any misfire on this engine would indicate good mixture control so look for an ignition problem. Please note, with a "real" ignition problem, the HC and O₂ would be elevated based on catalytic converter efficiency. A weak Cat would show elevated values and a strong Cat would be lower.



The GTC 505 ignition analyzer is an easy tool to use for quick ignition testing. This V8 has a misfire showing on the "burn time" screen.

The image below shows an E90 328i after replacing coils and plugs. Note, the firing KV is cut off at the top since the purpose of this test is to analyze burn time and to look for "KV kick" from a shorted output.



Tip; Modern BMWs have a multi-spark strategy at idle. Note the 7 peaks in the waveform to the left.

(Con't on page 21)

"Alternative Diagnostics" (con't from p. 20)

Once you determine whether it's fuel or ignition you can use a scope to measure voltage on one channel and current on another to diagnose faults.

Current ramping; Current ramping is the practice of using an amp clamp to measure the amperage in a circuit and display it as a waveform. Remember; the scope only "sees" voltage. The amp probe or clamp converts the amperage in a wire to voltage and outputs the voltage to the scope.

For example, to current ramp injectors, you can amp clamp the main feed to the injectors and see each injector on the circuit in sequence. Port injected BMWs are power side fed and grounded by the DME. Direct injected BMWs (including diesels) have power and ground side controlled by the DME. Always look at the wiring diagram to determine circuit design and DME pins. It is best to find an easy location to place the amp clamp. When possible, use a fused jumper at the fuse box and then surround the wire with your amp clamp. Remember; current is the same anywhere in a circuit. On a typical port injected BMW, I use the fused jumper for current ramping and read voltage at the DME pin for the bad cylinder.

A similar testing strategy works for ignition. By using a "sync" signal you can determine which ignition or fuel circuit is failing.

Tip; BMW has used a multi-strike strategy for fuel injectors for many years. This allows the use of low resistance / high performance fuel injectors without burning DME driver transistors. This strategy is the reverse of coils and increases the number of strikes as load increases.

Any motor or load can be diagnosed using current ramping. An example is a fuel pump. All BMWs can be tested at the pump. Again, look at the wiring diagram first so you understand

(Con't on page 24)



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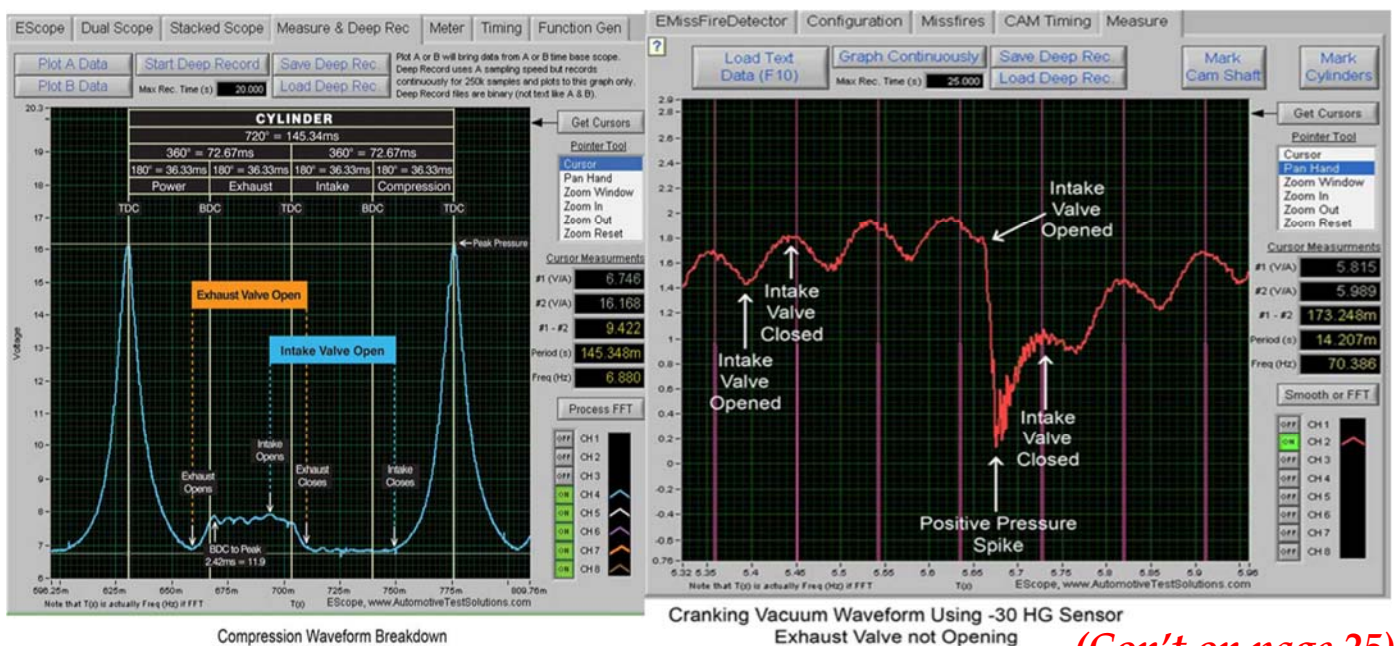


"Alternative Diagnostics" (con't from p. 21)

where to test. On many BMWs, you can use a looped fused jumper to test easily. You can see each winding of the pump armature, determine pump RPM and total current draw. If the pump runs slow look for voltage drop on power and ground side wiring. A too fast running pump can be caused by air / cavitation or low fuel pressure.

An erratic signature indicates wear and I like to advise my customers of potential pump failure when I see one. Remember, small decreases in pump speed will decrease fuel volume dis-proportionately while fuel pressure stays constant. You can confirm a volume problem with a flow gauge. Current ramping can be used on any other system on BMWs - for example transmission, body functions, ABS.

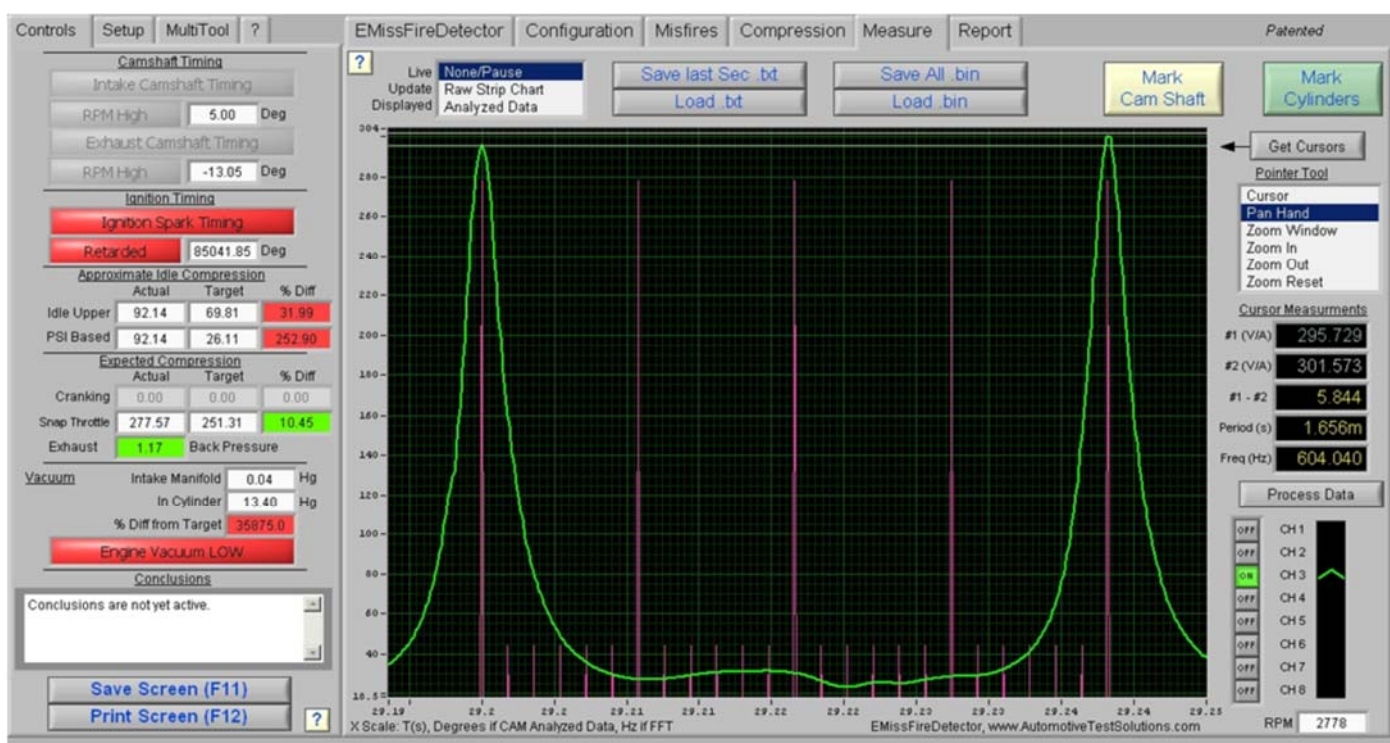
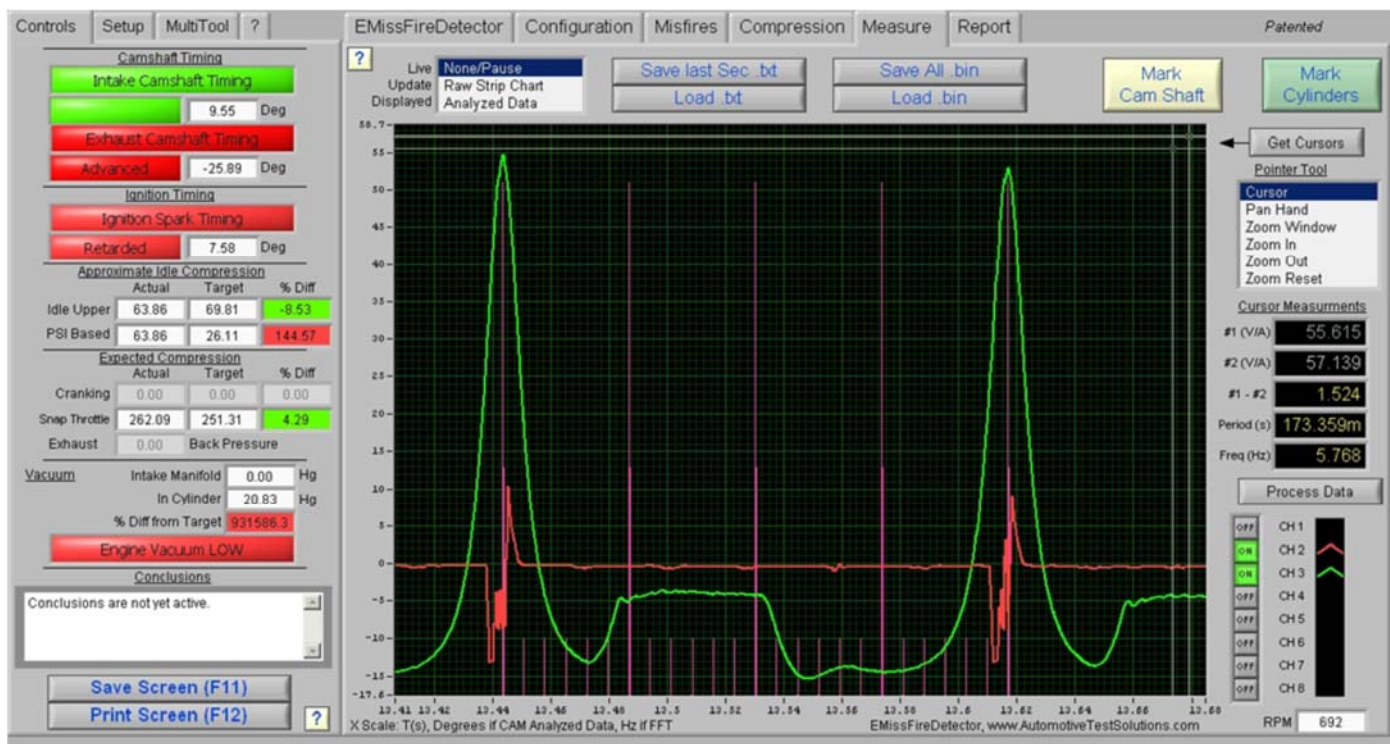
Pressure Transducers; Another alternative diagnostic method is to use pressure transducers. The purpose of the article is to expose the existing technology but using transducers is quite a large subject so let's touch on a few examples. Fuel pressure testing. Instead of using an analog gauge, by using a transducer you can plot pressure, in very fine detail, over time. Engine diagnostics. In cylinder diagnostics and pressure/ vacuum testing in the intake or crankcase.



(Con't on page 25)

"Alternative Diagnostics" (con't from p. 24)

Below are running compression waveforms on a '08 BMW 328i. First below is at idle and the second is a snap throttle condition.



Article by Pierre Respaut, Vice President ASE Master & L1 Technician and Eric Dibner TST Board Member

“TST Seminars and Big Event For 2018 & 2019”

The new season for seminars started in September and continues on with this month's. We have 3 more seminars besides November's that are in January, March and May 2019.

TST has a total of 6 seminars, 5 of which be held in four different states along with 5 simulcast seminars.

We also have our 16th annual TST Big Event on Saturday March 30, 2019. The list of instructors for this season are once again the top in the industry. This year started off with Bob Augustine in September and rolls along with; Eric Ziegler in October, Pete Meier in November, Brandon Stickler in January, **Kris Lewis, John Anello, John Thornton for the Big Event**, and Ken Zanders to finish the season of training up.

Members can save money by purchasing the package, bringing the seminar price down to \$50.00 for seminar and \$30.00 for simulcast. The TST Big Event can be purchased with the seminar package for \$100.00 if your membership is up to date. If you have not purchase a seminar package you can do so at the adjusted rate. A credit for the months that have past will be offered. ***Remember that the TST seminar package saves you money!***

No problem if you miss a seminar, since you will receive online access for one year along with the handout of the seminar and the TST newsletter.

Another benefit that is part of a TST membership is discounts on tools and equipment. Before you purchase any tools check with TST to see how much you can save.

Note: We made more room for additional table seats for the TST Big Event by moving the vendors. SIGN UP NOW to reserve you spot at a table. Once again every techs receives a FREE New ANDROID TABLET.

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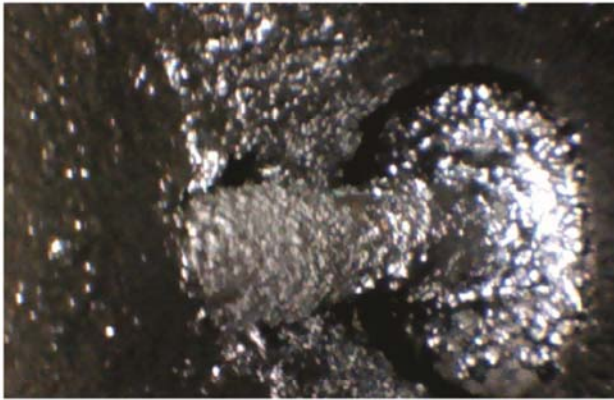
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- ▶ **Ultra Sharp Waveforms:** No need for filters that can mask data. ATS designs our scopes so the signal is accurate and clean.
- ▶ **Dual Time Base:** This allows two different frequencies to be displayed on one screen with two different scope displays, simultaneously.
- ▶ **Pull Down Circuit:** A Controlled pulse that sinks power from vehicle circuit to ground. Control circuits like ignition coils, fuel injectors and solenoids.
- ▶ **TTL Output:** Sends a 0-5v square wave signal out of scope. Turn on devices such as ignition coil drivers, test vehicle's circuits, and test vehicle's circuits for loading.
- ▶ **Automatic Test Lead Connection Detection:** This unique feature allows you to know the scope lead has a good connection. "Red" = Bad connection. "Green" = Good connection. It's that easy!
- ▶ **Patented Overlay Technology:** ATS' unique programming overlays an engine cycle grid over your waveforms.
- ▶ **Automatic voltage attenuator:** Just change the voltage setting and the scope does the rest.
- ▶ **Deep Record Function:** No time, voltage, or trigger setup needed.
- ▶ **Pressure Transducers:** Drives four pressure transducers at once.

Finally...

A Cleaning Solution That Actually Works!

1.6L Turbo Mini Cooper at 83,000 miles

Before Cleaning



After Cleaning



3C Intelligent Induction Cleaner

Patent Pending

3C Intelligent Induction Cleaner (Patent Pending) removes heavy carbon deposits from the internal combustion engine's induction system in just 20 minutes.

Air Assist Injection Nozzle (Patent Pending) delivers chemical in small droplets that are suspended and carried to the carbon deposits by the engine's air flow. This air assisted nozzle is superior to any other nozzle available for carbon removal.

Chemical Layering (Patent Pending) removes more carbon because it alters the application of chemical mixtures between chemical A and Chemical B in on/off cycles, then washes the induction system with Chemical C.

Micro-Burst Injection Technology (Patent Pending) delivers the maximum amount of chemical during the cleaning process while still allowing the engine to run well.

3C Chemical A, 3C Chemical B, 3C Chemical C (Patent Pending) are laboratory proven to remove more carbon weight from different carbon types than any other commercially available induction carbon cleaning chemical, while having a low HMIS health rating of (2).