WHICH SCOPE/METER IS RIGHT FOR YOU?

By Jorge Menchu

If you're in the market for a hand-held tester, here's a look at six popular scope/meters and what they can do, plus a side-by-side comparison to help you make a more informed buying decision.

If you were told there was a tool that would allow you to learn more and learn it faster, plus fix cars quicker and more accurately, would you be interested? Well, let me introduce you to the System ACE Viewer. With it you can see things you've never seen before. And you'll do things you never thought possible!

Photos & screen saves: Jorge Menchu

What makes a System ACE Viewer so powerful? The magnificently simple way that it represents and organizes system events and quantities—more specifically, the *A*ctivities, *C*ommunications and electrical *E*nergy of the system.

So how come you've never come across such a great tool? Oh, you have, and it's called a lab scope!

Fact is, without the detail of a lab scope, many of your diagnostic decisions become nothing more than educated guesses. If you don't own a scope, you simply can't learn as much and as fast as someone with equal ability who does have one. And then there's the ultimate goal—developing an understanding of automotive systems so well, you'll know when you have to use a lab scope and when you don't.

This article will give you a close-up look at six scope/meters so you can compare the features of each to see which best fits your needs. The units are: the UEI ADL-7100, Fluke 98 Series II, OTC Perception, Snap-on's Vantage PGM, Interro's PDA and the Vetronix MTS 5100. Check out the comparison boxes beginning on page 32.

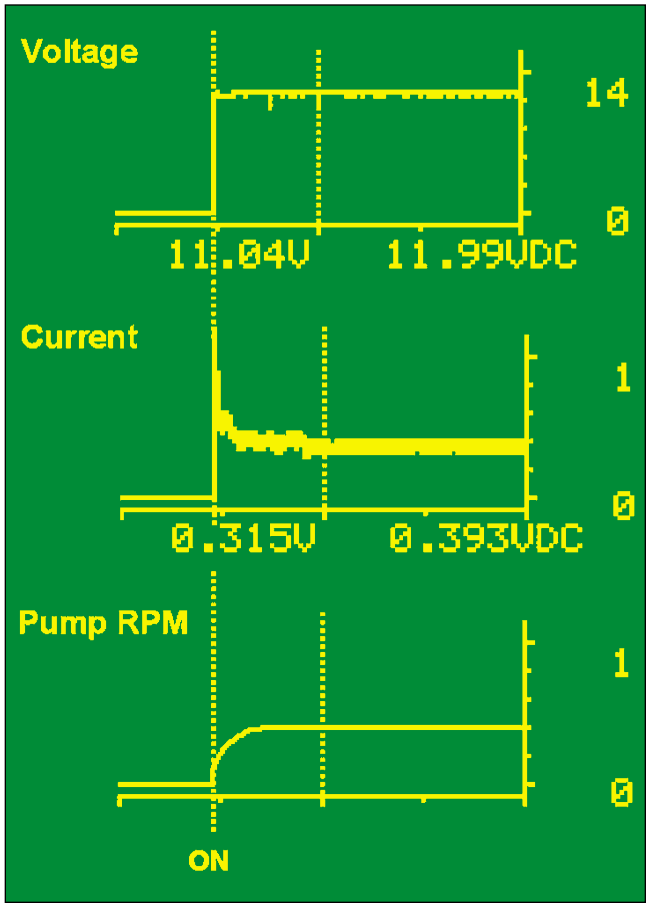

Fig. 1

ACE in the Hole

Primarily a voltmeter, a lab scope offers high-speed charting of circuit voltage and current (using a current probe). Of course, these are two of the three main ingredients of Ohm's Law, and between them, one can get a pretty good picture of System ACE.

Let's take a look at Fig. 1 at left. This is a comparison of fuel pump voltage and current as they relate to pump rpm.

The voltage waveform represents all of the **activities** and conditions that must be present to activate and keep the pump circuit activated. The current waveform shows an inrush of current, with the curved ramp down indicating, to some degree, the spin of the pump motor. System **communication** is represented by the activation of the cir-

Fig. 2

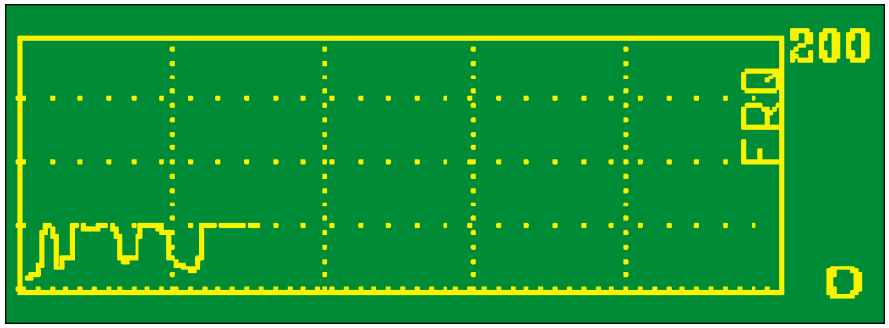

Fig. 3

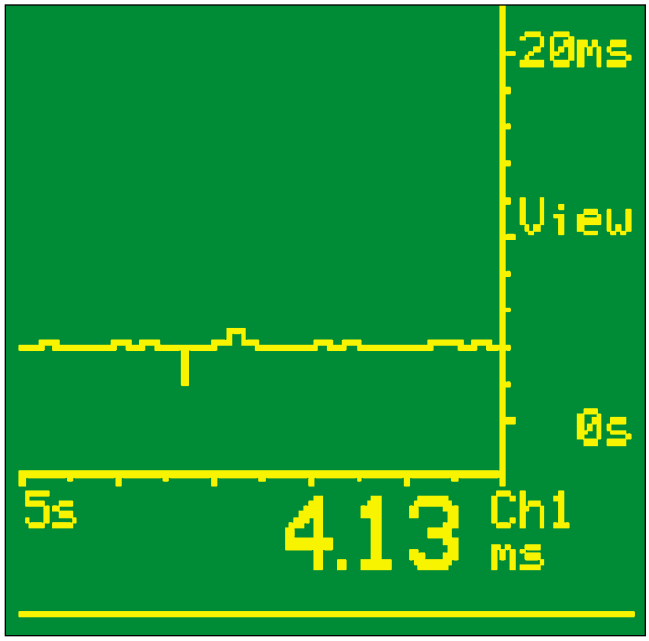

Fig. 4

cuit and the resulting waveform changes. The voltage waveform indicates the integrity of the **energy** source. The current waveform, meanwhile, shows how much energy is actually available to drive the pump.

To some degree, System ACE can be found in all waveforms. Being aware of this is the first step toward successful waveform analysis, even if you're not an electronics expert! If you have a general understanding of automotive systems and circuits, waveform analysis starts simply by relating signal changes to what you see and hear in the environment, what you know about the system and circuit and the occurrence of the problem you're looking for.

So, are you ready to get your own System ACE Viewer? Good! But there are a few considerations to keep in mind to get the most out of your investment.

First off, the best way to determine if a particular scope is right for you is to use it for a week or two. Of course, that's not always possible, so ask around and get opinions from other techs. But beware: Others' choices are most likely driven by needs that may differ from yours. So get an idea of what's available, then combine that with an evaluation of *your* needs and expectations.

Today the term *lab scope* is actually used to describe a multifunction instrument that offers information in many formats, including waveforms, numeric displays and graphs. Therefore, an important consideration when purchasing one is to determine what features and display modes it offers. To do that, you have to understand what each mode is and how it's applied:

Digital Meter Mode (DMM). Many numeric display modes are characterized

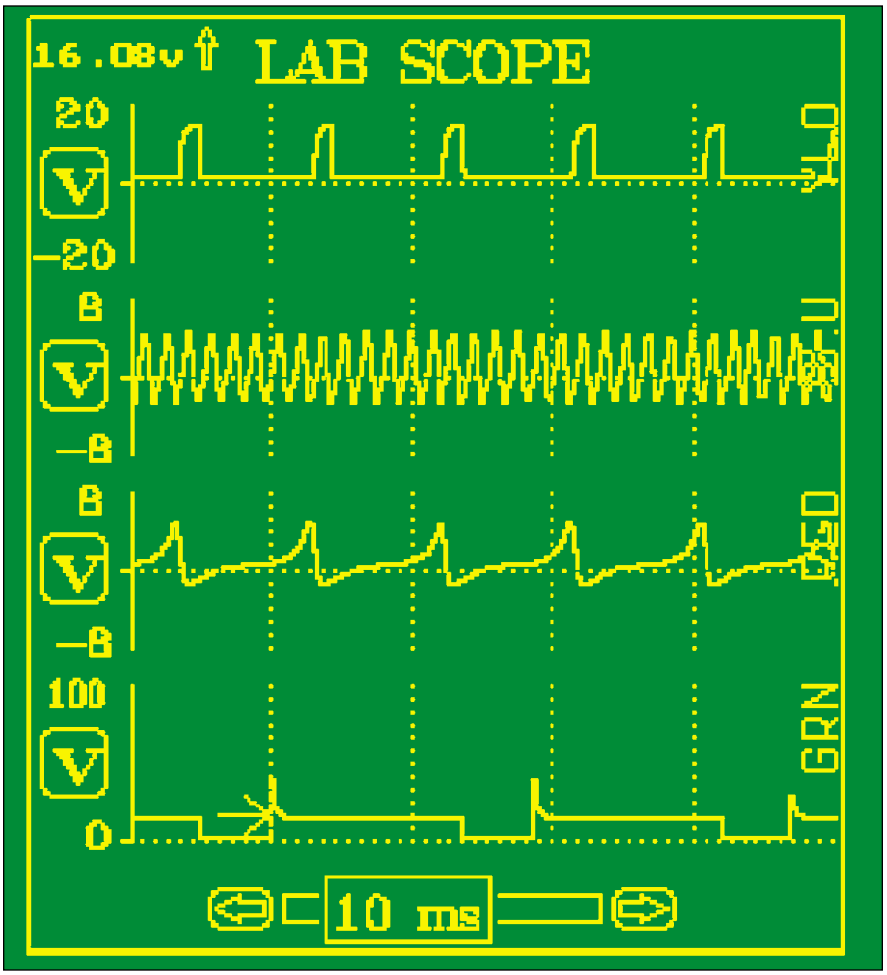

Fig. 5

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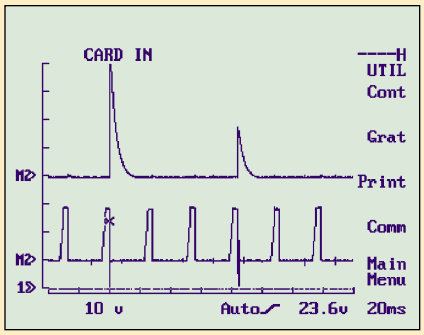
by a slow update (two to four times per second) and the fact that the values are most likely averaged. The digital meter mode (Fig. 2, page 28) is ideal for determining specific values of measured quantities such as frequency, pulse width, duty cycle and discrete voltage levels. But because of the averaged value and slow update, this mode is not recommended

Use the following boxes to compare the features and capabilities of six of the most popular scope/meters on the market. Keep in mind that many of the points mentioned may be simply a matter of personal preference. In the "Is it for you?" line, the numbers refer to the following user profile:

1 - You don't want to stress your brain; you just want to see a waveform.
2 - You need something more than a DMM and just want to get cars fixed.
3 - You're a student or are just starting out in the repair industry.
4 - You're an educator and want a portable, hand-held scope.
5 - You're trying to comply with smog program requirements.
6 - You have a power graphing meter (PGM) and want more powerful waveform capabilities.
7 - You want the best balance between power and price.
8 - You want a second scope.
9 - You want a PGM.
10 - You want a PGM and scope.
11 - You want to replace a big box ignition analyzer with a hand-held unit.
12 - You aspire to be a cutting-edge automotive diagnostician.
13 - You want the latest and greatest tool out there.

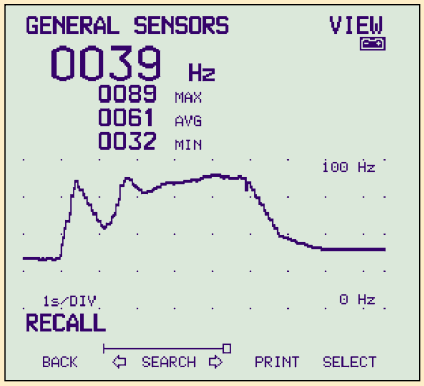
UEI ADL-7100



Peak detect results in clear, accurate waveforms, even when using two channels.

Approximate price	$750
Format	DSO
General comments	A 2-channel lab scope, it includes PCMCIA slot for a program card with sample waveforms and scope setups. Comes equipped with secondary pickup and basic lead set. Has peak detect on both channels, making it perfect for viewing injector spikes and high-frequency signal changes. Peak detect feature can be a problem when viewing some signals, such as O_2 sensors, because it can result in a hairy (noisy) signal. This can be minimized with shielded test leads and/or a low-pass filter.
Notable features	Combination of fast screen update and peak detect makes scope ideal for displaying fast signal changes and glitches. It works well for superimposing ignition waveforms. Use this meter when you're in a hurry and simply want a waveform. It's quick, easy and powerful.
Is it for you?	3,5,6,8
Pros	Fast screen update •Easy to operate •Good bang for the buck
Cons	Needs better leads •Max voltage setting of 10v/div can limit diagnosis •Just a lab scope
To learn more	*www.uei.com*

Fluke 98 Series II



Power graph of a timing control pulse. The PGM function of the 98 indicates the history and trends of a signal, and because it's a power graph, will nail dropouts easily.

Approximate price	$2500 (no longer in production)
Formats	DMM, GMM, PGM, DSO, Ignition Analyzer, Engine Analyzer
General comments	The combination of lab scope mode (DSO), PGM and the continuous waveform record makes this scope an ideal data acquisition unit. When you hold this meter in your hand, you know you have a solid piece of engineering, inside and out. Perfect for training because it can show the application of all measurement modes. Use it when faced with a tough diagnostic situation, to take advantage of the PGM, DSO and continuous waveform record.
Notable features	Set the standard for automotive lab scope technology with a powerful combination of quality, features and capabilities. This 2-channel scope comes equipped with a very complete test lead kit, including standard ignition and trigger pickups. Has a feature for most diagnostic situations.
Is it for you?	3,5,7,10,12
Pros	Great screen layout •Automotive-specific menus based on signals, not vehicles •Great mix of features
Cons	No longer being produced, although still supported by Fluke •Peak detect on only one channel •No expansion ports
To learn more	*www.fluke.com*

for high-speed glitch detection or in-depth circuit analysis.

Graphing Meter Mode (GMM). Graphing meters are similar to the digital meter mode in almost all respects, including the averaging of the displayed value. The difference is how the value is shown. Instead of a numeric display, the value is graphed over time.

A graph offers one major advantage over a numeric display—the plot shows the history and trends of the measured value (Fig. 3, page 28). But because of its "averaging" aspect, the graphing meter mode, like the digital meter mode, is not recommended for detecting high-speed signal changes.

Power Graphing Mode (PGM). At first glance, the PGM appears similar to the graphing meter mode. But there's one significant difference—the values are *not* averaged. The PGM plots individual values that reflect the greatest change from the last plotted value. The power of a PGM is realized when measuring the frequency, duty cycle or pulse width of repetitive signals. For example, the Snap-on Vantage can react to and analyze every pulse of a repetitive signal up to 20kHz. This means that if a single cycle drops out, or a high-speed glitch occurs, the Vantage will catch it (Fig. 4, page 30).

Lab Scope Mode (DSO—digital storage oscilloscope). The lab scope mode, also called a *waveform viewer* by some manufacturers, offers two-way high-speed charting of signal levels: the voltage waveform and the current wave-

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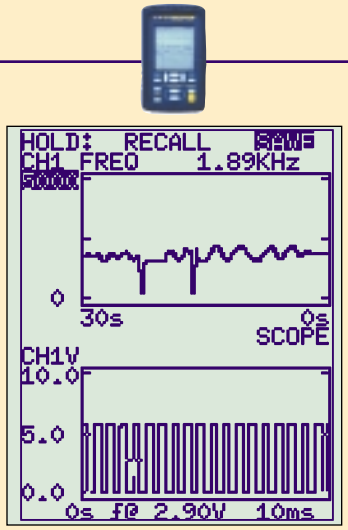
OTC Perception



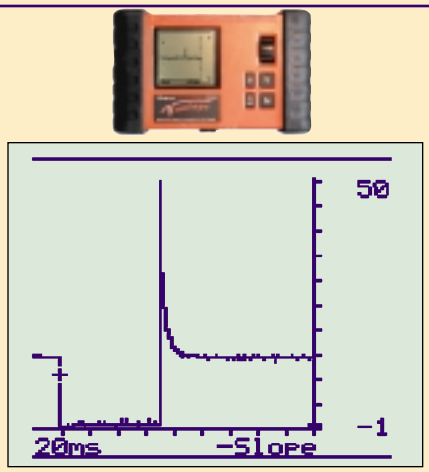
The Perception can display both a power graph (top) and a waveform of a digital signal on one screen.

Approximate price	$1700
Formats	DMM, PGM, DSO, Ignition analyzer capabilities
General comments	In many respects, this meter is one of the best-kept secrets in automotive, and is a great balance among power, ease of use and cost. A 2-channel multifunction instrument, it includes an information database and allows for the display of a power graph and waveform at the same time. Comes standard with a very basic lead set.
Notable features	The only scope on the market that has a true glitch detect, as opposed to a peak detect. This feature draws a dynamic envelope around the incoming signal; if the signal exceeds the envelope, you hear a beep and the waveform is saved in the scope's memory. Powerful! Use this meter when you don't have time to watch the screen waiting for a problem to occur.
Is it for you?	3,5,7,10,12
Pros	True glitch detect •Power graph & waveform can be displayed simultaneously •Info database
Cons	Busy screen •User interface requires extensive key manipulation •Needs lead upgrade
To learn more	*www.otctools.com*

form (with an appropriate current probe). Voltage and current—two of the three Ohm's Law variables! The lab scope is imperative for detailed, in-depth analysis of high-speed signals (Fig. 5, page 30).

There are other products in addition to the meters compared in detail here, and you should know about them. For example, the Fluke 123 and 190 and the Tektronix 700 series. These pure lab scopes are diagnostic powerhouses for general electronics that can easily be adapted for automotive use with the inclusion of a good automotive test lead set. On the more specialized side and certainly worth investigating are the Vetronix Mastertech and the Blue Streak BDM. Both are state-of-the-art scanners, with lab scope capabilities built in. And if you want to see the latest trend, check out the CJMax at *www.injectoclean.com*. This is the first lab scope on the market based on a hand-held computer! Could this be the thing of the future? Only time will tell.

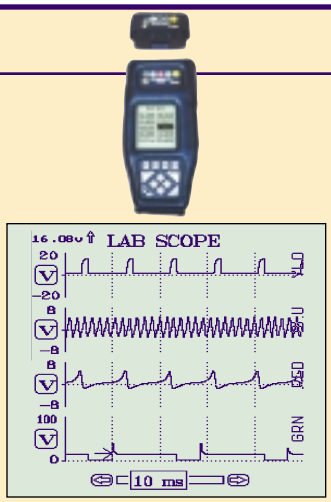
Snap-on Vantage PGM



The Vantage's Waveform Viewer is very capable, as witnessed by this saturated injector waveform. Notice how clearly the spike is displayed.

Approximate price	$2000
Formats	DMM, PGM, Waveform Viewer (DSO), Ignition capabilities (with optional kV module)
General comments	A 2-channel instrument that's primarily a PGM, but also has waveform viewer capabilities. It's the first hand-held to combine an information database with a test instrument. The database includes very useful information, including test procedures and options, as well as connector locations.
Notable features	Extremely adept at analyzing repetitive signals. Tremendous power and convenience. Use the Vantage for general-purpose testing and when trying to capture an intermittent in a repetitive signal.
Is it for you?	1,2,3,9,10
Pros	Extremely powerful power graphing •Built-in world-class info base •Extremely easy to use
Cons	Average display •Basic waveform capabilities only •Low battery life (try rechargeable alkaline cells)
To learn more	*www.snap-on.com*

Interro PDA



Using multiple channels allows for detailed analysis of signal relationships, such as in this example. From top: timing control, crank signal, cam signal and injector waveforms.

Approximate price	$1195 (base unit only; modules extra)
Formats	DMM, GMM, DSO, Ignition Analyzer, Engine Analyzer
General comments	Actually a base unit that includes expansion and PCMCIA slots. An array of plug-ins convert the base unit into a 4-channel lab scope, ignition analyzer, engine analyzer or system sweep tester. First hand-held ignition analyzer on the market. Clean waveform display and good screen update rate. Simple to use, very adaptable and powerful.
Notable features	Multipanel display in DMM mode displays different types of measurements on each channel. Record and playback functions are terrific. Plays back signal as if it were live! Grab the PDA when you're preparing documentation and need waveforms. Can also be used for general testing purposes, especially when you need to analyze the relationships of four different signals.
Is it for you?	5,6,8,11
Pros	Screen record & playback as movie •The power of 4 channels •Easily expandable
Cons	No AC input coupling •Just a GMM, not a PGM •Test leads are fat & heavy
To learn more	*www.interro.com*

Bringing Everything Together

This article should offer a good starting point in your quest for a quality diagnostic tester. One thing I'd like to mention is that if I were working on vehicles full time, I'd have both a power graphing meter and a lab scope. I'd use the PGM to determine if a problem exists in a repetitive signal, then the DSO to examine the signal in greater detail. Note that you can get both in one platform, or purchase them separately. It's your call.

Whatever you decide, get a tool that inspires you to use it. This could mean that it's easy to use, or, for the power hungry, has a bunch of buttons and fancy options. And finally, remember: It's not only a tool to help you fix cars; it's paramount for learning about them and their circuits. M

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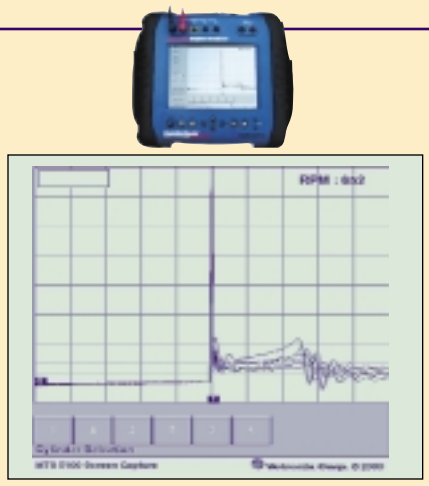
Vetronix MTS 5100


The high-speed screen update is perfect for superimposing ignition waveforms. Bad ignition events will not line up with the good cylinders.

Approximate price	$6355
Formats	DMM, PGM, DSO, Ignition Analyzer, Engine Analyzer
General comments	Latest, most sophisiticated offering on the market. A well-engineered 4-channel scope with multiple inputs, including separate DMM and ignition inputs. Has a USB port and other standard computer interface ports. Very large, ultra-sharp display with touch screen, which is part of the user interface.
Notable features	Unbelievable hardware package, with power to spare. What it is now can be easily expanded with future software updates. With all the in/out data ports, this is certainly a platform made to grow. If you want raw power and the ability to control it, this meter is the ticket!
Is it for you?	5,10,11,12,13
Pros	Fast screen update (8 times/sec) •4-plus channels •Extremely powerful hardware
Cons	Not for tight budgets •Short battery life •Power graphing feature can't be used on more than one channel
To learn more	*www.vetronix.com*