CHOOSING A SCOPE

Frank Massey scopes out what technicians should look for when picking a oscilloscope

Having just completed a foundation oscilloscope course this weekend, it became very apparent that a large number of technicians in our industry lack good advice in both choosing and using cutting edge diagnostic tools.

So this topic is dedicated to my favourite friend – the oscilloscope. This year, June to be exact, will be my 50th year in automotive engineering, so I have witnessed first hand how mechanical systems and electronics have evolved.

Adapt and change

I don't agree with all that's happening, with autonomous self-drive a clear example. I do however agree in the way we must adapt and change. My diagnostic career began with analogue or moving beam scopes. My first experience with digital scopes was a disaster. The Crypton Cudos not only failed regarding signal integrity, it also caused a probing reaction in sensitive circuits, like Lambda and some crank angle sensors.

This led to a fateful decision in seeking a competent oscilloscope from the electronics industry. I owned various Fluke and Tektronix scopes, before moving to the Pico range. During years of research into high performance scopes I became unpopular with most automotive diagnostic scope providers.

Going digital

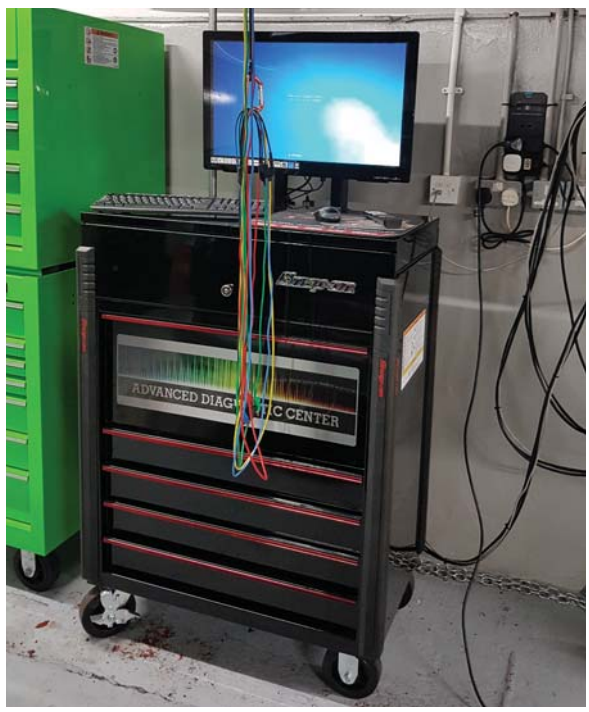
So, what is a digital oscilloscope, how do they work, how do you choose one, and what ancillary accessories are important?

- Performance
- User interface
- Industry standard connectivity
- Software support
- Cost

Performance is critical. Bandwidth is the maximum frequency of the incoming signal that can be reproduced without a reduction of signal integrity. It must be ten times the input signal frequency. Assuming high speed can at 1MHz, the minimum specification should be 10 MHz. The minimum standard set by professional scope manufacturers is 20MHz. This is often compromised with multiple channels that divide the AC/DC conversion. This means that selecting multiple channel input can divide bandwidth, so check specs carefully. Test leads can also reduce bandwidth ensure they match or exceed the scope bandwidth. A lack of bandwidth will distort signal amplitude, edges will disappear or become distorted and high frequency changes will not be resolved.

A digital scope takes multiple samples of the incoming waveform, stores them, and then reassembles them as a visual image. The higher the sample rate, the more detail you have. Unfortunately, if the bandwidth or sample rate is to low you will get an image that is not a true representation. This is called aliasing.

BY **Frank Massey**



Below: Equipment in the workshop

Critical tools

The three critical tools of a digital scope are:

- Acquisition
- Storage
- Display

These are different ways the sampling is applied to the incoming signal:

- Acquisition tools
- Sample mode
- Peak detect
- High resolution
- Envelope
- Average

Storage is often the deal breaker, as scopes must be both fast and have vast storage capacity. I own a fabulous 2.5GHz Tektronix digital phosphor scope. It offers a two thousand five hundred million bandwidth, but has a very limited internal memory. Therefore, I use a Pico scope. It is fast and utilises the PC memory. Job done.

Display; Interface; Connectivity

How the data is displayed on the digital monitor is very important, as is having the tools available to enhance or change its appearance. Pico has a 12bit resolution offering exceptional clarity. Do not confuse clarity with accuracy as some scopes offering visual clarity lack signal integrity.

User interface is achieved through the knobs and buttons that you use to manipulate the scopes controls. My Tektronix scope has manual buttons and switches whereas the Pico has virtual buttons. They both do the same job. The important feature here is that are they simple and unambiguous.

Universal connectivity is a big help too. Does the scope offer BNC ports? If it does then the world is your oyster. These are the industry standard, offering a wealth of accessories. Many automotive tool manufacturers offer their own non-standard ports restricting your flexibility and offer costly and limited accessories.

The accessories options are wide and extensive so let's explore what is vital and what's advantageous.

Test leads; High frequency signals demand 10.1 attenuation with 10meg Ohm resistance. The bandwidth is vital and must match or exceed the scope range. 1.1 leads are fine for most automotive applications; However, consider how you are going to probe various automotive sockets. Colour and length help working flexibility.

Current measurement is the holy grail of load bearing circuit evaluation. They range from 2k amps down to milli amps. Pressure measurement offers a unique insight into mechanical functionality in real time. All our compression testing is conducted with a running engine. Turbo boost and control evaluation exposes discrete errors. Vibration and noise measurement is the new kid on the block, well not quite. Other industries have been relying on its importance for many years. Our gifted Royal Navy submariners can monitor and identify target vessels thousands of miles away from sound waveform signatures. Everything we take for granted in a vehicle is based on frequency signatures. Measure them identify them and accurately predict their status.

To conclude, the subject is enormous. I have been a pioneer for over 30 years and I am still learning. a final word of advice before you choose a scope demand the full spec sheet. If it does not exist there is a good reason.

Walk away!

Right:
Pico kit