BY DICK LAJEUNESSE*

Making Your Job Easier with a DSO

NOT THAT LONG AGO, ANALOG-OSCILLOSCOPE TECHNOLOGY WAS THE ONLY PRACTICAL SCOPE TECHNOLOGY AVAILABLE. IN THOSE DAYS, ANALOG SCOPES PERFORMED VERY WELL; THEY DISPLAYED REPETITIVE SIGNALS IN REAL TIME and were affordable, familiar tools that users had come to depend upon.

Over time, as the use of electronic devices accelerated, so did signal complexity. New measurement power was needed to capture and analyze the new, complex, and, in many cases, single-shot signals. The answer proved to be digital technology, and a new generation of scopes was born—the digital storage oscilloscope, or DSO.

Initially, digital technology was too expensive for all but high-end R&D applications. Also, technical limitations such as limited sampling rates, slow screen updates, and unfamiliar user interfaces slowed widespread acceptance of DSO technology by analog users.

Today, much has changed. Digital-storage technology has become highly affordable, and an exciting DSO technology called Digital Real Time (DRT) has overcome the sampling limitations in lower cost DSOs. Screen-update rates and the user interface also have improved dramatically.

What benefits can you expect from the new digital storage oscilloscopes, and how will they make your job easier? Digital storage capabilities fall naturally into four categories, and, as we shall see, there are benefits to be found in each: The first is acquisition (of waveforms); second is viewing (the information); third is interpretation (of the data); and fourth and last is storage (of waveforms and data). Within those categories, you'll have the ability to capture and analyze the most complex single-shot signals; manipulate them on-screen; analyze them with automatic measurements and reference waveforms; store them indefinitely; and obtain hard copy from a variety of printing resources. Those are all capabilities that are not provided by analog oscilloscopes.

Acquiring Waveforms

In addition to the acquisition capabilities you've come to expect from your analog scope—automatic setups, cursor-based readouts, save/recall settings, peak detect and triggers—you'll be pleasantly surprised by the significant new acquisition capabilities a digital scope supplies.

Whether you are troubleshooting an electronic device such as a CD player or dealing with the kinds of signal noise that electronic devices generate over power lines, you will find today's DSO an invaluable tool. It will enable you to capture easily not only the single-shot signals that occur frequently in the digital world, but also a variety of glitches, high-frequency noise, and harmonic signals. Those are the kinds of events that you were unable to view with your analog scope, but that you may be encountering much more regularly in your work.

When your DSO incorporates DRT technology, your job becomes dramatically easier. That is because DRT oscilloscopes run at incredibly high sample rates (up to 5 GS/sec) and actually acquire their signals in real time. At such high sampling speeds, they can gather from each signal cycle all the samples necessary to faithfully construct the waveform, even from elusive single-shot events.

In fact, DSOs with DRT can achieve real-time acquisition up to their full analog bandwidth, both for repetitive and single-shot events. And they provide that capability on all acquisition channels

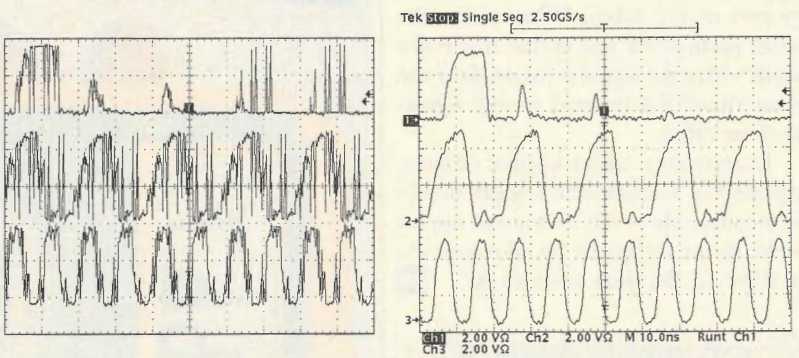

FIG. 1—A DRT (LEFT) ELIMINATES the confusing distortion and aliasing sometimes found in conventional DSOs (right), while achieving full bandwidth for repetitive and single-shot events.

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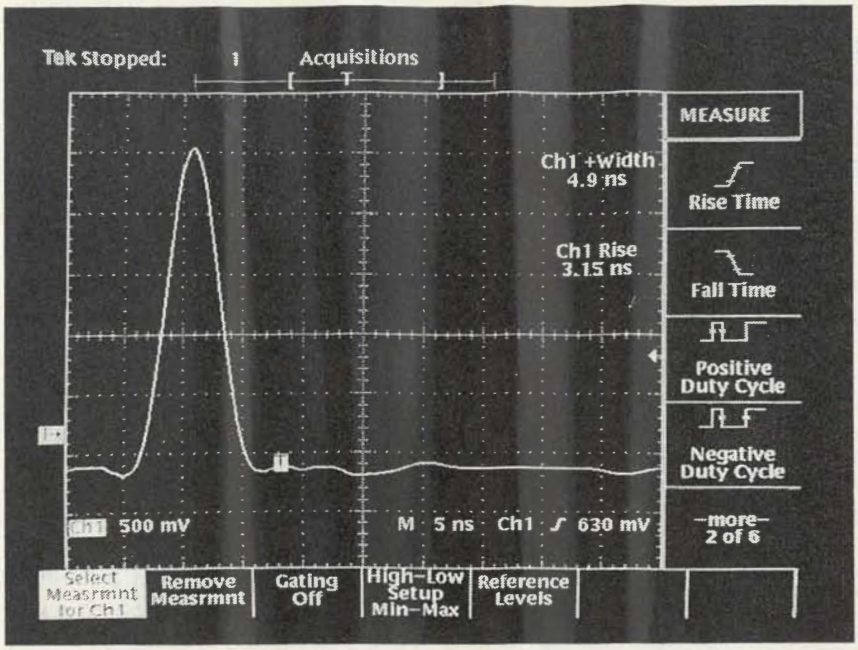


FIG. 2—AUTOMATIC MEASUREMENTS, like pulse width and rise time, help take the guesswork out of interpreting the information and give you the confidence of right answers every time.

simultaneously. The benefit for you is a clear, easily understood display (see Fig. 1) without the confusing distortion and aliasing found in conventional DSOs.

What's more, you can now choose from a variety of acquisition modes to find the optimum method you need to capture the waveform information. For example, you can select from sample mode to uncover spurious events, or peak-detect mode to see the extremes of the signal. You also might choose envelope mode to show the signal's highest and lowest points, or average mode to minimize the effects of noise. In addition, pre-trigger, a function not available in analog scopes, lets you capture information that occurs prior to a trigger event.

With a modern DSO, you also will be able to easily save not only the waveforms you need for future reference, but any setups as well. Saving sample waveforms can facilitate your job significantly when it comes to viewing and analyzing the information.

Viewing the Data

Because the data is stored permanently in a DSO, you gain a lot of flexibility when viewing the information. Unlike analog displays, you can manipulate the DSO display in any number of ways to view the information after the acquisition. For example, you can zoom in or out on segments of the waveform. Although you might have set up the scope in one way to view the entire waveform, with DSO waveform-manipulation features, you are free to isolate any segment of it, including the trigger point, and examine it in greater detail. You can limit your measurements, including any pre-trigger conditions, within a specific region of data or view the waveform in its entirety.

Interpreting the Information

Once you've captured and viewed the information, a whole new world opens to you when analyzing the data. Automatic measurements, which take much of the drudgery out of your work, give you the confidence of right answers every time. Automatic measurements essentially give you a computer inside your scope in the form of digital signals processors (DSPs). The DSPs perform a variety of mathematical calculations very rapidly and supply answers that make it significantly easier to interpret the waveform (see Fig. 2).

Beyond the common arithmetic functions of add, subtract, divide, and multiply, users benefit from averaging functions that remove noise and improve resolution. FFT (Fast Fourier Transform) functions perform spectral analysis of any trace, and histograms show distributions of measured values. Pass/fail testing functions and trending data, as well as a variety of other useful calculations, round out the selection of automatic measurements found on most modern DSOs.

Reference waveforms—waveforms you saved earlier—now can be used to compare with current waveforms. By simply overlaying the reference waveform on the newly acquired one, you can readily see the differences between the two and more easily interpret the conditions that caused the change.

Alphanumeric readouts, while not new to DSOs, are considerably improved.

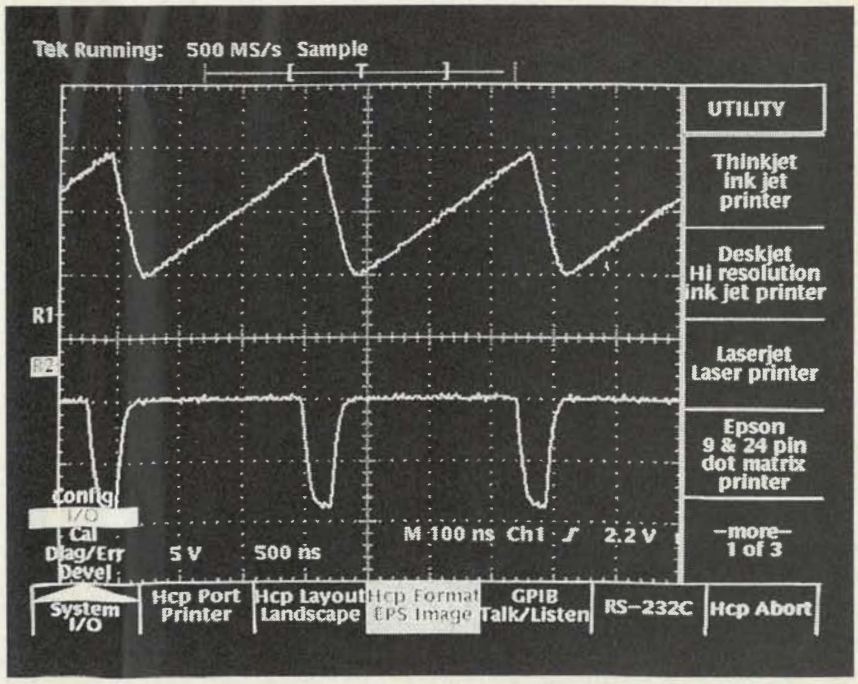
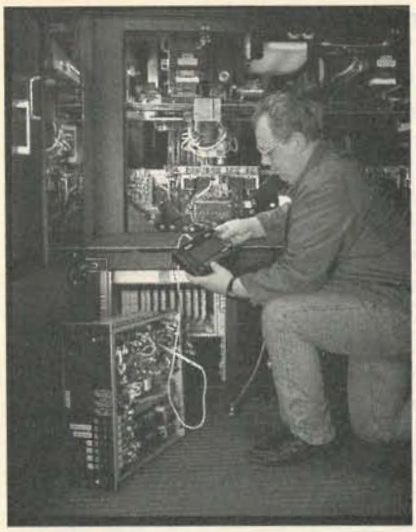


FIG. 3—ALPHANUMERIC READOUTS of control settings provide confirmation when setting up your DSO, as well as helping you interpret the waveform data once it's acquired.



TODAY'S DSOs can make even the toughest troubleshooting job much easier.

Instead of only cursor-based readouts, you see computed values displayed in alphanumeric form as they occur. That means you can look at characteristics while you are acquiring the data and decide which data to keep. You'll benefit both from how easy it is, as well as from the increased accuracy of a value continuously displayed in alphanumeric form.

In addition to providing readouts of automatic measurements, alphanumeric readouts of the various control settings are simultaneously displayed (see Fig. 3). They provide confirmation to guide you in setting up the instrument and interpreting the waveform data once it's acquired.

Storing the Data

If you are like the majority of new DSO users, data storage is becoming increasingly important. You might need to use waveform data in a variety of reports, including service reports and statistical-trend analysis. Waveform storage in a DSO can range from saving a few reference waveforms to mass storage of entire runs, typically on floppy disks. The built-in floppy disk drive has become standard for transferring waveforms to a personal computer for further analysis or reporting functions.

DSOs also allow direct connection to a PC. Connection to a PC is useful, for example, in a manufacturing test environment where it's necessary to record the waveform quality from many measurements over time. That will not only enable easy documentation of test results, it will provide a simple way to collect data for statistical analysis or to detect trends.

Waveform storage also allows you to share data. For instance, you can easily distribute copies of important reference waveforms on diskettes to your supervisor, co-workers, or workers in the field. Besides facilitating communication, sharing data improves the teamwork and productivity of all workers.

Finally, because waveform storage is in digital format, it's easy to output the data directly to a number of hard-copy sources, with a wide variety of printers and plotters providing the most common formats. And, remember, any front-panel setups you've saved also can be printed, along with the waveforms.

In Conclusion

Twenty years ago, when analog was the only scope technology available, it served its users well. Today, you have a whole new world of oscilloscope technology available to you in the form of Digital Storage Oscilloscopes that will help you meet the challenges of an increasingly complex world. DSOs will make your work significantly easier with features such as reference waveforms, store and recall of multiple waveforms, and hard-copy output. Only DSOs can provide effort-saving automatic measurements such as averaging (to remove unwanted noise) and built-in pre-trigger (so you can view what happens before the main event).

Finally, with the advent of DSOs' newest technology—Digital Real Time—you have the long-awaited acquisition power to capture those single-shot and other infrequent events that are becoming such an important requirement in your workplace. Welcome to the world of digital storage oscilloscopes . . . and to new opportunities for high measurement confidence, increased productivity, and a job made easier. EN

COMPUTER CONNECTIONS

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of several key personality types in our world. Knowledge of these characteristics can teach you both about yourself, and about your friends, family members, and coworkers.

At the behest of several of the clinicians on the committee, I'll present a few hints about appropriate roles for personality types in which a particular characteristic dominates. For more detailed information, please contact the relevant academic department at the University of Chicago or Columbia University.

If your primary motivator is knowledge, don't even think about politics. If it's money you're after, don't even think about science. In contrast, if you're a Gomer or a Klutz, you're probably not going to want to be seen in public, so politics is out. On the other hand, a Gomer may be suitable for a bureaucratic position, particularly if you can enlist the aid of a Hemingway to keep you supplied with paper clips, notepads, and malicious gossip.

What About Me?

If you've gotten this far, and I hope you have, you're probably either rolling on the floor laughing, or wondering if I've left my senses. Well, I haven't (at least I think I haven't). In this high-stress, high-tech world, a little parody and humor from time-to-time can keep all of us a little saner—at least I hope so! That's all for now. Until next time, you can contact me at my psychiatrist's office, or via e-mail at jkh@acm.org. EN