Time-Saving Features in Economy Oscilloscopes Streamline Test

Application Note

Oscilloscopes are the go-to tool for debug and troubleshooting, whether you work in R&D, manufacturing or education. Like other electronic equipment, oscilloscopes are evolving to provide more capabilities at lower price points. In fact, some surprising features are available in models that cost just over $1,000—and these new capabilities can save you time and frustration no matter what your job is.

R&D: Designers use oscilloscopes to debug, troubleshoot and characterize designs, from prototype through the initial production run. In addition to accurate waveform capture, they need advanced analysis features to find root causes of problems quickly and shorten time to market.

Manufacturing: Oscilloscopes provide production engineers and technicians with repeatable pass-fail measurements and debug of products that don't pass. They need easy operation and fast test, as well as waveform analysis to identify problems.

Education: Educators use oscilloscopes to teach basic electronic principles and scientific measurements. Students need instruments that are easy to use, with connections to, or incorporation of signals, for analysis.

The list below shows the range of time-saving features available in today's economy scopes. By learning more about these capabilities and their benefits, you can select those that will save the most time in your applications.

Time-Saving Features

- Integrated function generator
- Large display
- Extremely fast update rate
- Mixed analog and digital inputs (MSO)
- Upgradability
- Applications
- Other time-saving options

Agilent Technologies

Integrated Function Generator

When you visit a typical engineer's lab, you generally see several common instruments. First and foremost is the oscilloscope; second is the function generator. Unfortunately the function generator may be missing—perhaps a colleague borrowed it, the bench doesn't have room for it or the budget didn't allow it. If your oscilloscope had a built-in function generator, however, it would always be available to provide stimulus for your designs. Your colleague couldn't borrow it, but you would save room on your bench and in your budget. Moreover you could set up your function generator using the same graphical user interface and display as your oscilloscope, as shown in Figure 1.

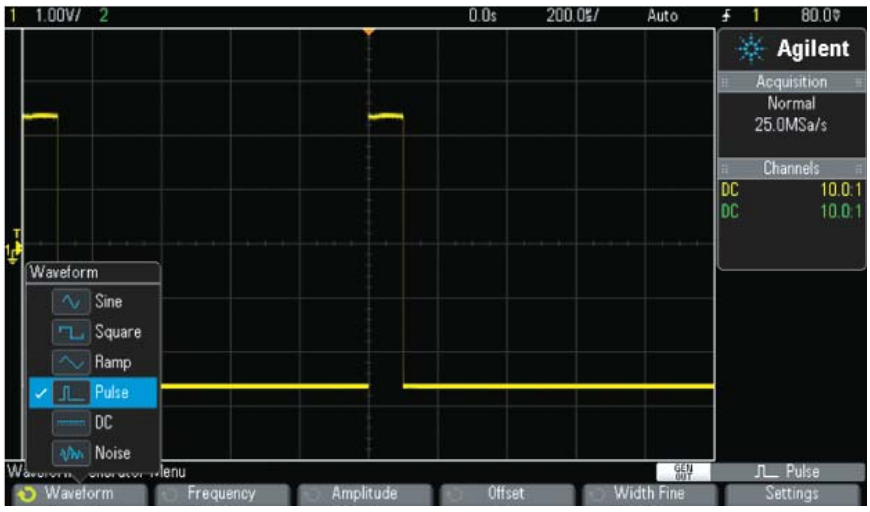

Figure 1: The integrated function generator in the Agilent 2000 and 3000 X-Series oscilloscopes uses the oscilloscope's large display to set up the waveform and saves space and money compared to a stand-alone function generator.

A built-in function generator not only is a huge time-saver for engineers, but it provides similar benefits for educators setting up a teaching lab. Equally valuable is a dedicated educators' toolkit, such as the one offered for the Agilent 2000 and 3000 X-Series scopes, that helps educators quickly create labs by supplying training signals for students to analyze.

Large Display

One of the first features evident in an oscilloscope is the display—both the size and crispness. A display large enough to simultaneously show your waveform and the math/measurements/analysis you are performing offers far more convenience: You won't need to hide menus to see your waveform and then unhide them to see your measurements. In addition, the higher the resolution of the display, the easier it is to see critical information about your signal. For example, the 8.5" WVGA display in the Agilent 2000 and 3000 X-Series provides almost double the viewing area and five times the resolution of a typical 5.7" QVGA display (Figure 2).

Figure 2: Agilents 8.5" WVGA offers 2 x the viewing area and 5 times the resolution

Extremely Fast Update Rates

The old saying "ignorance is bliss" fails when an infrequent glitch keeps your design from working. Oscilloscopes are a critical tool for debugging and troubleshooting, and one with a fast update rate can expedite both. What is update rate? It determines how quickly the oscilloscope can trigger, process the information it has captured, display it and then re-arm to trigger again. The time between triggers is often called "dead time." The faster the update rate (or the shorter the dead time), the more likely your scope is to capture infrequent events.

The fastest update rate available today is over 1,000,000 waveforms per second on Agilent's 3000 X-Series scopes, thanks to the included MegaZoom IV application-specific integrated circuit. The MegaZoom IV ASIC integrates several components that are handled separately in a typical oscilloscope, including the memory controller, acquisition memory, waveform plotter and display memory. Integrating these capabilities produces an oscilloscope that is faster than a typical analog oscilloscope, with the capabilities and features of a digital oscilloscope(Figures 3-4).

So how does a fast update rate save you time? What takes seconds to find using the 3000 X-Series could take minutes—or even hours—on oscilloscopes with slower update rates. When you need to see exactly what is happening in your circuit, a fast update rate can ensure you don't miss a critical event.

Discrete Scope Block Diagram

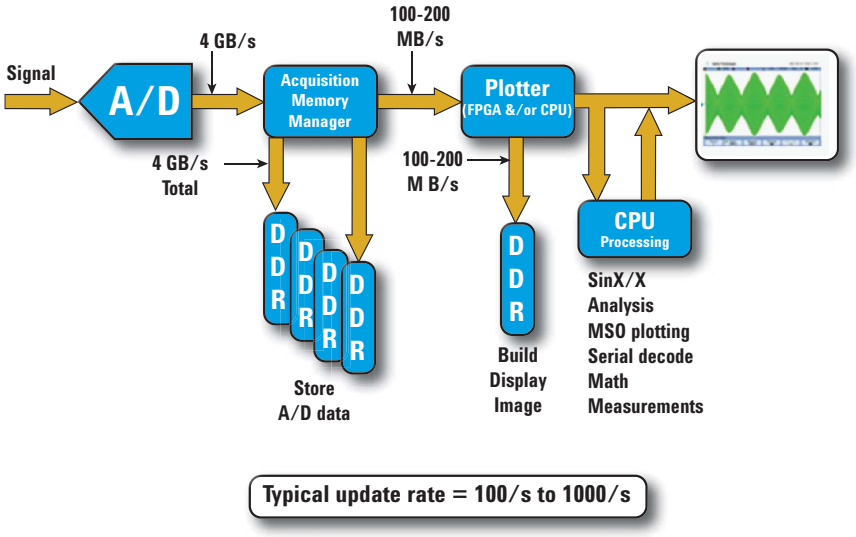

Figure 3: Traditional oscilloscope architectures use discrete components and place the CPU system in the display path of the waveform. Both of these combine to cripple update rate, often limiting it to just a few hundred waveform per second.

MegaZoom IV Scope Block Diagram

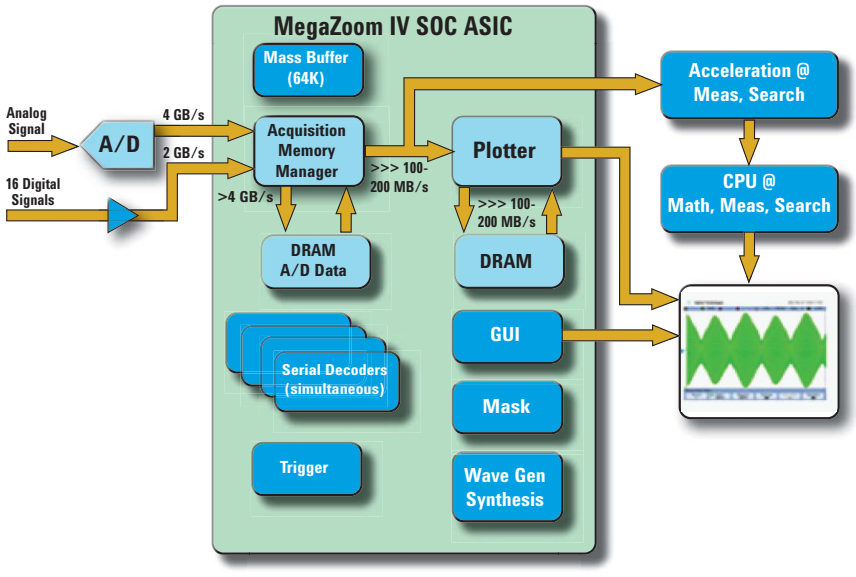

Figure 4: Agilent's MegaZoom IV ASIC combines many of the traditional discrete blocks in to a single chip that speeds the signal path considerably. In addition, it removes the oscilloscope's CPU system from the majority of operations accessing an update rate over 1 M waveforms per second.

Mixed Analog and Digital Inputs

Mixed-signal oscilloscopes combine traditional analog channels with 8 or 16 digital channels. An oscilloscope where those digital channels are integrated into the scope (instead of in a separate pod) can provide powerful triggering capabilities. An MSO could save you significant time in debugging a DDR interface, for example. Typical scopes do not have enough channels to trigger on a write or read, but an MSO can trigger on more than four channels to isolate writes from reads. Agilent's 2000 X-Series family is the first to offer an integrated, upgradable, eight-channel MSO in an entry-level oscilloscope.

Upgradability

Although an oscilloscope is often a designer's main tool, needs can change as a project evolves. Then the products your company manufactures may require test capabilities that your scope doesn't offer. One way around this is to upgrade your current equipment, which typically costs far less than purchasing a new instrument.

An oscilloscope like Agilent's 3000 X-Series allows you to add new applications, memory, digital channels, a function generator or even more bandwidth (up to 500MHz), all without replacing the instrument. This not only saves money, but time as well: Most of those upgrades can be handled with a license key, eliminating the need to get approval for a new capital expenditure or wait for a new piece of equipment to arrive.

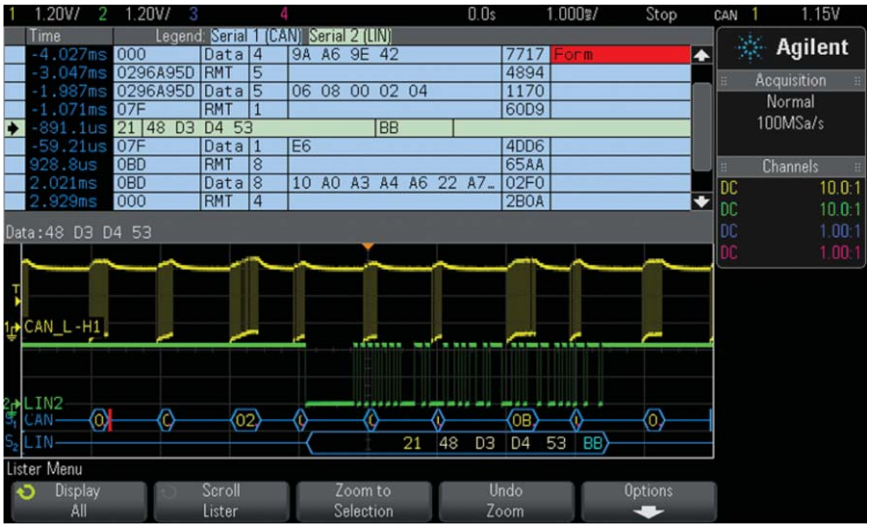

Figure 5: CAN bus triggering lets you decode a CAN bus and LIN bus, and simultaneously display packets time aligned in the lister.

Applications

Oscilloscopes are first and foremost viewing tools, but over time they have evolved to be application-specific tools as well. An oscilloscope with a CAN trigger and decode option, for example, will actually decode the CAN bus to provide protocol-level information in addition to physical-layer waveforms, as Figure 5 illustrates. This can be significantly faster than counting 1s and 0s and trying to decode the bus yourself. In addition, the scope triggering is adapted to be "protocol aware," which gives you the option of triggering on specific packet or frame information instead of using the scope's standard triggering.

Segmented Memory

Segmented memory saves time by letting you digitize only the information you want. This uses less memory and enables capture of a significantly larger amount of time at a higher sample rate, as shown in Figure 6. Segmented memory is ideal for capturing signals that have periods of burst data between long periods of idle time, including radar bursts and serial packets/frames.

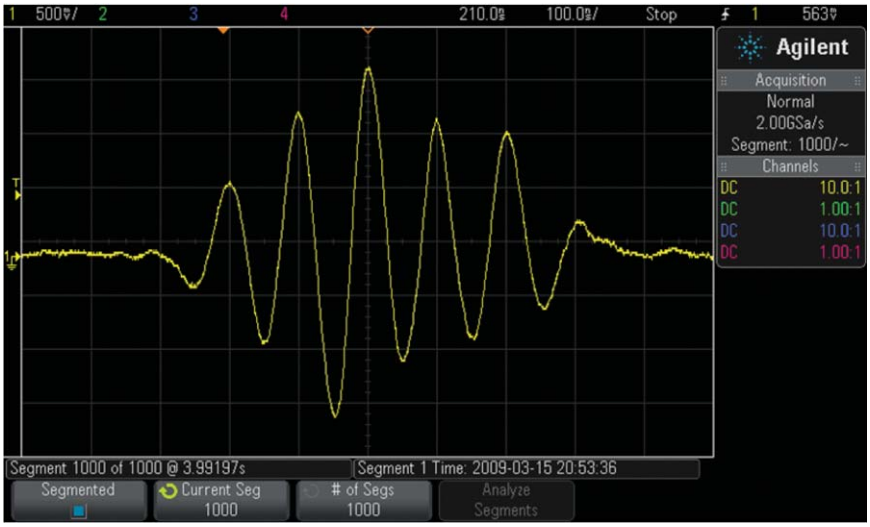

Figure 6. Segmented memory captures 1000 signal bursts (more than 3.9 seconds of bursts at 2 GS/s). To capture 1000 bursts in a traditional oscilloscope at 2 GSa/s without segmented memory would require almost 8 G of scope memory.

Mask Testing

Mask testing is a valuable application that adds pass/fail testing to a scope's traditional functions. Mask testing lets you capture a "golden" waveform and define tolerance limits to create a test envelope. Incoming signals are compared to the allowable tolerance range and flagged as pass or fail. You can then select the action the oscilloscope performs if it detects a violation of the mask. This alone saves time, but it becomes even more powerful if your oscilloscope can test against the mask very quickly, as shown in Figure 7. This helps ensure your customers receive higher quality products more quickly.

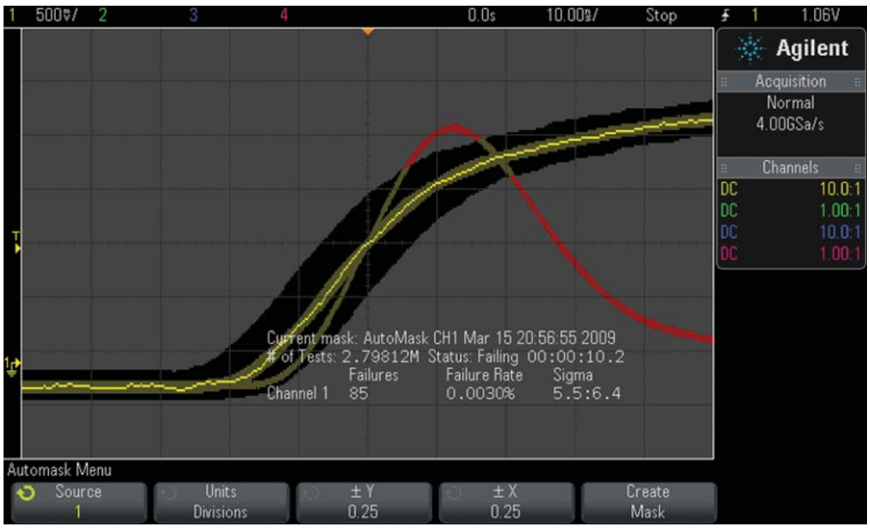

Figure 7. In this example from an Agilent 3000 X-Series scope, 2.8 million mask tests were executed in a little over 10 seconds. During this time, 85 failures were noted, resulting in a 0.0030% failure rate.

Other Time-Saving Options

Many other features available in scopes today can help you save time—even some you may not be familiar with yet. Some allow you to search through your data record for specific events; for example, with an Agilent 3000 X-Series scope you could identify all rise times less than 20 nS or all RS232 parity errors.

Most oscilloscopes also have functions like high-resolution mode or averaging mode. Both of these modes let you effectively increase the resolution of your oscilloscope (up to 12 bits), which can reduce noise and produce a smoother image on the screen. Other tricks possible when working with a noisy signal include noise-reject mode and high-frequency reject. Noise reject adds hysteresis to the trigger circuit, making it less sensitive to noise (although it may require a greater amplitude waveform to trigger properly). High-frequency reject adds a 50 kHz low-pass filter in the trigger path to remove unwanted noise, such as AM or FM broadcastsignals.

Another powerful feature that many scopes offer is a Fast Fourier Transform (FFT). FFT lets you to see the frequency content of the signal you are testing. This can be extremely useful when determining the cause of noise in a waveform, such as harmonic distortion, or fine-tuning a filter.

Bottom-Line Benefits of Saving Time

No matter which area of engineering you work in, time is money. As we rely more and more on electronic products in our daily lives, the need to speed up test increases. The faster you can get products to market, the faster your company can turn a profit. Using the waveform capture, display and analysis capabilities available in typical economy scopes—coupled with the time-saving features discussed here—can help you get your job done more quickly, easily and profitably than ever.

Agilent Technologies Oscilloscopes

Multiple form factors from 20 MHz to >90 GHz | Industry leading specs | Powerful applications

www.agilent.com
www.agilent.com/find/infiniivisionx-series

Agilent Email Updates

www.agilent.com/find/emailupdates
Get the latest information on the products and applications you select.

www.lxistandard.org
LXI is the LAN-based successor to GPIB, providing faster, more efficient connectivity. Agilent is a founding member of the LXI consortium.

Agilent Channel Partners

www.agilent.com/find/channelpartners
Get the best of both worlds: Agilent's measurement expertise and product breadth, combined with channel partner convenience.

Agilent Advantage Services

Agilent Advantage Services is committed to your success throughout your equipment's lifetime. We share measurement and service expertise to help you create the products that change our world. To keep you competitive, we continually invest in tools and processes that speed up calibration and repair, reduce your cost of ownership, and move us ahead of your development curve.

www.agilent.com/find/advantageservices

Agilent Electronic Measurement Group
KEMA Certified
ISO 9001:2008
Quality Management System
www.agilent.com/quality

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

www.agilent.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	(11) 4197 3500
Latin America	305 269 7500
Mexico	01800 5064 800
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Thailand	1 800 226 008

Europe & Middle East

Austria	43 (0) 1 360 277 1571
Belgium	32 (0) 2 404 93 40
Denmark	45 70 13 15 15
Finland	358 (0) 10 855 2100
France	0825 010 700*
	*0.125 €/minute
Germany	49 (0) 7031 464 6333
Ireland	1890 924 204
Israel	972-3-9288-504/544
Italy	39 02 92 60 8484
Netherlands	31 (0) 20 547 2111
Spain	34 (91) 631 3300
Sweden	0200-88 22 55
Switzerland	0800 80 53 53
United Kingdom	44 (0) 118 9276201

Other European Countries:
www.agilent.com/find/contactus

Revised: July 8, 2010

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, May 17, 2011
5990-7906EN

Agilent Technologies