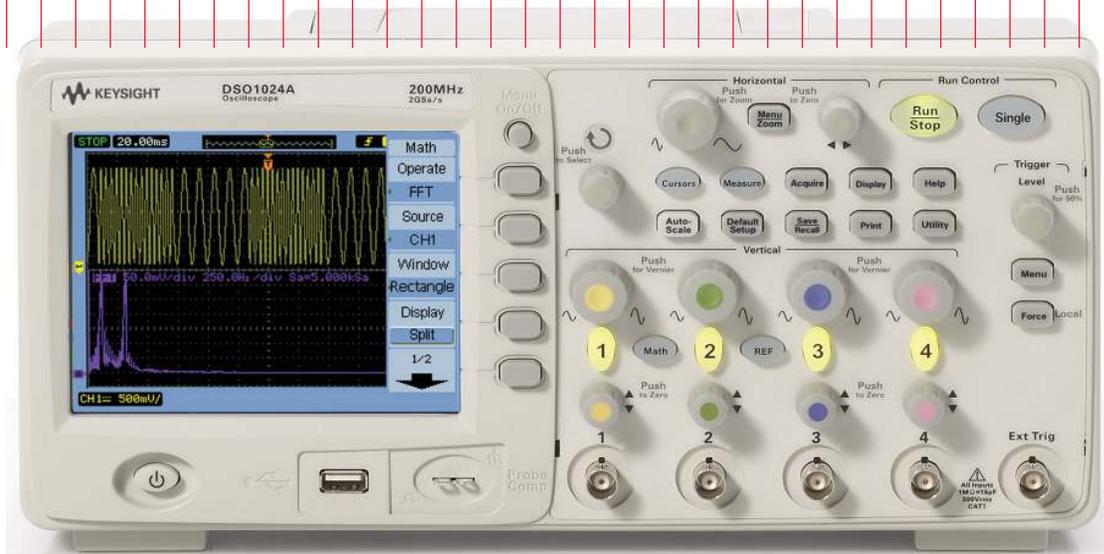


# Keysight Technologies

## Five Things That Can Save You Time When Using an Economy Oscilloscope

### Application Note





## Introduction

If you're involved in the design or manufacturing of any of the prolific products that employ electronic technology, selecting an oscilloscope is often one of the first critical decisions you make. And if you're operating on a tight budget your first thought may be that you'll have to settle for a scope with bare bones capability and make up for it with extra effort on your part. You may even purchase the same scope you've always used thinking that there's nothing better out there. However, today's economy scopes can be packed with features that might save you significant time. It's worth taking a few minutes to consider how the right scope could make a difference in your job. This application note gives you some things to consider when using your economy scope today or when making your next scope purchase.

After reading this document, you should have more information on how much more value you can get for your money in an economy oscilloscope.

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## Tip 1: Selecting bandwidth, sample rate and memory depth for optimum results

The primary function of an oscilloscope is to provide an accurate representation as voltage versus time of the signal you're viewing. With today's digitizing oscilloscopes, the combination of bandwidth, sample rate, and memory depth determines the scope's ability to display your signal accurately. A quick rule of thumb to make sure you have enough bandwidth is to consider the fastest signal rise time you'll need to view and use the following formula:

Scope bandwidth = 2 X signal bandwidth, where signal bandwidth = 1/ (2 X signal rise time)

For example,  
if your rise time is 5 ns,

$$\text{Scope bandwidth} = 2 \times \left( \frac{1}{2 \times 5 \cdot 10^{-9} \text{ sec}} \right) = 2 \times 100 \text{ MHz} = 200 \text{ MHz}$$

Your scope will need to sample at a rate that's at least 4 times the scope bandwidth in order to avoid missing key signal transitions.

And finally, you'll want to choose an economy scope with the most memory depth. This obviously allows you to see more time in a single acquisition so you have a better chance of capturing the cause of a problem. The deeper the memory, the more data points can be stored over the acquisition period, too, so that you can see the big picture of the signal and still zoom in on the critical details in specific areas of interest for faster insight.

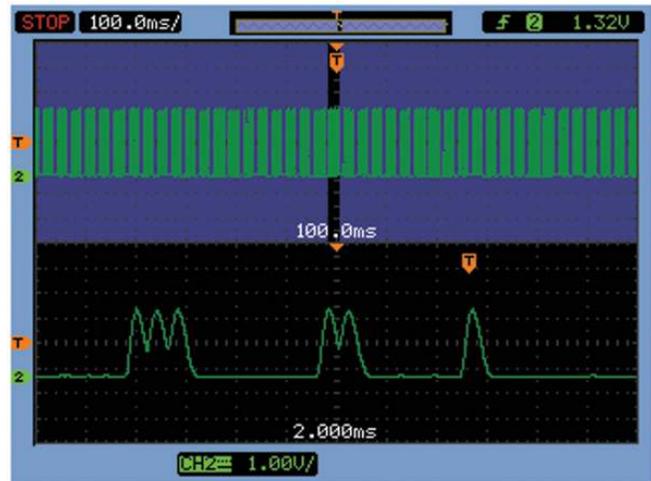


Figure 1. An example of a long acquisition utilizing the 20 kpts of memory on the Keysight Technologies, Inc. 1000 Series oscilloscope.

## Tip 2: Use your scope’s built-in measurement capability to save time and eliminate errors

When it’s important to record critical information about your signal, like frequency or peak-to-peak voltage, some of today’s economy scopes can take the manual effort and tendency for mistakes in readings or calculations out of the picture. Based on the signal data on screen these scopes can calculate and display numerous time and voltage measurements with the touch of a button.

Often the true insight into your problem isn’t apparent with the standard voltage versus time display of the scope. This is where standard math functions like addition, subtraction, or multiplication can be helpful. For example if you’re probing a differential signal and need to see the difference between the voltages on channel 1 and channel 2, displaying a math SUBTRACTION function will get you there quickly.

Some economy scopes also offer Fast Fourier Transform(FFT) capability so you can isolate the frequency components of a signal. This can help you quickly look at amplifier performance or determine whether your power supply is adding noise to a critical signal, for example.

Make sure your economy scope offers the capabilities you’re most likely to use, both today and in the future.

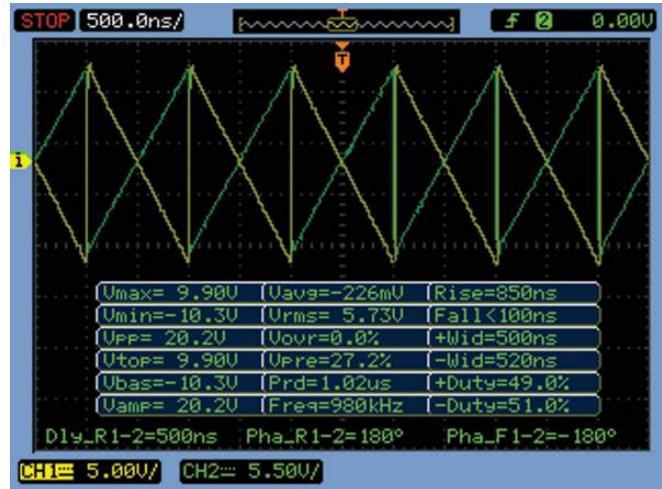


Figure 2 – An example of all signal measurements displayed on screen on an Keysight 1000 Series oscilloscope.

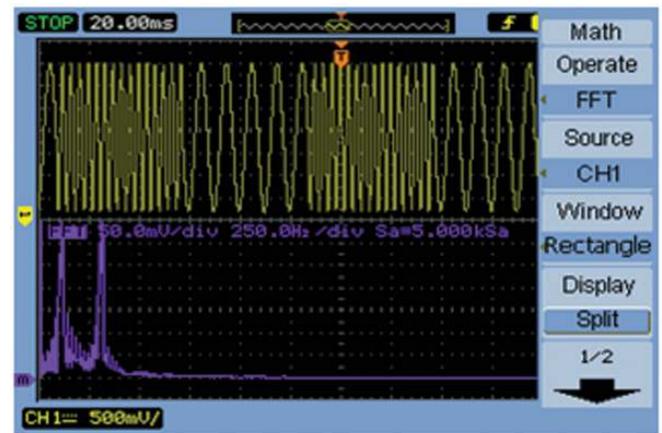


Figure 3 – Input sine wave shown on top half of the screen and the FFT analysis shown in the lower half of the screen on an Keysight 1000 Series oscilloscope.

### Tip 3: Use sequence mode to isolate areas of interest when you're not sure how to trigger on the problem

Often the fact that a problem is occurring is obvious, but capturing the failure condition on screen isn't immediate. Some economy scopes offer a feature called sequence mode to help. You can probe your critical signals and have the scope capture up to a thousand occurrences of the trigger conditions. Then you can play back each capture, much like you would on your home DVD player, to look for unexpected anomalies. Once you find them, you can refine your trigger conditions to discover the root cause.

Sequence mode can also be helpful with measurements on data that has bursts of activity in between long dead time like serial bus traffic. Capture a series of screen shots during the active time and avoid using your scope memory to store the uneventful dead time.

When making your next scope decision, be sure to consider whether the sequence mode functionality would offer benefits in your common tasks.

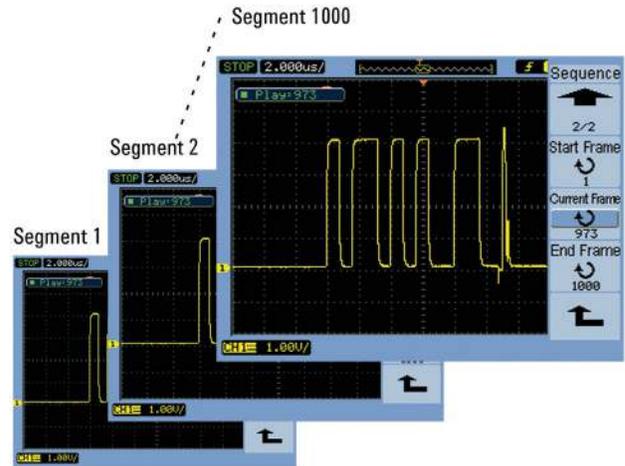


Figure 4. Use sequence mode to record up to 1000 triggers and review in playback mode for anomalies.

## Tip 4: Use go/no-go mask testing to make quick decisions or isolate problems

When you know that certain signals need to be within certain ranges for your design to work properly, mask testing can be an invaluable tool. Some economy scopes offer this capability which allows you to capture a “golden” waveform and define tolerance limits around it for correct performance. Incoming signals are then compared to the limits and flagged as pass/fail in the measurement results on screen. You can also trigger on failures and store a series of them for further analysis using sequence mode.

Repetitive testing for quality purposes can be accomplished much more quickly when mask test capability is a part of your scope’s feature set.

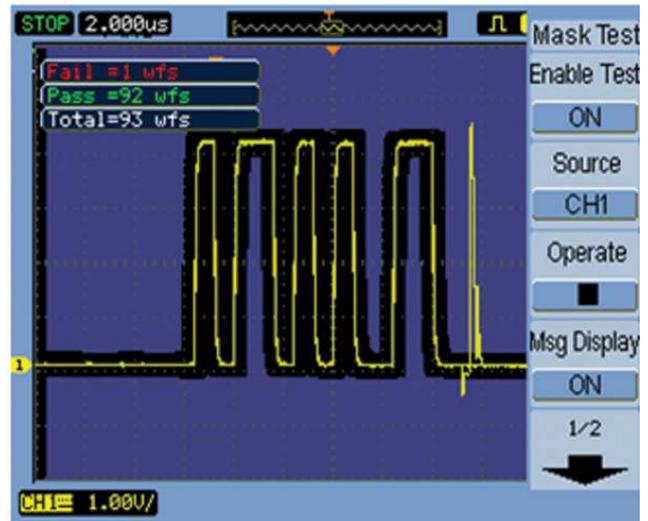


Figure 5. Capture a “golden” waveform and define tolerance limits. With go/no-go mask testing, incoming waveforms are evaluated as pass/fail with results available on screen.

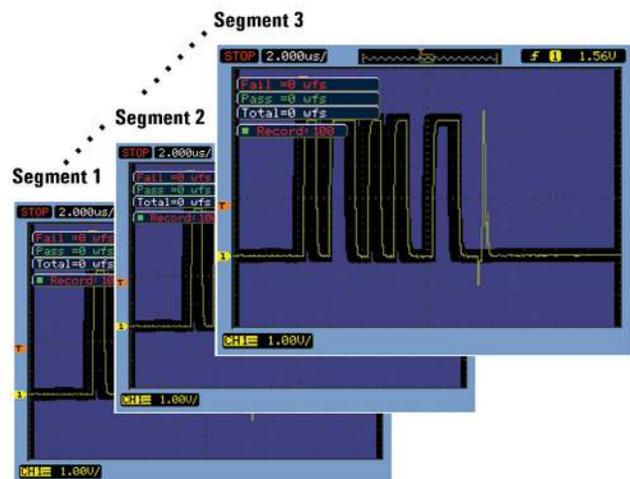


Figure 6 – Using Sequence mode in combination with mask testing on the Keysight 1000 Series oscilloscope to record and capture 1000 trigger occurrences.

## Tip 5: Make sure you consider usability. It matters.

We've talked a lot about the power packed into today's economy scopes. But the efficiencies you gain from built-in functionality can quickly be offset if you can't find the features or if you have to repeatedly do extra steps in order to make the basic measurements. Look for scopes that offer menus that are easy to navigate and show your choices in dropdown selections. One of the most obvious time savers is displaying both the entire captured waveform and the area you're zoomed in on at the same time and on the same screen so you can see the big picture and the signal detail all at once.

Brighter displays with wider viewing angles help you use the scope in less-than-ideal bench setups in the field, and dedicated knobs with strong visual ties to the waveforms help keep things simple.

And finally, if your team is worldwide, or if English isn't your language of choice, look for scopes that offer menus, help systems, manuals and front panels in your local language.

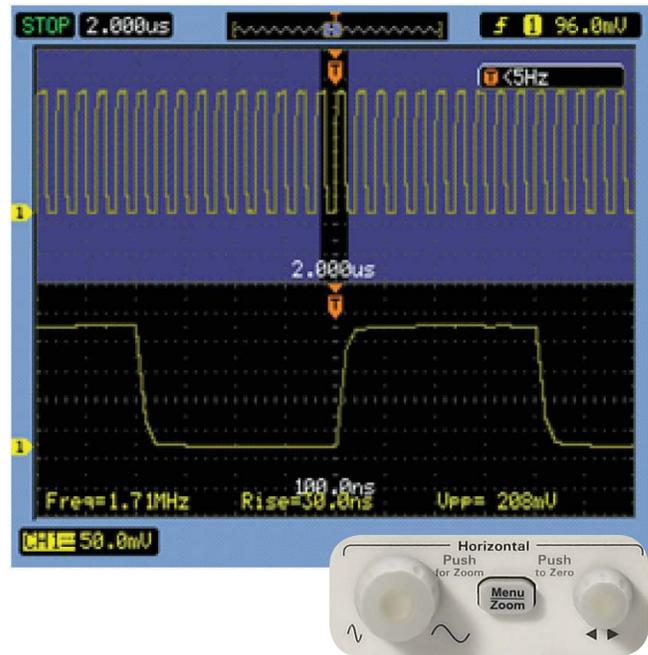


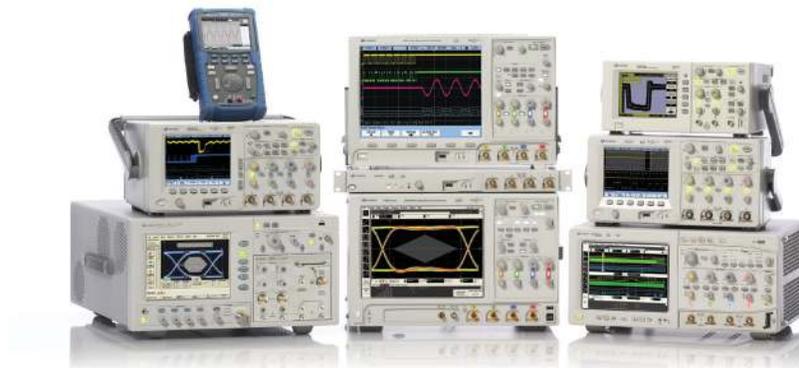
Figure 7 – An example of a bright crisp display on an economy oscilloscope with the zoom mode technology.

## Conclusion

Budget constraints don't have to mean bare bones scope choices with today's selection of economy oscilloscopes. Be sure to evaluate your typical measurements to understand whether you can save valuable time and get your products to market faster by taking advantage of key features available in some of today's economy scopes. Look for the deepest memory, the most measurement capability, and time-saving features like sequence mode and go/no-go mask testing. Finally, be sure your oscilloscope offers the best usability you can find for the basic tasks you perform often.

## Related Literature

Publication	Publication type	Publication number
<i>Keysight 1000 Series Oscilloscopes</i>	Data sheet	5989-9368EN
<i>Ten Things to Consider When Selecting Your Next Oscilloscope</i>	Application note	5989-0552EN
<i>Choosing an Oscilloscope With the Right Bandwidth for Your Application</i>	Application note	5989-5733EN



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