A Step Beyond the Basics, 6 Advanced Oscilloscope Tips

eBook

KEYSIGHT

Oscilloscope Basics

There is a lot of information out there covering oscilloscope basics. If you search for topics like triggering basics, why probing matters, how to scale correctly, etc., you are bound to find a plethora of helpful resources. On the other hand, there is also a lot of deep-dive application-specific content to learn from.

What about the stuff in-between? There are several other, somewhat advanced oscilloscope capabilities that typically aren't brought to light.

In this eBook, you'll learn about advanced functions that will help you gain even more insight into your designs, regardless of your industry or application. These capabilities can be found on all InfiniiVision oscilloscopes, including the new 1000 X-Series scopes. Test more efficiently by understanding how to:

- Find hidden errors using a Fast Fourier Transform (FFT)
- Simulate math operations before implementing
- Characterize device outputs with Bode plots
- Connect and control oscilloscopes remotely
- Gain a new perspective with horizontal modes
- Analyze samples differently using acquisition modes

If you think you need to take a step back and start out with the introductory version of this eBook, download **6 Essential Tips for Getting the Most Out of Your Oscilloscope** to learn the basics.

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Find Hidden Errors Using a Fast Fourier Transform (FFT)

TIP 1

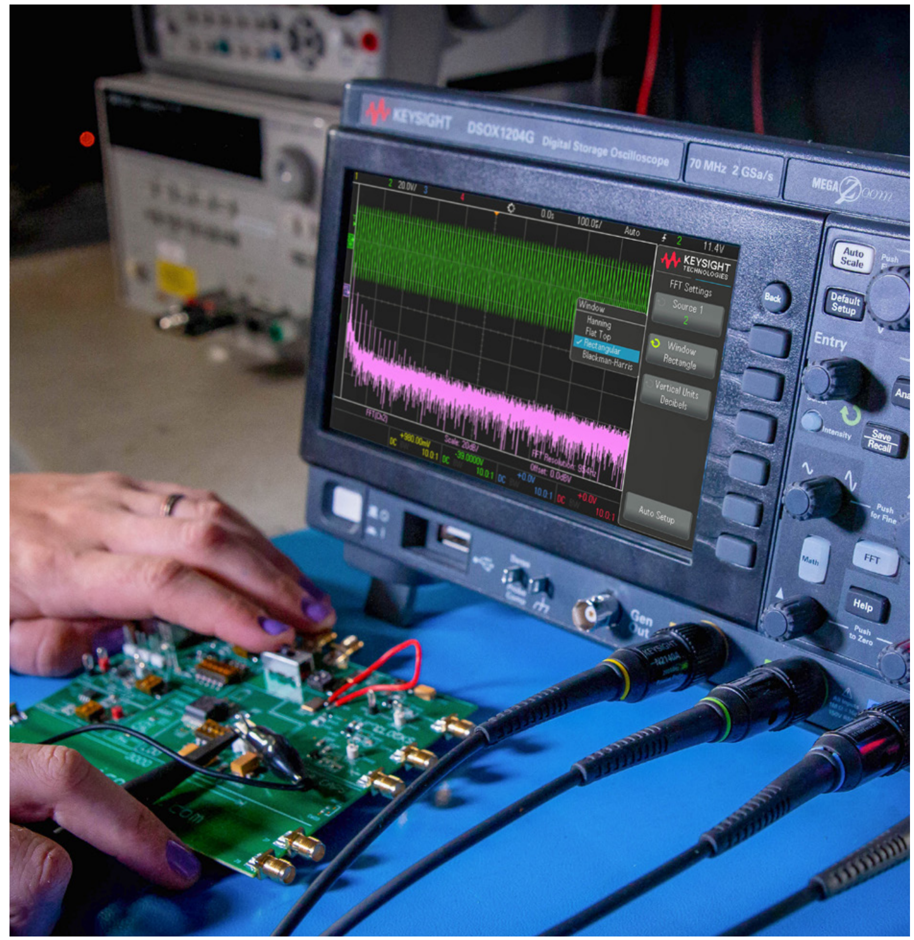
Find Hidden Errors Using an FFT

A Fast Fourier Transform (FFT) is perhaps the most popular oscilloscope math transform. So much so, that it gets its own button on most of our oscilloscopes, and even its own section in this eBook. The reason this capability is so prevalent is because it gives you an entirely new look into your signal – the frequency domain.

The FFT is something you historically would need an RF instrument to analyze, but is a common functionality built into modern oscilloscopes.

An FFT analyzes frequency components and potential glitches that you may not be able to see in the standard oscilloscope time domain.

With an FFT, you can view the frequency vs. power of the various components that make up your signal.

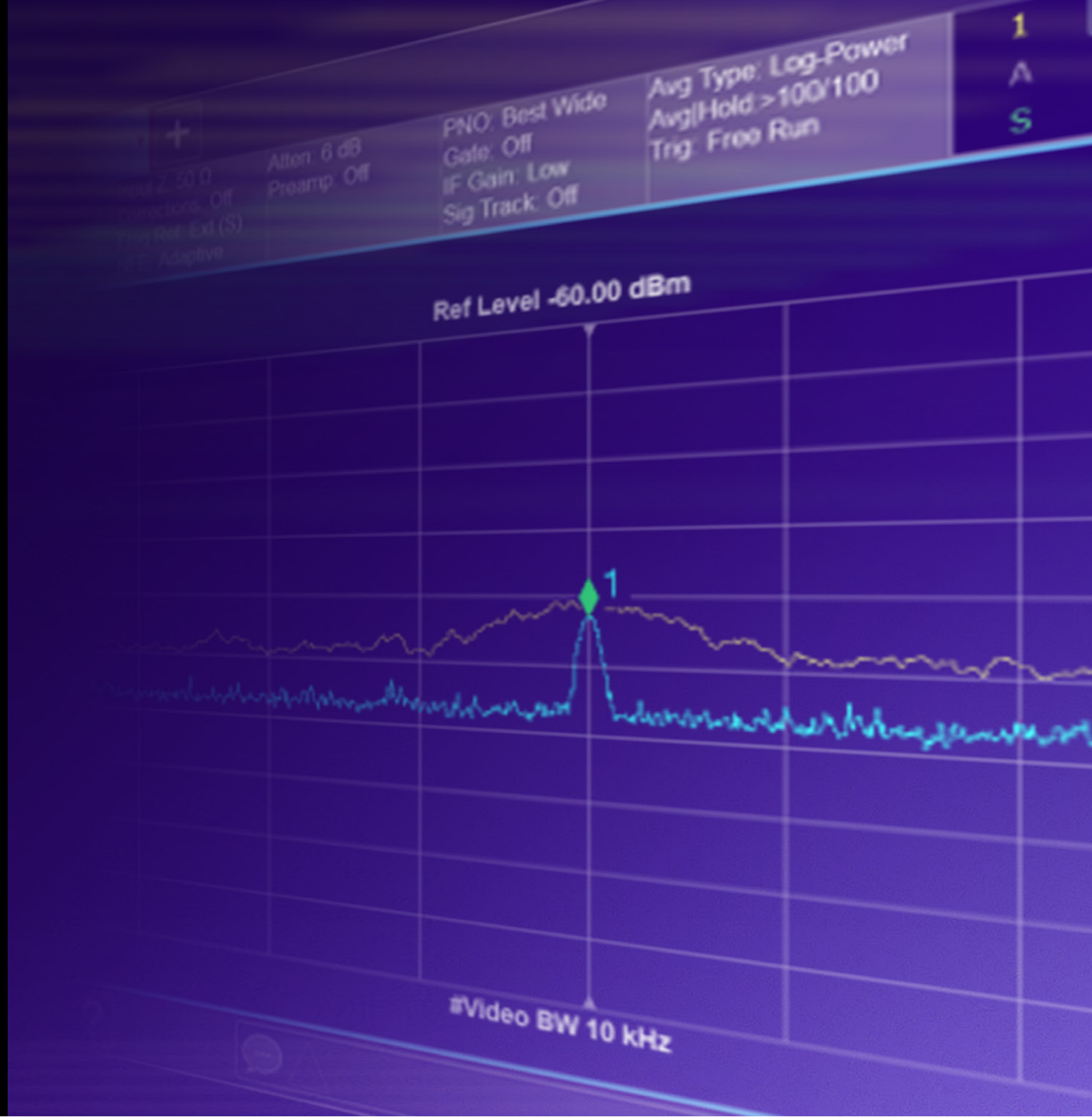


Want to Learn More?

Video: Learn more about what an FFT is, why it matters so much, and how to set one up in this episode of Scopes University.

TIP 2

Simulate Math Operations Before Implementing



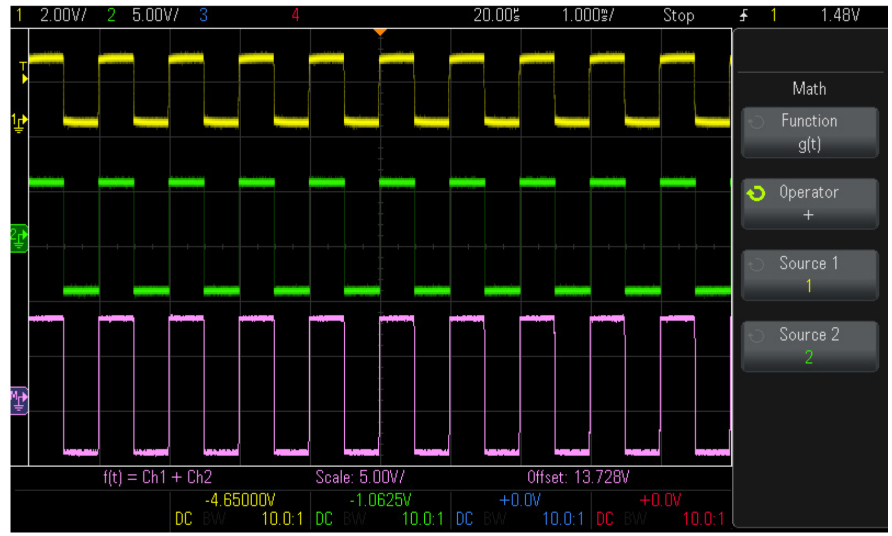
TIP 2

Simulate Operations Before Implementing

Measuring a signal as it exists is important, but what if you want to modify a signal? It is often far too expensive and time consuming to do this on your actual device. You only want to implement a design change if absolutely necessary. Math operations are the perfect way to simulate a design change or predict an output before you actually change anything on your device.

Math operations can be used in many different circumstances. A couple examples are:

- To see what would happen after two signals were passed through a differential amplifier
- To analyze the response of your device if a low pass filter were added to the circuit

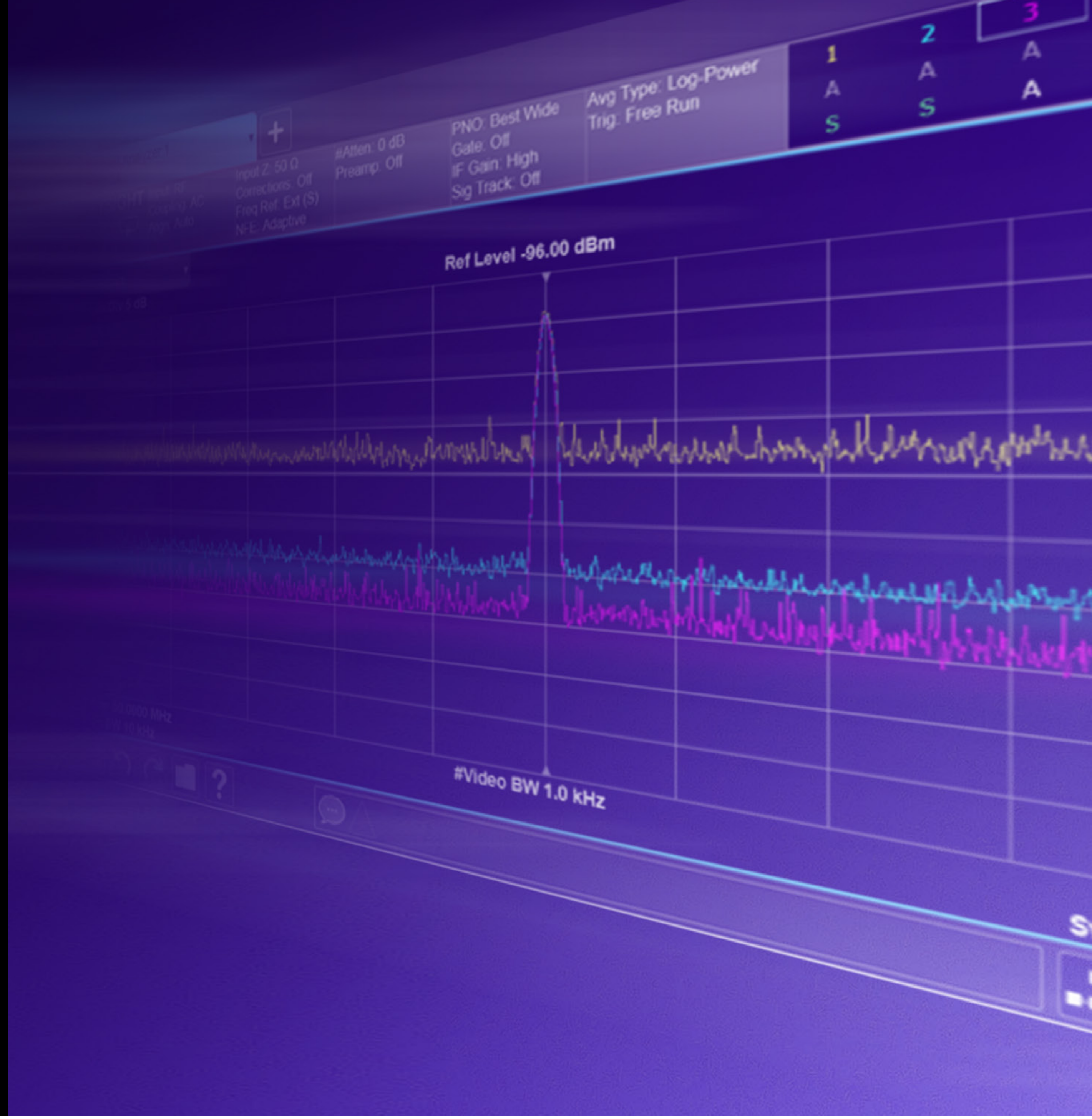


Want to Learn More?

Blog: Gain a deeper understanding of math operations and advanced measurements in this blog.

TIP 3

Characterize Device Outputs with Bode Plots

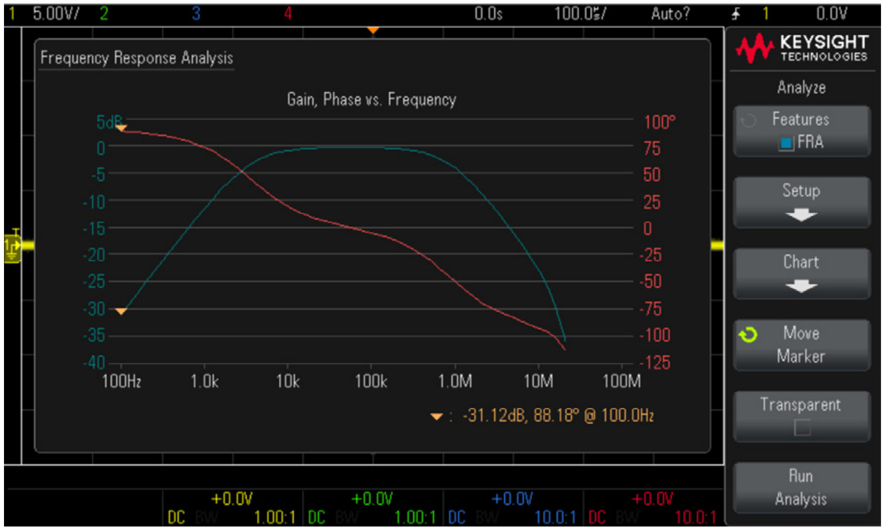


TIP 3

Characterize Device Outputs with Bode Plots

When you are testing devices where the output depends on the input, it is critical to analyze how it responds to signals of various input frequencies and amplitudes. This is especially important for devices like passive filters, amplifiers, switch mode power supplies, audio systems, etc. If you don't perform this analysis, your device may end up failing under certain input conditions. That's not something you want your customer to find!

Frequency response analysis on Keysight InfiniiVision oscilloscopes use a Bode plot to display the gain and phase of your system. You will quickly see if there are any unusual spikes in the gain or phase. Unwanted spikes would indicate that your design malfunctions when certain frequencies are input. This is something that could require a redesign, so be sure to start performing this analysis early on in the process.

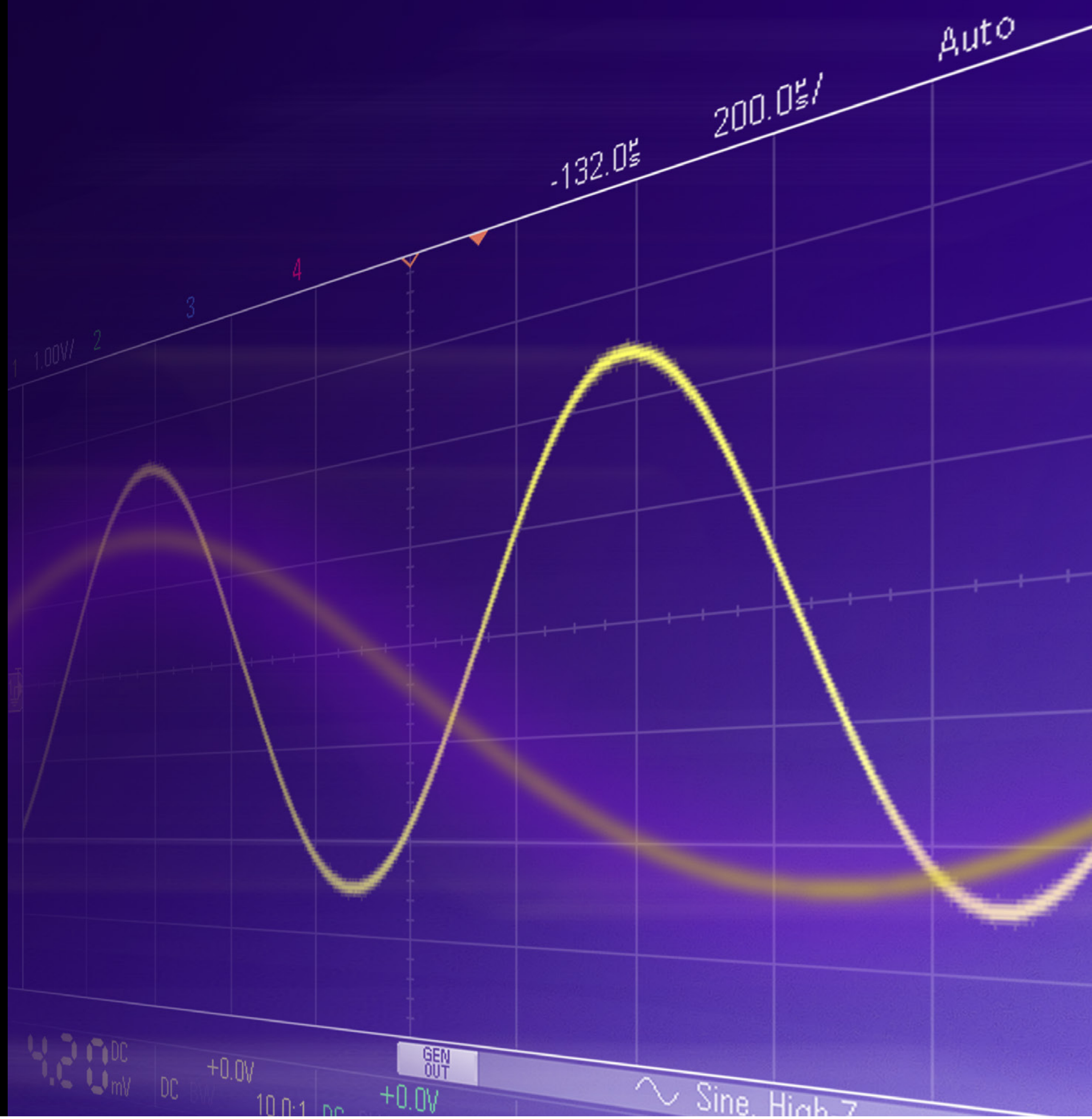


Want to Learn More?

Video: Learn how to easily set up this analysis on the instrument and read the resulting plot in this episode of Scopes University.

TIP 4

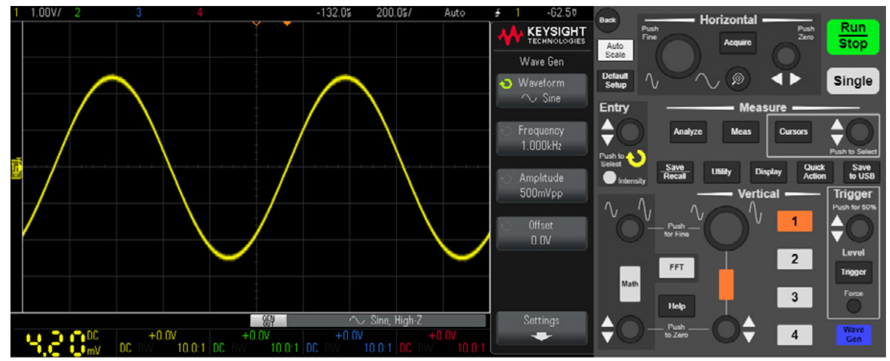
Connect and Control Oscilloscopes Remotely



TIP 4

Connect Remotely

Connecting to an oscilloscope remotely is just as easy as plugging in a keyboard and bringing up a website. LAN connectivity is a high-demand function that can be used to monitor instruments, control them remotely, or automate tests.



No matter if you're working in education labs, the design bench, or the manufacturing floor, LAN can improve your processes. It changes when and where you can work. Connect remotely with LAN connectivity to enable multi-engineer access. This allows students and coworkers to share equipment and work on projects from anywhere, ultimately saving budget.

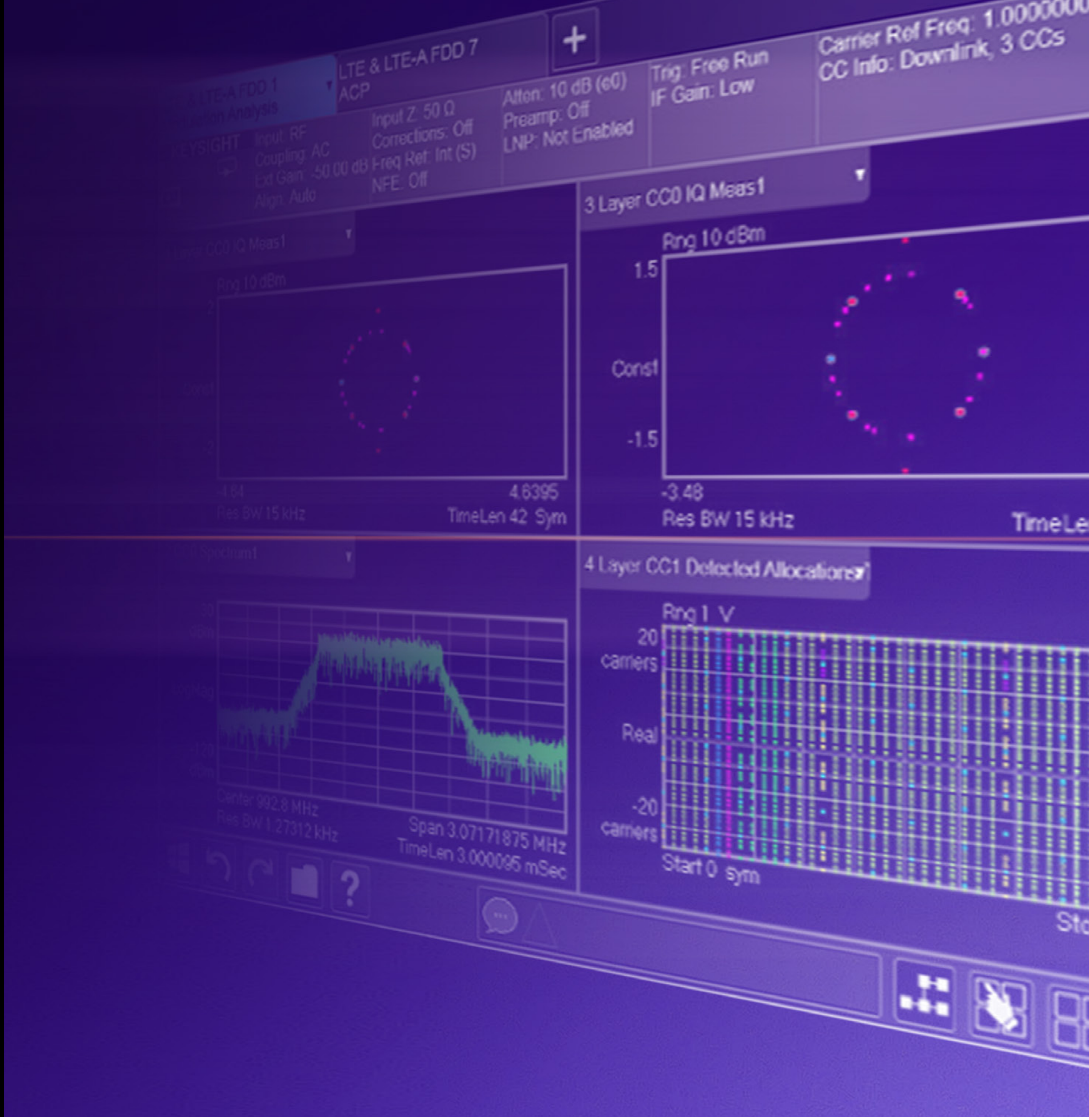
Try the **BenchVue software** for free, and be sure to verify whether your prospective instrument has a LAN connection.

Not only can you send remote commands to the instrument via LAN, but you can also completely control the instrument on a PC with the actual instrument screen and simulated hard key controls (see below).

Additionally, you can easily connect to PC software applications, like BenchVue. This lets you quickly develop custom automated tests using TestFlow, capture and log measurement data, and export results for offline analysis.

TIP 5

Gain a New Perspective with Horizontal Modes



TIP 5

Gain a New Perspective with Horizontal Modes

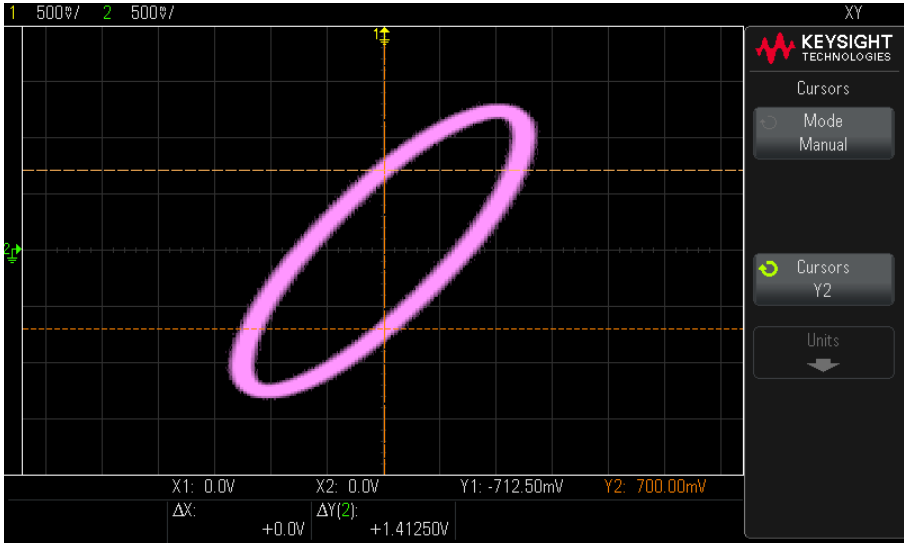
Viewing your signals from a different perspective lets you visualize how your device will respond under various circumstances. There are three different "horizontal modes" that give you unique perspectives of your signal. Each mode has a different purpose and situation where it'll be useful:

XY mode

XY mode, sometimes called a Lissajous plot, is a very common horizontal mode. Instead of plotting your waveform as a function of amplitude (typically voltage) vs. time, you can plot the amplitude of channel 1 vs. the amplitude of channel 2. This lets you analyze waveforms as voltage vs. voltage, voltage vs. current, or even flow vs. pressure.

There are some common uses for this mode:

- To analyze the voltage vs. current of semiconductor devices
- On a manufacturing floor, XY test patterns quickly tell the engineer if a device suffered a manufacturing error
- To characterize the frequency and phase relationship between two signals. A circle would mean the signals are 90° out of phase. The oval you see to the right indicates a 45° phase shift.



Roll mode

This mode operates like a strip-chart. It is used when working with very low-frequency waveforms, sometimes as low as a few Hz or less. With frequencies this low, there isn't always time to wait and record the entire waveform, especially if you are debugging by applying signals that could change the output you see on screen. It's necessary to see how the signal changes over time instead of waiting for the scope to plot one capture at a time. At slow time-per division settings, some oscilloscopes automatically switch to roll mode.

This mode is helpful when analyzing duty cycle, the relationship between two signals over time, drift in a DC line, switching behaviors in a power supply, etc. Keep in mind, this mode is untriggered and only used to visually see change in the waveform, not to make detailed measurements.

Zoom mode

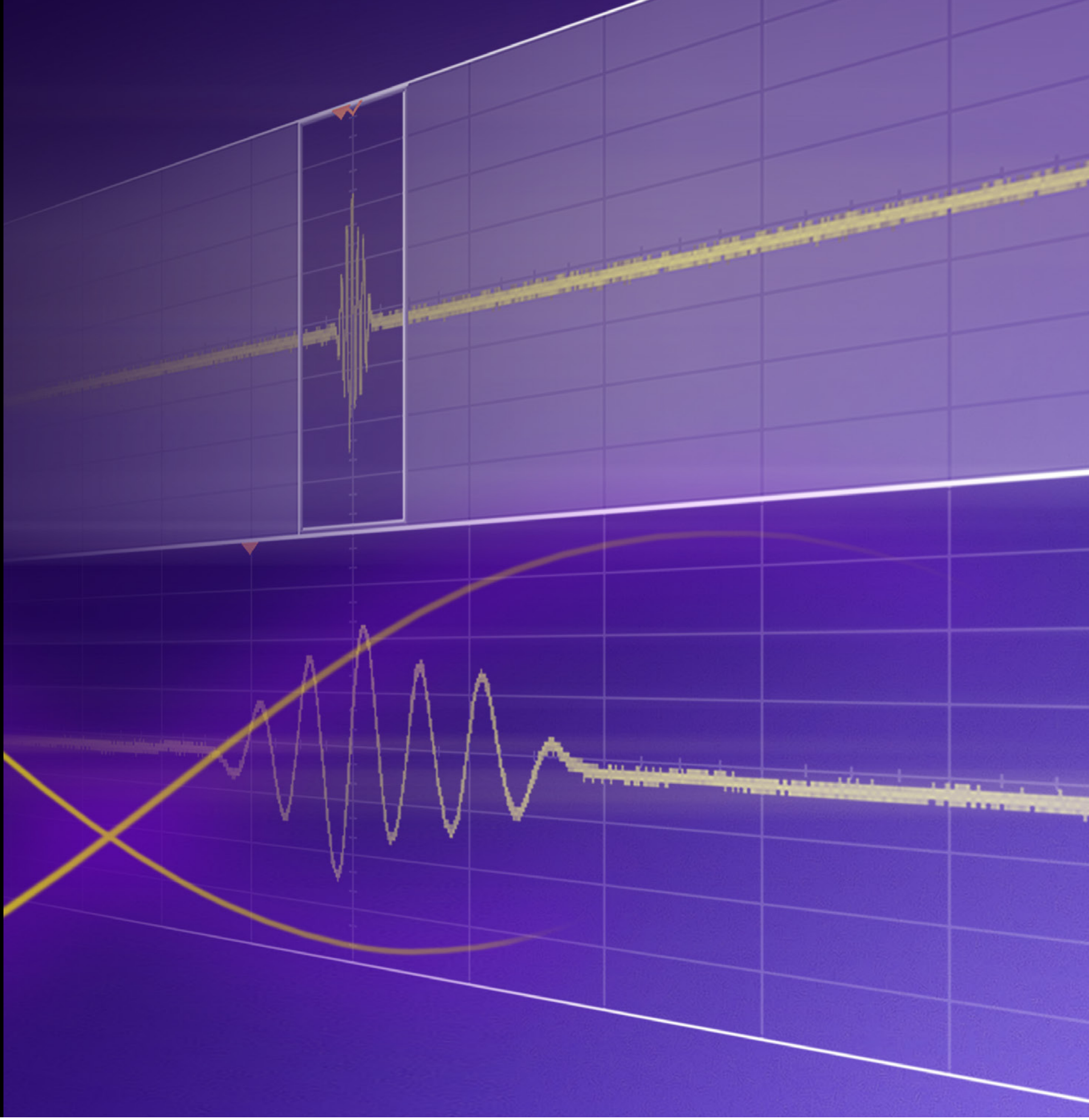
Zoom mode is pretty straightforward. It's used when you want to zoom in and analyze a small portion of a really long capture. In this mode, you can perform measurements and math operations just within that zoomed in window (a technique known as gating).

Want to Learn More?

Web Page: Check out a measurement example of how to set up and XY mode measurement on your InfiniiVision oscilloscope.

TIP 6

Analyze Samples Differently using Acquisition Modes



TIP 6

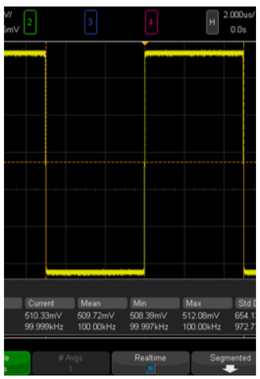
Analyze Samples Differently Using Acquisition Modes

To be sure you aren't missing anything in your analysis, it's important to understand your signals' strengths and weaknesses using various acquisition modes. Acquisition modes basically vary your oscilloscope's sampling method to analyze different signal characteristics.

Want to Learn More?

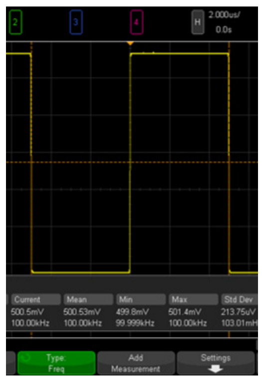
Article: Try analyzing your signal with various sample rate settings. Learn more about how each of these acquisition modes can help you in this article.

Normal



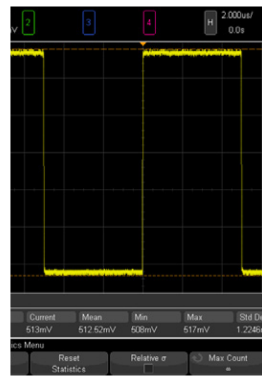
The most commonly used mode for day-to-day measurements. This acquires samples at a specified sample rate and displays all of them on screen at each trigger event. This is the safest mode to use because there are no major caveats to it.

Averaging



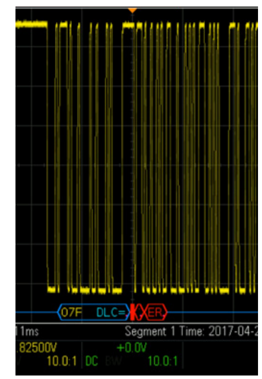
This mode captures multiple waveforms and averages them together. This is great for measuring periodic signals like a clock, or anything with a stable trigger. It is mainly used to hide transient noise or glitches to see the true, underlying signal. However, this mode should not be used for general debugging for that exact reason, only to get a glance at your true signal.

High resolution



Another averaging mode. However, instead of waveform-to-waveform averaging, this performs point-to-point averaging. This allows you to capture glitches and a periodic signals while still reducing some of the random noise riding on the signal.

Segmented



A unique mode that is used specifically to capture pulses, rare events, or infrequent glitches. Memory is wasted when you capture the downtime between infrequent events in the normal acquisition mode. With segmented memory, you're able to cut that time out and focus on the portions of the signal you want to analyze with even more detail.

Your everyday debugging oscilloscope has a few advanced functions that you may not have thought to use before. Now that you have the resources to learn about each of those capabilities in detail, hopefully they will help deepen your analysis. Looking at your signal in a completely different way could reveal something that you never knew was there.

Try to expand your testing to gain more insight, and don't forget about each of these functions when you start your debugging:

- Math operations, especially FFT
- Frequency response analysis with a Bode plot
- LAN connectivity
- Horizontal modes
- Acquisition modes

Beyond these capabilities, there are many additional ways to use your oscilloscope to increase your design insight. Learn about the more advanced options and applications available in the Scopes University video series.

Want to Learn More?

Video: About the more advanced options and applications available in the Scopes University video series.

Get Measurements You Can Count On

Measure with confidence to create designs that will change the future. The 1000 X-Series leverages the same, proven technology we use in our higher-end InfiniiVision family, giving you professional-level measurements you can trust. Now you can get even more functionality with capabilities like 4-wire SPI decode and remote connection via LAN. Get the performance you need to make measurements you can count on.

Check out the new 1000 X-Series scopes, along with more resources that can help take your testing to the next level.

Need more bandwidth and advanced applications? Check out the 2000 X-Series and 3000T X-Series oscilloscopes.

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