A Step Beyond the Basics: 6 Advanced Oscilloscope Tips

eBook

INTRODUCTION

A Step Beyond the Basics

There is a wealth of information available on oscilloscope basics. You will find helpful resources by searching for topics such as triggering basics, the importance of probing, and proper scaling techniques. Additionally, there is a significant amount of in-depth, application-specific content to explore. 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 will learn about advanced functions that will help you gain even more insight into your designs, regardless of your industry or application. These capabilities are available on all Keysight InfiniiVision oscilloscopes, including the entry-level Keysight 1000 X-Series and new Keysight HD3 Series oscilloscopes. 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 start with the fundamentals, download our introductory eBook **6 Essential Tips for Getting the Most Out of Your Oscilloscope**.

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TIP 1

Find Hidden Errors Using a Fast Fourier Transform

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Find Hidden Errors Using a Fast Fourier Transform

The fast Fourier transform (FFT) is the most commonly used math algorithm when using an oscilloscope. Using the FFT enables you to view your signal in a completely different way — the frequency domain.

Historically, analyzing the FFT required specialized RF instruments. However, modern oscilloscopes now include this functionality.

The FFT enables you to analyze frequency components and detect potential glitches that might not be visible in an oscilloscope's standard time domain view.

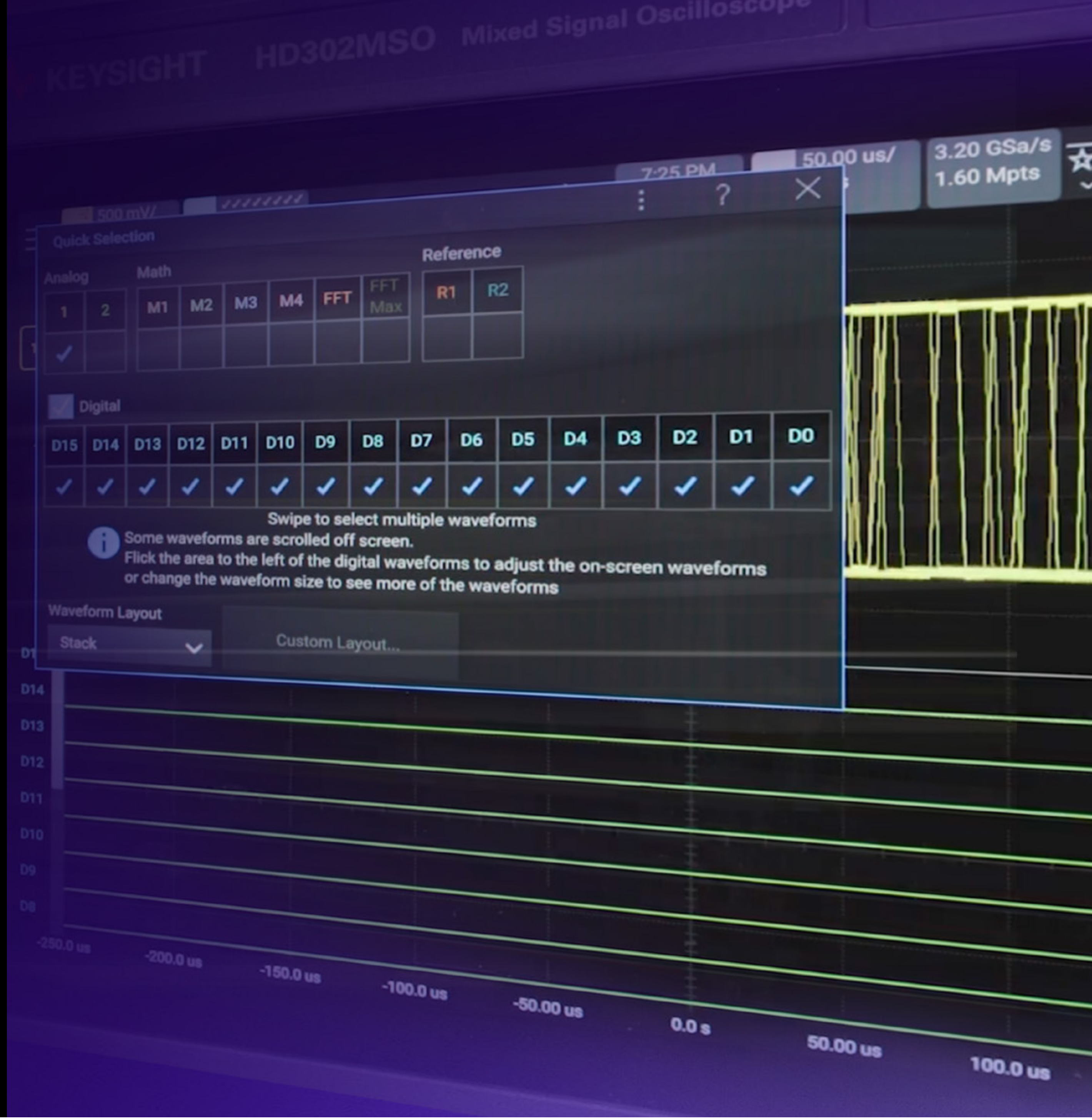
Using the FFT function, you can view the frequency versus power of the various components that make up your signal.

Want to learn more?

Video: Frequency Domain Measurements (FFT)

TIP 2

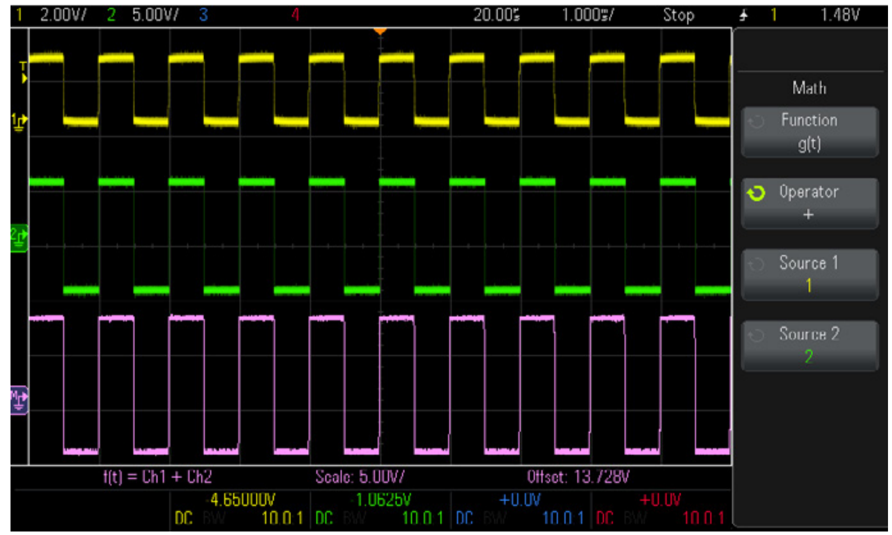
Simulate Math Operations Before Implementing



TIP 2

Simulate Math Operations Before Implementing

Measuring a signal as it exists is important, but what if you want to modify it? Doing this on your device is often expensive and time-consuming. You only want to implement a design change if absolutely necessary. Math operations make it easy to simulate a design change or predict an output before you actually change anything on your device.



You can use math operations in many different circumstances to do the following:

- See the outcome when you pass two signals through a differential amplifier.
- Analyze how your device responds when you add a low-pass filter to the circuit.

Want to learn more?

Video: Waveform Math and Power Measurements

TIP 3

Characterize Device Outputs with Bode Plots

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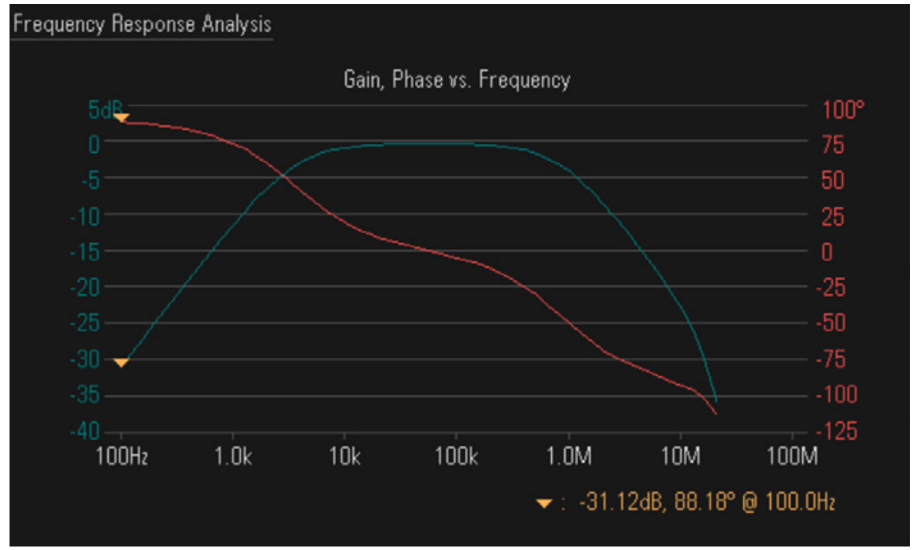
Characterize Device Outputs with Bode Plots

When testing devices with output dependent on input, it is critical to analyze their response to signals of varying input frequencies and amplitudes. This approach is especially important for devices like passive filters, amplifiers, switch-mode power supplies, audio systems, and more. Failing to perform this analysis may result in your device malfunctioning under specific input conditions, which is an outcome you certainly want to avoid.

Frequency response analysis on Keysight InfiniiVision oscilloscopes uses 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 indicate your design malfunctions at certain input frequencies. This issue may require a redesign, so performing this analysis early in the development process is essential.

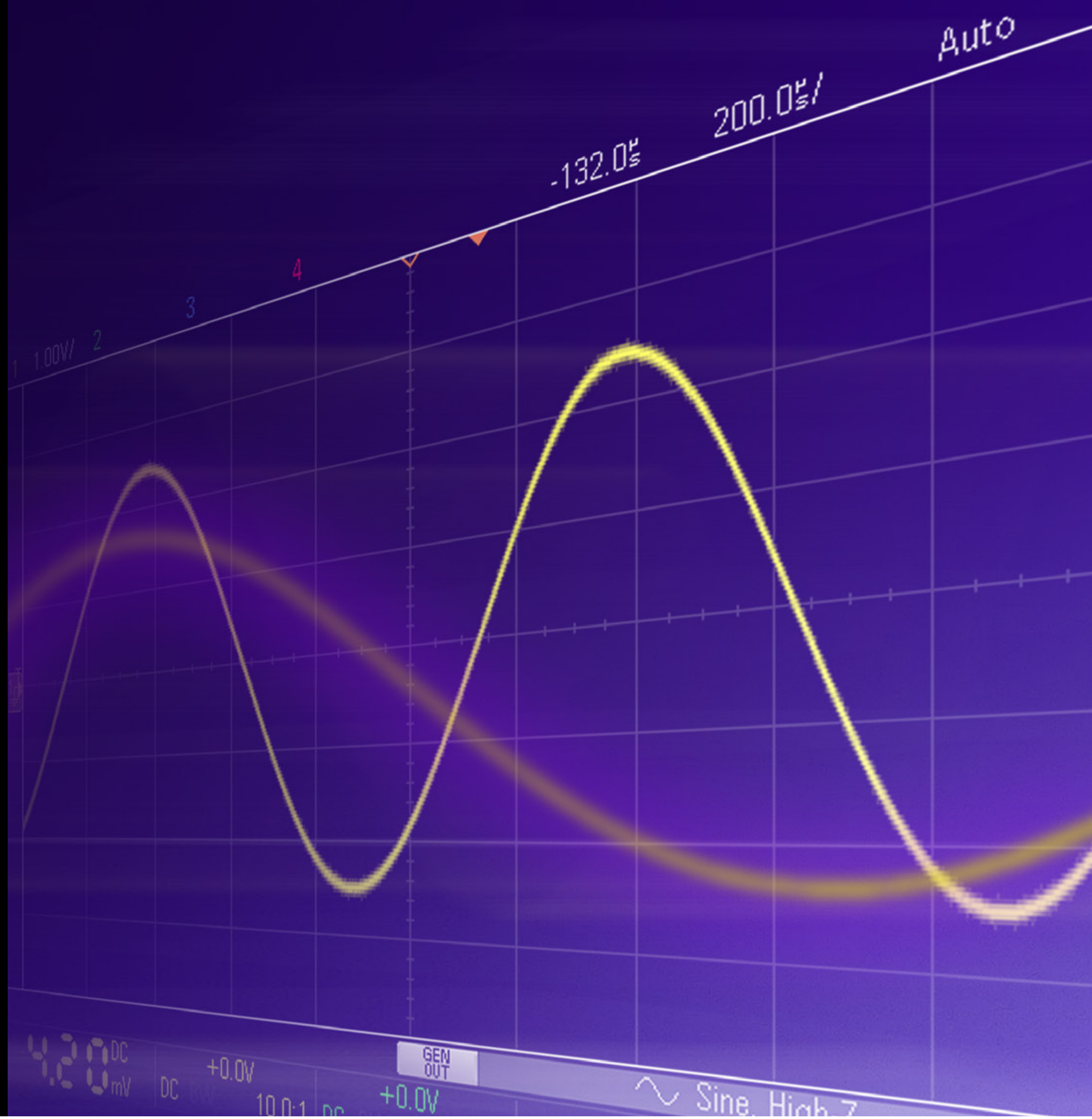


Want to learn more?

Video: Frequency Response Analysis (Bode Plots)

TIP 4

Connect and Control Remotely



TIP 4

Connect and Control Remotely

Connecting a remote oscilloscope is as easy as plugging in a keyboard and bringing up a website. Local area network (LAN) connectivity is a high-demand function used to monitor instruments, control them remotely, or automate tests.

Whether you are working in education labs, the design bench, or the manufacturing floor, a LAN can improve your processes. Using LAN changes when and where you work. Connect remotely with LAN connectivity to enable multi-engineer access. This process enables students and coworkers to share equipment and collaborate on projects from any location, ultimately reducing costs.

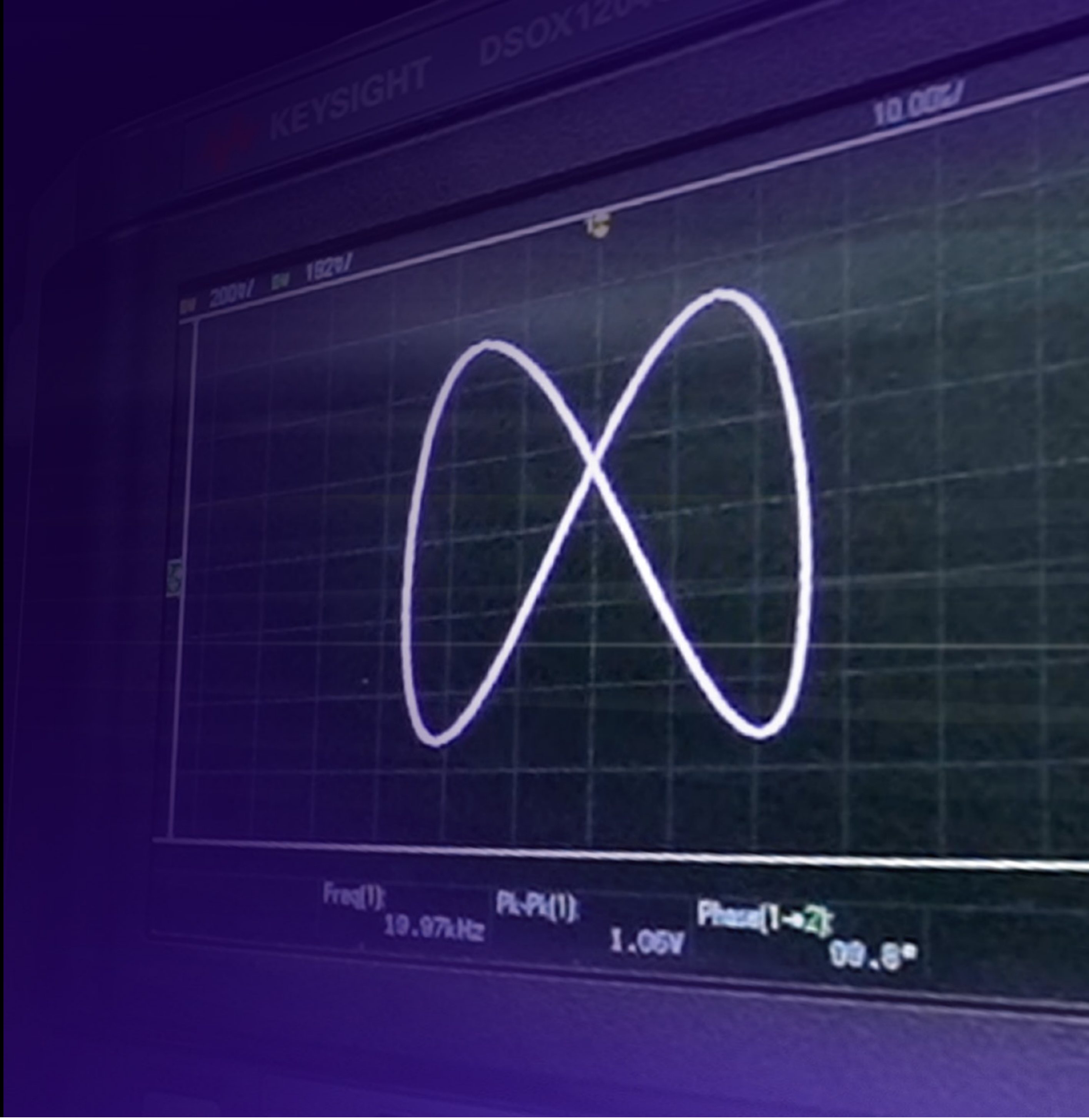
You can send remote commands to the instrument via the LAN and completely control the instrument on a PC with the actual instrument screen and simulated hard key controls. Additionally, you can easily connect to PC software applications, like Keysight BenchVue, to quickly develop custom automated tests using Keysight test flow software to capture and log measurement data and export the results for offline analysis.

Want to learn more?

Video: Automate Tests with BenchVue Oscilloscope Software

TIP 5

Gain a New Perspective with Horizontal Modes



TIP 5

Gain a New Perspective with Horizontal Modes

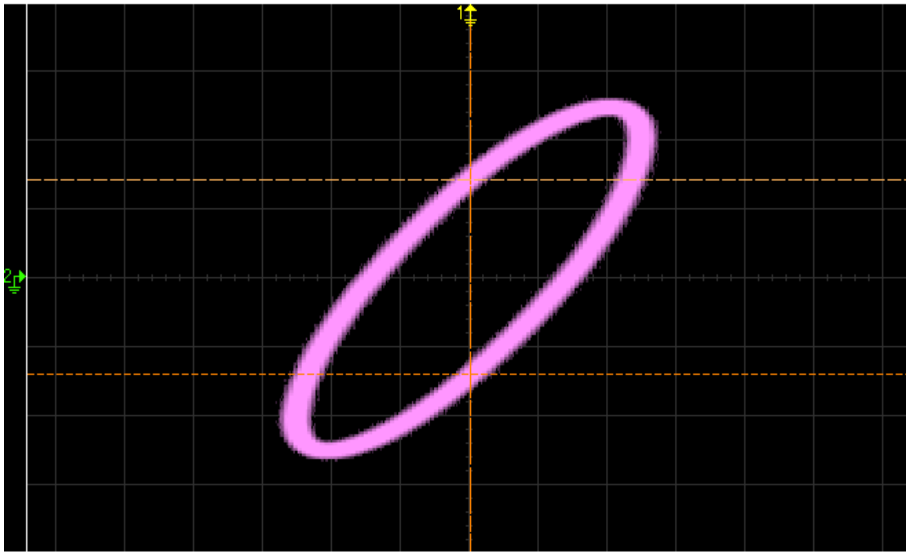
Viewing your signals from a different perspective enables you to visualize how your device will respond under various circumstances. There are three different horizontal modes that give you unique viewpoints of your signal.

XY mode

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

You can use the horizontal modes to help you perform the following:

- Analyze the voltage versus current of semiconductor devices.
- Use XY test patterns to detect if a device has experienced a manufacturing error.
- Characterize the frequency and phase relationship between two signals. A circle would mean the signals are 90 degrees out of phase. The oval you see in the image below indicates a 45-degree phase shift.



Roll mode

A roll mode operates like a strip chart when working with very low-frequency waveforms, sometimes as low as a few Hz or less. With frequencies this low, there is not 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 the display. Monitoring signal changes in real-time is essential, rather than waiting for the oscilloscope to plot each capture individually. When set to slow time per division, some oscilloscopes automatically switch to roll mode.

This mode is helpful when analyzing duty cycles, the relationship between two signals over time, DC line drift, and switching behaviors in power supplies. However, this mode is untriggered and intended only to visualize waveform changes, not to make detailed measurements.

Zoom mode

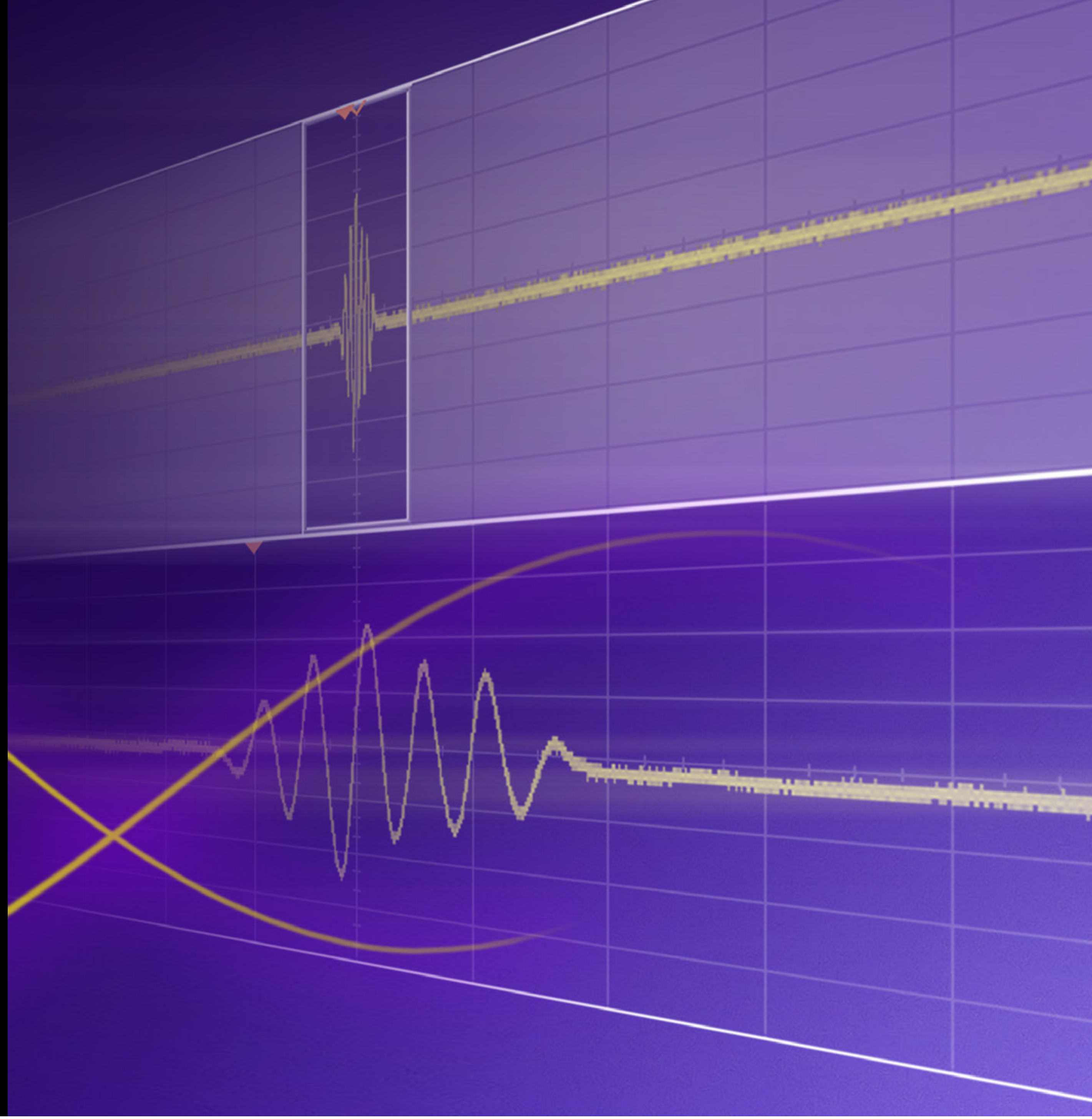
Zoom mode helps you to zoom in and analyze a small portion of a long capture. In this mode, you can perform measurements and math operations within that zoomed-in window, a technique known as gating.

Want to learn more?

Video: Lissajous Curves

TIP 6

Analyze Samples Using Acquisition Modes



TIP 6

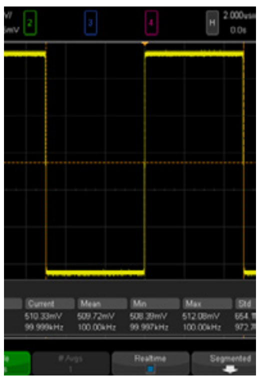
Analyze Samples Using Acquisition Modes

Understanding your signals' strengths and weaknesses is important by using various acquisition modes to ensure a comprehensive analysis. Acquisition modes vary your oscilloscope's sampling method to analyze different signal characteristics.

Want to learn more?

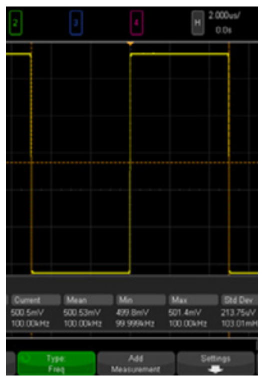
Video: Acquisition and Display Modes

Normal



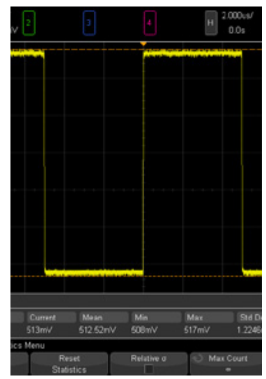
Normal is the most used mode for day-to-day measurements. This mode acquires samples at a specified sample rate and displays them on the screen at each trigger event. This mode is the safest to use.

Averaging



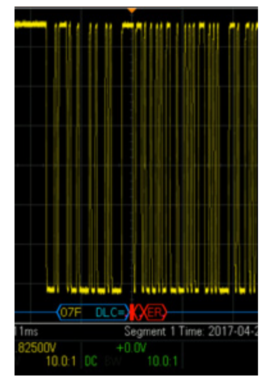
This mode captures multiple waveforms and averages them together. Use this mode to measure periodic signals like a clock or anything with a stable trigger. This mode hides transient noise or glitches to see the true, underlying signal.

High resolution



High resolution is another averaging mode. However, instead of waveform-to-waveform averaging, this mode performs point-to-point averaging. This mode enables you to capture glitches and periodic signals while still reducing some of the random noise riding on the signal.

Segmented



Segmented is a unique mode that specifically captures pulses, rare events, or infrequent glitches. Capturing the downtime between infrequent events in normal acquisition mode wastes memory. With segmented memory, you can eliminate that time and focus on the portions of the signal you want to analyze in greater 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.

Expand your testing to gain deeper insights, and remember to consider all aspects of your analysis with the following:

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

Explore InfiniiVision Oscilloscopes

The advanced measurement capabilities in this eBook are available on all InfiniiVision oscilloscopes, including the Keysight HD3 Series.

Perform digital debugging using a portable oscilloscope with a custom application-specific integrated circuit (ASIC) and 14-bit analog-to-digital converter (ADC) delivering four times the signal resolution and half the injected noise of other general-purpose oscilloscopes. Ensure product quality by debugging with an oscilloscope that can detect small signals beyond the noise to capture the slightest and most infrequent signal glitches.

With the HD3 oscilloscope, you have access to a large selection of serial bus protocols and application software, a wide variety of specialized probes, and a three-year warranty and KeysightCare Technical Support to derisk your project.

Check out the HD3 Series oscilloscopes to learn more.