Keysight Technologies
Oscilloscopes in R&D

Stimulus–Response Testing Using an Oscilloscope with Built-in AWG

The Keysight Technologies, Inc. InfiniiVision 3000T, 4000, and 6000 X-Series oscilloscopes can be op-tionally configured with a built-in function gener-ator with arbitrary waveform generation capability to help you more efficiently test your prototype designs under worst-case input conditions.

R&D hardware designers use a broad range of test and mea-surement equipment to test their prototype designs. The core instrument used to test the dynamic behavior of both transmitted and received signals is usually an oscilloscope. But to test designs under varied input signals conditions typically requires a signal source as well.

Nearly all electronic designs can be simplified down into transmitter circuits and receiver circuits. Although the receiver half of your design may respond correctly when stimulated by the existing transmitter half of your design, what if the signals generated by the transmitter circuitry exhibited characteristics that barely meet minimum output drive requirements? It's not a trivial task to "dumb down" your transmitter circuitry in order to generate output signals with worst-case characteristics so that you can test your receiver circuitry under marginal input condi-tions. A more efficient testing method is to temporarily replace the transmitter half of your design with an arbitrary waveform generator (AWG) that is able to produce signals that closely emulate the complex characteristic of your output signals.

There are various ways to create complex waveforms to download into an AWG, including building a waveform from scratch using an off-line AWG waveform editor on your PC. But perhaps the fastest and easiest method is to simply capture a known good waveform on an oscilloscope, and then transfer the waveform into the AWG for regeneration and modification.

With Keysight's 3000T, 4000 and 6000 X-Series oscilloscopes, the process of transferring a captured scope waveform into AWG memory is practically automatic since this scope comes with an optional built-in AWG (dual AWG in the 4000 and 6000 X-Series). A PC is not required. Storing the scope waveform in a .CSV format and then importing the file into the AWG is not required. Simply capture the reference waveform on one of scope's input channels, and then press the **Store Source to Arb** softkey. Let's now walk through a stimulus-response measurement example.

Figure 1 shows an example of the InfiniiVision X-Series scope capturing three serial packets on its channel-1 input. This complex signal represents a known good output signal from the transmitter part of a design.
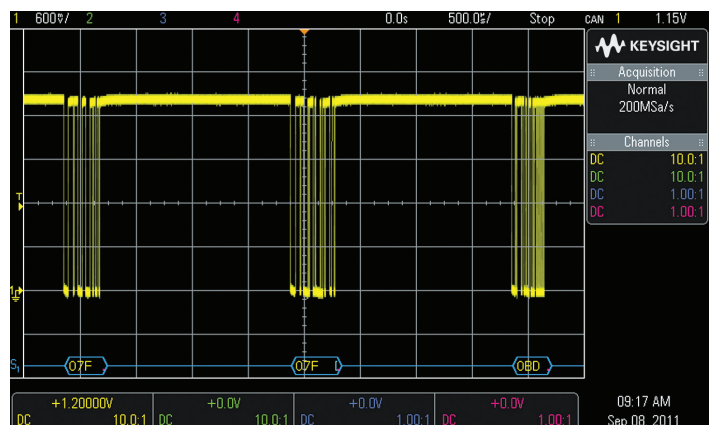

Figure 1. Three "good" serial packets captured on the scope.

Figure 2 shows the AWG editor screen after the waveform has been transferred from internal scope memory into AWG memory. Remember, transferring the waveform from scope memory into AWG memory only requires that you press the **Store Source to Arb** softkey shown in the lower right-hand corner of this screen image. However the waveform was originally scaled, captured, and displayed on the scope's screen (refer to Figure 1) is exactly what is transferred into the AWG's waveform memory.
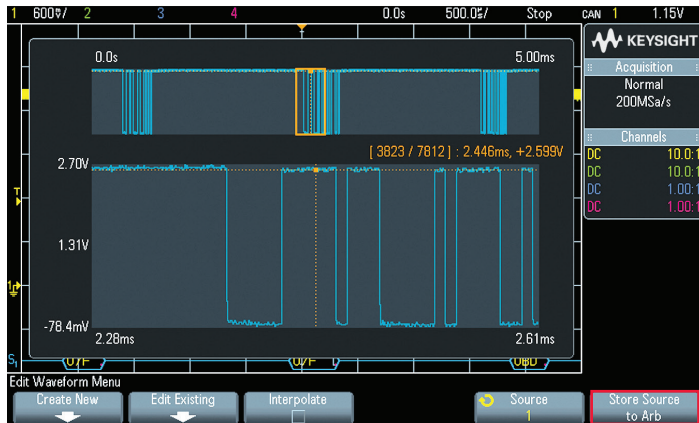

Figure 2. Using the scope's built-in AWG waveform editor after transferring the waveform from scope memory into AWG memory.

The upper blue trace represents the entire waveform memory of the AWG. The lower blue trace shows a zoomed-in portion of the stored waveform. This makes it easy to edit specific points (add points, delete points, modify voltage levels of specific points) using the scope's built-in AWG waveform editor. But for this particular stimulus-response measurement example, we don't need to edit individual points. To test our receiver for worst-case input signal conditions we need to modify characteristics of the entire waveform. We would like to test our receiver circuitry under reduced amplitude conditions to test the minimum input sensitivity, and add noise to the entire waveform to test for worst-case noise immunity of our new design. Note that we can also modify the frequency of the regenerated waveform to also test for baud rate sensitivity.

Figure 3 shows our regenerated signal from the scope's AWG with reduced amplitude and noise added to the signal. Making these modifications to the AWG signal to test for worst-case input signal conditions is very easy. Simply select the desired parameter, such as amplitude or frequency, and then dial-in a different value. Or add random noise to the entire waveform based on a percent of the amplitude setting.
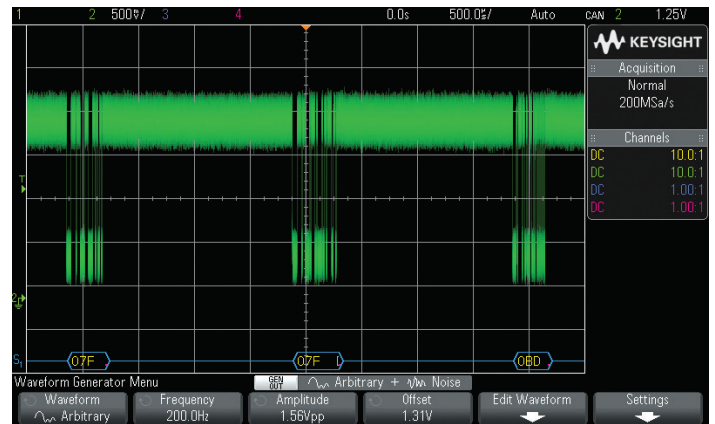

Figure 3. Regenerating the captured waveform with reduced amplitude and noise added.

Keysight's InfiniiVision 3000T, 4000 and 6000 X-Series Oscilloscopes

If you are in the market today to purchase your next oscilloscope, Keysight's 3000T, 4000 and 6000 X-Series oscilloscopes come in various bandwidth models ranging from 100 MHz up to 6 GHz. These scopes come with a 2-year recommended calibration cycle. When purchased with the DSOX3WAVEGEN, DSOX-4WAVEGEN2 or DSOX6WAVEGEN2 option, these scopes not only provide standard function generator capabilities, but also provide arbitrary waveform generated signals.
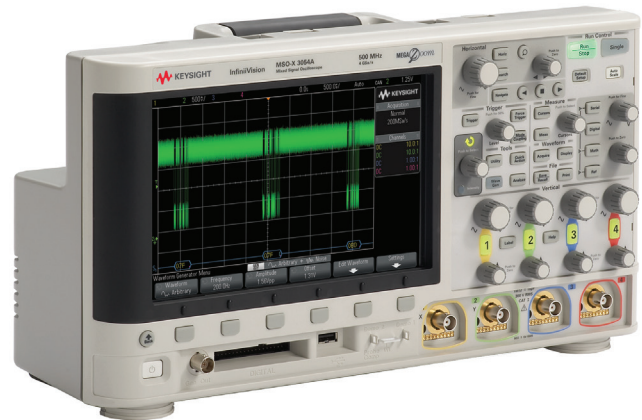
To learn more about Keysight's InfiniiVision 3000T, 4000 and 6000 X-Series oscilloscopes and mixed signal oscilloscopes, go to www.keysight.com/find/infiniivision

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