Demystifying the HD3's Digital Trigger

The InfiniiVision HD3 Series oscilloscope has a digital trigger — increasing trigger accuracy and sensitivity

Analog Versus Digital Triggering

Since digital triggering is a new capability for InfiniiVision, let's spend some time covering what a digital trigger is and how it differs from an analog trigger. An oscilloscope trigger tells the scope's acquisition system when it should begin acquiring data based on a set of conditions provided by the user. In simpler terms, you can think of a trigger like a photographer waiting for the perfect time to click the shutter button on their camera to take a picture. The trigger is responsible for not only taking the picture itself, but also deciding when it should take a picture of the incoming signal and display it on screen.

Before the HD3, our InfiniiVision oscilloscopes used an analog trigger system. **Oscilloscopes with analog triggers have independent signal path and trigger paths.** In this design, the signal goes through the preamp to the ADC to be digitized. Simultaneously, trigger comparators observe the output of the preamp and fire if it exceeds certain thresholds set either by the user, like if there is a rising edge on channel one, for example. When the trigger system conditions have been met, it sends a pulse on its output. When the scope's acquisition system sees the trigger system pulse, it will sweep the signal data and display it on screen.

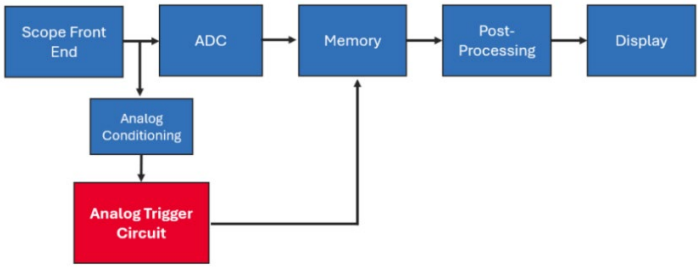

Figure 1. Signal path of an InfiniiVision scope with an analog trigger

In contrast, **the digital trigger system on the HD3 series has a single triggering and signal path.** The signal is digitized by the ADC and then the trigger system looks at the digitally processed data to determine when to trigger. This unified trigger and signal path can also be thought of as like using the viewfinder in the camera- you see the same light as it goes through the front lens and can actually tell what's in focus- the light, or the signal in scope terms, isn't being split into different paths.

Figure 2. Signal path of the HD3 with its digital trigger

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What Does a Digital Trigger Enable?

Analog trigger shortfalls

The practice of splitting the signal in an analog trigger design can make it difficult for the scope to pinpoint when the trigger event occurred on the signal. Even in well-designed scopes with analog triggers, there will always be some level of trigger jitter present. Trigger jitter is the difference between when a trigger condition is met and when the measurement sweep starts.

High trigger jitter can make it difficult to see what's actually happening with your signal— your waveform might look blurry on screen if trigger jitter causes the trigger point to shift slightly from one acquisition to another, or you could have trouble capturing fast or intermittent events that are obscured if your waveforms are not being aligned consistently on screen.

Analog triggers can also be subject to voltage errors or mismatch- which can cause missed or false triggers. A voltage error could cause the scope to fail to detect the signal crossing the trigger threshold when it actually did cross the trigger threshold.

Digital trigger benefits

Digital triggers enable higher trigger accuracy and trigger sensitivity. Trigger accuracy ensures that you can set very accurate triggers on specific parts of a signal, so they don't trigger on the wrong part or get false triggers. Trigger sensitivity refers to the minimum signal amplitude required for a scope to accurately detect a trigger event- or how sensitive the trigger is to small voltages. With higher trigger sensitivity, you can reliably trigger on very small signals on screen.

Because of the unified signal path with a digital trigger, digital triggers have significantly less jitter. That means you can be confident that their trigger points are aligned in the exact same place with each signal acquisition. Back to the camera analogy — a digital trigger is like having your camera automatically decide to take a picture when someone crosses a finish line: the decision to take the picture is a more automatic process and is based on the same data that gets recorded.

A digital trigger also addresses the potential time and voltage errors that can come from an analog trigger circuit. Using a digital trigger, the scope will trigger *whenever* the ADC samples cross the trigger threshold, even by just one bit. Another benefit to a digital trigger is that it has ideal rearming behavior. Digital trigger state machines can perfectly follow the signal's behavior through a sequence of events, but analog triggers can be slow to get their comparator and timing circuits ready for the next event after a false start of a partial trigger.

The HD3's digital trigger is just one of the many features that makes this scope so powerful. For more information on the InfiniiVision HD3 Series Oscilloscope, visit the product webpage on keysight.com.