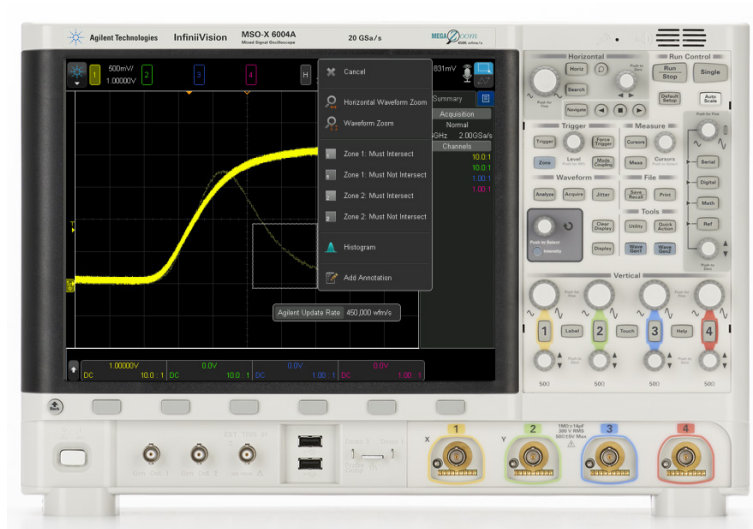# Finding the Cause of an Infrequent Glitch Using the InfiniiVision 6000 X-Series

Application Note

Introduction

Infrequent glitches, non-monotonic edges, and metastable signals are a few of the troublesome signal anomalies that can cause engineers long sleepless nights. Typically troubleshooting anomalies goes through a three step process;

1. Visible identification; confirm anomalies exist

2. Isolation; separate the anomalies from good signals

3. Insight collection; find clues leading to the root cause (such as the frequency of the anomalies, unique patterns, or other identifiers to lead to diagnosis of the reason for the anomaly in the first place.)

This application note is a supplement to "Finding the coupling signal that causes the glitch", which is one of the built-in automatic demonstrations in the Agilent InfiniiVision 6000 X-Series. This application note covers the following topics:

• Fast waveform update rate and why it is important

• Hardware InfiniiScan Zone touch trigger and how it accelerates your signal isolation

• Color grade enabled segmented memory and how it gives more insight into your signals

• 10-digit counter and totalizer and how the trigger qualified event counter aids your troubleshooting

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Confirm and isolate anomalies

If you suspect an anomaly is present in your design, either in the product development, design validation, or failure analysis, the first thing you need to do is find it. Figure 1 shows an example of an infrequent glitch that can show up mixed in with good signals. The glitch is causing the design to have intermittent operation failures. With a slow waveform update rate (trigger update rate) like that found in traditional digital storage oscilloscopes, this first step of visual confirmation can take a long time. However, with the 6000 X-Series' 450,000 waveforms per second (wfms/sec) update rate, you will see rare glitches, like this one, immediately. In terms of time saved, if it takes 10 seconds for a scope with 450,000 wfms/sec update rate to display a glitch, then it takes 75 minutes for a scope with 1,000 wfms/sec update rate to display the first same glitch!

Now that you confirmed the glitch, you would like to isolate it from good signals. The use of advanced triggers is a fundamental way to isolate signals in modern oscilloscopes. However, setting up advanced triggers requires expertise, and can be challenging depending on the complexity of anomalies you are trying to isolate. With the 6000 X-Series' exclusive hardware-based InfiniiScan Zone touch trigger, the signal isolation is as easy as drawing a box around the signal or area of interest, and select whether the signal "must intersect" or "must not intersect". The oscilloscope then displays just waveforms that meet this qualification. See Figure 2 and 3 for an example of InfiniiScan Zone isolating the rare glitch in our example signal. Because the 6000X' InfiniiScan Zone is hardware based, it can scan through triggers as fast as 160,000 waveforms per second. In comparison, a software-based zone trigger would only be able to look at ~1,000 waveforms per second.
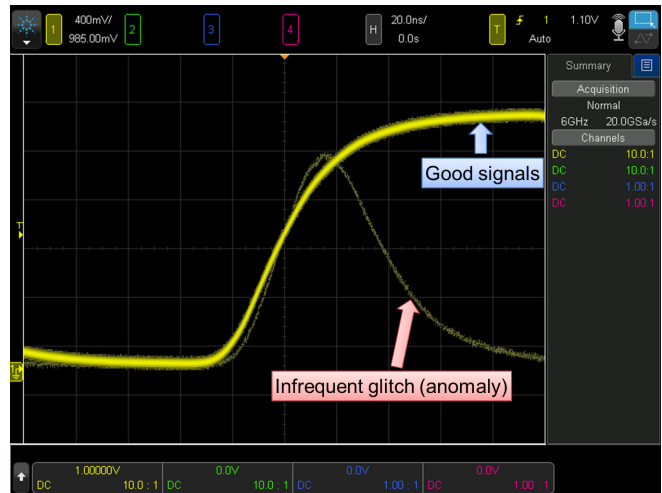

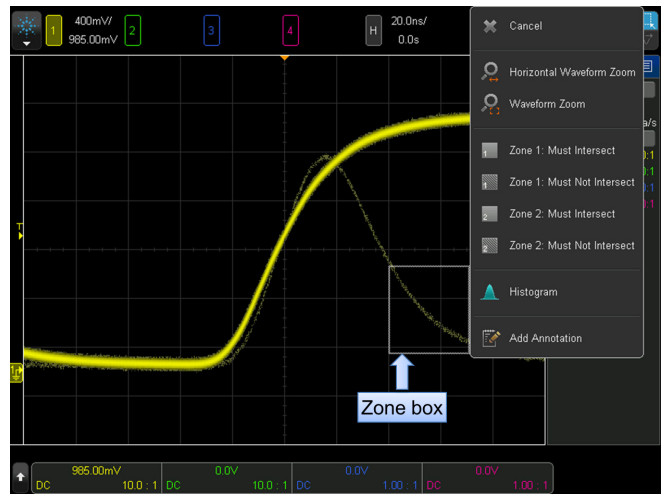*Figure 1. A fast update rate captures a rare glitch much faster.*

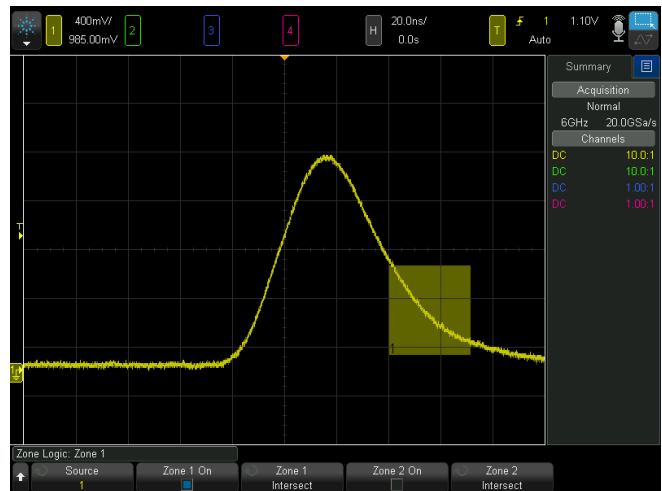*Figure 2. Draw the box to setup the InfiniiScan Zone touch trigger.*

Figure 3. Capturing and displaying just the waveforms that intersect the box drawn in figure 2.

2

Collect and analyze insights to determine the source of the glitch

Once anomalies are isolated, it is time to collect and analyze relative information to try and get to the bottom of the cause of this glitch. Using the dual cursor on the multi-touch screen of the 6000 X-Series, we can quickly measure the size of the glitch, in this case it is about 40 ns as shown in Figure 4. Knowing the width of this glitch, we can now isolate the glitch a second way.

What we would really like to know is if this glitch is happening more than once, and if so how often. In this case one of the advanced triggers, the pulse width trigger, is an ideal one. The pulse width trigger works by setting up "greater than", "less than" or "in between" pulse width conditions. Figure 5 shows the pulse width trigger setup at "less than 50 ns" pulse width.

But how can we find out how often it is happening? Segmented memory is a standard feature of the 6000 X-Series that lets you selectively capture and store important signal activity or a segment, without capturing unimportant signal idle time. A time stamp is provided with each segment relative to the first trigger event. The segmented memory is an ideal solution since we suspect this is a very infrequent glitch with long idle time in between. We will use segmented memory and the pulse width trigger to find out how many times this pulse size happens.

Figure 6 shows the result of capturing 50 glitches. Using the scrollable side bar events lister, you can quickly find out time stamps of each segment. The lister reveals the glitches are periodical and occurring every 42 ms or at a frequency of 23.8 Hz

$$\frac{1}{42ms} = 23.8 \text{ Hz}$$

In other words, you just identified a potential root cause of this glitch to be a coupling signal from a source with a frequency of around 23.8 Hz.
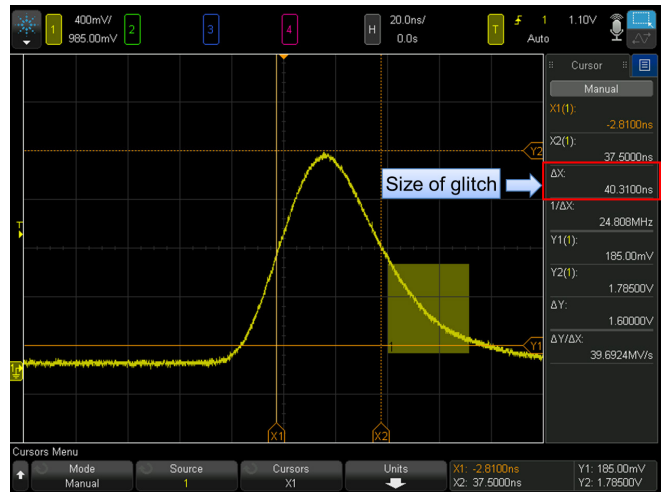

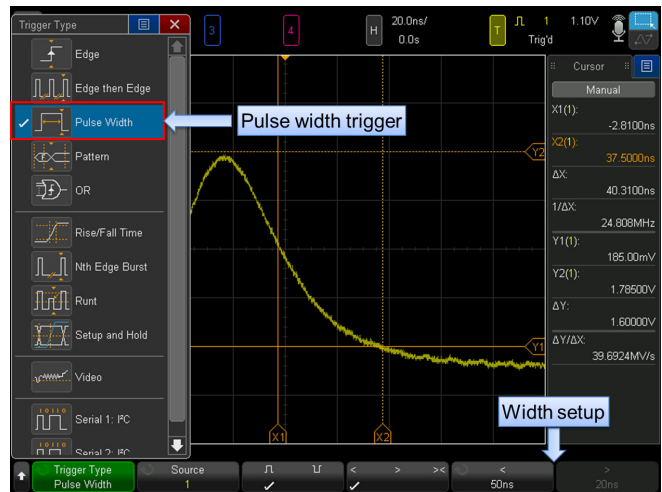Figure 4. Using the dual cursors to determine the glitch size.

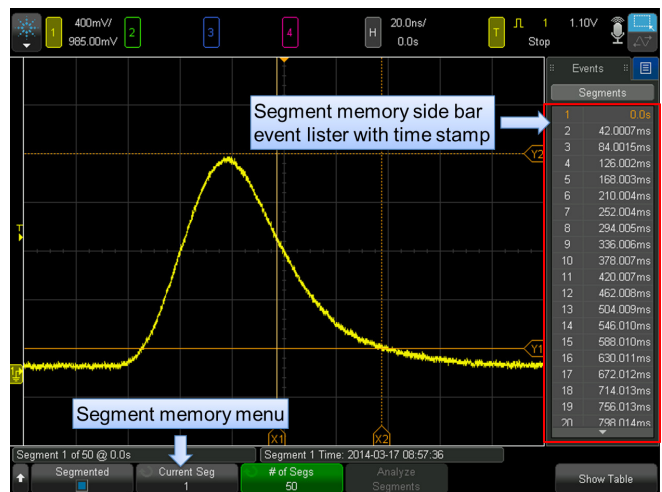Figure 5. Setting up the pulse width trigger.

Figure 6. Segmented memory captured 50 glitches. Side bar lister shows the relative time stamps.

Further insights can be obtained when segmented memory and color grade analysis are used simultaneously. The "analyzer segment" feature of segmented memory can overlay all segments using the color grade display when color grade is activated. Color grade can provide just how often a particular event of interest occurs by displaying a three-dimensional quantitative view of the waveforms, so it is an ideal solution to find outlier signals, as shown in figure 7.

Also note segmented memeory captured 50 glitches over the time span of 2 seconds at 20 a GSa/s. A traditional scope without a segmented memory feature requires 40 Gpts of memory to do a similar acquisition (2 sec / (1 pt / 20 GSa/s) = 40 Gpts).

$$\frac{2\ \text{sec}}{.05\ \text{GSa/s}} = 40\ \text{Gpts}$$

Figure 7: Color grade analysis on segmented memory can offer additional insight to the type of glitch you are dealing with.

10-digit counter and totalizer

The InfiniiVision 6000 X-Series offers one more alternative approach to discover how often a particular glitch is happening, using the built-in 10-digit counter and totalizer (option). The built-in 10-digit counter and totalizer counts the number of edges as well as "trigger qualified events". Figure 8 shows an example of the counter measuring the frequency of the pulse width trigger qualifying event taking place. As expected, the counter found out the glitch is happening at 23.8 Hz.

Conclusion

Oscilloscopes with slower waveform update rates may risk missing valuable information, however, with the 6000 X-Series' 450,000 waveforms/sec update rate, that risk is lowered considerably. The advanced triggers are powerful event isolation tools, however, the hardware InfiniiScan Zone takes trigger usability to the next level. With the hardware InfiniiScan Zone trigger, "if you can see it, you can trigger on it".

After isolating the glitch in our example, we determined the suspicious coupling signal to be at 23.8 Hz. We first started with segmented memory analysis where the time stamp revealed each glitch was occurring 42 ms apart. We were able to see that the glitch was periodic because we captured 2 seconds of time with consistent results. Without segmented memory, we would have needed a scope with over 40 Gpts of memory to capture the equivalent time. The combination of segment memory and color grade could have identified outlier glitches, if they existed. As an alternative troubleshooting approach, we then used the 10-digit counter to monitor the trigger qualified event and found out that the glitch was occurring with a frequency of 23.8 Hz.

Using the Agilent InfiniiVision 6000 X-Series, you can speed up the process to get to your root cause. With a 450,000 waveforms/sec update rate, hardware InfiniiScan Zone touch trigger, color grade enabled segmented memory, 10-digit built-in counter, and the ease-of-use of the multi-touch display, you get next generation oscilloscope technology at a price performance ratio your budget can handle.
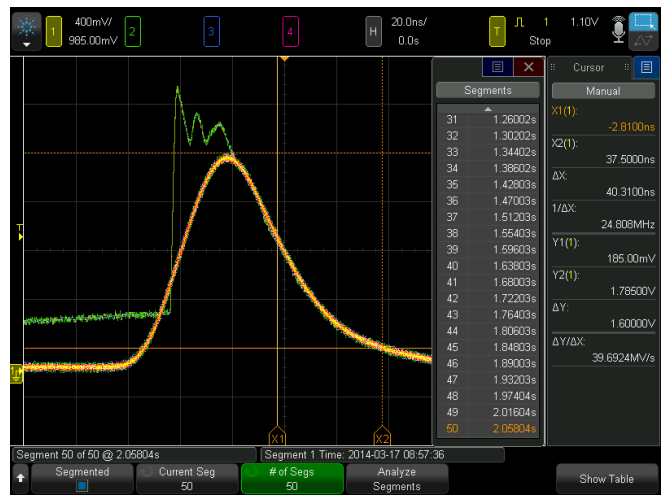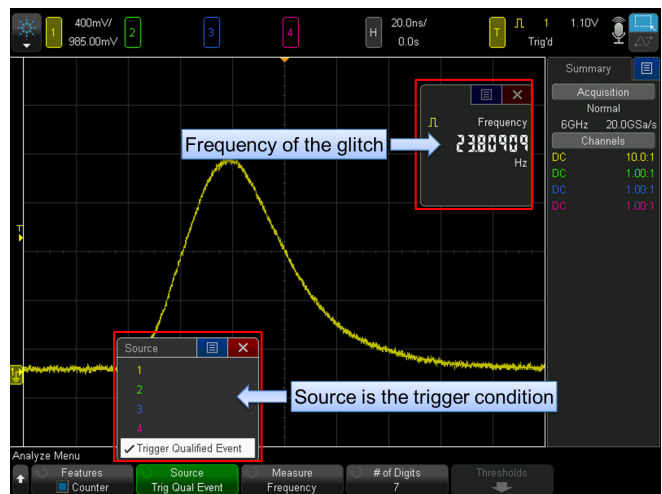

Figure 8. Using the 10-digit counter and totalizer to identify the frequency of trigger qualified events.

Related literature

Publication title	Publication type	Publication number
Agilent InfiniiVision 6000 X-Series Oscilloscopes (1 GHz to 6 GHz)	Data sheet	5990-4087EN
Fast Waveform Update Rates Enhance the Probability of Capturing Elusive Events	Application note	5989-7885EN
Oscilloscope Display Quality Impacts Ability to View Subtle Signal Details	Application note	5989-2003EN
Triggering on Infrequent Anomalies and Complex Signals using InfiniiScan Zone Trigger	Application note	5991-1107EN

To download these documents, insert the publication number in the URL: http://cp.literature.agilent.com/litweb/pdf/xxxx-xxxxEN.pdf

Product web site

For the most up-to-date and complete application and product information, please visit our product Web site at:
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