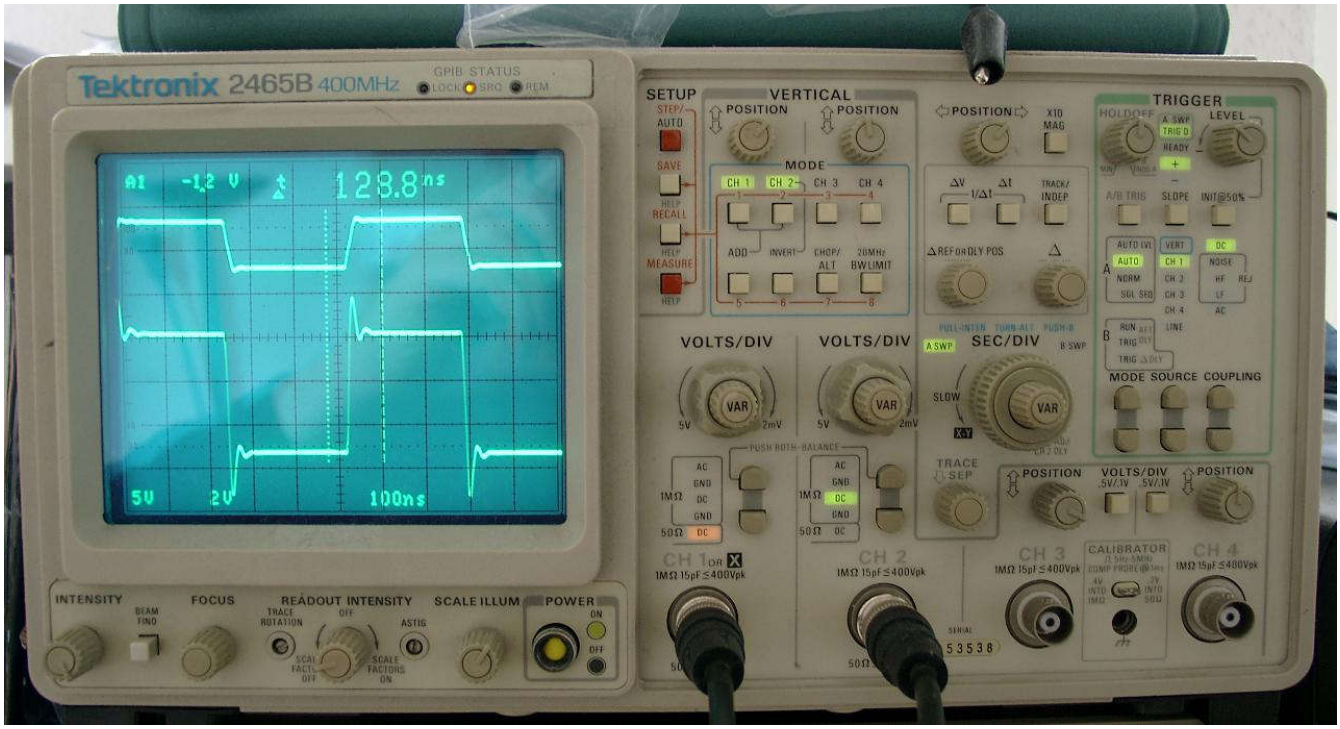
RAKO STUDIOS

Analog oscilloscope benefits

Analog scopes are not yet ready to be tossed into the dustbin of history.



In recent years digital storage oscilloscopes have become ubiquitous on test benches. Older folks like me still prefer analog scopes. With regard to my analog scopes, all I can say is that you can have my 400MHz Tek when you pry it from my cold dead hands. My everlasting desire to use analog scopes is driven by two factors:

1. Analog scopes rarely lie.
2. The decent user interface of analog scopes.

The first point is well understood. Digital scopes alias and display artifacts that have nothing to do with what is really going on. All a digital scope does is take a sample periodically and store it into memory. You have to understand that some software geek has decided how to "connect the dots" between samples. What it displays may have nothing to do with what it is connected to.

The second point is more a matter of personal preference. You need to understand that a digital scope's user interface is dictated by the whim and fancy of some 23 year-old software dweeb that got stuck doing the user interface because the alpha-geeks think it's macho to do algorithms and math, not the UI. The tragic lack of social skills of most software engineers only underscore the problems one would expect using any product designed by them.

The foremost feeling one gets when using a digital scope is the software geek's love of typing. Perhaps journalists share this love, after all, it is typing that provides both groups with their incomes. Any time you use a digital scope (or any other modern consumer product for that matter) one can almost hear the animated squeals of delight as the software geeks exclaim-- "Let's type!!" It seems everything is preceded by poking some patterns of "codes" into a front panel full of tiny little buttons, or worse yet, those HP scopes that just had a single knob on them.

That is not only software geek, but anally-retentive software geek. That single knob presages the goal of all software types-- the hardware interface is a single button and you tap in all the commands in a perverse variant of Morse code. This is how $8.75 clerk- typists can make six figure salaries and drive Ferrari's-- they make everything , even the most simple tasks into a puzzle full of "code" and misdirection and link lists to indirect pointers blah blah blah. This is evil.

When I consulted at a Teledyne division 10 years ago the HP guy came in and asked how he could get all the old Tek analog scopes off the benches. The lab manager replied: "Easy, just put three knobs on your scopes instead of one and label two of them vertical and the other one horizontal." Just last year I was using an old Agilent network analyzer-- the 3577A, to do gain-phase measurements on a batch of new chips. A test engineer asked me to help him set up the newer spiffy color Agilent network analyzer to do the exact same thing. After an hour of poking and prodding and cajoling and begging and profanity it was clear that just because I was an expert in 3577A I still didn't know the magic codes needed to get the newer unit to work. I felt pretty stupid. At least until the lab tech told me that the old network analyzer was designed by HP in Colorado and the new one, despite the HP/Agilent name, was done by a bunch of Japanese schoolchildren at Kiksui or some darn place. That would explain the user interface being completely different. That would also explain the fact that who ever did dream up the nightmare user interface never used a function generator with a frequency knob or a scope with a vertical and horizontal knob. They just dream up some clerk- typist interface that has absolute nothing to do with the 100 years of electrical engineering tradition that is based on clear and intuitive truths like the need to sweep analog voltages across cathode ray tube deflection plates and vary capacitances on wien-bridge oscillators.

Last week I had to take some picosecond rise-time measurements. A tech rolled up the Tek 11801B digital sampling scope. He gave a clearly sadistic grin and said "you should have a lot of fun with this". I soon understood what he meant. This scope is essentially unusable from the front panel. Now the tech made excuses, saying the scope was really set up to do TDR (Time Domain Reflectometry) measurements and that it was intended to be run from GPIB, not the front panel. I still consider the interface to be not only bad, but downright evil. I really mean it. Evil is badness that self-perpetuates and I sure don't see any scopes getting more intuitive. We are soon going to buy a 6GHz scope and it will be interesting to see whether Agilent, Tek or LeCroy has the most abominable interface.

When using that Tek11801B I had to have a 400 Mhz analog scope hooked up in parallel just to convince myself that there really was a signal there. Many times I just pressed "auto set" in order to get the darn thing to trigger and show something on the screen. This is pathetic,

that it takes one batch of overpaid software geeks to make an unusable interface so that you have to hire another batch of overpaid software geeks to do an "autoset" function just so the scope doesn't get tossed into to dumpster (or off the third floor parking deck, which has a certain tradition at National Semiconductor).

As I said, leave my analog scope alone! I still need it and will always need something that can put a valid waveform up in seconds, not minutes. Roy Childs once commented that the early libertarian movement was a bunch of people doing "talking, endless talking". I say that using digital scopes is an exercise in "typing, endless typing".

Now I don't want to be too dogmatic here either. There is a place for digital scopes. Sometimes a digital scope is the only thing that will get the job done. When I am trying to grab a one-time event I prefer a modern digital scope to an old analog storage scope. (But don't think that you can't get the exact same information from a 20-year-old scope you got at a flea market for 50 bucks.) This week I am putting huge current pulses into some transistors to observe the second-area breakdown effects. I don't want to put a repetitive pulse train into the transistor for two reasons: One, the repetitive pules will heat the transistor even if they don't blow it up. Second, because when it does blow up I want a picture of that one single exact pulse that did it. So in this case I got a digital scope and set it up for single-shot trigger mode. I did the same with the pulse generator so that I could wait a second or two between pulses to make sure the part had cooled down and was isothermal across the entire die. Another factor in my use of the digital scope was that I wanted to send the data in an email. This particular scope had a floppy disk in it so it was easy to save the file as a TIFF standard file. Then I could use IrfanView to convert it to a GIF file so that I could send it attached to an email in a format any web browser and most email packages can display. (Tek would probably be able to output a GIF except GIF is a patent of Compuserve so next time you think the patent system is something to help lowly engineers instead of give monopolies to corporations, think twice.)

Another place where digital scopes are the only answer is extreme high speed applications. There is a whole batch of 6GHz bandwidth scopes, some of which can sample at 20Gsamples/sec. This is great for tricky signals that may have multiple frequency non-synchronous signals superimposed. If you want to look at a 50 nSec pulse that has a 600 MHz oscillation on top of that pulse you need to get the picture of a single pulse in a single pass. I guess now might be a good time to look at the article that describes the difference between and analog and digital scopes as well as the difference between a sampling scope and a conventional scope.

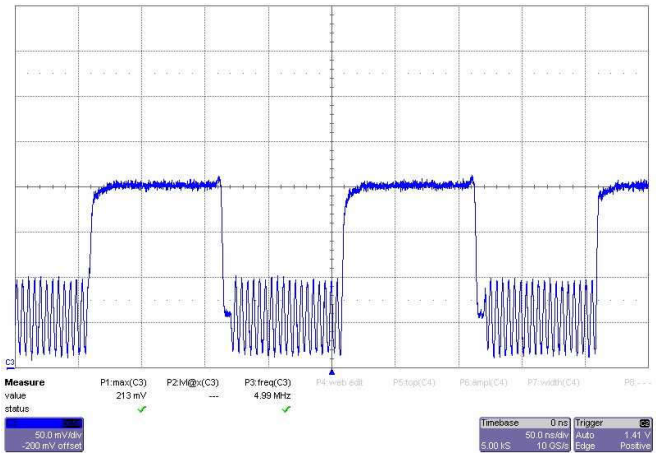


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Figure 1 might make the problem more understandable. The rising edge of the pulse is probably what you will trigger off of. The little 600 MHz oscillation on top of the pulse is asynchronous to the big pulse. It comes from a free-running oscillator that has nothing to do

with what creates the big pulse. The leading edge of the big pulse may coincide with the peak or the trough or any other place on that little oscillation. So if the scope is constantly triggering on the big pulses as they come along you will see a nice crisp rising and falling edge for the big pulse. But each different big pulse will have the little oscillations at a different place unless a very unusual situation arises where the two signals do happen to be synchronous to each other. Don't worry, it won't last long. So what you will see is the crisp rising and falling edges of the big pulse but the top edge of the pulse will be a big blur because every pulse that comes along is displaying that 600 MHz oscillation at a different point in the big pulse.

Now a clever engineer might set the trigger level to catch the little oscillator at it's peak and thereby stabilize the display of the 600 MHz oscillation on the screen. This is fine, but then the leading and falling edge of the big pulse will be smeared and fuzzy because they are unsynchronous-- not related in time-- to the little oscillations. So the only way to really catch this pulse is with a fast scope that can display the information from a single pulse event.

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