

## Re: Linux, PC-based, PCI or USB oscilloscopes?

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lbrtchx@xxxxxxxxx wrote:

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My son is quite a bit enthusiastic about computer electronics and he wants to use an oscilloscope for his learning/tinkering around

Then buy him one. For his first experiences it does not need to be a state of the art one. You can get good refurbished analog oscilloscopes in the 60MHz bandwidth range for about 400\$.

Especially for a beginner I recommend a analog oscilloscope, since digital ones can set traps you don't fall into with analog ones (one of those traps is undersampling, which you also mentioned).

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Oscilloscopes are not really mass-market toys, but very expensive pieces of equipment, so, I was telling him to check his options and he would now settle for a PC-based oscilloscope

Hehe, that can mean anything. For example the LeCroy Waverunner series (really state of the art and VERY expensive) are in fact very fast multichannel A/D samplers, connected to a PC on which runs: Windows... All in one housing. You can even connect keyboard, mouse, USB storage and stuff like that.

Now I think you might have thought about one of those USB connected A/D samplers, with some oscilloscope frontend software. We're using them here in university for educational purposes on `_slow_` signals. We used to use analog servo XY-plotters for that, but those things caused so much trouble, that we were happy to replace them.

## Re: Linux, PC-based, PCI or USB oscilloscopes?

For those problems where you really need an oscilloscope, those cheapo softscope USB boxes are IMHO not worth the bucks. For the same money you can get some 10MHz 8 channel A/D converter board you plug into the PCI slot, which easily outperforms them, plus for most of those there are open source drivers in the Comedi package.

I am more of a software guy, so, I don't know much about it, but I was trying to make him understand that he could certainly not use a PC with a chip pulsing at a given frequency to gauge another one with a (n equal? or) higher frequency

Yes, you're right: To sample a signal of frequency  $n$  you need a sampling rate of at least  $2*n$ , which is described by the Nyquist theorem.

That's why CD digital audio has a sampling frequency of 44,1kHz, as this results in a cutoff at 22,05kHz which is at the upper limits of human hearing capabilities. Since some individuals can hear beyond 22,05kHz (I'm one of those – so far, this changes with age), nowadays 48kHz sampling rate are used in recent audio applications (audio track on DVD AC3, DTS etc.). In production you also want to have some bandwidth reserve, so in the whole mastering process usually  $48\text{kHz}*2 = 96\text{kHz}$  are used.

However once you've sampled the signal there are no longer constraints. You can do any signal processing with any turing complete machine, no matter how slow it is. Of course for reproduction you've to go with the sample rate again.

Am I basically right? What other aspects should be considered while getting a PC-based oscilloscope? Which other functionality are you throwing out the window when you use a PCO?

If you can get a very fast A/D converter (we're talking about at least 300MHz single shot sampling rate at 12 bits resolution) a softscope gives you a lot more possibilities, than an analog scope, except: Analog scopes naturally expose a far better visualisation of the signal. E.g. if you've got some signal with harmonics on it a digital sampling scope will show you some jaggy wave – you can use the averaging function to cancel that out, but at the loss of the harmonics, the envelope will mostly show you the harmonics at loss of the main signal. An analog scope will however show you the main signal, but the shape gets blurred out by the harmonics giving you a much better idea of

Re: Linux, PC-based, PCI or USB oscilloscopes?

what's really going on.

There are BTW so called comboscopes which you can switch between analog and digital sampling mode. I own such a thing, a Hameg 1507-3, which you can even connect to a computer to download digitally sampled waveforms, or upload reference waveforms you can overlay into the display. It IMHO a very cool scope but it also costs something. The official price for a refurbished one is 1900€, I got one for about 1000€ a few weeks ago.

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