

Re: DDS issues...was sine generator ic solution

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From: mike (spamme0_at_netscape.net)

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John Larkin wrote:

> On Sun, 30 Jan 2005 14:47:13 -0800, mike <spamme0@netscape.net> wrote:

>

>

>>DDS issues???

>>

>>The concept of DDS frequency synthesizers comes up frequently.

>>I can't figure out what they're good for.

>>I took apart the prototype hardware, so you'll have to be

>>content with an Excel simulation.

>>Here's a plot of a DDS simulation.

>>

>><http://nm7u.tripod.com/homepage/sine.jpg>

>>

>>If you looked at it on a real-time scope, you'd likely

>>be impressed. All the points lie exactly on the sine wave,

>>(within D/A resolution)

>>so statistically it's a real sinewave. Averaged over time

>>the AVERAGE frequency can be very precise.

>>

>>But if you look at it on a storage scope, you can see that

>>each cycle is different. And the difference can change dramatically for

>>small changes in frequency. The graph shows how for some frequencies, the

>>output is amplitude modulated at a much lower frequency. You can't

>>take that out with a low-pass filter.

>>

>>The graph is deceptive cause it

>>linearly interpolates the points. In actuality, there's a big

>>ole step at each point. This becomes painfully clear if you try to use

>>a comparator to generate a square wave. Or if you try to DDS anything

>>other than a sine wave.

>>

>>Yes, if you filter it enough, you can make anything into

>>a sinewave. And if your hardware is a few orders of magnitude

>>faster than your output requirement, the filter is easier.

>>

>>What am I missing that makes DDS useful in any time-domain application

>>or wideband frequency-domain application?

>>mike

>

>

>

> *I can't see the pic, but a raw DDS output does indeed look nasty, and
> gets worse as you approach $F_{clk}/2$, the Nyquist frequency. But if you
> run it through a lowpass filter, you get a nice sine wave with
> respectably low jitter. The Sampling Theorem says so, and it works.*

>

> *We build an arbitrary waveform generator that includes four DDS clock
> sources. The crystal oscillator freq is 40 MHz, and we synthesize
> wavegen clocks up to 15 MHz. The DDS chip output feeds a 4-pole LC
> filter and a schmitt trigger gate and makes a pretty nice clock.*

Since you're triggering at the high slew rate part of the waveform, a little amplitude modulation probably won't affect you much.

I don't know whether to describe it as a mix or as an alias.

It's most observable where the sampling frequency is not quite exactly a multiple of the output frequency. Modulation depth is a function of frequency. I found it took a big chunk out of the top end I was expecting. I don't think most people would notice the problem or object until they wanted to use those frequencies in some test that counted on stable amplitude.

I've had reports that some people can't access tripod pictures.

Are there other free places to stick pictures that are more generally accessible? I'm not about to expose my primary address to spam.

Does this work any better?

<http://www.geocities.com/SiliconValley/Monitor/4710/sine.jpg>

mike

In

> *retrospect, we might have used a better filter, elliptical maybe, and
> got a bit less jitter, but it's not bad. The filters were tweaked to
> peak at 15 MHz to compensate for losses and sinc distortion. I posted
> a graph of DDS jitter vs frequency to a.b.s.e. a while back.*

>

> *If the output frequency is, say 5:1 or 10:1 below the clock frequency,
> the filter is easy and jitter will be very low. The rub is that at
> very low frequencies the filter essentially disappears and you're left
> with the dds dac steps re-emerging, so jitter trends toward some fixed
> fraction of the output period, 1/10,000 maybe, depending on the number
> of dac bits. In that case, one can switch filters, or keep the dds
> output up where the filter's still effective, and divide the schmitt
> output digitally to get a low-jitter lf clock.*

>

> *I haven't seen the lf modulation you refer to. Very close to Nyquist,*

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> *you'll get your desired signal and its image flipped about $F_{clk}/2$,*
> *which would take a brickwall filter to separate.*
>
> *Really, these things are great! But without a filter, they're junk.*
>
> *It is interesting that the Analog Devices datasheets used to show*
> *typical filters, and now they don't. And their eval boards used to*
> *include filters, and now don't. It's almost as if they're pretending*
> *that you don't need a filter.*
>
> *John*
>
>
>
>

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Return address is VALID.

Wanted, PCMCIA SCSI Card for HP m820 CDRW.

FS 500MHz Tek DSOscilloscope TDS540 Make Offer

<http://nm7u.tripod.com/homepage/te.html>

Wanted, 12.1" LCD for Gateway Solo 5300. Samsung LT121SU-121

Bunch of stuff For Sale and Wanted at the link below.

<http://www.geocities.com/SiliconValley/Monitor/4710/>