Experiments with simulated jitter

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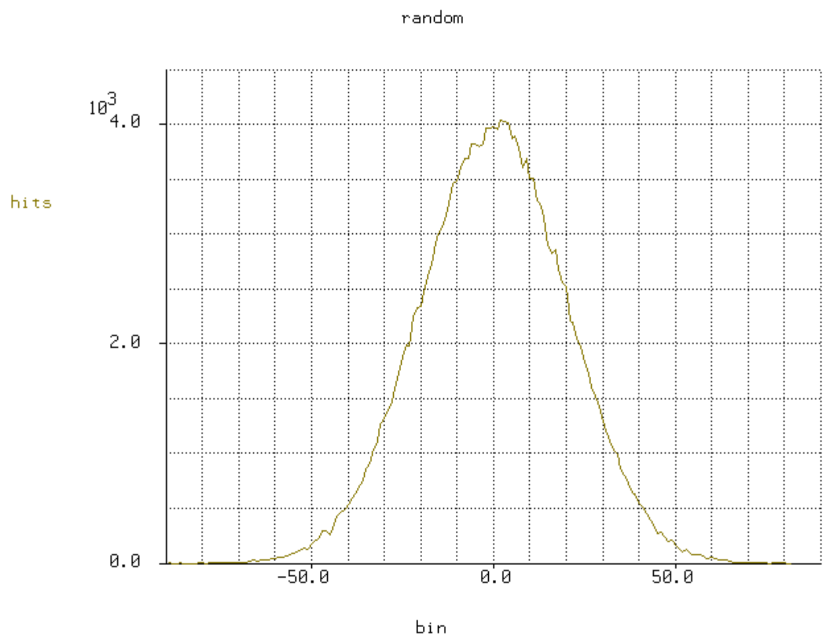
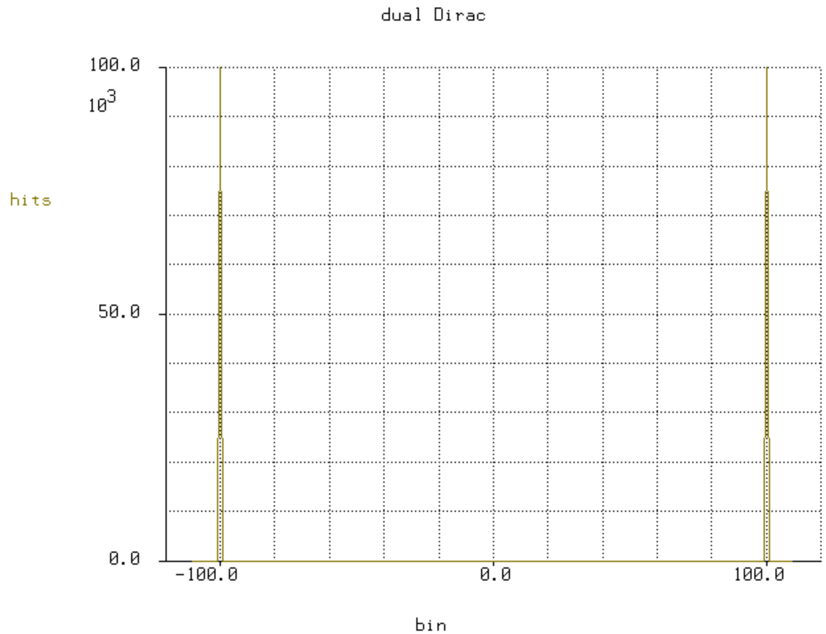
I generated simulated jitter by convolving a Gaussian random pattern with a deterministic pattern. The Gaussian random pattern was generated by convolving bits from a PRBS57 pattern enough times to get the desired variance. I used a bin size of 0.5 mUI (19.39ps). For the experiments I am reporting I use a random pattern of 10mUI RMS and deterministic pattern peak to peak of 100 mUI.

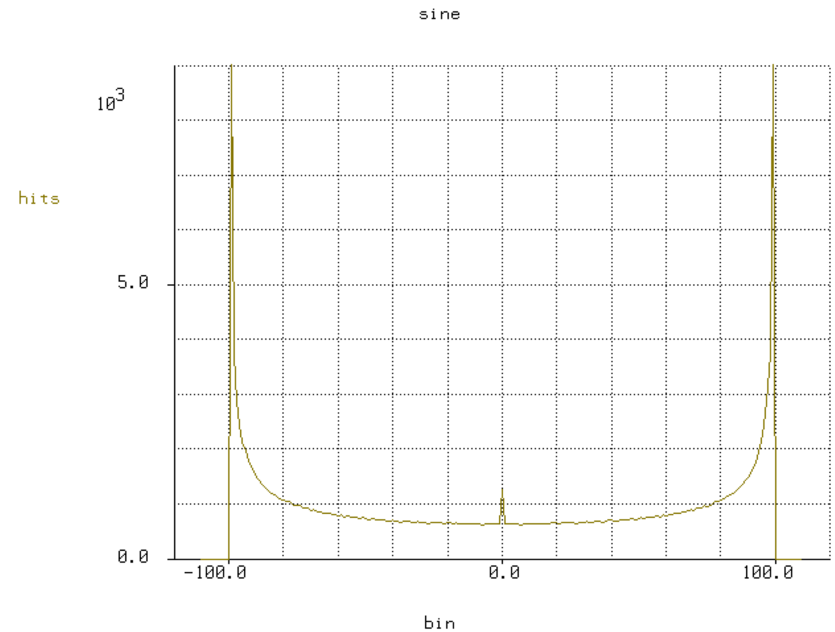


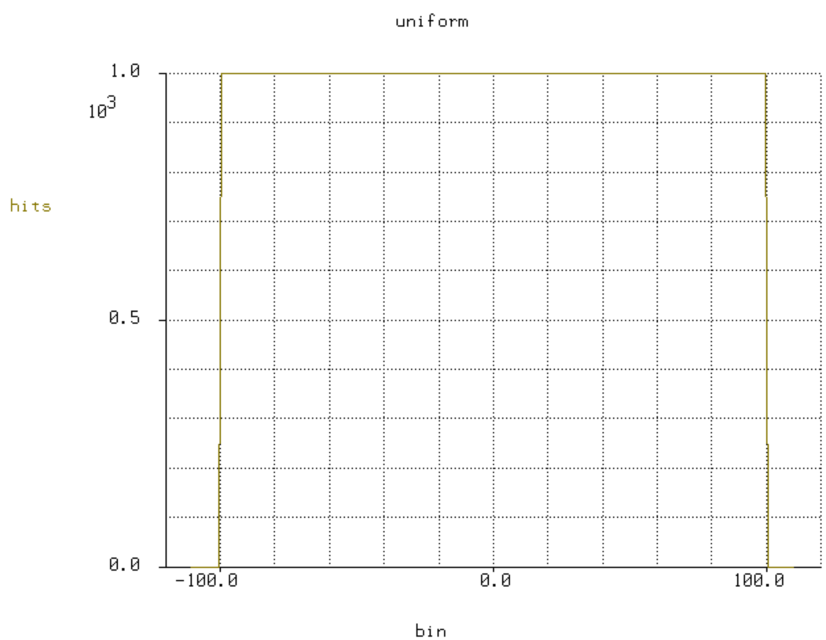
I used the deterministic patterns shown on the next slide.

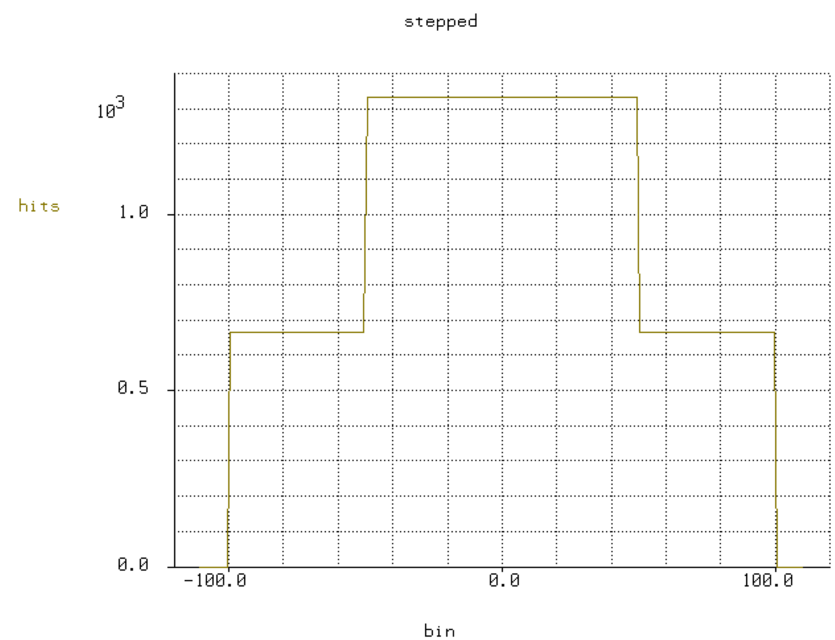
Note these show the distribution for 2.0×10^5 total hits. I did most of my computation at 2.0×10^7 total hits for better resolution.

Deterministic distributions









First try: dual Dirac plus RJ

Should work, after all we are using a “dual Dirac” model

Using 2×10^4 hits, using the method given in D3.0 92.8.3.9.2 I get

effective bounded uncorrelated jitter = 90.8 mUI p-p
effective random jitter = 10.7 mUI RMS

EBUJ is about 9% low and ERJ is about 7% high

If I increase the number of hits to 2×10^6 , using the same method:

effective bounded uncorrelated jitter = 101.9 mUI p-p
effective random jitter = 9.1 mUI RMS

More than 10% change. The result changes with number of samples.

If I keep the ratio of the boundaries of the fitting range to the number of samples constant by using 2000 and 50,000 instead of 20 and 500 for the case with 2×10^6 hits

effective bounded uncorrelated jitter = 91.3 mUI p-p
effective random jitter = 10.6 mUI pRMS

A minor change, within the limits of accuracy of the measurement.
Then let us change the bounds of the fitting region to a fraction of the number of hits. I suggest 1/1000 and 1/40.

I provide a backup slide showing the effect is larger for uniformly distributed deterministic jitter.

Getting RJ right

Notice that with dual Dirac deterministic jitter, using the proposed method, ERJ is larger the the actual RJ. For other deterministic patterns the effect is more dramatic:

Deterministic pattern	EBUJ (mUI)	ERJ (mUI)
ideal	100.0	10.0
dual Dirac	91.3	10.6
sine	68.6	12.6
uniform	52.6	14.0
stepped	42.5	15.2

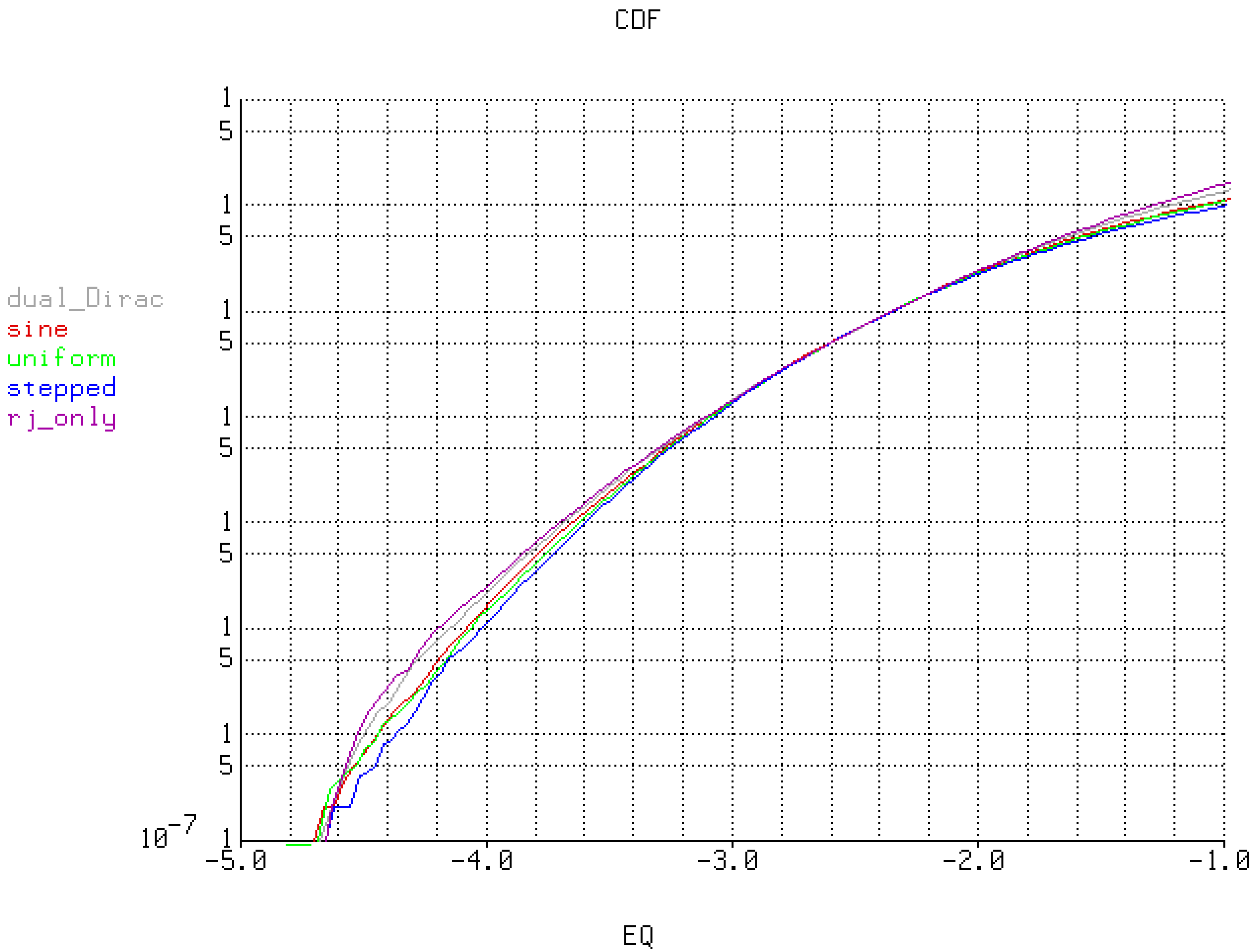
This show that ERJ measurement can be in error by more than 50%. That makes any tight spec on RJ unduly burdensome. We should drop the RJ spec and concentrate on EBUJ, which COM considers to be more significant than RJ, and add a TJ spec.

TJ spec

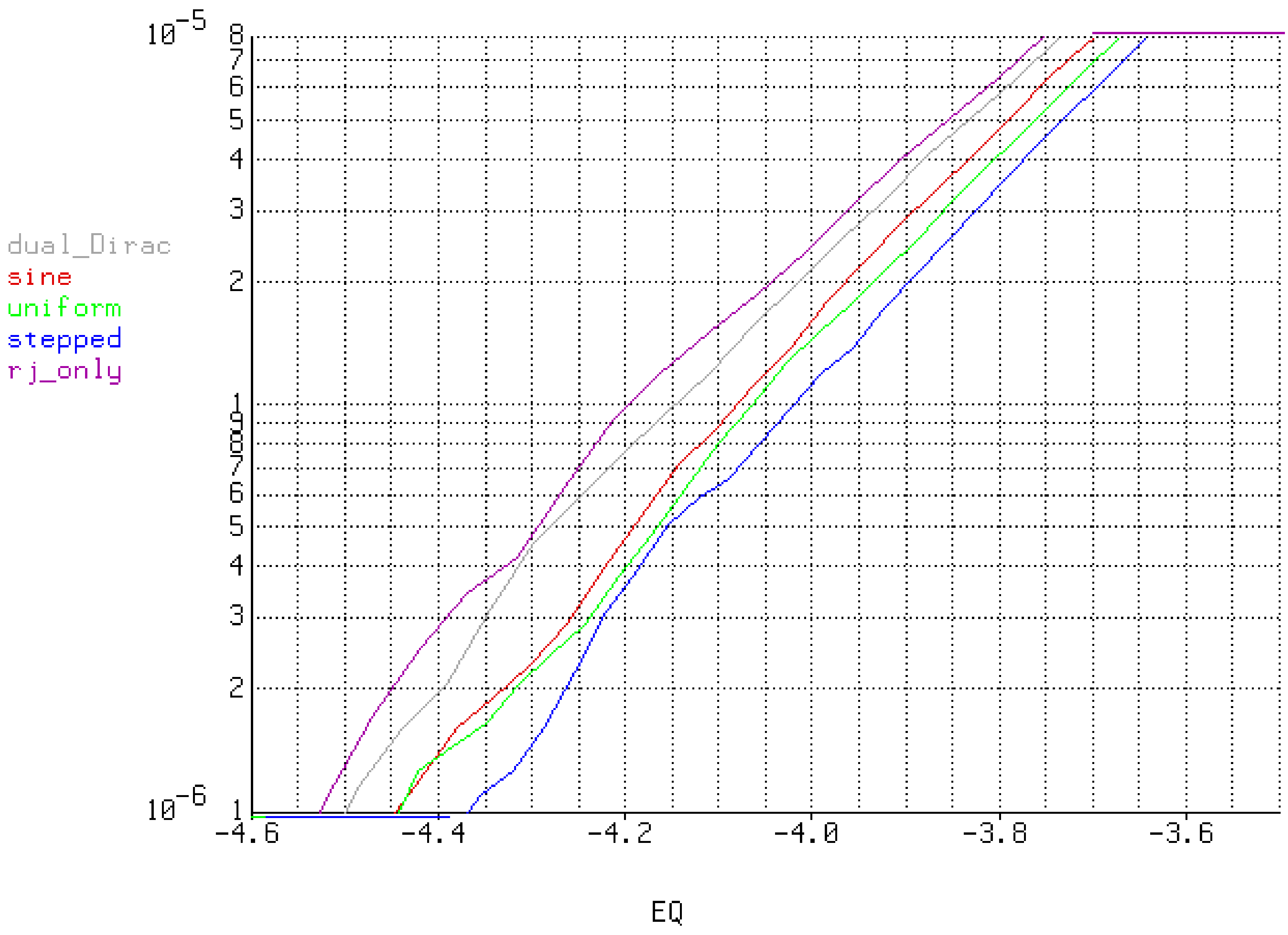
The most reasonable way to specify TJ is:

TJ=EBUJ+2 x EQ x ERJ

We the need to specify EQ. The value of EQ depends on the target BER for TJ. Here I plot log(CDF) vs EQ for a simulation of 2 x 10^6 samples.



Blowup around CDF=5 x 10^{-6}



Backup slide

For the case of 100mUI uniformly distributed deterministic jitter and 10mUI RMS RJ, with $2x10^4$ hits, using the method given in D3.0 92.8.3.9.2 I get

effective bounded uncorrelated jitter = 53.9 mUI p-p
effective random jitter = 13.7 mUI RMS

EBUJ is about 46% low and ERJ is about 37% high

If I increase the number of hits to $2x10^6$, using the same method:

effective bounded uncorrelated jitter = 68.5 mUI p-p
effective random jitter = 11.5 mUI RMS

More than 20% change in ERJ. The result changes with number of samples.

If I keep the ratio of the boundaries of the fitting range to the number of samples constant by using 2000 and 50,000 instead of 20 and 500 for the case with $2x10^6$ hits

effective bounded uncorrelated jitter = 52.6 mUI p-p
effective random jitter = 14.0 mUI RMS

A minor change, within the limits of accuracy of the measurement.