W2022 Siemens ADCs

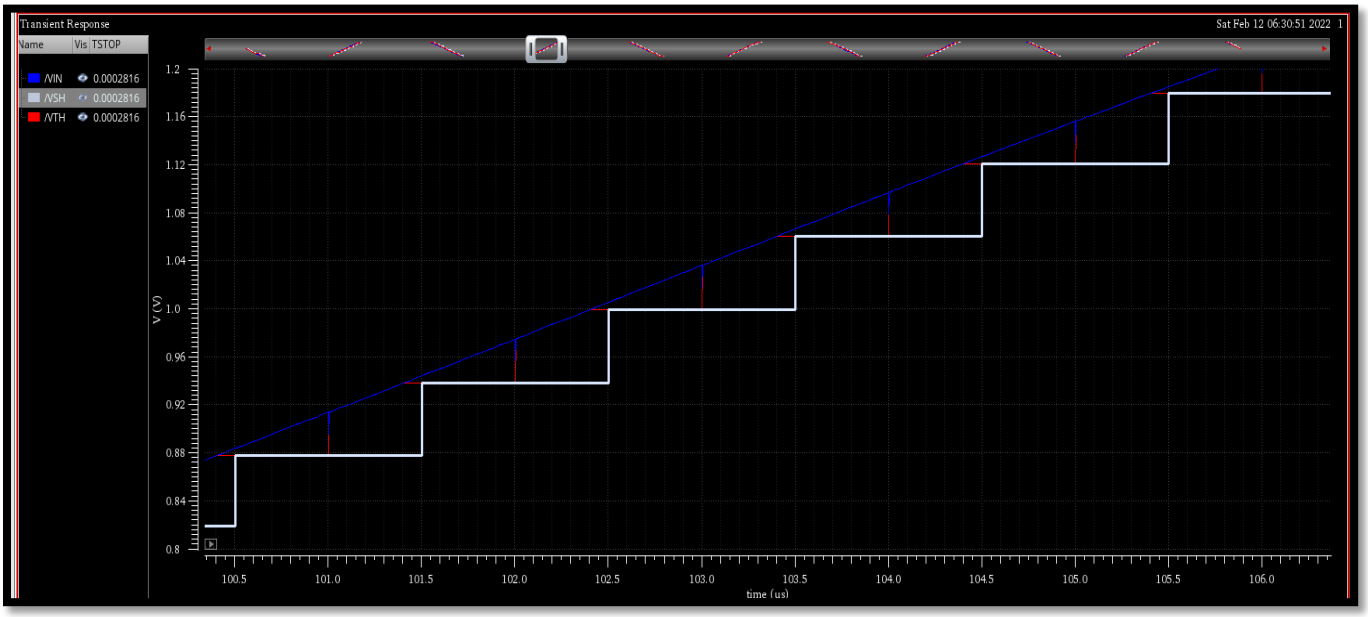
Lab 1

Sampling and Quantization in Cadence Virtuoso

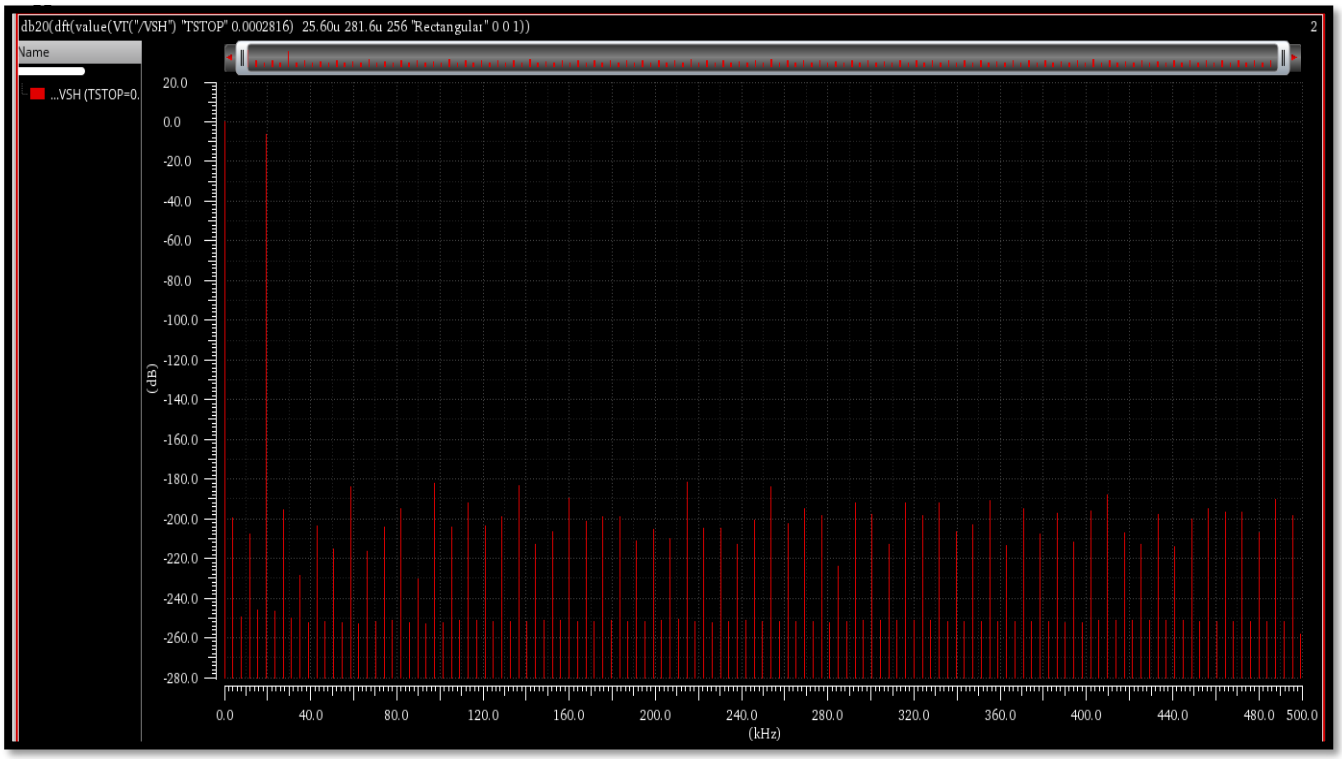
Contents

Part I : Sampling :

Transient plot (VIN,VTH,VSH):



Fft plot for VSH:



What is the power of the peak signal ?

Power =3 dBFS.

How many bins are occupied in test signal ?

1 bin

What is the noise floor (in dBFS)?

noise floor is around 197.04 dBFS

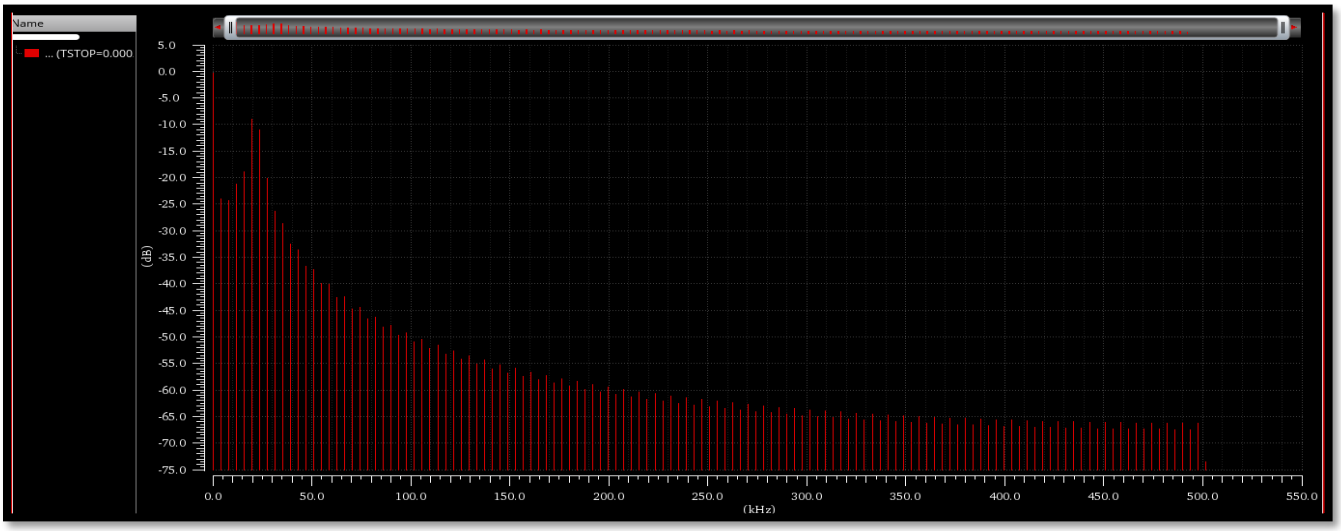
What is the relation between the SNR, NFFT, Signal Power, and Noise Floor?

As Signal power increase the SNR increase as SNR is the ratio between the signal power and the noise power, also as the NFFT increases the SNR little bit decreases as if the NFFT increases the noise expands on larger number of bins so the power of each bin decreases so the SFDR increases but noise floor little bit increase so SNR decreases.

If the sampling is ideal, what is the source of error that causes the noise floor?

error is due to quantization noise made by the simulator itself as the simulator work on discrete time and amplitude .

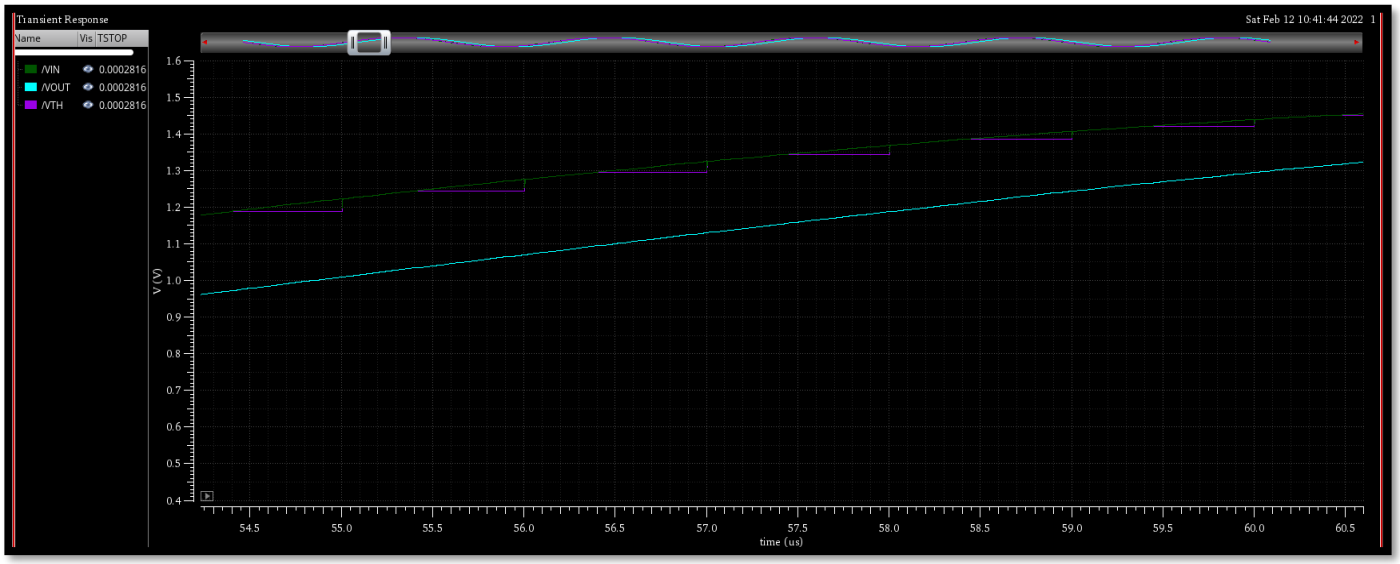
Plot of FFT with NCYC=5.5 :



we note that in this case noise floor has been raised roughly and SNR degraded due to noncoherent condition .

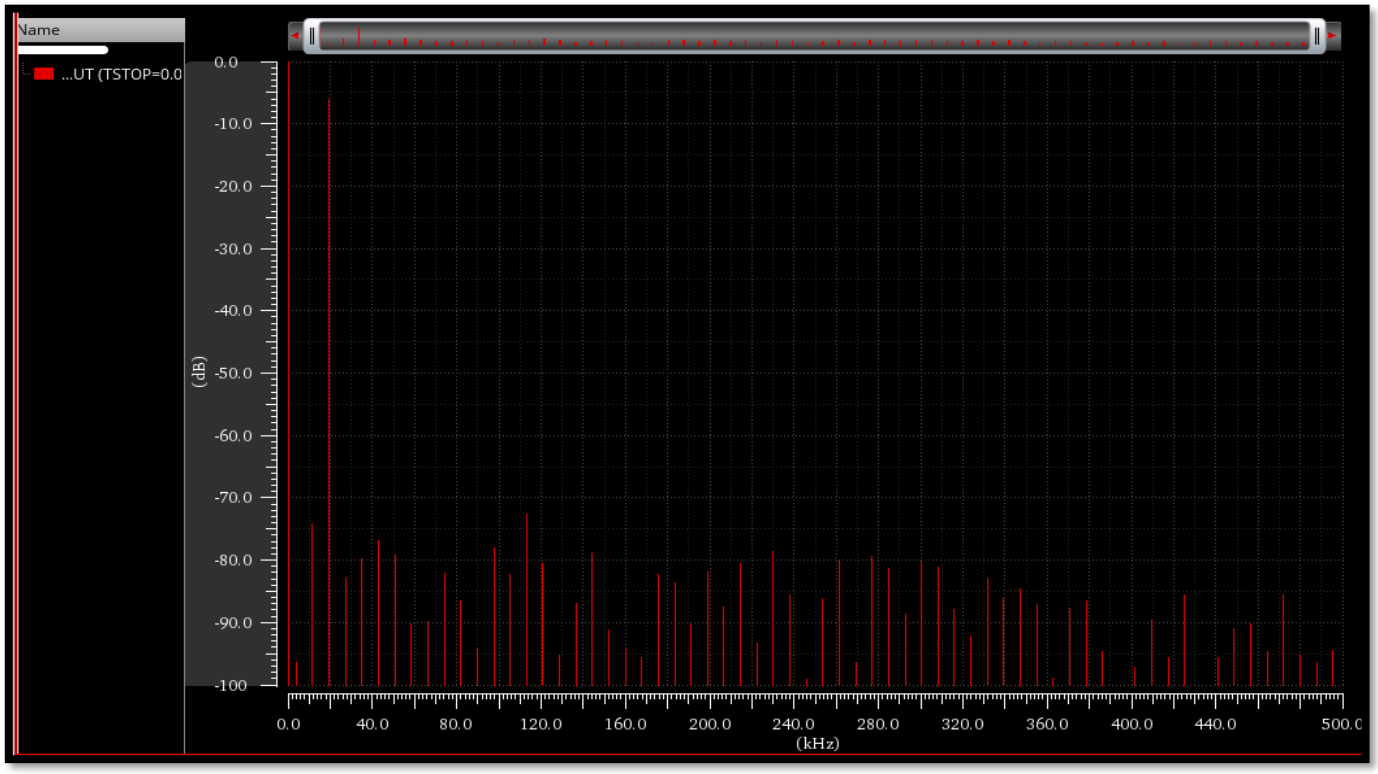
part II:Quanntization:

timing diagram of VIN,VTH&VOUT :



from timing graph we see that the input signal is pure sine wave and Vth is the same signal but sampled by (S/H)technique so take snapshot from the wave and hold on it by value V_{LSB}each time so the output is almost the input sinusoidal that outputted from DAC.

FFT spectrum of the Vout:



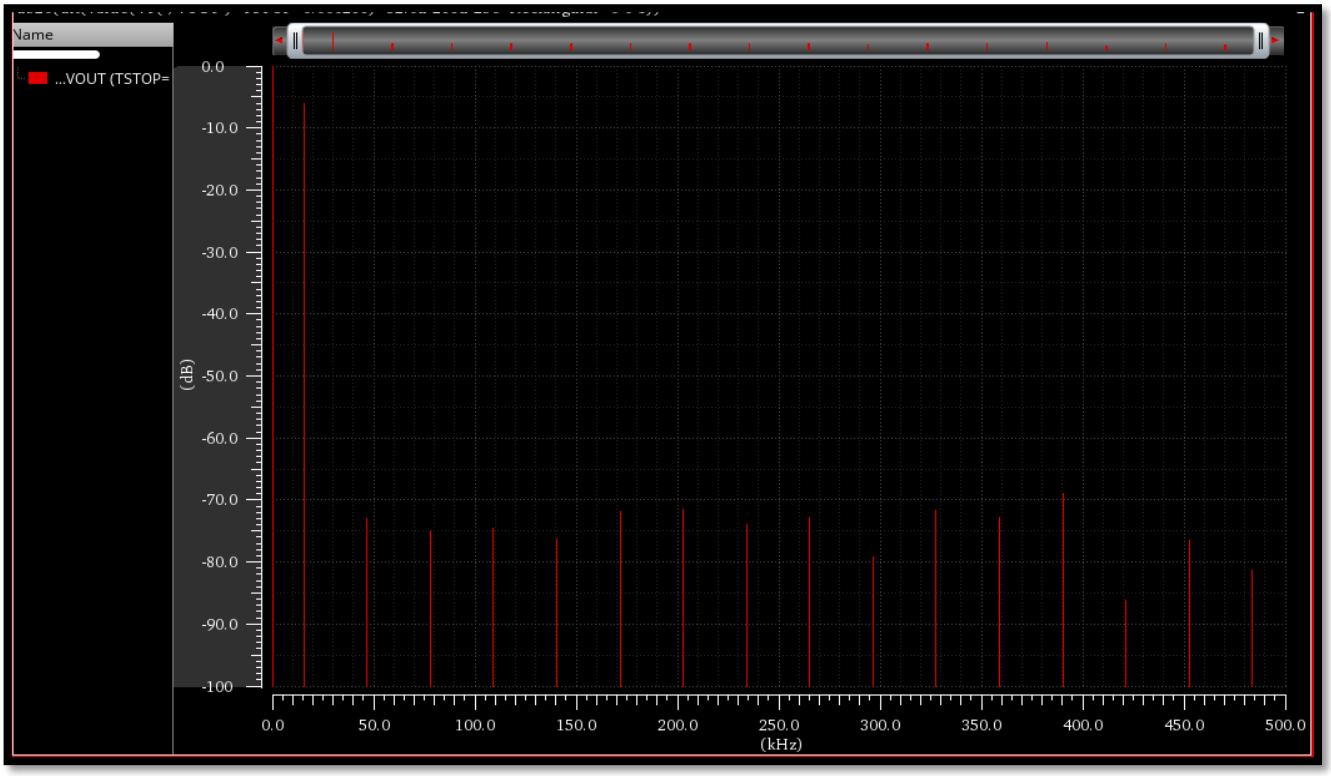
Comparing simulated results with theorical ones:

P.O.C	From simulation	Theoretical
SNR(dBFS)	58.8	61.96
ENOB	9.467	Expected to be 10
Signal Power(dBFS)	3.026	3.01
DC Power(dBFS)	-3.00185	-3
Noise Floor/bin(dBFS)	85.9	82.83

SFDR=66.58 dBFS.

Note that the values in Dft is 20log(Amplitude),not 20log(rms),so we convert it .
And in analytical solution we normalize around DC power as it's the largest power .

Now changing NCYC to 4 :



SFDR=62.89 dBFS

Comment : We Noticed that the SFDR has been degraded in the 2nd case as NCYC/NFFT is integer so there is correlation between the test tone the original signal leads to spectral leakage so the power of some harmonics increased so the SFDR decreased .