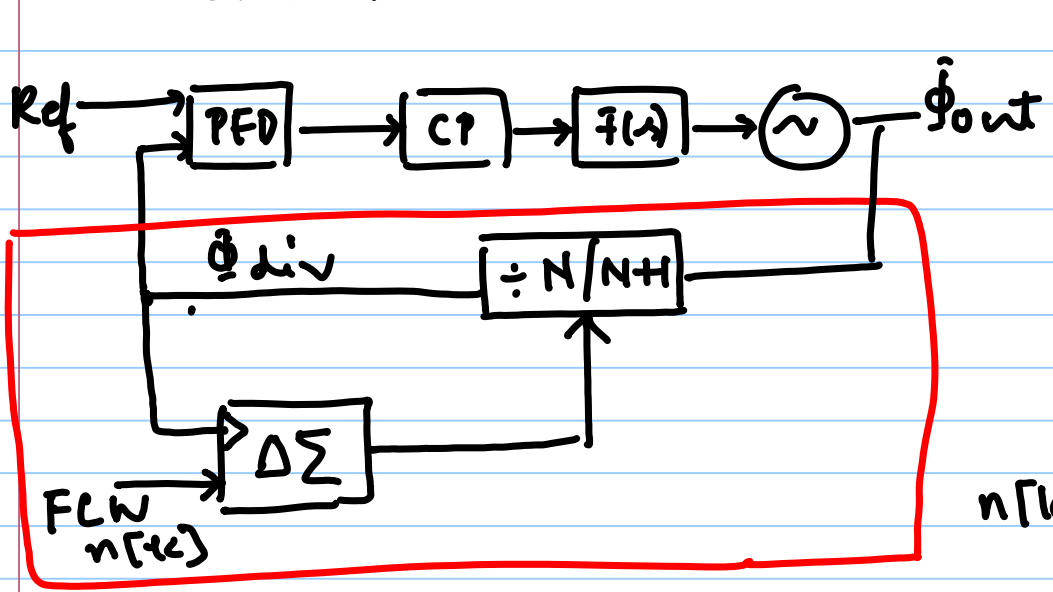
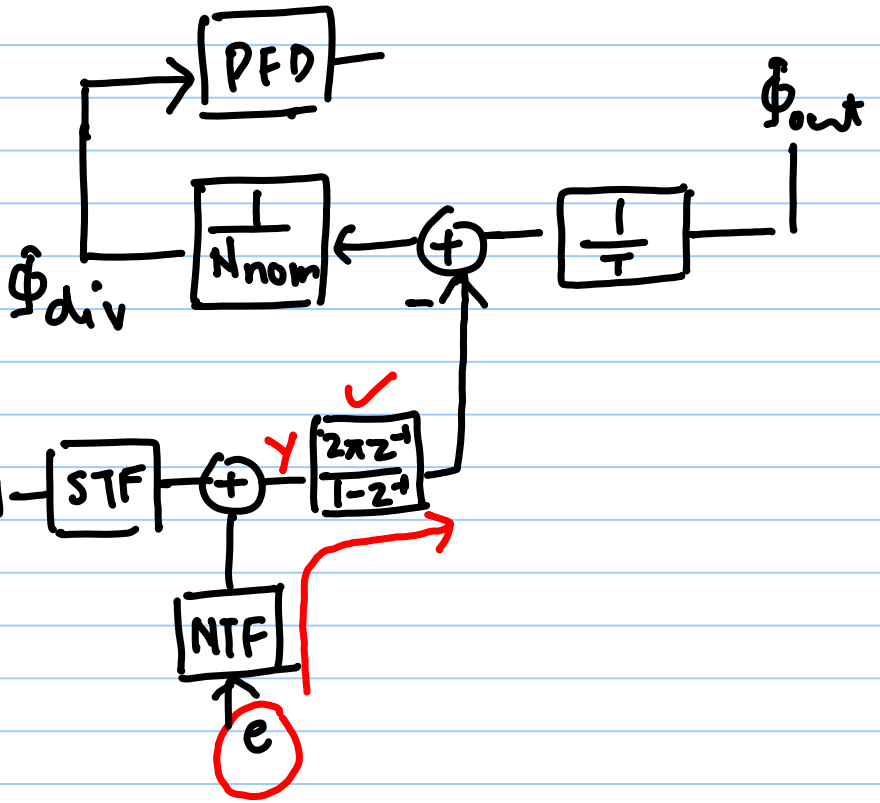
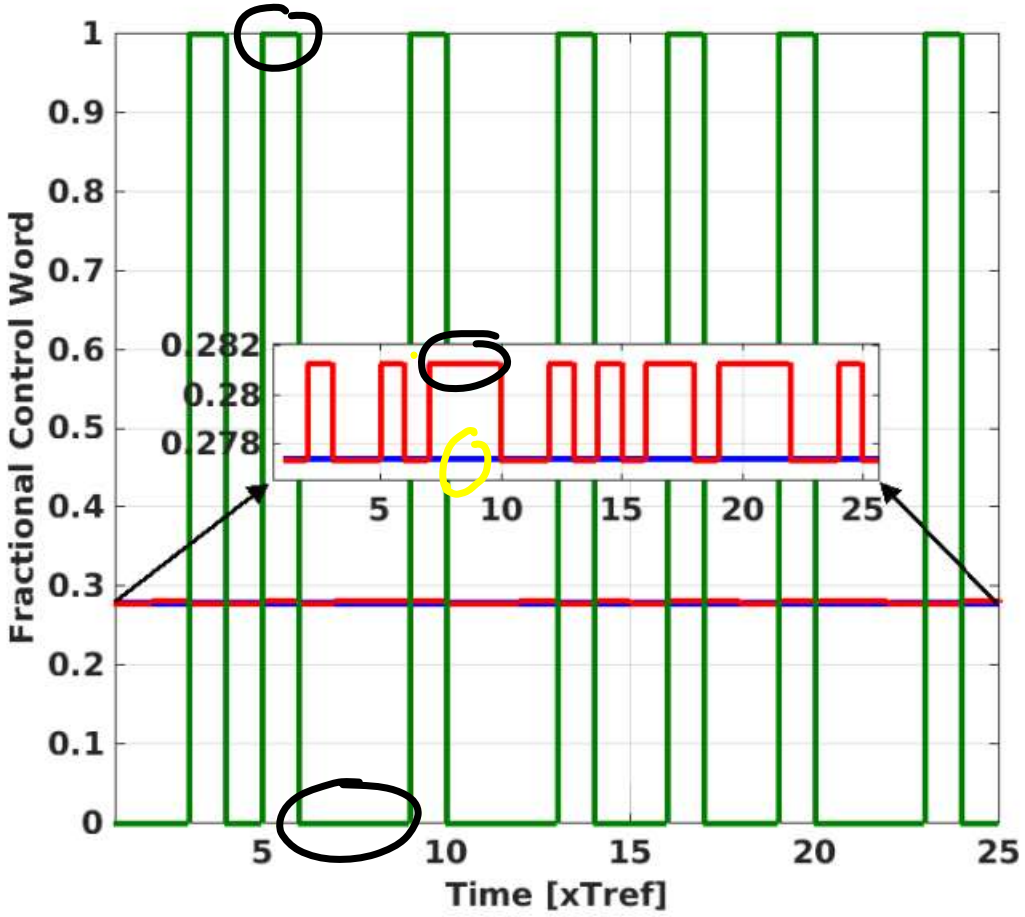
Lecture # 50

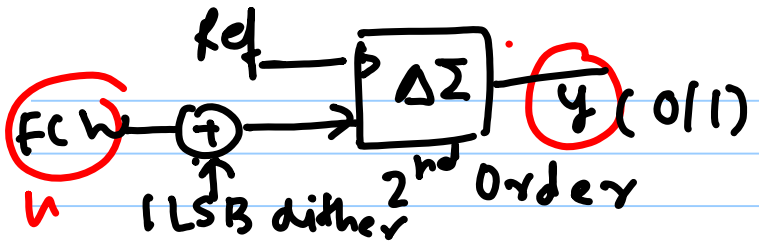
Note Title 07-11-2017

Fractional -N PLL









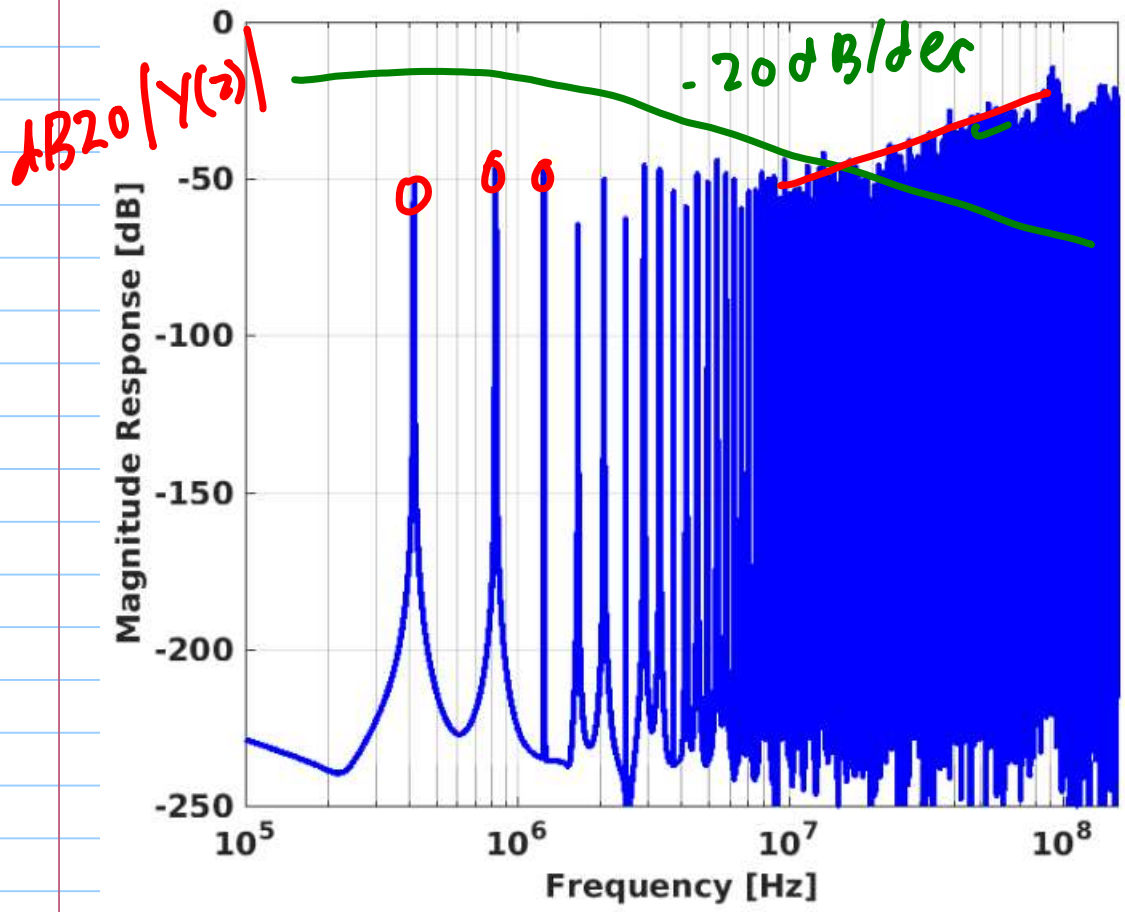
$$N_{nom} = N + \alpha$$

$$\alpha = \frac{71}{256}$$

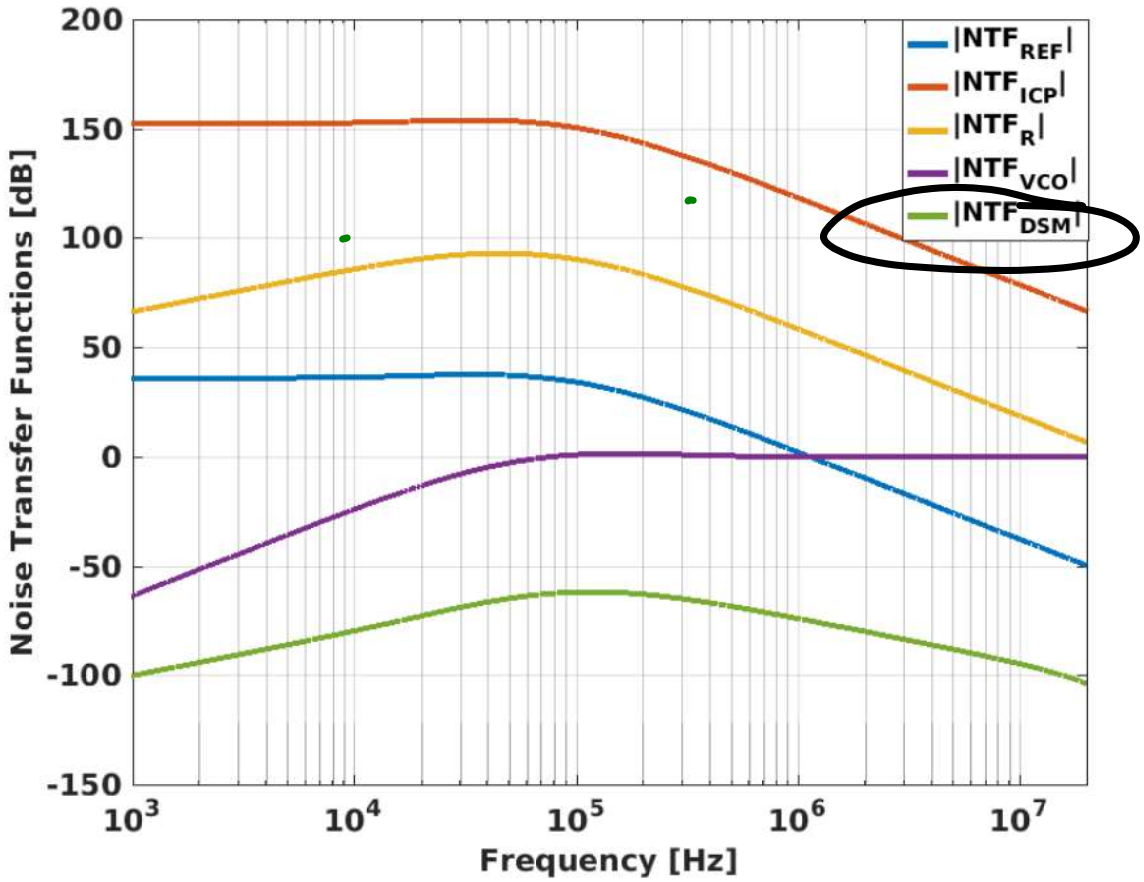
$$f_{out} = \left(8 + \frac{71}{256}\right) \cdot f_{ref}$$

$$\bar{y} = \frac{71}{256}$$

$$Y(z) = STF(z)\,U(z) + NTF(z)\,E(z)$$


dB20|Y(z)|
-20dB/dec
0
-50
-100
-150
-200
-250
Magnitude Response [dB]
10^5
10^6
10^7
10^8
Frequency [Hz]

Noise Transfer functions in Frac-N PLL

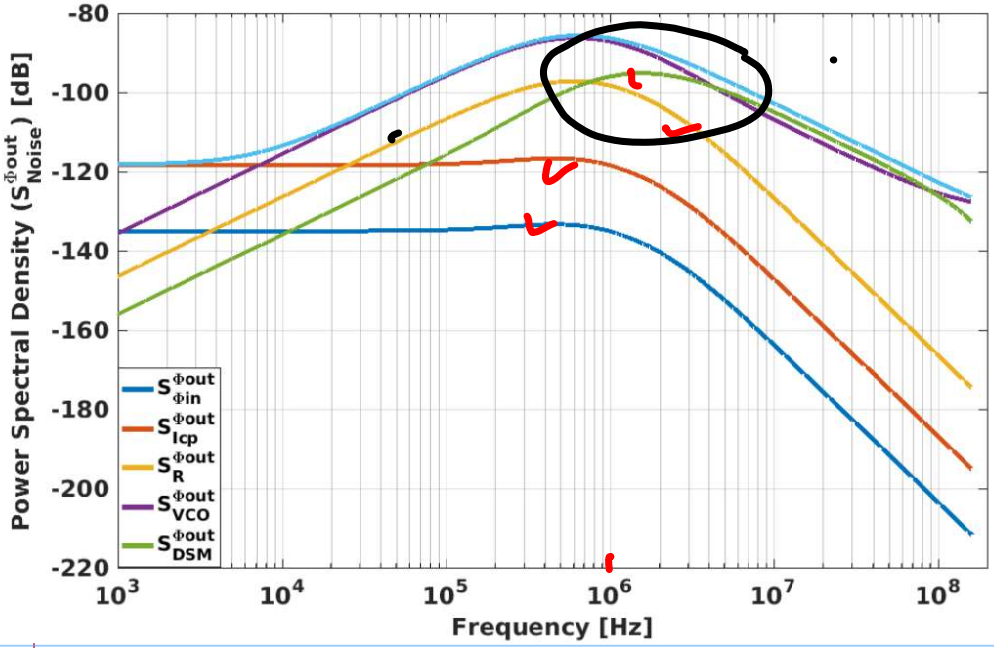


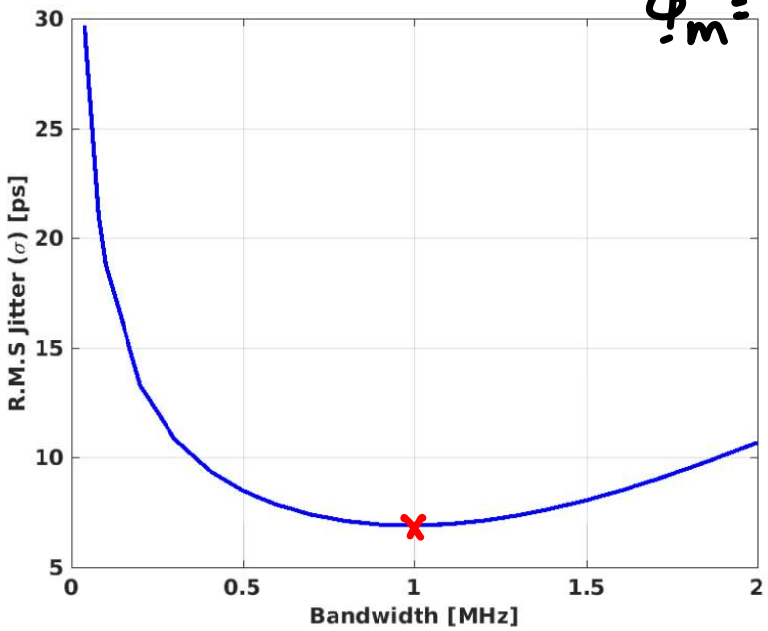
$PSD = |NTF|^2 S_{noise}$

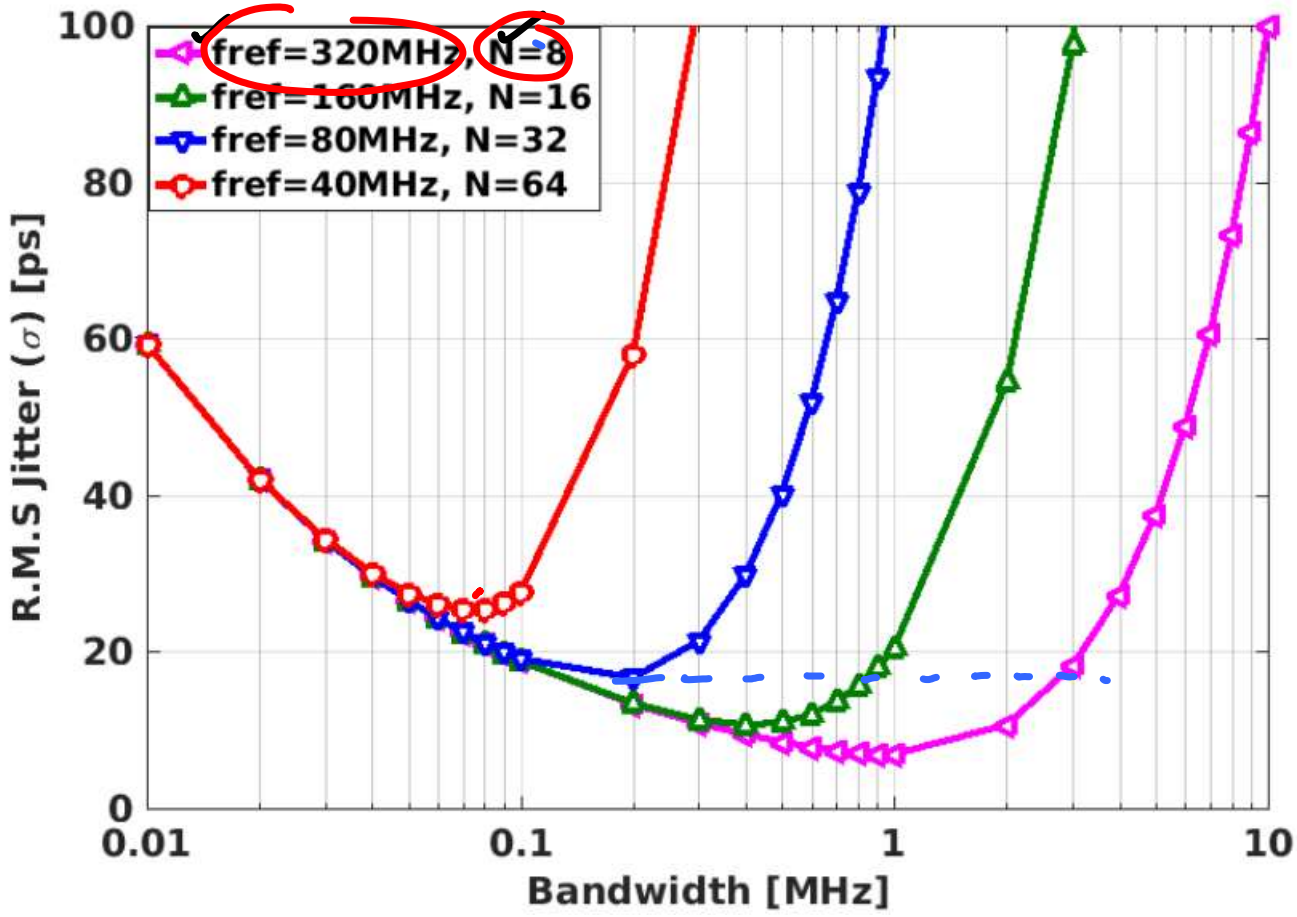
$f_{ref} = 320MHz$, $N = 8$, $f_{out} = 2.56GHz$

Phase Noise = $-87 dBc/Hz$ @ $1MHz$.

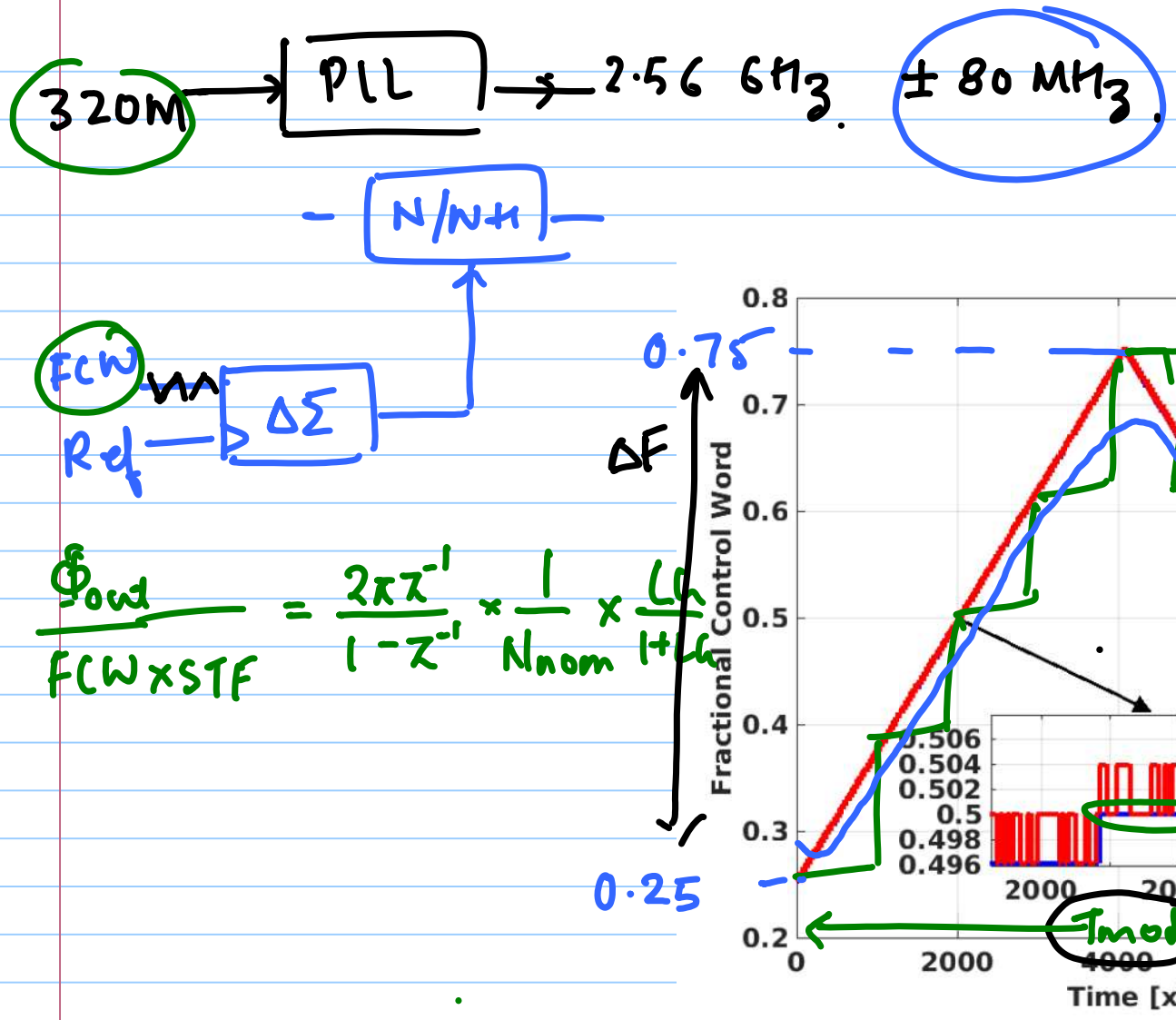
$\phi_m = 60°$.






fref=320MHz, N=8
fref=160MHz, N=16
fref=80MHz, N=32
fref=40MHz, N=64
R.M.S Jitter (σ) [ps]
Bandwidth [MHz]
0
20
40
60
80
100
0.01
0.1
1
10

$f_{out} = 2.5G\ Hz.$



$$f_{out} = (N + \frac{\alpha}{FCW})\, f_{ref}$$

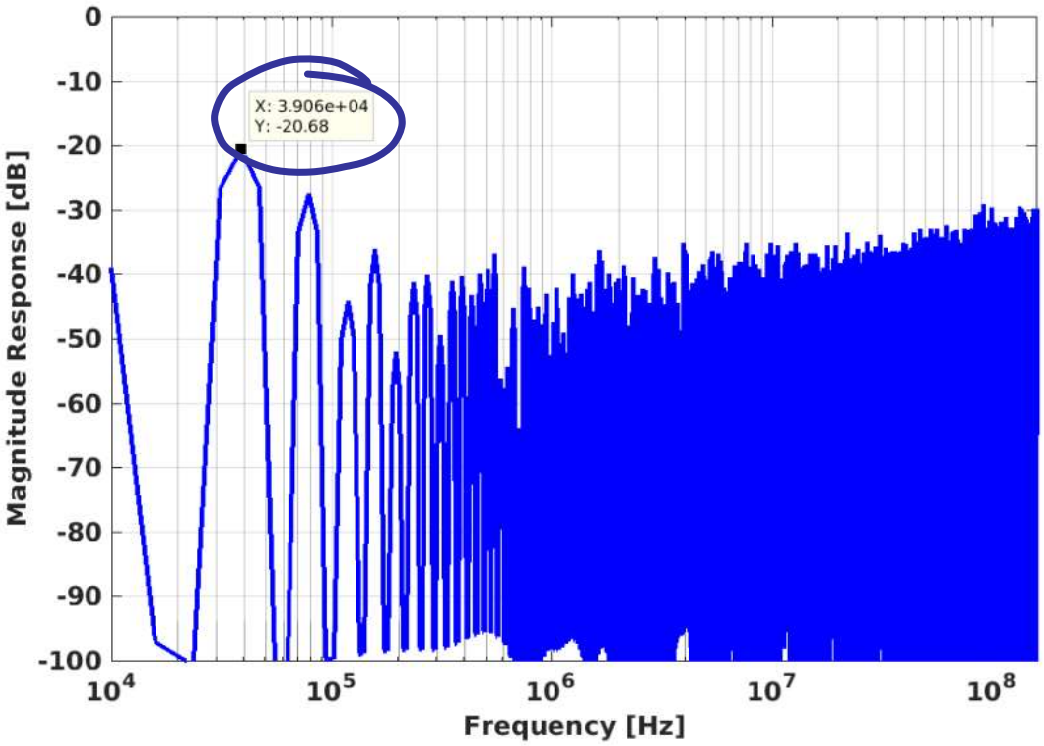
$f_{out,max} = 8.75\, f_{ref}$

$f_{out,min} = 8.25\, f_{ref}$

$\Delta F = 0.5\, f_{ref} = 160\ MHz$

$$\frac{\Phi_{out}}{FCW \times STF} = \frac{2\pi z^{-1}}{1 - z^{-1}} \times \frac{1}{N_{nom}} \times \frac{LG}{1 + LG}$$

$f_{mod} > F_{BW,PLL}$



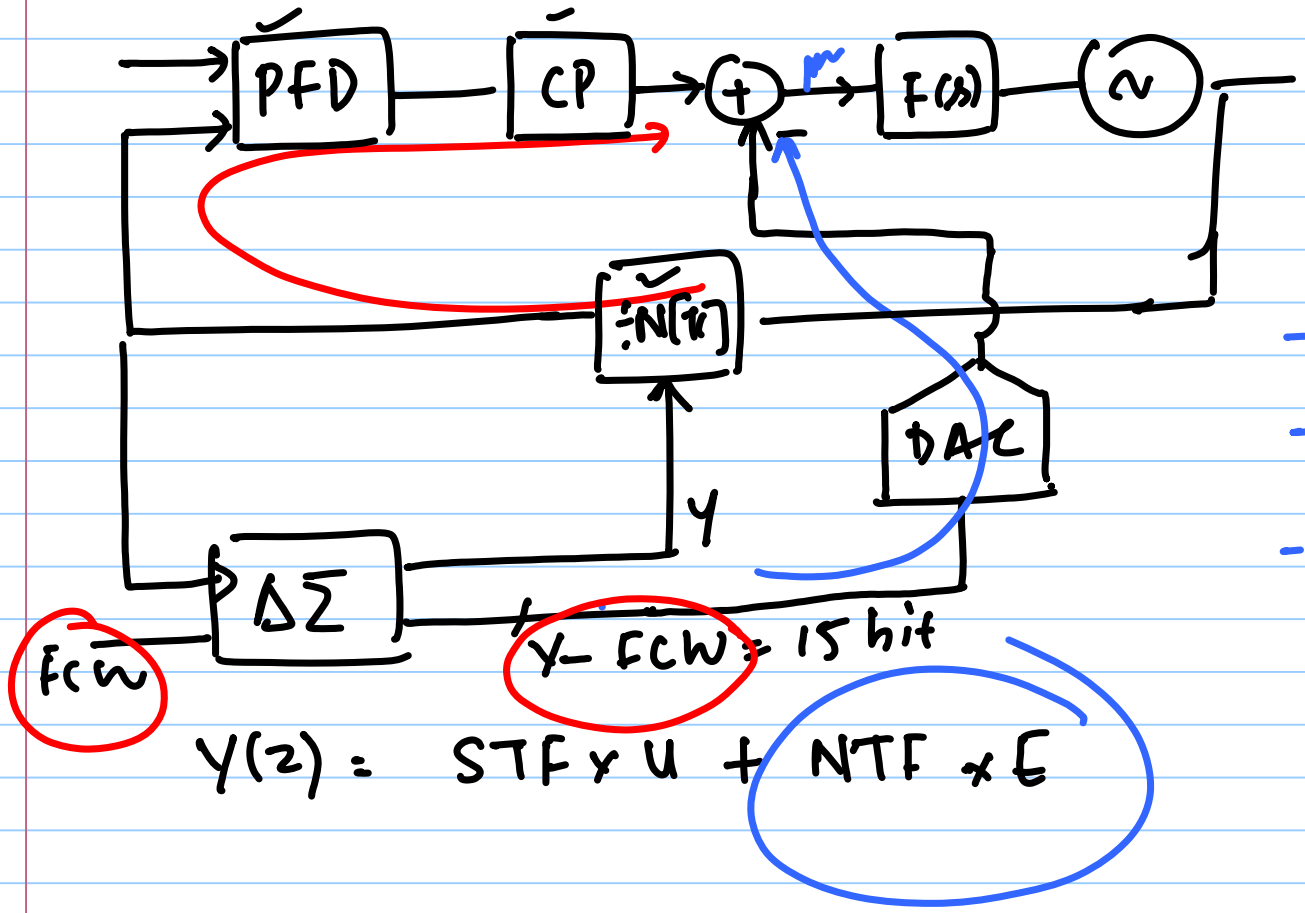
- $F_{mod} = \frac{1}{T_{mod}}$
- ΔF

f_{mod} = Rate of change of freq. applied to PLL

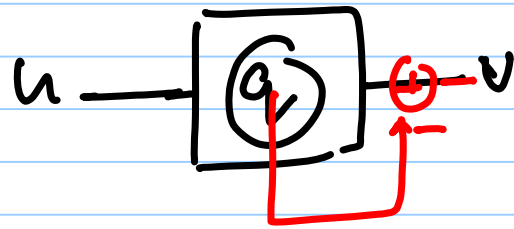
ΔF = magnitude of change.

FMCW

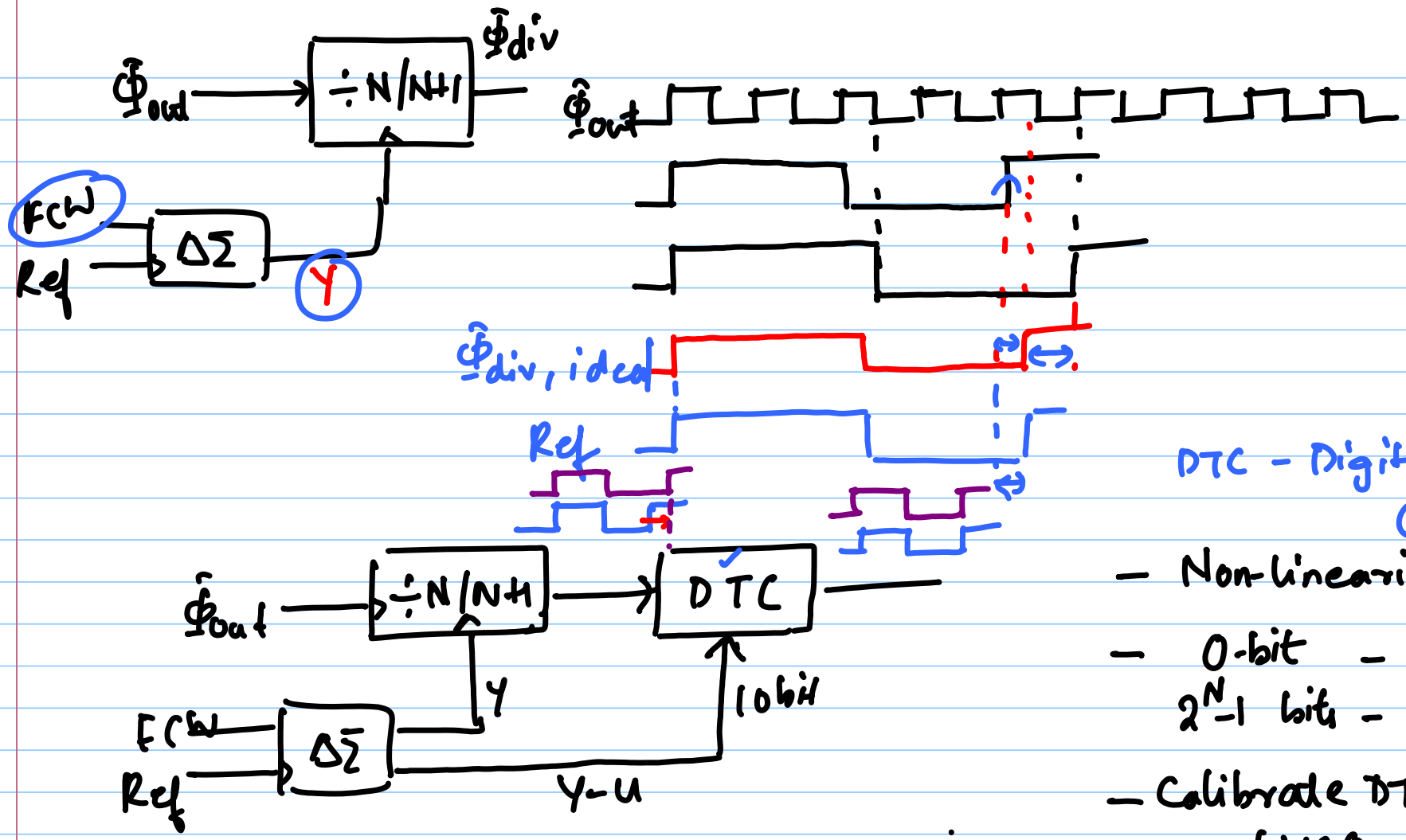
Frequency Modulated Continuous Wave Radar.



$$Y(z) = STF \times U + NTF \times E$$



- Mismatch in two paths.
- Non-linearity of DAC
- Finite-bit DAC control.



DTC - Digital to time Converter

- Non-linearity of DTC.
- 0-bit - Δt_{min}
  2^N-1 bits - Δt_{max}.
- Calibrate DTC to 1 VCO period.