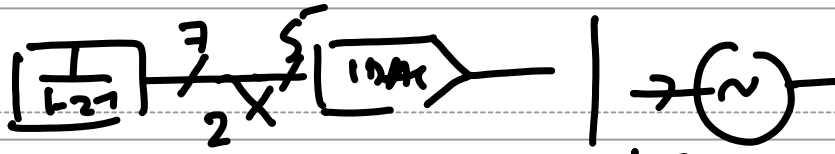
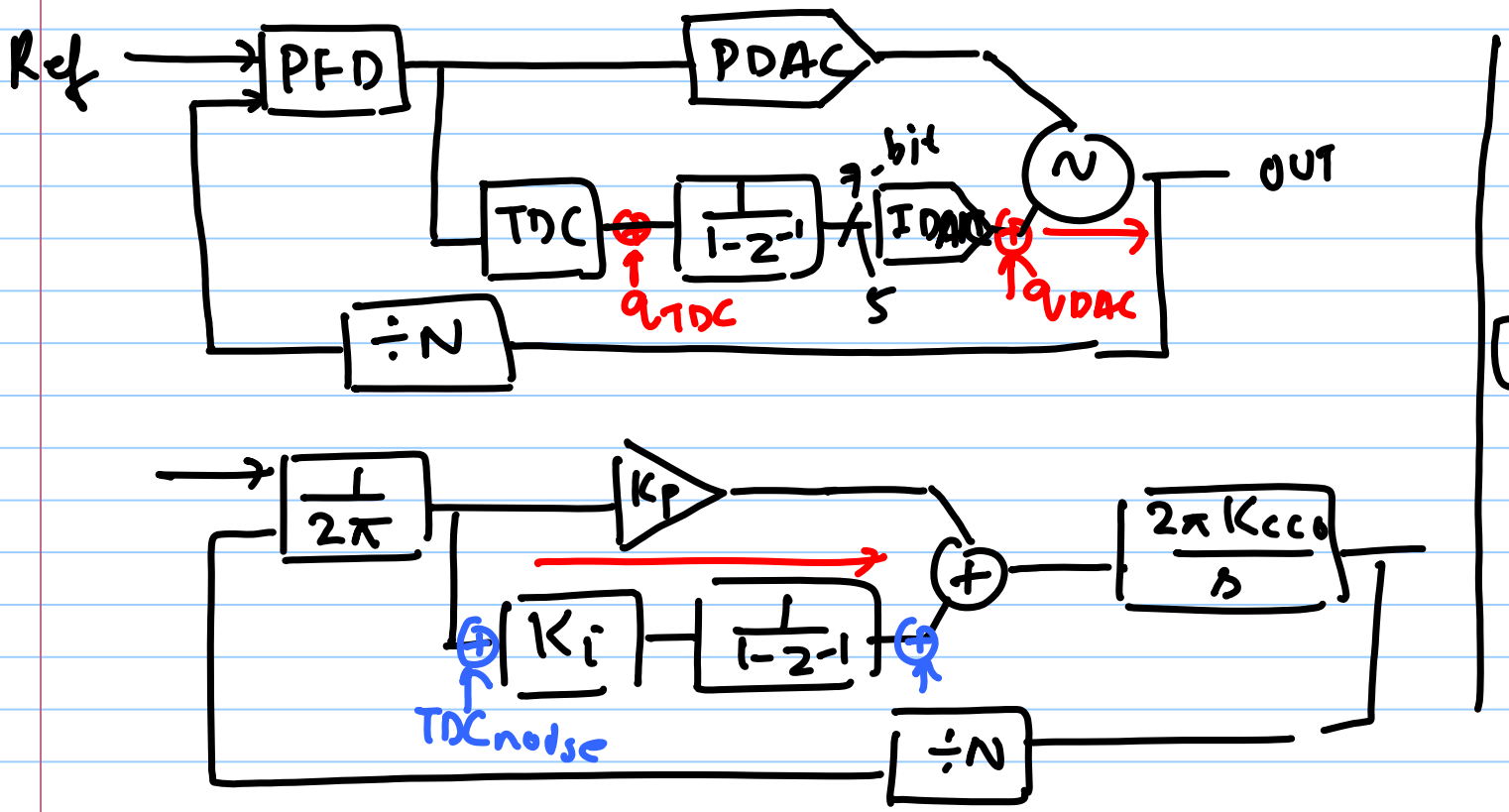
Lecture #46

Note Title 30-10-2017





$\omega_{p1}, \omega_{p2} = 0$

$\omega_2 = -\frac{K_i f_{ref}}{K_p}$

$[K_{CCO}] = Hz/A$

1.550 mA — 1.500 mA

$$LG(s) = \frac{1}{2\pi}\left(K_p + \frac{K_i}{1-z^{-1}}\right)\frac{1}{N} \cdot \frac{2\pi K_{cco}}{s}$$

$$= \frac{K_{cco}}{Ns}\left(K_p + \frac{K_i f_{ref}}{s}\right) = \frac{K_{cco}}{s^2 N}\left(sK_p + K_i f_{ref}\right)$$

$z = e^{+s/f_{ref}}$

$1 - z^{-1} = 1 - (1 - s/f_{ref}) = s/f_{ref}$

For DAC noise.

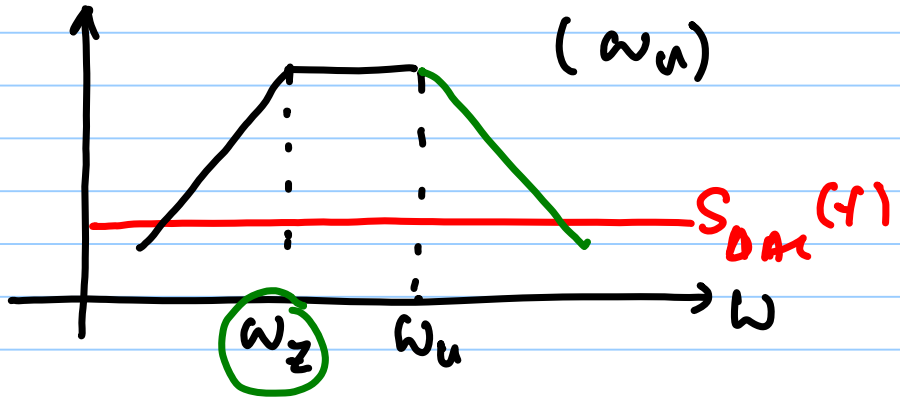
$|L_G(\omega_u)| = 1 \qquad \omega_u = \frac{K_{VCO} I_{CP}}{N}$

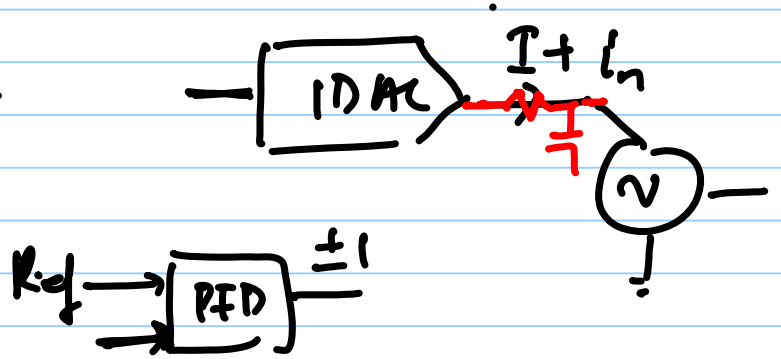
$$NTF_{IDAC} = \frac{2\pi K_{VCO}/s}{1 + L_G} = \frac{2\pi K_{VCO}/s}{1 + \frac{K_{VCO}}{s^2 N}(sK_P + K_I f_{ref})}$$

$$= \frac{2\pi K_{VCO} \cdot N \cdot s}{s^2 N + s K_{VCO} \cdot I_{CP} + K_{VCO} K_I f_{ref}}$$

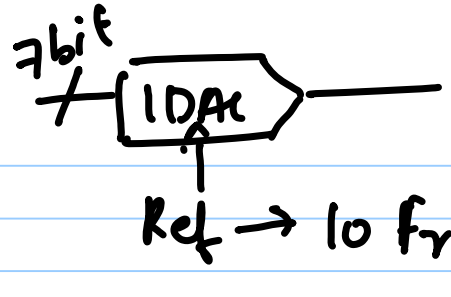
$s \approx \frac{K_{VCO} \cdot I_{CP}}{N}$, $\frac{K_I f_{ref}}{K_P}$

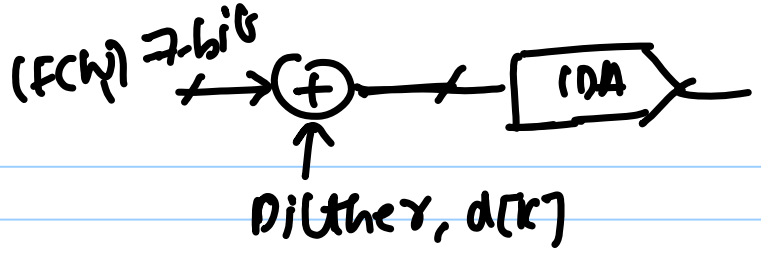
(ω_u) (ω_z)

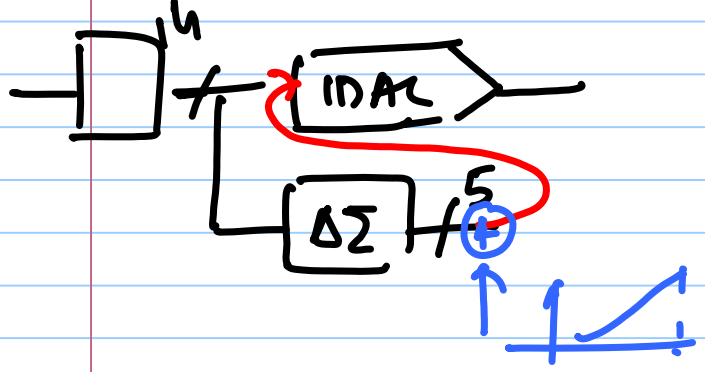


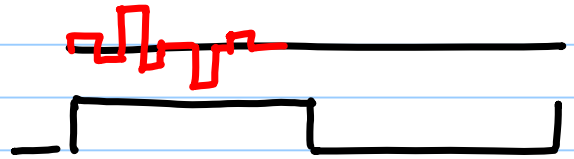


— LSB of IDAC → Spur
— Non-uniform seg. of IDAC
— Low-pass filter IDAC o/p







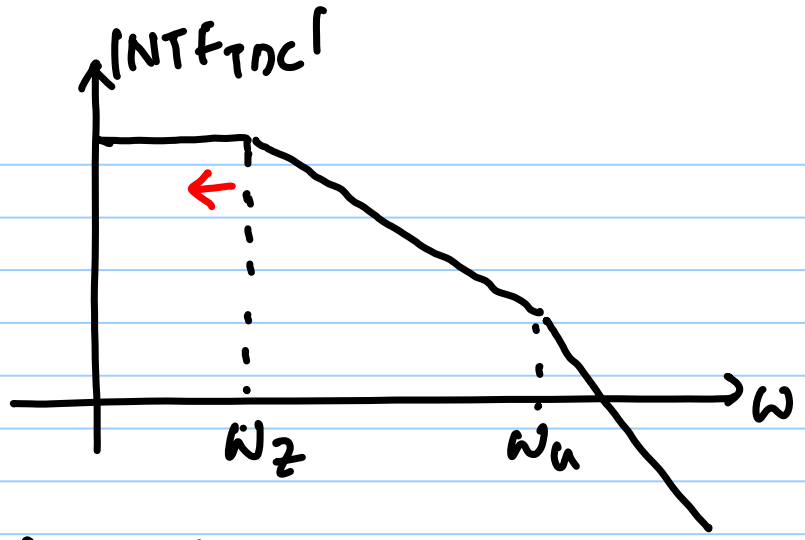


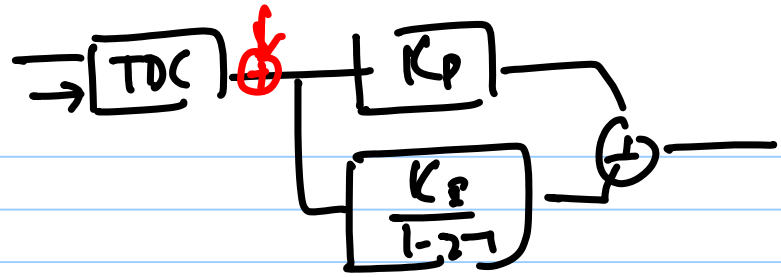
TDC Noise

$$NTF_{TDC} = \frac{K_i f_{ref}}{s} \cdot \frac{2\pi K_{vco}/s}{1+LL_1} = \frac{2\pi K_{vco} \cdot K_i f_{ref} N}{(\quad)}$$

Poles: $\omega_{p1} = \omega_z$ (PLL loop)

$\omega_{p2} = \omega_n$ (PLL loop)

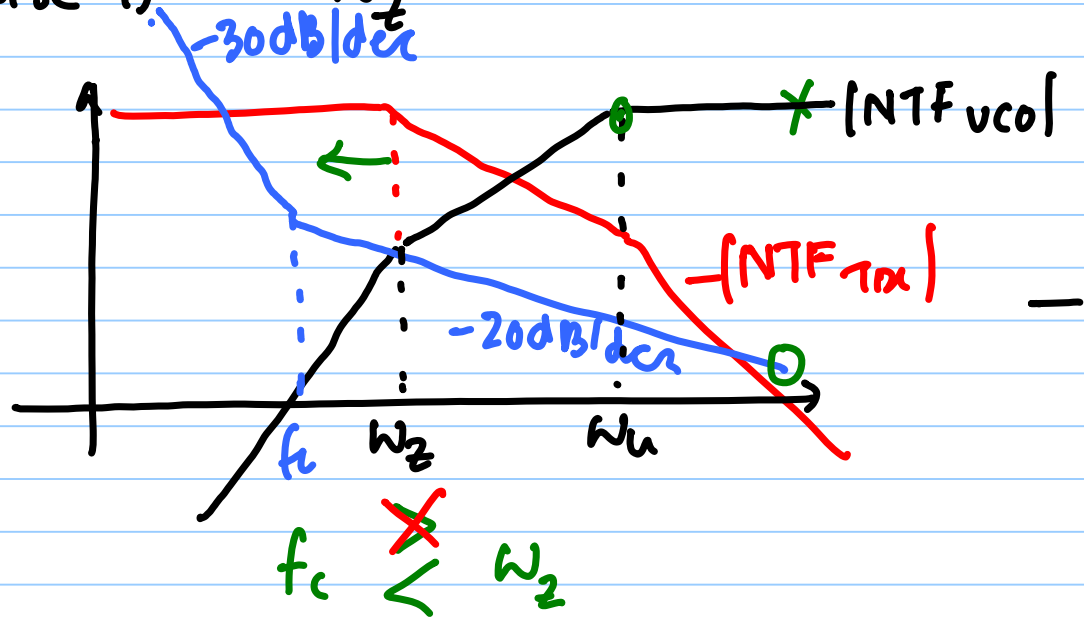




Noise BW = ω_n

$NTF_{VCO} = \frac{1}{1+LG}$

Noise BW = ω_z

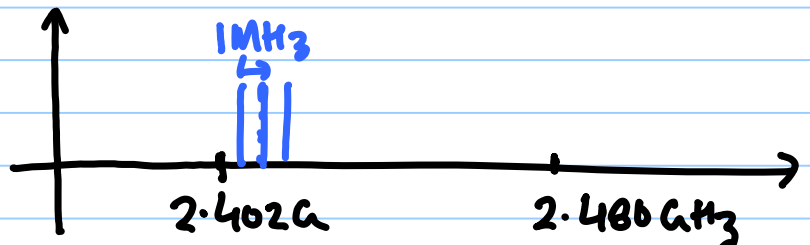


$f_c < \omega_z$

$\omega_z \to 0$

- TDC noise reduces
- VCO flicker noise dominates

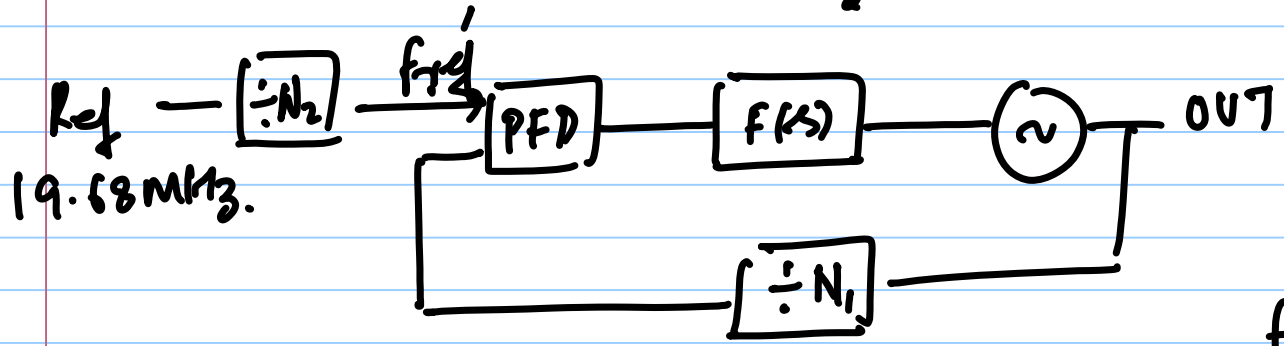
Fractional-N PLL



PLL — 2.402 GHz — 2.480 GHz

Δf = 1MHz.

Clock ref. (Crystal) = 19.68 MHz.



$\frac{2.402 \times 10^9}{40 \times 10^3}$

$\frac{f_{ref}}{N_2} = \frac{f_{out}}{N_1}$

f_{ref}	f_{out}	N_1
19.68MHz	2.402G	122.052846

GCD (f_{out}, f_{ref}) = 80kHz. $N_1 = 30250$

ΔF = 1MHz.

$\frac{f_{out}}{f_{ref}} = \frac{N_1}{N_2} = \frac{240200}{19.68} =$

$\frac{f_{ref}}{1968} = \frac{19.680 \times 10^3}{1968} = 10\ kHz.$

$80\,kHz \times 30250 = 2.402\,GHz$:

$2.403\,GHz$.

$$\frac{\Delta F}{80\,kHz} = \frac{1\,MHz}{80\,kHz} \longrightarrow 40\,kHz$$

$N_1 = 60500$