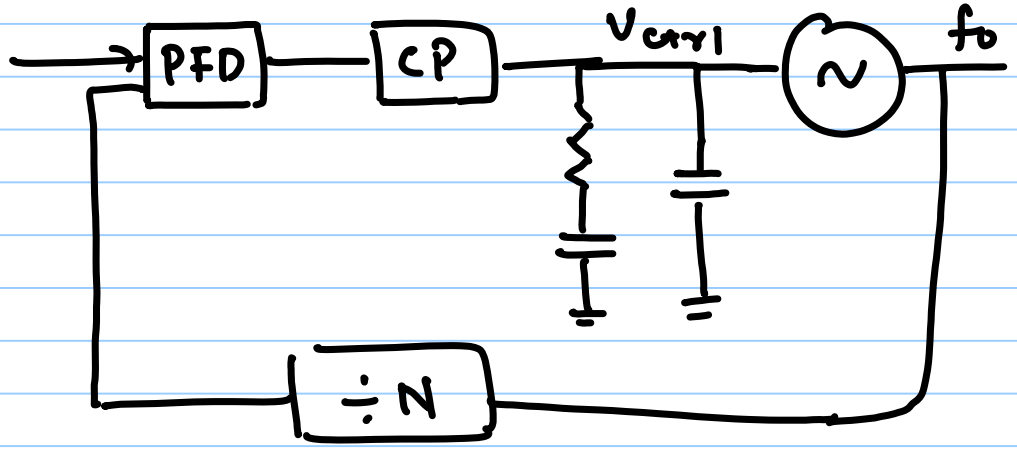
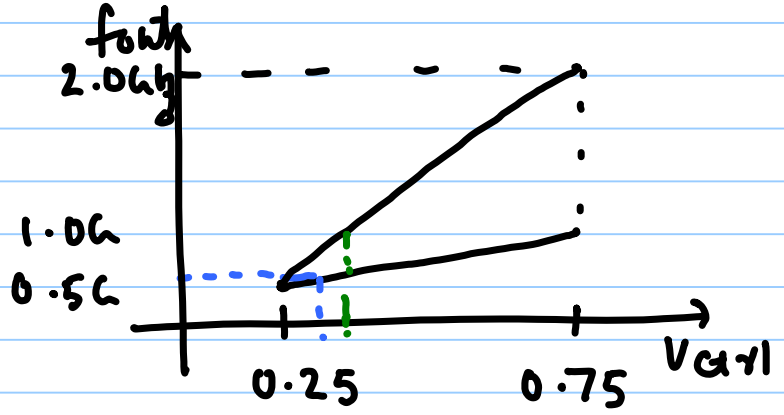
Lecture # 42

Note Title 23-10-2017

Split-tuned PLLs.





Δf_o is large

$\Rightarrow$ Large K_{VCO}

ΔV_{ctrl} is limited by tech.

$$L_G(s) = \frac{I_{cp}}{2\pi} \frac{2\pi K_{VCO}}{s^2(C_1+C_2)} \frac{(1+sRC_1)}{(1+sRC_1C_2/(C_1+C_2))}$$

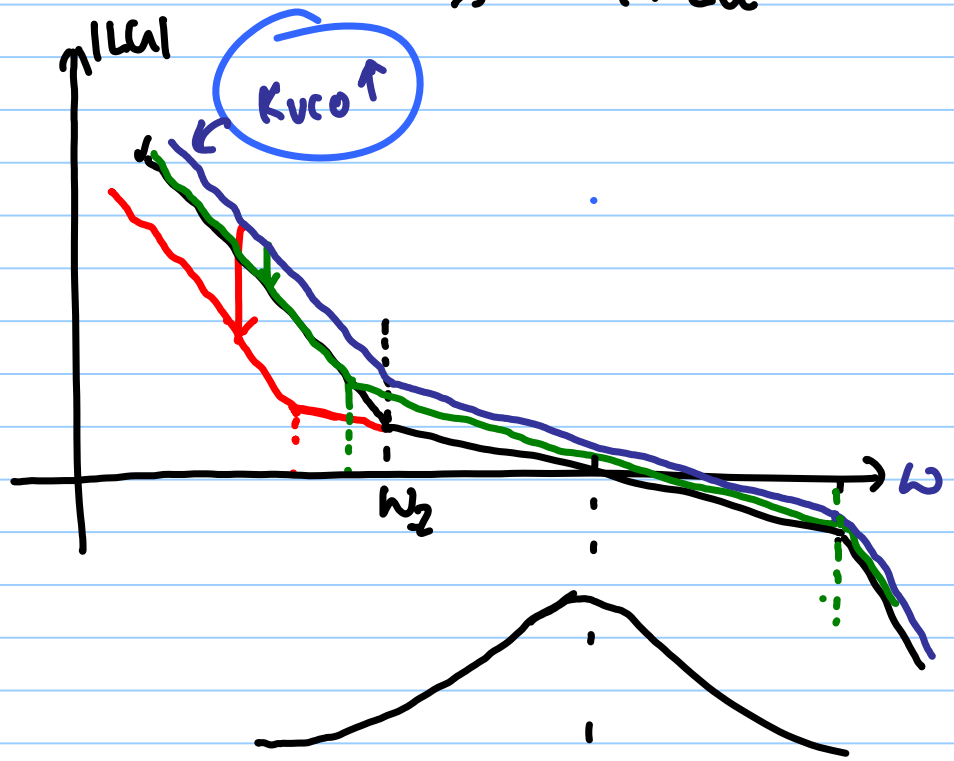
if K_{VCO} is large $\rightarrow$ $I_{cp}\downarrow$

$$|NTF_{icp}| = \frac{2\pi}{I_{cp}} \frac{N \cdot L_G}{1+L_G}$$

$$S_{icp} = \frac{8kT}{3} \cdot \frac{2I_{cp}}{\Delta V} \times \alpha.$$

$$S_{icp}^{out} = S_{icp} |NTF|^2 \propto \frac{1}{I_{cp}}$$

$$|NTF_R| \approx \frac{2\pi K_{VCO}}{} \frac{1}{1+LG} \Rightarrow \text{Noise due to resistor}$$



$$|LG|_{\omega=1} = \frac{I_{cp}}{2\pi} \frac{2\pi K_{VCO}}{(C_1+C_2)}$$

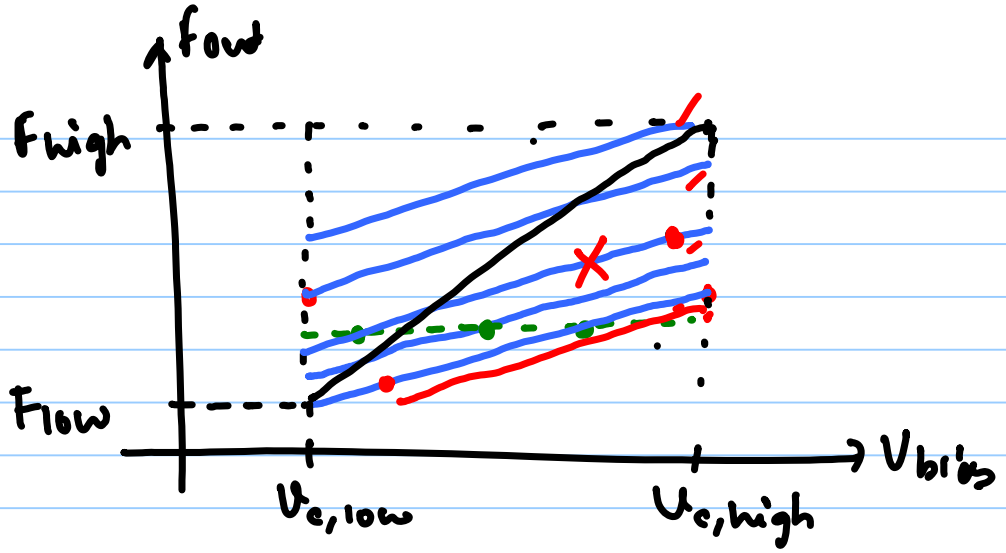
$$\omega_2 = \frac{1}{RC_1}, \quad \omega_{p3} = \frac{1}{R\frac{C_1C_2}{C_1+C_2}}$$

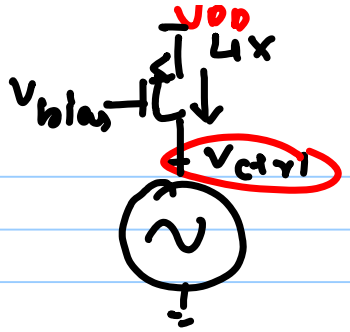
$$\omega_{p1} = \omega_{p2} = 0, \quad K_{VCO}$$

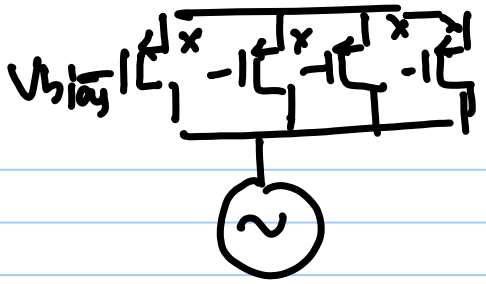
$$K_{VCO,n} = K \cdot K_{VCO}, \quad I_{cp} = \text{const.}$$

$$C_{1,n} = K \cdot C_1 \Rightarrow \omega_2 = \frac{1}{KRC_1}$$

$$\omega_{p3} = \frac{1}{R\frac{KC_1C_2}{KC_1+C_2}}$$





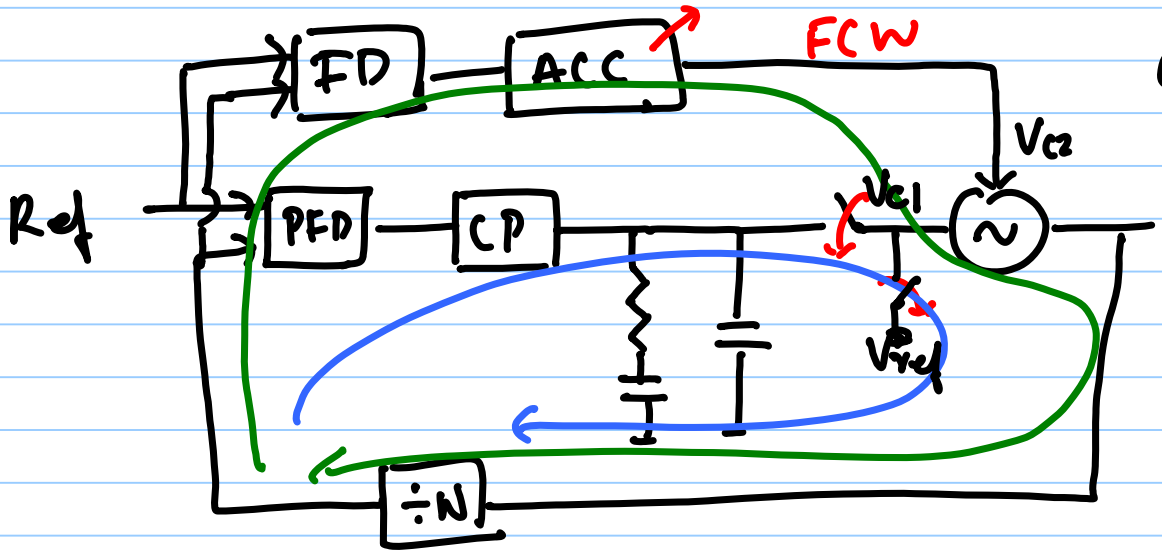


0.5 – 1.5

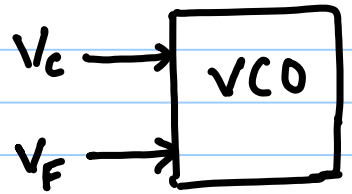
0.25 – 0.75 V 0.25 – 0.75 V

0.2 m – 0.8 mA

0.5 – 0.75	x
0.75 – 1.00	2x

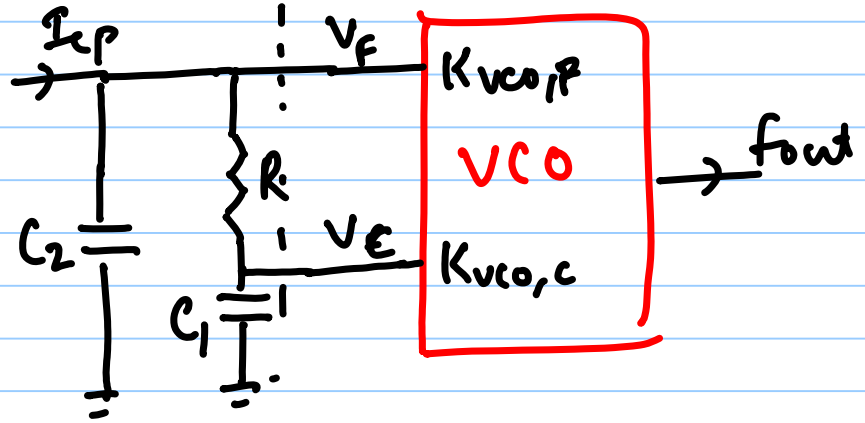


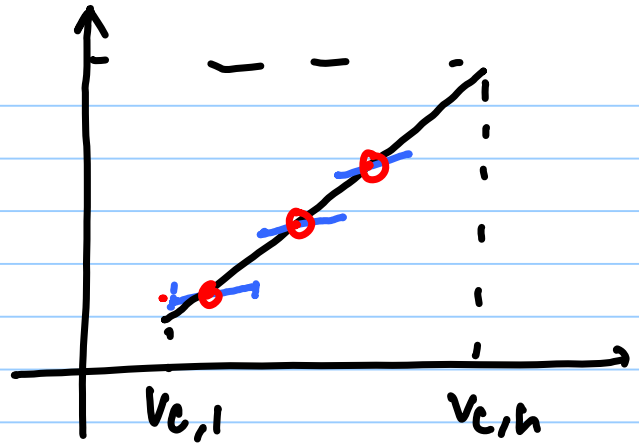
FCW (freq. Control Word)



V_c : $K_{VCO,c}$

V_f : $K_{VCO,F}$





$$F(s) = (R + 1/sC_1) \,||\, \frac{1}{sC_2}$$

$$f_{out} = (K_{VCO,F} \cdot v_f + K_{VCO,c} \cdot v_c)$$

$$LG(s) = \frac{I_{CP}}{2\pi} F(s) \cdot \frac{2\pi K_{VCO,F}}{s} + \frac{I_{CP}}{2\pi} F(s) \times \frac{1}{1+sRC_1} \times \frac{2\pi K_{VCO,c}}{s}$$

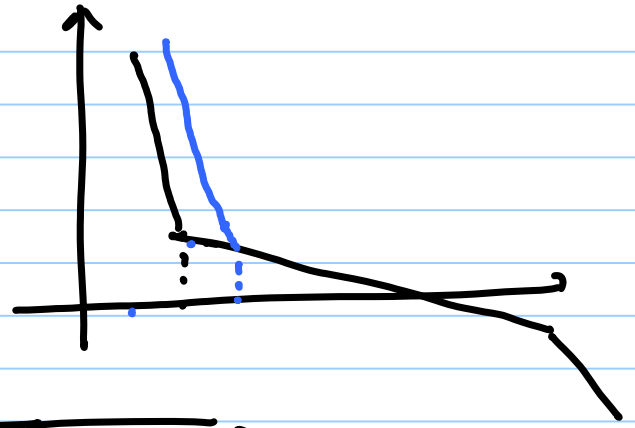
$$= \frac{I_{CP} F(s)}{s} \left[K_{VCO,F} + \frac{K_{VCO,c}}{1+sRC_1} \right]$$

$$= \frac{I_{cp} F(s)}{s} \left[\frac{K_{VCO}}{K} + \frac{(K-1)}{K} \frac{K_{VCO}}{(1+sRC_1)} \right]$$

$$= \frac{I_{cp} F(s) K_{VCO}}{sK} \left[\frac{1 + sRC_1 + K - 1}{1 + sRC_1} \right]$$

$$= \frac{I_{cp} \cdot K_{VCO}}{s} \frac{(1+sRC_1/K)}{(1+sRC_1)} \frac{(1+sRC_1)}{\left(1+sR\frac{C_1C_2}{C_1+C_2}\right)} \times \frac{1}{s(C_1+C_2)}$$

$$= \frac{I_{cp} K_{VCO}}{s^2 (C_1+C_2)} \frac{(1+sRC_1/K)}{\left(1+sR\frac{C_1C_2}{C_1+C_2}\right)}$$



$$\omega_z = \frac{1}{RC_1/K}$$

$$C_{LP} = KC_1$$

$$\Rightarrow L_{CL} = \frac{I_{cp} K_{VCO}}{s^2 (KC_1+C_2)} \frac{(1+sRC_1)}{(1+sR\,KC_1C_2/KC_1+C_2)}$$