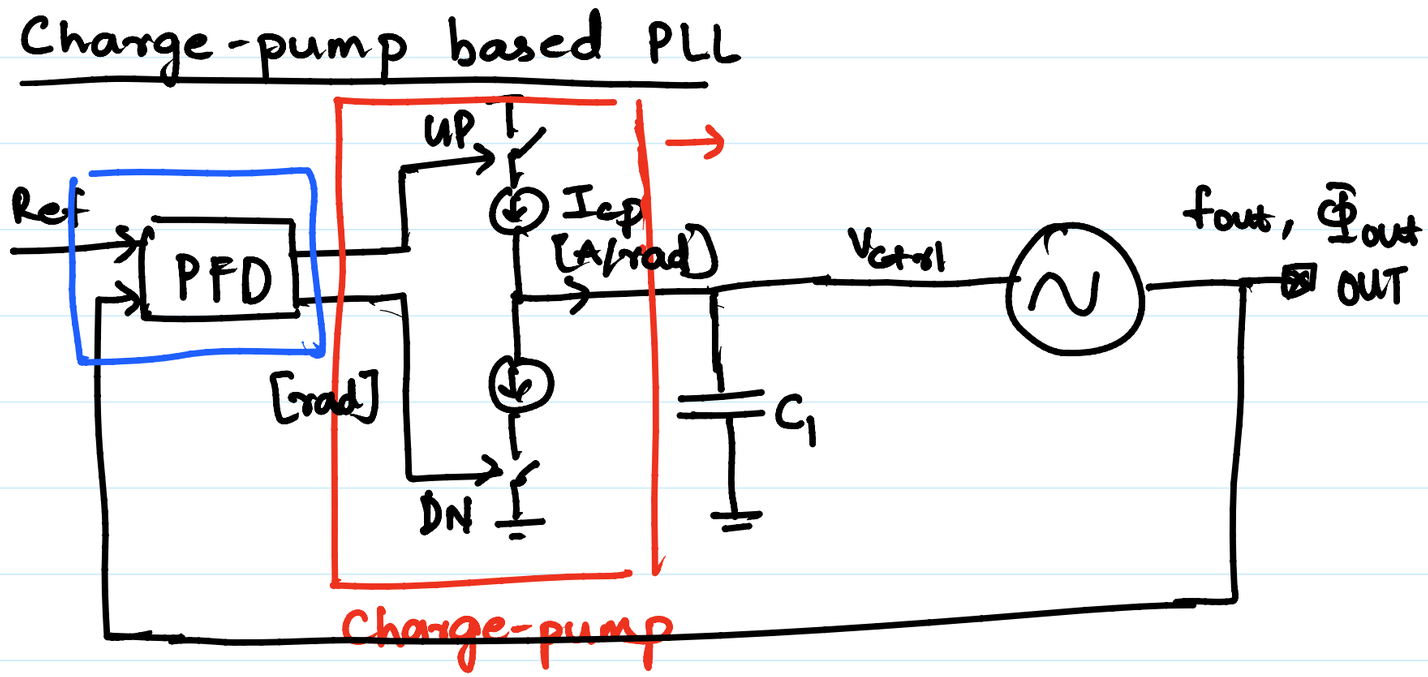
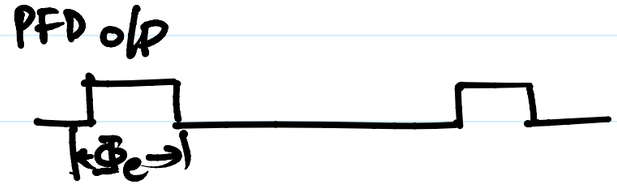
Lecture 09

Wednesday, February 1, 2017 7:57 AM

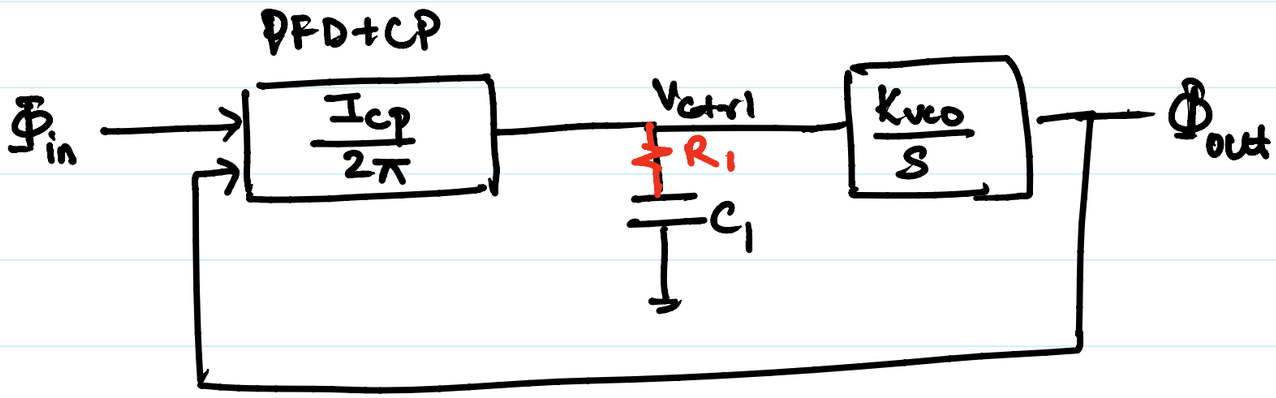
Charge-pump based PLL





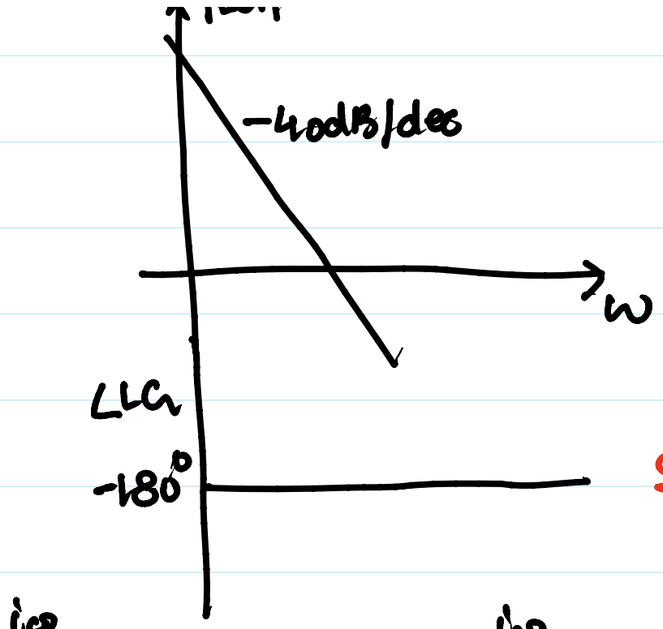
$$[rad] \times \frac{A}{rad} \times \Omega = V$$

$$[K_{VCO}] = \frac{rad}{V}$$

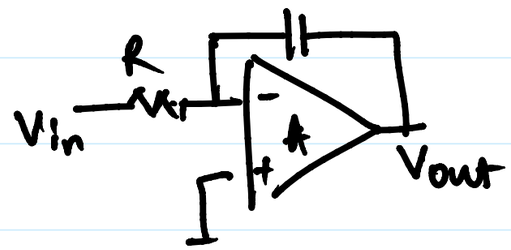


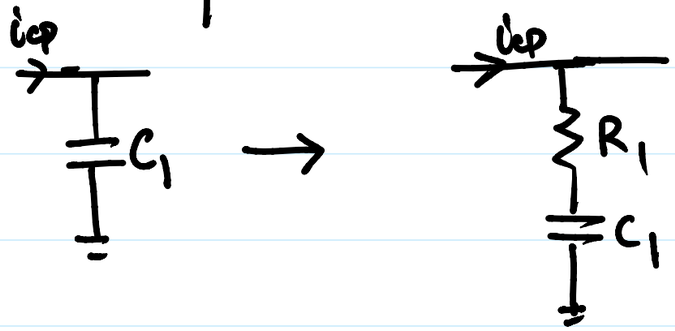
$$\text{Open loop gain, } LG(s) = \left.\frac{\Phi_{out}}{\Phi_{in}}\right|_{\text{open loop}} = \frac{I_{CP}}{2\pi} \frac{1}{sC_1} \frac{K_{VCO}}{s}$$

|LG|



Stability



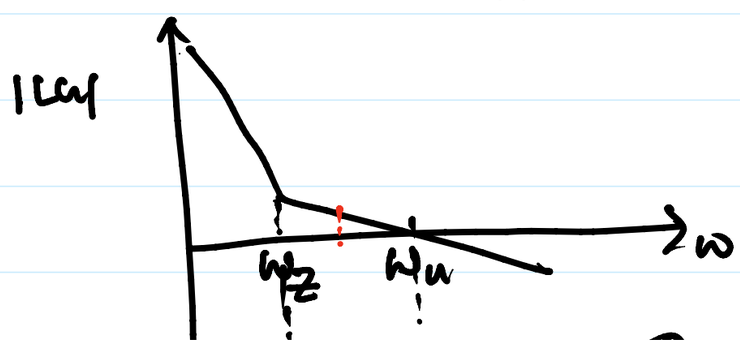


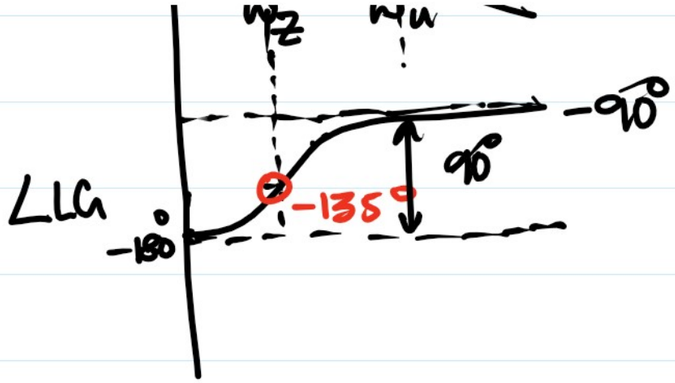
$$V_{ctrl}(s) = I_{cp}\left(R_1 + \frac{1}{sC_1}\right)$$

$$= I_{cp}\frac{(1+sR_1C_1)}{sC_1}$$

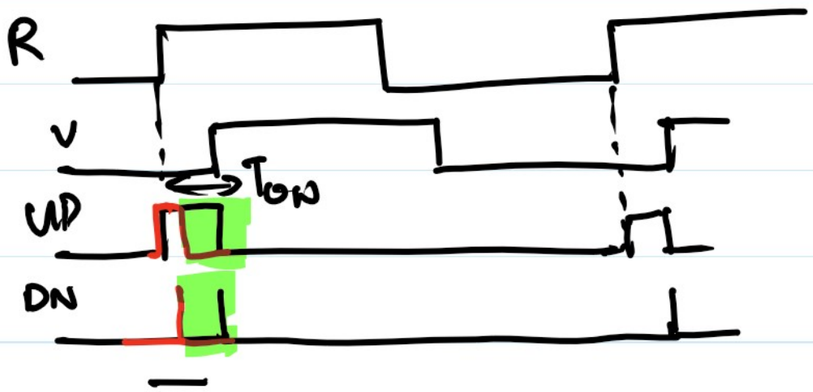
$$= \frac{I_{cp}}{sC_1}(1+sR_1C_1)$$

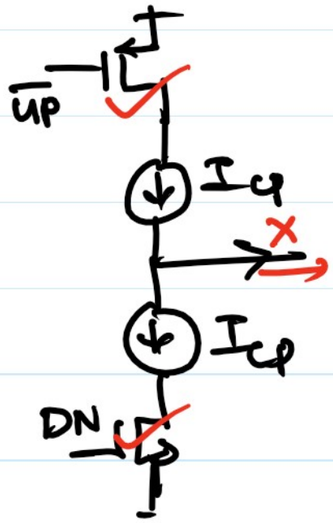
$$LG(s) = \frac{I_{cp}}{2\pi}\,\frac{1+sR_1C_1}{sC_1}\,\frac{K_{VCO}}{s} \quad ; \quad \omega_z = \frac{1}{R_1C_1},\ \omega_{p1} = \omega_{p2} = 0$$

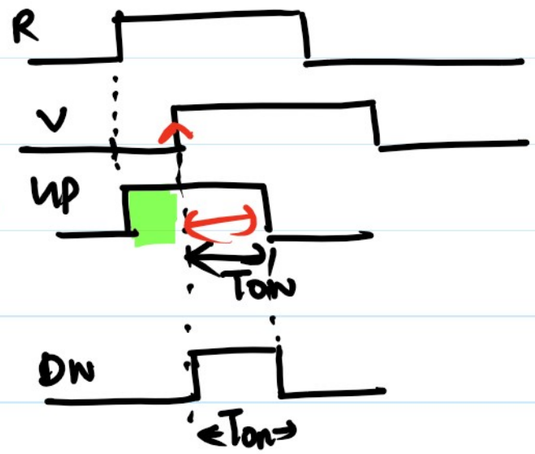


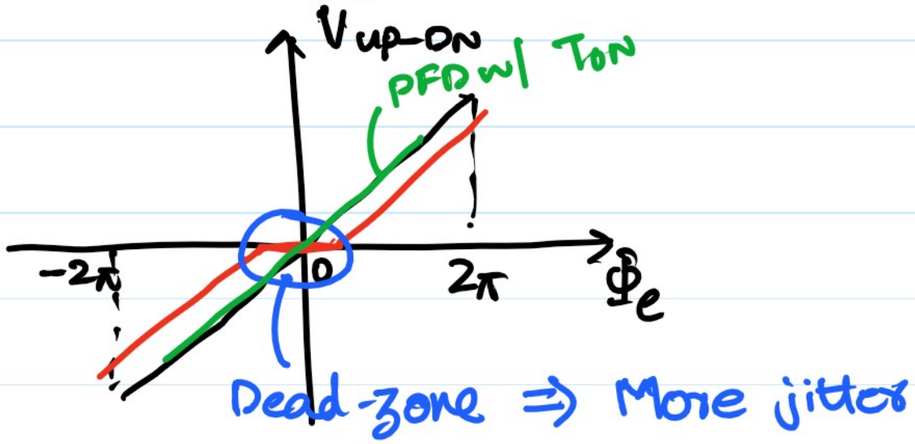


PFD o/p.



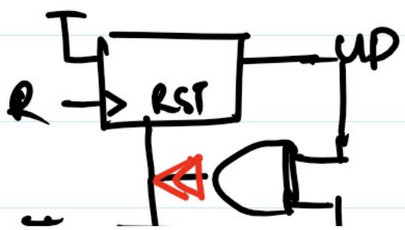


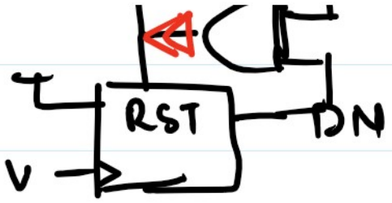


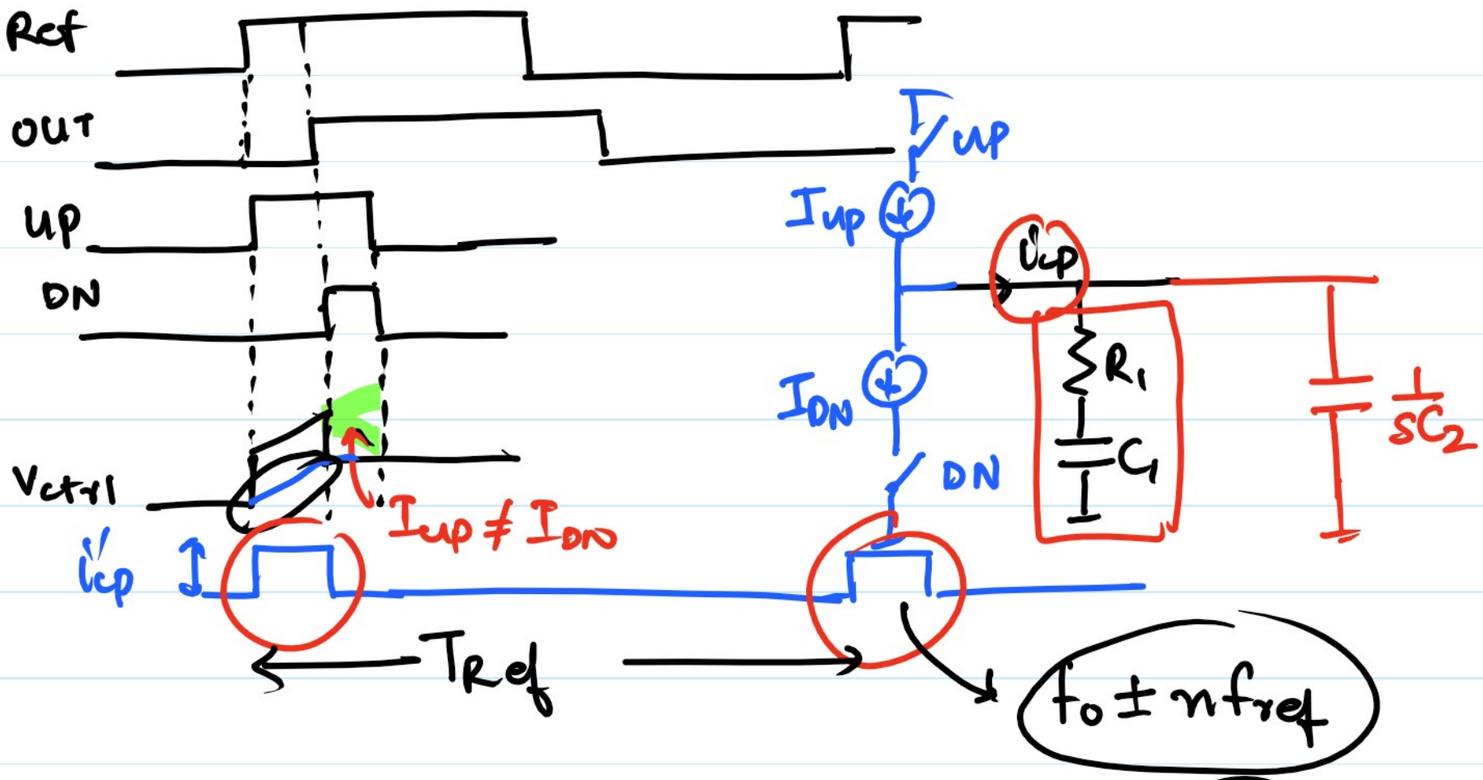


Dead-zone ⇒ More jitter

* Minimum T_{ON} time for PMOS/NMOS switches to switch <u>ON</u>







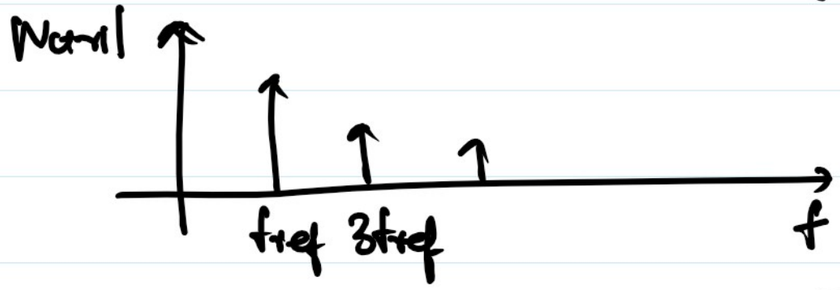
$$\left|\frac{1}{\omega_{Ref} C_2}\right| \ll \left|R_1 + \frac{1}{j\omega_{Ref} C_1}\right|$$

Ref. Spur Mag. ↓ ⇒ C_2 ↑

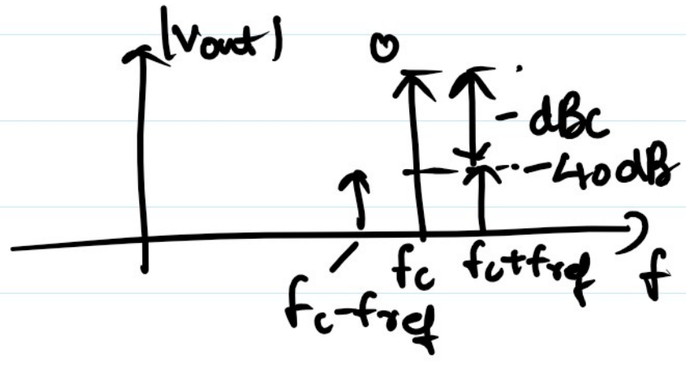
Stability ⇒ C_2 ↓

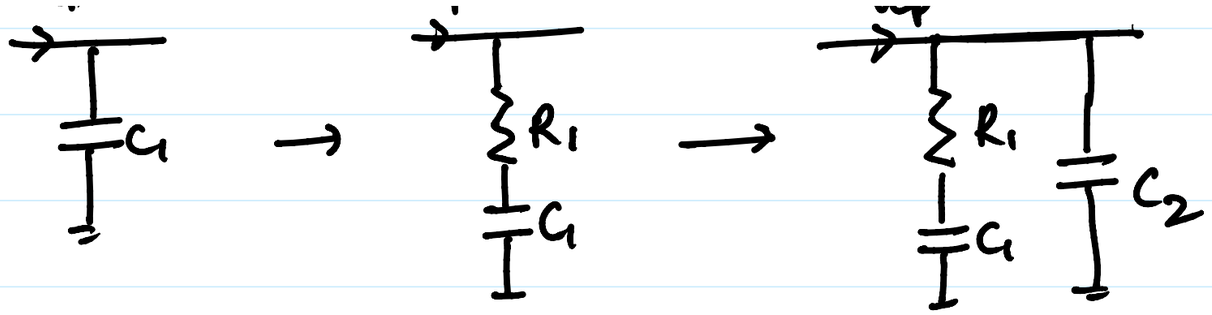
$$f_{out} = K_{VCO} \cdot (V_{ctrl})$$

$$= K_{VCO} \cdot \left[\sum v_n \sin(n\omega_{ref} t)\right]$$



Reference Spur [-dBc]





$$Z = \left(\frac{1+sR_1C_1}{sC_1} \parallel \frac{1}{sC_2}\right)$$

$$= \frac{1+sR_1C_1}{sC_2+sC_1+s^2R_1C_1C_2}$$

$$= \frac{1}{s(C_1+C_2)} \quad \frac{1+sR_1C_1}{1+sR_1C_1\frac{C_2}{C_1+C_2}}$$

$$\omega_z = \frac{1}{R_1C_1}$$

$$Z = \frac{\left(s+\frac{1}{R_1C_1}\right)}{\left(s+\frac{C_1+C_2}{R_1C_1C_2}\right)} \times \frac{1}{sC_2}$$

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

$$\omega_{p3} = \frac{1}{R_1\frac{C_1C_2}{C_1+C_2}}$$