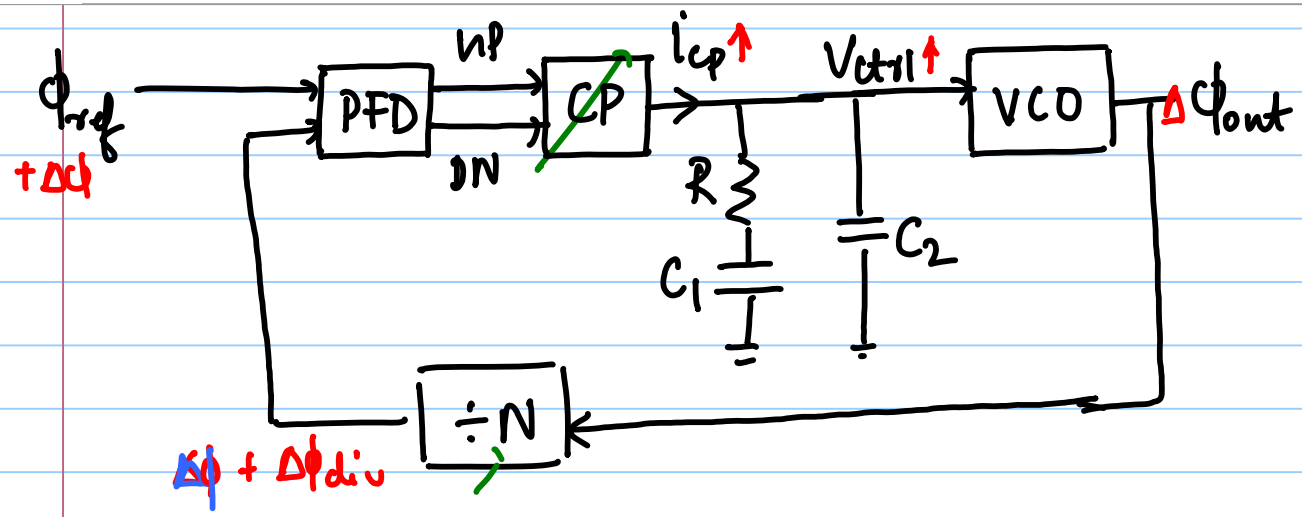
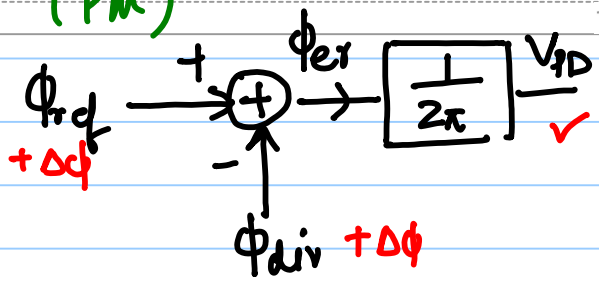
Lecture #20

- Frequency Modulation (FM)
- Phase Modulation (PM)

Note Title 16-10-2020





$$V_{PD} = \frac{1}{2\pi}\phi_{er} = \frac{1}{2\pi}(\phi_{ref} - \phi_{div})$$

$\Rightarrow$ For $+\phi_{er} = \Delta\phi$

$$V_{PD} = \frac{1}{2\pi}\cdot\Delta\phi$$

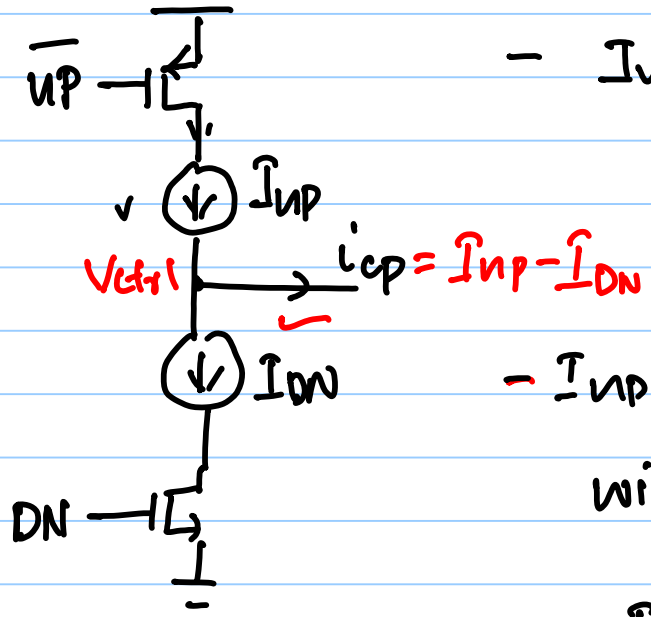
For $\phi_{er} = -\Delta\phi$

$$V_{PD} = -\frac{1}{2\pi}\Delta\phi$$

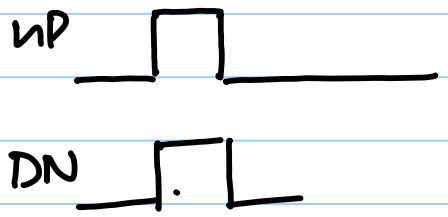
- Dead-zone of PFD

- PFD non-linearity

Non-linearity in CP



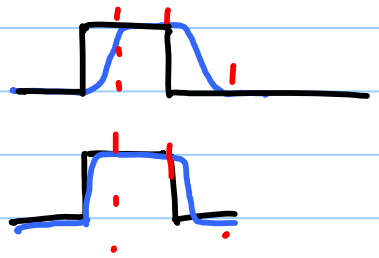
- $I_{UP} \neq I_{DN}$

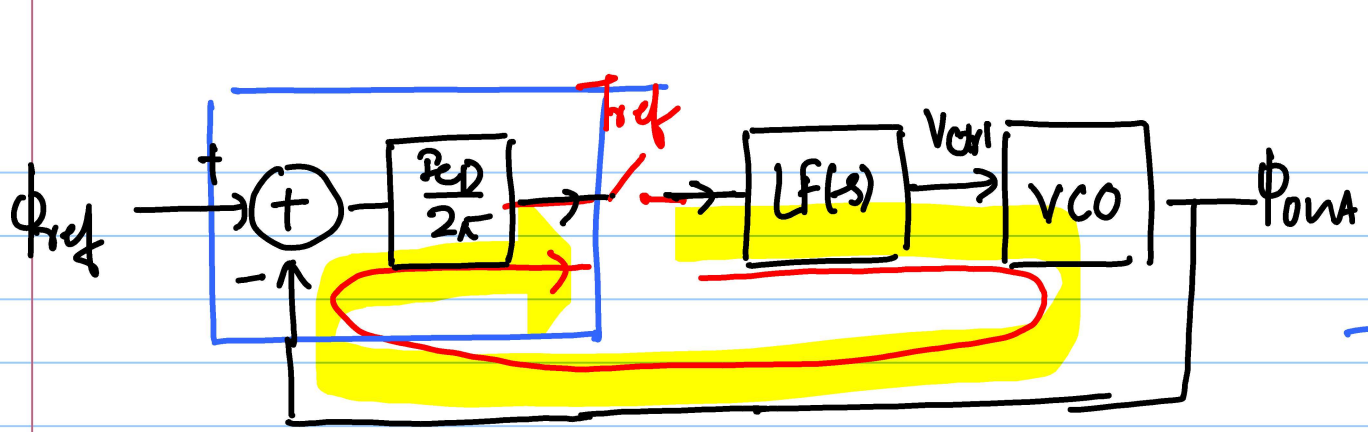


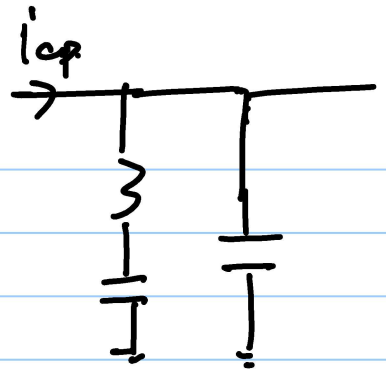
- $I_{UP} = I_{DN}$ @ $V_{Ctrl} = 0.9V$

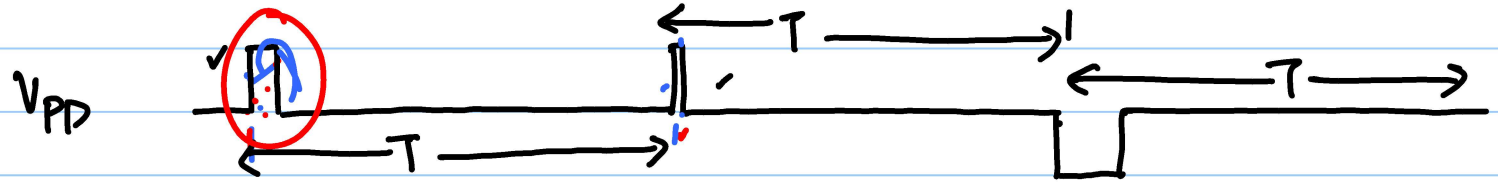
with $V_{Ctrl} = 0.9V \pm \Delta V \Rightarrow I_{UP} \neq I_{dn}$

- $I_{UP} = I_{DN}$

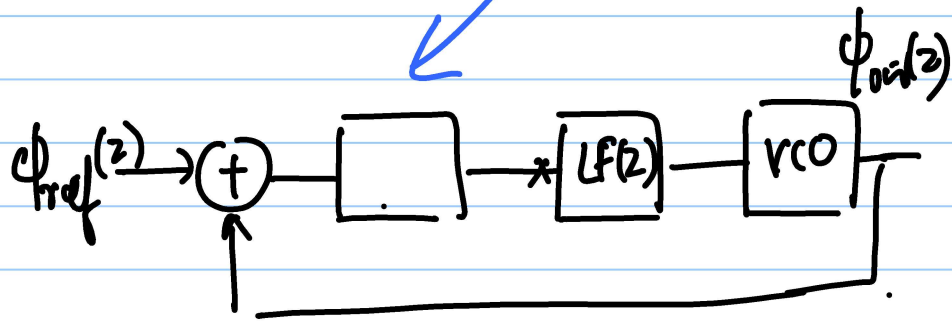


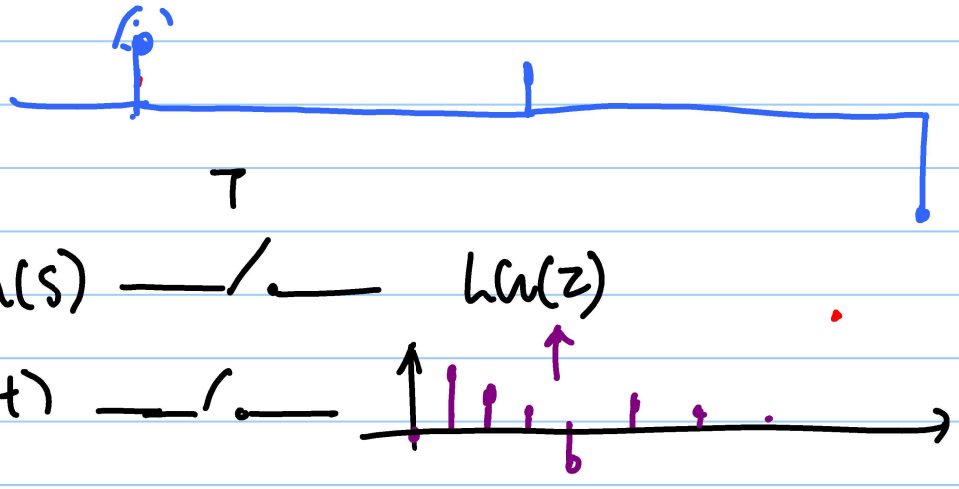






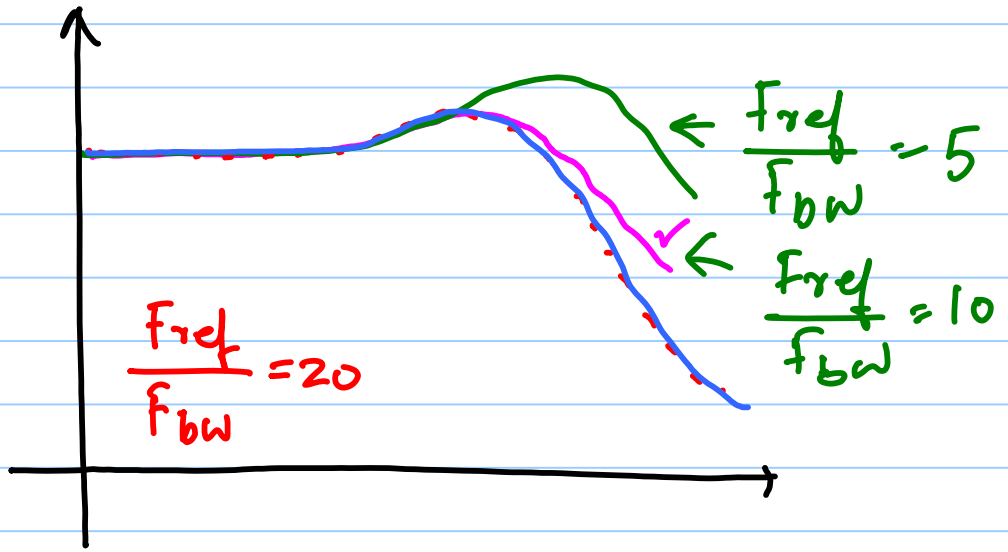
$$f_{BW} \leq \frac{f_{ref}}{10}$$





$$H(z) = K \frac{z^2\left(\frac{C_1(1-a)}{C_1+C_2} + \frac{2\pi}{RC_1\omega_i}\right) - z\left(\frac{C_1(1-a)}{C_1+C_2} + \frac{2\pi}{RC_1\omega_i}a\right)}{z^3 - z^2(2+a) + z(1+2a) - a}$$ ✓

$$a = \exp(-\omega_{p3}T) \quad \text{and} \quad K = \frac{K_{VCO} I_{cp} R C_1}{\omega_{i\_}(C_1+C_2)}$$



$$\frac{\phi_{out}}{\phi_{ref}} = \frac{K_{DC}}{(1+s/\omega_p)}$$

$$\boxed{\omega_p = \frac{\omega_{ref}}{10}}$$

$$\Delta\phi_{ref} = \Delta\phi(0)\,u(t) \Longrightarrow \Delta\phi_{out}(t) = K_{DC}\omega_p\left(1-e^{-\omega_p t}\right)\Delta\phi(0)$$