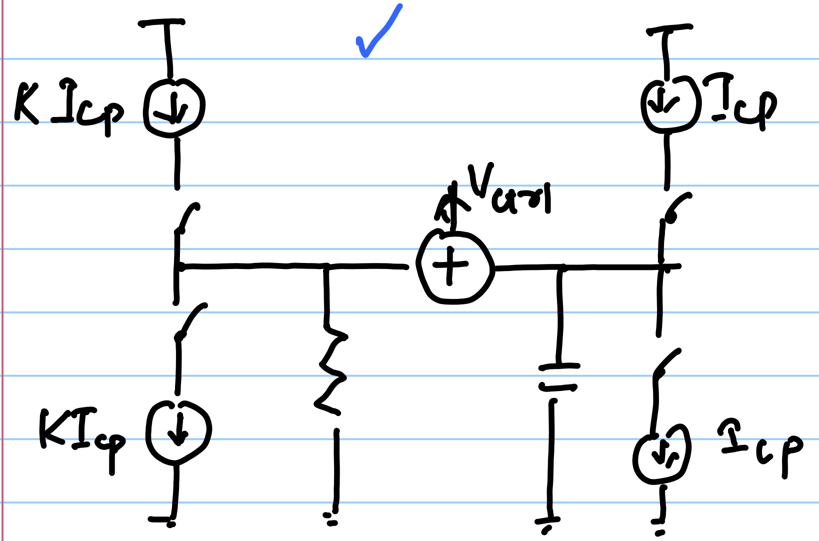
Lecture # 43

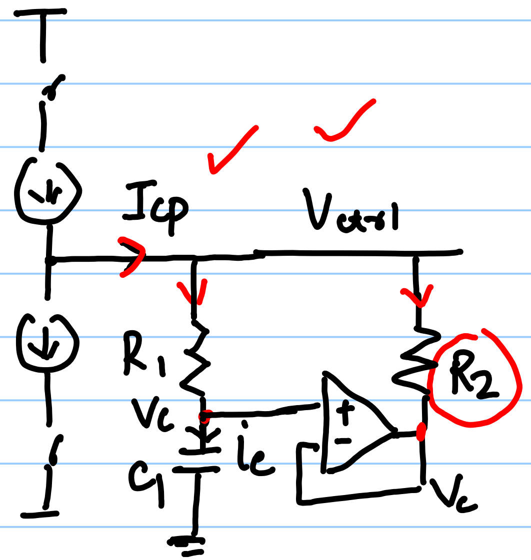
Note Title 07-12-2020



$$I_{cp} = (V_{ctrl} - V_c)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

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

$$= KI_{cp}(s) \cdot R + \frac{I_{cp}(s)}{sC_1}$$



$$I_{cp} = \frac{V_{ctrl} - V_c}{(R_1 \parallel R_2)}$$

$$i_c = \frac{V_{ctrl} - V_c}{R_1}.$$

$$= V_c \cdot sC_1$$

$$\Rightarrow V_c = \frac{V_{ctrl}}{1 + sR_1C_1}$$

$$I_{cp} = \frac{V_{ctrl} - \frac{V_{ctrl}}{1+sR_1C_1}}{R_1R_2/(R_1+R_2)} = \frac{V_{ctrl}\, s\cancel{R_1}C_1 / 1+sR_1C_1}{\cancel{R_1}R_2 / R_1+R_2}$$

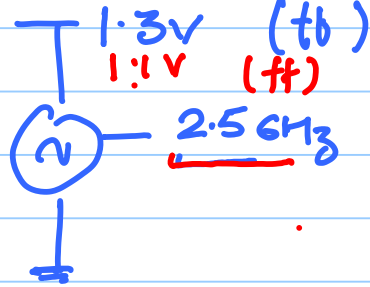
$$I_{cp} = \frac{V_{ctrl}\, sC_1 \left(\frac{R_1+R_2}{R_2}\right)}{1+sR_1C_1}$$

$$\frac{V_{ctrl}}{I_{cp}} = \frac{1+sR_1C_1}{sC_1\underbrace{\left(\frac{R_1}{R_2}+1\right)}}$$

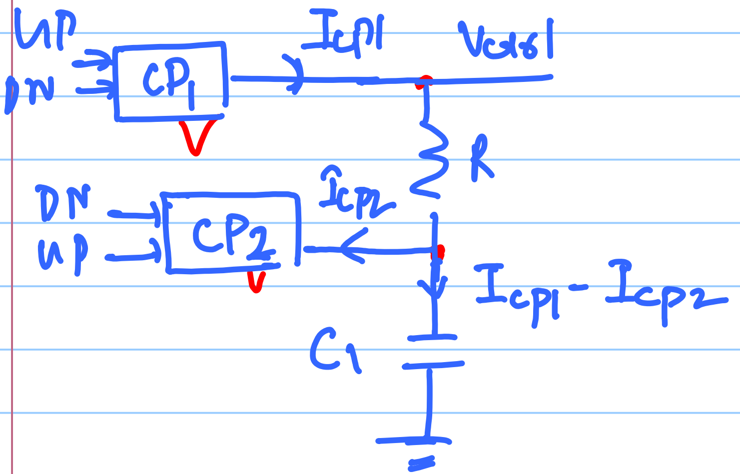
More noise.

$$H(s) = \frac{I_{cp}\downarrow}{2\pi}\;\frac{(1+sRC_1)}{\underbrace{sC_1}\uparrow}\;\frac{2\pi K_{vco}\uparrow}{N} \quad ✓$$

$sC_1\left(1+\frac{R_1}{R_2}\right)$



Kvco varies.

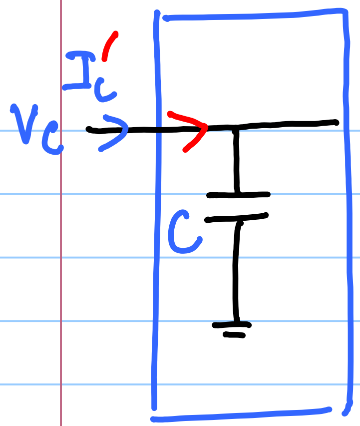


$$V_{ctrl}(s) = (I_{cp1}-I_{cp2})\frac{1}{sC_1} + I_{cp1}\cdot R$$

$$= I_{cp1}\left[R + \left(1-\frac{I_{cp2}}{I_{cp1}}\right)\frac{1}{sC_1}\right]$$

$$= I_{cp}\left[R + (1-\alpha)\frac{1}{sC_1}\right]$$

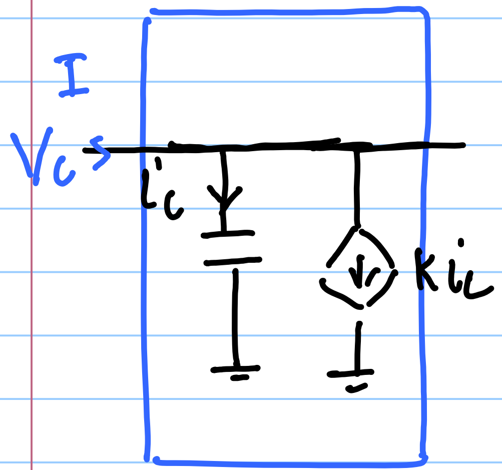
$$= I_{cp}\left[R + \frac{1}{s(C_1/(1-\alpha))}\right]$$



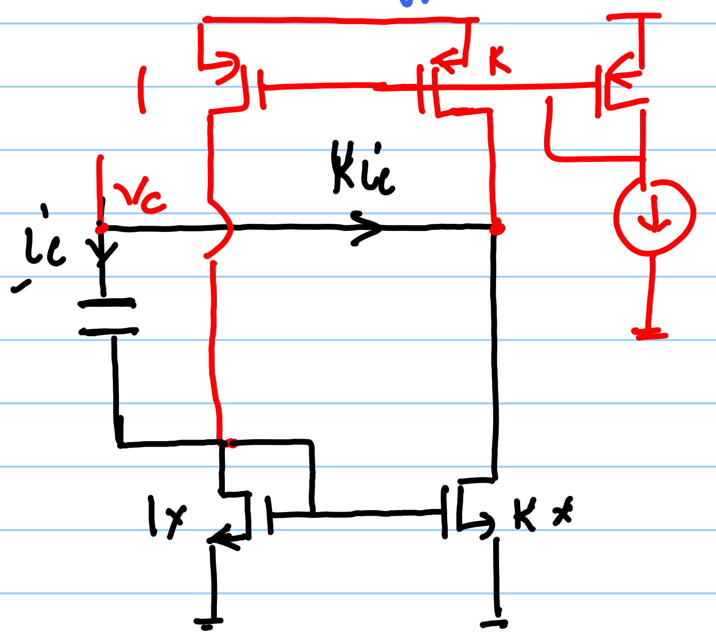
$$\frac{V_c}{I_c} = \frac{1}{sC}$$

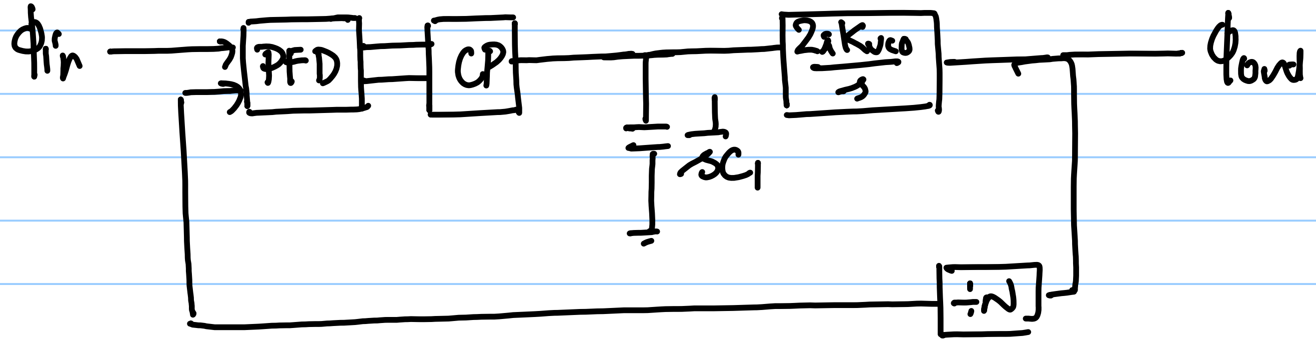
$$I_c' = (K+1)\,I_c \Rightarrow C_{eff} = (K+1)C$$

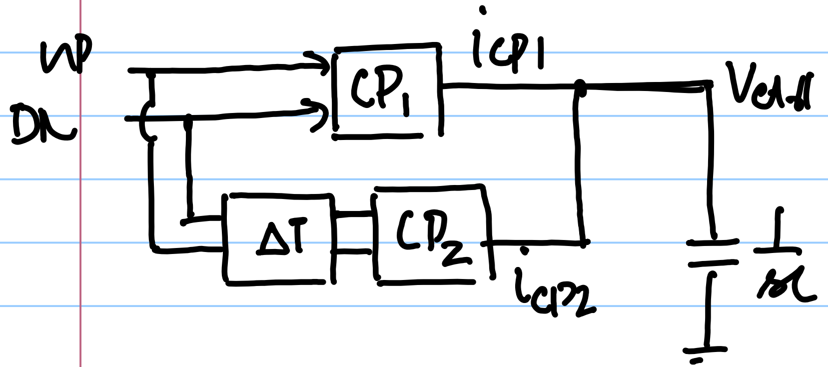
$$= (K+1)\ V_c \cdot sC$$



$$I = i_c + Ki_c \Rightarrow C_{eff} = (K+1)C$$







$$i_{cp2} = -\alpha\, i_{cp1}$$

$$V_{ctrl} = i_{cp1}\frac{1}{sC} + i_{cp2}\, e^{-s\Delta T}\frac{1}{sC}$$

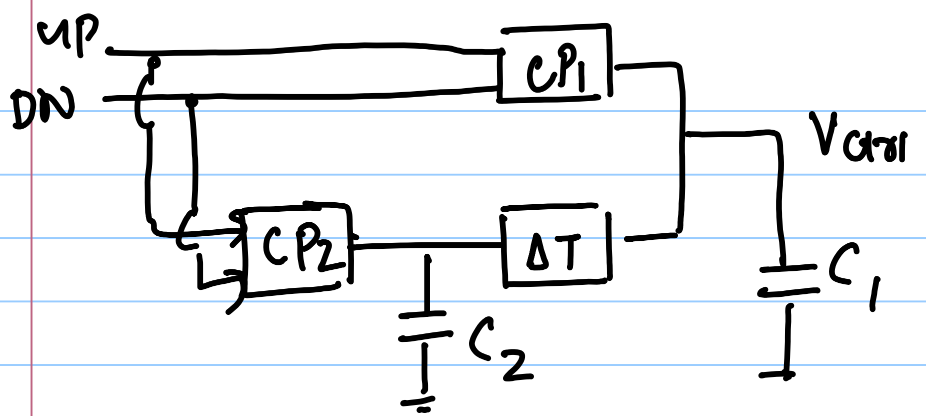
$$\approx \left[i_{cp1} + i_{cp2}(1 - s\Delta T) \right] \frac{1}{sC}$$

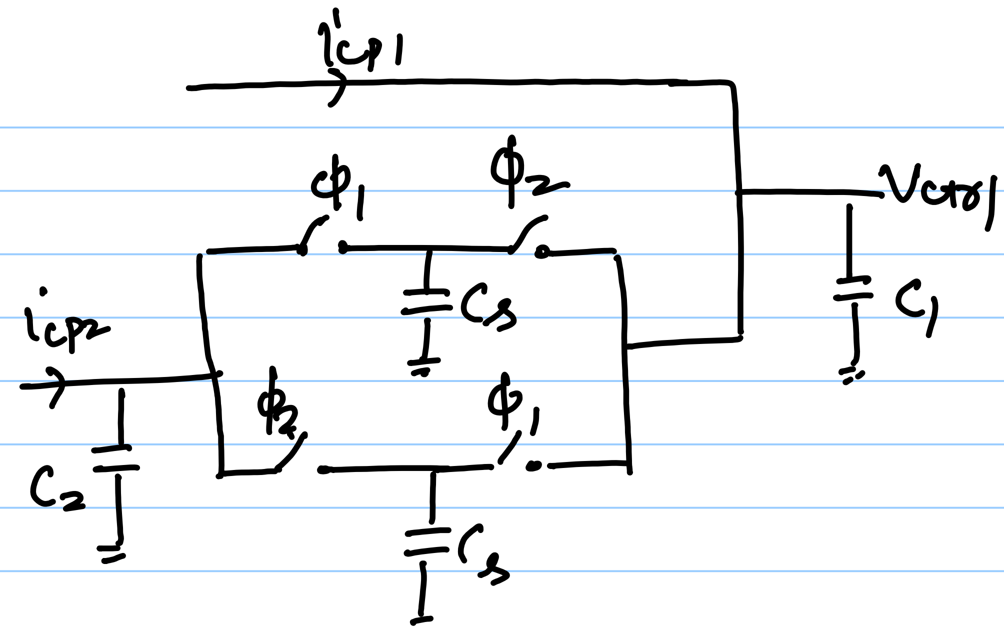
$$= \left[i_{cp1} + i_{cp2} - s\, i_{cp2}\cdot\Delta T \right] \frac{1}{sC}$$

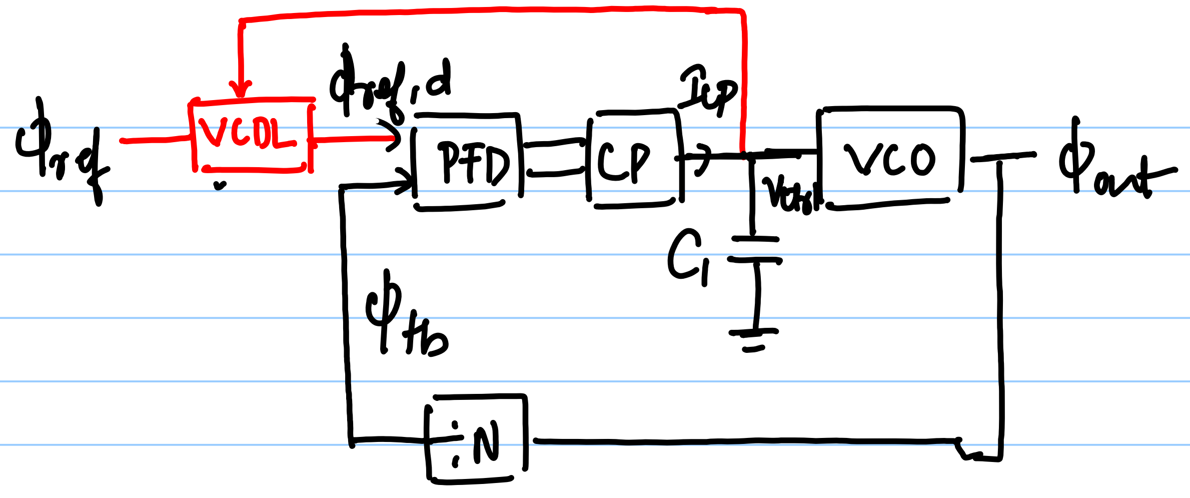
$$= \left[(i_{cp1} - \alpha\, i_{cp1}) + s\, i_{cp2}\,\Delta T \right] \frac{1}{sC}$$

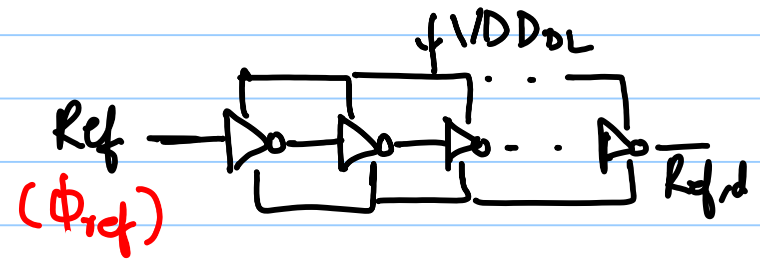
$$= i_{cp1}(1-\alpha)\left[1 + \frac{s\alpha}{1-\alpha}\cdot\Delta T \right] \frac{1}{sC}$$

$$w_2 = \frac{1-\alpha}{\alpha}\,\frac{1}{\Delta T}$$


UP
DN
CP_1
CP_2
ΔT
C_2
V_{ctrl}
C_1


i_{cp1}
ϕ_1
ϕ_2
V_{ctrl}
C_s
C_1
i_{cp2}
ϕ_2
ϕ_1
C_2
C_s





$$\phi_{ref,d} = \phi_{ref} + \phi_{off} + K_{VCDL} \cdot \Delta VDD_{DL}$$ ✓

$\Delta\phi_{o}$