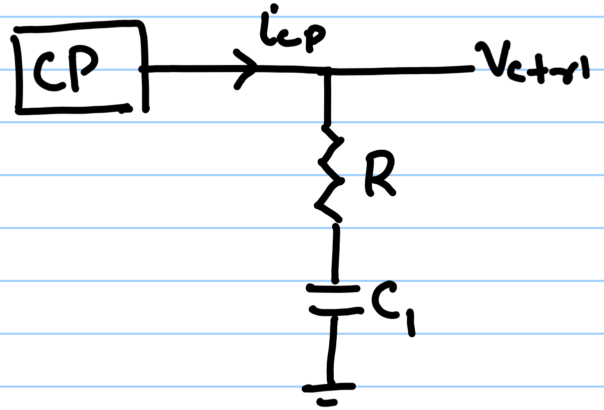
Note Title 20-10-2017

Lecture # 41

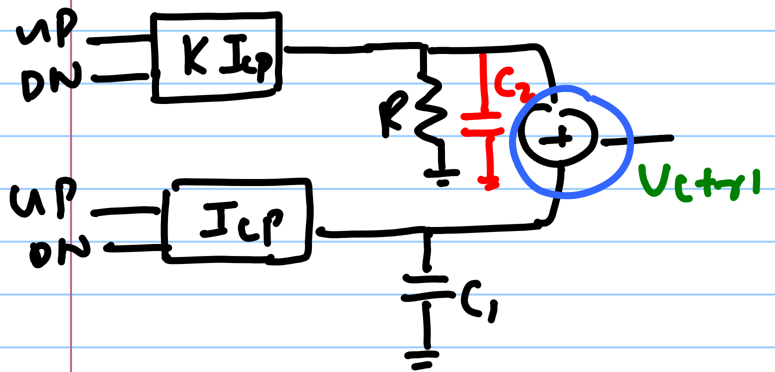
Dual-path loop filter. (DPLF)



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

$$= I_{cp}\,\frac{(1 + sRC_1)}{sC_1}$$

$$= \underbrace{I_{cp}(R)}_{\text{Prop.}} + \underbrace{I_{cp}\left(\frac{1}{sC_1}\right)}_{\text{Int.}}$$



$$V_{ctrl}(s) = K_P + \frac{K_I}{sC_1}$$

$$= \frac{sC_1 \cdot K_P + K_I}{sC_1}$$

$$= I_{cp1} R + I_{cp2} \frac{1}{sC_1}$$

$$= \frac{s I_{cp1} \cdot R C_1 + I_{cp2}}{sC_1}$$

$$W_Z = \frac{K_I}{C_1 K_P} = \frac{1}{RC}$$

$$W_Z = \frac{I_{cp2}}{I_{cp1}} \frac{1}{RC_1} \quad C_1 \rightarrow 0.1 C_1 \Rightarrow I_{cp1} = 10 I_{cp}.$$

$$\frac{V_{ctrl}(s)}{\Delta\Phi} = K I_{cp}\left(\frac{R}{1+sRC_2}\right) + I_{cp}\frac{1}{sC_1}$$

$$= \frac{I_{cp}}{sC_1}\left[\frac{sKRC_1 + 1 + sRC_2}{1+sRC_2}\right]$$

$$= \frac{I_{cp}}{sC_1}\left[\frac{1 + sR(C_2+KC_1)}{1+sRC_2}\right]$$

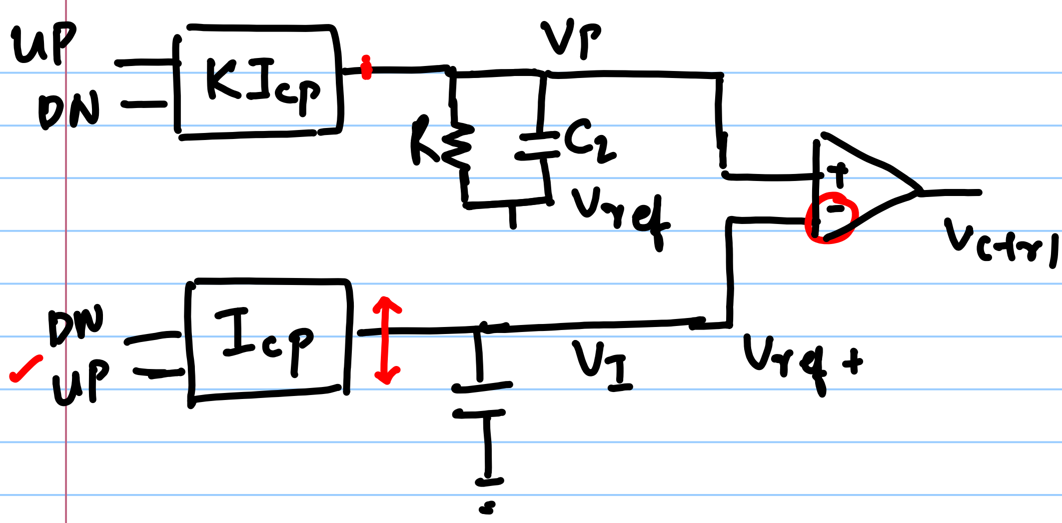
$$\omega_z = \frac{1}{R(C_2+KC_1)}, \quad \omega_{p1} = 0, \quad \omega_{p2} = \frac{1}{KC_2}$$

- More current in CP ✓

$$S_{icp}(f) = \frac{8KT}{3}(g_{mn} + g_{mp})\frac{T_{RST}}{T_{Ref}}$$

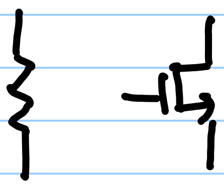
$$NTF = \frac{2\pi}{I_{cp}}\frac{LG}{1+LG}$$

1.

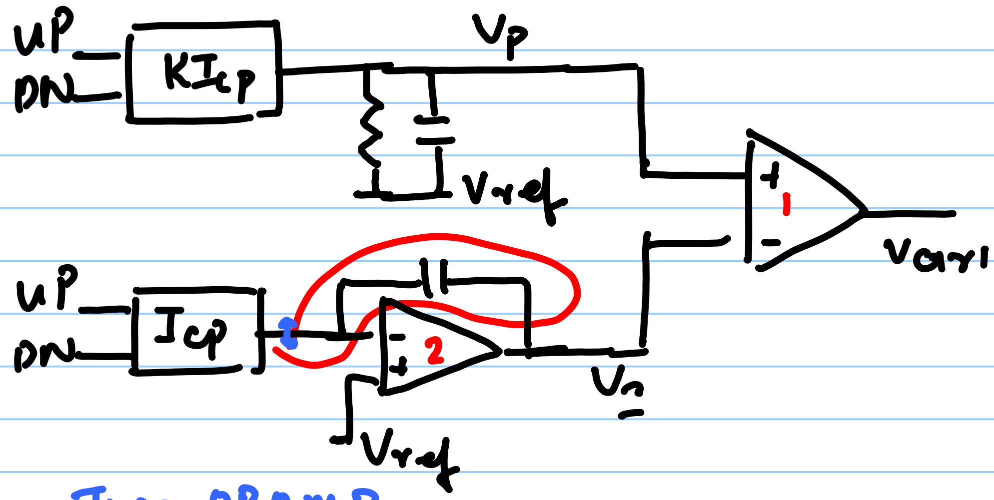


- Power
- Noise

} OPAMP

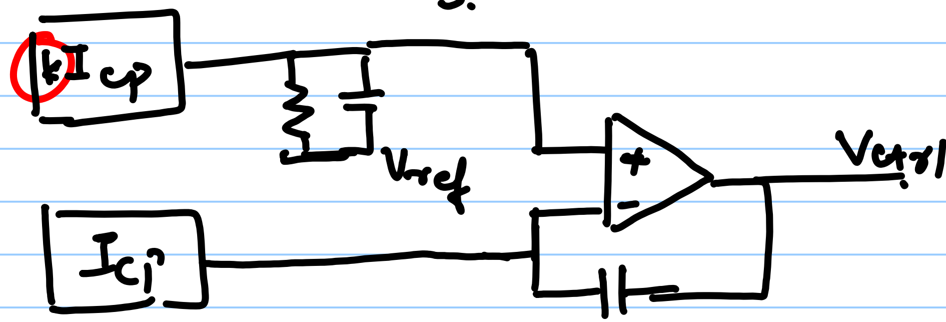


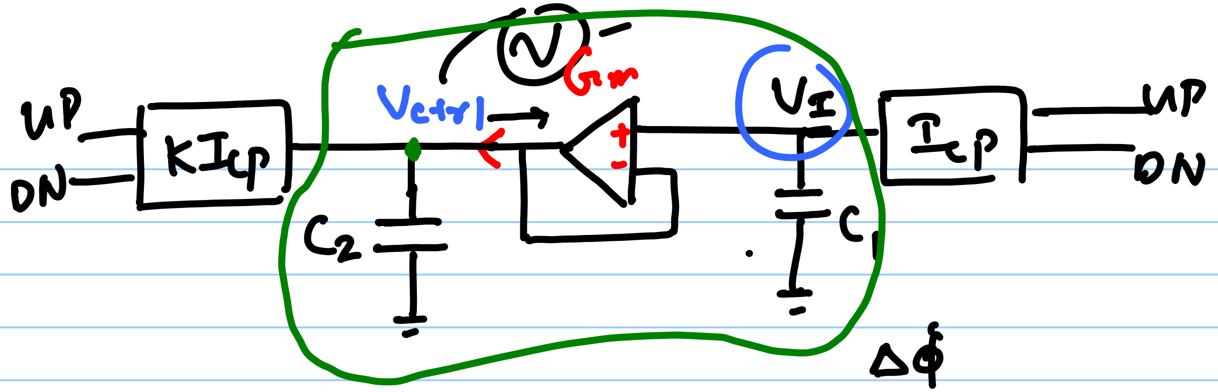
2



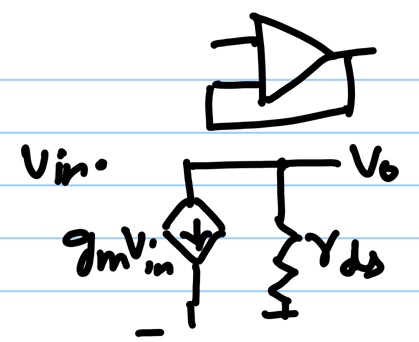
- Two OPAMP
- Added Noise.

3.





$\Delta\phi$

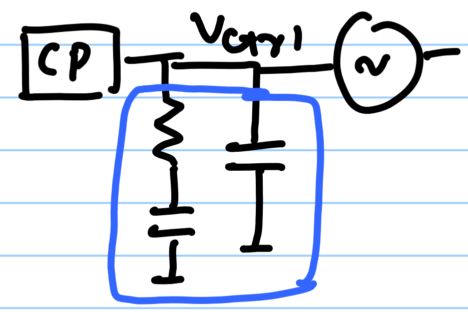


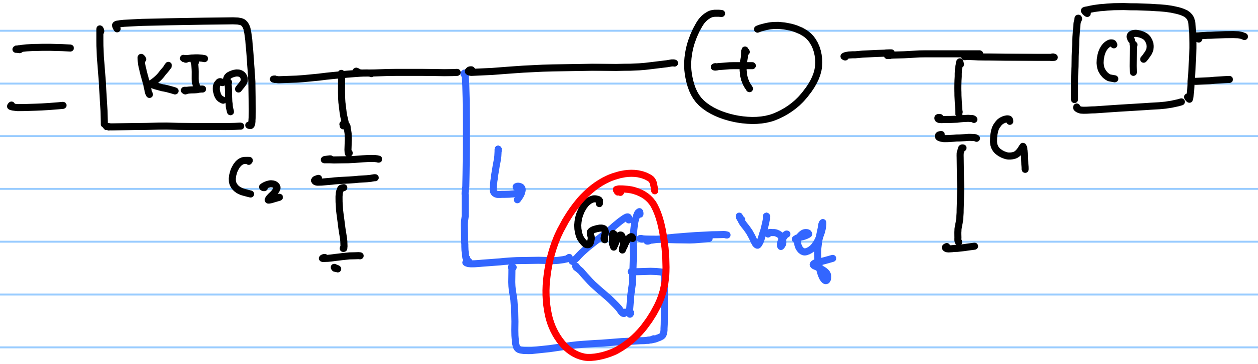
$$V_{ctrl}(s) = \left[G_m \left(V_I - V_{ctrl} \right) + kI_{cp} \right] \times \frac{1}{sC_2}$$

$$V_{ctrl} \left(1 + \frac{G_m}{sC_2} \right) = \frac{G_m}{sC_2} \times \frac{I_{cp}}{sC_1} + \frac{KI_{cp}}{sC_2}$$

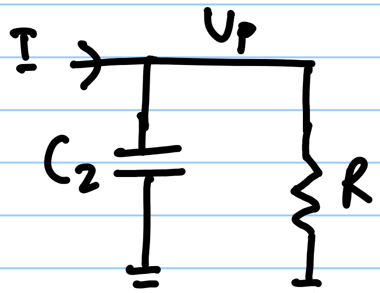
$$= \frac{I_{cp}}{sC_2} \left(\frac{G_m + sC_1K}{sC_1} \right)$$

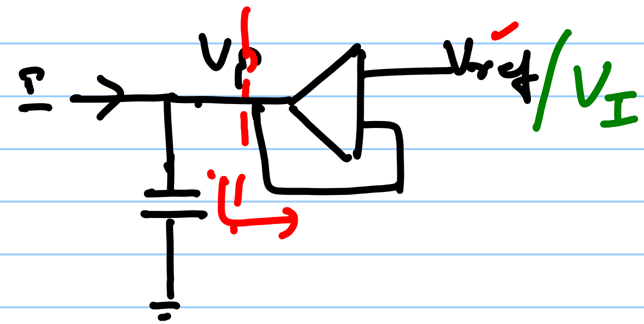
$$\frac{V_{ctrl}}{I_{cp}} = \frac{(G_m + sC_1K)}{sC_1 \, (G_m + sC_2)}$$

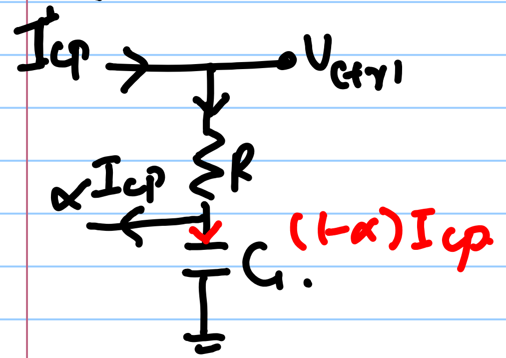




$R = \frac{1}{G_m}$







$K > 1$

$V_{ctrl} = \uparrow I_{cp} \cdot R + I_{cp} \frac{1}{sC_1} = K_p + \frac{K_I}{sC}$

$\omega_z = \frac{K_I \downarrow}{\uparrow K_p C}$

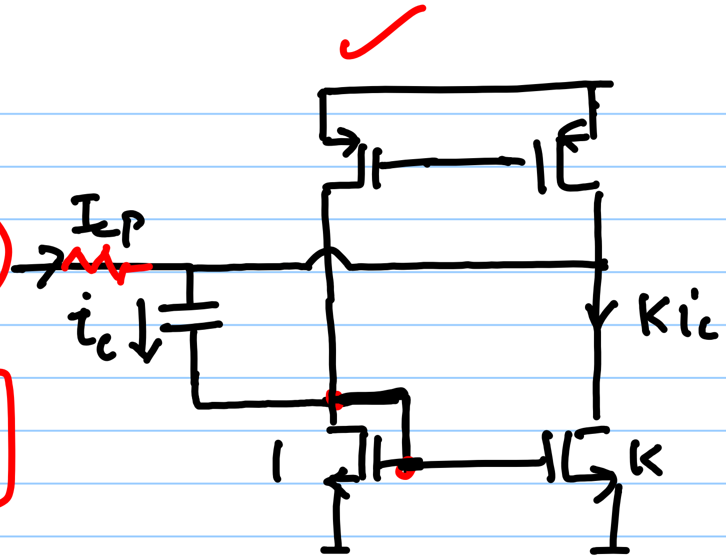
$V_{ctrl}(s) = I_{cp} \cdot R + \alpha \cdot I_{cp} \frac{1}{sC}$

$\alpha < 1$

$$V_{ctrl}(s) = I_{cp} \cdot R + (1-\alpha) I_{cp} \cdot \frac{1}{sC}$$

$$= \frac{I_{cp}}{sC}\left(sRC + (1-\alpha)\right)$$

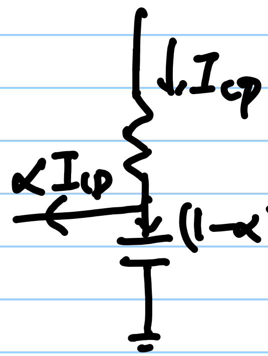
$$= \frac{I_{cp}(1-\alpha)}{sC}\left[\frac{sRC}{1-\alpha} + 1\right]$$



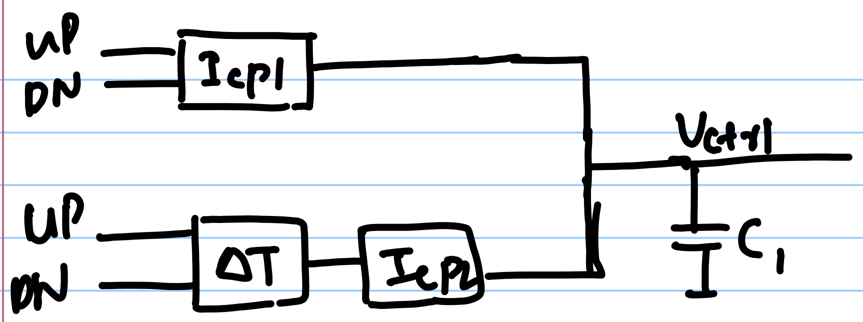
$$C_{new} = \frac{C}{1-\alpha}, \quad ; \ \alpha < 1$$

$$= \underbrace{\left(\frac{1}{1-\alpha}\right)}_{>1} C$$

$I_{cp} = i_c + K i_c$



$$\frac{K i_c}{i_c} = \frac{\alpha I_{cp}}{(1-\alpha) I_{cp}}$$



$1 + sRC$ $\qquad e^{-s.\Delta T}$

$$V_{ctrl}(s) = \frac{I_{cp1}}{sC_1} + \frac{I_{cp2}e^{-s.\Delta T}}{sC_1}$$

$$= \frac{1}{sC_1}\left[I_{cp1} + I_{cp2}(1 - s.\Delta T)\right]$$

$$= \frac{1}{sC_1}(I_{cp1} + I_{cp2})\left[1 - \frac{I_{cp2}.\Delta T}{I_{cp1}+I_{cp2}} s\right]$$

$$\boxed{I_{cp2} = -\alpha I_{cp1}}$$

$$= \frac{1}{sC_1}(1-\alpha) I_{cp1}\left[1 + \frac{\alpha \Delta T}{1-\alpha} s\right]$$

$$\omega_2 = \frac{1-\alpha}{\alpha . \Delta T}$$