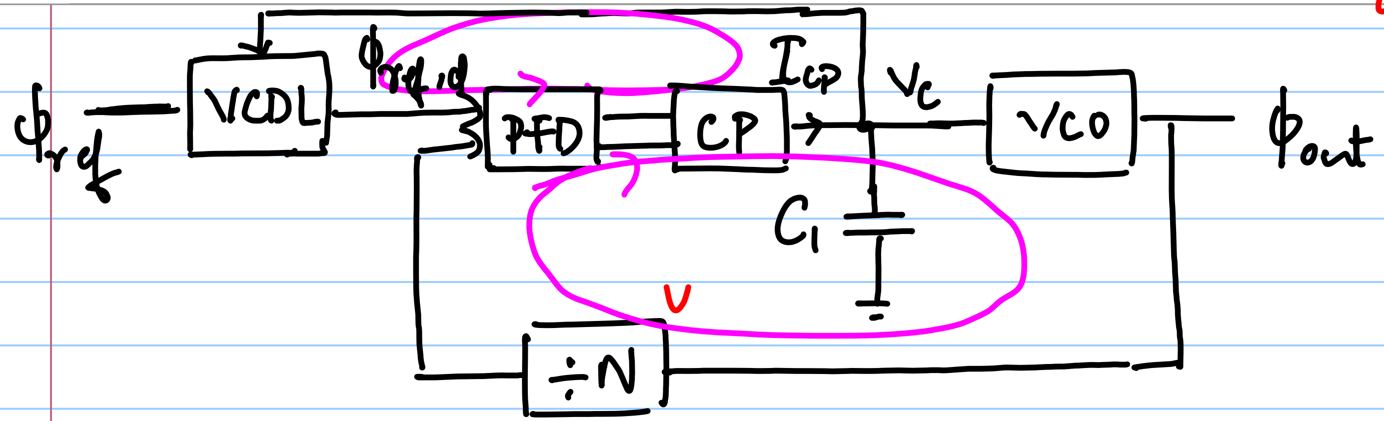
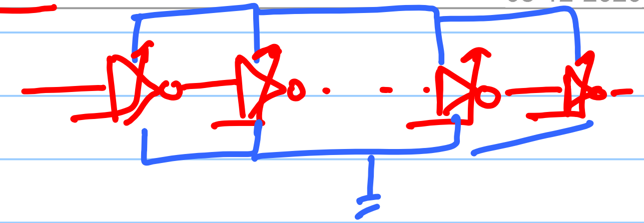
Note Title

lecture # 44

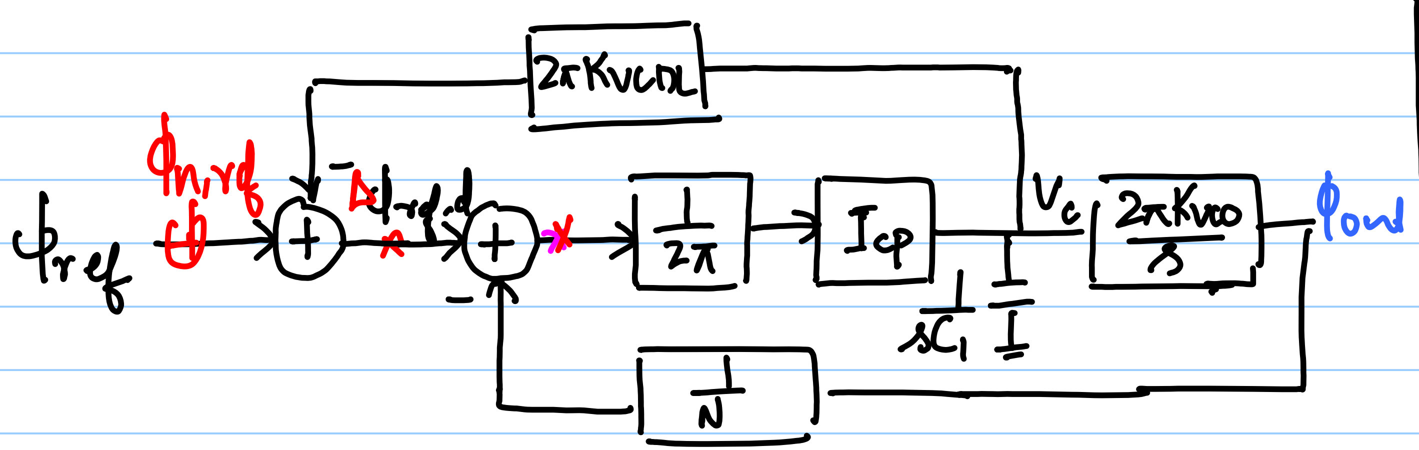
08-12-2020



$\underline{\Delta\phi_{VCDL}} = 2\pi K_{VCDL} \cdot \Delta V_c$



$[2\pi K_{VCDL}] = rad/V.$



$\left(\phi_{ref} - 2\pi K_{VCDL} V_c - \frac{\phi_{out}}{N}\right) \frac{I_{cp}}{2\pi} \frac{1}{sC_1} = V_c$

$\phi_{out} = \frac{2\pi K_{VCO}}{s} \cdot V_c$

$$LG = \frac{1}{2\pi} I_{cp} \frac{1}{sC_1} \left[2\pi K_{VCDL} + \frac{2\pi K_{VCO}}{sN}\right]$$

$$= \frac{I_{cp}}{sC_1}\left[K_{VCDL} + \frac{K_{VCO}}{sN}\right] = \frac{I_{cp} K_{VCO}}{s^2 C_1 N}\left[1 + s \cdot \frac{N K_{VCDL}}{K_{VCO}}\right]$$

$\omega_{p1} = \omega_{p2} = 0,$ $\quad \omega_z = K_{VCO} / N K_{VCDL}$

$$\left(\phi_{ref} - 2\pi K_{VCDL} V_c - \frac{\phi_{out}}{N}\right)$$

$$\frac{I_{cp}}{2\pi} \frac{1}{sC_1} = V_c$$

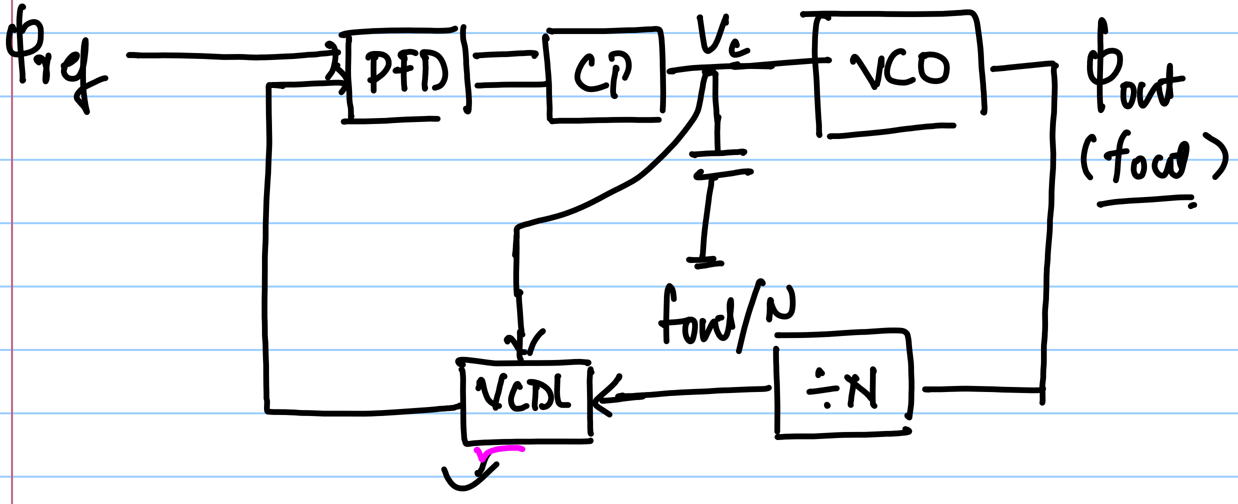
$$\phi_{out} = \frac{2\pi K_{VCO}}{s} \cdot V_c$$

$$\phi_{ref} - \frac{\phi_{out}}{N} - 2\pi K_{VCDL} V_c = \frac{2\pi s C_1}{I_{cp}} V_c$$

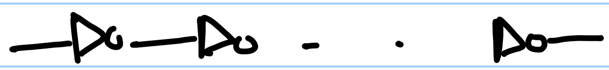
$$\phi_{ref} = \phi_{out}\left(\frac{1}{N} + \left(2\pi K_{VCDL} + \frac{2\pi s C_1}{I_{cp}}\right)\frac{s}{2\pi K_{VCO}}\right)$$

$$= \phi_{out}\left(\frac{1}{N} + \frac{sK_{VCDL}}{K_{VCO}} + \frac{s^2 C_1}{I_{cp} K_{VCO}}\right)$$

$$\frac{\phi_{out}}{\phi_{ref}} = \frac{1}{\frac{1}{N} + \frac{sK_{VCDL}}{K_{VCO}} + \frac{s^2 C_1}{I_{cp}} \times \frac{1}{K_{VCO}}}$$



f_{out}	N	f_{ref}
5 GHz	4	1.25 GHz
2.5 GHz	2	1.25 GHz
2.5 GHz	4	0.625 GHz

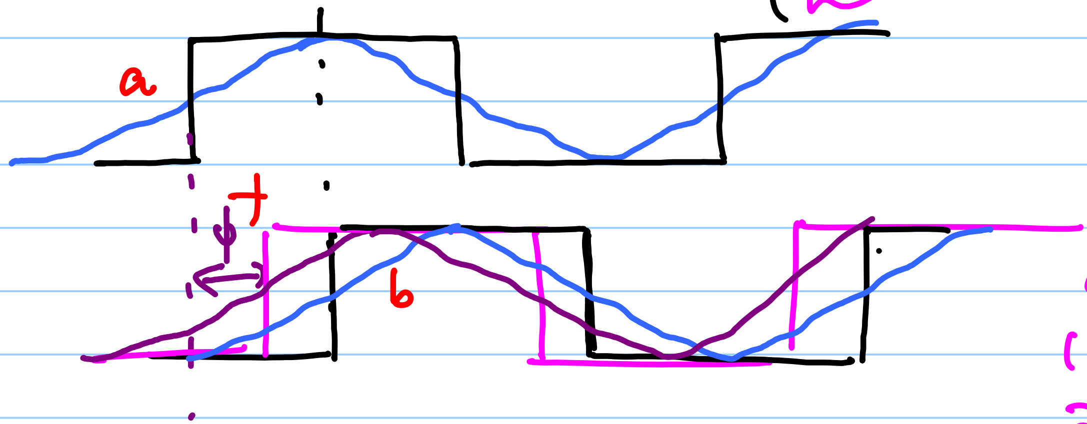


$$V_{out} = A\cos(\omega_0 t \pm \phi)$$

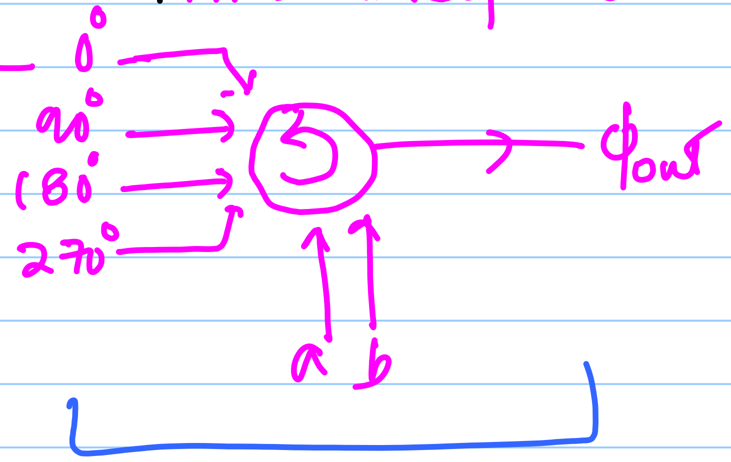
$$V'_{out} = a \cdot \underbrace{A\cos(\omega_0 t)}_{I} + b \cdot \underbrace{A\sin(\omega_0 t)}_{Q}$$

$$= A\sqrt{a^2+b^2}\left(\frac{a}{\sqrt{a^2+b^2}}\cos(\omega_0 t) + \frac{b}{\sqrt{a^2+b^2}}\sin(\omega_0 t)\right)$$

$$= A\sqrt{a^2+b^2}\,\sin(\omega_0 t + \phi) \qquad \phi = \tan^{-1}\left(\frac{a}{b}\right)$$



Phase Interpolator (PI)



$$\left(\frac{2\pi K_{VCO}}{s} + 2\pi K_{VCDL}\right)\frac{1}{N}$$