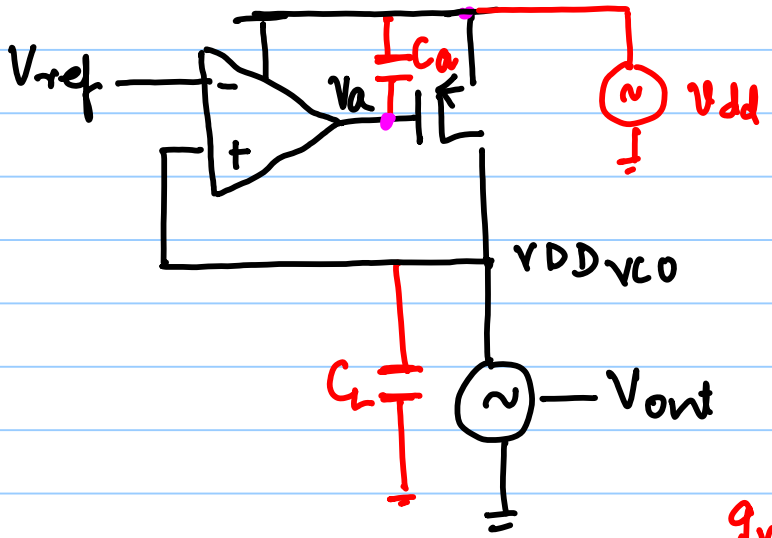
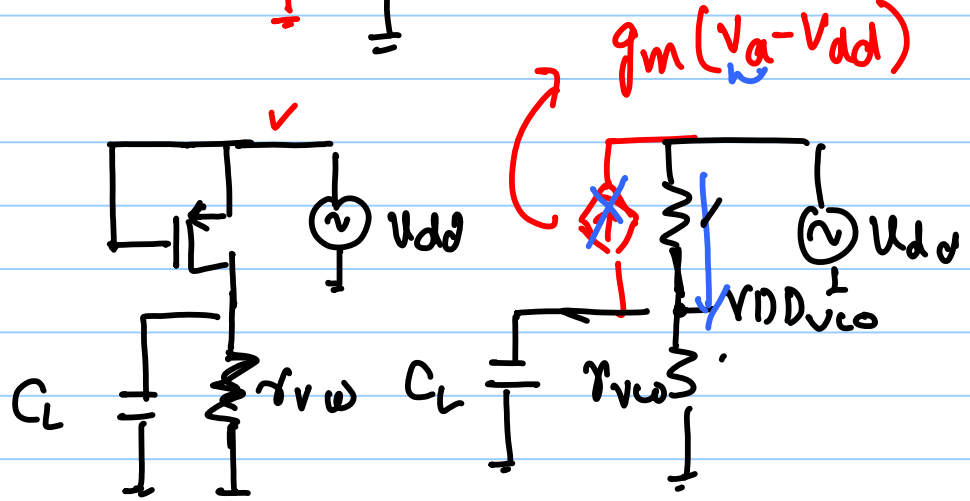
Lecture #33

Note Title 12-11-2020



$$\frac{VDD_{vco}}{v_{dd}} = \frac{S_{vdd}\,(1+s/\omega_a)}{\left(1+\frac{s}{\omega_a}\right)\left(1+\frac{s}{\omega_L}\right)+A_aA_0}$$

$$\frac{VDD_{vco}}{V_{ref}} = \frac{kh}{1+kh} = \frac{A_aA_0}{\left(1+\frac{s}{\omega_a}\right)\left(1+\frac{s}{\omega_L}\right)+A_aA_0}$$

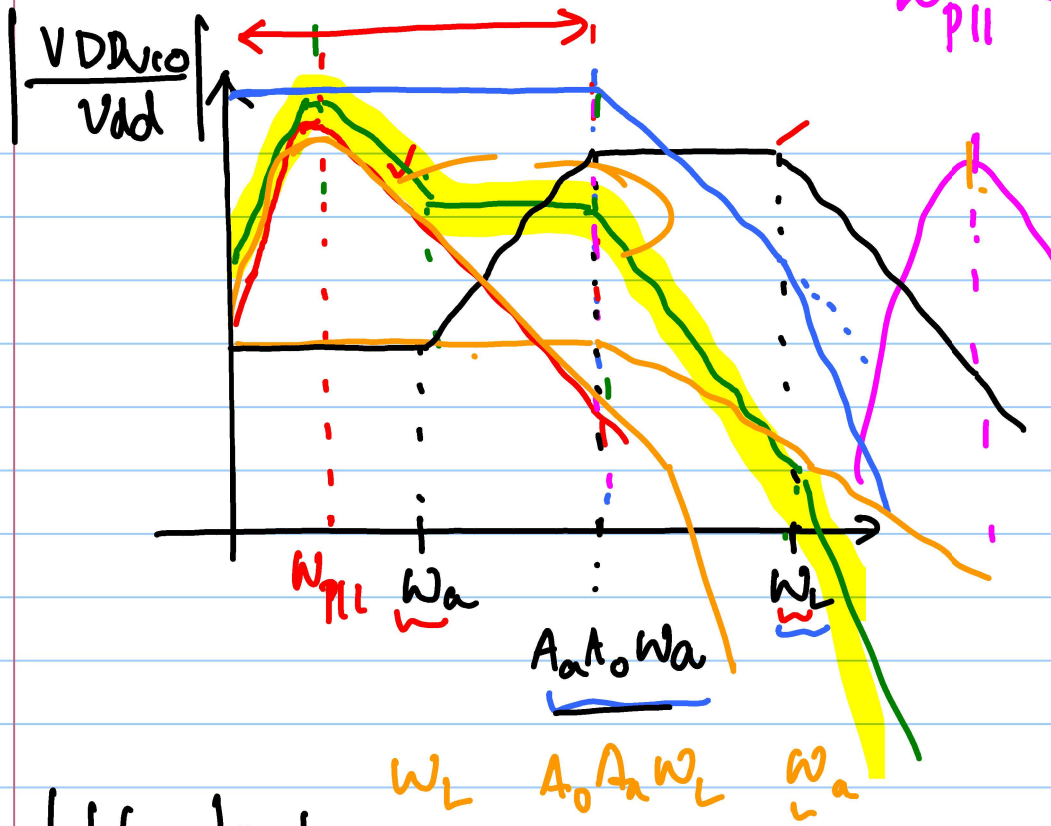


$$\frac{VDD_{vco}}{V_{dd}} = \frac{r_{vco}}{r_{vco}+r_{ds}}\cdot\frac{1}{1+sR_LC_L}$$

$$\frac{\left(r_{vco}\,\|\,\frac{1}{sC_L}\right)}{\left(r_{vco}\,\|\,\frac{1}{sC_L}\right)+r_{ds}} = \frac{r_{vco}/(1+sC_Lr_{vo})}{r_{ds}+\frac{r_{vco}}{1+sC_Lr_{vo}}}$$

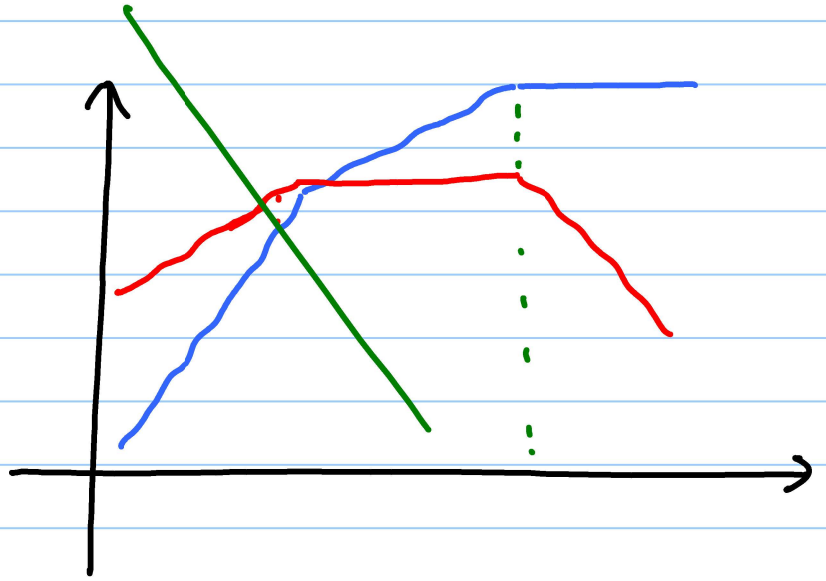
$$= \frac{r_{vco}}{r_{ds}+r_{vco}+sC_Lr_{vo}r_{ds}}$$

$\omega_{PLL} < \omega_{reg}$; $\omega_{PLL} = 4\text{-}5\,\omega_{reg}$



$$LG_{PLL} = \frac{I_{cp}}{2\pi} \frac{(1+sRC_1)}{\left(1+sRC_1\frac{C_2}{C_1+C_2}\right)} \frac{1}{s(C_1+C_2)} \frac{2\pi K_{vco}}{s\cdot N} \times \left(\frac{VDD_{vco}}{V_{ref}}\right)$$

$$\frac{\phi_{out}}{V_{dd}} = \frac{VDD_{vco}}{V_{dd}} \times \frac{2\pi K_{vco}/s}{1+LG_{PLL}}$$

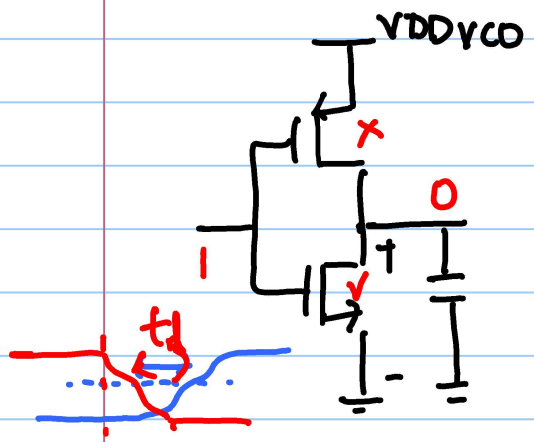


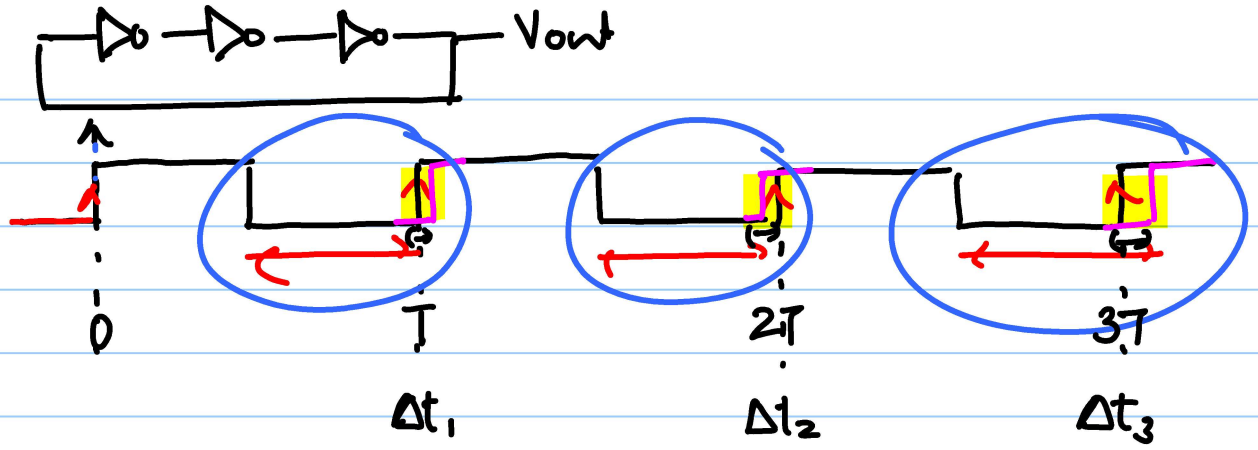
$|LG_{PLL}| = 1$

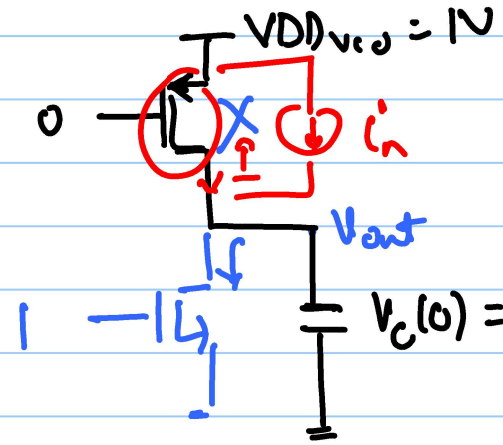
$$\frac{I_{cp}\,\omega_n R C_1\, K_{vco}}{N\,\omega_n^2\,(C_1+C_2)} \simeq 1$$

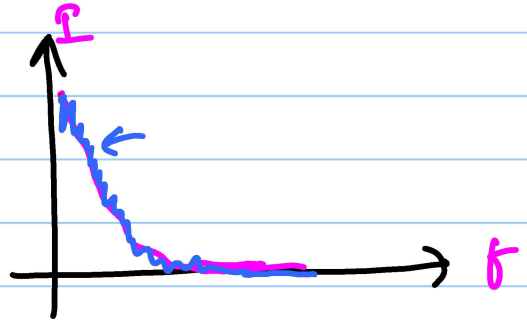
$$\Rightarrow \omega_n = \frac{I_{cp} R K_{vco}}{N} \frac{C_1}{C_1+C_2}$$

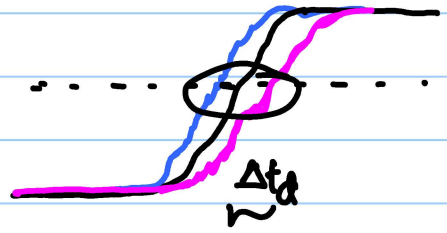
Phase Noise.











$$\langle i_n \rangle = 0$$

$$S_{in,N} = 4kT\gamma_N g_m$$

$$= \frac{8kT}{3}\frac{2I_{DNsat}}{V_{DD}-V_{tN}} \checkmark$$

$$= 8kT\gamma_N \frac{P_{DNsat}}{V_{DD}-V_{tn}}$$

$$I_{DNsat} = \frac{1}{2}\mu_n C_{ox}\left(\frac{W}{L}\right)(V_{DD}-V_{tN})^2 \checkmark$$

$$\frac{dV_{out}}{dt} = \frac{I_N}{C} = \frac{I_{DNsat} + i_n}{C}$$

$$\int_0^{t_{dN}} \frac{I_{DNSat} + i_N}{C} \cdot dt = \Delta V_{out}$$ ✓

$$\langle t_{dN} \rangle = \frac{C V_{DD}}{2 I_{DNSat}}$$

$$\sigma_{t_{dn}}^2 = \frac{1}{I_{DNSat}^2} \left\langle \left(\int_0^{t_{dN}} i_n \cdot dt \right)^2 \right\rangle$$

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