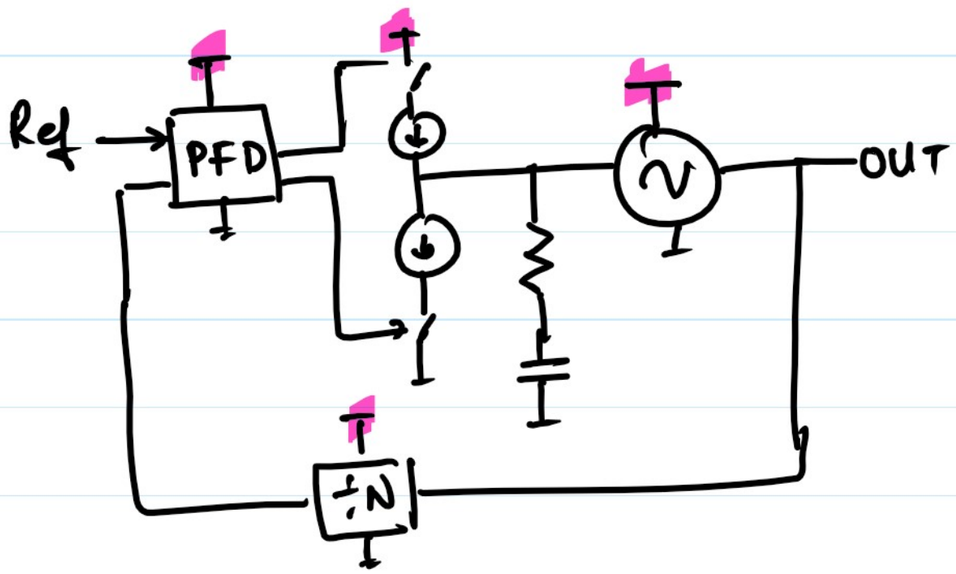
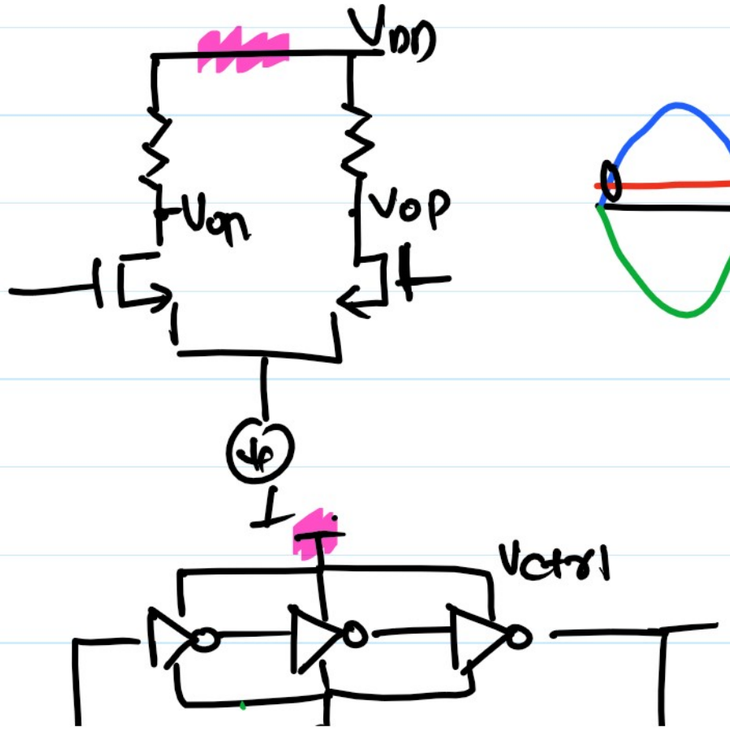
Lecture 28

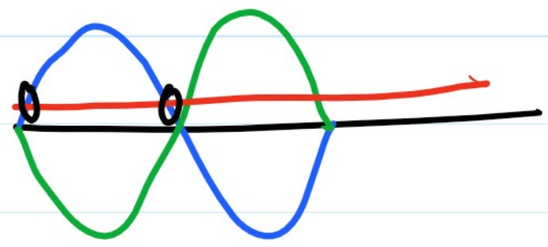
Thursday, March 16, 2017 10:58 AM

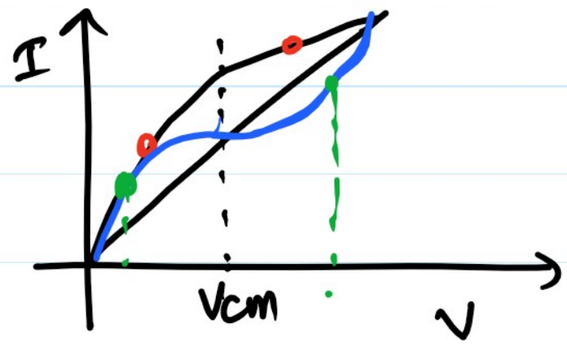
Power Supply Rejection in PLL



Power Supply Noise Rejection, PSNR [dB] = $20\log_{10}\left(\frac{\Delta T/T}{\Delta V_{dd}}\right)$

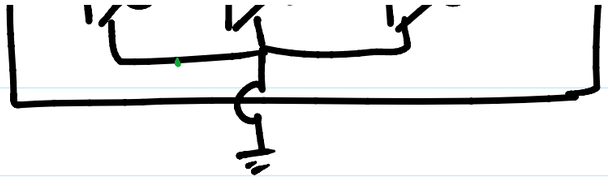






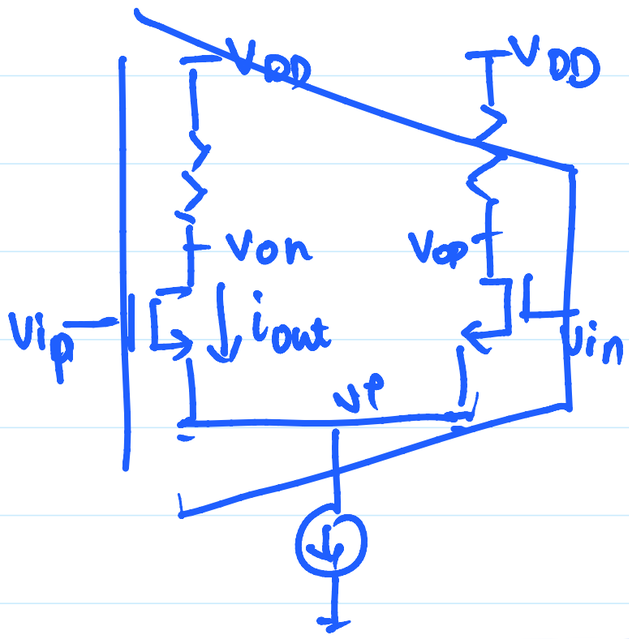
$f_{out} = K_{VCO} \cdot V_{ctrl}$

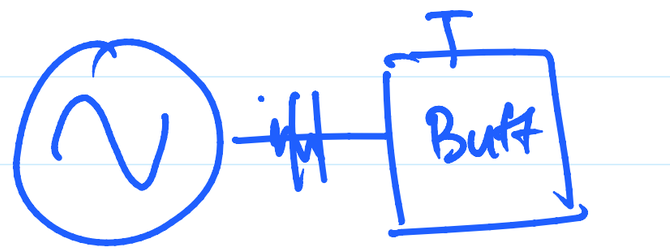
$f_{out}(t) = K_{VCO} V_{dd} + K_{VCO} V_{ctrl}$



$$f_{out}(t) = K_{VCO} V_{dd} t + K_{VCO} v_{dd}$$

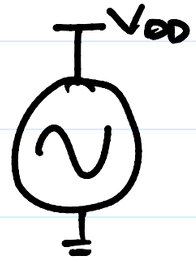
$$\Phi_{out}(t) = 2\pi \int f_{out} \cdot dt$$

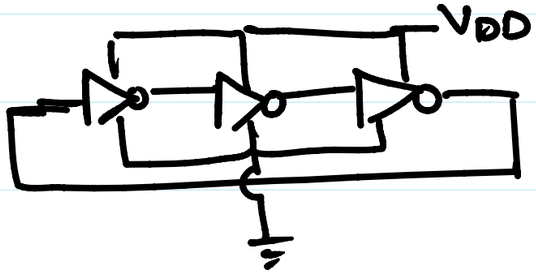


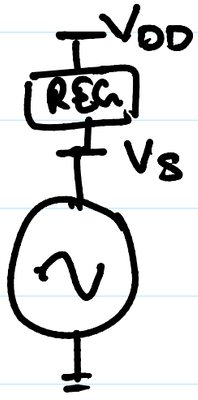


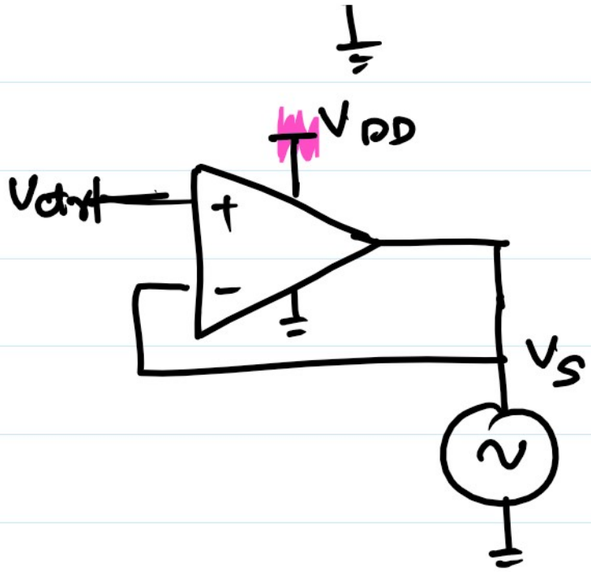
Pseudo diff.

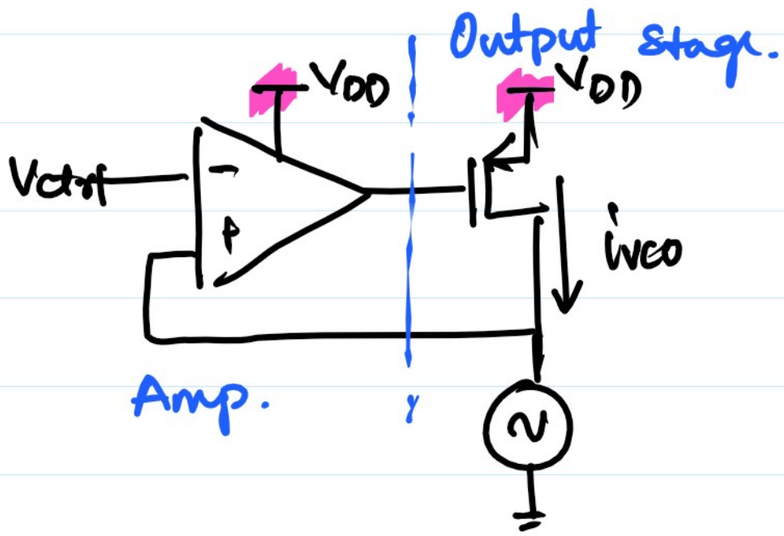
Supply regulation in ring oscillators







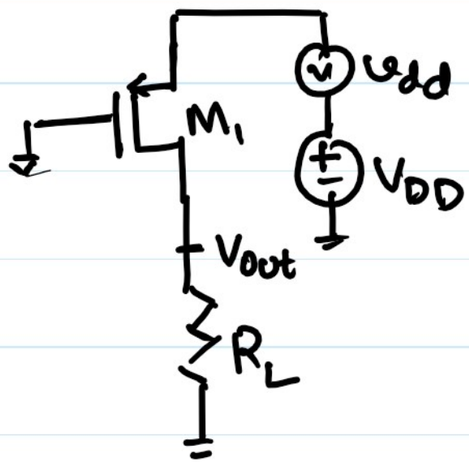




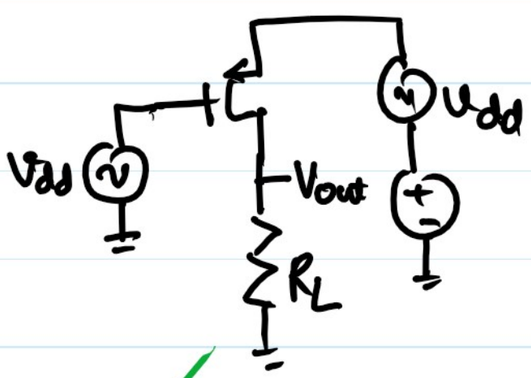
Output Stage.

1.) PMOS o/p

2) NMOS o/p



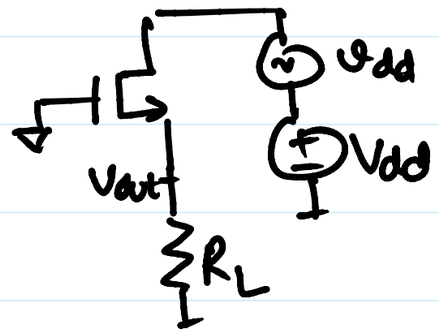
$$\frac{V_{out}(s)}{v_{dd}(s)} = g_{m1}\left(r_{ds1} \,||\, R_L\right)$$

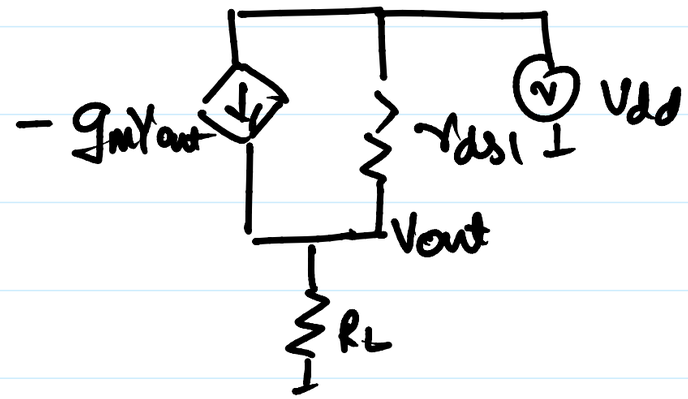


$$\frac{V_{out}(s)}{V_{dd}(s)} = \frac{R_L}{R_L + r_{ds1}}$$

$\frac{}{v_{dd}(s)}$

Ideal $r_{ds} \to \infty \Rightarrow$ lower $V_{out} \Rightarrow$ lower f_{out}

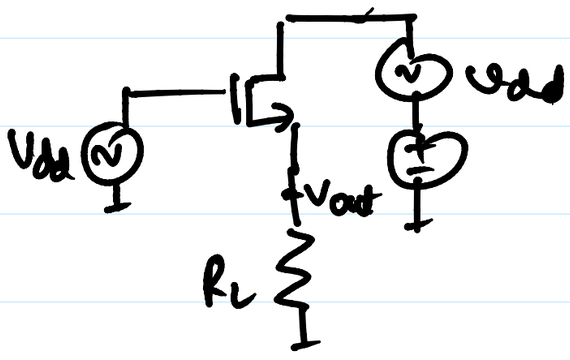




$$\frac{V_{out}(s)}{v_{dd}(s)} \cong \frac{1}{g_m r_{ds1}}$$

$$-g_m v_{out} + \frac{v_{dd} - V_{out}}{r_{ds1}} = \frac{V_{out}}{R_L}$$

$$V_{out}\left(\frac{1}{r_{ds1}} + \frac{1}{R_L} + g_m\right) = \frac{V_{dd}}{r_{ds1}}$$



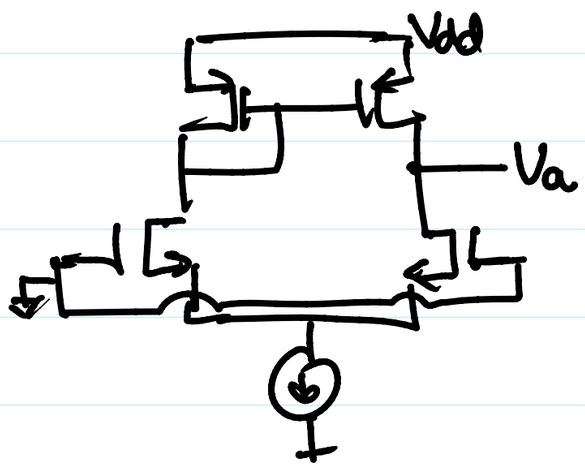
$g_m(V_{dd} - V_{out})$

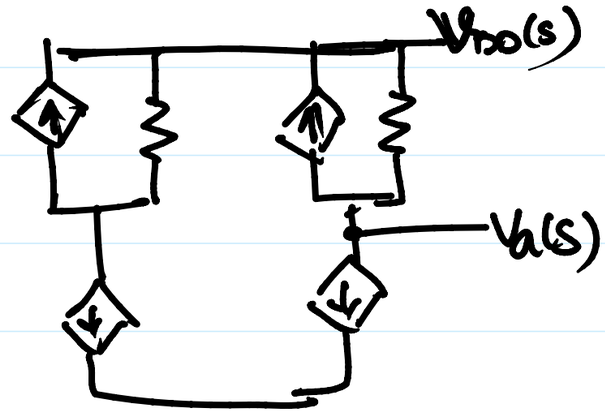
$\frac{V_{out}(s)}{}$ ≈ 1

$$\frac{V_{out}(s)}{V_{dd}(s)} \approx 1$$

Amplifier stage.

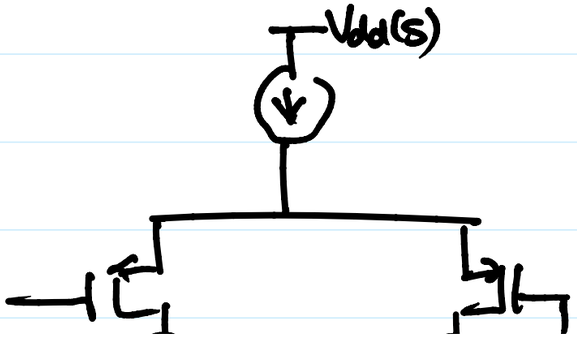
NMOS i/p stage



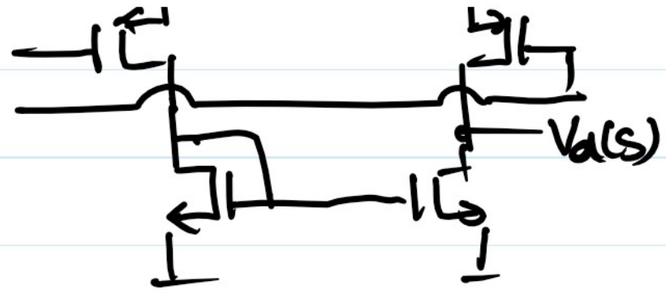


$$\frac{V_a(s)}{V_{dd}(s)} = 1$$

PMOS i/p stage



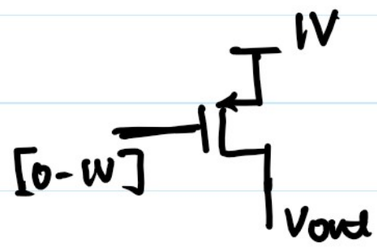
$$\frac{V_a(s)}{} = 0$$

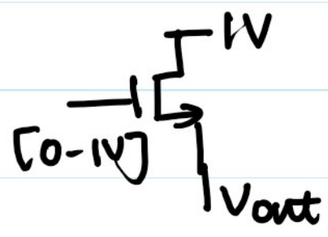


$$\frac{V_a(s)}{V_{dd}(s)} = 0$$

Amp. stage + o/p stage

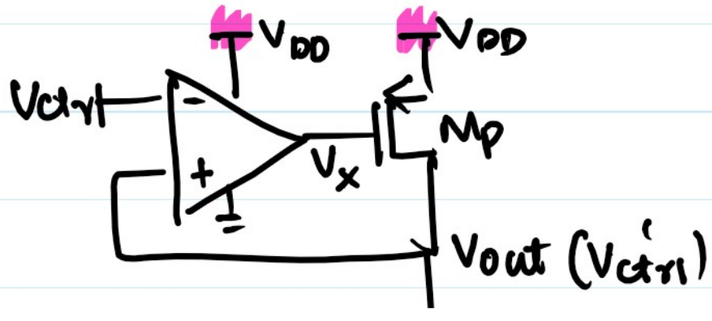
1) NMOS i/p amp. + PMOS o/p stage ✓
2) NMOS i/p amp + NMOS o/p stage
3) PMOS i/p amp + PMOS o/p stage
4) PMOS i/p amp + NMOS o/p stage. ✓

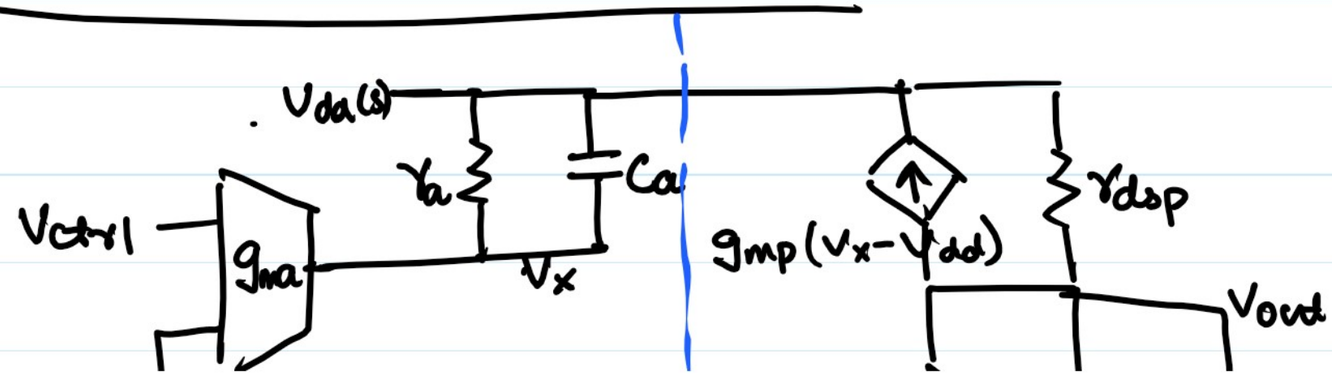


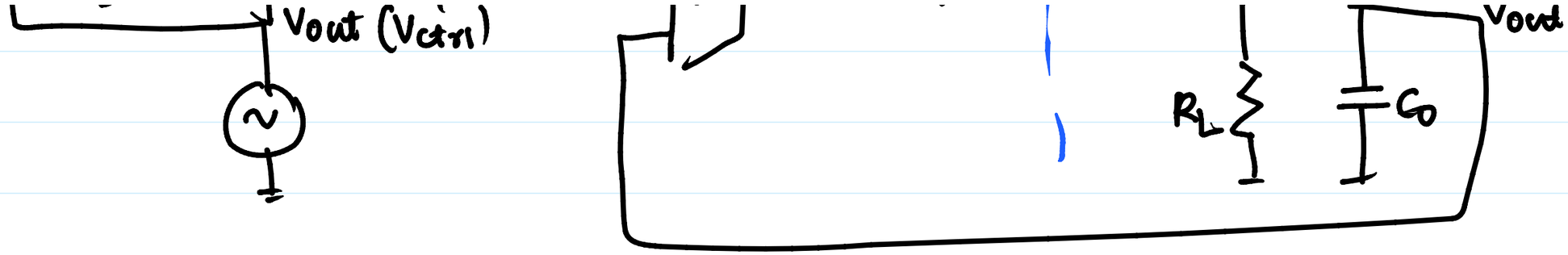


$V_{out,max} = V_{DD} - V_{OV}$

$V_a - (V_{DD} - V_{OV}) - V_T = V_{OV}$





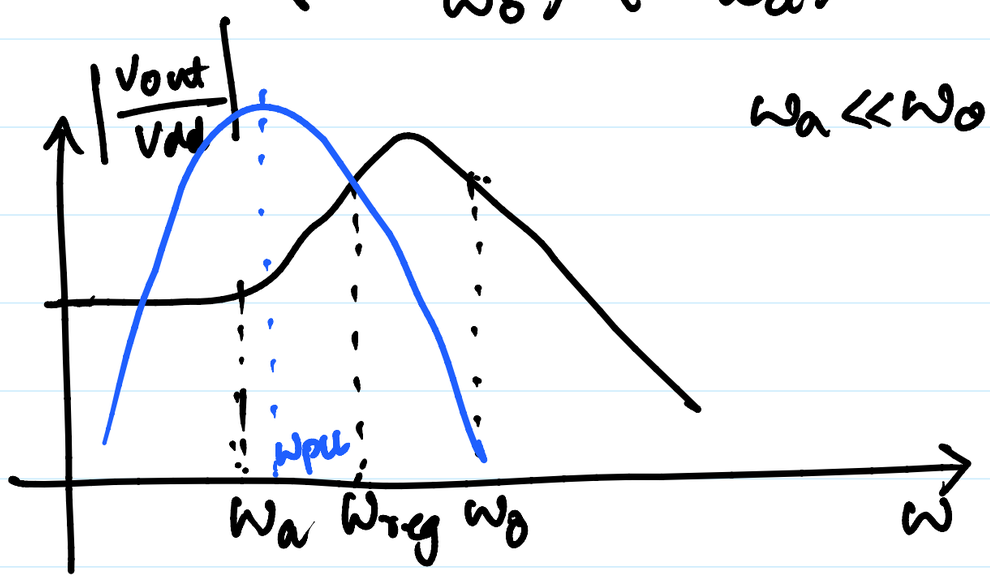


$$\frac{V_{out}(s)}{V_{dd}(s)} = \frac{S_{vdd}}{\left(1+\frac{s}{\omega_0}\right)\left(1+LG_{reg}\right)} = \frac{S_{vdd}\left(1+s/\omega_a\right)}{\left(1+\frac{s}{\omega_a}\right)\left(1+\frac{s}{\omega_0}\right)+A_0A_a}$$

$$S_{vdd} = \frac{R_L}{R_L+r_{dsp}} \quad , \quad \omega_0 = \frac{1}{(r_{dsp}\|R_L)\,C_0}$$

$$LG_{reg} = \frac{A_aA_0}{\left(1+\frac{s}{\omega_0}\right)\left(1+\frac{s}{\omega_a}\right)} \quad ; \quad A_a = g_{ma}r_a \,, \quad A_0 = g_{mp}(r_{dsp}\|R_b)$$

$$\omega_a = \frac{1}{r_aC_c}$$



$\omega_a \ll \omega_0$

$$\frac{S_{vdd}}{1+LG_{OL}}$$

$$\frac{\Phi_{out}}{V_{ctrl}(s)} = \frac{K_{VCO}}{s}\,\frac{1}{1+LG_{PLL}}$$