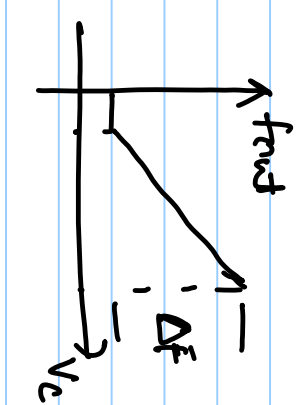
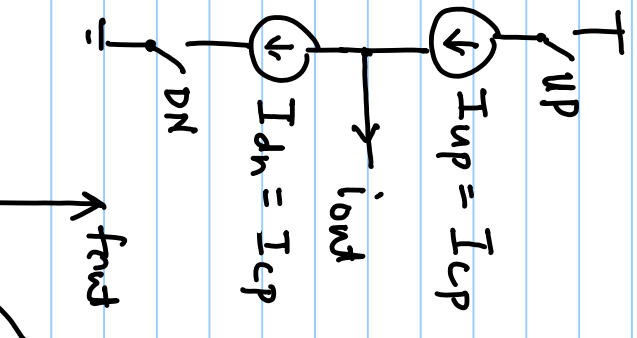
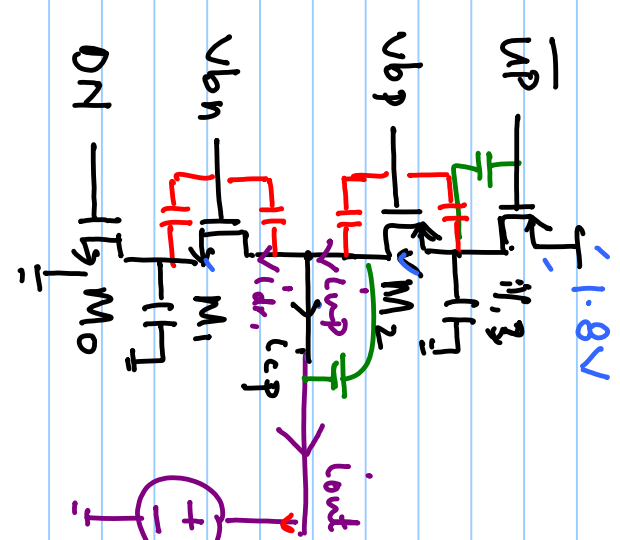


Lecture # 33

Charge-pump.

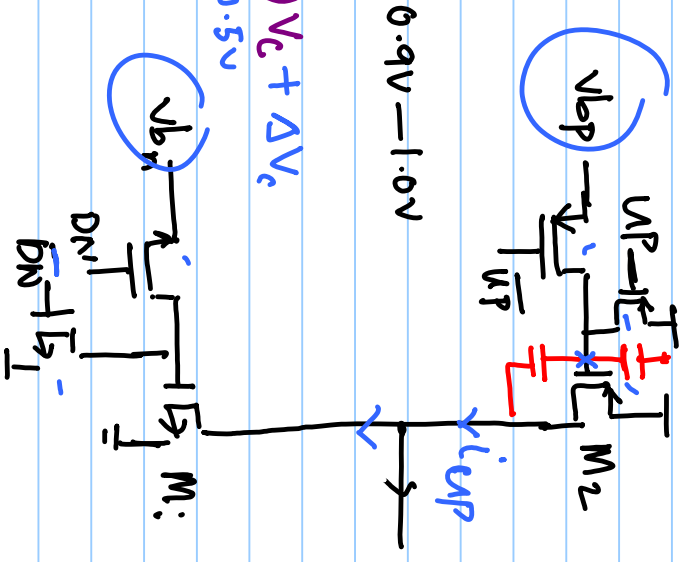


Source-switched CP



M_0, M_3 : switches
 M_1, M_2 : current source

Gate-switched CP

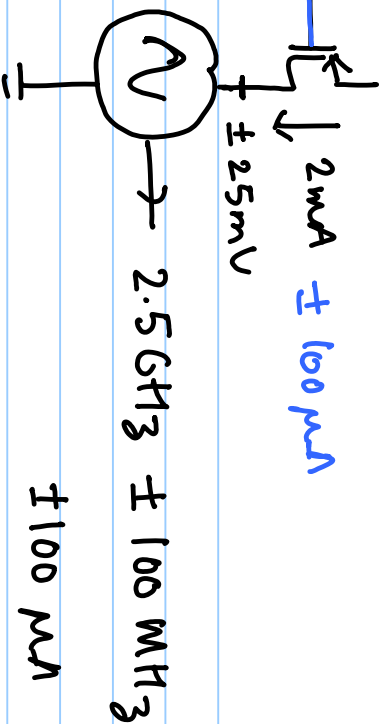
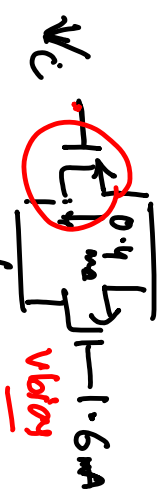


M_1, M_2 : current source

- Voltage-headroom for current source / loop filter (ΔV_{th})

$\Delta f = f_{100 \text{ MHz}}$

$\Delta V_{bp} \rightarrow 2 \text{ mA} \pm 100 \mu\text{A}$



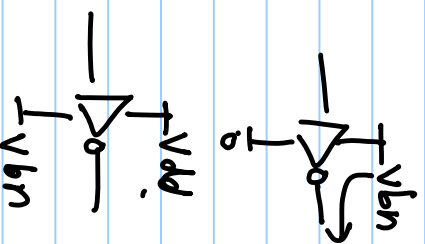
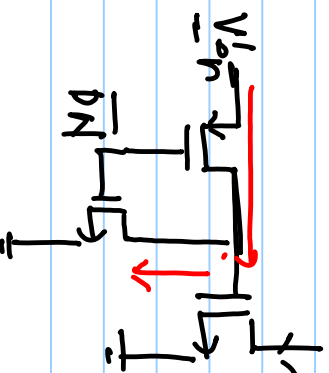
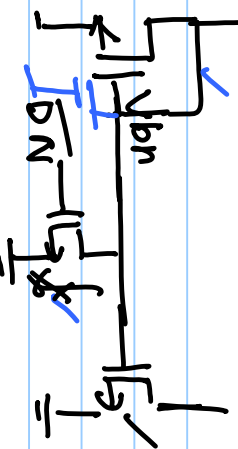
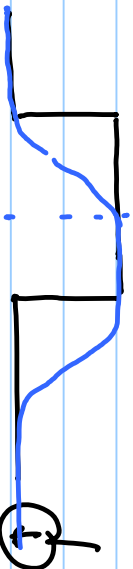
$g_m \Delta V_{bp} = 100 \mu\text{A}$

$K_{VCO} = \frac{\Delta f_{out}}{\Delta V_{bp}}$

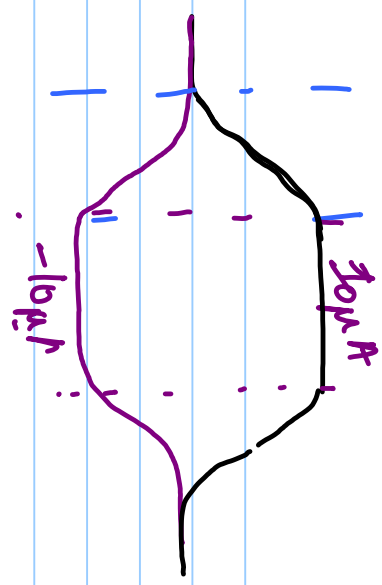
Large $g_m \rightarrow$ small ΔV_{bp} .

$K_{VCO} \rightarrow \frac{1}{5}$
 Large Δf

— Response time of charge-pump



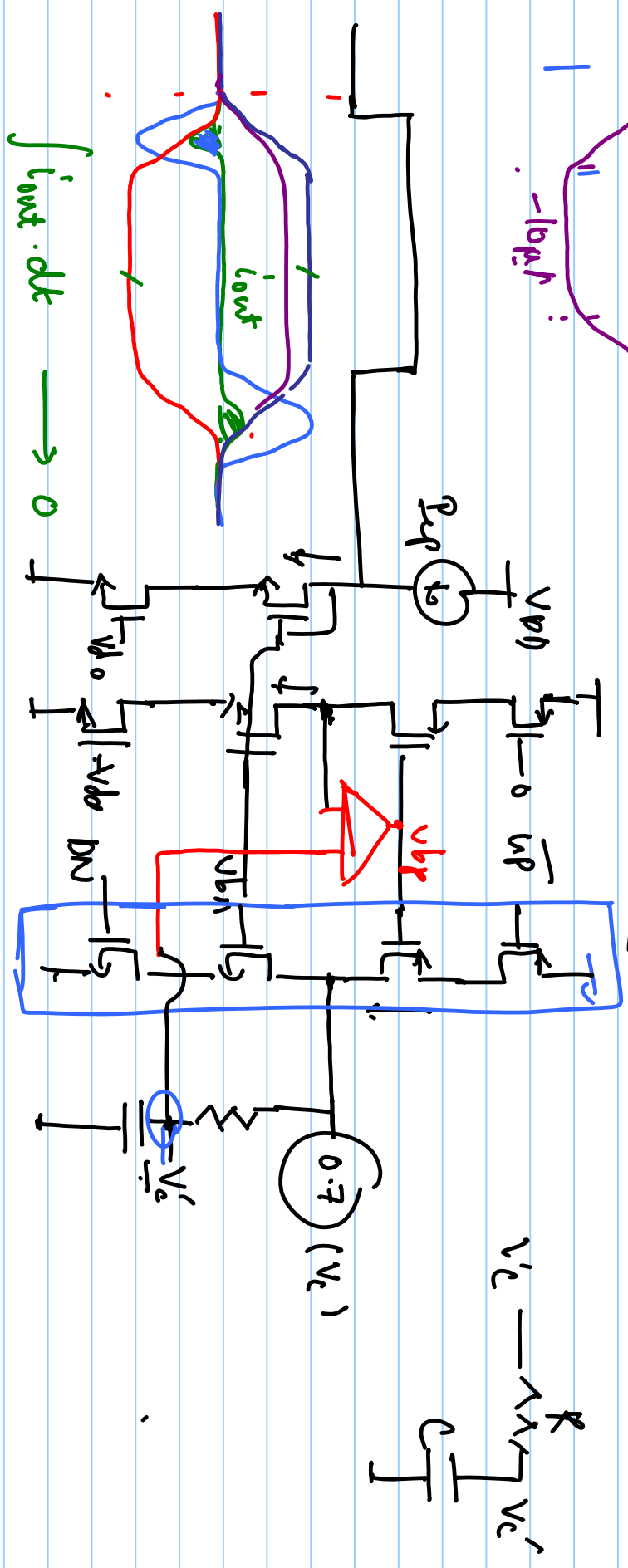
i_{out}



$f_0 = 2.56 \text{ GHz}$, $V_c = 0.9 \text{ V}$ ✓

$\pm 500 \text{ MHz}$, $V_c = 0.7 - 1.0 \text{ V}$ ✓

$\int i_{out} \cdot dt = 0$



$\int i_{out} \cdot dt \rightarrow 0$

— clock-feed through.

