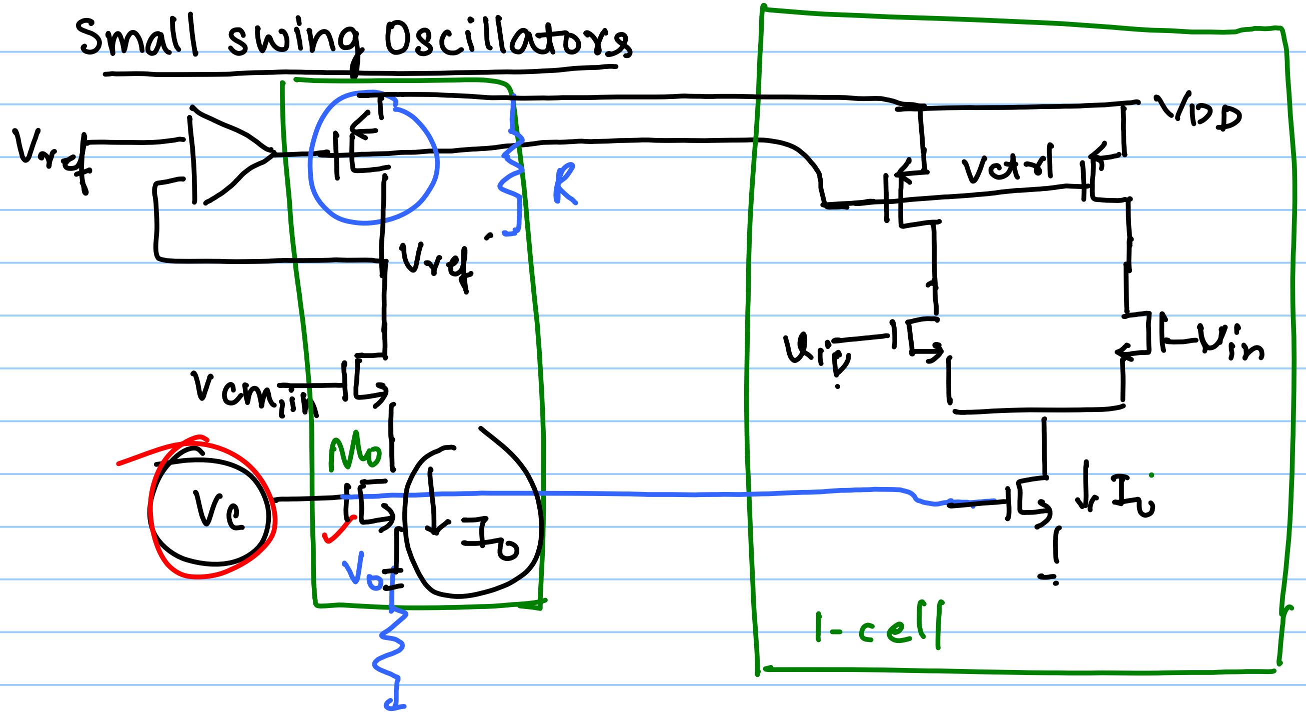
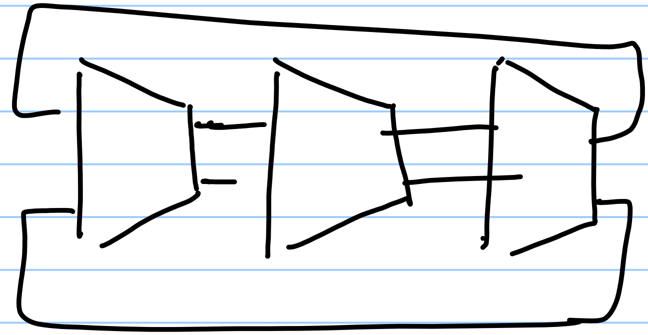
Lecture # 22

Note Title 19-09-2018

Small swing Oscillators





$f_{osc} = \frac{\sqrt{3}}{RC} = \frac{\sqrt{3}}{C} \cdot \frac{\frac{KW}{L}(V_{DD} - \ldots)}{1}$

$R = \frac{V_{DD} - V_{ref}}{I_0}$, $V_{out,max} : I_0 \cdot R = V_{DD} - V_{ref}$

V_c / R_{rail}

$\omega_{osc} = \frac{\sqrt{3}}{RC}$, $f_{osc} = \frac{1}{2\pi} \frac{\sqrt{3}}{RC} = \frac{\sqrt{3}}{2\pi C} \frac{I_0}{V_{DD} - V_{ref}}$ ✓

$I_0 = g_m V_c$ ✓

$\Rightarrow f_{osc} \propto V_c$

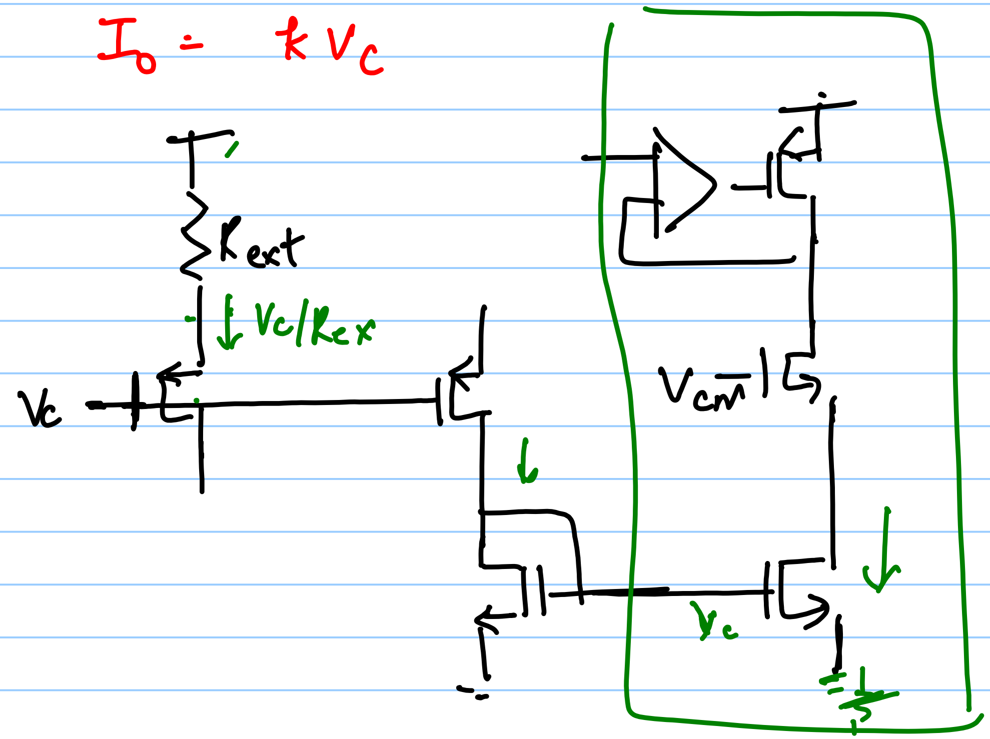
Case 1. f : fixed, vary amp.

Case 2: f : vary, fixed amp.

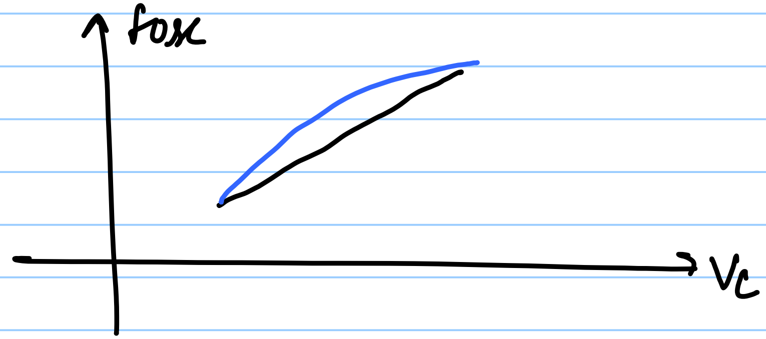
1. Amplitude
2. Frequency

} Tunability.

$I_0 = k V_c$



linearity in freq. tunability

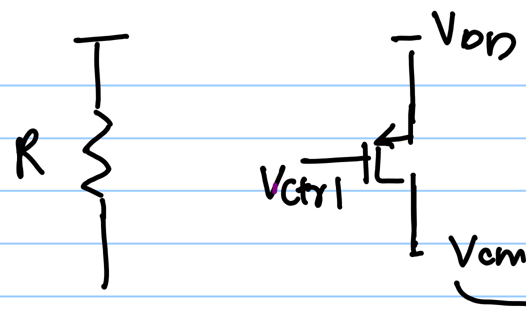


$f_{osc} = f(V_c)$

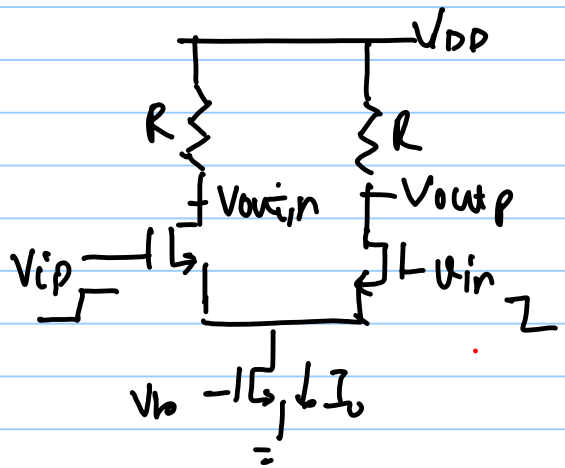
$f_{osc} = k_0 V_c + k_1 V_c^2 + \dots$

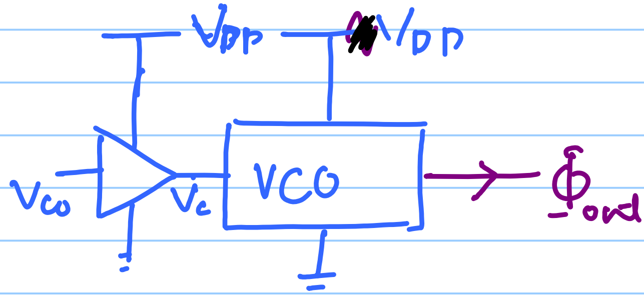
$= g_m V_c$

$= /$



$V_{cm,out}$ / $V_{DD} - I_0 R$





PSRR: Power Supply Rejection Ratio.

$V_{out,p} = \Delta V + V_{DD} - \left(\frac{I}{2} - \Delta I\right) R_{Right}$

$V_{out,n} = \Delta V + V_{DD} - \left(\frac{I}{2} + \Delta I\right) R_{Left}$

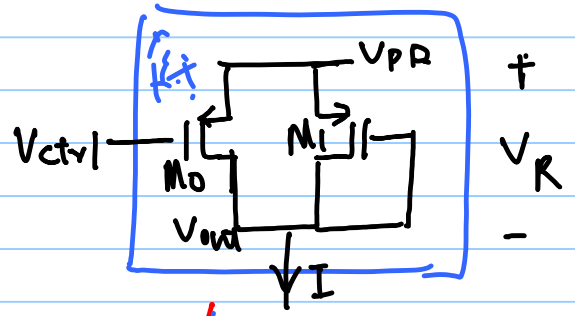
$V_{out,p} - V_{out,n}$

$= \frac{I}{2} \left(R_{left} - R_{right}\right)$

$+ \Delta I \left(R_{right} - R_{left}\right)$ ✓

$$V_{out} = \left(\frac{I}{2} - \Delta I\right)\left(R_{left} - R_{right}\right)$$

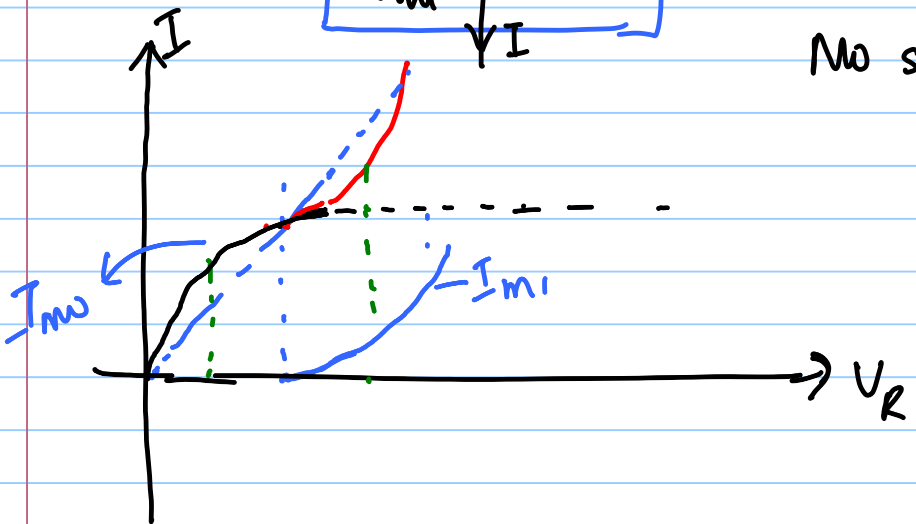
$$= \left(\frac{I}{2} - \Delta I\right)\left[R\left(V_{DD} + \Delta V, V_{out,n}\right) - R\left(V_{DD} + \Delta V, V_{out,p}\right)\right]$$



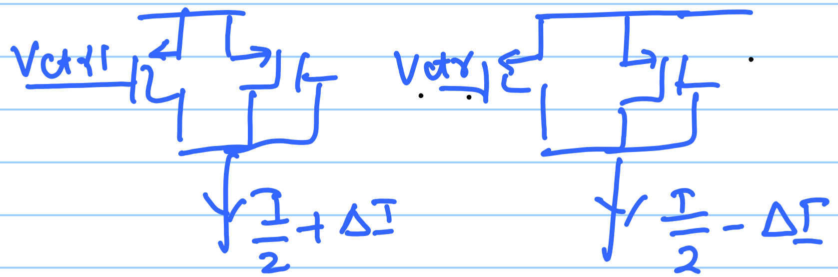
$V_R = 0$, $V_{out} = V_{DD}$: M0 – ON, M1 : off

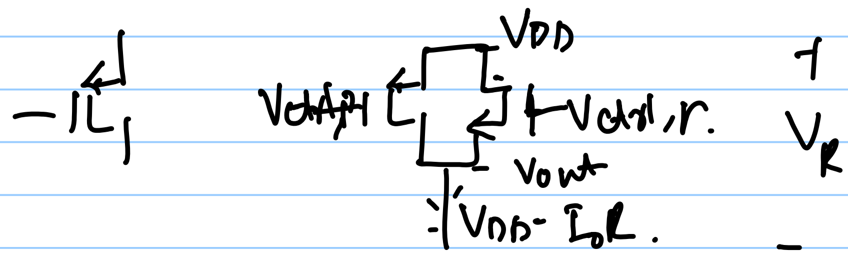
$V_R \geq |V_{TP}|$, $V_{out} = V_{DD} - |V_{TP}|$: M1: saturation.

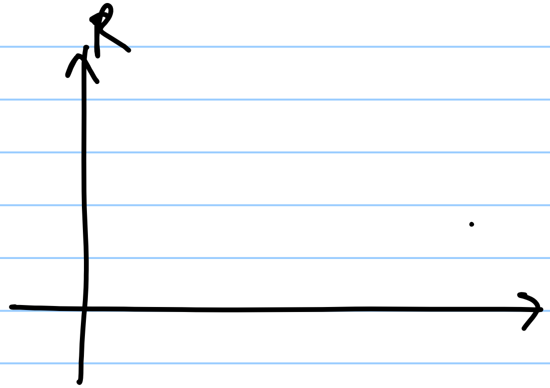
M0 sat: $V_R \geq (V_{DD} - V_{ctrl} - |V_{TP}|)$



$$I_{M1} = \frac{KW}{2L}\left(V_R - |V_{TP}|\right)^2$$







$$R_{pmos} = \frac{1}{\frac{kW}{L}\left(V_{DD} - V_{ctrl,p} - |V_{TP}| - \frac{V_R}{2}\right)}$$

$$R_{nmos} = \frac{1}{\frac{kW}{L}\left(V_{ctrl,n} - V_{Tn} - \frac{V_R}{2}\right)}$$