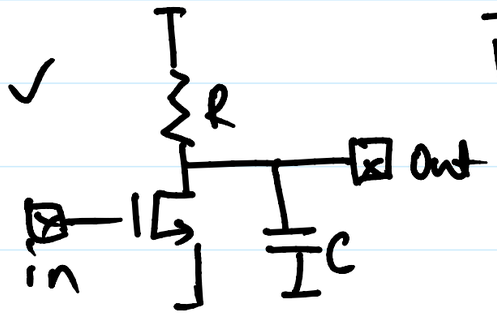
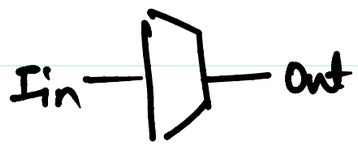
Lecture 24

Thursday, February 23, 2017 10:54 AM

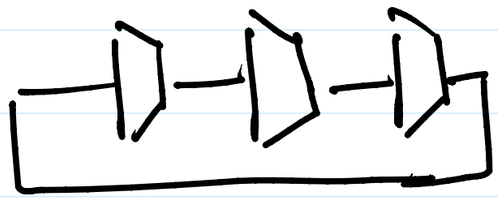
Oscillators

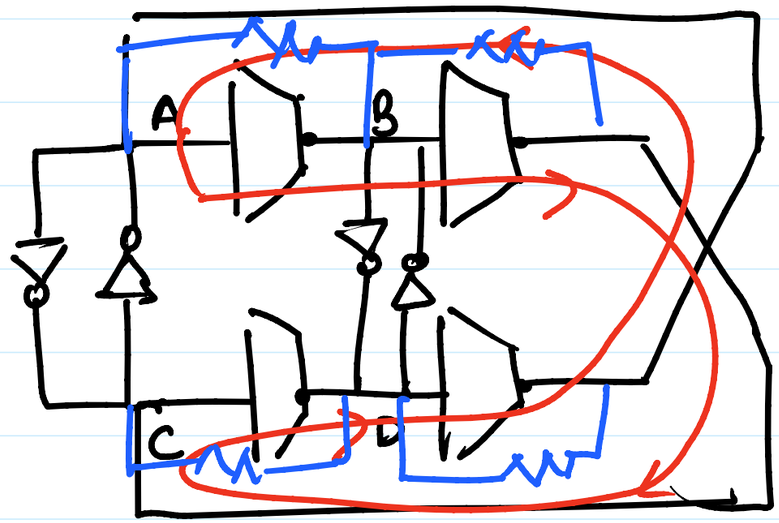




$A = \overline{C}$, $B = \overline{D}$

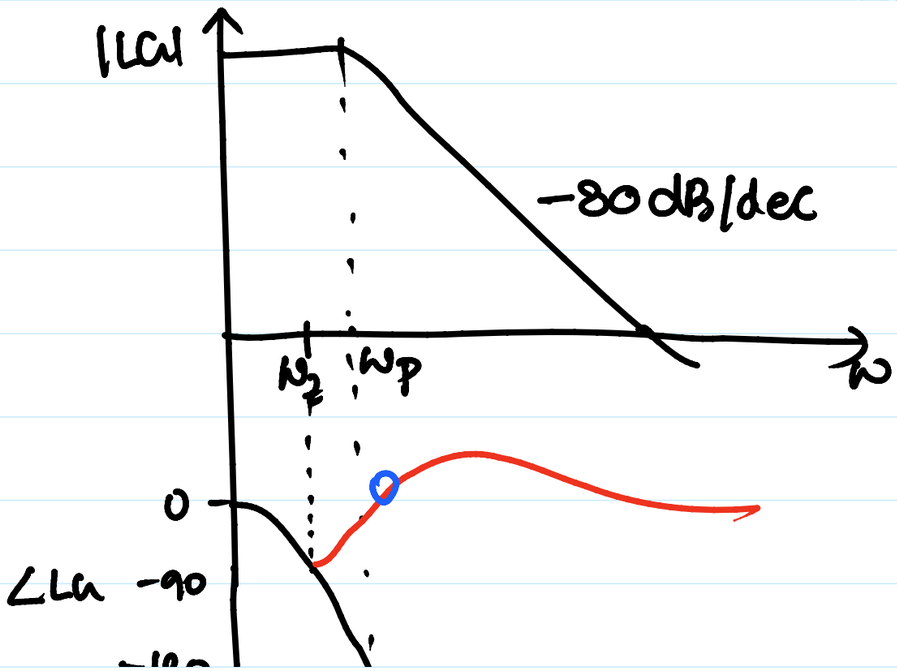
$$\frac{-A_0}{1+s/\omega_p}$$

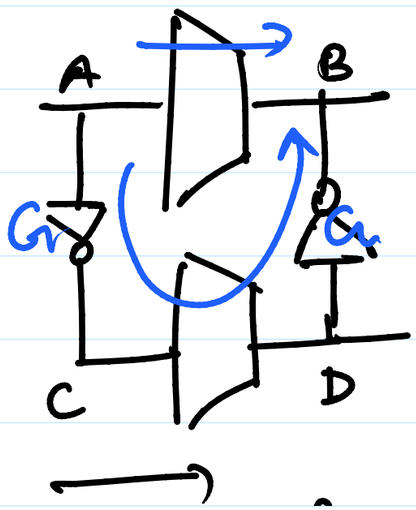




w/ cross-coupled inverters

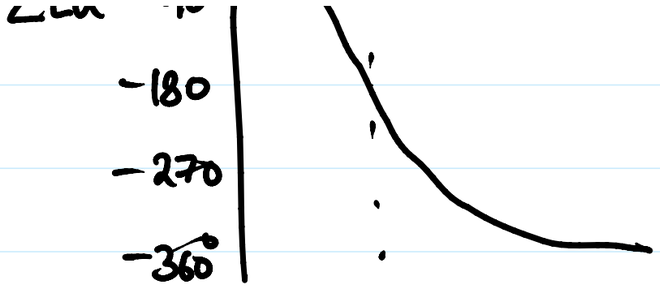
- Enforce $A = \overline{C}$, $B = \overline{D}$
-

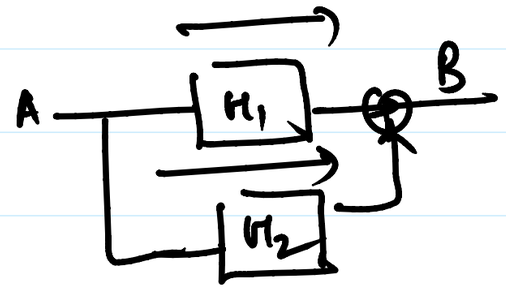


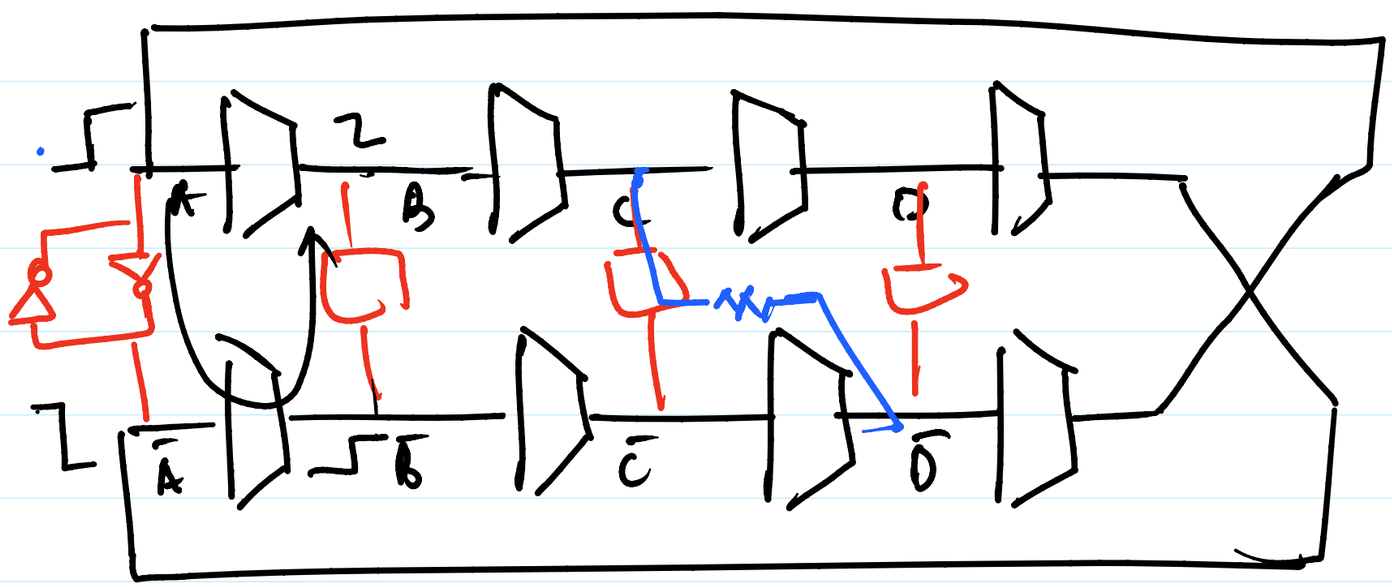


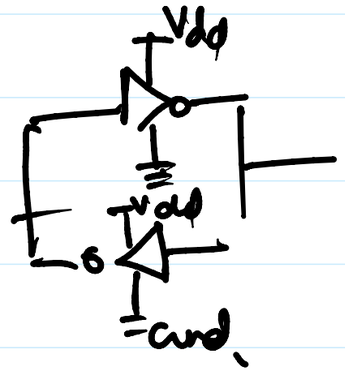
$$\frac{V_B}{V_A} = \frac{-A_0}{1+s/\omega_p} \quad \text{(old)}$$

$$\frac{V_B}{V_A} = \frac{-A_0'}{(1+s/\omega_p)} (1+s/\omega_z)$$









Drawbacks of cross-coupled inverter

— frequency of oscillation reduces.

— Power consumption increases.

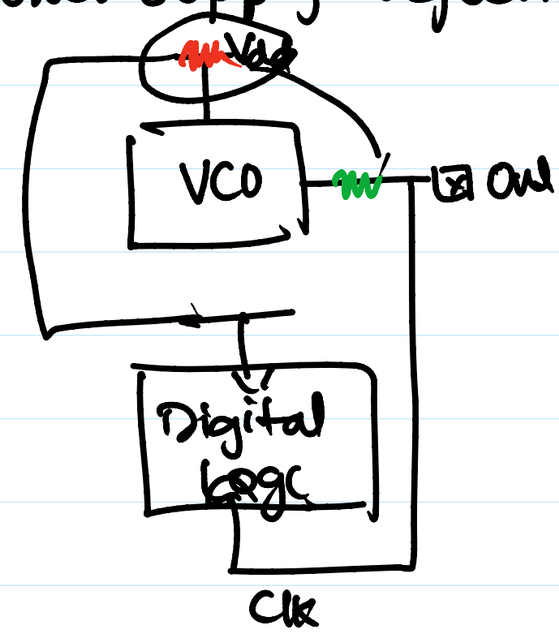
Oscillators Parameter / Performance metrics

1. Amplitude
2. Frequency
   - Tuning Range
   - Tuning Linearity

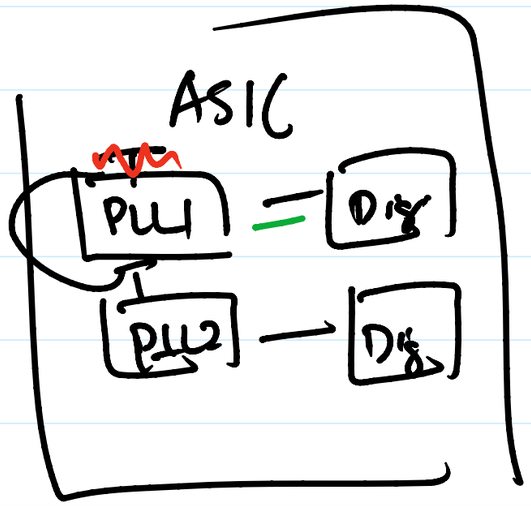
} Ideally. large tuning range
Linear Kvco

- Tuning Linearity] Linear Kvco

3. Power supply rejection ratio (PSRR)



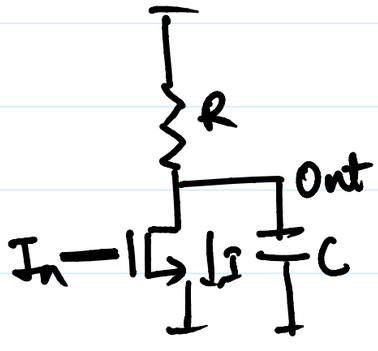
(Jitter)



Designer's Choice

4) Power } lowest power

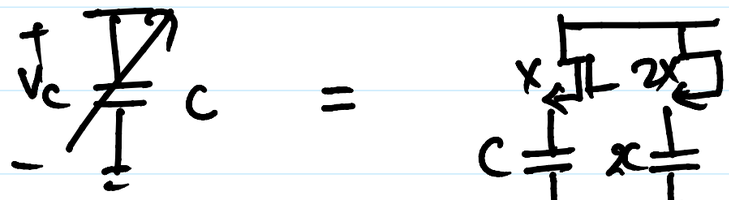
5) Phase noise } Low phase noise



$\omega_p = \frac{1}{RC}$

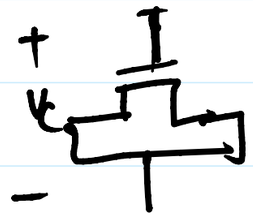
R ±20%, C ±20% ⟹ ω_{osc} variation

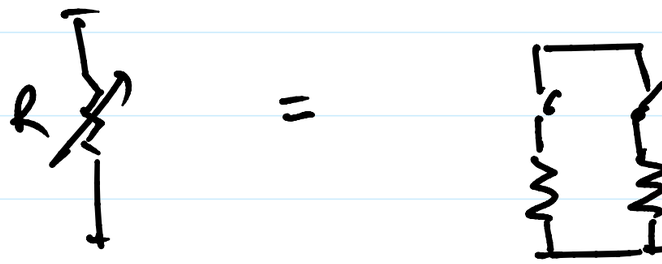
Want to vary oscillation frequency — Vary R & C



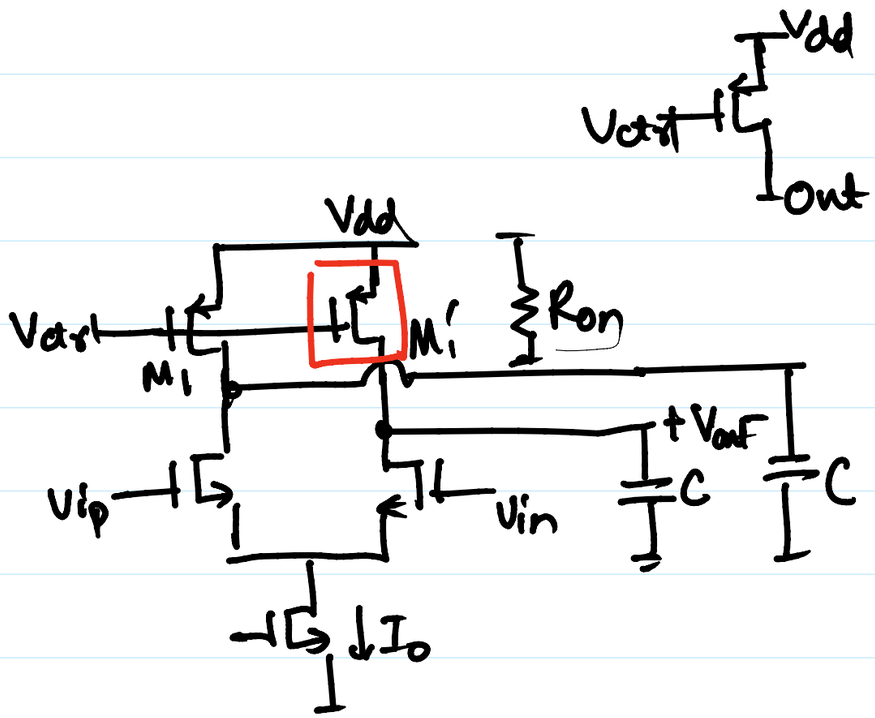
capacitor bank.

Use MOS capacitance & vary V_{gs}





Resistor bank



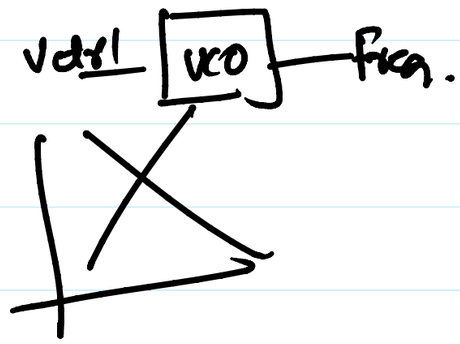
* M_1, M_1' are in linear region of saturation

$$I = \frac{kW}{L}\left((V_{DD} - |V_{tn}| - V_{ctrl})V_{SD} - \frac{V_{SD}^2}{2}\right)$$

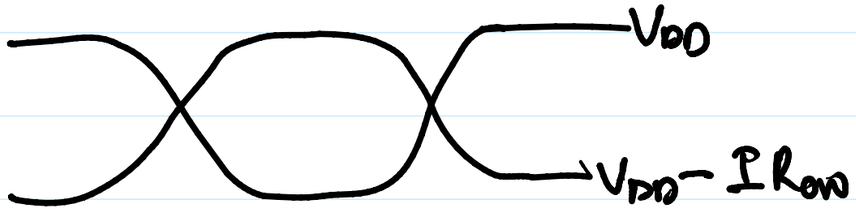
$$R_{ON} \approx \frac{1}{\frac{kW}{L}\left[V_{DD} - |V_{tn}| - V_{ctrl}\right]}$$

$f_{osc} \propto \frac{1}{} = \frac{kW}{} \left[V_{DD} - |V_{tn}| - V_{ctrl}\right]$

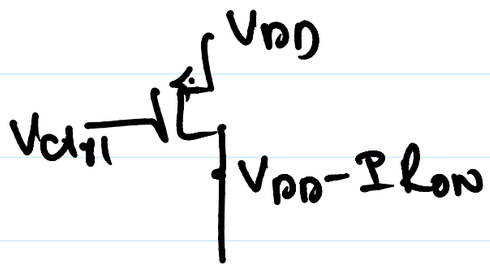
$$f_{osc} \propto \frac{1}{R_{ON}C} = \frac{\frac{KW}{L}\left[V_{DD} - |V_{Th}| - V_{ctrl}\right]}{C}$$



$f_{osc} \propto V_{ctrl}$



$$\text{Amplitude} = I R_{ON} = \frac{I}{\frac{KW}{L}\left[V_{DD} - |V_{Th}| - V_{ctrl}\right]}$$



$$V_{DD} - V_{ctrl} - |V_{Th}| > I R_{ON}$$