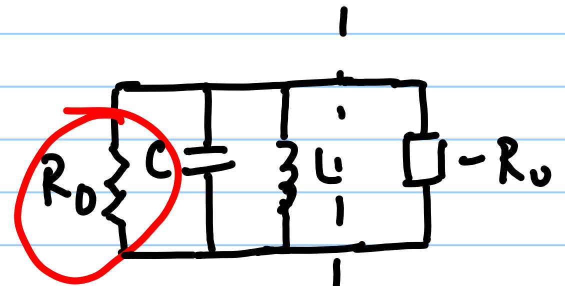
Note Title 28-09-2017

Lecture #30

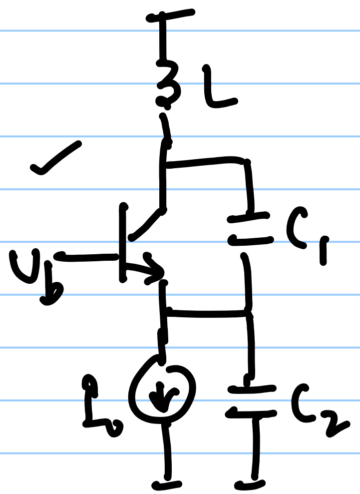
Oscillator

1. Crystal oscillator
2. Tuned LC oscillator



$\omega_0 = \frac{1}{\sqrt{LC}}$

- L, C
- loss
- Compensate loss



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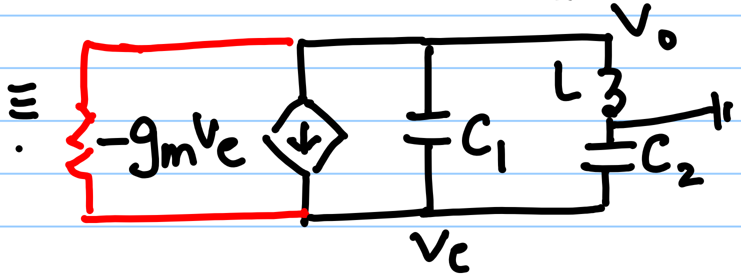
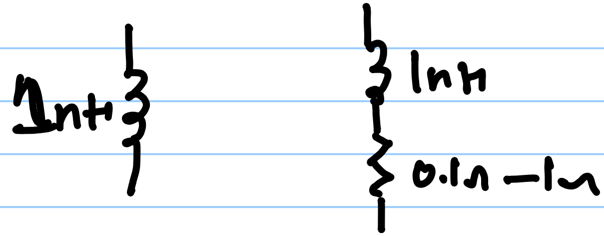
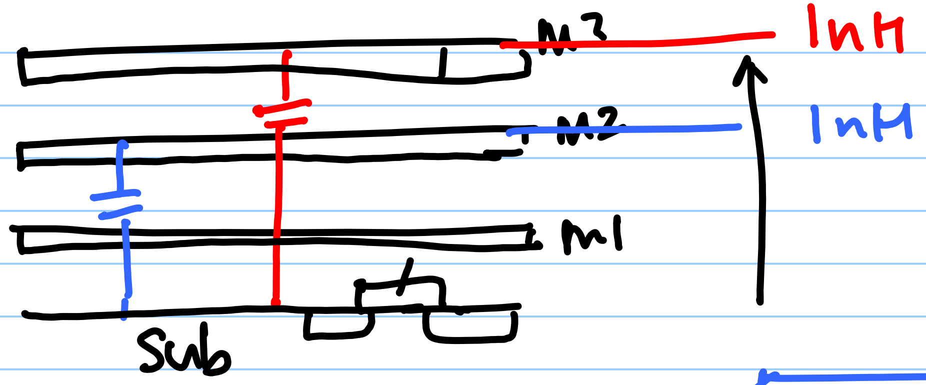


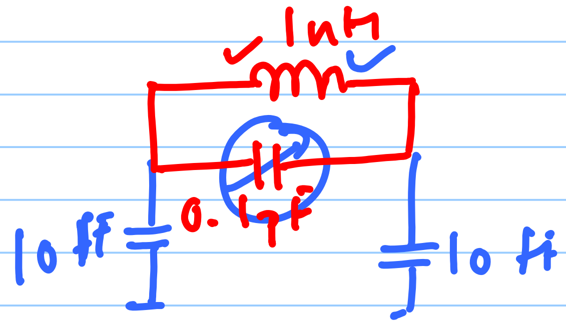
$\omega_0 = \frac{1}{\sqrt{L\, C_1C_2/C_1+C_2}}$

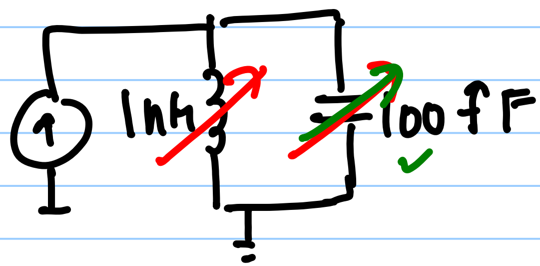
- Frequency is moderately stable
- Integrated on chip but with large area.



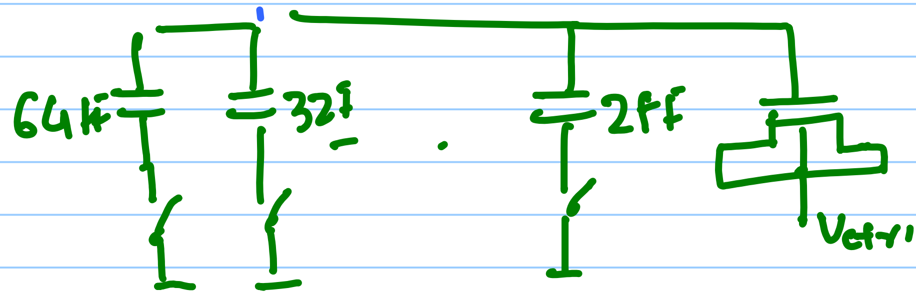
- Phase noise is good
- Tuning range is limited



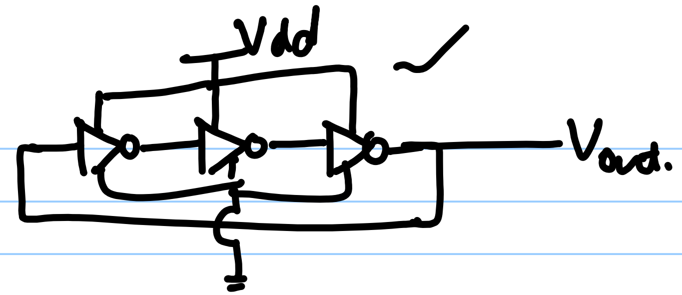




$$\omega_0 = \frac{1}{\sqrt{LC}}$$

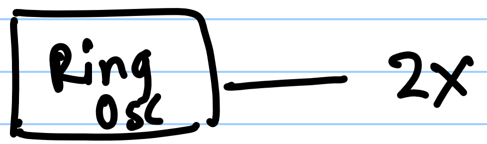


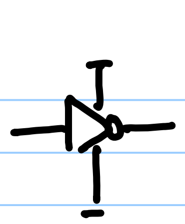
3. Ring Oscillators

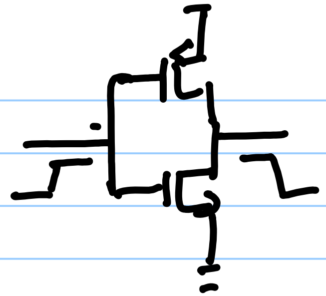


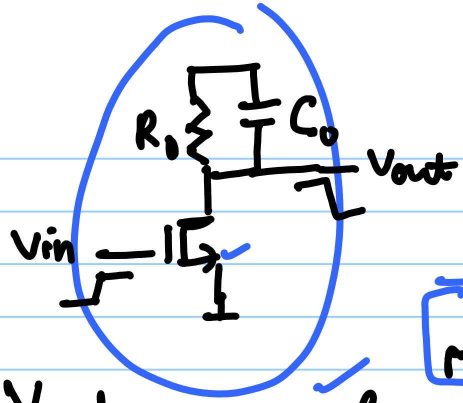
- Large tuning range
- Small area
- Phase noise is more
- Frequency stability is bad

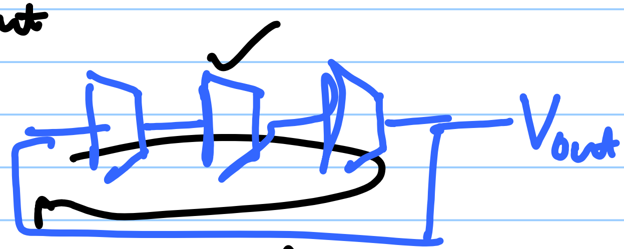
$f_{osc} = \frac{1}{6 t_d}$

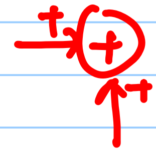






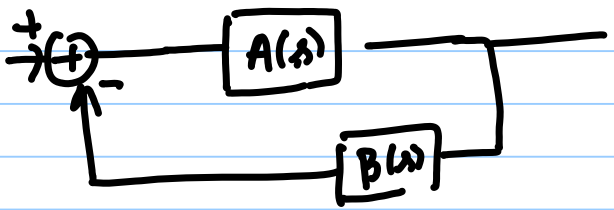






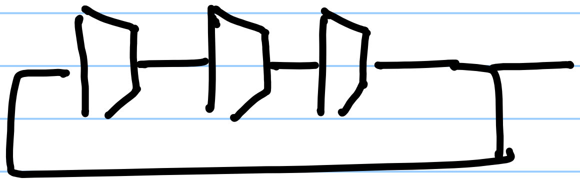
$$\frac{V_{out}}{V_{in}} = \frac{-g_m R_0}{(1+sR_0C_0)} = \frac{-A_0}{(1+s/\omega_p)}$$

Barkhausen Criterion

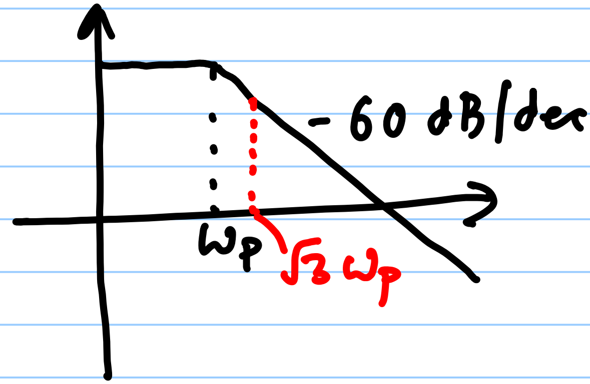


$$|LG(j\omega_{osc})| = 1$$

$$\angle LG(j\omega_{osc}) = 180^\circ$$



$$LG(s) = \frac{-A_0^3}{(1+s/\omega_p)^3}$$



$$\angle LG(j\omega_{osc}) = 360^\circ/0 = 180^\circ - 3\tan^{-1}\left(\frac{\omega_{osc}}{\omega_p}\right)$$

$$\tan^{-1}\left(\frac{\omega_{osc}}{\omega_p}\right) = +60^\circ$$

$$\omega_{osc} = \omega_p \tan(60^\circ) = \sqrt{3}\,\omega_p$$