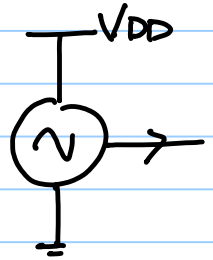
Lecture # 19

Note Title 11-09-2018

Oscillator

VCO : Voltage Controlled Oscillator
CCO : Current " "

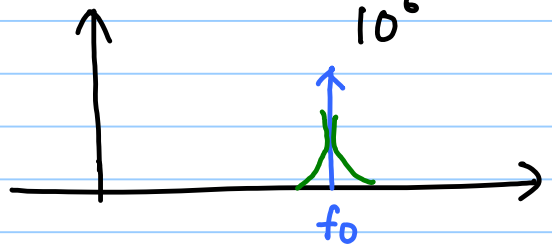


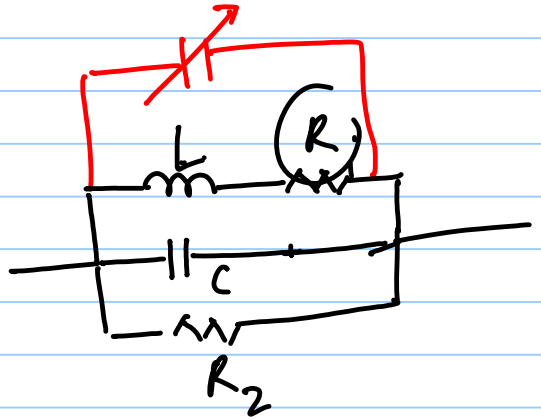
Periodic event

Crystal Oscillators (f_0)

- Frequency stable (10 – 100 ppm)
- Excellent phase noise
- low frequency
- low tunability.
- Large form-factor.

$f_0 \pm \frac{10}{10^6} f_0$

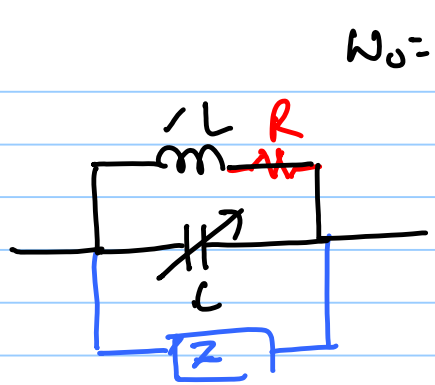




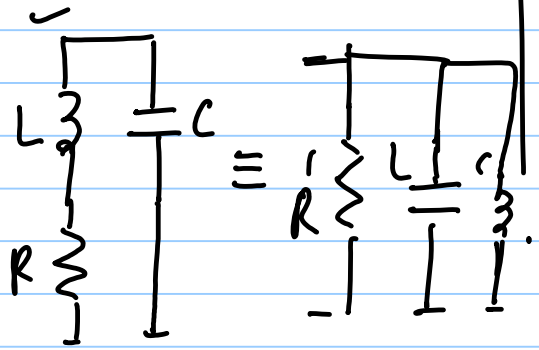
Tuned Oscillators

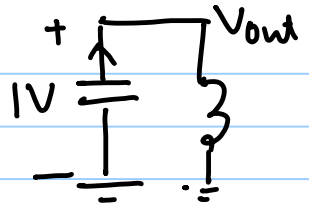
- L, C (Ideal no freq. limitation)
- Frequency stability moderate.
- Phase noise is good.
- large size
-

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



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





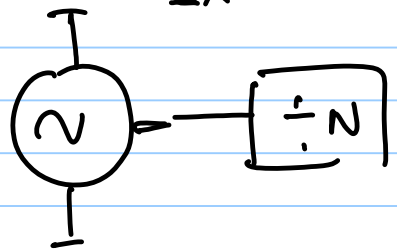
at $t=0$, $V_{out} = 1V$

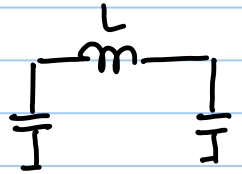
$$-C\frac{dV}{dt} = I_L$$

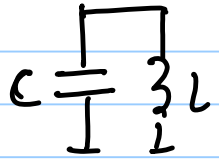
$$V = L\frac{dI_L}{dt}$$

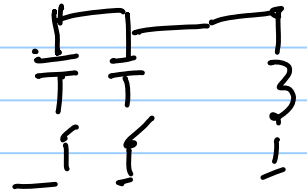
$5\,GHz \xrightarrow{f_0 \rightarrow 2f_0} 10\,GHz$

2X









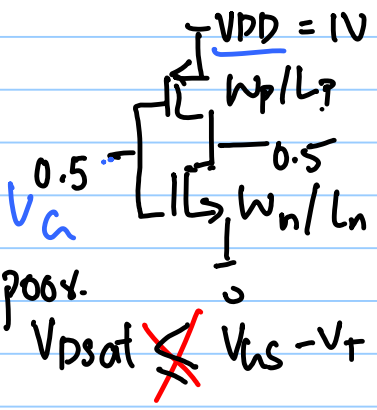
Ring Oscillators.

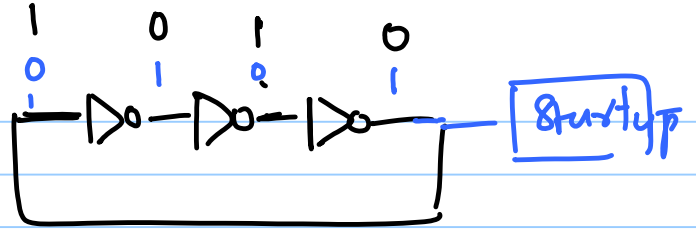
- Wide frequency range ✓
- Small form factor ✓
- Phase noise is poor.
- Frequency stability is poor.

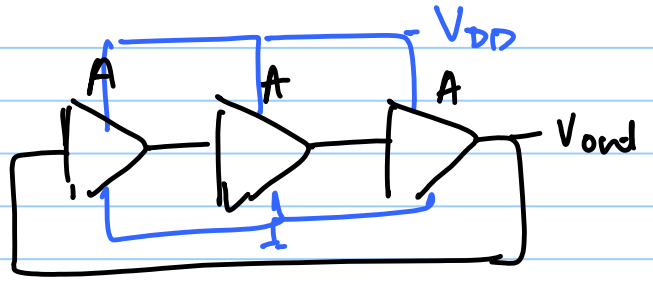
$$V_{DD} \geq V_{Tn} + |V_{TP}| \quad \checkmark$$

$$0 \leq V_{in} \leq V_{DD} \quad \checkmark$$

$$f_0 = \frac{1}{6 t_d}$$







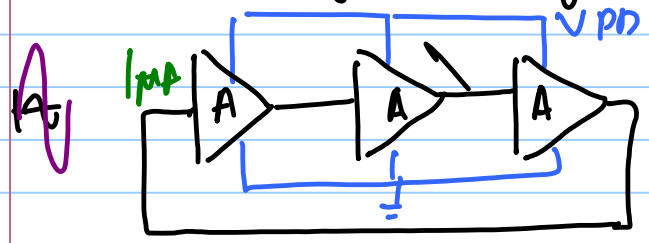
$$A = \frac{-A_0}{1 + s/\omega_p}$$

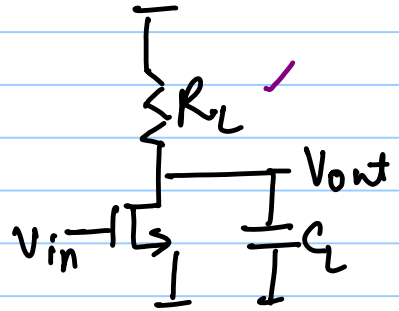
$$L_{in} = \left[\frac{-A_0}{1 + s/\omega_p}\right]^3$$

$$|L_{in}(\omega_{osc})| = 1$$

$$\angle L_{in}(\omega_{osc}) = 2\pi n$$

Small-signal swing Oscillators





$$A(s) = \frac{-A_0}{1+s/\omega_p}$$

$$\frac{V_{out}}{V_{in}} = \frac{-g_m R_L}{1+s R_L C_L}$$

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

$$|LG(\omega_{osc})| = 1 \Rightarrow \frac{A_0^3}{8} = 1 \Rightarrow A_0 = 2$$

$$\angle LG(\omega_{osc}) = 2n\pi$$

$$-180^\circ - 3\tan^{-1}\left(\frac{\omega_{osc}}{\omega_p}\right) = 2n\pi \Rightarrow \tan^{-1}\left(\frac{\omega_{osc}}{\omega_p}\right) = 60^\circ \longrightarrow \omega_{osc} = \omega_p\sqrt{3}$$

Large signal swing osc.

$$|LH(0)| = 8 \longrightarrow 18\ dB$$

$$|LH(\omega_{osc})| = 1 \longrightarrow 0\ dB$$