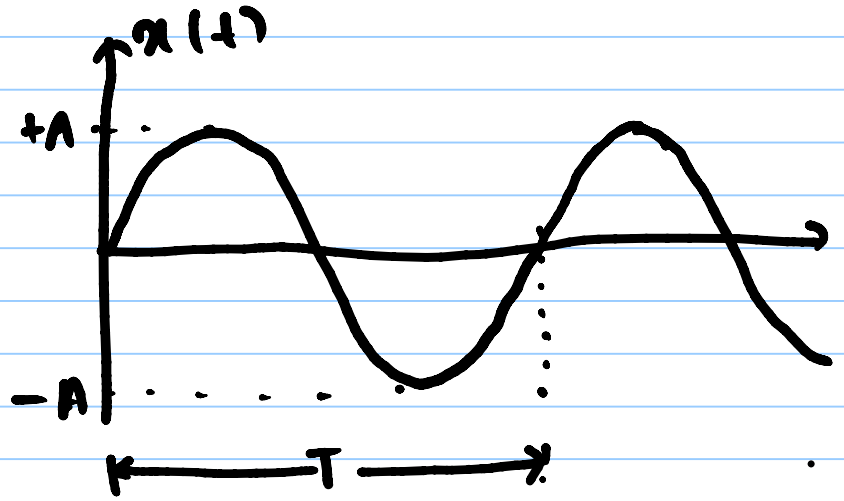
Note Title 01-08-2017

Lecture # 2

Phase-locked loops.



Amplitude = A

Time period = T

Frequency, $f = \frac{1}{T}$

$\omega = \frac{2\pi}{T}$

$$x(t) = A \sin(\omega t)$$

$$= A \sin(\underbrace{2\pi f t}_{\phi})$$

$$\text{Phase} = 2\pi f t = \int 2\pi f \, dt$$

ppm = parts per million

f = 100 MHz, T = 1 ns

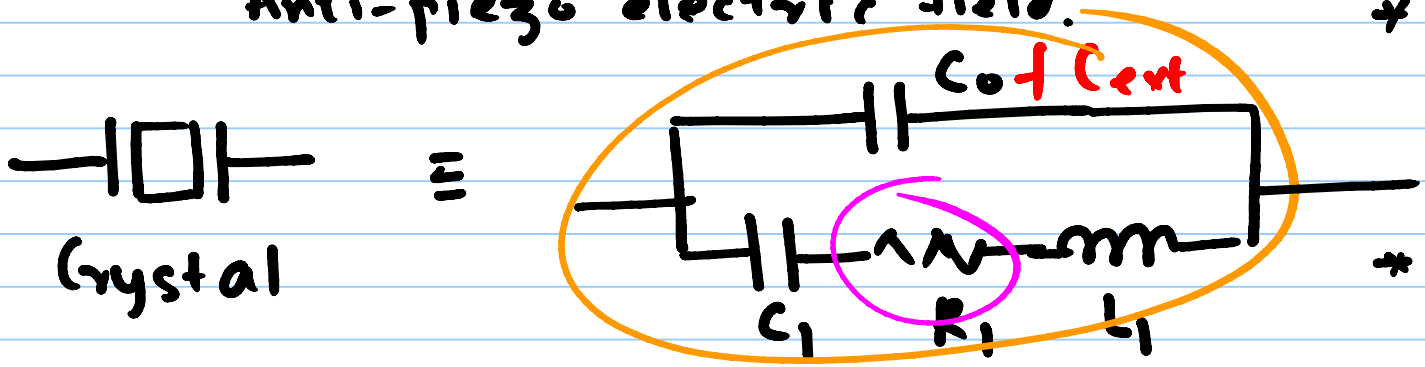
100 ppm → $100 \times 10^{-6} \times 100\ \text{MHz}$

Ref. clock source

Crystal device — Periodic outputs

Anti-piezo electric field.

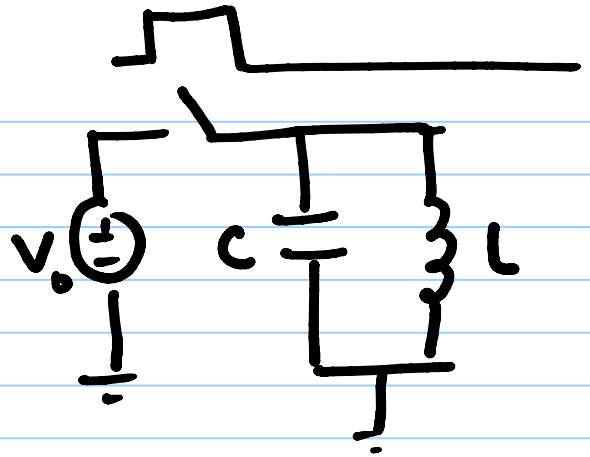
* Accuracy of clock < 100 ppm



* $f_{out} < 100\ \text{MHz}$
* PVT: Very less susceptible.
* Tunable range is very less

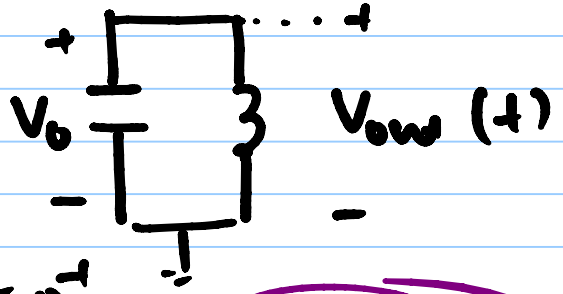
$$Z(s) = \frac{\left(s^2 + s\left(\frac{R_1}{L_1}\right) + \omega_s^2\right)}{sC_0\left(s^2 + s\left(\frac{R_1}{L_1}\right) + \omega_p^2\right)}$$

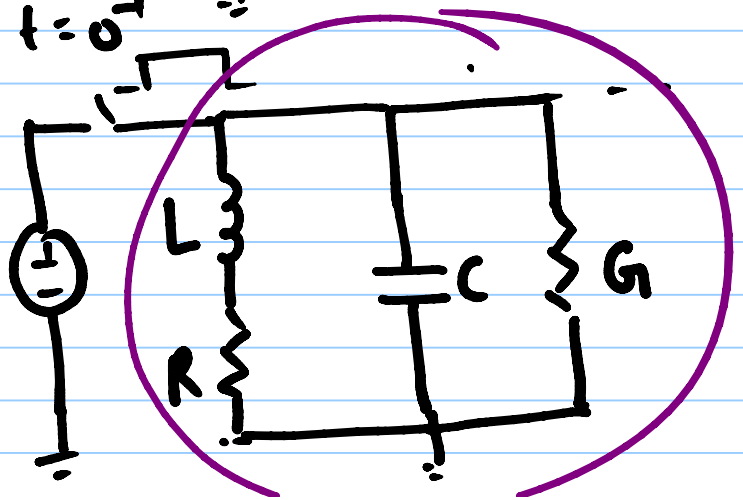
$$\omega_s = \frac{1}{\sqrt{L_1 C_1}} \qquad \omega_p = \frac{1}{\sqrt{L_1 \frac{C_1 C_0}{C_1 + C_0}}} \approx \omega_s\left(1 + \frac{C_0}{2C_1}\right)$$

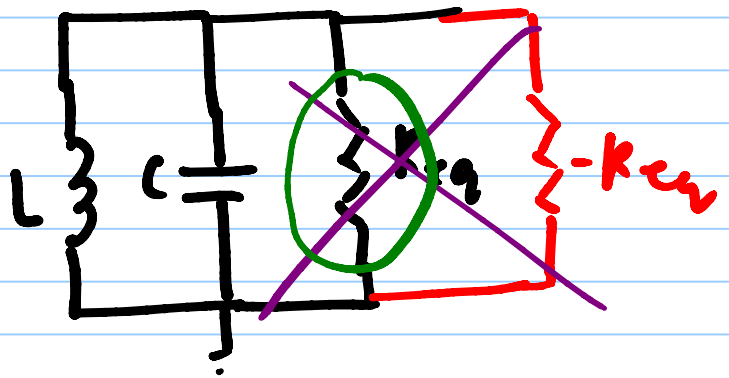


$$\omega_0 = \frac{1}{\sqrt{LC}} \checkmark$$

$$V_{ow} = A\sin(\omega_0 t)$$

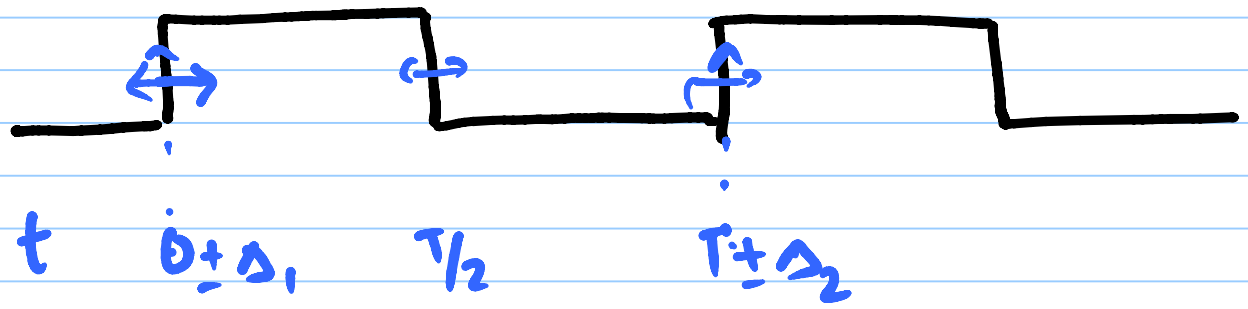


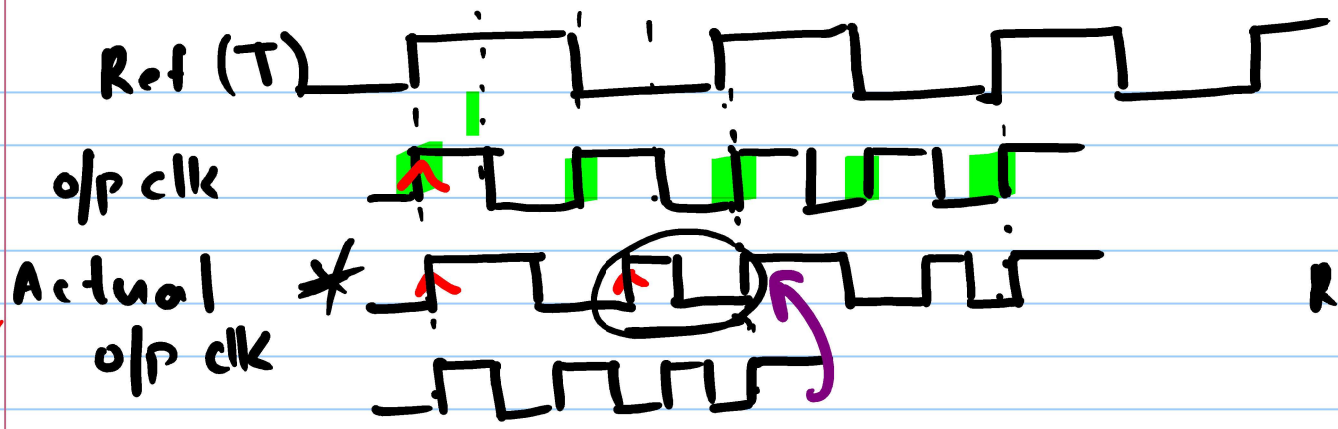




* Wide tunable range
* No limit on frequency
* More susceptible to PVT variations

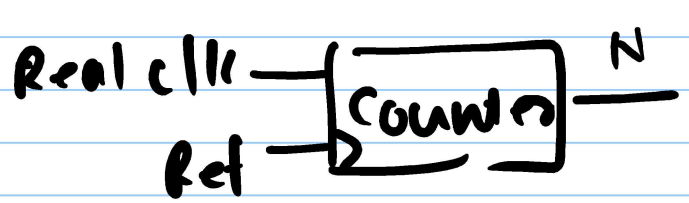
1. Ref. clock source : Highly accurate but limited freq.
2. LC resonator : less accurate but no limit on freq.



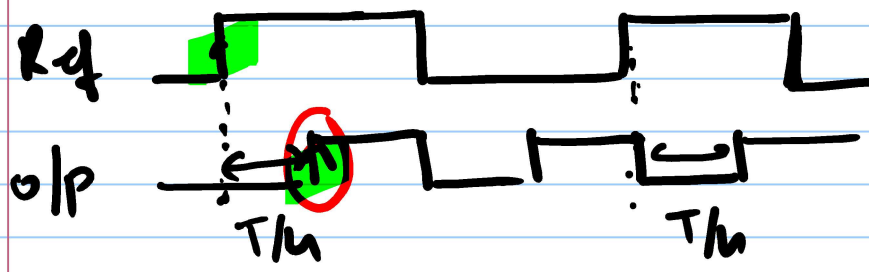


$T_{out} = T/2$

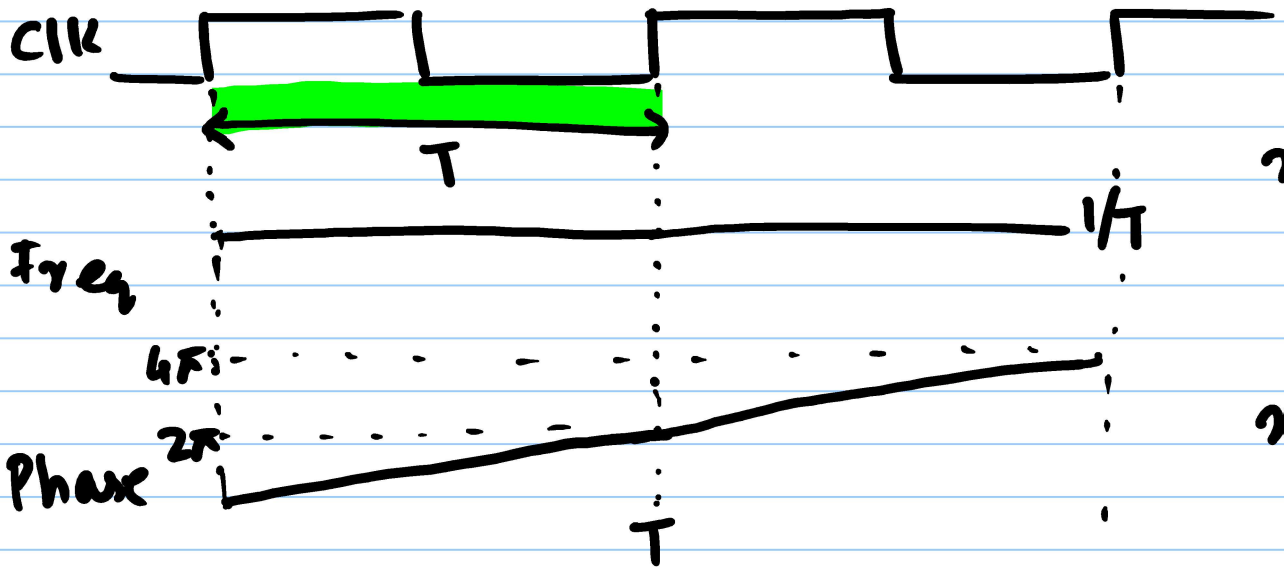
Ref. period = T



FLL: Frequency locked loop.



Phase-locked loop: Fix timing error b/w ref. & o/p clock.

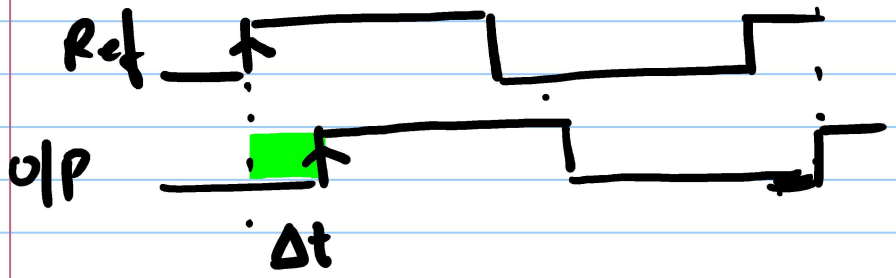


$$x(t) = \sum c_n \exp(j\omega_0 n t)$$

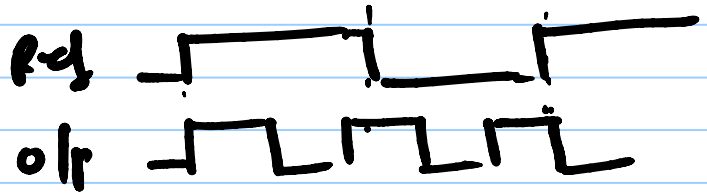
$$\omega_0 = \frac{2\pi}{T}$$

$$x_1(t) = A \sin\left(\frac{2\pi}{T} t\right)$$

$$\phi = \frac{2\pi}{T} t$$



$$\frac{\Delta\phi}{2\pi} = \frac{\Delta t}{T} \Rightarrow \Delta\phi = \frac{2\pi \Delta t}{T}$$



2.5
25
125
o/p. clock

} Fractional-N PLL