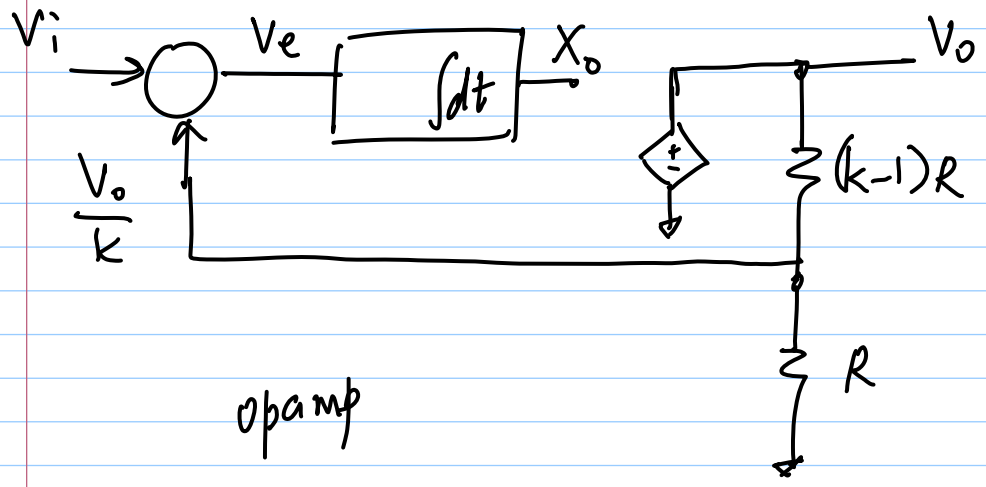
09-04-2013

Lec 40

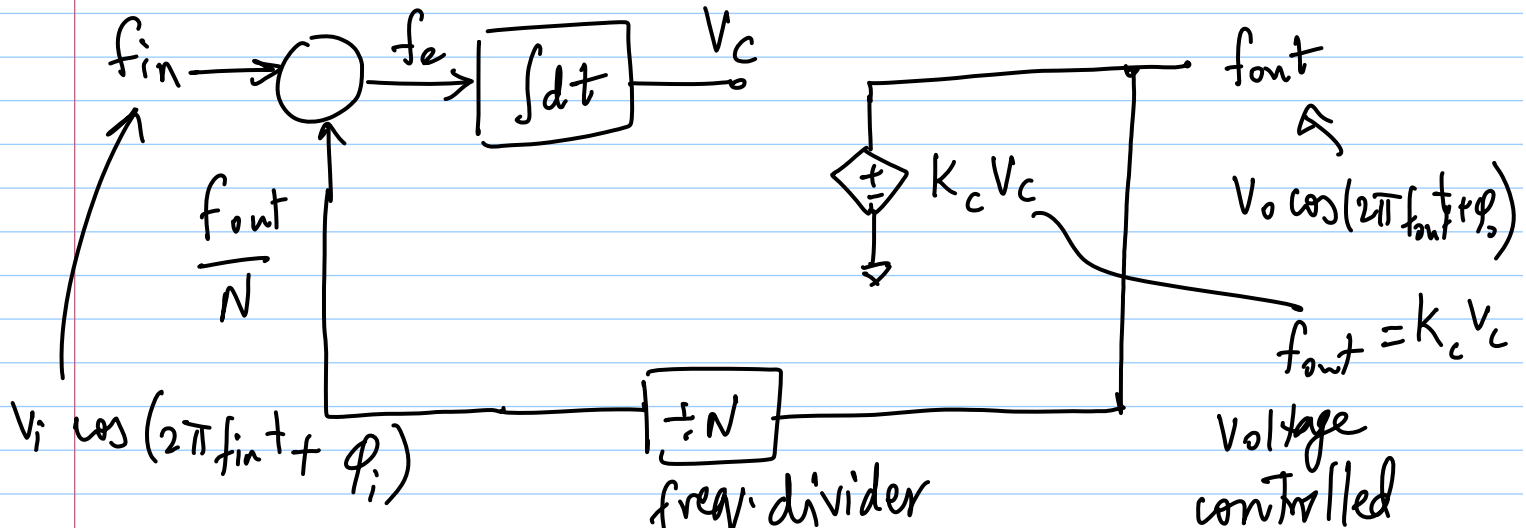
Voltage Amplifier

$V_o = kV_i$



Frequency Multiplier

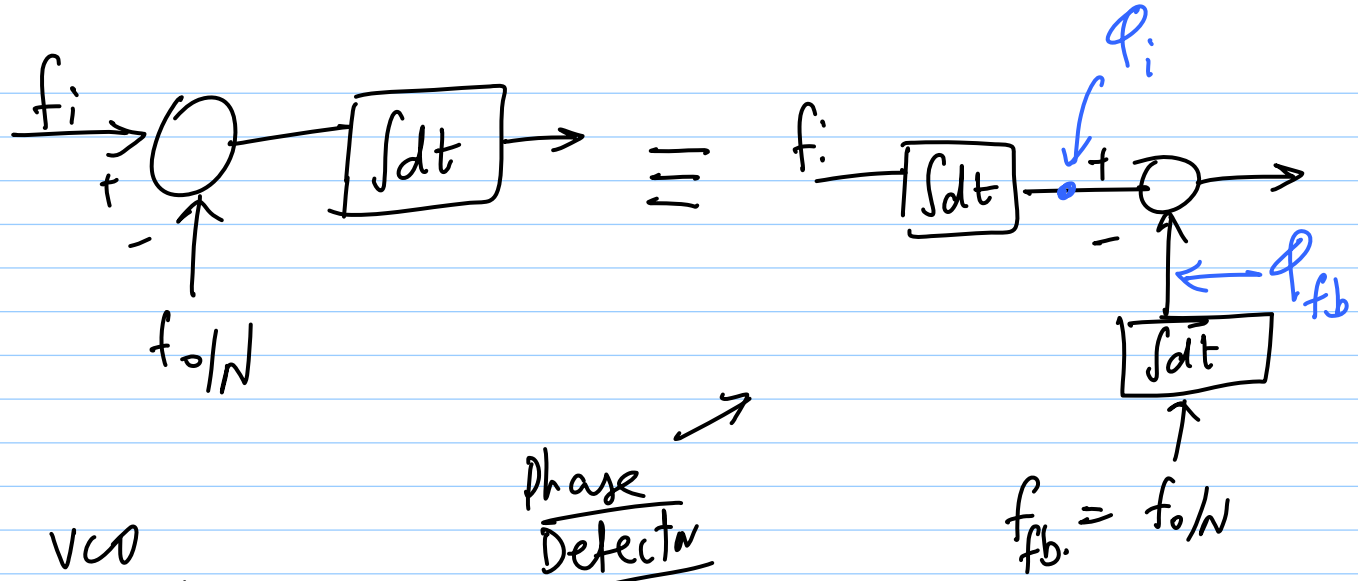
$f_{out} = N \cdot f_{in}$



P.D.

Digital counter

N = integer



Phase Detectn

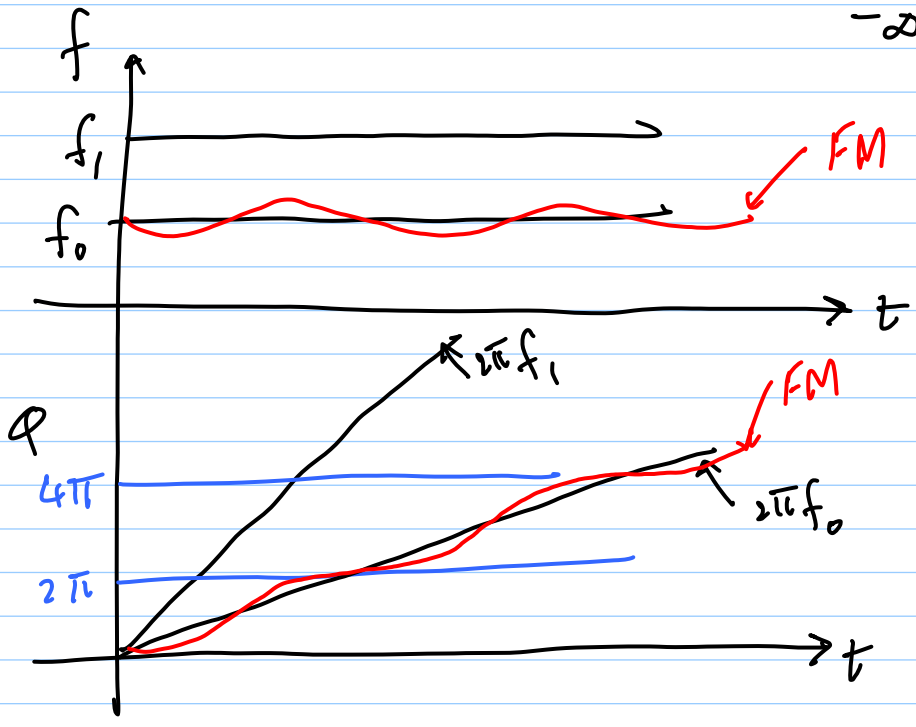
VCO

$\cos(\omega_{out} t)$ (periodic @ 2π)

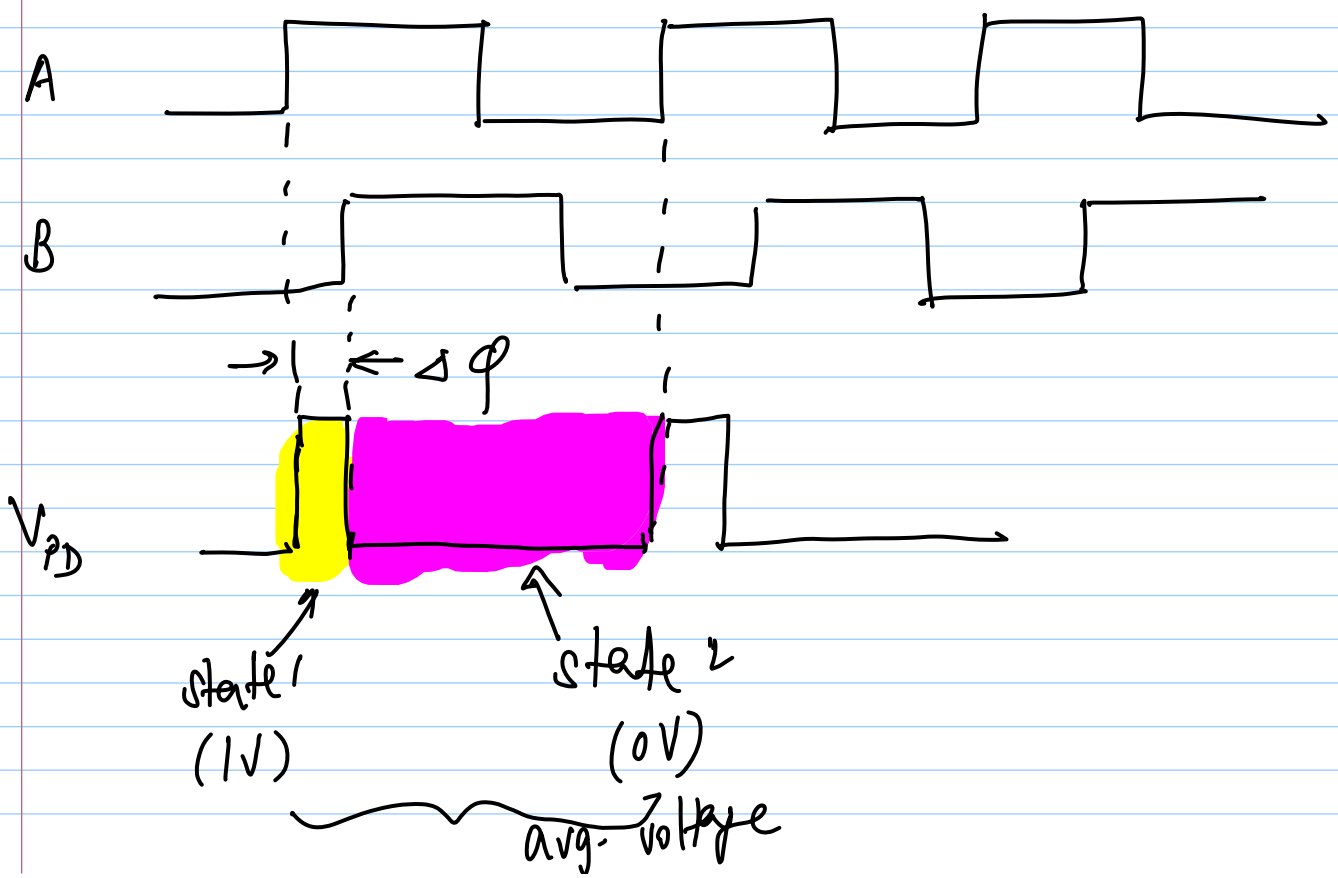
$$f_{out} = f_{free} + K_{VCO} \cdot V_c$$

K_{VCO}: Hz/V

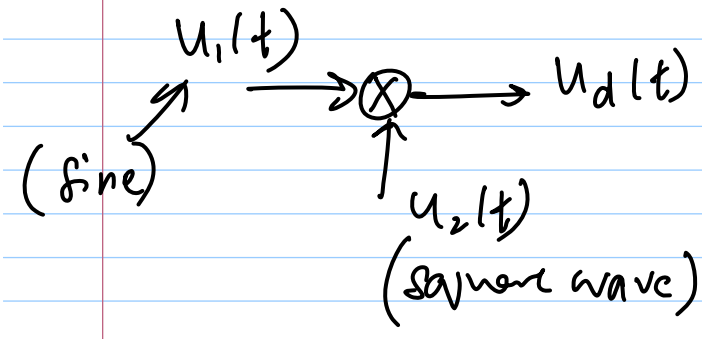
$$\varphi_{out} = 2\pi f_{free} t + 2\pi K_{VCO} \int_{-\infty}^{t} V_c \, dt + \varphi_o$$



Phase Detector



Multiplier PD



$$u_1(t) = u_{10} \sin(\omega_1 t + \theta_1)$$

$$u_2(t) = u_{20} \left[\frac{4}{\pi} \cos(\omega_2 t + \theta_2) + \frac{4}{3\pi} \cos(3\omega_2 t + \theta_2) + \frac{4}{5\pi} \cos(5\omega_2 t + \theta_2) + \dots \right]$$

$$u_d(t) = u_1(t) \times u_2(t)$$

$$= U_{10}U_{20}\frac{4}{\pi}\sin(\omega_1 t+\theta_1)\cos(\omega_2 t+\theta_2)$$

$$+ U_{10}U_{20}\cdot\frac{4}{3\pi}\sin(\omega_1 t+\theta_1)\cdot\cos(3\omega_2 t+\theta_2)$$

$$+ \cdots$$

$$= \frac{2}{\pi}U_{10}U_{20}\left[\sin\left((\omega_1+\omega_2)t+\theta_1+\theta_2\right)\right.$$

$$\left.+\sin\left((\omega_1-\omega_2)t+\theta_1-\theta_2\right)\right]$$

$$+ \cdots$$

LPF gives $(\theta_1-\theta_2)$ term