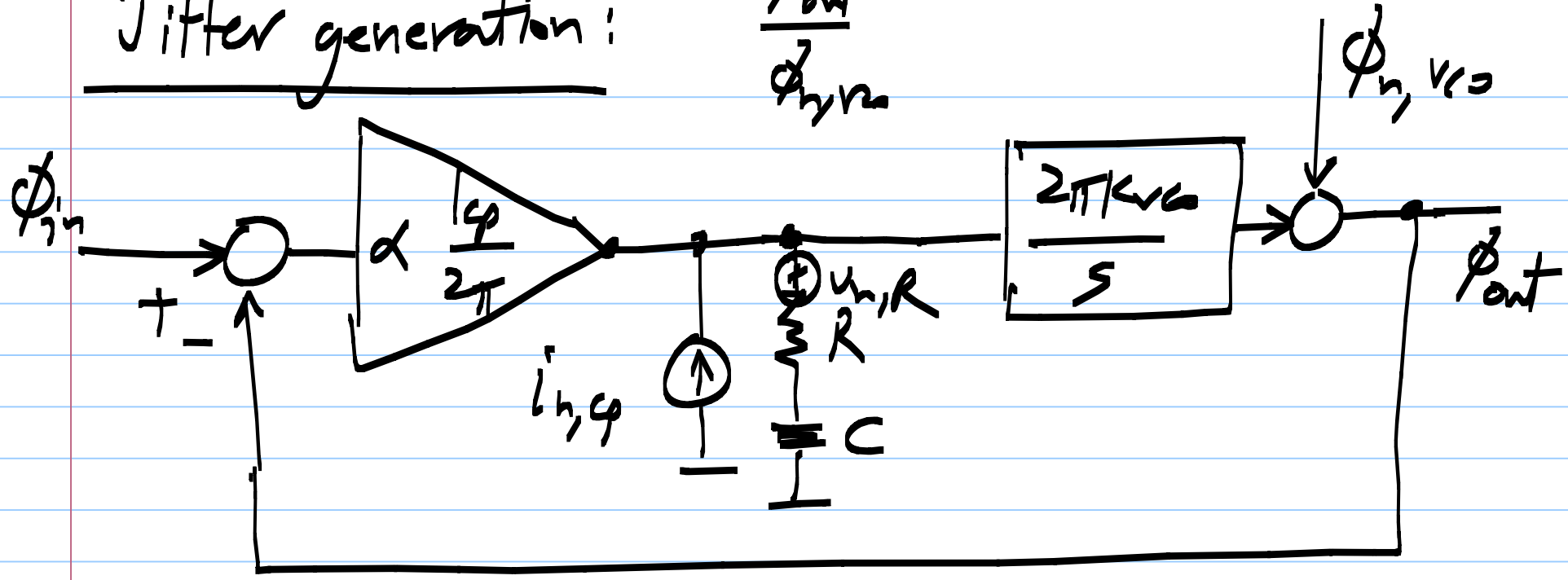
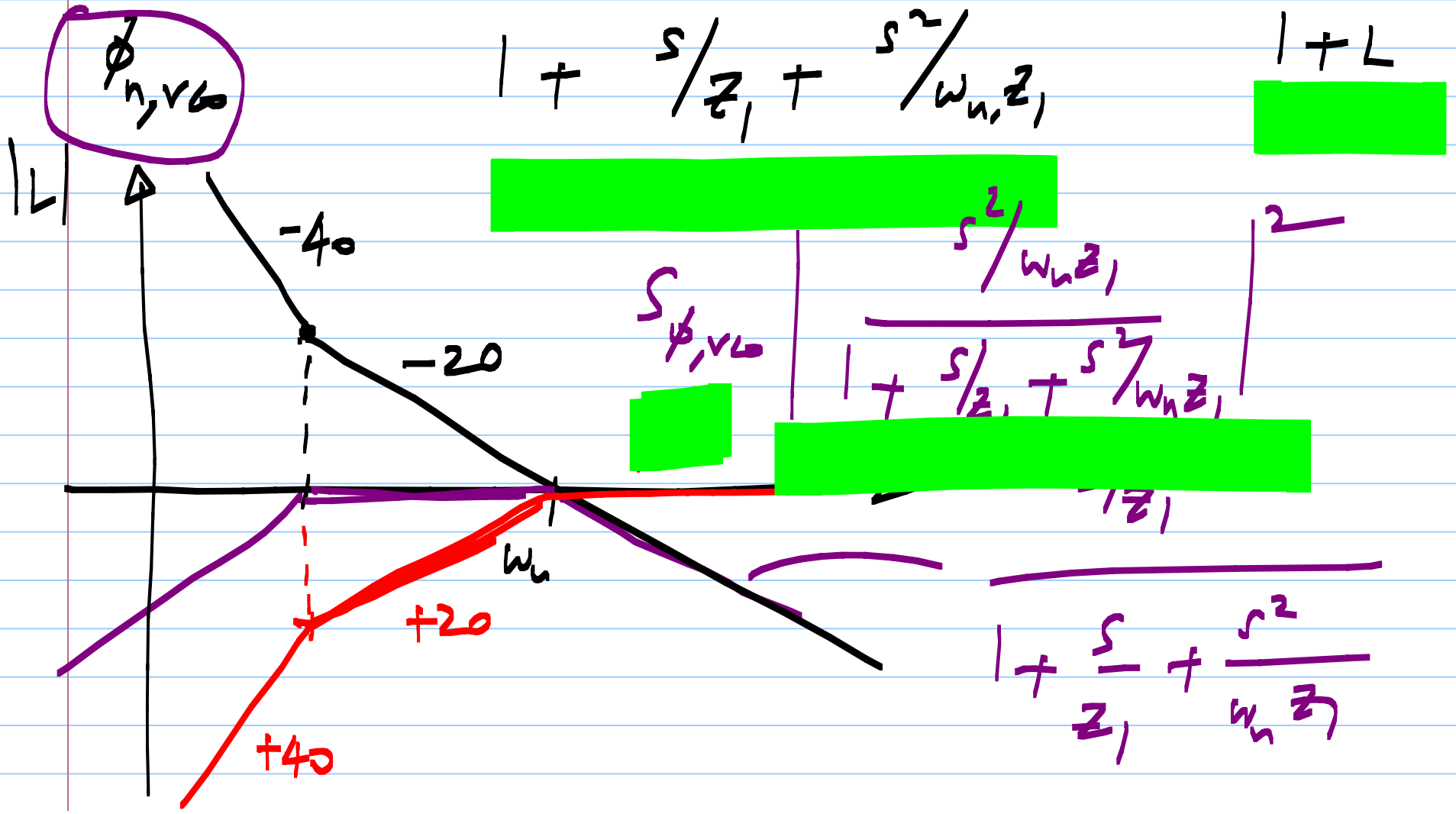
Jitter generation:

$$\frac{\phi_{out}}{\phi_{n,VCO}}$$



$$L(s) = \frac{\alpha \cdot I_\varphi R K_{VCO}}{s}\left(1 + \frac{1}{sCR}\right) = \frac{\omega_n}{s}\left(1 + \frac{z_1}{s}\right)$$

$$\frac{\phi_{out}}{\phi_{in,vo}} = \frac{s^2/\omega_n z_1}{1 + s/z_1 + s^2/\omega_n z_1} = \frac{1}{1+L}$$



$$S_{\phi,vo} = \frac{s^2/\omega_n z_1}{1 + s/z_1 + s^2/\omega_n z_1}$$

$$1 + \frac{s}{z_1} + \frac{s^2}{\omega_n z_1}$$

$$\frac{\phi_{out}}{V_{n,R}} = \frac{\phi_{out}}{\phi_{n,VCO}} \cdot \frac{2\pi K_{VCO}}{s} =$$

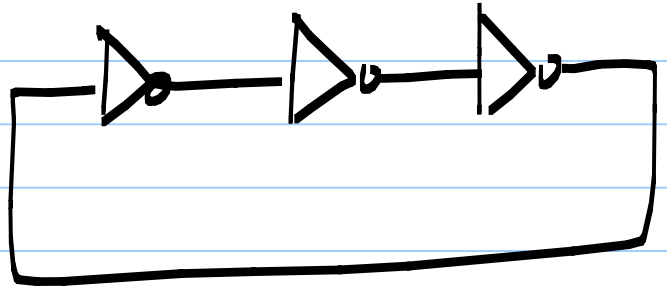
$$\frac{2\pi K/_{VCO}}{s} \cdot \frac{R}{\left(\omega_n \cdot z_1\right)}$$

$$\alpha I_{CP} R \cdot K/_{VCO}$$

$$= \frac{2\pi}{\alpha I_{CP} R} \cdot \frac{s/z_1}{1 + \frac{s}{z_1} + \frac{s^2}{\omega_n z_1}}$$

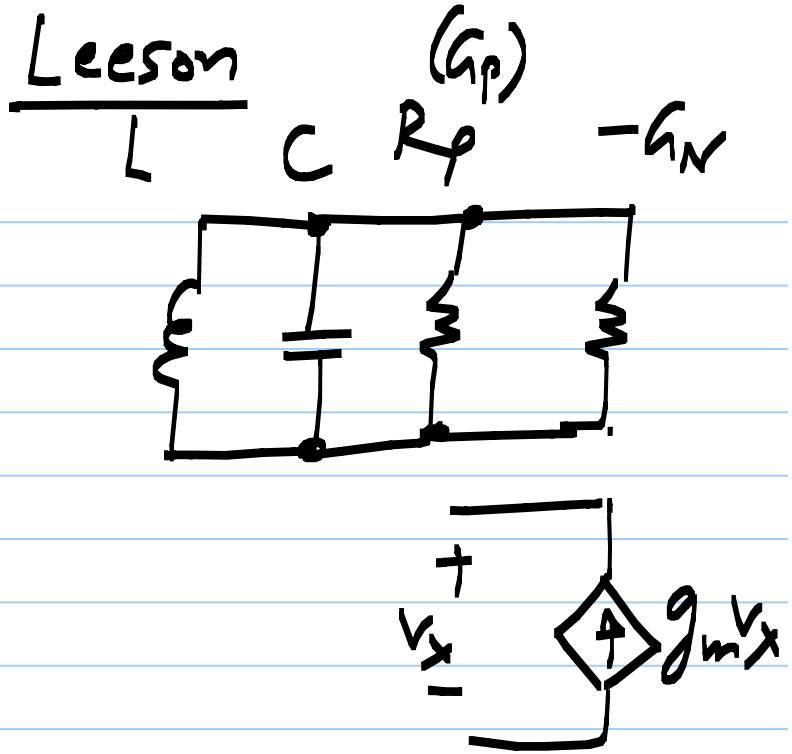
$$S_{\phi,out} = 4kTR \cdot \left(\frac{2\pi}{\alpha I_{CP} R}\right)^2 \cdot \left| \frac{s/z_1}{1 + s/z_1 + \frac{s^2}{\omega_n z_1}} \right|^2$$

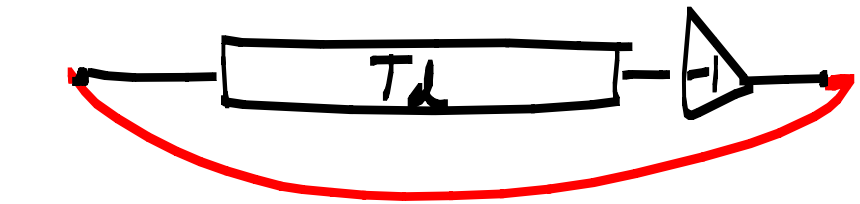
Oscillators:

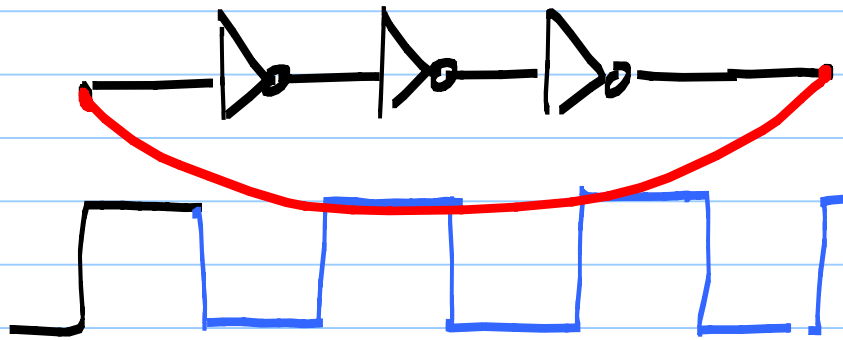


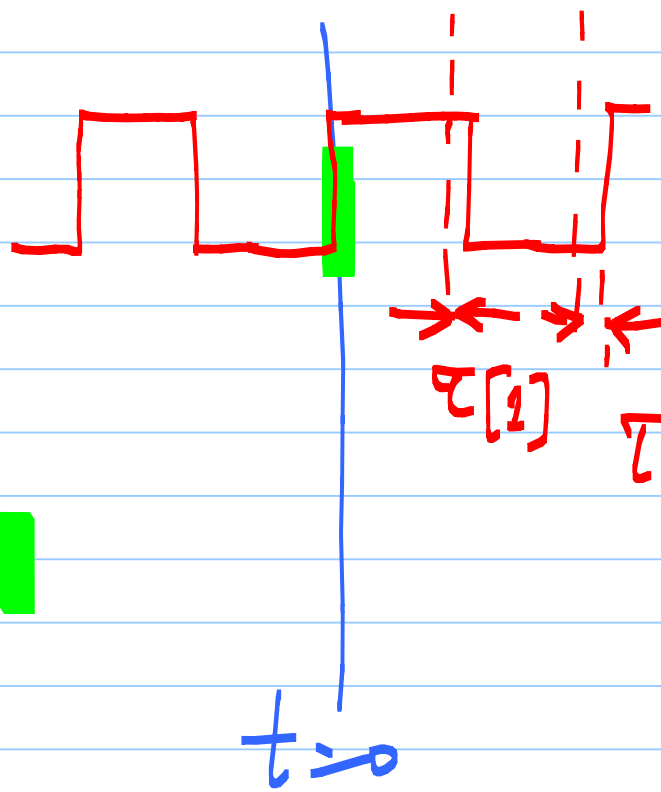
Ring oscillator

Leeson









$$\tau[1] = \frac{v_h[0]}{R}$$

$$\tau[2] = \frac{v_h[T_d/2]}{R}$$

noiseless:

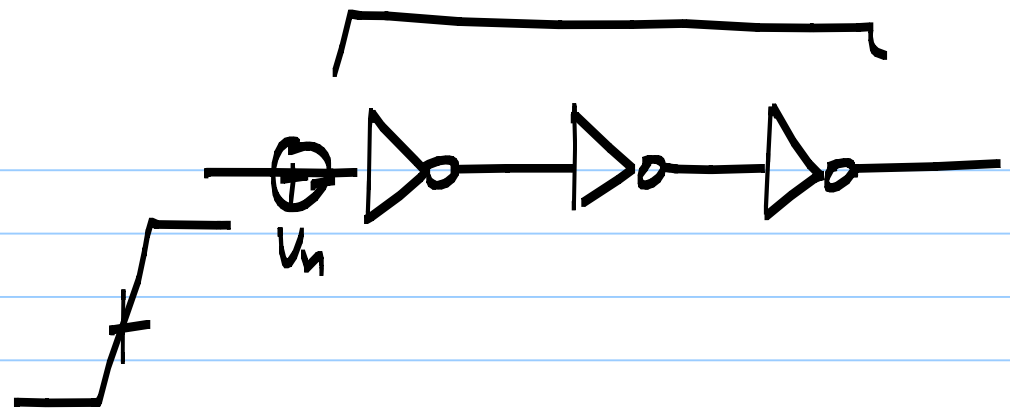
$$2T_d$$

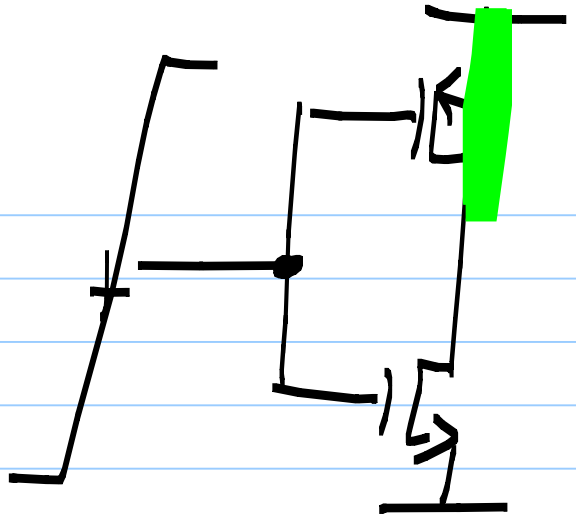
$$f_{osc} = \frac{1}{2T_d}$$

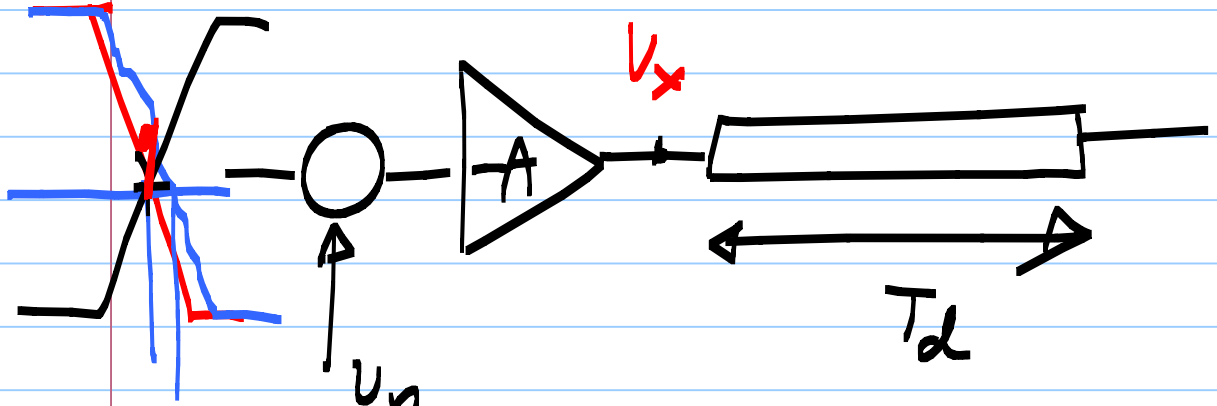
k^{th} edge will be displaced by $\sum_{n=0}^{k-1} \tau[n]$

$$= \sum_{n=0}^{k-1} \cdot \frac{v_h[k]}{R}$$

$$\frac{v_h[k]}{r^2}$$

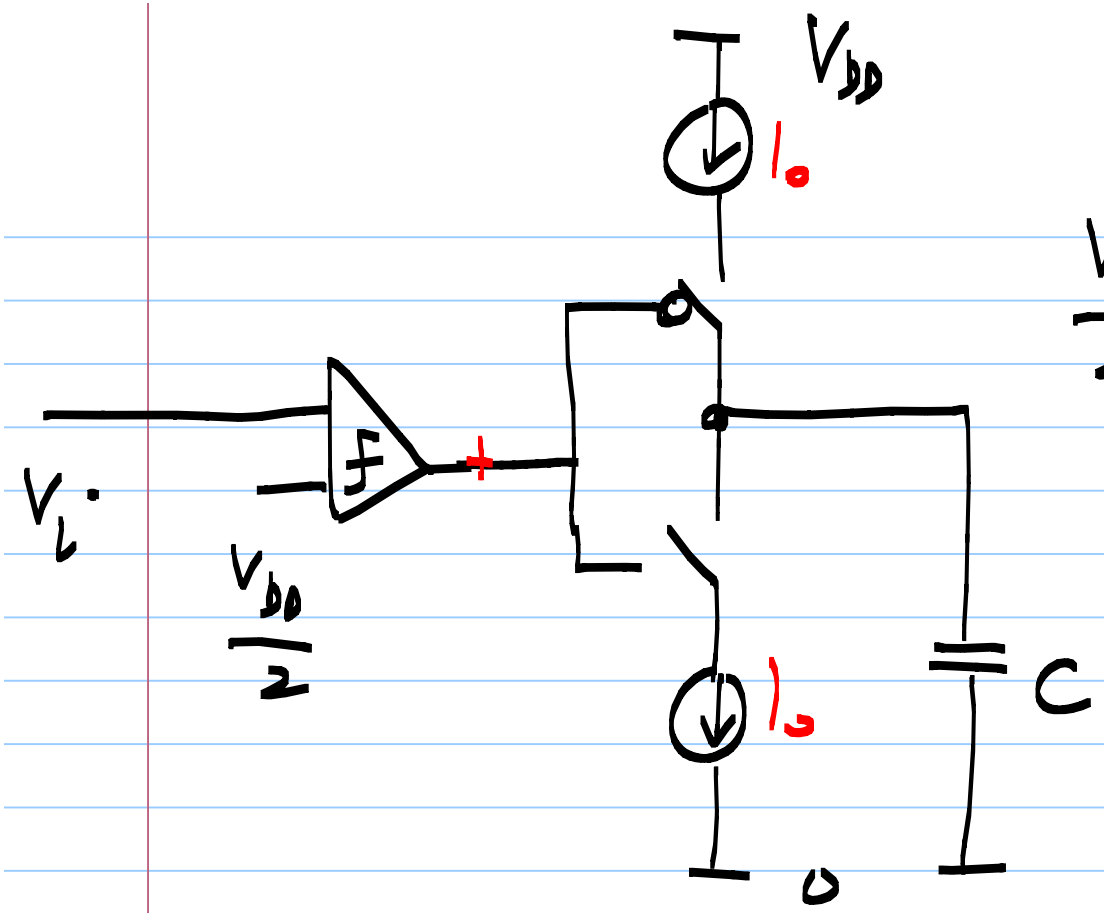


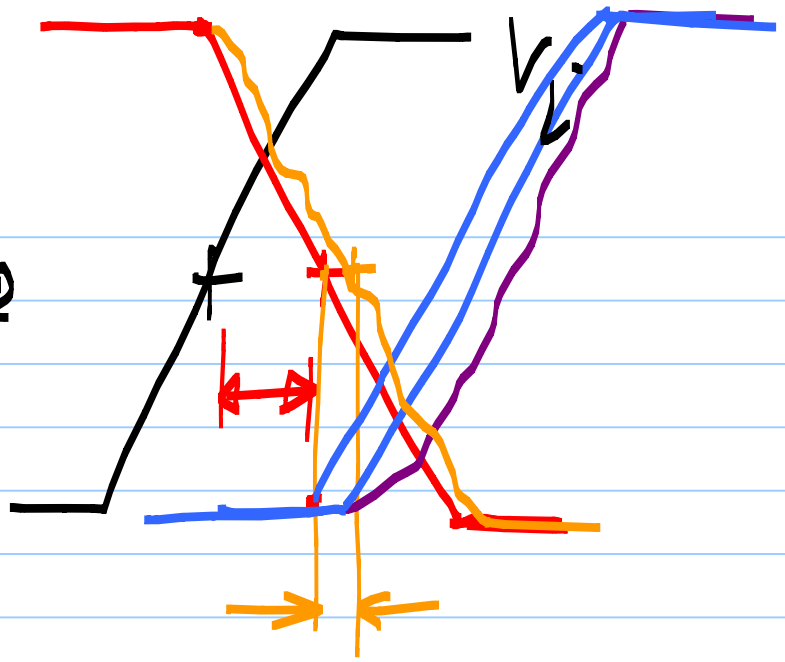


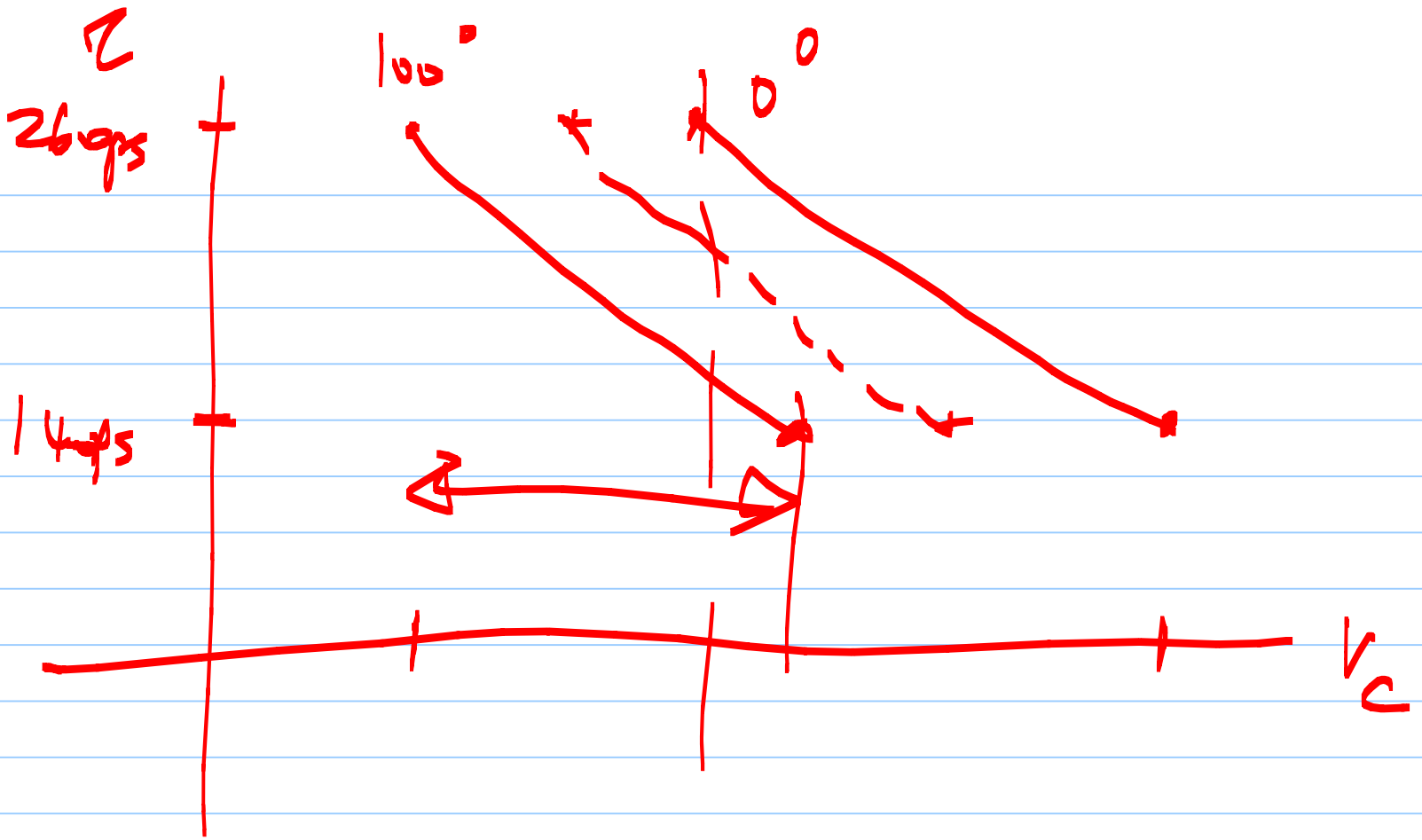


[redacted]put ref noise

slope : R


V_{DD}
I_0
V_i
$\frac{V_{DD}}{2}$
I_0
C
0


V_i
$\frac{V_{DD}}{2}$


τ
26μs
14μs
100°
0°
V_c