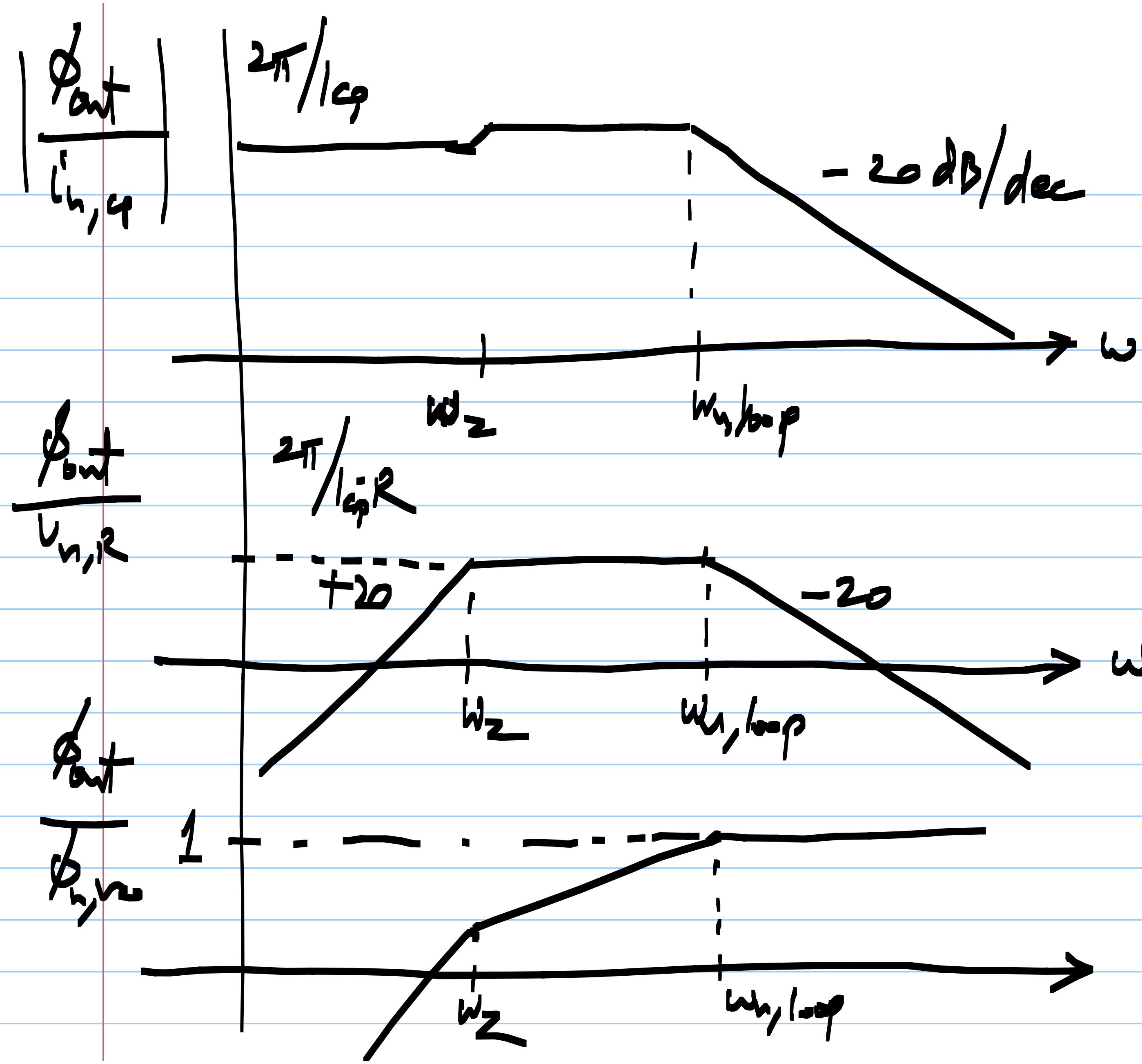
EE6322   Jitter generation in CDR   13/2/2018

$$\frac{\phi_{out}}{i_{n,cp}} = \frac{1}{I_{cp}/2\pi} \cdot \frac{1+sCR}{1+sCR+s^2C/I_{cp}K_{VCO}}$$

$$\frac{\phi_{out}}{V_{n,R}} = \frac{2\pi}{I_{cp}R} \cdot \frac{sCR}{1+sCR+s^2C/I_{cp}\cdot K_{VCO}}$$

$$\frac{\phi_{out}}{\phi_{n,VCO}} = \frac{s^2C/I_{cp}\cdot K_{VCO}}{1+sCR+s^2C/I_{cp}\cdot K_{VCO}}$$

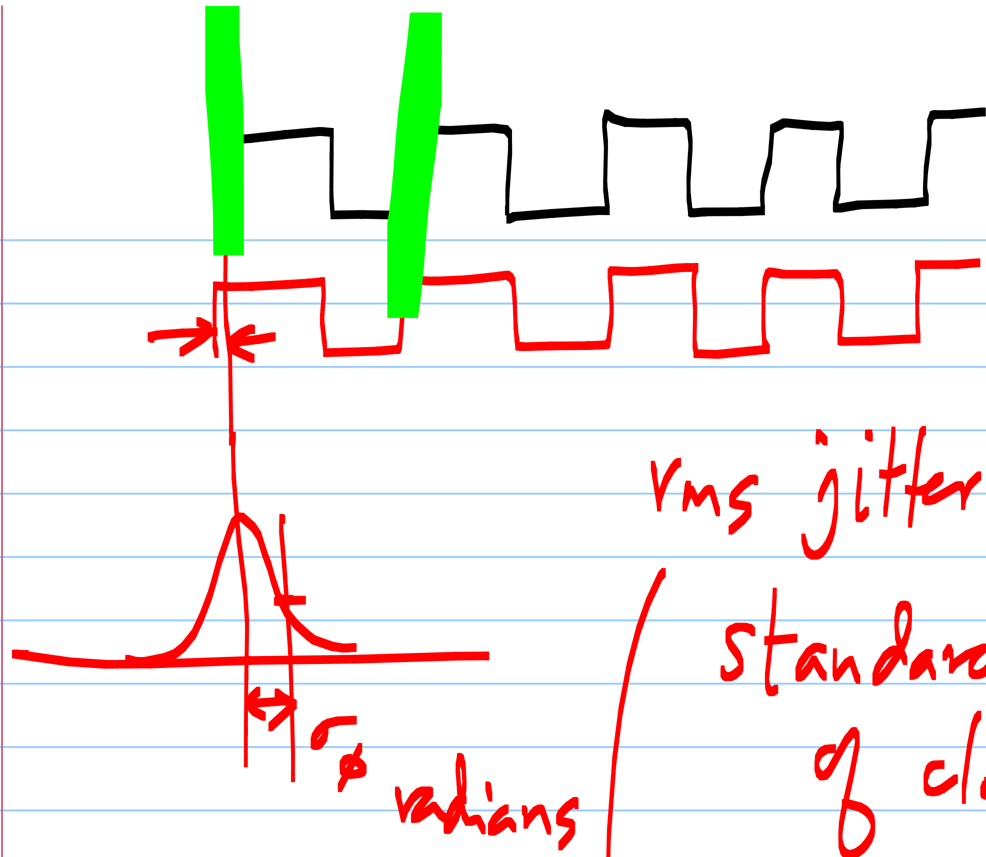


$\omega_z = 1/RC$

$S_{i,cp} \cdot \left|\frac{\phi_{out}}{i_{n,cp}}\right|^2$

$4kTR \left|\frac{\phi_{out}}{v_{n,R}}\right|^2$

$S_{\phi,VCO} \left|\frac{\phi_{out}}{\phi_{VCO}}\right|^2$



<u>absolute jitter</u>

rms jitter: standard deviation of phase of clock edges, compared to an ideal periodic clock

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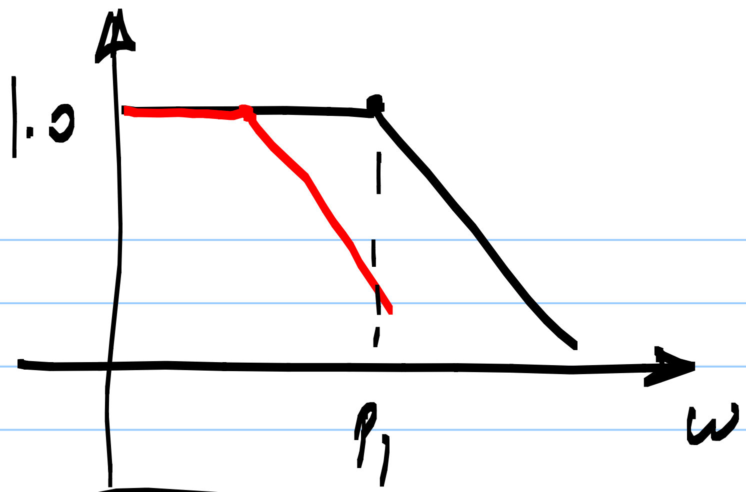
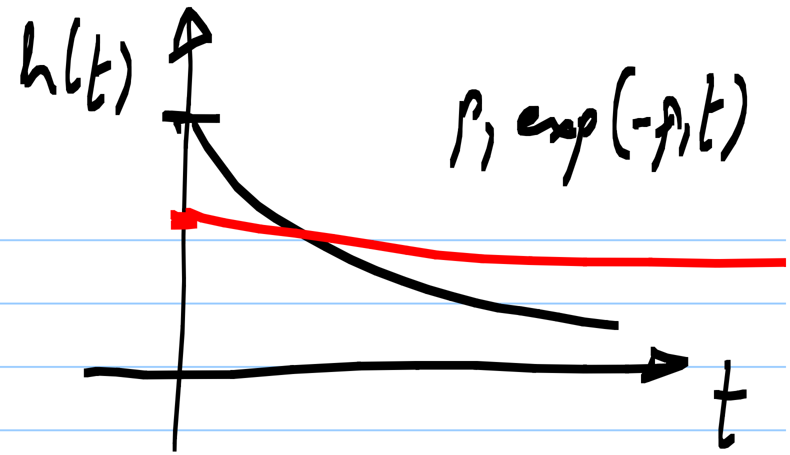
UI $\left[\sigma_\phi / 2\pi\right]$

$\phi \rightarrow \frac{\phi}{2\pi} \cdot T_s$

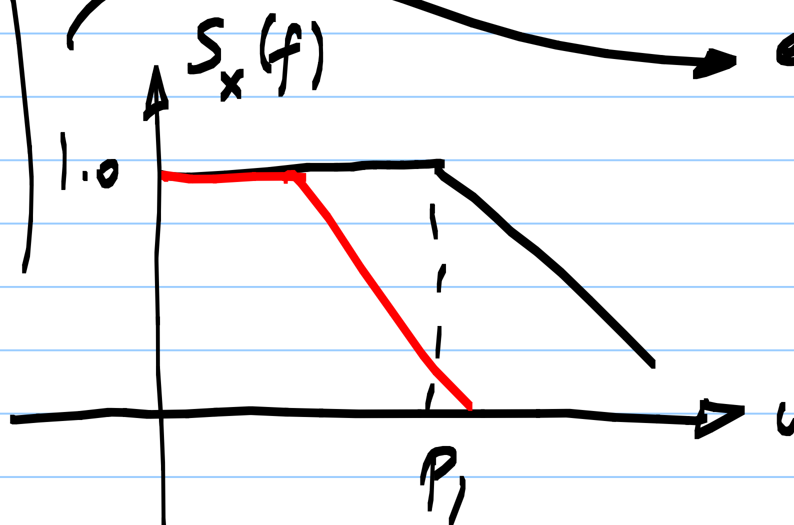
$\sigma_\phi \rightarrow \frac{\sigma_\phi}{2\pi} \cdot T_s$

$$H(s) = \frac{1}{1 + s/p_1}$$

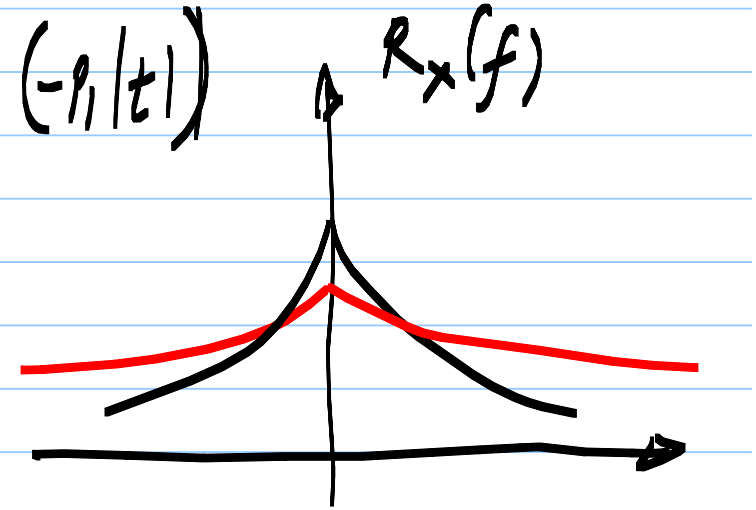




$$\left| \frac{1}{1 + j\omega/p_1} \right|^2$$



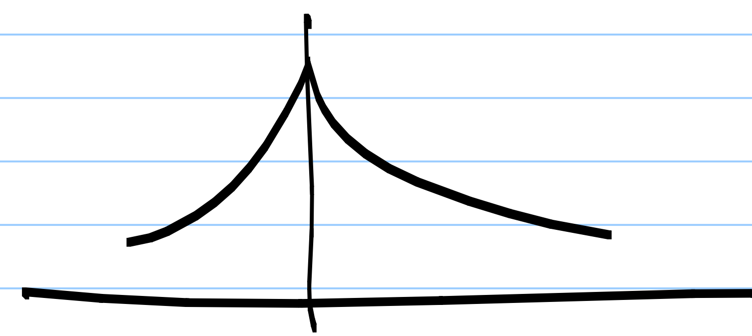
$\exp(-p_1|t|)$



$\cos(\omega_0 t)$: $\frac{s}{s^2+\omega_0^2}$ $\quad s=j\omega \quad$ $\frac{j\omega}{\omega_0^2-\omega^2} + \ldots$

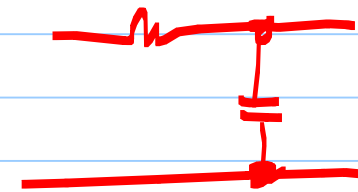
$\sin(\omega_0 t)$: $\frac{\omega_0}{s^2+\omega_0^2}$ $\quad$ $\frac{\omega_0}{\omega_0^2-\omega^2}$

$\frac{1}{\omega_0^2+\omega^2}$



$$R_x(\tau) = E\left[x(t)\,x(t+\tau)\right]$$

$\tau = 1\mu s$



$x(t)$: zero mean

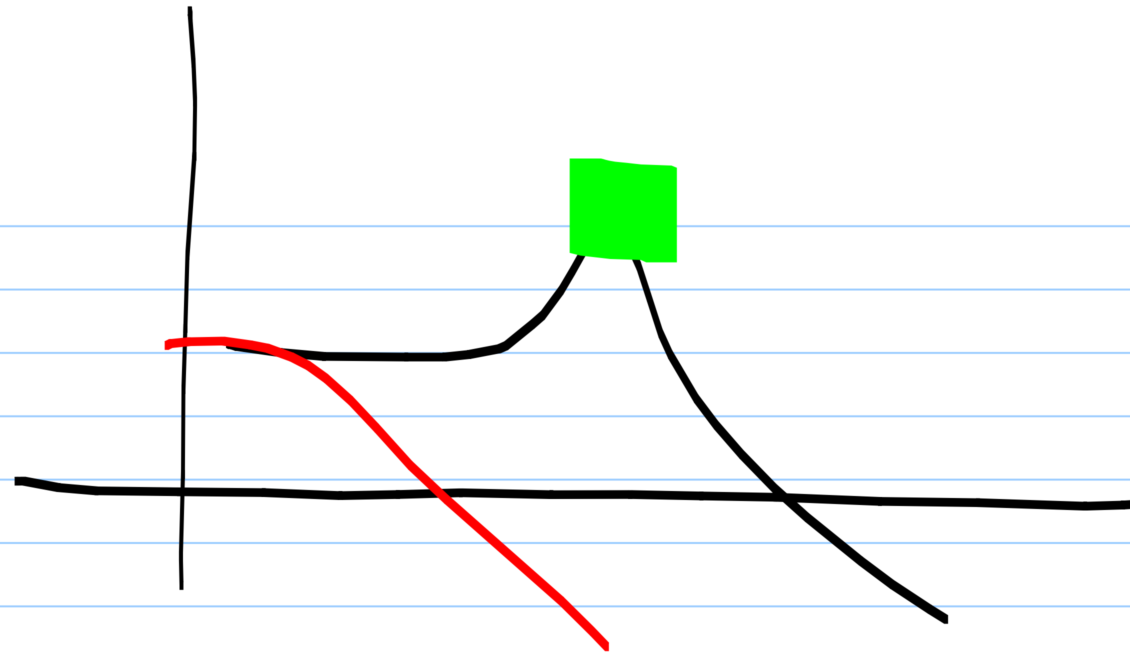
$$E\left[x(t)\right]\cdot E\left[x(t+\tau)\right]$$

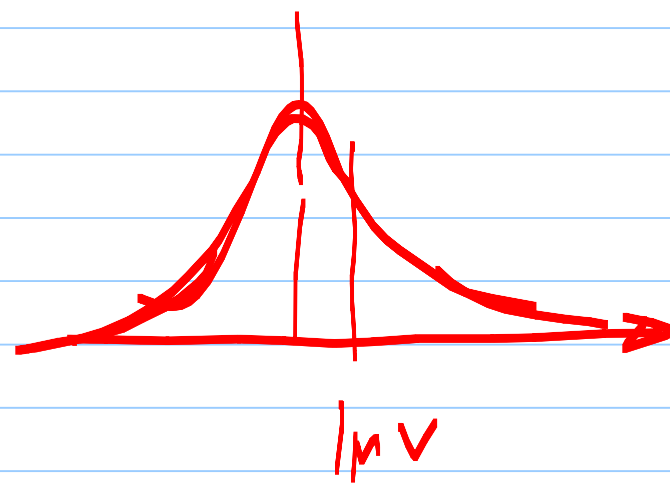
coin toss : $x[n]$

$$y[n] = x[n] + x[n-1] + x[n-2]$$

1 2 3 4 5 6 7 8 9

$\phi_{out} - \phi_{in}$





$$\int_0^\infty \underline{\text{spectral density}}\; df = \text{variance}$$

$$S_x(f) \xleftrightarrow{\mathcal{F}} R_x(\tau)$$

2-sided spectral density

$$S_x(f) = \int_{-\infty}^{\infty} R_x(\tau) \exp(-j2\pi f\tau)\, d\tau$$

$$R_x(\tau) = \int_{-\infty}^{\infty} S_x(f) \exp(j2\pi f\tau)\, df$$

$$R_x(0) = \sigma_x^2 = \int_{-\infty}^{\infty} S_x(f) \cdot df$$

one-sided S.D $\quad \displaystyle\int_{0}^{\infty} \underbrace{S_x(f)}_{\text{one-sided}} \, df$