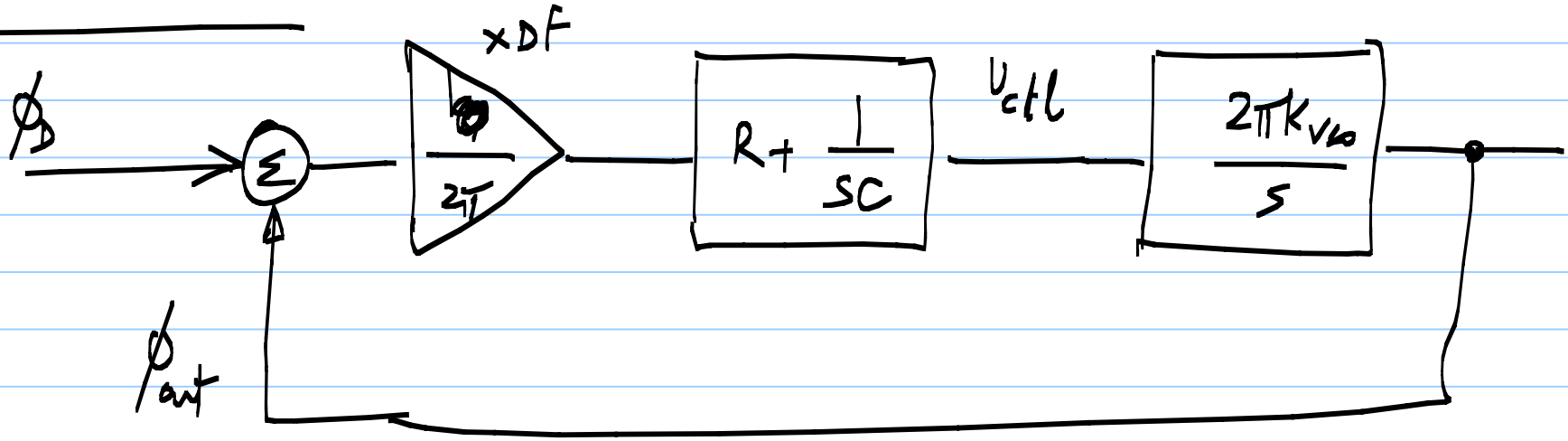
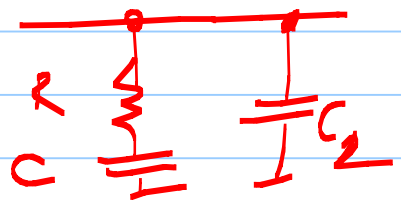
Lecture 18

Linear incremental model of the CDR with VCO & a linear PD.





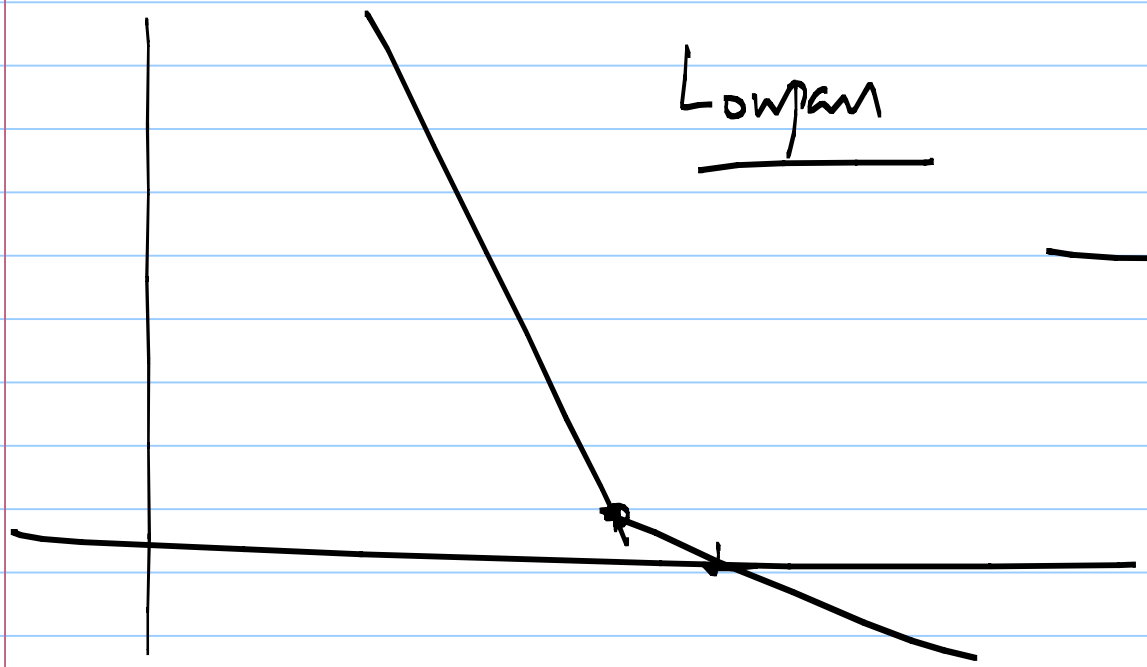
JTRAN.

$$\frac{\phi_{out}}{\phi_D} = \frac{1 + sCR}{1 + sCR + \frac{s^2C}{K_{VCO} \cdot I_0}}$$

2nd order TF w/ a zero

poles: $\sim 1/CR$

$\sim I_0 R \cdot K_{VCO}$



Lowpass

3 dB Bw of the TF (ω_{-3dB})

$\zeta \gg 1$ to avoid excessive peaking

JTOL :

$$|\phi_s - \phi_{out}| < \phi_x$$

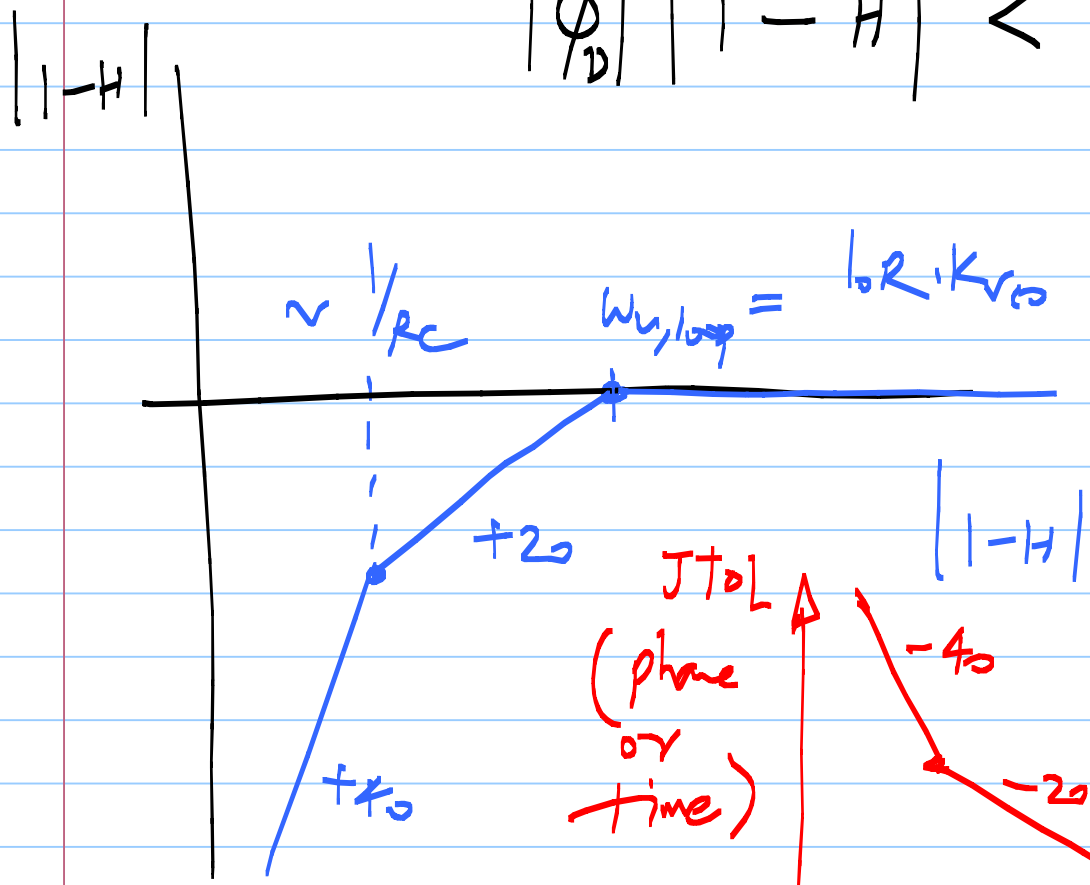
$$|\phi_D|\,|1 - H| < \phi_x$$

$$\left[|\phi_D \cdot \frac{T_0}{2\pi}\right]$$

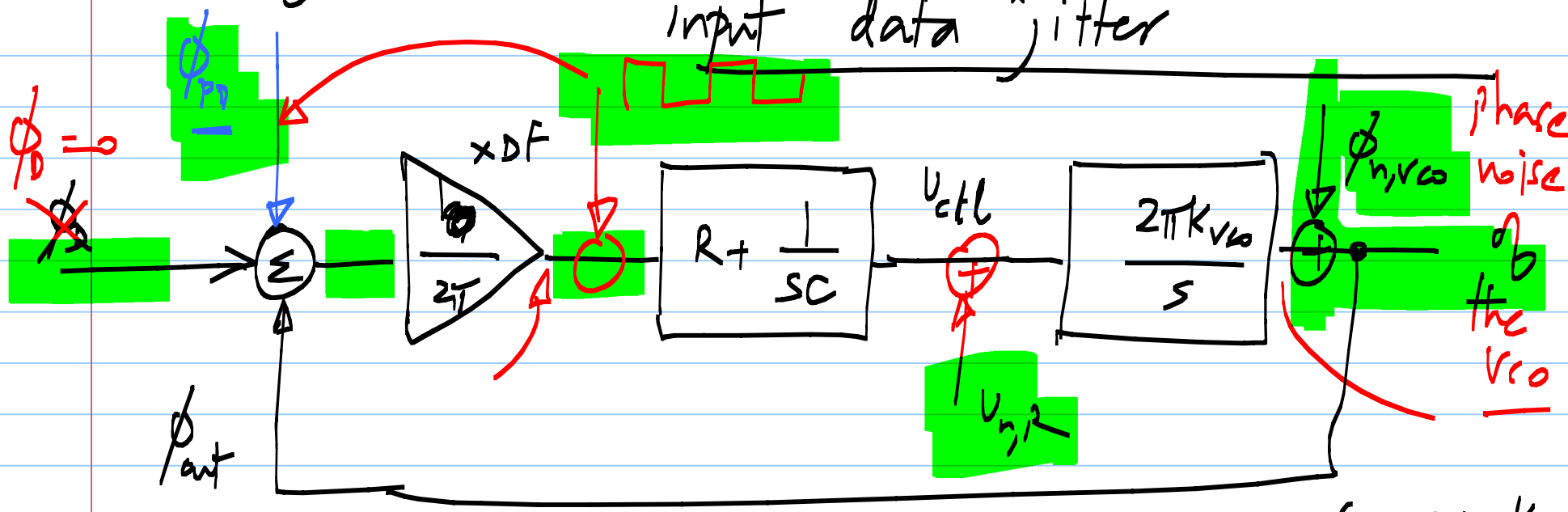
$$|\phi_D| < \frac{\phi_x}{|1-H|}$$

$$\frac{s^2C}{I_0 K_{VCO}}$$

$$1 + sCR + \frac{s^2C}{I_0 \cdot K_{VCO}}$$



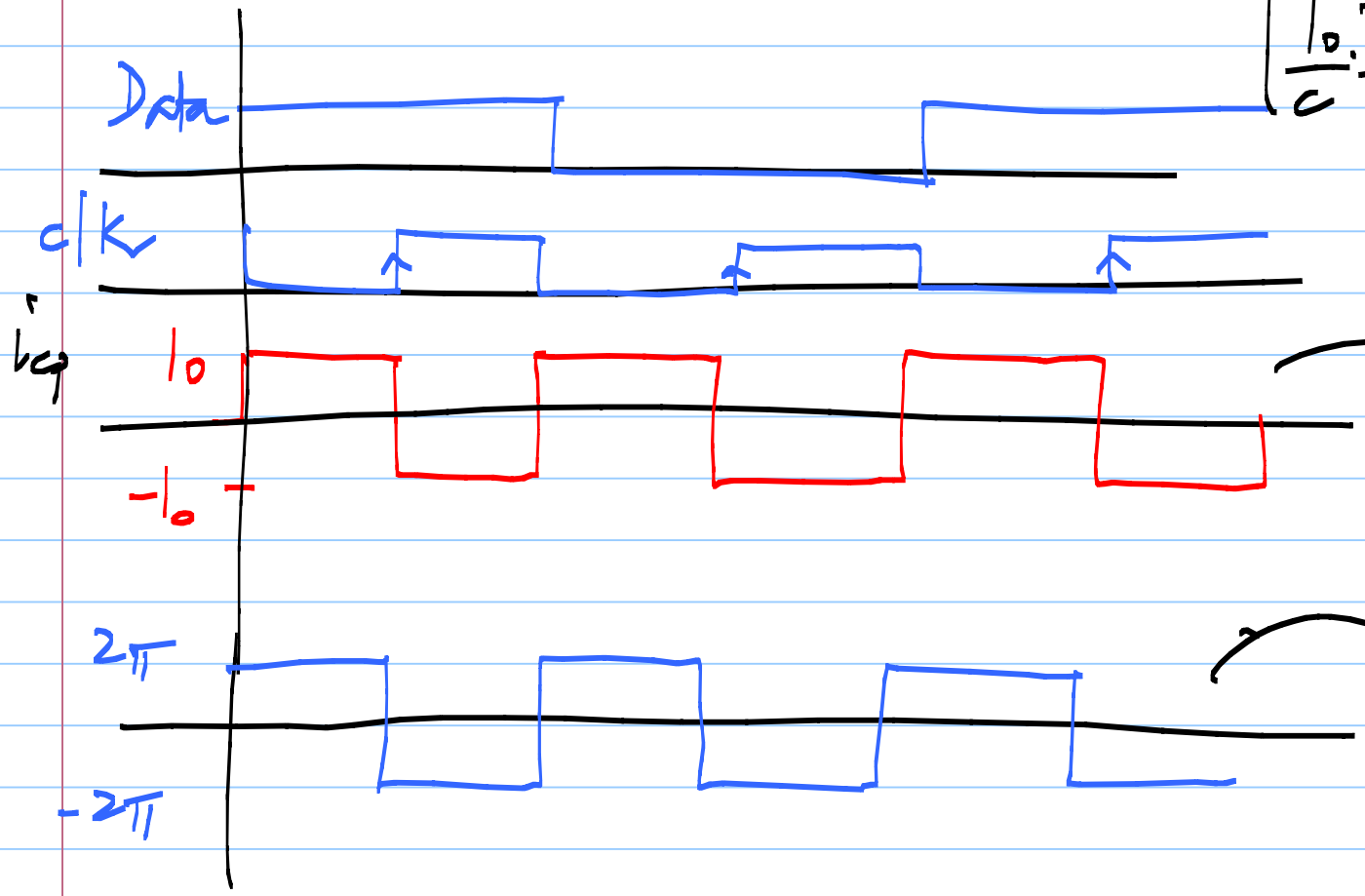
Jitter generation: output jitter in absence of input data jitter



$$L(s) = I_D\left(R + \frac{1}{sC}\right) \cdot \frac{K_{VCO}}{s}$$

$$\frac{\phi_{VCO}}{\phi_{n,VCO}} = \frac{\frac{s^2 C}{I_D K_{VCO}}}{\frac{s^2 C}{I_D K_{VCO}} + s \cdot CR + 1}$$

Linear PD in ideal steady state



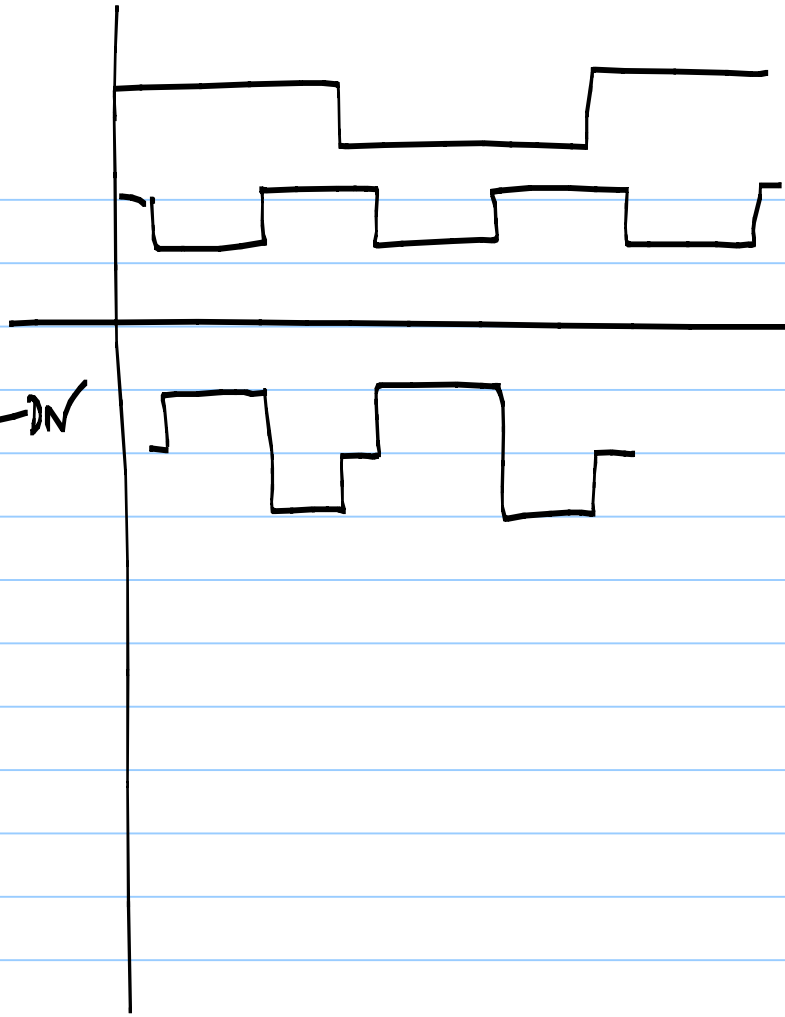
$I_0 R$

$\left(\frac{I_0 \cdot T_b}{C} \cdot \frac{1}{2}\right)$

$\left(R + \frac{1}{sC}\right) \times$

$\frac{2\pi K_{vco}}{s}$

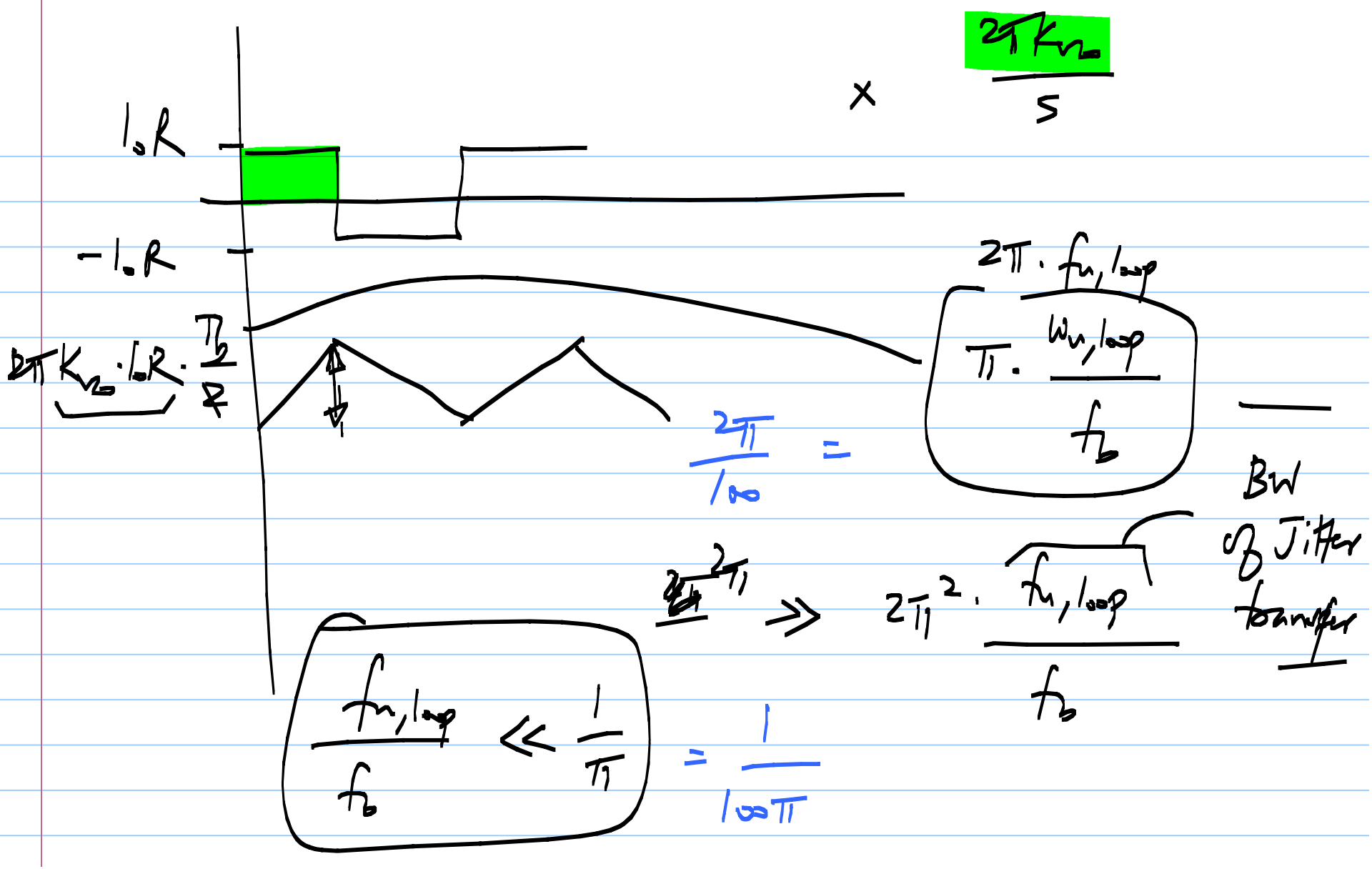
$\frac{T_b}{2[RC]} = \frac{1}{2\pi} \frac{2\pi f_b}{f_b}$

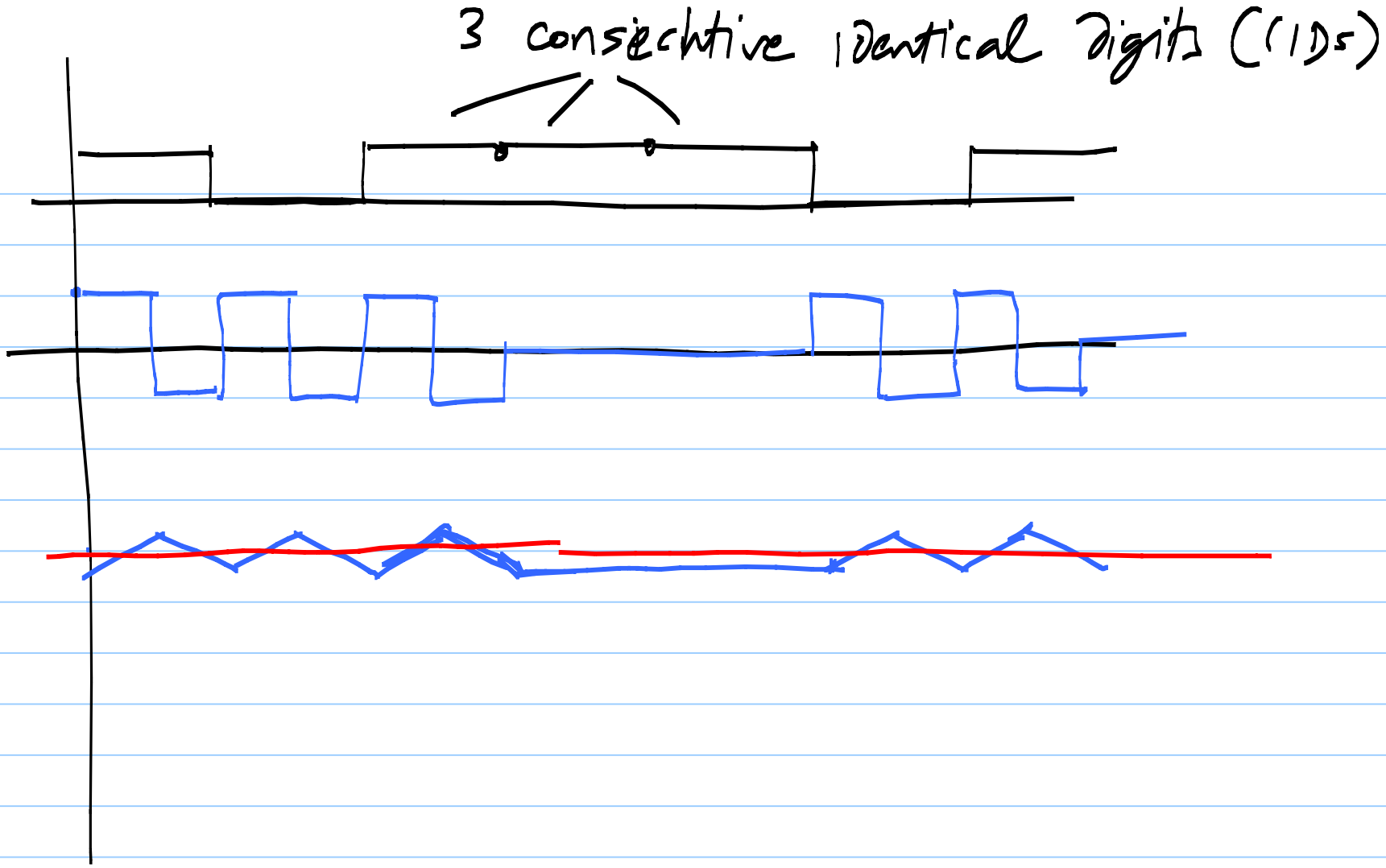


$\equiv$ avg + fluctuation

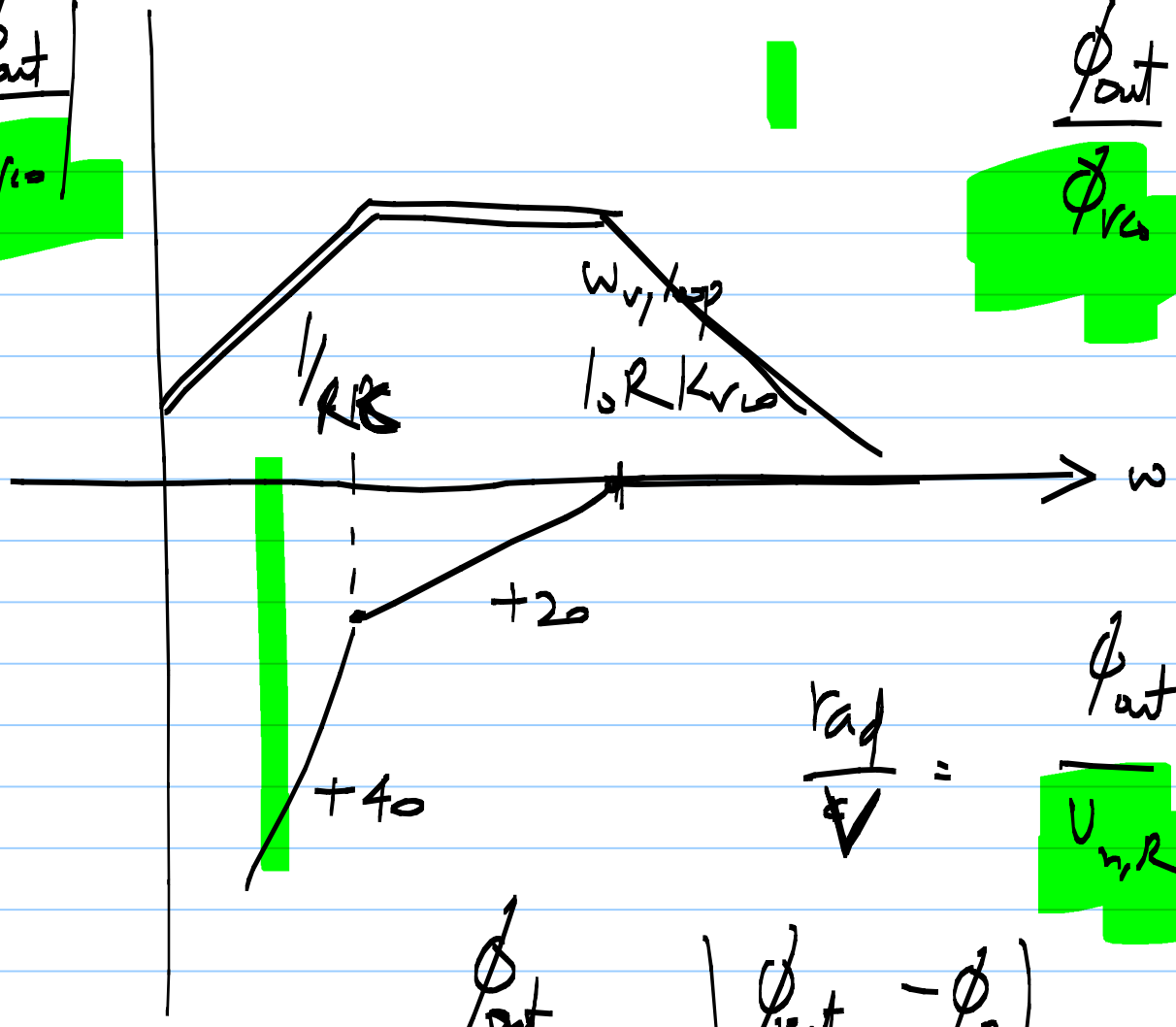
$$\left(\phi_{D-} - \phi_{out}\right)\frac{I_Q}{2\pi} + \Delta i$$

$$\left(\phi_1 - \phi_{out} + \phi_{PD}\right)\frac{I_Q}{2\pi}$$


$I_0 R$
$-I_0 R$
$2\pi K_{vco} \cdot I_0 R \cdot \frac{T_1}{2}$
T_1
$\times$
$\frac{2\pi K_{vco}}{s}$
$2\pi \cdot f_{n,loop}$
$T_1 \cdot \frac{\omega_{n,loop}}{f_s}$
$\frac{2\pi}{I_{oo}} =$
$\frac{2\pi}{2\pi T_1} \gg 2T_1^2 \cdot \frac{f_{n,loop}}{f_s}$
BW of Jitter transfer
$\frac{f_{n,loop}}{f_s} \ll \frac{1}{T_1}$
$= \frac{1}{I_{oo} T_1}$


3 consecutive identical digits (CIDs)

$\left|\frac{\phi_{out}}{\phi_{ref}}\right|$



$$\frac{\phi_{out}}{\phi_{ref}} = \frac{\frac{s^2 C}{I_0 K_{VCO}}}{\frac{s^2 C}{I_0 K_{VCO}} + sCR + 1} \times \frac{2\pi K_{VCO}}{s}$$

$$\frac{rad}{V} : \frac{\phi_{out}}{U_{in,R}} = \frac{2\pi \frac{S \cdot C}{I_0}}{D(s)}$$

$\phi_{out}, \quad |\phi_{out} - \phi_0|$