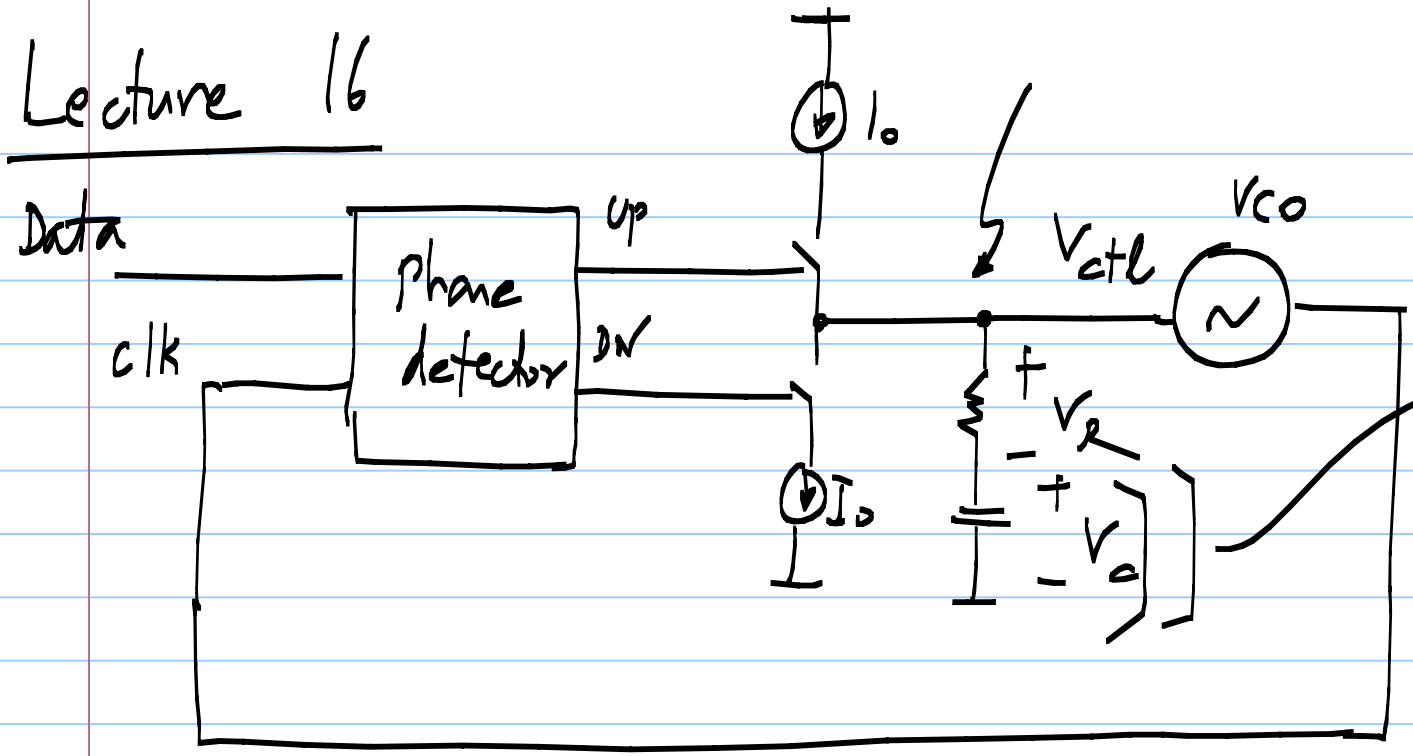
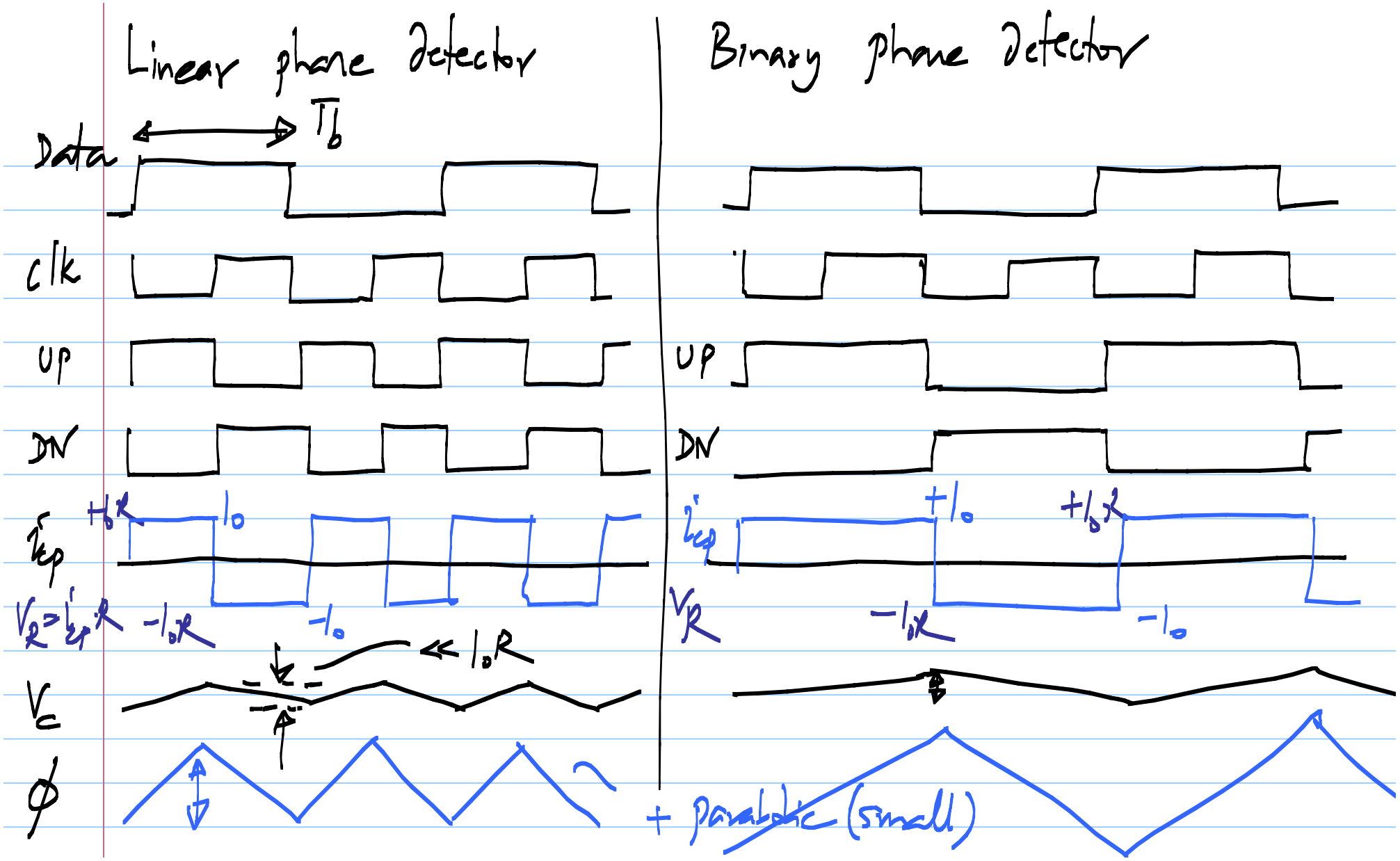
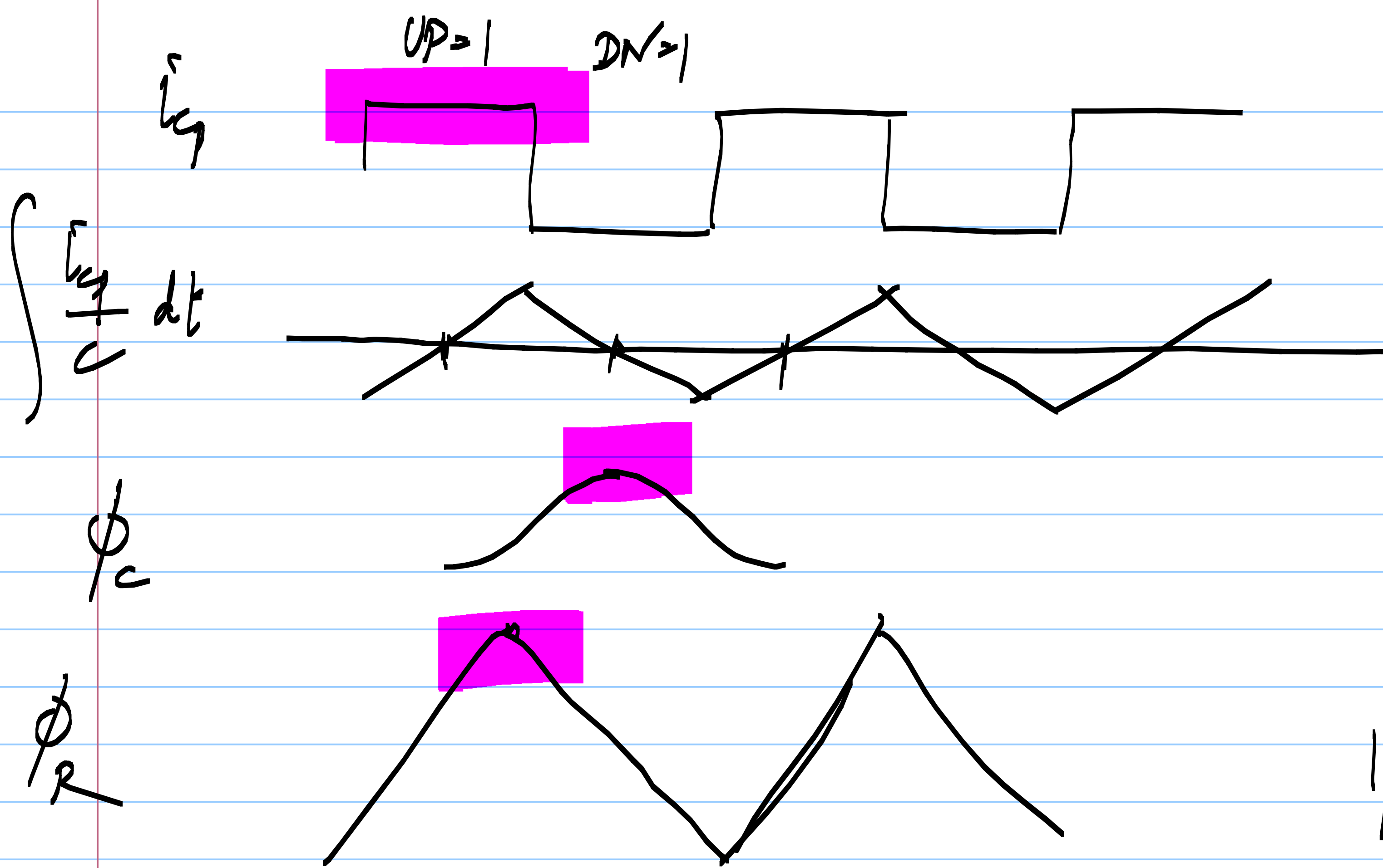
Lecture 16

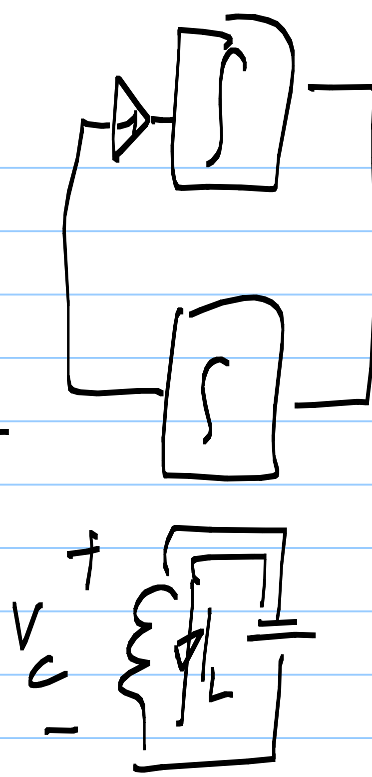


$f_0 + K_{VCO} \cdot V_c$

average value of V_c moves the frequency to the right value


Linear phase detector
Binary phase detector
Data
T_b
clk
up
DN
i_{cp}
$+I_0R$
I_0
$V_R = i_{cp} \cdot R$
$-I_0R$
$-I_0$
$\ll I_0R$
V_c
ϕ
up
DN
i_{cp}
$+I_0$
$+I_0R$
V_R
$-I_0R$
$-I_0$
+ parabolic (small)

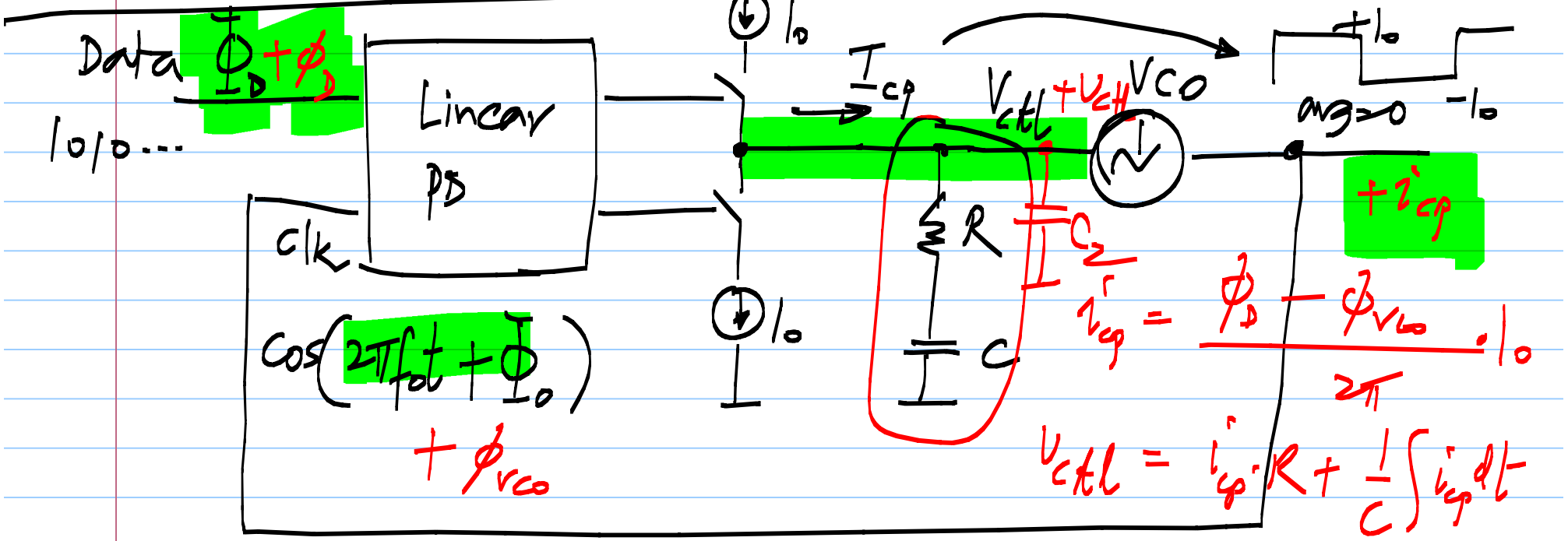


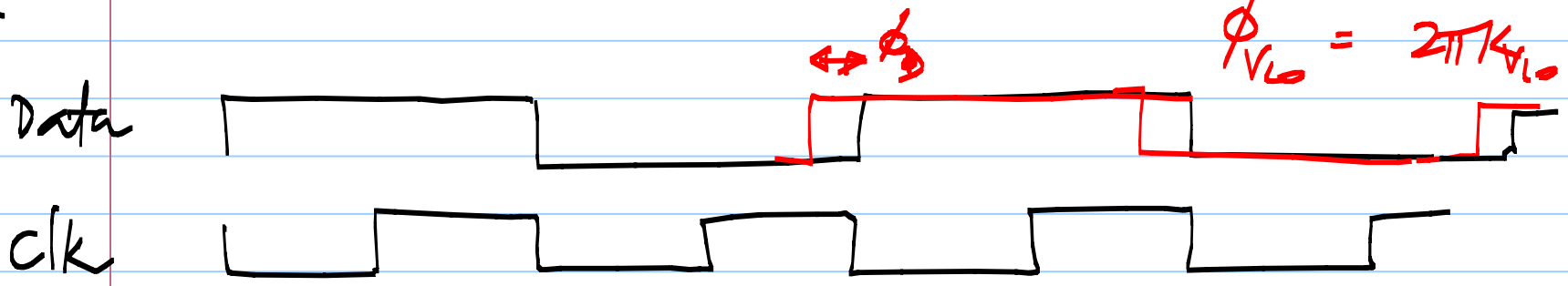


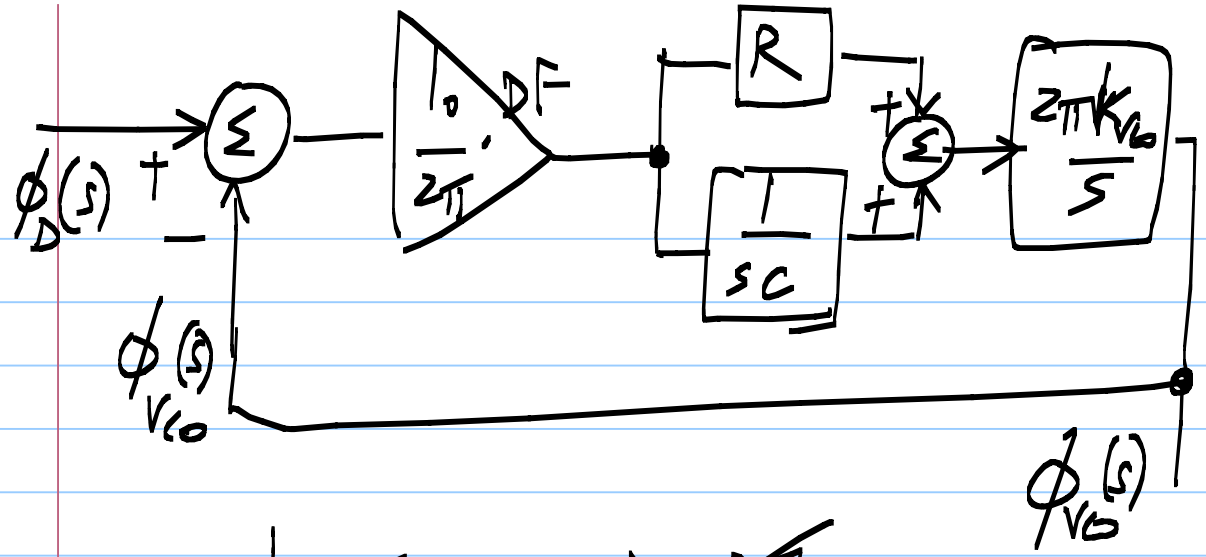
$$I_L = \frac{V_c}{sL}$$

$$-V_c = \frac{I_L}{sC}$$

Incremental model for the CDR loop with the linear PD







$$i_{cp} = \left(\phi_D - \phi_{VCO}\right)\frac{I_0}{2\pi}$$

$$v_{ctl} = \underbrace{i_{cp}\cdot R + \frac{1}{C}\int i_{cp}\,dt}$$

$$\phi_{VCO} = 2\pi K_{VCO}\int v_{ctl}\,dt$$

$$L(s) = \frac{I_0}{2\pi}\left(R + \frac{1}{sC}\right)\cdot\frac{2\pi K_{VCO}}{s}$$

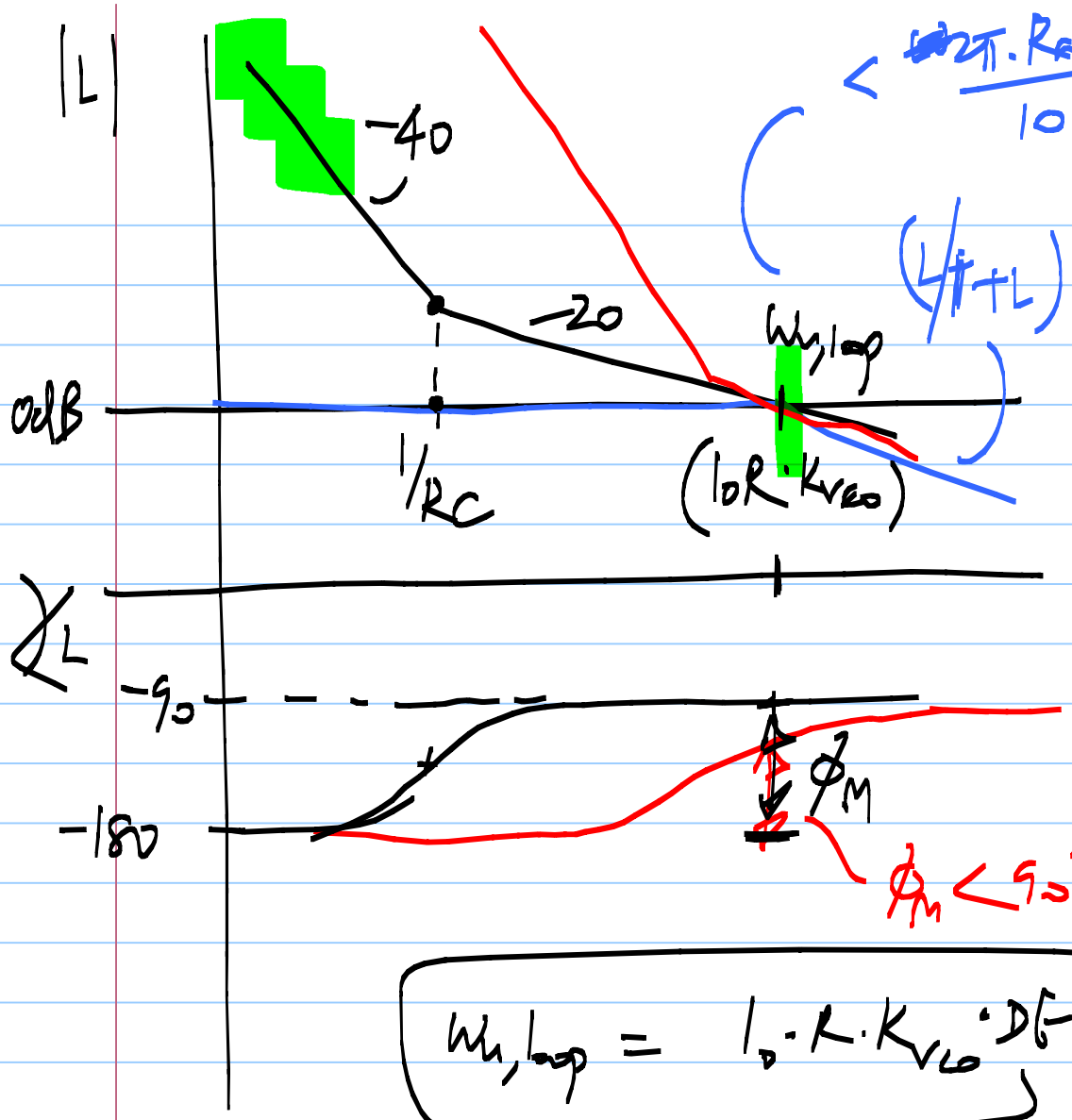
$$= \underbrace{\frac{I_0 R\cdot K_{VCO}}{s}}_{HF} + \underbrace{\frac{I_0}{C}\cdot\frac{K_{VCO}}{s^2}}_{LF}$$

$$= \frac{I_0 K_{VCO}}{C\cdot s^2}\left(1 + sCR\right)$$

2 poles @ origin

(Type II)

1 zero



$< \frac{2\pi \cdot Rate}{10}$

K_{VCO} · Hz/V

$\omega_{u,loop} = I_D R \cdot K_{VCO}$ · rad/s

$(1/F + L)$

Stability: $\omega_2 \ll \omega_{u,loop}$

(ϕ_M)

$\frac{1}{RC} \ll I_D R \cdot K_{VCO}$

$\frac{\phi_{VCO}}{\phi_D}$

$$\omega_{u,loop} = I_D \cdot R \cdot K_{VCO} \cdot DF$$

$$\frac{L}{1+L} = \frac{1}{1+\frac{1}{L}} \simeq 1 \quad \text{if } |L| \gg 1$$

$$\simeq L \quad \text{if } |L| \ll 1$$