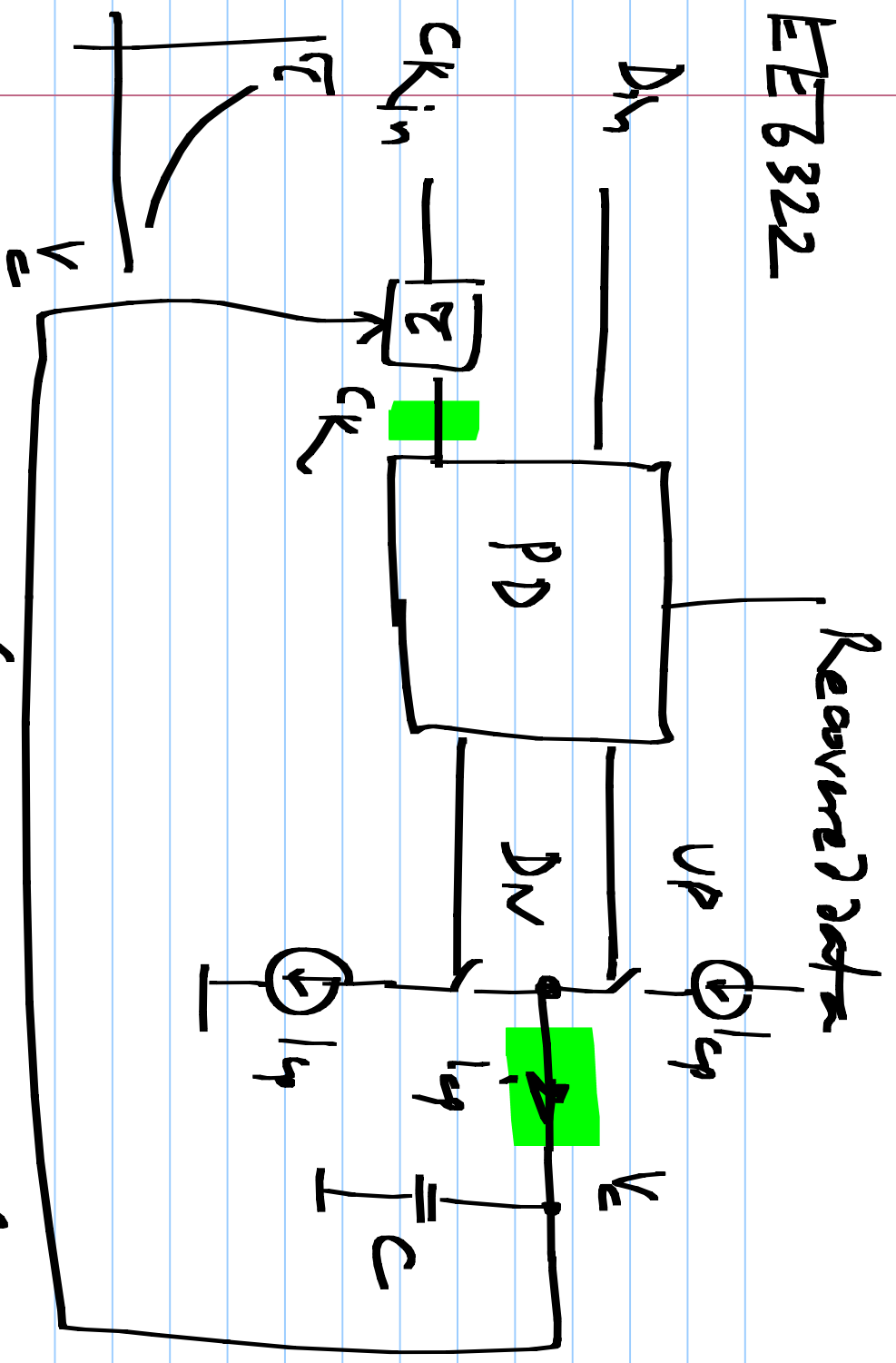
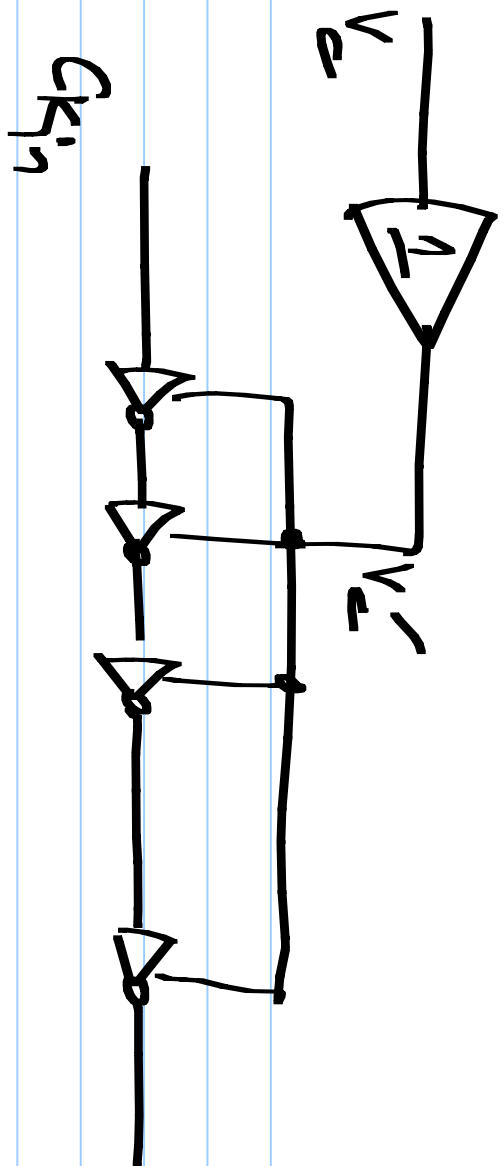


EECS 3322

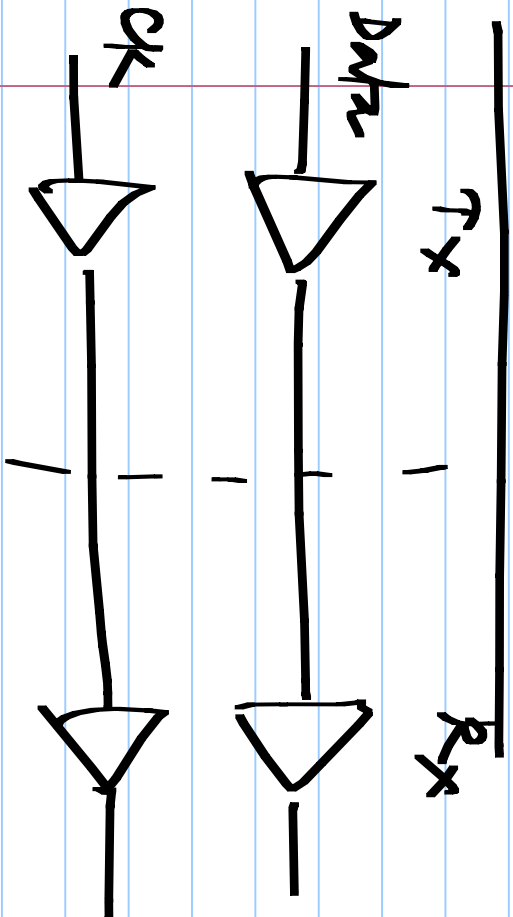
2/2/2018



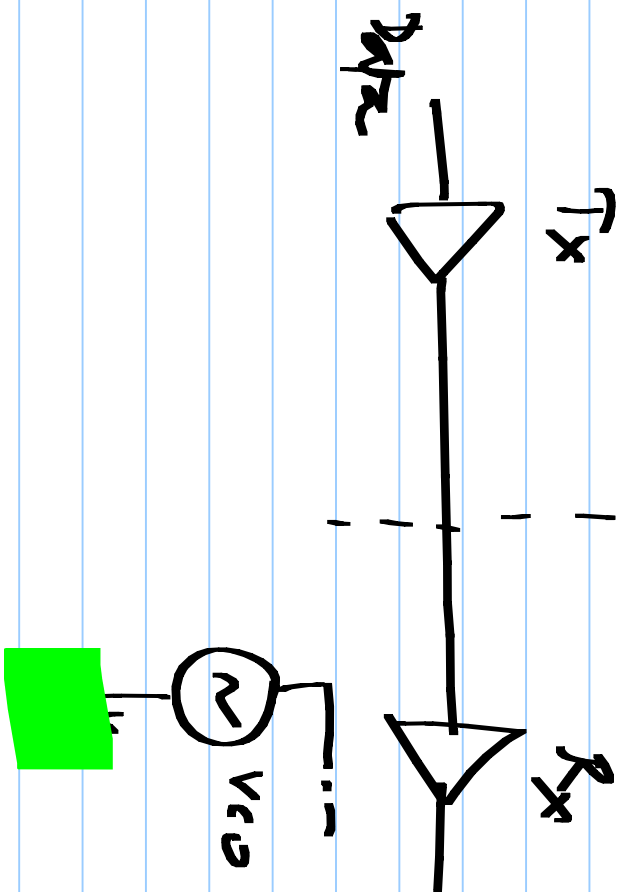
In steady state (avg. $i_p = 0$) Rising edge of the clock is in the middle of DATA symbol.

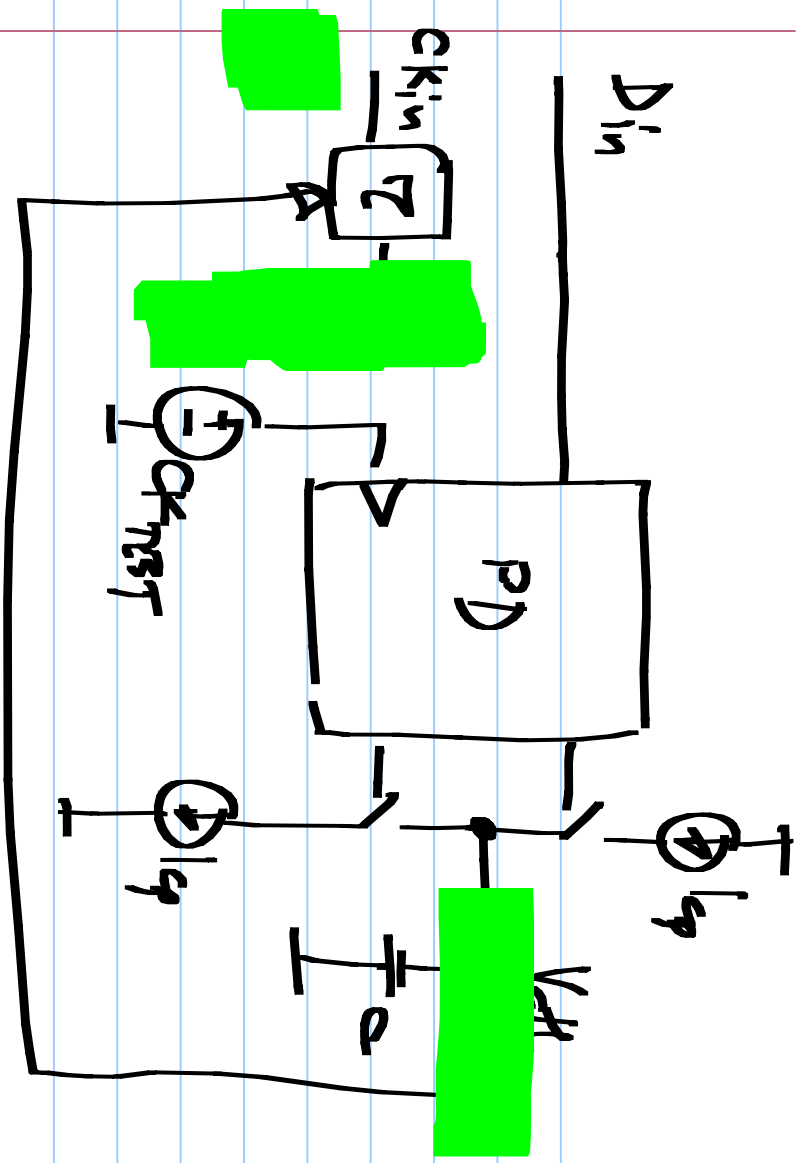


With forwarded clock:

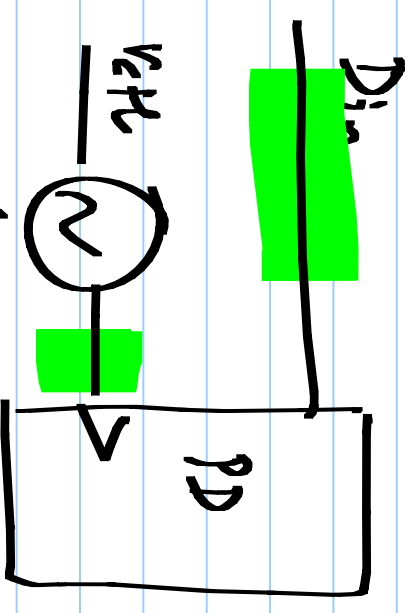


w/o forwarded clock





Clock w/ forwarded clock

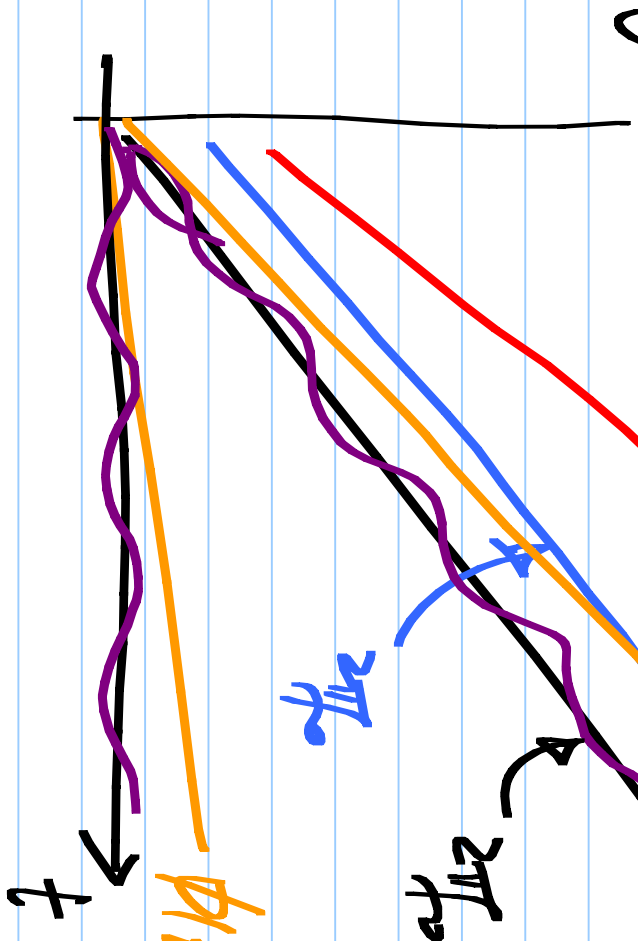


generate our clock

w/o forwarded clock

$p(\theta(t))$: p : periodic in θ with a period 2π
 $\cos(\theta(t))$: periodic in θ with a period 2π

$\theta = 2\pi f_0 t$ — signal with frequency f_0 Hz
 $\theta = 2\pi f_0 t + \phi_0$ — $2\pi f_0$ rad/s



$$\theta = 2\pi f_0 t + \phi_0 + \phi(t)$$

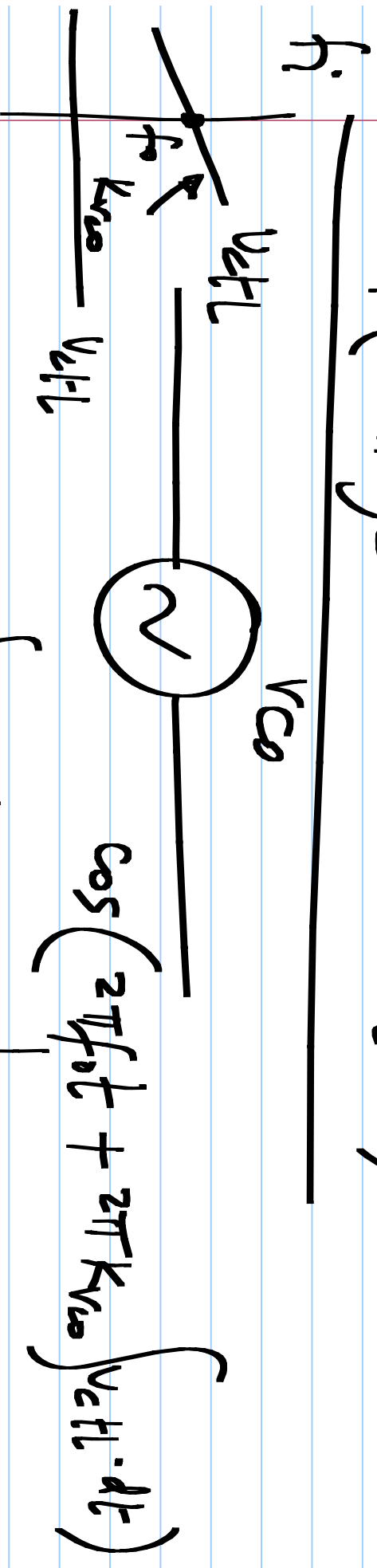
$$f_i = \frac{1}{2\pi} \left[\frac{d\theta}{dt} \right]$$

$$\theta(t) = 2\pi f_0 t + \phi(t)$$

$$f_1 \neq f_0$$

$$2\pi f_0 t + 2\pi (f_1 - f_0) t$$

VCO: (Voltage controlled oscillator)



free running

$$\theta = 2\pi f_o t + 2\pi K_{VCO} \int V_{ctl} \cdot dt$$

$$f_i = \frac{1}{2\pi} \cdot \frac{d\theta}{dt} = f_o + K_{VCO} \cdot V_{ctl}$$

freq. of the vco

$$\rightarrow 42/V$$

θ

θ

higher freq

$2\pi f_c t$ free-running

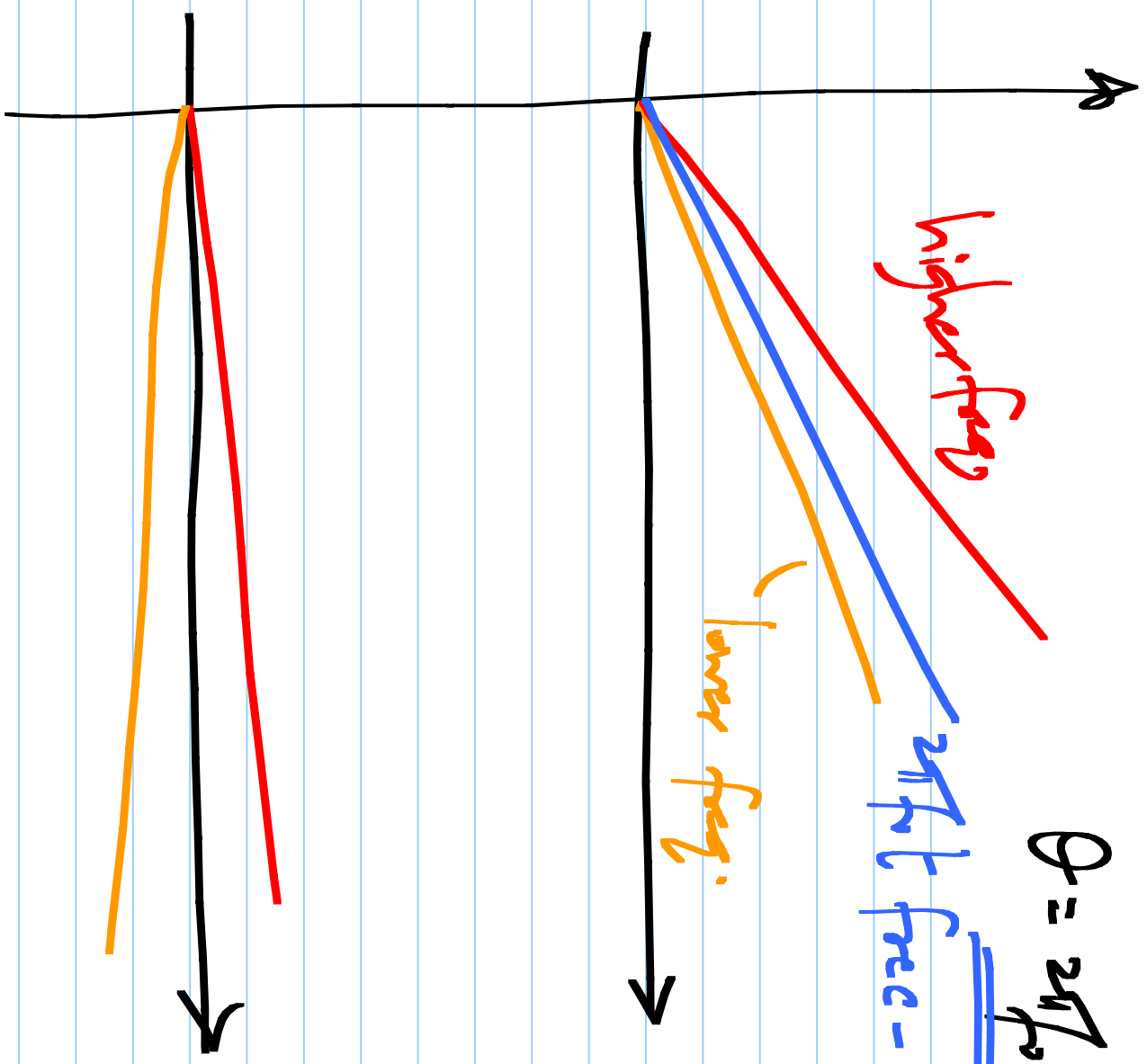
$$\theta = 2\pi f_c t + 2\pi K_v \int v_{eH} dt$$

lower freq

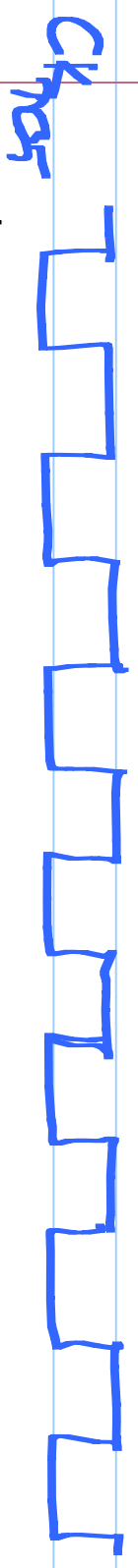
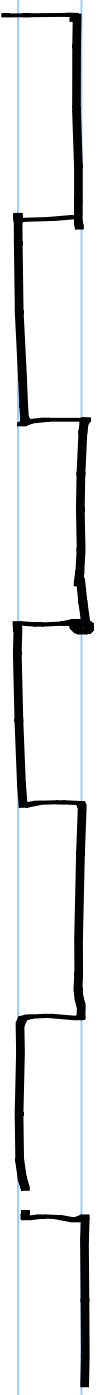
θ

dc $v_{eH} > 0$

dc $v_{eH} < 0$



CDR w/ forwarded clock: loop broken



$A_{\text{avg}}(V_{\text{avg}})$



V_{avg}
lang. behavior



Ск: 3



Ск

