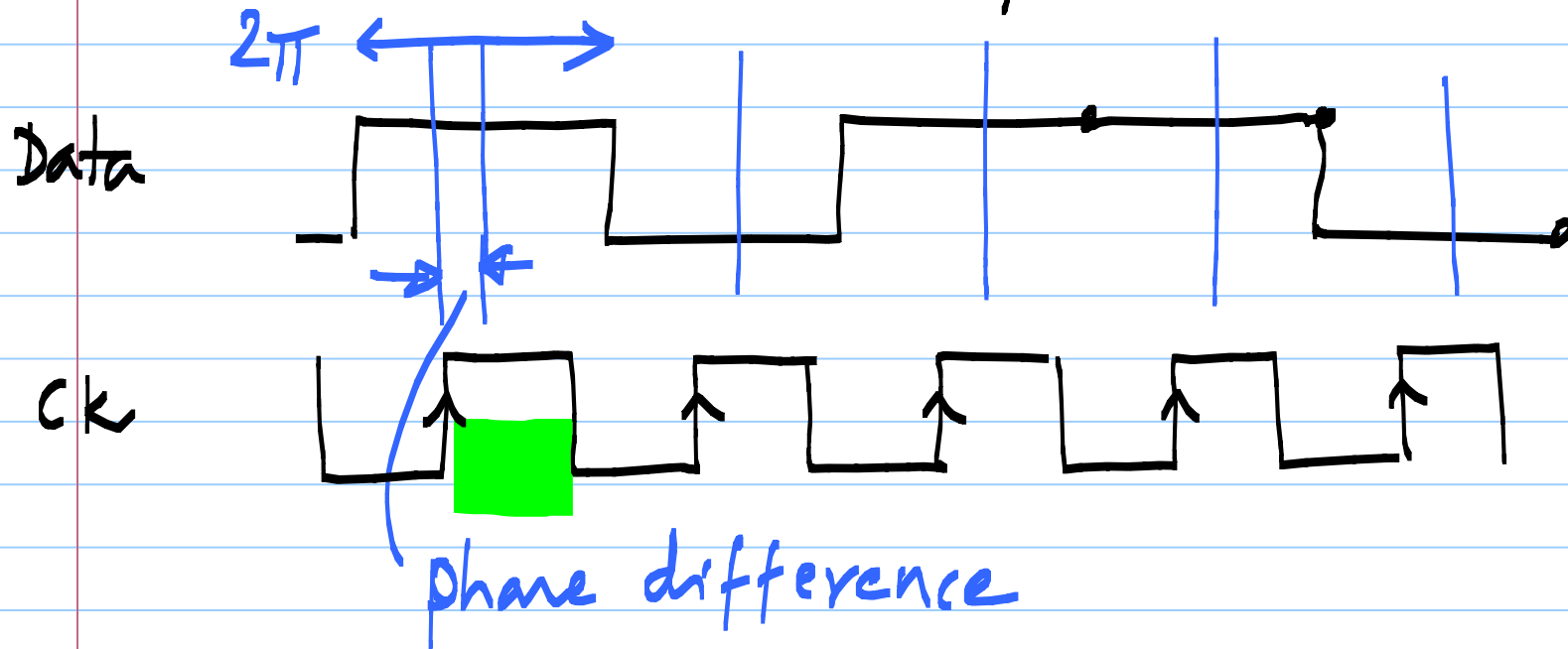
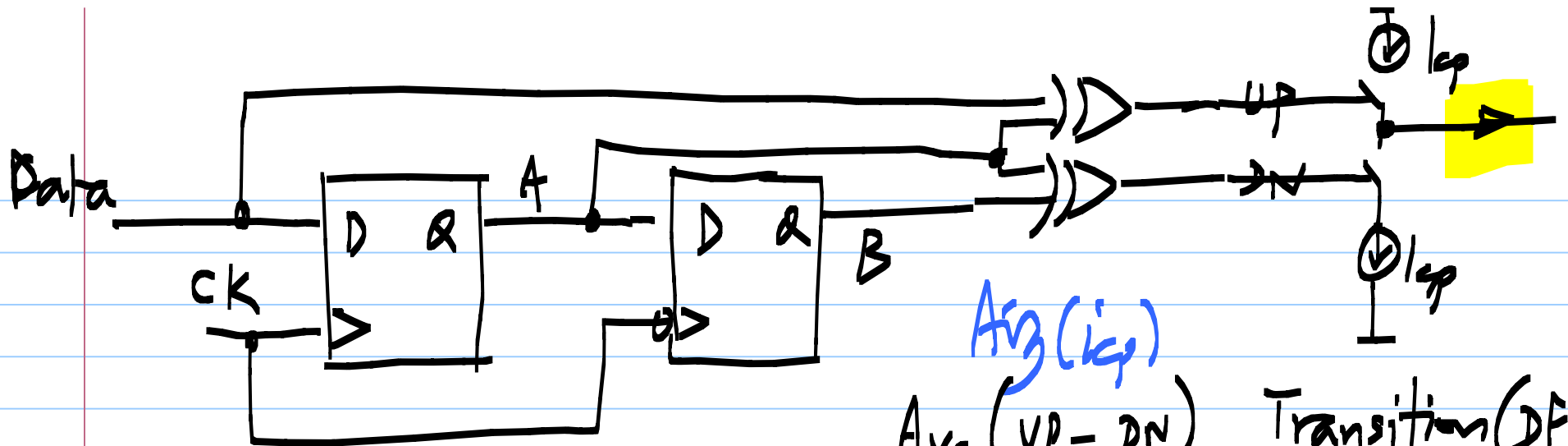


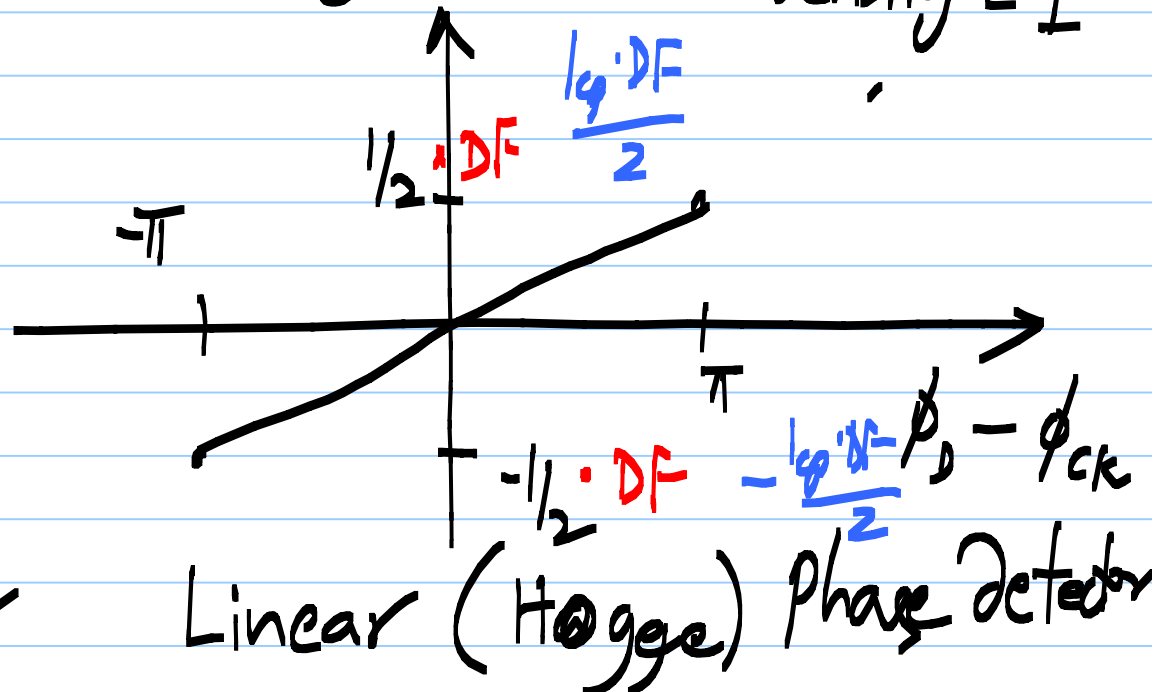
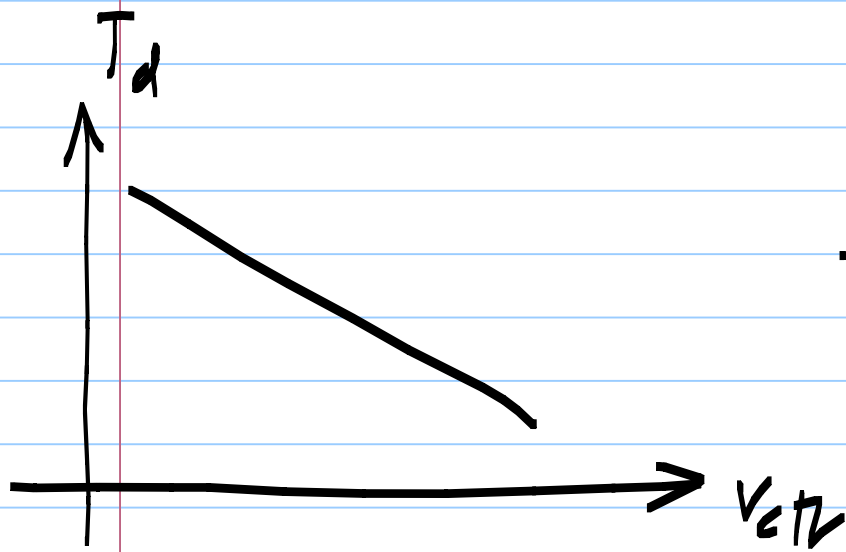
Clock and data recovery circuits

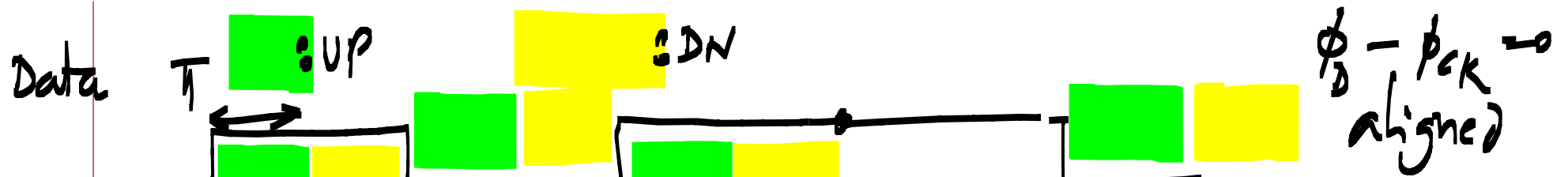
- Random data
- with forwarded clock.
- Recover the clock phase.





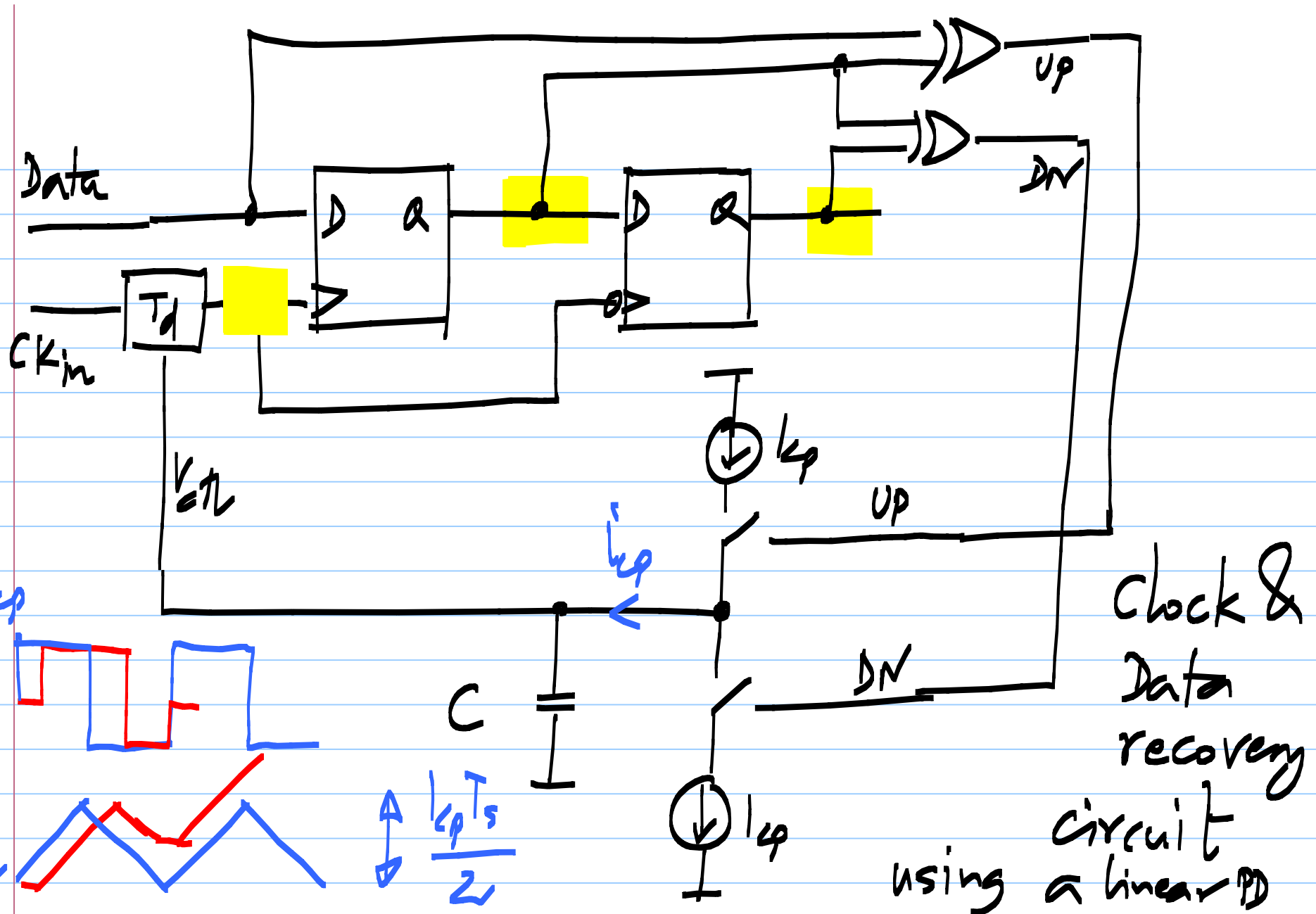
$Avg(I_{cp})$
 $Avg(V_p - V_n)$, Transition (DF)
 density = 1

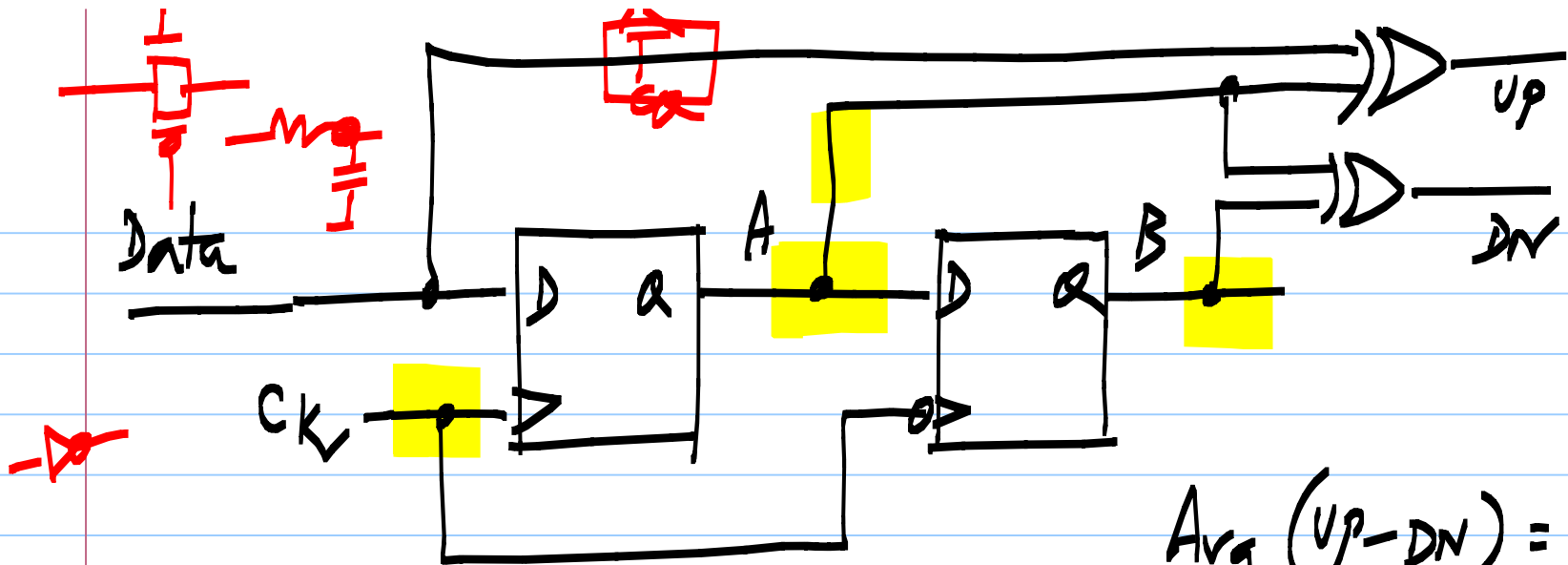




DN: width = π ; width of up pulse: $\pi + (\phi_D - \phi_{CK})$

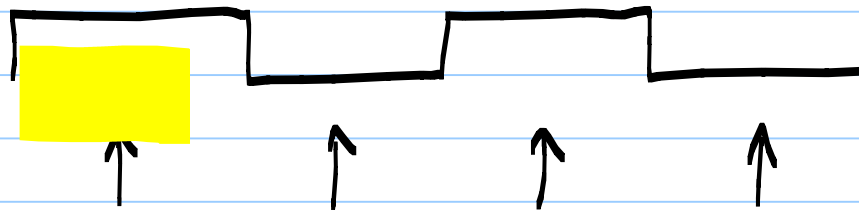
$$\begin{aligned} \text{Avg (UP-DN)} &= \text{Avg (UP)} - \text{Avg (DN)} \\ &= \frac{\phi_D - \phi_{EK} + \pi}{2\pi} - \frac{\pi}{2\pi} \\ &= \frac{\phi_D - \phi_{EK}}{2\pi} \end{aligned}$$





$$\text{Avg (UP-DN)} = \frac{\phi_D - \phi_{CK}}{2\pi}$$

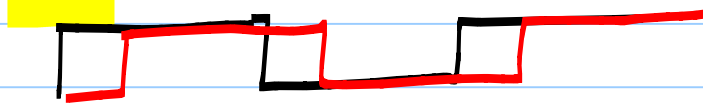
Data



A



B



$$+ \frac{t_{co}}{T_s}$$

CDR will lock with an offset