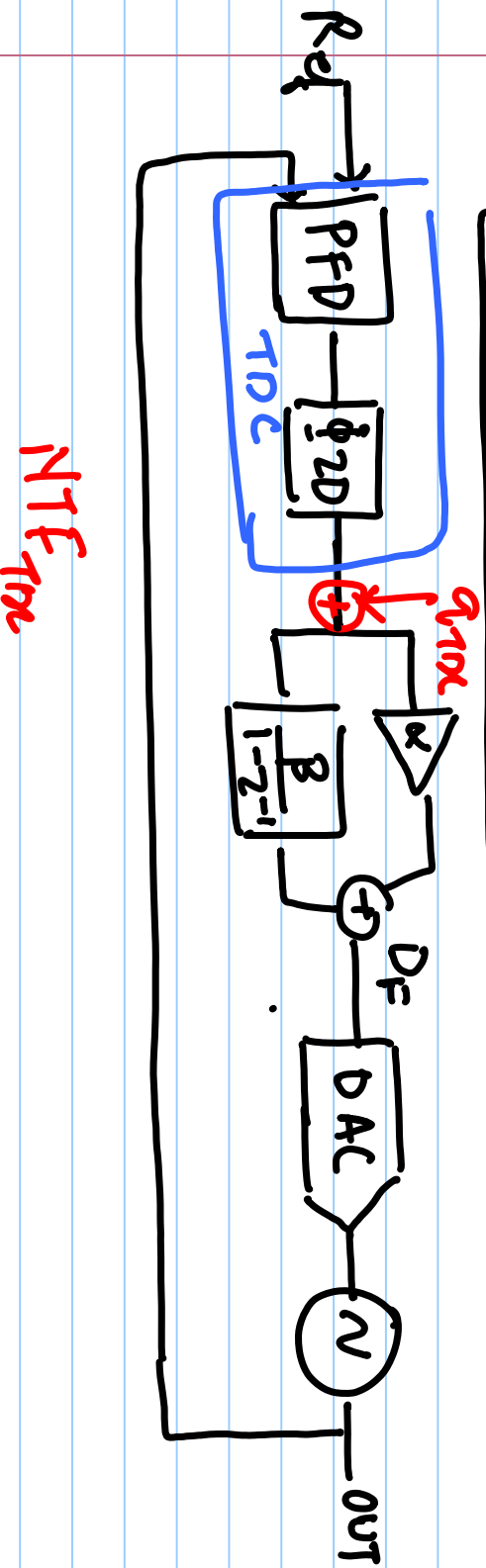
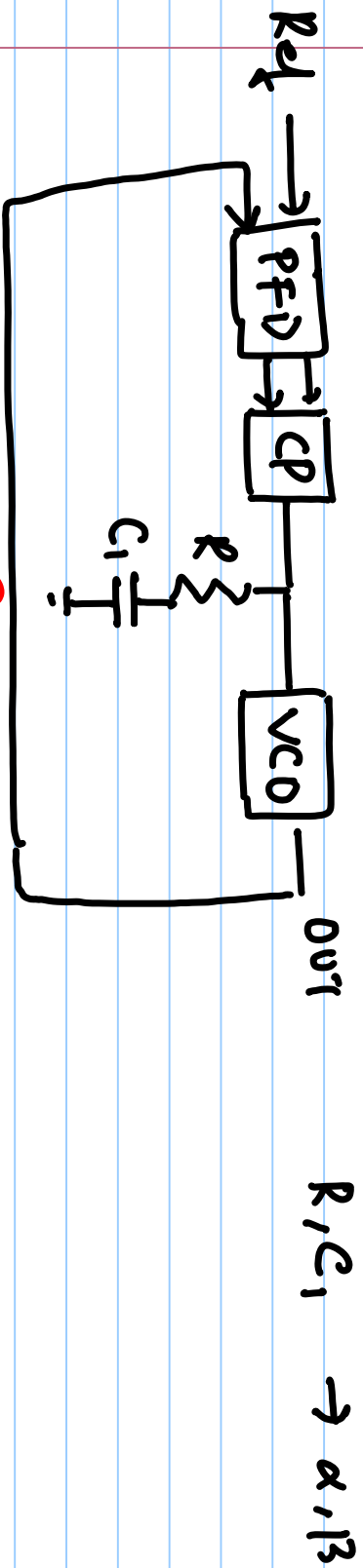
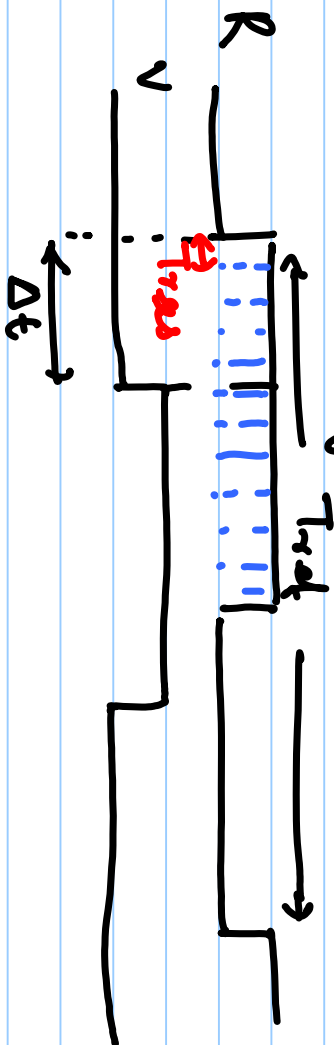


Lecture # 44

Digital PLL



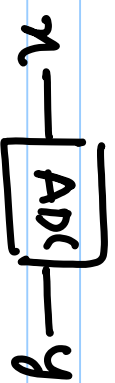
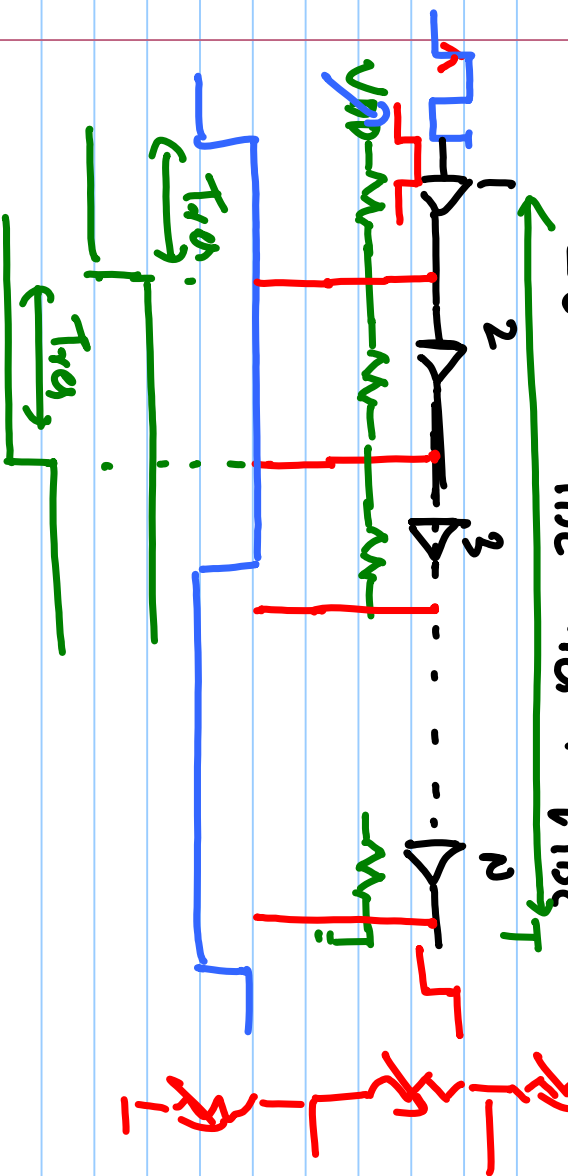
Time to Digital Converter (TDC)



$$\phi_{err} = 2\pi \cdot \frac{\Delta t}{T_{req}}$$

$$T_{req} = N \times T_{res}$$

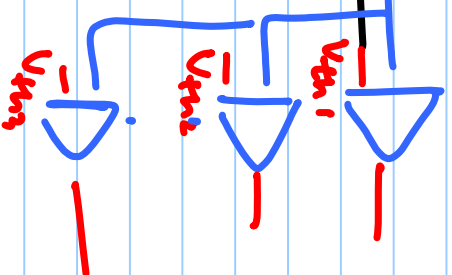
$$\Delta t = D_{TDC} \times T_{res} + q \cdot T_{DQS}$$

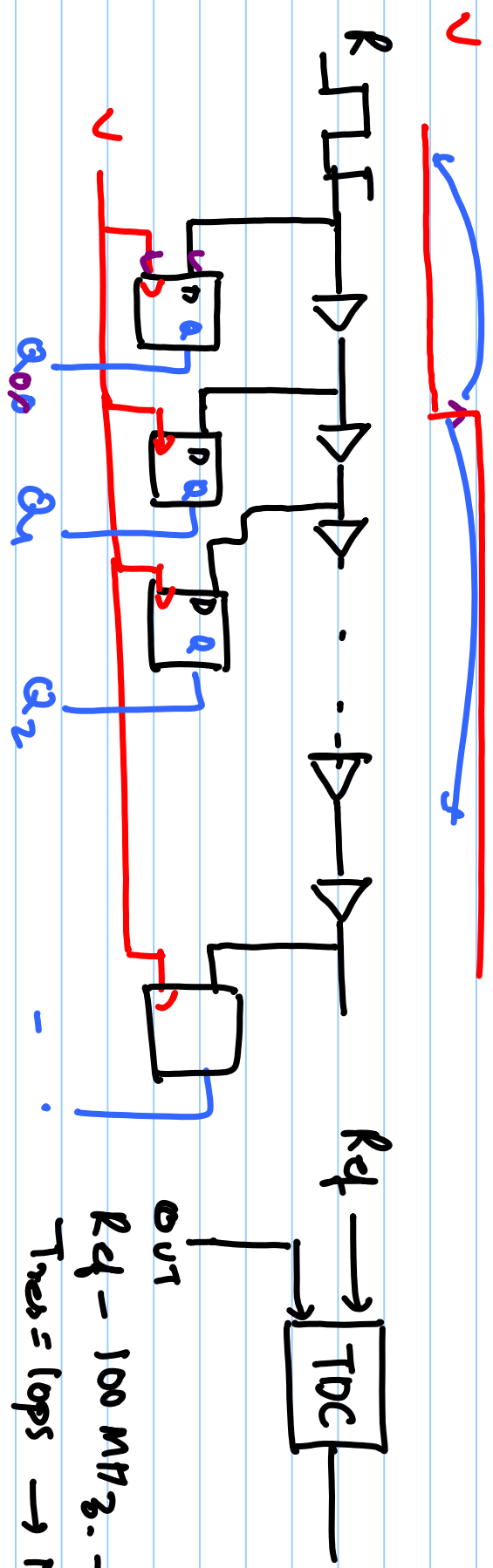
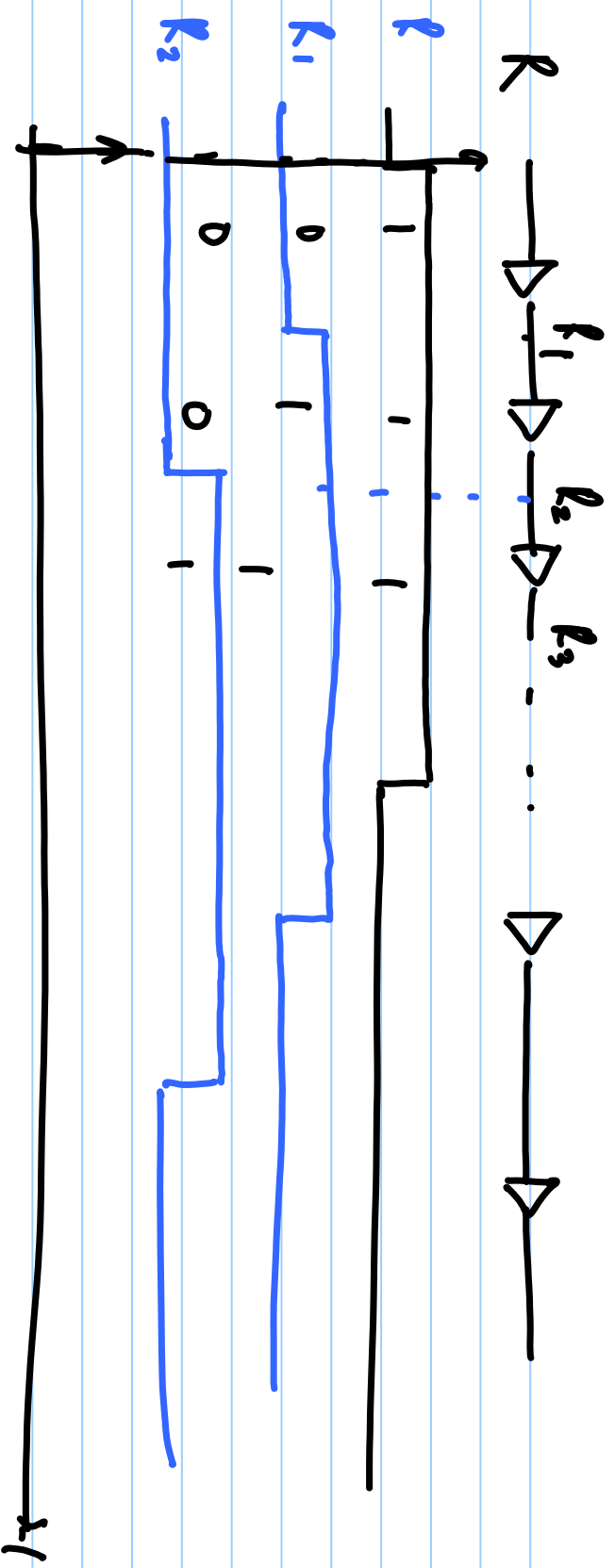


$$y = x + q$$

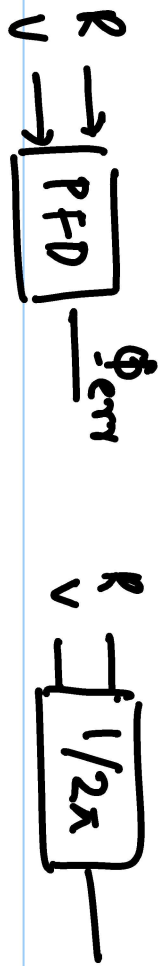
$$V_{USB} = \frac{V_{DD}}{N}$$

$$T_{USB} = \frac{T}{N}$$





$R_{cl} \rightarrow$ out
 $R_{cl} - 100 \text{ MHz} \rightarrow 10 \text{ ns}$
 $T_{res} = 10 \text{ ps} \rightarrow N = 1000$



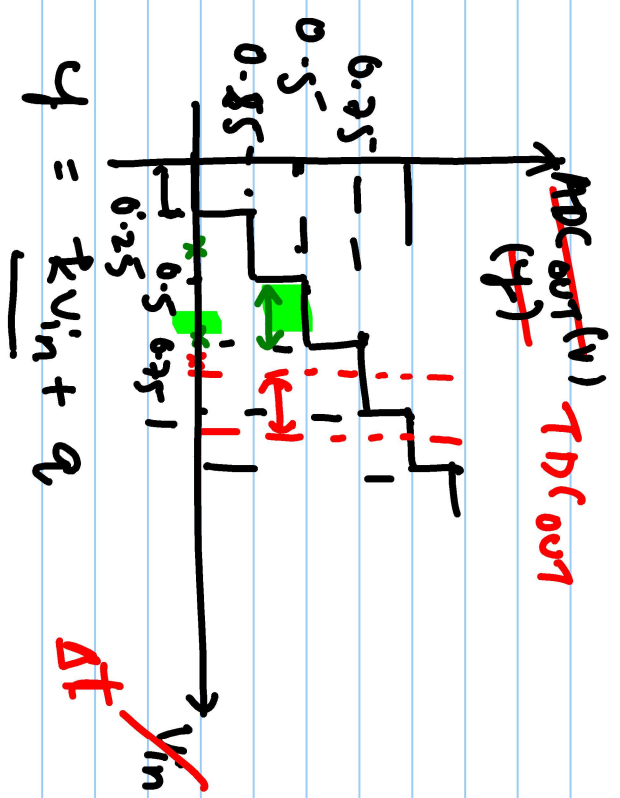
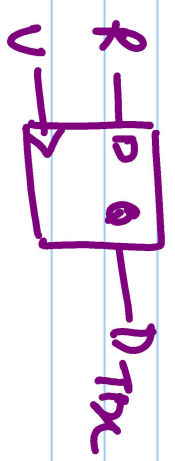
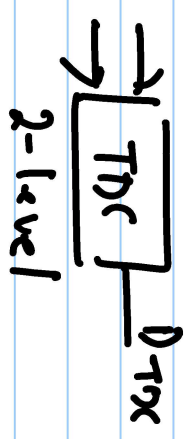
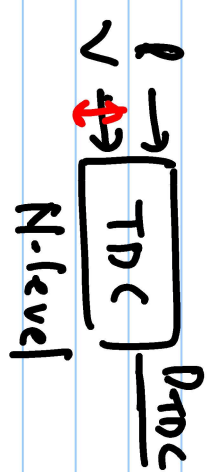
$$T_{res} = \frac{T_{ref}}{N}$$

$$\phi_{res} = 2\pi \cdot \frac{T_{res}}{T_{ref}}$$

$$= \frac{2\pi}{N}$$

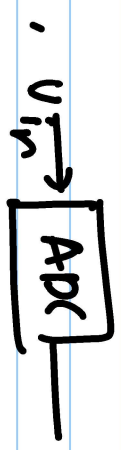
N: Number of delay cells

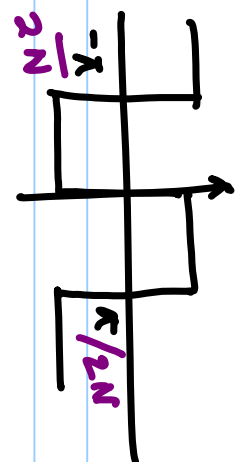
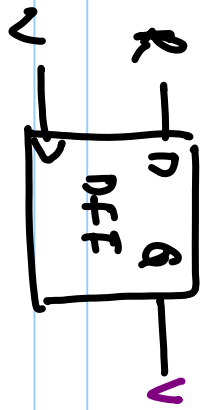
$$|q_{TDC}| < \frac{\phi_{res}}{2}$$



$$y = k V_{in} + q$$

$$= 1 V_{in} + q$$

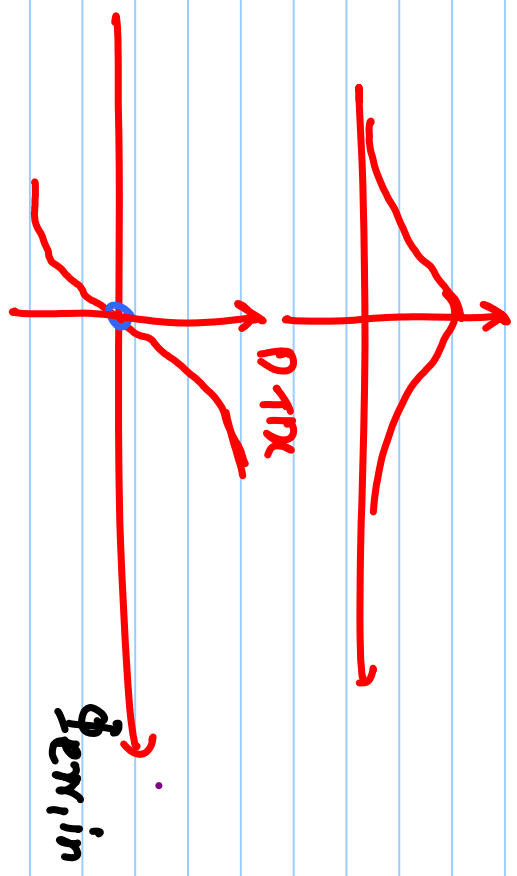




N-level TDC in locked

(1-bit TDC (CTOC) (Statistical gain) f (jitter))

↓
Depends on S_{TDC}



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