

# Lecture # 24

Phase frequency detector :

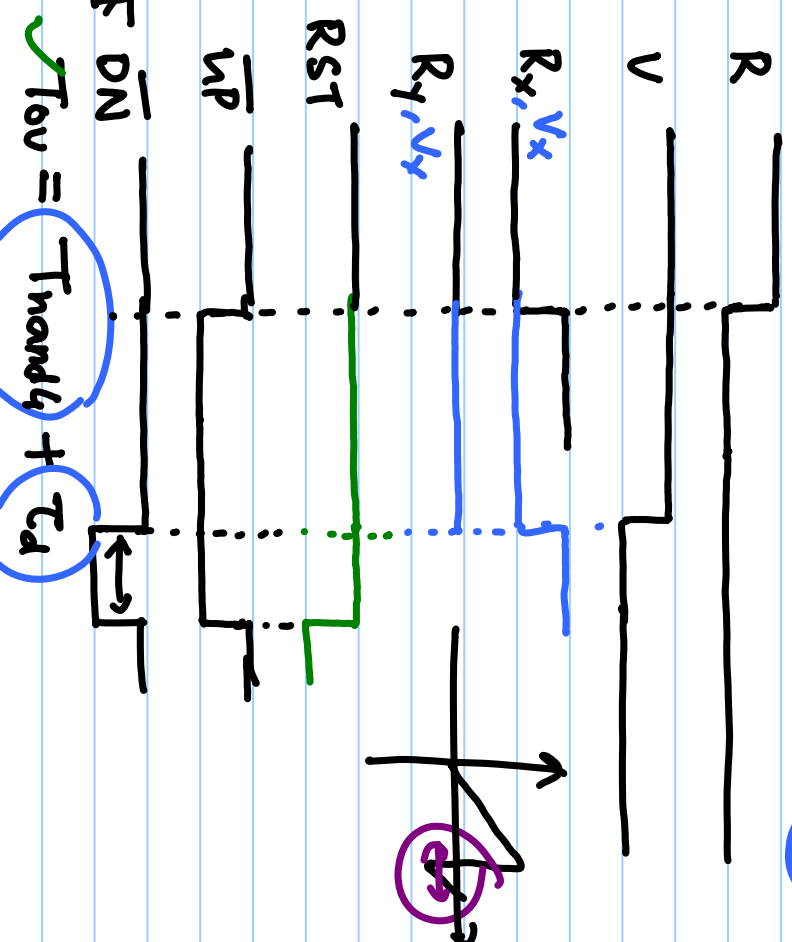
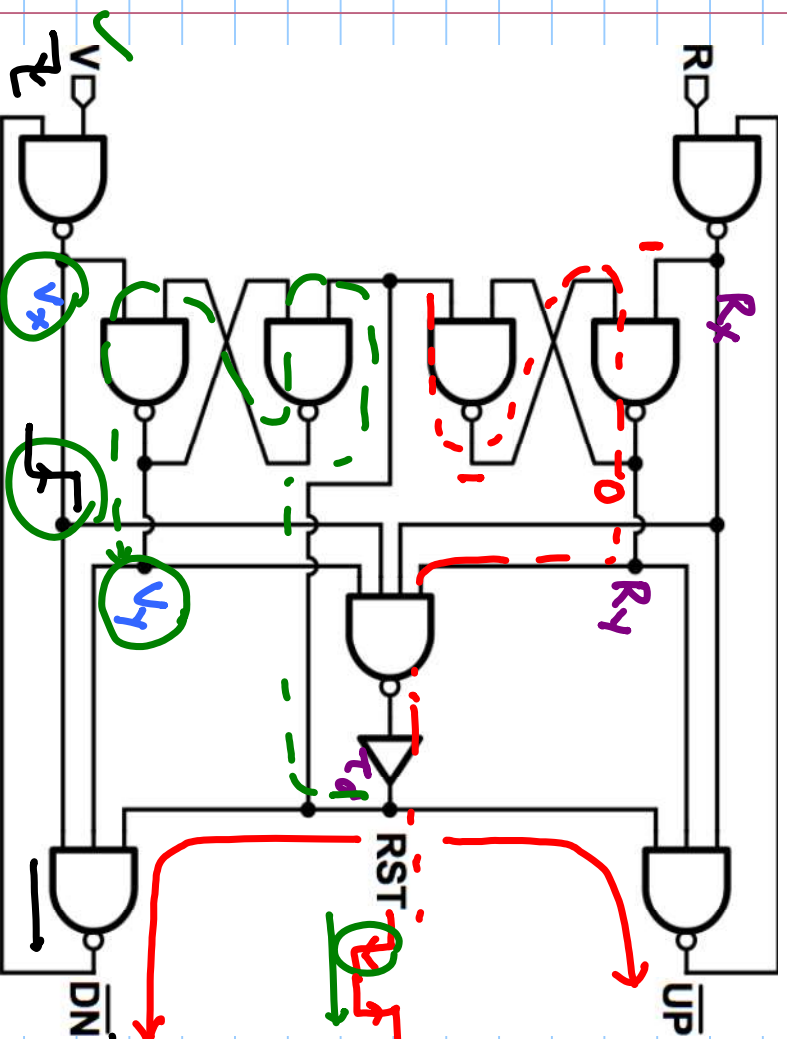
1. D-flipflops & NAND gate

$$T_{RST} = T_{RST-Q} + T_{NAND} + T_d$$

2. NAND based PFD

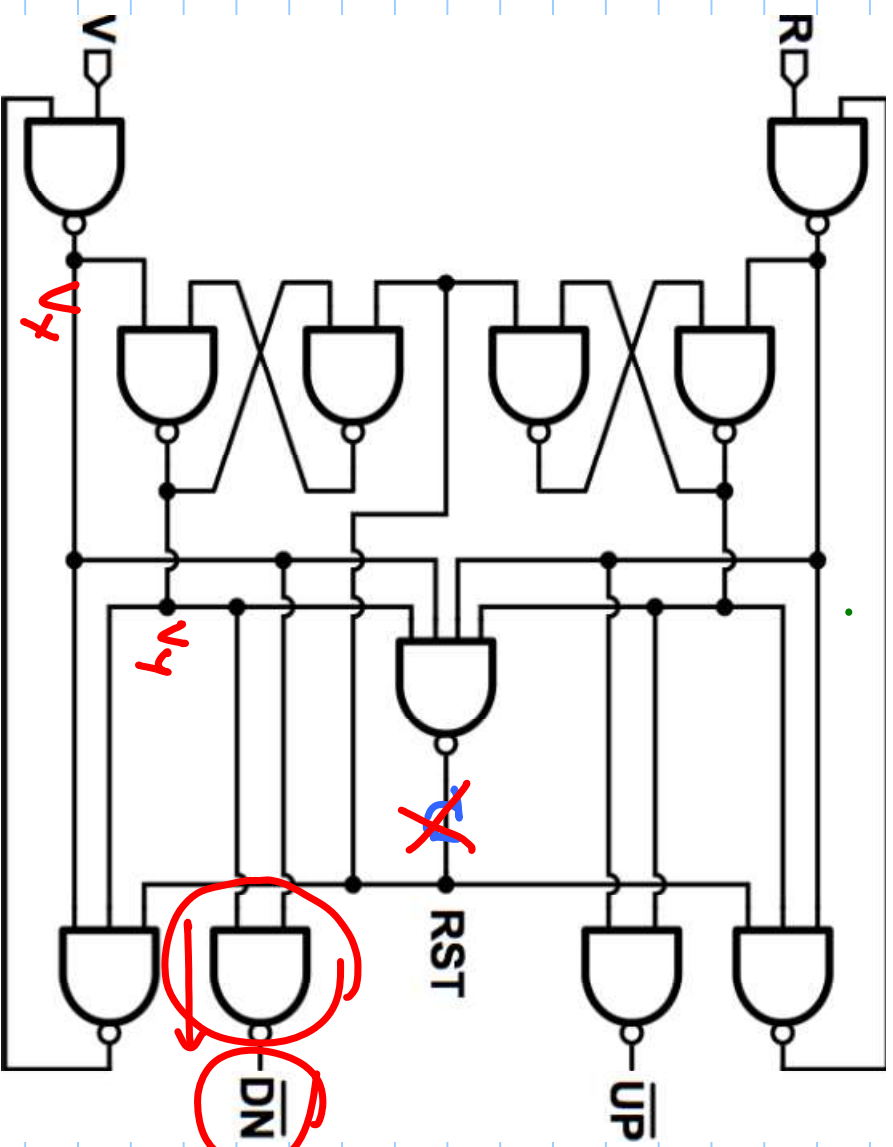
$$T_{ov} = ''$$

$$T_{RST} = 2T_{nand2} + T_{nand4} + T_d$$



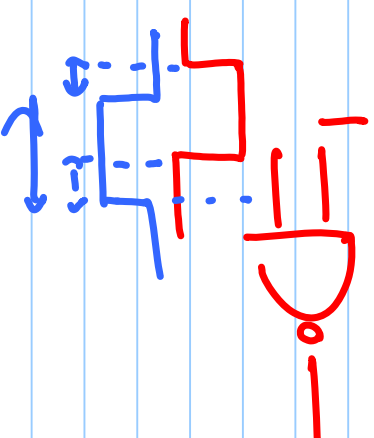
$$T_{ov} = T_{nand4} + T_d$$

$$T_{\text{ NAND } 4} + T_d + 2T_{\text{ NAND } 2}$$

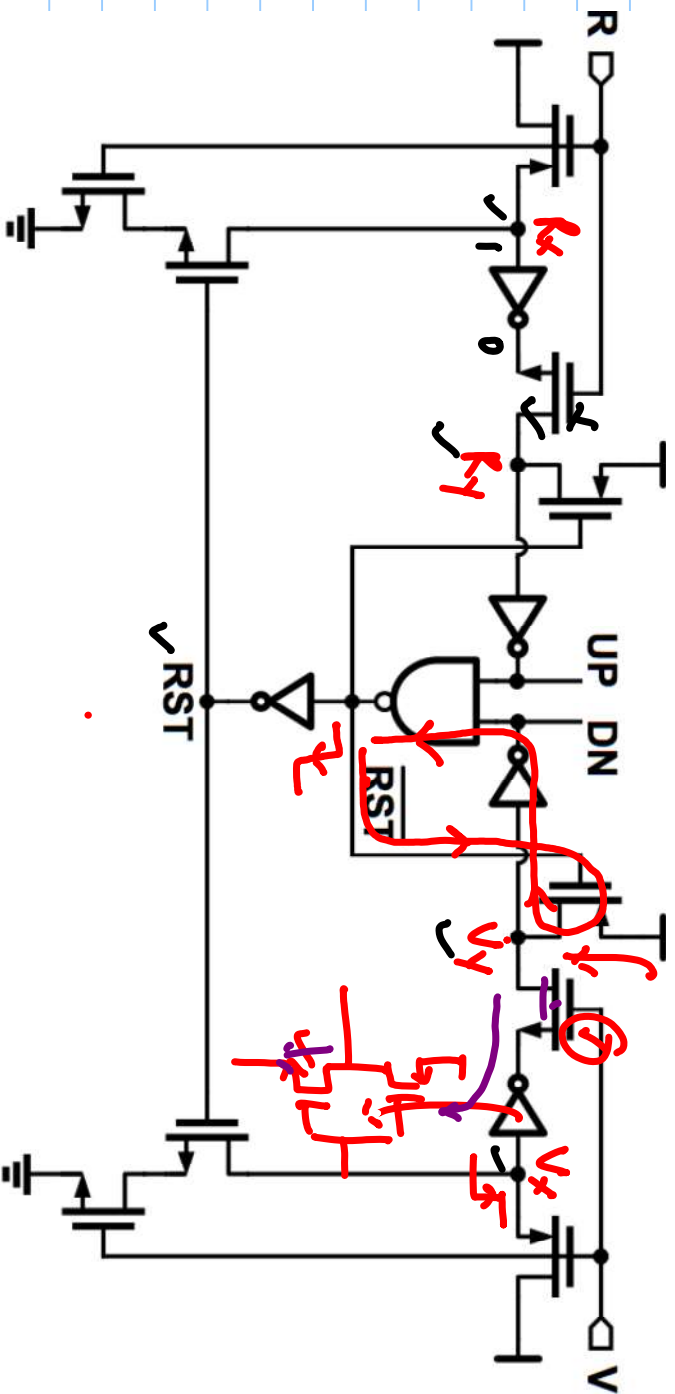
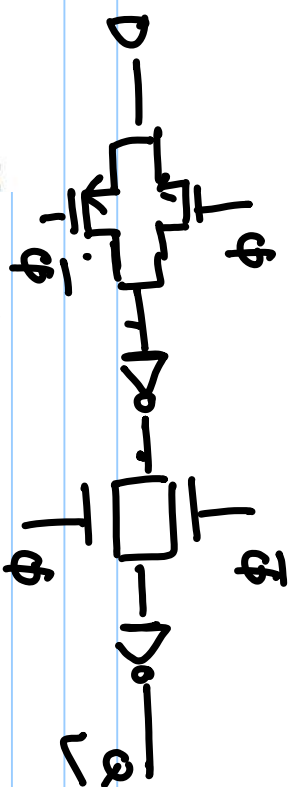


$$T_{OV} = 2T_{\text{ NAND } 2} + T_{\text{ NAND } 4}$$

$$T_{RST} = 2T_{\text{ NAND } 2} + T_{\text{ NAND } 4}$$

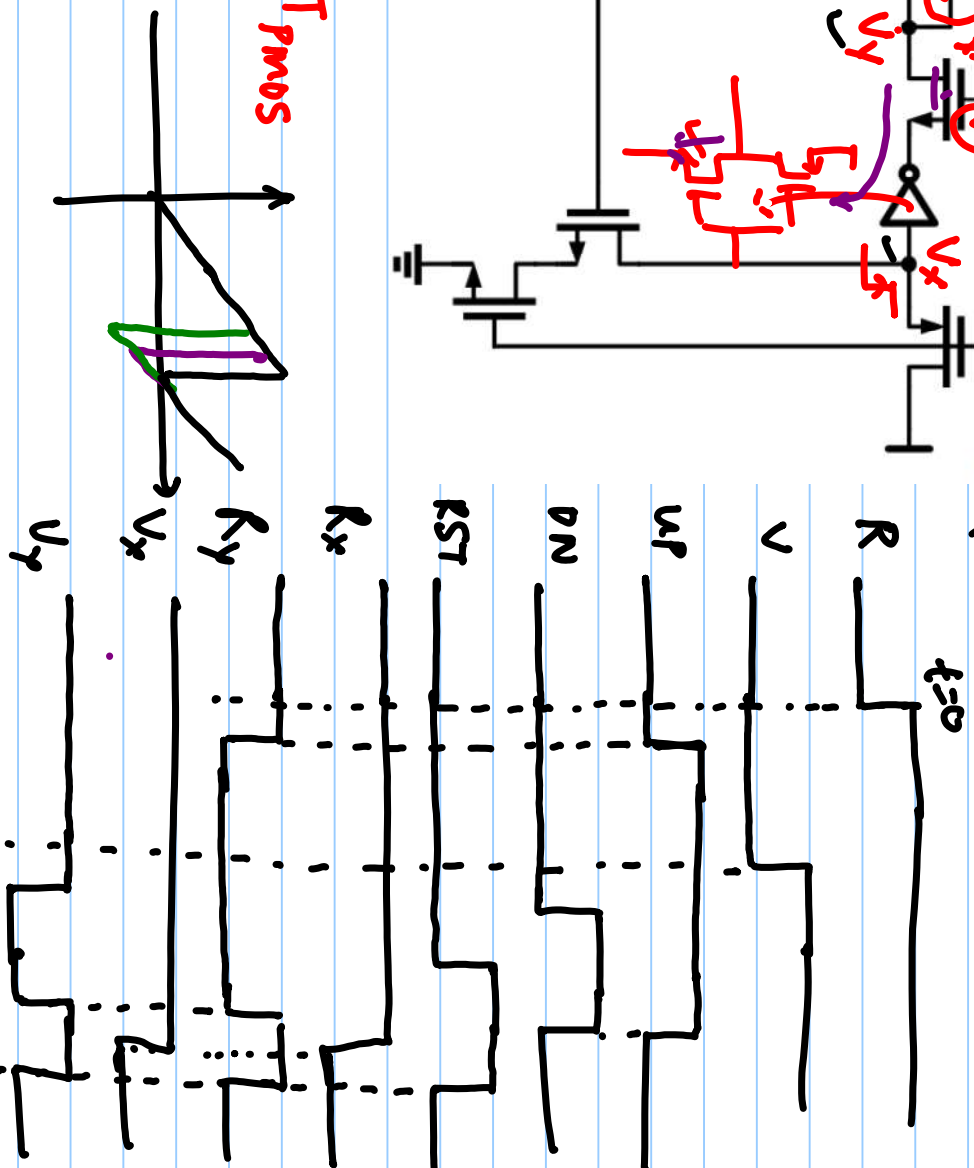


# Pass-transistor for PFD

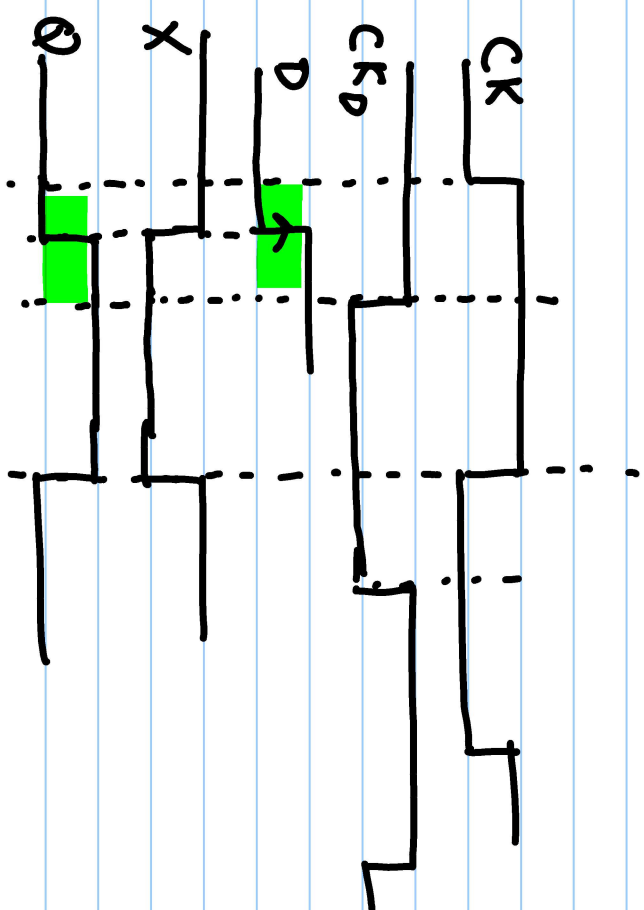
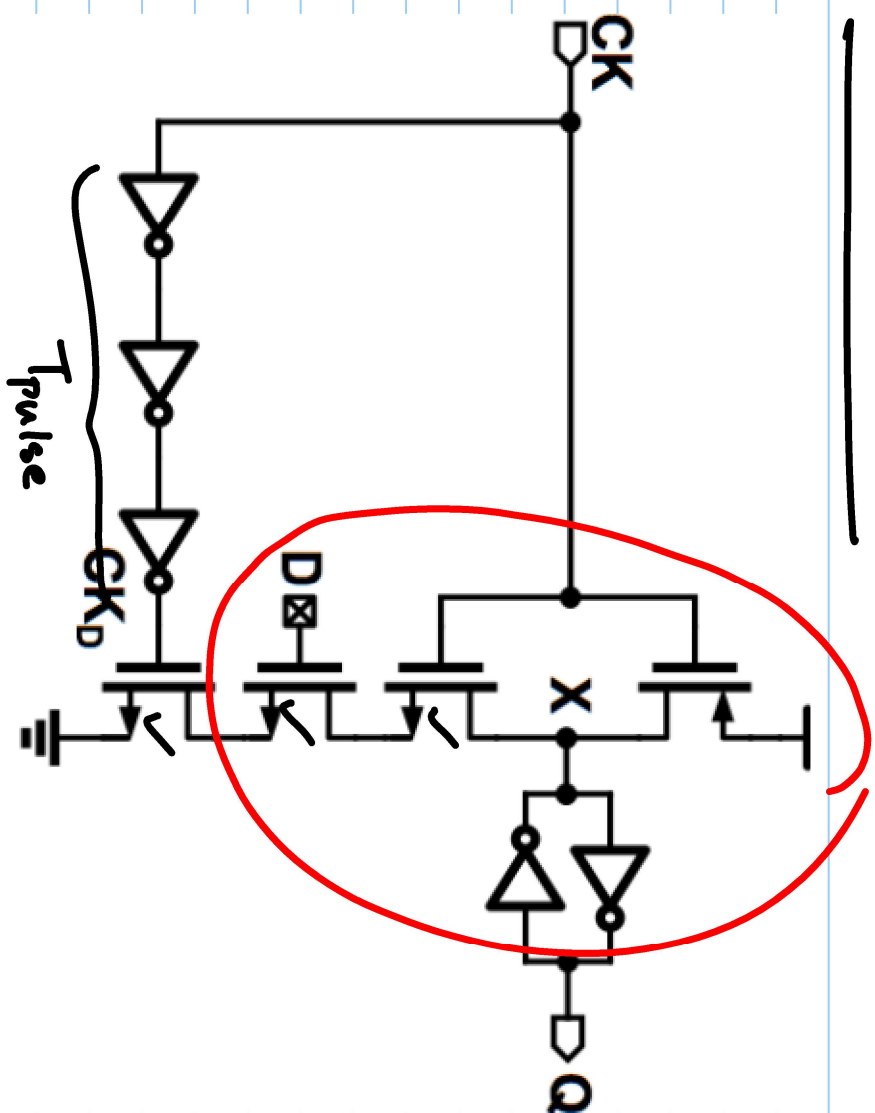


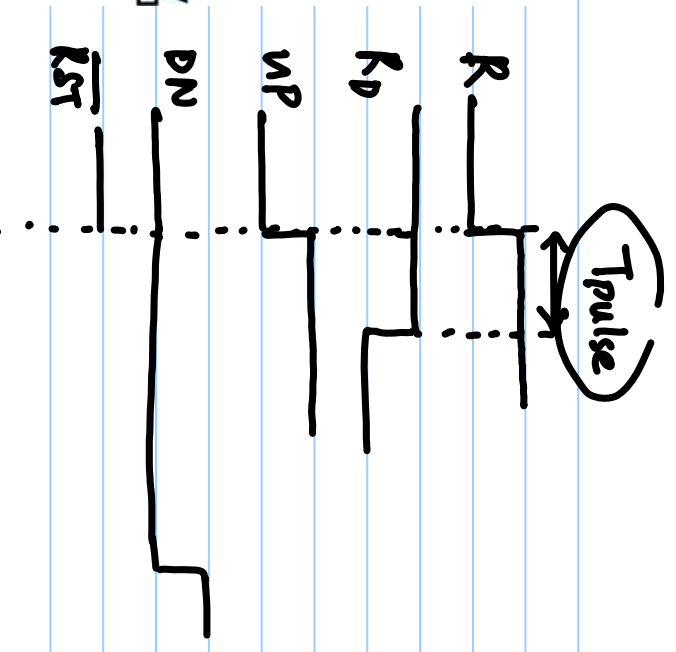
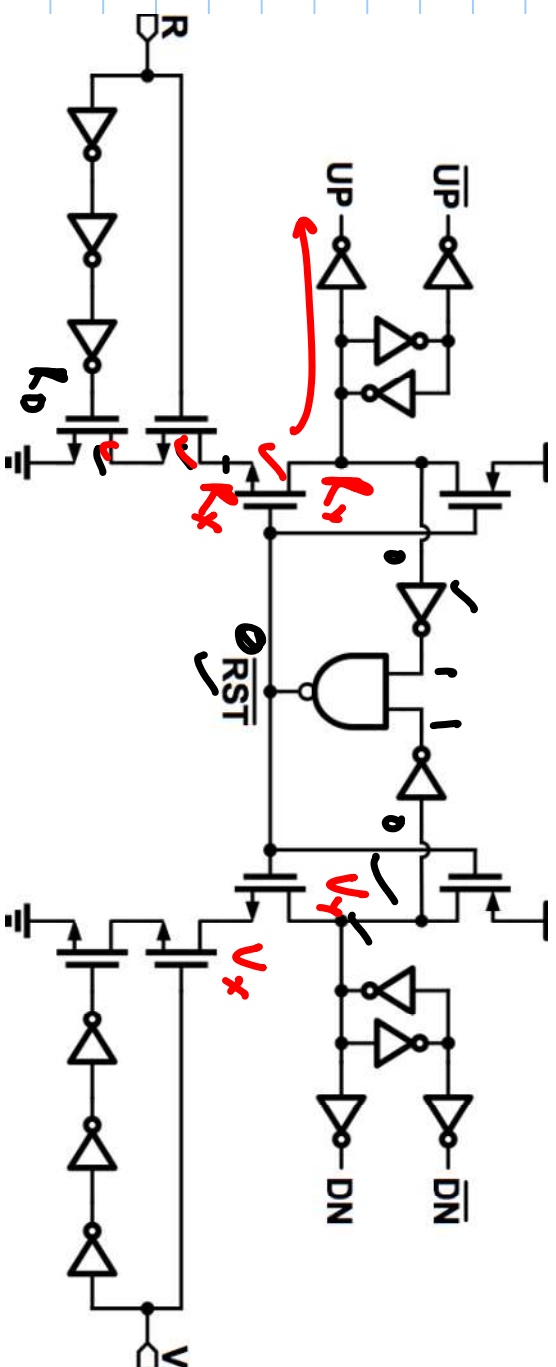
$$T_{RST} = T_{hand2} + T_{inv} + T_{pmos}$$

$$T_{RST} = T_{ov} \approx 2T_{hand2} + T_{inv}$$



# Glitch-based PFD





$$T_{RST} = 2T_{inu} + T_{and2}$$

