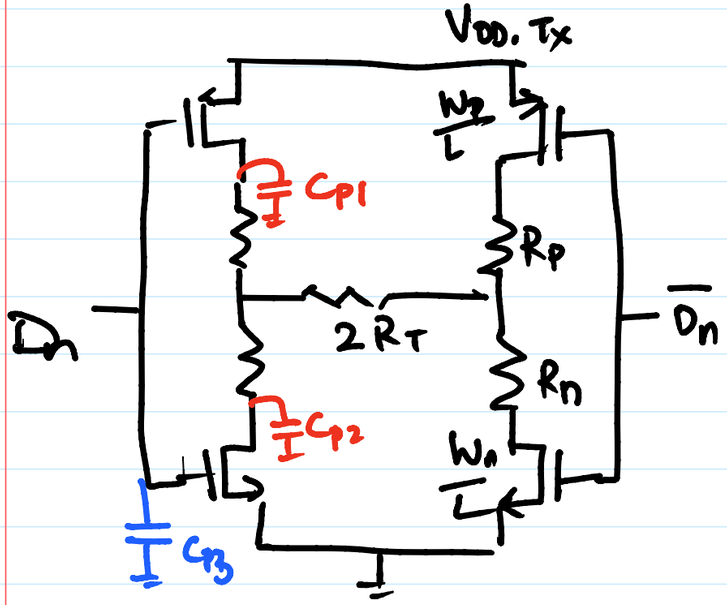
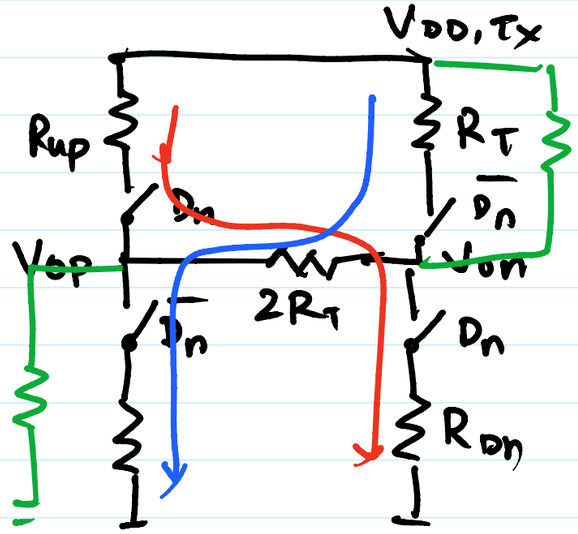
Lecture 36

Monday, October 17, 2016 9:58 AM

Lecture - 36

High Swing VM o/p driver



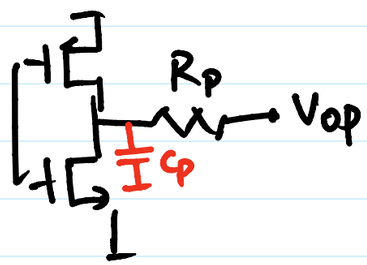


$$V_{op} - V_{on} = \pm \frac{V_{DD,Tx}}{2}$$

$$R_T = R_{PMOS} + R_D$$

$$= R_{NMOS} + R_D$$

$R_P \gg R_{MOS}$ ⟨ Process variation negligible
Parasitic cap large



$R_{PMOS} + R_{P1} = R_{NMOS} + R_{P2} \approx R_T$ (Typ. 27°C, 1V)

$R_{PMOS} + R_{P1}$ → ±20%

$R_{NMOS} + R_{P2}$ → ±10%

To compensate PVT variation ⟨ Vary size
Vary Vctrl (Fixed V_{DD}, Gnd)

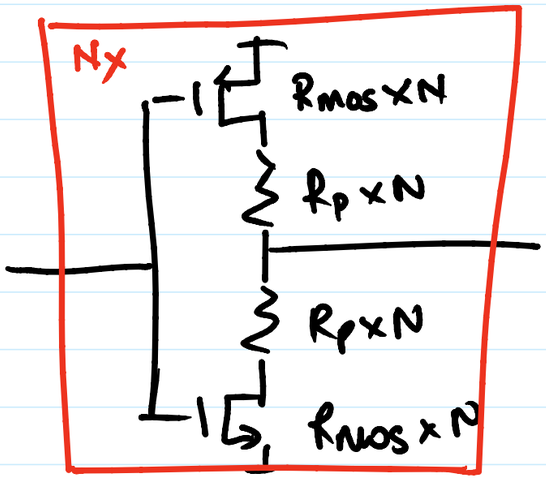
$$R_T = \frac{(R_{MOSP} + R_{POLY0})}{N} \quad \text{(Typical)}$$

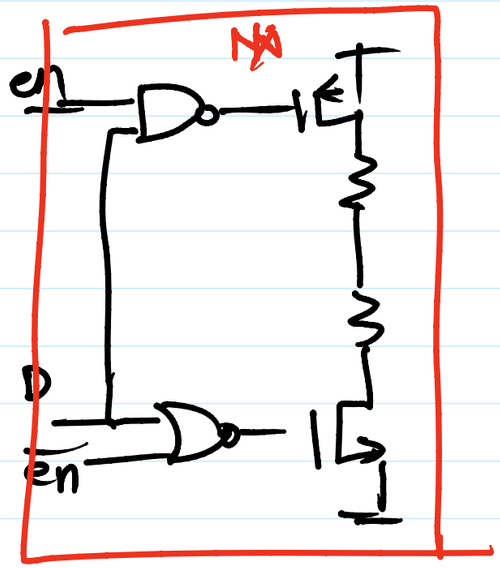
'ss', 'tt', 'ff', 'sf', 'fs'

$$= \frac{(R_{mos0} + R_{poly0})}{M\ (>N)} \quad (ss)$$

PMOS slow — Higher V_t

NMOS fast — lower V_t

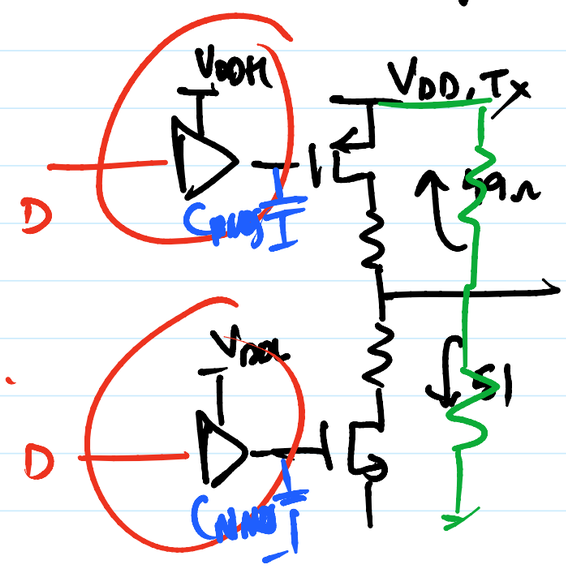




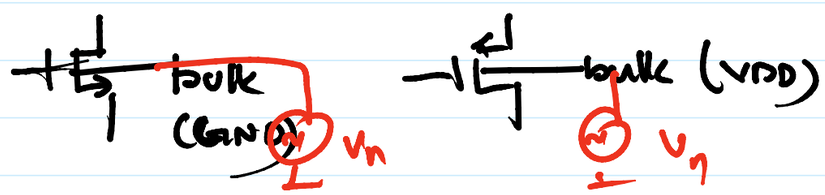
en = 1

en	D	PMOS	NMOS
0	0	off	ON
0	1	off	off
1	0	off	ON
1	1		

N = 1000 Higher reso

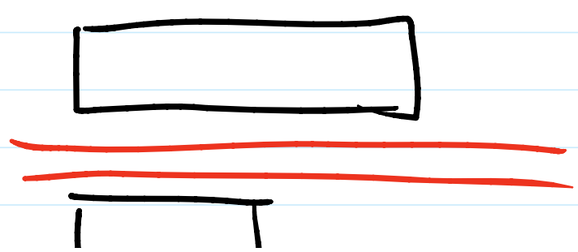


Vary V_{DDH}, V_{VDDL} for $R_T = 50$



Pcell — 64

Ncell — 32

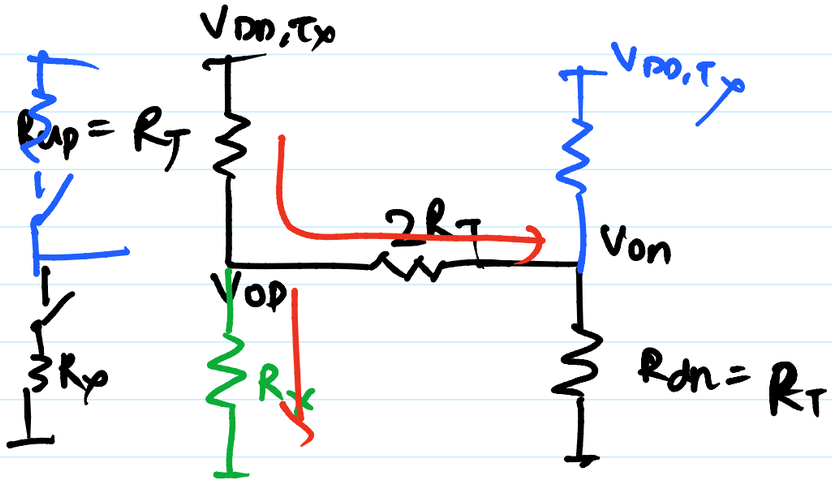


Ncell — 32

$$V_{ovd,min} = \frac{1}{2}\left(\max(|V_{THP}|, V_{THn})\right)$$

PMOS gets cut off $\Rightarrow$ $V_{DD,Tx} = |V_{Th,P}|$

NMOS " " $\Rightarrow$ $V_{DD,Tx} = V_{Th,n}$

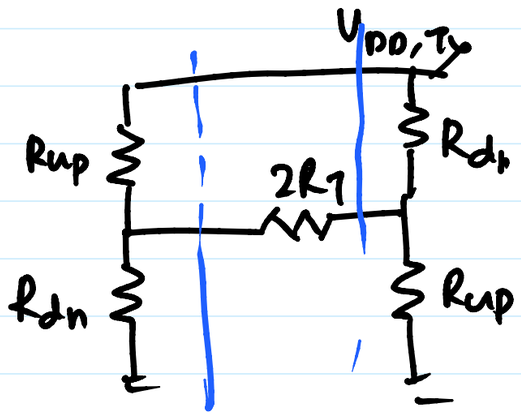


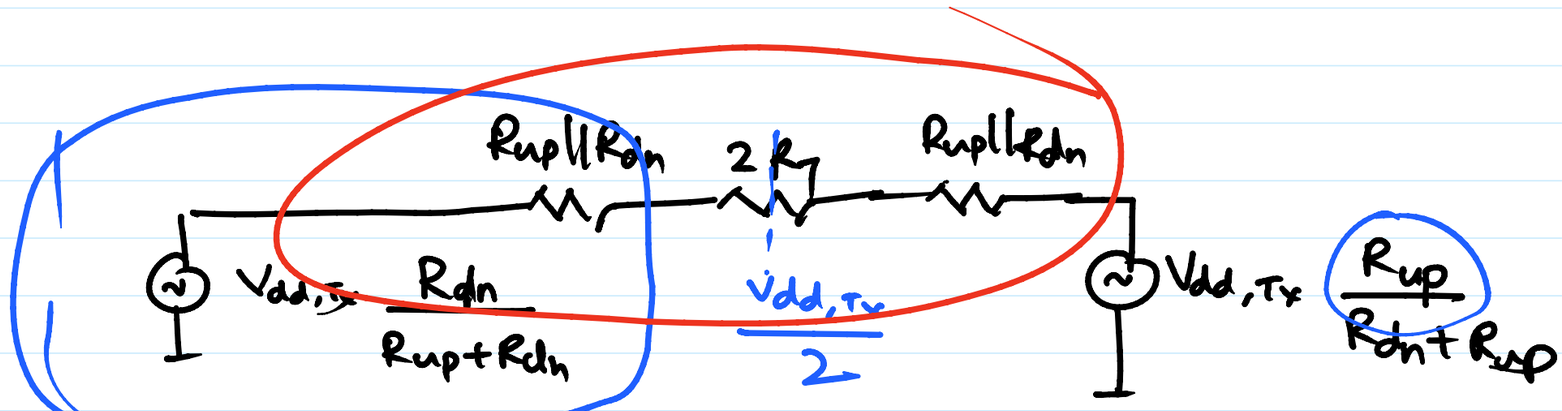
$$V_{op} = \frac{3}{4} V_{DD,Tx} \downarrow$$

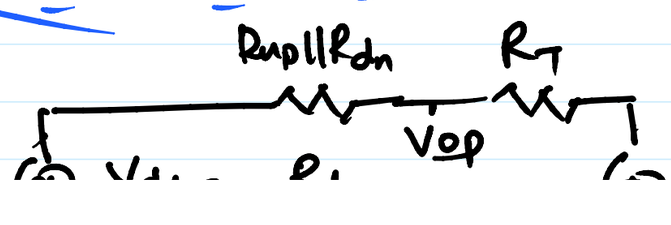
$$V_{on} = \frac{1}{4} V_{on,Tx} \uparrow$$

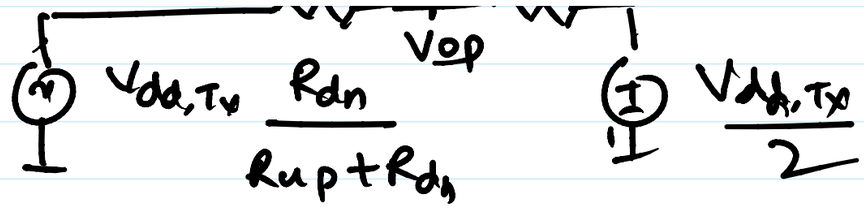
$$(V_{op} - V_{on}) \downarrow$$

$$R_{up} || R_x = R_T$$









$$V_{op} = \frac{R_T}{R_T + R_{up} \| R_{dn}} \underbrace{V_{dd,Tx} \frac{R_{dn}}{R_{up} + R_{dn}}} + \frac{R_{up} \| R_{dn}}{R_T + R_{up} \| R_{dn}} \frac{V_{dd,Tx}}{2}$$

$$V_{cm} = \frac{R_T + (R_{up} \| R_{dn})}{2(R_T + R_{up} \| R_{dn})} \times \frac{R_{dn}}{(R_{dn} + R_{up})} V_{dd,Tx}$$

$$+ \frac{R_T + (R_{up} \| R_{dn})}{2(R_T + (R_{up} \| R_{dn}))} \times \frac{R_{up}}{R_{dn} + R_{up}} V_{DD,Tx}$$

$R_{up} \| R_{dn} = R_T$ Channel term

$$V_{op} = \frac{R_T \cdot R_{dn}}{R_T (R_{up} + R_{dn})} \frac{V_{DD,Tx}}{2} + \frac{R_T}{2R_T} \frac{V_{dd,Tx}}{2}$$

$$= \frac{R_{dn}}{R_{up} + R_{dn}} \frac{V_{DD,Tx}}{2} + \frac{V_{DD,Tx}}{4}$$

$$V_{on} = \frac{R_{up}}{R_{up}+R_{dn}} \frac{V_{DD,Tx}}{2} + \frac{V_{DD,Tx}}{4}$$

$$V_{op}-V_{on} = \left[\frac{R_{dn}-R_{up}}{R_{up}+R_{dn}}\right] \frac{V_{DD,Tx}}{2} = \frac{R_{up}\cdot R_{dn}}{R_{up}+R_{dn}} \left[\frac{1}{R_{up}} - \frac{1}{R_{dn}}\right] \frac{V_{dd,Tx}}{2}$$

$$= \frac{V_{dd,Tx}}{2} \cdot R_T \left[\frac{1}{R_{up}} - \frac{1}{R_{dn}}\right]$$

$$R_{dn} \to \infty \quad , R_{up} = R_T \quad \Rightarrow \quad V_{op}-V_{on} = \frac{V_{DD,Tx}}{2}$$