Speed Vs Area Trade off

$t_r = 2.2 R_p C_{out}$ | $t_f = 2.2 R_n C_{out}$

- rise time, fall time are dependent on parasitic Capacitances and resistances.

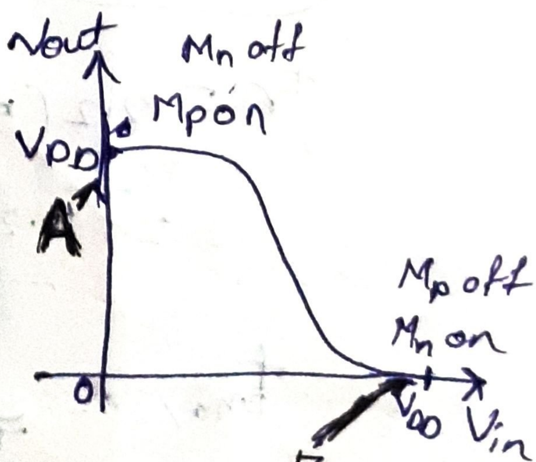
↳ If we increase(↑) ~~decrease~~ the aspect ratio $\left(\frac{W}{L}\right)$ then Resistance(↓) then, t_r & t_f(↓) decreases.

So, MOSFET is "operating fastly" ~~with few~~

↳ So, inorder to get faster MOSFET, we increase the area(↑). then integration density will be lesser(↓).

DC Current flow

In this graph, there ~~any da~~ is no rail to rail Connect because, at point "A" M_p is on but M_n is off.



Here There is no path from VDD to ground so there is "no rail to rail" Connect

→ at point B, M_n is on but M_p is off

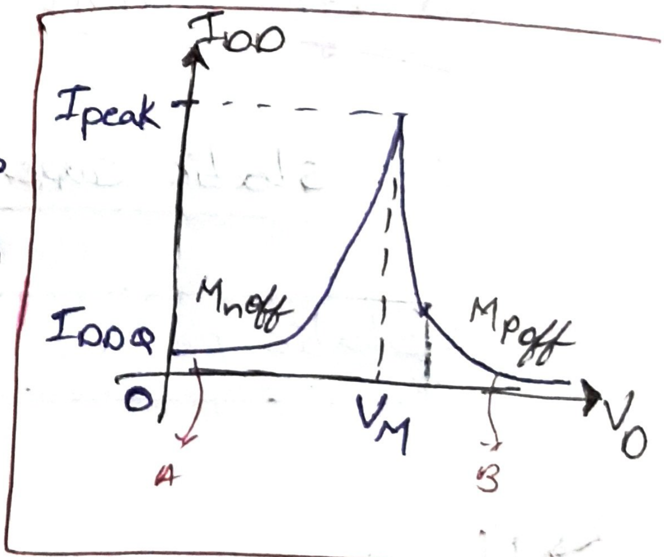
There is no path connecting from V_{DD} to ground.

→ If we have path from V_{DD} to ground then only we can say, ~~we~~ that current is flowing through the transistor.

→ when the current will flow, power dissipitation will occur.

→ At point A, M_n is off and at Point B M_p is off.

↳ M_n & M_p are getting ON at V_M.



Then both the transistors are equally connected & they have low resistance (current is high). And this resistance is connected to GND.

→ $\boxed{I_{DDq} = \text{Quiescent Current / leakage current}}$

I_{DDQ} → it is the static current flowing through the transistor even when it is not switching.

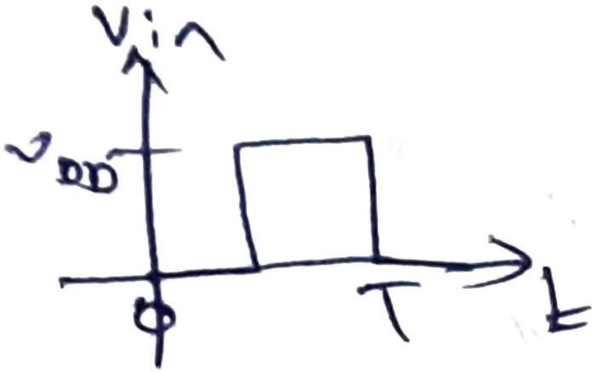
→ This is not completely open CKT [even if we don't apply i/p] because of high resistance b/w Drain & Source. Because of this there will be some ~~less~~ small leakage current. This current is known as **static current** (I_{DDQ})

$$\boxed{\text{Static power} = V_{DD} I_{DDQ}}$$ → static power

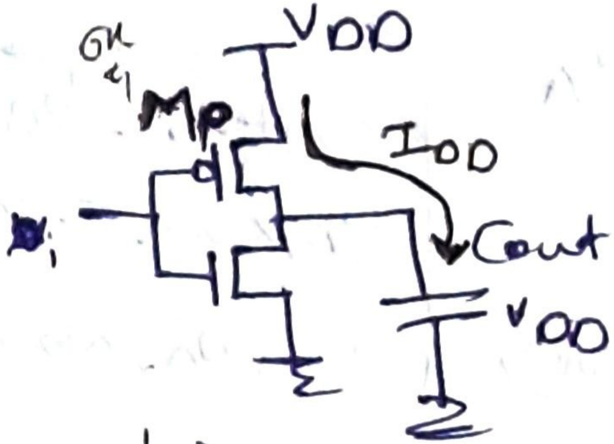
→ When the transistors are switching, capacitor charges and discharges that will contribute charging and discharging currents. These currents ~~are~~ will contribute power i.e Dynamic power.

$$\boxed{P_{av} = V_{DD} I_{DD} = V_{DD}\left(\frac{Q_e}{T}\right)}$$

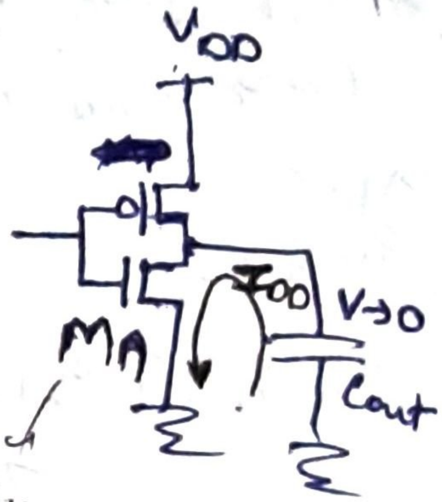
(where $Q_e = C_{out} V_{DD}$)



(a) I/P Voltage



(b) charge



(c) Discharge

$$\boxed{P_{sw} = C_{out} V_{DD}^2 f} \rightarrow \text{Dynamic power}$$

$$\boxed{P = \underbrace{V_{DD} I_{DDQ}}_{\text{Static power}} + \underbrace{C_{out} V_{DD}^2 f}_{\text{Dynamic power}}}$$