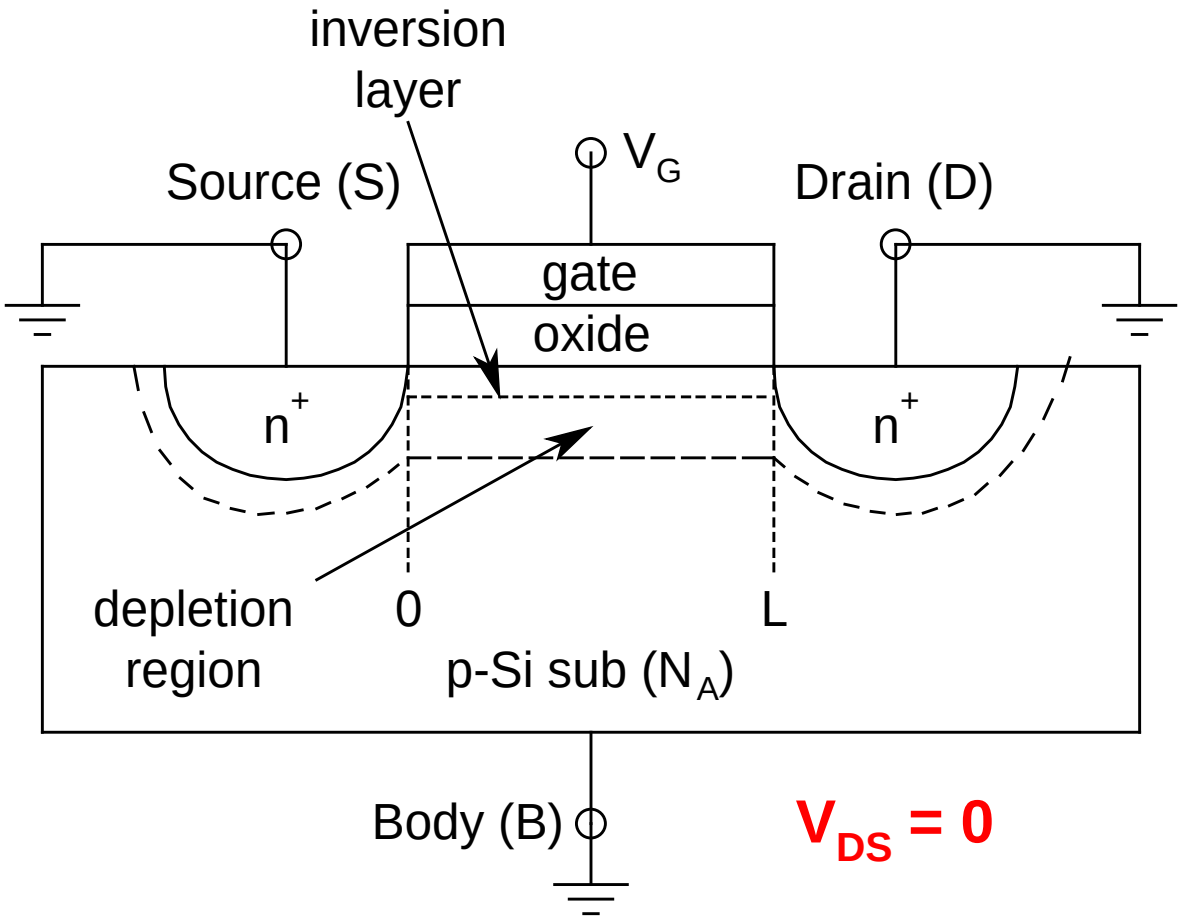
Operation


inversion
layer
Source (S)
V_G
Drain (D)
gate
oxide
n^+
n^+
depletion
region
0
L
p-Si sub (N_A)
Body (B)
$V_{DS} = 0$

- The structure is ***similar*** to an ***n^+pn^+ BJT***
- However, ***BJT action*** is ***not possible*** due to ***large channel length*** (L)
- The way to make the device ***conduct*** is to form a ***layer of electrons*** between S and D
  - Known as ***Inversion Layer***
- Then, if a ***bias*** is applied ***between S and D***, then ***inversion layer electrons*** will move ***towards the higher potential*** due to ***drift***
  - A ***current*** would result

- Consider $V_S = V_D = V_B = V_G = 0$
  - Device is ***off*** and ***no current flows***
- Note that the ***structure*** is similar to a ***capacitor***
- Now, as V_G is made ***positive***, initially it will ***repel holes from surface towards bulk***, ***uncovering ionized acceptor atoms there***
  - ***Formation of a depletion layer***
- There will be ***depletion layers*** around ***SB and DB junctions*** as well

- As V_G is kept on ***increasing***, the ***depletion charge*** will keep on ***increasing***
- At a ***certain value*** of V_G (= V_{GS}), a ***layer of electrons*** will ***appear at the surface***
- This ***particular value*** of V_{GS} is known as the ***threshold voltage*** V_{TN}
- Still ***no current*** would flow, since $V_{DS} = 0$
- ***SB and DB junctions*** must remain ***either at zero bias or reverse bias*** all the time
  - V_{SB} and $V_{DB} \geq 0$