EE303

Note Title 1/26/2011

Diodes; p. 150 - key eq. 3.40 (solid-state, pn junction)

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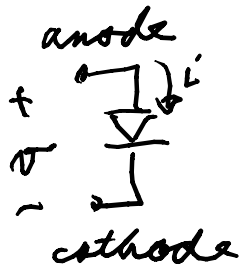
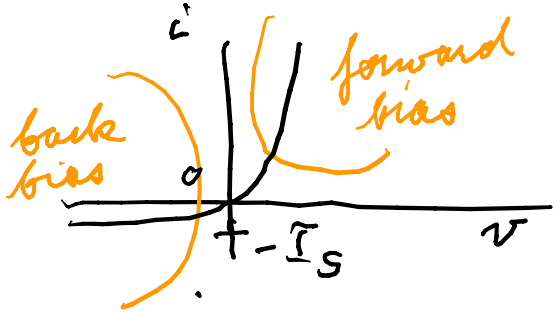
use SSL vpn.ece.umd.edu/ece





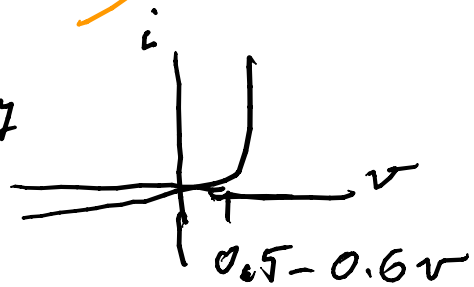
$$i = I_S\left(e^{v/V_T} - 1\right)$$

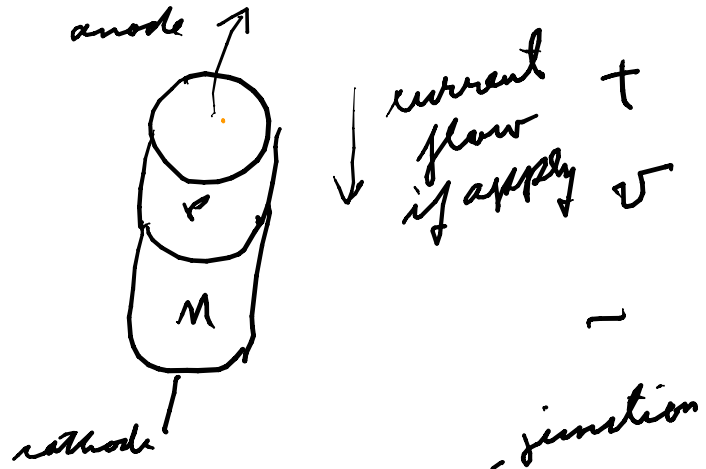
V_T = thermal voltage

$= kT/q$

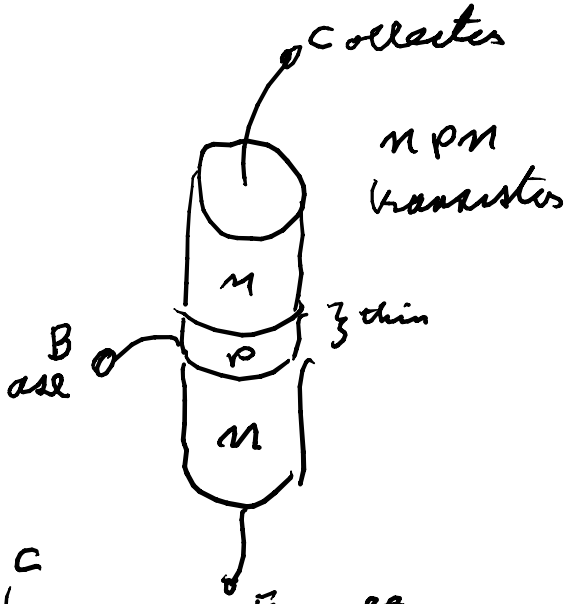
$\approx$ 26 mV @ room temp

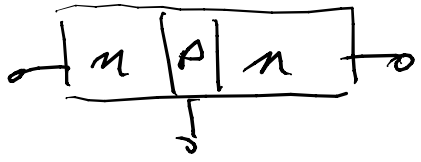
D = ideal component

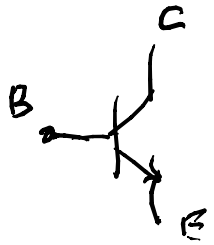


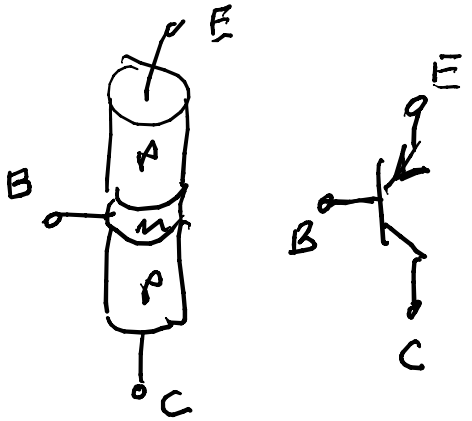


Use these in BJT transistor = transfer resistor
"bipolar"

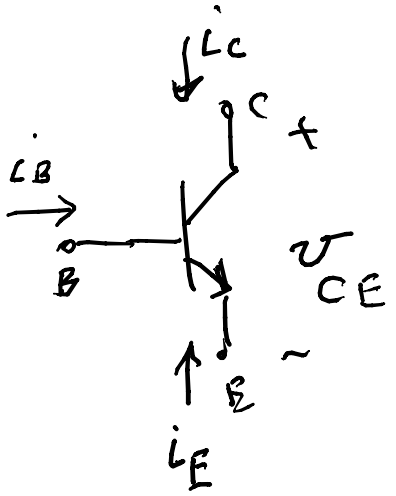


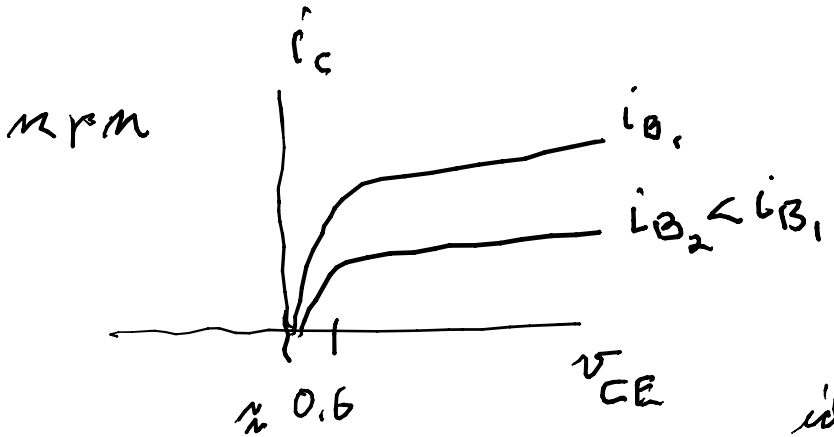






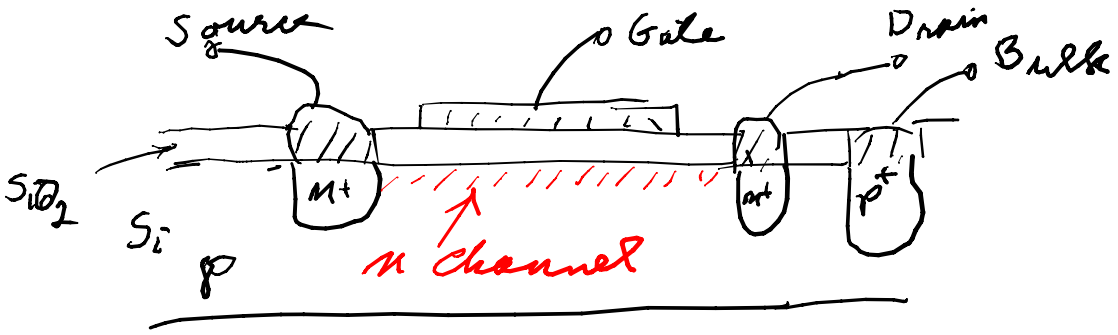
arrow direction is of a forward bias diode current

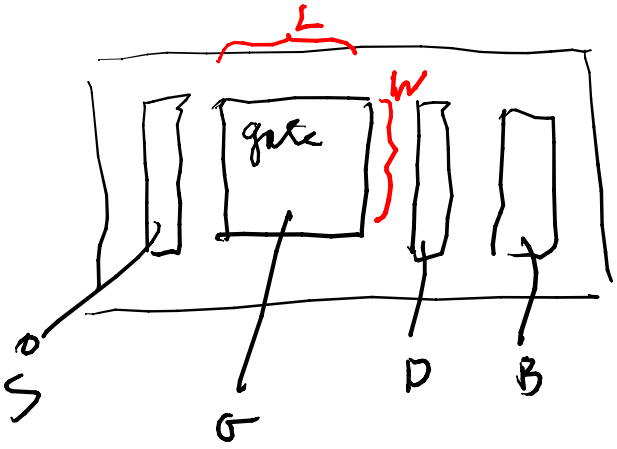


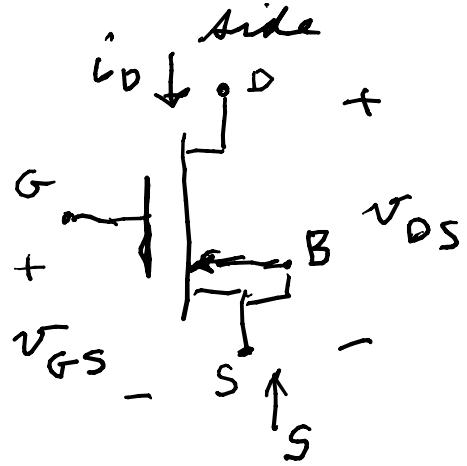


ideally $i_C = \beta i_B$; β = current gain

Move to MOS $\Rightarrow$ goes to planar technology



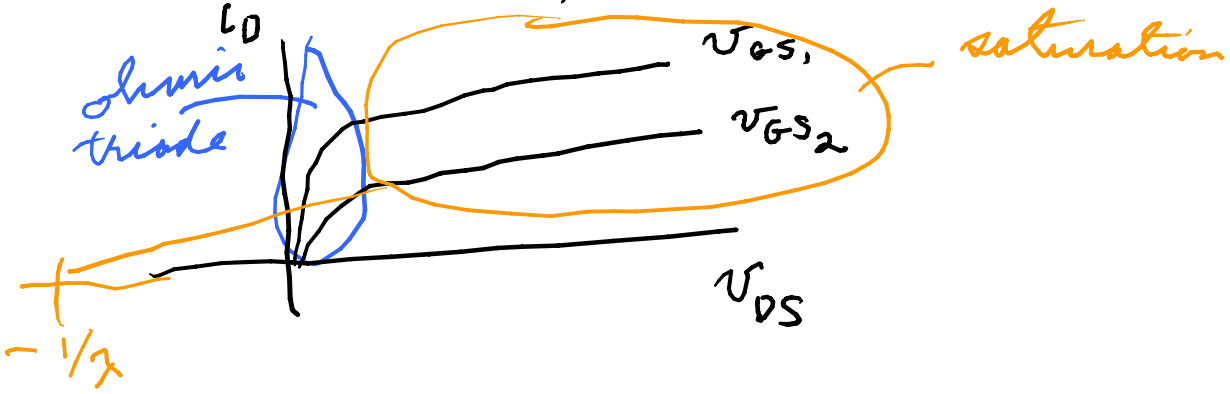




M = spice symbol

need

$v_{GS} > VTO$ = threshold voltage to turn on



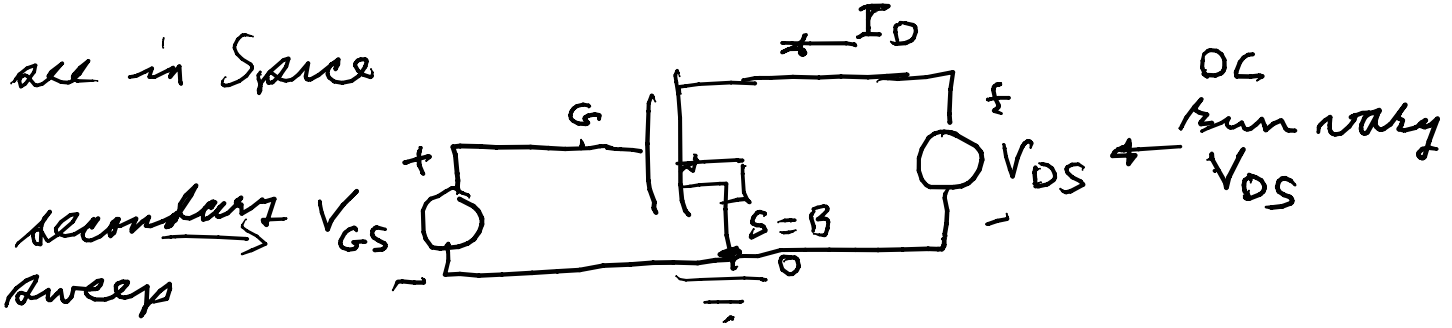
Eqs. pp. 243, 241 $\quad v_{DS} > 0$

$$i_D = \begin{cases} 0 & v_{GS} < VTO \quad \text{cutoff} \\ \frac{KP}{2}\frac{W}{L}\left\{2(v_{GS}-VTO)v_{DS} - v_{DS}^2\right\}(1+\lambda v_{DS}) & \text{triode ohmic} \quad v_{GS}-VTO \geq v_{DS} \\ \frac{KP}{2}\frac{W}{L}(v_{GS}-VTO)^2(1+\lambda v_{DS}) & \text{saturation} \quad v_{GS}-VTO \leq v_{DS} \end{cases}$$

a voltage (v_{DS}) controlled resistor

a current source controlled by v_{GS}

To all in Space



In Spice G = voltage controlled current

G-value (allows a function)