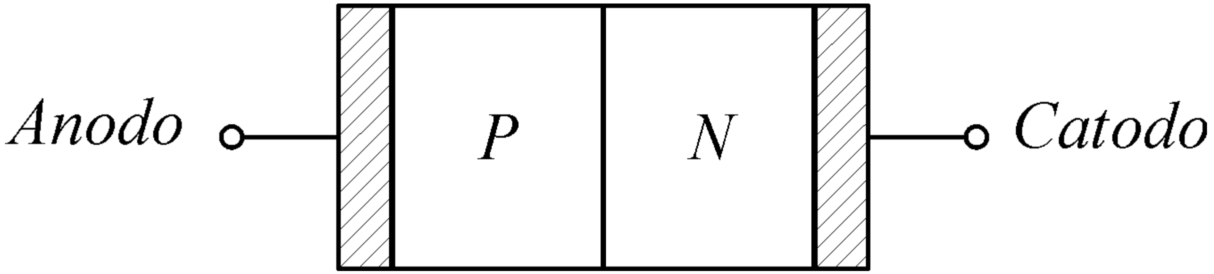
Elettronica Digitale
A.A. 2020-2021

Lezione 08/03/2021

Giunzione P/N



$$p_p = N_A = 10^{17}\ cm^{-3}$$

$$n_n = N_D = 10^{16}\ cm^{-3}$$

$$n_p = \frac{n_i^2}{N_A} = 10^{3}\ cm^{-3}$$

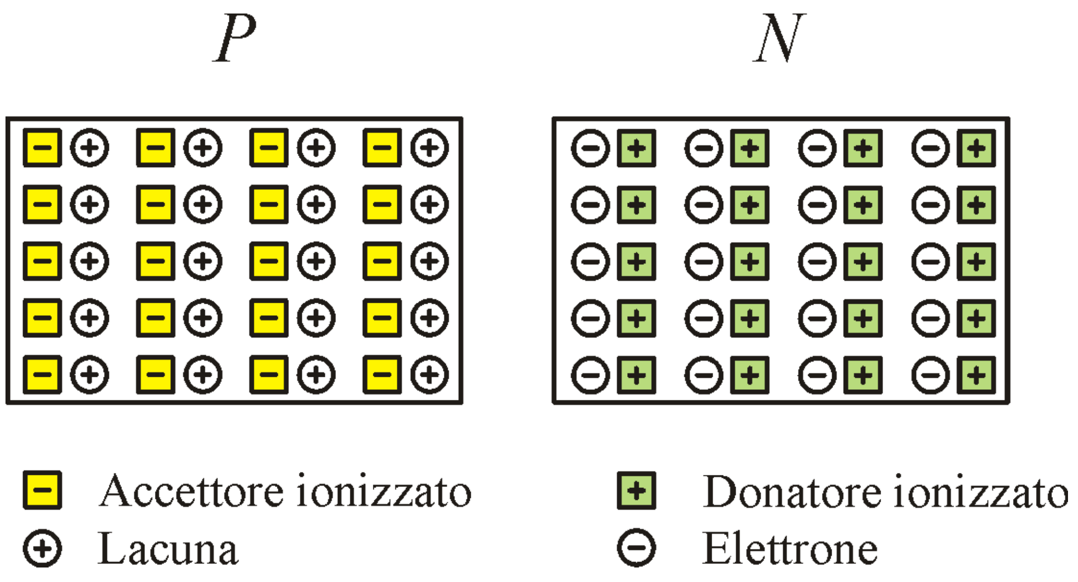
$$p_n = \frac{n_i^2}{N_D} = 10^{4}\ cm^{-3}$$

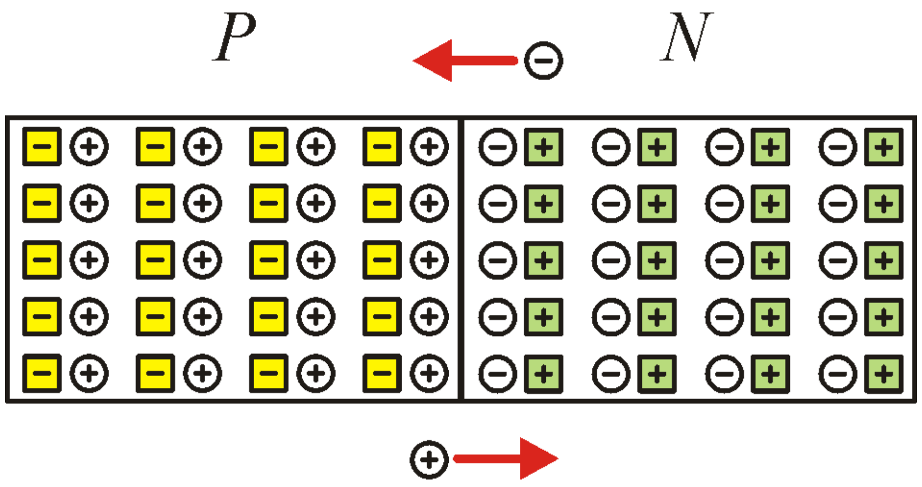
$$\boxed{J_p = -qD_p \frac{dp}{dx}}$$

$$\boxed{J_n = qD_n \frac{dn}{dx}}$$

$$\boxed{J_T = J_p + J_n \neq 0\ !?}$$

Giunzione P/N





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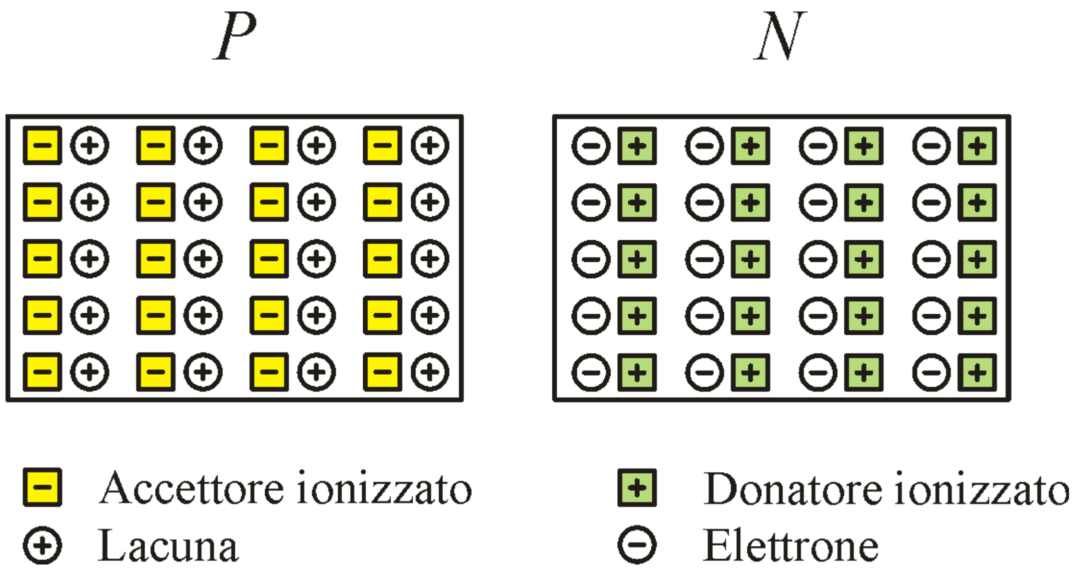
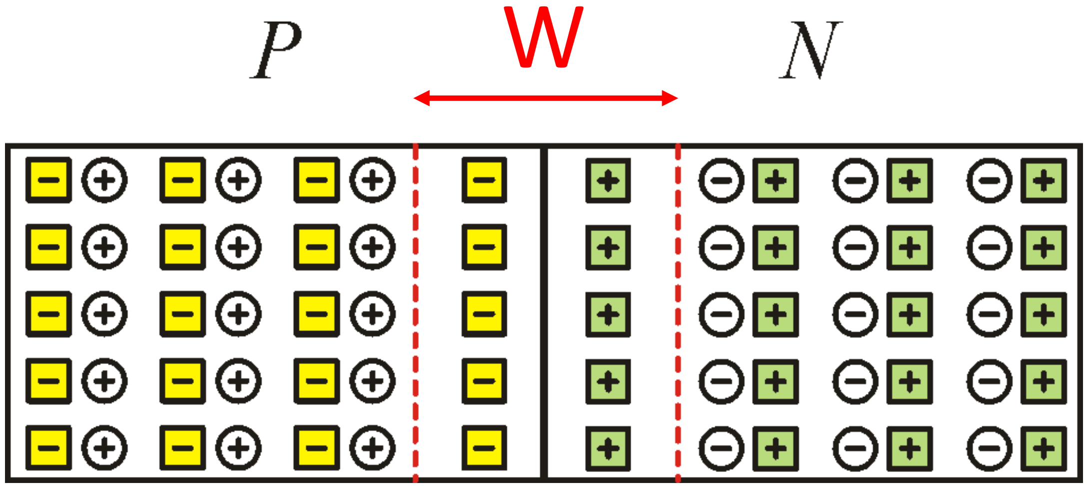
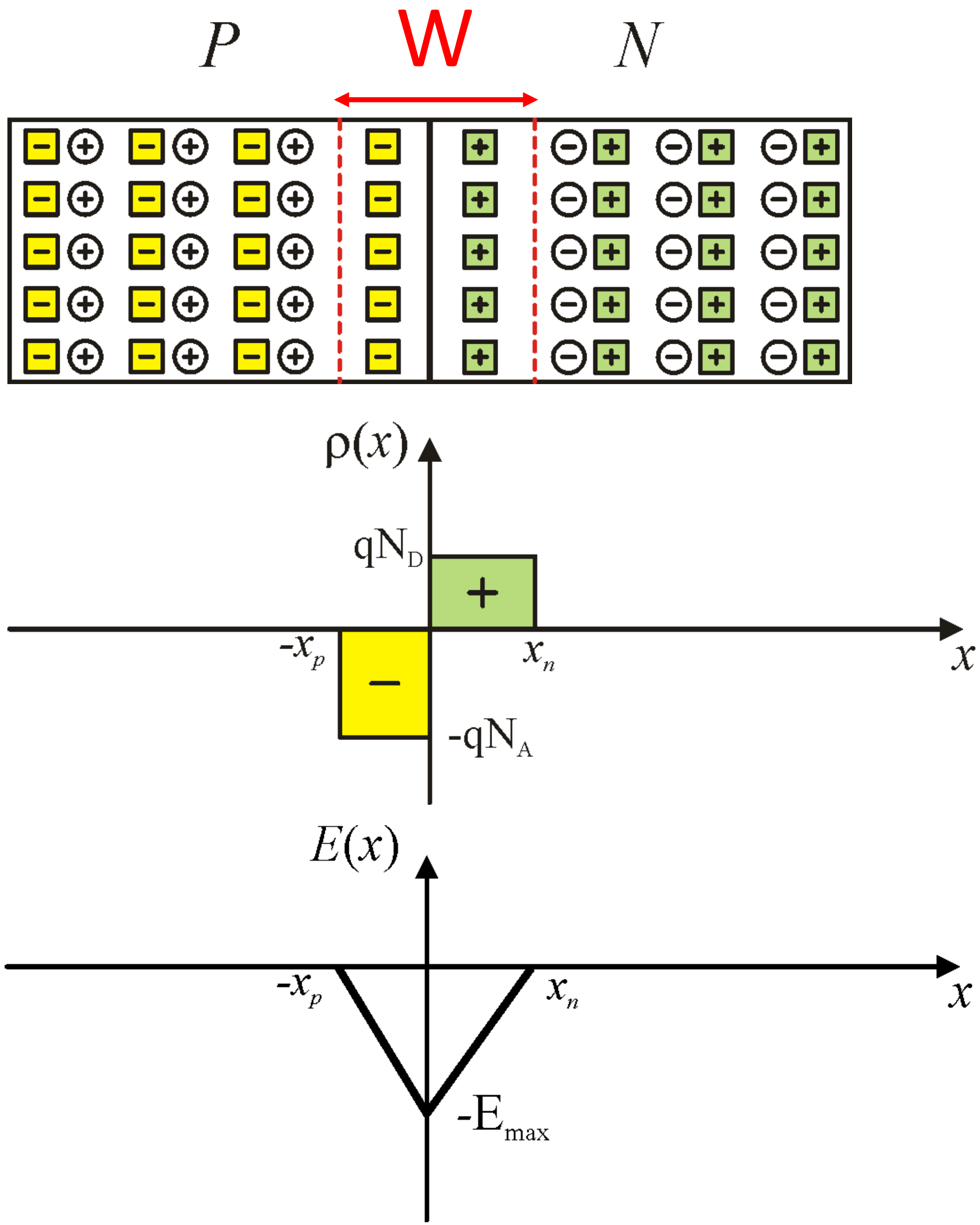


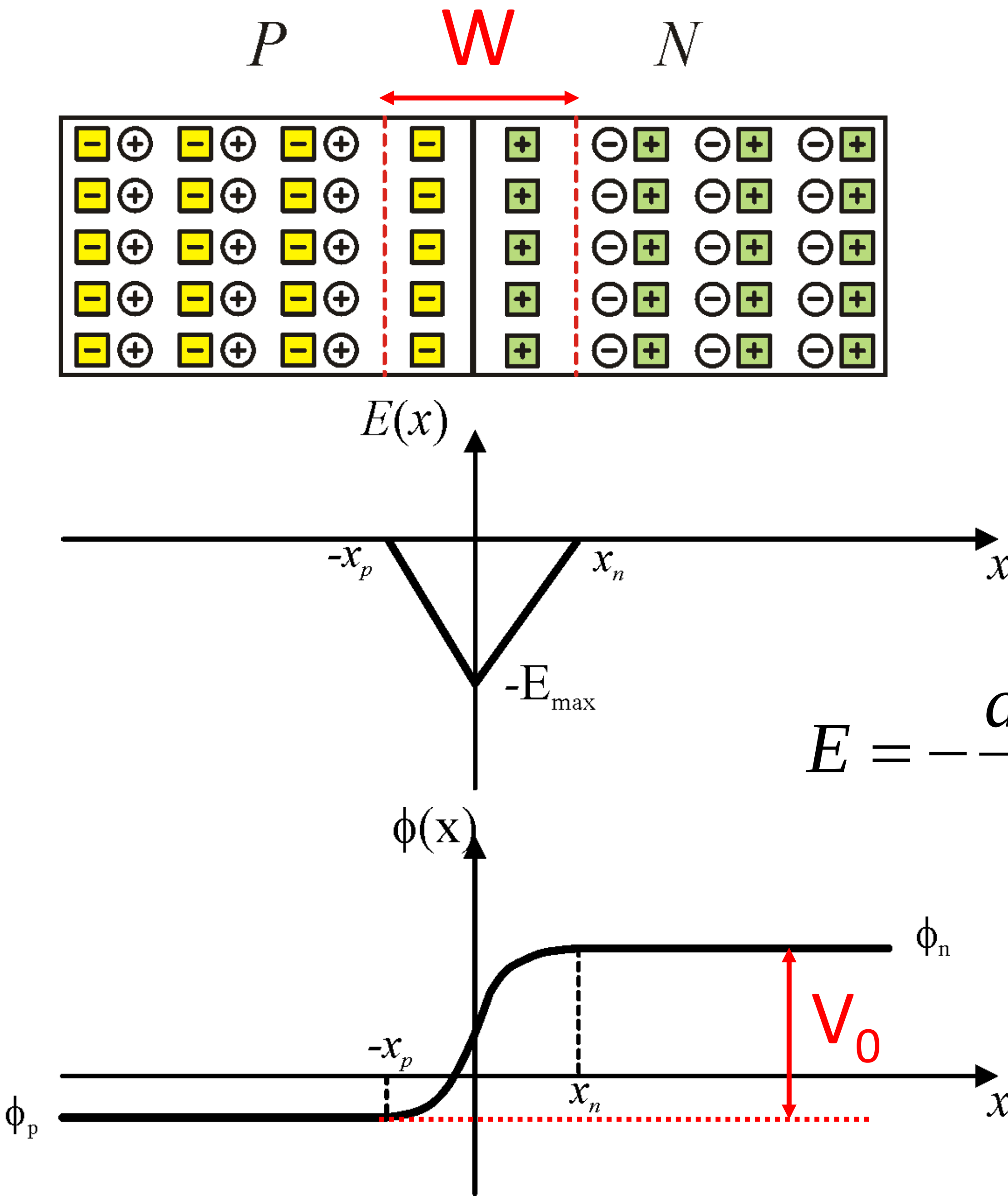


Giunzione P/N



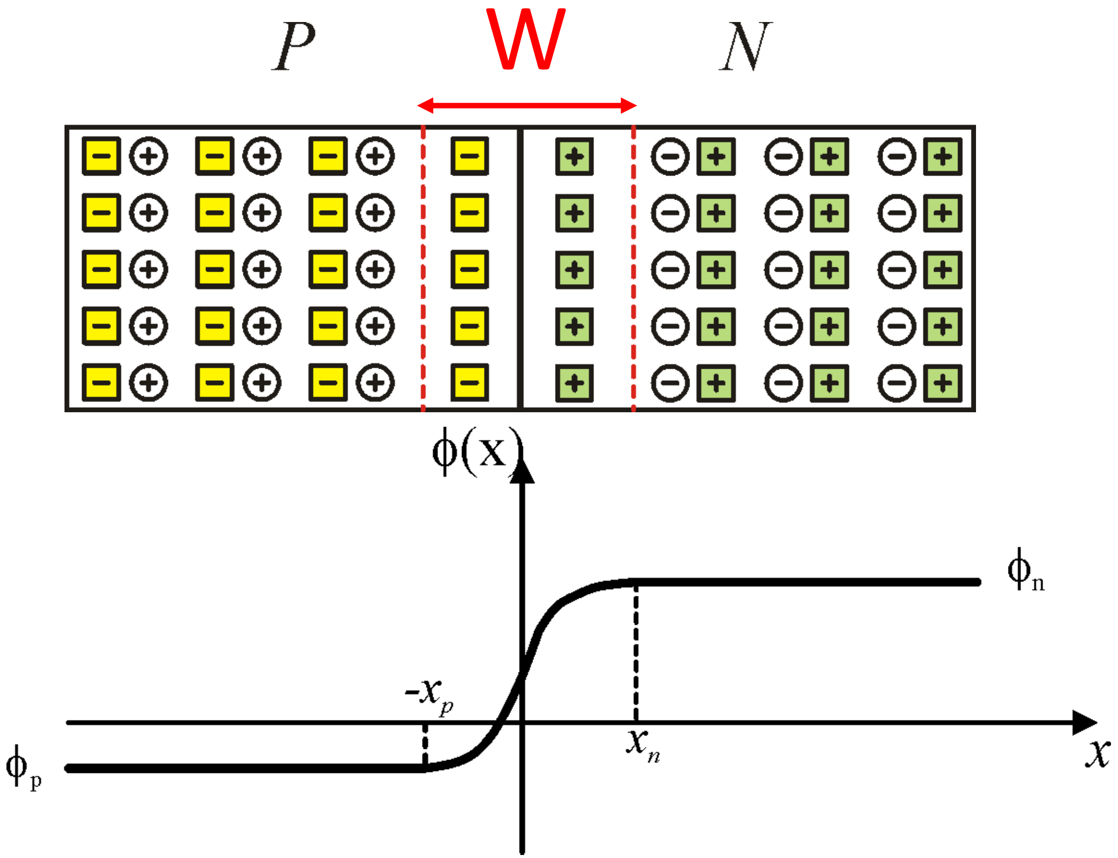
$$\frac{dE}{dx} = \frac{\rho(x)}{\varepsilon}$$

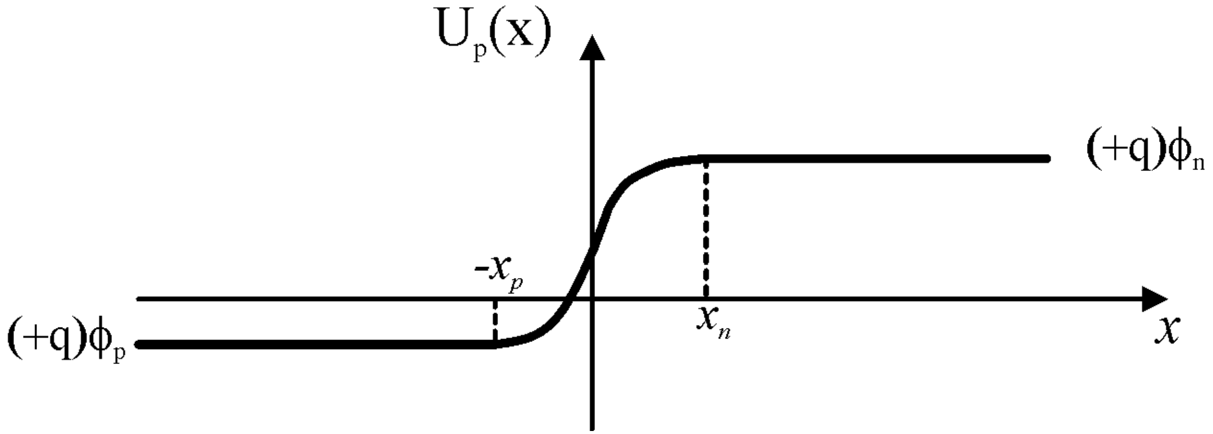
Giunzione P/N

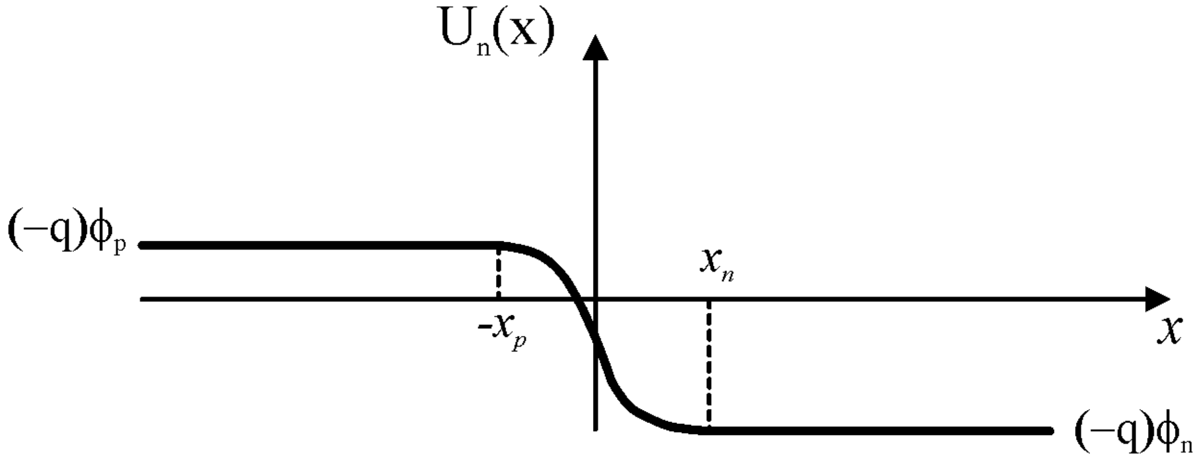


$$E = -\frac{d\phi(x)}{dx}$$

Giunzione P/N







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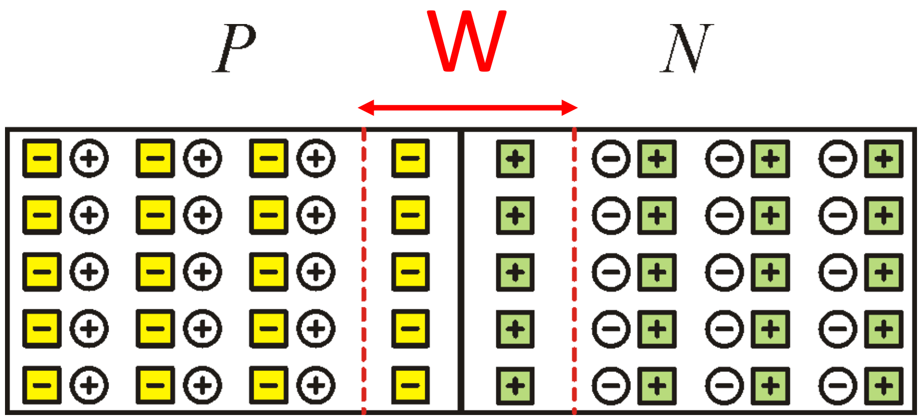
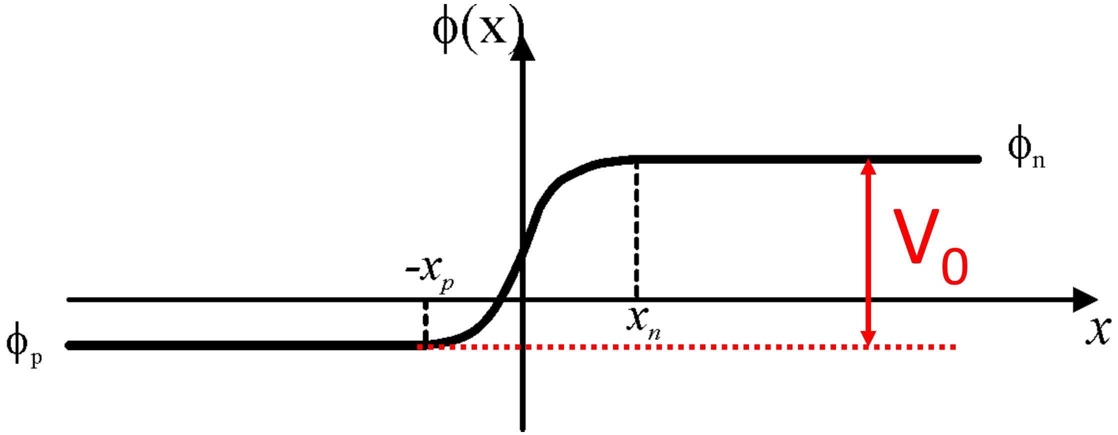


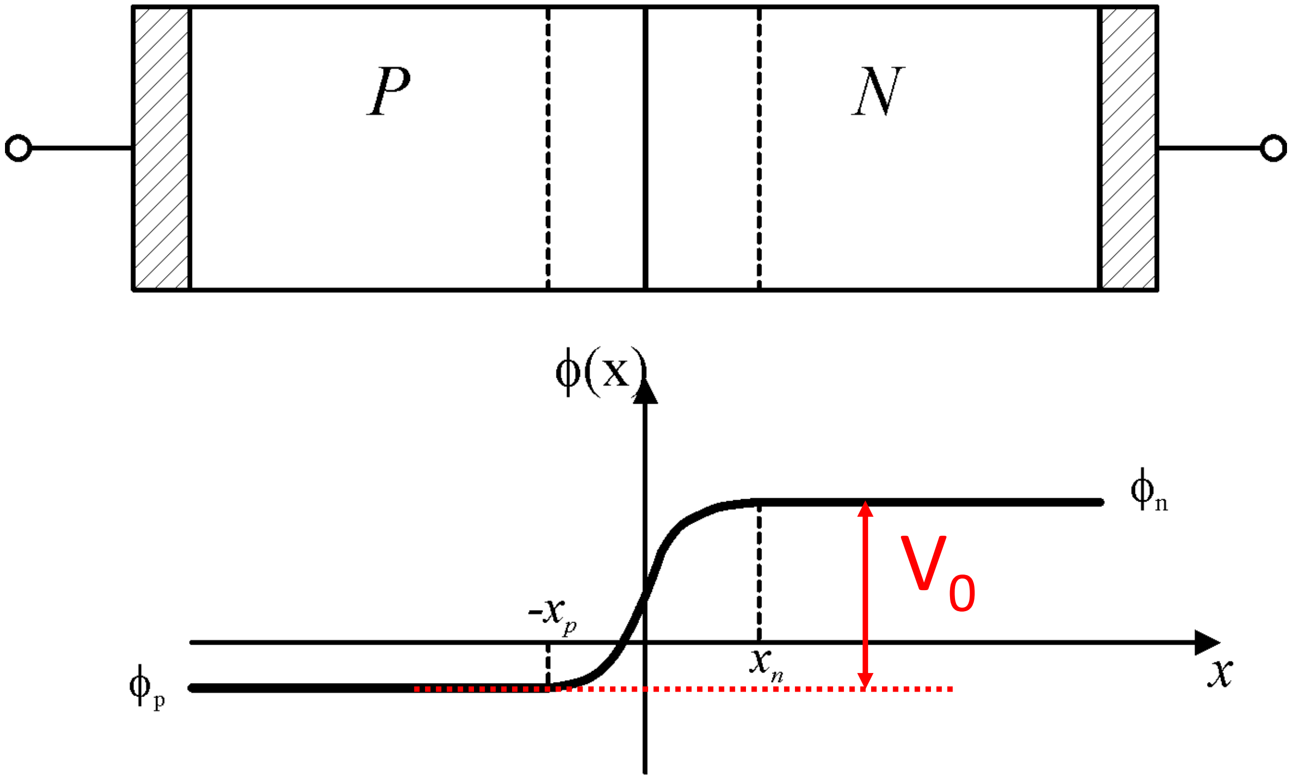


$$J_n = J_{n,drift} + J_{n,diffusione} = 0$$

$$J_p = J_{p,drift} + J_{p,diffusione} = 0$$

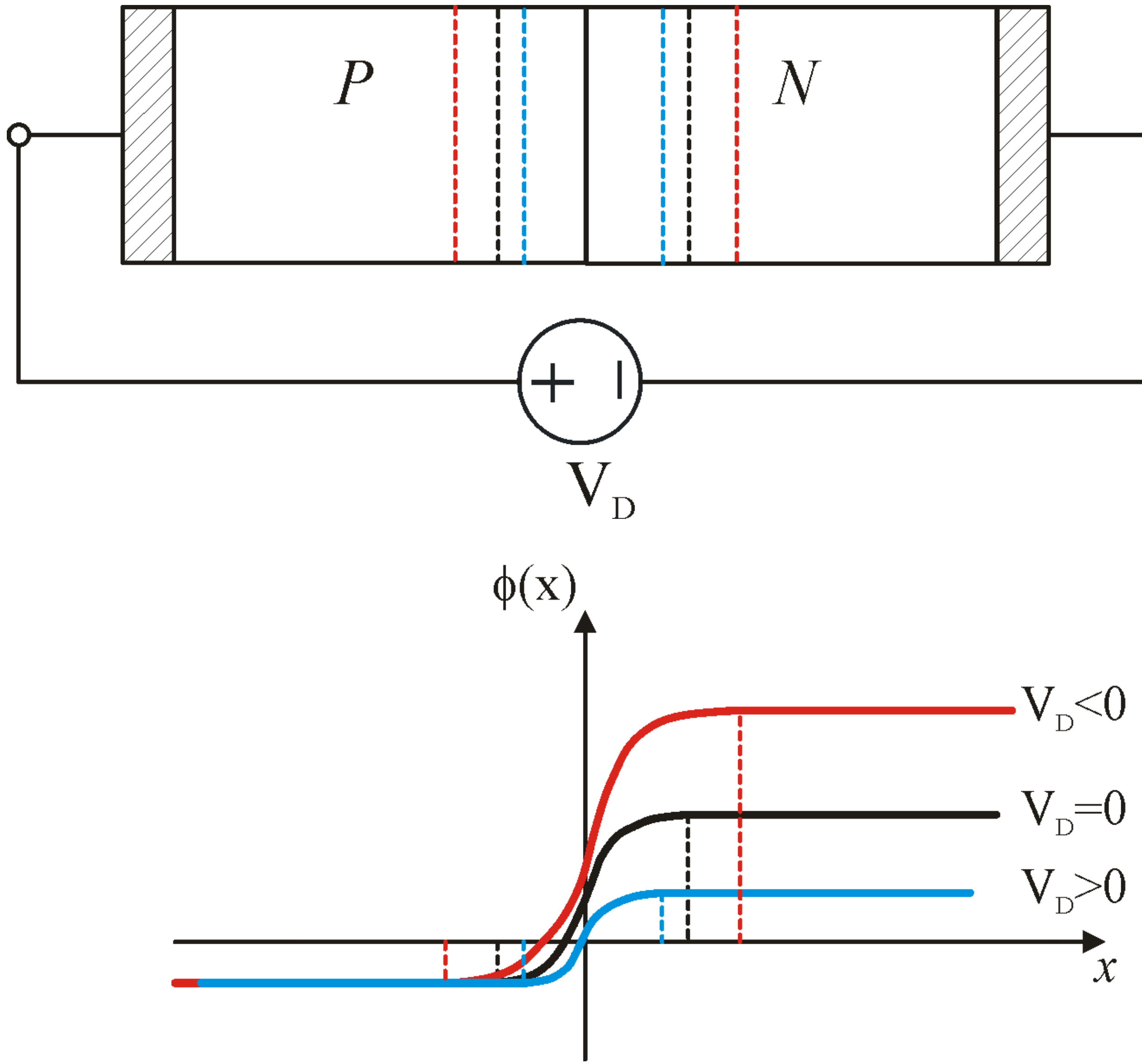
$$\Rightarrow \quad V_0 = \frac{kT}{q} \ln\left(\frac{N_A N_D}{n_i^2}\right)$$

Giunzione P/N



La tensione misurata tra i terminali è comunque nulla perché V_0 risulta compensata dai potenziali di contatto metallo-semiconduttore tra le zone p ed n e gli elettrodi esterni.

Giunzione P/N



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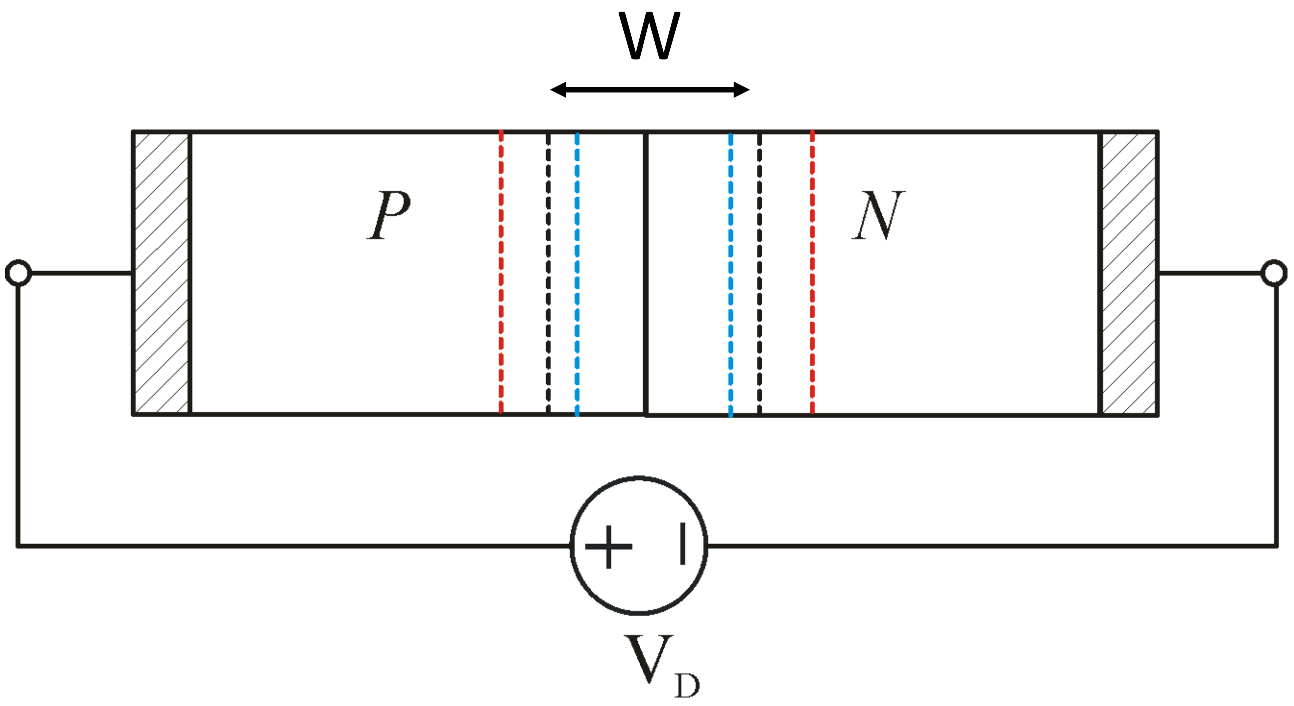

$$W = \sqrt{\frac{2\varepsilon}{q}\left(\frac{1}{N_A}+\frac{1}{N_D}\right)(V_0 - V_D)}$$

$$\boxed{I_D = I_S\left(\exp\left(\frac{V_D}{\eta V_T}\right)-1\right)}$$

Modello di Shockley

Giunzione P/N

$$\boxed{I_D = I_S\left(\exp\left(\frac{V_D}{\eta V_T}\right)-1\right)}$$

Modello di Shockley

$$V_T = \frac{kT}{q} \approx 26\, mV\ @\ 300\ K$$

$I_S : 10^{-18} \div 10^{-9}\ A$ Corrente inversa di saturazione

$\eta : 1 \div 2$ Fattore di idealità

Giunzione P/N

$$\boxed{I_D = I_S\left(\exp\left(\frac{V_D}{\eta V_T}\right)-1\right)}$$