Diodi

Esercitazione 1

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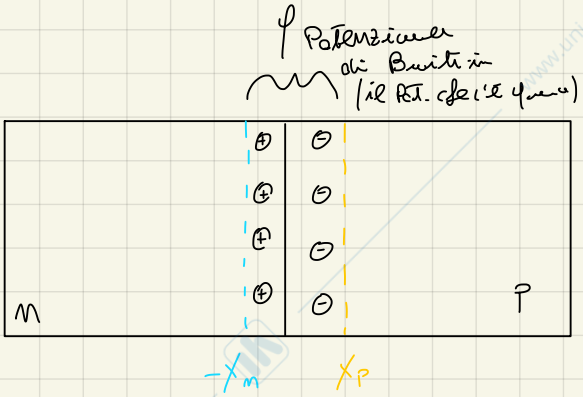


P: 10^{16} $\frac{at}{cm^3}$ (n) N_D

B 10^{14} $\frac{at}{cm^3}$ (P) N_A

1) concentraz Portatori minoritari nel lato P e n

legge di azione di massa (del materiale) $pn = n_i^2$

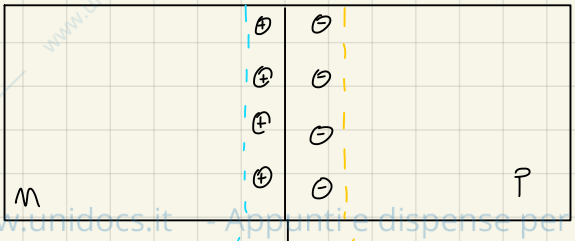
P) $p \simeq N_A = 10^{14}$ $\quad n = \frac{n_i^2}{p} = 10^6$

n) $n \simeq N_D$ $\quad p \simeq \frac{n_i^2}{n} \simeq 10^4$

2) determinare il Potenziale di B

$$\varphi = V_T \ln\left(\frac{N_A N_D}{n_i^2}\right) \simeq 0{,}599\ V$$ ← Pote Port

3) valor massimo del campo elettr



$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon}$$

E_{max})

$$E_p(x) = \frac{-qN_A}{\varepsilon} x + \frac{qN_A}{\varepsilon} x_p$$

con $E_p(0) =$

$$E_n(x) = \frac{qN_A}{\varepsilon} x + \frac{qN_D}{\varepsilon} x_n$$

$N_A x_p =$

$$\varphi = \frac{q}{2\varepsilon} \left(N_D x_n^2 + N_A x_p^2 \right)$$

$$x_n = \sqrt{\frac{2\varepsilon}{q} \varphi \frac{N_A}{N_D} \frac{1}{N_A + N_D}}$$

$$x_p = \sqrt{\frac{2\varepsilon}{q} \varphi \frac{N_D}{N_A}}$$

$x_n = 0{,}028 \ \mu m$

$x_p = 2{,}8 \ \mu$

$E_{max} = 4{,}23 \cdot 10^3 \ V/cm$

4) W spessore della regione di s

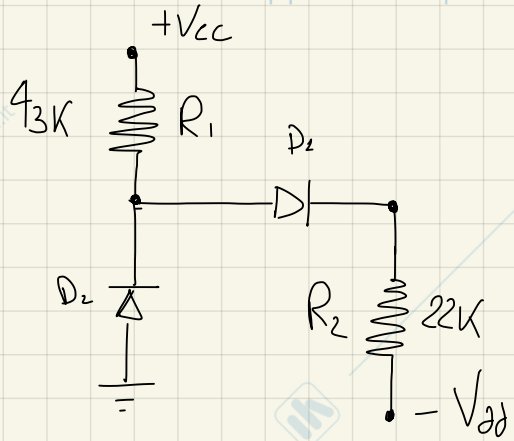
1. $V_A = 0$
2. $V_A = 0{,}2 \ V$
3. $V_A = -0{,}5 \ V$

$W = x_p + x_n =$

1) $= 2{,}828 \ \mu m$

2) $= 2{,}3 \ \mu m$ D

3) $= 3{,}8 \ \mu m$ a

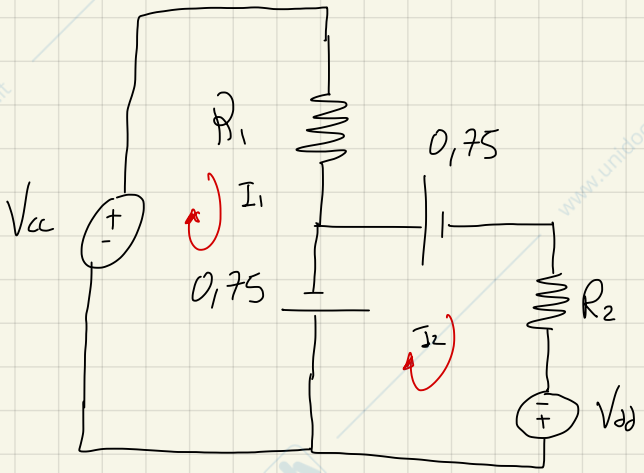


$V_{cc} = 6\,V$

$V_{dd} = 9\,V$

$V_{ON} = 0{,}75\,V$

ipotizziamo che son
i diodi accesi



$$V_{cc} - R_1 I_1 + V_{ON}$$

$$I_1 = \frac{V_{cc} + V_{ON}}{R_1}$$

$$V_{dd} - 2\,V_{on} -$$

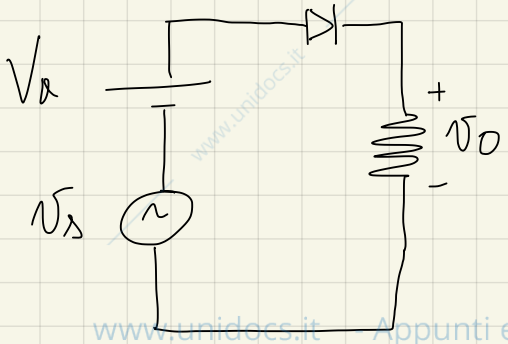
$$\bar{I}_2 = \frac{V_{dd} - 2V}{R_2}$$

$I_{D1} = I_2 =$

$I_{D2} = I_2 - I_1 = 185\,\mu A \quad \Rightarrow D$

Allora l'HP iniz
entrambi i di
conduzione al
tensione corrisp

modello del diodo più accurato:



$V_a = 12\,V$

$V_s = V_S \sin(\omega t)$

$V_S = 0{,}2\,V$

$R_L = 2\,K\Omega$

$V_{ON} = 0{,}6\,V$

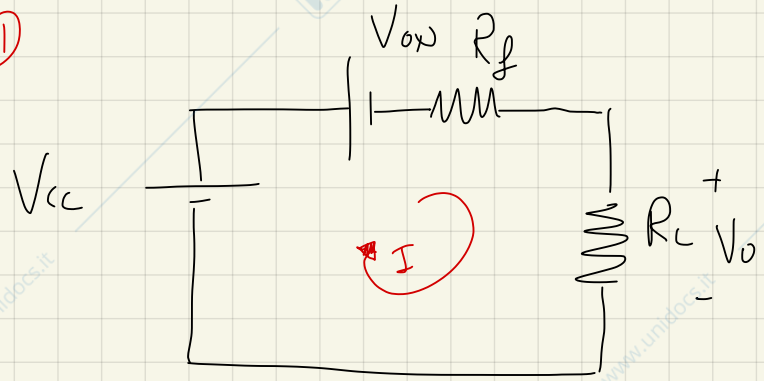
$R_f = 10\,\Omega$

$\eta = 2$

$v_o(t) = V_o + v_o(t)$ facciamo quindi

$= 11,4\,V + 0,149 \sin(\omega t)\,V$

①



$$I = I_Q = \frac{V_{CC} - V_{ON}}{R_f + R_L}$$

$$V_O = R_L I = 11.4\,V$$

② Per Piccoli segnali

consideriamo il Punto di lavoro e calcoliamo

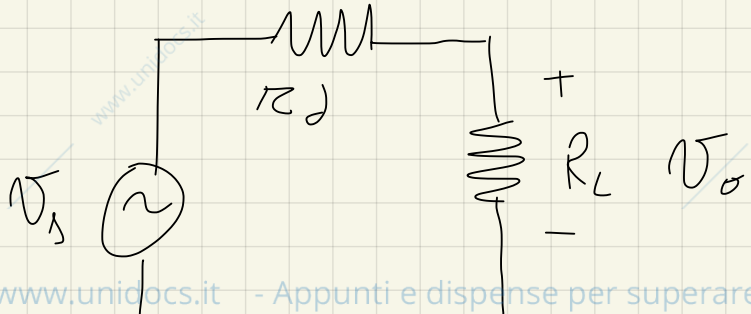
$$r_d = \frac{1}{g_d} \qquad g_d = \left.\frac{\partial i_D}{\partial v_D}\right|_Q$$

$i_D =$

$$g_D = \frac{\partial}{\partial v_D}\left(I_S\left(e^{\frac{v_D}{\eta V_T}} - 1\right)\right)\Big|_Q = \frac{I_S e^{\frac{v_D}{\eta V_T}}}{\eta V_T}$$

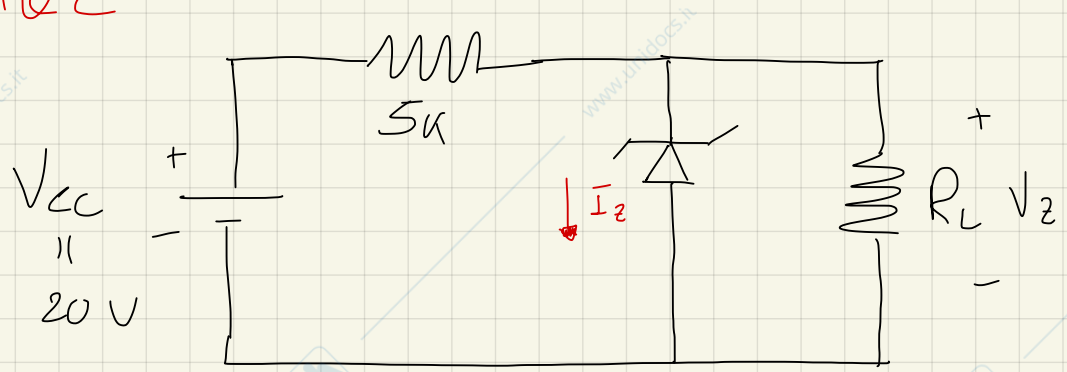
$$r_d = \frac{\eta V_T}{I_Q} \simeq 9\,\Omega$$

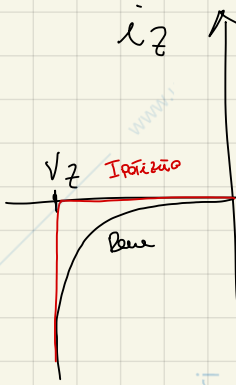
Per il Piccolo segnale il diodo è una



$$v_o = v_s \frac{R_L}{R_L +$$

Zener2





R_{min}

$$I_S = I_z + I_L$$

$$I_z = I_S - I_L = \frac{V_S}{R_S} - V_z\left(\frac{1}{R_S} + \frac{1}{R_L}\right) > 0 \qquad R_L$$

con un unico il regolare