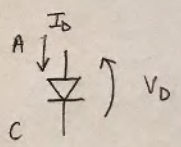
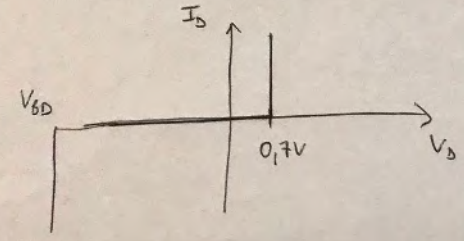
giulia.acconcia@polimi.it

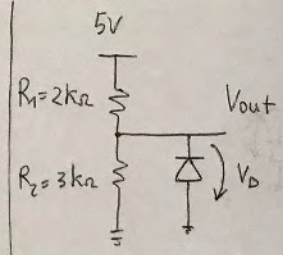
SIMBOLO



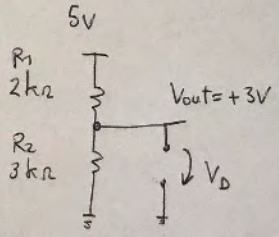
MODELLO CIRCUITALE



ES1)



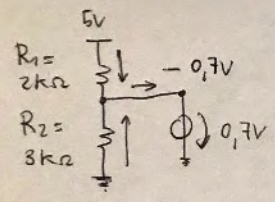
HP DIODO SPENTO

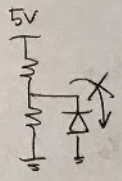


$$V_{R2} = 5V \cdot \frac{R_2}{R_2+R_1} = +3V$$

$$V_D = 0 - 3V = -3V$$

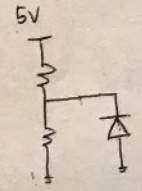
HP ② DIODO ACCESO





HP ② è sbagliata

allora DIODO SPENTO

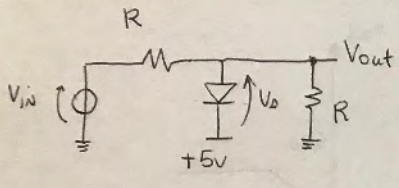


← ANODO CONNESSO A TENSIONE PIÙ BASSA DEL CIRCUITO

↓

DIODO è per forza Spento

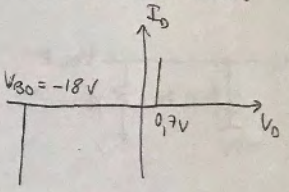
ES 2)



$R = 5k\Omega$

$V_{BD} = -18V$

CARATTERISTICA APPROX DIODO

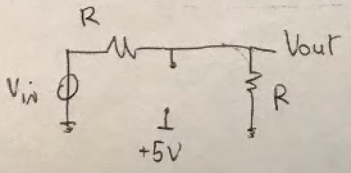


1) Caratteristica statica $V_{out} = f(V_{IN})$

hp diodo spento

hp è verificata se

$-18V < V_D < 0,7V$



$V_D = V_{out} - 5V$

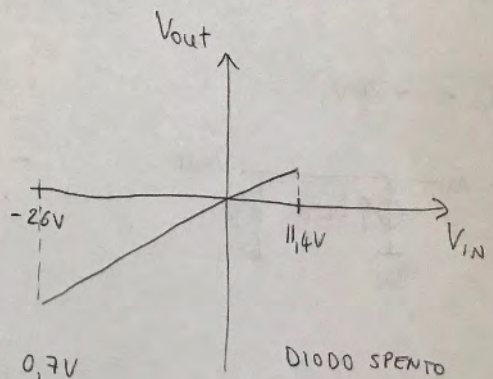
con diodo spento

$V_{out} = V_{in} \cdot \frac{R}{R+R} = \frac{V_{in}}{2}$

$-18V < V_D < 0,7V$

$-18V < V_{out} - 5V < 0,7V$

$-18V < \frac{V_{in}}{2} - 5V < 0,7V$

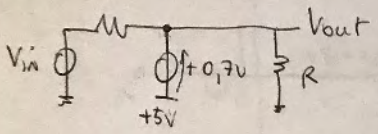


DIODO SPENTO

$V_{in} < +11,4V$

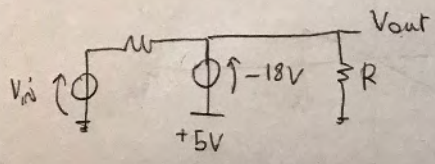
$V_{in} > -26V$

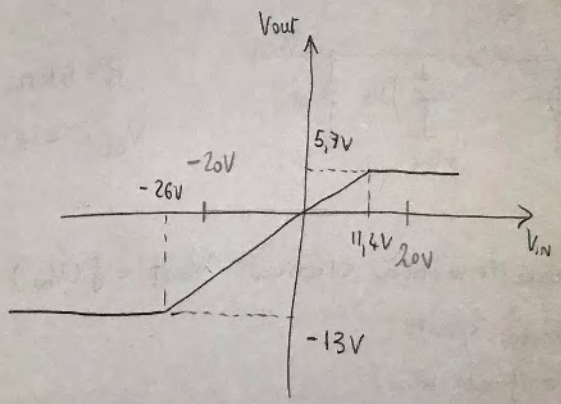
Per $V_{in} > 11,4V$ DIODO è ACCESO IN DIRETTA



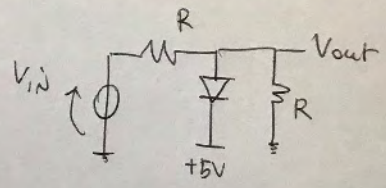
$V_{out} = +5,7V$

Per $V_{in} < -26V$

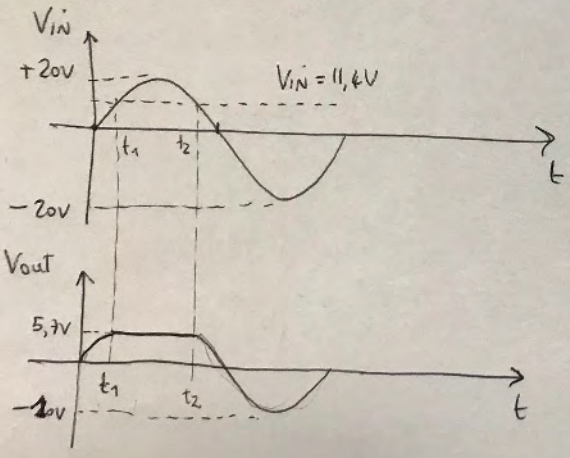




2) Sia $V_{in} = V_0 \sin(2\pi f t)$ $V_0 = 20V$ $f = 50Hz$



Disegnare $V_{out}(t)$



Per $V_{in}(t) < 11,4V$

$V_{out}(t) = \frac{V_{in}(t)}{2}$

Per $V_{in}(t) > 11,4V$

$V_{out} = +5,7V$

t_1 tale che

$V_{in}(t_1) = 11,4V$

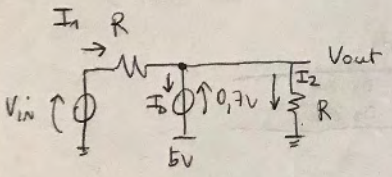
$20V \sin(2\pi f t_1) = 11,4V$

$t_1 = 1,93ms$

$t_2 = \frac{T}{2} - t_1 = 10ms - 1,93ms = 8,07ms$

3) P_{MAX} dissipata dal diodo con $V_{in}(t) = 20V \sin 2\pi f t$ (come punto 2)

$P_D = V_D \cdot I_D$



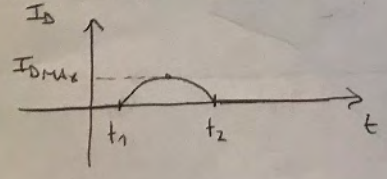
DIOD è acceso

$I_D = I_1 - I_2$

$I_1 = \frac{V_{in}(t) - V_{out}(t)}{R} = \frac{V_{in}(t)}{R} - \frac{5,7V}{R}$

$I_2 = \frac{V_{out}(t)}{R} = \frac{5,7V}{R}$

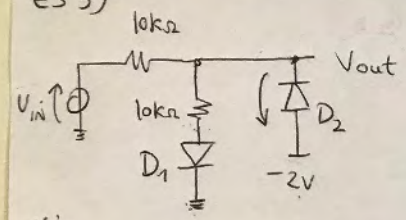
$I_D = \frac{V_{in}(t)}{R} - \frac{5,7V}{R} - \frac{5,7V}{R} = \frac{V_{in}(t)}{R} - \frac{11,4V}{R}$

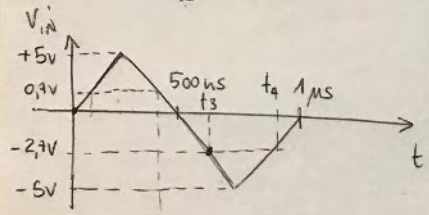


I_{DMAX} si ha per $V_{in}(t)_{MAX}$

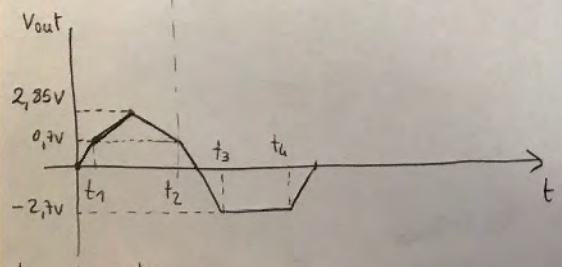
$I_{DMAX} = \frac{20V}{R} - \frac{11,4V}{R} = 1,72mA$ → $P_{DMAX} = 0,7V \cdot I_{DMAX} = 1,2mW$

ES 3)





1) Tracciare su un grafico Vout(t)

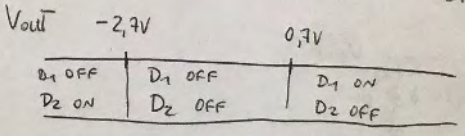


tra t_1 e t_2

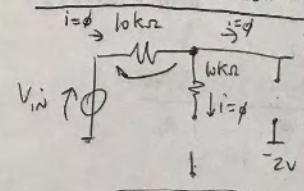
$$V_{out} = \frac{V_{in}(t)}{2} + 0{,}35V$$

D_2 ~~si accende~~ è spento per $V_{out} > -2{,}7V$

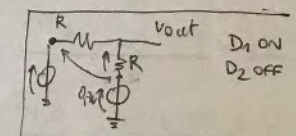
D_1 è spento per $V_{out} < +0{,}7V$ (con D_1 spento $V_{A_{D1}} = V_{out}$)



Se entrambi i diodi sono spenti



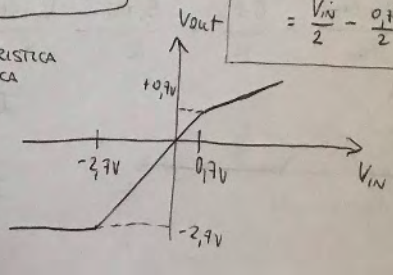
$V_{out} = V_{in}$



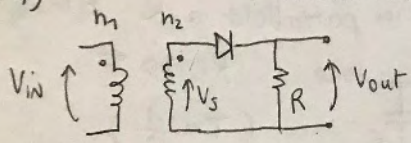
$$V_{out} = (V_{in} - 0{,}7V)\frac{R}{2R} + 0{,}7V$$

$$= \frac{V_{in}}{2} - \frac{0{,}7V}{2} + 0{,}7V = \frac{V_{in}}{2} + 0{,}3$$

CARATTERISTICA STATICA



ES 4) RADDRIZZATORE A SINGOLA SEMIONDA



$V_{in} = 220\sqrt{2}\,V \sin 2\pi f t$ con $f = 50Hz$

$R = 1k\Omega$

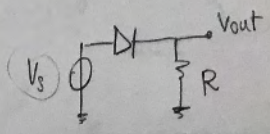
1. Dimensionare $\frac{n_1}{n_2}$ per avere $V_{S\,MAX} = 12V$

$$\frac{V_{in}}{n_1} = \frac{V_S}{n_2}$$

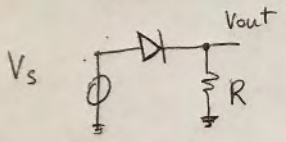
$$V_S = V_{in} \cdot \frac{n_2}{n_1}$$

$$V_{S\,MAX} = V_{in\,MAX}\,\frac{n_2}{n_1} = 12V \rightarrow \frac{n_1}{n_2} = 26$$

CIRCUITO EQUIVALENTE per analizzare $V_{out} = f(V_S)$



2) Disegnare $V_{out}(t)$

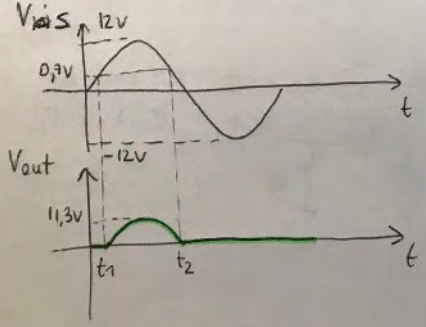


$V_s = 12V \sin(2\pi f t)$, $f = 50Hz$

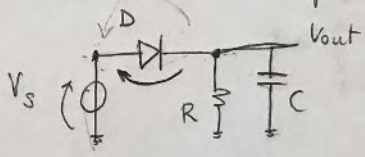
DIODO si accende per $V_s(t) > 0,7V$

DIODO ACCESO → $V_{out} = V_s - 0,7V$

DIODO SPENTO → $V_{out} = 0V$

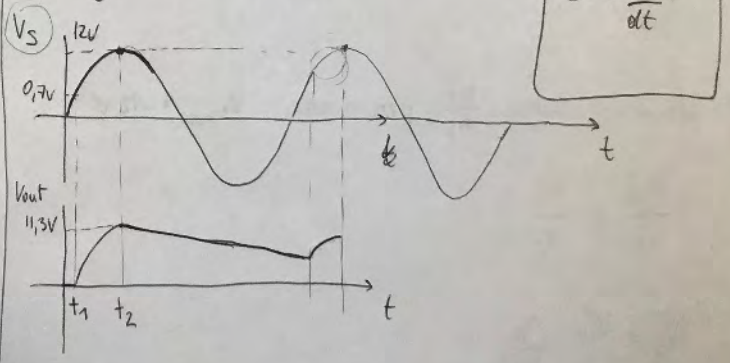


3) Aggiungere C in parallelo a R tale che $RC >> T$ $\left(T = \frac{1}{f}\right)$

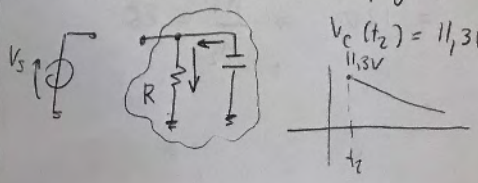


Disegnare $V_{out}(t)$

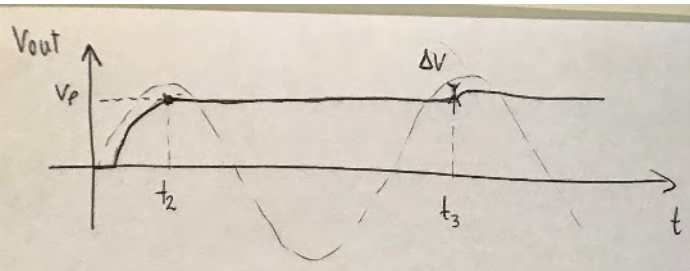
CONDENSATORE $i_c = C \frac{dV_c}{dt}$



per $V_s(t_2^+) = 12V$ diodo si spegne



$V_{out}(t) = 11,3V\, e^{-\frac{t-t_2}{RC}}$



tra t_2 e t_3 scarica esponenziale del condensatore

$$V_{out} = V_p\, e^{-\frac{t}{RC}}$$

$$\text{Ripple} \triangleq \frac{\Delta V}{V_p}$$

4) Dimensionare C per avere un ripple < 1%

con diodo spento

$$V_{out} = V_p\, e^{-\frac{t}{RC}}$$

$V_{out}(t_3) = ?$ $\quad \Delta V_{MAX} = V_{out}(t_3) - V_p$

↳ approssimiamo $V_{out}(t_3)$ come $V_{out}(T)$ [conservativo!]

$RC \gg T$

$$V_{out} = V_p e^{-\frac{t}{RC}} \simeq V_p \left(1 - \frac{t}{RC}\right)$$

$$\Delta V \simeq V_p - \left[V_p \left(1 - \frac{T}{RC}\right)\right] =$$

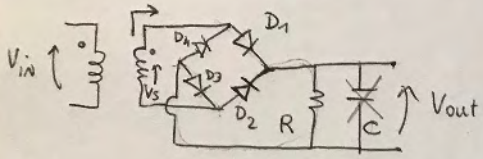
$$= V_p \cdot \frac{T}{RC}$$

$$\frac{\Delta V}{V_p} < 1\%$$

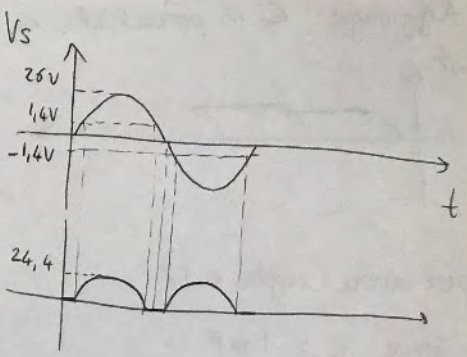
$$\frac{T}{RC} < 0{,}01$$

$$C > \frac{20ms}{1k\Omega \cdot 0{,}01} = 2\,mF$$

RADDRIZZATORE A DOPPIA SEMIONDA



$R = 1k\Omega$

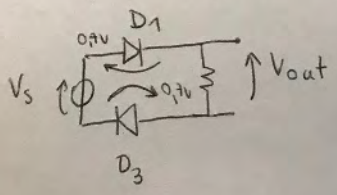


$V_S = 26V \sin(2\pi f t)$

1) Tracciare $V_{out}(t)$ senza considerare la capacità C

per V_S positivo

D_4 spento, D_2 spento



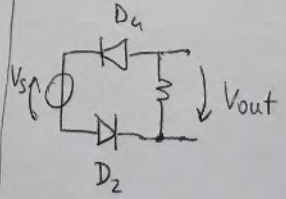
DIODI SI ACCENDONO per $V_S > 1{,}4V$

CON DIODI ACCESI $V_{out} = V_S - 1{,}4V$

CON DIODI SPENTI $V_{out} = 0V$

per V_S negativo

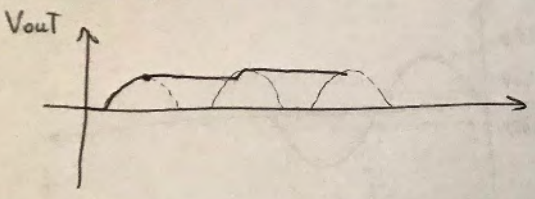
D_1, D_3 spenti



diodi si accendono per $V_S < -1{,}4V$

$V_{out} = -V_S - 1{,}4V$

Aggiungo C in parallelo a R



per avere ripple < 1%.

Serve $C > 1\,mF$