FILTRI RC/CR (RL/LR)

1

Riepilogo

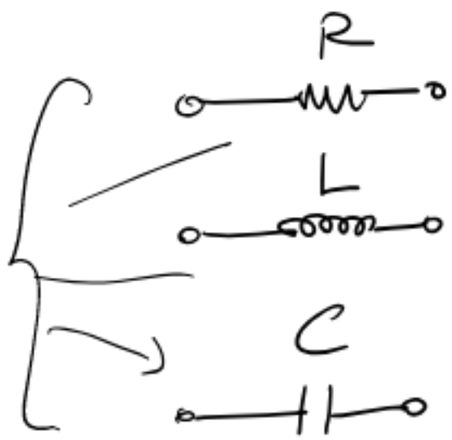
Regime sinusoidale.

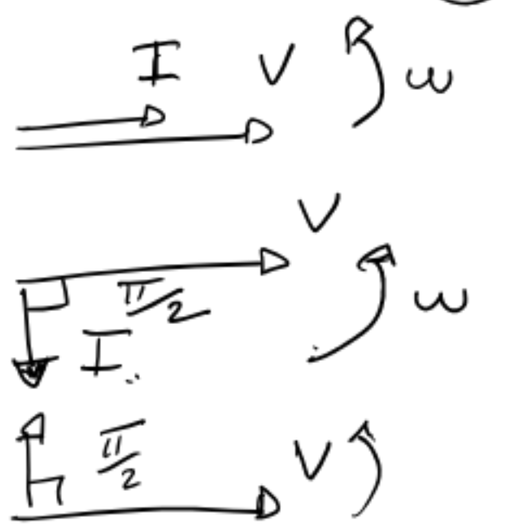
(Z) IMPEDENZA

$Z = R + jX$

Reattanza $>0 \Rightarrow X_L$

$<0 \Rightarrow X_C$

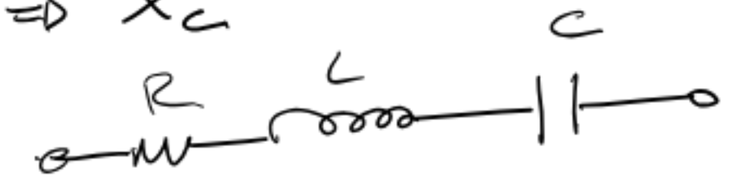




$Z = R + jX_L - jX_C$

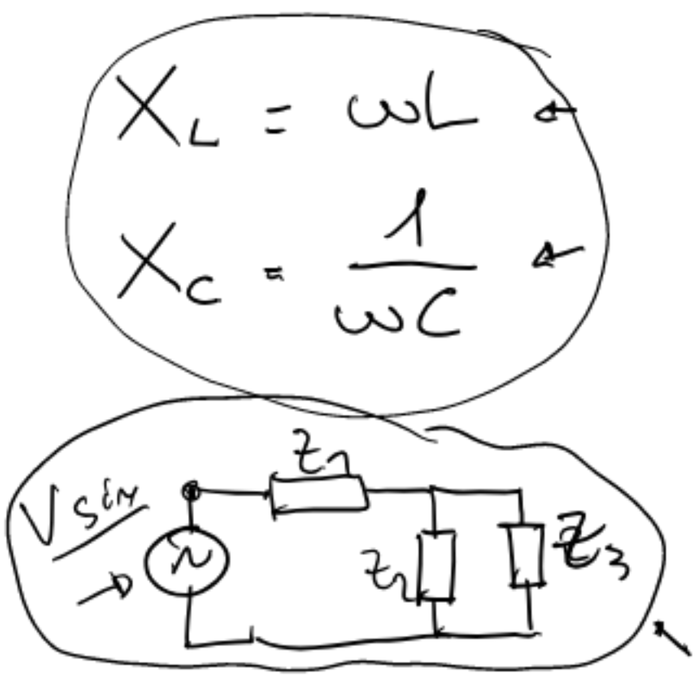
$= R + jX$

$X = X_L - X_C$



$X_L = \omega L$

$X_C = \frac{1}{\omega C}$



Hz

$\omega = 2\pi f$

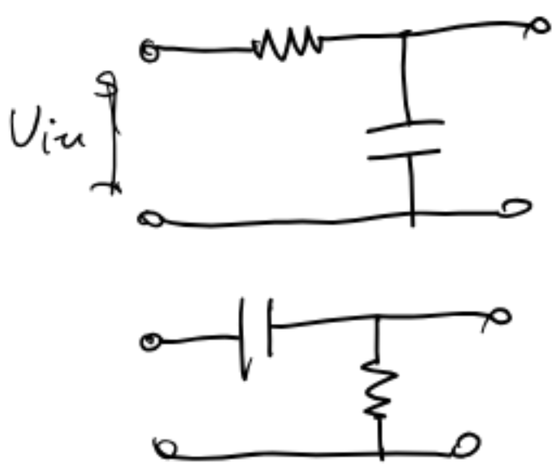
$V = V_0 \sin(\omega t)$

RC ⟺ (LR)

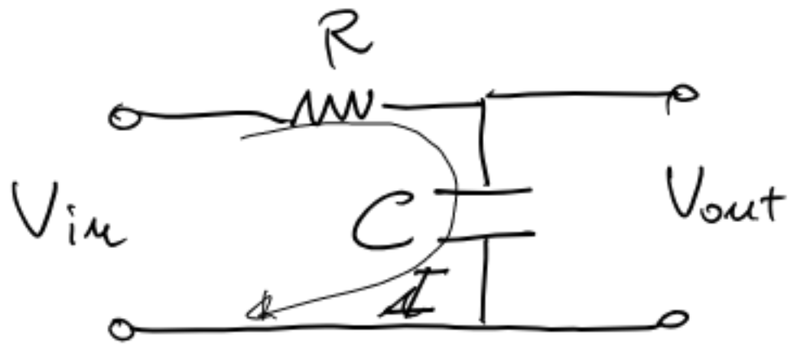
CR ⟺ (RL)

I, II KCI R...

$V = Z \cdot I$ ⟶ C



FILTRO RC



$V_{in} = V_{in}$

$V_{out} = f(V_{in})$

Funzione di trasferimento $T = \left\{ \frac{V_{out}}{V_{in}} \right\}$

$|T|$

$V_{out} = Z_C \cdot I$

$V_{in} = (Z_R + Z_C) \cdot I \Rightarrow \quad I = \frac{V_{in}}{Z_R + Z_C}$

$V_{out} = \frac{Z_C}{Z_R + Z_C} \cdot V_{in}$

$T = \left| \frac{V_{out}}{V_{in}} \right| = \left| \frac{Z_C}{Z_R + Z_C} \right| \qquad Z_R = R \qquad Z_C = -jX_C \quad \left(X_C = \frac{1}{\omega C} \right)$

$$\frac{Z_C}{Z_R + Z_C} = \frac{-jX_C}{R - jX_C} = \frac{-jX_C(R + jX_C)}{R^2 + X_C^2} = \frac{X_C^2 - jRX_C}{R^2 + X_C^2} = \frac{X_C}{R^2 + X_C^2}(X_C - jR)$$

$$|T| = \frac{X_C}{R^2 + X_C^2} \sqrt{R^2 + X_C^2} = \frac{X_C}{\sqrt{R^2 + X_C^2}} = \frac{1}{\sqrt{(\omega RC)^2 + 1}}$$

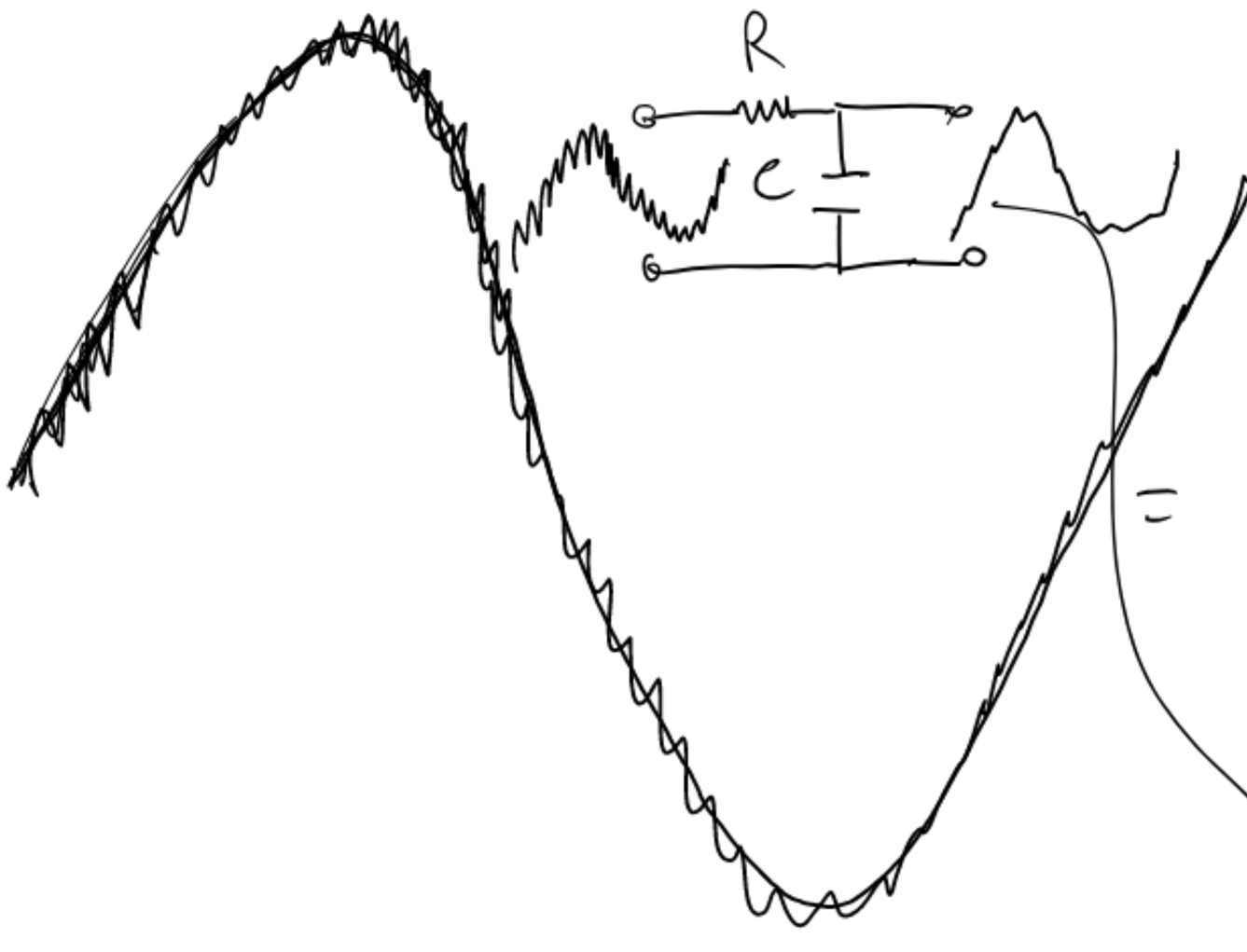
($X_C = \frac{1}{(\omega C)^2}$)

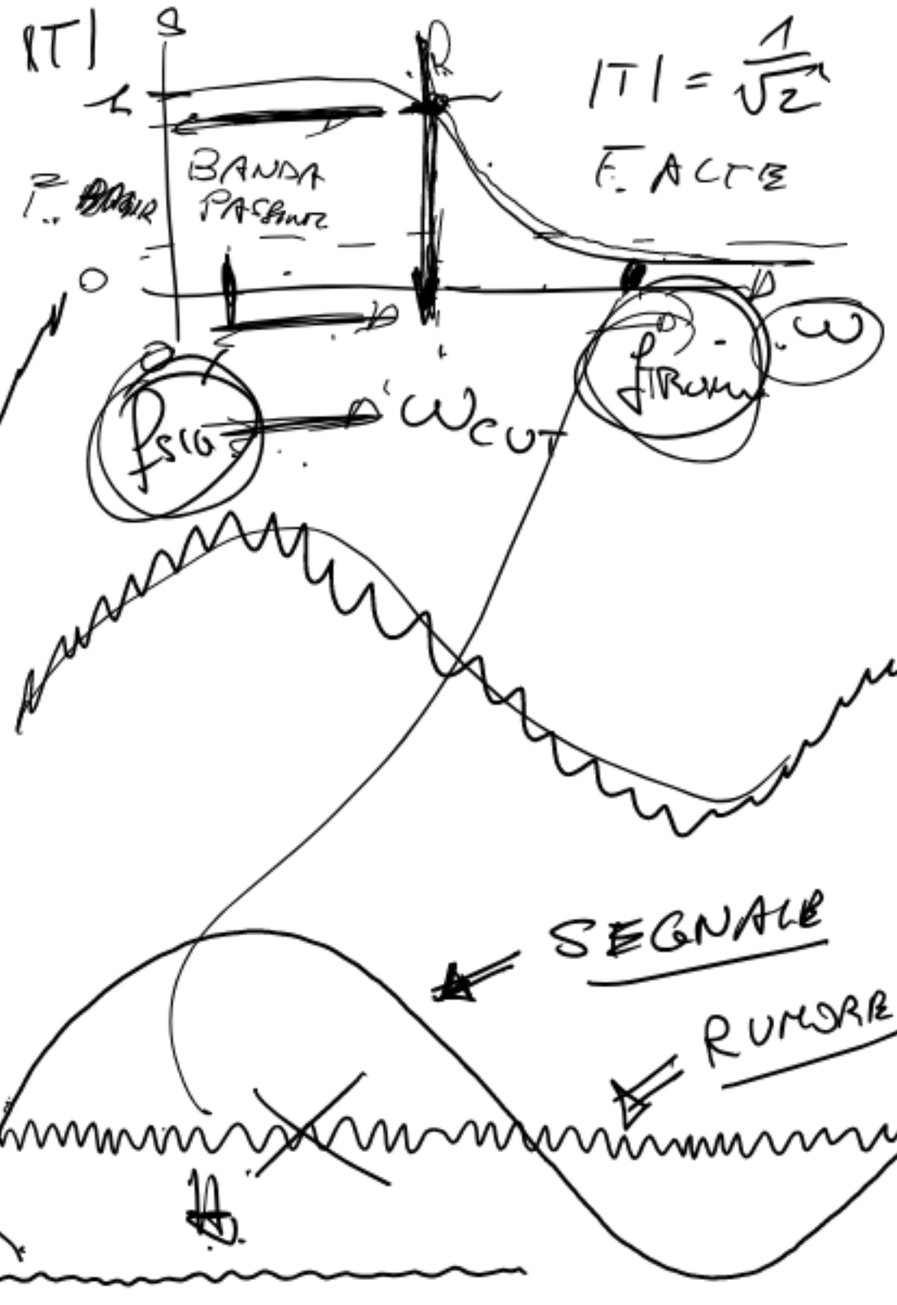
$$|T| = \frac{1}{\sqrt{1 + (\omega RC)^2}}$$

$\omega \to 0 \Rightarrow 1 \Leftarrow |V_{out}| \simeq |V_{in}|$ ③

$\omega \to +\infty \Rightarrow 0 \Leftarrow |V_{out}| \simeq 0$

FILTRO PASSA-BASSO RC



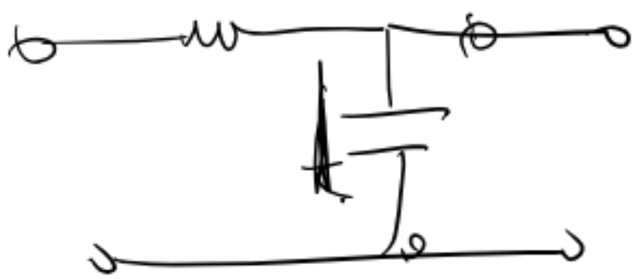


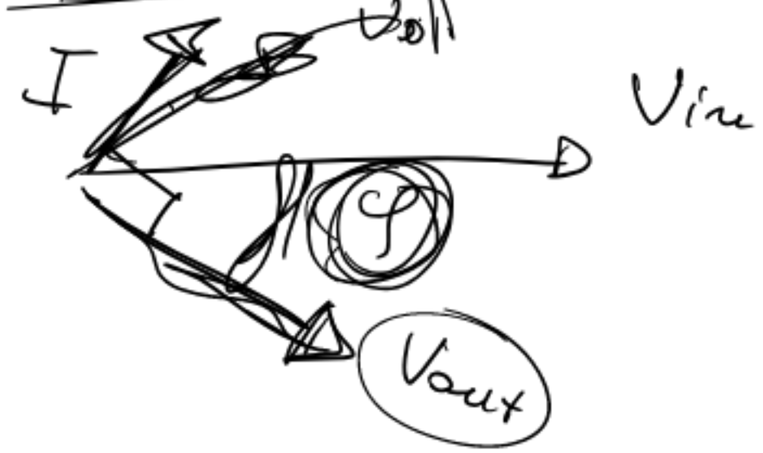
$$\frac{V_{out}}{V_{in}} = \frac{Z_C}{Z_R + Z_C} = \frac{X_C}{R^2 + X_C^2}\,(X_C - jR)$$

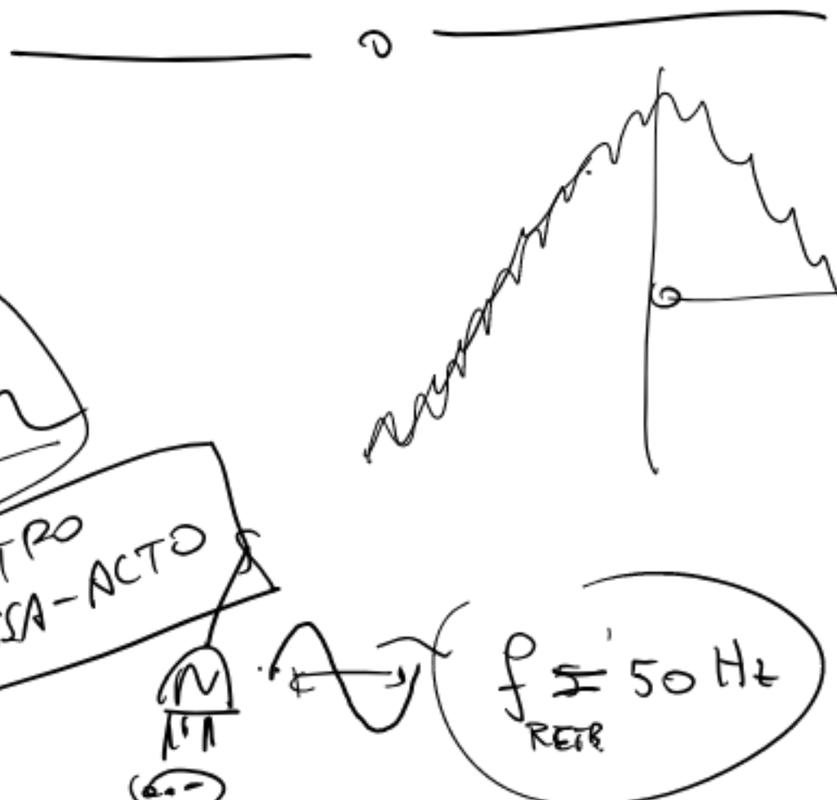
$\frac{V_{out}}{V_{in}}$ sfasata rispetto

Re

$$\varphi = \operatorname{arctg}\frac{-R}{X_C} = \operatorname{arctg}(-\omega RC)$$





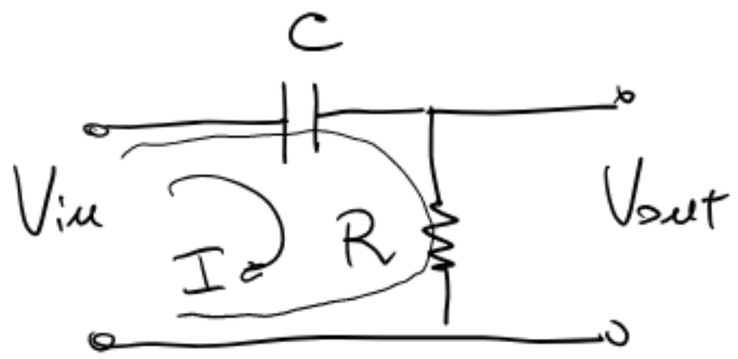


$f = 50\,Hz$
$(T = 20\,ms)$

$f_{RETE} = 50\,Hz$

f_{ALTA} STUDIARE

FILTRO CR - PASSA ALTO



$$T = \frac{V_{out}}{V_{in}} \qquad V_{in} \; R_e$$

$$V_{out} = z_R \cdot I = R \cdot I$$

$$V_{in} = (z_R + z_C) \cdot I \Rightarrow I = \frac{V_{in}}{z_R + z_C}$$

$$T = \frac{V_{out}}{V_{in}} = \frac{R}{z_R + z_C} = \frac{R}{R - jX_C} = \frac{R(R + jX_C)}{R^2 + X_C^2} = R\,\frac{R^2 + jX_C}{R^2 + X_C^2}$$

$$X_C = \frac{1}{\omega C}$$

$$|T| = \frac{R}{R^2 + X_C^2}\sqrt{R^2 + X_C^2} = \frac{R}{\sqrt{R^2 + X_C^2}} = \frac{1}{\sqrt{1 + \frac{X_C^2}{R^2}}}$$

$$|T| = \frac{1}{\sqrt{1 + \left(\frac{1}{\omega RC}\right)^2}}$$

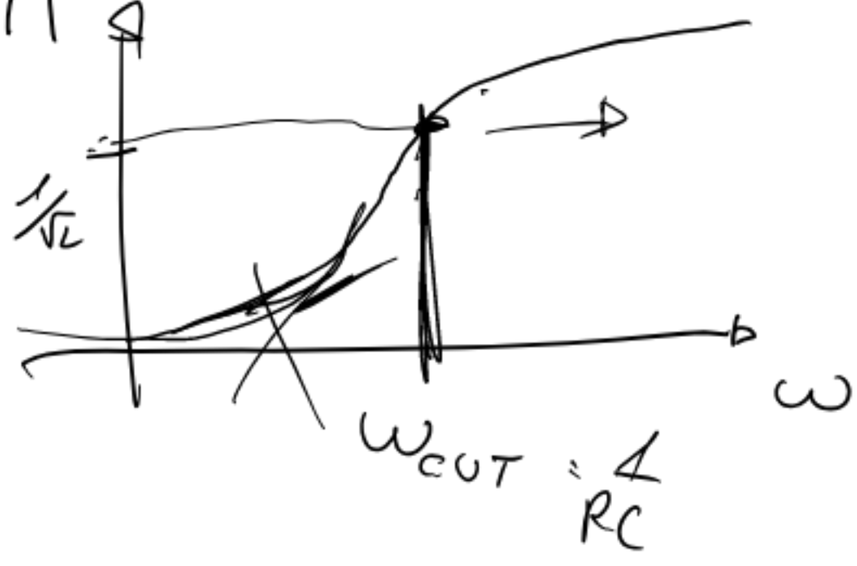
$\omega \to 0 \Rightarrow 0$

$\omega \to +\infty \Rightarrow 1$

$\omega \to +\infty \Rightarrow +\infty$

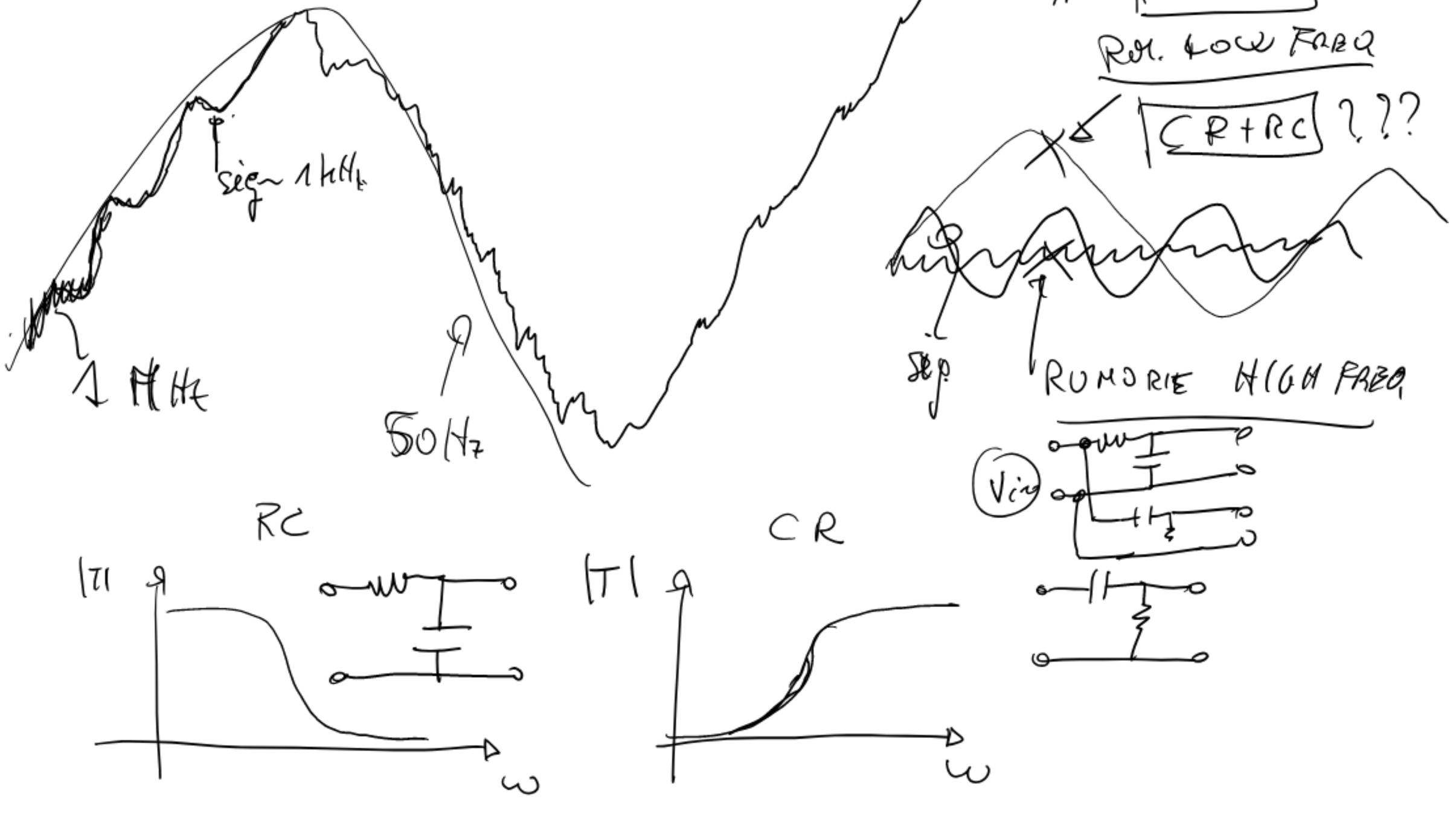
$\omega \to 0 \Rightarrow 0$

$\omega = \frac{1}{RC}$



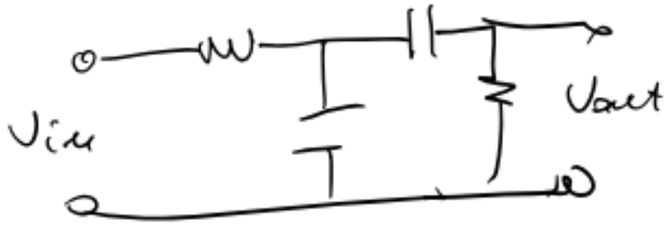
FILTRO PASSA BANDA

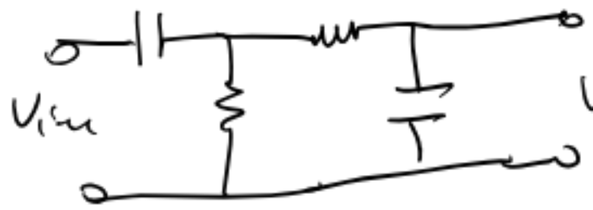
f_{SIG} = 1 kHz ← + 1 MHz
← + 50 Hz

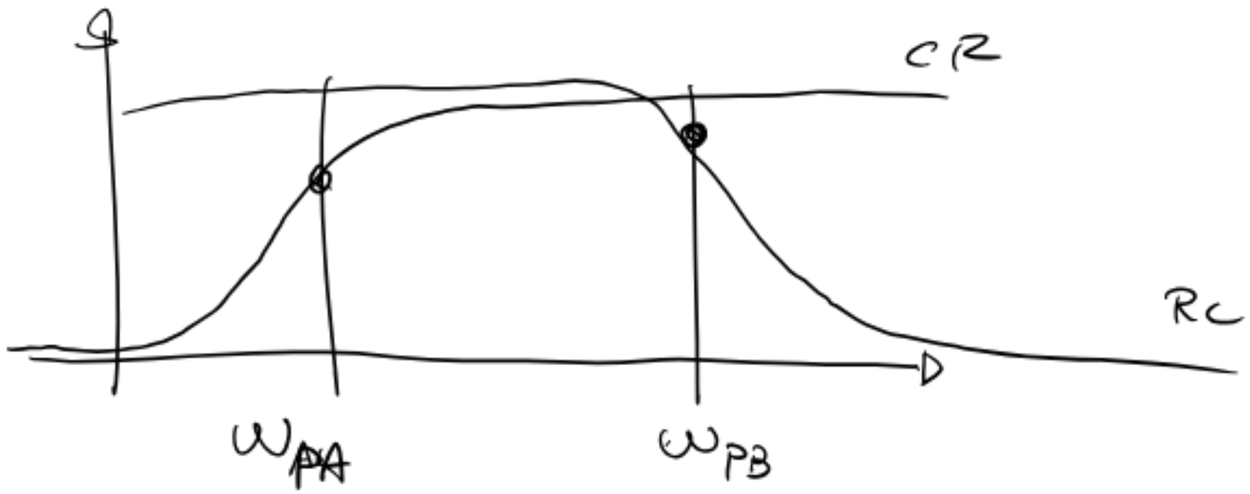


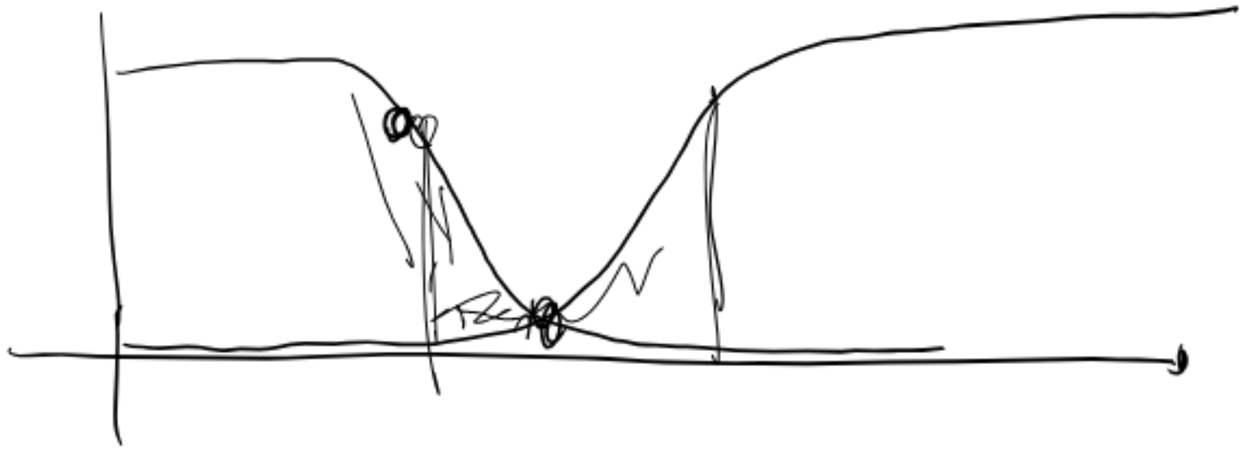
FILTRO PASSA-BANDA

RC + CR CR + RR







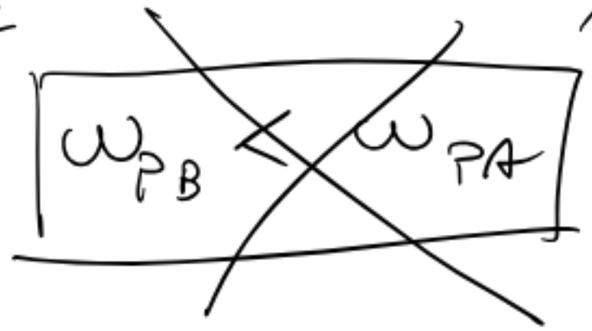


$$T = \frac{R}{R^2 + X_C^2} \; R + jX_C R$$

$$\varphi = \arctg \frac{X_C}{R}$$

$$\frac{Z_{eq}}{Z_{eq}} = \frac{1}{Z_R} + \frac{1}{Z_C}$$

$\omega_{PB} > \omega_{PA}$ OK



$$X_C = \frac{1}{\omega C}$$

~~FILTRO~~
PARTITORE COMPENSATO

OSCILLOSCOPIO

LCD

Schermo

V

1mV

t

Ampiezza

Temp.

CH1 CH2

TRG IN

SIG. IN

CANALI

CH1 VS. CH2

10V

VAN

0

BIN

8 BIT

10

12

14

CR

TRIGGER

f_1 ... f_2

25 GS/s

$\frac{1}{25}$ ns = 0,04 ns = 40 ps

TRIGGER

CONDIZIONE FA PARTIRE L'ACQ.