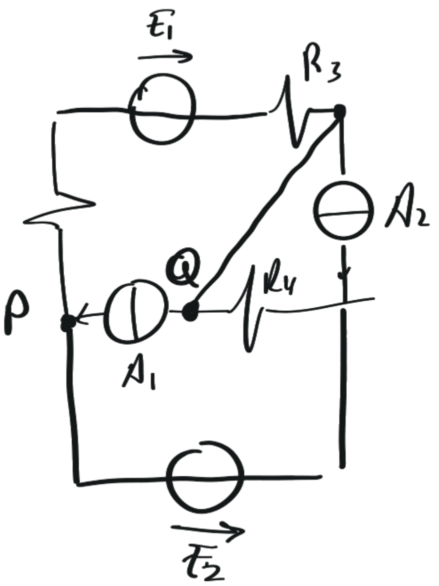


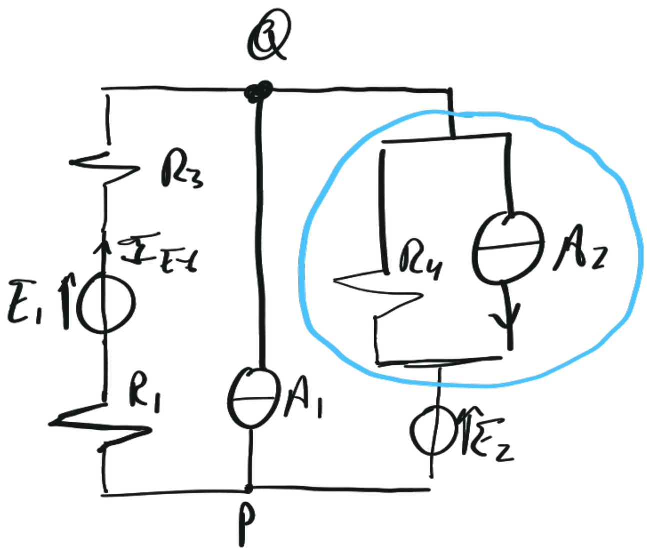
$E_1 = 50V$ $\quad R_1 = 5\Omega$

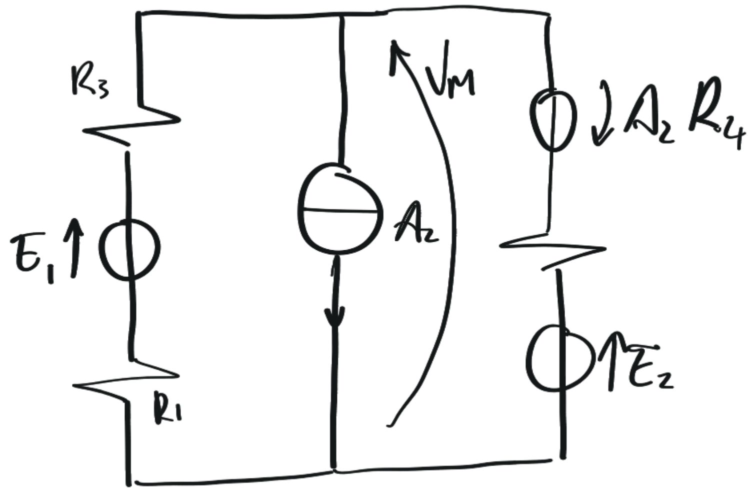
$E_2 = 25V$ $\quad R_3 = 20\Omega$

$A_1 = 2A$ $\quad R_4 = 40\Omega$

$A_2 = 1A$ $\quad I_{E1} = ?$

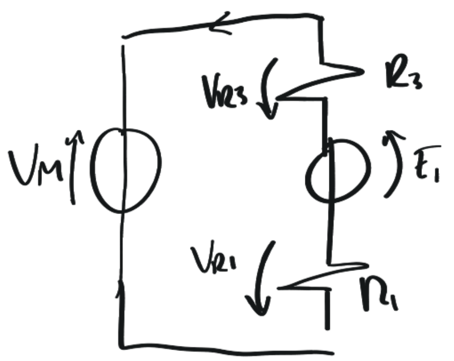
Si può solvere con millmann





$$V_M = \frac{\frac{E_1}{R_1+R_3} - A_1 + \frac{E_2 - A_2 R_4}{R_4}}{\underbrace{\frac{1}{R_1+R_3}}_{\frac{1}{20}} + 0 + \underbrace{\frac{1}{R_4}}_{\frac{1}{40}}} = \frac{-0{,}375}{\frac{1}{20}+\frac{1}{40}} = -5{,}76\,V$$

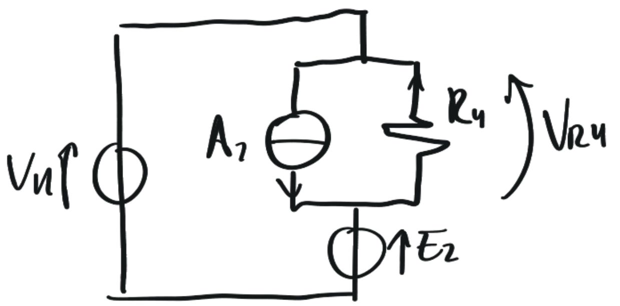
Corto Circuito
è serie



$$I_{E1} = \frac{E_1 - V_M}{R_1+R_3} = 2{,}23\ A$$

Se chiesti I_{R4}?

dobbiamo togliere la semplificazione



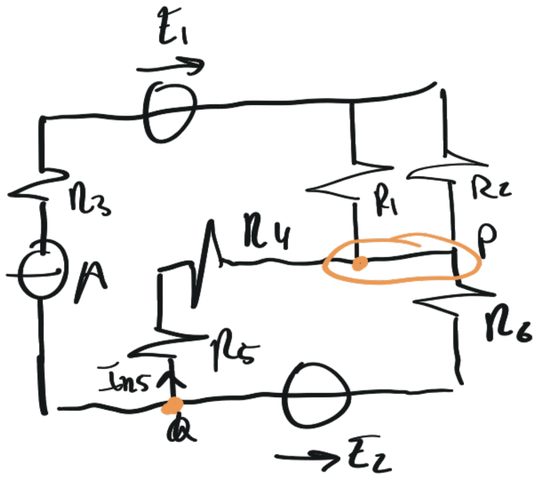
Molti metodi:

1. Troviamo V_{R4}

$$V_{R4} = V_M - E_2 = -30{,}76\,V$$

$$I_{R4} = \frac{-V_{R4}}{R_4} = 0{,}77\,A$$

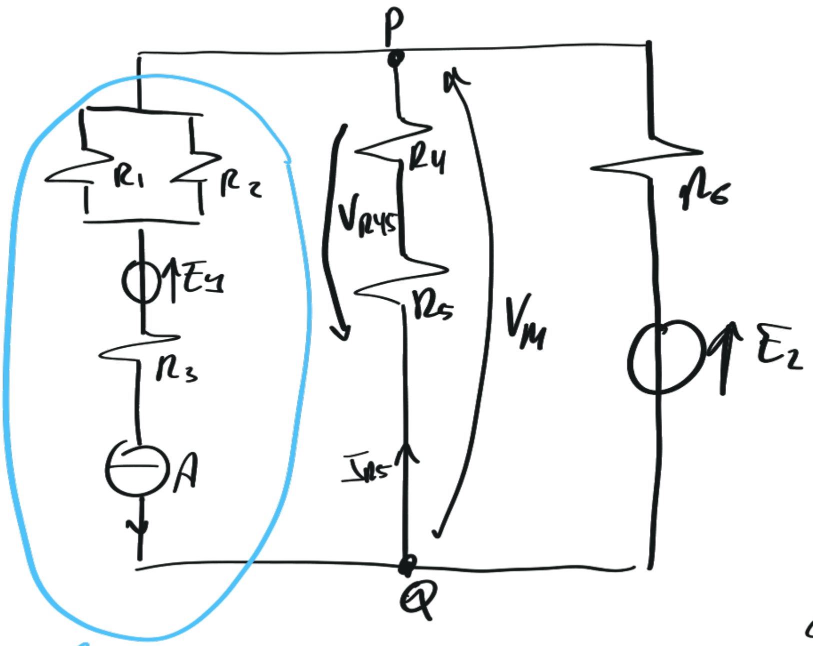
2)



$A = 4A$
$E_1 = 25V$
$E_2 = 40V$

$R_1 = 10\Omega$
$R_2 = 10\Omega$
$R_3 = 4\Omega$
$R_4 = 10\Omega$
$R_5 = 5\Omega$
$R_6 = 15\Omega$

$I_{R5} = ?$



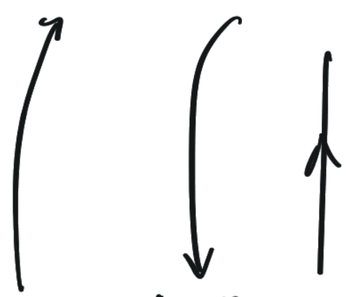
$$V_M = \frac{\overset{-4}{-A} + 0 + \overset{\frac{8}{3}}{\frac{E_2}{R_6}}}{0 + \frac{1}{R_4+R_5} + \frac{1}{R_6}} = $$

$$= -10V$$

generatore di corrente diventa circuito aperto quindi $G=0$

Equivalenza al solo generatore di corrente

$$I_{R5} = \frac{-V_M}{R_4+R_5} \qquad -V_M = V_{R45}$$



Fine esercizi specifici su Millmann

Regime Sinusoidale

Equivalente Fasiali

$$v(t)=\sqrt{2}\,V\cdot\cos(\omega t+\varphi_v) \rightarrow \bar{V}=Ve^{j\varphi_v}$$

↑ Fasore Tensione

Diversi

$$i(t)=\sqrt{2}\cdot I\cdot\cos(\omega t+\varphi_I) \rightarrow \bar{I}=Ie^{j\varphi_I}$$

↑ Fasore Corrente

Valore Efficace

$$e^{j\varphi}=\cos(\varphi)+j\sin(\varphi)$$

Portare indietro a trigonometria

$$v(t)=\Re\left[\sqrt{2}\,Ve^{j(\omega t+\varphi_v)}\right]$$

$$\omega=2\pi f$$

$$\bar{V}=V_{\mathbb{R}}+jV_{\mathbb{I}}$$

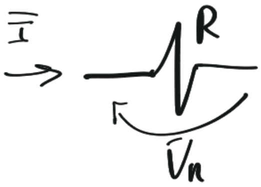
$$V_r=V\cos(\varphi_v)$$

$$V_j=V\sin(\varphi_v)$$

$$A=\sqrt{P^2+Q^2}$$

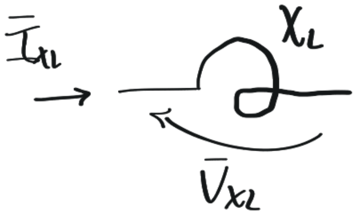
$$V=\sqrt{V_r^2+V_j^2}$$

$$\varphi_v=\arg(V_r+jV_j)=\begin{cases}\arctan\left(\frac{V_j}{V_r}\right) & : V_r>0\\ \arctan\left(\frac{V_j}{V_r}\right)+\pi & : V_r<0\\ \frac{\pi}{2} & : V_r=0 \text{ e } V_j>0\\ -\frac{\pi}{2} & : V_r=0 \text{ e } V_j<0\\ \text{indefinito} & : V_r=0 \text{ e } V_j=0\end{cases}$$



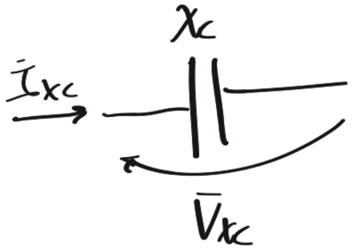
$$\bar{V}_R=R\bar{I}_R$$

Impedenze



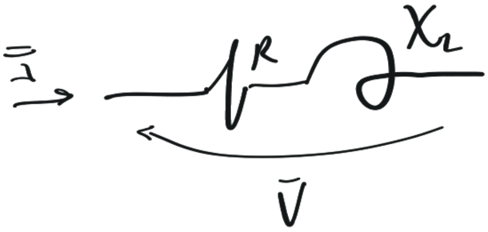
$\bar V_{XL} = j X_L \bar I_{XL}$ $\quad X_L = \omega L$

↑ Crea un ritardo nella corrente



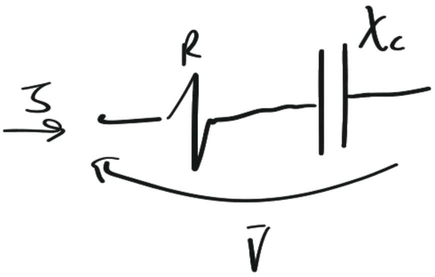
$\bar V_{XC} = -j X_C \bar I_{XC}$ $\quad X_C = \frac{1}{\omega C}$

↑ Crea un anticipo nella corrente



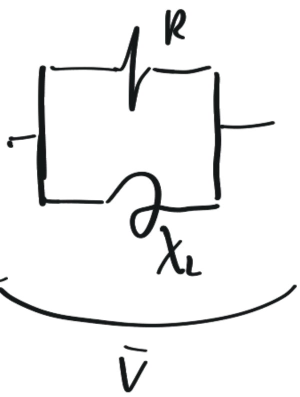
$\bar V = \bar Z \cdot \bar I$

$\bar Z = (R + j X_L)$

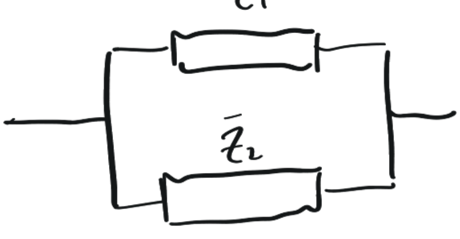


$\bar V = \bar Z \bar I$ $\quad \bar Z = R - j X_C$

Impedenza in Parallelo



$\bar V = \bar Z \bar I$ $\quad \bar Z = \frac{R \cdot j X_L}{R + j X_L}$



$\bar Z_{eq} = \frac{\bar Z_1 \bar Z_2}{\bar Z_1 + \bar Z_2}$

$\bar{Y}$ = Ammettenza = $\frac{1}{\bar{Z}}$

Cose da memorizzare:

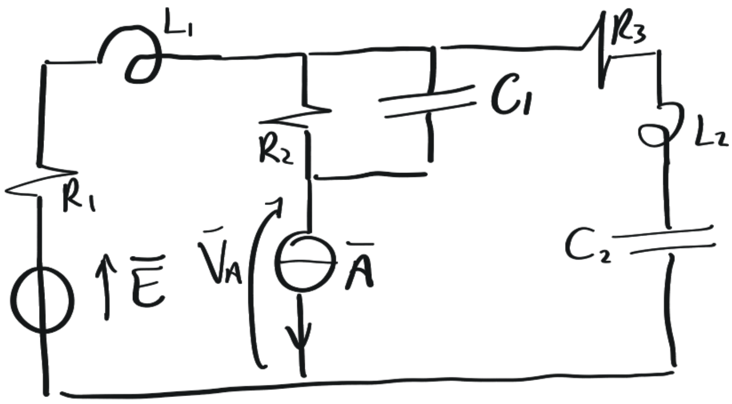
<! Immagine telefono >

↳ $e^{j\varphi} = \cos(\varphi) + j\sin(\varphi)$

$X_r = X\cos(\varphi)$

$X_j = X\sin(\varphi)$

Aggiungi alla riscritta della immagine



$R_1 = 5\,\Omega$

$R_2 = 7\,\Omega$

$R_3 = 4\,\Omega$

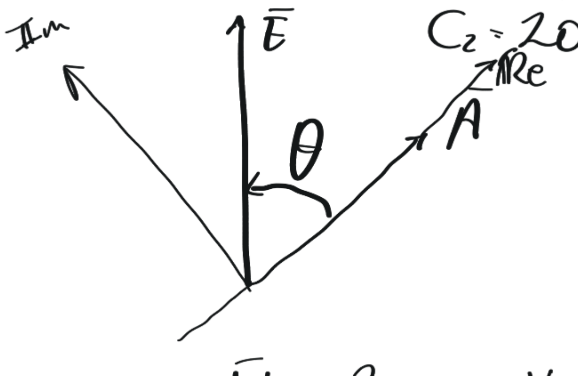
$L_1 = 1\,mH$

$L_2 = 3\,mH$

$C_1 = 10\,\mu F$

$C_2 = 20\,\mu F$

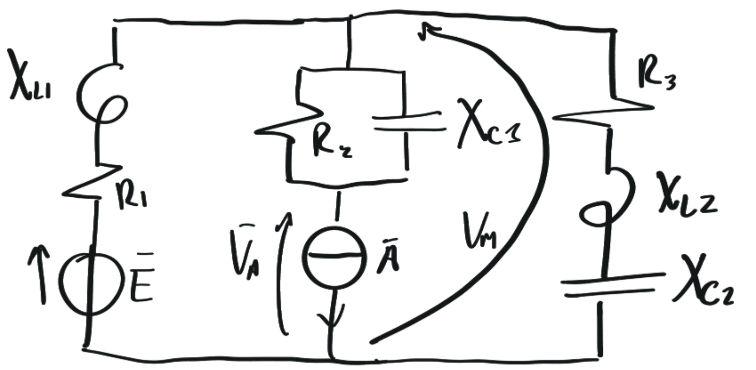
Solo moduli $\begin{cases} E = 5V \\ A = 10A \end{cases}$



$\theta = \frac{\pi}{3}$ rad

$f = 50\,Hz$

$\bar{V}_A = ?$ $\quad v_A(t) = ?$

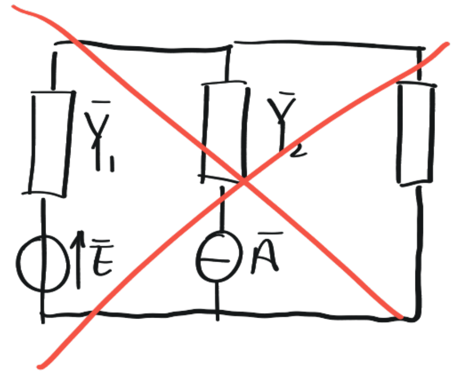


$X_{C1} = \frac{1}{2\pi f C_1} = 318{,}31\,\Omega$

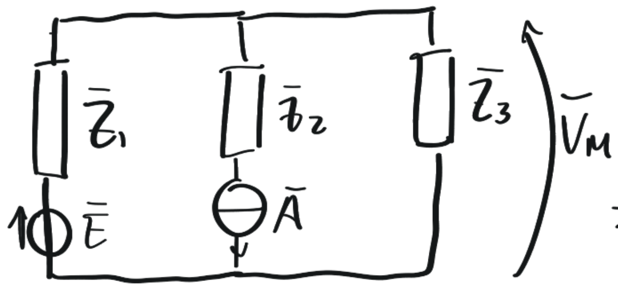
$X_{L1} = 2\pi f L_1 = 0{,}314\,\Omega$

$X_{C2} = \frac{1}{2\pi f C_2} = 159{,}155\,\Omega$

$X_{L2} = 2\pi f L_2 = 0{,}942$



Di solito evitiamo $\bar{Y}$ anche in pratica



$\bar{Z}_1 = R_1 + j X_{L1} = 5 + j\,0{,}314\ \Omega$

$\bar{Z}_3 = R_3 + j X_{L2} - j X_C = 4 - j\,158{,}213\ \Omega$

$$\bar{Z}_2 = \frac{R_2 \cdot -j X_{C1}}{R_2 - j X_{C1}} = 7 - j\,0{,}15\ \Omega$$

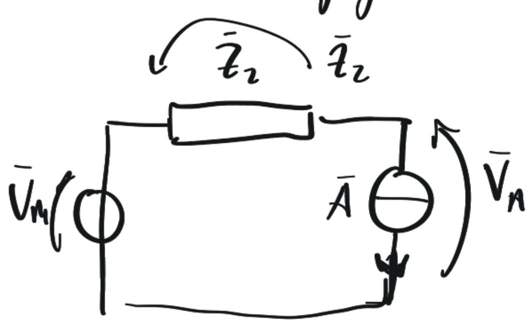
$\bar{A} = 10\,A$ se $\varphi_I = 0$

$\bar{E} = E e^{j\theta} = E\cos\theta + j E \sin\theta$

$= 2{,}5 + j\,4{,}33\ V$

$$\bar{V}_M = \frac{\frac{\bar{E}}{\bar{Z}_1} - \bar{A}}{\frac{1}{Z_1} + 0 + \frac{1}{Z_3}} = -47{,}47 + j\,2{,}69\ V$$

Spegnendo A non circola corrente $Y = 0$



$\bar{V}_A = \bar{V}_M - \bar{Z}_2 \bar{A} = -117{,}47 + j \cdot 4{,}19\,V$

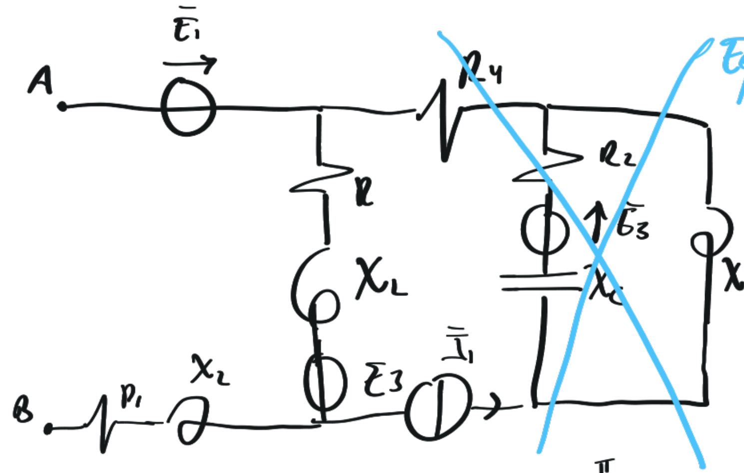
$= 117{,}54 e^{j3{,}10}$

Compito: Studiare la calcolatrice

$\varphi \to$ argomento
fase
phase-angle

X modulo
abs

$$V_A = \sqrt{2} \cdot 117,54 \cos(314,16 \cdot t + 3,10)$$



Thevenin AB?

$R_1 = R_4 = 25\,\Omega$

$R_2 = R_3 = 10\,\Omega$

$X_L = 15\,\Omega$

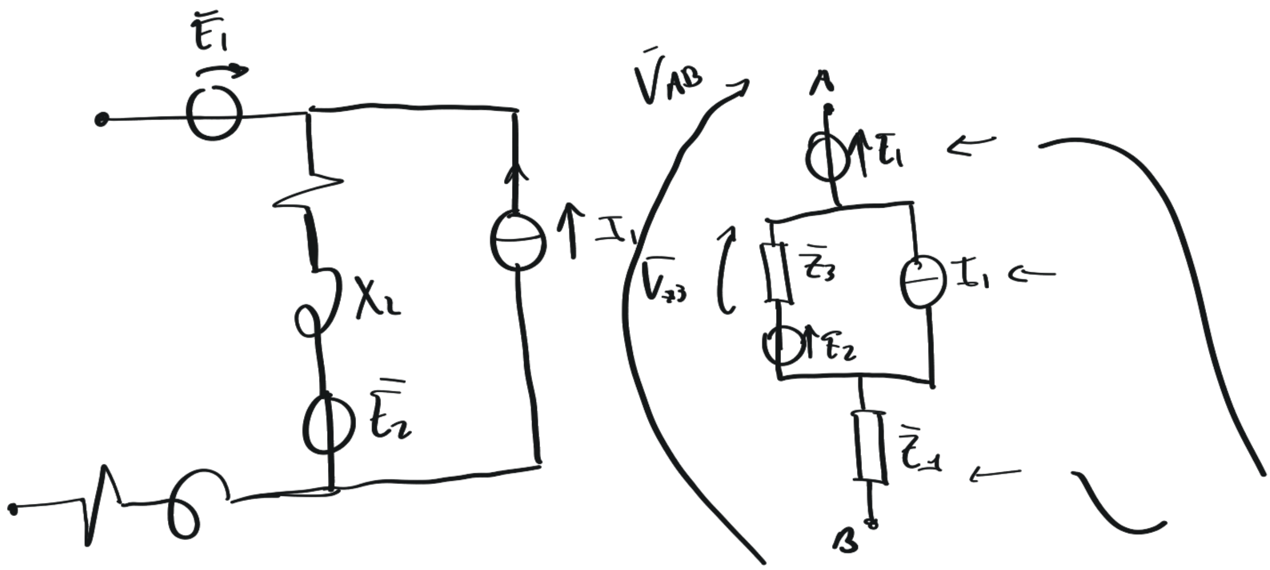
$X_C = 15\,\Omega$

$\bar E_2 = 10 e^{j\frac{\pi}{3}}$

$\bar E_1 = 20 e^{-j\frac{\pi}{4}}$

$\bar I_1 = 5 e^{j\pi/3}$

$\bar E_3 = \bar E_1$



$\bar E_1 = 14,14 - j\,14,14$ V

$\bar E_2 = 5 + j\,8,66$ V

$\bar Z_1 = R_1 + jX_L = 25 + j \cdot 15\ \Omega$

La corrente passa ma non va da nessuna parte, quindi diciamo che I_1 circola nella maglia.

Immagina come se fosse isolato dal circuito Π attaccato tra A e B.

$\bar{Z}_3 = R_3 + jX_2 = 10 + j15\ \Omega$

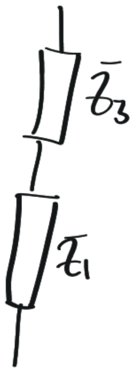
$\bar{I}_1 = 2,5 + j\,4,33\ A$

$\bar{V}_{Z3} = \bar{Z}_3 \cdot \bar{I}_1 = -39,95 + j80,8\ V$

$\bar{V}_{AB} = -\bar{E}_2 + \bar{V}_{Z3} - \bar{E}_1$

$= (-5 - 39,95 - 14,14) + j(-8,66 + 80,8 + 14,14) = -59,09 + j86,28\ V$

Req



$\bar{Z}_{AB} = \bar{Z}_1 + \bar{Z}_3 = 35 + j30\ \Omega$