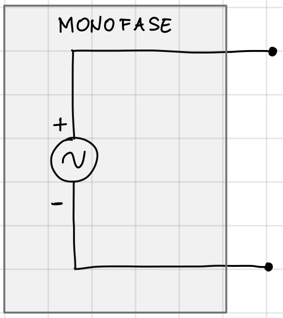
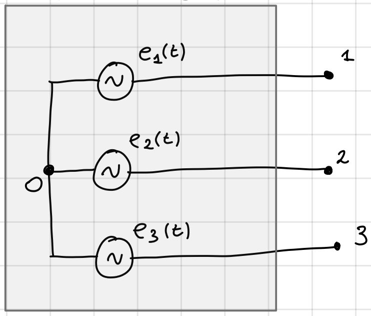
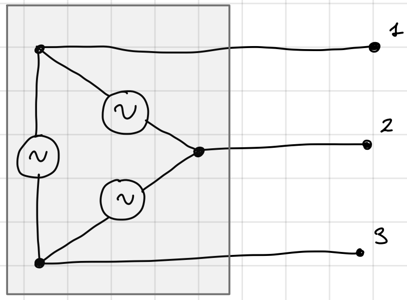
Sistemi trifase



TRIFASE - STELLA ⅄



TRIFASE - TRIANGOLO △



Facendo riferimento alla conf a ⅄ $\quad * \ \frac{2}{3} + \frac{2}{3} = \frac{4}{3}$

$$\begin{cases} e_1(t) \rightleftharpoons \bar{E}_1 = E_0 \\ e_2(t) \rightleftharpoons \bar{E}_2 = E_0 \, e^{\pm j \frac{2}{3}\pi} \\ e_3(t) \rightleftharpoons \bar{E}_3 = E_0 \, e^{\pm j \frac{4}{3}\pi} \end{cases}$$

← sfasati di $\frac{2}{3}\pi$

Stesso valore efficace

TERNA SIMMETRICA

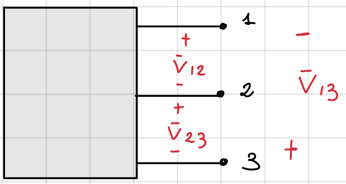
DIRETTA: $0, +\frac{2}{3}\pi, +\frac{4}{3}\pi$

INVERSA: $0, -\frac{2}{3}\pi, -\frac{4}{3}\pi$

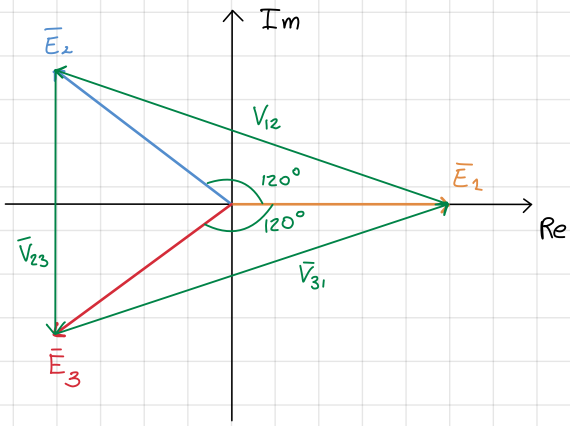
POTENZIALI

$$e_1(t) = U_1$$
$$e_2(t) = U_2$$
$$e_3(t) = U_3$$

$$\bar{E}_1 = E_0$$
$$\bar{E}_2 = E_0 \cdot e^{\frac{2}{3}\pi j} = E_0 \angle \tfrac{2}{3}\pi = E_0 \angle 120^\circ$$
$$\bar{E}_3 = E_0 \, e^{\frac{4}{3}\pi j} = E_0 \angle \tfrac{4}{3}\pi = E_0 \angle 240^\circ$$



$$\bar{V}_{12} = \bar{E}_1 - \bar{E}_2 = E_0 - E_0 \angle \tfrac{2}{3}\pi$$
$$\bar{V}_{23} = \bar{E}_2 - \bar{E}_3 =$$
$$\bar{V}_{31} = \bar{E}_3 - \bar{E}_1 =$$



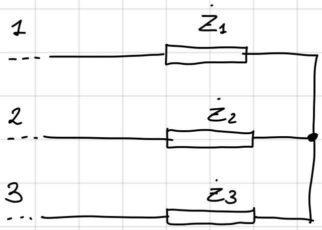
$$\boxed{V_{12} + V_{23} + V_{31} = \varnothing}$$

dim: LKT_M: $V_{12} + V_{23} + V_{13} = \varnothing$

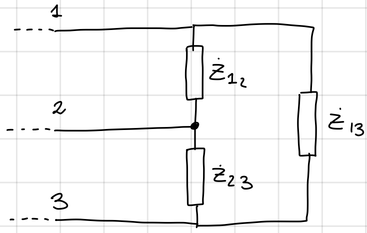
oppure con le regole dei vettori

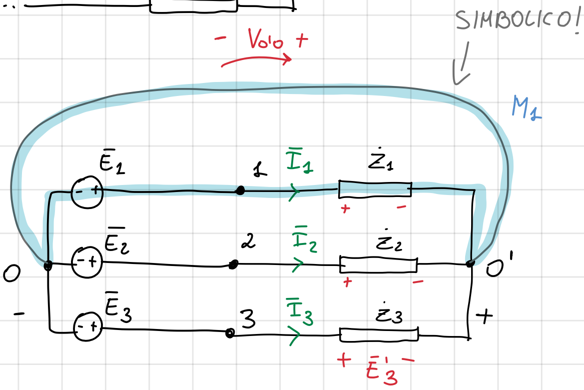
CARICO TRIFASE

STELLA



TRIANGOLO





Se $\bar{E}_1 \neq \bar{E}_2 \neq \bar{E}_3$ e $\dot{Z}_1 \neq \dot{Z}_2 \neq \dot{Z}_3$

$\Rightarrow \bar{V}_{12} \neq \bar{V}_{23} \neq \bar{V}_{31}$, $\bar{I}_1 \neq \bar{I}_2 \neq \bar{I}_3$

(1) $LKC_{O'}$: $\bar{I}_1 + \bar{I}_2 + \bar{I}_3 = 0$

(2) Vedo $\bar{V}_{o'o}$ come la d.d.p. tra i due centri stella

$\rightarrow LKT_{M_1}$: $\bar{E}_1' - \bar{E}_1 + \bar{V}_{o'o} = 0 \rightarrow \begin{cases} \bar{E}_1' = \bar{E}_1 - \bar{V}_{o'o} \\ \bar{E}_2' = \bar{E}_2 - \bar{V}_{o'o} \\ \bar{E}_3' = \bar{E}_3 - \bar{V}_{o'o} \end{cases}$

Tensioni alle imped. — gen — d.d.p. O'O

(3) Siccome $\bar{I} = \dfrac{\bar{E}}{\dot{Z}}$

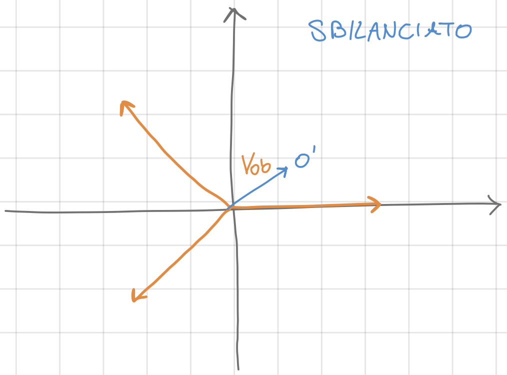
$\rightarrow \underbrace{\dfrac{\bar{E}_1'}{\dot{Z}_1} + \dfrac{\bar{E}_2'}{\dot{Z}_2} + \dfrac{\bar{E}_3'}{\dot{Z}_3}}_{\text{CORRENTI}} = \dfrac{\bar{E}_1 - \bar{V}_{o'o}}{\dot{Z}_1} \quad \dfrac{\bar{E}_2 - \bar{V}_{o'o}}{\dot{Z}_2} \quad \dfrac{\bar{E}_3 - \bar{V}_{o'o}}{\dot{Z}_3} = \emptyset$

(4) Trovo $V_{o'o}$

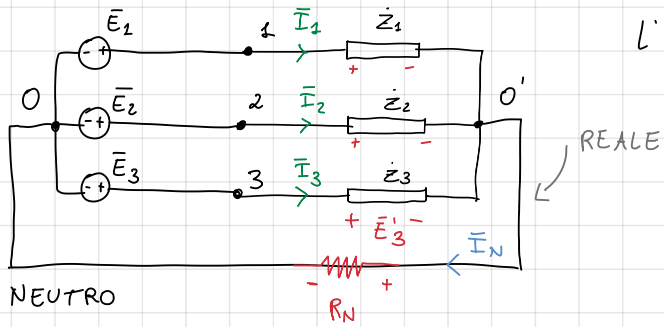
$\rightarrow \dfrac{E_1}{Z_1} - \dfrac{V_{o'o}}{Z_1} + \dfrac{E_2}{Z_2} - \dfrac{V_{o'o}}{Z_2} + \dfrac{E_3}{Z_3} - \dfrac{V_{o'o}}{Z_3} = 0 \rightarrow V_o(\dot{Y}_1 + \dot{Y}_2 + \dot{Y}_3) = \dot{Y}_1 E_1 + \dot{Y}_2 E_2 + \dot{Y}_3 E_3$

$$\rightarrow \boxed{\bar{V}_{o'o} = \dfrac{\dot{Y}_1 E_1 + \dot{Y}_2 E_2 + \dot{Y}_3 E_3}{\dot{Y}_1 + \dot{Y}_2 + \dot{Y}_3}}$$

FORMULA DI MILLMANN



STELLA - STELLA CON NEUTRO



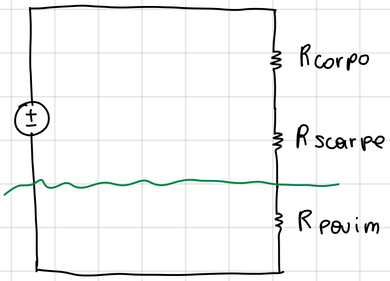
L'obbiettivo è ottenere $\boxed{\bar{V}_{O'O} = 0}$

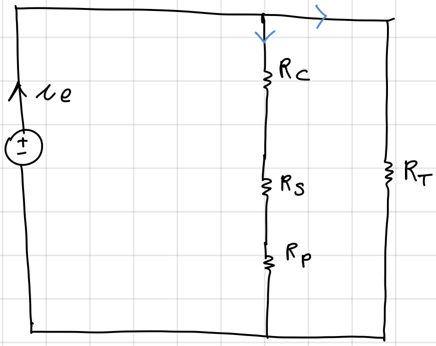
Se $R_N = 0 \rightarrow \bar{V}_{O'O} = \emptyset \Rightarrow \begin{cases} \bar{E}'_1 = \bar{E}_1 \\ \bar{E}'_2 = \bar{E}_2 \\ \bar{E}'_3 = \bar{E}_3 \end{cases}$

ma se $R_N \neq 0 \rightarrow \bar{V}_{O'O} = R_N \cdot \bar{I}_N \neq \emptyset \Rightarrow P_N = |\bar{V}_N| \cdot |\bar{I}_N| = R_N \cdot |\bar{I}_N|^2 \neq 0$

Potenza sprecata!

NO MESSA A TERRA





Se $R_T << R_C + R_S + R_P$

P.C. $\rightarrow i_p = i_e \cdot \frac{R_T}{R_T + R_C + R_S + R_P} << i_e$

POTENZA

HP. Abbiamo una T.S.D. con Carico Bilanciato $\rightarrow$ $\bar{E}_1' = \bar{E}_1$, $\bar{E}_2' = \bar{E}_2$, $\bar{E}_3' = \bar{E}_3$

$\hookrightarrow \bar{E}_1 + \bar{E}_2 + \bar{E}_3 = 0$

$$\begin{cases} e_1(t) = \sqrt{2}\, E_0 \cos(\omega t) \\ e_2(t) = \sqrt{2}\, E_0 \cos(\omega t - \frac{2}{3}\pi) \\ e_3(t) = \sqrt{2}\, E_0 \cos(\omega t - \frac{4}{3}\pi) \end{cases} \qquad \begin{cases} i_1(t) = \sqrt{2}\, I_0 \cos(\omega t - \varphi) \\ i_2(t) = \sqrt{2}\, I_0 \cos(\omega t - \frac{2}{3}\pi - \varphi) \\ i_3(t) = \sqrt{2}\, I_0 \cos(\omega t - \frac{4}{3}\pi - \varphi) \end{cases}$$

$$\Rightarrow P(t) = P_1(t) + P_2(t) + P_3(t) = 2 E_0 I_0 \Big[\cos(\omega t)\cos(\omega t - \varphi) + \cos(\omega t - \tfrac{2}{3}\pi)\cdot\cos(\omega t - \tfrac{2}{3}\pi - \varphi) + \cos(\omega t - \tfrac{4}{3}\pi)\cdot\cos(\omega t - \tfrac{4}{3}\pi - \varphi) \Big]$$

Sfrutto $2\cos(x)\cos(y) = +\cos(x+y)\ \cos(x-y)$

$$\hookrightarrow P(t) = E_0 I_0 \cdot \Big[\cos(\omega t + \omega t - \varphi) + \cos(\omega t - \omega t + \varphi) + \cos(\omega t - \tfrac{2}{3}\pi + \omega t - \tfrac{2}{3}\pi - \varphi) + \cos(\omega t - \tfrac{2}{3}\pi - \omega t + \tfrac{2}{3}\pi + \varphi) + \cos(\omega t - \tfrac{4}{3}\pi + \omega t - \tfrac{4}{3}\pi - \varphi) + \cos(\omega t - \tfrac{4}{3}\pi - \omega t + \tfrac{4}{3}\pi + \varphi) \Big]$$

$$= E_0 I_0 \Big[\cos(2\omega t - \varphi) + \cos(\varphi) + \cos(2\omega t - \tfrac{4}{3}\pi - \varphi) + \cos(\varphi) + \cos(2\omega t - \tfrac{8}{3}\pi - \varphi) + \cos(\varphi) \Big] = \boxed{3 E_0 I_0 \cdot \cos(\varphi)}$$

$3\cos(\varphi)$

T.S.D. $= 0$

media $\equiv$ istantanea

la Pow di un sistema Trifase è COSTANTE (anche se i gen sono $\sim$)