

Korronte alterno trifasikoa, 3. ariketa

Irudiko zirkuituari sekuentzia zuzeneko tentsio-sistema simetriko eta orekatua aplikatu zaio, non tentsio konposatua $\underline{U}_{12} = 230\sqrt{3} \angle 0^\circ \text{V}$ den.

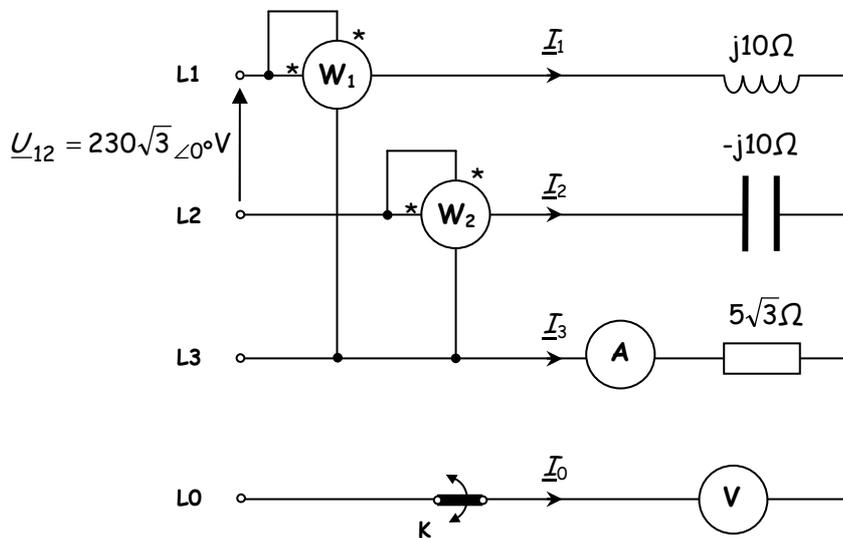
Zehaztu:

K itxita dagoenean:

- 1 Lineako korronteak: \underline{I}_1 , \underline{I}_2 , \underline{I}_3 eta \underline{I}_0 .
- 2 Tresnen neurketak: A_I , V_I , W_{1I} eta W_{2I}
- 3 Zirkuituan xahututako potentziak: P , Q , eta S .
- 4 Bektore-diagrama osoa

K etengailua irekitzen da:

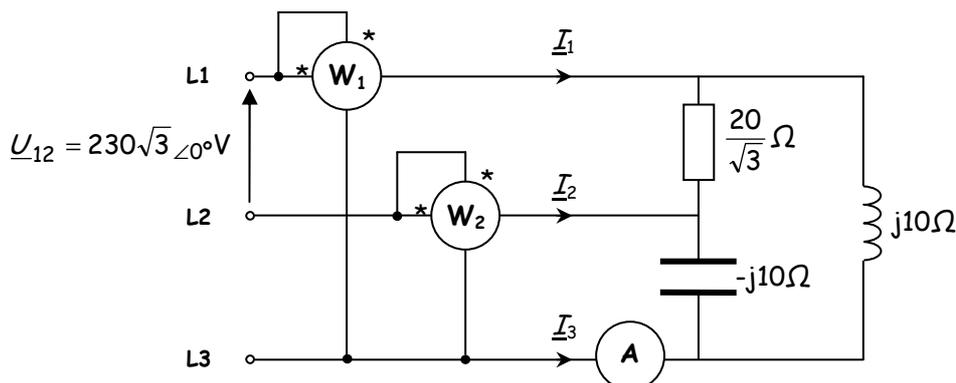
- 5 Lineako korronte berriak: \underline{I}_1 , \underline{I}_2 , \underline{I}_3 eta \underline{I}_0 .



EBAZPENA:

K zabalik zein itxita egon, \underline{I}_0 korrontea nulua izango da ($\underline{I}_0=0$) izan ere voltmetroaren inpedantziak infiniturantz jotzen du eta beraz etengailuaren bi kokapenetarako egoera beraren aurrean egongo gara: hiru hariko sistema. Bi egoeren arteko alde bakarra voltmetroaren neurketa izango da. Izan ere, K itxita dagoenean voltmetroak neutroaren desplazamendua neurtuko $V_I = |\underline{U}_{0'0}|$ du eta K zabalik dagoenean $V_I=0\text{V}$ izango da.

Ordezkapen metodoak erabiliz: Izar triangulu transformazioaren bidez (Kenelly-ren teorema) ebatziz:



$$\underline{Z}_1 \cdot \underline{Z}_2 + \underline{Z}_2 \cdot \underline{Z}_3 + \underline{Z}_1 \cdot \underline{Z}_3 = j10 \cdot (-j10) + (-j10)5\sqrt{3} + j10 \cdot 5\sqrt{3} = 100 \Omega$$

$$\underline{Z}_{12} = \frac{100}{5\sqrt{3}} = \frac{20}{\sqrt{3}} \Omega; \quad \underline{Z}_{23} = \frac{100}{j10} = -j10 \Omega; \quad \underline{Z}_{31} = \frac{100}{-j10} = j10 \Omega$$

$$\underline{I}_{12} = \frac{\underline{U}_{12}}{\frac{20}{\sqrt{3}}} = \frac{230\sqrt{3} \angle 0^\circ}{\frac{20}{\sqrt{3}}} = 34,5 \angle 0^\circ \text{ A}$$

$$\underline{I}_{23} = \frac{\underline{U}_{23}}{10 \angle -90^\circ} = \frac{230\sqrt{3} \angle -120^\circ}{10 \angle -90^\circ} = 23\sqrt{3} \angle -30^\circ \text{ A}$$

$$\underline{I}_{31} = \frac{\underline{U}_{31}}{10 \angle 90^\circ} = \frac{230\sqrt{3} \angle 120^\circ}{10 \angle 90^\circ} = 23\sqrt{3} \angle 30^\circ \text{ A}$$

1 Lineako korronteak:

$$\underline{I}_1 = 34,5 \angle 0^\circ - 23\sqrt{3} \angle 30^\circ = 11,5\sqrt{3} \angle -90^\circ \text{ A}$$

$$\underline{I}_2 = 23\sqrt{3} \angle -30^\circ - 34,5 \angle 0^\circ = 11,5\sqrt{3} \angle -90^\circ \text{ A}$$

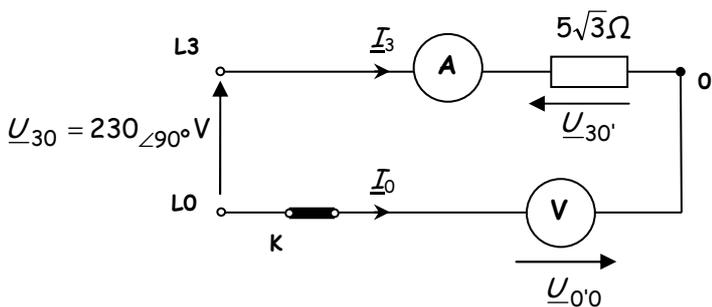
$$\underline{I}_3 = 23\sqrt{3} \angle 30^\circ - 23\sqrt{3} \angle -30^\circ = 23\sqrt{3} \angle 90^\circ \text{ A}$$

2 Tresnen irakurketak:

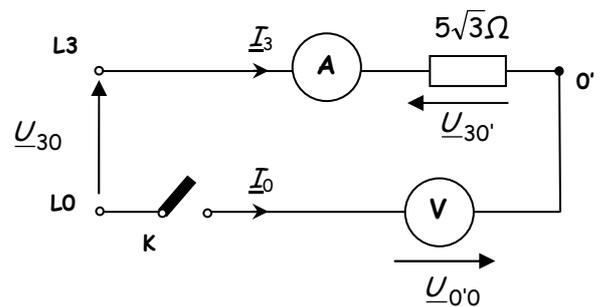
Amperemetroaren irakurketa:

$$A_I = |\underline{I}_3| = 23\sqrt{3} \text{ A}$$

Voltmetroaren irakurketa:



K itxita



K zabalik

K itxita:

$$\underline{U}_{0'0} = \underline{U}_{30} - \underline{U}_{30'} = 230 \angle 90^\circ - 5\sqrt{3} \cdot 23\sqrt{3} \angle 90^\circ = 230 \angle 90^\circ - 345 \angle 90^\circ = 115 \angle -90^\circ \text{ V}$$

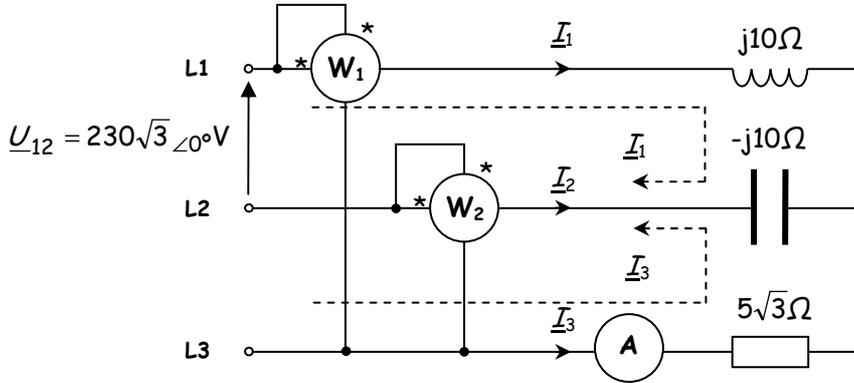
Beraz, voltmetroaren irakurketa K itxita dagoenean:

$$V_I = |\underline{U}_{0'0}| = 115 \text{ V}$$

$$\underline{U}_{20} = 10 \angle -90^\circ \cdot 11,5\sqrt{3} \angle -90^\circ = 115\sqrt{3} \angle 180^\circ \text{V}$$

$$\underline{U}_{30} = 5\sqrt{3} \angle 0^\circ \cdot 23\sqrt{3} \angle 90^\circ = 345 \angle 90^\circ \text{V}$$

Analisirako metodo orokorren bidez (sareen metodoa) ebatziz:



$$\begin{bmatrix} 0 & -j10 \\ -j10 & 5\sqrt{3} - j10 \end{bmatrix} \cdot \begin{bmatrix} \underline{I}_1 \\ \underline{I}_3 \end{bmatrix} = \begin{bmatrix} 230\sqrt{3} \angle 0^\circ \\ -230\sqrt{3} \angle -120^\circ \end{bmatrix}$$

Lehenengo errenkada garatuz:

$$0 \cdot \underline{I}_1 - j10 \cdot \underline{I}_3 = 230\sqrt{3} \angle 0^\circ \rightarrow \underline{I}_3 = \frac{230\sqrt{3} \angle 0^\circ}{10 \angle -90^\circ} = 23\sqrt{3} \angle 90^\circ = j23\sqrt{3} \text{A}$$

Bigarren errenkadaren garapena:

$$-j10 \cdot \underline{I}_1 + (5\sqrt{3} - j10)j23\sqrt{3} = 230\sqrt{3} \angle 60^\circ \rightarrow$$

$$\underline{I}_1 = \frac{115\sqrt{3} + j345 - j345 - 230\sqrt{3}}{-j10} = \frac{-115\sqrt{3}}{-j10} = -j11,5\sqrt{3} = 11,5\sqrt{3} \angle -90^\circ \text{A}$$

$$\text{Eta azkenik: } \underline{I}_2 = -(\underline{I}_1 + \underline{I}_3) = -(j23\sqrt{3} + j11,5\sqrt{3}) = 11,5\sqrt{3} \angle -90^\circ \text{A}$$

$$\underline{I}_0 = 0 \text{A}$$

Gainontzekoa lehen bezala.

Sareen oinarritzko teoremak erabiliz (Millman-en Teorema):

$$\underline{U}_{0'0} = \frac{\underline{U}_{10} \cdot \underline{Y}_1 + \underline{U}_{20} \cdot \underline{Y}_2 + \underline{U}_{30} \cdot \underline{Y}_3}{\underline{Y}_1 + \underline{Y}_2 + \underline{Y}_3 + \underline{Y}_0} =$$

$$\underline{U}_{0'0} = \frac{230 \angle -30^\circ \cdot \left[\frac{1}{10} \right] \angle -90^\circ + 230 \angle -150^\circ \cdot \left[\frac{1}{10} \right] \angle 90^\circ + 230 \angle 90^\circ \cdot \left[\frac{1}{5\sqrt{3}} \right] \angle 0^\circ}{\left[\frac{1}{10} \right] \angle -90^\circ + \left[\frac{1}{10} \right] \angle 90^\circ + \left[\frac{1}{5\sqrt{3}} \right] \angle 0^\circ + \frac{1}{\infty}} =$$

$$\underline{U}_{0'0} = 5\sqrt{3} \left[23 \angle -120^\circ + 23 \angle -60^\circ + \left[\frac{46}{\sqrt{3}} \right] \angle 90^\circ \right] = 115 \angle -90^\circ \text{V}$$

$$\underline{U}_{10'} = \underline{U}_{10} - \underline{U}_{0'0} = 230_{\angle -30^\circ} - 115_{\angle -90^\circ} = 115\sqrt{3}_{\angle 0^\circ} \text{V}$$

$$\underline{U}_{20'} = \underline{U}_{20} - \underline{U}_{0'0} = 230_{\angle -150^\circ} - 115_{\angle -90^\circ} = 115\sqrt{3}_{\angle 180^\circ} \text{V}$$

$$\underline{U}_{30'} = \underline{U}_{30} - \underline{U}_{0'0} = 230_{\angle -90^\circ} - 115_{\angle -90^\circ} = 345_{\angle 90^\circ} \text{V}$$

Eta korronteak:

$$\underline{I}_1 = \frac{\underline{U}_{10'}}{10_{\angle 90^\circ}} = \frac{115\sqrt{3}_{\angle 0^\circ}}{10_{\angle 90^\circ}} = 11,5\sqrt{3}_{\angle -90^\circ} \text{A}$$

$$\underline{I}_2 = \frac{\underline{U}_{20'}}{10_{\angle -90^\circ}} = \frac{115\sqrt{3}_{\angle 180^\circ}}{10_{\angle -90^\circ}} = 11,5\sqrt{3}_{\angle 270^\circ} \text{A}$$

$$\underline{I}_3 = \frac{\underline{U}_{30'}}{5\sqrt{3}_{\angle 0^\circ}} = \frac{345_{\angle 90^\circ}}{5\sqrt{3}_{\angle 0^\circ}} = 23\sqrt{3}_{\angle 90^\circ} \text{A}$$

Gainontzekoa aurreko kasuetan bezala.