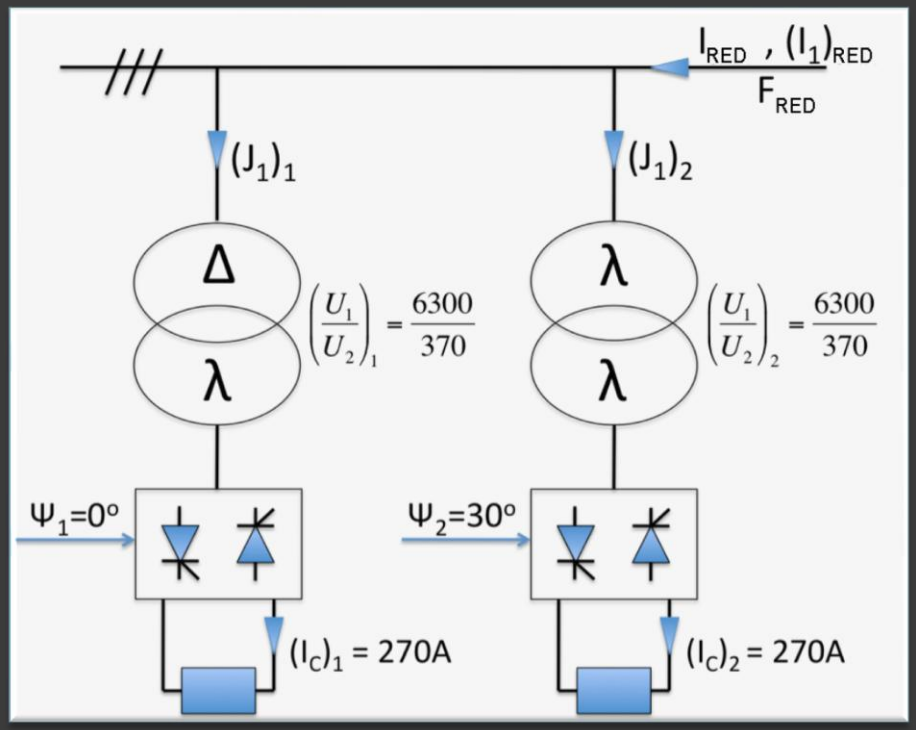
OpenCourseWare de la Universidad del País Vasco / Euskal Herriko Unibertsitatea
http://ocw.ehu.es

Estudio de Rectificadores Trifásicos

Ejercicio 2. Un rectificador controlado y otro no controlado

F. Javier Maseda, Oskar Casquero, Itziar Martija & Jesús Romo

Ejercicio 2. Un rectificador controlado y otro no controlado

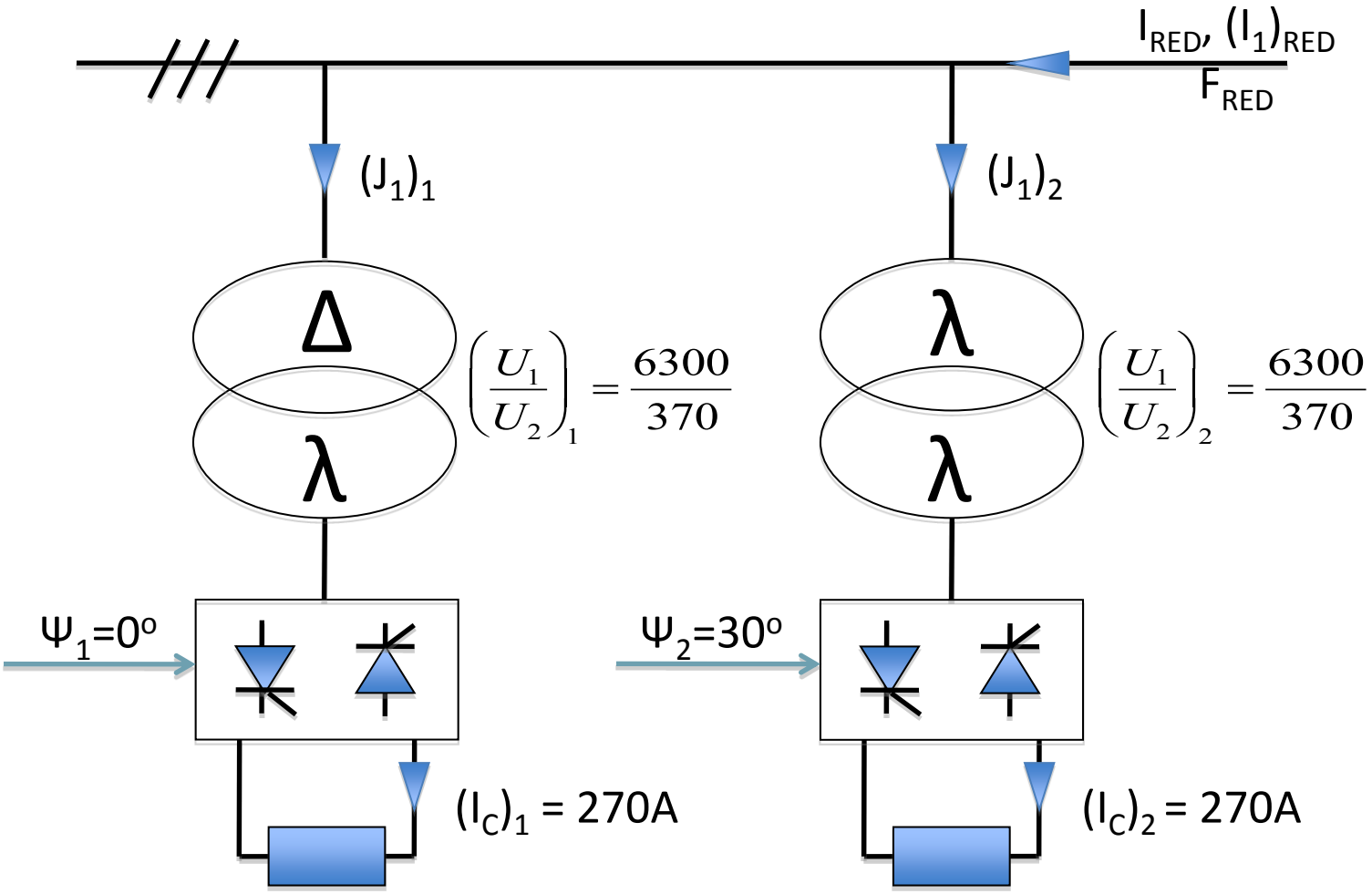


1. Dibujar el diagrama vectorial de las tensiones $(V_{13})_1$ y $(V_{13})_2$.
2. Calcular $\left(\frac{n_2}{n_1}\right)_1$ y $\left(\frac{n_2}{n_1}\right)_2 = f\left(\frac{n_2}{n_1}\right)_1$
3. Dibujar I_{RED} y calcular su valor eficaz.
4. Calcular F_{RED}
5. Kalkulatu $(\varphi_1)_1$ y $(\varphi_1)_2$
6. Calcular $(I_1)_{RED}$ y τ_{RED}

Nota: Considerar $(\Delta V_X)_1 = (\Delta V_X)_2 = \frac{12}{100} VLC_0$

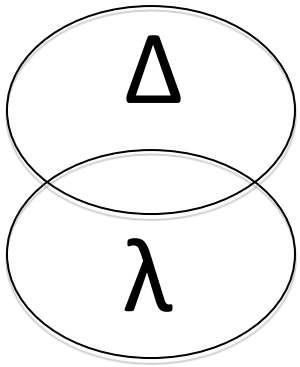
F. Javier Maseda, Oskar Casquero, Itziar Martija & Jesús Romo

Circuito

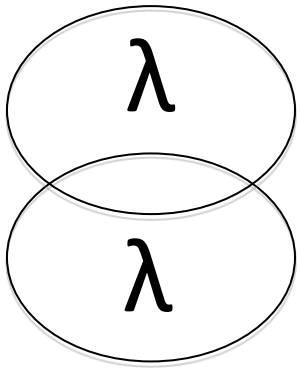


F. Javier Maseda, Oskar Casquero, Itziar Martija & Jesús Romo

Resolución



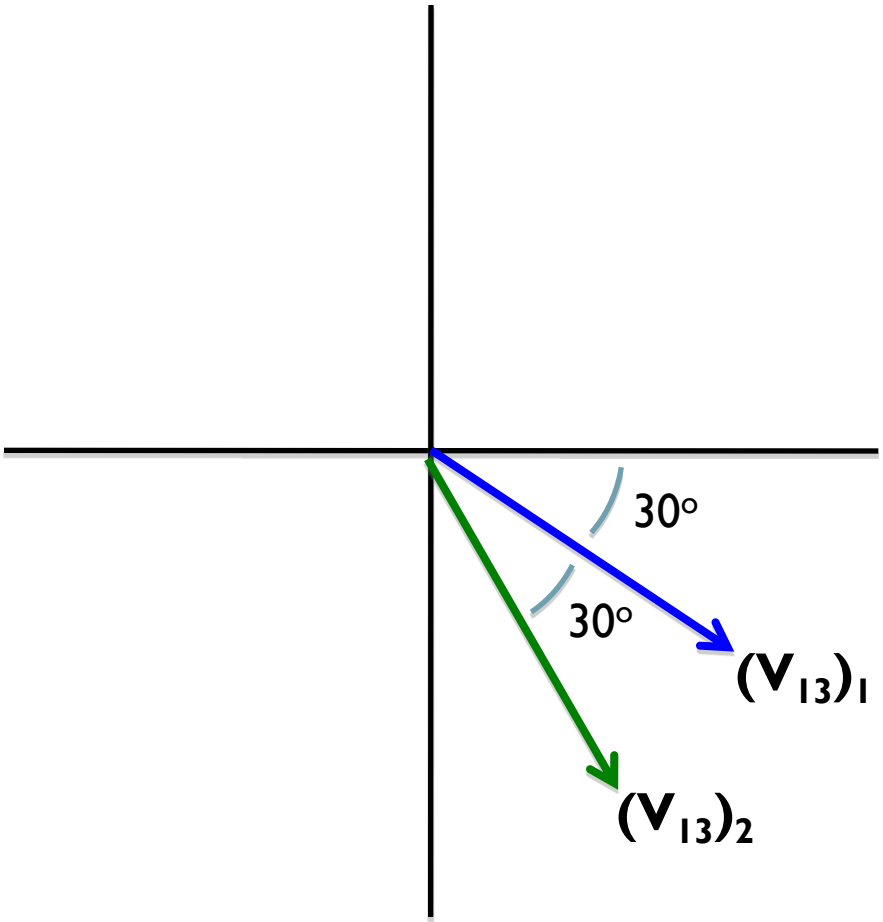
$$\left(\frac{U_1}{U_2}\right)_1 = \frac{6300}{370} \Rightarrow \left(\frac{n_1}{n_2}\right)_1 = \frac{U_1}{U_2} = \frac{6300}{370/\sqrt{3}} = 17\sqrt{3}$$



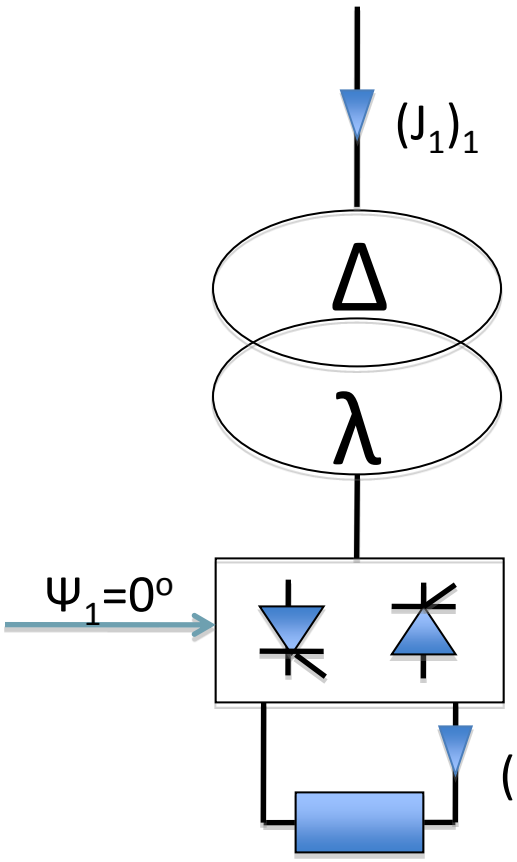
$$\left(\frac{U_1}{U_2}\right)_2 = \frac{6300}{370} \Rightarrow \left(\frac{n_1}{n_2}\right)_2 = \frac{U_1/\sqrt{3}}{U_2/\sqrt{3}} = \frac{6300/\sqrt{3}}{370/\sqrt{3}} = 17$$

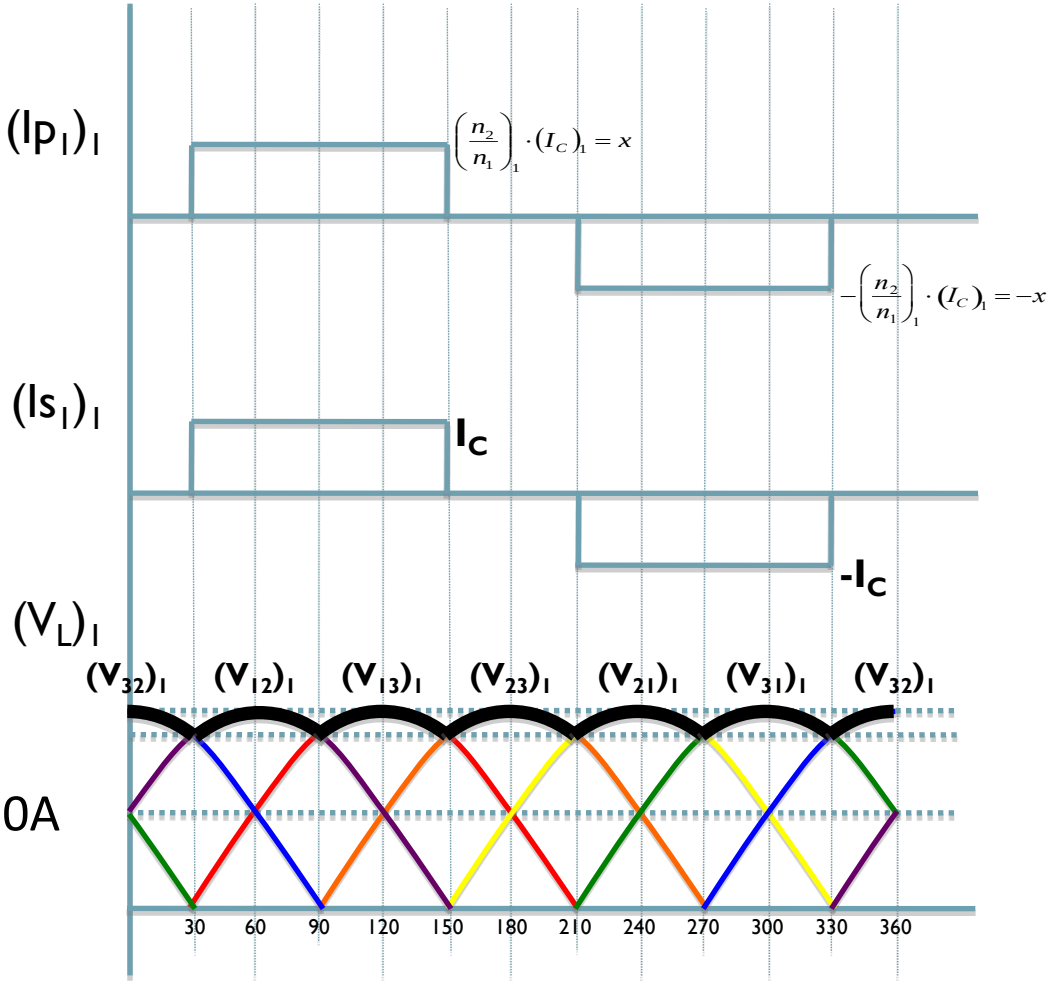
$$\Rightarrow \left(\frac{n_2}{n_1}\right)_2 = \sqrt{3} \cdot \left(\frac{n_2}{n_1}\right)_1$$

Resolución



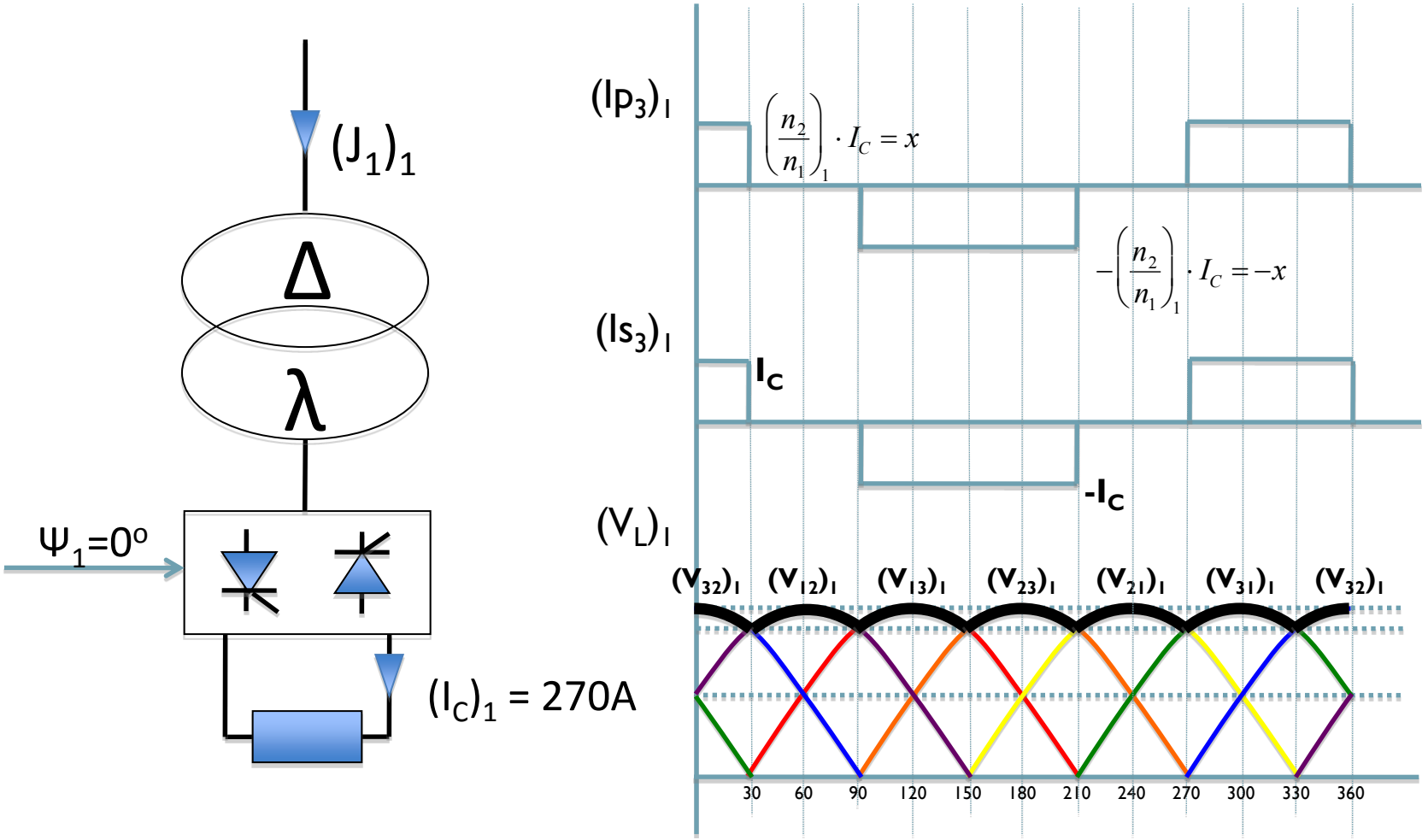
Resolución



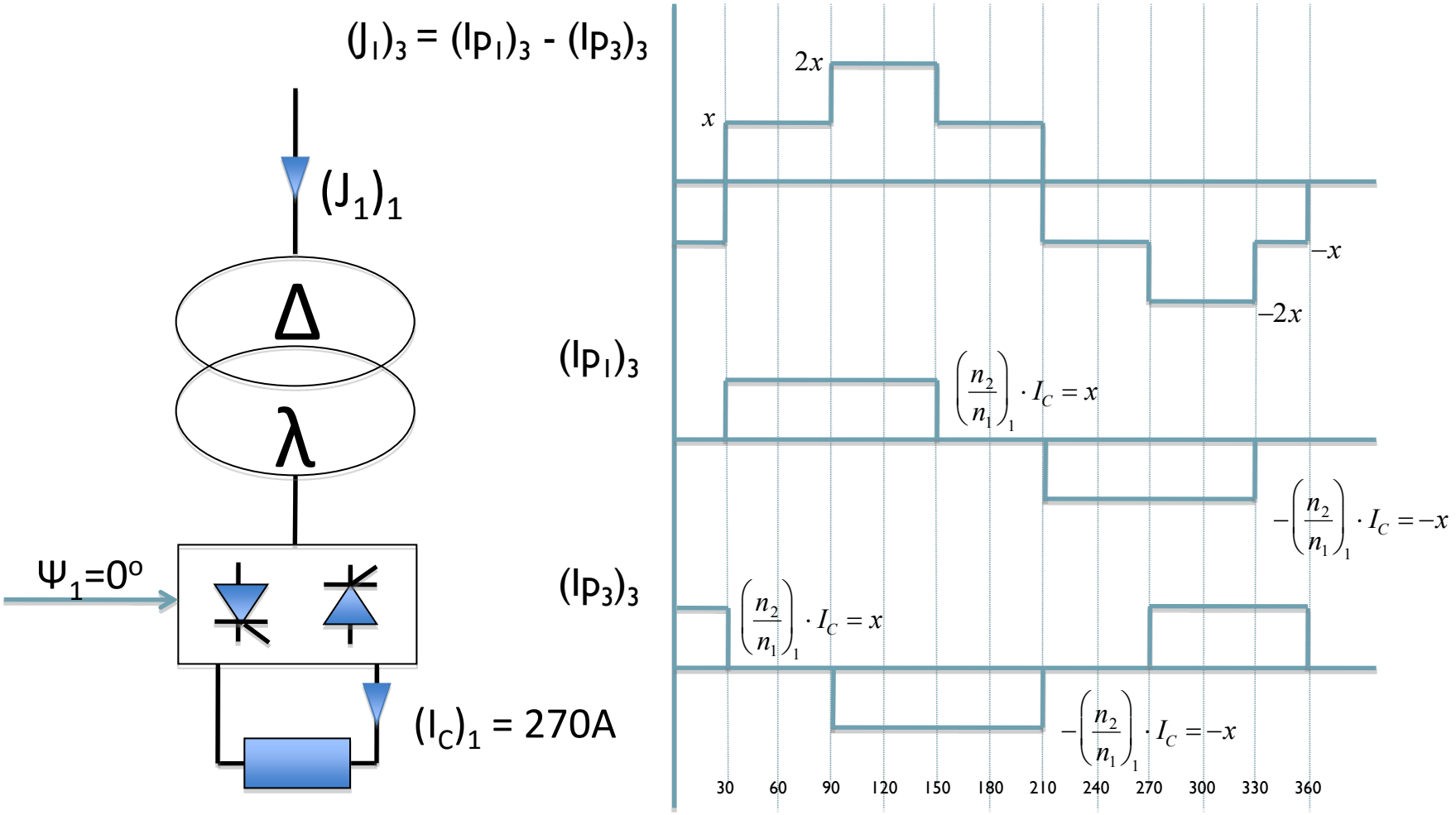


F. Javier Maseda, Oskar Casquero, Itziar Martija & Jesús Romo

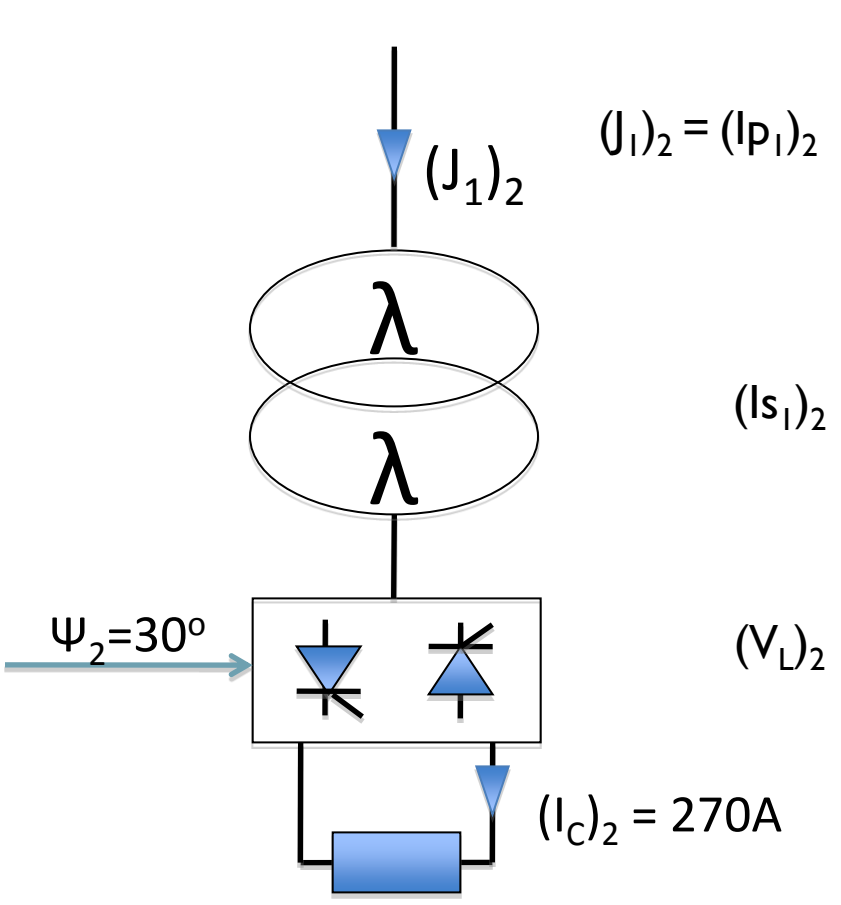
Resolución


$(J_1)_1$
Δ
λ
$\Psi_1=0^o$
$(I_C)_1$ = 270A
$(Ip_3)_1$
$\left(\frac{n_2}{n_1}\right)_1 \cdot I_C = x$
$-\left(\frac{n_2}{n_1}\right)_1 \cdot I_C = -x$
$(Is_3)_1$
I_C
$-I_C$
$(V_L)_1$
$(V_{32})_1$ $(V_{12})_1$ $(V_{13})_1$ $(V_{23})_1$ $(V_{21})_1$ $(V_{31})_1$ $(V_{32})_1$
30 60 90 120 150 180 210 240 270 300 330 360

Resolución


$(J_1)_3 = (Ip_1)_3 - (Ip_3)_3$
$(J_1)_1$
Δ
λ
$\Psi_1=0^o$
$(I_C)_1 = 270A$
$(Ip_1)_3$
$(Ip_3)_3$
$2x$
x
$-x$
$-2x$
$\left(\frac{n_2}{n_1}\right)_1 \cdot I_C = x$
$-\left(\frac{n_2}{n_1}\right)_1 \cdot I_C = -x$
$\left(\frac{n_2}{n_1}\right)_1 \cdot I_C = x$
$-\left(\frac{n_2}{n_1}\right)_1 \cdot I_C = -x$
30 60 90 120 150 180 210 240 270 300 330 360

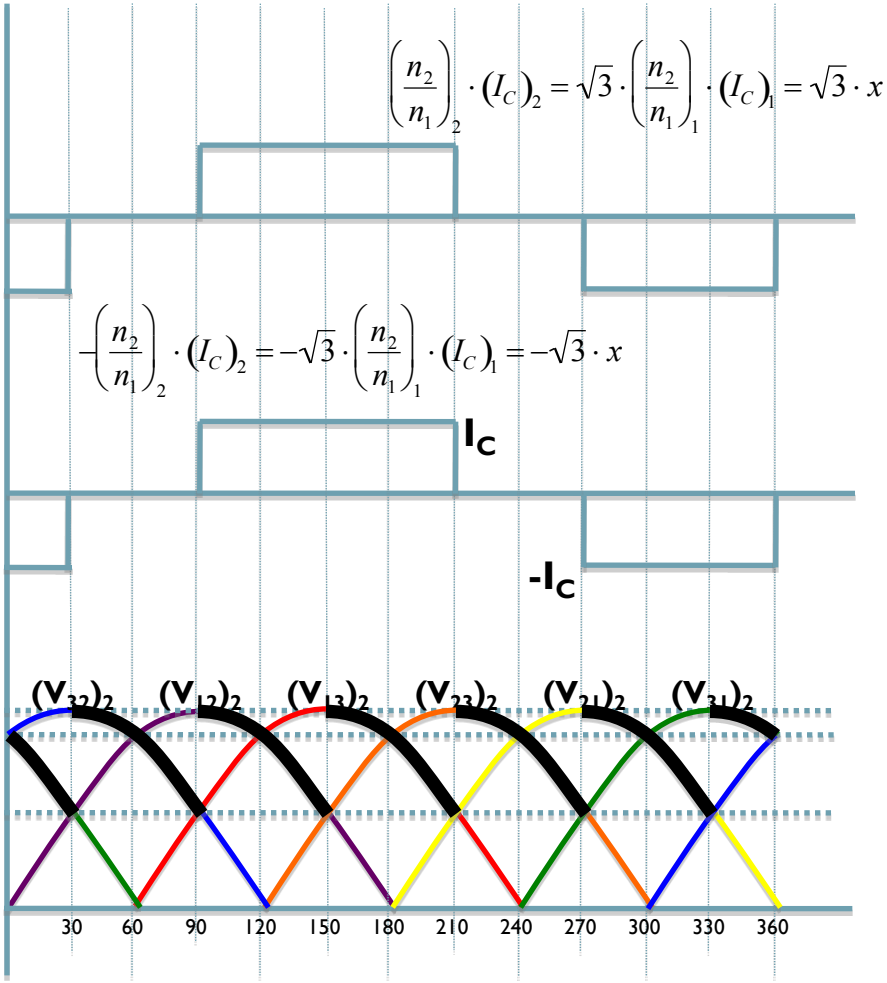
Resolución



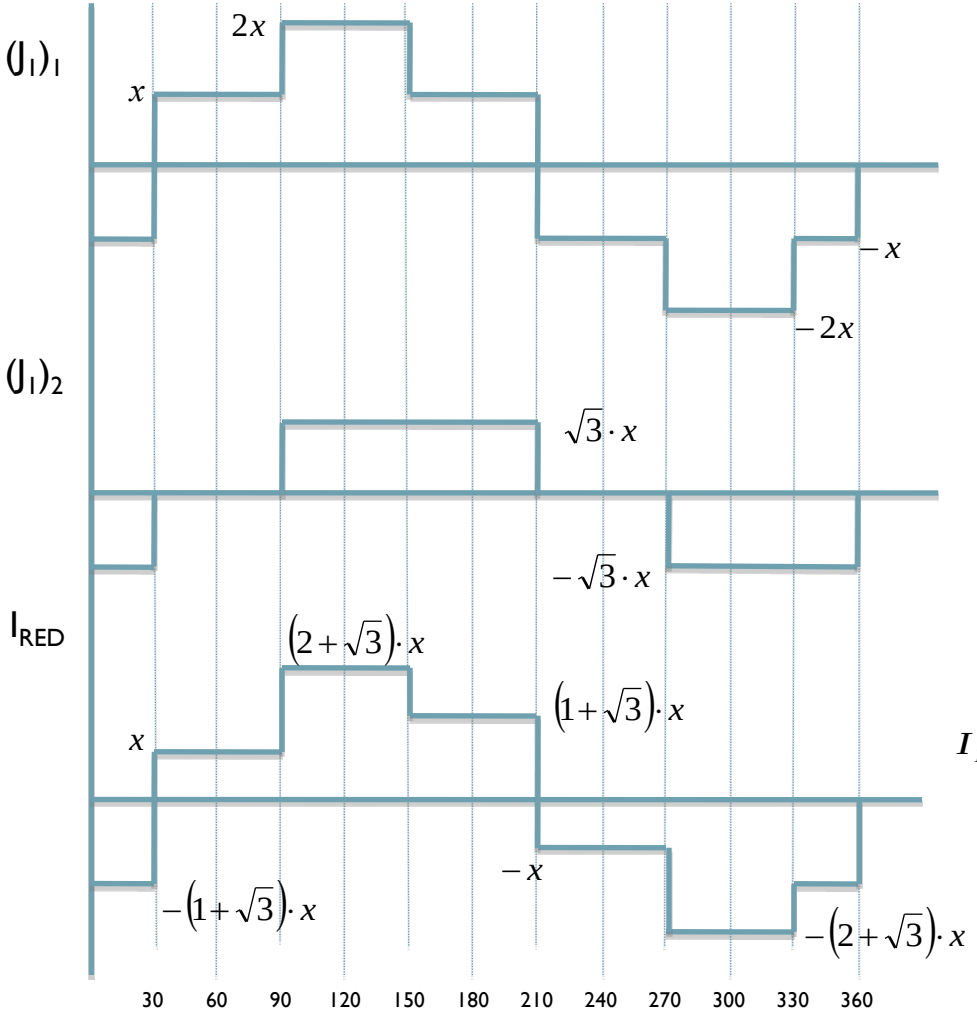
$(J_1)_2 = (Ip_1)_2$

$(Is_1)_2$

$(V_L)_2$



Resolución



$$x = \left(\frac{n_2}{n_1}\right)_1 \cdot (I_C)_1 = \frac{1}{17\sqrt{3}} \cdot 270 = 9.17A$$

$$(1+\sqrt{3})\cdot x = (1+\sqrt{3})\cdot 9.17 = 25A$$

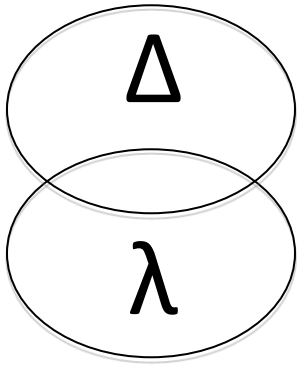
$$(2+\sqrt{3})\cdot x = (2+\sqrt{3})\cdot 9.17 = 34.22A$$

$$I_{RED} = \sqrt{\frac{1}{2\pi}\cdot\left[2\cdot\frac{\pi}{3}\cdot 9.17^2 + 2\cdot\frac{\pi}{3}\cdot 25^2 + 2\cdot\frac{\pi}{3}\cdot 34.22^2\right]}$$

$$= \sqrt{\frac{9.17^2 + 25^2 + 34.22^2}{3}}$$

$$I_{RED} = 25A$$

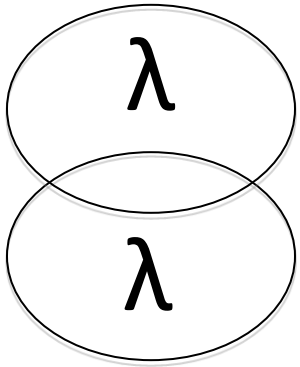
Resolución



$$(V_{LC})_1 = (V_{LC0})_1 - (\Delta V_X)_1 = 500 - 60 = 440V$$

$$(V_{LC0})_1 = V_{LC0}|_{PD3} = \frac{3\sqrt{3}V_O|_{PD3}}{\pi} = \frac{3\sqrt{3}\left(370\sqrt{\frac{2}{3}}\right)}{\pi} = 500v$$

$$V_O|_{PD3} = \sqrt{2}\cdot\left(U_2/\sqrt{3}\right) = 370\sqrt{\frac{2}{3}}$$



$$(V_{LC})_2 = (V_{LC}')_2 = (V_{LC0}')_2 - (\Delta V_X)_2 = 433 - 60 = 373V$$

$$(V_{LC0}')_2 = (V_{LC0})_2 \cdot \cos\psi_2 = 500 \cdot \cos 30^\circ = 433V$$

$$(V_{LC0})_2 = V_{LC0}|_{PD3} = \frac{3\sqrt{3}V_O|_{PD3}}{\pi} = \frac{3\cdot\sqrt{3}\cdot\left(370\sqrt{\frac{2}{3}}\right)}{\pi} = 500v$$

$$V_O|_{PD3} = \sqrt{2}\cdot\left(U_2/\sqrt{3}\right) = 370\sqrt{\frac{2}{3}}$$

Resolución

$$F_{RED} = \frac{(P_{LC})_1 + (P_{LC})_2}{\sqrt{3}\cdot U_1 \cdot I_{RED}} = \frac{[(V_{LC})_1 \cdot (I_C)_1] + [(V_{LC})_2 \cdot (I_C)_2]}{\sqrt{3}\cdot U_1 \cdot I_{RED}} = \frac{[440\cdot 270] + [373\cdot 270]}{\sqrt{3}\cdot 6300\cdot 25} = 0.80$$

$$\cos(\varphi_1)_1 = 1 - \left(\frac{\Delta V_X}{V_{LC0}}\right)_1$$

$$\cos(\varphi_1)_1 = 1 - 0.12 = 0.88$$

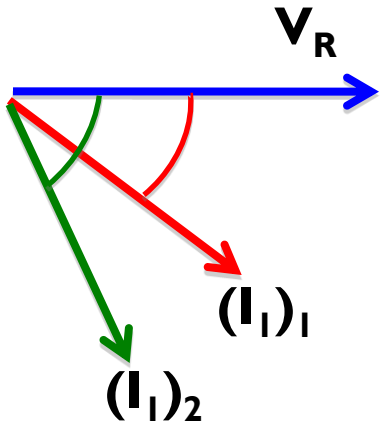
$$(\varphi_1)_1 = \arccos(0.88) = 28.35^\circ$$

$$\cos(\varphi_1)_2 = \cos\psi_2 - \left(\frac{\Delta V_X}{V_{LC0}}\right)_2$$

$$\cos(\varphi_1)_2 = \cos 30^\circ - \frac{60}{500} = 0.74$$

$$(\varphi_1)_2 = \arccos(0.74) = 41.75^\circ$$

$$(\varphi_1)_1 \neq (\varphi_1)_2$$



Resolución

$$(I_1)_1 = \frac{(V_{LC0})_1 \cdot (I_C)_1}{\sqrt{3} \cdot U_1} = \frac{500 \cdot 270}{\sqrt{3} \cdot 6300} = 12.37A$$

$$(I_1)_2 = \frac{(V_{LC0})_2 \cdot (I_C)_2}{\sqrt{3} \cdot U_1} = \frac{500 \cdot 270}{\sqrt{3} \cdot 6300} = 12.37A$$

$$(I_1)_{SARE} = \sqrt{(I_1)^2_{SARE,X} + (I_1)^2_{SARE,Y}} = \sqrt{20.11^2 + 14.11^2} = 24.56A$$

$$(I_1)_{SARE,X} = (I_1)_{1,X} + (I_1)_{2,X} = 10.88 + 9.23 = 20.11A$$

$$(I_1)_{1,X} = (I_1)_1 \cdot \cos(\varphi_1)_1 = 12.37 \cdot \cos 28.35 = 10.88A$$

$$(I_1)_{2,X} = (I_1)_2 \cdot \cos(\varphi_1)_2 = 12.37 \cdot \cos 41.75 = 9.23A$$

$$(I_1)_{SARE,Y} = (I_1)_{1,Y} + (I_1)_{2,Y} = 5.87 + 8.24 = 14.11A$$

$$(I_1)_{1,Y} = (I_1)_1 \cdot \sin(\varphi_1)_1 = 12.37 \cdot \sin 28.35 = 5.87A$$

$$(I_1)_{2,Y} = (I_1)_2 \cdot \sin(\varphi_1)_2 = 12.37 \cdot \sin 41.75 = 8.24A$$