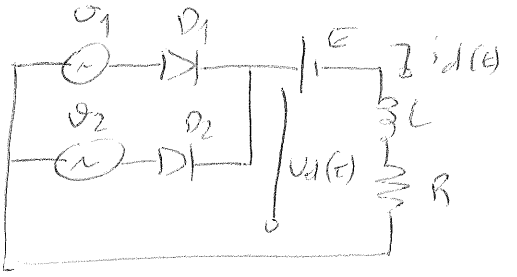
(1)

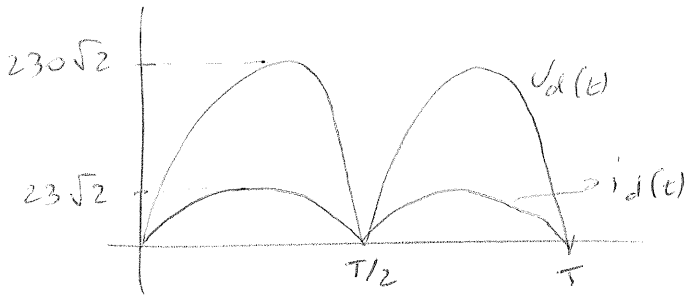
i) $R = 10\,\Omega$

$E = 0$

$L = 0$



$\vartheta_1 = -\vartheta_2 = 230\sqrt{2}\,\sin(100\pi t)$



$$V_{do} = \frac{2}{\pi}\,230\sqrt{2}\,\sin\frac{\pi}{2} = 207{,}1\ V$$

$$P = \frac{1}{2\pi}\int_0^{2\pi} v_d(\theta)\,i_d(\theta)\,d\theta$$

$$= \frac{2\times 1}{2\pi}\int_0^{\pi/2} 230\sqrt{2}\,\sin\theta \cdot \frac{230\sqrt{2}\,\sin\theta}{10}\,d\theta$$

$$= 5290\ W$$

$$i_{dmedio} = \frac{207{,}1}{10} = 20{,}7\ A$$

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ii) $R = 10\,\Omega$

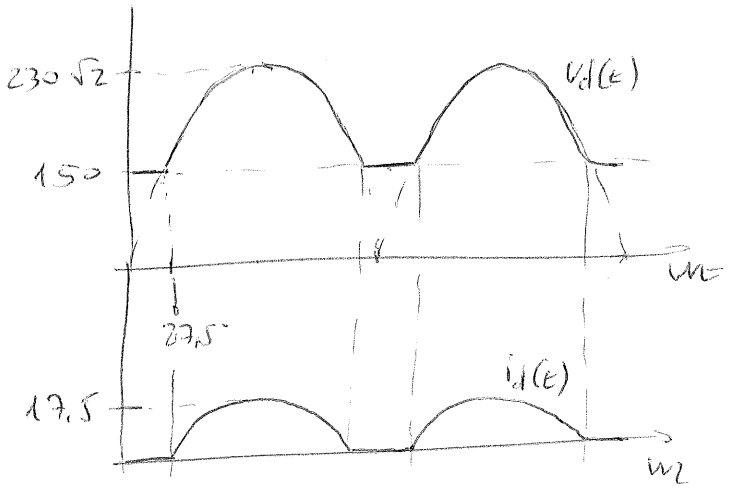
$E = 150\ V$

$L = 0$

$i_d > 0 \Rightarrow \vartheta_1 > E$

$150 = 230\sqrt{2}\,\sin\theta \Rightarrow \theta = 27{,}5^\circ = 0{,}48\ rad$

$$i_{dmax} = \frac{230\sqrt{2} - 150}{10} = 17{,}5\ A$$



$$V_{do} = V_{dmedio} = \frac{1}{2\pi}\int_0^{2\pi} v_d(\theta)\,d\theta = 2\times 4\left(\frac{1}{2\pi}\int_0^{0{,}48} 150\,d\theta + \frac{1}{2\pi}\int_{0{,}48}^{\pi/2} 230\sqrt{2}\,\sin\theta\,d\theta\right)$$

$$= 229{,}5\ V$$

$$i_{dmedio} = \frac{V_{dmedio} - E}{R} = \frac{229{,}5 - 150}{10} = 7{,}95\ A$$

$$i_{d_{rms}}^2 = 4 \times \frac{1}{2\pi} \int_0^{0,48} \left(\frac{230\sqrt{2}\,\sin\theta - 150}{10} \right)^2 d\theta = 110,5\ A^2$$

$$i_{d_{rms}} = \sqrt{110,5} = 10,5\ A$$

$$P = R\, i_{d_{rms}}^2 + E\, i_{d_{medio}} = 10 \times 110,5 + 150 \times 7,95$$

$$= 2297,5\ W$$

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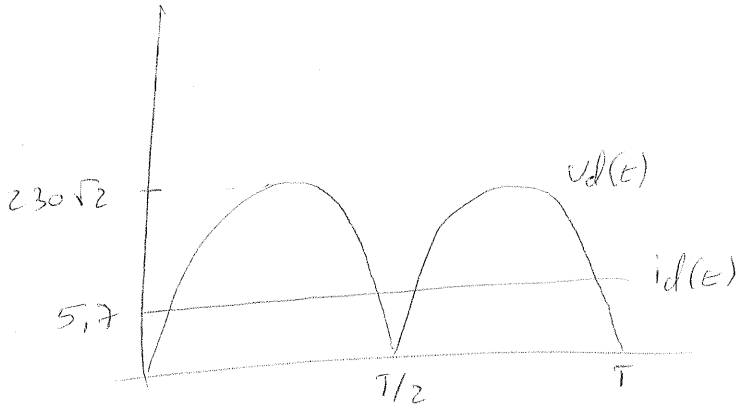
iii) $R = 10\,\Omega$

$E = 150\ V$

$i_d(t) = \text{constante}$



$$V_{do} = \frac{2}{\pi} 230\sqrt{2}\,\sin\frac{\pi}{2}$$

$$= 207,1\ V$$

$$i_{d_{medio}} = \frac{207,1 - 150}{10} = 5,7\ A = i_{d_{rms}}$$

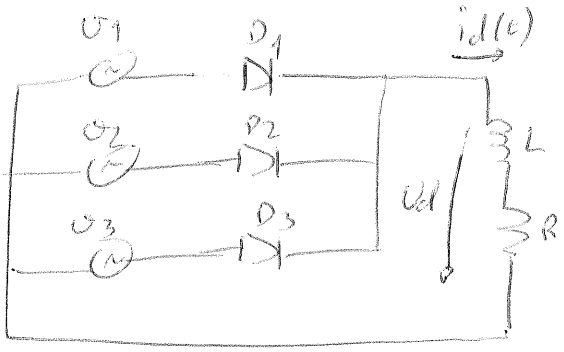
$$P = R\, i_{d_{rms}}^2 + E \cdot i_{d_{medio}} = 10 \cdot 5,7^2 + 150 \times 5,7 = 1180\ W$$

ou

$$P = \frac{1}{2\pi} \int_0^{2\pi} v_d(\theta)\, i_d(\theta)\, d\theta = 5,7 \cdot \frac{1}{2\pi} \int_0^{2\pi} v_d(\theta)\, d\theta = 5,7 \cdot V_{do} = 1180\ W$$

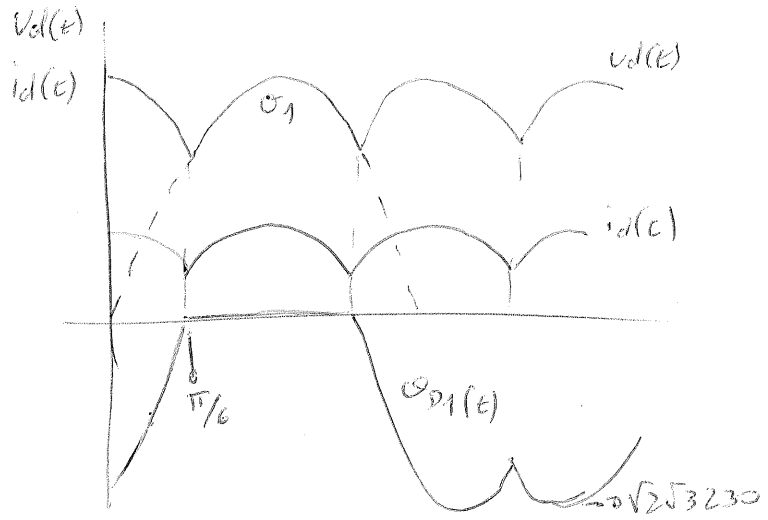
(2)

i) $L = 0$, $R = 100\ \Omega$



$230/400\,V$ $50\,Hz$

a)



$$v_{d\,max} = 230\sqrt{2} = 325,3\,V$$

$$v_{d\,min} = \frac{230\sqrt{2}}{2} = 162,6\,V$$

$$i_{d\,max} = \frac{325,3}{100} = 3,25\,A$$

$$i_{d\,min} = \frac{162,6}{100} = 1,63\,A$$

b)

$$U_{d0} = \frac{3}{\pi}\sqrt{2}230 \cdot \operatorname{sen}\frac{\pi}{3} = 269,0\,V$$

$$i_{d\,medio} = \frac{U_{d0}}{R} = \frac{269,0}{100} = 2,69\,A$$

$$U_{d\,rms}^2 = \frac{3}{2\pi}\int_{\pi/6}^{\pi/6+2\pi/3} (\sqrt{2}230\,\operatorname{sen}\theta)^2\,d\theta = 74769,4\,V^2$$

$$U_{d\,rms} = 273,4\,V$$

$$i_{d\,rms} = \frac{U_{d\,rms}}{R} = 2,73\,A$$

c) $P_{carga} = R\, i_{d\,rms}^2 = 100 \times 2,73^2 = 745,3\,W$

d) Carga resistiva $\Rightarrow FP_{carga} = 1$

ii) $i_d(t) = constante$

b) $V_{do} = 269,0\ V$

$V_{drms} = 273,4\ V$

$I_{dmedio} = I_{drms} = \frac{269,0}{100} = 2,69\ A$

c) $P_{carga} = R I_{drms}^2 = 100 \times 2,69^2 = 723,6\ W$

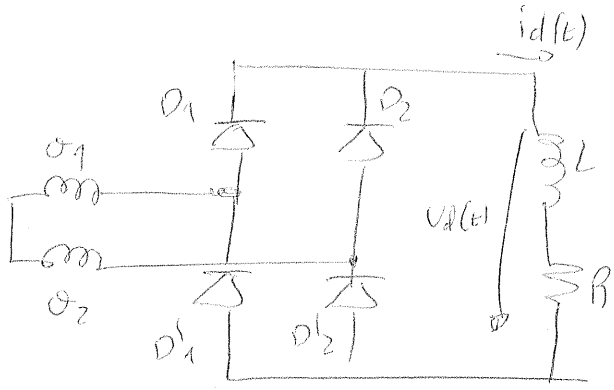
d) $FP_{carga} = \frac{P}{S} = \frac{723,6}{273,4 \times 2,69} = 0,984$

(3)

$v_1 = -v_2 = 230\sqrt{2}\,\sin(100\pi t)$

$R = 20$

$i_d(t) = \text{constante}$

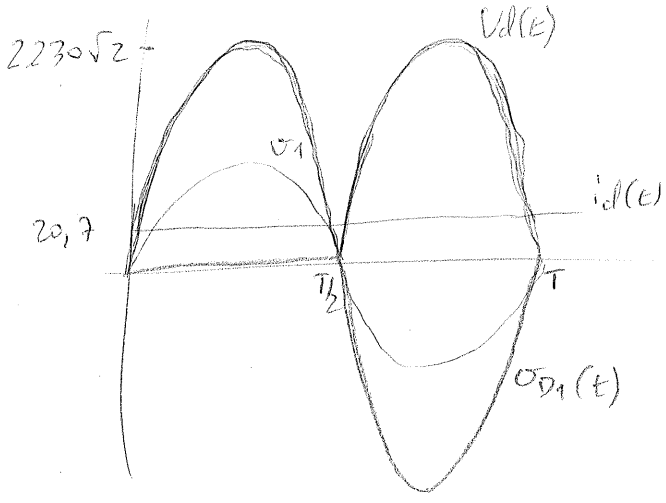


$V_{do} = 2\cdot\frac{2}{\pi}\,230\sqrt{2}\,\sin\frac{\pi}{2} = 414{,}2\,V$

$i_{d\,medio} = \frac{414{,}2}{20} = 20{,}7\,A$

$V_{d\,rms}^2 = 2\cdot\frac{1}{2\pi}\int_0^{\pi}(2.230\sqrt{2}\,\sin\theta)^2 d\theta$

$= 211600\ V^2$



$V_{d\,rms} = \sqrt{211600} = 460\,V$

$i_{d\,rms} = i_{d\,medio} = 20{,}7\,A$

d)

$i_{D1\,medio} = \frac{1}{2\pi}\int_0^{\pi} 20{,}7\,d\theta = \frac{20{,}7}{2\pi}[\theta]_0^{\pi} = 10{,}35\,A$

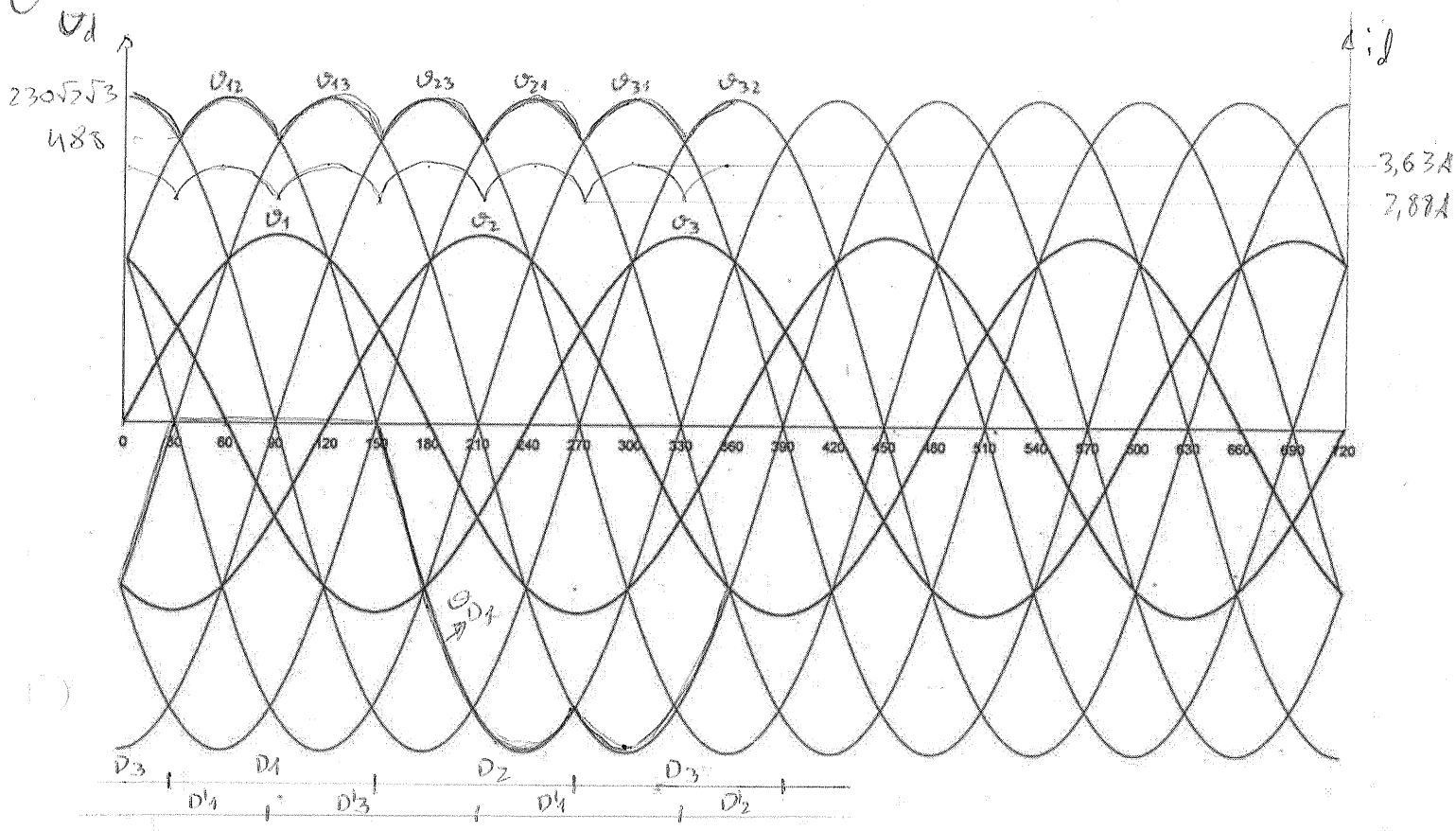
$i_{D1\,rms} = \sqrt{\frac{1}{2\pi}\int_0^{\pi} 20{,}7^2\,d\theta} = \sqrt{\frac{20{,}7^2}{2\pi}[\theta]_0^{\pi}} = \frac{20{,}7}{\sqrt{2\pi}}\cdot\sqrt{\pi} = \frac{20{,}7}{\sqrt{2}}$

$= 14{,}64\,A$

e)

$P = R\,i_{d\,rms}^2 = 20\cdot 20{,}7^2 = 8570\,W$

(4)



$R = 100\,\Omega$

$E = 200\,V$

$L = 0$

$v_{13} = v_{23} \Rightarrow v_{13}\left(\frac{\pi}{3}\right) = 230\sqrt{2}\sqrt{3}\,\sin\frac{\pi}{3}$

$= 230\sqrt{2}\sqrt{3}\,\frac{\sqrt{3}}{2} = 488\,V$

Como $E < 488 \Rightarrow$ a corrente nunca se anula

Vou tratar a forma como se $i_d(t) =$ constante

$v_{d_{max}} = 230\sqrt{2}\sqrt{3}\,V \Rightarrow i_{d_{max}} = \frac{230\sqrt{2}\sqrt{3} - 200}{100} = 3,63\,A$

$v_{d_{min}} = 488\,V \Rightarrow i_{d_{min}} = \frac{488 - 200}{100} = 2,88\,A$

b) $V_{do} = 2.\frac{3}{\pi}.230\sqrt{2}\,\sin\frac{\pi}{3} = 538\,V$

$v_{d_{rms}} = \left[6.\frac{1}{2\pi}\int_{\pi/3}^{2\pi/3}(230\sqrt{2}\sqrt{3}\,\sin\theta)^2\,d\theta\right]^{1/2} = 538,5\,V$

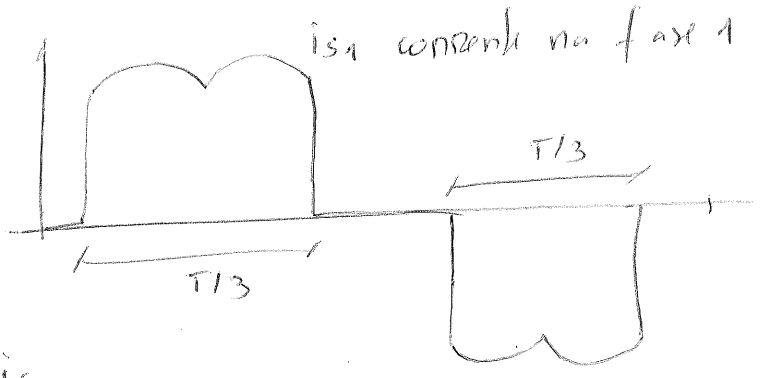
$i_{d_{medio}} = \frac{V_{do} - E}{R} = \frac{538 - 200}{100} = 3,38\,A$

$i_{d_{rms}} = \left[6.\frac{1}{2\pi}\int_{\pi/3}^{2\pi/3}\left(\frac{230\sqrt{2}\sqrt{3}\,\sin\theta - 200}{100}\right)^2 d\theta\right]^{1/2} = 3,39\,A$

c) P fornecida pela fonte = P activa na carga

$P = R\, i_{d\,rms}^2 + E \cdot i_{d\,medio}$

$= 100 \cdot 3{,}39^2 + 200 \cdot 3{,}38 = 1825\ W$



$$i_{s1\,rms} = \left[4 \cdot \frac{1}{2\pi} \int_{\pi/3}^{2\pi/3} \left(\frac{230\sqrt{2}\sqrt{3}\sin\theta - 200}{100} \right)^2 d\theta \right]^{1/2} = 2{,}766\ A$$

$$U_{1\,rms} = 230\ V$$

$$S = 3 \times U_{1\,rms} \cdot i_{s1\,rms} = 1908{,}5\ VA$$

$$FP_{fonte} = \frac{P}{S} = \frac{1825}{1908{,}5} = 0{,}956$$

ii) $R = 100\ \Omega$

$E = 200\ V$

comutação contínua

forma de onda igual a i) mas com $i_d = \text{constante} = \frac{538 - 200}{100} = 3{,}38\ A$

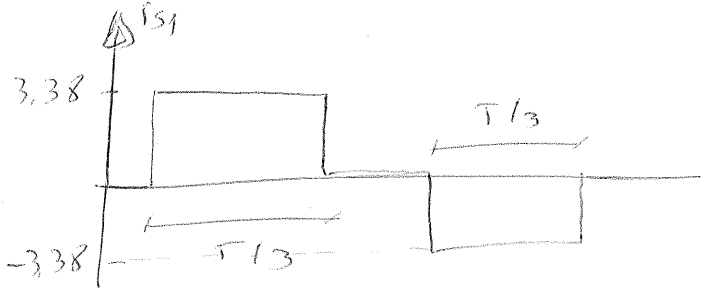
$U_{do} = 538\ V$

$U_{d\,rms} = 538{,}5\ V$

$i_{d\,medio} = i_{d\,rms} = 3{,}38\ A$

$P = R\, i_{d\,rms}^2 + E \cdot i_{d\,medio} = U_{do} \times i_{d\,medio} = 538 \times 3{,}38$

$= 1818{,}5\ W$



$$i_{S1\,rms} = \left[4 \cdot \frac{1}{2\pi} \int_{\pi/3}^{2\pi/3} 3{,}38^2\, d\theta \right]^{1/2} = \sqrt{\frac{3{,}38^2 \cdot 2}{\pi} \left[\frac{2\pi}{3} - \frac{\pi}{3} \right]}$$

$$= 3{,}38 \cdot \frac{\sqrt{2}}{\sqrt{3}} = 2{,}76\ A$$

$U_{1\,rms} = 230\ V$

$S = 3 \times 230 \times 2{,}76 = 1904{,}4\ VA$

$FP = \frac{P}{S} = \frac{1818{,}5}{1904{,}4} = 0{,}955$