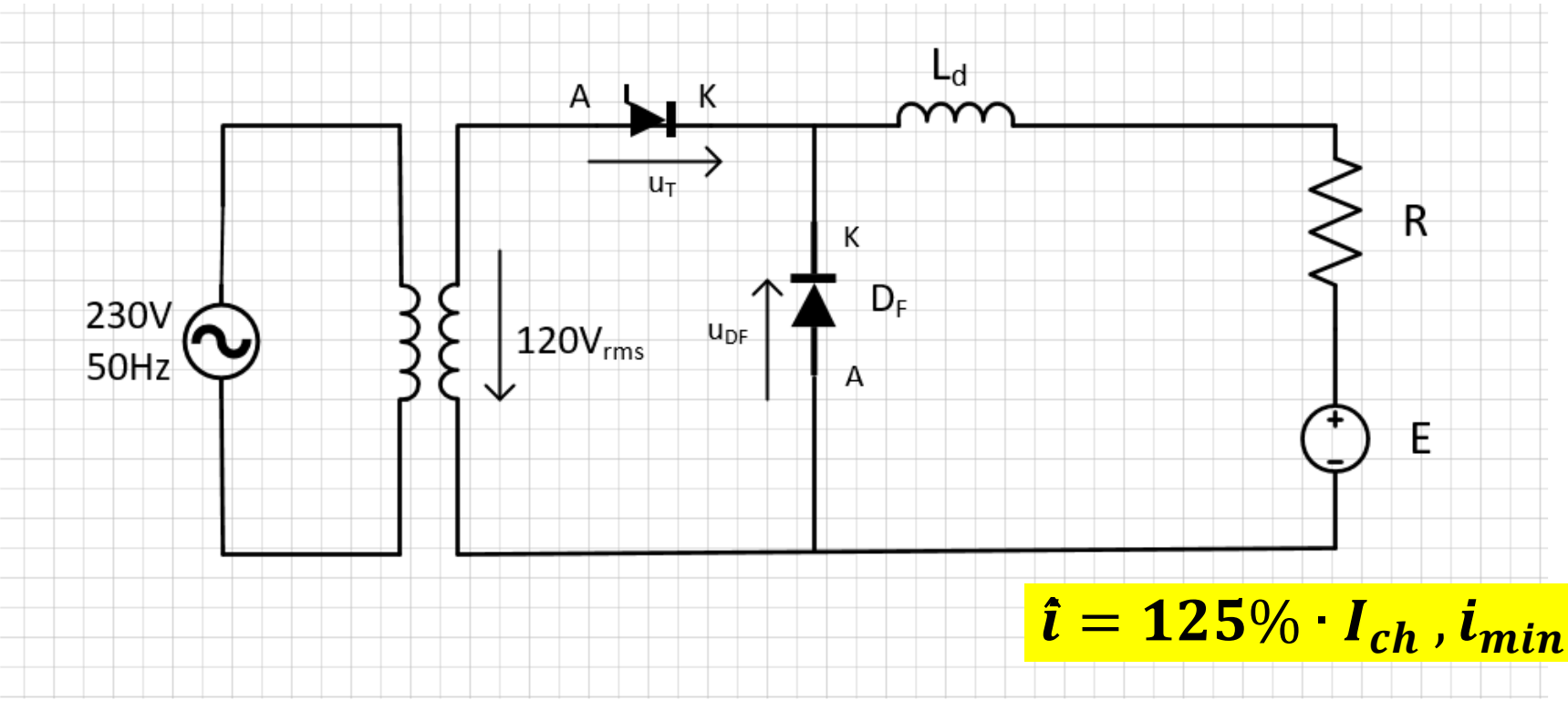
1. Σχεδιασμός Φορτιστή 1 παλμού



E=48V

I_{ch}=12A

R=200mΩ

$$\hat{i} = 125\% \cdot I_{ch} \, , i_{min} = 75\% \cdot I_{ch}$$

Η D_F άγει για $\varphi \geq \pi$, $\varphi \leq 2\pi + \alpha$ (Συνεχής Αγωγή)

Το Τ άγει για $\alpha \leq \varphi \leq \pi$

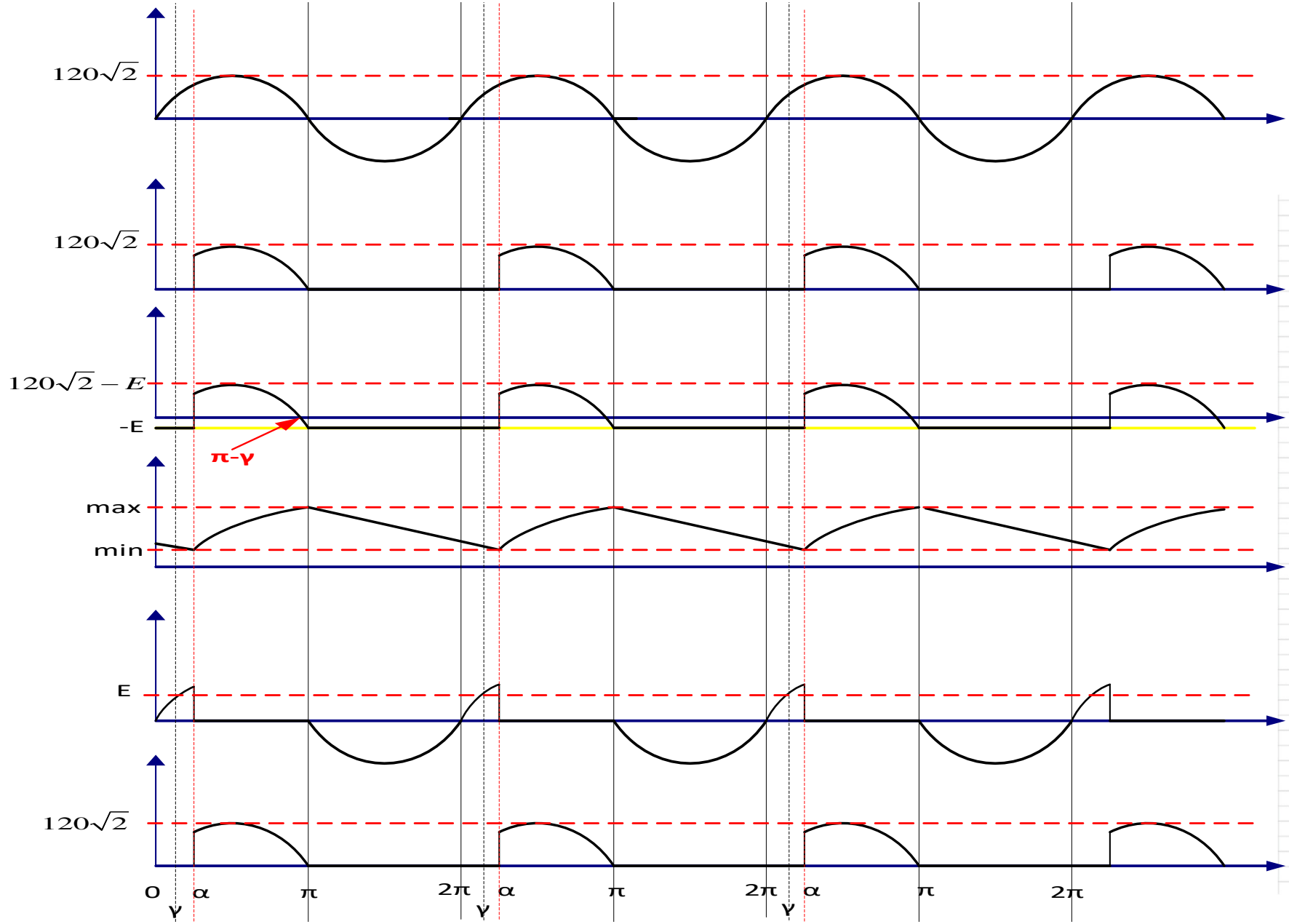
i) Υπολογισμός α, γ

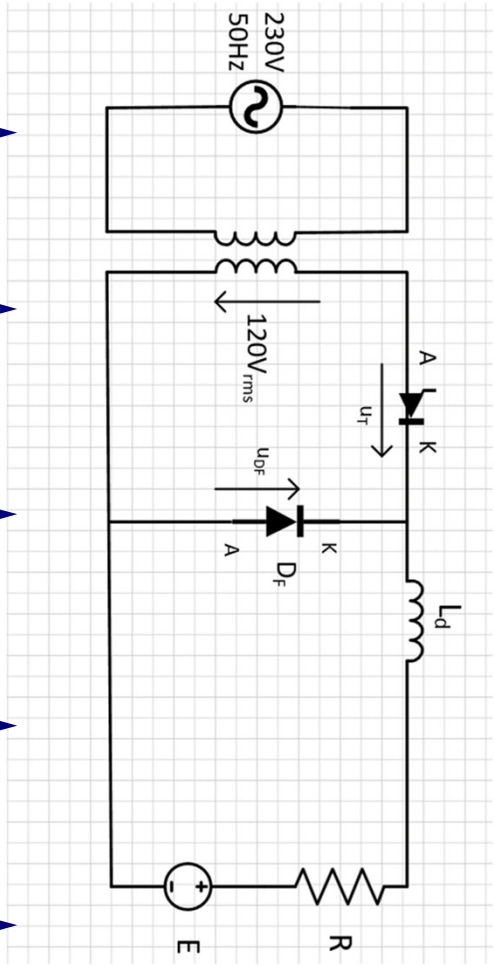
- $\gamma = \sin^{-1}\frac{E}{V_{2,rms}\sqrt{2}} = \sin^{-1}\frac{48}{120\sqrt{2}} \Rightarrow \gamma = 16{,}4°$

- $V_0 = I_{ch} \cdot R + E = 12\text{A} \cdot 200\text{m}\Omega + 48\text{V} \Rightarrow V_0 = 50{,}4\text{V}$

- $V_0^{(E=0)} = \frac{1}{2\pi} V_{2,rms}\sqrt{2}\,[1 + cosa] \Rightarrow cosa = \frac{\pi\sqrt{2}V_0}{V_{2,rms}} - 1 = 1{,}86 - 1 = 0{,}86$
  $\Rightarrow \alpha = 30{,}7^0$

ii) Σχεδιασμός $u_2(t)$, $u_0(t)$, $u_{Ld}(t)$, $i_{ch}(t)$, $u_T(t)$, $u_{DF}(t)$ ($i_{ch}R \cong 0$)





iii) Υπολογισμός του συντελεστή αυτεπαγωγής L_d

- $a \le \varphi \le \pi: \quad u_2 - E = L_d \frac{di_{ch}}{dt} \Rightarrow -I_{\varnothing} + \quad i_{ch}(\varphi) =$

  $\frac{1}{x_L}\left[\int_a^{\varphi} \sqrt{2}\, V_{2,rms} \sin\varphi d\varphi - \int_{\alpha}^{\varphi} E\, d\varphi\right] \Rightarrow i_{ch}(\varphi) =$

  $$= \frac{\sqrt{2}V_{2,rms}\ (\cos a - \cos\varphi) - E(\varphi - \alpha)}{x_L} + I_{\varnothing}$$

- $\hat{\imath} = i_{ch}(\pi - \gamma) = I_{\varnothing} + \frac{\sqrt{2}V_{2,rms}\ (\cos a + \cos\gamma) - E(\pi - \gamma - \alpha)}{x_L}$
- $i_{min} = i_{ch}(a) = I_{\varnothing}$
- $\Delta i = \hat{\imath} - i_{min} = 0{,}5 I_{ch} = \frac{\sqrt{2}V_{2,rms}\ (\cos a + \cos\gamma) - E(\pi - \alpha - \gamma)}{x_L} \Rightarrow$

  $x_L = \frac{120\sqrt{2}(\cos 30{,}7 + \cos 16{,}4) - 48(\pi - 0.26\pi)}{6} = \frac{120\sqrt{2}(0{,}86 + 0{,}96) - 48 \cdot 0{,}74 \cdot \pi}{6} = \frac{308{,}8 - 111{,}5}{6} \Rightarrow$

  $x_L = 32{,}9\Omega$

  Άρα: $L_d = \frac{x_L}{314} = \frac{32{,}9}{314} H \Rightarrow L_d = 105mH$

iv) Υπολογισμός των η, pf_2 για $L_d \to \infty$, I_{avg}, I_{rms}

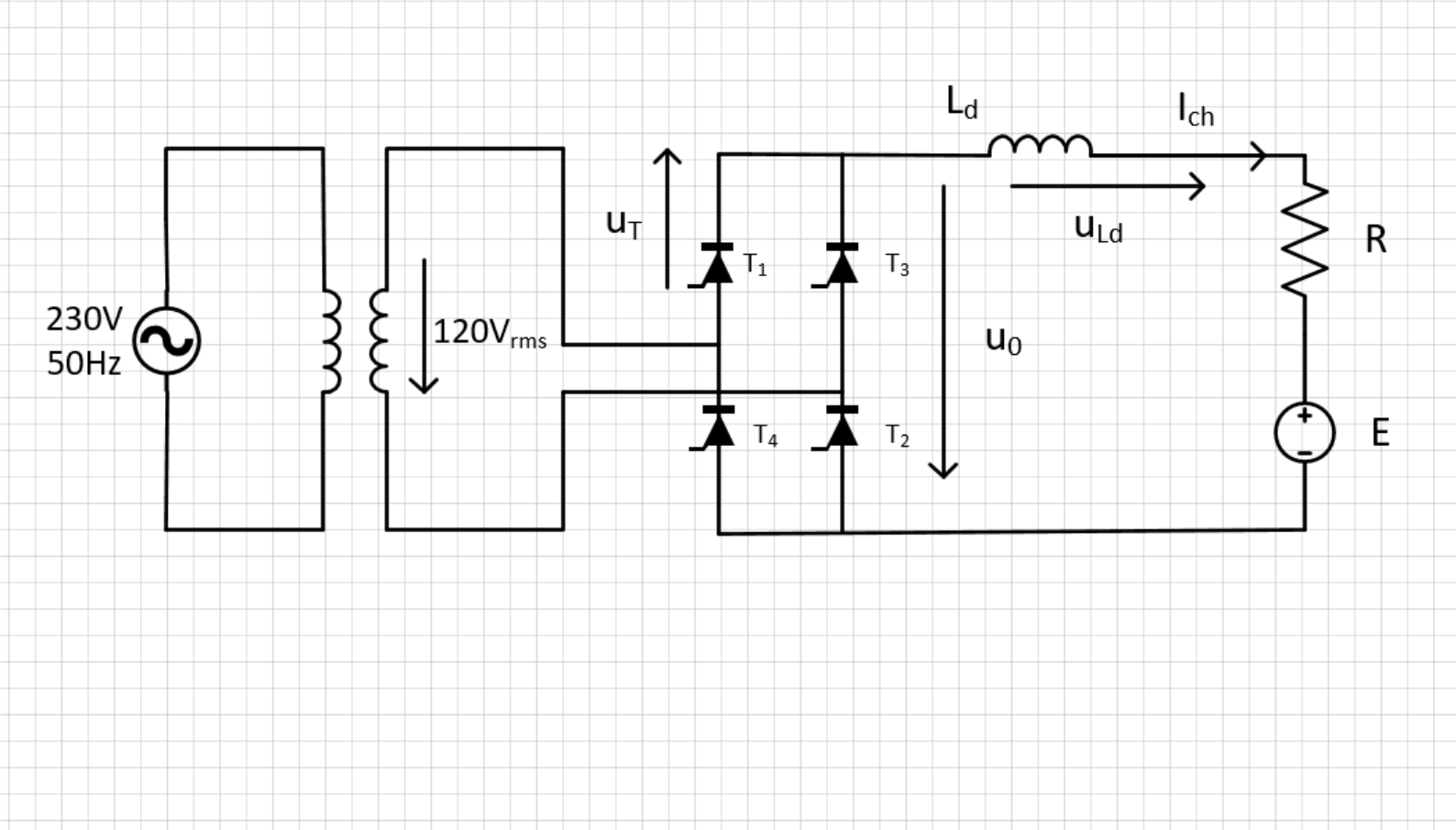
$L_d \to \infty \Rightarrow i_{ch} = I_{ch}$, $i_T = \begin{cases} I_{ch}, & a \le \varphi \le \pi \\ 0, \alpha\lambda\lambda o\acute{\upsilon} \end{cases}$, $i_{DF} = \begin{cases} 0 & , \quad a \le \varphi \le \pi \\ I_{ch}, & \pi \le \varphi \le 2\pi + \alpha \end{cases}$

- $I_T = I_{ch} \frac{\pi - \alpha}{2\pi} = I_{ch} \frac{0{,}83}{2} \Rightarrow I_T = 0{,}415 I_{ch} \Rightarrow I_T \simeq 5A$
- $I_{DF} = I_{CH} - I_T = 7A$
- $I_{Trms}^2 = \frac{1}{2\pi} \int_\alpha^\pi I_{ch}^2 \, d\varphi - I_{ch}^2 \frac{\pi - \alpha}{2\pi} = I_{ch}^2 0{,}415 \Rightarrow I_{Trms} = I_{ch} \sqrt{0{,}415} \Rightarrow$

$$I_{Trms} = I_{ch} \cdot 0{,}644 = 7{,}7A$$

- $I_{DF,rms}^2 = I_{ch}^2 - I_{T,rms}^2 = 144 - 59{,}29 \Rightarrow I_{DF,rms} = 9{,}2A$
-
- $\eta = \frac{P_{ch}}{P_R + P_{ch}} = \frac{576}{12^2 \cdot 0{,}2 + 576} = \frac{576}{28{,}8 + 576} \Rightarrow \eta = 95{,}2\%$
-
- $S = V_{2,rms} I_{T,rms} = 120V \cdot 7{,}7A \Rightarrow S = 924VA$
-
- $pf_2 = \frac{P_R + P_{ch}}{S} = \frac{28{,}8 + 576}{924} \Rightarrow pf = 0{,}65$

2. Να επανασχεδιαστεί το κύκλωμα για πλήρη ανόρθωση



$\hat{\imath} = 125\% I_{ch}$

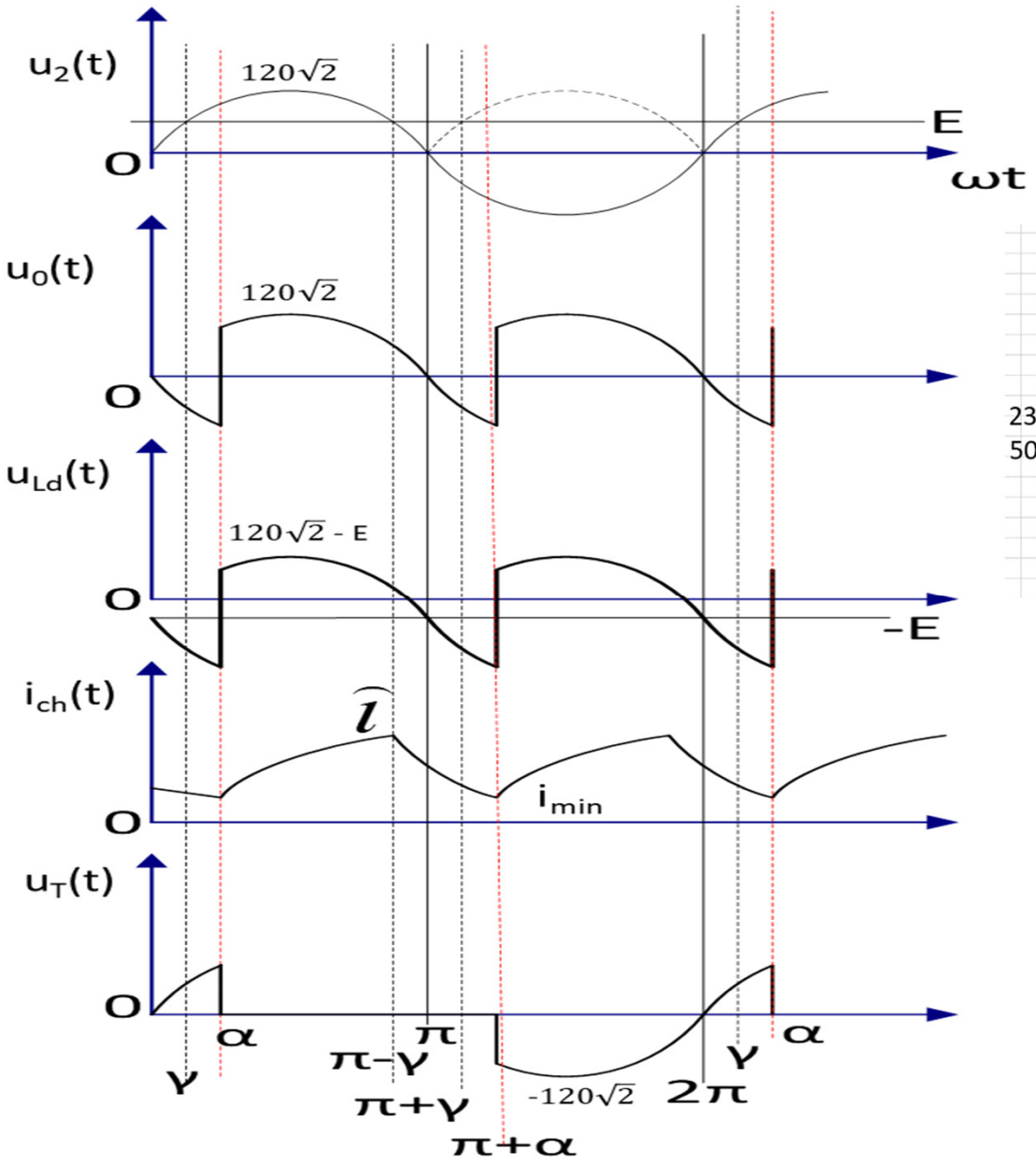
$\imath_{min} = 0{,}75 I_{ch}$

γ=16,4°

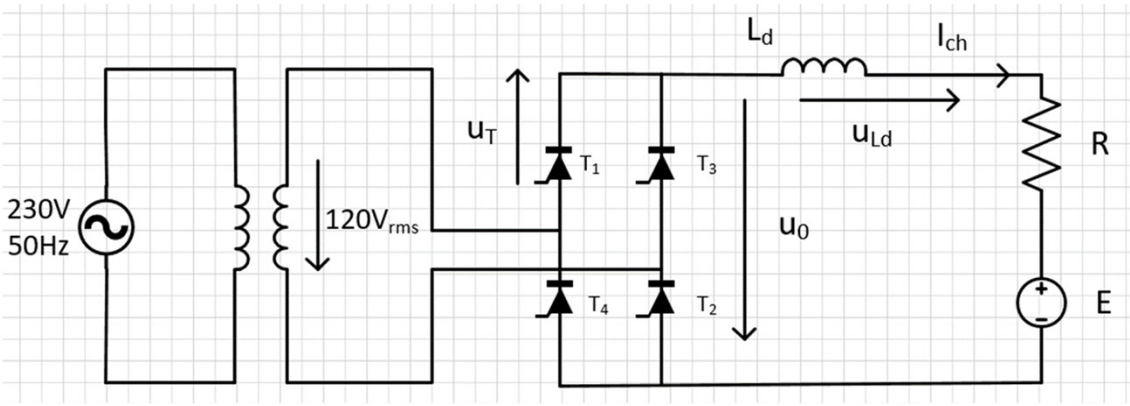
V_0=50,4V

i)Υπολογισμός α – Συνεχής αγωγή

$$V_0^{(E=0)} = \frac{V_{2,rms}\sqrt{2}}{\pi}\, cosa \;\Rightarrow cosa = \frac{\pi V_0}{V_{rms}\sqrt{2}} = 0{,}9326 \;\Rightarrow a = 21^{o}$$



ii) Σχεδιασμός $u_2(t)$, $u_0(t)$, $u_{Ld}(t)$, $i_{ch}(t)$, $u_T(t)$, ($i_{ch}R \cong 0$)



iii) Υπολογισμός της αυτεπαγωγής L_D

$\alpha \leq \varphi \leq \pi+\alpha : i_{ch}(\varphi) = \frac{\sqrt{2}V_{2,rms}\,(\cos a - \cos \varphi) - E(\varphi - \alpha)}{x_L} + I_{\varnothing}$

$$\Delta i = 0{,}5 I_{ch} = i_{ch}(\pi - \gamma) - i_{ch}(a) = \frac{\sqrt{2}V_{2,rms}\,(\cos a + \cos \gamma) - E(\pi - \gamma - \alpha)}{x_L} \Rightarrow$$

$$x_L = \frac{120\sqrt{2}(\cos 21 + \cos 16{,}4) - 48(\pi - 0{,}21\pi)}{0{,}5 \cdot 12} = \frac{120\sqrt{2}(0{,}934 + 0{,}959) - 48(0{,}79\pi)}{6} \Rightarrow x_L = \frac{321{,}2 - 119{,}6}{6}$$

$$\Rightarrow x_L = 33{,}7\Omega$$

Άρα : $L_D = \frac{x_L}{2\pi F} H = \frac{33{,}7}{314} H \Rightarrow L_D = 107mH$

iv) Να υπολογιστούν τα I_{avg}, I_{rms}, η, pf_2, για $L_D \to \infty$

- $I_T = I_{ch}\frac{\pi}{2\pi} = 0{,}57 I_{ch} = 6A$
- $I_{T,rms} = \frac{I_{ch}}{\sqrt{2}} = 8{,}5A$
- $I_{2,rms} = I_{ch} = 12A$
- $\eta = \frac{P_{ch}}{P_{R+}P_{ch}} = \frac{576}{0{,}2\cdot 12^2+576} = \frac{576}{604{,}8} = 95{,}2\%$
- $S_2 = V_{2,rms} I_{2,rms} = 120 \cdot 12VA = 1440VA$
- $pf_2 = \frac{604{,}8}{1440} = 0{,}42$

4. Να σχεδιαστεί το κύκλωμα με SemiConverter

i) V_0=50,4V , γ=16,4^0

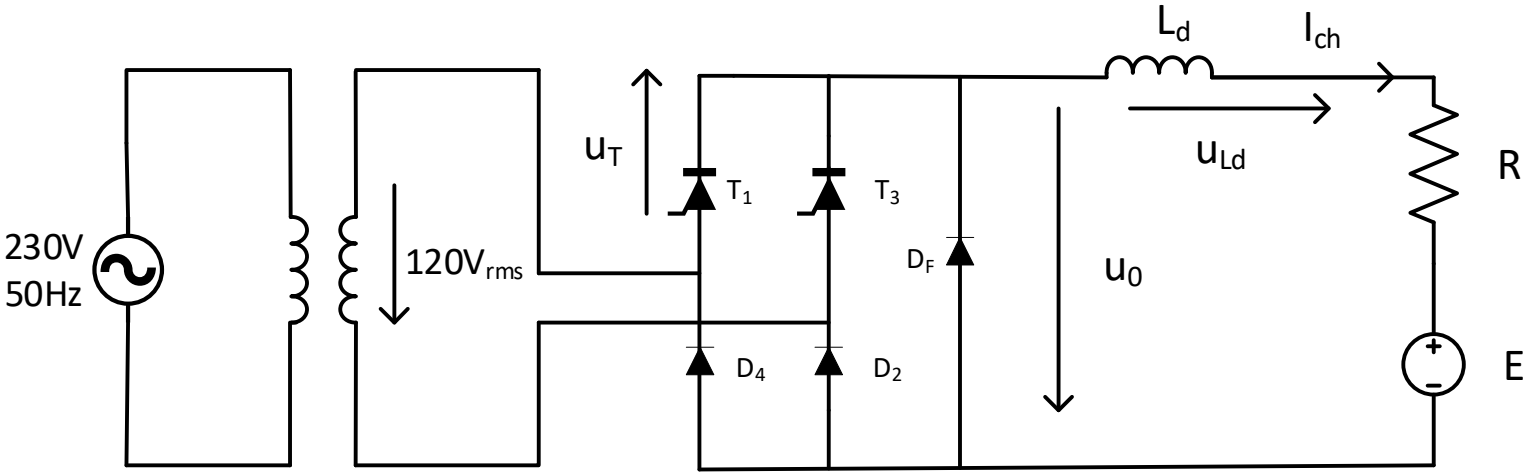
- $V_0^{(E=0)} = \frac{\sqrt{2}V_{2,rms}}{\pi}(1+\cos\alpha) => \cos\alpha = \frac{\pi V_0}{\sqrt{2V_{2,rms}}} - 1 = 0{,}933 - 1 = -0.067 \Rightarrow a \simeq 90^0$

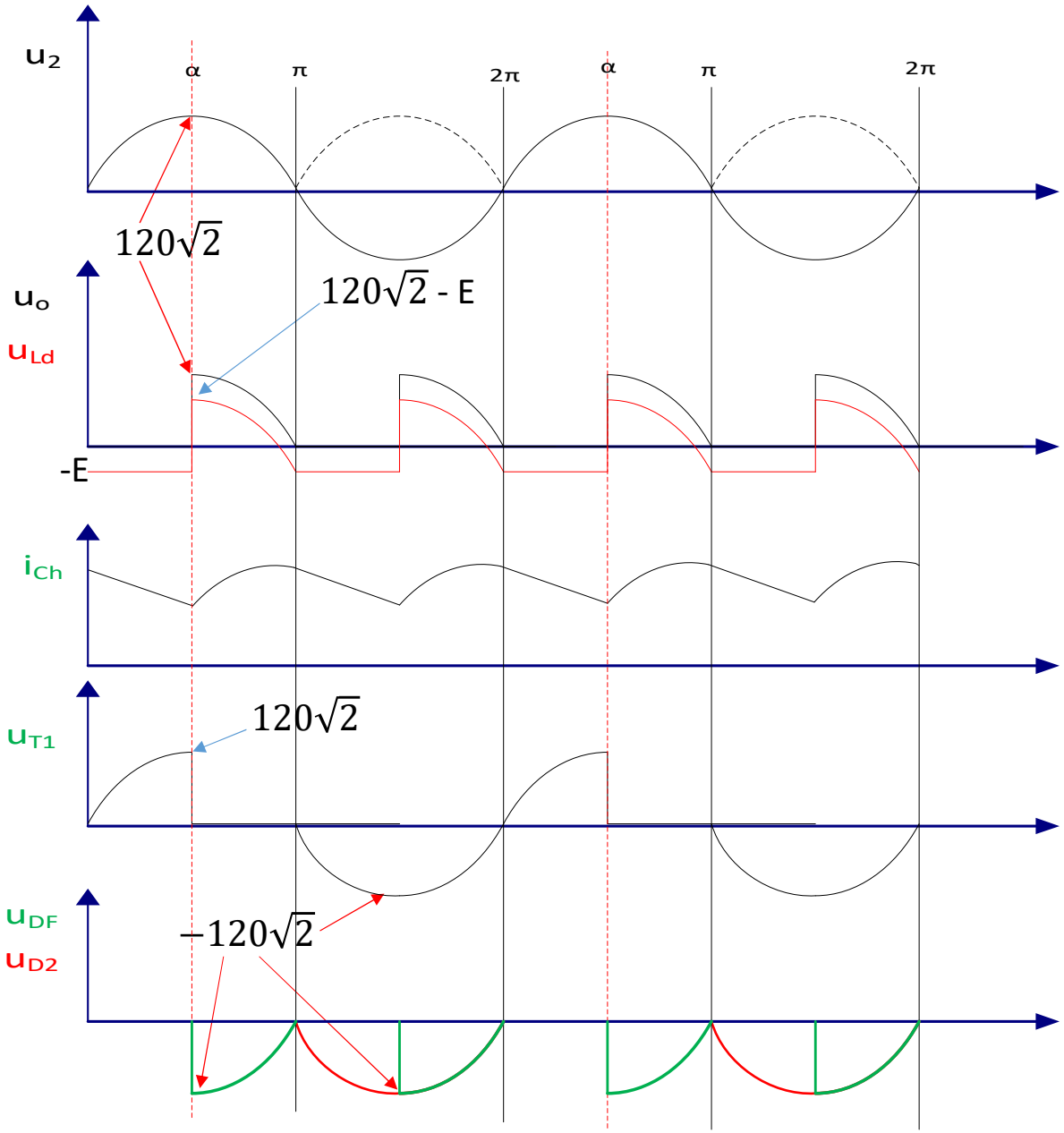
  Διάρκεια αγωγής κάθε ζεύγους θυρίστορ: (π – α)

ii) α≤φ≤π: $i_{ch}(\varphi) = \frac{\sqrt{2}V_{2,rms}(\cos\alpha - \cos\varphi) - E(\varphi-\alpha)}{x_L} + I_{ø}$

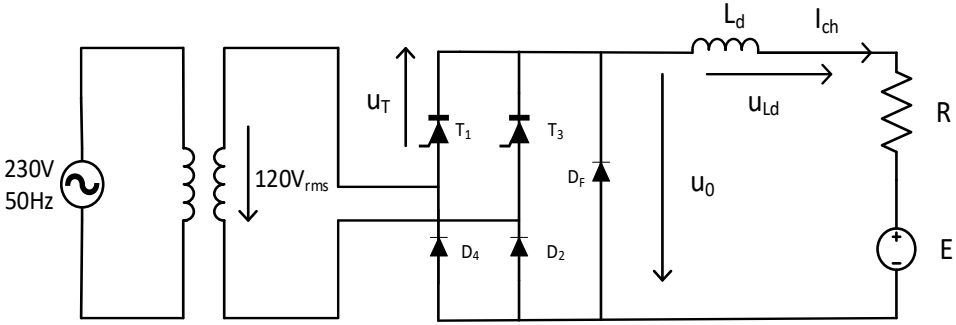
Δi=0,5I_{ch} $= i_{ch}(\pi-\gamma) - i_{ch}(\alpha) = \frac{\sqrt{2}V_{2,rms}(\cos\alpha + \cos\gamma) - E(\pi-\gamma-\alpha)}{x_L} \Rightarrow x_L = \frac{120\sqrt{2}\cdot 0{,}959 - 48\cdot 0{,}41\pi}{0{,}5\cdot 12} = \frac{162{,}7-61{,}8}{6} \Rightarrow x_L = 16{,}8\Omega$

Άρα $L_d = \frac{16{,}8}{314} H \Rightarrow L_d = 53{,}5mH$





iii) Να σχεδιαστούν $u_2(t)$, $u_0(t)$, $u_{Ld}(t)$, $i_{ch}(t)$, $u_T(t)$, $u_{DF}(t)$, $u_D(t)$



iv) Να υπολογιστούν τα I_{avg}, I_{rms},η , pf_2 για $L_d \to \infty$

η=95,2%, P_R=28,8W, P_{ch}=576W

- $I_T = \frac{1}{2\pi} I_{ch}(\pi - \alpha) = \frac{I_{ch}}{4} = 3A$
- $I_{DF} = 2I_T = 6A$
- $I_{T,rms}^2 = \frac{1}{2\pi} I_{ch}^2(\pi - \alpha) \Rightarrow I_{T,rms} = \frac{I_{ch}}{2} = 6A$
- $I_{ch}^2 = 2I_{T,rms}^2 + I_{DF,rms}^2 \Rightarrow 144 = 2 \cdot 36 + I_{DF,rms}^2 \Rightarrow I_{DF,rms} = 8{,}5A$
- $I_{2,rms}^2 = 2I_{T,rms}^2 \Rightarrow I_{2,rms} = I_{T,rms}\sqrt{2} = \sqrt{2} \cdot 6A \Rightarrow I_{2,rms} = 8{,}5A$
- $S_2 = V_{2,rms} I_{2,rms} = 120V \cdot 8{,}5A \Rightarrow S_2 = 1020VA$
- $pf_2 = \frac{604{,}8}{1020} \Rightarrow pf_2 = 0{,}59$