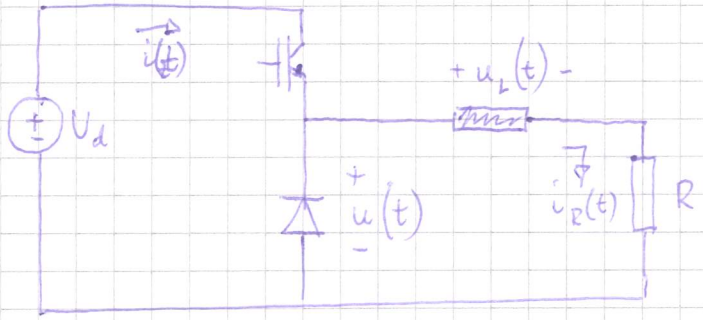
10.1 LS - omriktare 10.1

switchfrekv. $f = 4\,kHz$; $U_d = 72\,V$; $R = 4\,\Omega$

a) $I_R = 15\,A$; $t_p = ?$

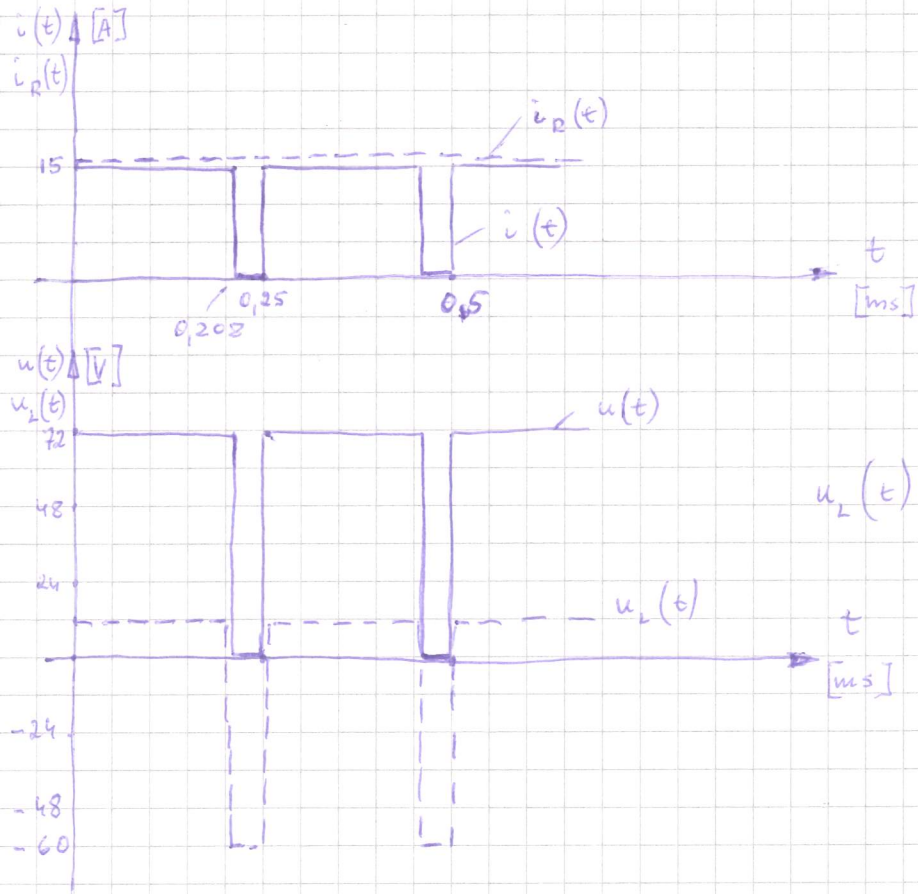


$$U_R = \frac{t_p}{T} U_d \quad ; \quad T = \frac{1}{f} = \frac{1}{4 \cdot 10^3} = 0{,}25\,ms$$ - modulationsperiod

$$U_R = I_R \cdot R = 15 \cdot 4 = 60\,V$$

$$t_p = T \frac{U_R}{U_d} = 0{,}25 \cdot \frac{60}{72} = \underline{0{,}208\,ms}$$

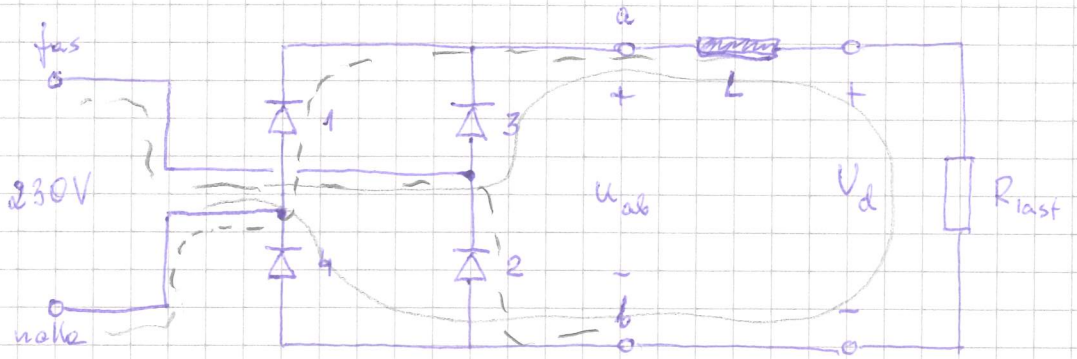
b)



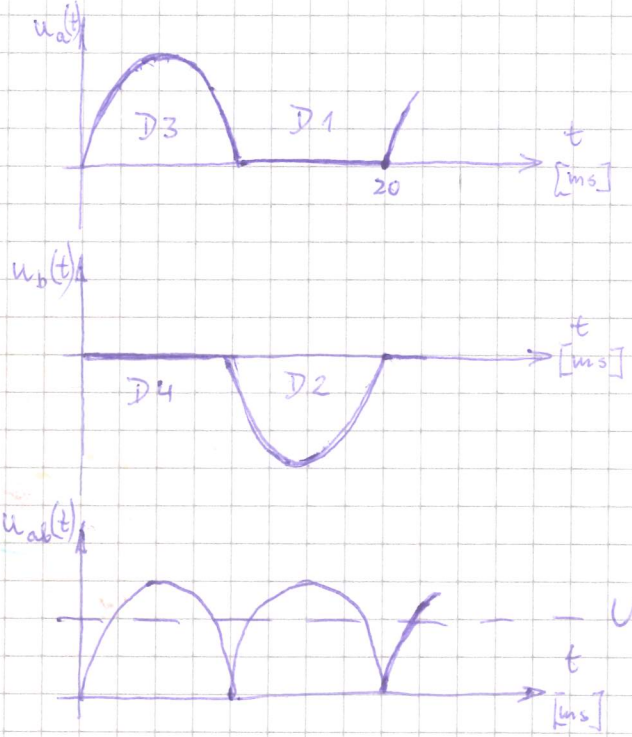
$$u_L(t) = u(t) - u_R(t)$$

c) $I_{Rmax} = \frac{72}{4} = \underline{18\,A}$; $\frac{t_p}{T} = \underline{1}$

10.2



$U_d = ?$



U_d - medelvärdet av u_{ab}

$$U_d = \frac{1}{T}\int_0^T u_{ab}(\omega t)\, d(\omega t) =$$

$$= \frac{1}{\pi}\int_0^{\pi} \sqrt{2}\, U_f \sin(\omega t)\, d(\omega t) =$$

$$= \frac{1}{\pi}\sqrt{2}\, U_f \left(-\cos(\omega t)\right)\Big|_0^{\pi} =$$

$$= \frac{1}{\pi}\sqrt{2}\, U_f \left(1+1\right) = \frac{2\sqrt{2}}{\pi}\, U_f = 0{,}9\, U_f$$

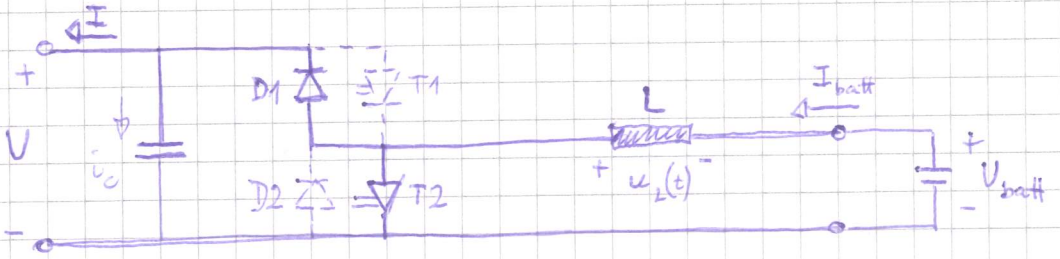
$U_f = 230\,V \Rightarrow U_d = 0{,}9 \cdot 230 = \underline{\underline{207\,V}}$

10.3

10.3

$U_{batt} = 96\,V$; $I = 10\,A$; $U = 300\,V$; $T = 0{,}1\,ms$

L o C - mycket stora



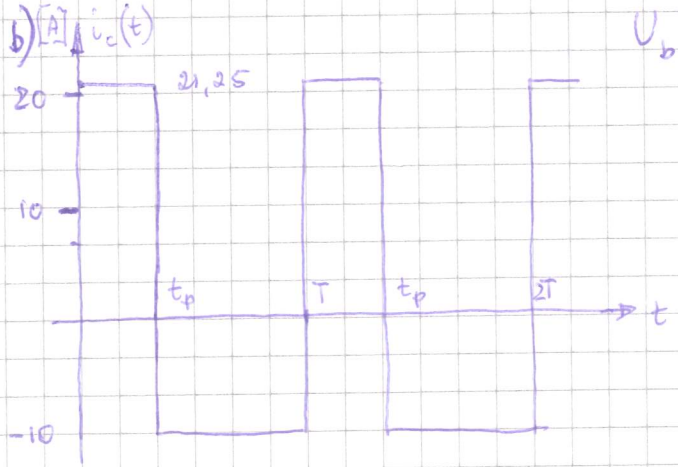
a) $\frac{t_p}{T} = ?$ $\qquad 0 \le t < t_p$ D1

$t_p < t < T$ T2

$U_{batt} = \frac{t_p}{T} U$ $\qquad \frac{t_p}{T} = \frac{96}{300} = 0{,}32$

$t_p = 0{,}32 \cdot 0{,}1 = \underline{0{,}032\,ms}$

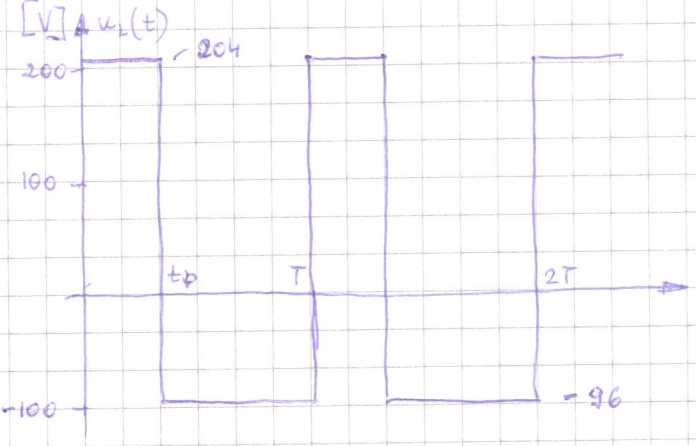
b)



$U_{batt} \cdot I_{batt} = UI$

$I_{batt} = \frac{300}{96} \cdot 10 = 31{,}25\,A$

$i_C(t) = 31{,}25 - 10 = 21{,}25\,A$



$u_L = U - U_{batt} =$

$= 300 - 96 = 204\,V \rightarrow (t_p)$

$u_L = -96\,V \rightarrow (T - t_p)$

c) $I_{batt} = 31{,}25\,A$

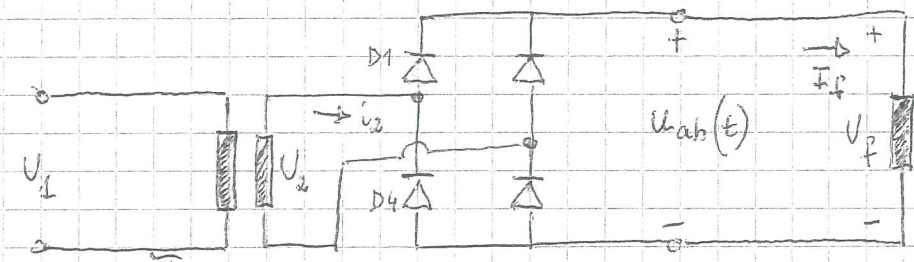
10.4

F6 ~~F6~~

LM's fältlindning matas från nätet via trafo och helvågslikriktare.

$U_1 = 230\,V$; $U_f = 110\,V$; $I_f = 4\,A$; $L_f = \infty$

$\frac{U_1}{U_2} = ?$; $S_n = ?$ (sp. fall försummas) ; $I_{vmv} = ?$; $U_{vback} = ?$



$u_{ab} = \hat{U}_2 \sin\omega t$

$$U_f = \frac{1}{\pi}\int_0^{\pi} \sqrt{2}\,U_2 \sin\omega t \; d(\omega t) = \frac{\sqrt{2}\,U_2}{\pi}\left[-\cos\omega t\right]_0^{\pi} = \frac{2\sqrt{2}}{\pi}\,U_2 = 110\,V$$

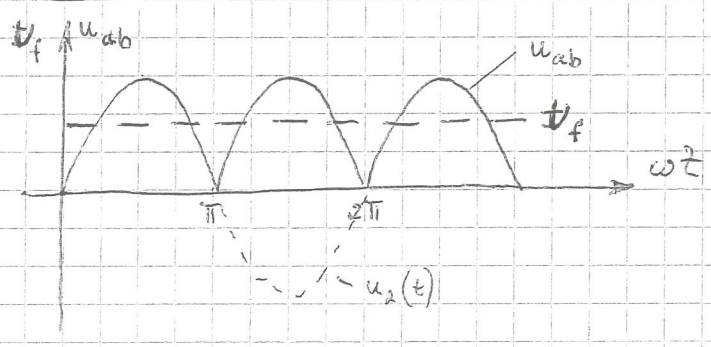
U_f medelvärde

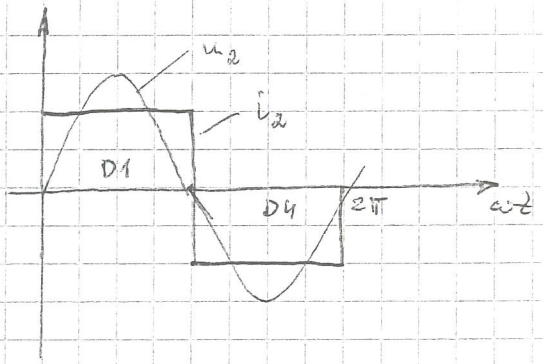
$$U_2 = \frac{110\,\pi}{2\sqrt{2}} = 122{,}2\,V \Rightarrow \frac{U_1}{U_2} = \frac{230}{122{,}2} = 1{,}88 \text{ trafos omsättning}$$

$$S_n = U_2 \cdot I_2 = U_2 \cdot I_f = 122{,}2 \cdot 4 = 488{,}8\,VA$$

$$I_{vmv} = \frac{4}{2} = 2\,A$$

$$U_{vback} = \hat{U}_2 = \frac{110\,\pi}{2} = 172{,}8\,V \quad (\text{eller } 122{,}2 \cdot \sqrt{2})$$





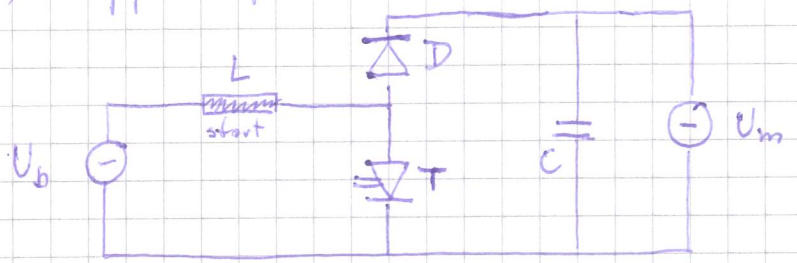
$I_f = I_{mv} = I_{2eff}$

Likriktade medelvärde $U_{lm} = \frac{1}{T}\int_0^T |u(t)|\,dt$ storheten beloppsintegreras

Effektivvärde $U_{eff} = \sqrt{\frac{1}{T}\int_0^T u(t)^2\,dt}$

10.5 $U_b = 12\,V$; $U_m = 24\,V$ 10.5

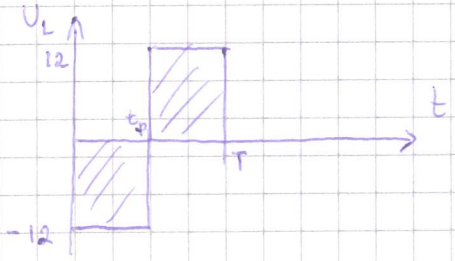
a) Upptransformerande LS-omriktare:



b) då

T är tänd $U_L = U_b$ → t_p

T är släckt $U_L = U_m - U_b$ → $T - t_p$



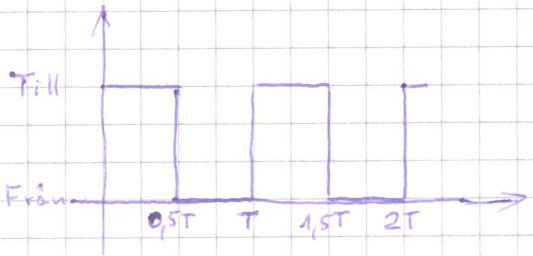
ytor lika

$$U_b \cdot t_p = (U_m - U_b)(T - t_p)$$

$$U_b t_p = U_m T - U_b T - U_m t_p + U_b t_p$$

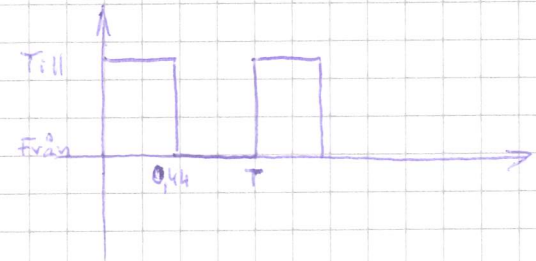
$$U_m T - U_b T = U_m t_p$$

$$t_p = \frac{U_m - U_b}{U_m} T = \frac{12}{24} T = 0{,}5\,T$$



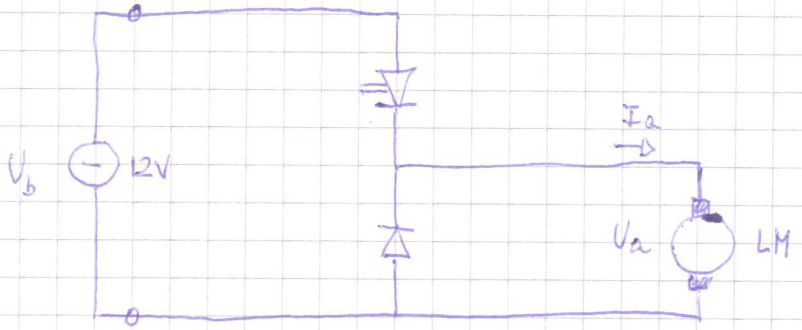
c) $U_b = 13{,}5\,V$; $U_m = 24\,V$

$$t_p = \frac{24 - 13{,}5}{24} T = \frac{10{,}5}{24} T = \underline{0{,}4375\,T}$$



10.6 Varvtalsstyra 12 V LM 10.6

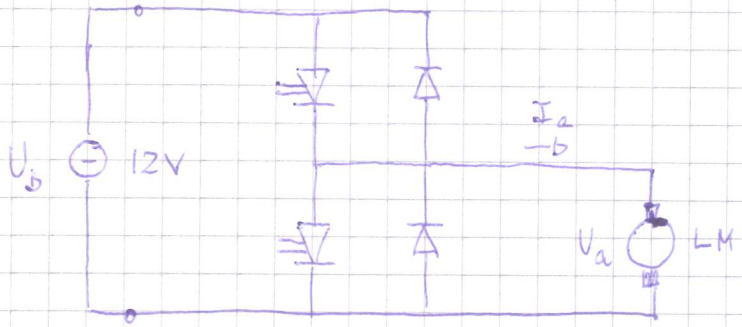
a) 12 V batteri in → 0 ÷ 12 V ut



$$U_a = \frac{t_p}{T} U_b$$

b) En enkvadrant nedspänningshackare

c) En tvåkvadrants — " —

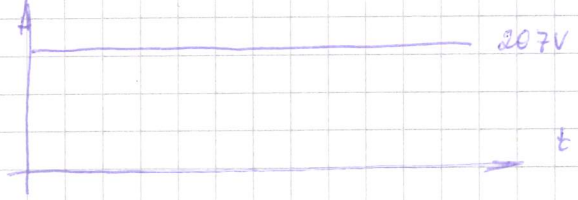


10.7

10.7

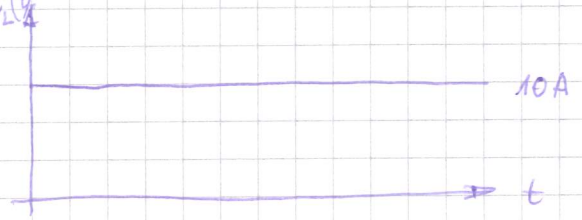
a) som 10.2 → 207 V

b) $u_c(t)$



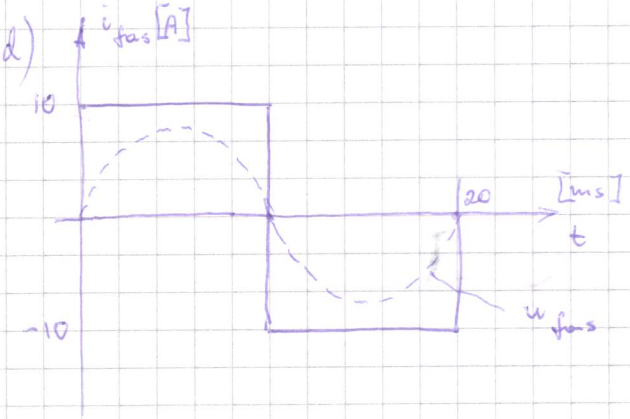
helt slät (m. stor kondensator)

c) $i_L(t)$



helt slät (m. stor induktans)

d)



10.8

10.8

3-f. diodhkv. riktare

$U = 380$ V

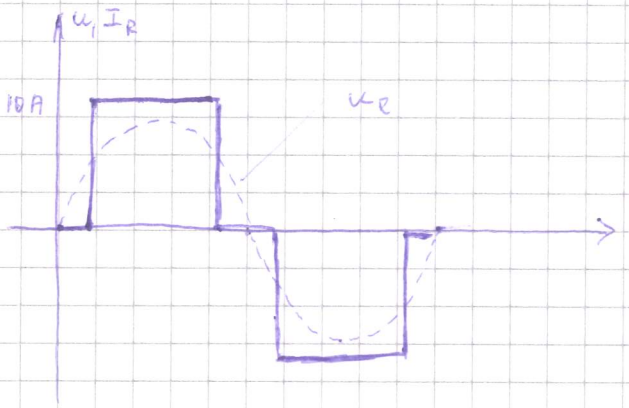
a) U_{ab} - se bilden 5.10 i komp

$$U_d = 1{,}35\,U = 513 \text{ V}$$

b) L - mycket stor

$I = 10$ A strömmen genom spolen helt slät

c)



30° - 1,67 ms

150° - 8,33 ms

210° - 11,67 ms

330° - 18,33 ms

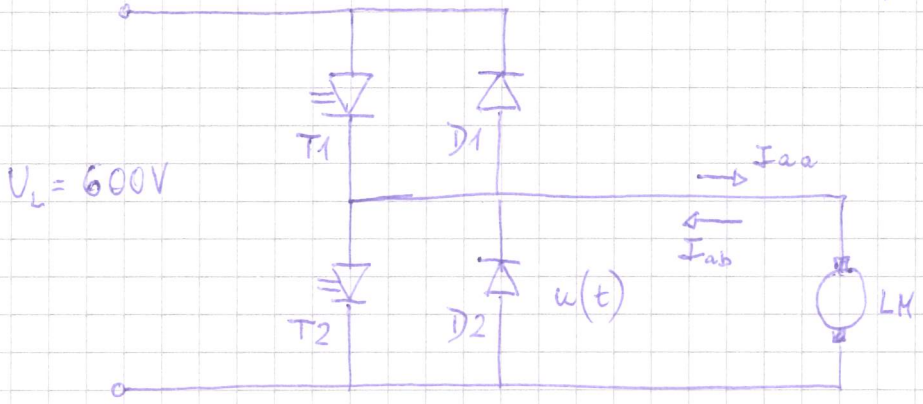
$$U_d = \frac{3}{\pi}\int_{-\frac{\pi}{6}}^{\frac{\pi}{6}} \sqrt{2}\,U\cos\omega t\, d(\omega t) = \frac{3}{\pi}\sqrt{2}\,U \sin\omega t \Big|_{-\frac{\pi}{6}}^{\frac{\pi}{6}} =$$

$$= \frac{3}{\pi}\sqrt{2}\,U\left(0{,}5+0{,}5\right) = \frac{3\sqrt{2}}{\pi}\,U = 1{,}35\,U$$

10.9

10.9

$E_a = 200\,V$; $f = 1\,kHz$



a) $I_{aa} = 200\,A$ T1 ; D2

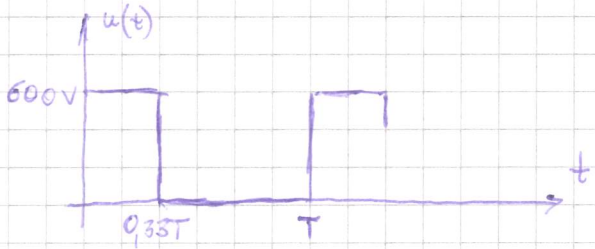
T1 leder → $u(t) = 600\,V$ $0 < t_{\text{tänd}} \leq t_p$

$$\frac{t_p}{T} = \frac{E_a}{U_L} \Rightarrow \frac{200}{600} = 0{,}33$$

nedsp.

$$T = \frac{1}{f} = \frac{1}{10^3} = 10^{-3}\,s \Rightarrow t_p = 0{,}33\,ms$$

D2 leder → $u(t) = 0$ $t_p < t < T$



b) $I_{ab} = -200\,A$

D1 leder $u(t) = 600\,V$

T2 leder $u(t) = 0$

uppsp.

fig. som ovan

F8 Tvåvägs-sexpulskoppling – laddning av batterier

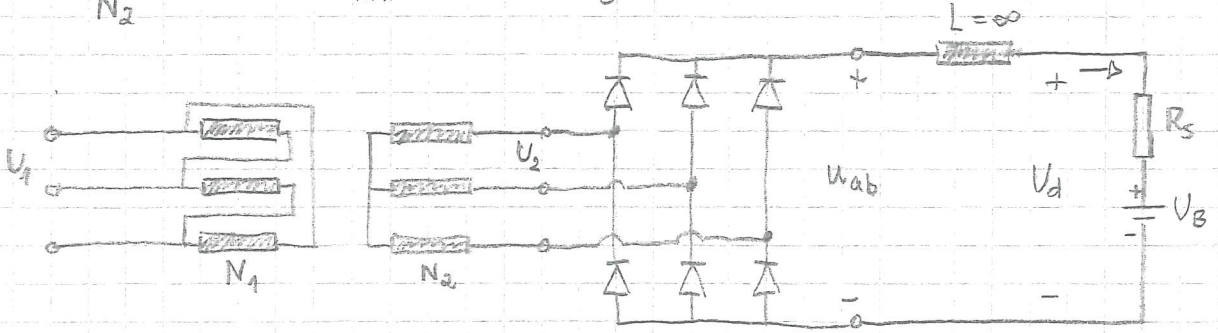
~~F8~~

10.10

$108 \le U_B \le 125\ V$ $\quad I_{ladmax} = 60\ A$

$U_1 = 400\ V$ $\quad \Delta/Y$ - trafo $\quad \Delta U_v = 0,7\ V$

$\frac{N_1}{N_2} = ?$ $\quad I_{mv} = ?$ $\quad R_s = ?$



$u_{ab}(t) = \sqrt{2}\, U_2 \cos\omega t$ OH

$$U_d = \frac{1}{\frac{2\pi}{6}} \int_{-\pi/6}^{\pi/6} \sqrt{2}\, U_2 \cos\omega t \, d(\omega t) = \frac{3\sqrt{2}}{\pi} U_2 \left(\frac{1}{2} + \frac{1}{2}\right) \cong 1,35\, U_2$$

$U_d' = U_d + 2\Delta U_v = U_{Bmax} + 2\Delta U_v = 125 + 1,4 = 126,4\ V$

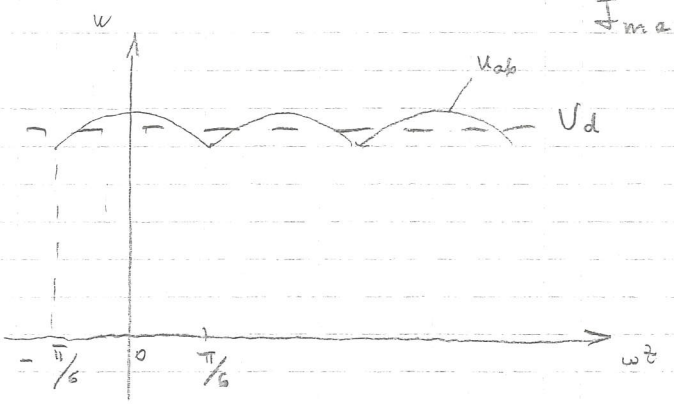
$U_2 = \frac{126,4}{1,35} = 93,6\ V \quad \Rightarrow U_{2f} = 54,04\ V$

$\frac{N_1}{N_2} = \frac{U_1}{U_{2f}} = \frac{400}{54,04} = \underline{\underline{7,4}}$ oms. mellan trafos lindningar

Varje ventil leder ström under 1/3 period

$I_{vmv} = \frac{I_{max}}{3} = \frac{60}{3} = \underline{\underline{20\ A}}$

Serieresistansen $R_s = \frac{U_{Bmax} - U_{Bmin}}{I_{max}} = \frac{125 - 108}{60} = \underline{\underline{0,283\ \Omega}}$

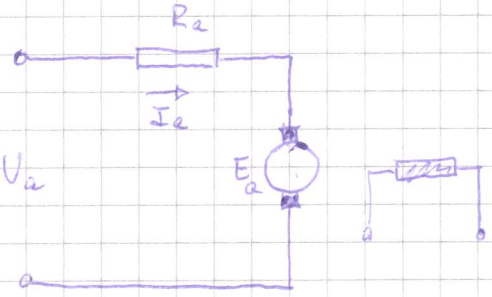


10.11 $U = 100\,V$ 10.11

a) som 10.9

b) $R_a = 1{,}3\,\Omega$; $E_{ao} = 75\,V$; $n = 1000\,rpm$; $I_a = 10\,A$

$\frac{t_p}{T} = ?$



$U_a = E_a + R_a I_a$

$U_a = 75 + 10 \cdot 1{,}3 = 88\,V$

$\frac{t_p}{T} = \frac{88}{100} = 0{,}88$

c) $I_a = -30\,A$ $\quad n = 1000\,rpm$

$U_a = 75 - 30 \cdot 1{,}3 = 75 - 39 = 36\,V$

$\frac{t_p}{T} = 0{,}36$