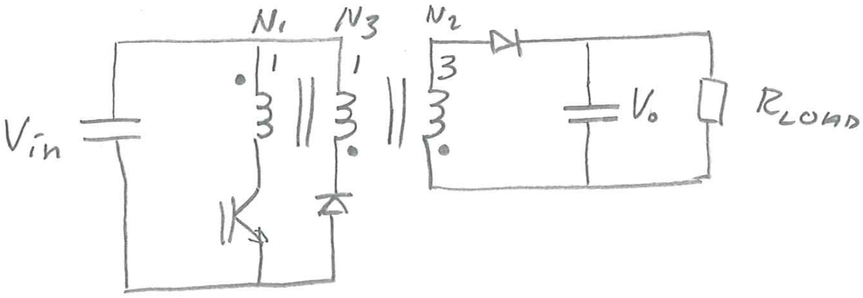
BWW Ex 17.8

Flybackomvandlare med trafo

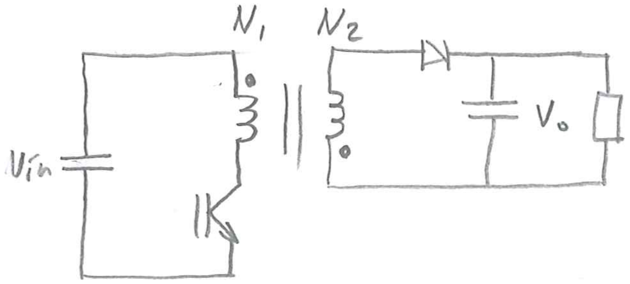
$V_{in} = 50\,V$ $\quad R_{LOAD} = 22{,}5\,\Omega$

$V_o = 225\,V$ $\quad L_m' = 300\,\mu H$

Trafo 1:1:3



i) CCM ⇒ Demagnetisering sker i sekundären ⇒



T = TILL: $\quad L_m' \cdot \frac{\Delta i_m'}{\Delta t} = V_{in} \Rightarrow \Delta i_m' = \frac{1}{L_m'} V_{in} t_T$

S = FRÅN: $\quad -L_m'' \frac{\Delta i_m''}{\Delta t} - V_o = 0$

$$-L_m' \left(\frac{N_2}{N_1}\right)^2 \frac{\Delta i_m' \left(\frac{N_1}{N_2}\right)}{\Delta t} - V_o = 0$$

$$-L_m' \left(\frac{N_2}{N_1}\right) \frac{\Delta i_m'}{\Delta t} - V_o = 0$$

Negativ derivata ⇒

$$-L_m' \left(\frac{N_2}{N_1}\right) \frac{-|\Delta i_m'|}{\Delta t} - V_o = 0$$

$$|\Delta i_m'| = \frac{1}{L_m'} \left(\frac{N_1}{N_2}\right) V_o t_D$$

17.8

LIKHET:

$$\frac{1}{L_m'} V_{in} t_T = \frac{1}{L_m'} \left(\frac{N_1}{N_2}\right) V_o t_D$$

$$V_{in} \cdot \delta_T T_{sw} = \frac{N_1}{N_2} V_o (1-\delta_T) T_{sw}$$

$$\delta_T \left(V_{in} + \frac{N_1}{N_2} V_o\right) = \frac{N_1}{N_2} V_o$$

$$\delta_T = \frac{N_1/N_2 \, V_o}{V_{in} + N_1/N_2 \, V_o} = \frac{1/3 \cdot 225}{50 + 1/3 \cdot 225} = 0,6$$

ii) $\bar{I}_o = \frac{V_o}{R_{LOAD}} = \frac{225}{22,5} = 10A$

$P_{in} = P_{ut} \Rightarrow$

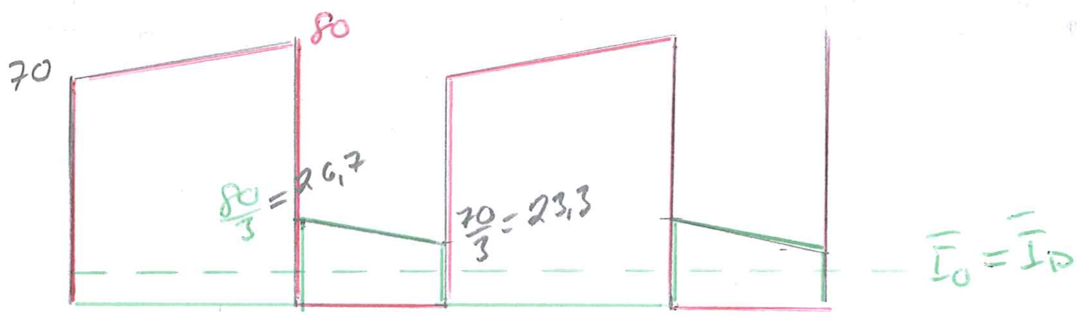
$$I_{in} = \frac{V_o}{V_{in}} \cdot \bar{I}_o = \frac{225}{50} \cdot 10 = 45A$$

iii) T = FRÅN:

$$\Delta i_m'' = \frac{1}{L_m''} \cdot V_o \cdot t_D = \frac{1}{L_m' \left(\frac{N_2}{N_1}\right)^2} \cdot V_o \cdot t_D =$$

$$= \frac{1}{300 \cdot 10^{-6} \left(\frac{3}{1}\right)^2} \cdot 225 \cdot 40 \cdot 10^{-6} = 3,33A$$

Medelströmmen genom dioden måste vara lika stor som medelströmmen till lasten. $\bar{I}_D = \bar{I}_o$



17.8

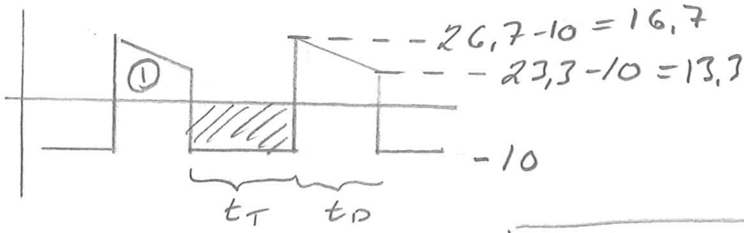
Medelströmmen under pulsen på sek. är

$$\bar{i}_{D,puls} = \frac{\bar{I}_0}{1-\delta_T} = \frac{10}{0,4} = 25\,A$$

$$\hat{i}_D = \hat{i}_m'' = \bar{i}_{D,puls} + \frac{\Delta i_m''}{2} = 25 + \frac{3,33}{2} = 26,7\,A$$

$$\check{i}_D = \check{i}_m'' = \bar{i}_{D\,puls} - \frac{\Delta i_m''}{2} = 25 - \frac{3,33}{2} = 23,3\,A$$

(v) $i_C = i_D - \bar{I}_0$ (när dioden leder, annars $-10\,A$ som går till lasten)



$$i_{C,RMS} = \sqrt{\frac{1}{T}\int i^2\,dt} = \sqrt{\frac{1}{T}\left(\int_0^{t_T}(-10)^2\,dt + \int_0^{t_D}\left(16,7 - \frac{3,33}{t_D}\cdot t\right)^2 dt\right)} =$$

$$= \{t_T = 60\,\mu s \quad t_D = 40\,\mu s\} = 12,26\,A$$

$$i_C = C\frac{dv}{dt} \Rightarrow \Delta v = V_1 - V_2 = \frac{1}{C}\int_{i_C<0} i_C\,dt$$

$$\Delta v = \frac{1}{C}\int_0^{t_T} 10\,dt = \frac{1}{1100\cdot 10^{-6}}\cdot 10\cdot 60\cdot 10^{-6} = \underline{\underline{545\,mV}}$$

Det hade blivit samma resultat genom att integrera den positiva arean ① istället.

c/

Medelströmmen i pulsen är

$$\bar{i}_{puls} = \frac{\bar{I}_0}{1-\delta_T} = \{CCM/DCM\} = \frac{\Delta \hat{i}_m''}{2}$$

$$\Rightarrow \bar{I}_{0_{crit}} = \frac{\Delta \hat{i}_m''}{2}(1-\delta_T) = \frac{3,33}{2} \cdot 0,4 = 0,67$$

$$R_{crit} = \frac{V_0}{\bar{I}_{0crit}} = \frac{225}{0,67} = \underline{\underline{338\,\Omega}}$$

$$R = 22,5\,\Omega \Rightarrow \bar{I}_0 = 10\,A$$

$$\Delta \hat{i}_m'' = \frac{2 \cdot \bar{I}_0}{1-\delta_T} = \frac{2 \cdot 10}{0,4} = 50\,A$$

$$L_m'' = \frac{1}{\Delta \hat{i}_m''} \cdot V_0 \cdot t_D = \frac{1}{50} \cdot 225 \cdot 40 \cdot 10^{-6} = 180\,\mu H$$

Motsvarar $L_m' = \left(\frac{N_1}{N_2}\right)^2 \cdot L_m'' = \left(\frac{1}{3}\right)^2 \cdot 180\mu = \underline{\underline{20\,\mu H}}$