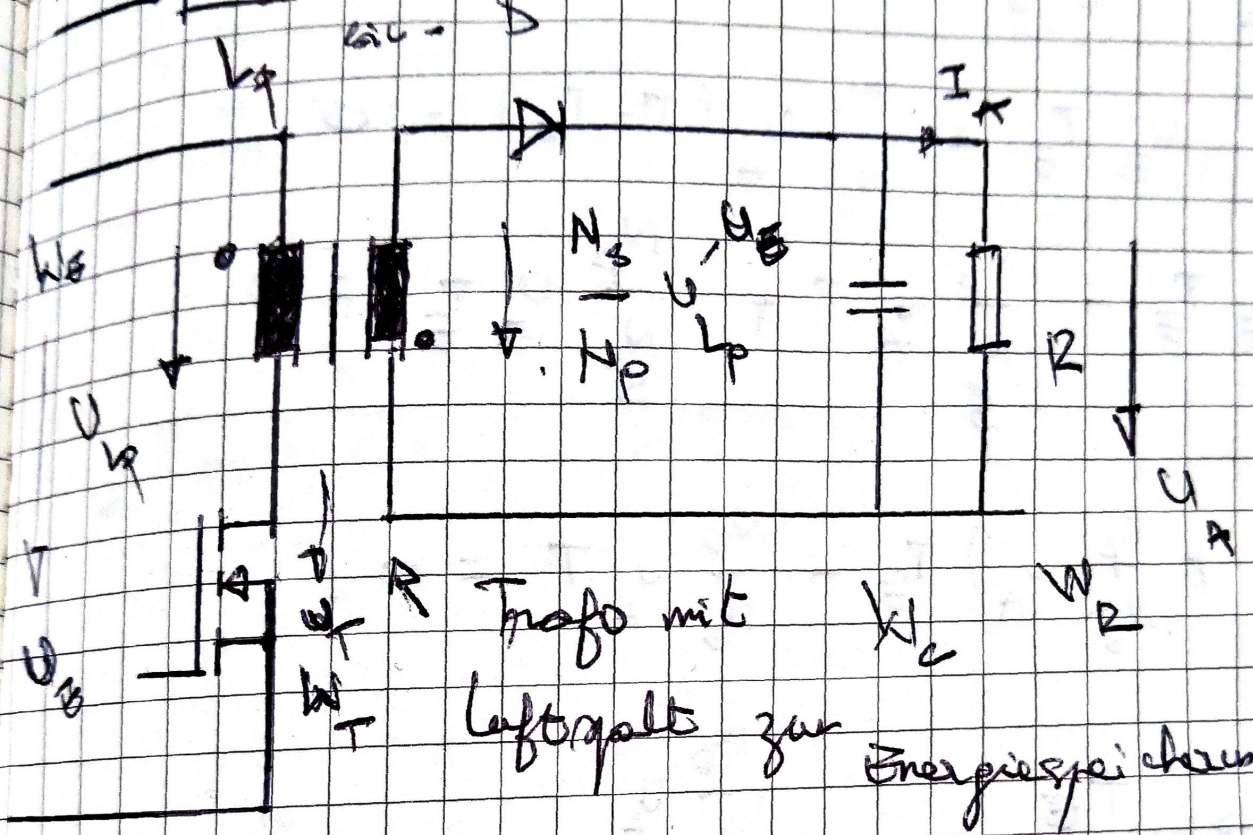
Sperrwandler: $P < 100\,W$

Auslegung Flyback-Konverter



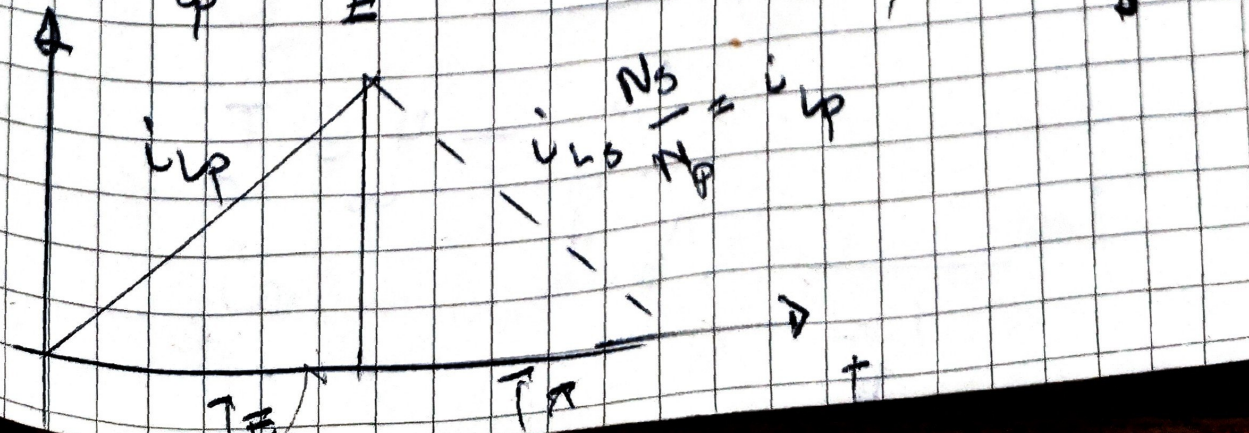
Trafo mit Luftspalt zur Energiespeicherung

$N_P = 3$; $N_S = 1$; $N_{aux} = 1$

$U_E = [12V - 60V]$; $U_A = 12V$

* Duty Cycle: $D = \frac{T_E}{T}$

T_E: $U_{LP} = U_E$; T_A: $U_{LP} = -\frac{N_P}{N_S} U_A$



$$\rightarrow U_{L_p} T_E + U_{L_p} T_A = U_E T_E - \frac{N_p}{N_s} U_A T_A = 0$$

mit $T_A = T - T_E$

$$\text{Lo} \quad U_E T_E - \frac{N_p}{N_s} U_A (T - T_E) = 0$$

$$U_E T_E - \frac{N_p}{N_s} U_A T + \frac{N_p}{N_s} U_A T_E = 0$$

$$\left(U_E + \frac{N_p}{N_s} U_A\right) T_E - \frac{N_p}{N_s} U_A T = 0$$

$$\rightarrow \frac{T_E}{T} = D = \frac{\frac{N_p}{N_s} U_A}{U_E + \frac{N_p}{N_s} U_A} = \frac{1}{1 + \frac{U_E}{\frac{N_p}{N_s} U_A}}$$

$$\text{Lo} \quad D = \frac{T_E}{T} = \frac{1}{1 + \frac{U_E}{\frac{N_p}{N_s} U_A}} \quad U_{L_p} \text{ @ } T_E$$

$$- U_{L_p} \text{ @ } T_A$$

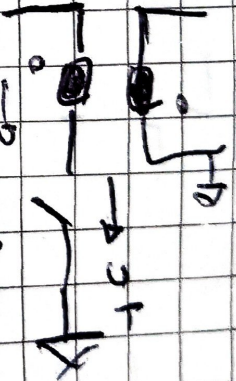
$f = 100\,kHz \rightarrow \frac{1}{f} = T \simeq \frac{10\,\mu s}{?}$

$U_B = [12V - 60V]$; $U_A = 12V$

$\hookrightarrow T_E[12V] = \frac{1 * 10\mu s}{1 + \frac{12V}{\frac{3}{1}\,12V}} \simeq 7{,}5\,\mu s$

$T_E[60V] = \frac{1 * 10\mu s}{1 + \frac{60V}{\frac{3}{1}\,12V}} \simeq 1{,}6\,\mu s$

* Mosfet: Spannungsfestigkeit



T_A: $U_T = U_E + U_{P_{T_A}}$

$U_{T_{max}} = U_B + \frac{N_P}{N_S} U_A = 60V + \frac{3}{1}\,12V$

$\hookrightarrow U_{T,max} \simeq \frac{96V}{2}$

Größer kann ich auswählen!

* L_p: Primär induktivität Wert

DCM-Mode

$$W_A = U_A I_A T = \frac{1}{2} L_p \hat{I}_E^2 \quad (1)$$

(2) T_E: $U_{L_p} = U_E = L_p \frac{\hat{I}_E}{T_E} \rightarrow L_p = \frac{U_E \cdot T_E}{\hat{I}_E}$

Aus (1) $L_p = \frac{2 U_A I_A T}{\hat{I}_E^2} = \frac{2 U_A I_A T}{\left(\frac{U_E T_E}{L_p}\right)^2}$

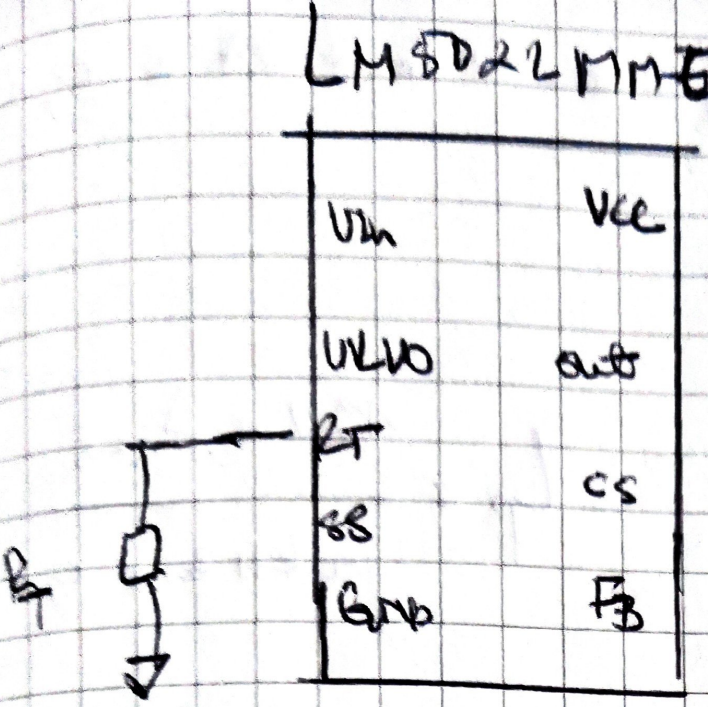
$U_{E,min} = 12V \rightarrow$ lückende Betrieb!

$$L_p = \frac{2 U_A I_A T}{(U_E \cdot T_E)^2} = \frac{2 W_A}{U_E \cdot T_E}$$

$$L_p \approx \left(\frac{2 * 12V * 3A * 10\mu s}{(12V * 7,5\mu s)^2} \right)^{-1} \approx 1,25\mu H$$

Bei diesem Wert liegt Sperrwandler im lückenden Betrieb bei 12V (DCM)

LM5022MMTE



für $f_{sw} = 100\,kHz \rightarrow R_T = \frac{1 - 8 \cdot 10^{-9} * f_{sw}}{f_{sw} * 5{,}77 \cdot 10^{-11}}$

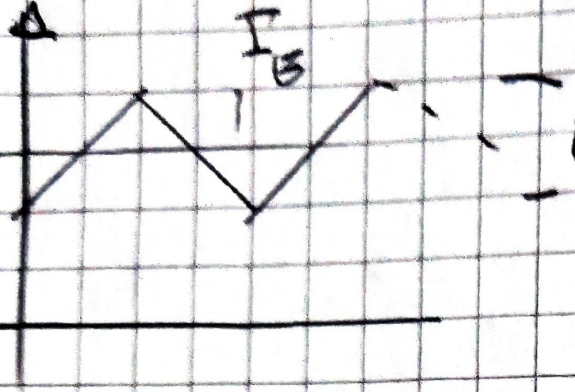
$\hookrightarrow R_T \approx \frac{173\,k\Omega}{2}$ (Datenblatt)

Im CCM $\quad L_p = \frac{U_{\Theta,min} \cdot D_{max}}{f_s * \Delta I_p}$

$I_{pk} = \frac{P_{in}}{V_{in}}$ mit $P_{in} = P_{out}$ (Annahme

$I_{pk} = \frac{36W}{12V} = 3A$

$\Delta I_p = I_0 \% + I_E = 20\% + 3A = 0,6A$



$$L_p = \frac{12V * D_{max}}{100kHz * 0,7A}$$

$D_{max}(12V) = 0,75$ $\quad \rightarrow L_p \simeq 128\mu H$

mit $\frac{N_p}{N_s} = \frac{3}{1}$