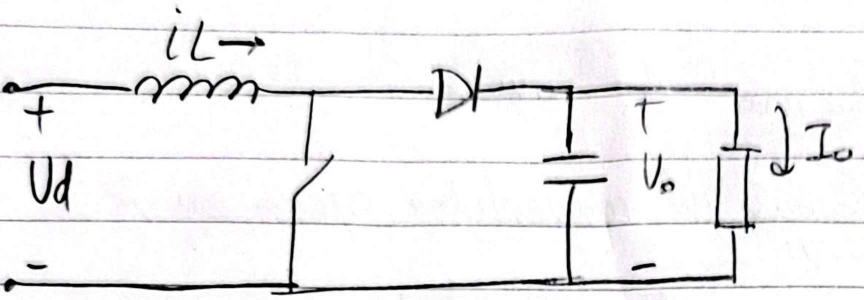
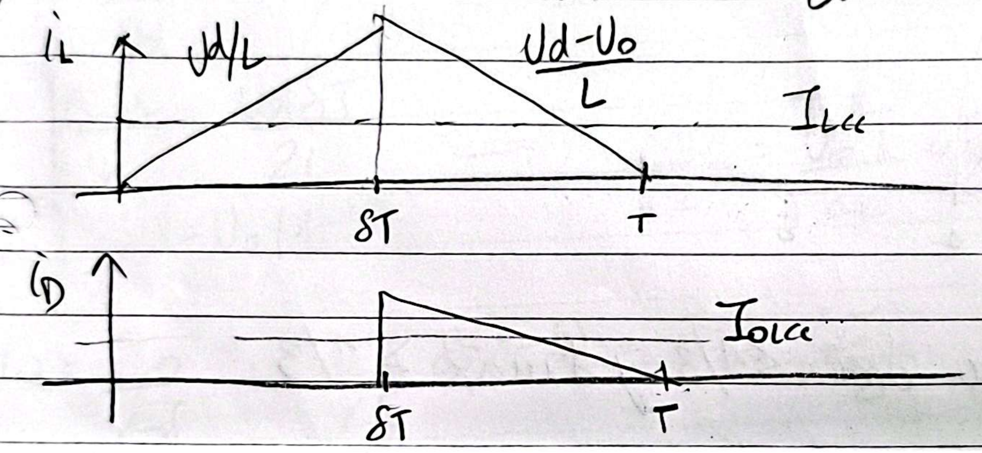
PROBLEMA 2



$P_{o\,max} = 3\,KW$
$U_o = 300\,V$
$U_{d\,min} = 100\,V$
$U_{d\,max} = 250\,V$
$f = 100\,KHz$

A) En el límite de conducción continua



$I_o = \langle i_D \rangle$

$$I_{Llc} = \frac{1}{T}\int_0^T i_{Llc}(t)\,dt = \frac{1}{2\cancel{T}} \cdot \cancel{T} \cdot \frac{U_d}{L}\delta T = \frac{U_d \delta T}{2L}$$

Es válida la transferencia en MCC: $\frac{U_o}{U_d} = \frac{1}{1-\delta}$

$$U_d = U_o(1-\delta)$$

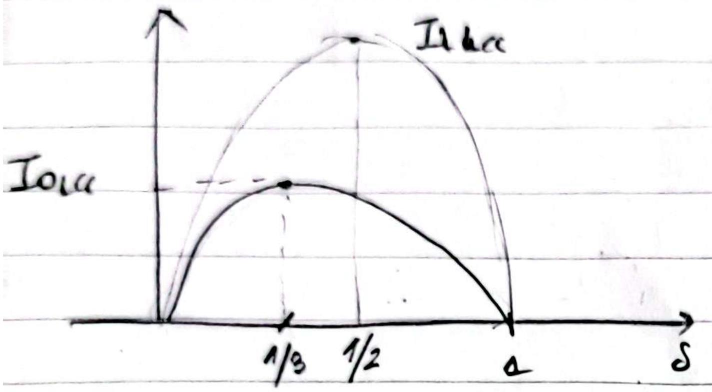
$$\rightarrow I_{Llc} = \frac{U_o \delta (1-\delta)}{2Lf}$$

Además: $I_{olc} = \frac{1}{\cancel{T}} \cdot \frac{1}{2}(1-\delta)\cancel{T} \cdot \frac{U_d}{L}\delta T = \frac{(1-\delta)\delta\, U_d}{2Lf}$

$$I_{olc} = \frac{(1-\delta)^2 \delta\, U_o}{2Lf}$$

Supongo que $I_{o_{Lc\,máx}} = \frac{1}{2} I_{o\,máx}$

$\forall\ I_o > \frac{1}{2} I_{o\,máx}$ el convertidor opera en MOC.



Debo verificar que $\delta_{min} < 1/3$ y $\delta_{máx} > 1/3$

$$\frac{V_o}{V_{d\,máx}} = \frac{1}{1-\delta_{min}} \longrightarrow \delta_{min} = 1 - \frac{V_{d\,máx}}{V_o}$$

$$\delta_{min} = 1 - \frac{V_{d\,máx}}{V_o} = 1 - \frac{250}{300} = 0{,}166$$

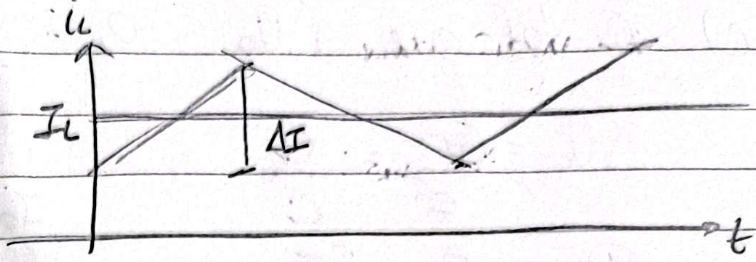
$$\delta_{máx} = 1 - \frac{V_{d\,mín}}{V_o} = 1 - \frac{100}{300} = 0{,}66$$

$$I_{o\,máx} = \frac{P_{o\,máx}}{V_o} = \frac{3000W}{300V} = 10A \qquad \frac{I_{o\,máx}}{2} = \frac{V_o\delta^*(1-\delta^*)^2}{2Lf}$$

$$L = \frac{V_o\delta^*(1-\delta^*).2}{2f\,I_{o\,máx}} = 44\mu H$$

$$L = \frac{300\,(1/3)(2/3)^2.2}{2.(100\times10^3)(10)} = 44\mu H$$

b) Corriente por el MOSFET



$$\hat{i}_Q = I_L + \frac{\Delta I_L}{2}$$

$$P_{in} = P_{out} \rightarrow V_d I_L = V_o I_o$$

$$I_L = \frac{V_o}{V_d} I_o = \frac{I_o}{(1-\delta)}$$

$$\begin{cases} \frac{\Delta I_L}{2} = \frac{V_d \delta T}{2L} \\ V_d = V_o(1-\delta) \end{cases} \longrightarrow \frac{\Delta I_L}{2} = \frac{V_o T}{2L} \delta(1-\delta)$$

$$i_Q = \frac{I_o}{1-\delta} + \frac{V_o T}{2L}\delta(1-\delta) = I_L + \frac{\Delta I_L}{2}$$

- $I_L \uparrow$ con δ
- ΔI_L tiene un máximo en $\delta = 1/2$

Corresponde ver qué pasa para $\delta = 1/2$ y $\delta_{max} = 0{,}66$

$$\delta = 0{,}5 \qquad i_Q = \frac{10}{1-0{,}5} + \frac{300.(0{,}5)(1-0{,}5)}{2.(100\times10^3)(44\times10^{-6})} = 28{,}43 A$$

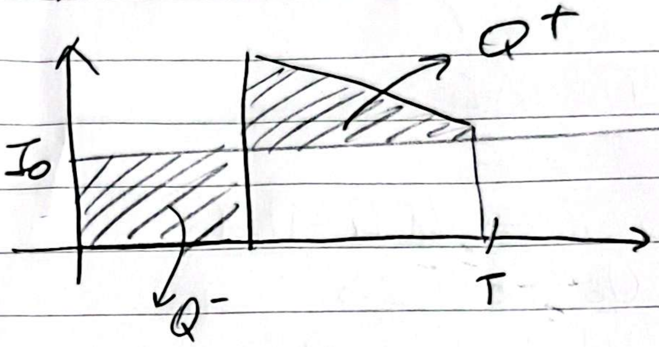
$$\delta = 0{,}66 \qquad i_Q = \frac{10}{1-0{,}66} + \frac{300(0{,}66)(1-0{,}66)}{2.(100\times10^3)(44\times10^{-6})} = 37{,}5 A$$

$$I_{Qmax} = 37{,}5 A$$

c) C tal que $\Delta V_o < 0{,}001 V_o$

$$\Delta V_o = \frac{Q^-}{C} = \frac{Q^+}{C}$$

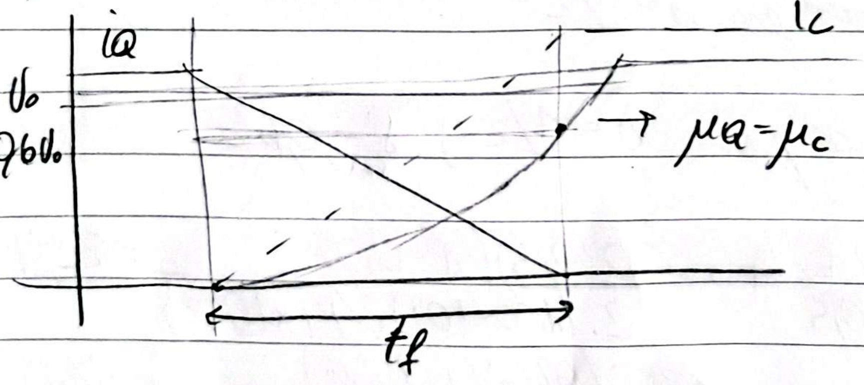
$$Q^- = I_o \cdot \delta T$$

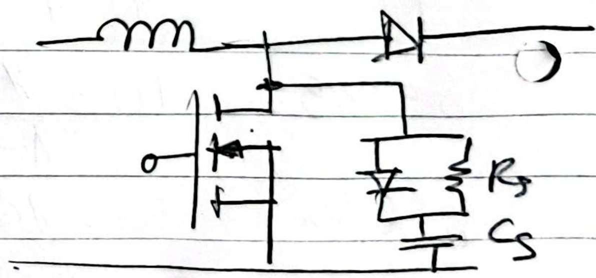


$$\Delta V_{o\,máx} = \frac{Q^-}{C} = \frac{I_o \delta_{máx} T}{C}$$

$$C = \frac{I_o \delta_{máx} T}{\Delta V_{o\,máx}} = \frac{(10).(0{,}66)}{0{,}001.300.(100\times10^3)} = 222\,\mu F$$

d) Circuito Snubber de Apagado $t_f = 67\,ns$





$$\Delta \mu_c = Q / C_s$$

$$Q = \int_0^{t_f} i_c(t)\,dt$$

$$i_c(t) = \frac{I_{a\,máx}\, t}{t_f}$$

$$Q = \frac{I_{a\,máx}}{t_f}\frac{t_f^2}{2} = \frac{I_{a\,máx}\, t_f}{2}$$

Escaneado con CamScanner

$$\Delta\mu c = \frac{I_{Qmáx}\, t_f}{2C_s}$$

$$C_s = \frac{I_{Qmáx}\, t_f}{2\Delta\mu c}$$

$$C_s = \frac{(37{,}5A)\cdot(67\times10^{-9})}{2\cdot(0{,}6\times300)} = 6{,}9\,nF$$

Tiempo min de descarga del condensador: $\delta_{min}\,T$

$$3R_sC_s \leq \delta_{min}T \Rightarrow R_s \leq \frac{\delta_{min}T}{3C_s} = 79\ m\Omega$$

$$P_{Rs} = \frac{E_c}{T} = \frac{1}{T}\,\frac{1}{2}\,C_sV^2 = \frac{(6{,}9\times10^{-9})\cdot(300^2)(100\times10^3)}{2}$$

$$P_{Rs} = 31{,}4\,W$$