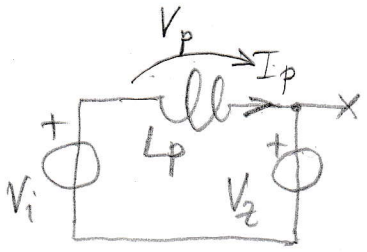
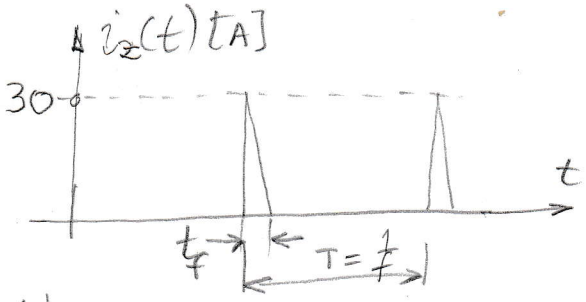
(1)





$$I_{Qmax} = \frac{\int_{t_f} v_p(t)\,dt}{L_p} = \frac{(V_z - V_i)\,t_f}{L_p} \Rightarrow t_f = \frac{I_{Qmax} \cdot L_p}{V_z - V_i}$$

$$t_f = \frac{30 \cdot 500 \cdot 10^{-9}}{100 - 48} = \underline{288\,ns}$$

$$P_{z\,max} = I_{Qmax} \cdot V_z = 30 \cdot 100 = \underline{3\,kW};$$

$$\overline{P_z} = W_z \cdot f_s; \quad W_z = \int_0^{t_f} i_z(t) \cdot v_z(t)\,dt = \int_0^{t_f} i_z(t) \cdot 100\,dt$$

$$W_z = 100 \cdot t_f \cdot \frac{I_{Qmax}}{2} = 100 \cdot 288 \cdot 10^{-9} \cdot \frac{30}{2} = 432\,\mu J.$$

$$\overline{P_z} = 432 \cdot 10^{-6} \cdot 30 \cdot 10^3 = \underline{12{,}96\,W}.$$

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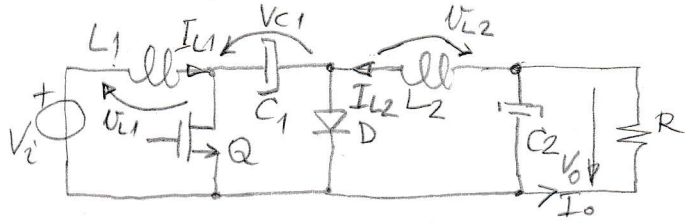
(2)



a) $V_i \cdot DT = (V_{C1a} + V_D - V_i)(1-D)T \Rightarrow \cancel{V_i D} = V_{C1a} + V_D - V_i - V_{C1a} \cdot D - V_D \cdot D + \cancel{V_i D}$

$$-V_{C1a}(1-D) = V_D(1-D) - V_i$$

$$V_{C1a} = \frac{V_i}{1-D} - V_D = \frac{12}{0{,}5} - 1 = \underline{23\,V}$$

$$(V_{C1a} - V_{oa})\,DT = (V_{oa} + V_D)(1-D)T$$

$$V_{C1a} \cdot D - V_{oa} D = V_{oa} + V_D - V_{oa} D - V_D \cdot D$$

$$V_{C1a} = \frac{V_{oa} + (1-D)V_D}{D} = \frac{V_{oa} + 0{,}5 \cdot 1}{0{,}5}$$

$$= 2V_{oa} + 1$$

$$23 = 2V_{oa} + 1 \Rightarrow V_{oa} = \frac{22}{2} = \underline{11\,V}$$

b) $[V_i - (I_{L1} + I_{L2})\,r_{DSon}]\,DT = (V_{C1b} + V_D - V_i)(1-D)T$

$$\cancel{V_i D} - (I_{L1} + I_{L2})\,r_{DSon} \cdot D = V_{C1b} + V_D - V_i - V_{C1b} D - V_D \cdot D + \cancel{V_i D}$$

$$V_{C1b} = \frac{V_i - (1-D)V_D - (I_{L1} + I_{L2}) \cdot r_{DSon}}{1-D}$$

$$(V_{C1b} - V_{ob} - (I_{L1} + I_{L2})\,r_{DSon})\,DT = (V_{ob} + V_D)(1-D)T$$

$$V_{C1b} \cdot D - V_{ob} \cdot D - (I_{L1} + I_{L2}) \cdot r_{DSon} \cdot D = V_{ob} + V_D - V_{ob} D - V_D \cdot D$$

$$V_{C1b} = \frac{V_{ob} + V_D(1-D) + r_{DSon}(I_{L1}+I_{L2})\cdot D}{D}$$

$I_{L2} = I_o = 25\,A.$

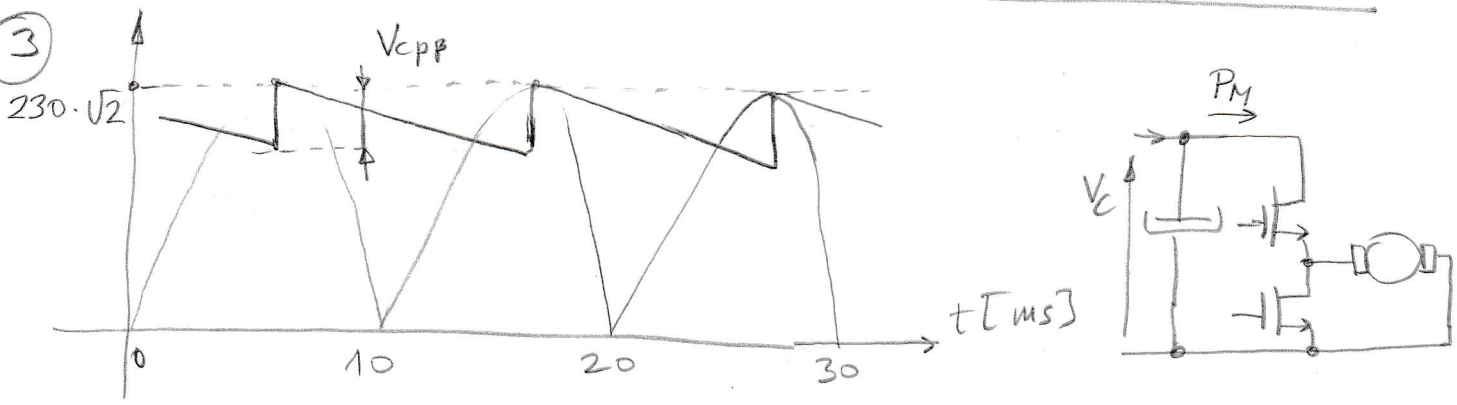
$DI_{L2} = (1-D)I_{L1} \Rightarrow I_{L1} = \frac{DI_{L2}}{1-D} = \underline{25\,A}$; $V_{ob} = 0{,}97 \cdot V_{oa} = \underline{10{,}67\,V}$

$$\frac{V_i - (1-D)V_D - (I_{L1}+I_{L2})\cdot r_{DSon}}{1-D} = \frac{V_{ob} + (1-D)V_D + (I_{L1}+I_{L2})r_{DSon}\cdot D}{D}$$

$$\frac{12 - 0{,}5\cdot 1 - 50\cdot r_{DSon}}{0{,}5} = \frac{V_{ob} + 0{,}5\cdot 1 + 50\cdot r_{DSon}\cdot 0{,}5}{0{,}5}$$

$12 - 0{,}5 - 0{,}5 - 75\,r_{DSon} = V_{ob} \Rightarrow r_{DSon} = \frac{11 - V_{ob}}{75} = \frac{0{,}33}{75} = \underline{4{,}4\,m\Omega}$

(3)



$P_M = V_M \cdot I_M = 120 \cdot 15 = \underline{1800\,W}$

$W_M = P_M \cdot \frac{T}{2} = 1800 \cdot 10 \cdot 10^{-3} = \underline{18\,J}$

$W_M = \frac{1}{2} C (V_{cmax}^2 - V_{cmin}^2)$

$C = \frac{2\,W_m}{V_{cmax}^2 - V_{cmin}^2} = \frac{36}{(230\sqrt{2})^2 - (230\sqrt{2} - 50)^2} = \underline{1{,}2\,mF}$