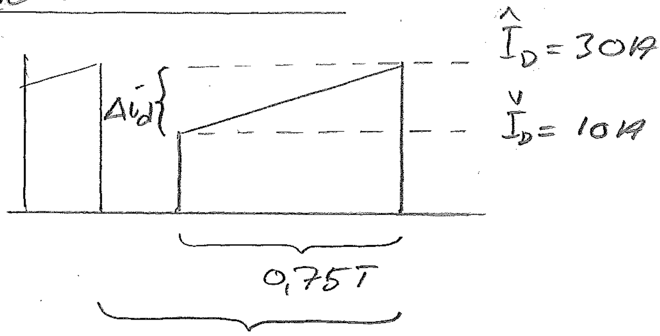
BWW 5.6



$$T = \frac{1}{20kHz} = 50\,\mu s$$

i)

$$t_{turn\text{-}on} = t_{ri} + t_{fv} = 100\,ns$$

$$t_{turn\text{-}off} = t_{fv} + t_{ri} = 200\,ns$$

$$P_{SW,ON} = \frac{V_{dc} \cdot \check{I}_d}{2} \cdot t_{turn\text{-}on} \cdot f_{sw} = \frac{340 \cdot 10}{2} \cdot 100 \cdot 10^{-9} \cdot 20 \cdot 10^{3} = 3{,}4W$$

$$P_{SW,OFF} = \frac{V_{dc} \cdot \hat{I}_d}{2} \cdot t_{turn,off} \cdot f_{sw} = \frac{340 \cdot 30}{2} \cdot 200 \cdot 10^{-9} \cdot 20 \cdot 10^{3} = 20{,}4W$$

$$P_{SW} = P_{SW,ON} + P_{SW,OFF} = 3{,}4 + 20{,}4 = \underline{\underline{23{,}8W}}$$

ii)

$$P_{cond} = \frac{1}{T} \int_0^{t_T} \underbrace{R_{DS(ON)} \cdot i_D(t)}_{U_{DS}} \cdot i_D(t)\, dt =$$

$$= \frac{1}{T} \int_0^{t_T} R_{DS(ON)} \cdot \left(\check{I}_d + \frac{\Delta i_d}{t_T} \cdot t\right)^2 dt =$$

$$= \frac{1}{T} \int_0^{t_T} R_{DS(ON)} \left(\check{I}_d^{\,2} + 2\check{I}_d \cdot \frac{\Delta i_d}{t_T} \cdot t + \left(\frac{\Delta i_d}{t_T}\right)^2 \cdot t^2\right) dt =$$

$$= \frac{R_{DS(ON)}}{T} \left[\check{I}_d^{\,2} \cdot t + \check{I}_d \frac{\Delta i_d}{t_T} t^2 + \left(\frac{\Delta i_d}{t_T}\right)^2 \frac{t^3}{3}\right]_0^{t_T} =$$

$$= R_{DS(ON)} \underbrace{\left(\check{I}_o^{\,2} + \check{I}_o \Delta i_d + \frac{\Delta i_d^{\,2}}{3}\right) \frac{t_T}{T}}_{I_{D,RMS}^2} =$$

$$I_{D,RMS}^2 \Rightarrow I_{D,RMS} = 18{,}03A$$

$$= 0{,}1 \left(10^2 + 10 \cdot 20 + \frac{20^2}{3}\right) 0{,}75 = \underline{\underline{32{,}5W}}$$

iii) $T_a = 40°C$

$T_j = P_{LOSS} \cdot R_{th,ja} + T_a =$

$= P_{LOSS}(R_{th,jc} + R_{th,ca}) + T_a =$

$= (23{,}8 + 32{,}5)(0{,}4 + 0{,}6) + 40 = 96{,}3°C$