Lösungsvorschlag Übung 8 - Halbleiter

Ein- und Ausschaltentlastung:

1. $L_{B\min} = \frac{u}{di/dt_{\max}} = \frac{U_1}{di/dt_{\max}} = \frac{2800V}{200\,A/\mu s} = \underline{\underline{14\,\mu H}}$

2. $E_L = \frac{1}{2} L I^2 \qquad E_R = E_L = \frac{1}{2} \cdot 14\mu H \cdot 1000^2\,A^2 = \underline{\underline{7Ws}}$

3. $C_{B\min} = \frac{I}{du/dt_{\max}} = \frac{1000\,A}{500V/\mu s} = \underline{\underline{2\,\mu F}}$

4. Maximum beim Einschalten mit $U_R = U_C = U_1$

   $I_R = \frac{U_1}{R_B} \qquad R_{B\min} = \frac{U_1}{I_{R\max}} = \frac{2800V}{200\,A} = \underline{\underline{14\Omega}}$

5. $\tau = R_B \cdot C_B = 14\Omega \cdot 2\,\mu F = \underline{\underline{28\mu s}}$

6. $F_{\max} = \frac{1}{T_{\min}} = \frac{a_{\min}}{T_{ein\min}} = \frac{a_{\min}}{3\tau} = \frac{U_{2\min}}{3\,\tau \cdot U_1} = \frac{100V}{3 \cdot 28\mu s \cdot 2800V} = \underline{\underline{425.2\,Hz}}$

Verlustleistung:

1. $P_{V\,Leit} = \frac{1}{T}\int u(t) \cdot i(t)\,dt = U_{t0} I_{avg} + R_t I_{rms}^2 = \underline{\underline{931W}}$

   $I_{avg} = \frac{1}{T}\int_0^{T_{ein}} I\,dt = \frac{T_{ein}}{T} I = a\,I = 0.5 \cdot 700\,A = 350\,A$

   $I_{rms} = \sqrt{\frac{1}{T}\int_0^{T_{ein}} I^2\,dt} = \sqrt{\frac{T_{ein}}{T} I^2} = \sqrt{a}\,I = \sqrt{0.5} \cdot 700\,A = 495\,A$

2. $P_{V\,Schalt} = F \cdot E_{onoff} = 1000\frac{1}{s} \cdot 0.588Ws = \underline{\underline{588W}}$

3. $\Delta T = P_{tot} \cdot R_{th\,jh} = \left(P_{V\,Leit} + P_{V\,Schalt}\right) \cdot R_{th\,jh} = 1519W \cdot 0.023\,K/W = 35\,K$

   $T_{h\max} = T_{j\max} - T_{Reserve} - \Delta T = 125°C - 25K - 35K = \underline{\underline{65°C}}$