

BWW Uppg 8.12

$$\bar{I}_C = I_0 \left(1 - \frac{t}{t_{fr}}\right)$$

$$\bar{I}_{C_s} = I_0 - \bar{I}_C = I_0 - I_0 \left(1 - \frac{t}{t_{fr}}\right) = I_0 \frac{t}{t_{fr}}$$

$$\begin{aligned} U_{C_s}(t) - U_{C_s}(0) &= \frac{1}{C_s} \int I_0 \frac{t}{t_{fr}} dt = \frac{1}{C_s} \left[I_0 \frac{t^2}{2t_{fr}} \right]_0^t = \\ &= \frac{I_0}{2t_{fr}C_s} t^2 \end{aligned}$$

$$\begin{aligned} E_{off} &= \int_0^{t_{fr}} U_{C_s}(t) \cdot \bar{I}_C(t) dt = \\ &= \int_0^{t_{fr}} \frac{I_0}{2t_{fr}C_s} t^2 \cdot I_0 \left(1 - \frac{t}{t_{fr}}\right) dt = \int_0^{t_{fr}} \frac{I_0^2}{2t_{fr}C_s} \left(t^2 - \frac{t^3}{t_{fr}}\right) dt = \end{aligned}$$

$$= \frac{I_0^2}{2t_{fr}C_s} \left[\frac{t^3}{3} - \frac{t^4}{4t_{fr}} \right]_0^{t_{fr}} =$$

$$= \frac{I_0^2}{2t_{fr}C_s} \left(\frac{t_{fr}^3}{3} - \frac{t_{fr}^3}{4} \right) = \frac{I_0^2}{2C_s \cdot 12} \cdot t_{fr}^2 = \frac{1}{24} \frac{I_0^2 t_{fr}^2}{C_s}$$

$$P_{off} = E_{off} \cdot f_{sw} = \frac{1}{24} \frac{I_0^2 t_{fr}^2}{C_s} \cdot f_{sw} \Rightarrow$$

$$C_s = \frac{1}{24} \frac{I_0^2 t_{fr}^2}{P_{off}} \cdot f_{sw} = \frac{1}{24} \frac{10^2 \cdot 100\text{ns}^2}{1} \cdot 20\text{kHz} = \underline{\underline{0,83\text{nF}}}$$

$$U_{C_s}(t_{fr}) = \frac{I_0}{2t_{fr}C_s} \cdot t_{fr}^2 = \frac{24 P_{off}}{I_0^2 t_{fr}^2 \cdot f_{sw}} \cdot \frac{I_0}{2t_{fr}} \cdot t_{fr}^2 =$$

$$= \frac{12 P_{off}}{I_0 f_{sw} t_{fr}} = \frac{12 \cdot 1}{10 \cdot 20\text{kHz} \cdot 100\text{ns}} = \underline{\underline{600\text{V}}}$$