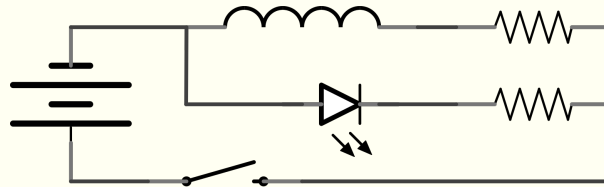


1. Selbstinduktion

$$U = 50 \text{ V}; \quad U_z = 80 \text{ V}; \quad R_1 = 1500 \, \Omega; \quad I_0 = 0.15 \text{ A}; \quad \delta t = 1 \text{ ms}$$

(a)



$$(b) \quad R_2 = \frac{U}{I_0}; \quad U_{\text{ind}} = U(R_1 + R_2)$$

$$L \frac{dI}{dt} = -I(R_1 + R_2)$$

$$I(t) = I_0 e^{-\frac{R_1 + R_2}{L}t}$$

$$U(t) = -L \frac{dI(t)}{dt} = I_0(R_1 + R_2) e^{-\frac{R_1 + R_2}{L}t}$$

$$U(10^{-6}) = 80 \quad \Rightarrow \quad L = \underline{\underline{1.48 * 10^{-3} \text{ H}}}$$

(c)

$$U + L \frac{dI}{dt} = -IR_2$$

$$I(t) = I_0 \left(1 - e^{-\frac{R_2}{L}t} \right)$$

$$I(t)/I_0 = 0.99 \quad \Rightarrow \quad t = \underline{\underline{2.05 * 10^{-5} \text{ s}}}$$

- (d) The Diode is current blocking in one direction and permissive in the other. When the circuit is closed current flows in the wrong direction, whereas when the circuit is opened current flows from the Inductor in the permissive direction to the diode.

2. Transformator

$$U_1 = 230 \text{ V}$$

(a)

$$U_2 = \underline{\underline{U_1 \frac{N_2}{N_1}}}$$

(b) $N_2 = 1$; $R_2 = 0.2 \text{ } \Omega$; $P = 800 \text{ W}$

$$P = \frac{U_2^2}{R_2}$$

$$U_2 = \sqrt{PR_2}$$

$$N_1 = \frac{U_1 N_2}{\sqrt{PR_2}} = \underline{\underline{18.18}}$$

(c)

$$I = \frac{P}{U} = \underline{\underline{3.48 \text{ A}}}$$

(d) Without using a spool on the underside of the pots ($\Rightarrow N = 1$) you have to use a lot of current to heat the pot. That's why heating via induction utilizes eddy currents to heat more efficiently.

3. Energiedichte einer Zylinderspule

(a)

$$B = \mu_0 \frac{n}{l} I$$

$$\Phi = \int \vec{B} \cdot d\vec{A} = \mu_0 \frac{n}{l} I \int 1 \cdot d\vec{A} = A \mu_0 \frac{n}{l} I$$

$$L = N \frac{d\Phi}{dt} = \underline{\underline{\frac{\mu_0 A n^2}{l}}}$$

(b) $n = 2000$; $A = 4 \text{ cm}^2$; $l = 0.3 \text{ m}$; $I = 4 \text{ A}$

$$E = \frac{1}{2} L I^2 = \frac{\mu_0 A n^2 I^2}{2l} = \underline{\underline{0.054 \text{ J}}}$$

(c)

$$\rho = \frac{E}{V} = \frac{\mu_0 n^2 I^2}{2l^2} = \underline{\underline{446.80 \text{ J/m}^3}}$$

(d)

$$\omega_{\text{mag}} = \frac{B^2}{2\mu_0} = \mu_0 \frac{n^2}{2l^2} I^2 = \underline{\underline{446.80 \text{ J/m}^3}}$$