Maschensatz (t=0)

$$U_1 = i_L \cdot (R_1 + R_2) + L \cdot \left(\frac{\mathrm{d}}{\mathrm{d}t} i_L\right)$$

Dgl.

$$\frac{\mathrm{d}}{\mathrm{d}t} i_L + \frac{R_1 + R_2}{L} \cdot i_L = \frac{U_1}{L}$$

Lösung der homogenen Dgl.

$$i_h(t) = i_{h0} \cdot e^{\frac{-t}{\tau}} \qquad \tau = \frac{L}{R_1 + R_2}$$

partikuläre Lösung

$$\frac{R_1 + R_2}{L} \cdot i_p = \frac{U_1}{L} \qquad i_p = \frac{U_1}{R_1 + R_2}$$

Gesamtlösung

$$i_L(t) = i_h + i_p = i_{h0} \cdot e^{\frac{-t}{\tau}} + \frac{U_1}{R_1 + R_2}$$

Anfangsbedingung

$$i_{L0}(0) = i_{h0} \cdot e^{\frac{0}{\tau}} + \frac{U_1}{R_1 + R_2} = -\frac{U_2}{R_2}$$

$$i_{h0} = -\frac{U_2}{R_2} - \frac{U_1}{R_1 + R_2}$$

$$i_L(t) = \left(-\frac{U_2}{R_2} - \frac{U_1}{R_1 + R_2}\right) \cdot e^{\frac{-t}{\tau}} + \frac{U_1}{R_1 + R_2}$$

allgemeine Lösung

$$i_L(t) = -\frac{U_2}{R_2} \cdot e^{\frac{-t}{\tau}} + \frac{U_1}{R_1 + R_2}\left(1 - e^{\frac{-t}{\tau}}\right)$$

Beispiel

$U_1 := 37\ V$ $U_2 := 13\ V$ $R_1 := 1\ \Omega$ $R_2 := 33\ \Omega$ $L := 628\ mH$

$\tau := \frac{L}{R_1 + R_2} = 0.018\ s$ $-\frac{U_2}{R_2} = -0.394\ A$

$i_L(t) := -\frac{U_2}{R_2} \cdot e^{\frac{-t}{\tau}} + \frac{U_1}{R_1 + R_2}\left(1 - e^{\frac{-t}{\tau}}\right)$ $i_{Lp}(t) := \frac{U_1}{L} - \frac{R_1 + R_2}{L} \cdot i_L(t)$

$U_L := i_{Lp}(63\ ms) \cdot L = 1.664\ V$

$U_L(t) := \left(\frac{U_1}{L} - \frac{R_1 + R_2}{L} \cdot \left(-\frac{U_2}{R_2} \cdot e^{\frac{-t}{\tau}} + \frac{U_1}{R_1 + R_2}\left(1 - e^{\frac{-t}{\tau}}\right)\right)\right) \cdot L$

$U_L(t) := \left(\left(\frac{R_2 + R_1}{R_2}\right) \cdot U_2 + U_1\right) \cdot e^{\frac{-t}{\tau}}$ $U_L(63\ ms) = 1.664\ V$