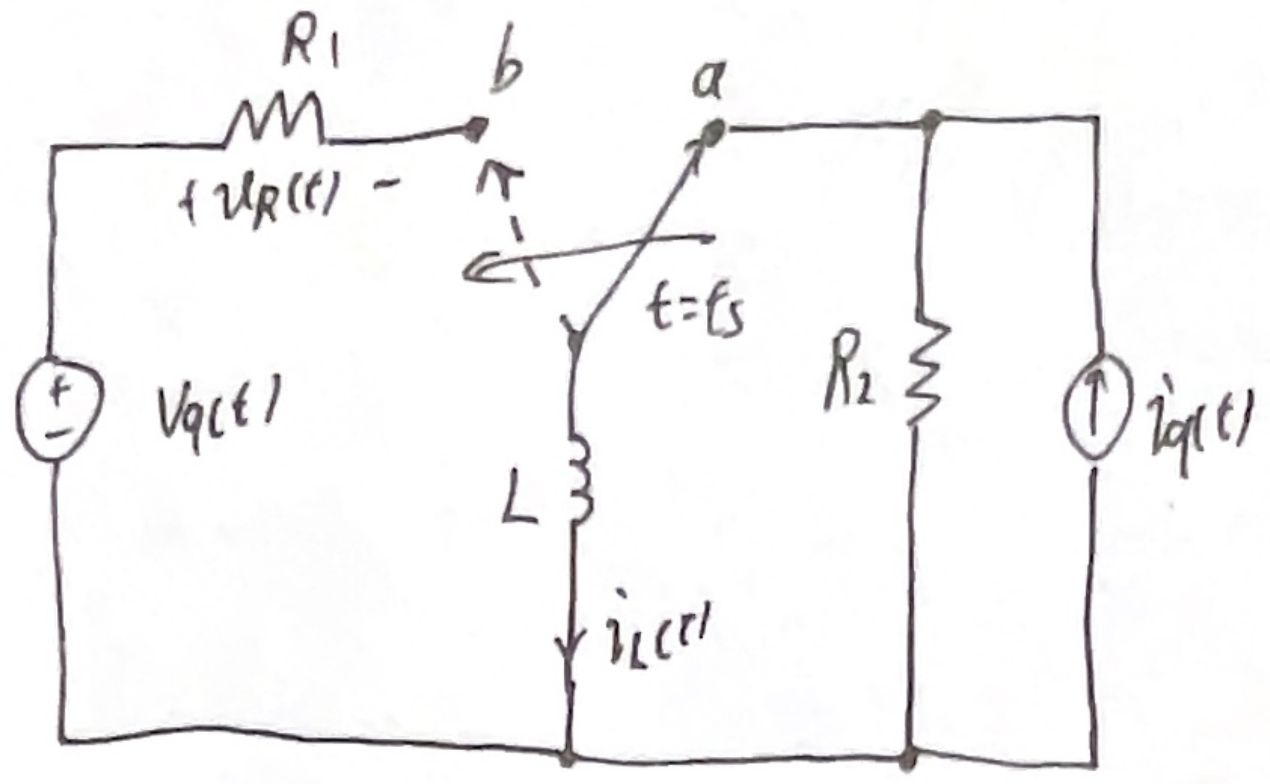
Zeitbereich



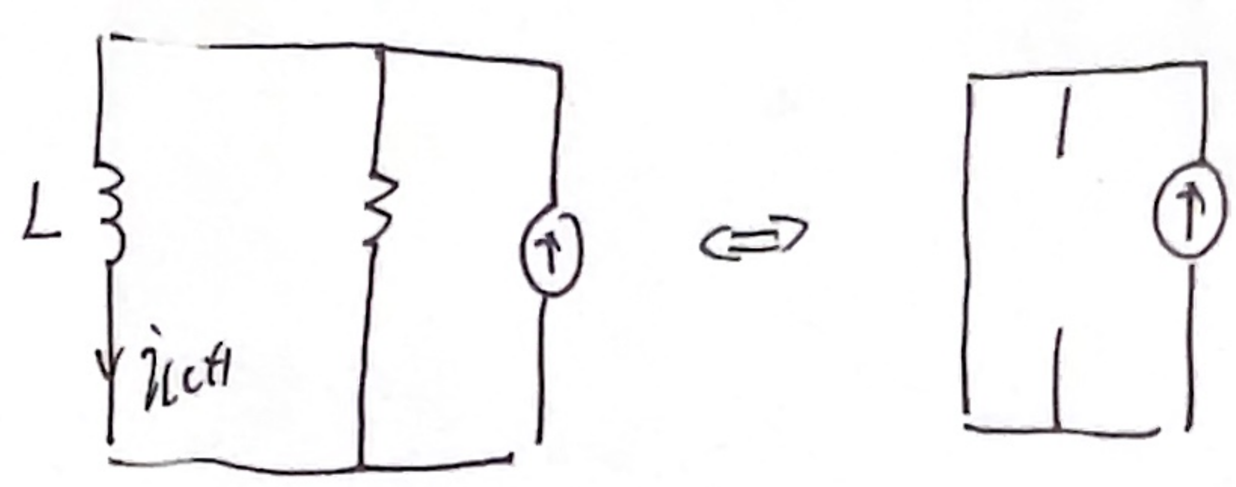
$i_q(t) = I_0$

$V_q(t) = V_0$

$t = t_s = 0$

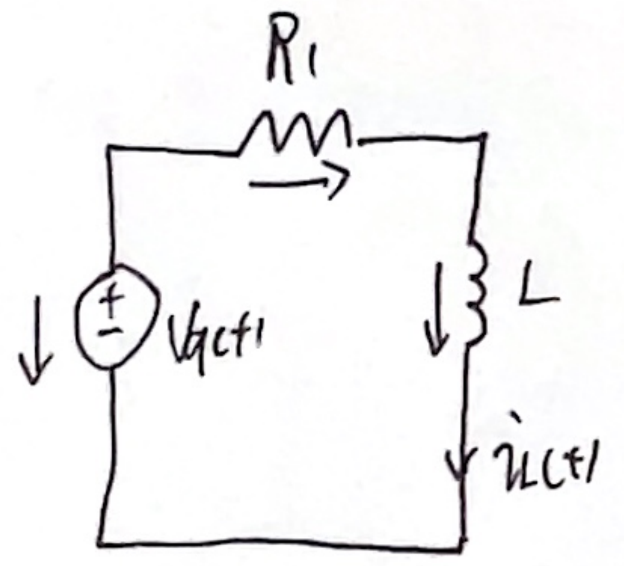
$f:\ i_L(t)$

1. $t<t_s$



$\Rightarrow\ i_L(0) = I_0$

2. $t>t_s$



$$u_L(t) = L\frac{di_L(t)}{dt}$$

$$V_q(t) = u_{R_1}(t) + u_L(t)$$

$$= i_L(t)\cdot R_1 + L\frac{di_L(t)}{dt} \qquad \text{DGL}$$

① homogen

$$i_L(t)\,R_1 + L\frac{di_L(t)}{dt} = 0$$

$$i_L(t)\,R_1 = -L\frac{di_L(t)}{dt}$$

$$\cancel{-\frac{R_1}{L}\, i_L(t)\,dt = di_L(t)}$$

$$\cancel{-\frac{R_1}{L}\int_{t=0}^{t} i_L(t')\,dt' = \int_{i_L(0)}^{i_L(t)} di_L(t')}$$

$$\cancel{-\frac{R_1}{L}}$$

$$-\frac{R_1}{L}\,dt = \frac{1}{i_L(t)}\,di_L(t)$$

$$-\frac{R_1}{L}\int_0^t dt' = \int_{i_L(0)}^{i_L(t)} \frac{1}{i_L(t')}\,di_L(t')$$

$$-\frac{R_1}{L}t = \ln\frac{i_L(t)}{i_L(0)}$$

$$e^{-\frac{R_1}{L}t} = \frac{i_L(t)}{i_L(0)}$$

$$i_L(t) = i_L(0)\,e^{-\frac{R_1}{L}t}$$

$$\Rightarrow\ i_{L,h}(t) = i_L(0)\,e^{-\frac{R_1}{L}t}$$

② inhomogen

sei $i_{L,p}(t) = K_p(t) e^{-\frac{R_1}{L}t}$

$$i_{L,p}(t) R_1 + L \frac{di_{L,p}(t)}{dt} = V_a(t)$$

$$K_p(t) e^{-\frac{R_1}{L}t} R_1 + L \frac{d}{dt}\left[K_p(t) e^{-\frac{R_1}{L}t}\right] = V_0$$

$$K_p(t) e^{-\frac{R_1}{L}t} R_1 + L e^{-\frac{R_1}{L}t} \frac{d}{dt} K_p(t) - L K_p(t) \frac{R_1}{L} e^{-\frac{R_1}{L}t} = V_0$$

$$\cancel{K_p(t) e^{-\frac{R_1}{L}t} R_1} + L e^{-\frac{R_1}{L}t} \frac{d}{dt} K_p(t) \cancel{- K_p(t) R_1 e^{-\frac{R_1}{L}t}} = V_0$$

$$L e^{-\frac{R_1}{L}t} \, dK_p(t) = V_0 \, dt$$

$$dK_p(t) = \frac{V_0}{L} e^{\frac{R_1}{L}t} dt$$

$$\int_{K_p(0)}^{K_p(t)} dK_p(t') = \frac{V_0}{L} \int_{t'=0}^{t'=t} e^{\frac{R_1}{L}t'} dt'$$

$$K_p(t) - K_p(0) = \frac{V_0}{L} \frac{L}{R_1} \left[e^{\frac{R_1}{L}t'}\right]_0^t$$

$$K_p(t) - K_p(0) = \frac{V_0}{R_1}\left[e^{\frac{R_1}{L}t} - 1\right]$$

wähle $K_p(0) = 0$, nur wenn $K_p(0) = 0$ erfüllt,

$$K_p(t) = \frac{V_0}{R_1}\left(e^{\frac{R_1}{L}t} - 1\right)$$

$$\Rightarrow i_{L,p}(t) = K_p(t) e^{-\frac{R_1}{L}t} = \frac{V_0}{R_1}\left(1 - e^{-\frac{R_1}{L}t}\right)$$

$$\Rightarrow i_L(t) = i_{L,h}(t) + i_{L,p}(t)$$

$$= i_{L(0)} e^{-\frac{R_1}{L}t} + \frac{V_0}{R_1}\left(1 - e^{-\frac{R_1}{L}t}\right)$$

$$= I_0 e^{-\frac{R_1}{L}t} + \frac{V_0}{R_1}\left(1 - e^{-\frac{R_1}{L}t}\right)$$