

Inductor

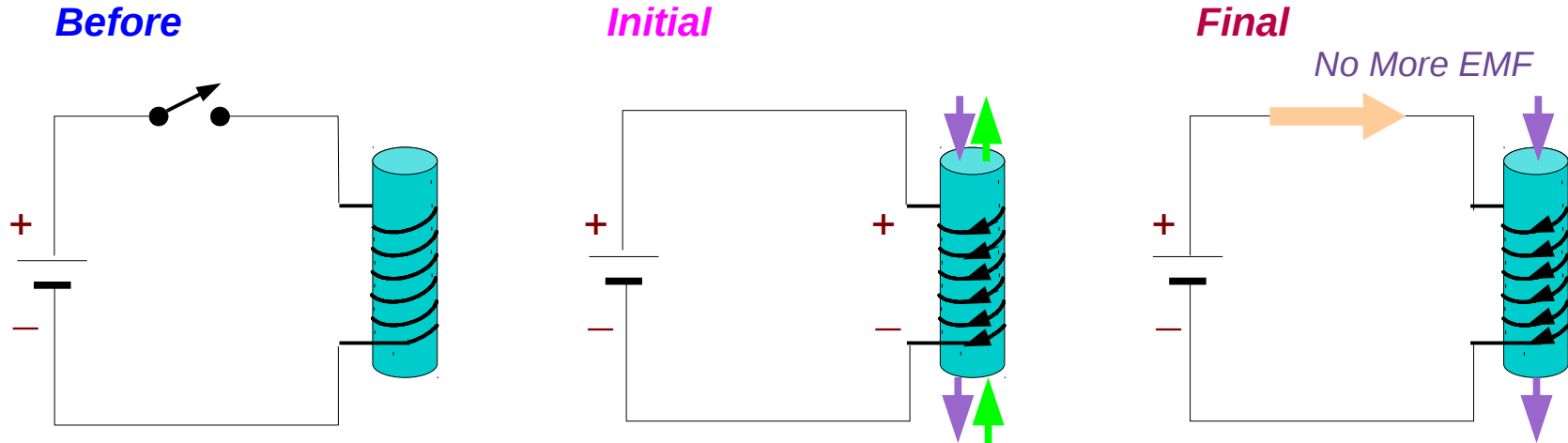
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Resisting Magnetic Field



Induced EMF

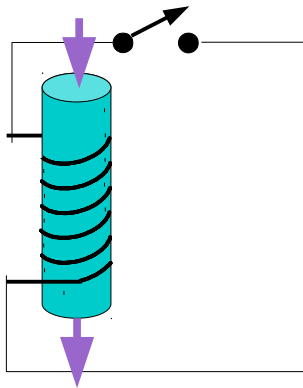
$$v_c(0^-) \neq v_c(0^+) \quad \text{voltage jump}$$
$$i_c(0^-) = i_c(0^+) \quad \text{unyielding current}$$

Energy stored in Electric Field

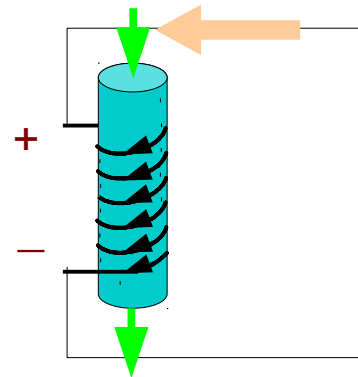
$$v_c(\infty) = 0$$
$$i_c(\infty) \neq 0$$

Maintaining Magnetic Field

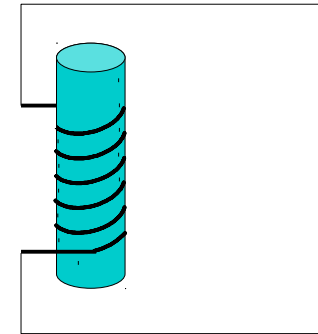
Before



Initial



Final



No Energy in magnetic field

Induced EMF

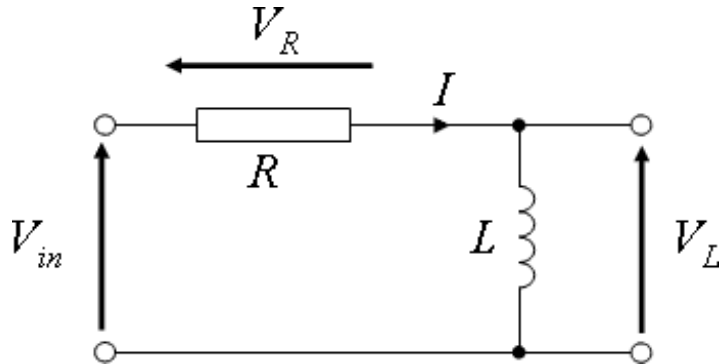
$$v_c(0^-) \neq v_c(0^+) \quad \text{voltage jump}$$

$$i_c(0^-) = i_c(0^+) \quad \text{unyielding current}$$

$$v_c(\infty) = 0$$

$$i_c(\infty) \neq 0$$

Storing Magnetic Energy

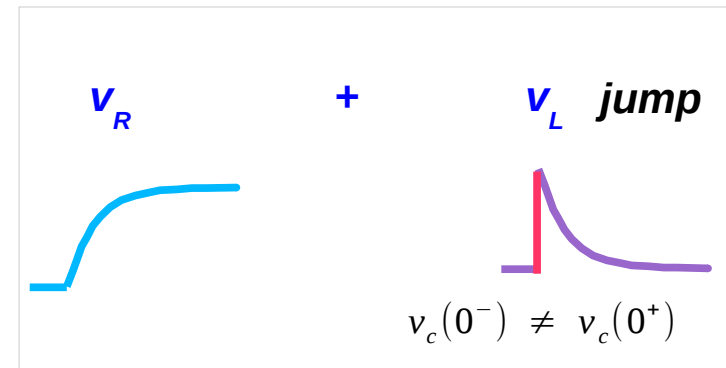
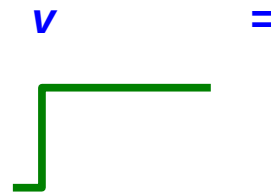


$$v_L = L \cdot \frac{di_L}{dt}$$

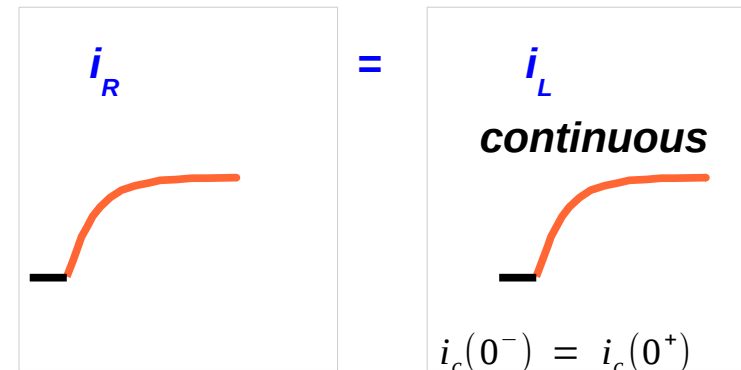
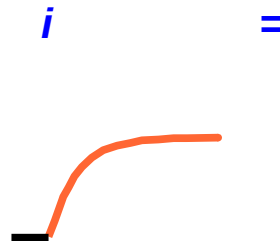
unyielding current

voltage jump

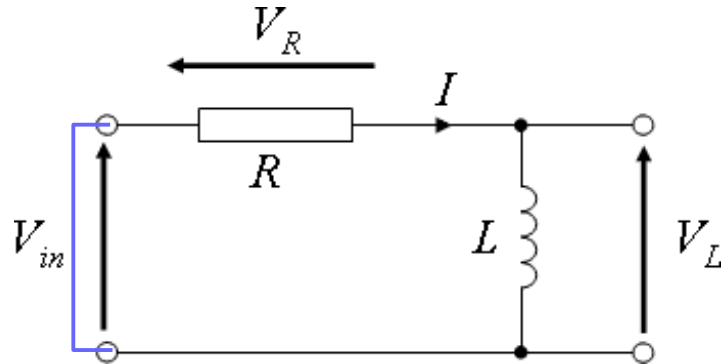
the inductor voltage changes abruptly by the applied step input voltage and then slowly becomes zero



the inductor current slowly follows the shape of the applied step input voltage



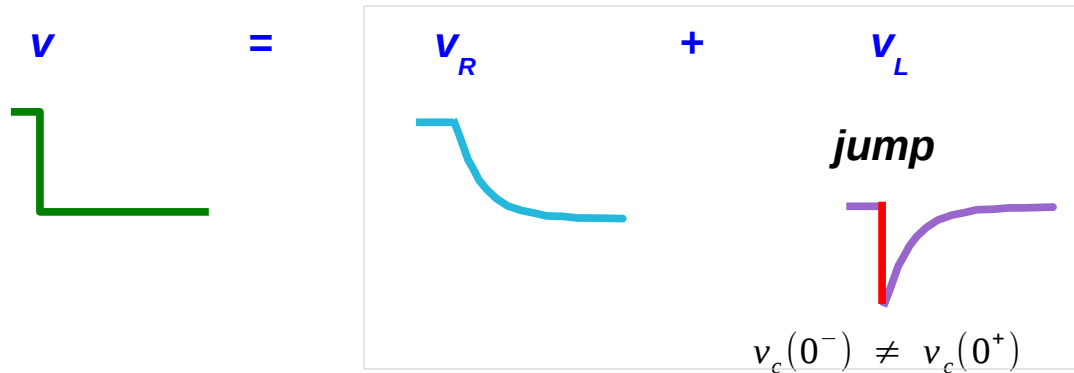
Dissipate Magnetic Energy



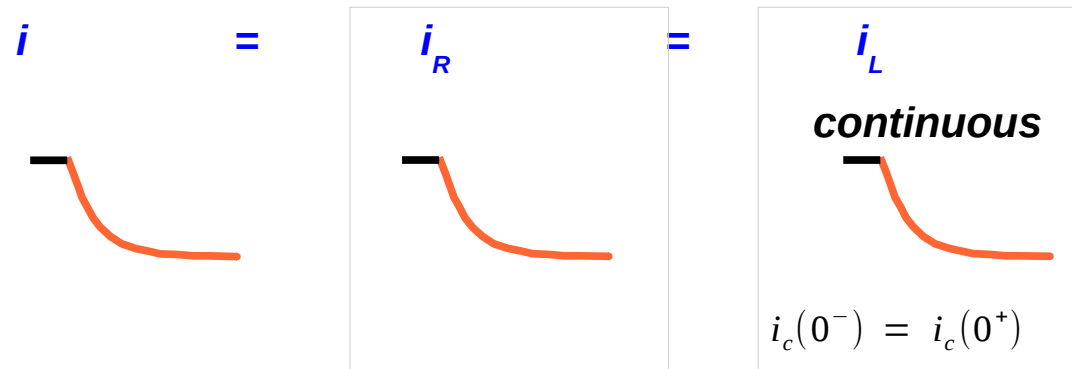
$$v_L = L \cdot \frac{di_L}{dt}$$

unyielding current
voltage jump

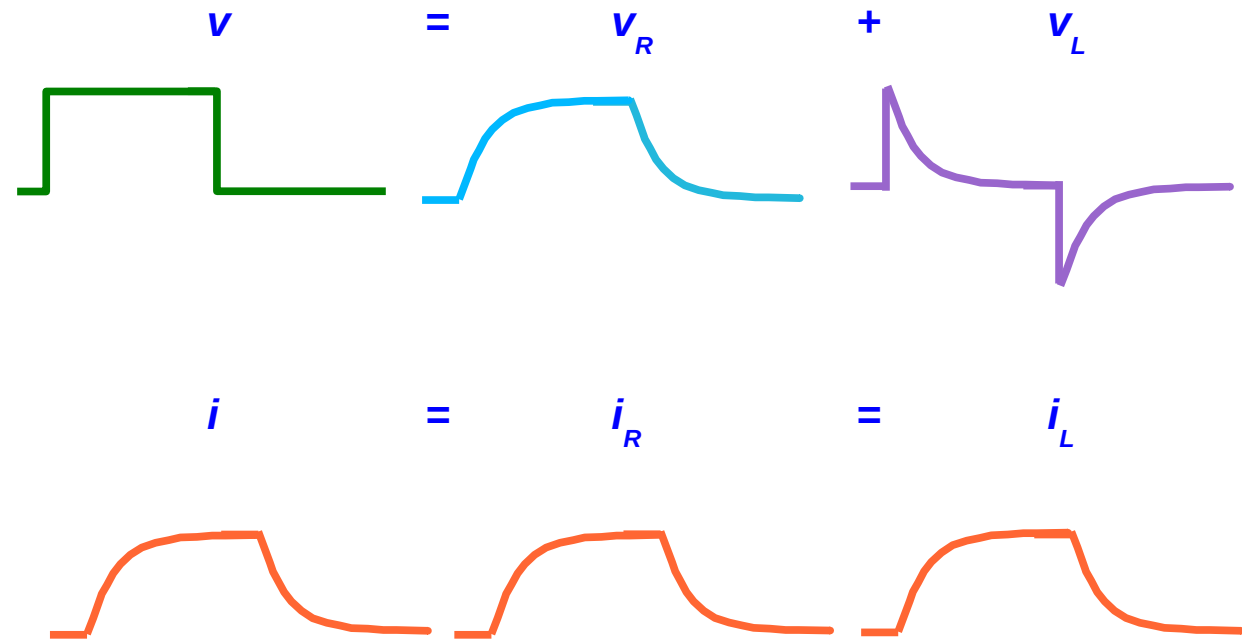
the inductor voltage changes abruptly by the applied step input voltage and then slowly becomes zero



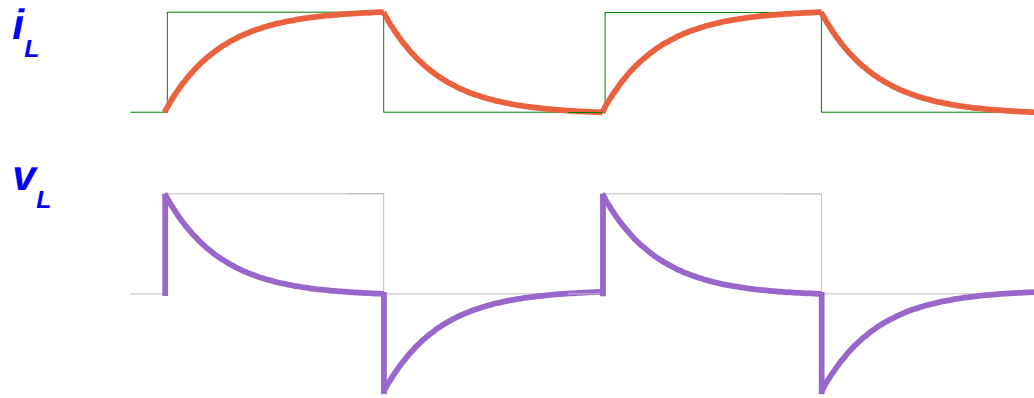
the inductor current slowly follows the shape of the applied step input voltage



Pulse

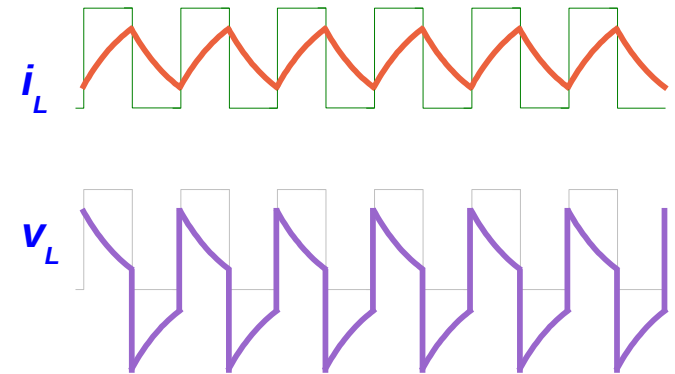
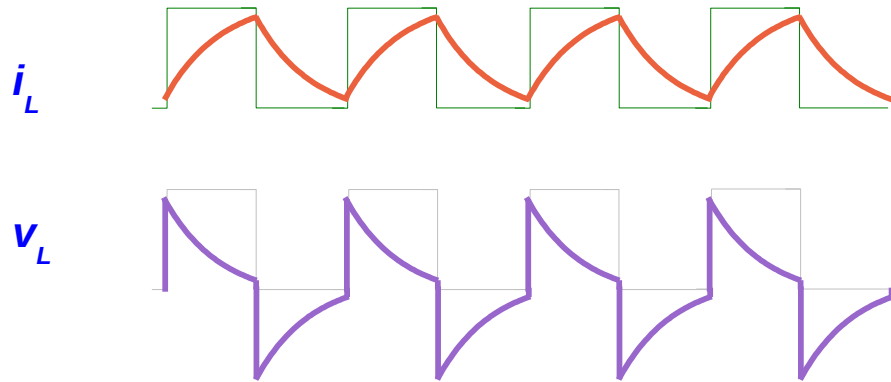


Pulse



$$v_L = L \frac{di_L}{dt}$$

ω ↑ v_L ↓ X_L ↑



Phasor

Sinusoid (Sine Waves)

$$A \cos(\omega t + \theta)$$

$$\left\{ \begin{array}{ll} \text{Amplitude} & A \\ \text{Angular Frequency} & \omega \\ \text{Angular Frequency} & \theta \end{array} \right.$$

1. Representation using Euler's Formula

$$A \cos(\omega t + \theta) = \frac{A}{2} \cdot e^{+i(\omega t + \theta)} + \frac{A}{2} \cdot e^{-i(\omega t + \theta)}$$

2. Representation using Real Part

$$A \cos(\omega t + \theta) = \operatorname{Re}\{A e^{i(\omega t + \theta)}\} = \operatorname{Re}\{A e^{i\theta} \cdot e^{i\omega t}\}$$

$$\rightarrow A e^{i\theta} \cdot e^{i\omega t}$$

$$\rightarrow A e^{i\theta}$$

$$\rightarrow A \angle \theta$$

Phase Lags and Leads

$$\frac{d}{dx} f(x) = \cos(x) \quad \text{leads} \quad f(x) = \sin(x)$$

$$\frac{d}{dx} f(x) = -\sin(x) \quad \text{leads} \quad f(x) = \cos(x)$$

$$\int f(x) dx = -\cos(x) + C \quad \text{lags} \quad f(x) = \sin(x)$$

$$\int f(x) dx = \sin(x) + C \quad \text{lags} \quad f(x) = \cos(x)$$

$$\frac{d}{dx} f(x) \quad \text{leads} \quad f(x) \quad \text{by} \quad \frac{\pi}{2}$$

$$\int f(x) dx \quad \text{lags} \quad f(x) \quad \text{by} \quad \frac{\pi}{2}$$

I lags V by 90°

Initial charge



OPEN

I = 0

V : peak

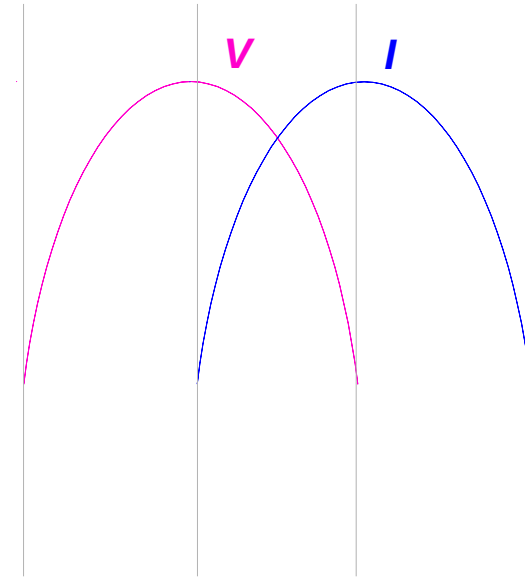
Full charge



SHORT

V = 0

I = Peak



References

[1] <http://en.wikipedia.org/>

[2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003