Inductor

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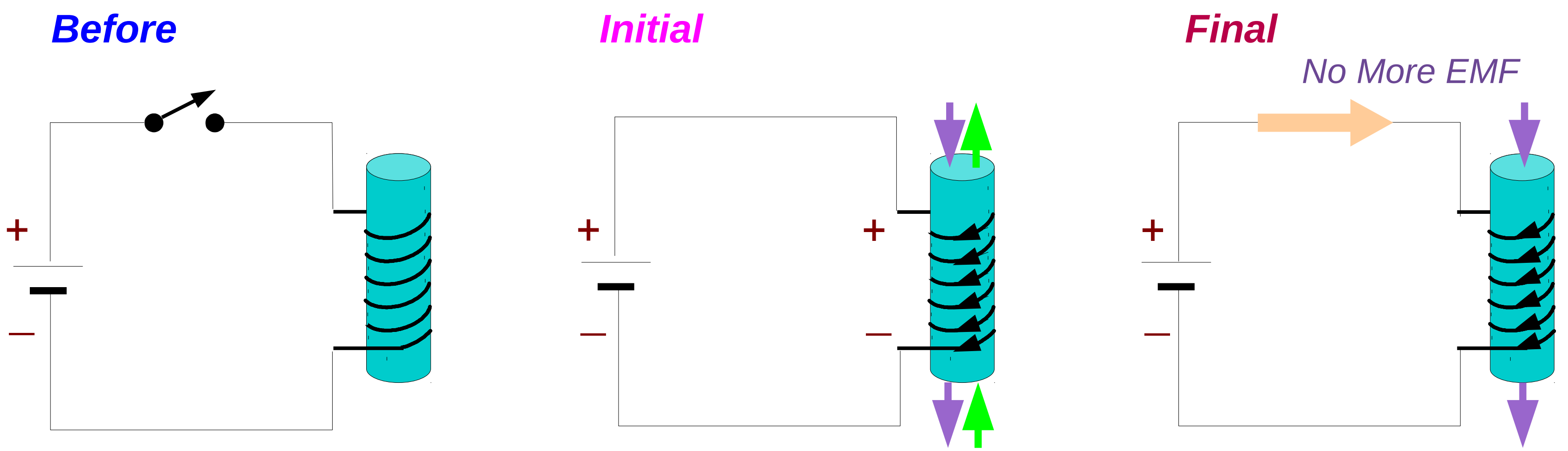
Resisting Magnetic Field



Induced EMF

Energy stored in Electric Field

$$v_c(0^-) \neq v_c(0^+)$$ *voltage jump*

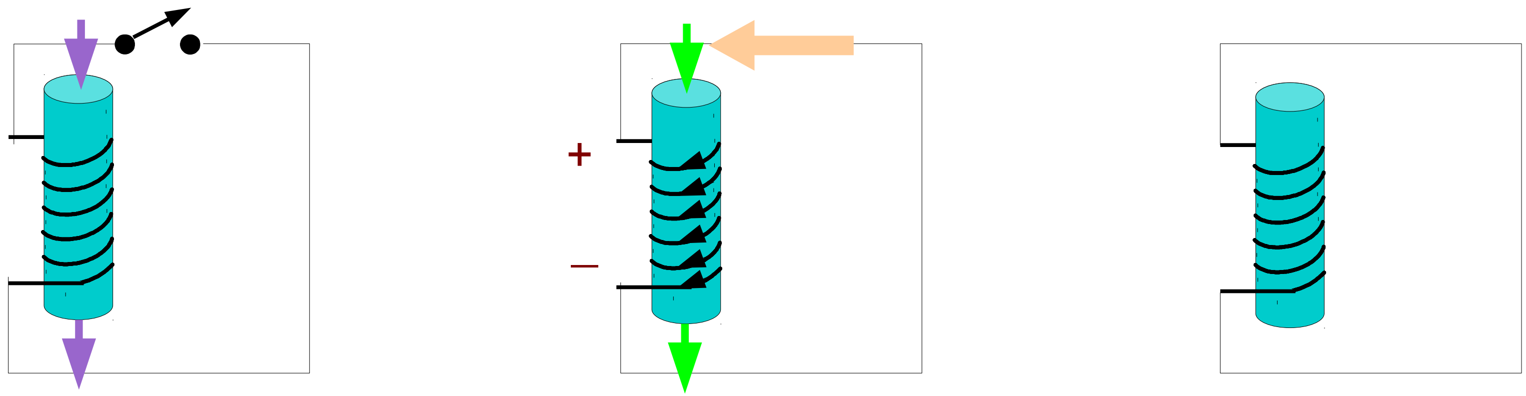
$$i_c(0^-) = i_c(0^+)$$ *unyielding current*

$$v_c(\infty) = 0$$

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

Maintaining Magnetic Field

Before **Initial** **Final**



No Energy in magnetic field

Induced EMF

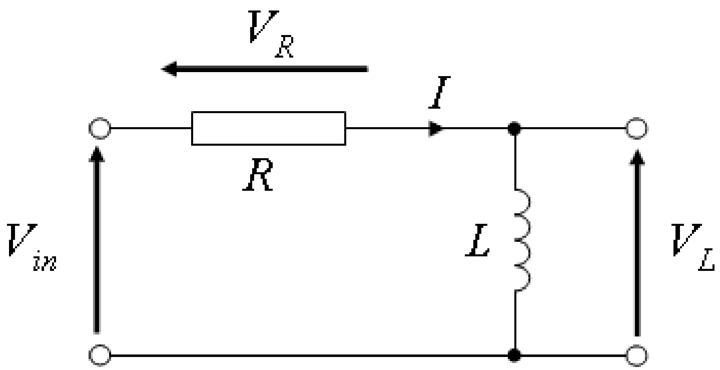
$$v_c(0^-) \neq v_c(0^+)$$ *voltage jump*

$$i_c(0^-) = i_c(0^+)$$ *unyielding current*

$$v_c(\infty) = 0$$

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

Storing Magnetic Energy



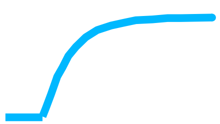
$$v_L = L \cdot \frac{d i_L}{d t}$$

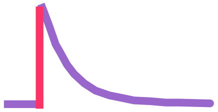
unyielding current

voltage jump

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

v = **v_R** + **v_L** ***jump***



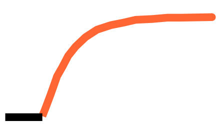


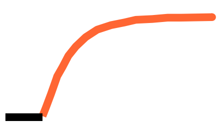
$$v_c(0^-) \neq v_c(0^+)$$

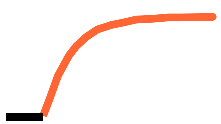
the inductor current slowly follows the shape of the applied step input voltage

i = **i_R** = **i_L**

continuous

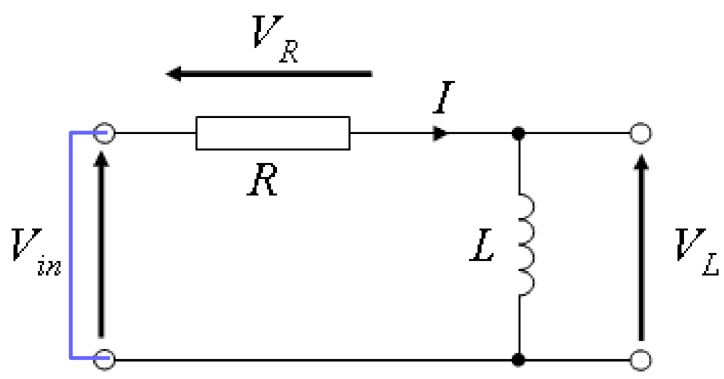






$$i_c(0^-) = i_c(0^+)$$

Dissipate Magnetic Energy



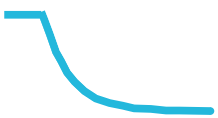
$$v_L = L \cdot \frac{d\, i_L}{d\, t}$$

unyielding current

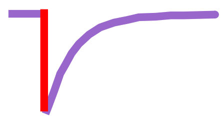
voltage jump

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

v **=** ***v**$_R$* **+** ***v**$_L$*



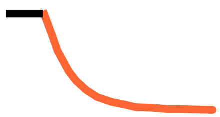
jump

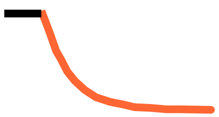


$v_c(0^-) \neq v_c(0^+)$

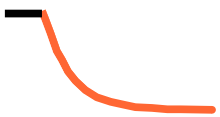
the inductor current slowly follows the shape of the applied step input voltage

i **=** ***i**$_R$* **=** ***i**$_L$*



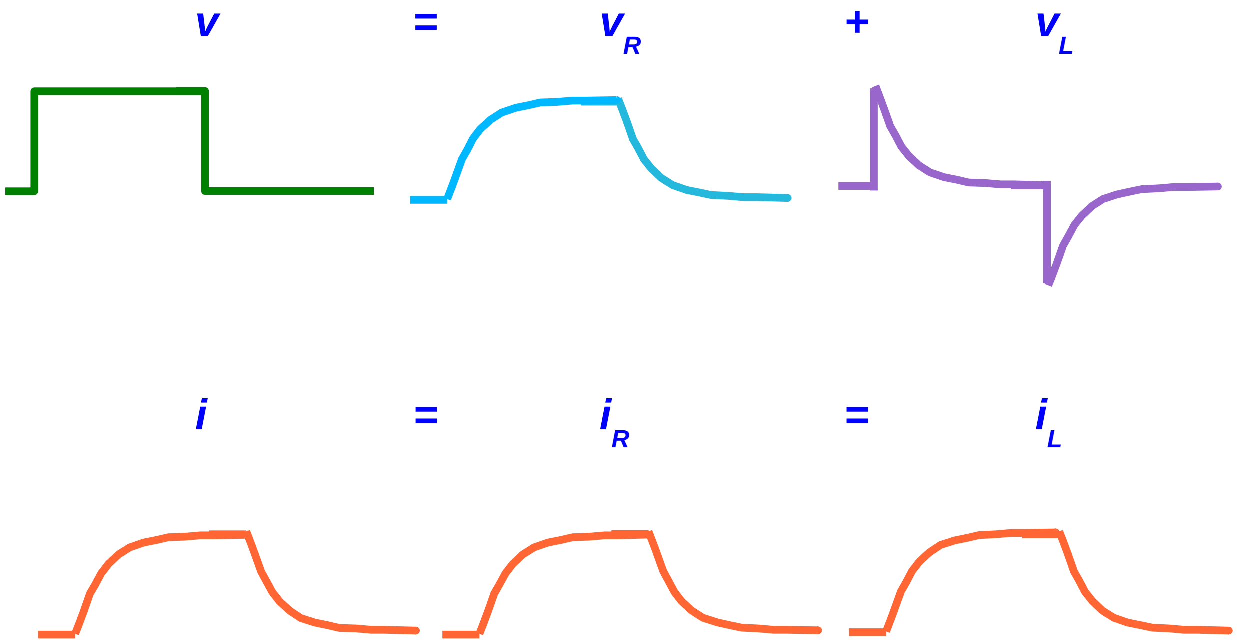


continuous

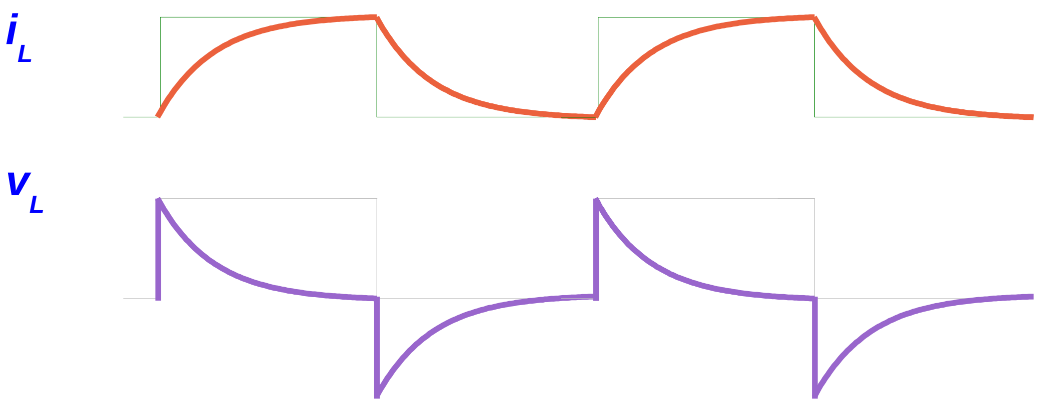


$i_c(0^-) = i_c(0^+)$

Pulse

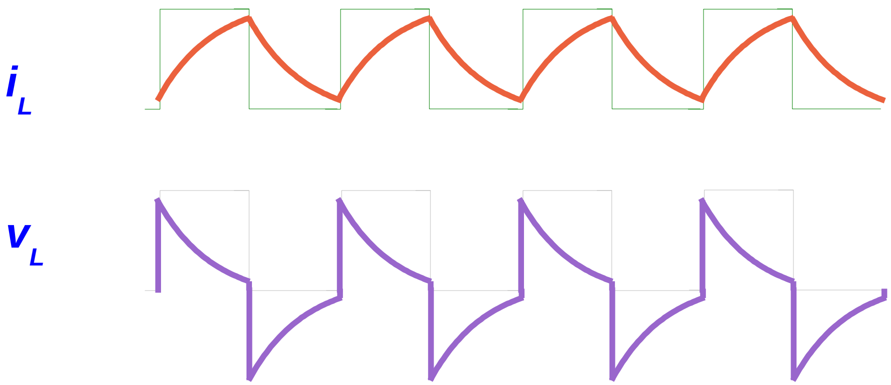


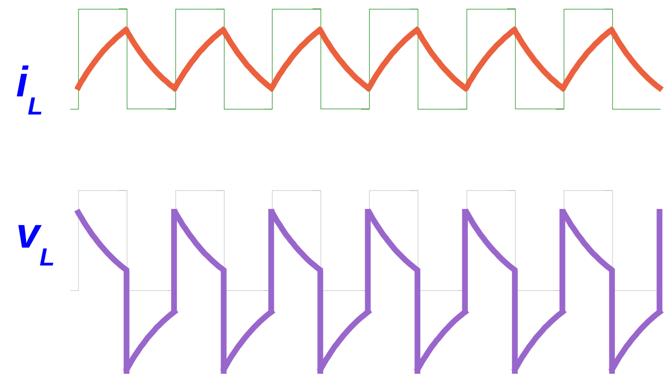
Pulse



$$v_L = L \frac{d\, i_L}{d\, t}$$

ω ↑ v_L ↓ X_L ↑





Phasor

Sinusoid (Sine Waves)

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

- *Amplitude* A
- *Angular Frequency* ω
- *Angular Frequency* θ

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

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

➡ $Ae^{i\theta}\cdot e^{i\omega t}$

➡ $Ae^{i\theta}$

➡ $A\measuredangle\theta$

Phase Lags and Leads

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

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

$$\int f(x)\,dx = -\cos(x) + C$$ **lags** $$f(x) = \sin(x)$$

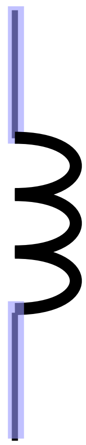
$$\int f(x)\,dx = \sin(x) + C$$ **lags** $$f(x) = \cos(x)$$

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

$$\int f(x)\,dx$$ **lags** $f(x)$ **by** $\frac{\pi}{2}$

I lags V by 90°

Initial charge

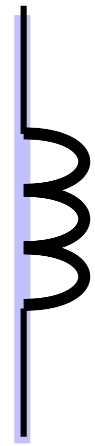


OPEN

I = 0

V : peak

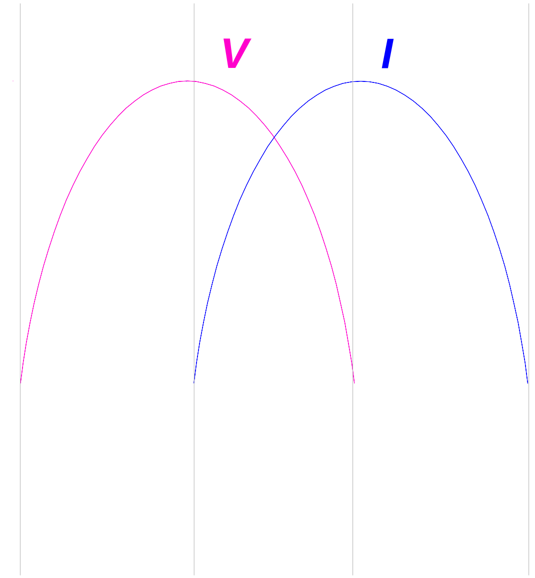
Full charge



SHORT

V = 0

I = Peak



References

[1] http://en.wikipedia.org/
[2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003