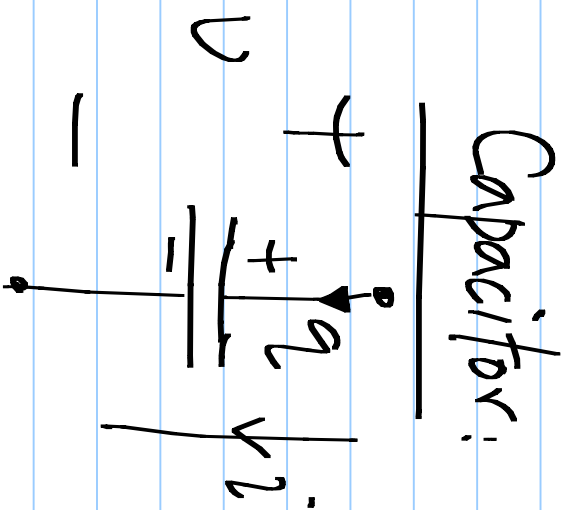
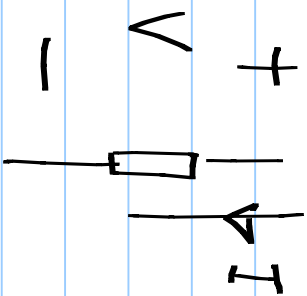


# Lecture 3

## Two terminal elements



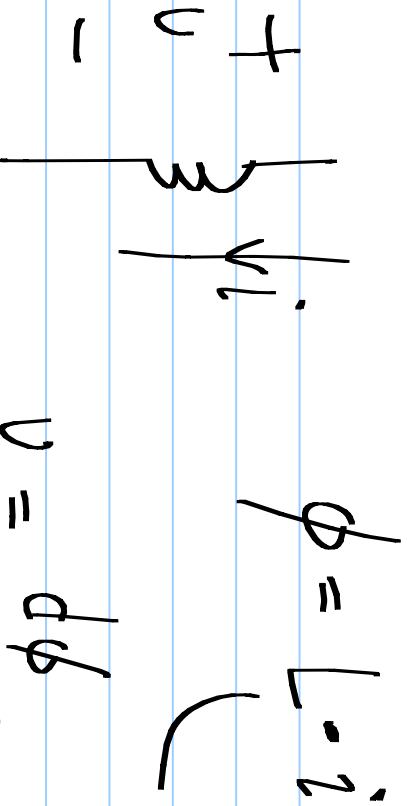
Stores charge

$$q = C \cdot V$$

$$i = \frac{dq}{dt} = C \cdot \frac{dV}{dt}$$

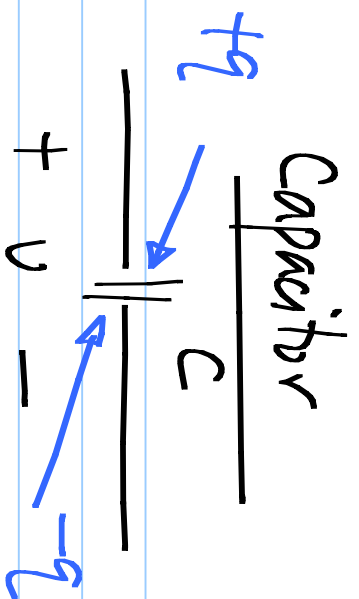
$$V = \frac{1}{C} \int i dt$$

Inductor



Inductance

$$V = \frac{d\phi}{dt}$$



\* Stores charge  $q = C \cdot V$

\*  $i = \frac{dq}{dt} = C \cdot \frac{dV}{dt}$

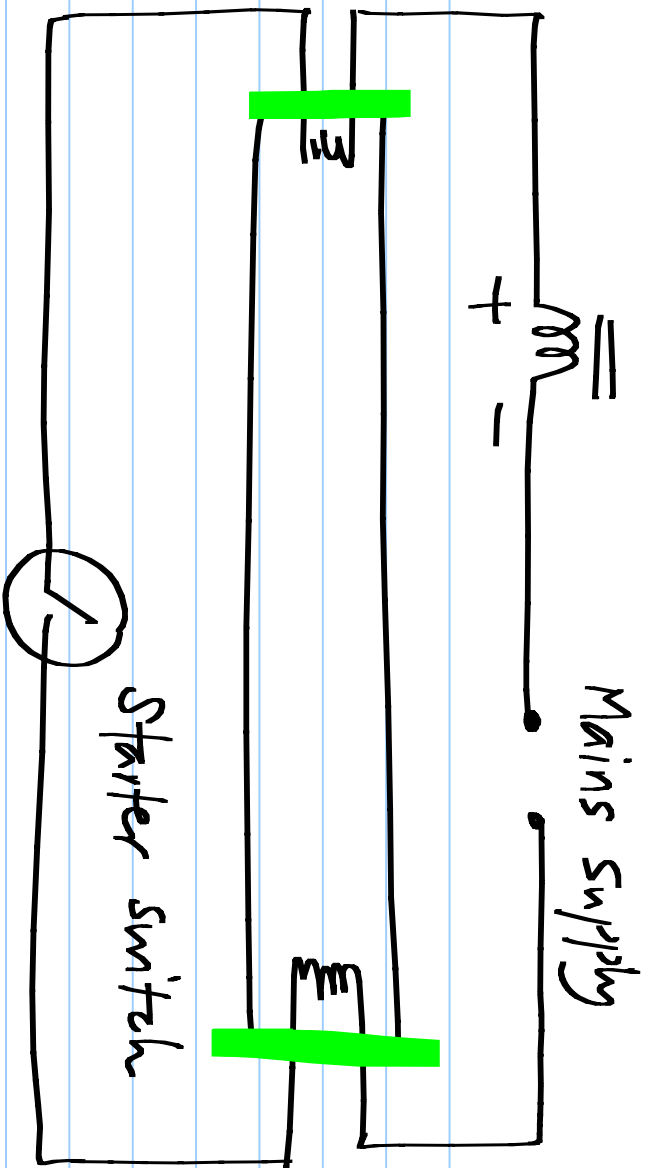
\* Resists change in voltage



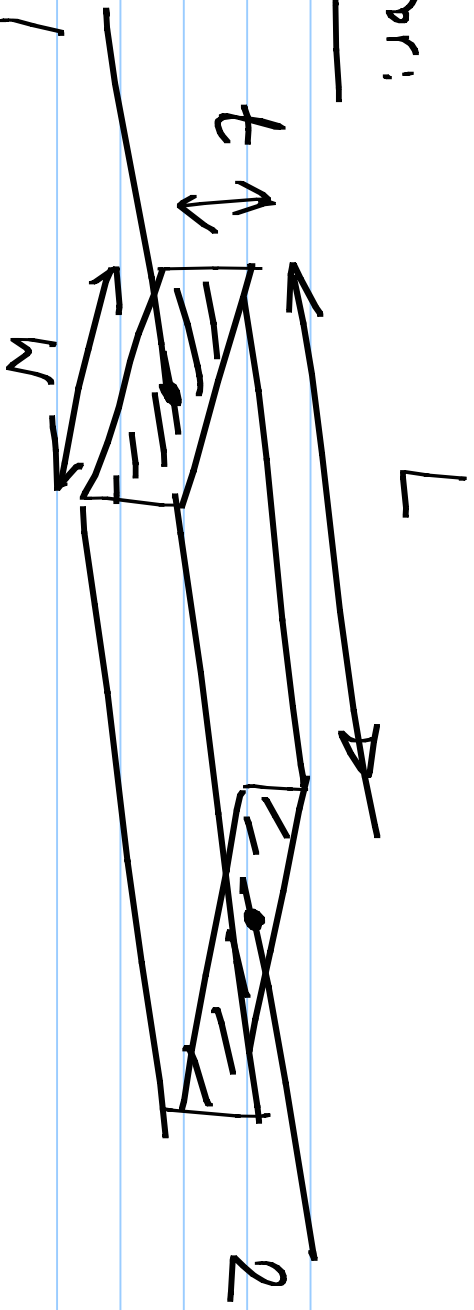
\* Stores flux  $\psi = L \cdot i$

\*  $V = \frac{d\psi}{dt} = L \cdot \frac{di}{dt}$

\* Resists change in current



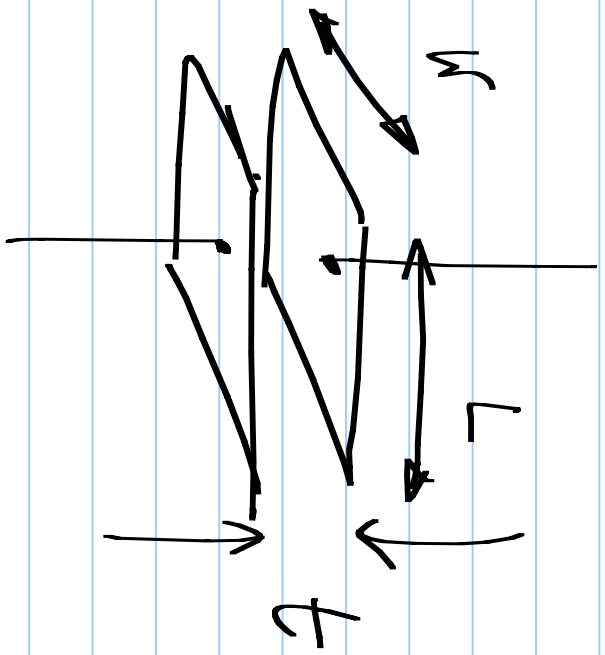
Resistor:



$$R_{12} = \rho \cdot \frac{L}{Wt}$$

Capacitor:

$$C_{12} = \epsilon \cdot \frac{WL}{t}$$



Resistance:  $\Omega$  (ohms)

ohms — Megohms

$10^6 \Omega$

Capacitance: F (Farad)

$\mu F$  — pF

$10^{-6}$  —  $10^{-12}$

Inductance: H (Henry)

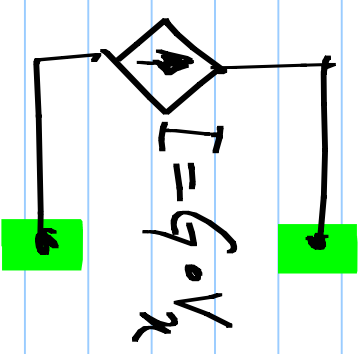
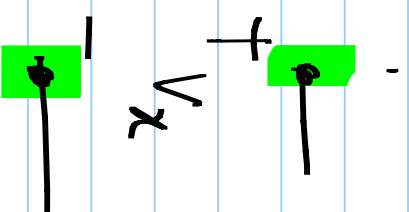
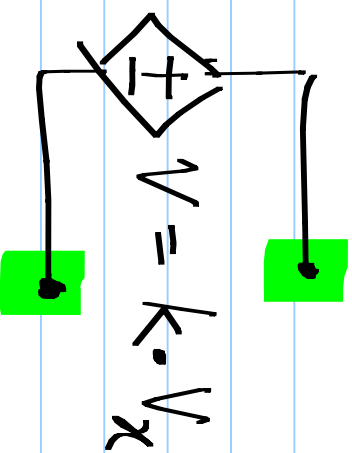
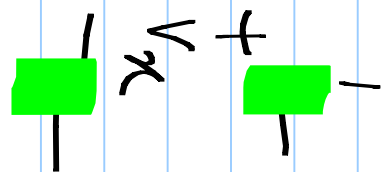
mH — nH

$10^{-3}$  —  $10^{-9}$

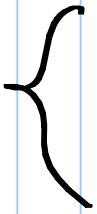
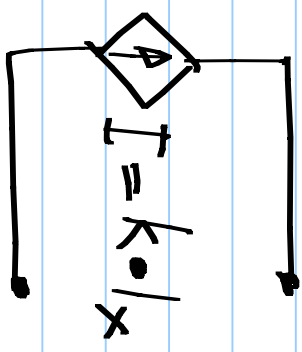
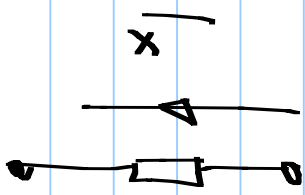
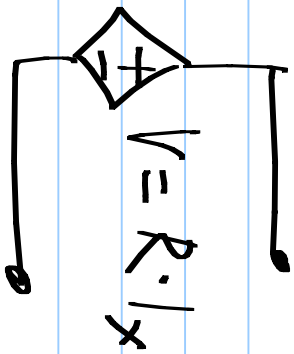
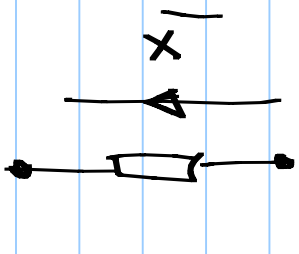
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# Controlled sources

Voltage controlled voltage source / Current source



Current controlled voltage source / current source



Some

branch

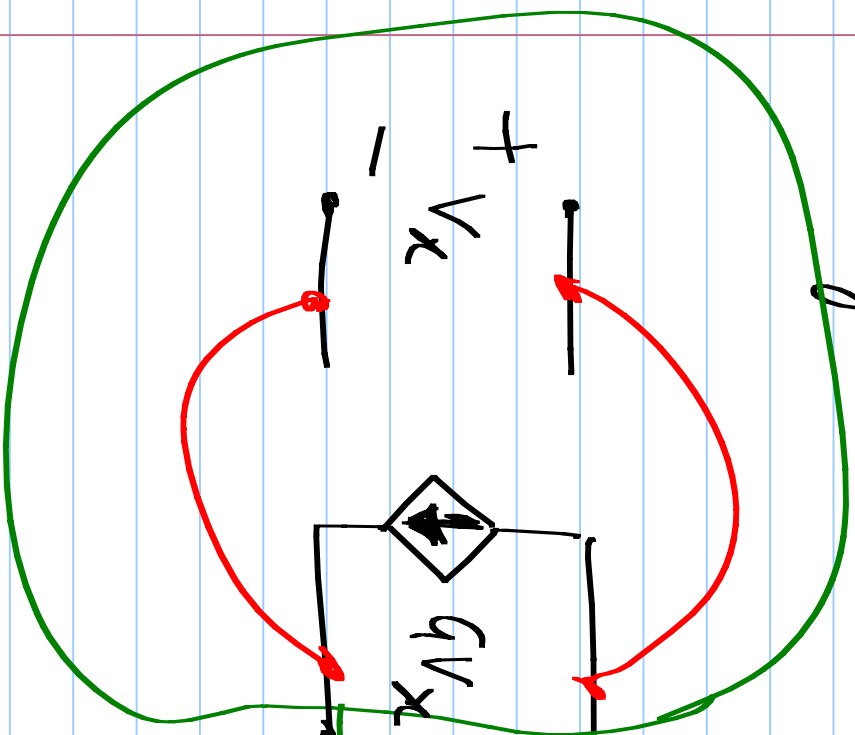


Some

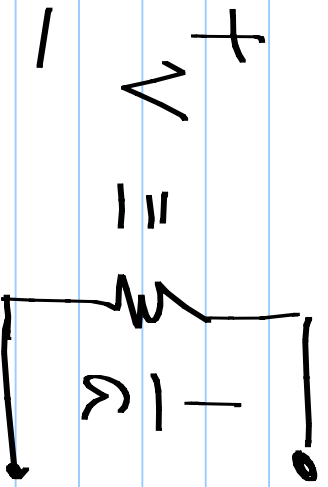
branch



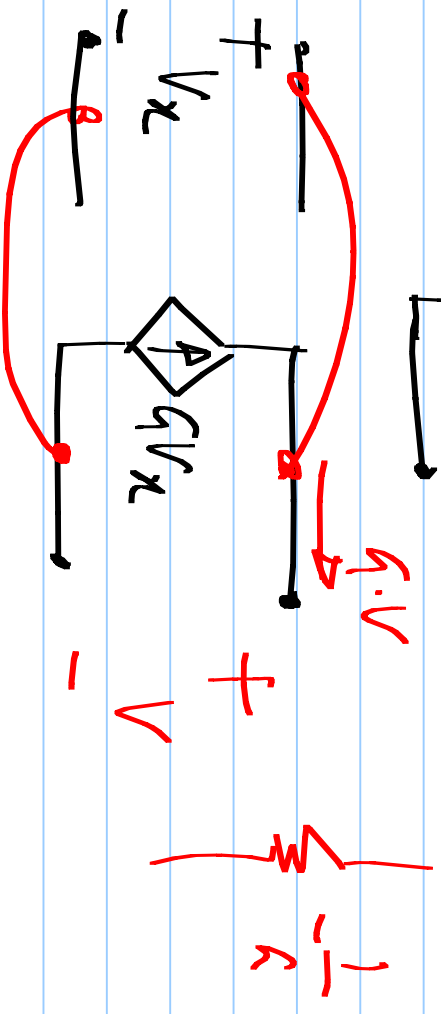
# Voltage controlled current source (VCCS)



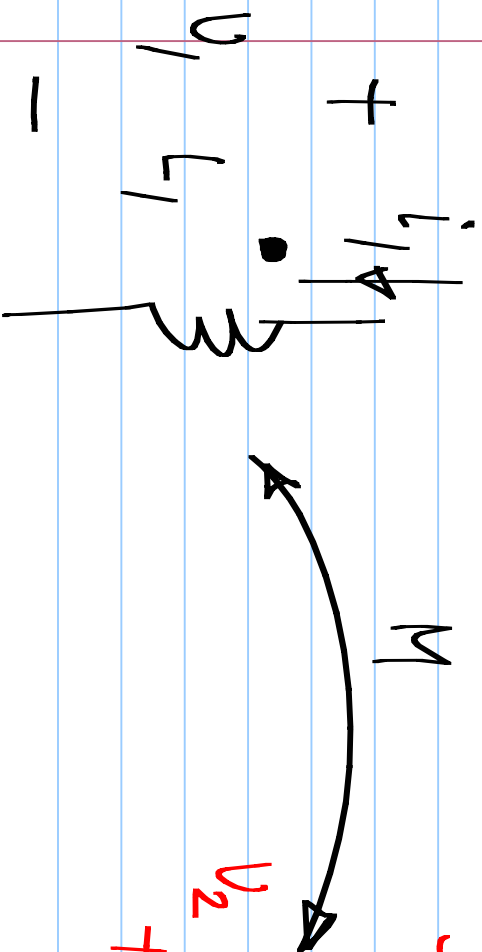
$$I = g \cdot V$$



VCCS  
CCCS  
CCVS

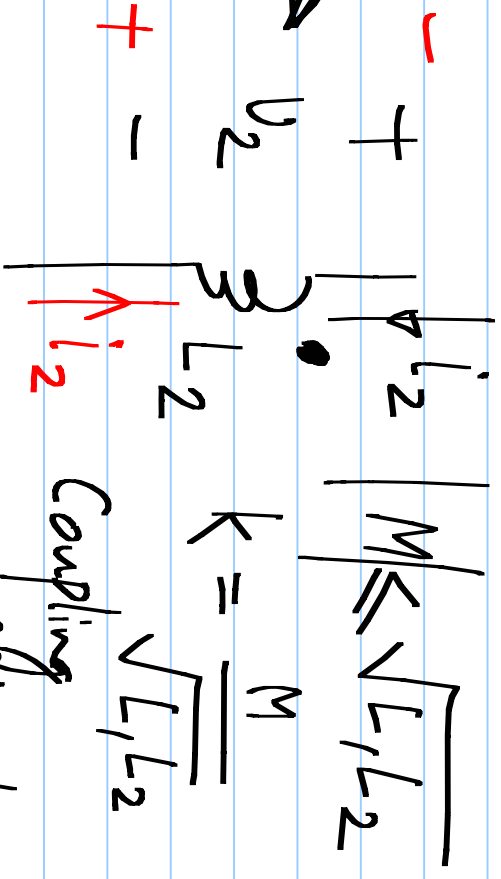


Mutual inductor:



$$V_1 = L_1 \frac{di_1}{dt} + M \frac{di_2}{dt}$$

M: Mutual inductance



$$k = \frac{M}{\sqrt{L_1 L_2}}$$

Coupling coefficient

$$V_2 = M \frac{di_1}{dt} + L_2 \frac{di_2}{dt}$$