EE 580 - Lecture 8 Monday Mar 27, 2000

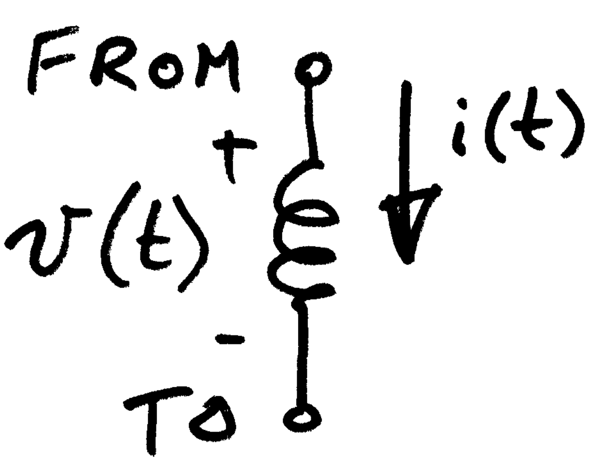
Topics for Today:

- Term Projects - What to do Next.
- Capacitor Banks - Operating Problems
- More on Capacitor Banks - Configurations
- More on Current Limiting Reactor Sizing ←
- Internal workings of ATP - Rs, Ls, Cs, T-lines

(CH. 12)

ATP Simulation Pointer for the day:

Polarity of branch voltage and current waveforms in PL4 files depends on the connection of the related element in ciruict. Look at the "From" node and the "To" node. If you need to reverse the polarity, then go back to the circuit, rotate the element 180 degrees, and re-run the simulation.



EE 582 - Term Projects, Spring 2000

Cho - Lighting Surge Study for Substation Design

LaFrance/Fischer - Modeling of Generator and controls for Out-of-Step Stability concerns.

Myers - a) Breaker Bounce problems during transformer energization, or b) Load Tap Changer contact transients.

Nickels - Modeling Transformer Coil for Insulation Stresses during Lightning Impulse

Parkinson - Development & Implementation of Transformer Model in ATP.

Runowski - UPFC Modeling in ATP (or maybe MatLab).

Wang - Transmission Line Energization Transients (overvoltage, insulation stresses, surge arrester concerns?).

Zou - Comparison of ATP/ATPDraw with MatLab/Simulink/Power Toolbox.

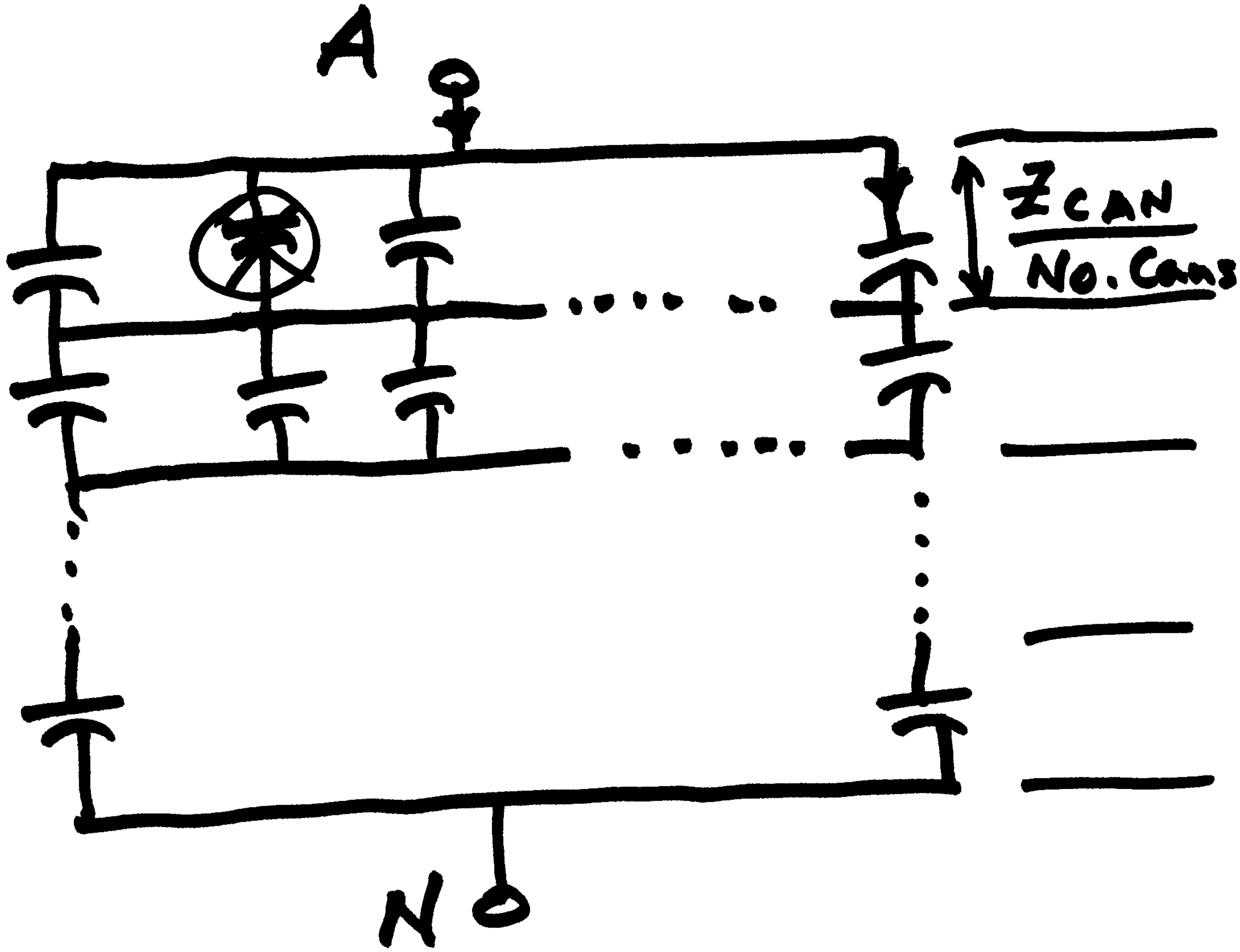
Projects –

April 5th – Detailed Outline w/references.

- Project Org.
- What's to be done
- Deliverables
- Reference List.

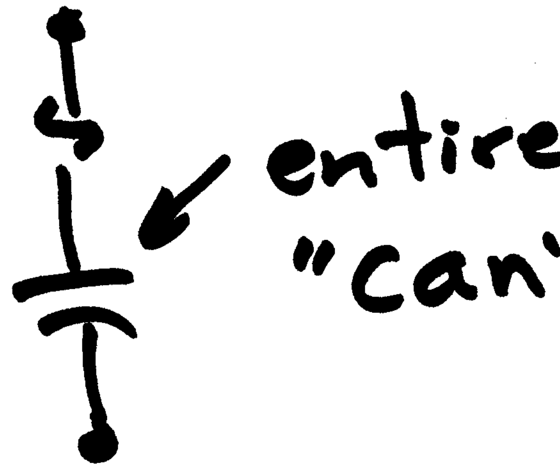
CAP BANK CONFIGURATIONS.

- Typically in WYE.

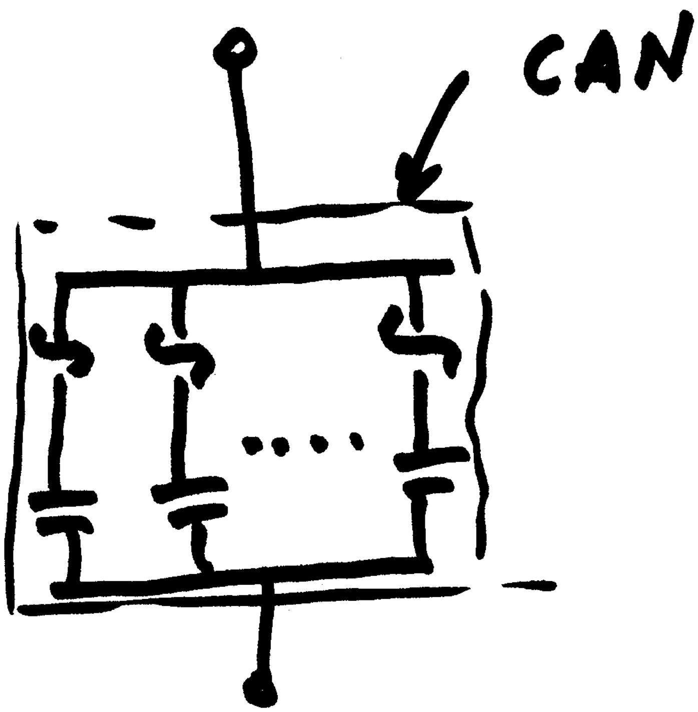


Fusing - External
Internal
Fuseless

External



Internal



Fuseless

Look at series section that loses one of its parallel cans.

Gets Larger $\left(Z_{SECTION} = \dfrac{Z_{CAN}}{(\text{No. Cans} - 1)} \right.$

Othess –

stay same $\left(Z_{SECTION} = \dfrac{Z_{CAN}}{(\text{No. Cans})} \right.$

∴ Section that loses can is exposed to overvoltage.

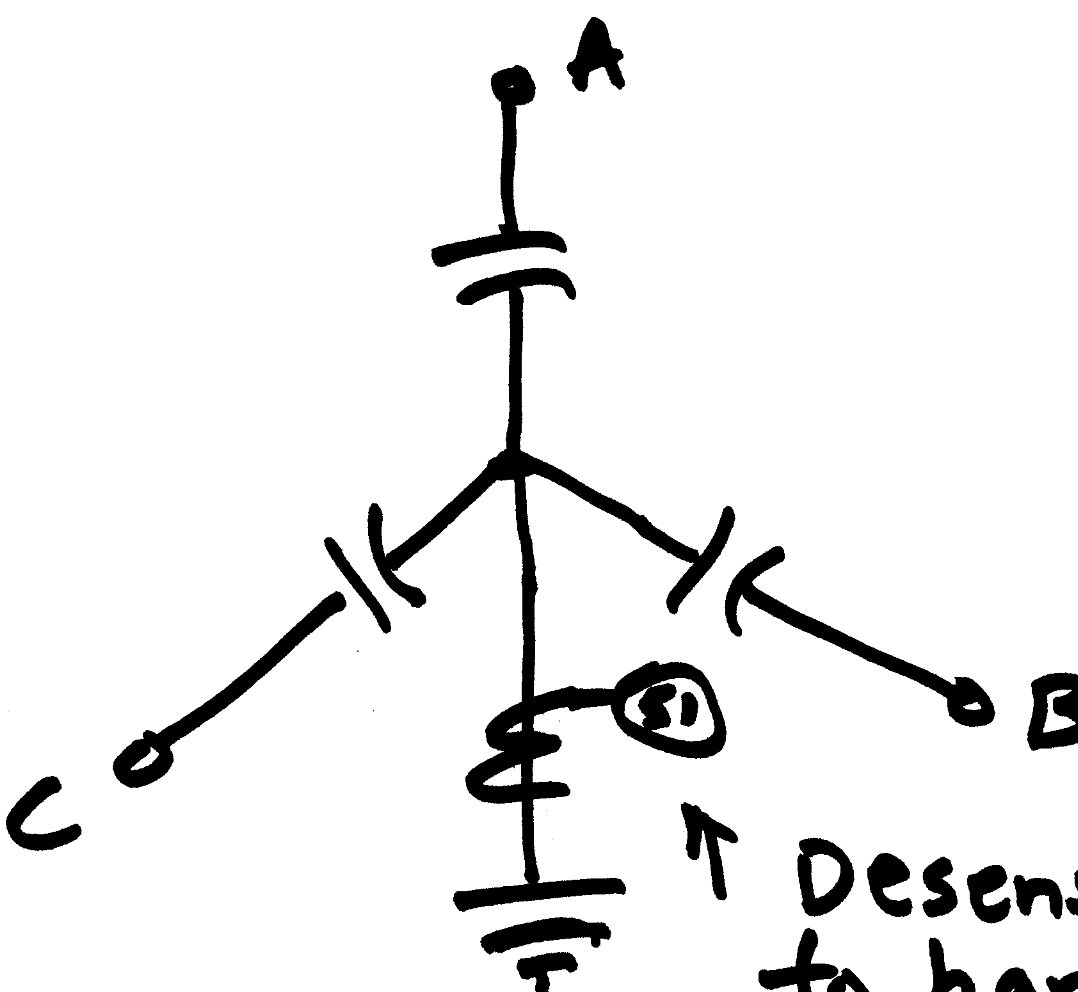
A <u>cascaded</u> <u>failure</u>:

when add'l cans fail after first one (dominos).

Typical - Limit overvoltage to ≤ 10%.

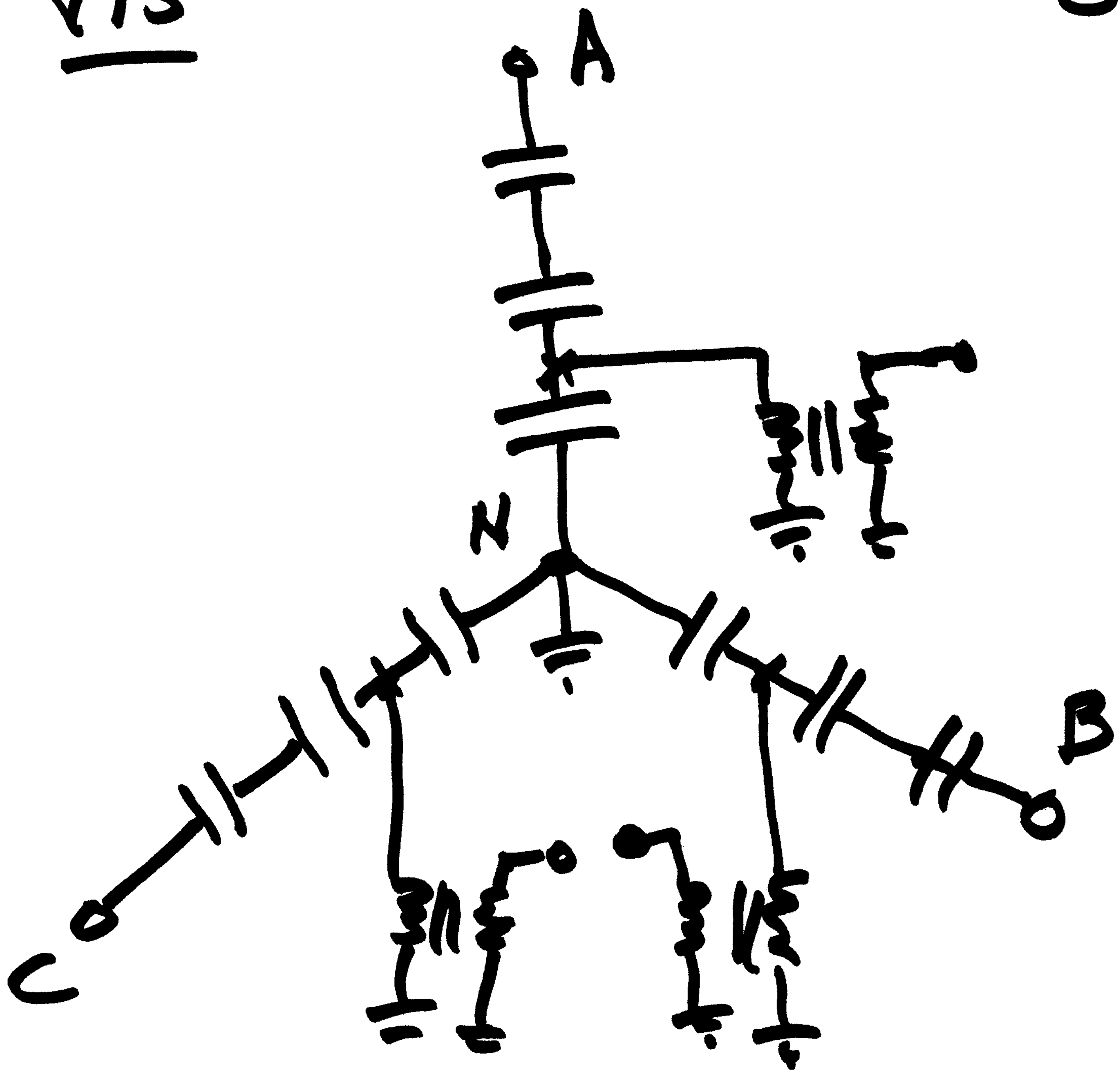
If system is at 1.05 p.u., not much room for increase

Monitoring & Protection -

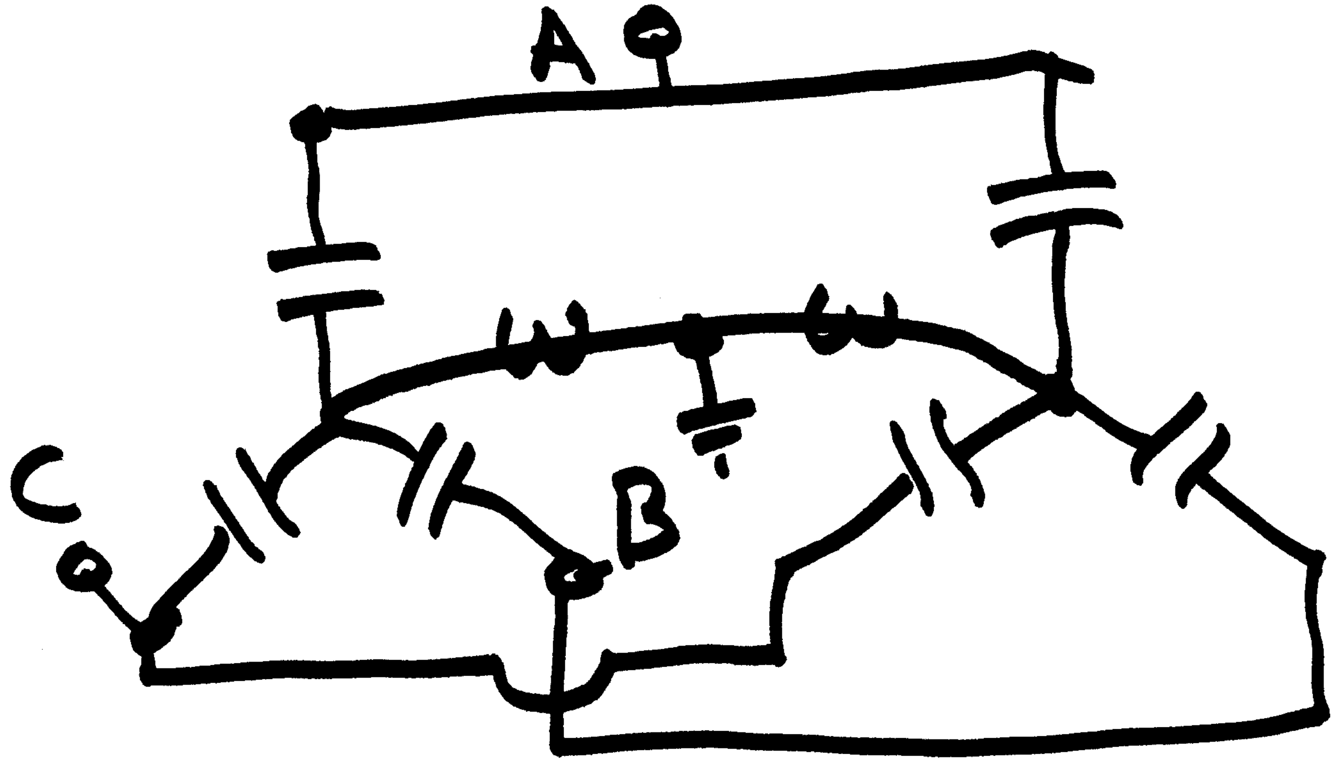


↑ Desensitize to harmonics (60-Hz Only)

VTs



Monitor Voltage balance between the 3 VT secondaries.



Other configs also possible.

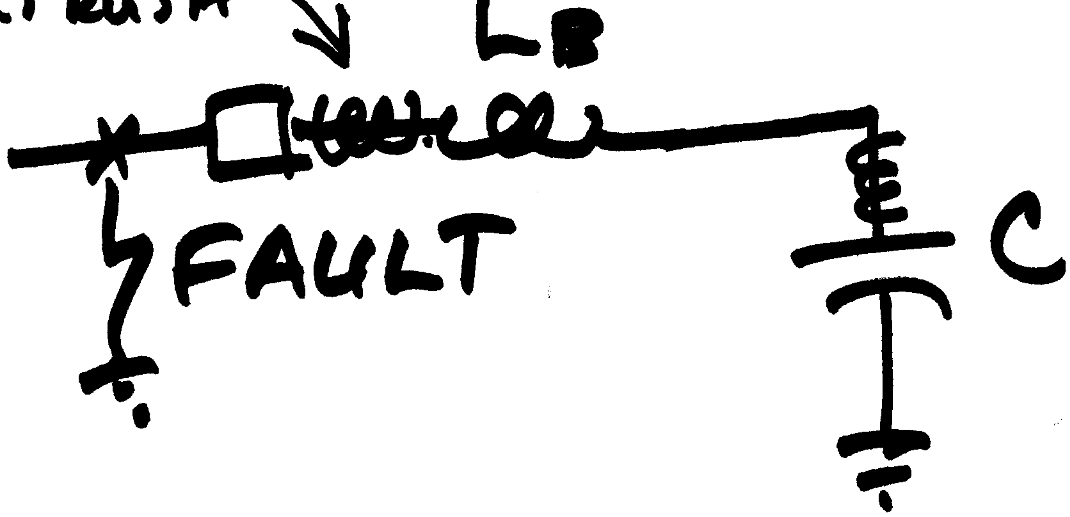
Inrush & outrush current limiting calcs.

$$I_p \times f_0 \leq 2\times 10^7$$

$$I_p = \frac{V_p}{\sqrt{\frac{L}{C}}} \qquad f_0 = \frac{1}{2\pi\sqrt{LC}}$$

ADD

LOUTRUSH ?



$$\frac{V_p}{\sqrt{\frac{L}{C}}} \times \frac{1}{2\pi\sqrt{LC}} \leq 2\times 10^7$$

$$\boxed{\frac{V_p}{2\pi L} \leq 2\times 10^7}$$

Solve for L ← <u>Min required</u>

$$L = L_{BUS} + L_{REACT}$$

If $L \le L_{BUS} \Rightarrow$ No Reactor Needed!

If $L > L_{BUS}$

$$\Rightarrow L_{REACTOR} = L - L_{BUS}$$

For definite purpose:

a) $\omega_0 < \omega_{rated}$

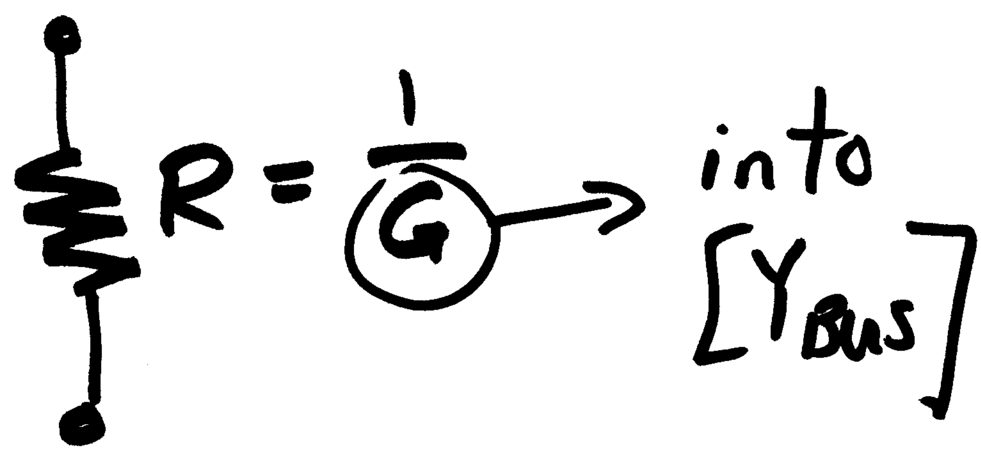
[redacted]

b) f $I_p < I_{rated}$

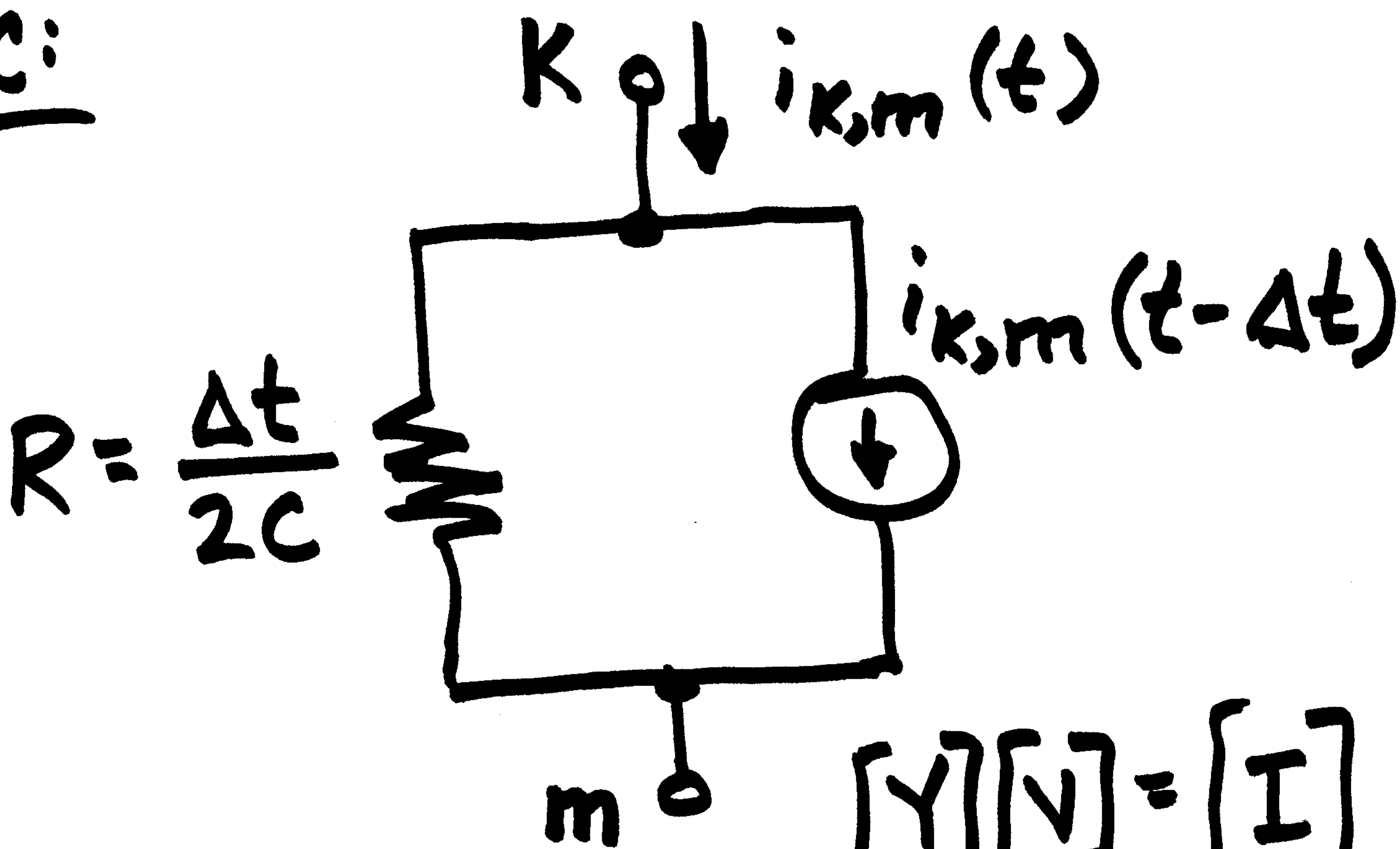
$$\boxed{I_p \omega_0 < \text{rated.}}$$

$[Y_{BUS}]$ is augmented according to system elements needed.

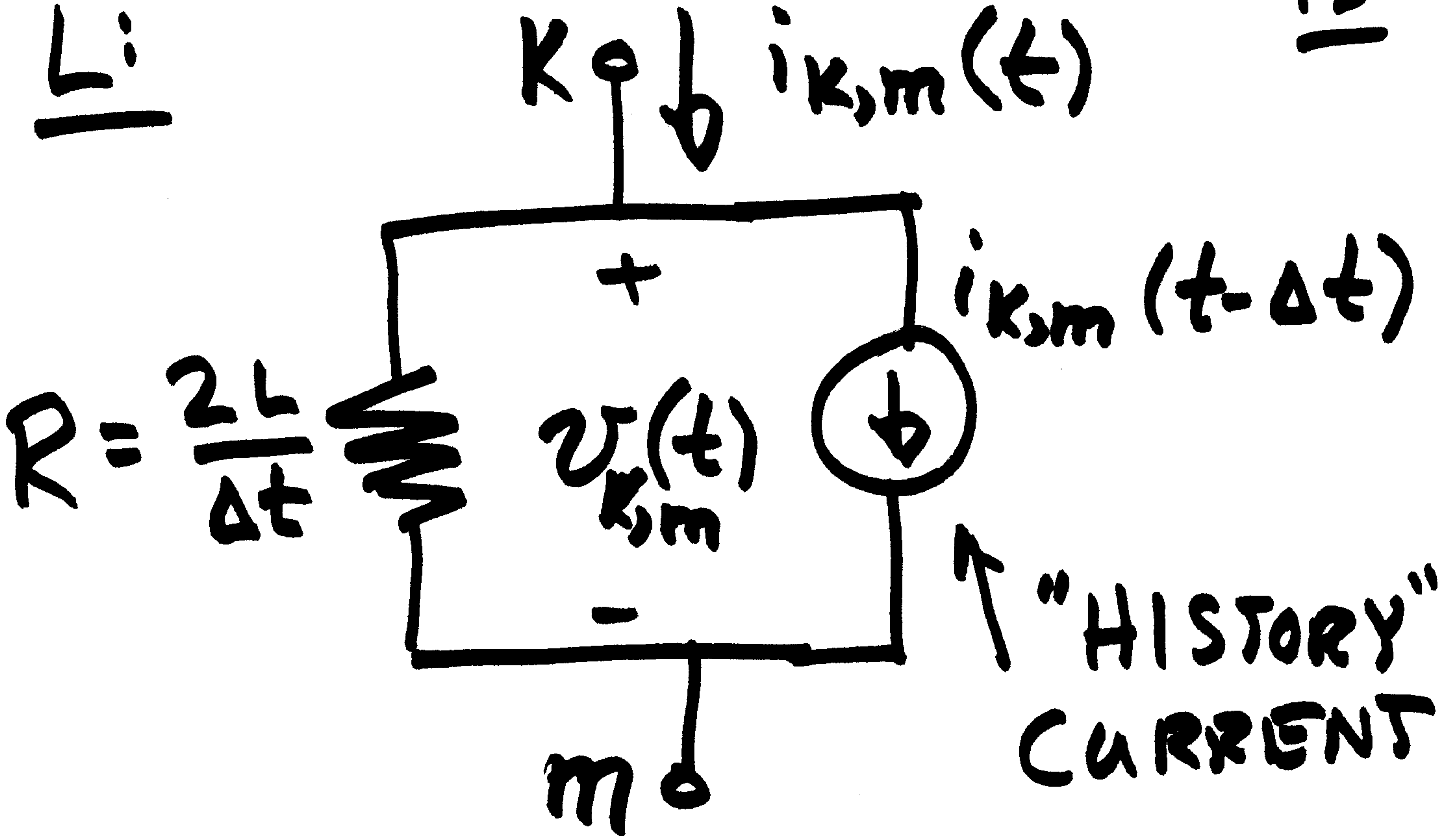
R:



C:



$[Y][V] = [I]$


L:
K
$i_{k,m}(t)$
+
$i_{k,m}(t-\Delta t)$
$R = \frac{2L}{\Delta t}$
$v_{k,m}(t)$
−
"HISTORY" CURRENT
m