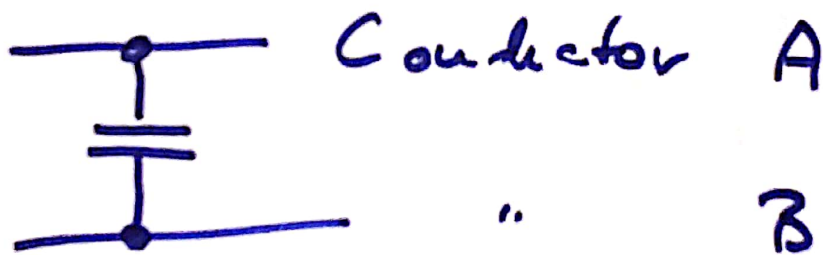


EE16A Lecture 7, Mod 2 ①

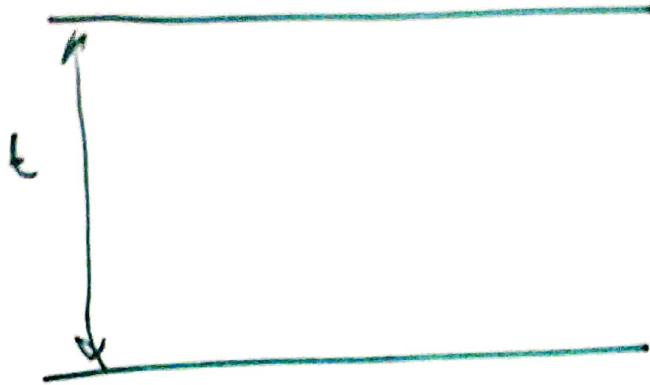
- Capacitive Touch Screen
- Comparator
- Energy stored in Capacitor

Capacitor

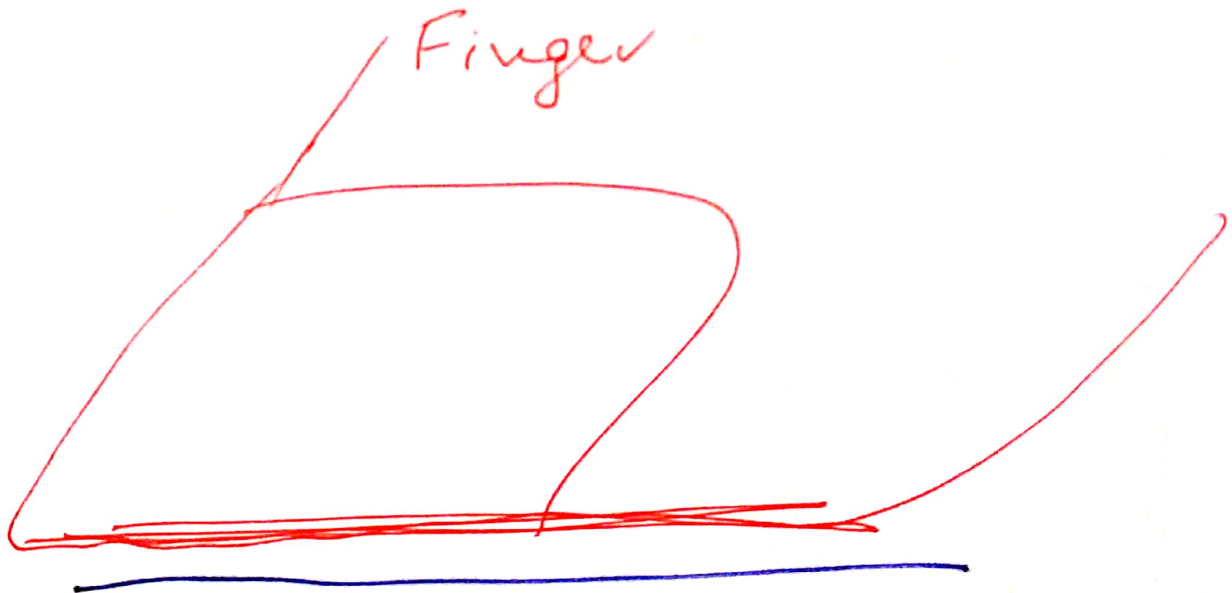


# Touch Sensor

(2)



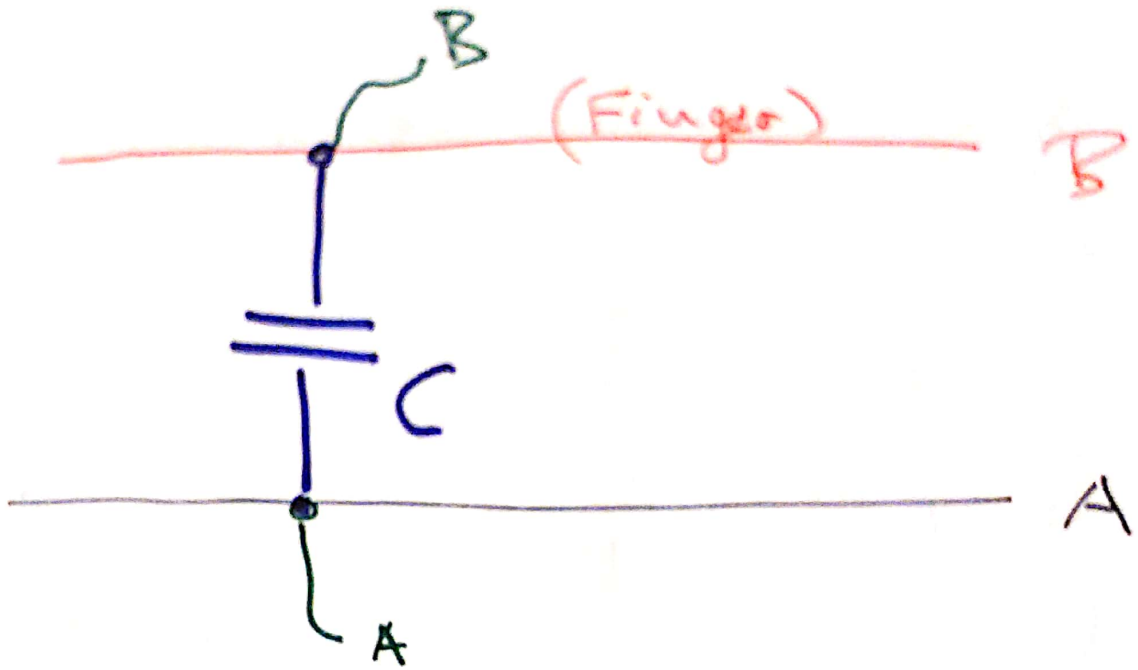
$$C = \epsilon \cdot \frac{A}{t}$$



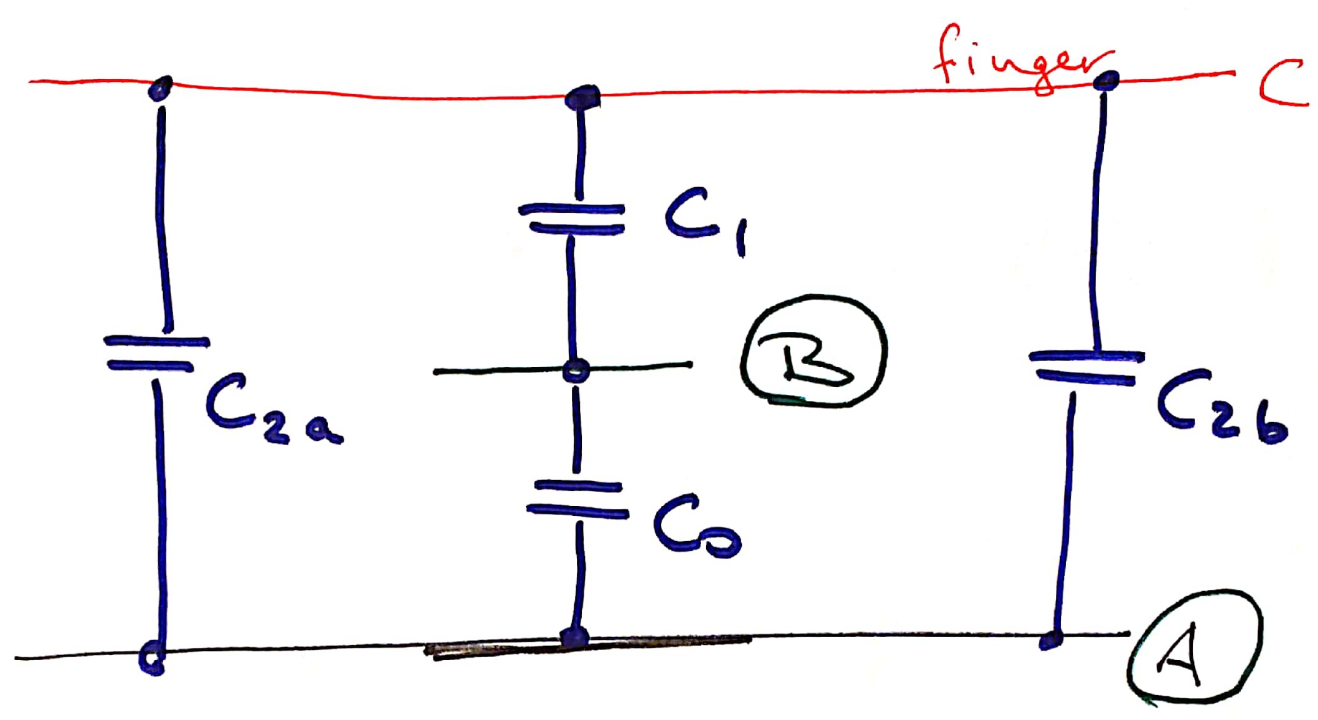
Insulator



3

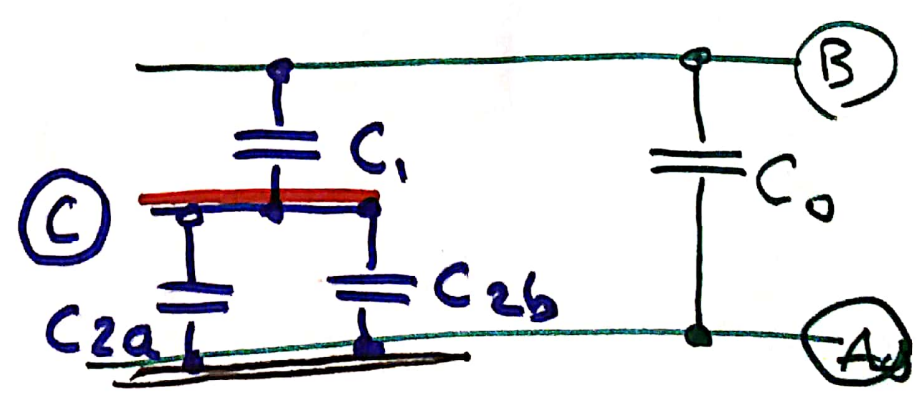
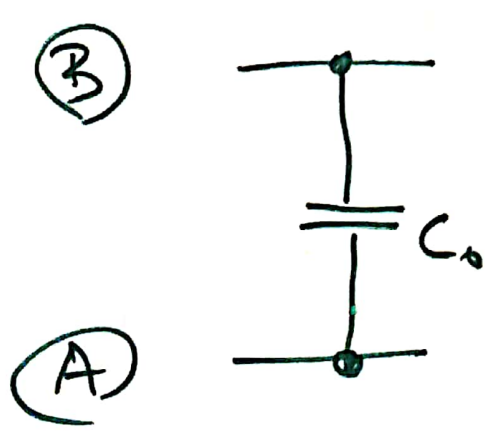


4



no finger

w/ finger



$$C_{AB}^{no} = C_0$$

$$C_{AB} = \left[ (C_{2a} + C_{2b}) \parallel C_1 \right] + C_0$$

$$C_{AB}^{f_i} = \left[ \frac{C_1 (C_{2a} + C_{2b})}{C_1 + C_{2a} + C_{2b}} \right] + C_0$$

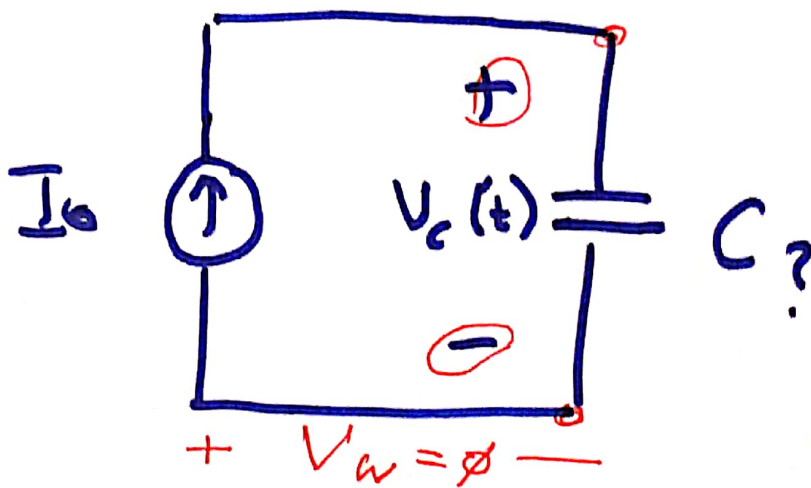
$$C_2 = C_{2a} + C_{2b}$$

$$C_{AB}^{f_i} = \frac{C_1 C_2}{C_1 + C_2} + C_0$$

(5)

$$Q_c = C \cdot V_c$$

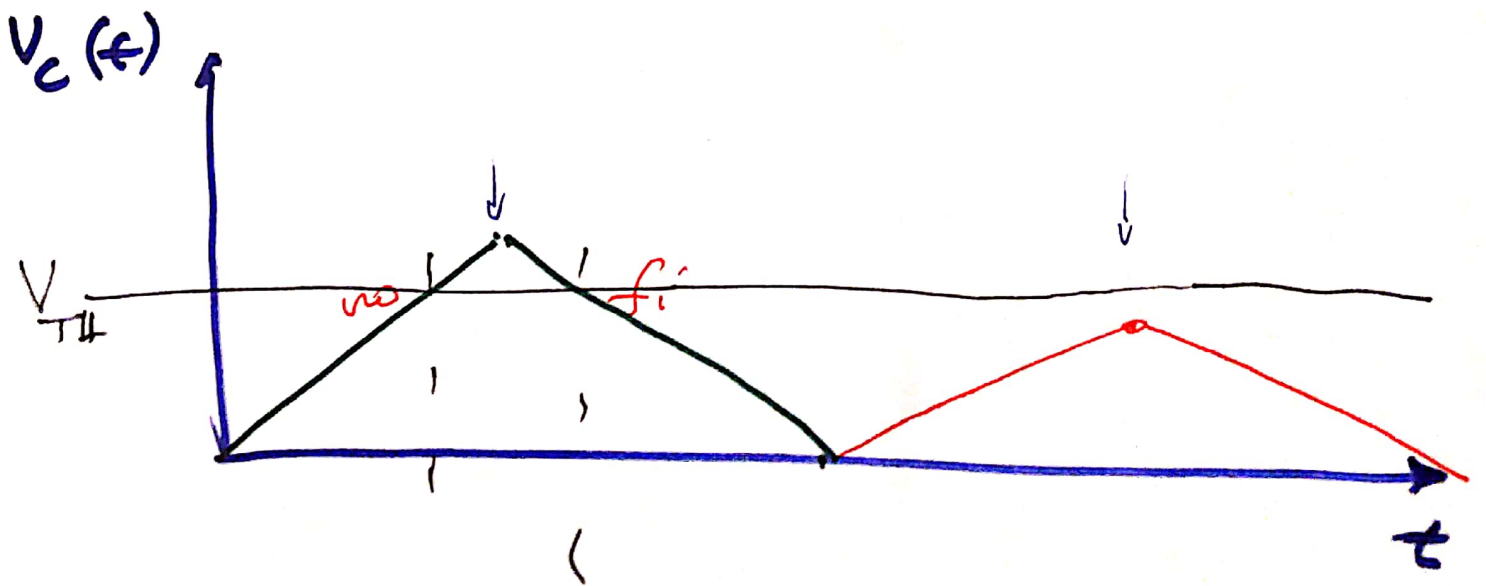
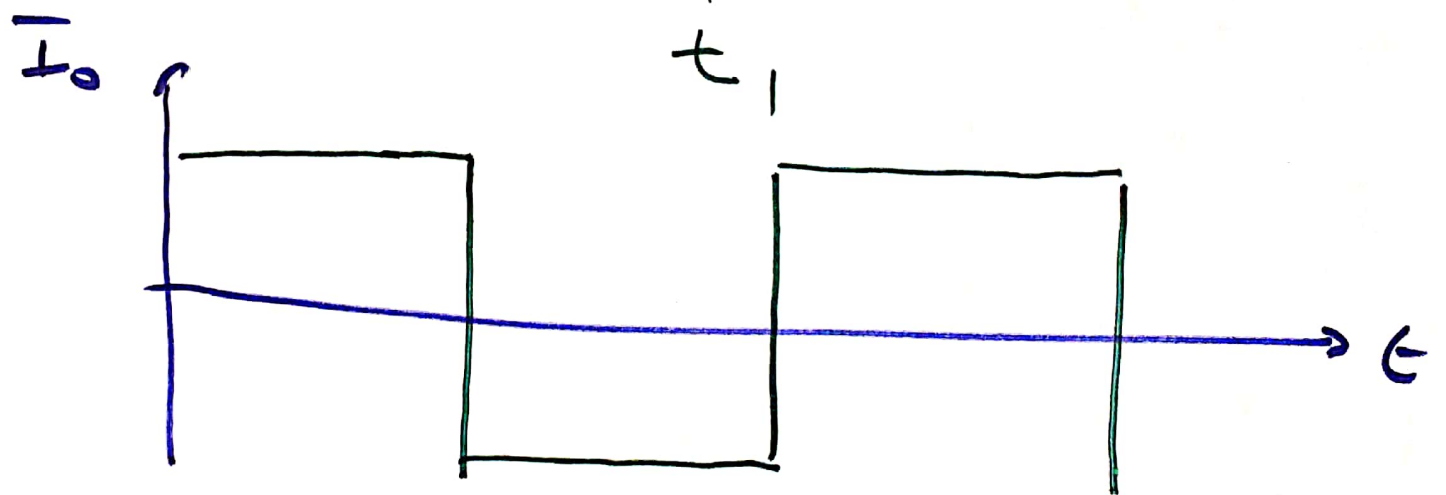
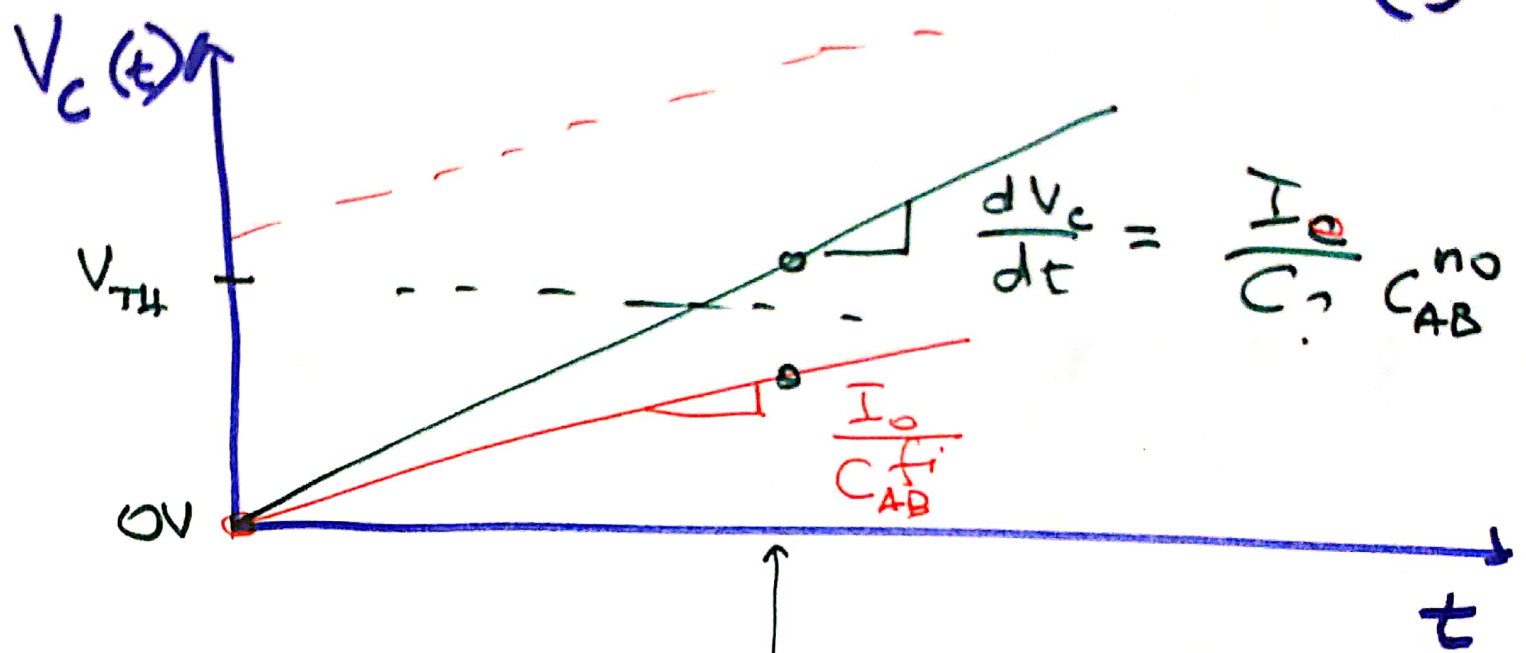
$$I_c = C? \cdot \frac{dV_c(t)}{dt}$$



$$C? = \frac{I_0}{dV_c/dt}$$

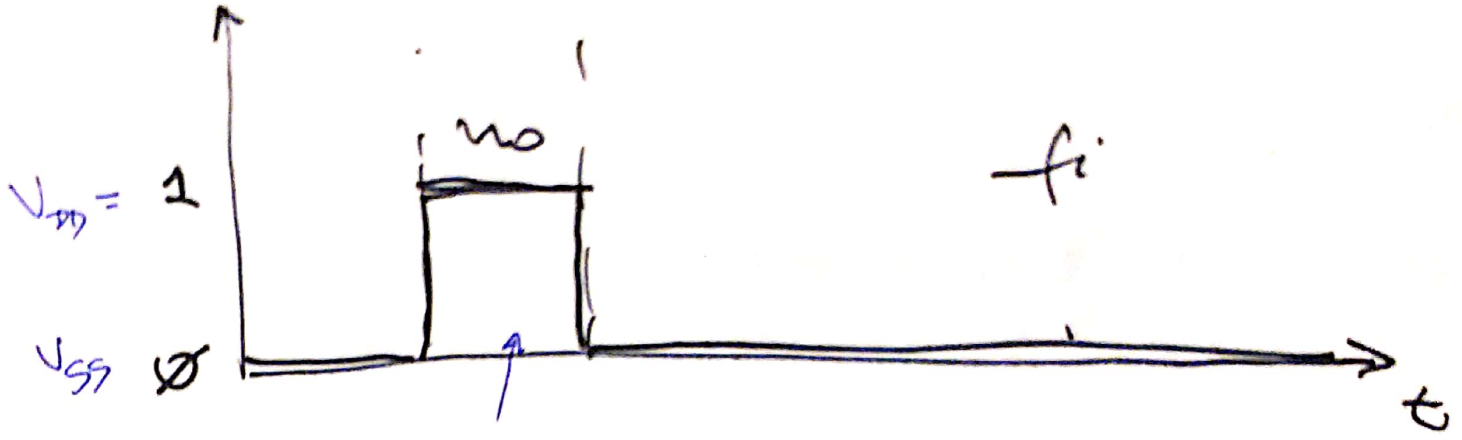
$$\frac{dV_c}{dt} = \frac{I_c}{C?}$$

(6)

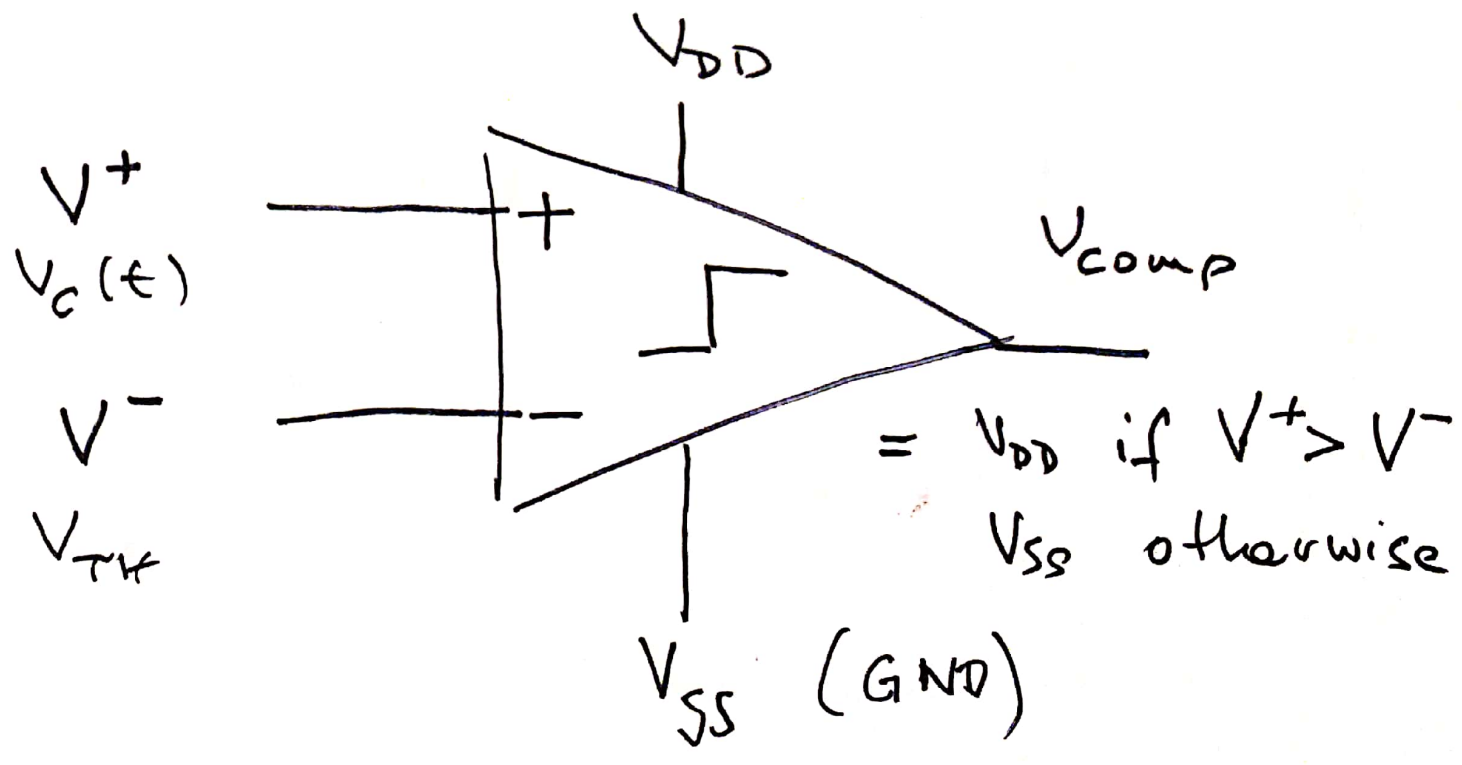


7

$V_C(t) > V_{TH} \leftarrow$



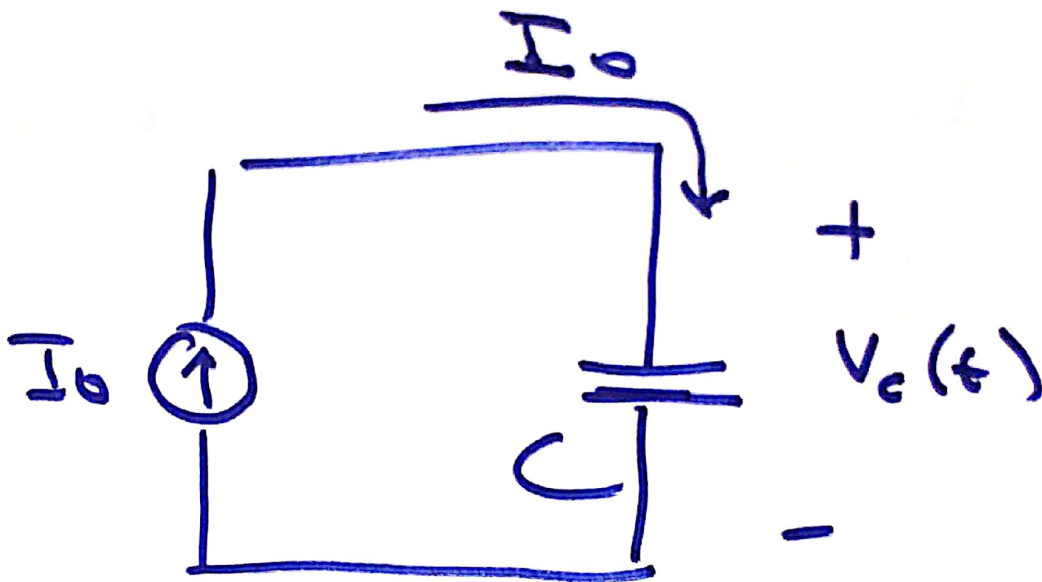
### Comparator





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# Energy



$$\Rightarrow p_c(t) = V_c(t) \cdot I_0$$

$$dV_c(t) = \frac{I_0}{C} \cdot dt$$

$$V_c(t) = \frac{I_0}{C} \cdot t$$

Integriere

$$p_c(t) = \frac{I_0}{C} \cdot I_0 \cdot t \Rightarrow$$

$$W = \int_0^T p(t) dt$$

$$Q = C \cdot V$$

$$W_c = \int_0^T \frac{I_0^2}{C} dt$$

$$= \frac{I_0^2}{C} \cdot T^2 \cdot \frac{1}{2}$$

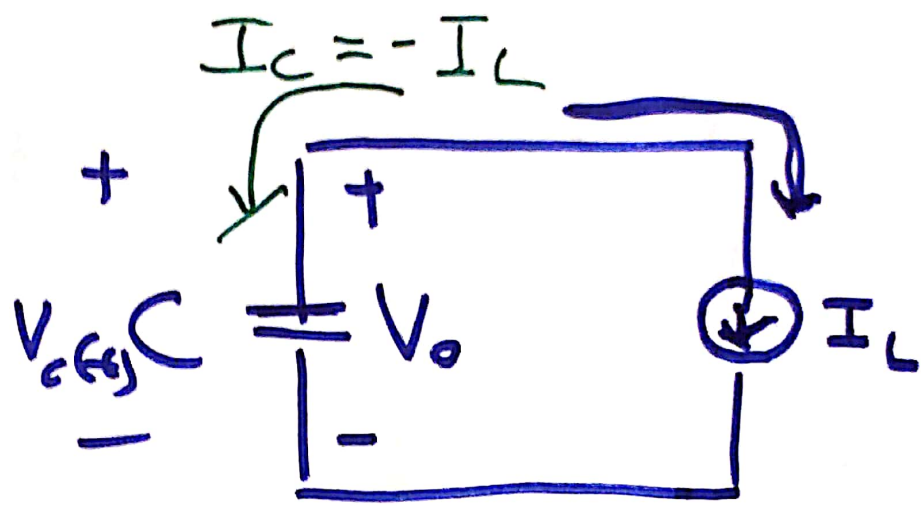
$$= \frac{(I_0 \cdot T)^2}{2C}$$

$$= \frac{Q^2}{2C}$$

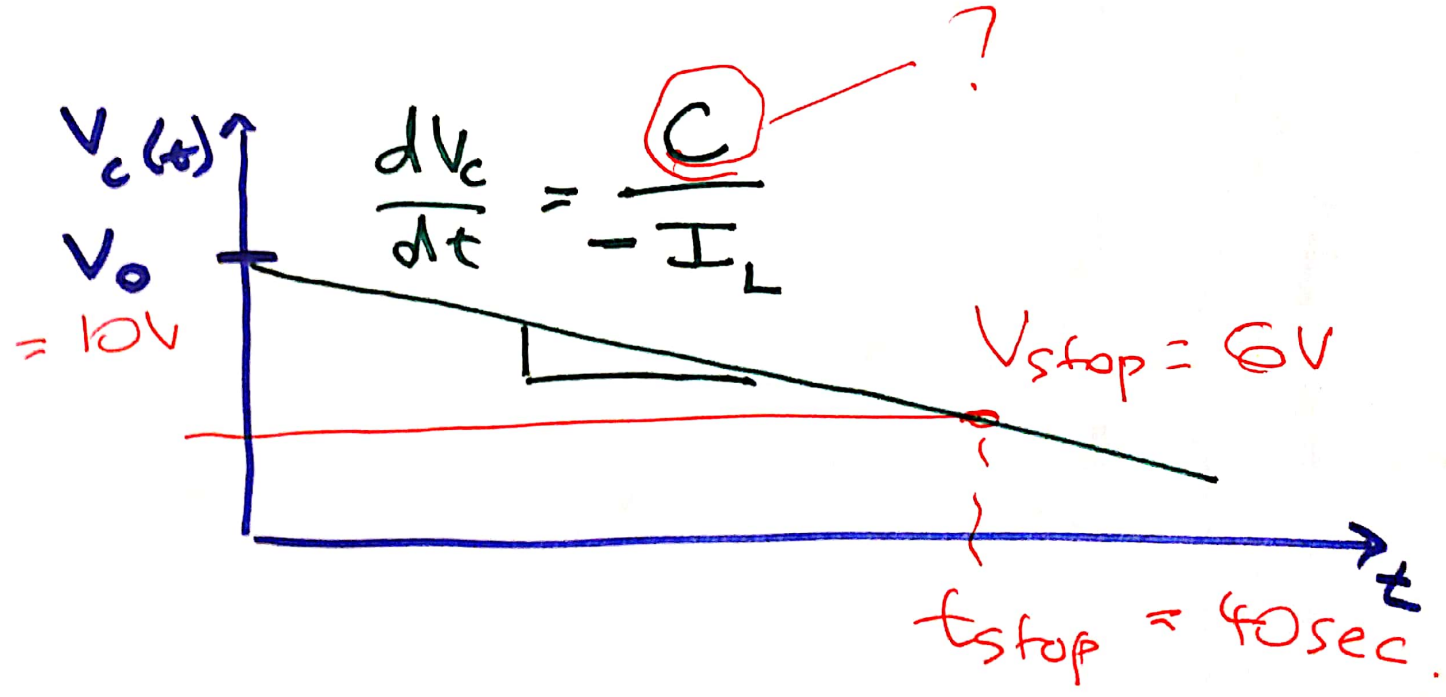
$$E_c = \frac{1}{2} C V_c^2$$

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# Cap as "Battery"



robot  
 $I_L = 0.1A$



(12)

$$V_c(t) = V_0 + \frac{dV_c}{dt}$$

$$= V_0 - \left( \frac{C}{I_L} \right)^{-1} t$$

$$V_{\text{stop}} = V_0 - \frac{I_L}{C} \cdot t_{\text{stop}}$$

$$\therefore \cancel{t_{\text{stop}}} = \underline{\text{Supercapacitor}}$$

$$\begin{aligned} \therefore C &= \frac{t_{\text{stop}}}{V_0 - V_{\text{stop}}} \cdot I_L \\ &= \frac{40\text{s}}{\underbrace{10\text{V} - 6\text{V}}_{4\text{V}}} \cdot 0.1\text{A} = \underline{\underline{1\text{F}}} \end{aligned}$$

(13)

$$Q = C \cdot V$$

$$I_c = C \cdot \frac{dV_c}{dt}$$

$$\Rightarrow \frac{dV_c}{dt} = \frac{I_c}{C}$$