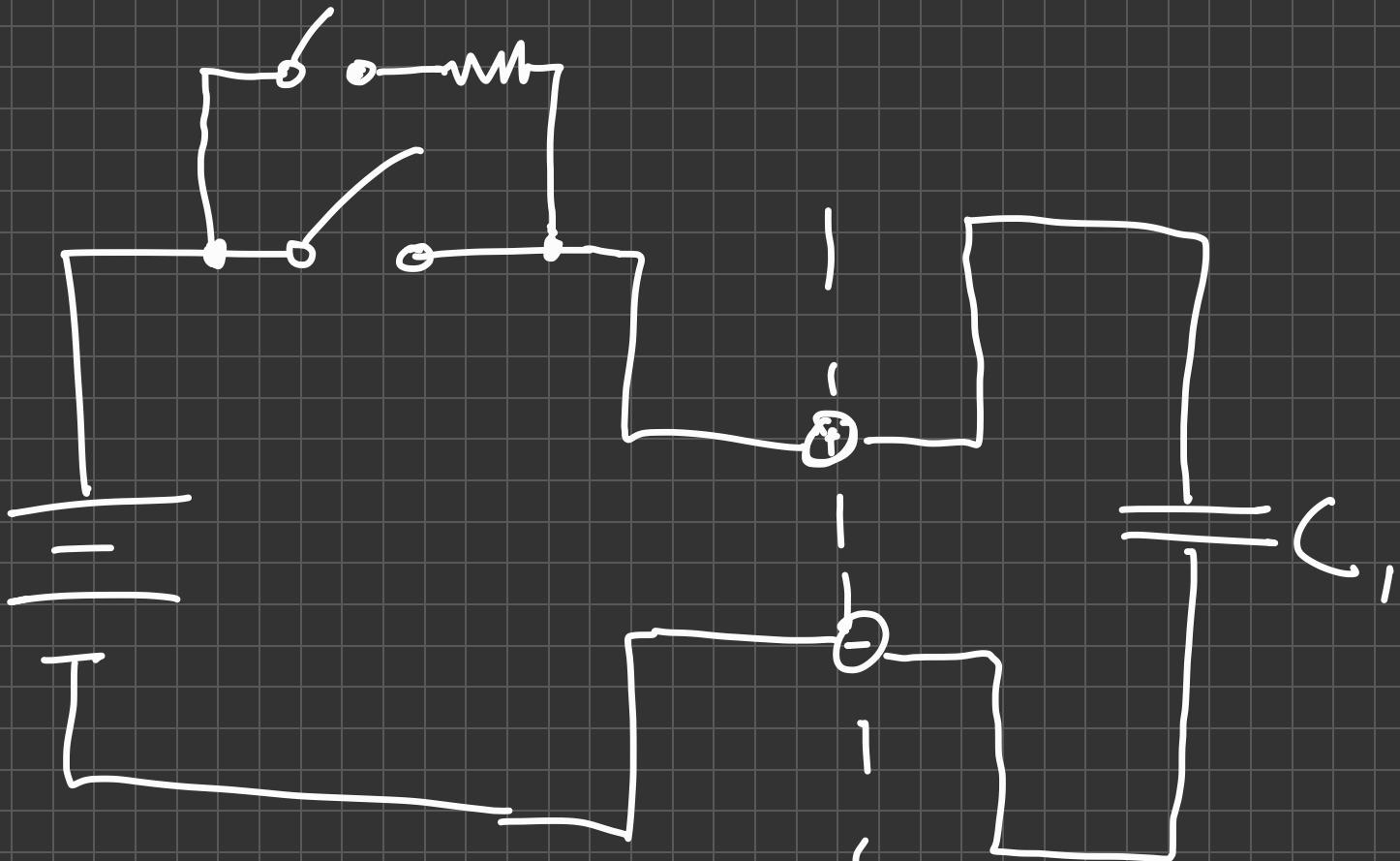


# Pre-Charge

Very important to have PL circuit for  
any high voltage system



$C_1$  can be any motor inverter or high freq.  
switching

Capacitance : ability of a component or circuit to store energy .

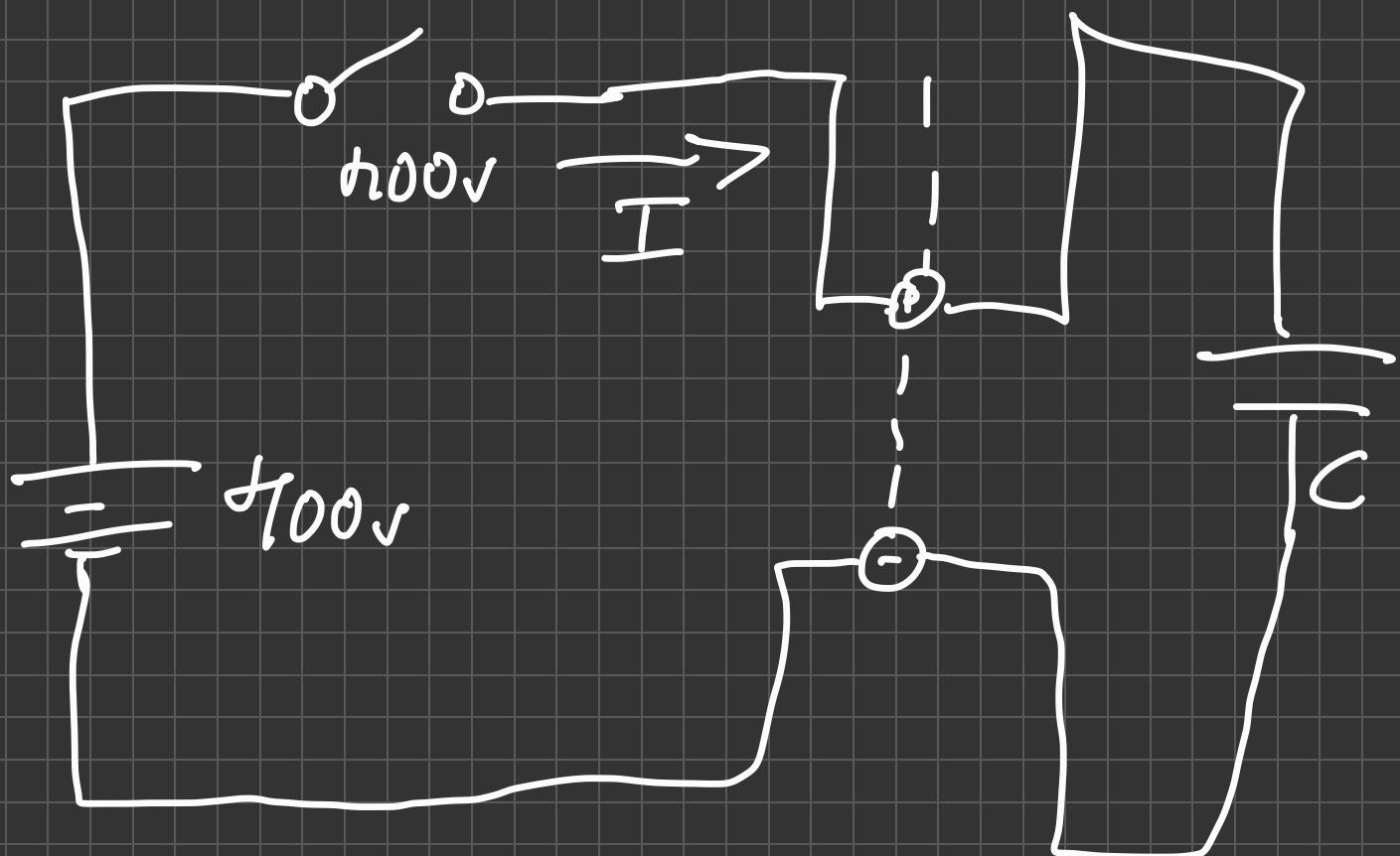
(How well it can hold electrical charge)

$$C = \frac{Q}{V}$$

↑                    Q ← charge stored (charge)  
                    V ← voltage

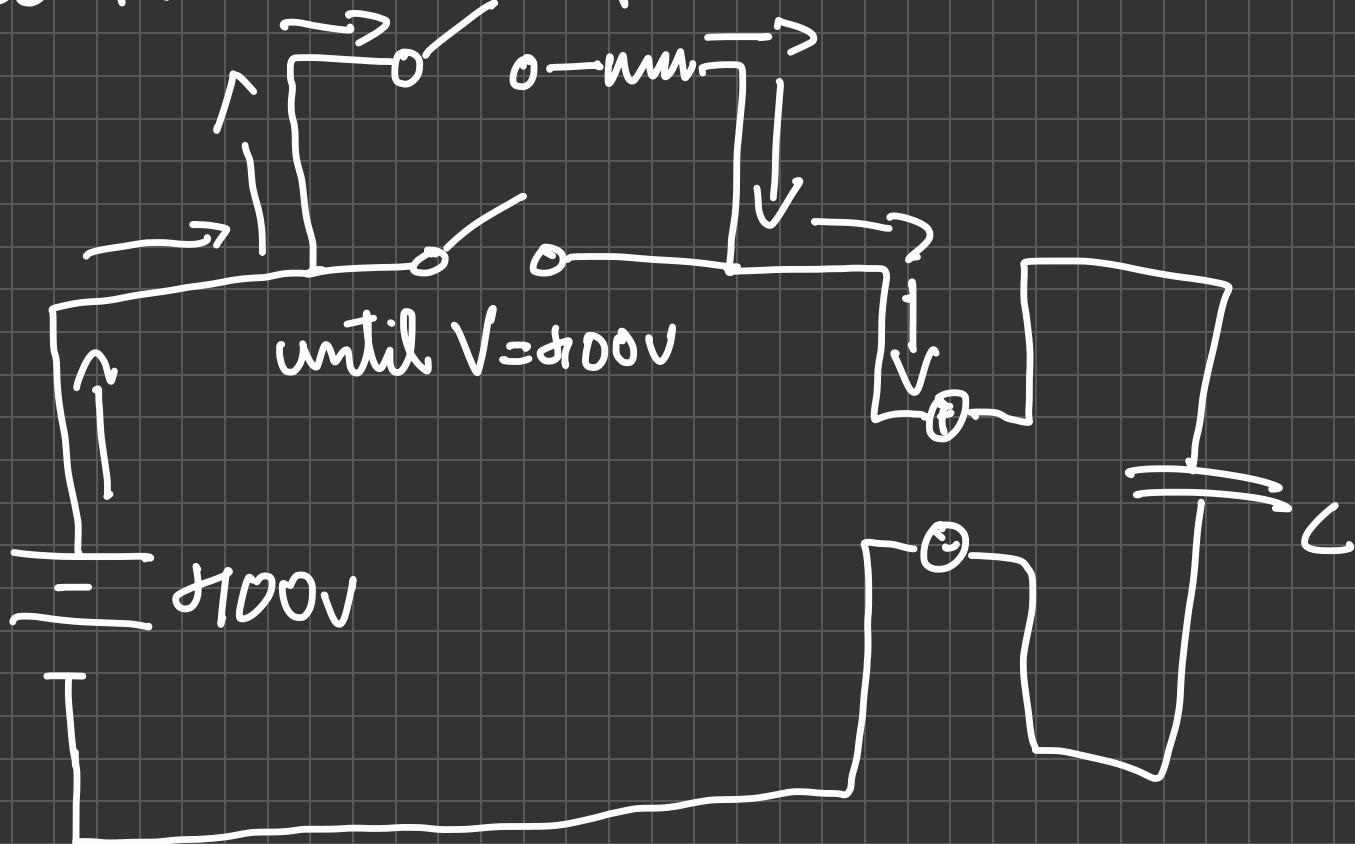
Capacitance

as voltage ↑ capacitance ↓



w/o a PC circuit the 100V would rush to the capacitor and the switch would weld shut and damage capacitor

so How does a PC circuit work



- current is limited by resistance of resistor
- when the  $V$  flowing through PLC circuit starts to get closer to  $V_{battery}$ , the main relay closes

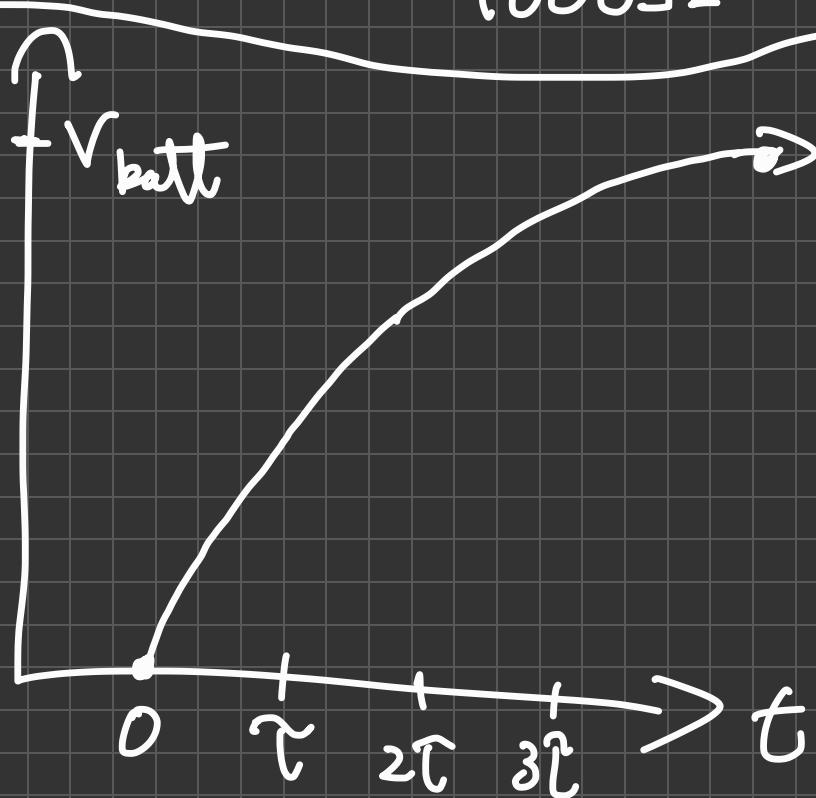
Eg:

$$V = 100V$$

more generous

$$R = 1000\Omega$$

$$I = \frac{100V}{1000\Omega} = 100mA$$



at this  $t = n\tau$ ,  
main relay/contactors  
close

$$\tau = R \cdot C$$

↑ resistance  
↑ capacitance

$\tau$  is an RC time constant

$$I\tau \approx 0.63 V_{batt}$$

$$2\tau \approx 0.87 V_{batt}$$

$$3\tau \approx 0.95 V_{batt}$$

Eg.  $V = 2100V$   
 $R = 1000\Omega$   
 $C = 400\mu F$

$$T = 1000 \cdot 400\mu F = 200ms$$

95% of  $V_{batti}$  is enough to close main relay ( $3T$ )

Why not choose a really small resistor val?

$$P = \frac{V^2}{R} = \frac{(2100)^2}{1000\Omega} = [160W] \leftarrow \text{very high power dissipator}$$

power dissipation of resistor

best practice: use pre-charge rated resistor, or high pulse rated resistor on chassis mat resistor

The power dissipation is maximized at  $t=0$ ,  
and then it starts decaying.

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Note: want to enable a fault checking  
system in BMS