Capacitor

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Charge

Before

Initial

Final

No more electrons to leave

V_0

V_0

$+ \; + \; + \; + \; +$

$+$

$−$

$+$

$−$

$+$

$−$

$− \; − \; − \; − \; −$
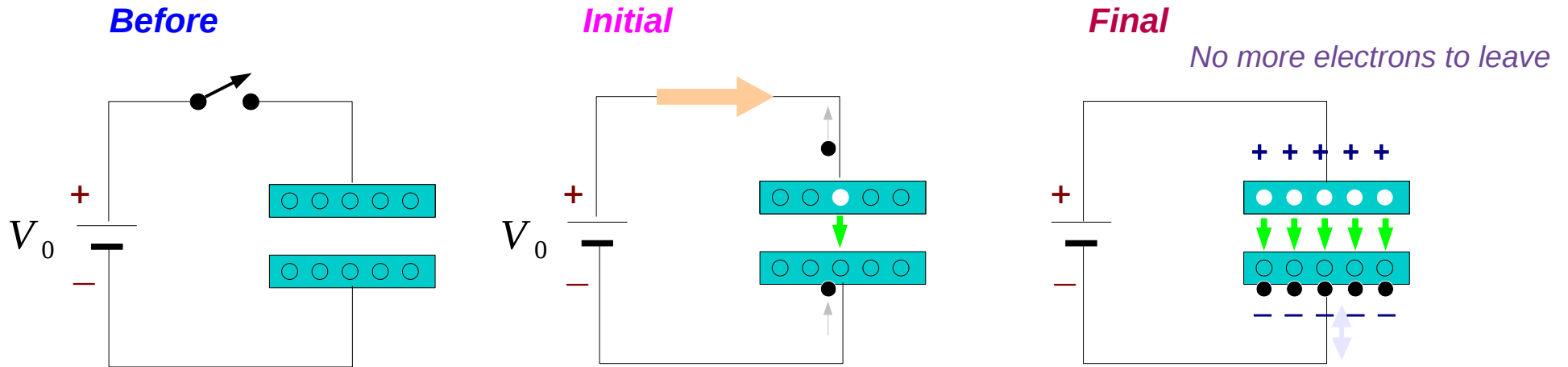
crowded electrons prevent
other electrons from arriving

Energy stored in Electric Field

$$i_c = C \cdot \frac{d\,v_c}{d\,t}$$

$$v_c(0^-) = v_c(0^+) \qquad \textit{unyielding voltage}$$

$$v_c(\infty) = V_0$$

$$i_c(0^-) \neq i_c(0^+) \qquad \textit{current jump}$$
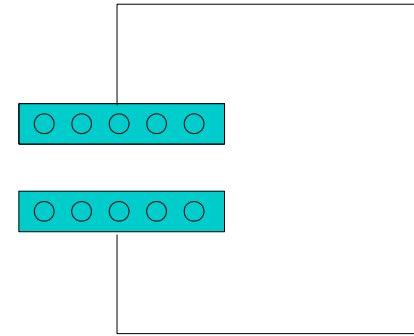
$$i_c(\infty) = 0$$

Capacitor

3

Discharge
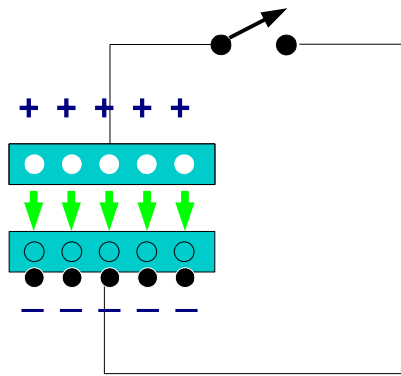
Initial   **Final**
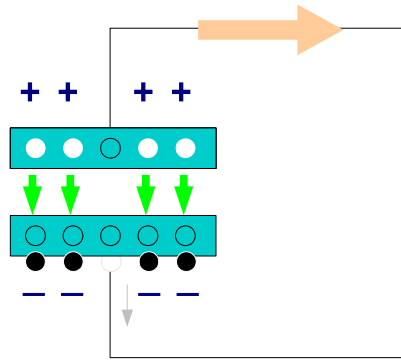
No more electrons moving

$$i_c = C \cdot \frac{d\,v_c}{d\,t}$$

$$v_c(0^-) = v_c(0^+)$$ *unyielding voltage* $$v_c(\infty) = 0$$

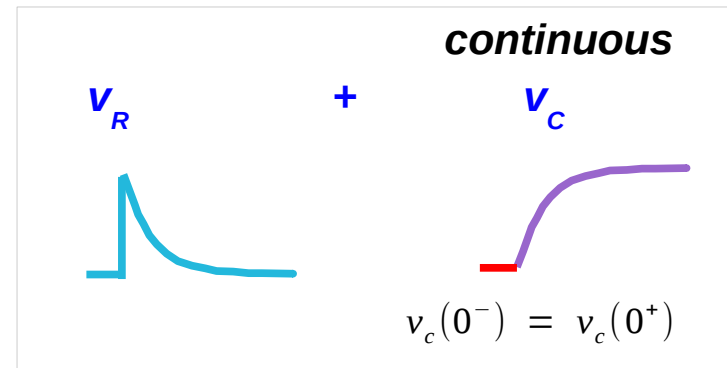$$i_c(0^-) \neq i_c(0^+)$$ *current jump* $$i_c(\infty) = 0$$

Charge
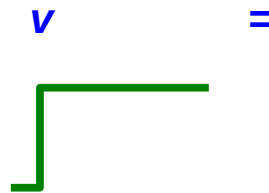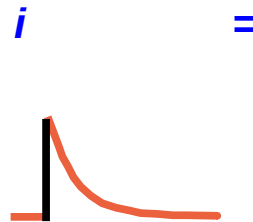

$$i_c = C \cdot \frac{d v_c}{d t}$$

unyielding voltage

current jump

v   =   **v$_R$**   +   **v$_C$**   **continuous**
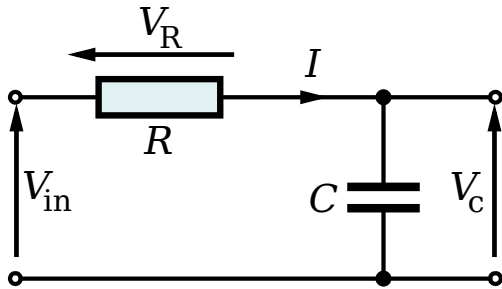
the capacitor voltage slowly follows the shape of the applied step input voltage

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

i   =   **i$_R$**   =   **i$_C$**   **jump**

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

$$i_c(0^-) \neq i_c(0^+)$$
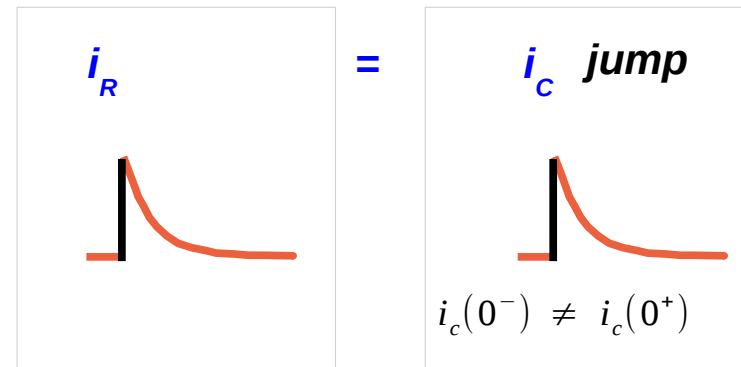
Discharge

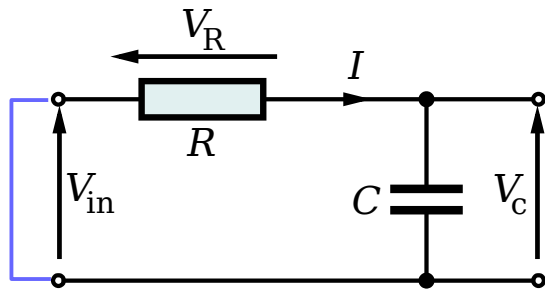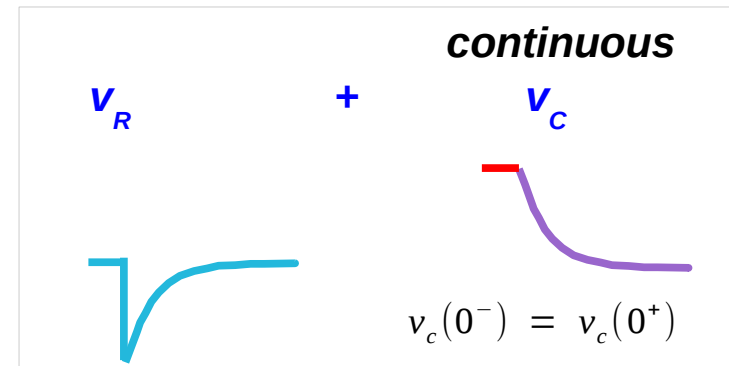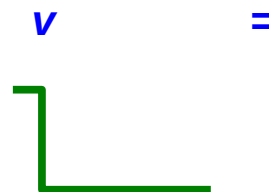$$i_c = C \cdot \frac{d v_c}{d t}$$

unyielding voltage

current jump

v = v_R + v_C **continuous**
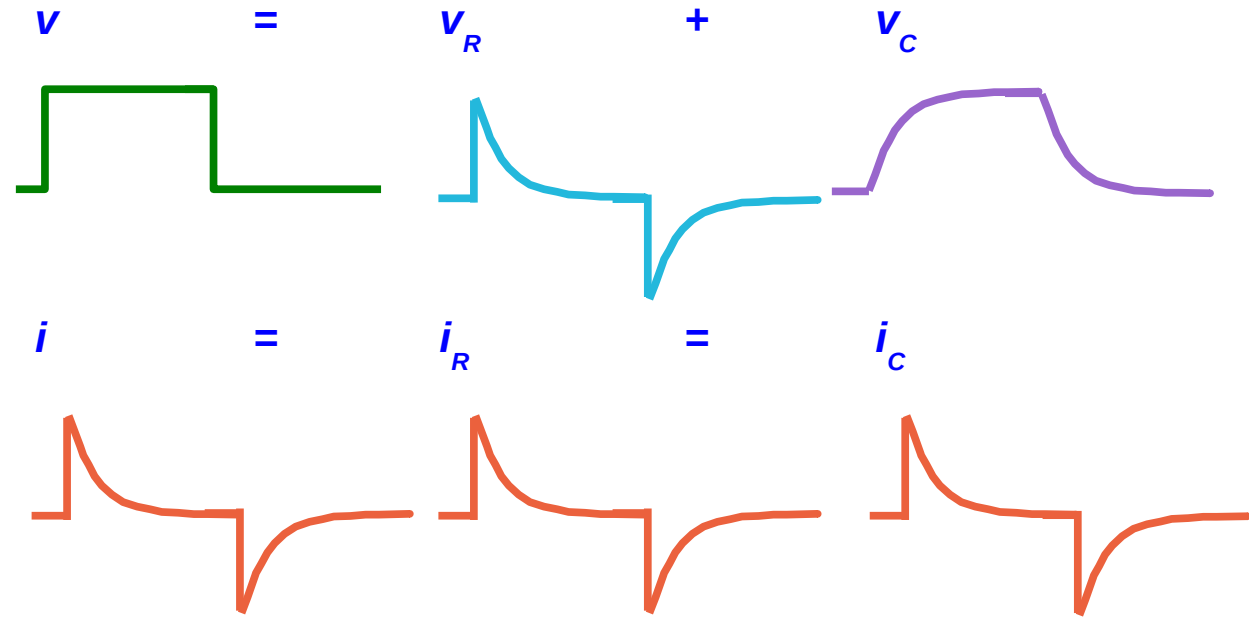
the capacitor voltage slowly follows the the shape of the applied step input voltage
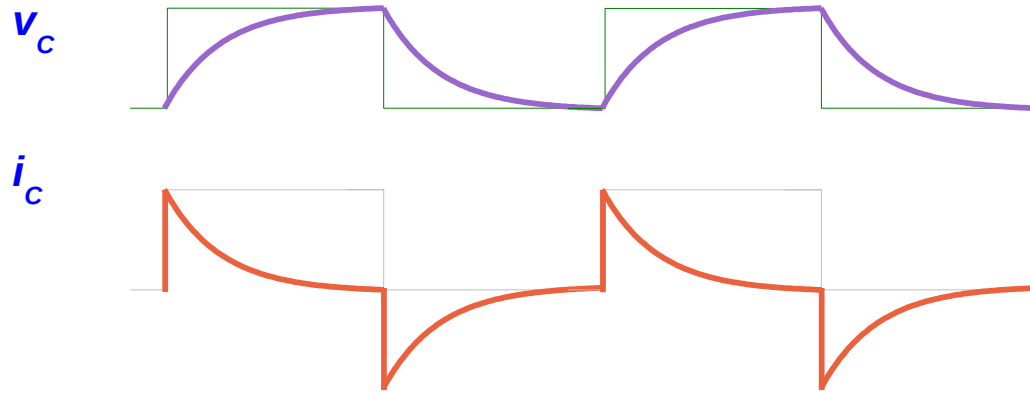
$$v_c(0^-) = v_c(0^+)$$

i = i_R = i_C *jump*

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

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

Pulse

$$v \quad = \quad v_R \quad + \quad v_C$$

$$i \quad = \quad i_R \quad = \quad i_C$$

Pulse

v_C

i_C

$$i_C = C \frac{d v_C}{d t}$$

ω ↑ i_c ↑ X_c ↓

v_C

i_C

v_C
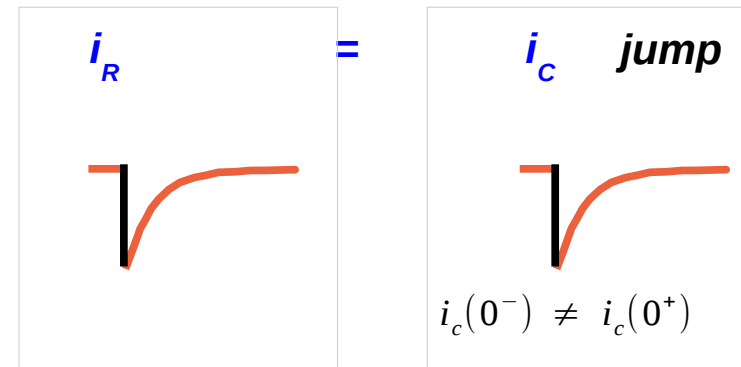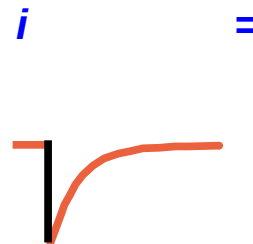
i_C
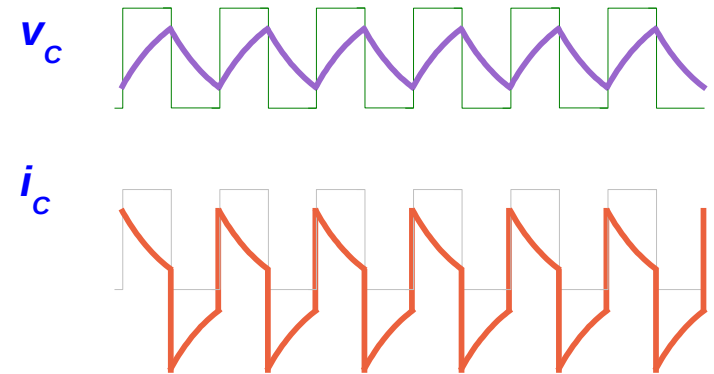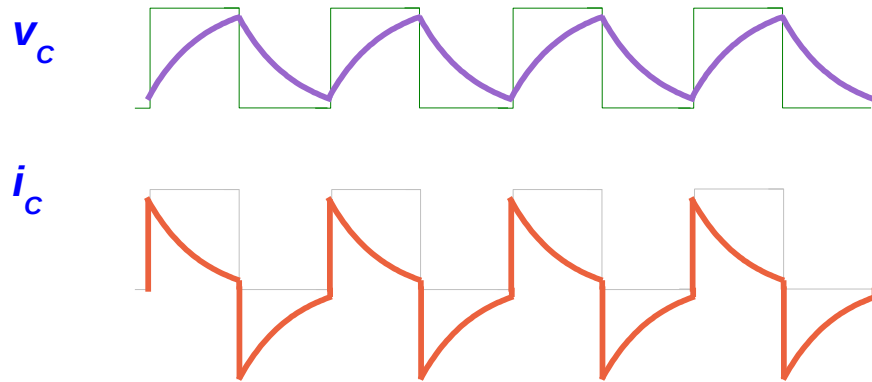
I leads V by 90°

Initial charge
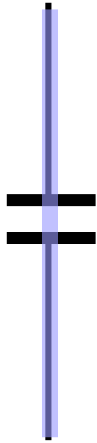
SHORT

V = 0

I : peak

Full charge

OPEN

I = 0

V : peak

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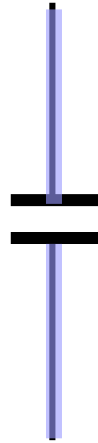
References
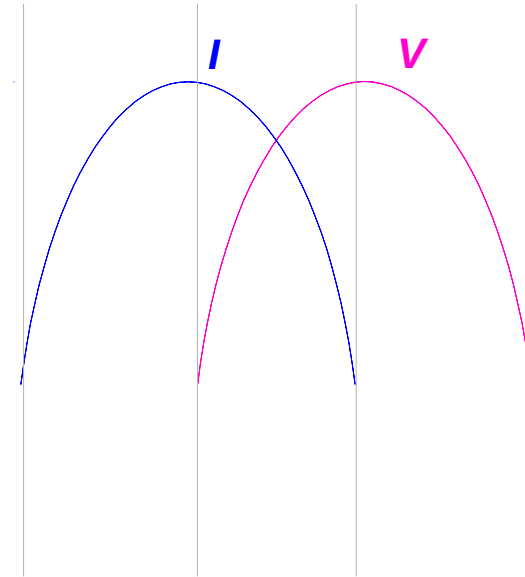
[1]   http://en.wikipedia.org/
[2]   J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003