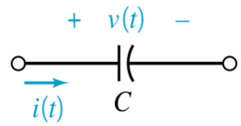
Capacitors



$$i(t) = C\frac{d}{dt}v(t) \quad \text{and} \quad v(t) = \frac{1}{C}\int_{-\infty}^{t} i(\tau)\,d\tau = v(0) + \frac{1}{C}\int_{0}^{t} i(\tau)\,d\tau$$

These equations describe an voltage and current that adhere to the passive convention.

All of the currents and voltages are constant in a dc circuit. When the capacitor voltage is constant, the capacitor current is zero.

Capacitors act like open circuits in dc circuits.

Suppose the capacitor voltage is discontinuous, for example

$$v(t) = \begin{cases} 4.3 & t < 2.5 \\ 4.4 & t > 2.5 \end{cases}$$

That is, the voltage changes from 4.3 V to 4.4 V abruptly at time $t = 2.5$ s . At $t = 2.5$ s , the derivative of the capacitor voltage is

$$\frac{d\,v}{d\,t} = \lim_{\Delta t \to 0} \frac{v(t+\Delta t) - v(t-\Delta t)}{(t+\Delta t) - (t-\Delta t)} = \lim_{\Delta t \to 0} \frac{4.4 - 4.3}{2\,\Delta t} = \infty$$

Consequently, discontinuous capacitor voltages require infinite capacitor currents. Infinite currents are physically impossible, so discontinuous capacitor voltages are physically impossible.

In the absence of infinite currents, capacitor voltages must be continuous.