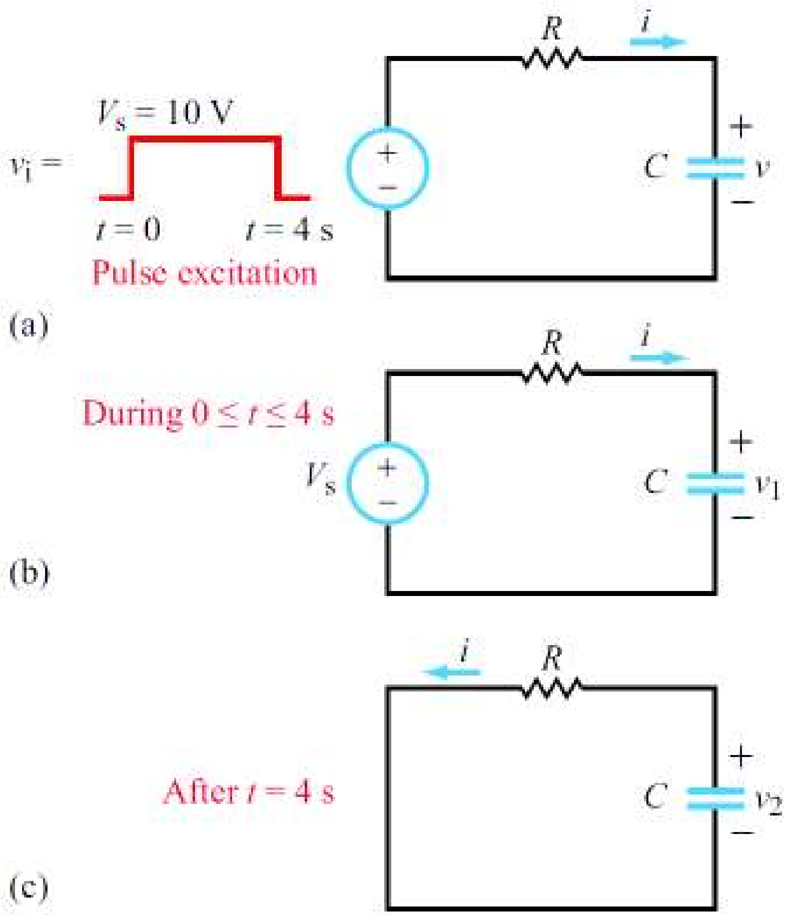
Example: Rectangular Pulse



$$v_i(t) = V_s\, u(t) - V_s\, u(t-4).$$

Since the circuit is linear, we can apply the superposition theorem to determine the capacitor response $v(t)$. Thus,

$$v(t) = v_1(t) + v_2(t).$$

$$v_1(t) = v_1(\infty) + [v_1(0) - v_1(\infty)]e^{-t/\tau}$$
$$= V_s(1 - e^{-t/\tau}) \qquad (\text{for } t \geq 0).$$

For $V_s = 10$ V and $\tau = RC = 25 \times 10^3 \times 0.2 \times 10^{-3} = 5$ s,

$$v_1(t) = 10(1 - e^{-0.2t}) \text{ V} \qquad (\text{for } t \geq 0).$$

The second step function has an amplitude of $-V_s$ and is delayed in time by 4 s. Upon reversing the polarity of V_s and replacing t with $(t-4)$, we have

$$v_2(t) = -10[1 - e^{-0.2(t-4)}] \text{ V} \qquad (\text{for } t \geq 4 \text{ s}).$$

The total response for $t \geq 0$ therefore is given by

$$v(t) = v_1(t) + v_2(t)$$
$$= 10[1 - e^{-0.2t}] - 10[1 - e^{-0.2(t-4)}]\, u(t-4) \text{ V}$$