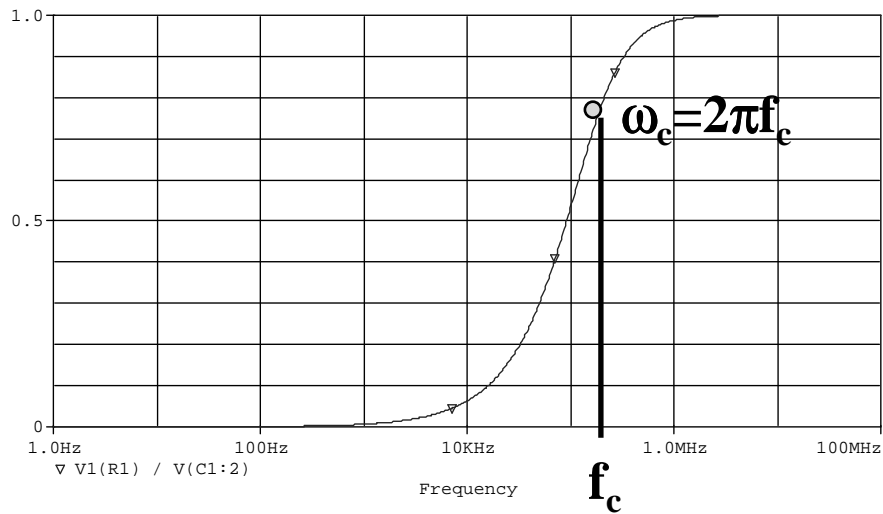


RC 회로의 주파수 특성

High and Low Pass Filters

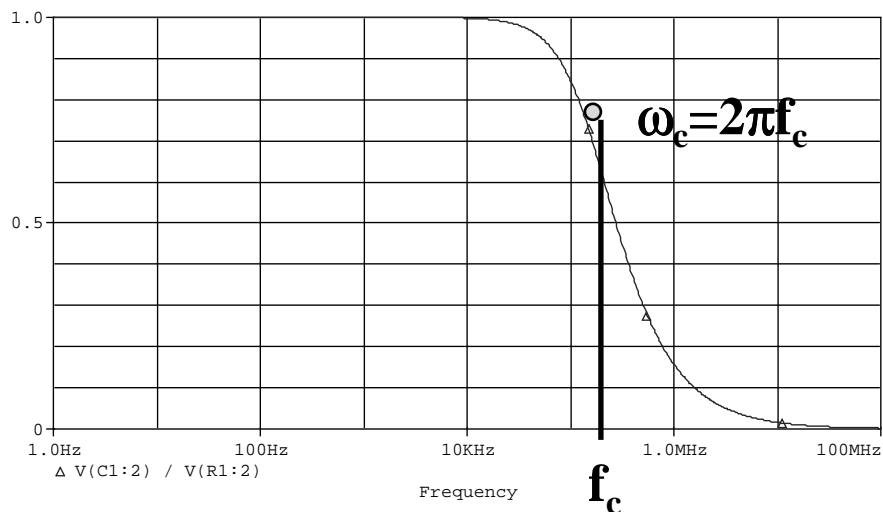


High Pass Filter

$$H = 0 \text{ at } \omega \rightarrow 0$$

$$H = 1 \text{ at } \omega \rightarrow \infty$$

$$H = 0.707 \text{ at } \omega_c$$



Low Pass Filter

$$H = 1 \text{ at } \omega \rightarrow 0$$

$$H = 0 \text{ at } \omega \rightarrow \infty$$

$$H = 0.707 \text{ at } \omega_c$$

Corner Frequency

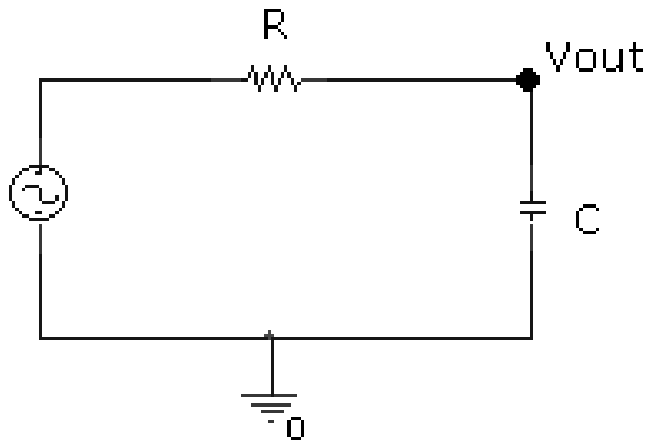
❖ The corner frequency of an RC or RL circuit tells us where it transitions from low to high or visa versa.

❖ We define it as the place where $|H(j\omega_c)| = \frac{1}{\sqrt{2}}$

❖ For RC circuits: $\omega_c = \frac{1}{RC}$

❖ For RL circuits: $\omega_c = \frac{R}{L}$

Example



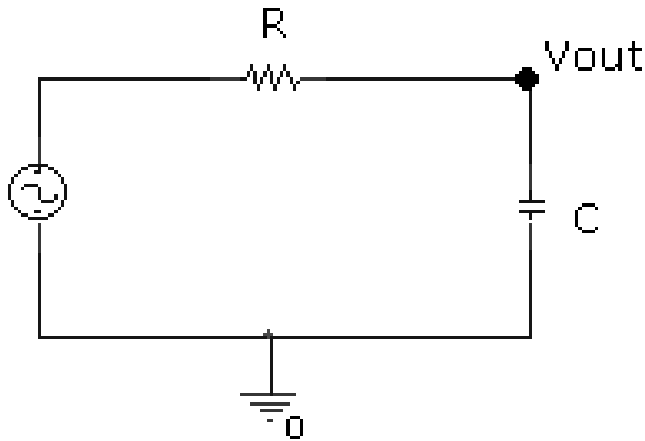
$$H(j\omega) = \frac{1}{1 + j\omega RC}$$

$$|H(j\omega)| = \frac{1}{\sqrt{2}}$$

$$|H(j\omega)| = \frac{1}{\sqrt{1 + (\omega RC)^2}} = \frac{1}{\sqrt{2}} \quad \frac{1}{1 + (\omega RC)^2} = \frac{1}{2}$$

$$2 = 1 + (\omega RC)^2 \quad \frac{1}{(RC)^2} = \omega^2 \quad \omega_c = \frac{1}{RC}$$

Example at Low Frequency



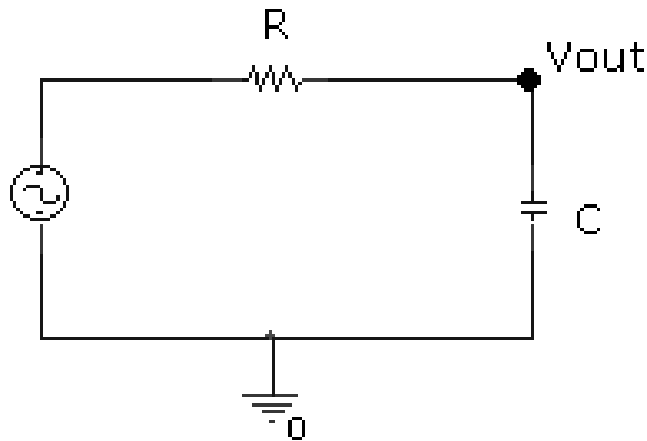
$$H(j\omega) = \frac{1}{1 + j\omega RC}$$

$$H_{LOW}(j\omega) = \frac{1}{1 + 0} = 1$$

$$|H_{LOW}(j\omega)| \text{ as } \omega \rightarrow 0 = |1| = 1$$

$$\angle H_{LOW}(j\omega) = \tan^{-1}\left(\frac{0}{1}\right) = 0 \text{ (on } +x \text{ axis)}$$

Example at High Frequency



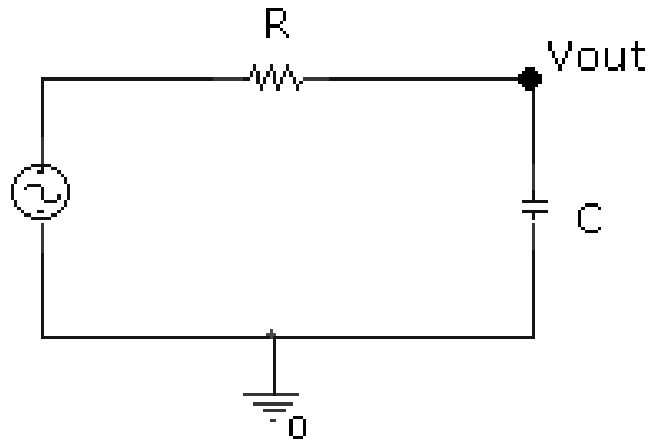
$$H(j\omega) = \frac{1}{1 + j\omega RC}$$

$$H_{HIGH}(j\omega) = \frac{1}{j\omega RC}$$

$$|H_{HIGH}(j\omega)| \text{ as } \omega \rightarrow \infty = \left| \frac{1}{j\omega RC} \right| = \frac{1}{\infty} = 0$$

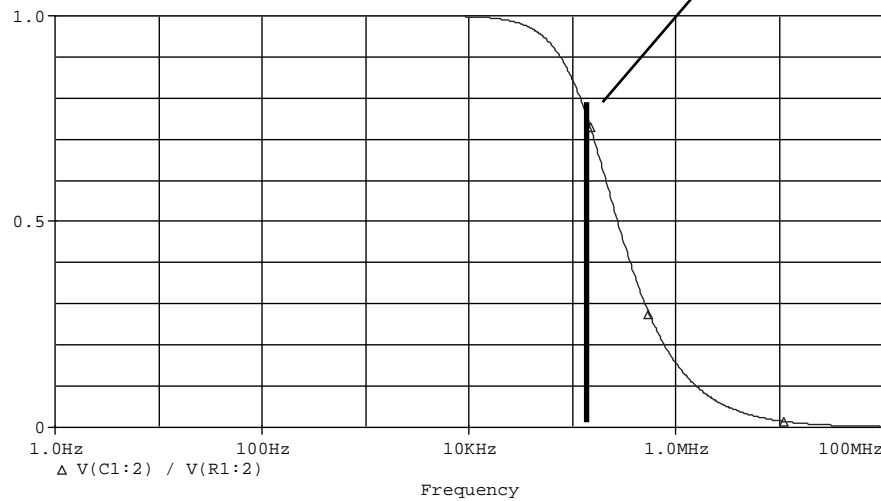
$$\angle H_{HIGH}(j\omega) = \tan^{-1}\left(\frac{0}{1}\right) - \tan^{-1}\left(\frac{\omega RC}{0}\right) = 0 - \frac{\pi}{2} = -\frac{\pi}{2}$$

Example: Low Pass Filter



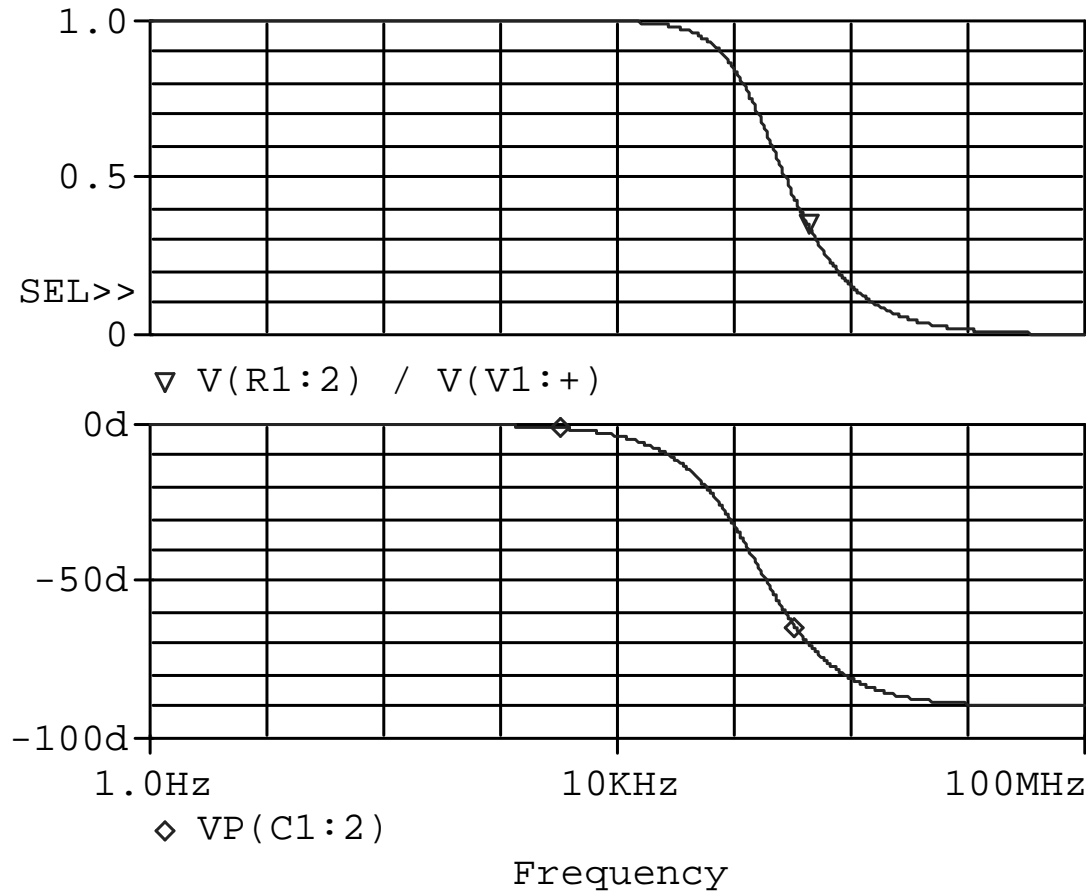
$$|H_{LOW}| = 1 \quad |H_{HIGH}| = 0$$

$$f_c = \frac{\omega_c}{2\pi} = \frac{1}{2\pi RC}$$



What about the phase?

Example: Phase Shift



$$|H_{LOW}| = 1$$

$$|H_{HIGH}| = 0$$

$$\angle H_{LOW}(j\omega) = 0$$

$$\angle H_{HIGH}(j\omega) = -90^\circ$$