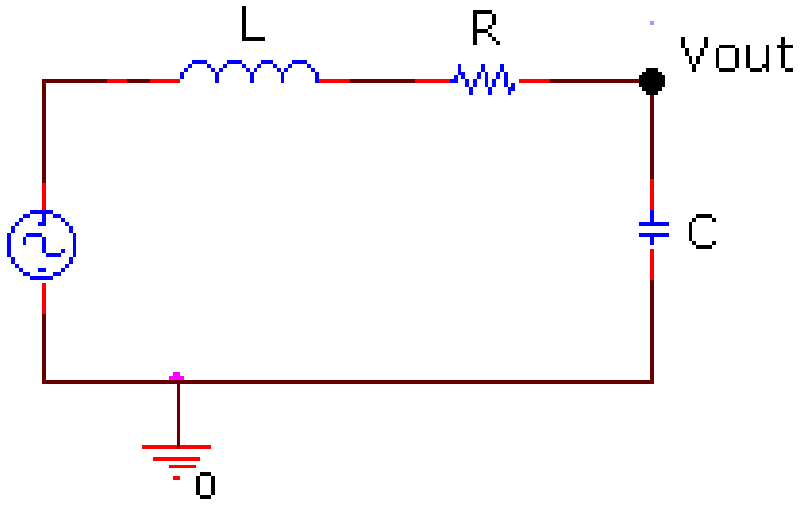
직렬 및 병렬 RLC 회로의 주파수 특성

RLC Series Circuit (I)



$$Z_{eq} = R + j\omega L + \frac{1}{j\omega C}$$

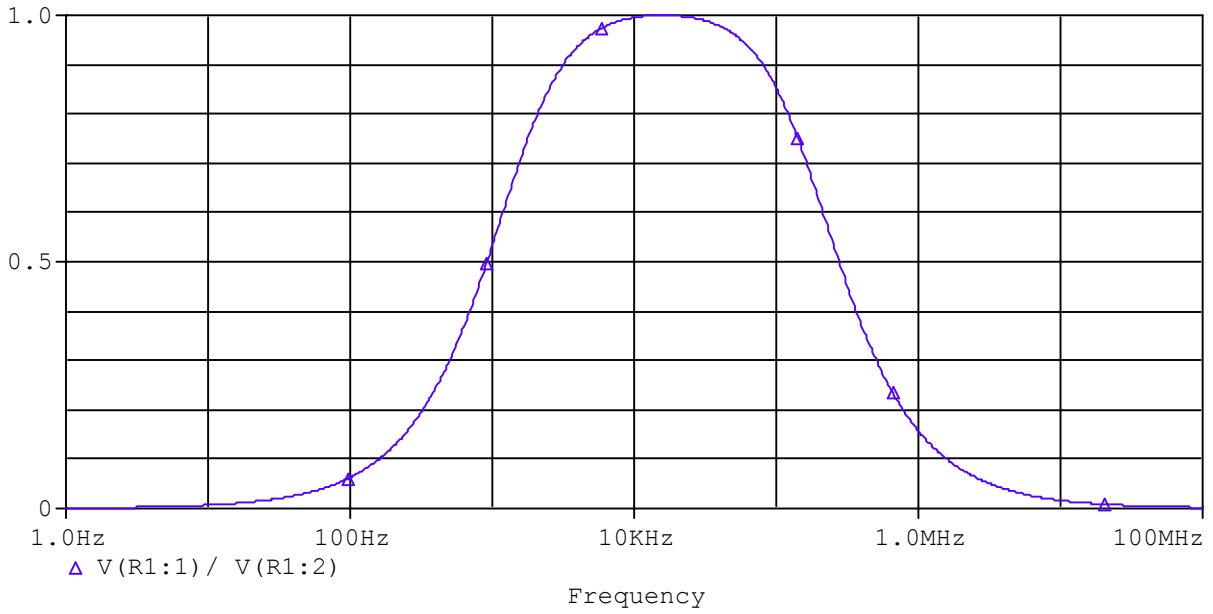
$$= \frac{(j\omega)^2 LC + j\omega RC + 1}{j\omega C}$$

$$= \frac{(1-\omega^2 LC) + j\omega RC}{j\omega C}$$

$$\frac{V_{out}}{V_{in}} = \frac{\frac{1}{j\omega C}}{Z_{eq}} = \frac{1}{(1-\omega^2 LC) + j\omega RC}$$

RLC Series Circuit (II)

$$\frac{V_R}{V_{in}} = \frac{R}{Z_{eq}} = \frac{j\omega RC}{(1-\omega^2 LC) + j\omega RC}$$



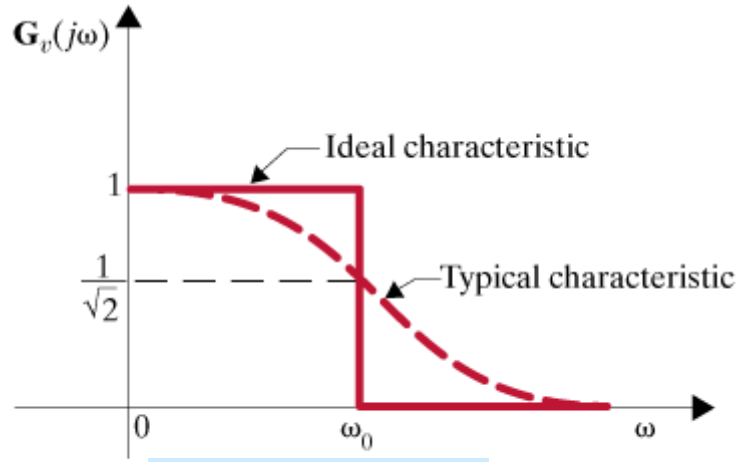
Resonant Frequency

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

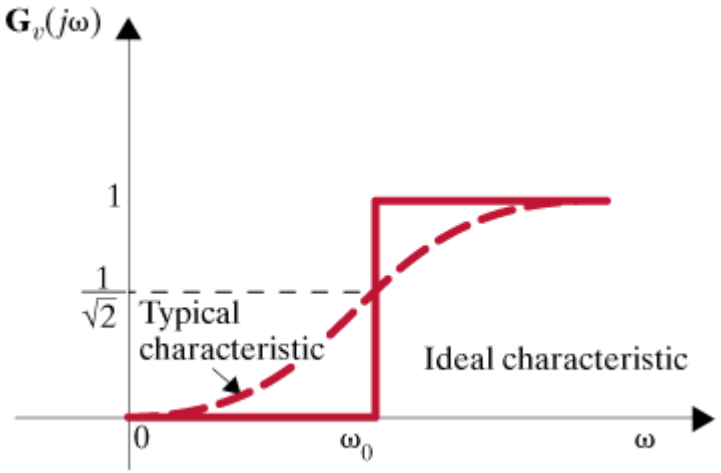
$$\frac{V_R}{V_{in}} = \frac{R}{Z_{eq}} = \frac{j\omega_0 RC}{(1-\omega_0{}^2 LC) + j\omega_0 RC} = 1$$

This can define the center of the band (on a band filter) or the location of the transition (on a high or low pass filter).

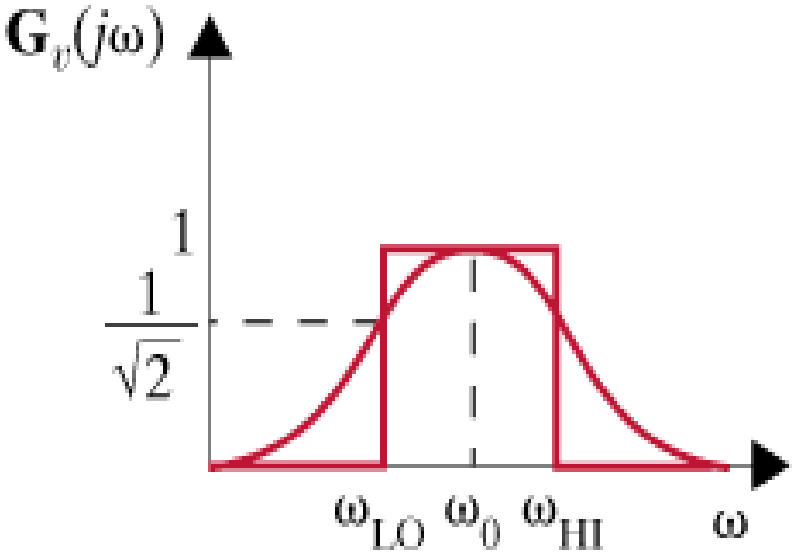
Various Filters



Low-pass filter

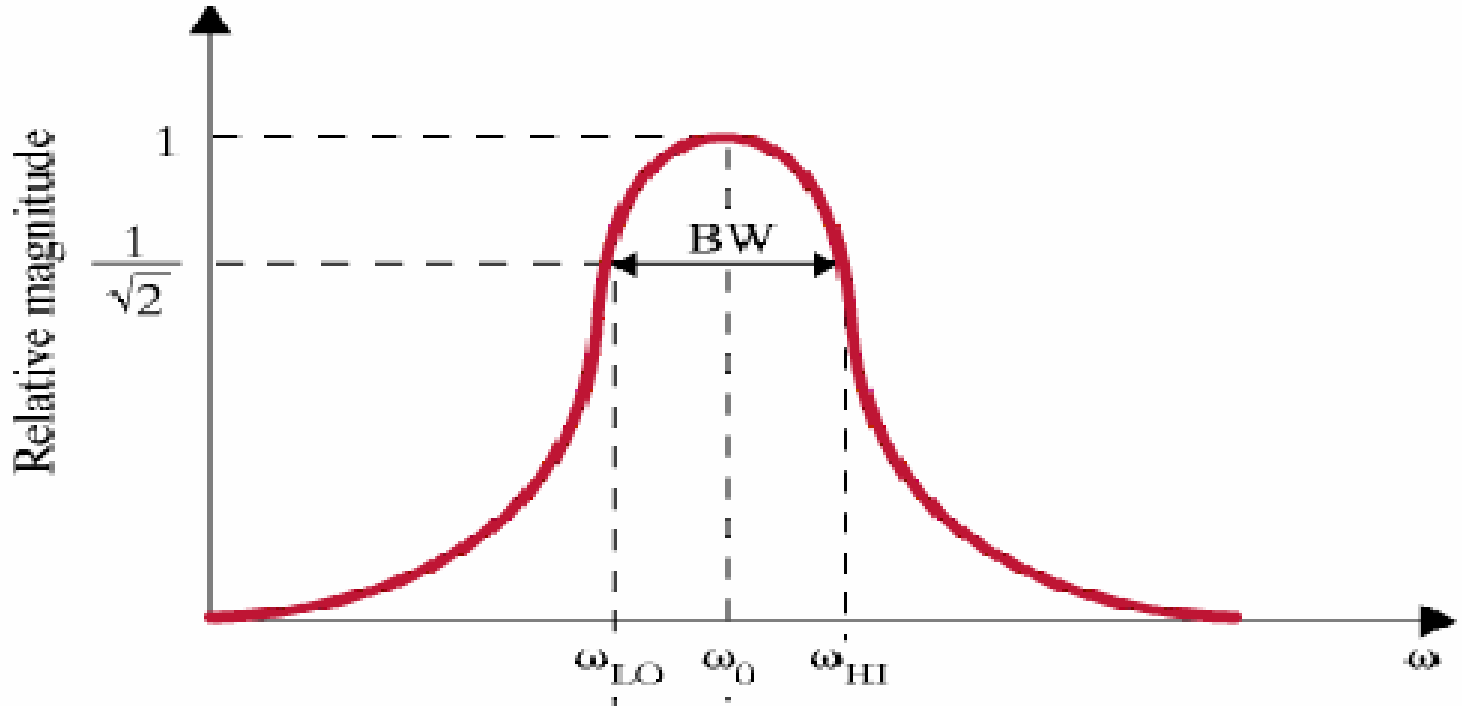


High-pass filter



Band-pass filter

Bandwidth and Q-Factor



$$BW = \omega_{HI} - \omega_{LO}$$

$$Q = \frac{\omega_0}{BW}$$

Band Rejection Filter