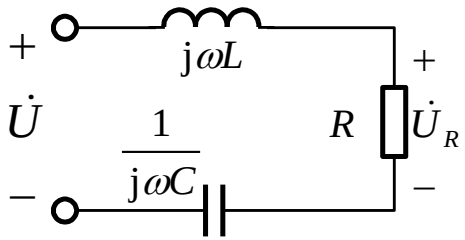
RLC 串联电路频率特性和滤波



$$|H_R(j\omega)| = \frac{1}{\sqrt{1+\frac{1}{R^2}\left(\omega L-\frac{1}{\omega C}\right)^2}} = \frac{1}{\sqrt{1+Q^2\left(\frac{\omega}{\omega_0}-\frac{\omega_0}{\omega}\right)^2}}$$

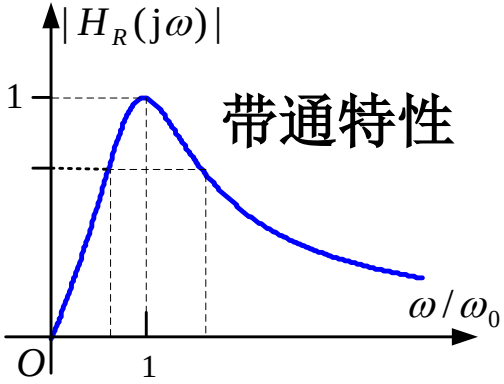
$$H_R(j\omega) = \frac{\dot{U}_R}{\dot{U}} = \frac{R}{R+j[\omega L-1/(\omega C)]}$$

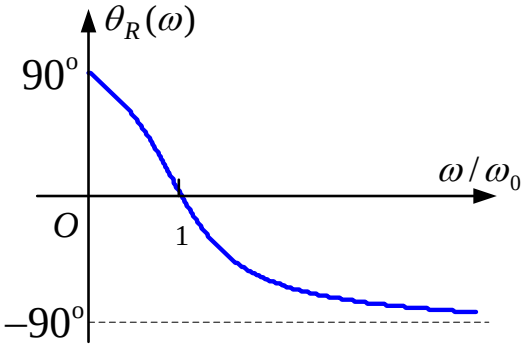
$$\omega_0 = \frac{1}{\sqrt{LC}} \qquad Q = \frac{\rho}{R} = \frac{\omega_0 L}{R} = \frac{1}{R\omega_0 C} = \frac{1}{R}\sqrt{\frac{L}{C}}$$

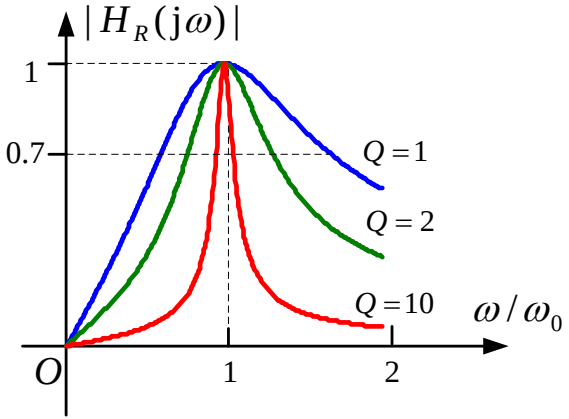
$$\theta_R(\omega) = -\arctan Q\left(\frac{\omega}{\omega_0}-\frac{\omega_0}{\omega}\right)$$

ω/ω_0	$\lvert H_R(j\omega)\rvert$	$\theta_R(\omega)$
0	0	90°
1	1	0°
⋮	⋮	⋮
⋮	⋮	⋮
∞	0	–90°

RLC 串联电路频率特性和滤波







幅频特性

相频特性

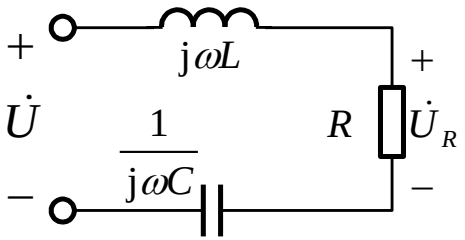
$$\frac{1}{\sqrt{1+Q^2\left(\frac{\omega_c}{\omega_0}-\frac{\omega_0}{\omega_c}\right)^2}}=\frac{1}{\sqrt{2}}$$

$$\omega_{c2}=\omega_0\left(\frac{1}{2Q}+\sqrt{\frac{1}{4Q^2}+1}\right)$$

$$\omega_{c1}=\omega_0\left(-\frac{1}{2Q}+\sqrt{\frac{1}{4Q^2}+1}\right)$$

$$\Delta\omega=\omega_{c2}-\omega_{c1}=\omega_0/Q$$

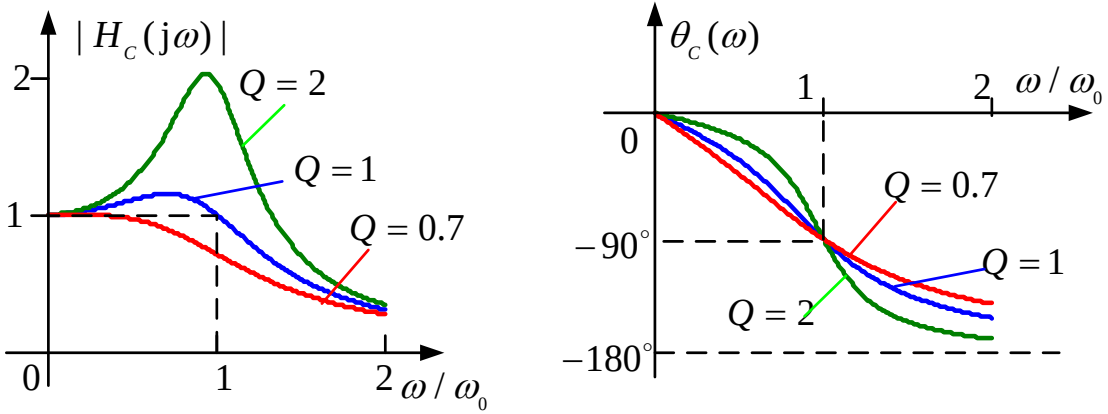
RLC 串联电路频率特性和滤波



$$H_C(j\omega)=\frac{\dot{U}_C}{\dot{U}}=\frac{1/(j\omega C)}{R+j\omega L+1/(j\omega C)}=\frac{1}{\left[1-\left(\frac{\omega}{\omega_0}\right)^2\right]+j\frac{1}{Q}\left(\frac{\omega}{\omega_0}\right)}$$

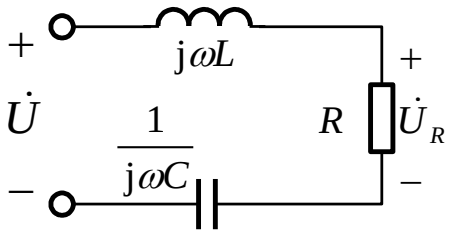
$$|H_C(j\omega)|=\frac{1}{\sqrt{\left[1-\left(\frac{\omega}{\omega_0}\right)^2\right]^2+\frac{1}{Q^2}\left(\frac{\omega}{\omega_0}\right)^2}}$$

$$\theta_C(\omega)=-\arctan\frac{1}{Q\left(\frac{\omega_0}{\omega}-\frac{\omega}{\omega_0}\right)}$$



RLC低通电路的滤波特性

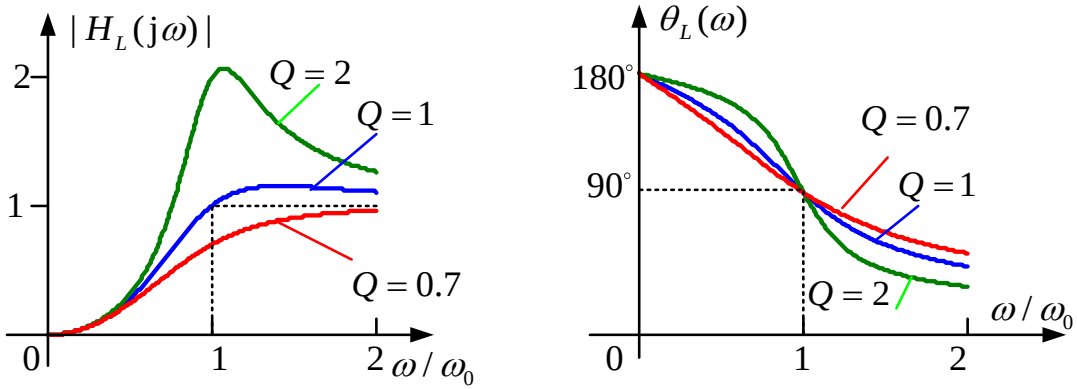
RLC 串联电路频率特性和滤波



$$H_L(j\omega)=\frac{\dot{U}_L}{\dot{U}}=\frac{j\omega L}{R+j\omega L+1/(j\omega C)}=\frac{1}{\left[1-\left(\frac{\omega_0}{\omega}\right)^2\right]-j\frac{1}{Q}\left(\frac{\omega_0}{\omega}\right)}$$

$$|H_L(j\omega)|=\frac{1}{\sqrt{\left[1-\left(\frac{\omega_0}{\omega}\right)^2\right]^2+\frac{1}{Q^2}\left(\frac{\omega_0}{\omega}\right)^2}}$$

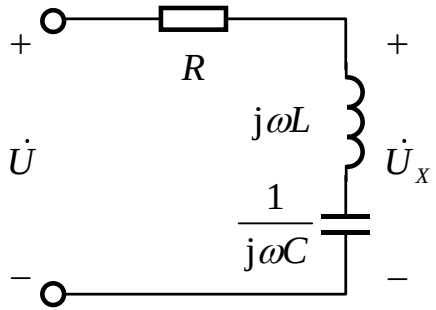
$$\theta_L(\omega)=-\arctan\frac{-1}{Q\left(\frac{\omega}{\omega_0}-\frac{\omega_0}{\omega}\right)}$$

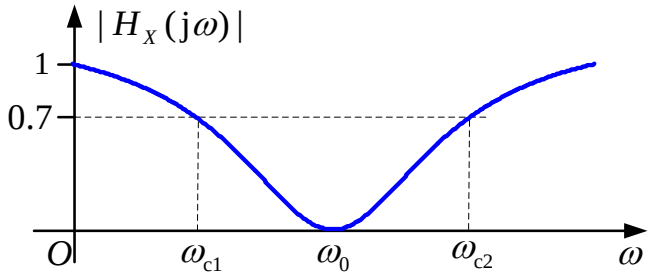


RLC高通电路频率特性

RLC 串联电路频率特性和滤波

RLC串联电路能否实现带阻特性？





$$H_X(\mathrm{j}\omega)=\frac{\dot{U}_X}{\dot{U}}=\frac{\mathrm{j}[\omega L-1/(\omega C)]}{R+\mathrm{j}[\omega L-1/(\omega C)]}$$

$$\omega_{c1}=\omega_0\left(-\frac{1}{2Q}+\sqrt{\frac{1}{4Q^2}+1}\right)$$

$$\omega_{c2}=\omega_0\left(\frac{1}{2Q}+\sqrt{\frac{1}{4Q^2}+1}\right)$$