

TOOL: For a 2-pole low-pass filter with conjugate poles, straight-line approximations work poorly on a Bode plot of phase angles. Thus, we use the actual phase response curves shown below as a function of ζ .

The transfer function for a 2-pole low-pass filter is

$$H(j\omega) = \frac{1}{\left| \left(\frac{j\omega}{\omega_0} \right)^2 + \frac{1}{Q} \left(\frac{j\omega}{\omega_0} \right) + 1 \right|}$$

or, terms of ζ :

$$H(j\omega) = \frac{1}{\left| \left(\frac{j\omega}{\omega_0} \right)^2 + 2\zeta \left(\frac{j\omega}{\omega_0} \right) + 1 \right|}$$

The plot below is for $\omega_0 = 1$. Shift the curve right or left to position it at the desired ω_0 . Shift right by $(\log_{10}) 2\pi$ if converting frequency to ω in rad/s.

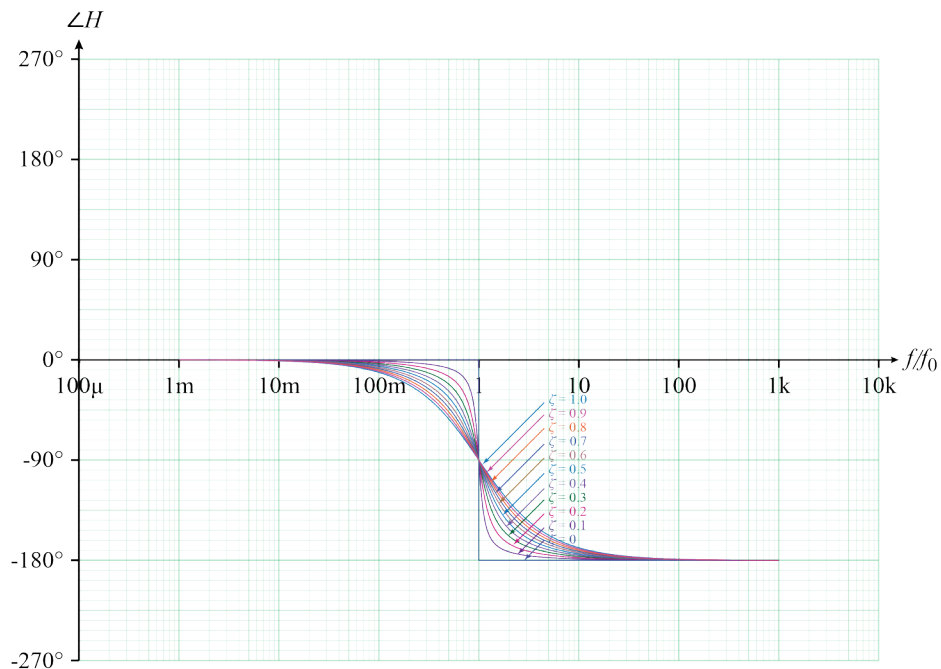


Fig. 1. Conjugate pole phase plots versus ζ .