



$$Z_L \parallel Z_C = \frac{j\omega L \cdot \frac{1}{j\omega C}}{j\omega L + \frac{1}{j\omega C}} = \frac{j\omega L}{(j\omega)^2 LC + 1}$$

$$\therefore \frac{V_{out}}{V_s} = \frac{Z_L \parallel Z_C}{Z_L \parallel Z_C + Z_R} = \frac{\frac{j\omega L}{(j\omega)^2 LC + 1}}{\frac{j\omega L}{(j\omega)^2 LC + 1} + R}$$

$$= \frac{j\omega L}{j\omega L + R[(j\omega)^2 LC + 1]} = \frac{j\omega L / R}{j\omega L / R + (j\omega)^2 LC + 1}$$

$$\left(\frac{\omega}{\omega_0} LC\right) = \frac{j\omega}{RC} \stackrel{Q_{parallel} \omega_0}{=} \frac{j\omega}{RC} + (j\omega)^2 + \left(\frac{1}{LC}\right) \omega_0^2$$

$$\text{check: } R\sqrt{\frac{C}{L}} / \frac{1}{\sqrt{LC}} = R\sqrt{\frac{C}{L}} \sqrt{LC} = RC$$

$$\frac{V_{out}}{V_s} = \frac{j\omega \frac{\omega_0}{Q}}{(j\omega)^2 + j\omega \frac{\omega_0}{Q} + \omega_0^2}$$

$$\text{where } Q_{parallel} = R\sqrt{\frac{C}{L}}$$

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