Huazhong University
of Science & Technology

Electronic Circuit of Communications

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and Commnications

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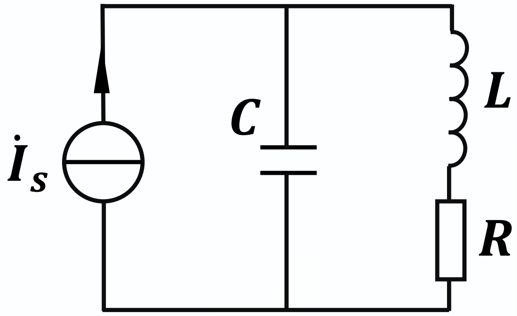
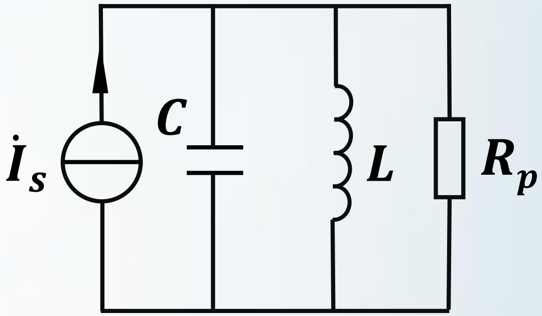
Equivalent Conversion

Review

Parallel Resonance Q_p



$\Leftrightarrow$



$$Q_p = \frac{\omega_p L}{R}$$

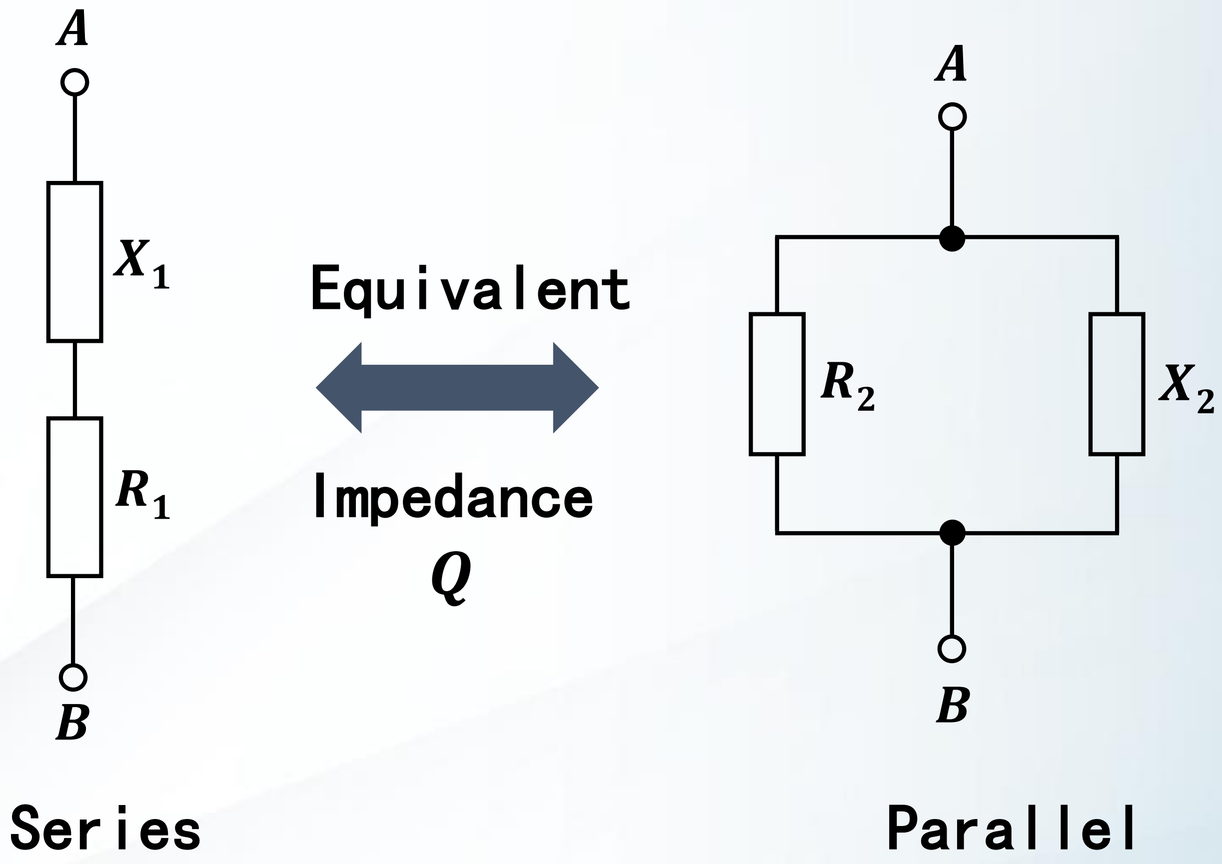
Loss Resistance

$$Q_p = \frac{R_p}{\omega_p L}$$

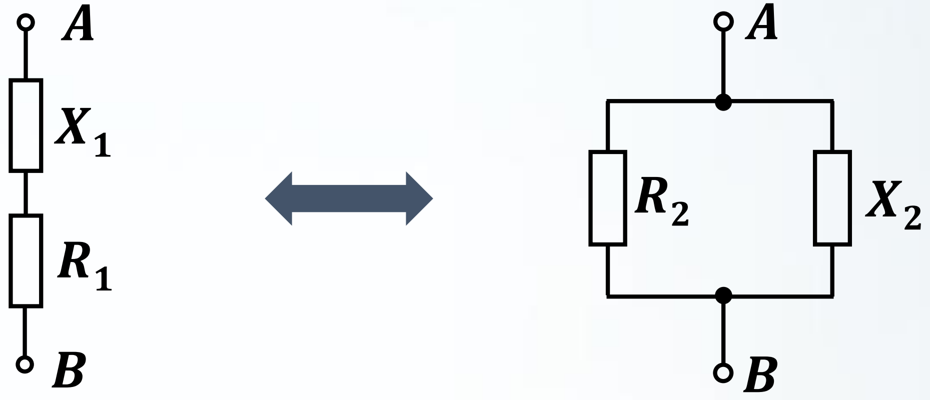
$$Q_p^2 \cdot R = R_p$$

$$R \overset{Q^2}{\Leftrightarrow} R_p$$

Equivalent Conversion of Series & Parallel Circuit



Equivalent Conversion



Equivalent Impedance

$$R_1 + jX_1 = \frac{R_2(jX_2)}{R_2 + jX_2} = \frac{R_2 X_2^2}{R_2^2 + X_2^2} + j\frac{R_2^2 X_2}{R_2^2 + X_2^2}$$

$$\Rightarrow \begin{cases} R_1 = \dfrac{R_2 X_2^2}{R_2^2 + X_2^2} \\ X_1 = \dfrac{R_2^2 X_2}{R_2^2 + X_2^2} \end{cases} \Rightarrow \begin{cases} R_2 = R_1\left(1 + \left(\dfrac{R_2}{X_2}\right)^2\right) = \boxed{R_1(1 + Q^2)} \\ X_2 = X_1\left(1 + \left(\dfrac{X_2}{R_2}\right)^2\right) = \boxed{X_1\left(1 + \dfrac{1}{Q^2}\right)} \end{cases}$$

Equivalent Q

$$Q = \frac{X_1}{R_1} = \frac{R_2}{X_2}$$

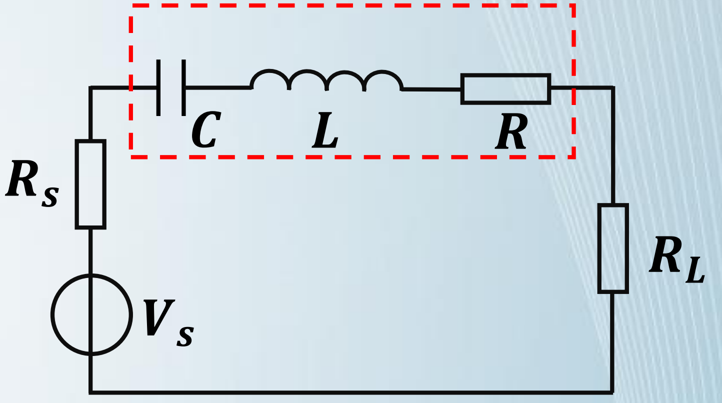
High Q (≥10)

$$\Rightarrow \begin{cases} R_2 \approx R_1 Q^2 & \text{Parallel >> Series} \\ X_2 \approx X_1 & \text{No change} \end{cases}$$

Review

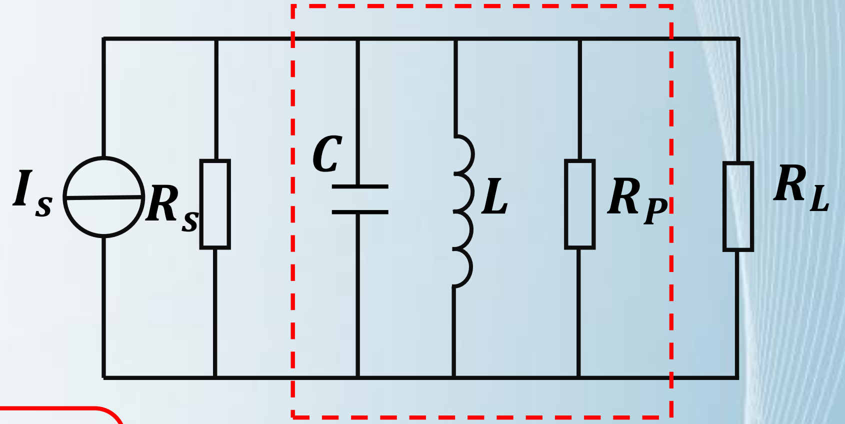
R_s R_L Small: Series

分压小



R_s R_L Big: Parallel

分流小

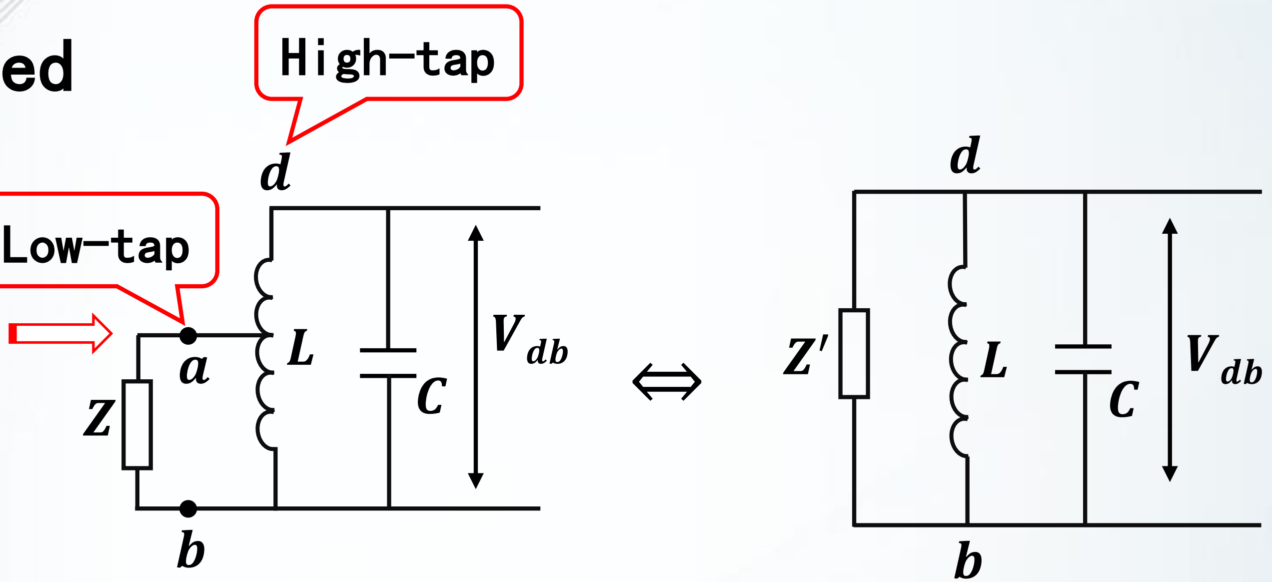


R_s R_L Middle:

Impedance Conversion

Tap Connection

Tap-Connected



Access Factor: $p = \dfrac{V_{ab}}{V_{db}} \leq 1$

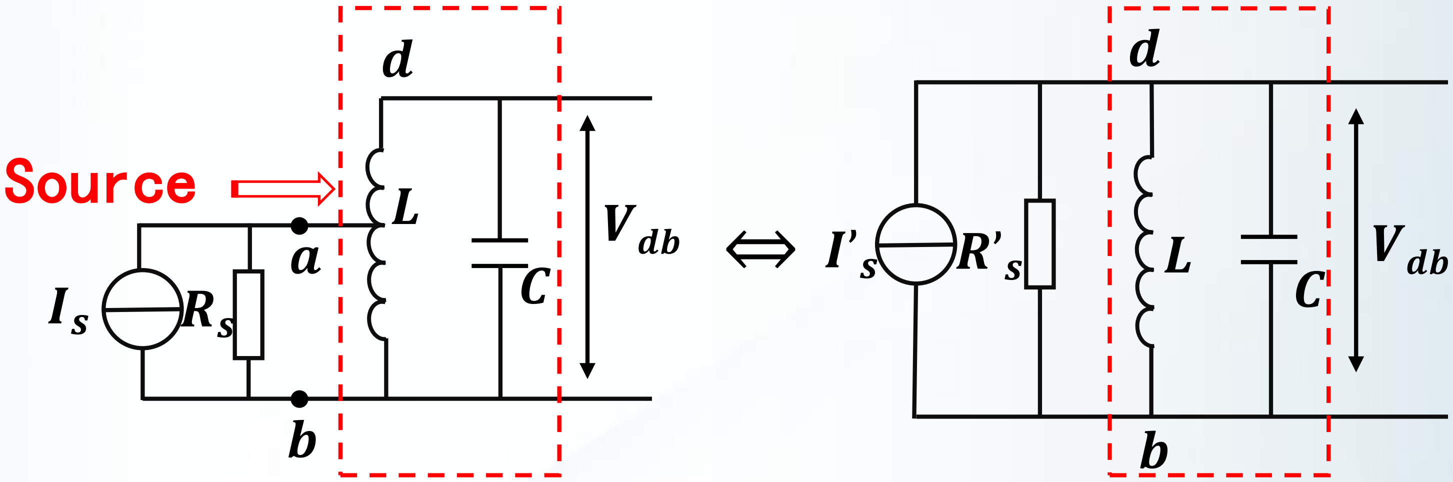
Equivalent Power: $\dfrac{V_{ab}^2}{Z} = \dfrac{V_{db}^2}{Z'} \Rightarrow Z' = \left(\dfrac{V_{db}}{V_{ab}}\right)^2 Z = \dfrac{1}{p^2} Z$

Low-tap → High-tap Equivalent impendance ↑ $\dfrac{1}{p^2}$

Voltage ↑ $\dfrac{1}{p}$

Current ↓ p

Tap-Connected



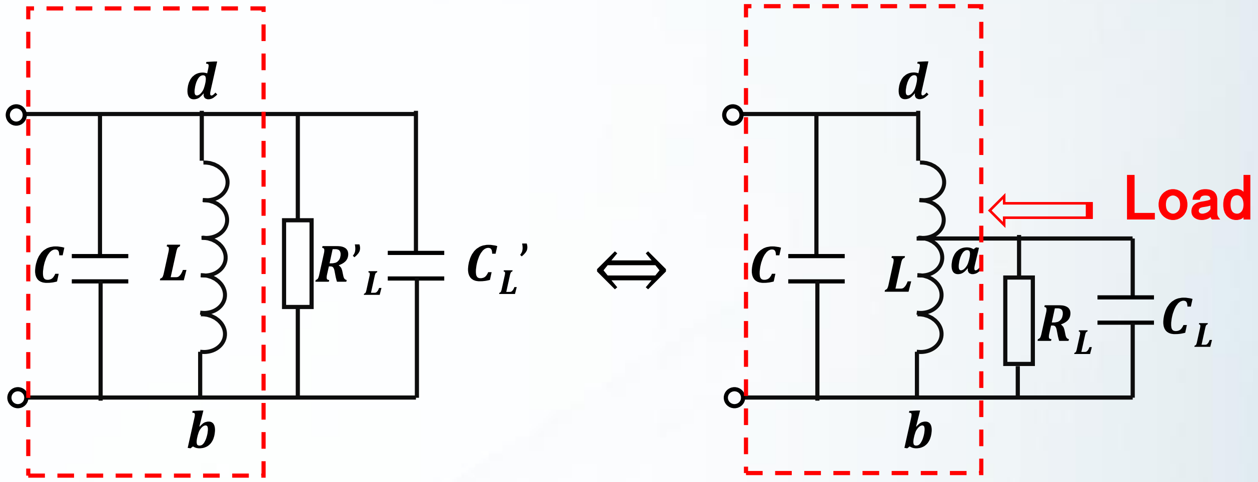
Low-tap → High-tap ：

$$R'_s = \frac{1}{p^2} R_s \Leftrightarrow R'_s \uparrow \quad \frac{1}{p^2}$$

$$I'_s = p \cdot I_s \Leftrightarrow I'_s \downarrow \quad p$$

Equivalent Power：
$I_s \cdot V_{ab} = I'_s \cdot V_{db}$

Tap-Connected



Low-tap → High-tap ：

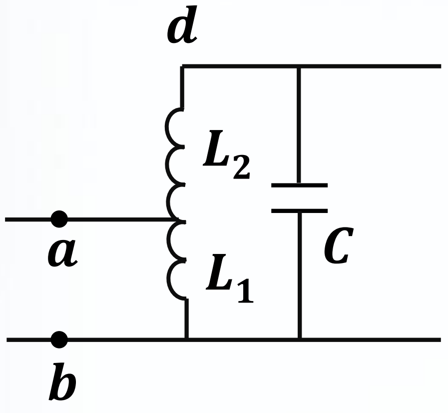
$$R_L' = \frac{1}{p^2} R_L \Leftrightarrow R_L' \uparrow \frac{1}{p^2}$$

$$\frac{1}{\omega C_L'} = \frac{1}{p^2} \cdot \frac{1}{\omega C_L} \Leftrightarrow \frac{1}{\omega C_L'} \uparrow \frac{1}{p^2}$$

$\Rightarrow$ $C_L' = p^2 \cdot C_L \Leftrightarrow$ Capacitance $C_L' \downarrow p^2$

Access Factor p

Inductor Tap



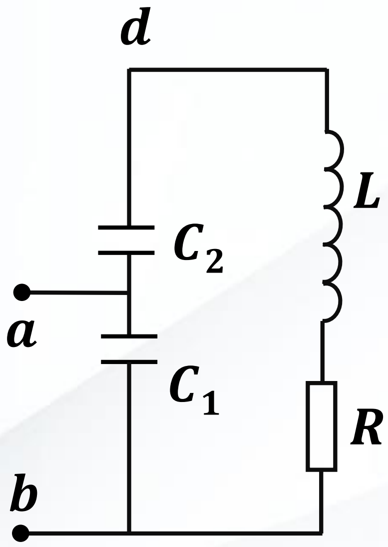
Not consider M:

$$p = \frac{L_1}{L_1 + L_2} = \frac{N_1}{N_1 + N_2}$$

Consider M:

$$p = \frac{L_1 \pm M}{L_1 + L_2 \pm 2M}$$

Capacitor Tap



$$C = \frac{C_1 C_2}{C_1 + C_2}$$

$$p = \frac{C}{C_1} = \frac{C_2}{C_1 + C_2}$$