ECE 2101L
Electrical Circuit Analysis II Laboratory

Lab 12
Maximum Power Transfer and Power Factor Correction

Prelab

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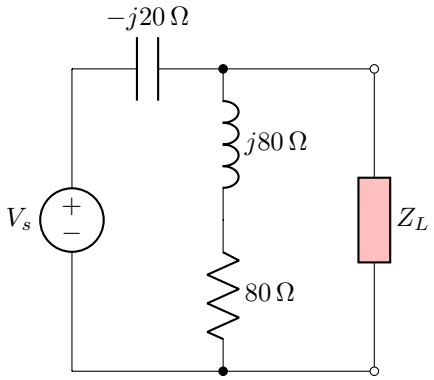
1 Maximum power transfer



Z_L required to maximize power transfer is the complex conjugate of the Thevenin impedance between the two terminal of the load impedance.

$$Z_L = (\frac{1}{\frac{1}{80+j80} + \frac{1}{-j20}})^* = 3.2 + j22.4\,\Omega$$

$$S_{max} = \frac{|V_L|^2}{Z_L^*} = \frac{\left| \frac{\frac{200\sqrt{2}}{\sqrt{2}} \frac{1}{\frac{1}{80+j80} + \frac{1}{3.2+j22.4}}}{\frac{1}{\frac{1}{80+j80} + \frac{1}{3.2+j22.4}} - j20} \right|^2}{3.2 - j22.4} = \frac{640000}{3.2 - j22.4} = 4000 + j28000\,\text{VA}$$

$$P_{max} = 4000\,W$$

2 Power factor correction

Given $I = 10\underline{/9.2^\circ}$ and $V = 240\underline{/62^\circ}$

$$S = \frac{1}{2} V_m I_m \underline{/\theta_v - \theta_i} = \frac{1}{2}(240)(10)\underline{/62^\circ - 9.2^\circ}$$

$$S = 1200\underline{/52.8^\circ} = 725.5 + j955.8\,\text{VA}$$

Apparent Power

$$|S| = 1200\,\text{VA}$$

Real Power

$$P = 725.5\,\text{W}$$

Reactive Power

$$Q = 955.8\,\text{VAR}$$

Power Factor

$$PF = cos(\theta_v - \theta_i) = cos(52.8^\circ) = 0.6046$$

The capacitance required to 0.97 lagging can be determined as follow,

$$C = \frac{1}{\omega |Z_C|} = \frac{Q_c}{\omega V_{rms}^2} = \frac{Q - P\, tan(cos^{-1}(0.97))}{\omega V_{rms}^2}$$

$$C = \frac{955.8 - (725.5)(0.2506)}{28800\omega} = \frac{0.02687}{\omega}\,\text{F}$$