Series Resonance

\[ Z = j\omega L + \frac{1}{j\omega C} + R \]
Impedance Plot: Series LRC

Normalized Frequency

$|Z|$, ohms

Normalized Frequency
Maximizing Power to Load

\[ P_L = \frac{1}{2}|i|^2 R_L \]

\[ |i| = \text{max when } X_{\text{comp}} = -\Im m(Z_L) \]
Power Factor Correction

\[ P_{\text{apparent}} = 1/2 |V||I| \]

\[ |I| = \sqrt{\Re(I)^2 + (\Im(I))^2} \]

\[ P_{\text{apparent}} = \min \text{ when } i_{\text{comp}} = -\Im(i_L) \]

\[ 1/X_{\text{comp}} = -\Im(1/Z_L) \]
Feedback Amplifier

\[ V_{out} = A(\omega)(V_{in} - fV_{out}) \]

\[ \frac{V_{out}}{V_{in}} = \frac{A(\omega)}{1 + fA(\omega)} \]

Typically:

\[ A(\omega) = \frac{A_0}{1 + j\omega/\omega_0} \]
Calculated Bode Plot: Op-Amp

Normalized Frequency

-20. dB
+0. dB
+20. dB
+40. dB
+60. dB

Normalized Frequency
Bode Plot: 741 Op-Amp