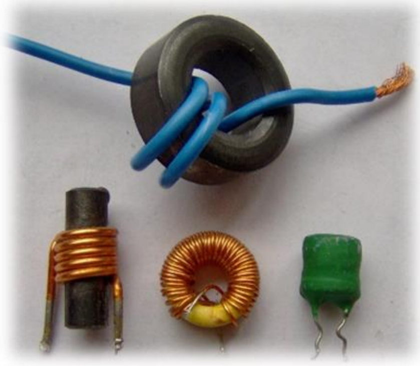
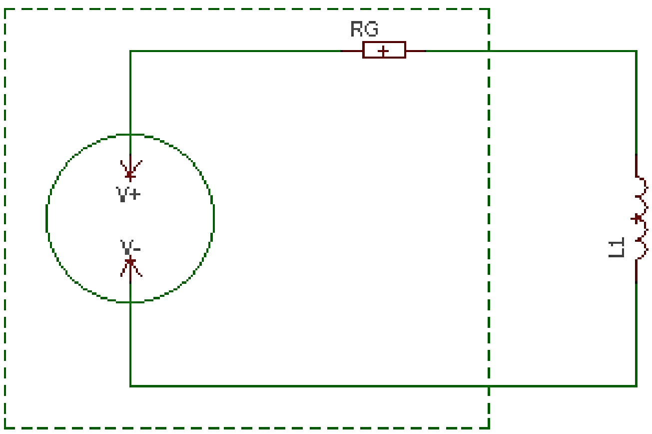
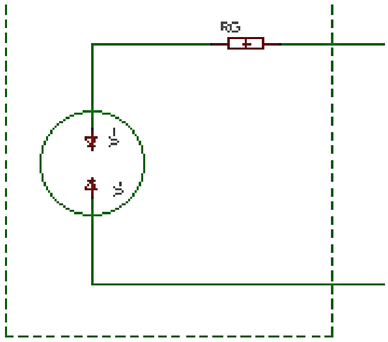


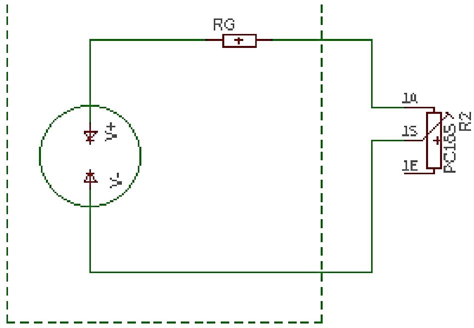
$$V_L(t) = L\frac{di}{dt}$$

$$X_L = j\,\omega\,L$$

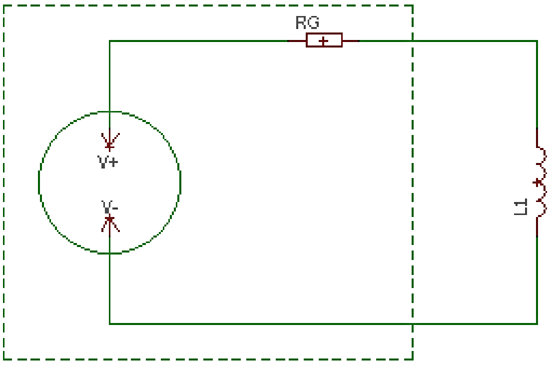


Medición de la impedancia de salida del Generador de funciones:





Primera aproximación (inductor ideal):



$$V_{Out} = \frac{Z_2}{Z_1 + Z_2}\, V_{in} \;\Rightarrow\; \frac{V_{Out}}{V_{in}} = \frac{Z_2}{Z_1 + Z_2}$$

$$\underbrace{\frac{V_{Out}}{V_{in}}}_{K} = \frac{j\,\omega\,L}{R_G + j\,\omega\,L} \;\Rightarrow K = \frac{j\,\omega\,L}{(R_G + j\,\omega\,L)}\,\frac{(R_G - j\,\omega\,L)}{(R_G - j\,\omega\,L)}$$

$$K = \frac{j\,\omega\,L\,R_G - (j\,\omega\,L)^2}{R_G^2 - (j\,\omega\,L)^2} \;\Rightarrow\; K = \frac{\omega^2\,L^2 + j\,\omega\,L\,R_G}{R_G^2 + \omega^2\,L^2}$$

Recordar que por definición: $j^2 = -1$

$$K = \frac{\omega^2\,L^2}{R_G^2 + \omega^2\,L^2} + j\,\frac{\omega\,L\,R_G}{R_G^2 + \omega^2\,L^2} \;\Rightarrow$$

$$|K| = \sqrt{\left(\frac{\omega^2\,L^2}{R_G^2 + \omega^2\,L^2}\right)^2 + \left(\frac{\omega\,L\,R_G}{R_G^2 + \omega^2\,L^2}\right)^2} \;\Rightarrow$$

$$|K| = \sqrt{\frac{\omega^4\,L^4}{(R_G^2 + \omega^2\,L^2)^2} + \frac{\omega^2\,L^2\,R_G^2}{(R_G^2 + \omega^2\,L^2)^2}} \;\Rightarrow$$

$$|K| = \frac{\sqrt{\omega^4\,L^4 + \omega^2\,L^2\,R_G^2}}{R_G^2 + \omega^2\,L^2} \;\Rightarrow\; |K| = \frac{\sqrt{\omega^2\,L^2\,(\omega^2\,L^2 + R_G^2)}}{R_G^2 + \omega^2\,L^2}$$

$$|K| = \frac{\sqrt{(\omega\, L)^2}\sqrt{(R_G^2 + \omega^2\, L^2)}}{R_G^2 + \omega^2\, L^2} \;\Rightarrow\; |K| = \frac{\omega\, L\sqrt{(R_G^2 + \omega^2\, L^2)}}{R_G^2 + \omega^2\, L^2}$$

$$\therefore\; |K| = \frac{\omega\, L}{\sqrt{(R_G^2 + \omega^2\, L^2)}}$$

Por otro lado:

$$|K| = \left|\frac{V_{Out}}{V_{in}}\right| = \left|\frac{1}{2}\right| = \frac{1}{2}$$

$$\frac{\omega\, L}{\sqrt{(R_G^2 + \omega^2\, L^2)}} = \frac{1}{2} \Rightarrow \left(\frac{\omega\, L}{\sqrt{(R_G^2 + \omega^2\, L^2)}}\right)^2 = \left(\frac{1}{2}\right)^2$$

$$\frac{\omega^2\, L^2}{R_G^2 + \omega^2\, L^2} = \frac{1}{4} \Rightarrow 4\, \omega^2\, L^2 = R_G^2 + \omega^2\, L^2$$

$$4\, \omega^2\, L^2 - \omega^2\, L^2 = R_G^2 + \omega^2\, L^2$$

$$L^2\, (4\, \omega^2 \, - \omega^2) = R_G^2$$

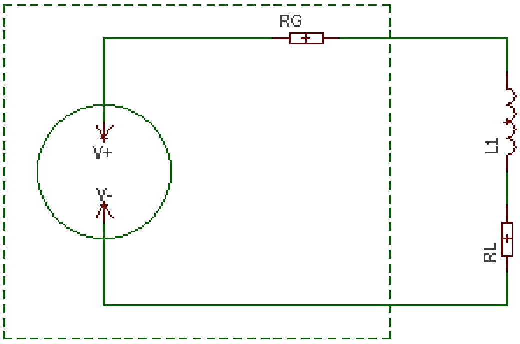
$$L^2 \; = \frac{R_G^2}{3\, \omega^2} \Rightarrow L = \sqrt{\frac{R_G^2}{3\, \omega^2}}$$

$$\therefore\;\; L = \frac{R_G}{\sqrt{3}\, \omega}$$

Relacionando: $\omega = 2\, \pi\, f$

$$\boxed{L\, (f) = \frac{R_G}{2\, \sqrt{3}\, \pi\, f}}$$

Segunda aproximación (considerando “R” del bobinado):



$$V_{Out} = \frac{Z_2}{Z_1 + Z_2} V_{in} \Rightarrow \frac{V_{Out}}{V_{in}} = \frac{Z_2}{Z_1 + Z_2}$$

$$\underbrace{\frac{V_{Out}}{V_{in}}}_{K} = \frac{j\,\omega\,L + R_L}{R_L + R_G + j\,\omega\,L} \Rightarrow K = \frac{(j\,\omega\,L + R_L)}{(R_L + R_G + j\,\omega\,L)} \frac{(R_L + R_G - j\,\omega\,L)}{(R_L + R_G - j\,\omega\,L)}$$

$$K = \frac{j\,\omega\,L\,R_L + j\,\omega\,L\,R_G - (j\,\omega\,L)^2 + R_L^2 + R_L\,R_G - j\,\omega\,L\,R_L}{(R_L + R_G)^2 - (j\,\omega\,L)^2} \Rightarrow$$

$$K = \frac{\omega^2\,L^2 + R_L^2 + R_L\,R_G + j\,\omega\,L\,R_G}{(R_L + R_G)^2 + \omega^2\,L^2} \Rightarrow$$

$$K = \frac{\omega^2\,L^2 + R_L^2 + R_L\,R_G}{(R_L + R_G)^2 + \omega^2\,L^2} + j\,\frac{\omega\,L\,R_G}{(R_L + R_G)^2 + \omega^2\,L^2}$$

Tomamos módulo y resolvemos con el Mathematica para obtener:

$$\boxed{\therefore\ L\,(f, R_L) = \frac{\sqrt{R_G^2 + 2\,R_G\,R_L - 3\,R_L^2}}{2\,\sqrt{3}\,\pi\,f}}$$