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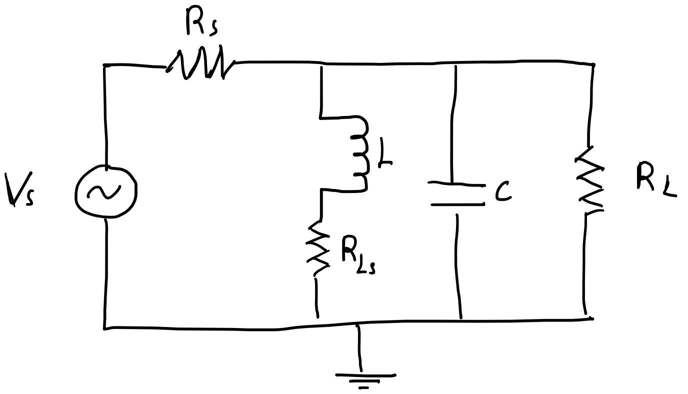
$L = 40\ nH$ $\quad f_r = 120\ MHz$

$Q = 100$ $\quad R_s = R_L = 50\ \Omega$

$C \rightarrow$ Ideal

a.



b.

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$120 \times 10^6 = \frac{1}{2\pi\sqrt{40 \times 10^{-9} \cdot C}}$$

$$120^2 \times 10^{12} = \frac{1}{4\pi^2 \cdot 40 \times 10^{-9} \cdot C}$$

$$C = \frac{1}{4\pi^2 \cdot 40 \times 10^{-9} \cdot 120^2 \times 10^{12}}$$

$$C = 4{,}398 \times 10^{-11}\ F$$

$$C = 43{,}98\ pF$$

c.

$$Q = \frac{X_s}{R_{Ls}}$$

$$R_{Ls} = \frac{2\pi \cdot f_r \cdot L}{Q}$$

$$R_{Ls} = \frac{2\pi \cdot 120 \times 10^6 \cdot 40 \times 10^{-9}}{100} = 0{,}3\ \Omega$$

$$R_{Lp} = R_{Ls}(Q^2+1)$$

$$R_{Lp} = 0,3(100^2+1)$$

$$R_{Lp} = 3\,k\Omega$$

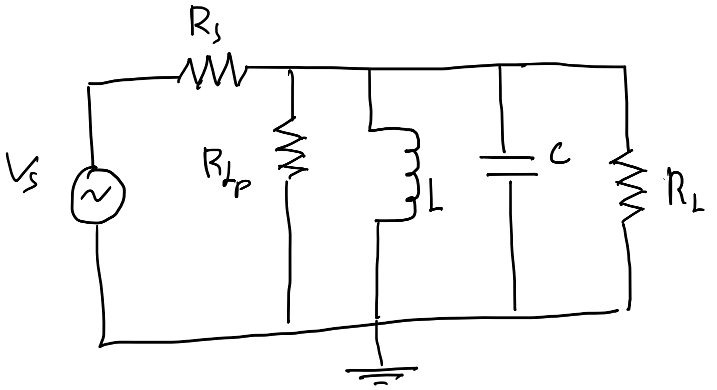
$$X_{Lp} = \frac{R_{Lp}}{Q}$$

$$2\pi \cdot f_r \cdot L_p = \frac{R_{Lp}}{Q}$$

$$L_p = \frac{3000}{2\pi \cdot 120\times10^6 \cdot 100}$$

$$L_p = 3,979\times10^{-8}\ H$$

$$L_p = 39,79\ nH$$



d. $$\frac{1}{R_p} = \frac{1}{R_s} + \frac{1}{R_L} + \frac{1}{R_{Lp}}$$

$$\frac{1}{R_p} = \frac{1}{50} + \frac{1}{50} + \frac{1}{3000}$$

$$\frac{1}{R_p} = \frac{121}{3000}$$

$$R_p = 24,79\ \Omega$$

$$Q_T = \frac{R_p}{X_p} = \frac{24,79}{2\pi \cdot f_r \cdot L}$$

$$Q_T = \frac{24,79}{2\pi \cdot 120\times10^6 \cdot 40\times10^{-9}}$$

$$Q_T = 0,82$$

$$Q_T = \frac{f_r}{BW}$$

$$BW = \frac{f_r}{Q_T}$$

$$BW = \frac{120\times10^6}{0,82}$$

$$BW = 146\ MHz$$

e. $R_Z = \dfrac{R_{Lp} \cdot R_L}{R_{Lp} + R_L} = \dfrac{3000 \cdot 50}{3000 + 50} = 49,18\ \Omega$

$$V_L = \frac{R_Z}{R_S + R_Z} \cdot V_S = \frac{49,18}{50 + 49,18} \cdot V_S = 0,496\, V_S$$

$$P_{Lossy} = \frac{V_L^2}{R_L} = \frac{(0,496\ V_S)^2}{50} = 4,92 \times 10^{-3}\ V_S^2$$

$$V_I = \frac{R_L}{R_S + R_L} \cdot V_S = \frac{50}{50 + 50} V_S = 0,5\ V_S$$

$$P_{Ideal} = \frac{V_I^2}{R_L} = \frac{(0,5\ V_S)^2}{50} = 5 \times 10^{-3}\ V_S^2$$

$$\text{Insertion Loss} = 10 \log \left(\frac{V_I}{V_L} \right)$$

$$= 10 \log \left(\frac{5 \times 10^{-3}\ V_S^2}{4,92 \times 10^{-3}\ V_S^2} \right)$$

$$= 0,07\ \text{dB}$$