For problem 1), using the designed match, calculate the match-point impedance, inductor impedance, input impedance (at terminals of matching network), input reflection coefficient, and SWR at 95, 100, & 105 MHz. Tabulate results. Format: col. 1 frequency, col. 2 $Z_m$, col. 3 $Z_{ind}$, col. 4 $Z_{in}$, col. 4 $\Gamma_{in}$, & col. 5 SWR.

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For a circuit operating at 100 MHz, design and sketch a single series inductor matching network for a load $Z_L = 100 + j150\ \Omega$ connected to a lossless transmission line ($250\ \Omega$, $2 \times 10^8$ m/s). Use Smith chart solution method.

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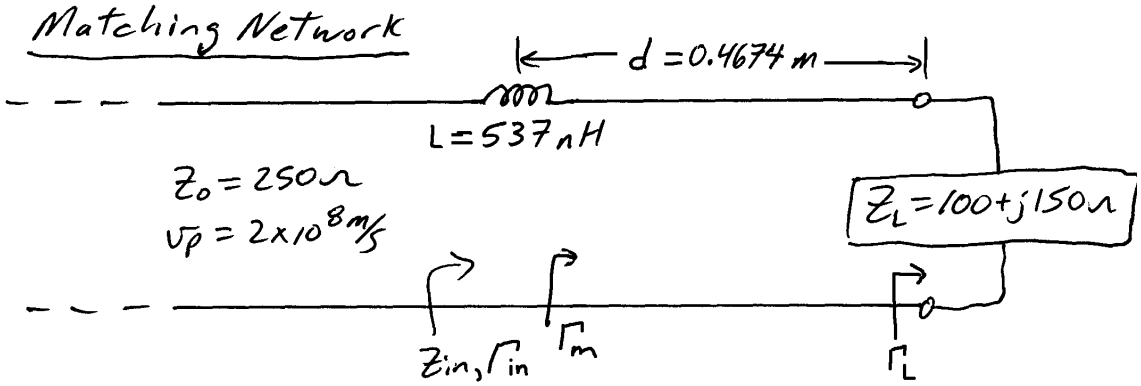


Used MathCad (next page) for calculations of the equations below-

$$\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0} \text{ (fixed value)}$$

$$\beta = \frac{\omega}{v_p} = \frac{2\pi f}{v_p} \text{ (changes w/ frequency)}$$

$$\Gamma_m = \Gamma_L e^{-j2\beta d} \Rightarrow Z_m = Z_0\left(\frac{1+\Gamma_m}{1-\Gamma_m}\right)$$

$$Z_{ind} = j\omega L = j2\pi f L \Rightarrow Z_{in} = Z_{ind} + Z_m$$

$$\Gamma_{in} = \frac{Z_{in} - Z_0}{Z_{in} + Z_0} \Rightarrow SWR = \frac{1+|\Gamma_{in}|}{1-|\Gamma_{in}|}$$

| $f$ (MHz) | $Z_m$ (Ω) | $Z_{ind}$ (Ω) | $Z_{in}$ (Ω) | $\Gamma_{in}$ (Ω) | SWR |
|---|---|---|---|---|---|
| 95 | 304.87-*j*366.31 | *j*320.54 | 304.87-*j*45.77 | 0.1283∠-35.1° | 1.294 |
| 100 | 248.15-*j*334.16 | *j*337.41 | 248.15+*j*3.24 | 0.0075∠119.3° | 1.015 |
| 105 | 205.92-*j*301.2 | *j*354.28 | 205.92+*j*53.08 | 0.1503∠123.1° | 1.354 |

**Given:**

$vp := 2 \cdot 10^{8}$ m/s $\quad Z0 := 250$ Ω $\quad ZL := 100 + j \cdot 150$ Ω

$d := 0.4674$ m $\quad L := 537 \cdot 10^{-9}$ H

$\Gamma L := \frac{ZL - Z0}{ZL + Z0}$ $\quad |\Gamma L| = 0.5571$ $\quad \arg(\Gamma L) \cdot \frac{180}{\pi} = 111.801$ deg

$SWR := \frac{1 + |\Gamma L|}{1 - |\Gamma L|}$ $\quad SWR = 3.5155$ no match

$f95 := 95 \cdot 10^{6}$ MHz $\quad f100 := 100 \cdot 10^{6}$ MHz $\quad f105 := 105 \cdot 10^{6}$ MHz

$\beta 95 := \frac{2 \cdot \pi \cdot f95}{vp}$ $\quad \beta 100 := \frac{2 \cdot \pi \cdot f100}{vp}$ $\quad \beta 105 := \frac{2 \cdot \pi \cdot f105}{vp}$

$\beta 95 = 2.985$ rad/m $\quad \beta 100 = 3.142$ rad/m $\quad \beta 105 = 3.299$ rad/m

$\Gamma m95 := \Gamma L \cdot e^{-j \cdot 2 \cdot \beta 95 \cdot d}$ $\quad \Gamma m100 := \Gamma L \cdot e^{-j \cdot 2 \cdot \beta 100 \cdot d}$ $\quad \Gamma m105 := \Gamma L \cdot e^{-j \cdot 2 \cdot \beta 105 \cdot d}$

$Zm95 := Z0 \cdot \frac{(1 + \Gamma m95)}{(1 - \Gamma m95)}$ $\quad Zm100 := Z0 \cdot \frac{(1 + \Gamma m100)}{(1 - \Gamma m100)}$ $\quad Zm105 := Z0 \cdot \frac{(1 + \Gamma m105)}{(1 - \Gamma m105)}$

$Zm95 = 304.87 - 366.31i$ Ω $\quad Zm100 = 248.15 - 334.16i$ Ω $\quad Zm105 = 205.92 - 301.2i$ Ω

$Zind95 := j \cdot 2 \cdot \pi \cdot f95 \cdot L$ $\quad Zind100 := j \cdot 2 \cdot \pi \cdot f100 \cdot L$ $\quad Zind105 := j \cdot 2 \cdot \pi \cdot f105 \cdot L$

$Zind95 = 320.537i$ Ω $\quad Zind100 = 337.407i$ Ω $\quad Zind105 = 354.277i$ Ω

$Zin95 := Zm95 + Zind95$ $\quad Zin100 := Zm100 + Zind100$ $\quad Zin105 := Zm105 + Zind105$

$Zin95 = 304.87 - 45.77i$ Ω $\quad Zin100 = 248.15 + 3.24i$ Ω $\quad Zin105 = 205.92 + 53.08i$ Ω

$\Gamma in95 := \frac{Zin95 - Z0}{Zin95 + Z0}$ $\quad \Gamma in100 := \frac{Zin100 - Z0}{Zin100 + Z0}$ $\quad \Gamma in105 := \frac{Zin105 - Z0}{Zin105 + Z0}$

$|\Gamma in95| = 0.1283$ $\quad |\Gamma in100| = 0.00749$ $\quad |\Gamma in105| = 0.15032$

$\arg(\Gamma in95) \cdot \frac{180}{\pi} = -35.12$ deg $\quad \arg(\Gamma in100) \cdot \frac{180}{\pi} = 119.28$ deg $\quad \arg(\Gamma in105) \cdot \frac{180}{\pi} = 123.07$ deg

$SWR95 := \frac{1 + |\Gamma in95|}{1 - |\Gamma in95|}$ $\quad SWR100 := \frac{1 + |\Gamma in100|}{1 - |\Gamma in100|}$ $\quad SWR105 := \frac{1 + |\Gamma in105|}{1 - |\Gamma in105|}$

$SWR95 = 1.294$ $\quad SWR100 = 1.015$ $\quad SWR105 = 1.354$