

Designing and Performance Evaluation of Microstrip Line for Wi-Fi Application

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Abstract

In this research a microstrip line is designed and performance of this line is evaluated at 2.4 GHz. The effect of substrate on the performance parameters of microstrip line is also investigated. Conducting line of microstrip line is designed using Copper material. Substrate material for designed microstrip line is FR4 and RT-5880. The structure of microstrip line is simulated by using High frequency structure simulator.

Index Terms— Microstrip line, Transmission losses, VSWR.

1. Introduction

Microstrip lines play an important role for transmission of signal in monolithic microwave integrated circuits. A microstrip transmission line consists of a narrow metallic trace separated from a metallic ground plane by a slab of dielectric material, as shown in Fig (1).

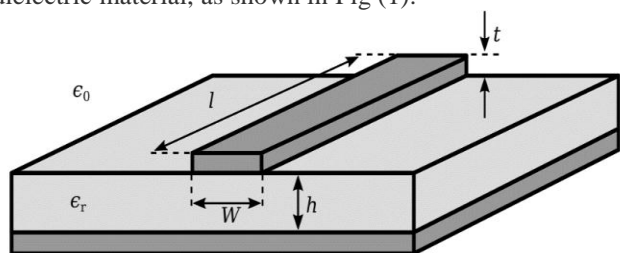


Figure.1 Microstrip line

Performance parameters of microstrip line depends on the dielectric constant of substrate, height of substrate and width of substrate.

The optimized expressions of Characteristics impedance of transmission line as given by [1-5] is

For $\frac{W}{h} \leq 1$

$$\epsilon_{re} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left[\left\{ 1 + 12 \left(\frac{h}{W} \right) \right\}^{-\frac{1}{2}} + .004 \left\{ 1 - \left(\frac{W}{h} \right) \right\}^2 \right] \text{-----(1)}$$

$$Z_c = \frac{60}{\sqrt{\epsilon_{re}}} \ln \left(8 \frac{h}{W} + .25 \frac{W}{h} \right) \text{-----(2)}$$

For $\frac{W}{h} \geq 1$

$$\epsilon_{re} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left[\left\{ 1 + 12 \left(\frac{h}{W} \right) \right\}^{-\frac{1}{2}} \right] \text{-----(3)}$$

$$Z_c = \frac{120\pi}{\sqrt{\epsilon_{re}} \times \left[\frac{W}{h} + 1.39 + \frac{2}{3} \ln \left(\frac{W}{h} + 1.44 \right) \right]} \text{----- (4)}$$

As per the design equations the parameters of interest for designing microstrip line is given below.

Table 1

S. No.	Name of Parameter	Value
1	Resonant Frequency	2.4 GHz
2	Microstrip line Length	2.28 Cm
3	Microstrip line width	.244 cm
4	Substrate Material	Duriod
5	Substrate height	.16 cm

In this research the effect of varying the dielectric constant of substrate on transmission characteristics of microstrip line at 2.4 GHz is investigated. High frequency structure simulator is used to design and extract the characteristics of microstrip line.

2. Results and Discussion

The structure of Microstrip line designed using High Frequency Structure Simulator for 2.4 GHz is shown in Fig (2).

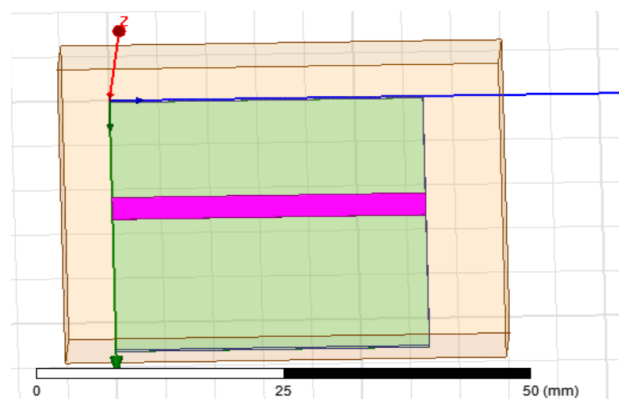


Figure 2. Structure of Microstrip line

Input Impedance of designed microstrip line is shown in Fig (3) and its magnitude is 41 Ω at 2.4 GHz

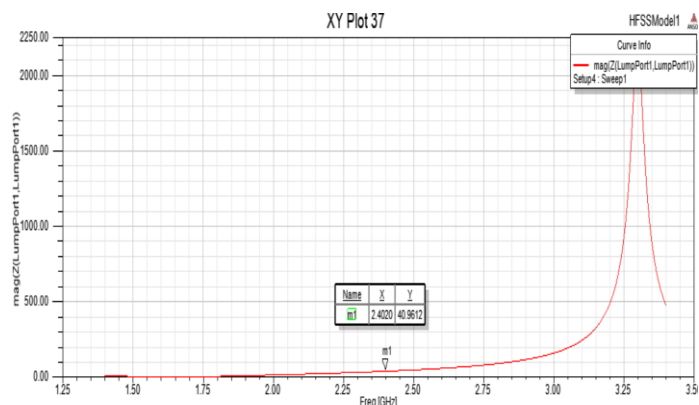


Figure 3. Input impedance of microstrip line

The transmission scattering parameter S_{12} is measured to be 0db and is shown in Fig (4). This indicates a loss of zero db when signal propagates from port 1 to port2.

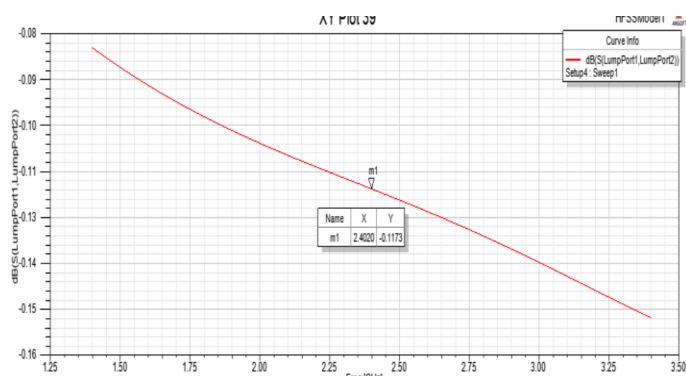


Figure 4. S_{12} graph of Microstrip line

In order to investigate the effect of substrate material substrate material is changed to FR4 without affecting the other parameters of microstrip line Input Impedance of designed microstrip line for FR4 substrate material is shown in Fig (5) and its magnitude is 365 Ω at 2.4 GHz.

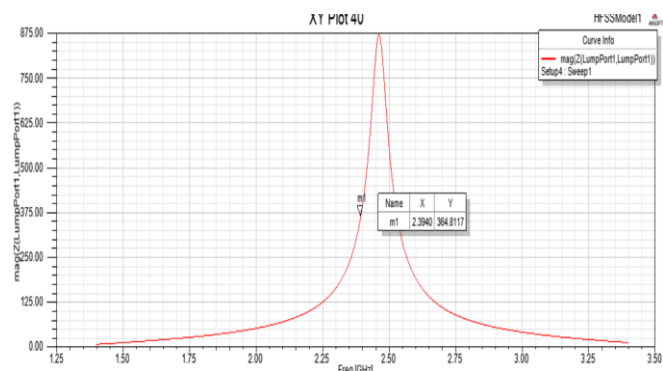


Figure 5. Input impedance of microstrip line

The transmission scattering parameter S_{12} is measured to be 0 db and is shown in Fig (6). This indicates a loss of zero db when signal propagates from port 1 to port2.

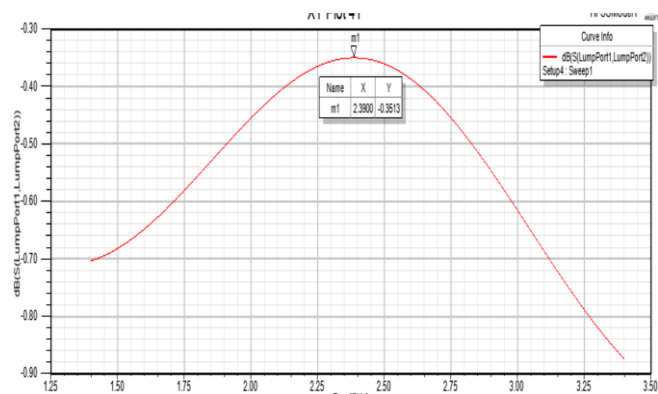


Figure 6. S_{12} graph of Microstrip line

Conclusion

A microstrip line for 2.4 GHz is designed and simulated. The transmission loss of designed microstrip line from input port to output port are zero i.e signal propagates from prt 1 to port 2 without any loss. By keeping the other parameters same substrate material is changed from duriod to FR4. How this change in substrate had not affected the performance of microstrip line.

References

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