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Design of Dual Band Micro Strip Antenna for 2.4 Ghz and 3.6 Ghz

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***Abstract:** As technology is growing, it has created a need for the antennas to transmit/ receive at faster rate, with more than one frequency at a time. This is possible with use of dual band antenna. In the given paper, the design of microstrip rectangular patch antenna for dual band application that uses two frequencies, 3.6GHz and 2.4GHz, is presented. The antenna consists of two rectangular slots, positioned on the rectangular patch which is mounted on the ground substrate made of FR4 epoxy. The standard antenna formulae are used to find the dimensions of the patch and positioning of the rectangular slots, and simulation-based optimization techniques in Ansys HFSS (High-Frequency Structural Simulator - a computer software dealing with 3D electromagnetic models). The position of slots determines the operating frequencies of the antenna. The dual band antennas are commercially used in routers, where there is a need for faster data rate.*

***Keywords:** dual band, HFSS, microstrip, slot antenna.*

I. INTRODUCTION

Today, the need for compact and less cost antennas pave way to the advancement of microstrip antennas for its planar configuration, small sizes and ability to work on high and multiple frequencies. The proposed dual band antenna design given has lots of practical uses, especially for mobile devices. These antenna operates on two bands of frequencies and can either work on these different frequencies one at a time or simultaneously. There are different ways to design an antenna that can operate for dual frequency, in this paper, slots are used for the same.The advantage of dual band antennas is their ability to provide a strong, stable wireless connection in often difficult to reach locations. It can also be used as an energy harvesting antenna. The two most common frequencies used in these antennas are 2.4 GHz and 3.6 GHz. The 3.6 GHz option has the higher frequency and subsequently, a smaller range. However, this higher frequency also allows the 3.6 GHz antenna to handle more information at any one time. The 2.4 GHz option inversely has a lower frequency, allowing the antenna to cover greater distances as well as penetrate surfaces more efficiently. Thus a dual band antenna can use both frequencies at once or switch between the two frequencies depending area.

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The dual band also provides us an alternative to avoid signal interference among different devices operating in the similar frequency range and therefore dual band antennas are a stable, easy way to connect between our day to day things.Rectangular microstrip antenna being simple in its geometry and construction can be used for the construction of dual band antenna by creating slots in the patch.

The operation of the slot antenna at a particular frequency depends on the geometry of antenna, type of substrate material, position of slots, type of feed, etc.

II. ANTENNA DESIGN

The designing of the antenna begins with the patch printed on the ground substrate. For the proposed antenna, the substrate has a thickness of h=1.6mmand a relative permittivity ε_r = 4.4 for FR-4 Epoxy dielectric. A 50Ω microstrip line is designed with a width of 3mm. The dimensions of the patch, length and width are 27.13mm and 38.03mm respectively, and the dimensions of substrate are length L=70mm and width W=70mm. The given dimensions of the antenna are calculated using following formulae:

A. Width of patch:

$$W = \frac{c}{2 f_r \sqrt{\frac{\varepsilon_r + 1}{2}}} \quad \text{mm} \qquad \text{-(1)}$$

B. Dielectric constant:

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2\sqrt{1 + \frac{12h}{W}}} \quad \text{F/m} \qquad \text{-(2)}$$

C. Length extension:

$$\frac{\Delta L}{h} = 0.412 \times \frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)} \qquad \text{-(3)}$$

W/h > 1

D. Effective length:

$$L = \frac{c_o}{2 f_r \sqrt{\varepsilon_{re}}} \quad \text{mm} \qquad \text{-(4)}$$

E. Feed point position for 50ohm

$$R_{in}(y = y_o) = R_{in}(y = 0)Cos^2(\frac{\prod}{L} y_o) \quad \Omega \qquad -(5)$$

where Rin (y=yo) is 50 Ohms and Rin (y=0)

The above equations are used to get the antenna parameters which are summarized in the table1.

Table1: Parameters of the antenna

PARAMETER	VALUE
Lg (Length of Substrate)	70mm
Wg (Width of Substrate)	70mm
Thickness of substrate	1.6 mm
ϵr(FR-4 Epoxy dielectric)	4.4
ϵreff	4.78
Lp (Length of Patch)	27.13mm
Wp (Width of Patch)	38.03mm
L1 (Length of feed line)	35mm
W1 (Width of feed line)	3mm
ΔL	0.72mm

III. ANTENNA SIMULATION AND RESULT

The rectangular slot antenna is designed with the help of Ansys HFSS software. The below figures are the results of the simulations done on Ansys HFSS software based on the specifications given in table1:

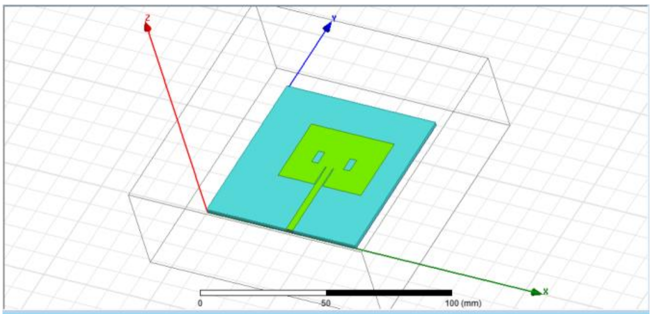

Fig.1 Geometry of Antenna

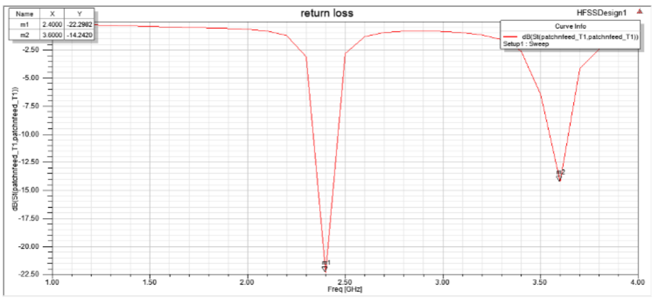

Fig.2 Return Loss vs Frequency

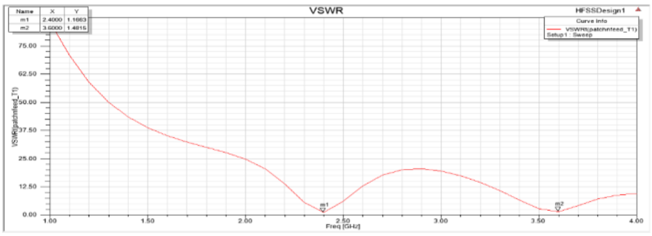

Fig.3 VSWR

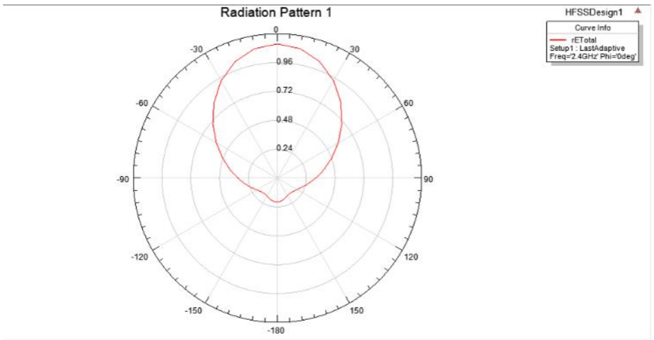

Fig.4 Radiation Pattern-2D

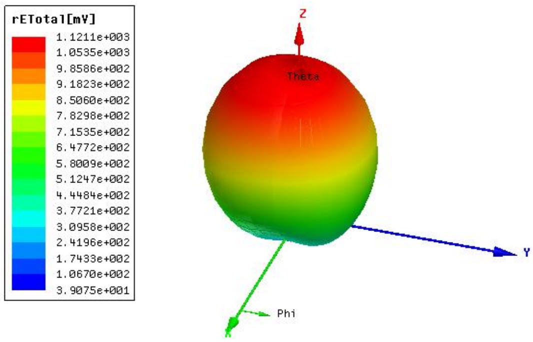

Fig.5 Radiation Pattern-3D

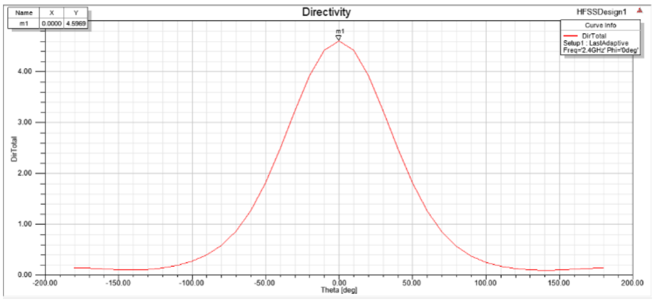

Fig.6 Directivity vs Frequency

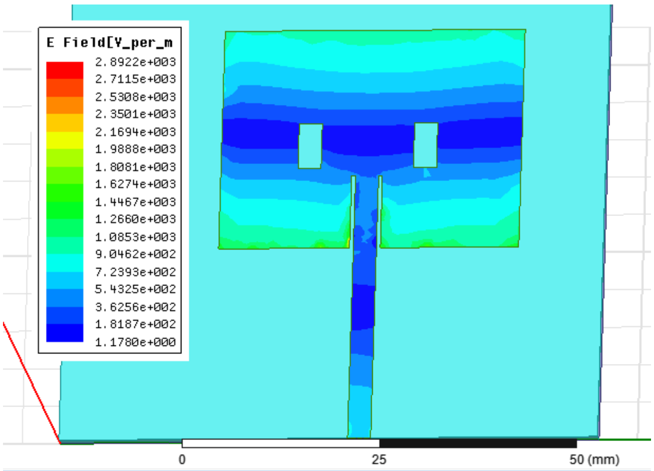

Fig.7 Current Distribution of Simulated Dual Band Antenna

The results obtained by simulation is consolidated in the following table2.

Table2: Simulated Results of Antenna

Frequency	**Values**
Return loss at 2.4GHz	-22.2982 dB
Return loss at 3.6GHz	-14.2420 dB
VSWR at 2.4GHz	1.1663
VSWR at 3.6GHz	1.4815

IV. CONCLUSION

The antenna is designed for dual band of frequencies of 2.4 GHz and 3.6 GHz. The proposed antenna is a rectangular patch microstrip antenna with two rectangular slots on the patch and a ground substrate of FR-4 Epoxy. Given antenna design is realized through simulation, optimization and testing features provided by Ansys HFSS 13(High-Frequency Structural Simulator) software. There are many aspects that affect the performance of the antenna such as dimensions, the shape of patch, slots, feeding technique, substrate. These parameters are varied to get optimized results. It is found that the results obtained after simulation are matching the expected results. Design parameters shown in table1 are used to design the antenna, the position of two slots are varied to optimize the return loss and and results are shown in table 2.

REFERENCES

1. Noor Hidayah Mohd Yunus, Jahariah Sampe and Jumril Yunas ,“ParameterDesign of Microstrip Patch Antenna Operating at Dual Microwave-Band for RF Energy Harvester Application”, Regional symposium on micro and nanoelectronics(RSM),2017.
2. Z. Zakaria, N. A. Zainuddin, M. Z. A. Abd Aziz, M. N. Husain, M. A. Mutalib “A Parametric Study on Dual-Band Meander Line Monopole Antenna For RF Energy Harvesting,Sept 2013.
3. Gregorio Zamora-Mej´ıa and Jaime Mart´ınez-Castillo “A 910MHz/2.4GHz Easily Tunable Dual-Band Antenna for Power Harvesting and Sensor Networking Applications”,ICCSAT, Dec 2015..
4. G.Indumathi K.Karthika “Rectenna Design for RF Energy Harvesting in Wireless Sensor Networks”,ICECCT, March 2015.
5. S. C. Pan and K. L. Wong, “Dual Frequency Triangular Microstrip Antenna With A Shorting Pin”, IEEE Trans Antennas Propagation, pp. 1889-1891, 1997.

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