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Dual Band Slot Patch Antenna for ISM Band Applications

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Abstract*—Wireless technology is booming extensively, which has fuelled a new dimension to this field. Antennas are an indispensable part of wireless communication and modern society. The paper will be categorized in three main antenna designs. The first is the design of circular patch antenna which resonates at the frequency of 2.45 GHz and the second antenna is the design of circular patch antenna which is operates at 5.8 GHz. The third sub-part is to design a dual band patch antenna operating simultaneously at both 2.45 and 5.8 GHz. Modeling, designing and simulation of all three antenna design with coaxial feeding technique with FR-4 as the substrate having dielectric constant of 4.4. The application includes Wi-Fi at 2.45 GHz and WLAN at 5.8 GHz center frequency.*

Keywords—patch antenna; dual band; coaxial feed

I. INTRODUCTION

The development of wireless local area networks is becoming vital in the field of information and communication technology. This leads to growth in the field of antennas, antenna being an inseparable part of communication. The vibrant field of Micro-strip antennas received immense attention due to the low cost, conformal radiators and miniature size. These antennas are the most suited for aerospace and mobile applications. The other advantages includes, light weight and low profile for satellite and aerospace applications.

The fundamental micro-strip antenna consists of three main elements, a base substrate of dielectric FR-4, a patch on the substrate of different shape and a ground below the substrate.Conducting material such as copper or gold are used for making the radiating patch, placed on the substrate by the process of photo-etching.The radiating patch can have different shapes. The basic shapes like rectangle, circle and triangle are used in patch antenna. The feeding technique used is coaxial feed. The advantage of coaxial feed is that is can be fabricated easily during hardware implementation and can be easily optimized to the proper position for impedance matching during simulation. However there are disadvantages like narrow bandwidth and difficulty in modeling of thick substrate.The other feeding technique includes transmission line feeding, proximity couple feeding and capacitive feeding. The ISM- band is license free band hence readily available for Wi-Fi application.

The HFSS 13.0 (High Frequency Structure Simulator) software is used for modeling, simulation and analysis purpose.

II. ANTENNA DESIGN

With the increase application in the communication systems there is a need for dual-band antennas. There are a quite few techniques currently available to achieve dual band operation with micro-strip antennas. Therefore the project work is divided into to three design categories.

A. Design Geometry

The first category is a patch design, with a circular shaped patch with radius 16.66 mm on the FR-4 substrate with thickness 1.6mm and dielectric constant 4.4. The second category is the same patch with reduced radius and increased substrate thickness. The third category includes introduction of slots on the patch with optimized radius and substrate as shown in Fig. 1 with its side view in Fig. 2.

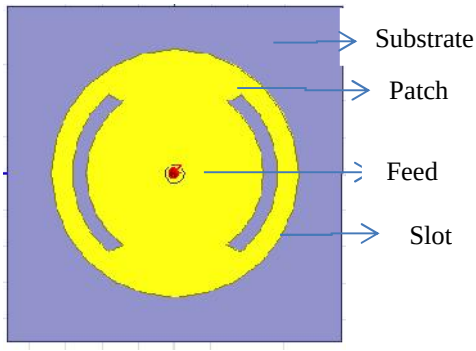

Fig. 1 Top view of Microstrip patch antenna

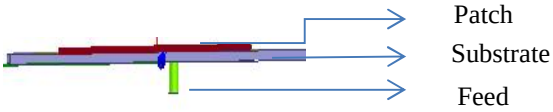

Fig.2 Side view of Microstrip patch antenna

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B. Specifications

The basic idea of the two semi-circular slots is for the better band-width and gain [1]. The complete dimensions of all parameters for three antennas are shown in the table below. The dielectric constant for all the three antennas is 4.4 as the substrate used in all the three stages is FR-4.

TABLE I: DESIGN DIMENSIONS

Antenna No.	PARAMETERS	VALUES
I	Resonant frequency	2.45 GHz
	Substrate height	1.6 mm
	Patch radius	16.66 mm
II	Resonant frequency	5.8 GHz
	Substrate height	3.2 mm
	Patch radius	3mm
III	Resonant frequency	2.45 GHz and 5.8 GHz
	Substrate height	1.6 mm
	Patch radius	17 mm
	Slot outer radius	15.9 mm
	Slot inner radius	15 mm
	Slot width	0.9 mm

III. SIMULATIONS AND RESULTS

All the designs are implemented using AnsoftHFSS13.0 software at selected designof 2.4 GHz frequency. The software simulations are thus performed and the results obtained are hence studied. The diagrams below show the corresponding results providing the validations.

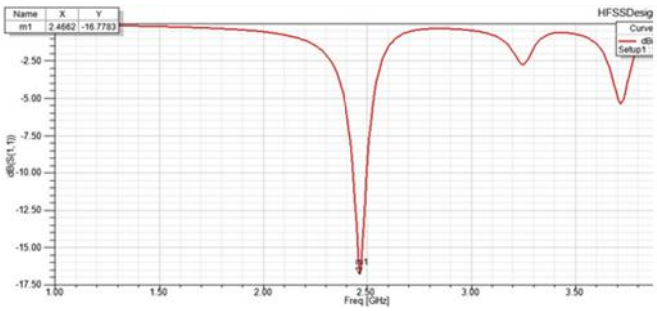

Fig. 3 Return loss at 2.4 GHz

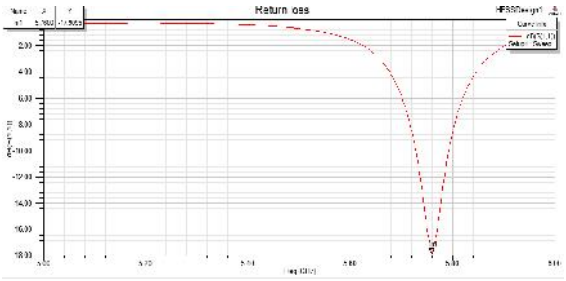

Fig. 4 Return loss at 5.8 GHz

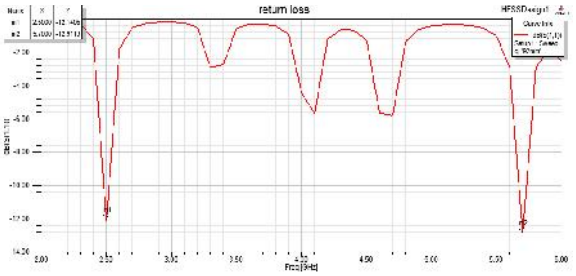

Fig. 5 Return loss at both 2.45 GHz and 5.8 GHz (dual band)

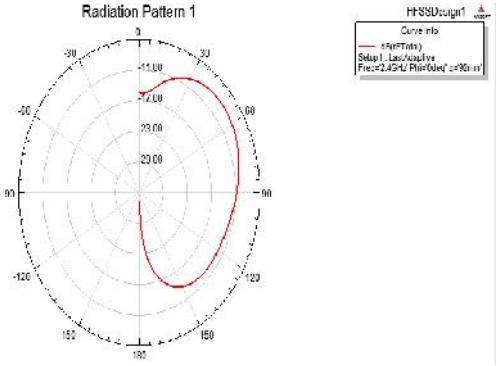

Fig. 6 Radiation pattern at 2.4 GHz

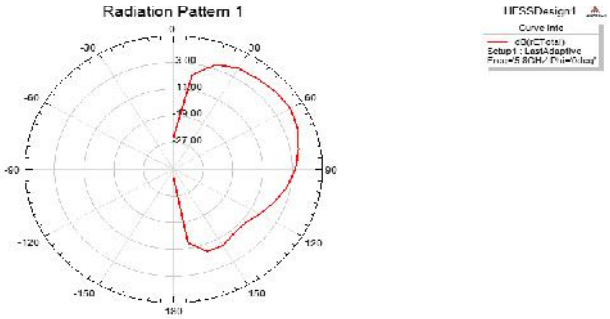

Fig. 7 Radiation pattern at 5.8 GHz

IV. CONCLUSION

After analysis the simulation results of all the three antennas it can be concluded that as the radius of the patch is decreased the resonating frequency increases. Also the return loss at 2.45 GHz is -16.77 dB, -17.90 dB at 5.8 GHz and for the dual band application it is approximately -12 dB for both the frequency. Implying that with multiband the return loss is decreased hampering the efficiency. The polarization for single band application was linear at the both resonating frequency. Further, the efficiency in terms of return loss has to be increased with dual polarization with linear polarization in 5.8 GHz and circular polarization in 2.45 GHz.

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