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Dual-Band Half Psi Shaped Antenna for WLAN, Wi-Fi and WiMAX Applications

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Abstract*: *In the last few decades, the evolution in new-fashioned wireless communication systems has actuated augmented exploration on uncomplicated dual band antennas. In this paper, a dual-band half psi shaped antenna for WLAN, Wi-Fi and WiMAX appliances is designed and analyzed. The intended antenna constitutes a half psi shaped radiating patch on the cost effective FR4-substrate with 1.6 mm thickness. A 50 ohms feed line is employed to feed half psi shaped antenna. Here a preferable impedance matching is attained by truncating a portion of the ground surface. The intended antenna has the potential to resonate between the frequency bands of 1.88 GHz-2.75 GHz and 5.17 GHz-5.74 GHz with S_{11} below -10 dB. The design of the antenna and its behavior over various frequencies ranges is done with the use of HFSS. The proposed antenna has higher gains at two regions. The simulated antenna is also prototyped and a fine similarity is attained in between the simulated parameters and measured parameters.

Index Terms*: *Dual-band, Half psi shape, Wi-Fi, WLAN, WiMAX.

I. INTRODUCTION

The breakthrough in the progression of contemporary wireless communication devices has outspread the demand of low-profile, simple and dexterous antennas for different operation modes. The Antennas are indispensable component of front face in every communication device that requires more concentration. The ingenious antennas must have the capacity of operating at various frequency regions, and are known as multi-band antennas.

The antennas which operate at multi-band are the integral part and perform a decisive role in various multifunctional devices. They perform different functions by preserving decent functioning with respect to gain and bandwidth in the desired band with uniform radiation [1-2].

The amelioration in different technologies like WLAN (2.4-2.48, 5.15-5.35, 5.725-5.825 GHz), Wi-Fi (2.4-2.485, 5.15-5.85 GHz), WiMAX (2.5-2.69, 3.4-3.69, 5.25-5.85 GHz) has directed the present researchers to design and analyze the antennas which can operate at various frequency bands with good performance. The above technologies have been extensively considered as feasible, inexpensive, and higher data rate connectivity, allowing operator mobility.

The printed monopole microstrip antenna methods are employed to design and analyze multi-band antennas .They endeavor design easiness and printed straightforwardly on different varieties of single or multiple layer substrates, exhibit broad bandwidth at the same time displaying adequate radiation patterns. The gain attained in the above technique is very less, to wit, 0.4 to 0.7 dB at the middle frequency [3-5].

The antennas operating at the WLAN, Wi-Fi and Wi-MAX are very impartment in various profitable communion appliances. A few distinct dual-band antennas are designed in the various articles that employ plain microstrip dipoles are conferred [6-8].

In this endorsed work, a half psi shaped dual band antenna operating at various wireless appliances is recommended. The proposed antenna uses microstrip line to pursuit easiness in the design of fabrication and assessment for a comfort of alliance with another component.

The proposed dual-band half psi shaped antenna is designed and analyzed by using the Ansoft HFSS software. This paper is categorized as detailed bellow: Sections II and III outline the antenna design and working principles of the projected antenna .The intended antenna results are examined in the Section IV. Lastly, the Section V draws conclusions of the entire work.

II. THE PROPOSED ANTENNA DESIGN

The architecture of intended dual-band half psi shaped antenna is depicted in Fig.1.

The dual-band half psi shaped antenna for WLAN, WiMAX and Wi-Fi appliances consists of an half psi shaped radiating patch on FR4-substrate with 1.6mm thickness, dielectric constant 4.4 and loss tangent of 0.02. The intended antenna is fed with the help of 50 ohms microstrip transmission line having a dimensions of l1 x d. The overall antenna dimensions are L x W. The rear side of the substrate poses a slotted ground conductor plane with dimensions L x W and a rectangular slot with dimensions s x r.

The size and position of rectangular shaped slot in ground conductor plane effects the impedance matching and dual band operation. The half psi shaped radiating patch has two stubs for providing radiation at dual bands. The lengths of the stubs are equal to the quarter wave length $\lambda_g/4$ from the feed point. The rectangular slotted ground plane resonates at the frequency whose $\lambda_g/4$ is equal to the diagonal length.

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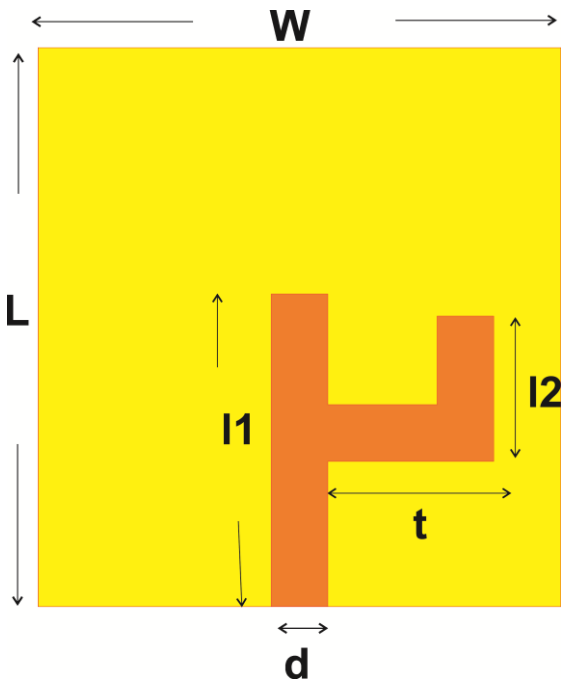
The dual-band half psi shaped antenna design is optimized by using the HFSS which uses FEM. The ameliorated dimensions of the intended antenna are listed in the table.1. The dual-band half psi shaped antenna for WLAN, WiMAX and Wi-Fi appliances was prototyped to test the antenna performance over the two operating regions.



(a)

b)

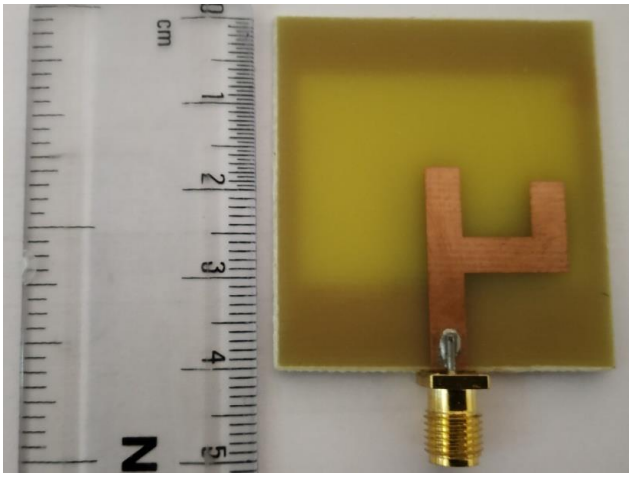
(

Fig.1. the intended antenna layout (a) front aspect (b) rear aspect

Table I. OPTIMIZED DIMENSIONS

S.NO	Parameters	Dimensions(mm)
1	L	41
2	W	38
3	r	33
4	s	24.5
5	d	4.1
6	l1	22.6
7	l2	6.4
8	t	12
9	h	1.6

The photos of a fabricated antenna are displayed in fig.2.



(a)

(b)

Fig.2. Fabricated antenna (a) front aspect (b) rear aspect

III. THE EVOLUTION OF HALF PSI SHAPED DUAL BAND ANTENNA

The Ant1 basically consists of a radiating single central strip with length 22.6 mm and width 4.1 mm on substrate with full ground.

This antenna operates at one resonant frequency of 3.455 GHz with S_{11} value -10.25 dB. The return loss is more due to poor impedance matching. The reflection coefficient of this is displayed in fig.4.

The inverted L-shaped conducting strip with length 6.1 mm and width 4.1 is attached to the left side of the central conducting strip of the Ant1 to evolve the Ant2. This antenna resonates at two separate resonant frequencies bands of 2.8529 GHz and 5.8 GHz with inadequate S_{11} values due improper impedance matching. The reflection coefficient of this is plotted in fig.4.

A rectangular slot with dimensions s x r is made to the ground in Ant2 to evolve the Ant3. This technique improves the impedance matching. This antenna resonates at two different frequency zones of 1.88 GHz-2.75 GHz and 5.17 GHz-5.74 GHz with S_{11} below -10 dB. The Ant3 is the proposed half psi shaped dual band antenna. The reflection coefficient of this is depicted in fig.4.

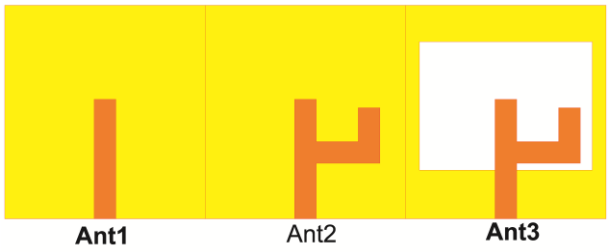


Fig.3. the evolution phases of half psi shaped dual band antenna

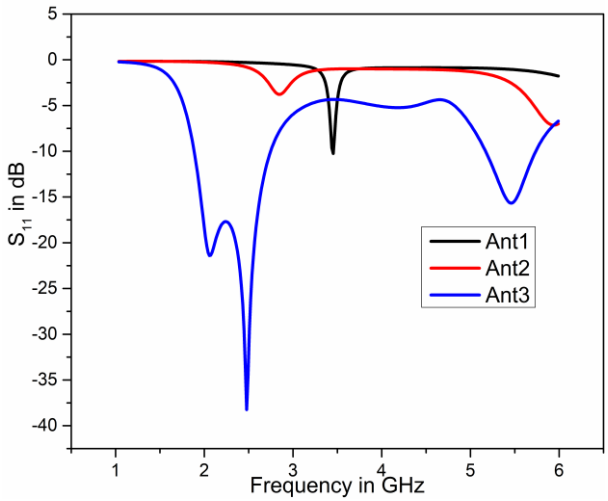


Fig.4. Reflection coefficient plot of Ant1, Ant2 and Ant3

IV. RESULTS

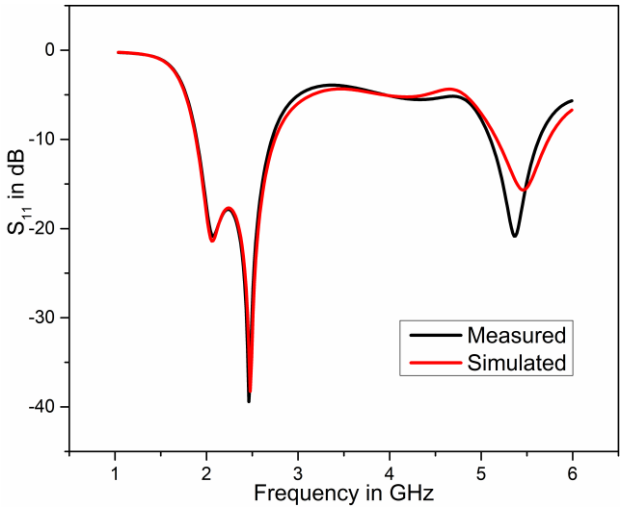


Fig.5. Reflection coefficient plot

The proposed half psi shaped dual band antenna has been simulated with help of the FEM based HFSS software. The same antenna is fabricated to examine its functioning at two operating frequencies. The photographs of the prototype are illustrated in fig.2.The S_{11} of proposed antenna was measured by employing network analyzer. In fig.5 the simulated reflection coefficient is compared with the measured one over the two bands of the intended half psi shaped antenna.

The fig.5 illustrates that the reflection coefficient of the half psi shaped dual band antenna covers the frequency regions of 1.88 -2.75 GHz and 5.17 -5.74 GHz with S_{11} below -10 dB while the S_{11} is less than -10 dB. The fig.5 also demonstrates that measured values are meticulously matches with that simulated values.

The negligible differences in the measured and simulated values are attributed to imperfection in fabrication, substrate losses, circumstances in measurement and coaxial connector influence.

The measured and simulated VSWR values of the intended dual-band half psi shaped antenna are portrayed in below fig.6.

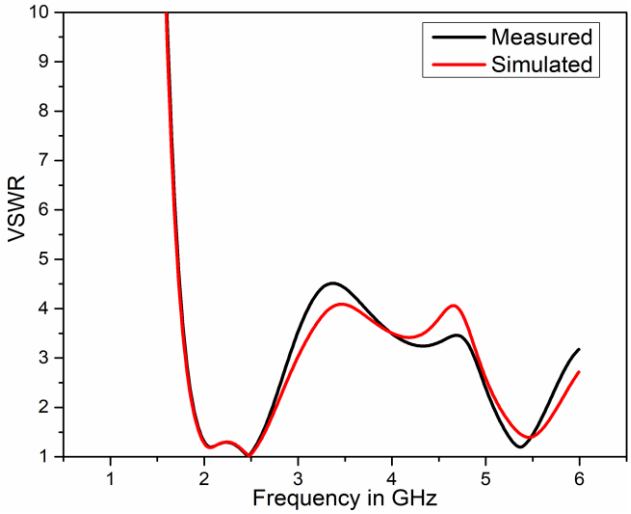


Fig.6. VSWR plot

The measured VSWR curve of the half psi shaped dual band antenna closely matches with that of simulated plot. The values of VSWR lie between 1 and 2 over three operating bands of the designed antenna. The dual-band antenna exhibits good performance in perspective of VSWR also. The dual-band antenna measurement setup is depicted in fig.7.

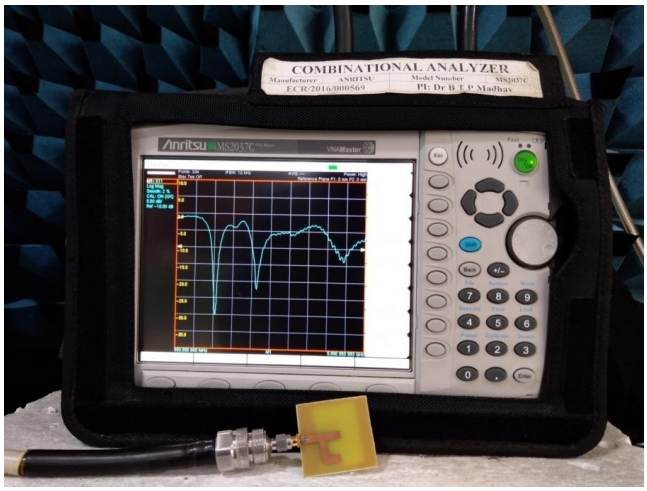
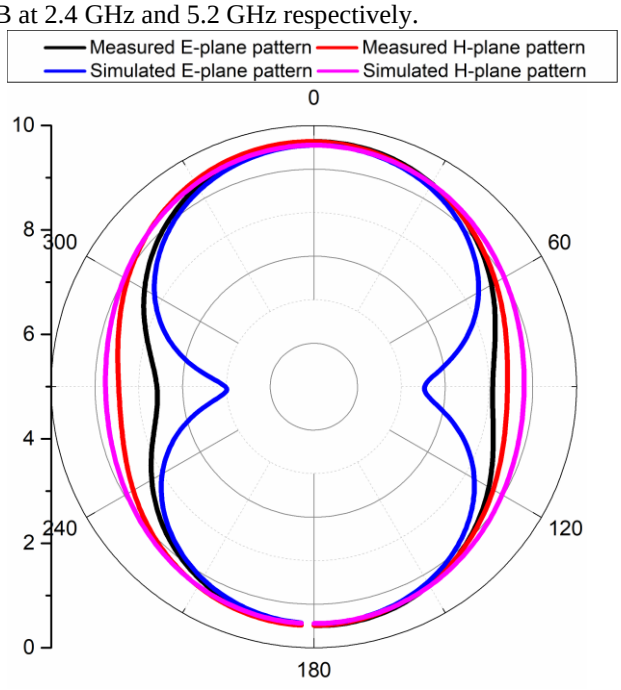
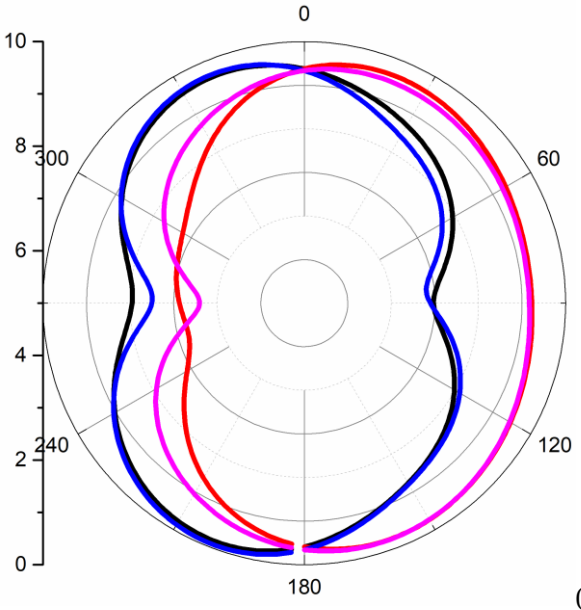


Fig.7. the photo of measurement setup of the intended antenna

The E and H-planes radiation characteristics of the given half psi shaped antenna are simulated then measured at the two different resonant frequencies of 2.4 GHz and 5.2 GHz respectively. The corresponding characteristics are portrayed in fig.8. The radiation characteristics seem nearly monopole and omni-directional in E and H-planes respectively. The intended half psi shaped antenna gains are about 2.7 and 4.6 dB at 2.4 GHz and 5.2 GHz respectively.



(a)



(b)

Fig.8. the half psi shaped dual band antenna radiation pattern at (a) 2.4 GHz and (b) 5.2 GHz

The proposed antenna exhibits higher gains at the two operating bands with adequate return loss hence this antenna cab be treated as better candidate for WLAN, Wi-Fi and WiMAX appliences.

V. CONCLUSIONS

A low profile dual-band half psi shaped antenna for WLAN, Wi-Fi and WiMAX appliences has been proposed and analyzed. The inverted L-shaped conducting strip is attached to the central radiating conductor to achieve dual-band operation for various applications. The proposed antenna operating principle has been conferred in detail. It has been exhibited that the low-profile planar half psi shaped dual band antenna can cover the frequency regions of 1.88 -2.75 GHz and 5.17 -5.74 GHz with adequate return loss. The measured results are nearly similar to that of simulated results. This antenna may find wide applications in radar, medical imaging and satellite communications.

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