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A Compact Mictrostrip-Fed Slot Antenna with Dualband Operation

Uma Nagar, Seema Nagar, R.S. Meena

***Abstract*— A compact microstrip-fed slot antenna with dualband operation is proposed for bluetooth, DECT (digital enhance cordless telecommunication system), and PHS (personal handy-phone system) applications. Structure of the proposed antenna consists of a rectangular patch (radiating element), ground plane, and microstrip line (50Ω). Three slots (one is horizontal and two are L-shaped slots) are introduced into the radiating element for achieving dualband performance. FR-4 substrate (ε_r=4.4) of size 30×80mm^2 (width ×length) is presented between patch and ground plane. To understand the performance of the proposed antenna return loss, radiation patterns (E and H plane) and current distribution results are obtained on the electromagnetic simulation software. From simulated (-10 dB) return loss, it is obtained that lower frequency band has frequency range from 1.86 to 2.09 GHz (for DECT, PHS). Frequency range for higher frequency band is 2.25-2.52 GHz (for bluetooth).**

***Index Terms*—Bluetooth, DECT, dualband operation, L-shaped slots, microstrip–fed.**

I. Introduction

Microstrip patch antennas become more popular in the wireless communication world, because they have various attractive features and advantages as compare to conventional antennas such as easy fabrication at low cost, low weight, low profile, and low losses. In recent years, uses of the dualband or multiband antennas are increased as compare to single band antennas.

Many microstrip antennas of different structure with different techniques for achieving dualband response have been already designed and reported [1]-[10]. A radiating patch (ring shape) is located on top of the dielectric substrate (FR-4). U-shaped slots of same dimensions are embedded into the ground plane to acquire dualband characteristic [1]. A dualband S-shaped slot antenna have been proposed as in [2]. A compact dualband antenna has been designed for satellite applications. The antenna comprises of rectangular patch (circle notched), circular patch (at center) and shorting pin. In this structure shorting pin is responsible for dualband [3]. A fork-shaped dualband antenna has been reported for Bluetooth and ultra wide band application. In this design structure FR-4 substrate contains fork like patch on top surface, while rectangular ground plane is located on bottom surface. Centeral longer element and U-shaped element is responsible for bluetooth and UWB application respectively [4].

The proposed prototype has simple design geometry with low profile and low weight. Section II describes the proposed antenna design geometry, which is modified structure of [5]. Section III shows simulated return loss, radiation patterns (E and H plane) at 2.03 GHz and 2.36 GHz frequency and current distribution at 2.03 GHz and 2.36 GHz frequency. Finally, section IV gives brief conclusion.

II. Antenna Design

Design configuration of the proposed compact microstrip-fed slot antenna with dualband operation is shown in Fig. 1 with top view. Rectangular patch (radiating element) having three slots, one of them is horizontal slot and two are of L- shaped slots. Microstrip line (50 Ω) of width 1.54mm is used for feeding the radiating element. Microstrip line and radiating patch both are located on top side of the FR-4 substrate (relative permittivity (ε_r) =4.4). Fig. 2 shows the bottom and side view of the proposed antenna. Ground plane of width M (30mm) and of length N (60mm) is presented on bottom side of the substrate.

Optimized dimensions of the proposed compact microstrip-fed slot antenna are listed in Table I.

Table I
Optimized dimensions of the proposed compact microstrip-fed slot antenna

Dimensions	Value (mm)	Dimensions	Value (mm)
A	58.48	H	24.5
B	21.51	I	3.9
C	18	J	2
D	30	K	3.5
E	22	L	1.54
F	60	M	30
G	14.61	N	60

***Uma Nagar**, Department of Electronics Engineering, University college of Engineering, Rajasthan Technical University, Kota, India, 9460404361.*
***Seema Nagar**, Department of Electronics Engineering, University college of Engineering, Rajasthan Technical University, Kota, India, 9460404361,*
***R.S. Meena**, Department of Electronics Engineering, University college of Engineering, Rajasthan Technical University, Kota, India, 9929517745,*

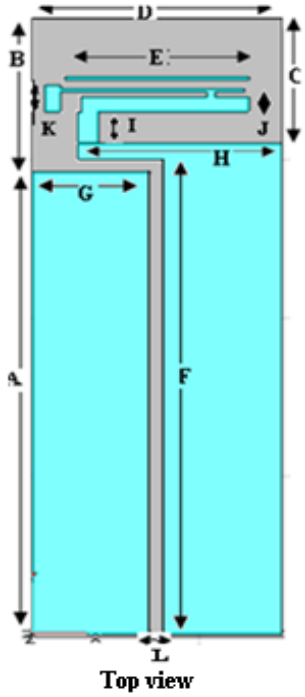
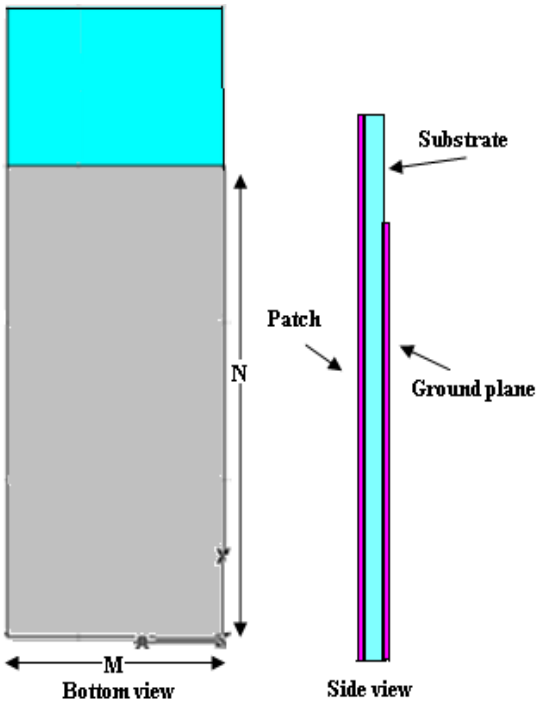


Fig. 1 Top view of the proposed compact microstrip-fed slot antenna with dualband operation



(a) (b)

Fig. 2 Proposed compact microstrip-fed slot antenna with dualband opereation with (a) Bottom view (b) Side view

III. Results And Discussion

The proposed compact microstrip-fed slot antenna with dualband operation design configuration, radiation patterns, current distributions and return loss were simulated on Electromagnetic Simulation software.

Simulated return loss curve against frequency is represented in Fig. 3, which demonstrates that proposed prototype has dualband response. Impedance bandwidth and center frequency for the lower frequency band (1.86-2.09 GHz) are 230 MHz and 2.03 GHz respectively, whereas impedance bandwidth and center frequency for the higher frequency band (2.25-2.52 GHz) are 270 MHz and 2.36 GHz respectively.

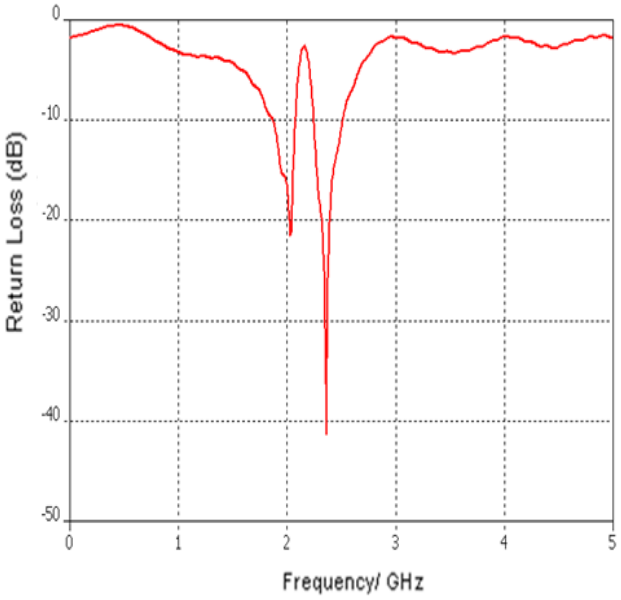


Fig. 3 Return loss curve with frequency for the proposed compact microstrip-fed slot antenna with dualband operation

3D view of the simulated radiation pattern (E plane) at 2.03GHz frequency is presented in Fig. 4.

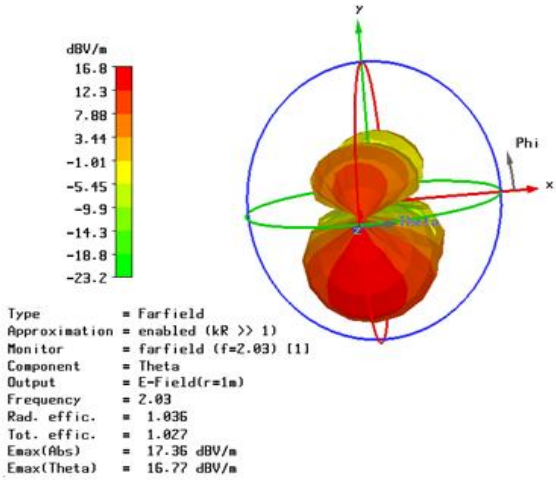


Fig. 4 Simulated radiation pattern (E plane, 3D view) at 2.03 GHz frequency for compact microstrip-fed slot antenna with dualband operation

3D view of the simulated radiation pattern (H plane) at 2.03GHz frequency is depicted in Fig. 5. 3D view of the simulated radiation pattern (E plane) at 2.36GHz frequency is depicted in Fig. 6. 3D view of the simulated radiation pattern (H plane) at 2.36GHz frequency is depicted in Fig. 7.

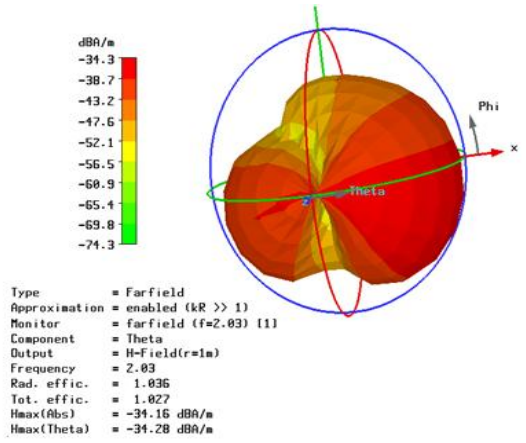


Fig. 5 Simulated radiation pattern (H plane, 3D view) at 2.03 GHz frequency for compact microstrip-fed slot antenna with dualband operation

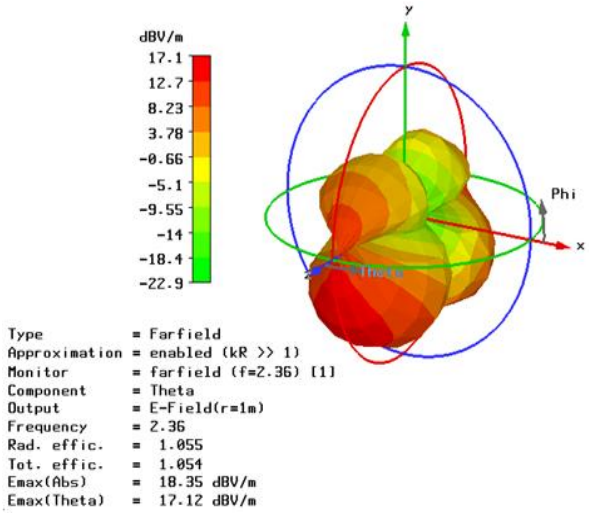


Fig. 6 Simulated radiation pattern (E plane, 3D view) at 2.36 GHz frequency for compact microstrip-fed slot antenna with dualband operation

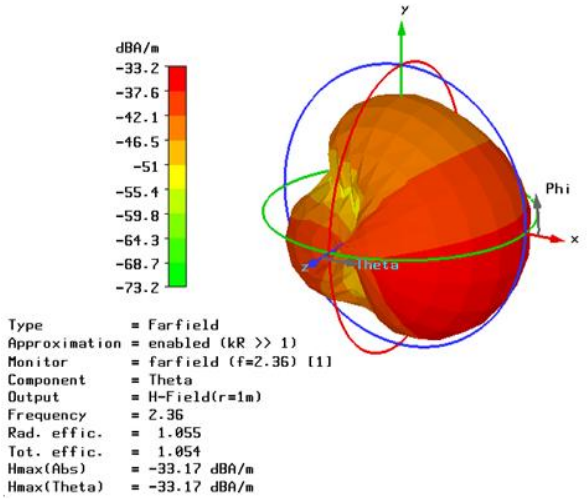


Fig. 7 Simulated radiation pattern (H plane, 3D view) at 2.36 GHz frequency for compact microstrip-fed slot antenna with dualband operation

Surface current distribution for compact microstip-fed slot antenna at 2.03GHz and 2.36GHz frequency is shown in Fig. 8 and Fig. 9 respectively. Current concentration at slots is maximum, whereas less current is present at the top of the ground plane at 2.03 GHz, it can be seen in Fig.8.

At 2.36 GHz maximum current is presented at the left edges of the slots, while in ground plane current presented at top (see Fig. 9).

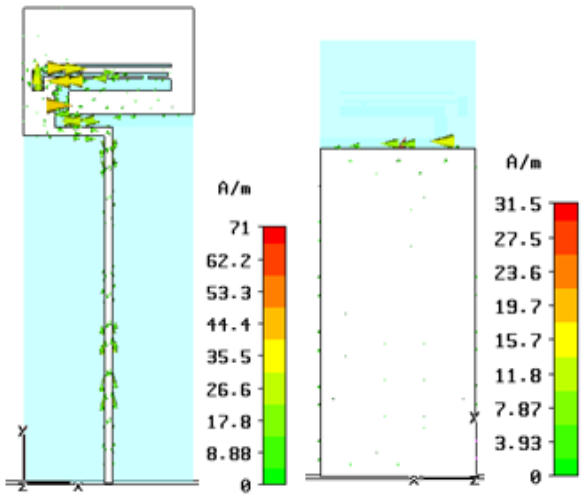


Fig. 8 Surface curent distribution at 2.03 GHz frequency for compact microstrip-fed slot antenna with dualband operation

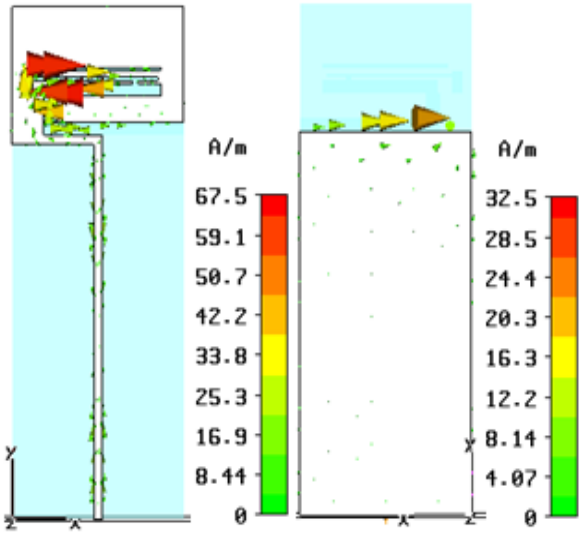


Fig. 9 Surface curent distribution at 2.36 GHz frequency for compact microstrip-fed slot antenna with dualband operation

IV. Conclusion

In this paper, a compact microstrip-fed slot antenna with dualband operation is reported for bluetooth, DECT, and PHS applications with simulated results. The antenna exhibits dualband operation and resonates over 1.86-2.09 GHz (lower frequency band) and 2.25-2.52 GHz (higher frequency band). In addition, the overall volume of the proposed antenna is 30× 80mm^2.

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Uma Nagar was born in Kota, Rajasthan, India, on 15th July, 1987. From Shrinathji Institute of Technology and Engineering (SITE), Udaipur, Rajasthan Technical University, Kota, Rajasthan, India, she received her B. Tech. degree with Honours in 2010 in Electronics and Communication Engineering and pursuing M. Tech. from RTU (University College of Engineering, Rajasthan Technical University), Kota, Rajasthan, India, in Digital Communication.
E- mail ID:

Seema Nagar was born in Kota, Rajasthan, India, on 20th June, 1989. From Shrinathji Institute of Technology and Engineering (SITE), Udaipur, Rajasthan Technical University, Kota, Rajasthan, India, she received her B. Tech. degree with Honours in 2010 in Electronics and Communication Engineering and pursuing M. Tech. from RTU (University College of Engineering, Rajasthan Technical University), Kota, Rajasthan, India, in Digital Communication.
E- mail ID:

R. S. Meena was born in Dausa, Rajasthan, India on 22nd June, 1969. From Rajasthan University, Kota, India, in 1993, he received his B. E. degree with Honours in Electronics and Communication Engineering, received M.Tech. degree in 2002 in Integrated Electronics and Circuits (IEC) from Indian Institute of Technology (IIT) Delhi, India and PhD Degree from IIT Delhi on "Preparation and Characterization of U-Type Hexaferrites for Microwave Absorption". At present he is a reviewer of European Physical Journal - Applied Physics (EPJAP), UK and Journal of Magnetism and Magnetic Materials (Elesvier), USA. At present he is professor in rajasthan technical university, Kota, Rajasthan, India.