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A DUAL BAND MIMO SLOT ANTENNA FOR WLAN APPLICATIONS

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Abstract- A compact multiple-input-multiple-output antenna with dual-band for WLAN application is presented in this paper. The antenna consists of two meander shaped slots and a Y-shaped isolator. Two T-shaped microstrip feedline has been printed on the substrate. The meander shaped slots radiate at two frequency bands. The proposed antenna with Y shaped isolator gives improvement in impedance bandwidth which covers 2.5-2.69 GHz in lower band and 5.2-5.3 GHz in upper band. The overall area of the MIMO antenna is 24x25 mm^2 Also, the obtained Envelope correlation coefficient (ECC) is suitable for WLAN application.
Keywords –Multiple-input-multiple-output (MIMO), Dual-Band, Wireless local area network (WLAN), meander slot antenna, isolator, envelope correlation co-efficient (ECC).

1. INTRODUCTION

Now a day, MIMO has been used in antenna design process. Because it has high reliability, high data rate, large signal to noise ratio. MIMO has attracted the researchers due to its capability of increase in the spectral efficiency. The MIMO antenna design consists of low profile, less cost, easy fabrication and integration. In modern days, printed antennas are also proposed. MIMO antenna is also used to enhance the performance of the wireless communication. Compact antennas are also designed with the dimensions as low as possible. MIMO antennas can also be used to increase the isolation. Due to increase in the number of users, traffic occurs in the wireless channels. Hence MIMO is used to increase the channel capacity of wireless channels. It also evades the multipath fading in high scattering environments.

2. PROPOSED ALGORITHM

2.1 Antenna Design

The proposed antenna also contains two printed meander-line antenna elements which are placed close to each other. The MIMO antenna system demonstrates satisfactory performance in terms of ECC, low return loss, improved gain and isolation. The antenna is designed with FR-4 substrate whose thickness is 1.6mm. The antenna is fed with a 50Ω stepped microstrip line which provides good impedance matching at dual frequency bands.

The following diagram includes two T-shaped patches, one Y-shaped isolator and two meander structures. . The Copper material is as the ground plane whose thickness is 0.035mm. The substrate is made of FR4 material whose thickness is 1.6mm.

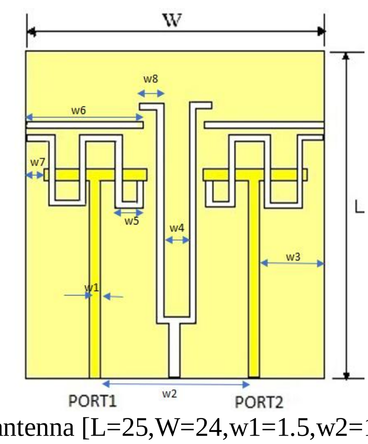

Figure 1(a) Geometry of proposed MIMO antenna [L=25,W=24,w1=1.5,w2=12.5,w3=4.25,w4=0.8,w5=2.4,w6=7.2,w7=1 and w8=2.4 (all are in mm)]

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The bottom side of the substrate contains two meander structures on the ground plane through which the broadside coupling with the radiators occur via holes. The geometry of the bottom side of the antenna is shown in Figure 1(b).

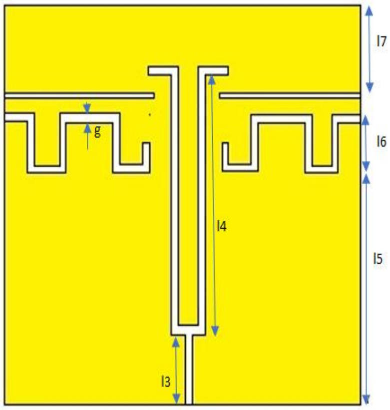

Figure 1(b) Geometry of bottom view of antenna [l3=4.9,l4=16.5,l5=13.7,l6=4,l7=4.8(all are in mm)]

2.2 Antenna Design Process –

To maintain good impedance matching at dual frequencies stepped feed line is used. The etched slots on the ground plane is used as a radiator which is approximately of quarter-wavelength. The meander slots radiate at a frequency of 2.4GHz and the straight-line slot radiates at the frequency of about 5.68GHz. The Figure 2(a) represents the simulated S-parameter result of the dual-band antenna with single port. The length of the meander structure is found to analyze the variations in length at the resonant frequencies. Since the wavelength and frequency are inversely proportional, there occurs the shifting of resonance to higher frequencies for smaller length and vice versa. The meander structures are added to increase the electrical length between the elements. Increase in the length of the slot increases the coupling effect between the antenna elements.

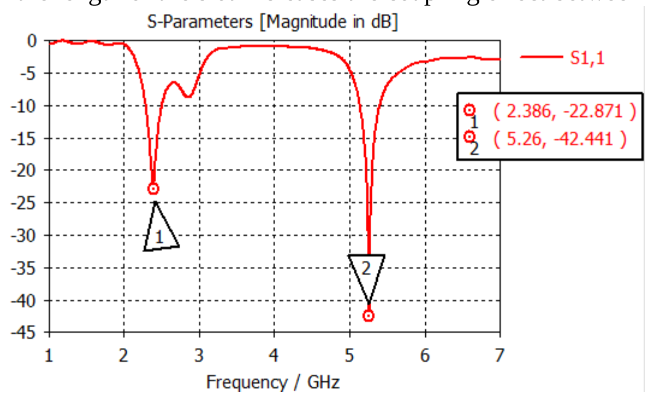

Figure 2(a)

The Figure 2(b) represents the simulated S-parameter result of the dual-band antenna with dual port.

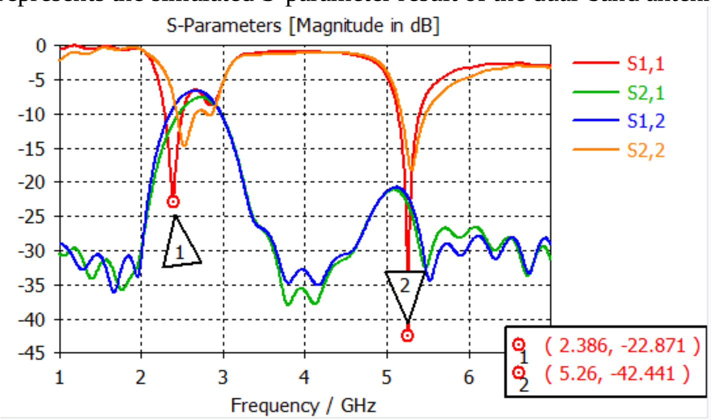

Figure 2(b)

3. EXPERIMENT AND RESULT

The proposed dual-band MIMO antenna design shown in Figure1(a) was simulated in CST software with the SMA connector model. The prototype was designed on FR-4 substrate.

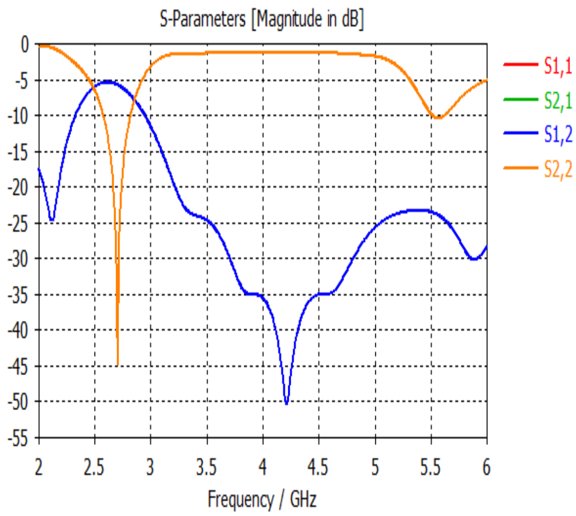

Figure 3(a)

There exist slight variations between the simulated result and the fabricated result due to the SMA connector loss. The obtained first resonant frequency is 2.4 GHz and the second resonant frequency is 5.6 GHz. At the resonant frequencies peak gains are obtained. The designed antenna shows low gain at the resonant frequency because of its very small size. Envelope Correlation Coefficient (ECC) is the parameter which is used to analyze the performance of the designed MIMO antenna.
The table shows that the proposed antenna exhibits better performance.

Different Parameters Of Mimo Antennas

S.No.	Antenna size	Bandwidth(GHz)	Min. Isolation(dB)
[2]	20X46	2.40-2.50/ 4.90-5.75	≥12
[4]	60X95	2.50-3.25/ 3.70-4.20	≥18
This work	24X25	2.5-2.69/ 5.2-5.3	≥20

The S-parameter expression of the ECC for the lossy MIMO antenna is given as

$$\rho_e = \frac{\left|S_{ii}^{*}S_{ij} + S_{ji}^{*}S_{jj}\right|^2}{\left(1-|S_{ii}|^2-|S_{ji}|^2\right)\left(1-|S_{jj}|^2-|S_{ji}|^2\right)\eta_{\mathrm{rad},i}\eta_{\mathrm{rad},j}}$$

where ηrad, i represents the radiation efficiencies of the i th antenna and ηrad, j represents the radiation efficiencies of the j th antenna. Measured S-parameter of the MIMO antenna system is given in Figure 5(b)

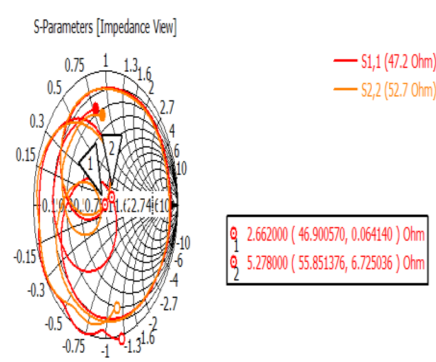

Figure 3(b)

The ECC acceptable limit is less than 0.5. When the MIMO antenna satisfies limit of ECC then the antenna ensures better spatial multiplexing performance and high data rate too. In the table 1, several parameters such as dimensions, operating frequency bands and isolation of the proposed antenna are compared with the previously reported MIMO antennas.

4.CONCLUSION

In this paper, a dual-band MIMO slot antenna for WLAN applications is proposed. The antenna elements used here are slot antennas that have two quarter-wavelength slots of different lengths in the ground planes. The antenna elements radiate at two distinct frequencies. The antenna contains open ended slots to achieve better isolation between the ports at the resonant frequencies and uses a good decoupling network. The antenna dimensions are 24 x 25mm with the operating frequencies 2.4-2.7 GHz and 5.5-5.7 GHz. The obtained ECC is within the acceptable limit and hence it offers high data rate via spatial multiplexing in wireless channels. The simulated antenna confirms that the proposed antenna is suitable for the wireless local area network applications.

5. REFERENCES

[1] D. W. Bliss, K. W. Forsythe, and A. M. Chan, “MIMO wireless communication,” Lincoln Lab. J., vol. 15, pp. 97–126, 2005.

[2] Saber Soltani, Parisa Lotfi, and Ross D. Murch, "A Dual-Band Multiport MIMO Slot Antenna for WLAN Applications”, IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 16, pp. 529-532,2017.

[3] Muhammad Saeed Khan, Muhammad Farahan Shafique, Aftab Naqvi, Antonio-D Capobianco, and Bilal Ijaz, Benjamin D. Braaten, "A Miniaturized Dual-Band MIMO Antenna for WLAN Applications," IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS,VOL.14, pp. 958-961, 2015.

[4] Yu-Ting Wu, and Qing-Xin Chu,"Dual-band multiple input multiple output antenna with slitted ground," IET Microwaves, Antennas & Propagation, Vol. 8, pp. 1007-1013, 2014.

[5] Sourav Nandi, and Akhilesh Mohan, "A Compact Dual-Band MIMO Slot Antenna for WLAN Applications," IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 16, pp. 2457-2460, 2017.

[6] Jian Ren, Wei Hu, and Yingzeng Yin, Rong Fan, "Compact Printed MIMO Antenna for UWB Applications," IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 13, pp. 1517-1520, 2014.

[7] Alishir MoradiKordalivand, Tharek A. Rahman, and Mohsen Khalily, "Common Elements Wideband MIMO Antenna System for Wi-Fi / LTE Access-Point Applications," IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 13, pp. 1601-1604, 2014.

[8] C. Y. Chiu, C. H. Cheng, R. D. Murchz, and C. R. Rowell, “Reduction of mutual coupling between closely-packed antenna elements,” IEEE Trans. Antennas Propag., vol. 55, no. 6, pp. 1732–1738, Jun. 2007.

[9] M. Sonkki and E. Salonen, “Low mutual coupling between mono pole antennas by using two λ / 2 slots,” IEEE Antennas Wireless Propagation Letter, Vol. 9, pp. 138–141, 2010.