A Novel Rectangular Microstip Antenna With Uniplanar EBG Cells For Performance Enhancement

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***Abstract*-A Novel Rectangular Microstrip antenna with Electromagnetic Band Gap (EBG) cells for performance enhancement. By loading the uniplanar EBG cells on the ground maximum gain is 4.71dBi. The antenna operates for (4GHz-12GHz).The virtual size reduction of 28% is obtained compared to RMSA. The proposed antenna designs are simulated by using IE3D simulation software. This antenna may find applications in WLAN, WiMax and other wireless communication applications.**

Keywords -rectangular Microstrip antenna, uniplanar EBG cells, bandwidth.

I. INTRODUCTION

Today, the reliability of digital circuit system is attend to more and more challenged with that, the ceaseless increase of the frequency of system clock, the enlarge size of the digital ICs, the sharp increase of the organ density on the Printed Circuit Board (PCB)[1]. Immense growth and advancement in wireless communication technology increases the demand for highly efficient compact devices. It is a challenge to be compatible with a wide range of small- scale applications while maintaining good performance. In the RF and microwave research arena, microstrip patch antennas are a smart solution for compact and cost effective wireless communication systems. Features such as light weight, low volume, low profile, low fabrication cost, robustness, ease of mounting on the host surface and integration with printed circuits led their use in a wide range of applications. However, compared to non-printed antennas, these types of antennas suffer from a number of drawbacks, such as narrow bandwidth, low gain, and poor radiation performance due to excitation of surface waves, etc. Considering these factors and the advantages of microstrip patch antennas, the incorporation of electromagnetic Band Gap (EBG) structures is an attractive research idea in the antenna community. The term `EBG' is modeled after PhotonicBband Gap (PBG) structures in optics because of their analogous properties of wave propagation and restriction at certain frequency ranges, which is known as a Band Gap [2].A periodic lattice of metallic or dielectric unit cells causes an electromagnetic band-gap (EBG). In recent years, there has been significant interest in investigating EBG structures, and varieties of EBG structures have been proposed for application in electromagnetics and antennas community. As typical uses, it has been integrated with antennas to enhance the gain and to reduce the backward radiation by suppressing surface wave, thus improving efficiency [3] Photonic Band Gap (PBG) structures are periodic structures in which optical waves are forbidden in certain frequency bands. PBG structures can be one-, two- or three-dimensional periodic structures Due to the analogy between electromagnetic wave propagation in multidimensional periodic structures and electron wave propagation in crystals, PBG structures find applications in both the optics and microwave regime. Although one- and two-dimensional periodic structures have long been investigated in the microwave community, new concepts and ideas recently developed in the optics regime have sparked new interest in the microwave area [4]. On the other hand, the EBG structures also reflect back a part of the energy that circulate along the substrate of the antenna, thus acting as reflecting walls across the antenna and thereby the cavity effect. With elite rows of EBG structures, minus energy is reflected back and the parasitic effect becomes prevailing. This contributes to the significant enhancement in the bandwidths. As the number of rows is increased, more of the energy circulate along the substrate is reflected back and the cavity effect becomes prevailing. This in turn enhances the Q-factor of the cavity made by the EBG structures surrounding the antenna and come down the bandwidths of the antenna [5-6].

plane the antenna is resonating at four frequency points. The overall bandwidth of the RMSA-UCEBG is 41.72% and the

II. Description of Antenna Geometry

The proposed antenna reported in this study is designed using low cost glass epoxy material of thickness h=1.6mm and permittivity εr=4.4. Fig. 1 shows the geometry of RMSA. The conventional antenna RMSA is designed for 6GHz with dimensions W=15.24mm and L=11.33mm respectively by a 50Ω centre feed microstrip line feed having (Lf50, Wf50) = (6.18mm, 3.06mm) trough a quarter wave transformer OF dimension (Lt, Wt) = (4.92mm, 0.50mm). The ground plane of the patch is Lg=40mm &Wg=40mm.

Further the study has been carried out by loading uniplanar EBG cells on the ground plane of the RMSA, for bandwidth enhancement by maintaing all the parameter of the radiating patch constant. The geometry of the proposed antenna RMSA-UCEBG is as shown in Fig. 2. There are 4x4 EBG cells with dimension of 9mmX9mm, the other parameters s=3mm and t=1mm.The characteristics of these antennas are studied & compared with RMSA. The single enlarged unit of uniplanar EBG is as shown in Fig.3.The table1 shows the various parameters of the uniplanar EBG cells of RMSA-UCEBG.

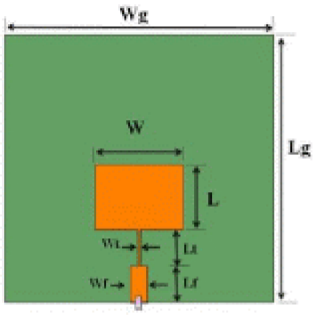


Fig.1 Geometry of the RMSA

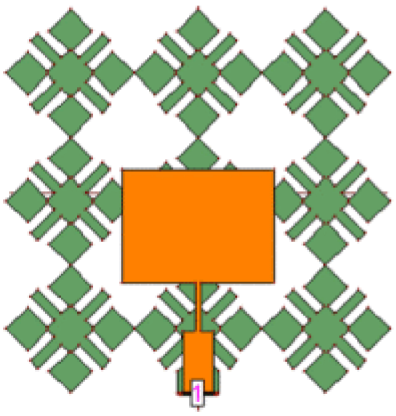


Fig.2 *Geometry of RMSAUC-EBG*

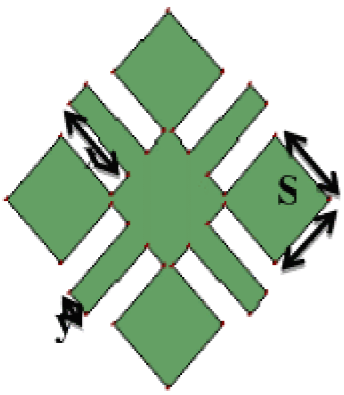


Fig. 3 Single enlarged uniplanar EBG cell

Parameter	RMSA-EBG in (mm)
A	9
B	9
g	0.75
s	3
t	1

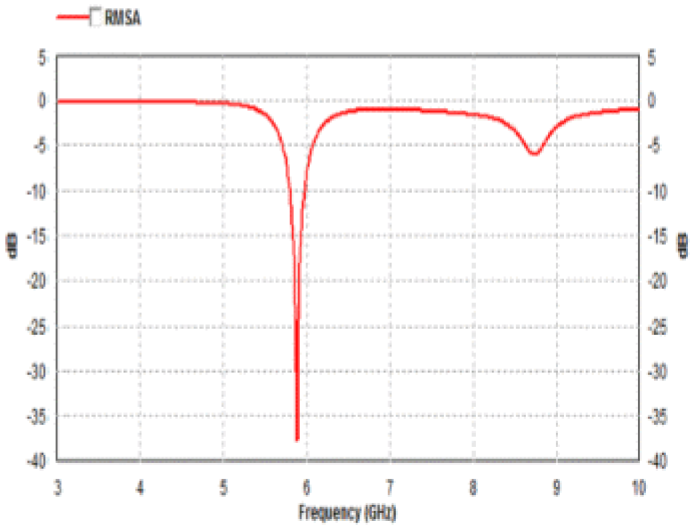
Table 1: Various dimensions of uniplanar EBG cells

III. Results and Discussions

The conventional microstrip antenna RMSA is showing a bandwidth of 2.88% (176MHz). The reason for this very narrow bandwidth is given in the introduction part with respect to the presence of surface waves in the patch substrate. The variation of return loss versus frequency of RMSA is as shown in Fig.4.

Fig.4 Variation of return loss versus frequency of RMSA

The RMSA ground plane was replaced by uniplanar EBG



cells in RMSA-UCEBG. The enhancement in bandwidth is

Antenna	*Resonating Frequency GHz*	*Return loss (dB)*	*Bandwidth in MHz*	*Bandwidth in (%)age*	*Overall Bandwidth in (%)age*	*Size Reduction in %*
RMSA	5.91	-37	176	2.88	2.88	-
RMSAUC-EBG	4.2 5.79 7.61 11.62	-26.45 -13.08 -13.48 -15.51	67 20 79 140	15.9 3.4 10.38 12.04	41.72	28

attributed by loading a uniplanar EBG cells on the ground plane which is acting as inductance and capacitance. The return loss characteristic of RMSA-UCEBG is as shown in Fig.5 uniplanar cell gives enhanced bandwidth of 41.72%. The antenna gives the virtual size reduction of 28%.The results of the proposed antennas are as shown in the table3.

Table 2: Results of RMSA and RMSA-UCEBG

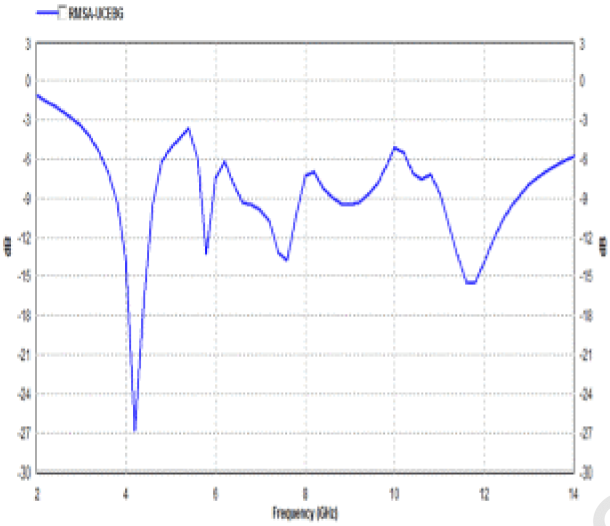
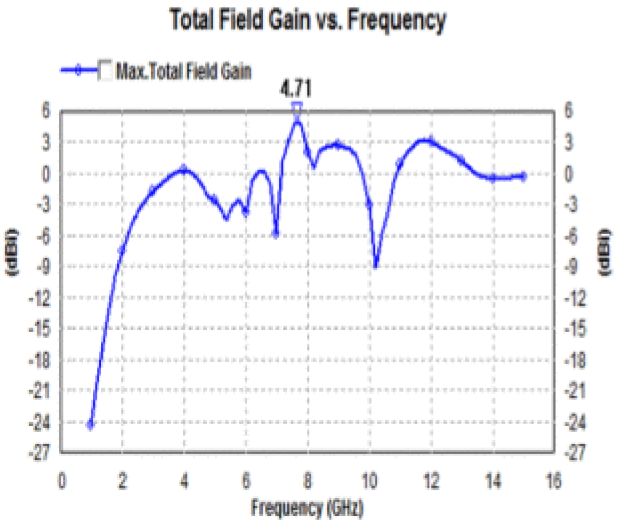


Fig.5: *Variation of return loss versus frequency of RMSA-UCEBG*



The highest gain of the RMSA-UCEBG is 4.71dBi is as shown in Fig.6. The radiation pattern of RMSA-UCEBG is as shown in the Fig.7.

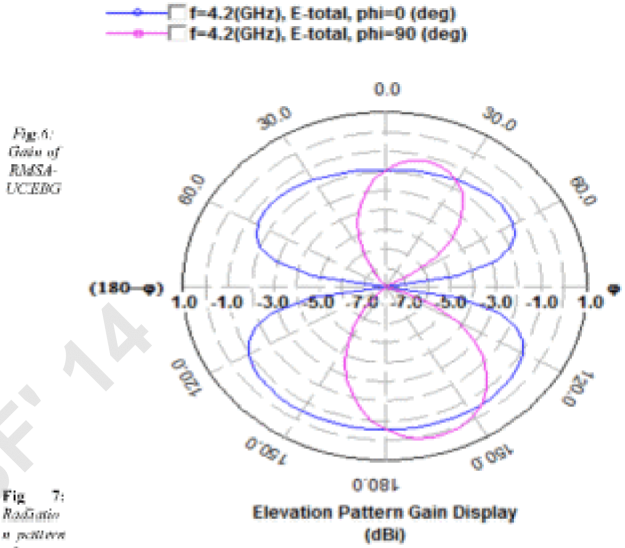


Fig 6: Gain of RMSA-UCEBG

Fig 7: Radiation pattern of RMSA-UCEBG

IV. CONCLUSION

In this paper, an attempt is made to study the rectangular microstrip antenna with uniplanar EBG cells on the ground plane of the RMSA. From the results it is found that in RMSA-UCEBG there is an enhancement in bandwidth by 41.72%. In the proposed antenna the virtual size reduction is 28%. The proposed antenna is light weight, use low cost substrate material and is simple for construction. With these features, the antenna may find applications in wireless communication.

REFERENCES

[1] Hua Yang, ShaoChang Chen, Qiang Zhang, and WenTing Zheng "Analysis of a Novel Electromagnetic Bandgap Structure for Simultaneous Switching Noise Suppression" Springer-Verlag Berlin Heidelberg CCIS 214, pp. 628–634,2011.

[2] M. S. Alam1, M. T. Islam2,and N. Misran, "a novel compact split ring slotted elec- tromagnetic bandgap structure for mi-crostrip patch antenna performance en-hancement" Progress In Electromagnetics Research, Vol. 130, 389-409, August 2012.

[3] Son Trinh-Van, Chien Dao-Ngoc, "A Novel Quadruple L-Shaped Meandered Lin Electromagnetic Band Gap Structure" IEEE 978-1-4244-7057-0/10/$26.00 ©2010.

[4] C. C. Chang, Y. Qian, and T. Itoh, "analysis and applications of uniplanar compact photonic bandgap structures" Progress In Electromagnetic Research, PIER 41, 211–235, 2003.

[5] Gaurav Kumar Sharma, Narinder Sharma "improving the performance parameters of microstrip patch antenna by using ebg substrate" IJRET: International Journal of Research in Engineering and Technology Volume: 02 Issue: 12, pp Dec-2013.

[6] Zahra MOUSAVI RAZI Pejman REZAEI Mohammad Esmacil ZAMAN, " Improving the bandwidth of high gain Fabry-Perot antenna using EBG substrate" International Journal of Natural and Engineering Sciences 7 (2): 78-81, 2013.