RECTANGULAR MICROSTRIP ANTENNA WITH SWASTIK ELECTROMAGNETIC BAND GAP STRUCTURE

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Abstract

This paper reports the Rectangular Microstrip Antenna with Swatik Electromagnetic Band Gap (EBG) structure on the ground plane. The performance of the proposed antenna are compared with the Conventional Rectangular Microstrip antenna (CRMA).It is observed that there is significant increase of bandwidth and better suppression of back radiation than the Conventional Rectangular Microstrip Antenna. The antenna operating in frequency range of 5-15 GHz which is one of the most usable for wireless application such as WLAN, Wimax etc..

Keywords: *Rectangular microstrip antenna, swastik electromagnetic band gap (EBG), bandwidth.*

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1. INTRODUCTION

Recently a growing demands of microwave & wireless communication system in various applications resulting in an interest to improve antenna performance. Therefore the selection of microstrip antenna is suitable to apply at various fields such as telecommunication, medical application satellite & military because antennas offer an attractive solution to easy of fabrication low profile, planar configuration due to this it is more commonly used in modern wireless communication system[1-2]. In spite of this the microstrip antenna are suffering from narrow bandwidth, spurious feed radiation, poor polarization, gain and tolerance problem. Bandwidth can be increased but at the cost of size of the patch, making bulky and large. To overcome this problem, a multi layer dielectric substrate has been used to improve bandwidth. Beyond certain thickness of substrate, the efficiency of antenna starts decreasing due to more surface wave generation [3-4]. The surface wave generation can be reduced in using Electromagnetic Band Gap (EBG) structure. In the last decade, periodic EBG structures were the focus of much attention due to their promising applications in microwave circuit and antenna design[5]. These EBG structure exhibit wide bandpass and band rejection properties at certain microwave frequencies. This unique property has been utilized in enhancing the performance of microstrip antenna [6-7].

In this paper a Rectangular Microstrip Antenna loaded with Swastika EBG in the ground plane (RMASWEBG) has designed which gives better bandwidth and gain enhancement compared to Conventional Rectangular Microstrip antenna (CRMA).

2. ANTENNA DESIGN

The proposed antennas are designed using a low cost glass epoxy material of dielectric constant εr =4.4, substrate of thickness h=1.6mm.The substrate is backed by a ground plane with dimension Lg=40mm and Wg= 40mm. The width of the CRMA is usually chosen to be larger than the length of the patch, L to get higher bandwidth. The antenna is designed to operate at frequency 6 GHz. The CRMA is shown in the Fig-1 (a) and Fig-1 (b) shows the photographic view of the CRMA. A high impedance swastik EBG structures (RMASWEBG) is introduced in the ground of the CRMA. The antenna RMASWEBG is shown in Fig-2 (a), the photographic view of the RMASWEBG is shown in Fig-2(b). The SWEBG structure prohibits propagation of electromagnetic waves in a certain frequency bands. This suppresses the surface waves and hence gives enhancement in the performance of the proposed antenna.

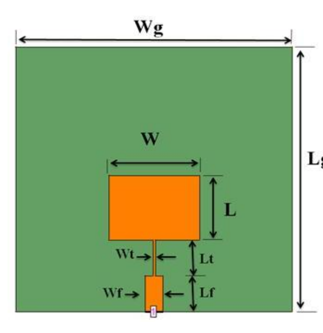


Fig-1 (a): Top View of the CRMA

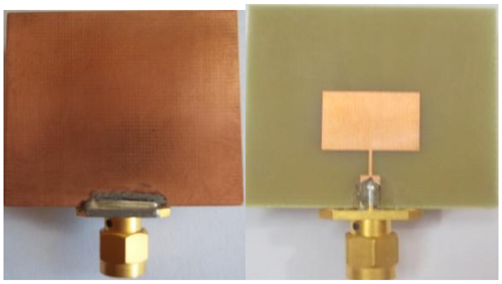
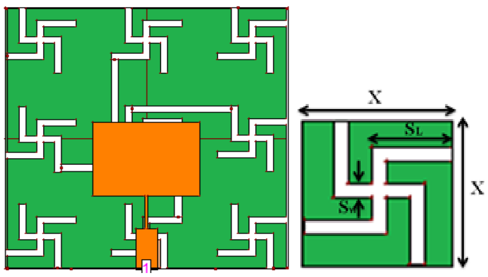


Fig-1 (b): Photographic Top & Bottom view of RMASWEBG



Fia-2 (a): Top RMASWEBG and a enlarged geometry of single EBG

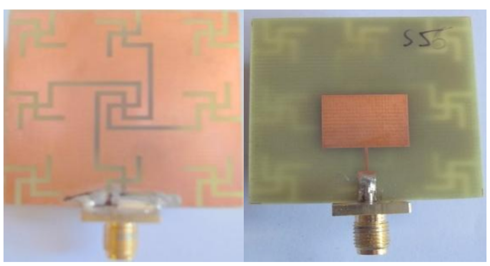


Fig -2 (b): Photographic view of top and bottom RMASWEBG

Table-1: Geometrical configuration of the CRMA & RMASWEBG

Antenna part	Parameters	Value
Patch	Length(L)	15.24 mm
	Width(W)	11.33 mm
Microstrip Feed	Length(L_{f50})	6.187 mm
	Width(W_{f50})	3.060 mm
Quaterwave Transformer	Length(L_t)	4.922 mm
	Width(Wt)	0.5 mm
Swastik EBG structures	Length(X)	8 mm
	Width(X)	8 mm
	Gap(G)	8 mm
	Length of the slot(SL)	4 mm
	Width of the slot(Sw)	1 mm

3. EXPERIMENTAL RESULTS & DISCUSSIONS

The designed antennas have been experimentally studied using Vector Network Analyzer (Rohde & Schwarz, Germany make ZVK model 1127.8651). Fig-3(a) shows the measured return loss (RL) versus frequency characteristics for CRMA & SEBGRMA. The results shows that patch antenna CRMA resonates at 5.99GHz with total available impedance bandwidth BW 120MHz at -10dB i.e., 2.03% covering the frequency range 5.794GHz to 5.914GHz. Then for antenna RMASWEBG BW1 covers the frequency range 5.593GHz to 5.815GHz & BW2 6.675GHz to 6.920GHz and BW3 12.60GHz to 15.01GHz. The total impedance bandwidth for BW1+BW2+BW3 is 467MHz i.e., (222+245+241) 287MHz i.e. (3.898+3.625+17.67) 25.19% impedance bandwidth resonating at covering c-band for RMASWEBG. The result of CRMA & RMASWEBG is shown in table-2.

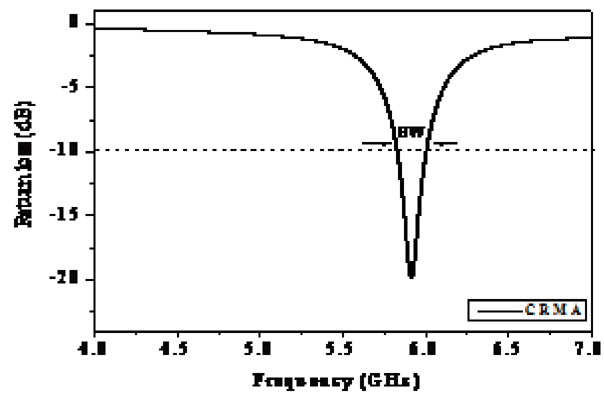


Fig- 3(a): Return loss Characteristics of CRMA

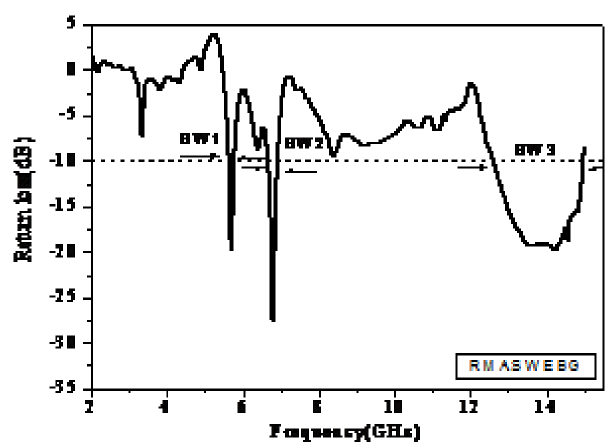


Fig-3 (b) Return loss Characteristics of RMASWEBG

Table-2: Results of CRMA & RMASWEBG

Antenna	No. of Bands	Return loss (dB)	Resonant Freq. (GHz)	Band Width in MHz	Band Width in (%)	Overall Band Width in (%)
CRMA	01	-15.25	5.99	176	2.93	2.05
RMASWEBG	03	-19.59 -27.32 -19.22	5.69 6.75 13.63	BW1=22 BW2=24 BW3=241	3.89 3.62 17.67	25.193

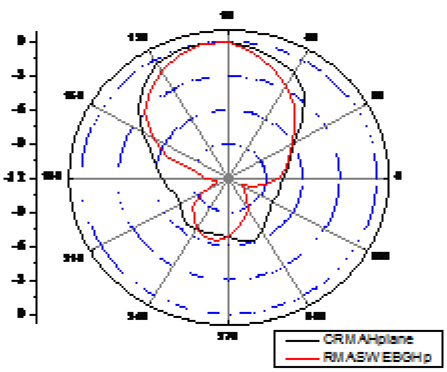


Fig.-4. H-plane radiation patterns of CRMA & RMASWEBG

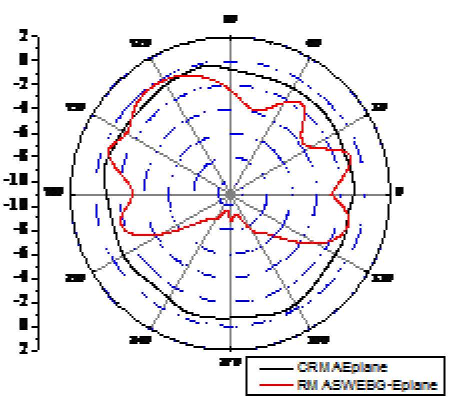


Fig.-5. E-plane radiation patterns of CRMA & RMASWEBG

Fig-4 shows the results of experimental comparison of E-plane co-polar radiation pattern of the designed antenna with CRMA. From the figure it is clear that the back lobe radiations of RMASWEBG are suppressed compared to the CRMA, by embedding the swastika EBG structure on the Ground plane. Fig5 shows the radiation pattern of H-plane co-polar with broad side with not much variation as in the E-plane radiation.

4. CONCLUSIONS

The study has demonstrated that, the proposed antenna with swastika EBG structure in the ground plane gives the impedance bandwidth of 287MHz (25.19%) as compared to the CRMA . also there is a reduction in back lobe reduction in compared to conventional antenna. This antenna can be used for wireless application.

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BIOGRAPHIES

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