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BANDWIDTH ENHANCEMENT OF MICROSTRIP ANTENNA USING EBG STRUCTURES FOR WIDE BAND WIRELESS APPLICATION

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ABSTRACT

A square edged micro strip patch antenna with rectangle like electromagnetic band gap (EBG) is used for wireless communication system. This antenna contains a four square like a patch at edges with rectangle like electromagnetic band gap structures. And the dimensions of the antenna are about 30 x 30 x 1.6 mm3. This antenna gives the results of three wide bands along with impedance beam width 93.7 MHz(3.325 – 3.4194GHz),136.9 MHz(5.4210 - 5.5579GHz)and172.6 MHz(6.4616–6.6352GHz) and resonantat3.34GHz,5.5GHzand6.55GHz withreturnlossof-13.1362dB,-23.6725dBand-15.5622 dBrespectively. Using the EBG structure the performance of antenna beamwidth, returnloss,andradiationpattern has been increasedoverantennawithoutEBG structure. We have used FR4 substrate for design of antenna with dielectric constant 4.4. Losstangent0.02and 1.6 is the height of the substrate.

Keywords: Electromagnetic Band Gap Structure (EBGs), microstrip antenna, multiband, mobile and wireless communication, periodic structure.

I. INTRODUCTION

Many researchers now days are involved in designing multiband, wideband, single direction and simple antenna structures for wireless communication system [1]-[8]. Due to its low cost the multiband antenna is very appealing now a days and it is also helps in removing the filters in a WLAN/WIMAX system to clamp down the dispensablebands [8]. Even though above mentioned antenna may having many advantages but still some areas of performance should be increased. Due to the large size and applications the design cost of the antenna may increase [7]-[8].Using the EBG structure in the antenna is widely used [9]-[12]. It has many advantages suchassmallsize,lowcostandenhance antennaperformancebysuppressingsurfacewave and improving the efficiency. Our aim is to obtain multiband with wide bandwidth which helps for the wireless communication using EBG structure.

To overcome this issue recently they have incorporated Electromagnetic Band-Gap (EBG) structure design to improve the performance of patch antenna. EBGs are applied to suppress the propagation of surface waves within the Band-Gap frequency range. EBGs are applied as reflectors or substrates of patch antenna to increase the peak gain of antenna and to achieve wide bandwidth. EBG cells are periodically arranged. EBG structures with defects cannot be seen because they are usually used to make directional antennas.

Using EBG substrates performance of antenna can be increased. However we know that EBG cell can cause frequency shifting and increase of back scattering, so they have to be carefully arranged. In this article, a square edged antenna based on a rectangular shaped slots EBG substrate structure is proposed. By this design we can achieve wide bandwidth, high gain, with the small size of antenna can achieved easily.

II ANTENNA DESIGN

Here rectangular shaped EBG is etched on the surface of the substrate and ground. And this will acts as a filter which helps in reducing the surface waves produced on the antenna. The impedance which produced on the EBG structure is a frequency responsive it is going to form an LC network. The presented square edged micro strip antenna which is used for wireless applications.

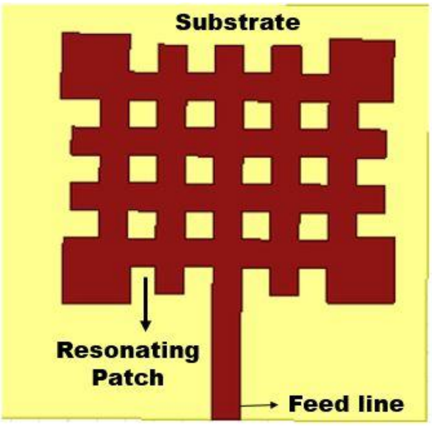

Fig. 1(a)

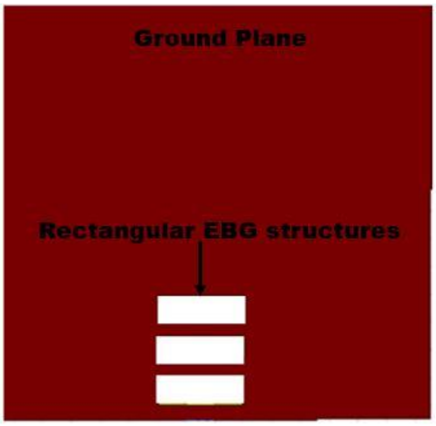

Fig. 1(b)

The antenna which consists of four square edged patches on the horizontal and vertical lines at the four corners and it is connected to co-axial feed. And EBG structure is implemented on substrate and ground.The dimensions of the antenna are given in below table 1. And the presented antenna without EBG structure is shown in fig. 1(a) Patch is inserted on FR4 substrate with dielectric constant 4.4. And the height is 1.6mm. 1(b) Shows the back view of ground plane antenna.

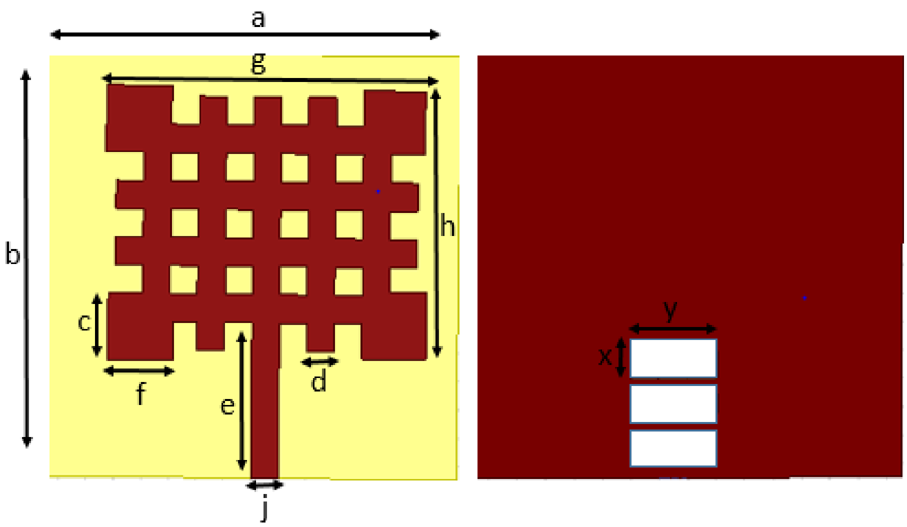

Fig.2. (a) Aerial View (b) Ground View of Bandwidth Enhancement of Microstrip Antenna Using EBG Structures for Wireless application.

2.1 Table

DimensionsofSquare edged microstrip patch Antenna

Parameter	Value(mm)	Parameter	Value(mm)
a	30	e	11
b	30	h	19.5
c	4.75	g	23.5
f	4.75	x	2
d	2	y	6
j	2		

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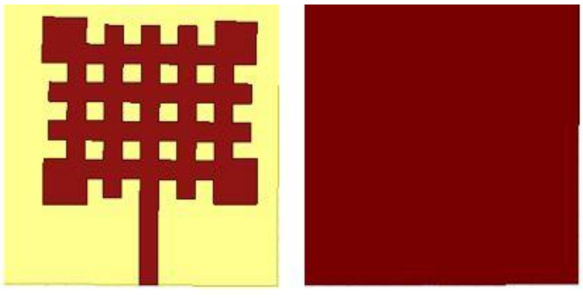
III. RESULTS

The resonance frequencies for the Bandwidth Enhancement of Microstrip Antenna are 3.34 GHz,5.5 GHz and6.55GHzwith the return losses of -20.4248 dB, -14.7067 dB and -20.42458 dB respectively. The acquired impedance bandwidths are closely93.7 MHz (3.325 – 3.4194GHz),136.9 MHz(5.4210 - 5.5579 GHz) and 172.6 MHz (6.4616 – 6.6352 GHz), Acquired frequency lies in three different mobile band ranges from (3.325 – 3.4194),(5.4210 – 5.5579) and (6.4616 – 6.6352).If we compare before cutting EBG and after shown in Fig. 3.



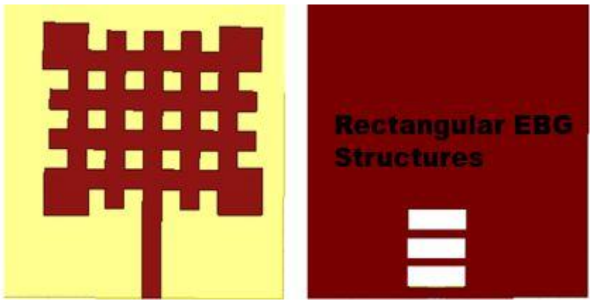
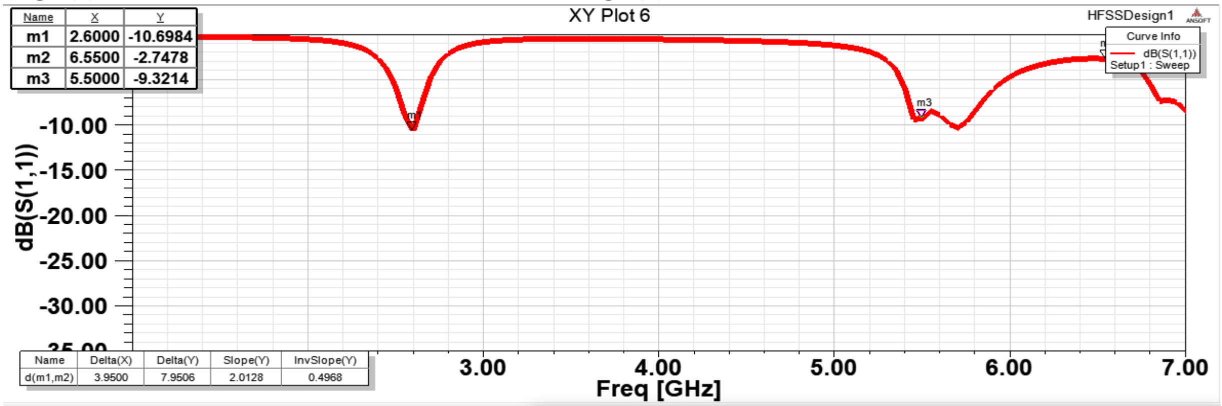


Fig 3(a) Structure without EBG **Fig 3(b) Structure with EBG**



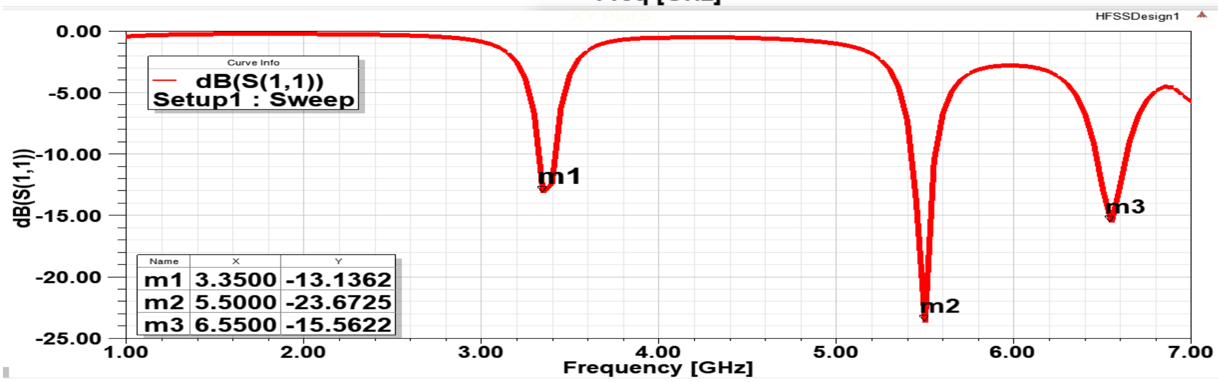


Fig 3(c) Without EBG **Fig 3(d) With EBG**

Fig. 3(c) 3(d)Reflection coefficientresults of implemented antenna with and without EBG.

The given outcome of the simulated results of VSWR Magnitudesis 1.5654, 1.1402 and 1.4000 at the resonant frequencies 3.3500 GHz, 5.5000 GHz, and 6.5500 GHz respectively as given in Fig 4.The maximum magnitude of VSWR should be less than 2 at the resonant frequency. If it is more than 2 then the implimented antenna will not give you expected results. So it will give you a maximum power of output radiations to input power.

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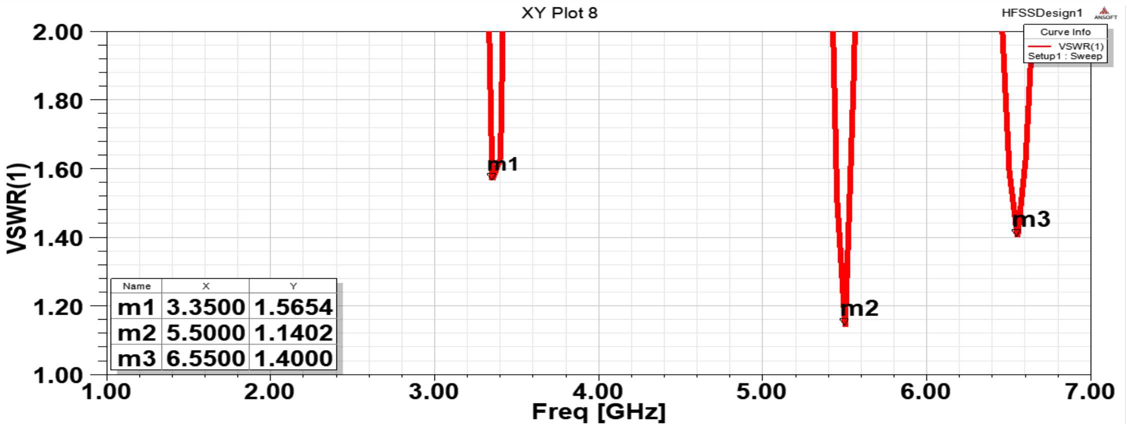

Fig 4 VSWR Plot

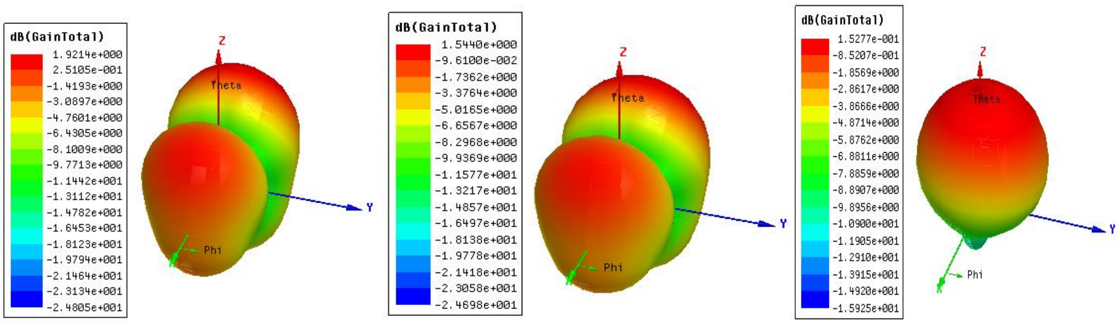

Fig 5. Gain plot for frequencies 5.5 GHz, 6.55 GHz and 3.5 GHz.

The given simulated results of gain plot is 1.9214, 1.5440 and 1.5277 at the resonant frequencies 3.3500 GHz, 5.5000 GHz, and 6.5500 GHz respectively as given in Fig 5.

IV. CONCLUSION

The outcome of this article, Bandwidth Enhancement of Microstrip Antenna Using EBG Structures for mobile Communication, satellite communication and also for military application. The analysis of outcome of antenna with EBG structures it covers three separated impedance bandwidths of93.7 MHz (3.325 – 3.4194 GHz), 136.9 MHz (5.4210 - 5.5579 GHz) and 172.6 MHz (6.4616 – 6.6352 GHz), resonant at 3.34 GHz, 5.5 GHz and 6.55 GHz with returns loss of -13.1362 dB, -23.6725 dB and -15.5622dB respectively. The above implemented antenna with EBG structure with improved performance of bandwidth, return loss, and radiation pattern when compared to without EBG structure. And also, it gives you a better improvement of bandwidth compare to literature. It can be used for the applications of the wireless communication system.

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