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A Wideband Microstrip Antenna with EBG Structure and Superstrate

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Abstract: A microstrip patch antenna withEBG structure and a dielectric layer have noteworthy effect on its input characteristics and band width. In this paper we studied both electromagnetic band-gap structure and a superstrate to increasing bandwidth of micrstrip patch antenna. We calculated bandwidth with and without EBG to design an Antenna for resonance frequency 4GHz. And then apply superstrate in EBG structure. This antenna simulated on Ansoft HFSS designer software,impedance bandwidth ,VSWR ,return losses & smith charts are observed and experimentally studied .Details of simulated results are presented and discussed.

Keywords:*Wideband, Superstrate layer, Microstrip antenna, Electromagnetic band-gap*

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1 INTRODUCTION

Due to the increasing demand of small antennas for personal as well as communication equipment Compact microstrip antennas have recently received much attention . It has been demonstrated that equilateral triangular microstrip patch can effectively reduce the required patch size for a given operating frequency [1]. In mobile communication system such as satellite, RADAR, Global Position System (GPS) often require extremely small size,light weight .Microstrip

Antenna also possess some limitations such as narrow impedance bandwidth ,low efficiency and gain.many process are used to overcome its limitations are reported[2]-[3].

Many techniques are uses to increase bandwidth like stacked patches with truncating the opposite corners [4]L-shaped probe with impedance matching network [5] but such processes require large antenna height and some additional impedance matching network that creates some problem to design antenna. The EBG structure shows high impedance characteristic. There are various type of EBG

structure are proposed but mushroom type structure are widely used [6]

superstrate a dielectric layer over patch antenna also a remarkable tool to improve impedance bandwidth of microstrip antenna . However , the presence of superstrate may affect the performance of antenna like gain and efficiency.

In proposed paper we compare the bandwidth of equilateral triangular patch in three condition –

(A) Patch without EBG and superstrate
(B) With EBG
(C) With EBG and superstrate.

We also discuss the details and design of proposed antenna.

2 DESIGN OF ANTENNA AND RSULTS

In proposed paper we uses an equilateral triangular patch whose dimensions' is 27×27 mm ,and uses 2.54 mm thick Rogers RT /Duriod 5880 with a permittivity of 2.2 and dielectric losses of 0.001. The EBG structure of proposed antenna is shown in fig (1)

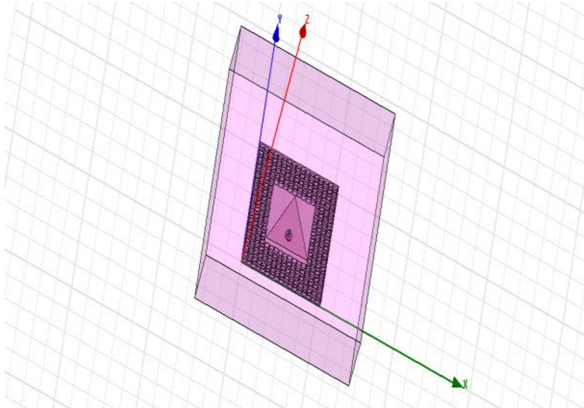

fig (1):2-D design of antenna with EBG structure

In EBG structure mushroom like structure is implemented in which unit cell dimensions of 2.4×2.4 mm with separation of 0.6 mm. the 4×4 row and column is implemented in proposed design.

Next we implemented a superstrate layer of thickness 11.54 mm shown in fig (2).

We observed that improved bandwidth is achieved by implemented superstrate layer over electromagnetic band-gap structure.

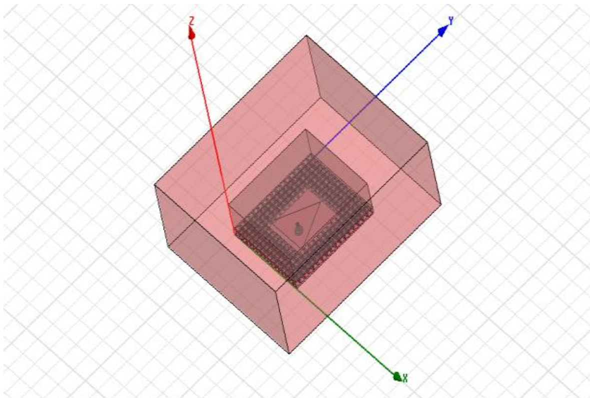

fig (2):2-D design of antenna with superstrate

3 SIMULATED RESULTS

The antenna is simulated using Ansoft HFSS 11.1 which employs finite element method .The simulated results of the return loss, VSWR , smith chart and 3-d polar plot are shown in following figs and comparison results shown in table 1 accordingly

A. ***The return loss** i.e. -22.0129 db as compare to -10 db (min) from Fig 3.1 shows that the design antenna has minimum radiation loss or and can be resonance at center frequency of 4.0947 GHz which is significant.*

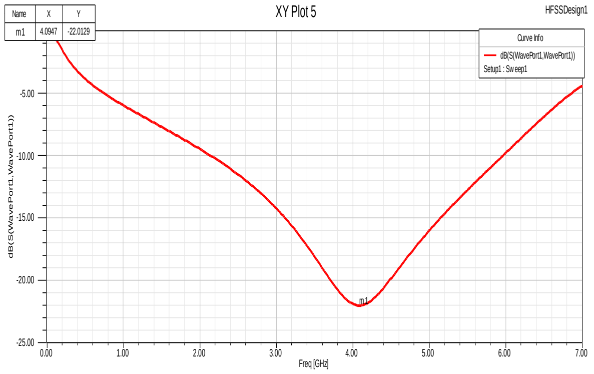

FIG:3.1

Measured return losses for with EBG and superstrate

B.The Percentage Impedance Bandwidth also measured from return loss chart is wide i.e. 47.85% as compared to simple Patch Antenna i.e. 38.62%. In patch with electromagnetic band-gap structure and superstrate higher frequency is 6.0563 GHz while lower frequency is 2.1377 GHz. So in this case bandwidth of 3.9186 GHz is achieved

C. ***The Voltage standing wave ratio***, is 1.17 at resonance frequency from Fig 3.2 tells us the design Antenna is most likely to have Impedance matching. so the proposed antenna can radiate more power, may be useful for many wireless application.

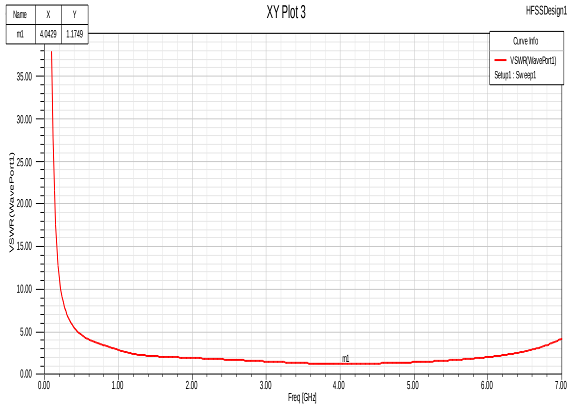

FIG:3.2

VSWR plot with EBG and superstrate

D. ***The Smith chart*** shows that the proposed antenna is resistive at resonance frequency of 4GHz as the circle intersects the middle line near the origin i.e. it radiates more power .Input impedance curve passing near to the one unit circle that shows perfect matching of input from Fig 3.3 we can say as frequency decreases from center frequency the proposed antenna become more capacitive, and above center frequency it becomes inductive i.e. it radiates low power.

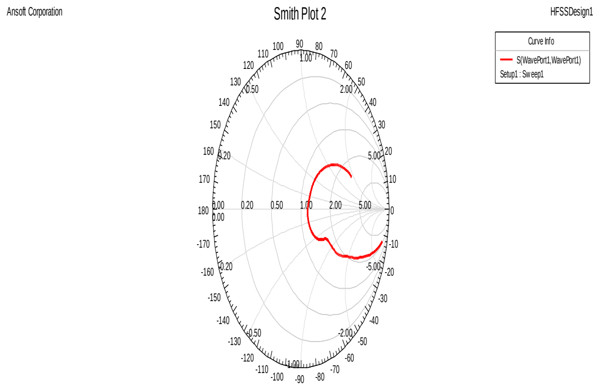

FIG 3.3

Smith chart with EBG and superstrate

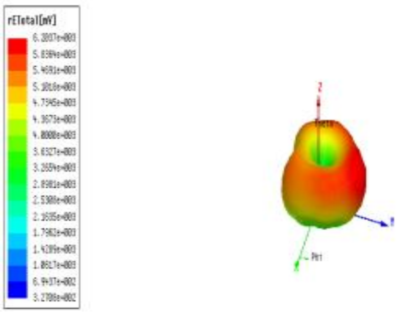

FIG-3.4 3-D polar plot

E. ***5Radiation pattern*** provides information which describes how an antenna directs the energy it radiates and it is determined in the far field region. The information is presented in the form of a polar plot and 2D radiation pattern drawn with the tool HFSS. Radiation pattern is measured at angles of 0^0, 10^0, 20^0 and so on.Fig 3.5 depicts the radiation pattern of the Antenna optimized with EBG and superstrate.

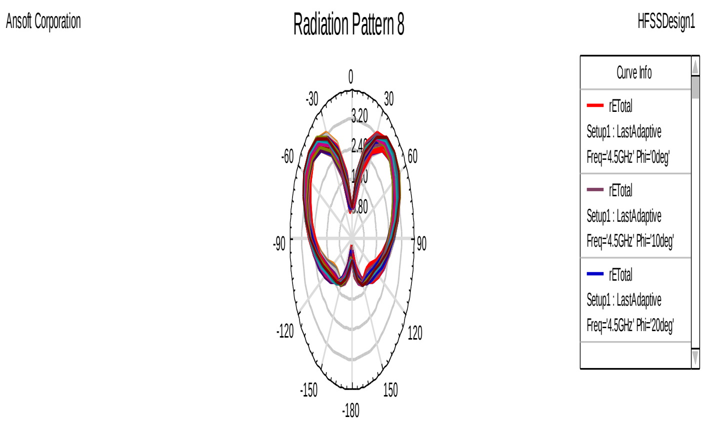

FIG-3.5

Radiation pattern

4.Comparison table:

	Bandwidth	VSWR	Retur loss (db)
Normal patch	38.62%	1.1009	-26.3670
With EBG	41.12%	1.0974	-26.6639
With superstrate	47.85%	1.1723	-22.0129

As comparison table 1 shows bandwidth of patch antenna is increased by 2.5 % by implementing Electromagnetic band gap structure, return loss is also minimized by implementing electromagnetic band –gap structure.Further when we implemented superstrate layer over electromagnetic band –gap structure bandwidth Is increased by 9.23% as shown in comparison table1.

5.Conclusions:

In this paper, design microstrip patch antenna with electromagnetic band gap (EBG) and with superstrate has been studied.

The main impact for studying this antenna structure with electromagnetic band gap structure and with superstrate is to increase the impedance bandwidth of patch antenna the antenna has successfully improved impedance bandwidth

6.References:

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