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OPTIMIZATION IN SIZE WITH EFFECTIVE BANDWIDTH ENHANCEMENT OF MICRO STRIP PATCH ANTENNA USING PBG STRUCTURE

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Abstract
Microstrip antenna has become more populer in the field of communication due to its verstality & uniqueness.The purpose of this paper is to design a low profile, conformal, small size antenna with high bandwidth along with good compromise in other factors like gain, directivity, efficiency etc. A E-shape patch antenna with suitable geometry is taken to provide good response of bandwidth about 59.09 % at centre frequency 2.28 GHz. Using FR-4 glass epoxy material, on insertion of PBG structure, creating deformities at ground plane side, the band width of the antenna is improved tremendously. The new design of antenna is found suitable for various wireless communications for 1.55-2.85 GHz band. The design approach & Simulation results are shown with the help of MOM based full wave simulator IE3D.

Keywords *- micro strip antenna; photonic band gap structure; bandwidth; probe feed antenna;*

INTRODUCTION

In the field of wireless technology, these technologies are highly performed in the field of spacecraft, satellite or aircraft application. Where size, weight, cost, performance, ease of installation and maintenance and aerodynamic profile are constraints, low profile antennas are required. the micro strip antenna has a very low profile, and can be fabricated using printed circuit techniques. In this high-tech environment of 3G & 4G. This technology are used in government and commercial applications, such as Cellular phone , global positioning system (GPS), remote sensing, radio, ships, land vehicles and wireless communications that have similar specifications micro strip or patch antenna are used. Microstrip antenna has low profile, Conformable to planar (2D) and non planar (3D) surfaces. Simple and inexpensive manufacturing using modern printed-circuit technology, mechanically robust when mounted on rigid surfaces, compatible with MMIC designs and Microwave circuits, and when the particular patch shapes and mode are selected, they are very versatile in terms of resonant frequency, impedance, polarization, and pattern. In addition, by adding loads between the patch and the ground plane such as short pin or short post. The major disadvantages of patch or micro strip antennas are their low efficiency and very narrow frequency bandwidth, spurious feed radiation, poor polarization purity, limited power capacity and low gain. The development of accurate and versatile analytical model for the understanding of the inherent limitations of micro strip antennas, as well as for their design and optimization.

The use of Photonic Band Gap (PBG) structure is becoming attractive for many researchers in photonic and antenna field. PBG had been used to improve the performance of various antennas such as patch antenna and resonant antenna. Microstrip patch antenna is promising to be a good candidate for wireless technologies. Microstrip patch antenna consists of a dielectric substrate, with a ground plane on the other side. Due to its advantages such as low weight, low profile planar configuration, low fabrication costs and capability to integrate with microwave integrated circuits

technology, the microstrip patch antenna is very well suited for applications such as wireless communications system, cellular phones, pagers, Radar systems and satellite communications systems.

Photonic Band Gap (PBG) or Photonic Band Gap (PBG) materials are periodic dielectrics, which can stop the propagation of photonic waves in certain directions, within certain frequency bands. Several types of PBG or PBG substrates have been investigated. It has been reported that PBG or PBG materials used with micro strip patch antennas can increase their gain and improve their radiation patterns, , and reduce the back lobe and side lobe levels. Also, some research has been reported on improving the antenna bandwidth by using PBG. PBG has been used in the ground plane to improve the bandwidth.PBG configurations in the microwave region are shown and include array antennas, high precision GPS, mobile telephony, wearable antennas and diplexing antennas. The dielectric constant of the materials used for the PBG components as an electrically inducing a change of dielectric properties by injecting additional charge carriers and electrically modifying the device geometry and/or the dielectric loading. Photonic Band Gap (PBG) surfaces can be used to mitigate or alter the photonic interaction between an antenna and the platform.PBG surfaces offer a mechanism to improve antenna performance, reduce antenna size and reduce antenna to antenna coupling on platforms.PBG surfaces may provide a mechanism for the reduction of SAR (Specific Absorption Rate) for soldier (body) worn antenna systems.

E-shape micro strip patch antenna with PBG structure gives a new dimension to antenna performance. The simulation results depiction makes this very clear as the various parameters like bandwidth, VSWR, efficiency, radiation pattern are affected significantly.

ANTENNA DESIGN

The proposed (E-shaped) antenna consists of a dielectric substrate epoxy/glass (FR4) lies between the range of dielectric constant 4.1 to 5.3(here it is taken as 4.2) and respectively their loss tangent 0.002 to 0.02. As compare to conventional rectangular patch antenna of similar size, insertion of four square cut PBG structure on ground plate make its performance batter, while creation of E- shape on patch layer put a very effective results in its all parameter along with enhancement in its band width. A simple square patch with given design specification is shown in fig.1.The both sided views (positive side and negative side) of proposed antennas are respectively shown in fig.2 and fig.3. The simulation results will be shown in figure.
The new design of proposed antenna consists of following design specifications

A basic U-shape microstrip patch antenna is designed and simuated on Zeland_IE3D_v9.0 simuator as shown in figure 1,further design improvement is made using PBG deformities on ground plane side.

Design specifications:

Length of ground plate:	45 mm
Width of ground plate:	45 mm
Length of E-limb patch:	30 mm
Width of E-limb patch	7.5 mm
Height of dielectric substrate:	1.6 mm
No. of PBG square cut on ground plate:	04
Size of PBG structure:	13 x 9.5 mm^2
Dielectric constant:	4.2

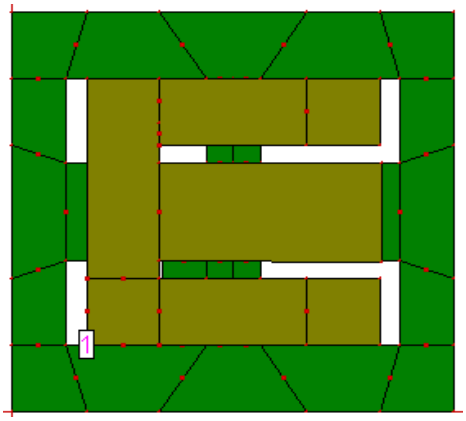

Fig.1 Proposed MSA with PBG on positive side

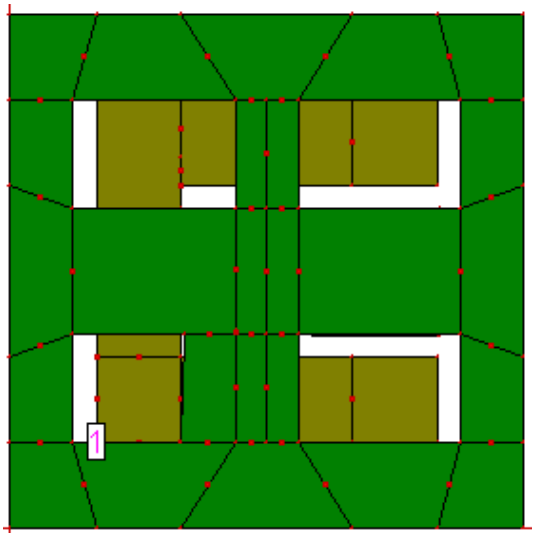

Fig.2 proposed MSA with PBG on negative side

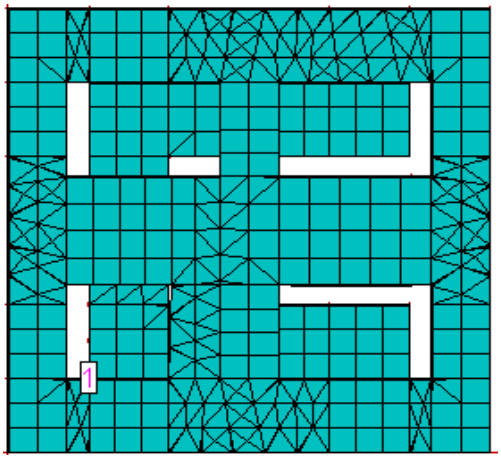

Fig.3 Meshed structure

SIMULATION RESULTS

The E-shape patch antenna surprising results are simulated and verified on Zeland_IE3D_V9.0.The simulation results show a very surprising improvement of bandwidth about 59.09 % at centre frequency 2.28 GHz. The E-shape patch antenna surprising results are simulated and verified on Zeland_IE3D_V9.0.The simulation result shows a very surprising improvement of bandwidth.

Antenna parameters	Results
Bandwidth	59.09 %
Centre frequency	2.28 GHz
Operating frequency band	1.55-2.85 GHz
Return losses at centre frequency	-22.5 dB
VSWR at centre frequency	1.17

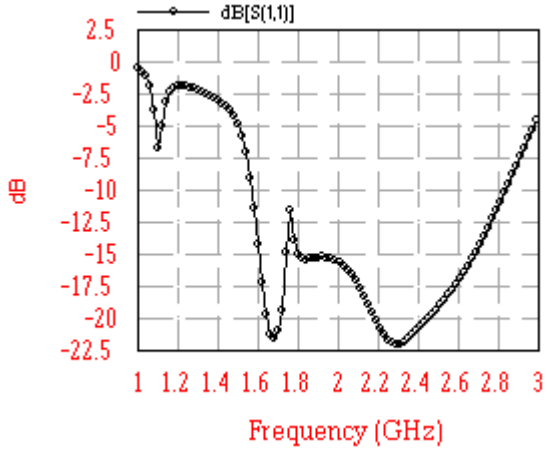

Fig.4 S_{11} parameter for proposed antenna

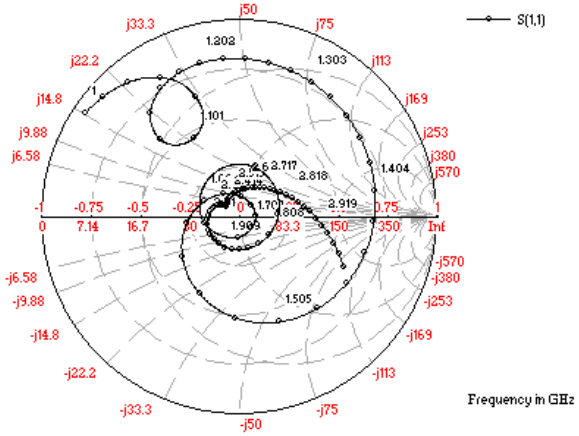

Fig.5 Smith chart

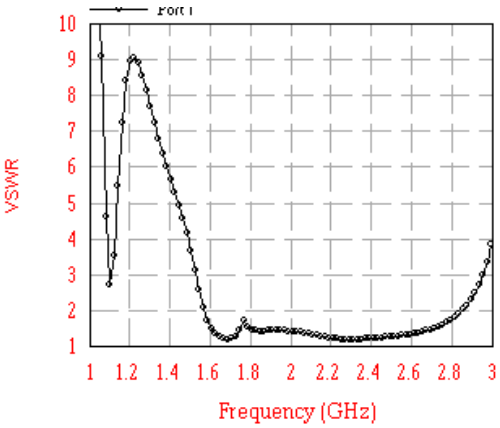

Fig.6 VSWR

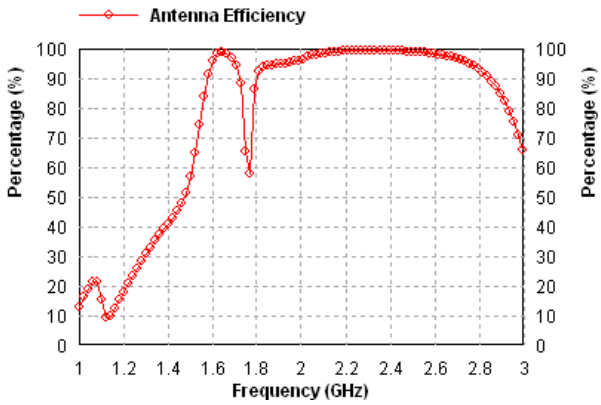

Fig.7 Efficiency

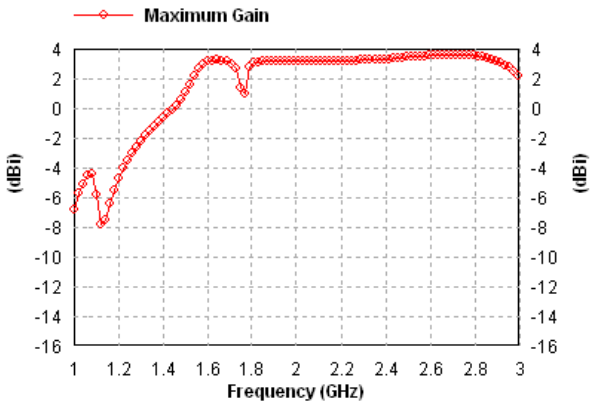

Fig.8 Gain

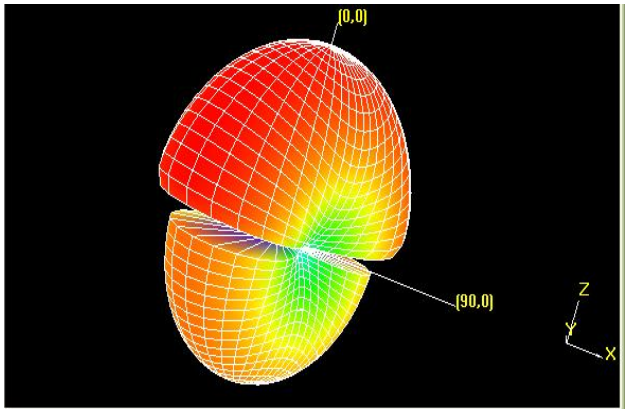

Fig.9 D Pattern view

CONCLUSION

An E-shape microstrip patch antenna is designed and tested for scattering parameter, and it is found that it has given a nice performance in the field bandwidth, on insertion of PBG deformities in the ground plane structure, the bandwidth of the antenna enhanced tremendously about 59.09 % at centre frequency 2.28 GHz. This shows the feasibility and reliability of antenna for wide band application of wireless communication. The new design approach has shown an improvement among various past research work, this would be really helpful for communication technology.

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