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E-H-Slotted Microstrip Patch Antenna

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ABSTRACT: A new E-H-slotted microstrip antenna is proposed. A patch antenna is a narrowband, wide-beam antenna These antennas are low profile, conformal to planar and non-planar surface, simple and inexpensive to manufacture using modern printed circuit technology, mechanically robust when mounted on rigid surface, compatible with MMIC designs and when the particular shape and mode are selected they are very versatile in terms of resonant frequency, polarization, field pattern and impedance. Microstrip antenna consist of a very thin metallic strip (patch) placed a small fraction of a wavelength above a ground plane. The patch is generally made of conducting material such as copper or gold and can take any possible shape.

This paper presents a design of E-H slotted microstrip patch antenna and experimentally studied on IE3D software. This design is achieved by cutting E-H shape in a patch. With E-H slotted shapes patch antenna is designed on a FR4 substrate of thickness 1.524 mm and relative permittivity of 4.4 and mounted above the ground plane at a height of 6 mm. Bandwidth as high as 46% are achieved with stable pattern characteristics, such as gain and cross polarization, within its bandwidth. Impedance bandwidth, antenna gain and return loss are observed for the proposed antenna. Details of the measured and simulated results are presented and discussed.

KEYWORDS: Bandwidth, E-H -Slot, Return Loss, Microstrip Antenna.

I. INTRODUCTION

A microstrip antenna consists of conducting patch on a ground plane separated by dielectric substrate. In the late 1970s, the rapid development of microstrip antenna technology began. By the early 1980s basic microstrip antenna elements and arrays were fairly well established in terms of design and modeling, and workers were turning their attentions to improving antenna performance features (e.g. bandwidth), and to the increased application of the technology. One of these applications involved the use of microstrip antennas for integrated phased array systems, as the printed technology of microstrip antenna seemed perfectly suited to low-cost and high-density integration with active MIC or MMIC (monolithic microwave integrated circuit) phase shifter and T/R circuitry. Low dielectric constant substrates are generally preferred for maximum radiation. The conducting patch can take any shape but rectangular and circular configurations are the most commonly used configuration [3]. Other configurations are complex to analyze and require heavy numerical computations. A microstrip antenna is characterized by its Length, Width, Input impedance, and Gain and radiation patterns. Various parameters of the patch antenna and its design considerations will discussed in the subsequent chapters. The length of the antenna is nearly half wavelength in the dielectric. it is a very critical parameter. which governs the resonant frequency of the antenna. There are no hard and fast rules to find the width of the patch.

II. LITERATURE SURVEY

Ashvini Chaturvedi , Dr. Yogesh Bhomia, Dinesh Yadav (2010) this paper presents a design of triangular microstrip antenna with truncated tip and experimentally studied on Ansoft Designer v-2.2.0 software. This design technology is achieved by cutting all three tips of the triangular microstrip antenna and placing a single coaxial feed. Triangular patch antenna is designed on a FR4 substrate of thickness 1.6 mm and relative permittivity of 4.4 and mounted above the ground plane at a height of 6 mm. Bandwidth as high as 11.07% are achieved with stable pattern characteristics, such

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as gain and cross polarization, within its bandwidth. Impedance bandwidth, antenna gain and return loss are observed for the proposed antenna. Details of the measured and simulated results are presented and discussed [17].

Dr. Yogesh Bhomia, Yogesh Kr. Sharma, Ramesh Bharti, Amit Kumar Jain (2013) presented a design of U-slotted microstrip patch antenna and experimentally studied on IE3D software. This design is achieved by cutting U shape in a patch. With U -slotted shapes patch antenna is designed on a FR4 substrate of thickness 1.524 mm and relative permittivity of 4.4 and mounted above the ground plane at a height of 6 mm. Bandwidth as high as 39% are achieved with stable pattern characteristics, such as gain and cross polarization, within its bandwidth. Impedance bandwidth, antenna gain and return loss are observed for the proposed antenna. Details of the measured and simulated results are presented and discussed [18].

Ravinder Kumar, Arushi Bhardwaj, Dr. Yogesh Bhomia (2016) presented a design U-H-Slotted Microstrip Patch Antenna using Two Feeding Techniques. There are various types of microstrip antenna that can be used for number of applications in wireless communication. In this paper, the design of rectangular shaped microstrip patch antenna with FR4 glass epoxy substrate having dielectric constant, Er of 4.4, and thickness 1.6mm has been presented. It is instigated using stripline and coaxial feeding. These antennas are compact, conformal to both the surfaces- planar& non-planar, simple, inexpensive, rugged, compatible with MMIC designs. Microstrip antenna is made up of a very thin metallic strip (patch) i.e, placed over a small fraction of a wavelength above a ground plane. The simulated results indicate that the antenna is suitable for RADAR (all types), GPS carriers, WLANs, Wimax, Satellite communication, navigation. The design is simulated using IE3D software and result is obtained in terms of smith chart, VSWR, return loss [19].

III. ANTENNA DESIGN

In a Wide-band operations of antenna have presented to satisfy various wireless applications. In this section, we demonstrate the validity of our proposed designed antenna through the simulation results. One of the main design features that make the PCB of E-H-slotted antenna, simple to use is the feeding with largest element. This configuration allows you to directly attach a coaxial cable feed to the microstrip transmission line on the board without having to use a matching network.

The design idea was taken from broadband antennas to make the antenna work in a large band of frequencies of the many broadband antennas [7]. Hence the chosen shape of the patch is E-H-slot shape microstrip patch antenna, with an aim to achieve smaller size antenna. The E-H-slot shape microstrip patch antenna is presented in fig.1 with front (top) view.

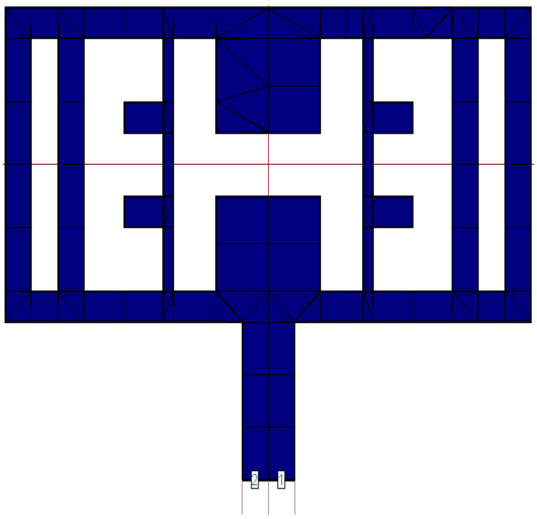

Fig.1. Geometry of proposed E-H-slotted shape microstrip patch antenna

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This E-H-slotted shape microstrip patch antenna is fabricated on a FR4 substrate [5] of thickness 1.524 mm and relative permittivity of 4.4. It is mounted above the ground plane at height of 6 mm. In this work, transmission line feed technique is used as its main advantage is that, the feed can be placed at any place in the patch to match with its input impedance (usually 50 ohm) [17]. The software used to model and simulate the E-H-slotted shape microstrip patch antenna was IE3D, it can be used to calculate and plot return loss, VSWR, radiation pattern, smith chart and various other parameter

IV. RESULT AND DISCUSSION

The proposed antenna has been simulated using IE3D software [9]. The physical parameters of all antennas are the same, but the resonant frequency decreased as the iteration order increased, thus the electrical length of the ground plane also decreased in their resonant frequency for the proposed patch antenna. The input characteristics of the fabricated small-size E-H-slotted patch antennas with different parameters are measured through a Vector Network Analyzer. Fig.2 shows the variation of return loss with frequency. Plot result shows resonant frequency 2.66 GHz and total availale impedance band width is 46% from the proposed antenna and -39.42 dB return loss is available at resonant frequency. Which is significant Fig.3 shows the input impedance loci using smith chart. Input impedance curve passing near to the 1 unit impedance circle that shows the perfect matching of input. Fig.4 shows the VSWR of the proposed antenna that is 1.02 at the resonant frequency 2.66 GHz.

In order to have a strong coupling among the element, a microstrip line is introduced between them. Then all the elements are coupled mostly by a guided wave through the microstrip line. Based on the measurement results, we can discuss the property of the proposed E-H-slotted patch antenna. From these results, it is observed that the proposed technique can achieve a maximum size reduction and better results that is good than the results obtained from other shapes.

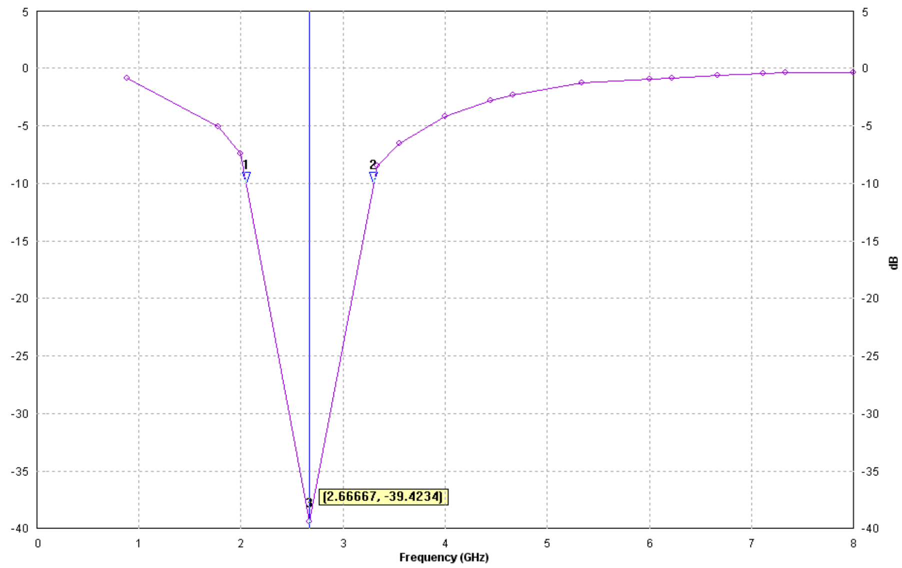

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Fig. 2 Return loss vs. Frequency curve for proposed antenna

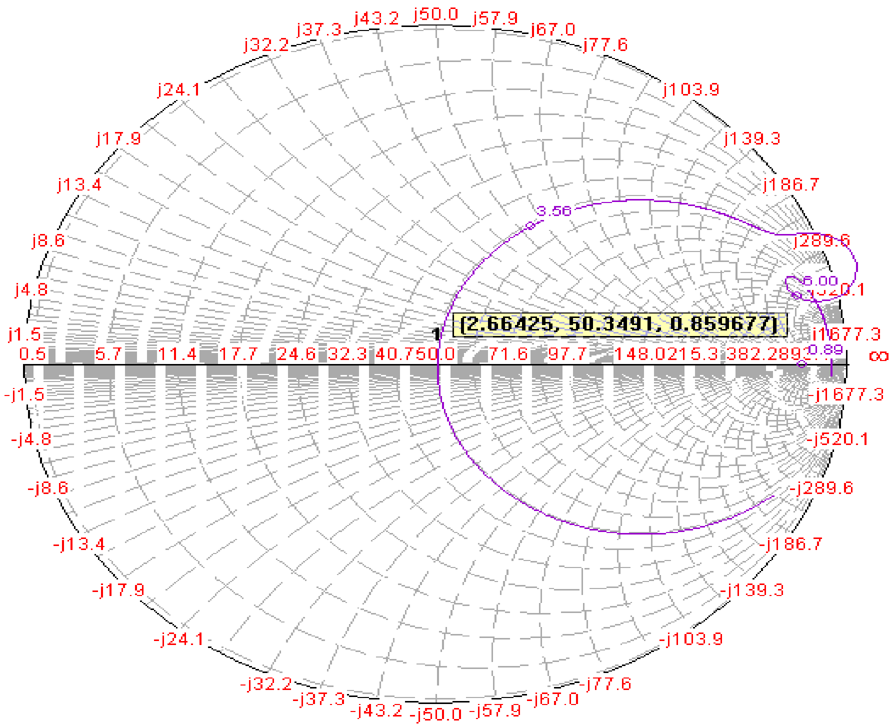

Fig.3. Input impedance loci using smith chart

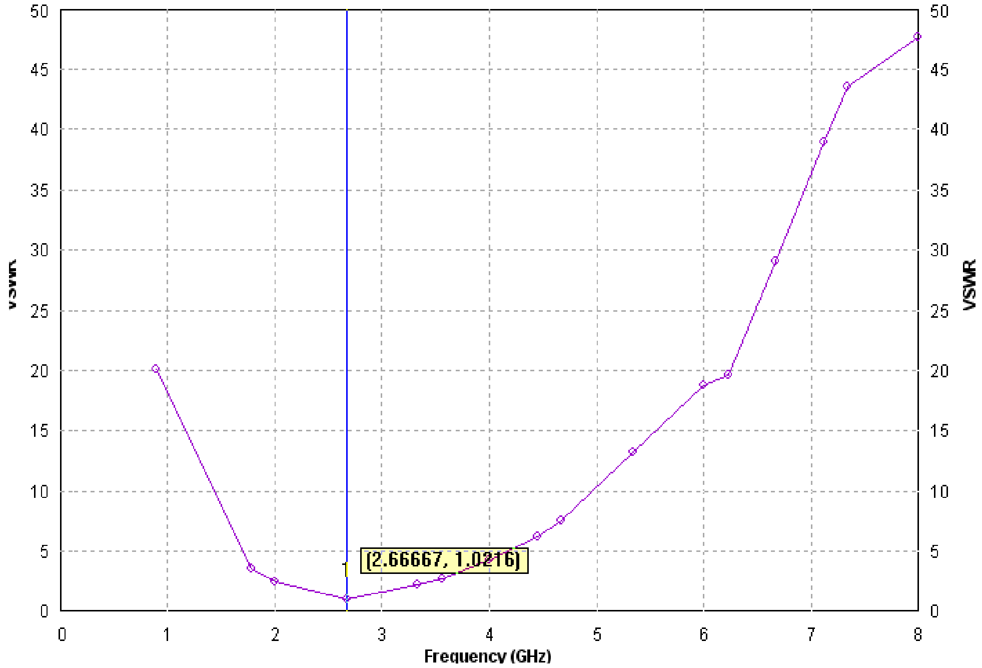

Fig.4. VSWR vs. Frequency curve for proposed antenna

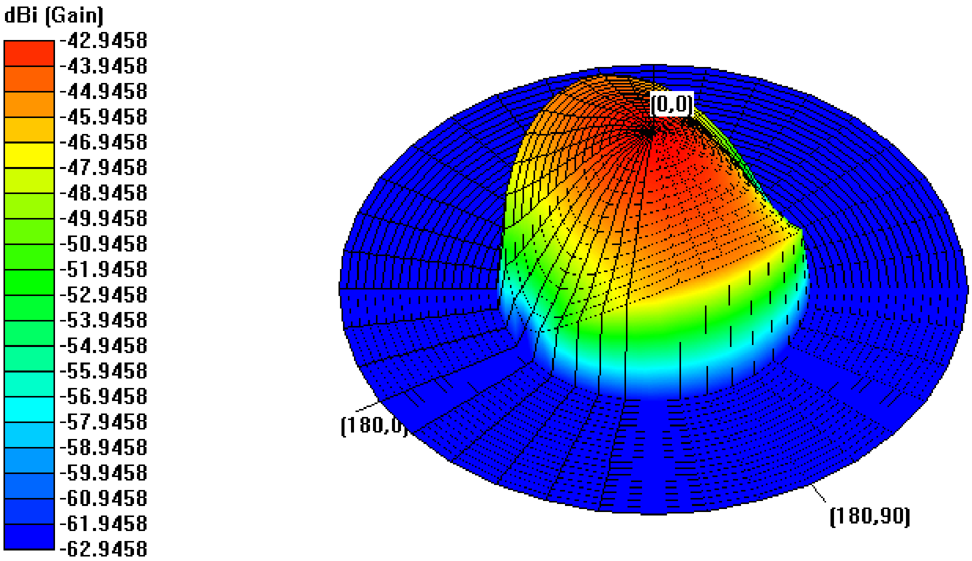

Fig.5 Radiation pattern

V. CONCLUSION

Microstrip patch antennas are increasing in popularity for use in wireless applications due to their low-profile structure. Therefore they are extremely compatible for embedded antennas in handheld wireless devices such as cellular phones, pagers etc. The telemetry and communication antennas on missiles need to be thin and conformal and are often in the form of Microstrip patch antennas. Another area where they have been used successfully is in Satellite communication. An Ultra Wide Band Microstrip E-H-slot antenna is presented. Simulation and measured results of our design show more than -39.42dB return loss at the resonant frequency of 2.66 GHz and VSWR is 1.02 at this frequency.

This novel design can be adjusted to work in higher frequencies which make it possible to add more slots and thus get higher gains with the aim to preserve compactness requirements and to maintain the overall layout as simply as possible and keeping the realization cost very low.

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BIOGRAPHY

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