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Designing of Compact Spectacles Shaped Ultra-wide band Microstrip Patch antenna

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Abstract: ***In this paper an antenna is designed for ultra-wideband for wireless applications. The antenna is resonating at 16 GHz frequency range. The proposed antenna is designed by using spectacles shaped defected patch i.e DMPS (Defected microstrip patch Structure) for particular feeding technique (microstrip line feed) is used. In this design antenna is fed by microstrip line feed with single port. In Microstrip Patch antenna, there are four types of feeding techniques, in which microstrip line and coaxial probe feeds are contacting schemes whereas proximity and aperture coupled feed are non-contacting schemes. In the Paper, we have designed the various parameters like bandwidth, return loss, S-Parameters, smith chart, radiation pattern, bandwidth, VSWR and resonant frequency an antenna and their effect. Finally simulation is done using design software HFSS(High Frequency Structure Simulator).***

Keywords: Ultra-wide band, Rectangular microstrip patch antenna, S-Parameters, smith chart, radiation pattern, bandwidth, VSWR, resonant frequency, HFSS

I. INTRODUCTION

Wireless communication systems have been growing as the application of mobile phones and systems are booming in use. For such wireless systems the crucial component to emit and collect signals is the antenna. Antenna is not active device; they are passive that only guides the signal energy in a peculiar direction in connection with isotropic antenna. They act as bridging links between transmitter, free space and the receiver. The main characteristics of antenna include low profile, radiation emitted from the antenna should be less, less bulkier, high gain, fabrication should be done in an uncomplicated manner and its overall cost be less and it need to have certain amount of compatibility with looped surfaces. But, stability is still one of the important properties of coming up application. Microstrip patch antenna is the most suitable and prevalent type of antenna in use today, their effective frequency range is in between 1GHz to 6GHz. Since 1970s this antenna has been flourishing, where its size and performance were very effective as conversation entity was required at these frequencies. The architecture of the microstrip patch antenna consists of the substrate of which below is the ground plane and above is the patch. These antennas find applications in mobiles instruments, receivers using GPS technologies and other wireless and wired products reason being there high values of dielectric constant and additional size reduction. Since this antenna has flat profile and is light in weight also makes them suitable for applications like airborne and spacecraft[3].

The advancements in microstrip antenna technology ensued its start in the late 1970s. Basic microstrip antenna elements and arrays in term of design and modeling had been utilized at fair level by the early 1980s. In the last decades printed antennas have been largely analyzed owing to their merits such as light weight property, miniaturized size, lesser cost, conformability and the easy integration with active device over other radiating systems. The conducting materials such as copper and gold due to their better conductivity and adhesive property to substrate are generally used on the outer surfaces of the substrate for the purpose of patch and ground. The radiating patch and the feed strip lines are usually photo etched on the dielectric substrate. Electromagnetic wave radiation from microstrip patch antennas occurs primarily by the reason of the fringing fields between the patch edge and the ground plane[4].

Microstrip Patch Antennas has quite a lot of advantages over other antennas due to their light weight, low profile, low cost of production, and are easily well-suited with optoelectronic integrated circuits (OBICs) and microwave monolithic integrated circuits (MMICs). Due to these striking features, the researchers are having noteworthy attention towards microstrip antennas. Microstrip patch antennas are used in extensive range of applications such as in wireless communication and biomedical diagnosis. In recent years, the widespread proliferation of wireless communication has augmented the demand for compact broadband antennas for handheld devices, satellite systems, etc. But it has a disadvantage of producing narrow bandwidth and low gain. To overcome the

inherent limitation, many techniques such as probe fed antenna, stacked shorted patches, patch antenna with thick substrate electrically and slotted patch antenna have been planned and investigated.

In general, Microstrip Patch Antenna is available in many different shapes for, such as Disc sector, Square, Rectangular, Elliptical, Dipole, Circular, Triangular, Circular ring and Ring sector. Each design has its own merits and demerits. In this paper, a fan shaped microstrip patch antenna for the above said application is presented. The fan shaped antenna resonates at two frequency with DGS provided to progress the antenna characteristics. Defected Ground Structure is a non-periodic or periodic cascaded configuration defect, provided in the ground plane of a coplanar or microstrip or conductor backed coplanar waveguide. This defect provided disturbs the current distribution of the patch antenna, which in turn is due to the change in characteristics of the effective capacitance and inductance of the microstrip patch antenna. These microstrip patch antennas have caused a tremendous revolution in the field of space technology owing to their promising [5].

A Microstrip patch antenna has a radiating patch on one side of a dielectric substrate and it has a ground plane (conducting) on the other side as shown in Figure 1.1.

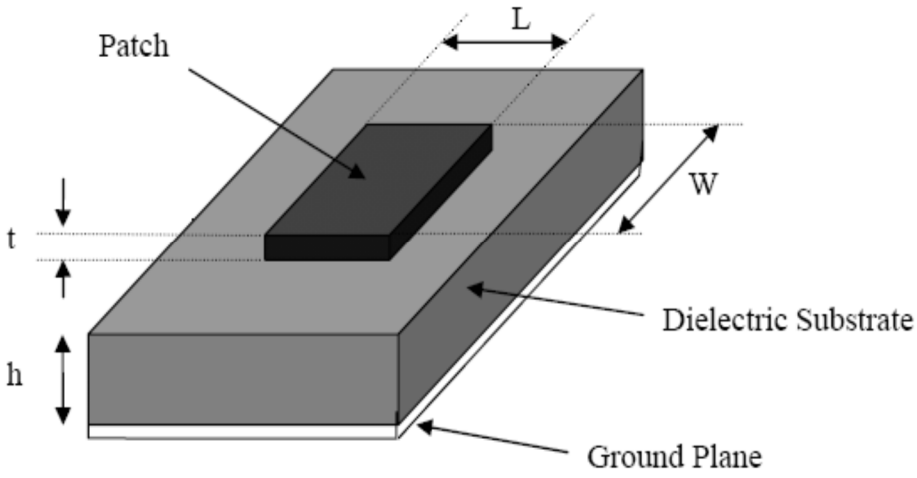

Figure 1.1:- Structure of a microstrip patch antenna.

The material of the patch conducting material such as copper or perfect electric conductor and will be of any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate.

To analyze the results and their prediction, we can take patch of any shape of the following that may be square, rectangular, circular, triangular, and elliptical or some other common shapes. Rectangular patches are probably the most utilized patch geometry. It has the largest impedance bandwidth compared to other types of geometries, and is the main research interest in this project. Circular and elliptical shapes are slightly smaller than of rectangular patches. Thus it will have smaller bandwidth and gain. This circular geometry patches were difficult to analyze due to its inherent geometry.

II. FEEDING METHOD TO BE USED

A. Microstrip Line Feed

In Microstrip line feed, we have to use a conducting strip that is connected directly to the edge of the patch. The width of conducting strip is smaller as compared to the patch. This type of feeding arrangement has the advantage that the feed and patch can be etched on the same substrate to provide a planar structure.

However as the thickness of the dielectric substrate being used increases, surface waves and spurious feed radiation also increases, which hampers the bandwidth of the antenna. The conducting materials such as copper and gold due to their better conductivity and adhesive property to substrate are generally used on the outer surfaces of the substrate for the purpose of patch and ground. The radiating patch and the feed strip lines are usually photo etched on the dielectric substrate. Electromagnetic wave radiation from microstrip patch antennas occurs primarily by the reason of the fringing fields between the patch edge and the ground plane. The only disadvantage of this feed radiation will leads to undesired cross polarized radiation. This feed method has simple planar structure; this is main advantage of this.

III. DESIGNING

A. design of ultra wideband with dmps and dgs

The geometry of proposed antenna which is microstrip line fed for wireless application is depicted. In which the antenna parameter are same as above but there is a change DMPS (Defected microstrip patch Structure) and uses defected ground plane. The dimensions of the designed antenna with microstrip line feed are same

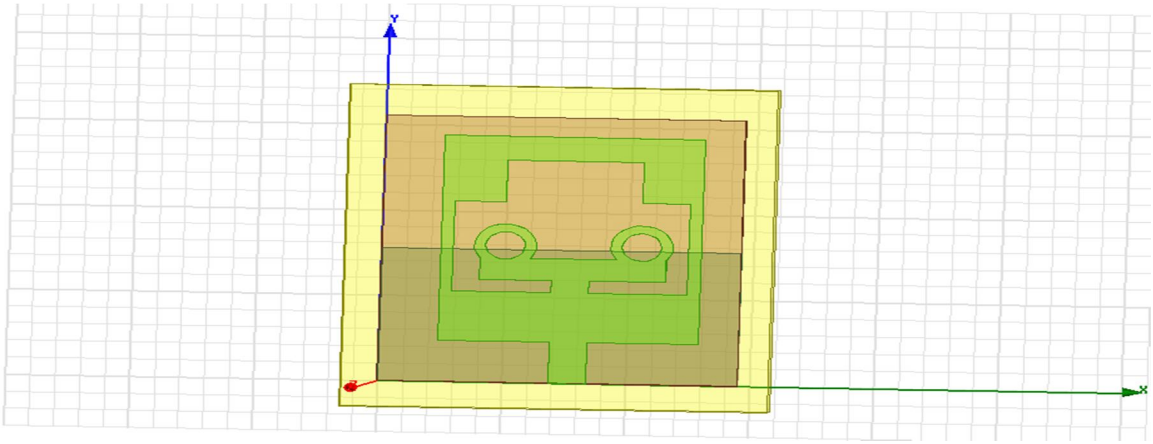

Figure 1.2 Geometry dimension of proposed antenna for ultra wideband

1) The return loss plot for the designed antenna at -10 dB bandwidth with microstrip line feed is shown in figure as below.
Resonant frequency = 16.2375 GHz at -32.16 dB
Band width= f2-f1= 25.9880-10.7018=15.2862 GHz= 15286 MHz

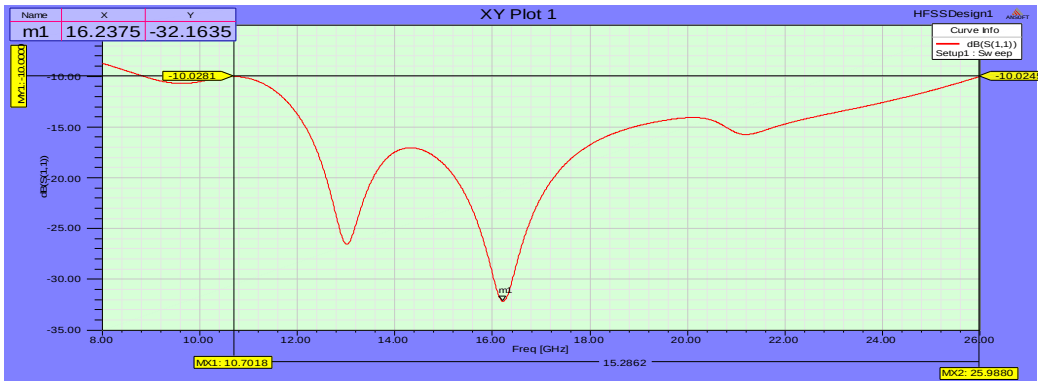

Figure 1.3 Simulated return loss

2) VSWR plot for the proposed antenna:- VSWR at Resonant frequency is 1.0505

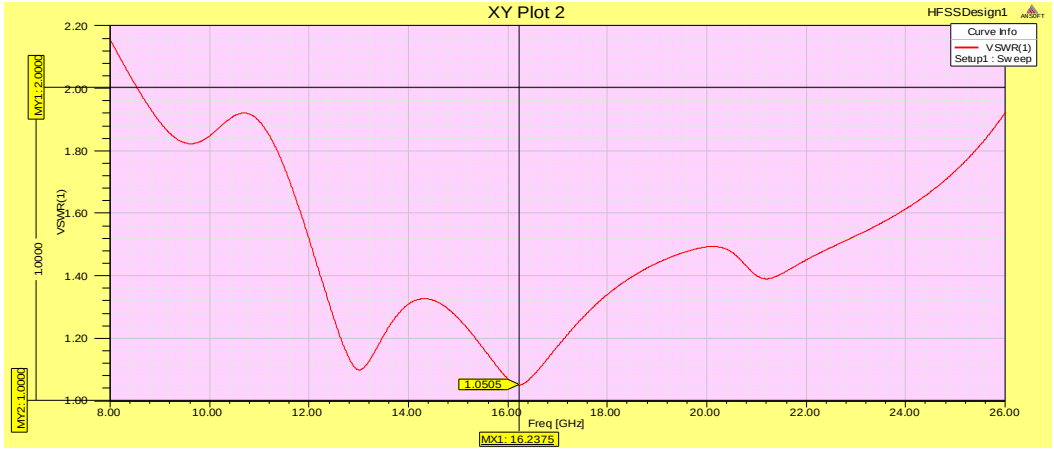

Figure 1.4 VSWR plot

3) The Smith Chart of Proposed Antenna: Smith Chart of this antenna shows a very good impedance matching of about value 1.0488×50=52.44 ohm

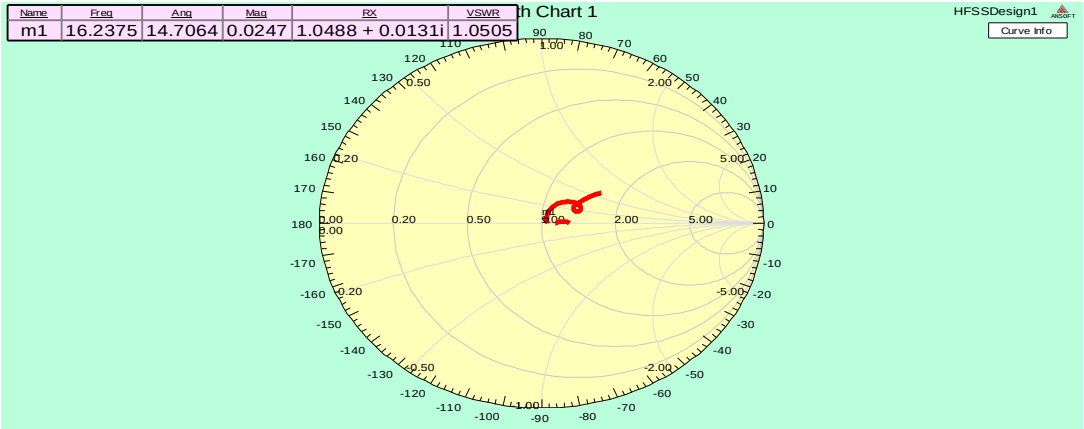

Figure 1.5 Smith Chart and Radiation Pattern Plot.

Table 1.1 Summarized results of the proposed antenna of ultra wide band

Sr.No	FREQUENCY (GHz)	RETURNLOSS (dB)	BANDWIDTH (GHz)	VSWR	IMPEDANCE MATCHING
1	16.2375	-32.1635	25.988-10.7018= 15.2862	1.05	52.44 ohm

B. Difference Table between results of reference and proposed antenna of ultra wide band:-

Table 1.2 Difference result of reference and proposed antenna of ultra wide band

Sr.No	FREQUENCY (GHz)	RETURNLOSS (dB)	BANDWIDTH (GHz)	VSWR	IMPEDANCE MATCHING
1. Reference Result	8.0	-26.23	11.5-3.00=8.5	1.1	About 55 ohm
2. Proposed Result	16.2375	-32.1635	25.988-10.701= 15.28	1.05	52.44 ohm

IV. CONCLUSION

An ultra-wide band Microstrip patch antenna wireless application using double microstrip line fed has been designed and simulated using HFSS V13 software. A simulation is made in terms of bandwidth, return loss, VSWR and patch size and smith chart. Hence, we can see that the use of feeding techniques for designing a antenna has an important role as it affects the all parameters of an antenna. A microstrip patch antenna excited by different excitation techniques gives different bandwidth, different gain, different efficiency etc. The output results of an antenna are analyzed for the optimized dimensions and the proposed antenna works well at 16 GHz frequency band.

The proposed antenna is designed by using rectangular type defected patch i.e DMPS (Defected microstrip patch Structure). We can also conclude that by changing the feed point where matching is perfect, the high return loss can be achieved at the resonant frequency. Various microstrip patch antennas with proximity coupled feeding technique are presented. And in the paper we have plotted the all useful antenna parameters like S-parameters, smith chart, return loss, radiation pattern, resonant frequency and VSWR are plotted for each antenna.

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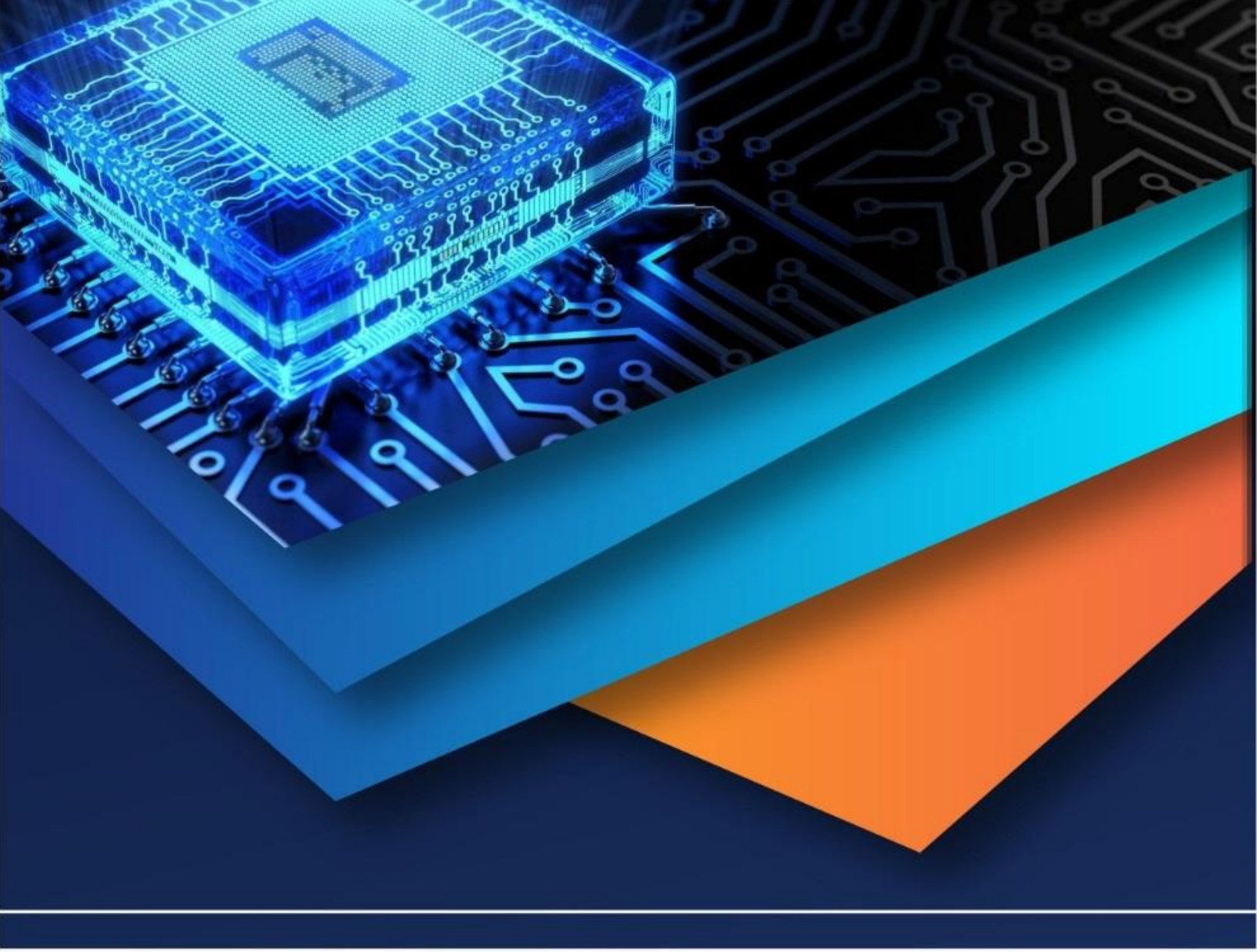

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