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Equilateral Triangular Microstrip Patch Antenna for C Band Application

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Abstract:
In recent years, microstrip patch antennas are extensively used in the field of communication due to their compact size, low cost, low weight and flexibility. An equilateral triangular microstrip patch antenna with tapered feed for C band applications is presented. The operational frequency is 6.5 GHz that undergoes in C band. The impedance bandwidth of the designed antenna is 300 MHz (6.34-6. 64) for reflection coefficient less than -10dB.The Simulation is done by CST Microwave Studio Suite (CST MW 2016) Simulator.

Keywords: Microstrip Patch Antenna, Return Loss, Slot, Tapered Feed, VSWR

I.INTRODUCTION

An antenna is a device that transmits the signal from one end to another producing EM field consisting of electric field and magnetic field [1]. By using Maxwell's equations the physical radiation mechanisms can be obtained. The Microstrip patch antennas are become researcher choice because these antenna have various advantage like low weight, cost, size, profile and its fabrication. The patch antenna is a transducer that converts the electrical signal in the form of Electro Magnetic waves. Microstrip patch antennas are widely used by many radio receiver or transmitter to couple its electrical connection to the EM field [2]. The basic configuration of a microstrip antenna consists of a ground, substrate and patch where a metallic patch printed on a thin, grounded dielectric substrate. Originally, the element was fed with either a coaxial line through the bottom of the substrate, or by a coplanar microstrip line [3]. There are different types of microstrip antenna and they vary in shape and size like Rectangular, Circular, Elliptical, Triangular and many more. Triangular Microstrip Patch Antenna has very wide scope in future[4]. In order to improve the impedance matching at higher frequencies. The feed line has been tapered [5] near the antenna feeding point. The proposed microstrip patch antenna radiate an Omni-directional radiation pattern [6]. In the table I the resultant parameter of equilateral triangular patch antenna, slot cut in patch with tapered feed and equilateral triangular microstrip antenna with inset feed are compared.

Table .1. Comparison of antenna

Parameter	Return Loss	Vswr	Gain
Triangular Microstrip Antenna With Tapered Feed	-36	1.1	Positive
Triangular Microstrip Antenna With Inset Feed	-30	1.2	Negative

In this paper equilateral triangular patch antenna, slot cut in patch with tapered feed is designed for 6.5 GHz frequency. The Radiation Pattern, Return Loss, Band Width, VSWR are observed for the Triangular Patch antenna using CST Microwave Studio software.

II. DESIGN AND ANALYSIS OF THE PROPOSED ANTENNA

A. *Design of Proposed Antenna*

An Equilateral Triangular microstrip patch antenna is designed using CST Microwave Stimulator which works on finite integral method a relative of FDTD. The volume of design antenna is 16.5 x20x1.6 mm^3. The antenna has been designed on 1.6 mm thick FR-4 (lossy) substrate with a relative permittivity of 4.3 with a dielectric loss tangent of 0.02 (tan δ = 0.02 as shown in fig 1 (a,b)

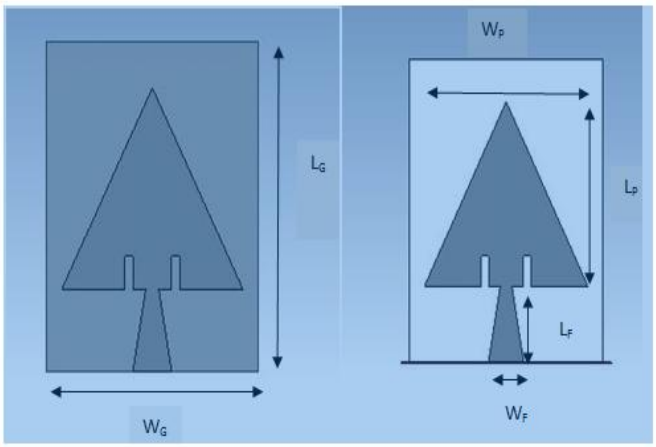

Figure.1. (a) **Figure.1. (b)**

Figure.1. (a) shows the Front View of proposed antenna
Figure.1. (b) shows the Front View of patch

The detailed parameters of the antenna are given in Table II

Table.2. Parameters of antenna

Symbol	Dimension(Mm)	Description
W_g	16.50	Antenna Width
L_g	20	Antenna Length
L_p	12.12	Patch Length
W_p	14	Patch Width
L_f	11.87	Feed Length
W_f	3	Feed Width

B. *Development of Antenna*

The performance of the antenna typically depends on the microstrip feed line at lower frequencies. The Lower band edge frequency of the antenna is determined by the microstrip feed line length and consequently defines its lateral size. In the proposed antenna, the equilateral triangle patch that is designed by using the standard formula given in[7] and tapered feeding is used for the impedance matching. The microstrip patch antenna is an equilateral triangle with edges 14 mm, feed length 11.87 mm and height of ground 20. By the two slot of 2x0.61mm^2 is cut in the lower edge of the patch to improve S11 and impedance parameters as shown in Fig. 2 which are optimized in CST microwave simulator.

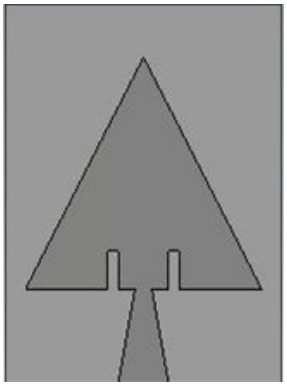

Figure.2. Proposed Antenna

III. RESULTS AND DISCUSSION

A. *Antenna S11*

S11 versus frequency graph has been shown in fig 3. The frequency range of the simulated antenna is from 6.34-6.64 GHz suitable for C band application like satellite communication transmission, wi-fi devices, cordless telephone etc. applications. Maximum return loss (minimum reflection coefficient) S11 is obtained less than -10 for the entire band of 300MHz

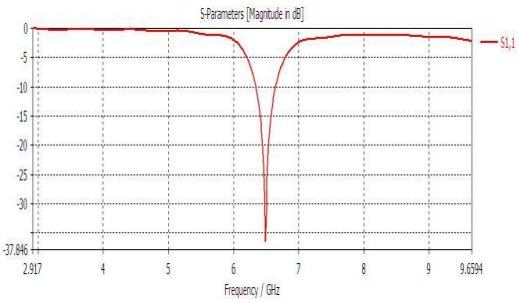

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Figure.3. S_{11} Parameter of proposed antenna

B. *Antenna VSWR*

Fig 4 shows the graph between VSWR versus frequency. Graph clearly indicates that VSWR is less than 1.5 in the entire frequency band.

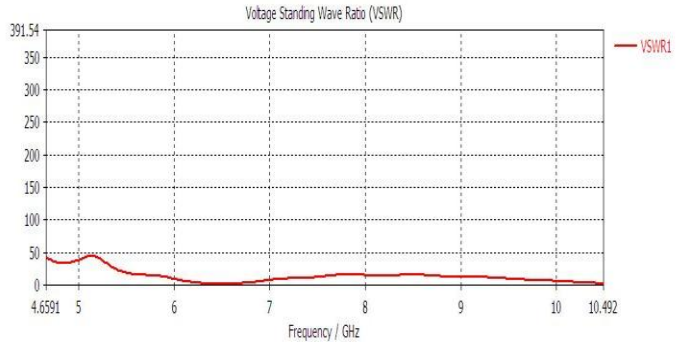

Figure.4. VSWR of proposed antenna

C. *Antenna Input Impedance*

The real and imaginary parts of antenna impedance versus frequency curve is shown in fig 5.The graph clearly indicates that the real part of impedance is 50 ohm which means that feed line characteristic impedance is matched with the load impedance and the imaginary part of the impedance is 0 means reactance is zero.

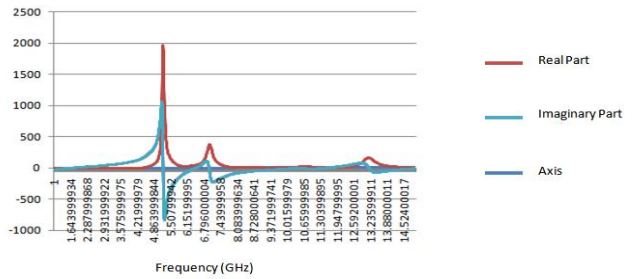

Figure. 5. Reference Impedance of proposed antenna

D. *Bandwidth*

Fig.6 describe the Bandwidth of the antenna

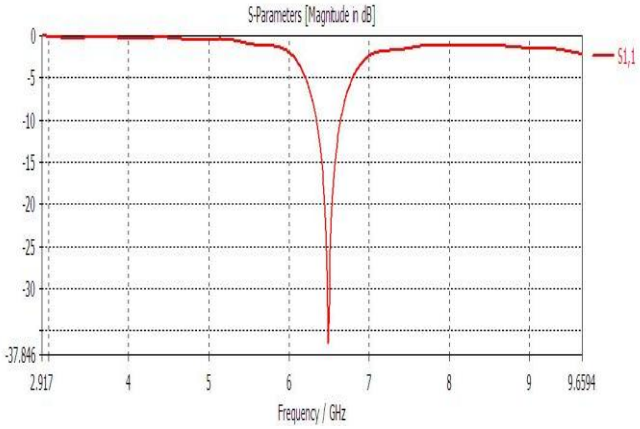

Figure.6. Bandwidth of proposed antenna

E. *Radiation Pattern*

Fig. 7 describe the Radiation Pattern of the antenna of the proposed antenna

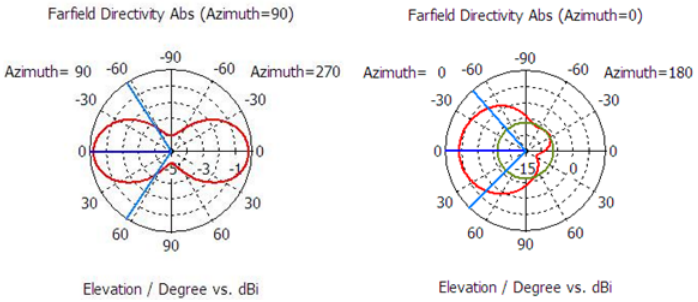

Figure.7.(a) H plane **Figure.7.(b) E plane**

Figure.7. Radiation Pattern of proposed antenna H plane and E plane

IV. CONCLUSION

In this paper the research work is mainly focused on the design and simulation of simple, small and narrowband equilateral triangular patch antenna using the tapered feed technique which is simulated using CST Microwave Studio Suite (CST MW 2016) Simulator. The Triangular microstrip patch antenna operates on the frequency 6.5 GHz. The Bandwidth of the proposed antenna is 300MHz while maintaining the lower size. Impedance matching is 50 ohms at resonant frequency of the design antenna which shows the good impedance matching. It can be used for various applications such as satellite communication, weather radar system application.

V. REFERENCES

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VI. AUTHORS

Sunil Kumar Singh was born in Chitrakoot district of Uttar Pradesh, India, in 1979. He completed his B. Engineering from Govind Vallabh Pant Engineering College Pauri Garhwal, Uttarakhand in year 2000. He received his Masters degree in Microwave Engineering with gold medal from Government Engineering College, Jabalpur, in 2005. In 2007 he joined Jabalpur Engineering College, Jabalpur, India, as an Assistant Professor. He coauthored more than 50 research papers and got published in various national and international journals and conferences on micro strip antennas and Electronic Band Gap (EBG) Substrates. Along with them his current research interest is Ultra Wide Band (UWB) Monopoles and MIMO/Diversity antennas. Currently he is a reviewing member of various reputed journals including MOTL and IET

Varsha Khatik was born in Kareli, Madhya Pradesh in 1992.She completed her B.Engineering in Electronics and Communication in 2014.She started her Master of Engineering from Jabalpur Engineering College, Jabalpur, Madhya Pradesh in 2015. Currently working on Microstrip Triangular Patch antennas.