CPW Fed Hexagonal Patch Shape with Hexagonal slot Ultra Wideband Antenna

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ABSTRACT

In this paper hexagonal patch shape with hexagonal slot, ultra wideband antenna is proposed. The total dimensions of antenna are 55×43.5mm. Sides of hexagonal patch are taken 13mm each and hexagonal slot sides are taken as 3mm each. The antenna resonates at two frequencies in ultra wideband range (UWB). There is enhancement in BW in upper range ultra wideband frequency from 6.2 GHz to 8.2GHz due to hexagonal slot cut in hexagonal patch. The design is carried out using Computer Simulation Technology (CST) Microwave Studio (MWS) suite. Co-Planar Waveguide (CPW) feed is used to feed antenna.

Keywords:

UWB, CST, CPW FEED, MICROSTRIP ANTENNA

1. INTRODUCTION

Recent trends demand for Ultra wideband applications require antenna to be designed for UWB applications. UWB (ultra wide band) occupy spectra from 3.1 GHz to 10.6 GHz. By means of UWB (ultra wide band) antennas, high data rate transmission is possible in short-range local networks while using short-duration pulses [1]. Printed planar microstrip antennas are getting popular for modern communication system due to their features which includes compact size, low cost and ease of fabrication. An extensive work on simple microstrip geometries including rectangular, circular and triangular shaped structures have been reported [2]. Bandwidth and efficiency of a Microstrip antenna depends upon many factors for eg patch size, shape, substrate thickness, dielectric constant of substrate, feed point type and its location, etc. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable for higher bandwidth, better efficiency and better radiation [3-5]. Circular or rectangular microstrip patch has been modified for some applications to other shapes. Hexagonal microstrip antenna (HMSA) has smaller size compared to the square and circular microstrip antennas for a given frequency. The small size is an important requirement for portable communication equipments [6-9]. In this paper hexagon patch shape is used for design of ultra wideband antenna. CPW feed is used to feed the antenna. Moreover thick substrate properties are used for improvement of proposed antenna. CST software is used to carry out the results. CST software is a fully featured software package for electromagnetic analysis and design in the high frequency range. The program is especially suited for the fast, efficient analysis and design of components like antennas, filters, transmission lines, couplers, connectors (single and multiple pin), printed circuit boards, resonators and many more. Since the underlying method is a general three dimensional approach, CST MICROWAVE STUDIO can solve virtually any high frequency field problem.

ANTENNA GEOMETRY:

In order to design hexagonal patch first of all circular patch is designed and its geometry is modified, considering the equivalence the areas of both the patches.

We know

$$F_R = \frac{8.791\times 10^9\ c}{2\,\pi\, a_e\sqrt{\epsilon_r}}$$

Where,

fr = resonant frequency

c = velocity of the light in free space

εr= relative permittivity of the substrate

and

$$a_e = a\{\,1+\frac{2h}{\pi\,\epsilon_r\,F}\left[\ln\left(\frac{\pi F}{2h}\right)+1.7726\right]\}^{1/2}$$

In which

a = actual radius of the circular patch antenna

h = height of the substrate

εr = relative permittivity of the substrate

The relationship between the equivalent areas of the circular and hexagonal patches is given as:

$$\pi\, a_e^2 = \frac{3\sqrt{3}}{2}\, S^2$$

Where

S = sides of a regular hexagonal patch antenna

ae= Effective radius of the circular patch antenna

Therefore in this way sides of hexagon are calculated for the design.

ANTENNA DESIGN & PARAMETERS:

Parameters for design of proposed antenna are written below. The antenna is implemented by using thick substrate of 1.4 thickness and dielectric constant of 4.3. CPW feed is used to feed the antenna. Hexagonal shape slot is cut in hexagonal patch. Due to this slot antenna now resonates on two frequencies. Moreover bandwidth in upper range of frequency is enhanced. The

simulation is done using CST software. Various parameters are listed below in tabular form:

Parameters	Dimensions
Substrate	55× 43.5mm
Patch sides	13mm each
Ground	55× 43.5 mm
Feed	CPW feed
ε_r	4.3
Hexa slot sides	3 mm each

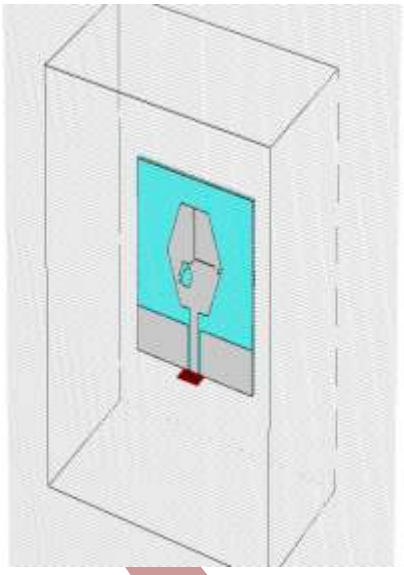

Fig 1 Design using CST software

RESULTS AND DISCUSSION:

The simulated s-parameters result shows two things firstly the antenna resonates at two frequencies i.e. at 3 GHz and at 6.2 GHz. Secondly there is enhancement in the BW. Now there is 2 GHz enhancement in the bandwidth in the upper range of frequencies from 6.2 GHz to 8.2 GHz for return loss less than -10 dB and the value of return loss is -38 dB at 8.2 GHz as shown below in fig 2.

The impedence shown by smith chart in figure 3, for proposed design is 48.94 ohm which is nearly equal to 50 ohm, the required value.

CONCLUSION:

Hexagonal patch shape with hexagonal slot, ultra wideband antenna is proposed in this paper. The total dimensions of antenna are 55×43.5mm. Sides of hexagonal patch are taken 13mm each and hexagonal slot sides are taken as 3mm each. The antenna resonates at two frequencies in ultra wideband range (UWB). There is enhancement in BW in upper range ultra wideband frequency from 6.2 GHz to 8.2GHz due to hexagonal slot cut in hexagonal patch. The design is carried out using Computer Simulation Technology (CST) Microwave Studio (MWS) suite. Co-Planar Waveguide (CPW) feed is used to feed antenna.

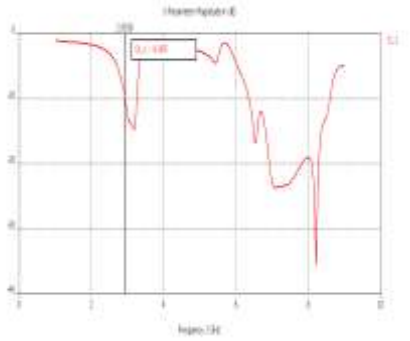

Fig 2 s-parameter

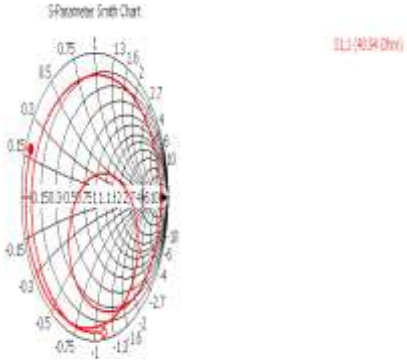

Fig 3 smith chart

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