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Design Microstrip Patch Antenna for UWB Applications

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ABSTRACT
The proposed antenna is fabricated with Fr4-epoxy has dielectric substrate permittivity of 5.5. This antenna operates with multiple operational frequencies covering the bands from 3.6 GHz to 10.5 GHz which is capable to perform UWB applications. The simulated results for various parameters like return loss, VSWR and gain are calculated with high frequency structure simulator(HFSS). The current work of this paper is to design U-shaped patch antenna with micro strip feed line which is applicable for ultra wide band applications.
Keywords - Fr4-epoxy, Multiple operational frequencies, UWB, ANSOFT HFSS software, Micro strip feed line.

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I. INTRODUCTION

The antenna design for high-speed multimedia connectivity represents a challenging activity for designers of fixed and mobile wireless communication systems. In fact, the rapid growth of mobile systems toward the fifth-generation (5G systems) requires multiband, wideband, and UWB antennas suitable to cover mobile and wireless services and to reduce the system complexity, the overall device dimensions, and costs. Many efforts are underway to identify new antenna geometries suitable to satisfy the challenging requirements of the modern wireless communication systems [1–4]. Over the years, number of methods have been proposed to enlarge the bandwidth of MPA such as adding an impedance matching network, using thick and low electric permittivity substrates[5-6], parasitic patches either in stack or coplanar geometry[7], slotting in patch can be done of various shapes like U-slot , T slot , reduced ground using defected ground structure etc.

Due to recent developments in mobile and wireless communication industry, urgent demand for wireless connectivity necessitates use of a single antenna to cover multiple frequencies. Thus, there is a growing demand for multiband micro strip patch antennas[8]. In general, wireless devices are used for integration of multiple technologies into a single device. One simple way to cover several frequencies is by using wideband antennas, but additional band pass filters are needed to prevent or minimize interference with other existing wireless systems while servicing within same geographical area. The proposed antenna can be used for the UWB application and also in the direct broadcast satellite. UWB systems can support more than 500 Mbps data transmission within 10m. Compact size, lowcost printed antennas with Wideband and Ultra wideband characteristic are desired in modern communications. The Ultra wide band antennas can be classified as directional and Omni-directional antennas [9]. A directional antenna has the high gain and relatively large in size. It has narrow field of view. Whereas the Omni-directional antenna has low gain and relatively small in size. It has wide field of view as they radiate in all the directions [10]. The UWB antennas have broad band. There are many challenges in UWB antenna design. One of the challenges is to achieve wide impedance bandwidth. UWB antennas are typically required to attain a bandwidth, which reaches greater than 100% of the centre frequency to ensure a sufficient impedance match is attained throughout the band such that a power loss less than 10% due to reflections occurs at the antenna terminals[11].

The antenna design with U-shaped parasitic strip line along the feeding line for UWB application is investigated in this paper.

II. MICROSTRIP LINE FEEDING

In micro strip line feed technique[12], a conducting strip is connected directly to the edge of the micro strip patch as shown in the figure 1. The conducting strip is smaller in width as compared to the patch. This kind of feed arrangement has the advantage that the feed can be etched on the same substrate to provide a planar structure. An inset cut can be incorporated into the patch in order to obtain good impedance matching without the need for any additional matching element. This type of feeding technique results in undesirable cross polarization effects.

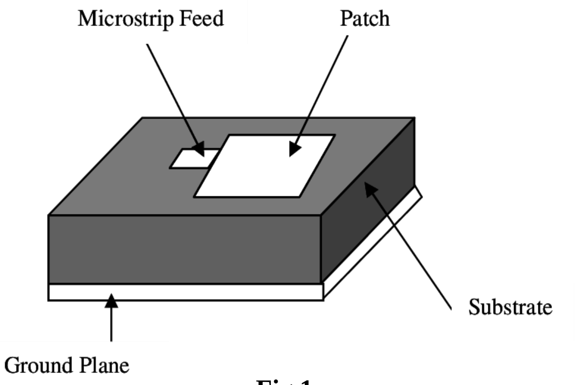

Fig.1

III. ANTENNA DESIGN AND ANALYSIS

In this paper the performance of the rectangular path with the micro strip line feeding has been discussed. The proposed antenna consists of port with compact size of substrate as 26 mm * 26 mm with height of substrate of 1.5 mm. The antenna designed consists of FR4 substrate with dielectric constant of 5.5. The design of proposed patch antenna is shown Fig. 2.

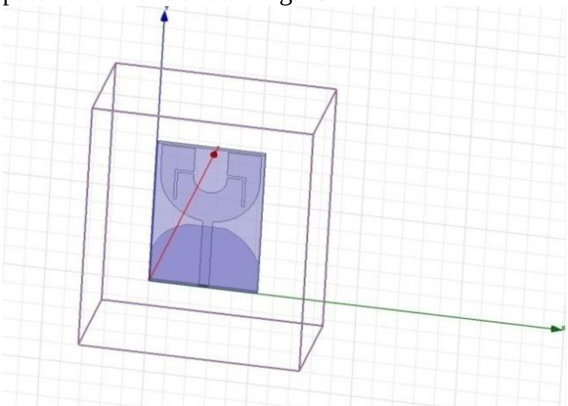

Fig. 2. Design of proposed patch antenna

Fig 2. shows the geometrical view of designed antenna which consists of U-shaped patch with reverse L slots on the U-shaped patch. The cutting of slots in the patch shows the improvement in the gain.

Table 1 shows the dimensions of the proposed antenna

Name of the parameter	Measurements
Length of substrate	26 mm
Width of substrate	38.1 mm
Height of substrate	1.5 mm
Frequency	5.5 GHz
Length of feed line	2.4 mm
Width of feed line	1.5 mm
Length of patch	2.4 mm
Width of patch	17.5 mm
Port length	2.4 mm
Port width	1.5 mm
Substrate	Fr-4 epoxy

IV. SIMULATION AND RESULTS:

4.1 Return loss:

Fig. 3 shows the simulated return loss(S parameter) of the proposed antenna. It can be clearly seen that the proposed antenna has a multiband characteristics in the UWB spectrum. Three resonant frequencies locate at about 3.8 GHz, 7.3 GHz and 9.7 GHz with the return losses -14.77 dB, -16.2 dB and -13.7 dB respectively. The antenna band width that is lower than -10 dB occupies from 3.6 GHz to 10.5 GHz. By this we can say that the proposed antenna can operate well in UWB applications.

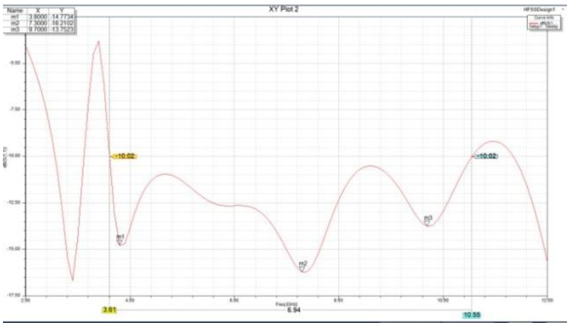

Fig. 3: S11 parameter Vs frequency plot

4.2 VSWR:

Fig 4. shows the VSWR plots for the proposed antenna. The VSWR obtained is less than 2 throughout the frequency range from 3.6 GHz to 10.5 GHz.

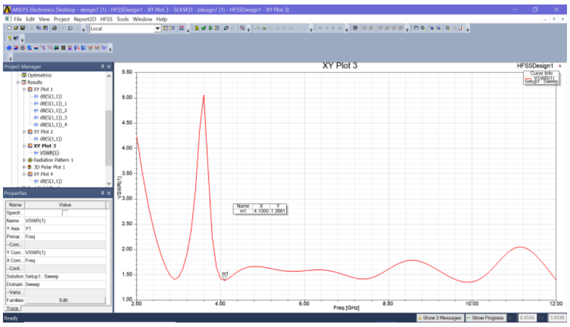

Fig 4: VSWR measurements

4.3 Gain:

The below figures shows the gain of the proposed antenna at three frequencies in which it was observed that the designed antenna is having good gain.

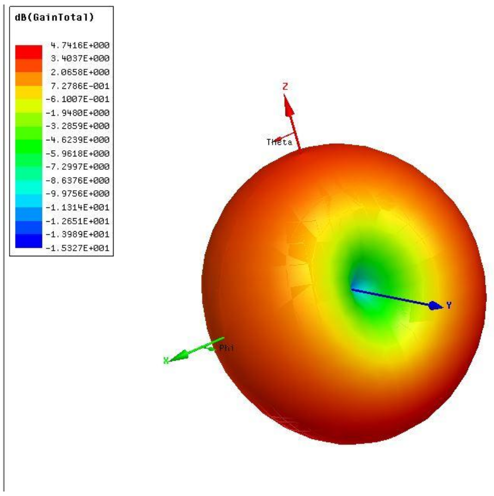

Fig 5. Gain plot at 3.8 GHz

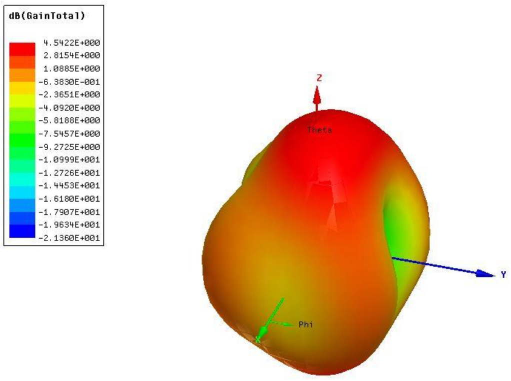

Fig 6. Gain plot at 7.3 GHz

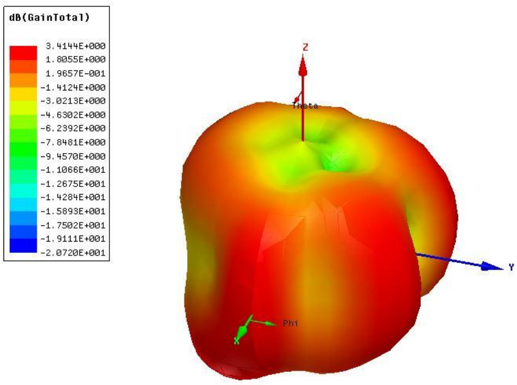

Fig 7. Gain plot at 9.7 GHz

V. CONCLUSION:

In this paper an ultra violet band(UWB) micro strip patch antenna has been proposed which is dual resonant at frequencies of 3.8 GHz, 7.3 GHz and 9.7 GHz respectively with impedance band width of 6.94 MHz. The antenna exhibits the return loss(S11) well below -10 dB for the frequency range mentioned. The simulated results indicate that an ultra wide band antenna with maximum fractional band width 6.94 MHz can be achieved. We conclude that proposed geometry is applicable for ultra wide band from 3.6 GHz to 10.5 GHz.

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