A Rectangular Patch Antenna for Ultra Wide Band Application Using HFSS Software

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Abstract— **In this paper, the radiation performance of a compact Rectangular patch antenna designed on glass epoxy FR4 substrate discussed. The proposed antenna is composed of a rectangular patch with a ground plane having compact profile, simple structure and easy for fabrication. The proposed antenna is capable to cover Wi MAX, Wi Fi, WBAN and Bluetooth operations and UWB applications. The antenna is constructed using a FR4 substrate with relative permittivity εr =4.4. The simulated results reveal that antenna shows impedance bandwidth 2.75 GHz-10.0 GHz and the VSWR< 2 through the impedance bandwidth and the return loss at that point is below -10db. Different parameters like operating frequency, VSWR, radiation pattern, 3D polar plots are simulated using HFSS Software. The antenna can be used for ultra-wide band application. Finally, the proposed design has wide applications in the field of communication like Bluetooth operations, Wi-Fi, Wi-MAX, Telemedicine and UWB applications.**

Keywords— Patch UWB antenna, Ground plane slot, Patch slots, Bandwidth enhancement

I. INTRODUCTION

Rectangular patch antennas are more popularly used now a day due to its various advantages such as light weight, less volume, compatibility with integrated circuits,easy to install on the rigid surface and low cost. Rectangular patch antennas are design to operate in dual-band and multi-band application either dual or circular polarization. These antennas are used in different handheld communicating devices.
Commission (FCC) allows the use of the unlicensed band ranging from 3.1 to 10.6 GHz frequency for UWB applications. The FCC has defined the operating range for UWB from 3.1 GHz to 10.6 GHz [1]. The system can support data transmission rates of 500 Mbps or more over a distance of 10 meters. In modern telecommunication, inexpensive printed antennas with broadband and ultra-wideband capabilities are desirable. UWB antennas can be classified into directional and omnidirectional. UWB antennas can be classified into directional and omnidirectional. Directional antennas are relatively large with high gain and narrow field of view. Omnidirectional antennas have a low gain and radiate in all directions, so they have a wide field of view and a relatively small size. Then the UWB antenna has a broadband connection. UWB antennas have some problems and they provide high impedance bandwidth. Ordinarily, UWB radio wires needed to achieve transfer speed, at that point it arrives at more noteworthy than 100% of recurrence to guarantee impedance match is accomplished with the end goal that a force not exactly 10% because of reflections at reception apparatus terminal.

II. LITERATURE REVIEW

According to [8] the substrate material plays significant role determining the size and bandwidth of an antenna. Increasing the dielectric constant decreases the size but lowers the bandwidth and efficiency of the antenna while decreasing the dielectric constant increases the bandwidth but with an increase in size. In [9] Microstrip patch antenna for GSM and Wi-Max application was proposed. The proposed antenna shows promising characteristics for WLAN, Wi-Max, and Satellite application at resonant frequencies of 5.5 GHz for WiMax, 5.2 GHz and 5.8 GHz for WLAN and 6-7 GHz for satellite application respectively. In [10]An Optimization of Circularly Polarized Knight"s Helm Shaped Patch Antenna for Ultra Wide Band Application is designed, the radiation performance of a small printed knight"s helm is capable to cover Wi MAX, Wi Fi, WBAN and Bluetooth operations and UWB applications. The Simulated results for various parameters like radiation patterns, total field gain, return loss, VSWR, radiation efficiency etc. are also calculated with high frequency structure simulator HFSS. Its simulate results display impedance bandwidth from 2.75 GHz to 10.0 GHz the antenna complies with the return loss of S11 less then -10db and VSWR < 2 throughout the impedance bandwidth.

[2] a simplified RMPA and its performance is compared to a faulty RMPA on the ground. This antenna was modeled using CAD-FEKO software at 2.4 GHz. This paper focus on a modification to the ground plane antenna called DGS (Defect Floor Structure). Antenna parameters such as reflectance, gain, VSWR and bandwidth (with and without DGS) were measured with a network analyzer. The main focus of this article is on increasing bandwidth. By increasing the bandwidth, patch antennas are used in DGS testing for broadband applications and antenna parameters. [3], they developed a faulty 2.45 GHz microcranial antenna on the bottom model for Bluetooth. Observe and simulate a rectangular microstrip antenna with DGS for wireless applications. The antenna is modeled at 2.45 GHz. It is a small antenna powered by a 1/4 inch transformer. This type of power supply is widely used for impedance comparison. The antenna is then simulated by the HFSS software. The antenna obtained by implementing the parameters is repaired with a damaged ground structure. In [4], a reception bandwidth for connecting microbands for GSM and Wi-Max applications is proposed. The proposed receiver channel demonstrates absolute properties for WLAN, Wi-Max and satellites using frequencies of 5.5 GHz for Wi-Max, 5.2 GHz and 5.8 GHz for WLAN and 6-7 GHz for satellite application. In [5] a microband antenna with hybrid fractal slots for broadband applications is designed. This article describes a microstrip patch antenna design that uses hybrid fractal slots with partial ground planes for broadband applications. The simulation result of the proposed antenna is observed by comparing it with the measurement result. [6], an antenna mounted on a small FR-4 substrate measuring 60 x 50 x 1.6 mm3 and a relative permittivity of $\varepsilon r = 4.4$ is developed. It comes with types of rectangular antennas: rectangular . The simulation result shows the antenna range in the frequency range from 2.75 to 6.9 GHz with reflectance reduced to -26.35 dB and a gain of 5.9 dB. This antenna is designed for use in UWB applications and other wireless communication systems. In [7], developed a 30mm x 35mm x 0.9mm antenna with an FR4 epoxy dielectric substrate with a dielectric constant of 4.4, which can provide efficient operation of ultra-wideband applications. The proposed antenna is designed using a circular ring and the excitation power used here is a microstrip control method. The antenna can be tuned from 3.1 GHz to 10.6 GHz and provides the best return loss. VSWR and antenna are very compatible with each other. In [8], developed two take-off bands for a flat UWB antenna and a UWB antenna. This antenna consists of a 50-ohm FR4 rectangular patch and has a Return Loss (RL) greater than 10 dB from 3.42 to 11.7 GHz in the simulation bandwidth. WLAN and X-Strip are obtained by inserting and inserting patch slots with strips removed. Simulation results show that the area has increased even more. In [9,10] have developed an optimization of a circularly polarized helmet antenna for UWB applications. It was developed by amplifying a circular polarized antenna in the shape of a knight's helmet for very long range applications. The printed radiation execution sync broadcast should include Wi-MAX, Wi-Fi, WBAN, Bluetooth activity, and UWB applications.

III. ANTENNA DESIGN AND METHODOLOGY

For planning of a Microstrip fix reception apparatus, we need to choose the thunderous recurrence and a dielectric medium for which radio wire is to be planned the boundaries to be determined are as under. The width of the patch is determined utilizing the following equation 1

$$W = \frac{C_0}{2f_r}\sqrt{\frac{2}{\varepsilon_r + 1}}$$

W = Width of the patch , εr = estimation of dielectric substrate.

The estimation of the dielectric reliable (ε) is resolved using the following equation 2

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2}, W/_h > 1$$

Due to bordering, electrically the size of the radio wire is expanded by a measure of (ΔL). Along these lines, the real expansion long (ΔL) of the patch is to be determined utilizing the following equation 3

$$\frac{\Delta L}{h} = 0.412\frac{(\varepsilon_{reff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\varepsilon_{reff}-0.258)\left(\frac{W}{h}+0.8\right)}$$

Where, h = stature of the substrate and the length (L) of the patch is presently to be determined utilizing the underneath referenced condition in equation 4

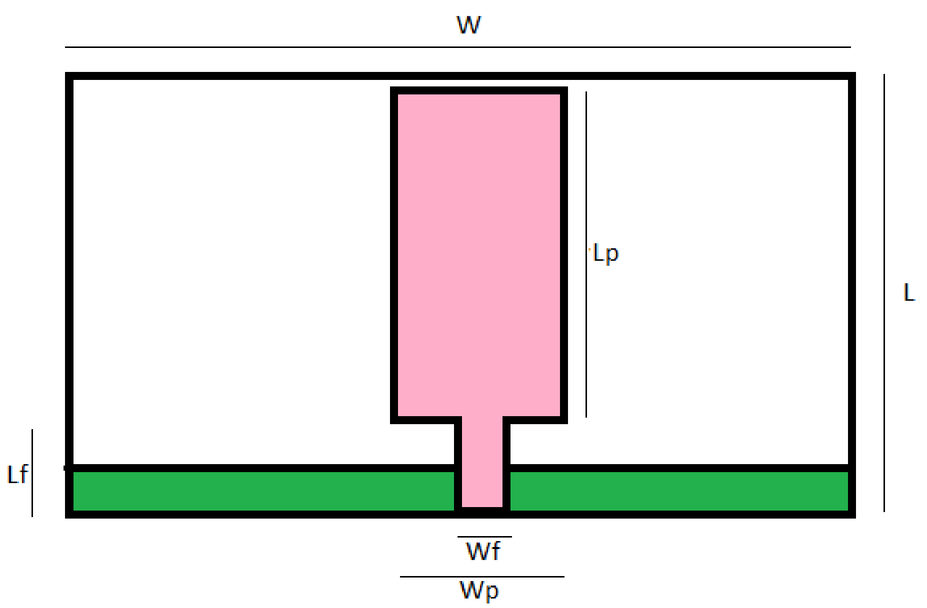
$$L = \frac{C_0}{2f_r\sqrt{\varepsilon_{reff}}} - 2\Delta L$$

Length (Lg) and width (Wg) of ground plane: Now the dimensions of a patch are known. The length and width of a substrate is equal to that of the ground plane. The length of a ground plane (Lg) and the width of a ground plane (Wg) are calculated using the following equations:

$$L_g = 6h + L$$
$$W_g = 6h + W$$

For feeding the micro strip patch antenna, there are different methods for example, feed line method, coaxial probe feeding method etc. But mostly coaxial probe method is used.

IV. DESIGNED OF PROPOSED ANTENNA



V. DIMENSIONS OF PROPOSED ANTENNA

Parameter	Value (in mm)	Parameter	Value (in mm)
W	50	**Lf**	20

L	60	**Wf**	3
Lp	50	**Lg**	6.8
Wp	11	**Wg**	50

W= Width of Substrate , L = Length of Substrate , Lp = Length of Patch , Wp = Width of Patch , Lf = Length of Feed , Wf = Width of Feed , Lg = Length of Ground , Wg = Width of Ground

VI. PROPOSED DESIGN OF ANTENNA

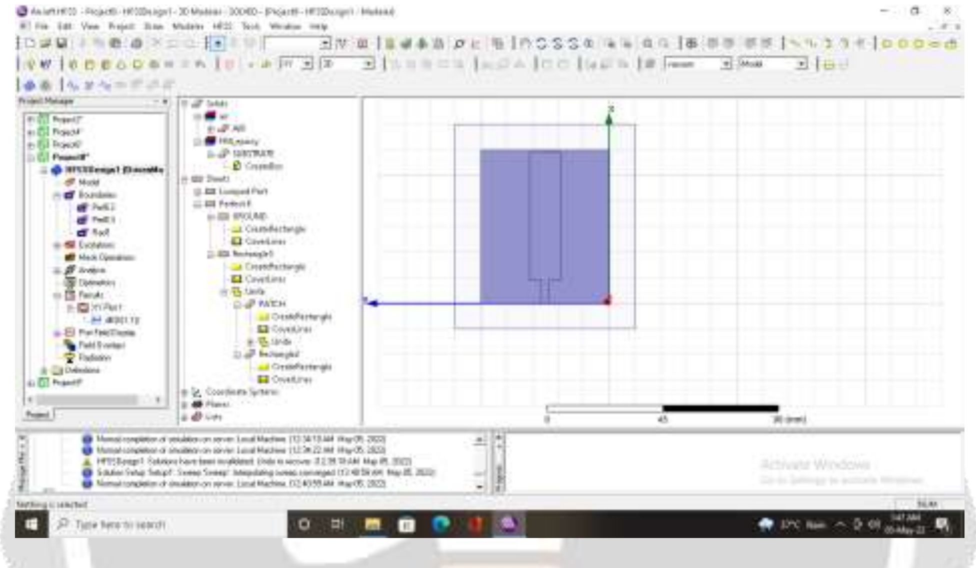


Fig.1

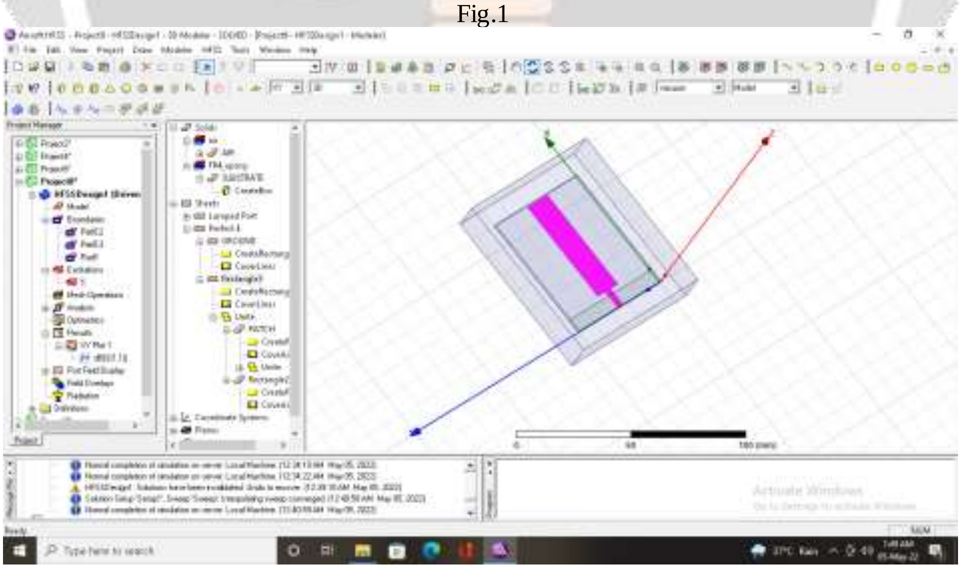


Fig.2

VII. SIMULATION RESULTS OF ANTENNA

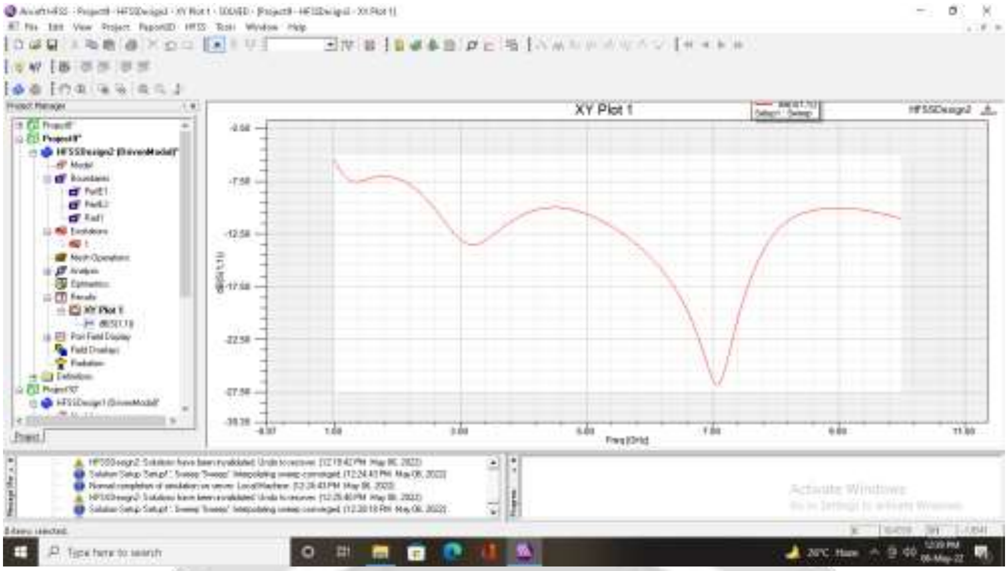


Fig.3 Return loss of the optimized proposed antenna

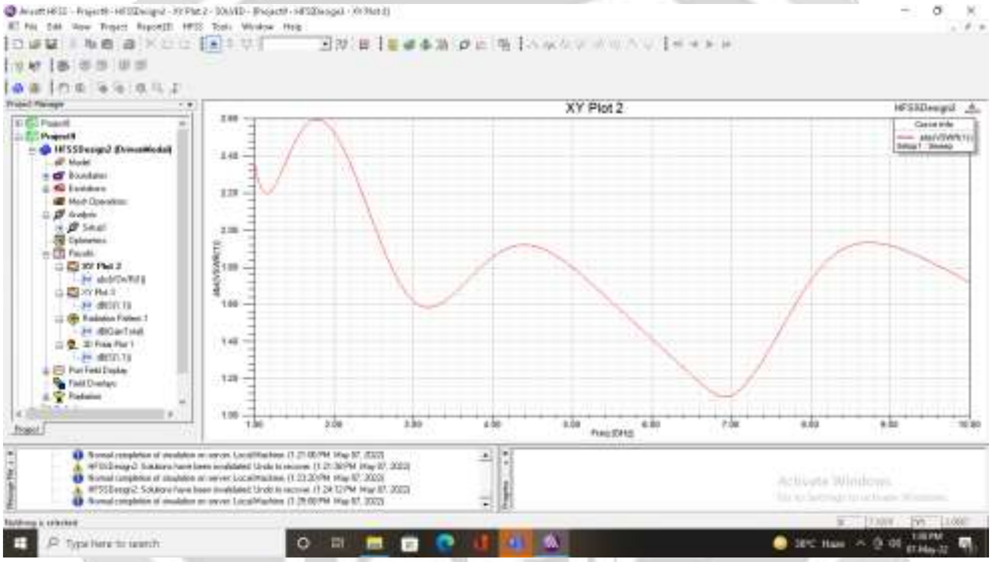


Fig.4 VSWR Measurements

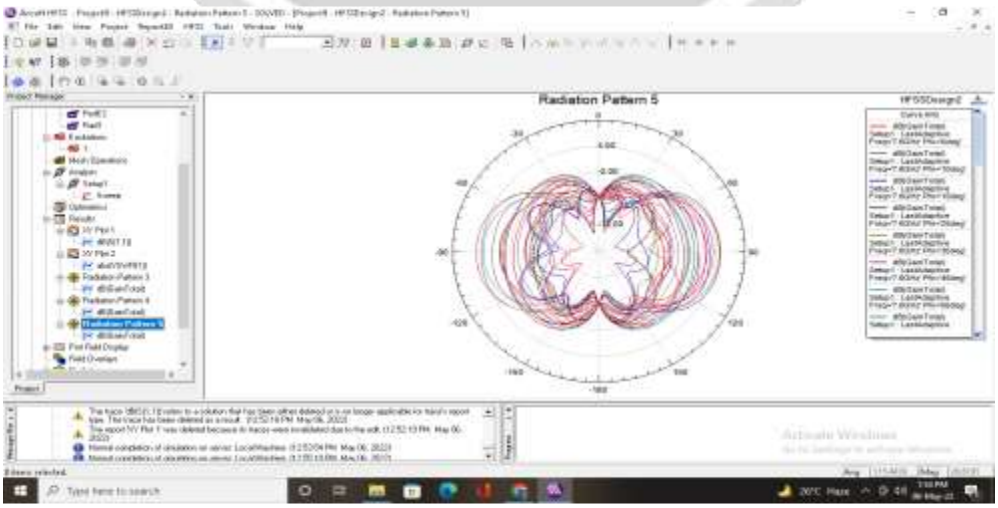


Fig.5 Radiation Pattern

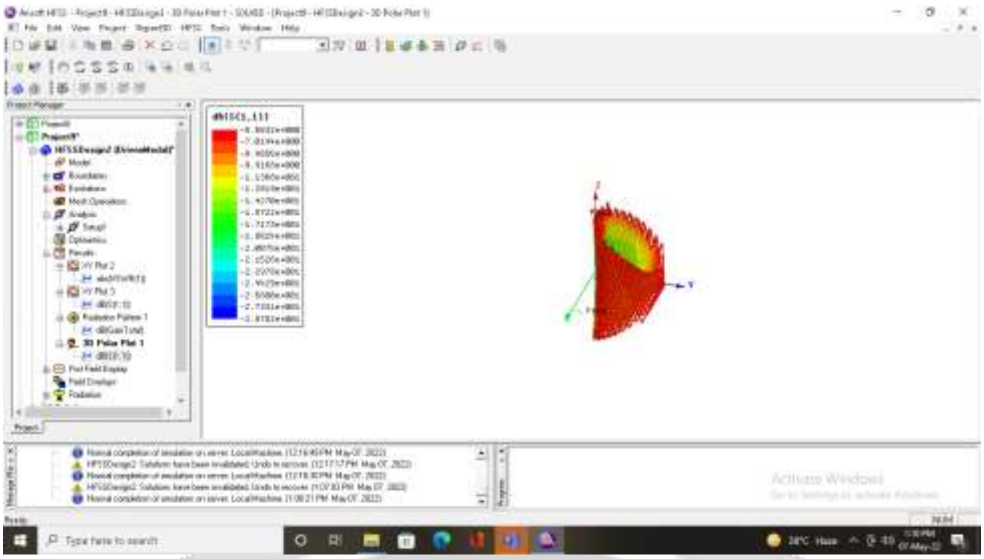


Fig.6 Polar Plot

VIII. RESULTS

The simulated results of the proposed antenna is discussed here. The Parameter S22 with respect to Frequency plot is shown in figure 3 and it's value is X = 6.9143 hz and Y= -26.35 db . VSWR measurement is shown in fig 4 and it's value is X = 6.92 and Y = 1.0973 . In fig 5, Radiation pattern and its frequency is 7.6 GHz and its phi value is 0 degree. It consists of both substrate and patch current distribution.

IX. CONCLUSION

The proposed work has benefits of little size, simple structure and basic function. Reception apparatus is a conservative model and works at 2.75 GHZ to 10.0 GHz with outright transmission capacity 8.301MHz. Radiation execution of fix reception apparatus is additionally introduced in this paper. The reproduced results show that a ultrawide band reception apparatus with most extreme fragmentary transmission capacity 8.301MHZ can be accomplished. We presume that proposed calculation is relevant for ultrawide band from 2.75 GHz to 10.0 GHz. In future the Radiation execution of novel Shape rectangular fix reception apparatus can be improved by utilizing diverse taking care of strategies.

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