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Design of a Highly Efficient Coplanar Waveguide Fed Bud Shaped Antenna with Defected Ground Structure for Ultra-Wideband Operations

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ABSTRACT: Design of a Modified Model with Ground Length of 8 mm using Microstrip line Feed and defected ground structure is proposed in this paper. The antenna is slightly tuned for better matching at 4.6GHz at Ground Length of 8 mm ground the BW ≈ 2.6 GHz. Due to such a high bandwidth the antenna can be used for ultra-wideband applications like body area networks or internet of things (IoT) networks. Antenna is designed with flame retardant (FR) woven glass reinforced epoxy resin (FR-4) material with a planar size of 28mm x 40mm and thickness of 1.6mm. Due to these compact dimensions, the antenna can be fixed in any circuit like on-body devices, IoT devices, etc. It can be directly connected with 50 ohms feed point normalized input due to its bud shaped radiator. This design can be used for wireless biomedical instruments, car antennas, and other wireless devices. Parameters including S11, Z11, directivity, gain, Radiation patterns, Ludwig patterns, E-field and H-field are evaluated on CST microwave studio, which is based on Finite Integration in Technique (FIT) that facilitates ease of antenna design.

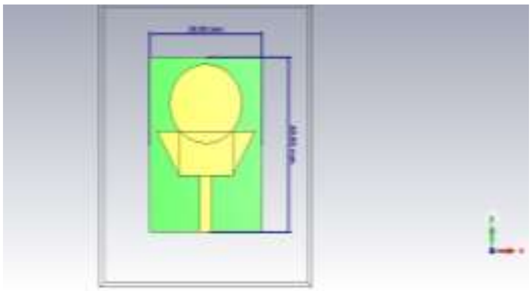
KEYWORDS: Antenna, design, coplanar waveguide, defected ground structure, ultra-wideband.

I. INTRODUCTION

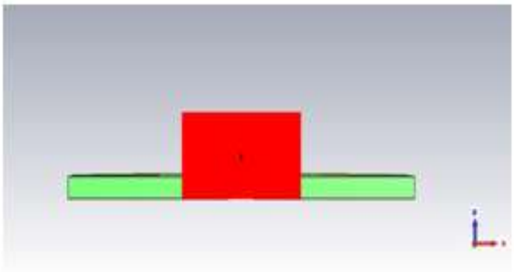
In the new days the scientists have been broadly researched the printed miniature strip antennas for on-body interchanges. The recurrence from 3.1GHz to 10.6GHz has allocated for ultra-wide band application in 2002 by Federal Communication Commission (FCC) [1]. Be that as it may, antenna plans actually face numerous difficulties, including impedance coordinating, radiation designs, etc. while working with human body and other wireless applications. An antenna with less expense, little in size and easy to coordinate with on-body are basically needed for the correspondence enterprises. The coplanar waveguide took care of antennas with different emanating shapes are drawing in the enterprises because of its ease, straightforward design, improved information rate and simple to associate. Assortments of CPW-took care of antennas were proposed in the previous years. In the two layers printed circuits antennas the arrangement issues are generally experienced [2,3]. While the CPW-took care of antennas has openings just as feed line in same side of the substrate. This dispenses with the arrangement issue while on drawing the two sides of the substrate. When contrasted with miniature strip line, the CPW has lower misfortune. The CPW-took care of antennas is having bidirectional radiation attributes, similarly as with miniature strip line excitation [4]. As a rule, while working miniature strip antennas at key thunderous mode produces slender data transmissions and half-frequency since its intrinsic character of the miniature strip antenna, henceforth the analysts in the field of antennas are moved toward various designs to address the issue of restricted transfer speed. Lately, numerous arrangements in the miniature strip fix have been created to expand the data transfer capacity of the antenna. The antenna proposed in this paper is comprising the radiation fix with great radiation execution at 4.5GHz in the UWB range [5, 6]. The tightened shape radiator with round fix addition limits the monopole antenna is the vital component in the proposed antenna. At the point when contrast with the customary radiator fix antenna to it decreasing the stature of the antenna. The Defected Ground Structure (DGS) was in the ground plane. The top edges of the two side ground planes are made bend-based construction rather than sharp corner for better recurrence arrangement. Along these lines, the wastage of enormous space around the radiator is viably saved in this antenna. The Fig.1 outlined the proposed construction of the antenna.

II. ANTENNA DESIGN OVERVIEW

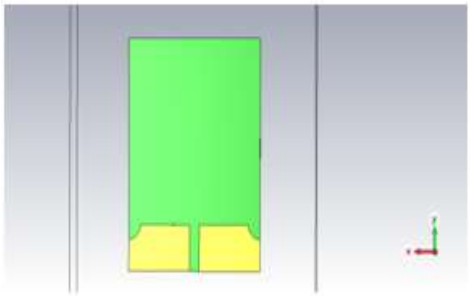
Because of the single reverberation character of the microstrip antenna, the data transmission isn't extremely wide. In this way, to plan an antenna to get reverberation at the UWB range is fundamental when it's cooperated with human skin [7,8]. The antenna is set over an improved on one layer bone model with a size of 28mm × 40mm to address the human on-body correspondence. This proposed configuration is getting resounding at 4.5GHz recurrence in the UWB range for accomplishing on-body correspondence in higher information rate [10, 11]. In this plan, the two ground planes with faulty top edge has been presented on a similar plane of the monopole, while the strong ground plane is utilized in the traditionally planned UWB monopole antenna [13, 14]. The calculation of the wearable CPW took care of bud shape antenna with faulty ground is appeared in Figure 1. The different plan abilities are drawn nearer to get great impedance coordinating at the full recurrence.



a) Top View



b) Bottom View



(c) Side View

Figure 1 (a), (b), (c). Proposed Antenna in different view

The rectangular fix with the components of L=40mm and W=28mm is the essential behind the monopole radiator.

III. ANTENNA DESIGN

The construction of the antenna is planned in the 28mm × 40mm FR4 substrate. The elements of 1.6mm and 0.1mm are taken as dielectric thickness and leading layers separately. The overall permittivity is picked as 4.5 for the entire examination. On the leading side we have a microstrip taking care of line joined with a changed roundabout circle. The design is having least thickness and palm and entities are having most noteworthy thickness esteem in the human body. In this paper the wrist territory skin of thickness 0.6mm has been taken for re-enactment. The feed point and Ground planes are isolated by 0.1mm hole at both the sides to accomplish 50ohm trademark impedance at the 4.5GHz recurrence, the width of the feed line is dimensioned as 2mm. Since the radiator is tightened with round fix addition which decreases the antenna region. The central point to cause capacitive coupling is the little hole between the feed line and the ground plane. The last objective is to get an antenna for on body correspondence with a decent return misfortune, voltage standing wave proportion and expanded directivity in the UWB range.

IV. SIMULATION RESULTS

The reverse gain for this antenna at 4.4GHz in the UWB range with great VSWR is accomplished. The acquired VSWR is under 2 at the recurrence 4.5GHz. Re-enacted after effects of proposed antenna appeared beneath, this shows the attributes of the planned antenna and has great directivity and gain at the 4.5GHz. consistent directivity and improved radiation design at a working recurrence of 4.5GHz. Further the directivity can in any case be improved by differing the stature of the tightened radiator fix. The straight

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forward arrangement, adaptability and effortlessness are genuine curiosity of proposed configuration to summon the ideal antenna reaction while set over the human skin. Values of different parameters can be observed from figure 2, 3, 4, 5, 6, 7 and 8.

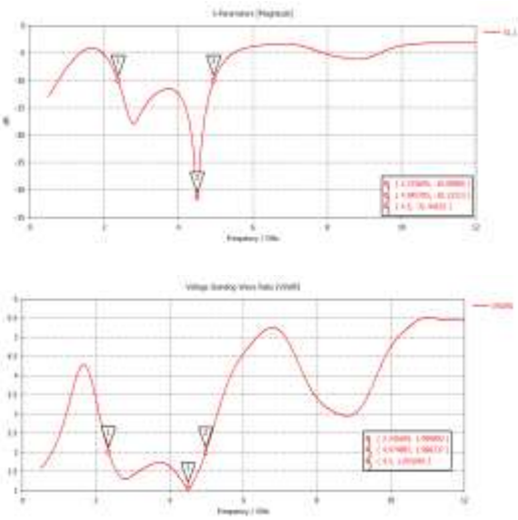

Figure 2. S-parameters and Voltage standing wave ratio for different frequencies.

From this figure, it can be observed that S11 at 4.5 GHz is -31.44 dB, thereby reducing any reverse gain components, while the system is wideband with a bandwidth of 2.6 GHz.

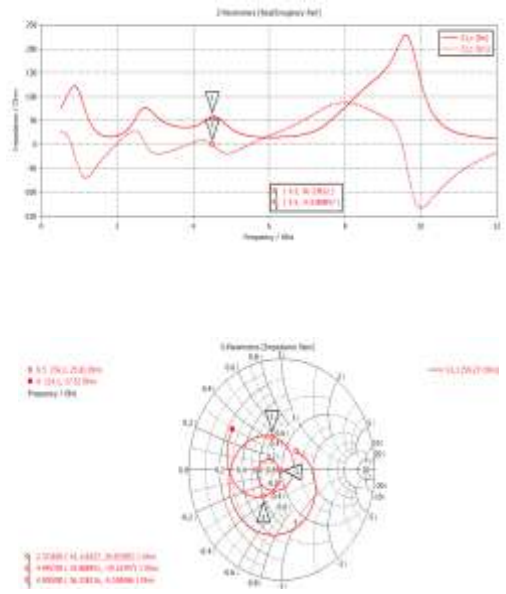

Figure 3. Z Parameters and impedance view of S-parameters at different frequencies.

From these results it can be observed that, Z11 at 4.5 GHz is 56.23-j0.53 Ohm, which makes it suitable for standard loads.

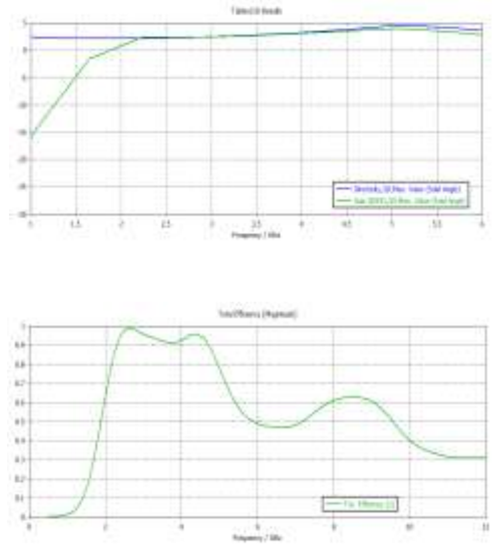

Figure 4. Directivity/Gain and Total efficiency for different frequencies

It is observed that the proposed design is effective for 4.5 GHz, and has highest values for efficiency, directivity and gains at that frequency.

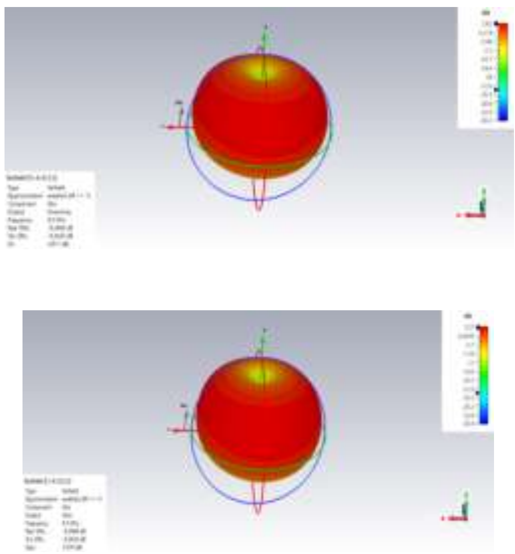

Figure 5. Radiation Pattern Results at 4.5GHz for different ground lengths

From these results it is observed that maximum realized gain at 4.5 GHz is 3.57 dBi, while max

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directivity at 4.5 GHz is 3.81 dBi, which makes it effective at 4.5 GHz.

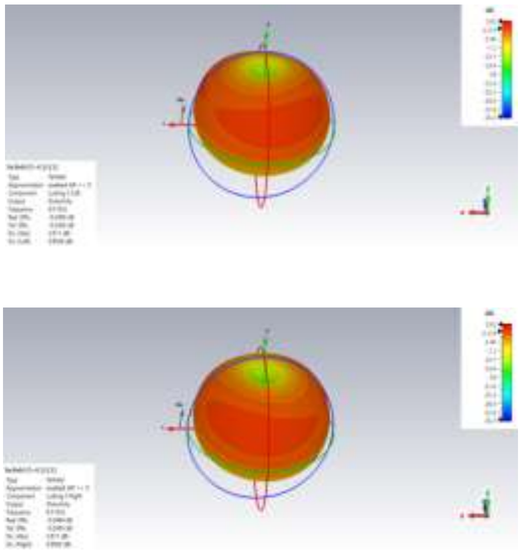

Figure 6: Ludwig 3 right and Left at 4.5GHz for different ground lengths

The Ludwig patterns are also optimized at 4.5 GHz, which makes the antenna efficient at that frequency.

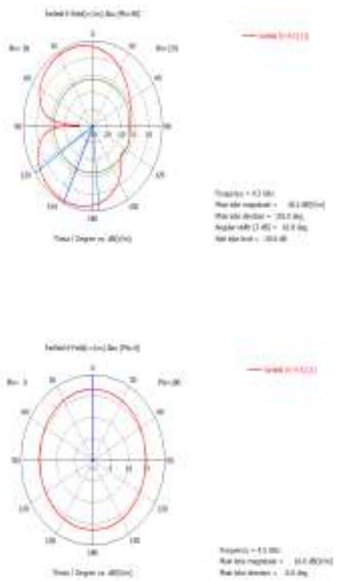

Figure 7. E-Field results at 0 and 90 degrees

Maximum main lobe amplitude, and minimum side lobe amplitude are observed from figure 7 at 4.5 GHz, which makes the design highly effective at this frequency.

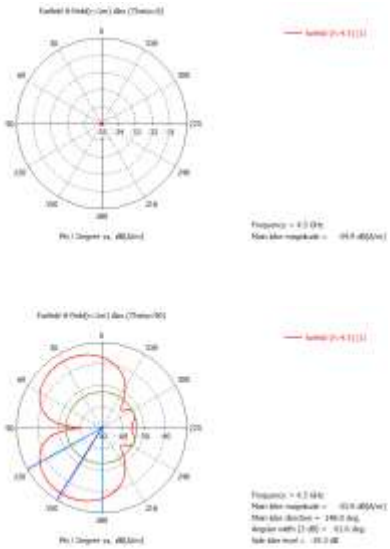

Figure 8. H-field (Theta=0 and 90) Patterns at 4.5GHz

Minimum main lobe amplitude, and maximum side lobe amplitude are observed from figure 8 at 4.5 GHz, which makes the design highly effective at this frequency.

V. CONCLUSION

From the design it can be observed that the proposed antenna model is highly effective at 4.5 GHz, and has high gain and reduced error performance. This allows the antenna to be used for real time designs, with high efficiency. Moreover, the efficiency of this design can be further improved via the use of better substrates and better grounding capabilities.

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