International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8, Issue-1, May 2019

CPW Fed Antenna with UWB Characteristics

K. Madhu Sudhana Rao, M.V.S. Prasad

Abstract*: *The design of Ultra-Wide Band (UWB) antenna for several commercial wireless applications has been always a challenging job for the antenna engineers. In this paper, such a coplanar waveguide (CPW) fed UWB antenna design is presented with excellent radiation characteristics. The antenna typically studied with the parametric response of the resonance characteristics. The antenna is designed and simulated in the Computer Simulation Tool (CST) and then analysed in terms of several simulated reports like reflection coefficient (S11), Voltage Standing Wave Ratio (VSWR) and radiation patterns. The current or the field distribution are used to analyse the surface current distribution of the geometry of the antenna.

Index Terms*: *CPW Feed, UWB Antenna, CST, Return Loss, VSWR.

I. INTRODUCTION

In the present day, wireless systems are prevalent in our daily life. Major electrical and electronic systems used wireless networks in various applications. An antenna plays a significant role in any wireless system for transmitting and receiving data [1-5]. The antenna is a device sends the electromagnetic waves into space by converting the electric power given at the input into the radio waves, and at the receiver side, the antenna intercepts these radio waves and converts them back into the electrical power. The Antennas are used in various wireless systems like cellular communications, radars, defense systems, aircraft systems, satellites, and many more wireless systems [4,5]. Every day the new wireless devices are introducing which increasing the demands of compact antennas with high data rates. Increase in the satellite communication and use of antennas in the aircraft and spacecraft has also increased the demands a low-profile antenna that can provide a reliable transmission.

A microstrip patch antenna (MPA) have a low profile and lightweight and used in several applications compare to the conventional antennas. It has broad beam radiation with very narrowband resonance. There are several shapes for the radiating patch like rectangle, square, triangle and circle, etc. Instead of using a dielectric substrate in antennas dielectric materials are used to increase the bandwidth. MPA is a low-profile antenna, mechanically rugged and easily mounted on any planar and nonplanar surfaces. The size of the microstrip antenna is related to the wavelength of operation generally λ/2. The applications of microstrip antennas are above the microwave frequency because below these frequencies the use of microstrip antenna doesn't make a sense because of the size of the antenna. At frequencies lower than the microwave, microstrip patches don't make sense because of the size is required. In present days, the MPAs are used in commercial applications due to its inexpensiveness (low cost), easy to manufacture and easy to integrate of any system due to benefit by advanced printed circuit technology. Due to the development and ongoing research in the area of the microstrip antenna, it is expected that in future after some time most of the conventional antenna will be replaced by microstrip antenna.

The broadband antenna design has become a challenge with the advent of wireless technology and its commercialization in every aspect of life now a day. The design challenge includes not only the broadband requirement but also several other features like miniaturization, multiband and conformal to the decorum of the equipment. The paper organized as follows, the second part discuss about proposed antenna design structure and third part of the paper gives the results and discussion of proposed antenna and the paper ends with the conclusion.

II. PROPOSED ANTENNA DESIGN

The geometry of the proposed antenna is as shown in the Fig.1. It typically consists of a triangular patch which is truncated at the two edges. The other edge is prolonged to be a part of the coplanar waveguide feed. The truncation refers to etching of both the corners in an arc shape of radius ‘r’ from the corner. The patch has a width of ‘W’ as similar to that of the width of the substrate. The substrate also has a length of ‘L’. Similarly, the length of the patch including the feed point till the end of the substrate is ‘L’. The triangular patch has a base dimension as similar as that of the substrate width of ‘W’ while the corresponding edges are tweaked by a length equal to the radius of the arc. The other two sides of the triangular patch have similar length depicting an isosceles triangle.

The composition of the coplanar waveguide is made up of two square conducting surfaces on two other corners of the substrate opposite to the base side of the triangular patch. The square patches have a side length denoted by ‘wg’. The strip line of length Lf runs through the gap between these two squares from the triangular patch to the substrate end.

Revised Manuscript Received on 30 May 2019.
***** Correspondence Author

K. Madhu Sudhana Rao*, Research Scholar, Department of ECE, ANU College of Engineering & Technology, Guntur, AP, India.

K. Madhu Sudhana Rao, Department of ECE, KKR & KSR College of Engineering, Vinjanampadu, Guntur, AP, India.

M V S Prasad, Professor, Department of ECE, RVR & JC College of Engineering, Chowdavaram, Guntur, AP, India.

This strip line also leaves a gap on eithers of it throughout its length which of the dimension denoted with (w1-wf) while the ‘w1’ is the separation between the two squares at the centre.

The substrate material used is FR4 which has a dielectric constant of 4.3. The corresponding thickness of the substrate is 1.6 mm. The optimal dimensions of the proposed antenna are tabulated in table 1.

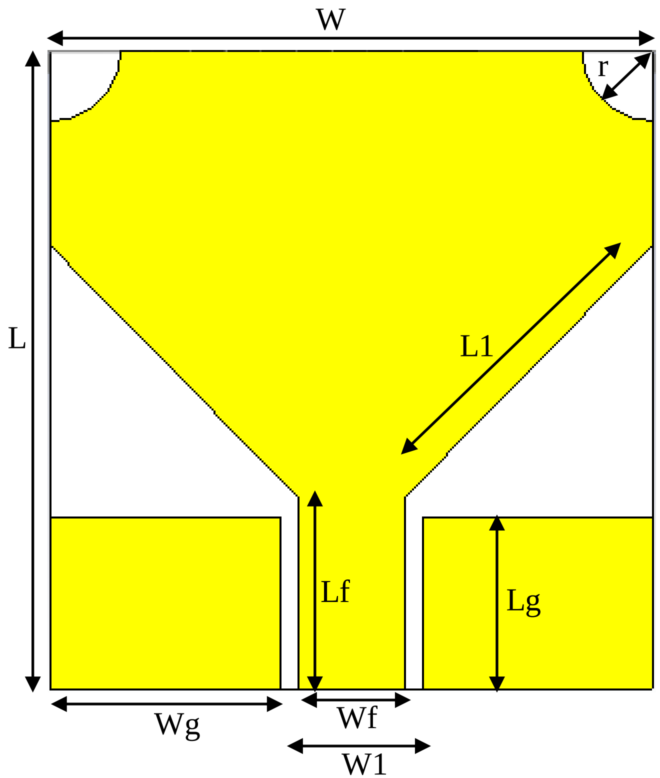


Fig.1: Geometry of the proposed antenna design

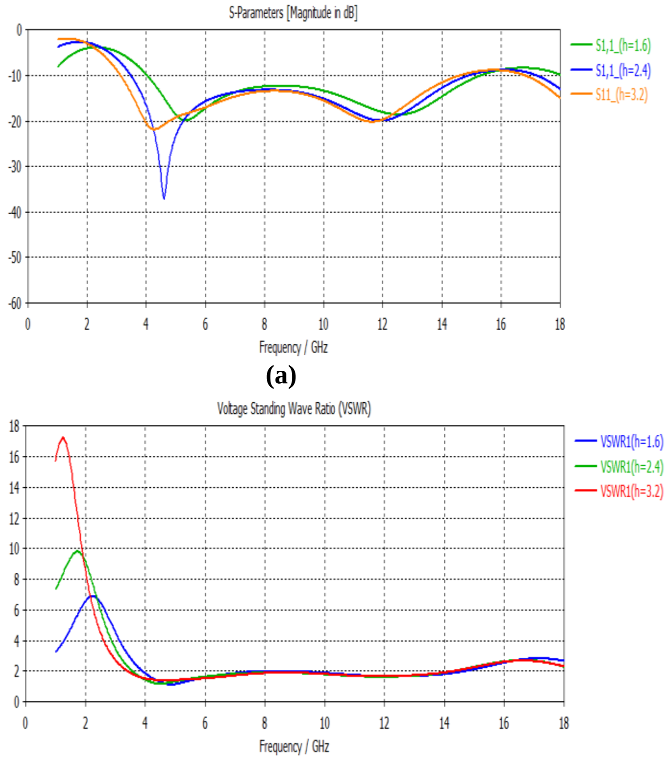
Table 1: The dimensions of the proposed antenna

S.no	Parameter	Dimension (mm)
1	L	18
2	W	17
3	Lf	5.4
4	Wf	3
5	Wg	6.5
6	Lg	4.85
7	W1	4
8	L1	5.5
9	R	2

III. RESULTS AND DISCUSSION

The results pertaining to the designed and simulated antenna are present in this Section. The simulated results are in terms of reflection coefficient, voltage standing wave ratio and radiation pattern plots along with field distribution at the ports. These plots can be used to obtain the frequency response characteristics of the antenna. The corresponding operating frequency, its bandwidth and the radiation features can be obtained from these plots. Further, the effect of the several physical dimensions of the antenna on the radiation and resonant properties are studied using the parametric study of the antenna.

Initially, the height of the substrate is considered and varied over a range (1.6 mm – 3.2 mm) with an interval of 0.8mm. The corresponding S11 and VSWR plots for this parametric analysis are as shown in Fig.2 (a) & (b). It can be inferred that the bandwidth enhanced with increase in the ‘h’. However, it evident that the lower frequency of the BW is varying while the upper frequency remains consistently the same.

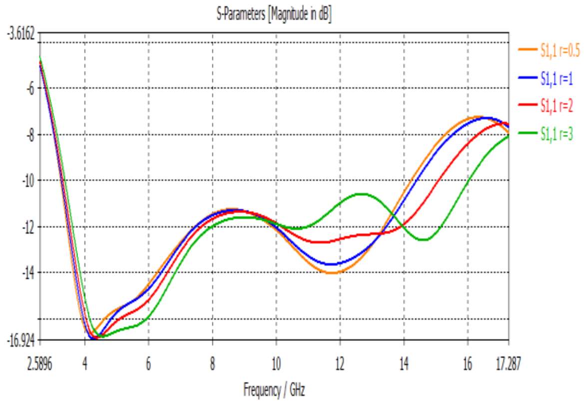


(a)

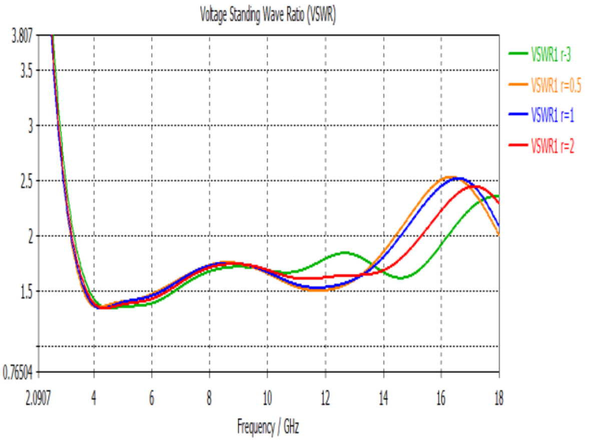
(b)

Fig.2: The effect of ‘h’ on the BW from (a) S11 plot and (b) VSWR

Similarly, the effect of the radius of the arc (r) can be studied from the Fig.3 (a) and (b). The corresponding parameter ‘r’ is varied over certain intervals through (0.5 mm, 1 mm, 2 mm, 3 mm). For every value of the ‘r’ the corresponding S11 is obtained over a rage of frequencies from 2.5 GHz to 17.25 GHz. Quite opposite to the previous case of varying the ‘h’, the lower frequency appears to be consistent while the upper frequency is varied. With increase in ‘r’ the corresponding upper frequencies and further the BW is enhanced.



(a)

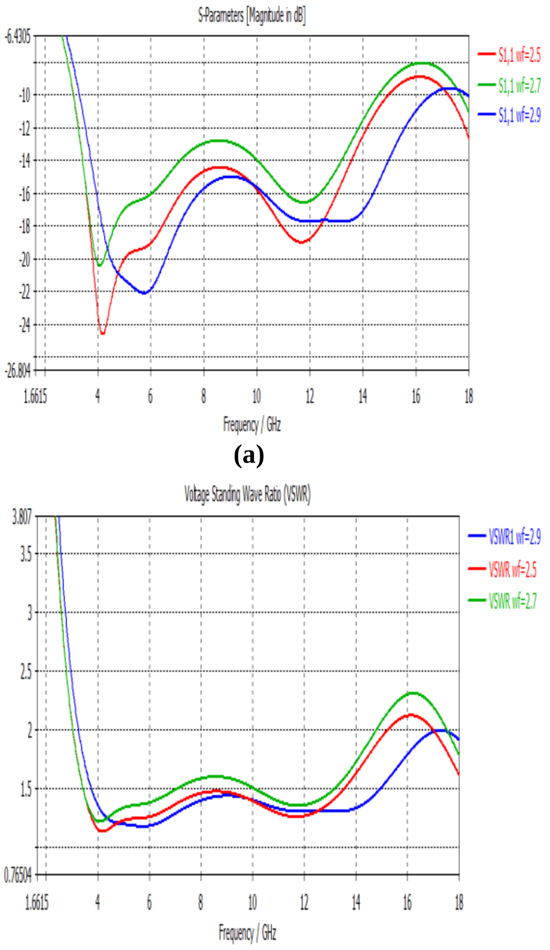


(b)

Fig.3: The effect of 'r' on the BW from (a) S11 plot and (b) VSWR

The effect of the 'wf' is as similar as that of 'h'. The 'wf' is varied with the set of values like (2.5 mm, 2.7 mm, 2.9 mm). The corresponding BW is similar for the first two values while the 'wf' is further enhanced with the last value. This is as shown in Fig.4 (a) & (b).

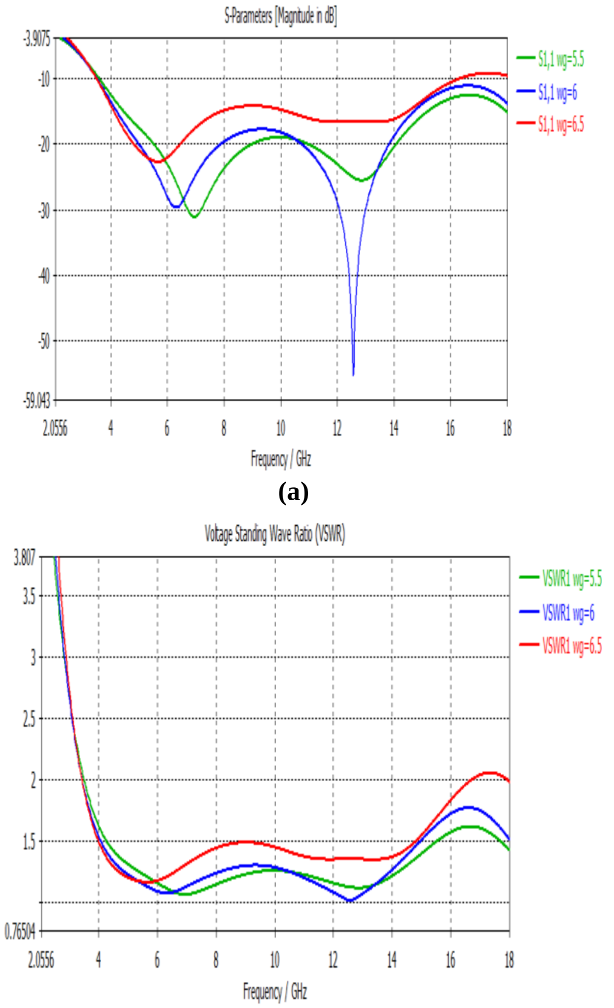
Quite opposite to the previous cases, the BW remains consistent for any change in the 'wg' over a wide range of values form 5.5 mm to 6.5 mm with an interval of 0.5mm. The corresponding plots are given in Fig.5 (a) & (b) in which the S11 and VSWR are mentioned respectively.



(a)

(b)

Fig.4: The effect of 'wf' on the BW from (a) S11 plot and (b) VSWR

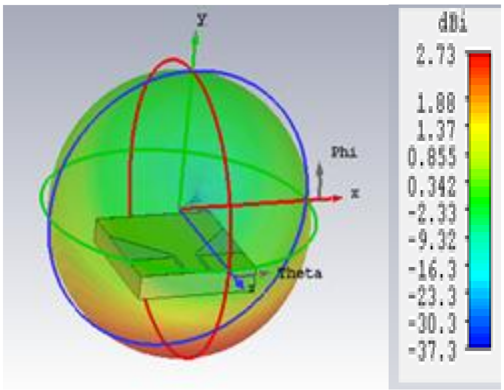


(a)

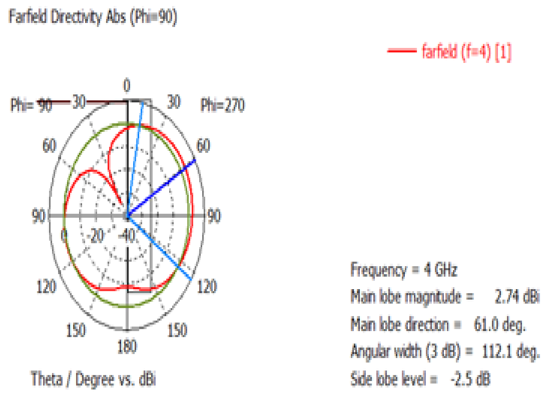
(b)

Fig.5: The effect of 'h' on the BW from (a) S11 plot and (b) VSWR

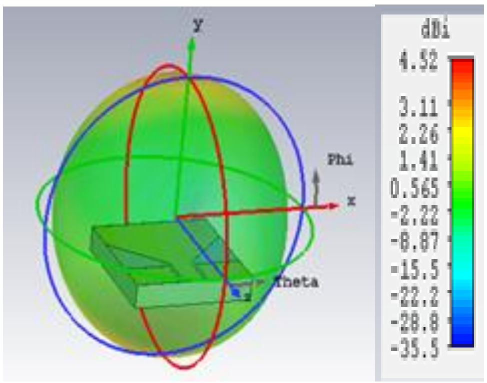
Further three different frequencies are selected from the resonant band which are 4GHz, 9.5GHz and 10.5GHz. For these frequencies, the corresponding radiation patterns are simulated and presented through Fig.6 (a) and Fig.6 (f).



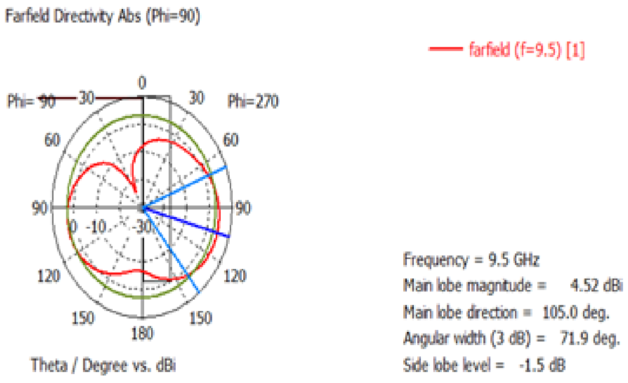
(a)



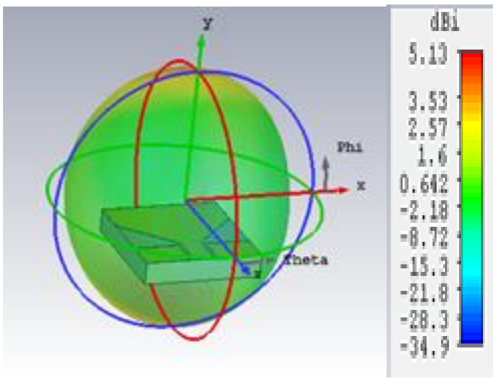
(b)



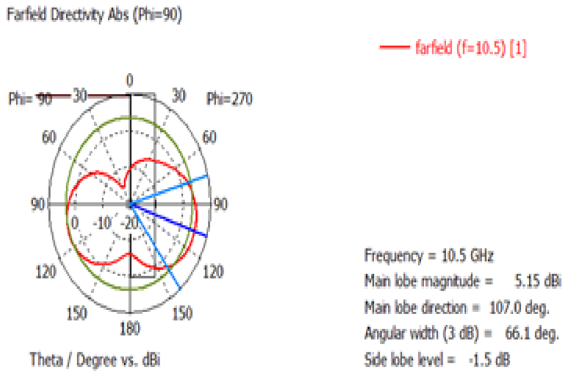
(c)



(d)



(e)



(f)

Fig.6: The 3D and 2D radiation pattern plots at frequencies (a) &(b) 4GHz, (c) & (d) 9.5GHz and (e) & (f) 10.5GHz respectively.

It is evident from the 3D and 2D radiation plots that the radiation patterns are similar to each other with the corresponding null positions being same. The radiation and the gain are minimal in the direction of 30^0 while the maximum radiation is along the broadside of the antenna.

IV. CONCLUSION

The antenna which can radiate over a wide range of frequencies covering the entire ultra-wide band is simulated with excellent parametric analysis. The antenna expressed consistent BW for any change in the physical dimension. The radiation pattern also expressed similar and more closely like patterns.

REFERENCES

1. Chowdary, P.S.R et.al., "Design and Performance Study of Sierpinski Fractal Based Patch Antennas for Multiband and Miniaturization Characteristics", Wireless Pers Commun, vol 83, 2015.
2. Terlapu S.K. et.al., "On the Design of Fractal UWB Wide-Slot Antenna with Notch Band Characteristics". Microelectronics, Electromagnetics and Telecommunications. Lecture Notes in Electrical Engineering, vol 471. Springer, Singapore 2018.
3. Mohamed Aboualalaa et.al., "Design of dual band microstrip antenna with enhanced gain for energy harvesting applications." IEEE Trans Ant Propag, Vol. 60, No. 1, January, 2016.
4. A. Nouri and G. R. Dadashzadeh "A compact UWB band-notched printed monopole antenna with defected ground structure." IEEE Ant Wireless propag Lett, Vol. 10, 2011.
5. Ying-Cheng Tseng, Pei-Yang Weng, and Tzong-Lin W, "compact wideband balanced filter for eliminating radio-frequency interference on differentially-fed antennas." IEEE Trans Ant Propag, Vol. 64, No. 3, March, 2015.