

Design of CPW-Fed UWB Monopole Antenna with Extended Ground Plane Stub

R.Mahalakshmi, Mrs.V.Dhanam, Dr.K.Ramasamy

Abstract— A compact coplanar-waveguide-fed (CPW) single-layer printed UWB monopole antenna is achieved. A combination of ultrawideband (UWB) rectangular monopole radiator etched with a half-elliptical slot with two symmetrical open-circuit stubs are extended from the ground plane to jointly achieve an ultrawideband impedance match with a compact size. The antenna size is 24 x 20mm². The ultrawide operating frequency range from 3.9 to 11 GHz with a quasi-omnidirectional gain from 2.0 to 6.2 dBi. The value of VSWR is less than 2. The compact size, improved voltage standing wave ratio (VSWR), and monolayer configuration without any back ground plane make it suitable for a wide range of UWB applications.

Index Terms— Coplanar-waveguide, ground plane, impedance matching, monopole antenna, radiation pattern, ultrawideband, VSWR.

1 INTRODUCTION

UltraWideBand (UWB) systems having wide bandwidth with low power spectral density and it is true that this increases efficiently the utilization of the radio frequencies. Federal Communications Commission (FCC) released its report in February 2002 permitting commercial use of UWB frequency range from 3.1 to 10.6 GHz [1]. UWB technology is based on the use of very narrow baseband pulses in the order of nanoseconds. UWB can be used in many applications. Such that require low probability of detection.

UWB used in military applications, radar and imaging technology, where the ability to resolve multipath delay in the nanosecond range, allowing for finer resolution if it is from a target or from an image. UWB can be used in Wi-MAX/WLAN, Bluetooth, Wi-Fi and C-band applications. Monopole antennas have been used in wireless communication system. Monopole antennas are symmetrical structure, good omnidirectional radiation patterns, low costs and easy fabrication process [2]. The coplanar waveguide (CPW) feed lines compared to microstrip feed lines such as lower dispersion at high frequencies, unipolar configuration, and easy integration with active devices, and minimal dependence on substrate thickness[3] and [4].The CPW offers several advantages over conventional micro strip line. First, it simplifies fabrication. Second, it facilitates easy shunt as well as series surface mounting of passive and active devices.

Third it eliminates the need for wrap around and via holes and fourth, it reduces radiation loss [5]-[10]. Various types of CPW-fed monopoles with a differently shaped radiators are drawing more and more attention due to their unique characteristics and compatibility with the printed circuit board (PCB) technique. U-shaped, circular, elliptical, and triangular patches have been investigated to achieve a UWB bandwidth.

This letter presents a novel compact coplanar-waveguide-fed (CPW) single-layer printed UWB monopole antenna. The antenna size is 24 x 20mm². The ultrawide operating frequency range from 3.9 to 11 GHz with a quasi-omnidirectional gain from 2.0 to 7.3 dBi.

2 ANTENNA CONFIGURATION AND ANALYSIS

Fig. 1 shows the structure of the monopole antenna without stub.

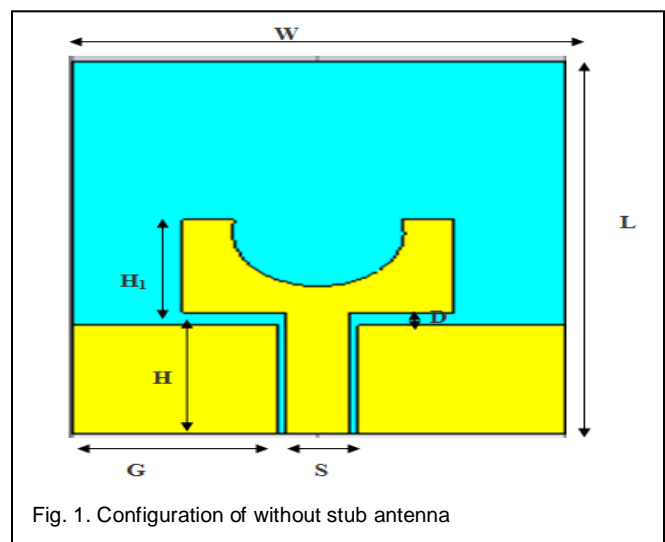


Fig. 1. Configuration of without stub antenna

Fig. 2 shows the structure of the monopole antenna

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with stub .The antenna size is 24 x 20mm².The antenna is symmetrical in the y-axis is printed 1-mm-thick FR-4 substrate with a relative permittivity of 4.6 and a loss tangent around 0.02.

The dimensions of the antenna given below.The antenna consists of a rectangular monopole radiator etched with a half-elliptical slot impedance 50-Ω CPW feeding with two symmetrical open-circuit stubs are extended from the ground plane. For good impedance matching, achieve an ultrawideband impedance match with a compact size. The rectangular monopole radiator is derived from a CPW-fed.

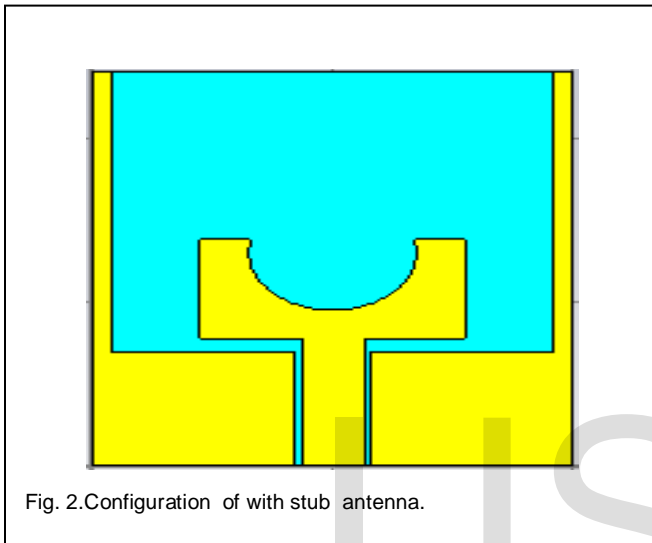


Fig. 2.Configuration of with stub antenna.

In Fig. 2 Stubs are added on both sides. Half-elliptical slot on the y-axis of the original small-sized rectangular patch brings in continuously tunable electrical resonance lengths for different fed wavelengths. The reduced radiation efficiency in the lower frequency band due to the small size of the radiator will be combination of open-circuit stubs. Microwave frequencies act as two capacitor-fed monopoles in the low frequency band. The antenna dimension is L=24mm, W=20mm, H=7mm, H1=13.3mm, G=8.4mm, S=2.6mm.The gap D is optimized as 0.8mm.

3 RESULTS AND DISCUSSION

The antenna structure is simulated using the Computer Simulation Technology (CST) Microwave Studio [11]. The antenna design frequency range from 3.9 to 11 GHz. The effective wavelength, where ϵ_r is the dielectric constant of the substrate.

$$\lambda_e = \lambda_0 / \sqrt{\epsilon_e \cdot \epsilon_r} \approx (\epsilon_r + 1) / 2 \quad [1]$$

Fig. 3 shows the simulated Return Loss of the without stub antenna in the terms of D=0.8. The Return loss is the parameter which indicates the amount of power that is loss. For D=0.8 with other dimensions fixed It is found that the input imped-

ance of the antenna. The measured return loss below -10dB.The simulated Return Loss of the without stub antenna not achieved by operating frequency (3.9 to 11 GHz).

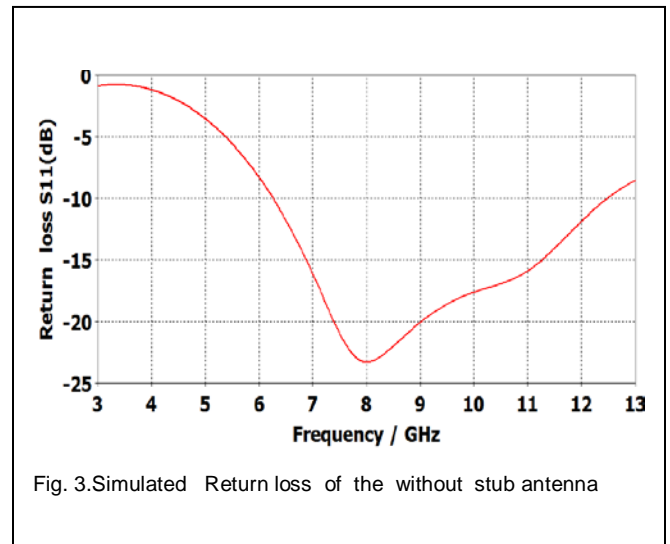


Fig. 3.Simulated Return loss of the without stub antenna

The frequency range from without stub antenna is 6.8 to 10.1 GHz. This frequency range is achieved by return loss value below -10dB.In Fig. 3 simulated Return Loss of the with stub antenna.

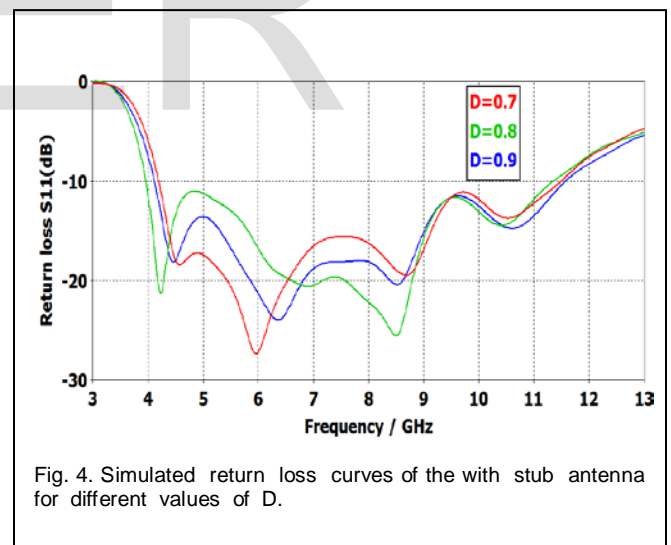
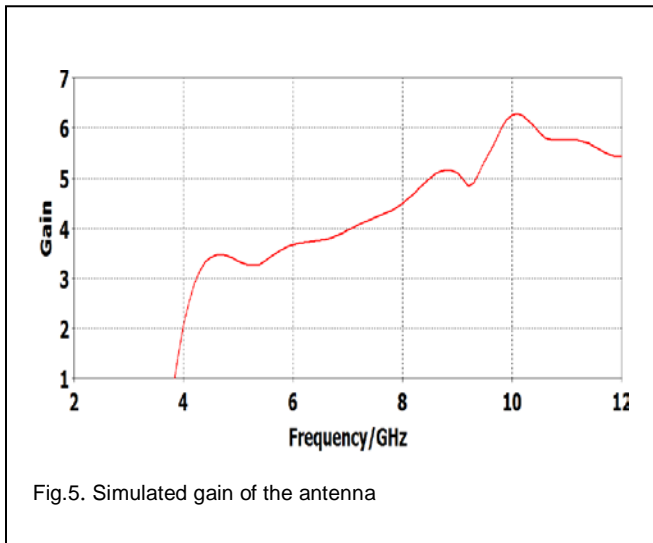


Fig. 4. Simulated return loss curves of the with stub antenna for different values of D.

The measured return loss below -10dB.The simulated Return Loss of the with stub antenna achieved by operating frequency (3.9 to 11GHz).In Fig. 4 shows the simulated Return Loss of antenna in the terms of D. Return loss is the parameter which indicates the amount of power that is loss. Return loss is loss of signal power resulting from reflection caused at a discontinuity in transmission line or optical fiber. For D=0.8, 0.7, 0.9 other dimensions fixed It is found that the input impedance of the antenna (D=0.8) is well matched as the bandwidth covers the entire UWB band (3.9- 11 GHz). The

comparison between antennas with and without stubs, the with step antenna achieved by operating frequency. But, without step antenna not achieved by operating frequency.



In Fig. 5 presents the simulated gain for antenna. The antenna gain in the UWB band is about 2-6.2 dBi. UWB band frequency range is 3.9 to 11 GHz. It is assumed that the antenna is receiving a signal in the direction of maximum gain. It is also common for the gain to be expressed in decibels and referenced to an isotropic source.

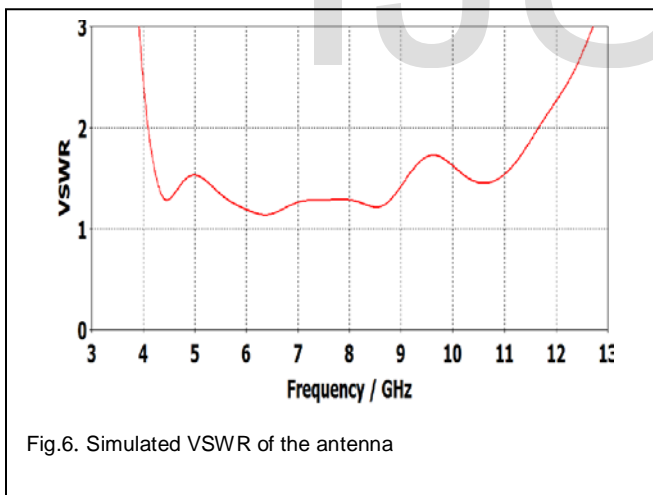
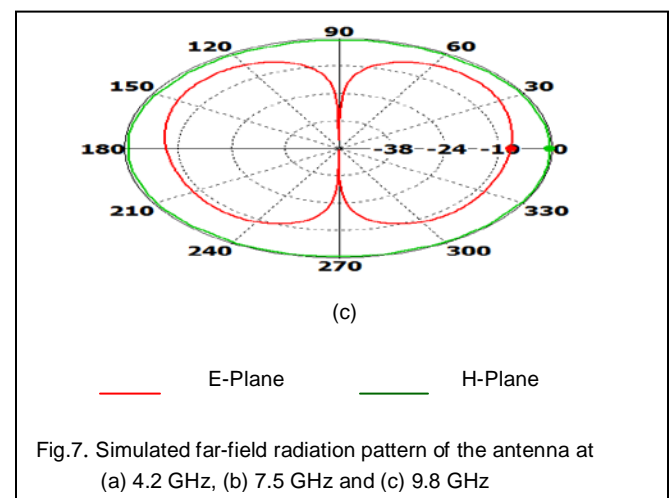
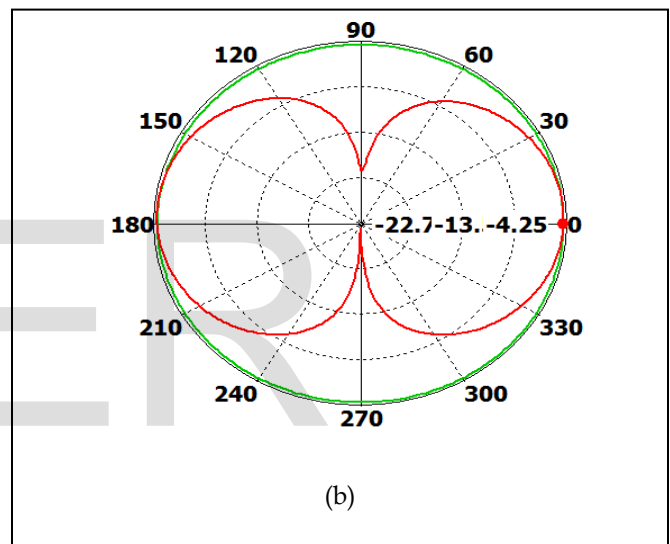
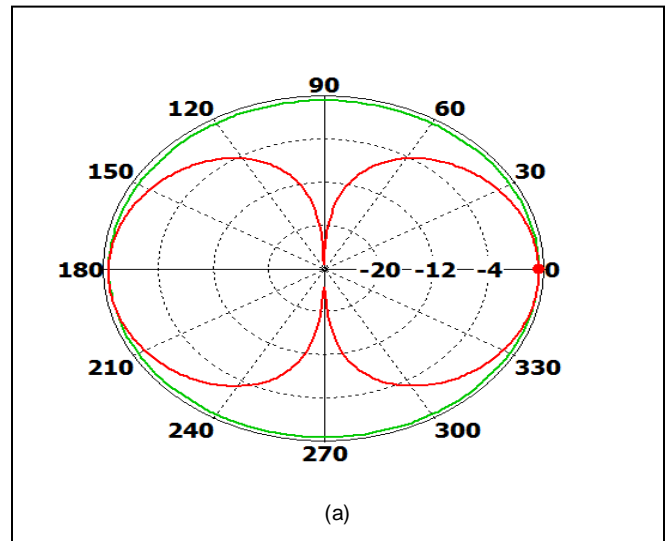
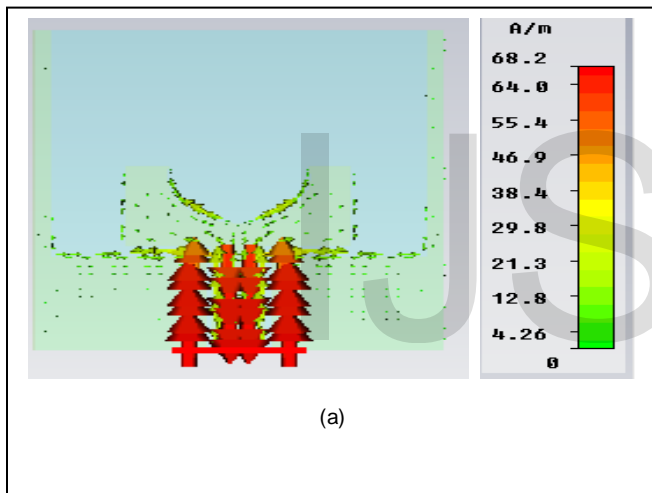


Fig. 6 being evidence of VSWR for beyond the required band width of 3.9 to 11 GHz with (VSWR < 2).

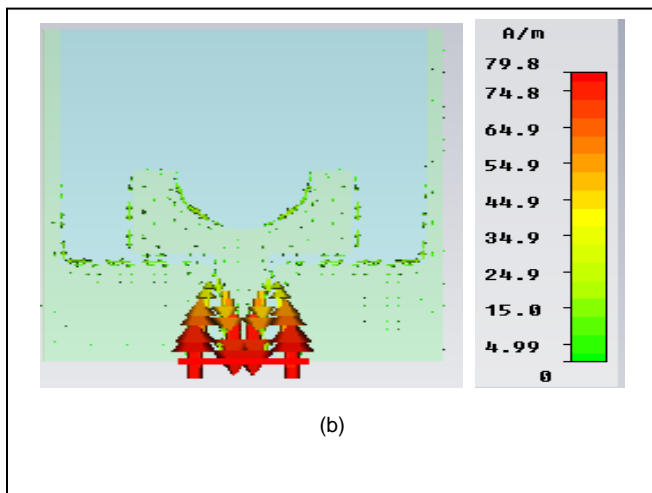


The simulated radiation patterns of antenna 3 in the E-plane (xz-plane) and H-plane (yz-plane) for three different frequencies 4.2, 7.5 and 9.8 GHz shown in Fig. 7. The radiation patterns frequency is calculated by resonance frequency. A mathematical function or a graphical representation of the radiation properties of the antenna as a function of space coordinates. In most cases, the radiation pattern is determined in the far field region and is represented as a function of the directional coordinates. The patterns in the H-plane are quasi-omni directional as expected. In the E-plane, the bidirectional radiation patterns remain roughly a dumbbell shape like a small dipole leading to bidirectional patterns. It has been seen that this antenna has nearly Omni-directional radiation pattern like normal monopole antennas.

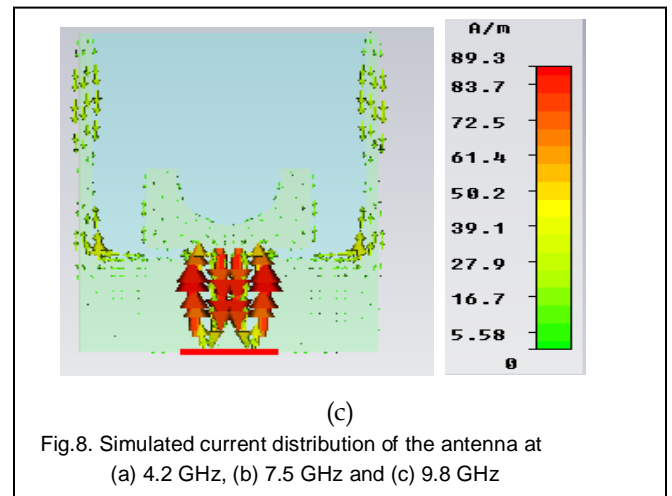
The surface current distribution on the radiator and the stubs are illustrated at the same frequencies of 4.2, 7.5 and 9.8 GHz as shown in Fig 8. The lower frequency resonance is dominated by the extended open-circuit stubs, which play a key role in achieving the low frequency radiation and impedance match.



(a)



(b)



(c)

Fig.8. Simulated current distribution of the antenna at (a) 4.2 GHz, (b) 7.5 GHz and (c) 9.8 GHz

On the other hand, the intermediate and higher frequency resonances are more determined by the elliptically edged small-size radiator, which is able to provide similar current distribution patterns with different, continuously tuned electrical resonance lengths. The surface current distribution compare the frequencies of 4.2, 7.5, and 9.8 GHz. shown in Fig 8 .Shows that the frequency resonance is dominate in increase of current 9.8 GHz.

4 CONCLUSION

In this paper, a CPW-Fed Folded UWB-Monopole antenna function has been discussed. The antenna has been successfully simulated. The ultrawide operating frequency range from 3.9 to 11 GHz. The antenna gain in the UWB band is about 2-6.2 dBi. The monopole antenna omni-directional radiation pattern. This antenna simple structure occupies an area of 24 x 20mm². With good radiation pattern and good gain, it suitable for a wide range of UWB applications.

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