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A Compact Wideband Antenna for Modern Wireless Communication Systems

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Abstract: **In this paper the authors present the analysis and design of a modified CPW antenna which covers a wide range of application bands for modern wireless communication systems. This design, provides a 2:1 VSWR bandwidth of 78% at 2.49 GHz that covers application bands including GPS systems (1.56-1.60)GHz, Global Star Satellite Phones (1.61-1.63 GHz uplink, 2.48-2.49 GHz), Advanced Wireless Systems (1.71-1.76 GHz, 2.11-2.17 GHz), DCS 1800 (1.71-1.88 GHz), Digital Cordless Phones (1.88-1.90 GHz), PHS/PCS/DCS-1900 (1.85-1.99 GHz), Satellite Radio (2.33-2.35 GHz) , WiBro (2.30-2.39 GHz), BlueTooth /WLAN-2.4/ WiBree/ ZigBee (2.40-2.49) and DMB(2.60-2.66 GHz). The omni-directional radiation patterns along with moderate gain make the proposed antenna suitable for above mentioned applications. Details of the antenna design and comparison of simulated and measured results are presented and discussed.**

1. INTRODUCTION

In the era of modern wireless communication systems, antennas capable of operating at broad frequency band range are increasingly demanded. Various antenna design which enable antennas with low profile, light weight, enhanced dual or wideband frequency capabilities have been developed and presented in the literature [1-6]. However, such antennas mostly need a large size of ground plane or a via hole connection for feeding the signal which increases manufacturing difficulty and cost. CPW-fed antennas for wireless communication have been discussed by many authors due to their attractive features such as low radiation loss, less dispersion, wide bandwidth, simple unipolar structure and easy integration with active devices without via holes. Recently various antenna designs for wideband applications are reported in the literature [7-8].

In this paper, we present a modified shorted CPW antenna which finds applications in the range of modern wireless communication gadgets. The antenna dimensions are optimized using FEM based commercial simulation. The parameters which affect the antenna characteristics are also studied and discussed.

2. ANTENNA DESIGN

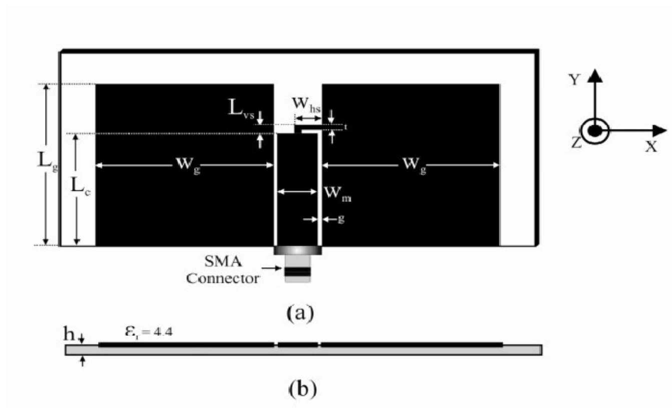


Fig. 1. Geometry of the proposed wideband antenna.
(a) Top view (b) Side View.

Lg =26,Wg =25, Lc =18,Wc =5.7,g =0.5, Lvs =1.5, Whs =3.85, t= 1, h=1.6 (Units in mm) εr = 4.4Fig. 1. depicts the geometry of the proposed antenna. In this design the conventional coplanar waveguide is modified to act as an efficient wideband radiator. By introducing a short at the optimum position, good impedance matching with high efficiency, moderate gain and good radiation characteristics can be achieved. Various antenna parameters including the position of the short and dimensions of the finite ground plane and centre conductor are optimized by Ansoft HFSS. The optimum design comprises of LgxWg = 26x25mm2, LcxWc =18 x 5.7mm2, g =0.5mm, Lvs = 1.5mm, t = 1mm and Whs = 3.85mm and is fabricated on a substrate with εr = 4.4 and thickness h=1.6mm.

3. RESULTS AND DISCUSSION

A conventional Finite ground CPW is modified to obtain wide band response at the frequencies of interest. The optimum length of the center strip and position of short is derived through a number of studies and its effect on the reflection characteristics are shown in fig. 2. It is observed that by introducing a short at the truncated end of the CPW, resulted resonance at 2.3 GHz with 49 % bandwidth. While modifying the centre strip with a stepped impedance transformer shifts the resonance to a lower frequency. After fixing the optimum value for the centre strip length Lc, investigations were done to observe the effect of shorting position on the antenna resonance. It is found that a drastic improvement in the bandwidth (up to 76 %) is obtained when the short is at the optimum position.

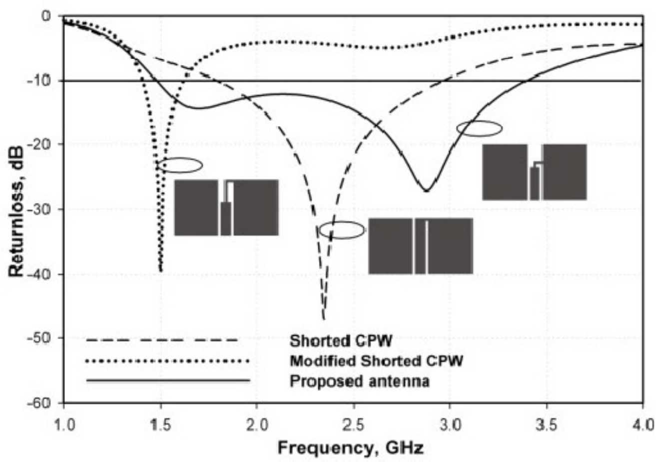


Fig. 2. Simulated reflection characteristics of the different antenna elements

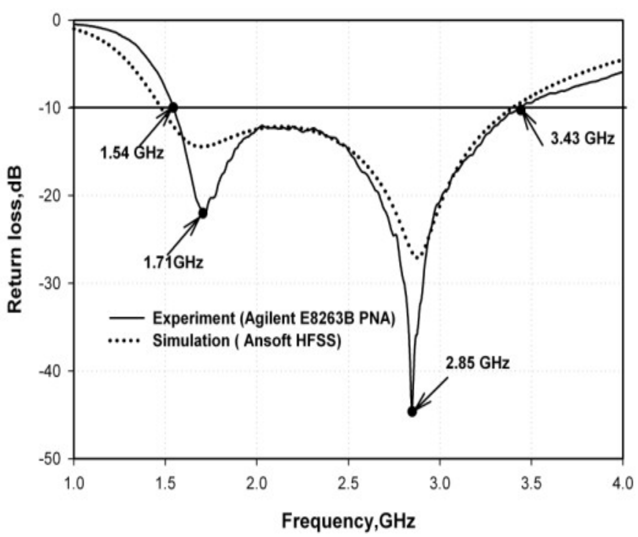
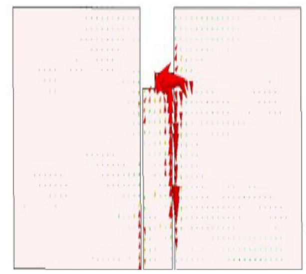


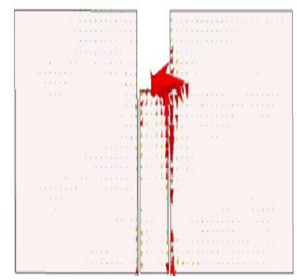
Fig. 3. Measured and simulated return loss of the proposed antenna GHz [Lg =26,Wg =25,

Lc =18,Wc =5.7,g =0.5, Lvs =1.5, Whs =3.85, t= 1, h=1.6 (Units in mm) εr = 4.4]

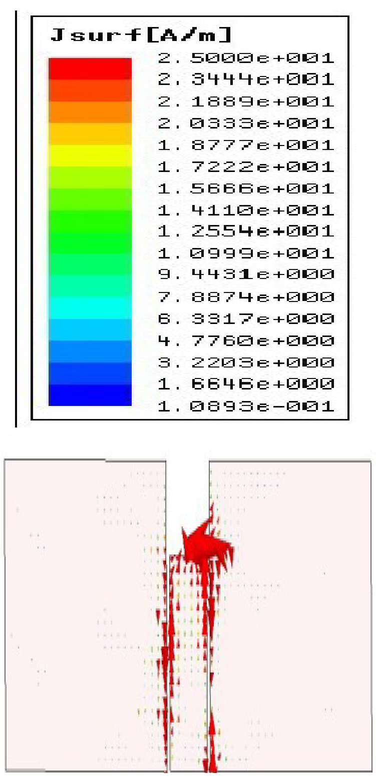
Current density plots at different frequencies obtained through simulation are depicted in fig.4. It is evident that the shorting element contributes for the radiation throughout the resonant band and current variations in the ground plane are almost negligible.



(a)



(b)



(c)

Fig. 4. Simulated current distributions at (a) 1.71 GHz (b) 2.49 GHz (c) 2.85 GHz [Lg =26,Wg =25,

Lc =18,Wc =5.7,g =0.5, Lvs =1.5, Whs =3.85, t= 1, h=1.6. (Units in mm) εr = 4.4]

An assessment of the radiation behavior for the proposed antenna is carried out by measuring the radiation patterns at different frequency points and is shown in fig. 5. The antenna offers nearly omni-directional radiation coverage throughout the resonance band which is suitable for the proposed applications. Measurement results reveals that the antenna is linearly polarized along the x direction with good polarization purity better that 10 dB at bore sight.

Average gain of the proposed antenna at different frequencies are measured and plotted in fig. 6. The antenna provides almost stable gain better than 3.9dBi over the resonant band. Efficiency of the antenna is measured experimentally using Wheeler cap [9] method and an average efficiency of 89 % is obtained for the optimized design.

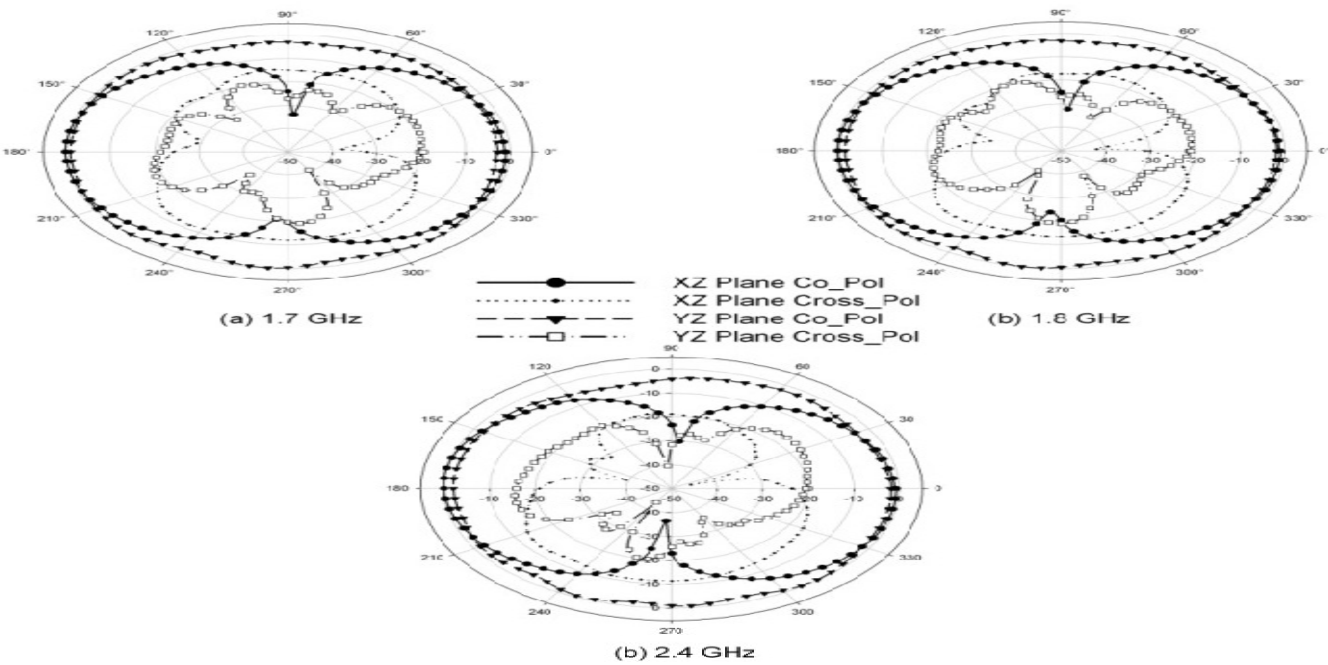


Fig. 5. Measured radiation patterns at (a) 1.71 GHz (b1.8 GHz (c) 2.4 GHz Lg =26,Wg =25, Lc =18,Wc =5.7,g =0.5, Lvs =1.5, Whs =3.85, t= 1, h=1.6 (Units in mm) εr = 4.4

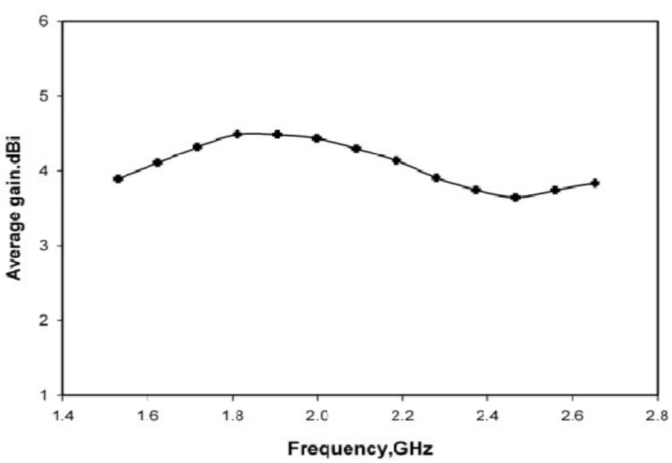


Fig. 6. Measured average gain in the application ban Lg =26,Wg =25, Lc =18,Wc =5.7,g =0.5, Lvs =1.5, Whs =3.85, t= 1, h=1.6 (Units in mm) εr = 4.4

Conclusion

The conventional CPW is modified to form a compact antenna serving wideband applications. The antenna exhibits VSWR bandwidth of 78 %. Various parameters of the antenna design are optimized and the optimized design is prototyped. Measurement results of return loss characteristics, radiation pattern and gain of the proposed design ensures that the antenna is suitable for modern wireless communication gadgets.

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