International Journal of Scientific Research Engineering & Technology (IJSRET)
Volume 1 Issue 5 pp279 -282 August 2012 www.ijsret.org ISSN 2278 - 0882

# Ultra-Wide bandwidth Circular Monopole Antenna

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## ABSTRACT

In this paper, a novel circular monopole Antenna for Ultra-Wideband application with corner-shaped ground plane is presented and discussed. It is printed on a dielectric substrate and fed by a 50 ohm microstrip line; a planar circular disc monopole has been demonstrated to provide an ultra wide 10 dB return loss bandwidth. The proposed design offers low profile, ultra high bandwidth and compact antenna element. This design offers the improved gain and directivity of antenna which is applied for high efficiency antenna. The maximum bandwidth from 1.30 GHz to 12GHz for voltage standing wave ratio (VSWR) < 2 and the peak antenna gain is 4dB to 9 dB.

***Keywords:*** *Ultra wideband (UWB), Corner shape ground plane, Circular disc monopole, microstrip line-fed, printed antennas.*

## I. INTRODUCTION

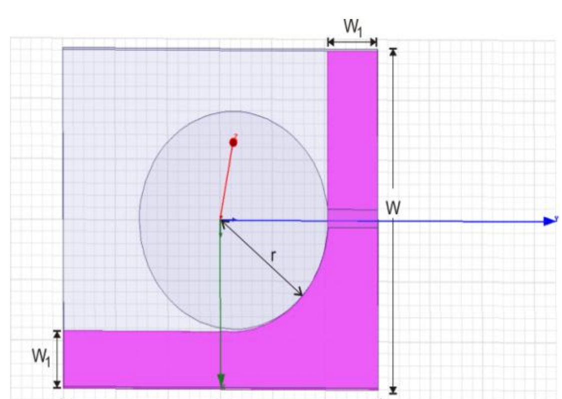
Ultra wideband (UWB) antennas have commanded increased interest in the last few years, due to the rapid development of wideband wireless communication systems. UWB technology has received an impetus and attracted academia and industrial attention in the wireless world ever since the Federal Communications Commission released a 10-dB bandwidth of 7.5 GHz (3.1–10.6 GHz) [1].A suitable UWB antenna should be capable of operating over an ultra wide bandwidth as allocated by the Federal Communications Commission. At the same time, reasonable efficiency and satisfactory radiation properties over the entire frequency range are also necessary [2-4].

UWB systems have many advantages because of their wide bandwidth and economics advantages have been used in communication system, medical imaging, radio communication and biomedical system [5-7]. Printed monopole antennas fabricated on a substrate offer wide impedance bandwidth that can cover UWB. Rectangular, circular disc, elliptical, and binomial curved-shaped UWB monopole antennas have been reported [8–14].

In this work, we propose a simple printed circular-shape patch with the corner shape ground plane multi-band antenna for UWB applications. Multi-band characteristics with desired bandwidth are obtained by fabricating a circular-shaped radiating patch on one side of the substrate and a corner shape ground plane on other side of the substrate as shown in fig 1. The shapes of the ground planes are carefully designed in order to increase both gain and bandwidth for a UWB radar transceiver operating at a central frequency of 7GHz with more than 160 percent bandwidth.

## II. ANTENNA STRUCTURE

The geometry of the proposed antenna is shown in Fig. 1. It is fed by a 50 ohm Microstrip line and fabricated on a 1.6 mm thick FR4 substrate with W=56mm and L=60 mm surface area. The relative permittivity and loss tangent of the substrate is 4.4 and 0.02 respectively as shown in fig 1. On one side of the board we have a 50-Ohm microstrip feeding line (width 3 mm and length is 10 mm), and a disc with diameter D = 36 mm and on the other side of the substrate we have an corner-ground plane, the corner is parabolic shape and the radius of sliced circle is r =18.5 mm and the width of the ground plane $W_1$.




(a)

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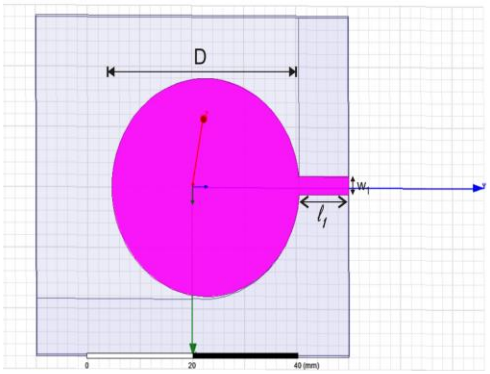



(b)

(c)

Fig1 Circular Monopole Antenna (a) corner shaped ground plane. (b) Circular patch with feed line, (c) prototype antenna.

## III. SIMULATED RESULTS

The aim of the work is to get a planar antenna with low return loss, with high gain and directivity, with enhanced radiation patterns, in the band between 1 and 12 GHz. We performed massive numerical simulation using the HFSS[15], which utilizes the finite element method for electromagnetic computation, in order to find a good tradeoff between these requirements.

The pattern of the CPW antenna [16-19] looks semi omnidirectional. But the structure studied in this paper has more directive than the CPW structure. One of the weaknesses of the CPW is antenna's gain, and it usually 1 to 7 dBi [16-19] but the gain of prototype antenna is 4-8.5 dBi and could achieve higher gain by applying the thin metal reflectors.

### *1. Return loss*

We can see from the fig 2 that it is multi band antenna from 1GHz to 12GHz band. Fig. 2 shows the input reflection coefficient of the antenna as obtained from Ansoft HFSS [15]. Good agreement is observed, thus verifying the design process. The predicted return loss is better than 10dB between 1.2 GHz and 1.9 Ghz.

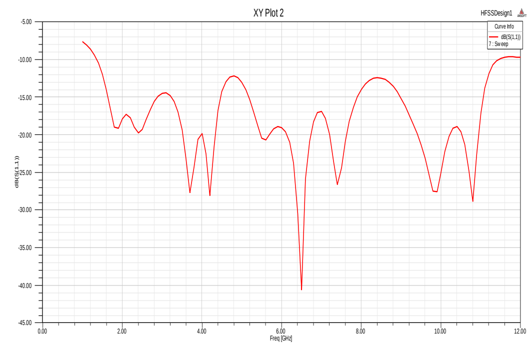



Fig 2 Simulated reflection coefficient of the circular monopolea antenna.

### *2. V.S.W.R*

Voltage Standing Wave ratio, that means the ratio between transmitted signal from source to the reflected signal from thee load (antenna), ideal case is VSWR=1, but of course it's not exists in the real life so the good ratio swinging between 1.0 to 1.2, over 1.5 is bad. As signal amplitude (voltage) is a proportion of impedance so VSWR equal to ratio between load impedance and transmit media, any difference will cause high VSWR. Here (VSWR) < 2 is from 1.2GHz too 11.70GHz.

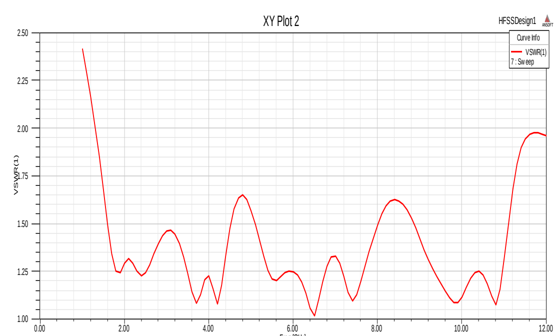



Fig 3: Simulated VSWR of proposed patch antennas at different frequencies.

### *3. Peak Gain*

The simulated gain of the proposed patch antenna at various frequencies is shown in Fig. 4. As shown in the figure, the maximum achievable peak gain is 4dB to 10 dB from 1GHz to 12 GHz.

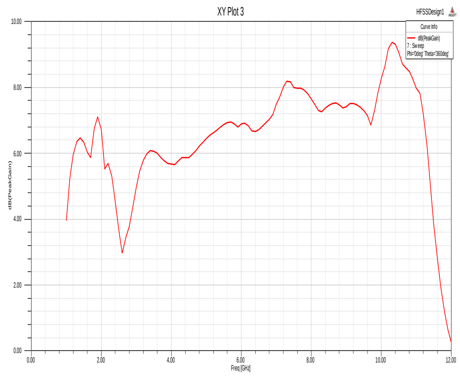
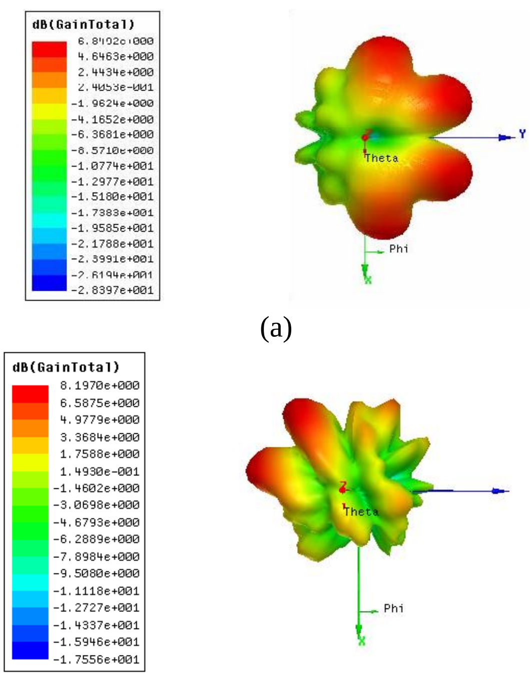



Fig 3: Simulated peak gain of proposed patch antennas at different frequencies.

### *4. Radiation patterns:*

We have presented here a comparison between the CPW antenna and our prototype antenna and for this comparison shown the 3D pattern of both antennas at 7GHz as shown in fig. 4. It shows that the CPW antenna has semi Omni directional pattern and its gain 6.84 dBi but in our prototype antenna the gain is 8.19dBi as shown inn fig 4 (b) and its pattern unidirectional.




(a)

Fig 4 Radiation pattern (a) CPW antenna (b) Proposed patch antenna.

## IV. CONCLUSION

In this paper we have presented the effect of corner-shaped ground plane and we have investigated and compared the effect of the small reflectors plan for circular CPW and the prototype antenna. Corner shape ground plane can increase the gain and directivity of antenna and it gives the multiband characteristic also. The impendence bandwidth between 1.2GHz to more than 12GHz is suitable for VSWR <2 and the antenna gain between 4-8.19 dBi.

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