



Gap Coupled Corner Truncated Monopole Rectangular Microstrip Antenna for Wideband Operation

Kalpna Chikatwar and S.N. Mulgi***

**Department of P.G. Studies and Research in Applied Electronics,
Gulbarga University, Kalaburagi, Karnataka, INDIA*

***Professor, Department of P. G. Studies and Research in Applied Electronics,
Gulbarga University, Kalaburagi, Karnataka, INDIA*

(Corresponding author: Kalpna Chikatwar)

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ABSTRACT: This paper presents novel design and development of gap coupled corner truncated monopole rectangular microstrip antenna (CTMRMA) for wideband operation. The proposed antenna is simple in its geometry and can be constructed by splitting the rectangular monopole MSA along its width and then by truncating the corner part of parasitic patch element. By suitably gap coupling this splitted parasitic patch element with the radiating patch, the wide band operation can be achieved. The antenna operates in the frequency band of 1.29GHz to 7.88 GHz and gives maximum impedance bandwidth of 143.8% and peak gain of 3.75 dB in its operating band. The proposed antenna may find application in microwave communication systems.

Keywords: Gap Coupled Rectangular Microstrip antenna, wide band, monopole, gain.

I. INTRODUCTION

Microstrip antennas are widely used for many industrial and military applications by virtue of its various advantages like light weight, low volume, thin profile configuration, low fabrication cost and small size etc. The inherent handicap of microstrip antennas is their narrow impedance bandwidth [1-3]. A good number of papers have presented in technical literature on bandwidth enhancement of microstrip patch antennas using additional resonators which are gap coupled to the driven patch along the radiating and non radiating edges. However, there are two problems associated with these techniques 1) Overall size of the antenna is large and hence they are not suitable as array elements 2) Distortion of radiation pattern with frequency [3-8]. Another technique used by many researchers to improve the bandwidth of microstrip antenna is monopole technique. Monopole antennas are finding increasing application because of their significant merits like wide band, low interference to other systems, low cost, low profile, light weight, omnidirectional radiation pattern, and ease of fabrication [9]. However the use of gap coupling by splitting the patch in to smaller element with monopole technique to improve bandwidth performance of antenna is found to be rare in literature.

In this paper a simple gap coupled monopole corner truncated rectangular microstrip antenna for wideband operation is designed. This technique of design also makes the antenna compact in size.

II. ANTENNA DESIGNING

Fig. 1 shows the top view geometry of proposed gap coupled corner truncated monopole rectangular microstrip antenna (CTMRMA). It is printed on a low cost glass epoxy substrate material of area $L_s \times W_s$ cm with thickness $h = 0.16$ cm and a relative permittivity (ϵ_r) of 4.2. The CTMRMA consists of a radiating patch of width 'W' and length 'L' cm. The antenna is excited by using a single 50 Ω microstripline feed of length $(L_g + d) = 2.77$ cm and width

$W_f = 0.32$ cm. A partial copper ground plane of height $L_g = 2.5$ cm is placed below the microstripline feed on the bottom layer of the substrate. The gap between the radiating patch and the partial ground plane is 'd' which is equal to 0.27 cm. In this design, the only one simple 50 Ω microstripline feed is used for impedance matching. The simulation performances are done by using commercial Ansoft HFSS software [10]. Further the antenna is splitted along the width of radiating patch at a distance ' $x_1 = 0.45$ cm' from left nonradiating edge

with a gap of $s=0.05\text{cm}$, and then it is corner truncated on both side as shown in figure. By suitably gap coupling this truncated parasitic element with the radiating patch a wide band operation can be achieved. The two corners of the rectangular patch are truncated

with the vertical and horizontal length of V and H respectively. The design parameters of the proposed antennas are given in Table-1. The HFSS model of the proposed antenna is shown in Fig. 2.

Table 1: Design parameters of the proposed antennas.

Antenna Parameters	Dimensions in cm	Antenna Parameters	Dimensions in cm
W_p	2.66	L_g	2.5
L_p	2.04	W_s	6
W_f	0.32	L_s	5
L_f	2.18	V	0.4
d	0.27	H	0.5
h	0.16	X	0.45

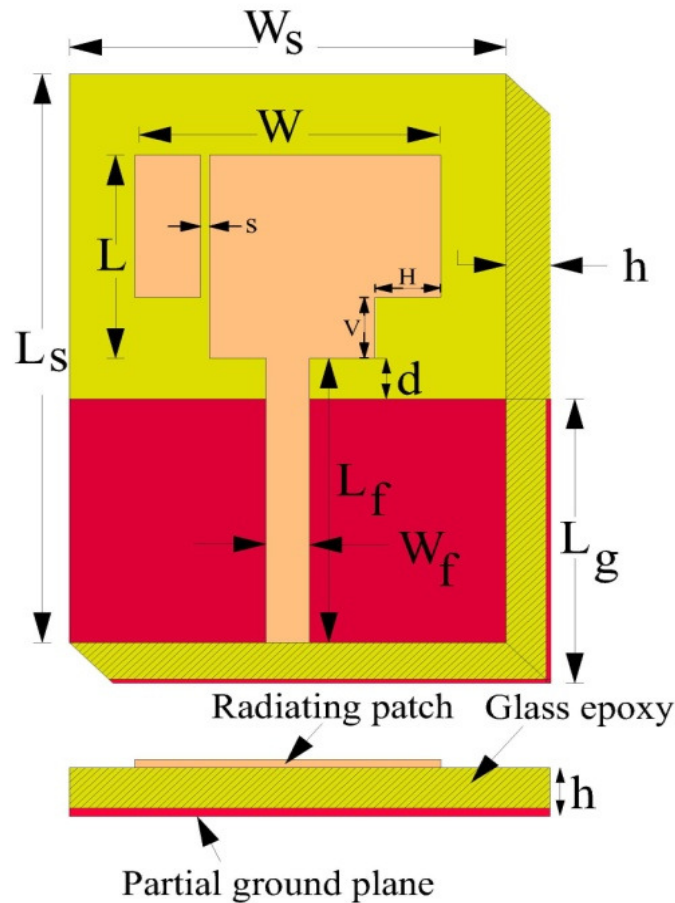


Fig. 1. Top view geometry of gap coupled CTMRMA.

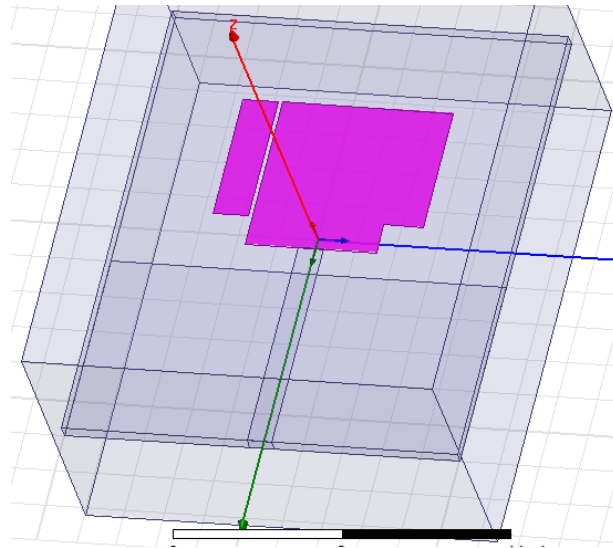


Fig. 2. The HFSS model of the proposed antenna.

III. RESULTS AND DISCUSSION

The variation of return loss versus frequency of gap coupled CTMRMA is as shown in Fig. 3. From the figure, it is clear that, the antenna operates for wide band of frequencies and gives a maximum impedance bandwidth of 143.8 % (1.29GHz-7.88GHz) with a peak gain of 3.75dB. The operating range of this antenna covers WCDMA (1.92 – 2.17), WLAN (2.4 –

2.48 GHz), GPS (1 – 3 GHz) and C-band long distance radio telecommunications. A typical 2D and 3D E-plane and H-plane radiation patterns of gap coupled CTMRMA is measured at the resonant frequencies m_1 and m_2 shown in Fig. 4 and Fig. 5 respectively. The obtained radiation patterns are nearly omnidirectional in nature.

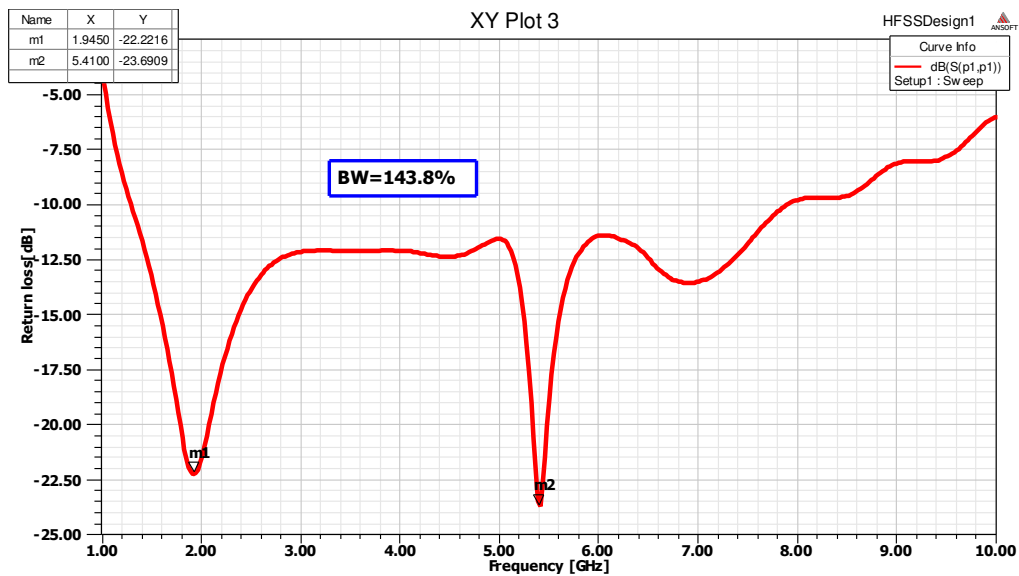


Fig. 3. Variation of return loss versus frequency of Gap Coupled CTMRMA.

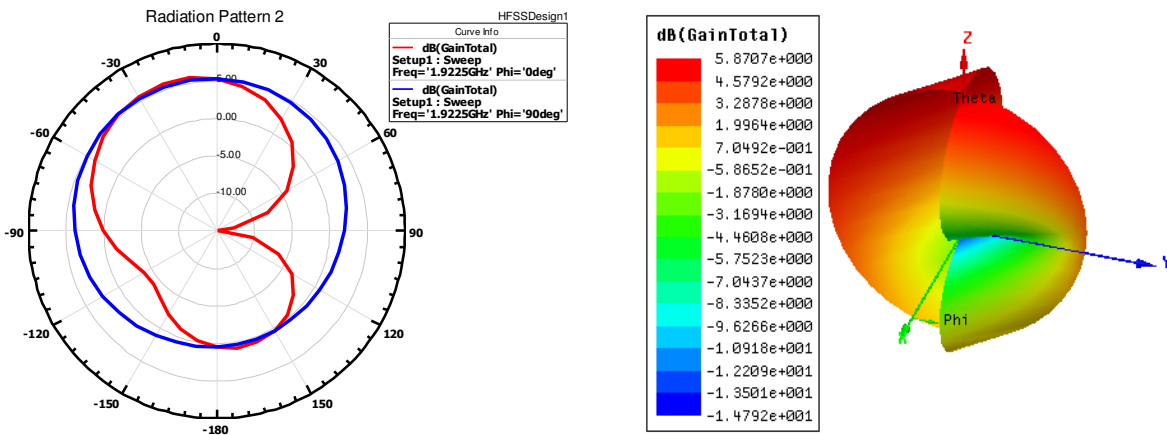


Fig. 4. Radiation pattern of gap coupled CTMRMA measured at 1.92 GHz.

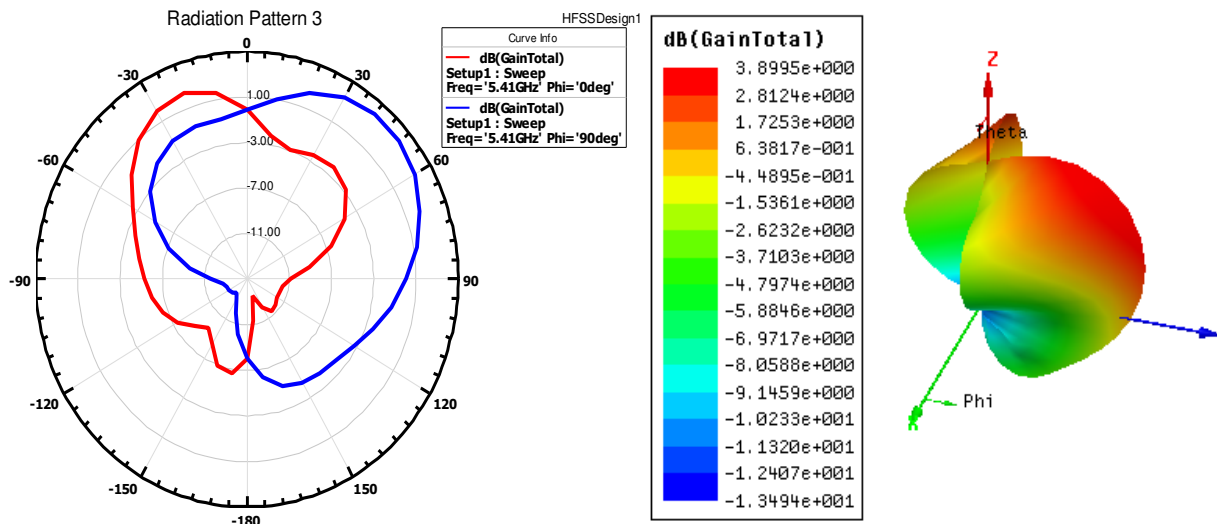


Fig. 5. Radiation pattern of gap coupled CTMRMA measured at 5.41 GHz.

Fig. 6 shows surface current distributions of gap coupled CTMRMA measured at 1.92GHz and 5.41GHz .From these figures it is seen that, the current distribution is observed towards the edge point of the microstripline feed, at the gaps on patch and uniform current distribution is also observed at the ground plane surface of the antenna causing wideband operation.

IV. CONCLUSION

A simple gap coupled corner truncated monopole rectangular microstrip antenna is designed for wide band operation. From the detailed simulation study it is

found that, when the monopole RMA is splitted along the width from the left non radiating edge of patch and then corner truncated on both side, the antenna operates for wide bands of frequencies from1.29GHz to 7.88 GHz with impedance bandwidth of 143.8% and peak gain 3.75dB.Further the antenna also shows the property of virtual and actual size reduction. The designed antennas are simple and compact in nature and can be fabricated using low cost modified glass epoxy substrate material and may find the applications in microwave communication systems.

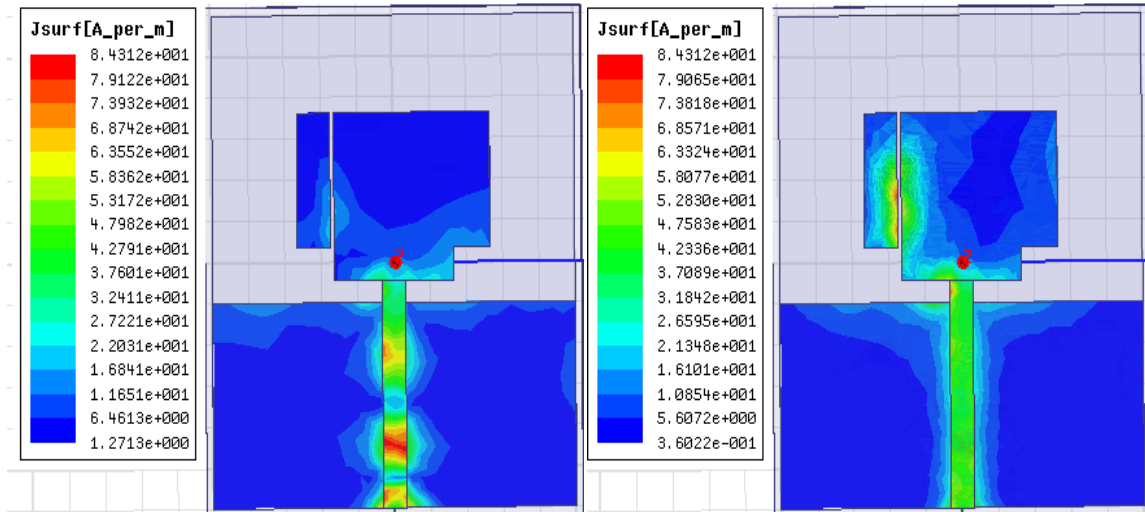


Fig. 6. Current distribution of gap coupled CTMRMA measured on patch and ground plane surfaces at 1.92GHz and 5.41GHz.

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