ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 4, Issue 2, March 2015

Modified Printed Square Monopole Antenna

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Abstract— Printed vertex truncated Square Monopole Antenna has been proposed, which yields ultra wide bandwidth. In this paper the comparison of bandwidth takes place by feeding printed square monopole antenna (PSMA) with micro strip line in different configurations. The bandwidth of vertex truncated PSMA is found large and it cover the ultra wideband (UWB). It gives VSWR bandwidth from 1.6 GHz to 11.8 GHz Furthermore; the antenna structure is extremely simple. A systematic study has been presented to explain the ultra-wide bandwidth obtained from this antenna.

***Index Terms*— Printed monopole antenna, printed square monopole antenna, printed vertex truncated square monopole antenna, ultra wideband.**

I. INTRODUCTION

The objective here is to have simple patch antenna that is wideband, is able to radiate omni -directionally, is compact in size and is easy to fabricate. Printed monopole antennas (PMAs) with a very large bandwidth are currently in great demand as they meet most of the above requirements. Printed monopole antennas (PMAs) are better suited for compact wireless communication systems because of their numerous advantages. Printed monopole antennas offer wide bandwidth, lightweight, low cost, their co-planar ground plane has made them low profile, compact and suitable to integrate them with other subsystems on a PCB [2-3]. Most of the PMAs can be categorized into two major groups; firstly, configuration with modified/slotted patches with and without modified partial ground plane and secondly regular shaped patches [2-4]. For the configurations in first category, generally, design equations are not available and these are designed and optimized through simulations [4-9]. On the other hand, the regular shaped patches, such as, Printed Square Monopole Antenna (PSMA), Rectangular (PRMA), Triangular (PTMA), Hexagonal (PHMA), Circular (PCMA), Elliptical (PEMA), etc., fall under the second group for which design equations for lower band edge frequency have been given [1].

In this paper, a systematic study has been presented for the regular Printed Square Monopole Antenna (PSMA) leading to a new configuration of vertex truncated PSMA to obtain ultra wide bandwidth. A regular PSMA can be fed using micro strip line along one of the sides or at one of the vertices, but neither of these two configurations yield wide. Bandwidth because of impedance mismatch. When the regular PSMA is fed with micro strip line through truncated vertex, it yields ultra wide bandwidth. The measured BW from 1.6 to 11.8 GHz has been obtained for this vertex truncated PSMA. The response of this new configuration has been explained by comparison with regular PSMA. This small size printed antenna has numerous potential applications such as ground penetrating RADARs, medical imaging in UWB range including applications, below 3.1GHz, like GSM cellular mobile (PCS), ISM, Wi-Fi and WLAN. The theoretical study of this configuration was carried out using a CADFEKO simulator.

II. PRINTED SQUARE MONOPOLE ANTENNA

Printed square monopole antenna (PSMA) can be fed at one of the side or at the vertex of square. The PSMA patch is designed at lower band edge frequency of approximately 1.6 GHz. The side length of PSMA a as 45.6 mm. The PSMA is fabricated on FR4 substrate of optimized size of 90 mm x 90 mm, thickness =1.59 mm, dielectric constant, ε_r= 4.2 and loss tangent tanδ = 0.02. A micro strip line feed with partial backing ground plane of size 90 mm x 10 mm has been used. The micro strip line feed is designed with width of 2.8mm for the impedance of 50Ω. The width of the ground plane below the 50Ω feed line was optimized at 10 mm. Ground plane of the same width is put in the front side of the substrate, as shown in Fig.1(a), to minimize radiation from the 50Ω feed line. [1]

Side fed PSMA

The regular PPMA fed with the 50Ω micro strip line at one of the sides, as shown in Fig.1 (a), there will be impedance mismatch at fL and also at higher order modes because of the variation in width. [Fig.1 (b)].

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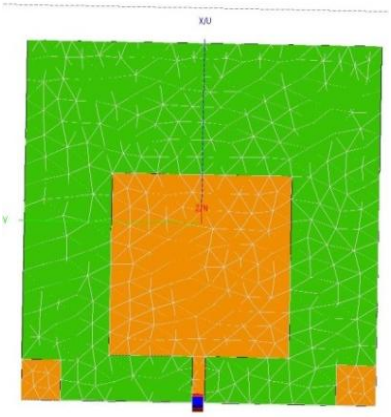

Fig.1 (a) Side fed PSMA

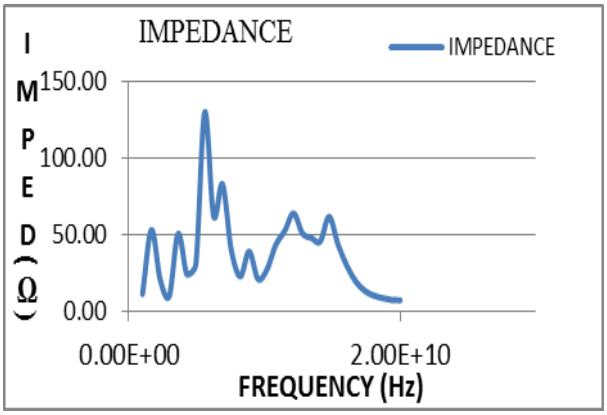

Fig.1(b) Impedance of Side fed PSMA

Vertex fed PSMA

In another configuration a regular PSMA is fed with micro strip line at the vertex, as shown in Fig. 2 (a). The input impedance at the vertex of the PSMA is high at the fundamental mode and there is a larger variation between higher order modes. The input impedance variation for vertex fed PSMA is shown in Fig 2 (b), which shows large impedance variations for fundamental and various higher order modes.

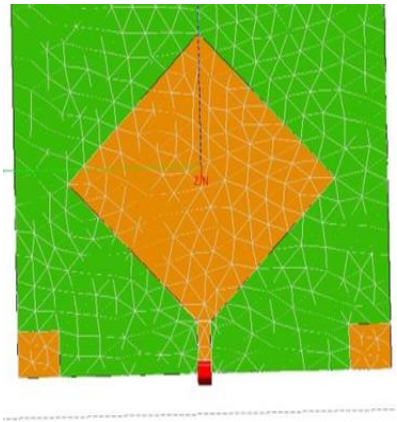

Fig.2 (a) Vertex fed PSMA

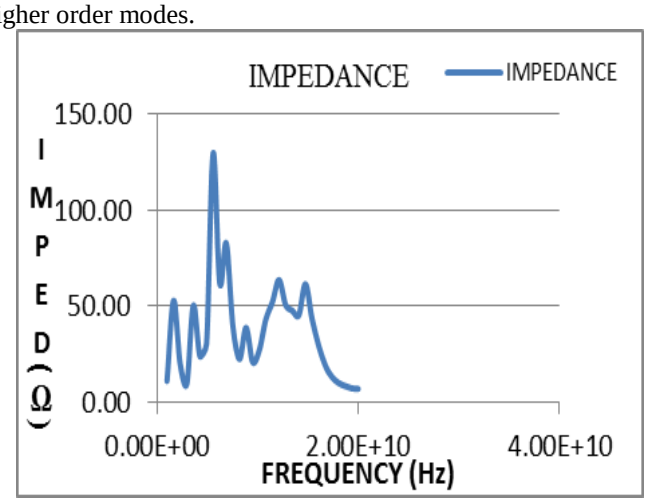

Fig.2 (b) Impedance of vertex fed PSMA

To overcome this input matching problem the vertex is truncated to reduce the input impedance at vertex, as shown in Fig.3 (a). The truncation (width x = 22mm) is optimized, through the simulation iteration, so that impedance variations over the frequency range remains within 25 to 100Ω ensuing matching with 50Ω input feed line (VSWR < 2).

Vertex truncated square fed at centre

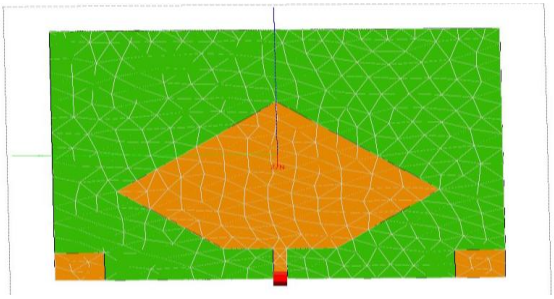

Fig. 3 (a) Vertex truncated square fed at centre

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Vertex truncated square fed at off centre

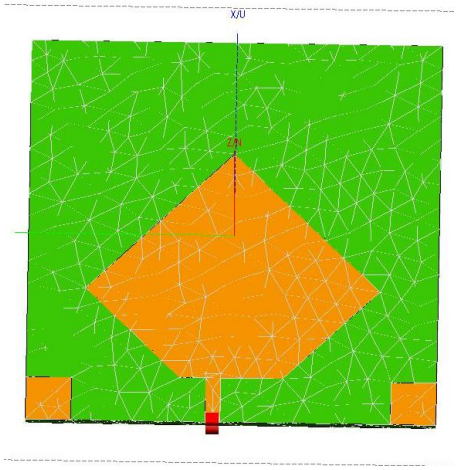

Fig. 4 (a) Vertex truncated square fed at off centre

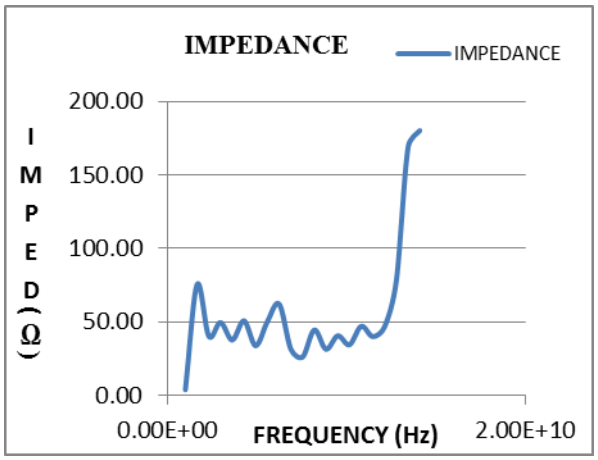

Fig. 4 (b) Impedance of vertex truncated square fed at off centre

III. RESULT AND ANALYSIS

Bandwidth of chopped PSMA fed off cantered is maximum among all configurations. It covers ultra wide band.

Configuration	Lower freq. f_L (GHz)	Higher freq. f_H (GHz)	Band-width (GHz)
Side Fed PSMA	1.6	2.2	0.6
Vertex Fed PSMA	3.47	4.2	0.73
Truncated PSMA Fed At Centre	1.63	2.63	1
Truncated PSMA Fed Off Centre	1.6	11.8	10.2

IV. CONCLUSIONS

A systematic study has been presented for the side fed and vertex fed PSMA leading to a UWB configuration of vertex truncated PSMA. New configuration of the vertex chopped PSMA that gives larger bandwidth than any other reported printed monopole configurations, has been investigated for UWB applications.

V. FUTURE ENHANCEMENT

In future, this configuration can be again modified by chopping more than one vertex. This technique also can be used for other regular shapes of printed monopole antenna like pentagon, hexagon etc.

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