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Circularly Polarized Square MS Patch Antenna Design with two Corners Chopped for ISM Band

M.S. Kasbe[1]*, T.H.Mujawar[1], V.D.Bachuwar[1], S.A.Pawar[2], S.S.Suryavanshi[1]

[1]*Department of Electronics (Commun.Sci.),*
School of Physical Sciences, Solapur University, Solapur 413 255, M.S, India.
[2]*Department of Electronics, Shri.Shivaji Mahavidyalaya, Barshi, M.S, India*

kasbe.meghana@yahoo.in

Abstract: **The paper present the design for circularly polarized Square Micro Strip patch antenna (MSPA) with two corners chopped. An extensive analysis of the return loss, radiation pattern, gain, VSWR, bandwidth and efficiency of the proposed antenna is shown in this paper. We are using CST simulation software for designing and analysis. The simple configuration and low profile nature of the proposed antenna leads to easy fabrication and make it suitable for the applications in Wireless communication system. The proposed antenna is developed for Transmitter and Receiver kits by FALKAN production which is used for transmits and receives the audio and video signals application operating at ISM band 2.45 to 2.485 GHz.**

***Keywords*: Square Micro strip patch antenna (MSPA), CST, smith chart, VSWR, S-polar, axial ratio, S-dB, radiation pattern.**

I. INTRODUCTION

A patch antenna also known as a square micro-strip antenna is a type of radio antenna with a low profile, which can be mounted on a flat surface [1]. It consists of a flat rectangular sheet or "patch" of metal, mounted over a larger sheet of metal called a ground plane. Patch antennas are simple to fabricate and easy to modify and customize. Future trend in communication design is towards compact devices. Low cost of fabrication and low profile features attract many researches to investigate the performance of a micro-strip patch antenna in various ways [2]. The radiation at the edges causes the antenna to act slightly larger electrically than its physical dimensions, so in order for the antenna to be resonant, a length of micro-strip transmission line slightly shorter than one-half a wavelength at the frequency is used. This antenna is usually constructed on a dielectric substrate, using the same materials and lithography processes used to make printed circuit boards. MSAs have several advantages compared to the conventional microwave antennas.

The main advantage of MSAs is lightweight and has a small volume and a low-profile planar configuration. Their ease of mass production using printed-circuit technology leads to a low fabrication cost. They are easier to integrate with other MICs on the same substrate. They allow both linear polarization and CP. They can be made compact for use in personal mobile communication [3-4].

The proposed antenna is simulated using CST software. It is easy to understand, and gives the accurate results without using other devices and instruments. We observed the response and results before making an antenna or micro strip devices. A circularly polarized patch antenna was designed and optimized for 2.45GHz.

II. DESIGN SPECIFICATIONS

The Square MSPA parameters are calculated from the following formulas [1]. Desired Parameter Analysis

A. Width (W) for Square MSPA:

$$W = \frac{c}{2f_0\sqrt{\frac{(\epsilon_r + 1)}{2}}}$$

Where, C=free space velocity of light ε_r=Dielectric constants of substrate

B.Effective width of Square MSPA(W_e):

$$W_e = W + 2\Delta W$$

C.Effective Length of Square MSPA (L_e):

$$L_e = L + 2\Delta L = \frac{\lambda_0}{2\sqrt{\epsilon_e}} = \frac{c}{2f_0\sqrt{\epsilon_e}}$$

$$\Delta L = \frac{h}{\sqrt{\epsilon_e}} \qquad \left(\frac{\Delta s}{S}\right) Q_0 = \frac{1}{K_{11}}$$

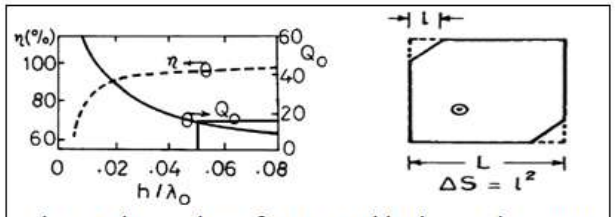


Fig. 1: Dimenssion of SMPA with chopped corners

D. BW and VSWR for Square MSPA:

$$BW = \frac{VSWR - 1}{Q\sqrt{VSWR}} \qquad VSWR = \frac{1 + |\Gamma|}{1 - |\Gamma|}$$

E. Frequeny(f_0) for Square MSPA:

$$f_0 = \frac{c}{2L_e\sqrt{\mu_e\epsilon_e}}$$

III. ANALYSIS OF SQUAR MICROSTRIP PATCH ANTENNA WITH SIMULATED RESULTS

The Squar Microstrip Patch Antenna is designed on FR-4 board which has the following parameters

Parameter	Dimension	Unit
Dielectric constant (€r)	4.4	--
Thickness of substrate	1.43	mm
Height of the copper layer	0.06	mm
Operating frequency	2.45-2.485	GHz

Table1:FR-4Specifications

Fig. 2: Design of proposed Square MSPA structure

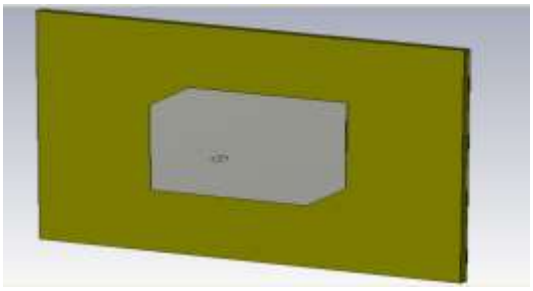


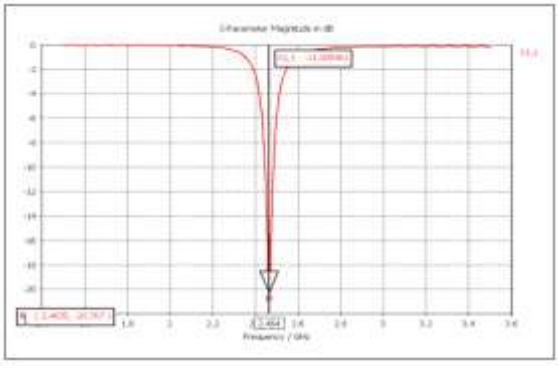
Table2: Squar Microstrip Patch Antenna Specifications

Parameter	Dimension	Unit
W	3.7257	cm
€e	4.155	mm
λo	2.49	cm
fo	1.2024	GHz
Le	6.12	cm
ΔS	0.633	mm
h/λo	0.055	--
Q_0	15	--
L	2.891	cm

Total perturbation area $\Delta S = l^2$ for a two-corner-chopped square MSA. CST-software is used to design the Squar Microstrip Patch Antenna(MSPA) at operating frequency 2.464GHz.Simulated result of Return loss and bandwidth of Squar Microstrip Patch Antenna(MSPA) is shown in fig 3[7].

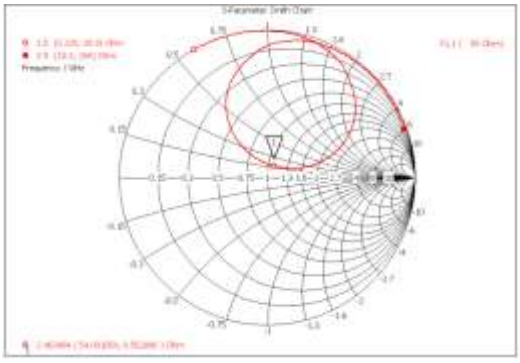
Fig. 3: Simulation of return loss and bandwidth of Square MSPA.

S dB:



The bandwidth of simple SMPA is 36 MHz and return loss is -20.767 dB

Fig. 3: Simulated Smith chart of Square MSPA



The Smith chart is plotted on the complex reflection coefficient plane in two dimensions and is scaled in normalised impedance (the most common), normalised admittance or both. Normalised scaling allows the Smith chart to be used for problems involving any characteristic or system impedance which is represented by the centre point of the chart. The most commonly used normalization impedance is 50 ohms [5]

Fig. 4: S-polar of Square MSPA

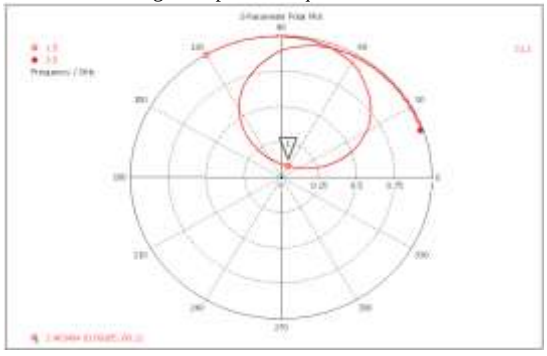


Fig. 5: Axial ratio of Square MSPA

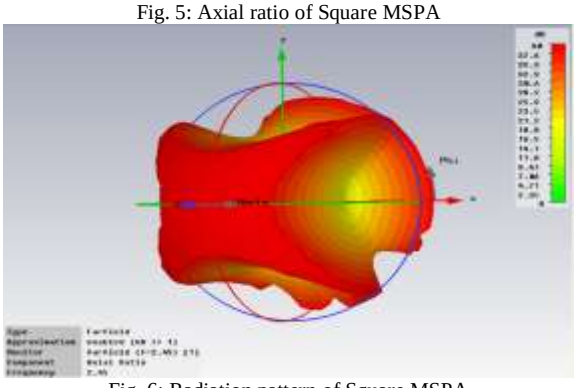


Fig. 6: Radiation pattern of Square MSPA

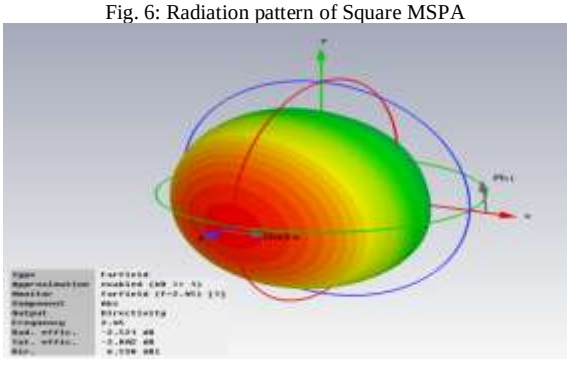
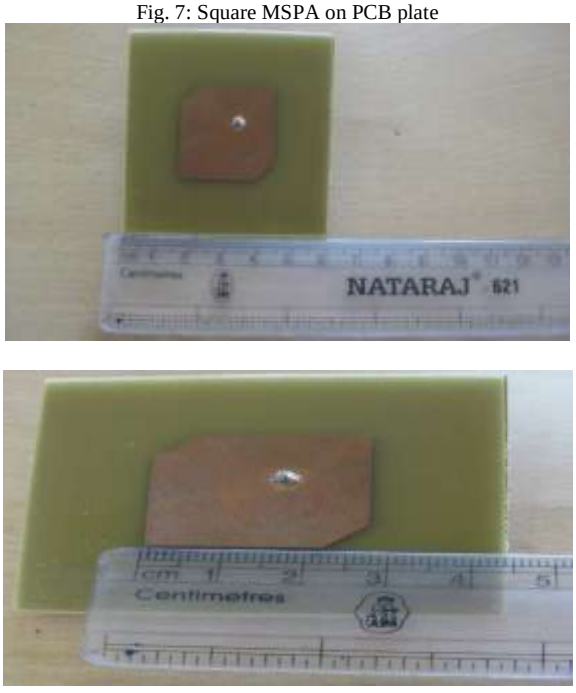


Fig. 7: Square MSPA on PCB plate



IV. SIMULATION RESULTS

The square MSPA is simulated with CST software. It gives the accurate results without using other devices and instruments [6]. Fig. 3 shows the band width and return loss of the proposed antenna i. e. 36 MHz and -20.767 dB. The directivity of proposed antenna is shown in Fig. 6 i. e. 6.538dBi.

V. CONCLUSION

The proposed square micro strip patch antenna with two corners chopped demonstrates various properties: improved bandwidth, return loss of the antenna as compared to the conventional antenna. These fundamental parameters are modelled with the equations and estimated with CST software. More over the radiating patch area is smaller as compare to conventional antenna which will cause overall reduction in antenna size.

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