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Edge Truncated Suspended Rectangular Microstrip Antenna

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ABSTRACT*:* In this paper a design and development of Edge Truncated Suspended Rectangular Microstrip Antenna (ETSRMSA) is presented. Here micro-strip patch antenna is designed to improve the bandwidth by edge truncating technique. The micro-strip patch antenna is very popular for its low profile, low cost, light weight, easy to feed, and their attractive application. The VSWR ≤ 2, the substrate material of FR-4 with relative permittivity 4.4 and loss tangent of 0.0245 is used in this proposed antenna. The Return loss, input impedance and VSWR have been measured by using Vector Network Analyser. Further antenna ETSRMSA gives the bandwidth of 27.84% and 47.86% respectively.

KEYWORDS: Edge Truncated Antenna, Suspended Microstrip antenna, Rectangular Patch antenna.

I. INTRODUCTION

Micro strip antenna is basically designed in such a way that an integration of two parallel conducting layers which is separated by a dielectric material is printed on to a single board. The lower layer and upper layers act as a ground plane and radiator respectively [1]. A simple patch antenna uses a patch of half wavelength long and having a larger ground plane which may increase the antenna size on the contrary gives better performance. We can design different shapes of micro strip patch elements such as dipole, triangular, rectangular, elliptical, and circular and square [3]. But we use rectangular microstrip for better radiation characteristics. Microstrip antennas are the successors of the printed antennas which are the present inventory for any type of wireless application with its frequency components sparing to different applications in defense, GPS, missile systems and satellite communications [2, 4].

Micro strip patch antenna contain a dielectric substrate on ground plane which is advantageous for configuration of low profile, low manufacturing cost ,less weight and is capable of integrate with micro wave integrated circuit technique. Not only in single frequency operation but also capable to operate in dual and triple frequency operation. Beside these advantages it has a major problem of narrow bandwidth which can be retrieved with several techniques like by increasing the thickness of substrate or modify by E shape and U slot patch antenna [5]. In this paper a design and development of Edge Truncated Suspended Rectangular Microstrip Antenna (ETSRMSA) is presented.

II. PROPOSED ANTENNA DESIGN

In the proposed design, the antenna has been designed for 6 GHz and is fed using microstrip line feed. The length and width of the rectangular patch are L and W respectively. The feed arrangement consists of quarter wave transformer of length L_t and width W_t which is connected as a matching network between the patch and the microstripline feed of length L_{f50} and width W_{f50}. At the very first the antenna is designed in a suspended mode. In the suspended rectangular microstrip antenna configuration, two layers of FR4 substrates ($\varepsilon r = 4.4$, $h = 1.6$ mm and $\tan \delta = 0.0245$) separated by air gap (Δ) is shown in Fig. 1.

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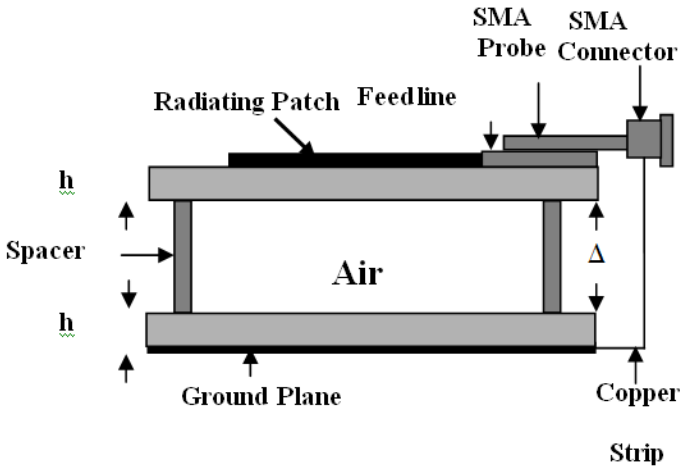

Fig.1.Schematic diagram of ETSRMSA (side view).

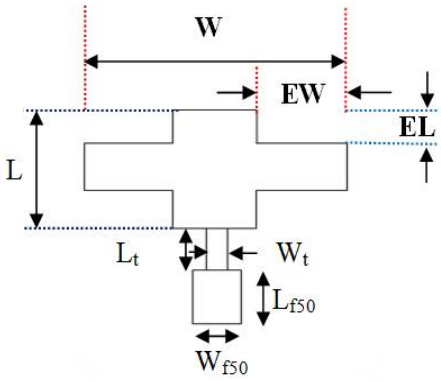

Fig.2.Top view geometry of ETSRMSA

Table.1 shows the dimensions of the proposed antenna.

Table 1: Dimensions of the Antenna

Parameter	Value in mm
Length of the Patch(L)	10.38
Width of the Patch(W)	15.21
L_t	6.35
W_t	0.46
L_{f50}	6.29
W_{f50}	3.06
Air gap (Δ)	0

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While truncating edge of the patch, antenna designed with air gap (Δ)=0 mm [6] is considered. Fig.2. shows the top view geometry of ETSRMSA. On the top of four sides of the patch edge is truncated [7]. The truncated edge length (EL) and edge width (EW) of the antenna are taken in terms of λ/20.66 mm and λ/9.59 mm respectively.

III. RESULTS AND DISCUSSION

The antenna bandwidth over return loss less than -10 dB is measured experimentally on Vector Network Analyser (Rohde & Schwarz, Germany make ZVK model 1127.8651.60). The variation of return loss verses frequency of ETSRMSA is as shown in Fig. 3. From this graph the experimental bandwidth (BW) is calculated using the equations

$$BW= [(f_2 - f_1)/f_c]\times 100\% \quad \text{----------eq.(1)}$$

were, f_1 and f_2 are the lower and upper cut of frequencies of the band respectively when its return loss reaches – 10 dB and f_c is the center frequency of the operating band. i.e.

$$f_c=[(f_1+f_2)/2] \quad \text{----------eq. (2)}$$

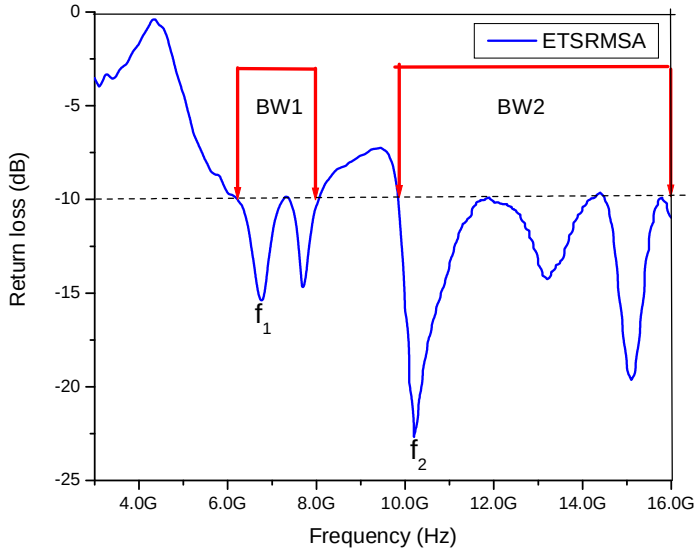

Fig. 3 Variation of Return loss Verses Frequency of ETSRMSA

From this figure, it is clear that, the antenna operates between 3 GHz to 16 GHz and gives two resonant modes at f_1 and f_2, i.e. at 6.12 GHz and 9.82 GHz. Fig.3 shows that the variation of return loss verses frequency of ETSRMSA. It is observed from the graph that the antenna operates for two bands of frequencies i.e., Band1 (BW_1) and Band2 (BW_2).

Table 2: Experimental results of ETSRMSA

Antenna name	Resonant Frequency (GHz)		Return Loss (dB)		Bandwidth (%)		VSWR ≤ 2	Input impedance
	f_1	f_2	Band1	Band2	BW1	BW2	1.15	56.00+j4.53
ETSRMSA	6.9	10.2	-15.45	-22.68	27.84	47.86		

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Table.2 shows the experimental results of ETSRMSA. From Table.2 it is observed that antenna resonates at 6.9 and 10.2 GHz frequencies. Further it is found that the return loss of the Band2 is better compare to Band1.

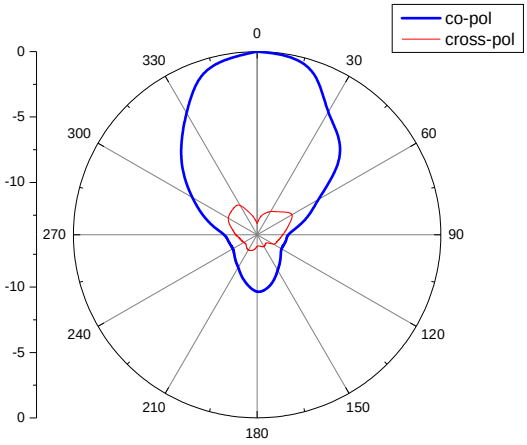

Fig.4 Radiation Pattern of Proposed ETSRMSA

Fig.4 shows the radiation pattern of ETSRMSA. It is seen that antenna shows co-polarization and better minimum cross-polarization. Further it shows maximum radiation in broadside direction.

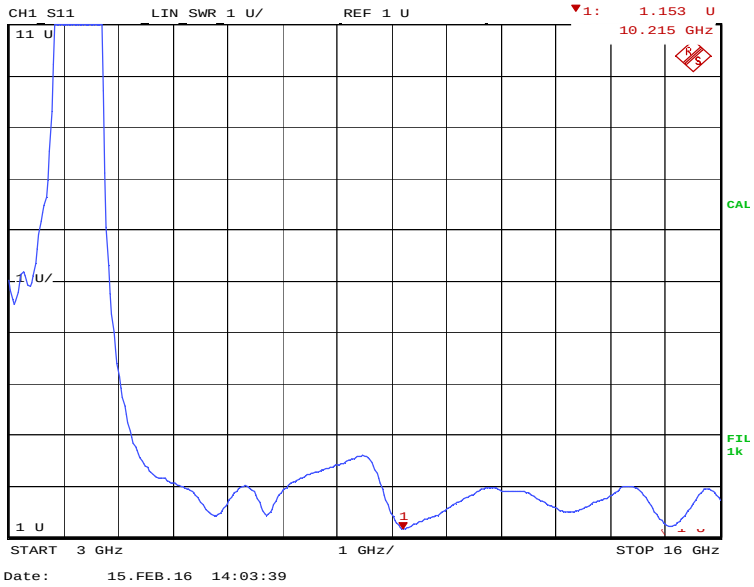

Fig.5 VSWR of ETSRMSA

Fig.5 shows the VSWR of ETSRMSA. From fig.5 it is clear that antenna shows less < 2 VSWR. Fig.6 shows the input impedance of ETSRMSA. It shows circular loops at the centre, which indicates good input impedance and wide band at 10.21GHz.

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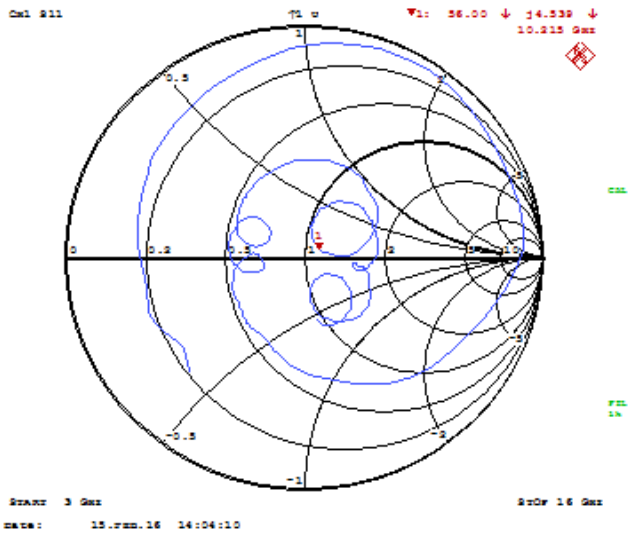

Fig.6 Input impedance plot of ETSRMSA

IV. CONCLUSION

In this paper design and development of Edge Truncated Suspended Rectangular Microstrip Antenna (ETSRMSA) is presented. From the detailed experimental study, it is concluded that, antenna operates for two bands of frequencies in the range of 3 GHz to 16 GHz. With these features the proposed antennas may find application in microwave communication systems operating in the frequency range of 3 to 16 GHz. Antenna gives better bandwidth of 27.84% and 47.86% respectively.

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