Single Arc Truncated Suspended Rectangular Microstrip Antenna

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Abstract— Today antenna designers are paying more focus on microstrip patch antennas, because of its numerous advantages in field of communication, such as high reliability, light weight, ease of fabrication etc. In this paper design of Single Arc Truncated Suspended Rectangular Microstrip Antenna (SATSRMSA) is presented which operates for dual bands. The substrate material of FR-4 with relative permittivity 4.4 and loss tangent of 0.0245 is used in th0is proposed antenna. The return loss and radiation pattern have been measured by using Vector Network Analyzer. The proposed antenna may find application in microwave communication systems operating in the frequency range of 3 to 16 GHz.

Keywords-*Microstrip Antenna, Single Arc Truncated antenna, Suspended Rectangular,FR-4 Substrate.*

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I. INTRODUCTION

Although microstrip antennas in their basic form normally provide linear polarization operation may be obtained by certain modifications to the basic antenna geometry and/or feed. These modifications include adjusting the dimensions of the basic patch with one or more feeds, trimming the corners of a square patch, feeding the patch at adjacent sides, feeding the patch (rectangular) from its corner along the diagonal, and cutting a slot inside the patch [1].

With the wide spread development in wireless communication technology in recent years, the requirement of compact size, low profile and broad bandwidth antenna has augmented drastically. To meet up with this requirement, the Microstrip patch antennas have been proposed. Microstrip patch antennas are attaining pronounced publicity due to its many alluring features such as light in weight, low volume, low cost, low profile, small dimensions and ease of fabrication and conformity etc. [2-4]. Microstrip patch antennas are highly valuable and have better prospects as compared to other conventional antennas. Moreover, the microstrip patch antennas can provide frequency agility, broad band-width and feed line flexibility. Microstrip antennas are used in numerous applications, ranging from biomedical diagnosis to wireless communications. But in spite of many advantages, one major problem of gain and bandwidth is concerned. Significant research work has been reported till now on increasing the gain and bandwidth of microstrip antennas e.g. probe fed stacked antenna, microstrip patch antennas on electrically thick substrate. In this paper a design of Single Arc Truncated Suspended Rectangular Microstrip Antenna (SATSRMSA) is presented.

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II. ANTENNA GEOMETRY AND DESIGN

The SATSRMSA is designed for 6 GHz of frequency using the equations available for the design of conventional rectangular microstrip antenna in the literature [7]. 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.Table - 1 shows the design parameters of the proposed antenna.

TABLE I. DESIGN PARAMETERS OF THE ANTENNA

Parameter	Value in mm
Length of the Patch(L)	9.76
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)	1
Arc length	4.7

The art work of the proposed antenna is sketched by using computer software Auto-CAD 2006 to achieve better accuracy and is fabricated on low cost glass-epoxy substrate material of thickness of h = 1.6 mm and permittivity Ɛr = 4.4. In the suspended rectangular microstrip antenna configuration, two layers of glass epoxy substrates separated by air gap (Δ) is shown in Figure 1. Figure 2 shows the top view geometry of single arc truncated suspended rectangular microstrip antenna (SATSRMSA). While truncating arc on the patch, antenna designed with air gap (Δ)=1 mm is considered. On the top of right side of the patch antenna, arc shape is incorporated. The

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fabricated antenna is tested using Vector Network Analyzer ZVK series 1127.8651.60.

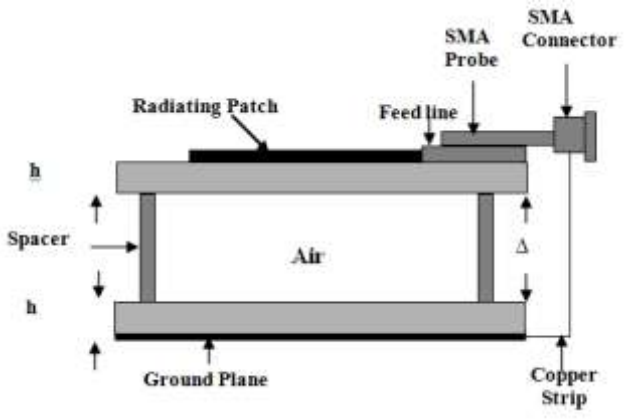

Figure 1. Side view of SATSRMSA

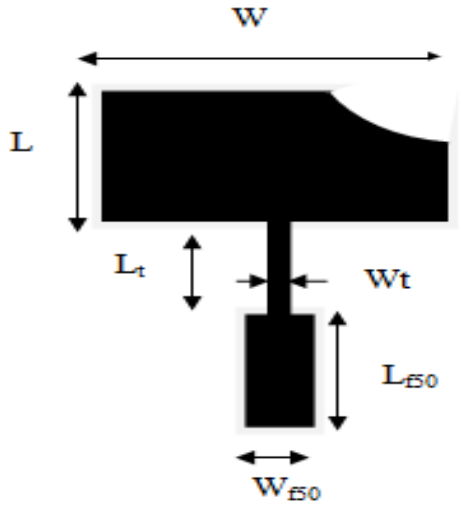

Figure 2. Top view geometry of SATSRMSA

III. Experimental Results and Discussion

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

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

where, 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.,

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

From this figure, it is clear that, the antenna operates between 3 GHz to 16 GHz and gives two resonant modes at f_1 to f_2, i.e. at 5.27, and 11.35 GHz.

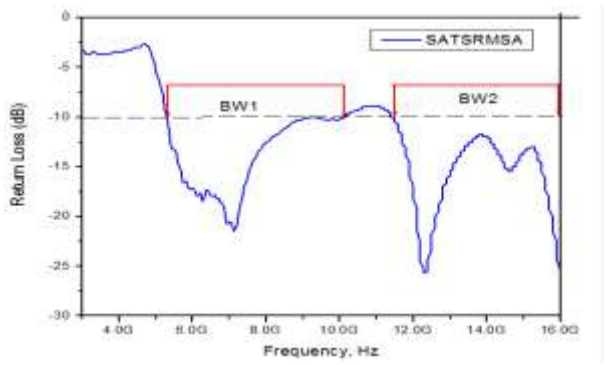

Figure 3. Variation of Return loss Verses Frequency of SATSRMSA

Fig.2 shows the variation of return loss verses frequency of SATSRMSA. It is observed from the graph that the antenna operates for two bands of frequencies i.e, Band1 (BW_1) and Band2 (BW2).

TABLE II. EXPERIMENTAL RESULTS OF SATSRMSA

Antenna Name	Resonant Frequency (GHz)	Return Loss (dB)		Bandwidth (%)	
		Band1	Band2	BW_1	BW_2
SATSRMSA	7.12	-21.43	-26.71	64.12	34.01

Table 2 shows the experimental results of SATSRMSA. From Table 2 it is observed that return loss of the Band2 is better compare to Band1. Further antenna resonates at 7.12 GHz frequency.

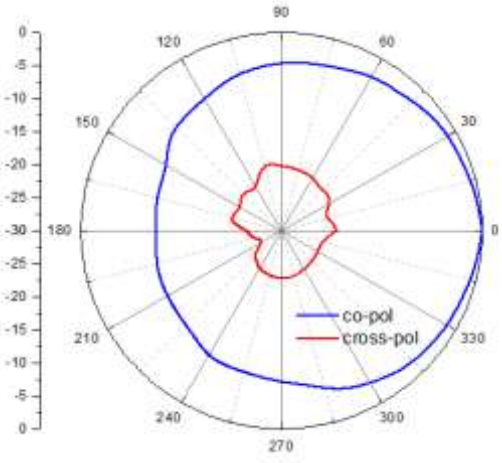

Figure 4. Radiation Pattern of Proposed SATSRMSA

Figure 4 shows the radiation pattern of SATSRMSA. It is seen that antenna shows omnidirectional radiation pattern.

IV. CONCLUSION

In this paper design of Single Arc Truncated Suspended Rectangular Microstrip Antenna (SATSRMSA) 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 64.12 and 34.01% respectively.

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REFERENCES

[1] Balanis, C. A., Antenna Theory, John Wiley & Sons, Inc., NewYork, 2004.

[2] D. R Jahagirdar and R D. Stewart, "Non-Leaky Conductor Backed Coplanar Wave Guide-Fed Rectangular Microstrip Patch Antenna," IEEE Microwave and Guided-Wave Letters. Vol 3, pp. 115-117, Mar. 1998.

[3] N. Herscovici, "New considerations in the design of microstrip antennas", IEEE Transactions on Antennas and Propagation, vol. 6, pp. 807- 812, Jun. 1998

[4] S. S. Pattnaik, GianlucaLazzi, and Om P. Gandhi, " On the Use of Wide-Band High-Gain Microstrip Antenna for Mobile Telephones", IEEE Antennas and Propagation Magazine, vol 40, pp. 88-90, Feb. 1998.

[5] D. Sanchez-Hernandez and I. D. Robertson, "A Survey of Broadband Microstrip Patch Antennas," Microwave Journal, pp. 60-84, sept 1996.

[6] Md. Nazrul Islam, FarhanaYasmine, Sharif M. Ismail, and Md. TanvirHasan, "Wideband Rectangular Patch Antenna for Wireless Applications", National Conference on Communication and Information Security (NCCIS 2009), Daffodil International University, Dhaka, Bangladesh, 14 February 2009, pp. 30-32.

[7] Kawei Qian and Xiaohong Tang, "Compact LTCC dual-band circularly polarized perturbed hexagonal microstrip antenna," *IEEE Antennas* and Wireless Propagation Letters, Vol. 10 pp. 1212-1215, 2011.

[8] K. Kumar and N. Gunasekaran, "A novel wideband slotted mm wave microstrip patch antenna," *Proc. IEEE Vol. 987-1, pp. 10-14, 2011.*

[9] S. I. Latif, Lotfollah Shafai and Satish Kumar Sharma, Member, IEEE, " Bandwidth Enhancement and Size Reduction of Microstrip Slot Antennas" , ieee transactions on antennas and propagation,vol. 53, no. 3, march 2005.

[10] Vidya Deshmukh & Abhilasha Mishra, "Analysis & Designing Of E-Shape Microstrip Antenna With Slot For Ism Band", *International* Journal of Research in Engineering & Technology (impact: ijret),issn(e): 2321-8843; issn(p): 2347-4599, vol. 2, issue 7, jul 2014, 41-48.

[11] Suryakanth Nirate, S.L.Mallikarjun, R.M.Vani, P.V.Hunagund, "Wideband Microstrip-Line-Fed Suspended Rectangular Microstrip Antenna",IJAREEIE,vol. 4, issue 9, september 2015,pp.7801-7805.

[12] I. J. Bahl and P. Bharatia, "Microstrip Antennas", Dedham,MA: Artech House, New Delhi, 1981.

[13] K.M.Luk, C.L. Mak, et al., "Broadband microstrip antenna," *Electronics letters*, Vol.34, 1998, pp.1442-1443.

[14] P.H.Rao, V.Fusco and R. Cahill, "Wideband Linear and circularly polarized patch antenna using printed stepped T-feed." *IEEE Trans.* Antennas and Propagation Vol.Ap-50, 2002. pp.356-361,

[15] H.F.Pues and A.R.Van de Capelle, "An impedance matching technique for increasing the bandwidth of microstrip antennas," *IEEE* Trans.Antennas and Propagation, Vol.Ap-37, pp.1345-1354, 1989.

BIOGRAPHY

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