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Arc Truncated Suspended Rectangular Microstrip Antenna

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ABSTRACT: In this paper design of Arc Truncated Suspended Rectangular Microstrip Antenna (ATSRMSA) is presented which operates for dual bands. The operating frequency range is from 3 GHz to 16 GHz. A low-cost glass epoxy substrate and is fed by a standard 50 Ω microstipline feed. The glass epoxy substrate with dielectric constant 4.4 is used for proposed design at resonant frequency of 8.91GHz. Radiation characteristics and return loss of the DBATSRMSA is measured by using Vector Network Analyser. The proposed antenna may find application in microwave communication systems operating in the frequency range of 3 to 16 GHz.

KEYWORDS: Microstrip Antenna, Arc Truncated antenna, Suspended, Rectangular, Glass epoxy Substrate.

I.INTRODUCTION

Microstrip patch antennas have a radiating patch, dielectric substrate and ground. Selecting substrate is a key step in designing because a property of an antenna varies with a different substrate materials. As we know that the demand of microstrip antenna is increasing day by day because of their large number of advantages such as low cost, low volume, easy integration and light weight etc. These advantages make microstrip antenna applicable for various applications such as mobile, radar, satellite communication field, etc [1-3].

Microstrip antennas are also relatively inexpensive to manufacture and design because of the simple 2-dimensional physical geometry. The other drawbacks of basic microstrip structures include low power handling capability, loss, half plane radiation and limitation on the maximum gain. Different techniques are used to overcome this narrow bandwidth limitation. These techniques include increasing the thickness of the dielectric substrate, decreasing dielectric constant and using parasitic patches [4]. However, research is still continuing today to overcome some of these disadvantages [5]. In this paper a design of Arc Truncated Suspended Rectangular Microstrip Antenna (ATSRMSA) is presented.

II.ANTENNA STRUCTURE

The ATSRMSA 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.

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 cm and permittivity $\varepsilon r = 4.4$. In the suspended rectangular microstrip antenna configuration, two layers of glass epoxy substrates separated by air gap (Δ) is shown in Fig. 1(a).

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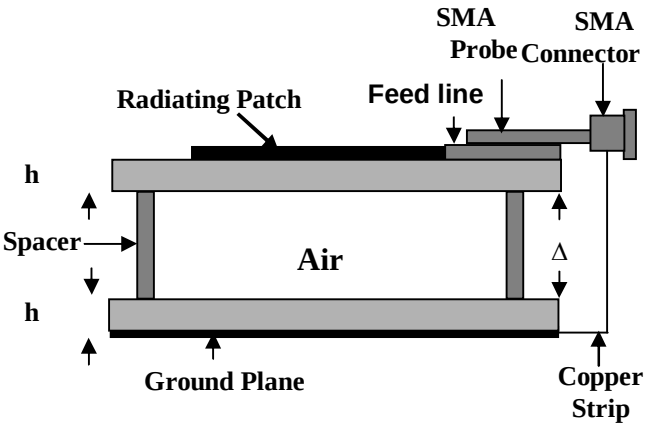
Table 1:Design Parameters of the Antenna

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
Arc length	10

Figure 1(b) shows the top view geometry of arc truncated suspended rectangular microstrip antenna (ATSRMSA). While truncating arc on the patch , antenna designed with air gap (Δ)=0 mm [6] is considered. On the top of right side of the patch antenna, arc shape is incorporated. The fabricated antenna is tested using Vector Network Analyser ZVK series 1127.8651.60.

(a) Side view



(b) Top view

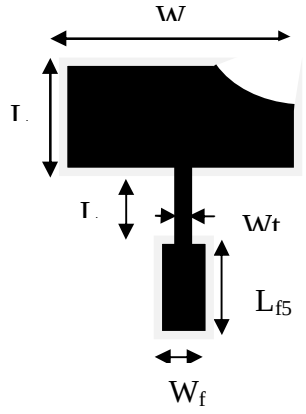


Fig.1 Schematic diagram of ATSRMSA

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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 ATSRMSA is as shown in Fig. 2. From this graph the experimental bandwidth (BW) is calculated using the equations

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

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 fc 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 5.76, and 8.86 GHz.

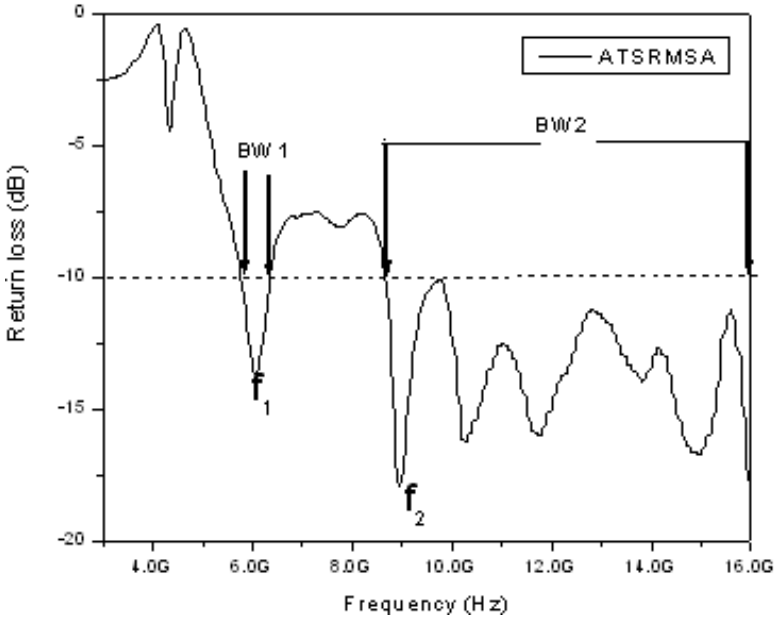

Fig. 2 Variation of Return loss Verses Frequency of ATSRMSA

Fig.2 shows the variation of return loss verses frequency of ATSRMSA. 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 ATSRMSA

Antenna name	Resonant Frequency (GHz)	Return Loss (dB)		Bandwidth (%)	
		$Band_1$	$Band_2$	BW_1	BW_2
ATSRMSA	8.91	-13.68	-17.96	9.7	59.65

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Table 2 show the experimental results of ATSRMSA and it is observed that return loss of the $Band_2$ is better compare to $Band_1$. Further antenna resonates at 8.91 GHz frequency.

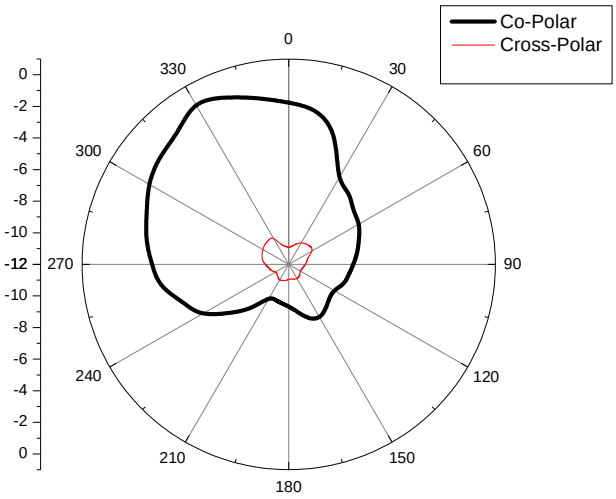

Fig.3 Radiation Pattern of Proposed DBATSRMSA

Fig.3 shows the radiation pattern of ATSRMSA. It is seen that antenna shows co-polarization and better minimum cross-polarization.

IV.CONCLUSION

In this paper design of Arc Truncated Suspended Rectangular Microstrip Antenna (ATSRMSA) 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 9.7 and 59.65% respectively.

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