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Suspended Rectangular Microstrip Antenna with Rectangular Slit

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ABSTRACT: A major disadvantage of the micro strip-patch antenna is its inherently narrow impedance bandwidth of only a couple of per cent. Intensive research is going on to develop bandwidth-enhancement techniques by keeping its size as small as possible. In this paper a suspended rectangular microstrip antenna with rectangular slit (SRMSARS) is presented. Obtained bandwidth is 15.71% & 50.50% respectively with respect to center frequency. 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 and radiation pattern have been measured by using Vector Network Analyser.

KEYWORDS: Rectangular slit, Suspended, Microstripline Feed, Rectangular Patch antenna.

I. INTRODUCTION

Deschamps first proposed the concept of the MSA in 1953 [1]. However, practical antennas were developed by Munson [2, 3] and Howell [4] in the 1970s. The numerous advantages of MSA, such as its low weight, small volume, and ease of fabrication using printed-circuit technology, led to the design of several configurations for various applications [5–9]. With increasing requirements for personal and mobile communications, the demand for smaller and low-profile antennas has brought the MSA to the forefront. An MSA in its simplest form consists of a radiating patch on one side of a dielectric substrate and a ground plane on the other side. Microstrip patch antennas, particularly with rectangular patch, is widely used in mobile radio, and a variety of other wireless communications devices for which small size, light weight, and low profile are the main considerations. As is well known, a major attribute that has limited their application capability is their inherent narrow impedance bandwidth (typically 2% to 3%). In certain applications, such as high data-rate wireless transmission, this low bandwidth is not adequate. In order to meet the demand for larger bandwidth, several techniques have been reported [10].The simplest and most widely used structure in this category is the suspended microstrip which, in view of the air gap next to the ground plane, offers improved efficiency.

When an antenna must operate at two frequencies that are far apart, a dual-frequency antenna can be used to avoid the use of two separate antennas. When two or more resonance frequencies of a MSA are close to each other, a broad BW is obtained. When these are separated, dual-band operation is obtained [11]. In this paper a Suspended Rectangular Microstrip Antenna with rectangular slit (SRMSARS) 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 (εr = 4.4, h = 1.6 mm and tan δ=0.0245) separated by air gap (Δ) is shown in Fig. 1.

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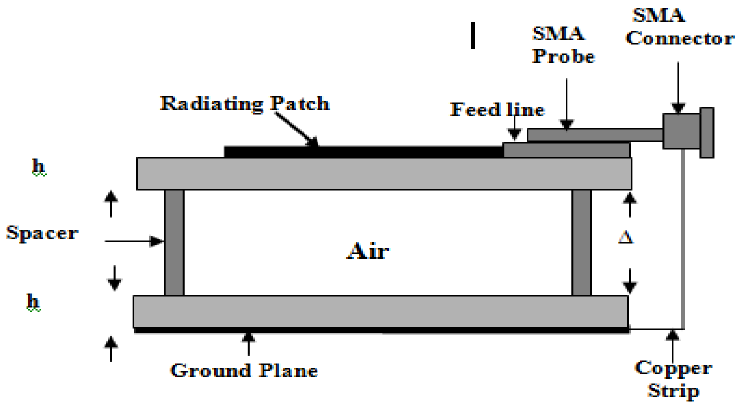

Fig.1 Side View of SRMSA

Fig.2. shows the top view geometry of SRMSARS. On the top of right side of the patch, rectangular slit is inserted. The dimensions of the slits are a = λ/20.66 mm, b = λ/9.59 mm respectively and c = 0.5 mm respectively.

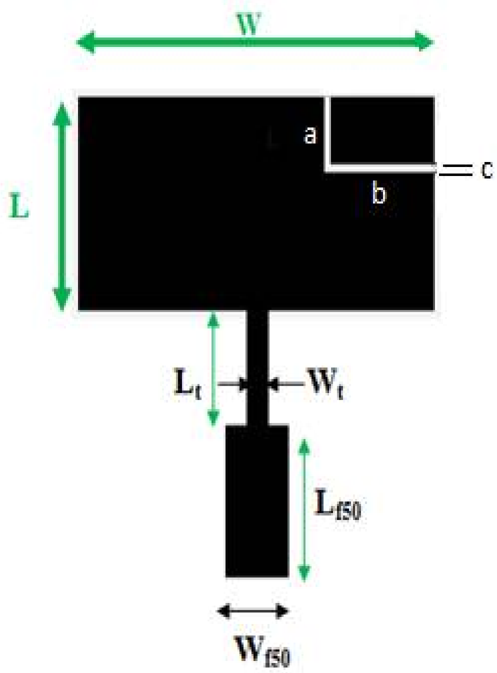

Fig. 2. Geometry of SRMSARS

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Table.1 shows the design parameters of the proposed antenna.

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

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 SRMSARS is as shown in Fig. 3.

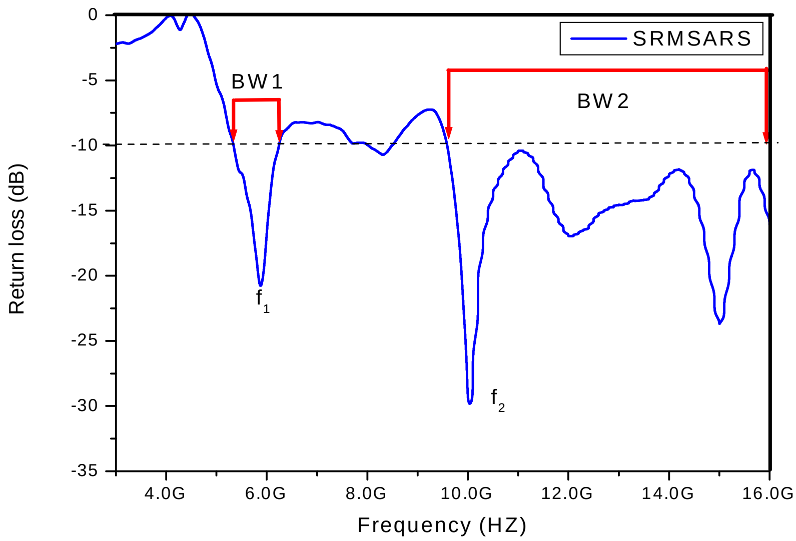

Fig. 3 Variation of Return loss Verses Frequency of SRMSARS

It is observed from the graph that the antenna operates for two bands of frequencies i.e, Band 1 (BW_1) and Band 2 (BW_2). The first resonant mode f_1 is at 5.34 GHz and the second resonant mode f_2 is at 9.56 GHz

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Table 2: Experimental results of SRMSARS

Antenna name	Resonant Frequency (GHz)	Return Loss (dB)		Bandwidth (%)	
		Band1	Band2	BW_1	BW_2
SRMSARS	10.05	-20.85	-30.09	15.71	50.50

Table.2 shows the experimental results of SRMSARS.T he proposed antenna resonates at 10.05 GHz. From the table it is observed that bandwidth of the BW_2 is more compare to BW_1.

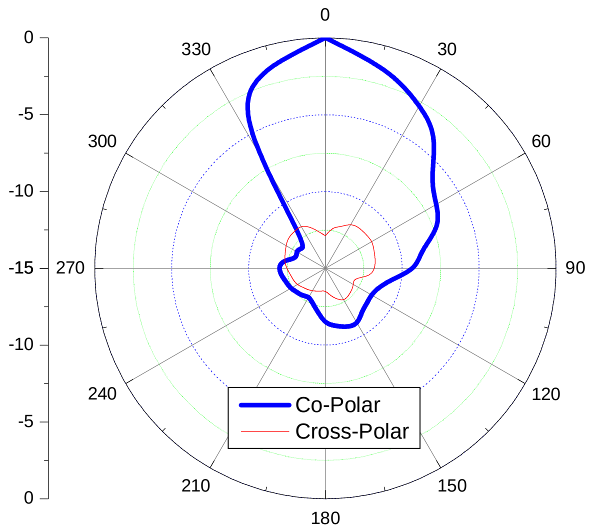

Fig.4 Radiation Pattern of Proposed SRMSARS

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

IV. Conclusion

In this paper a Suspended Rectangular Microstrip Antenna with Rectangular Slit (SRMSARS) 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 15.71 % and 50.50 % respectively.

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BIOGRAPHY

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