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Suspended Rectangular Slit Loaded Microstrip Antenna

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ABSTRACT: This paper presents designing of line fed and Slit Loaded Microstrip Antenna (MSA). The antenna is designed to overcome the disadvantage of MSA i.e. narrow bandwidth. Microstrip line fed antenna provides wide bandwidth. It's working frequency range 8.42-13.33GHz and 14.31-16GHz with return loss of less than -10 dB. Hence bandwidth enhancement can be obtained by Suspended Rectangular Slit Loaded Microstrip Antenna. Obtained bandwidth is 45.17 % & 11.15% 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 Analyzer.

KEYWORDS: Suspended Microstrip Antenna, Microstripline Feed, Slits, Rectangular Patch Antenna.

I. INTRODUCTION

Antenna is a transducer designed to transmit as well as receive electromagnetic waves. Also the antenna is transitional structure between free space and a guiding device. 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. With enormous growth in wireless communications technology from past few years, design of compact, low profile, and wideband antennas for wireless communications is a major challenge for antenna design researchers [1]. Microstrip patch antennas are commonly used in wireless communications like Bluetooth, Wi-Fi, WLAN, WiMax applications owing to their attractive features such as small size and hence conformal nature, easy to feed and design, low fabrication cost, robust nature, light in weight, and easily integrate with monolithic microwave integrated circuits (MMIC) [2]. However, standard microstrip patch antennas cannot satisfy the bandwidth requirements for most wireless communication systems because of their narrow bandwidth. This inherent drawback poses design challenge for the microstrip antenna designer to meet the requirements of wireless communications [3, 4]. Over the years various well-known designs have been investigated to improve the bandwidth of the microstrip antennas including the use of thicker substrates [5], use of different shapes of patch [6, 7, 8], use of low dielectric substrate, use of various impedance matching and feeding techniques like microstrip line or coaxial feeding [9], use of stacked microstrip patches [10] and parasitically coupled or gap-coupled patches [11], and the use of shorting pins [12].

Suspended microstrip antennas provide wide bandwidth due to the reduced effective dielectric constant and surface waves. The air gap is introduced in between substrate and ground. In this paper a Suspended Rectangular Slit Loaded Microstrip Antenna is presented.

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II. ANTENNA GEOMETRY AND 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.

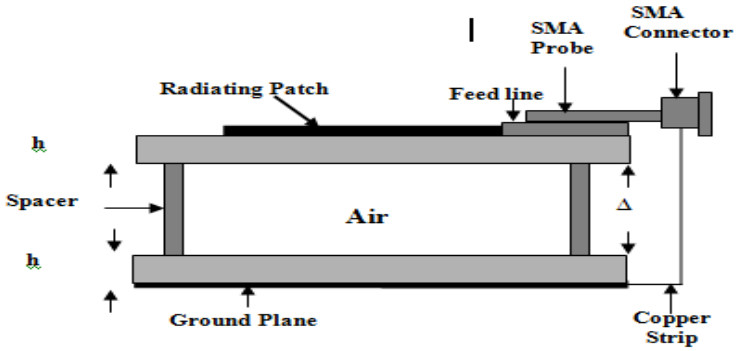

Fig.1 Side View of SRMSA

Fig.2. shows the top view geometry of Suspended Rectangular Slit Loaded MSA. On right and left si de of the radiating edges of the patch, rectangular slit is inserted. The dimensions of the slit is a1=a2=λ/7.57 mm, b1=b2=1 mm , c=4.19 mm and d=5.19 mm respectively.

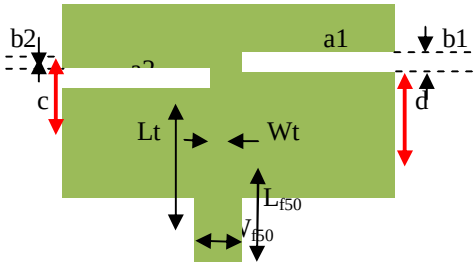

Fig.2 Geometry of Suspended Rectangular Slit Loaded MSA

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

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III.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 Suspended Rectangular Slit Loaded MSA is as shown in Fig. 3.

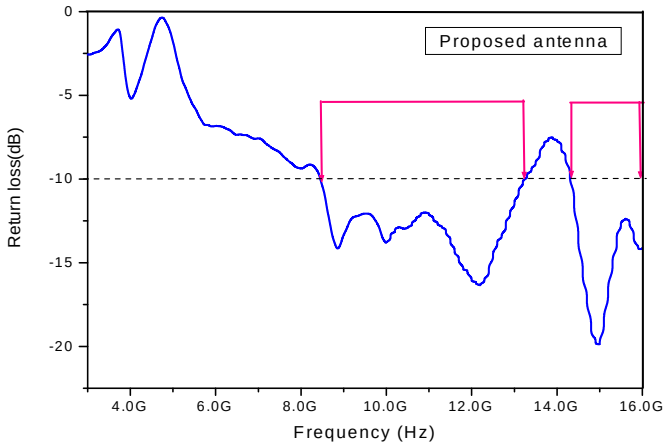

Fig. 3 Variation of Return loss Verses Frequency of Suspended Rectangular Slit Loaded MSA.

It is observed from the graph that the antenna operates for two bands of frequencies i.e., Band1 (BW_1) and Band2 (BW_2). The first resonant mode f_1 is at 8.42 GHz and the second resonant mode f_2 is at 14.96 GHz

Table 2: Experimental results of SRMSARS

Antenna name	Resonant Frequency (GHz)	Return Loss (dB)		Bandwidth (%)	
		$Band_1$	$Band_2$	BW_1	BW_2
Proposed Antenna	14.96	-16.34	-19.87	45.17	11.15

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Table.2 shows the experimental results of proposed antenna. The proposed antenna resonates at 14.96 GHz. From the Table.2 it is observed that bandwidth of the BW_1 is more compare to BW_2.

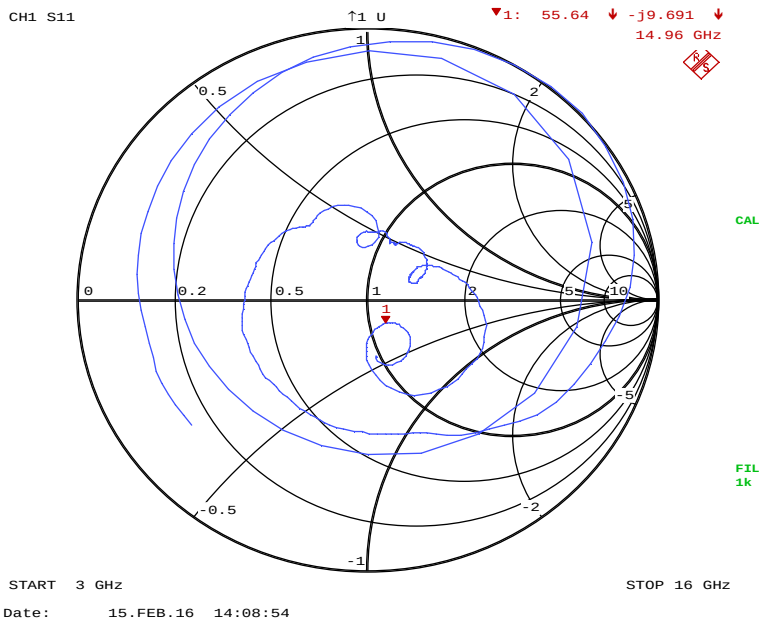

Fig.4 Input impedance plot of proposed Antenna

Fig.4 shows the Input impedance plot of proposed antenna. It shows good input impedance. Fig .5 shows radiation pattern for the proposed antenna.

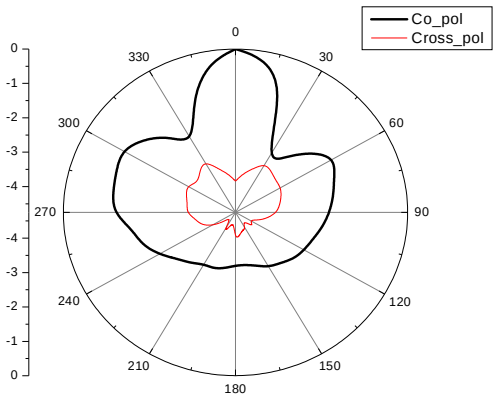

Fig .5 Radiation pattern of proposed antenna

From the above figure it is clear that antenna shows good co-polarization with minimum cross-polarization.

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IV. CONCLUSION

In this paper a Suspended Rectangular Slit Loaded Microstrip Antenna is presented. From the detailed experimental study, it is concluded that, antenna operates for two bands of frequencies in the range of 8 GHz to 16 GHz. With these features the proposed antennas may find application in microwave communication systems operating in the frequency range of 8 to 16 GHz. Antenna gives better bandwidth of 45.17 % and 11.15 % respectively. Also the antenna shows good input impedance of 55.64-j9.61.

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BIOGRAPHY

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