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A Novel Rectangular Slot Loaded Microstrip Patch Antenna

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Abstract: In this communication the inclined slot loaded rectangular microstrip patch antenna fed by microstripline is presented for modern communication system. The antenna is housed in a volume of 5X3X0.16cm^3. The low loss tangent and commercially available modified glass epoxy substrate material is used for the fabrication of the antenna. The design concept is presented. The proposed antenna gives a maximum bandwidth of 20.78% and overall bandwidth of 44.49% with operating range of 8.28 GHz to 12 GHz. The antenna shows broadside and linear radiation characteristics with a peak gain of 7.08 dB. The experimental and simulated results are compared. This antenna may find its applications in X-band range communication systems.
Keywords: Inclined slot, Rectangular, bandwidth, gain, radiation pattern

I. INTRODUCTION

In today's era the microstrip antenna has attained a good place in communication system because of its inherent properties like light weight, loss cost, ease of installation, planar in configuration, etc. In recent communication systems the microstrip patch antenna has become the important tool for effective communication. The use of dual, triple and multiband antennas are finding the wide applications for transmit/receive purposes(1-5). The antenna with radiating slots on the patch is designed to achieve dual and triple bands with better radiation characteristics. This kind of antenna is rarely found in the literature.

II. DESIGN CONSIDERATIONS

The AUTOCAD software is used to do the artwork of horizontal rectangular shaped slot loaded microstrip slot antenna (HSRMSA). The low cost modified glass epoxy substrate material of relative permittivity $\varepsilon_r = 4.2$ and loss tangent of 0.01 is used for the fabrication of the antenna. The antenna operates in X-band frequency range. The antenna uses a substrate of length L = 5 cm and width W= 3 cm. The horizontal slots of length L_s= 1.6 cm and width W_s= 0.2 cm are used on the top of the antenna. The microstripline feed of length L_f = 4.69 cm and width W_f = 0.9535 cm is used on the bottom side for exciting the antenna. The distance d and d` is maintained constant at 0.575 cm and 0.89 cm respectively to obtain better return loss. The separation between the slots is taken as D which act as the varying factor for the performance evaluation of the antenna. Figure -1 shows the structure of the HSRMSA

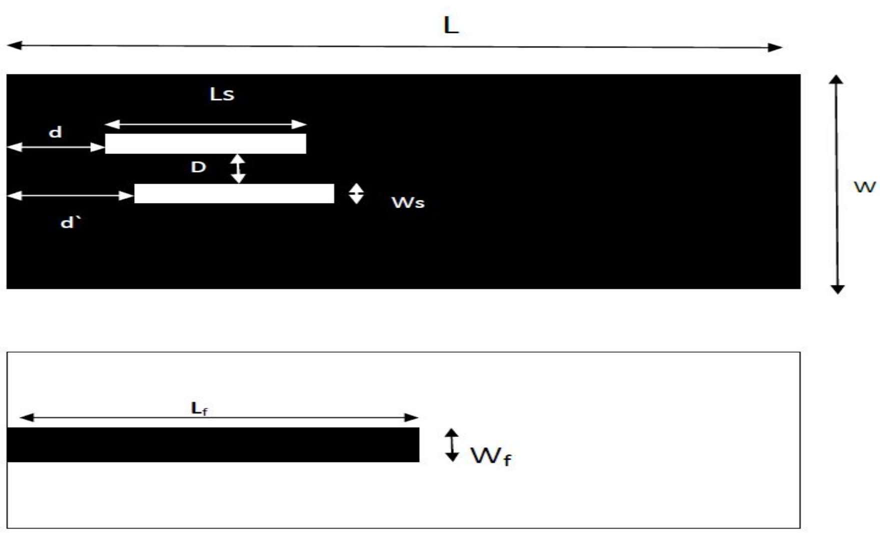

Figure-1 Structure of HSRMSA

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III. RESULT AND DISCUSSION

The variation of reflection coefficient versus frequency of HSRMSA is as shown in Fig. 2 The measurement is taken on VNA (Rohde and Schwarz, Germany make ZVK model 1127.865, 10 MHz - 40 GHz) and further simulated it on HFSS for validation.

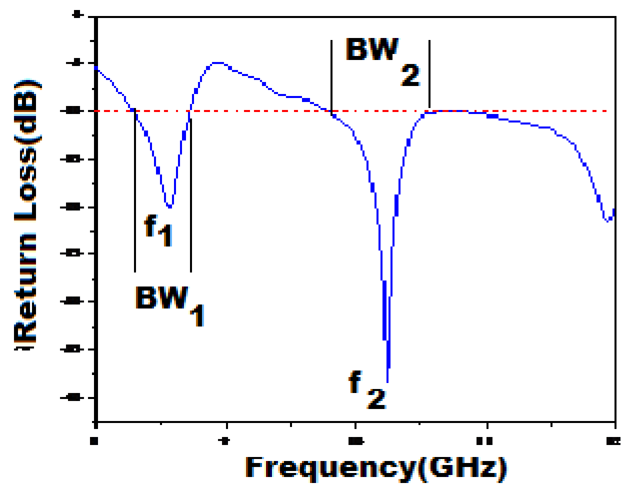

Figure-2 Variation of return loss versus Frequency of HSRMSA (D=0.8cm)

From figure-2 it is clear that the antenna shows two resonant modes f_1 and f_2 with respective bandwidths BW_1 = 5.91% (8.73 GHz - 8.28 GHz) BW_2=20.78%(12 GHz - 9.78 GHz). The minimum reflection coefficient at both the resonance is found to be -20.051 and -39.318 dB respectively.

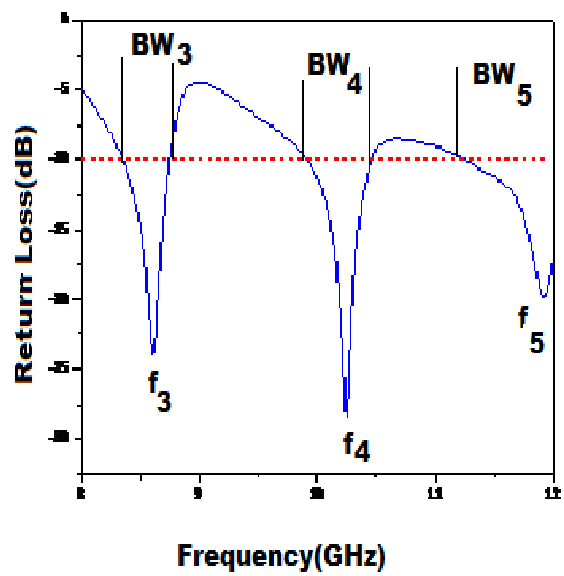

Figure-3 Variation of Return loss versus Frequency of HSRMSA(D=1 cm)

Figure-3 Shows the variation of return loss with frequency of HSRMSA for D=1cm. It is clear from this figure that, the antenna shows three resonant modes f_3 , f_4 and f_5 with respective bandwidths BW_3 = 4.8 % (8.61 GHz - 8.34 GHz), BW_4 =5.8 %(10.47 GHz - 9.89 GHz) and BW_5= 7.2% (12 GHz-11.24GHz). The minimum reflection coefficient at each resonance is found to be -24.001, -28.430 and -19.804 dB respectively.

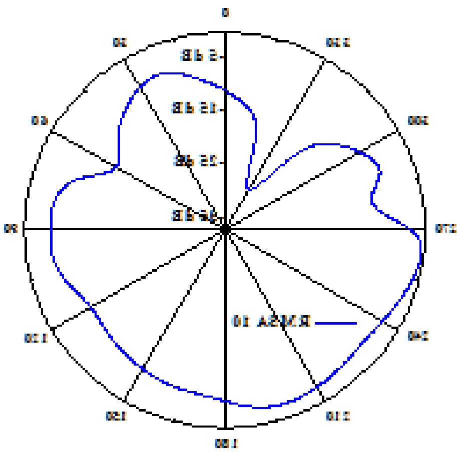

Figure-4 Radiation pattern of HSRMSA(D=0.8cm)

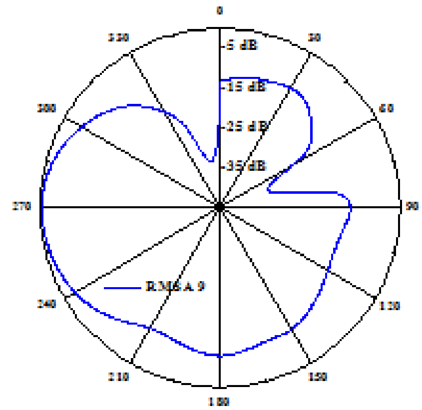

Figure-5 Radiation pattern of HSRMSA(D=1.0 cm)

Table-1 Measured reflection coefficient, impedance bandwidth, VSWR, input impedance and calculated gain of all the proposed antennas

Antenna	Resonating Frequency (GHz)	Reflection Coefficient (dB)	VSWR	Bandwidth		Gain (dB)	Input Impedance (Ohms)
				MHz	%		
HSRMSA (D=0.8 cm)	8.56	-20.051	1.035	460	5.41	8.26	49.41+j9.680
	10.24	-39.318		2260	20.79		
HSRMSA (D=1 cm)	8.61	-24.001	1.090	410	4.798	7.08	50.35+j6.591
	10.25	-28.43		590	5.798		
	11.92	-19.804		830	7.164		

Figures 4 and 5 show the radiation patterns of the proposed antenna in their operating frequencies it can be seen that, the patterns are broadside and linearly polarised . Table -1 shows the comparison of HSRMSA when D is changed from 0.8 cm to 1.0 cm it can be seen that, the dual bands of the antenna split into triple bands and the gain of the antenna rises from 8.26 dB to a maximum of 7.08 dB. The voltage standing wave ratio remains almost close to the unity which indicates good match of the antenna.

IV. CONCLUSION

The proposed antennas are light weight and handy in nature. These antennas exhibit broadside and linearly polarised radiation patterns. The antenna operates in X-band of frequencies. The maximum bandwidth of 20.78% and over all bandwidth of 44.49% is obtained which is very useful in SAR and X-band communication systems.

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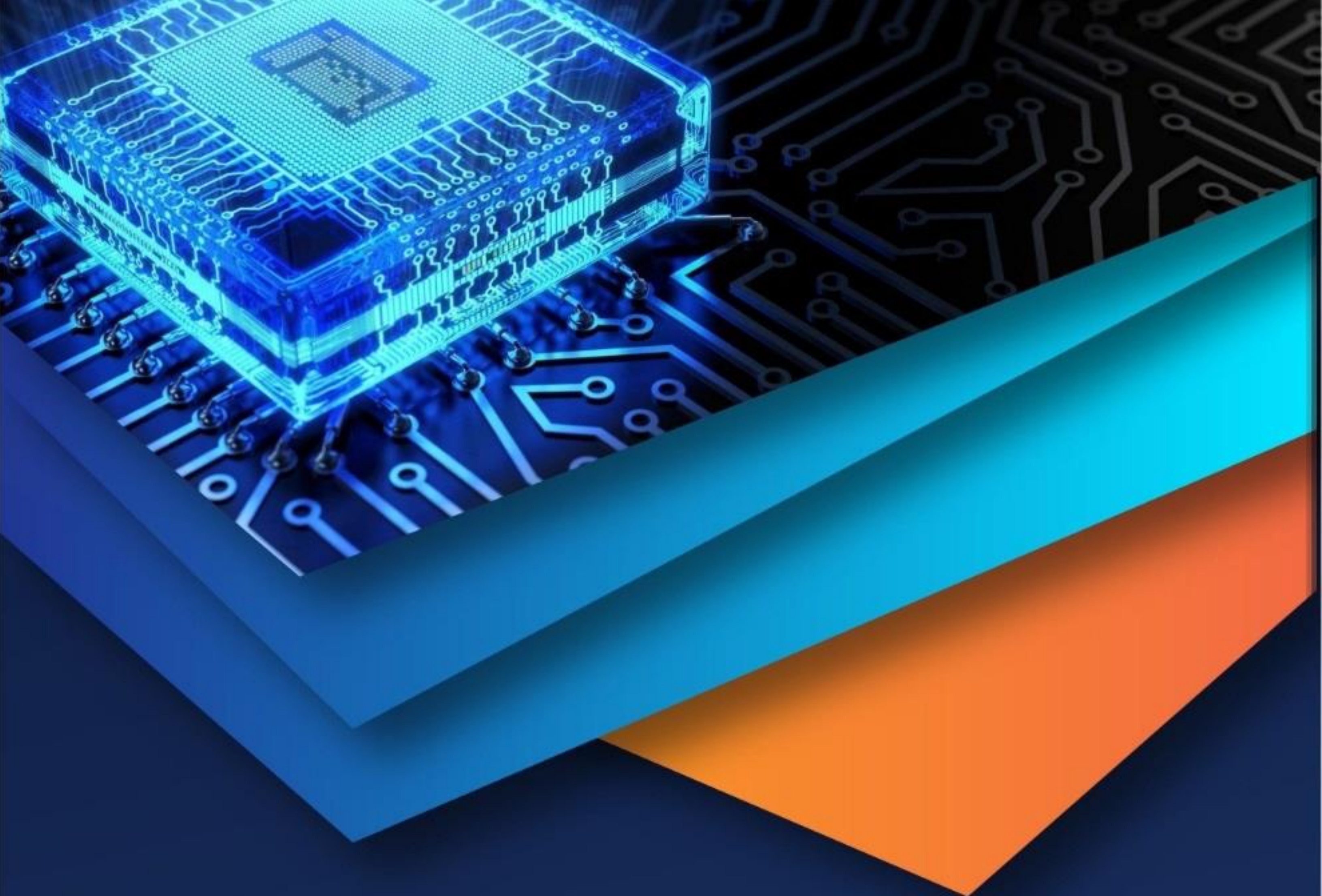

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