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Square Monopole Microstrip Antenna for Quad Band Operation

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Abstract: ***In this paper the square monopole microstrip antenna with slot on the radiating patch is presented for multiband operation. The antenna has a volume of 80× 80 × 16 mm^3. The antenna is fabricated using the modified glass epoxy substrate material. The antenna operates between the frequency range of 2.9 GHz to 10.87 GHz. The radiation characteristic is broadside and the peak gain of about 5.1dB is obtained in its operating frequency. The design details are tabulated and the results are presented and discussed. This antenna may find its applications in WLAN and Wi-max communication applications.***
Keywords: Microstrip antenna, multiband, gain, radiation pattern

I. INTRODUCTION

In the present scenario of modern communication systems the microstrip antennas are finding wide applications with advent of their inherent properties like low cost , light weight, planar configuration, low power handling capacity and ease of installation. The modern communication systems need the antenna to operate at different frequency bands with better radiation characteristics. The microstrip antennas have found them self suitable for this purpose. The dual, triple and multi band antennas fit the applications to work as transmit/receive antenna at wide range of frequencies. In this paper a simple square monopole microstrip antenna having a slot on its patch is presented for multiband operation.

II. ANTENNA DESIGN

In this study the square microstrip antenna is considered as conventional antenna(CSMSA). The antenna is fabricated with substrate mateirial of ε_r=4.2 using the photolithography process. The microstripline of length L_f and width W_f is used to excite the antenna. Figure 1 shows the Geometry of CSMSA. A quarterwave transformer of length L_t and width W_t is used to to match the impedamce between the microstripline and the patch. A 50Ω SMA connector is used to supply the microwave power

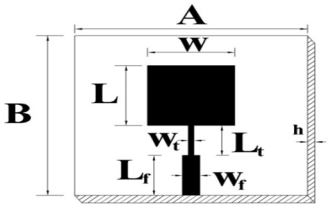

Figure-1 Conventional Square Microstrip antenna

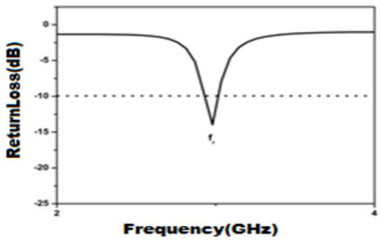

Figure-2 Return Loss versus frequency of the CSMSA

Figure 2 shows the return loss versus frequency of CSMSA, it is designed for 3 GHz frequency and it is resonated at 2.98 GHz of frequency which is very close to the designed value. Table-1 gives the design parameters of the antennas.

Table-1 Design Parameters of CSMSA

Parameter	A	B	L=W	L_f	W_f	L_t	W_t	h
Dimension(cm)	8	8	2.39	1.27	0.32	1.26	0.08	0.16

The slot loaded square microstrip antenna(SSMSA) is a modified form of CSMSA. The direct microstripline feed of length L_f=3.8 cm and width W_f = 0.32 cm is used to excite the patch. The vertical slot of length L_s=1.66 cm and 2 mm width is placed on the radiating patch to achieve multiple bands. Figure 3 and 4 show the SSMSA.

III. RESULTS AND DISCUSSION

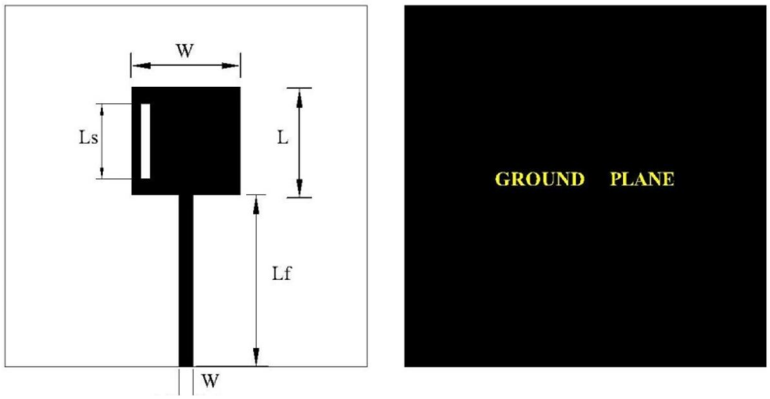

Figure-3 Slot loaded square monopole MSA with slot on left half of the patch(SSMSA)

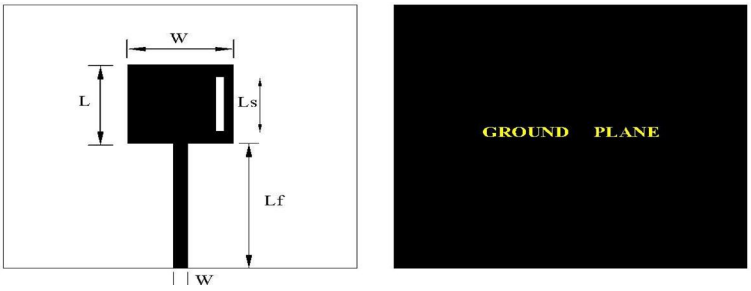

Figure-4 Slot loaded square monopole MSA with slot on right half of the patch(SSMSA)

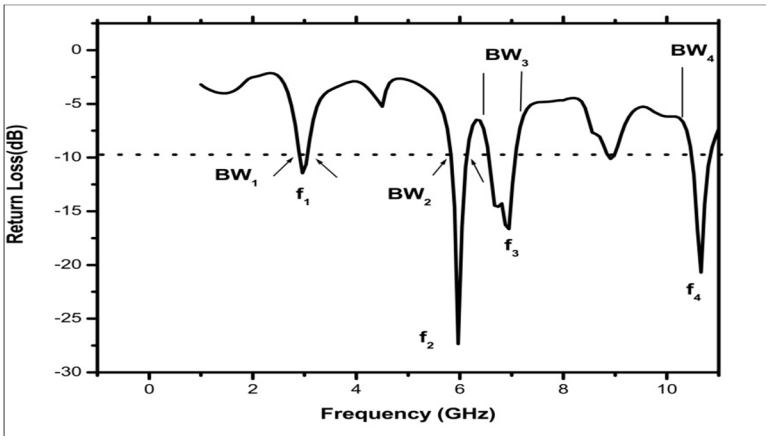

Figure-5 Variation of Return loss against frequency (slot on left half of the patch)

Figure 5 shows the Variation of Return loss against frequency when the slot is on left half of the patch. This antenna resonates for quad bands f_1 to f_4 with their respective bandwidths BW_1 to BW_4. BW_1= 6.6% (3.1GHz-2.9GHz), BW_2 = 6.67%(6.21GHz-5.81GHz) BW_3=8.8%(7.15 GHZ-6.55GHz) and BW_4=2.25%(10.87 GHz-10.46 GHz). It is observed that the fundamental resonance frequency is maintained with additional three bands. The frequency ratio f_2/f_1 of about 2 is obtained which indicates the tuning property of the antenna.

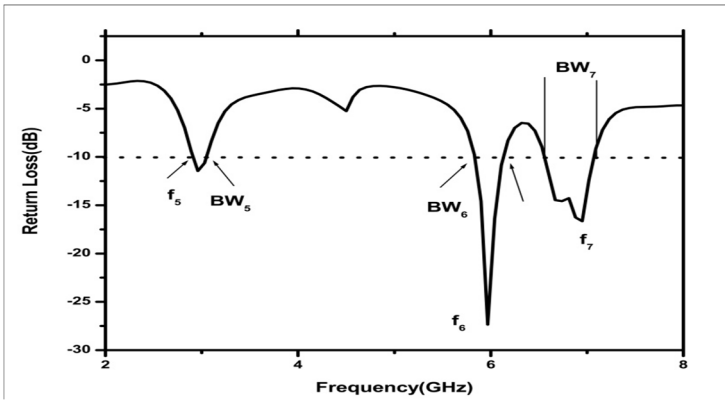

Figure-6 Variation of Return loss against frequency (slot on right half of the patch)

Figure 6 shows the Variation of Return loss against frequency when the slot is on the right half of the patch. This antenna resonates for triple bands f_5 to f_7 with their respective bandwidths BW_5 to BW_7. BW_5=5.1%(3.05GHz-2.9GHz), BW_6=5.2%(6.15-GHz-5.84GHz) and BW_7=8.6% (7.1GHz-6.52GHz). It is seen that the fundamental resonance frequency remains unchanged with additional two bands. The frequency ratio f_2/f_1 of about 2.01 is obtained which indicates the tuning property of the antenna.

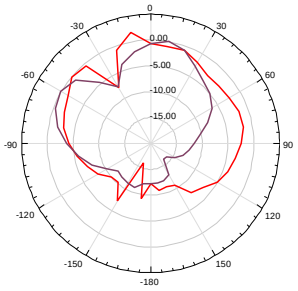

Figure-7 Radiation Pattern of SSMSA (slot on left half of the patch)

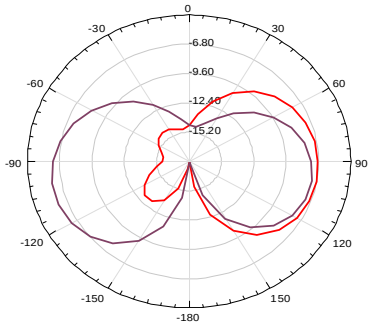

Figure-8 Radiation Pattern of SSMSA (slot on right half of the patch)

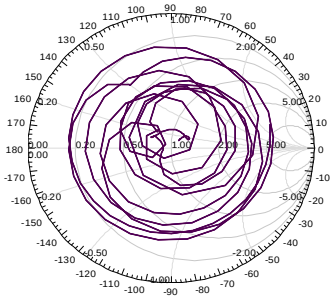

Figure-9 Smith Chart of SSMSA

Figures 7 and 8 show the radiation patterns of the SSMSA in their operating bands. It is clear that the patterns are broadsided and linearly polarized giving maximum gain of 5.1dB. Figure-9 shows the Smith chart of SSMSA. Figure-10 shows the photograph of the antenna.

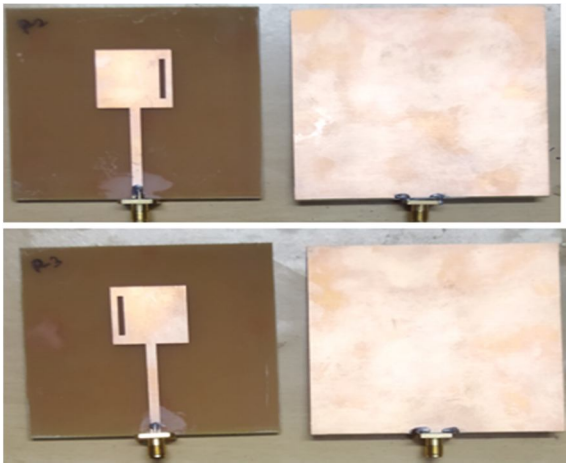

Figure-10 Photograph of the antenna.

IV. CONCLUSION

The antenna exhibits the broadside and linearly polarized radiation characteristics with a peak gain of 5.1dB. The antenna gives a maximum bandwidth of about 8.8 % and quad bands for operations. The cost of the material used is very less and this antenna may find its applications in WLAN and Wi-max communication applications.

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BIODATA

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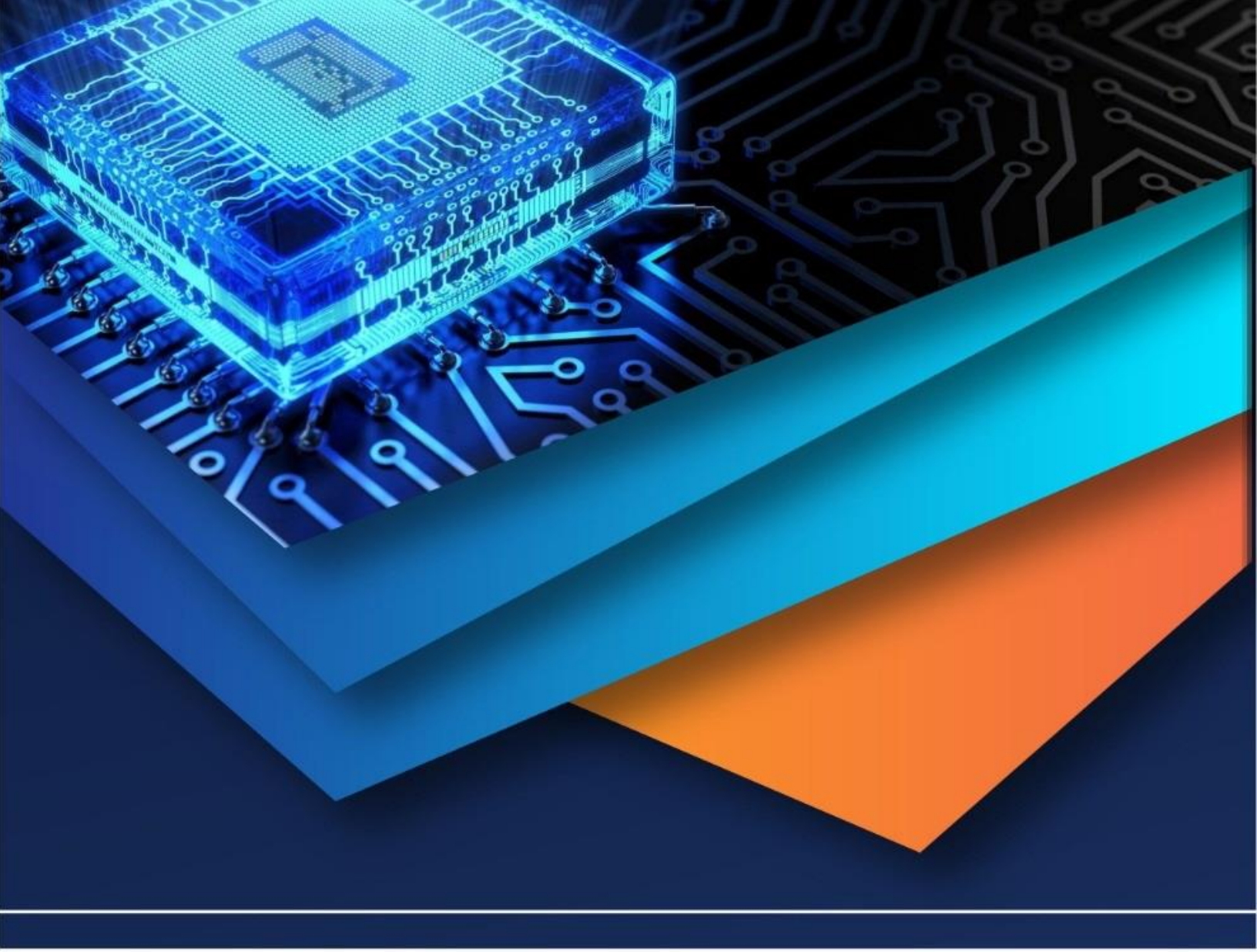

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