International Journal of Electronics Engineering (ISSN: 0973-7383)

Volume 10 • Issue 1 pp. 96-100 Jan 2018-June 2018 www.csjournals.com

Linearly Polarized Proximity Coupled S-Slot Back Fed Rectangular Microstrip Antenna

Nagraj Kulkarni,

Government College(Autonomous),Kalaburgi-585105, Karnataka, India

Abstract: A new design procedure for low-cost linearly polarized proximity coupled microstrip antenna is proposed for triple band operation. The antenna operates between 3.4 to 8.79 GHz giving a maximum impedance bandwidth of15.8 % with a peak gain of 3.58 dB and frequency ratio of 1.44 . The proposed antenna is employs the dual ground technique to improve the parameters. This antenna is fabricated on low cost glass epoxy substrate material. The antenna shows broadside radiation characteristics. The design methodology of the antenna is given and experimental results are presented and discussed. This antenna may find applications in WiMax and C band frequency systems

Keywords: Microstrip antenna, proximity coupling, dual ground, S slot, wide band.

I. Introduction

In the modern communication era Microstrip antennas have the attractive features of low profile, light weight, easy fabrication process, and conformability, but these antennas inherently suffer from the narrow bandwidth. Since the world is stepping towards wireless, current advancements in communication technology and significant growth in the wireless communication systems and consumer demand demonstrate the need for smaller and reliable antennas. The microstrip antennas are becoming popular because of their inherent advantages like low profile, light weight, robustness, integrability with MMICs, ease of installation and low production cost and low power handling capability [1]. The recent communication systems such as, WLAN, WiMax and SAR are use antennas operating at desired frequency bands without much interference between the bands. Hence an antenna operating at descrete frequency bands are more attractive candidates to use the device for the suitable applications. The microstrip antenna designers put forth their efforts to realize these antennas using many methods such as, cutting slots of different geometries on the radiating patch, use of defected ground method and sstubs on the patch [2-4] etc. But, in this study a simple proximity coupled microstrip antenna with S-shaped slot on the radiating patch employing the dual ground technique has been used to obtain triple bands with better gain. This kind of study is found to be rare in the literature.

II. Antenna Design

The modified glass epoxy substrate material of area ($P_{Substrate}$, $Q_{Substrate}$) of (5 , 8) cm, thickness h =0.16 cm and dielectric constant $\varepsilon_r = 4.2$ is used to fabricate the antenna. The proposed antenna is designed for the frequency of 3.5 GHz using the formulae available in the literature for the design of rectangular microstrip antenna [5].

International Journal of Electronics Engineering (ISSN: 0973-7383)

Volume 10 • Issue 1 pp. 96-100 Jan 2018-June 2018 www.csjournals.com

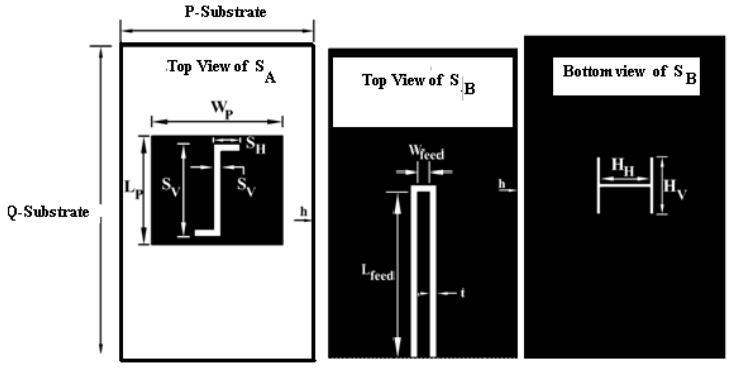

Figure- 1: Geometry of PCDSBFRMSA

Figure 1 shows the geometry of proximity-coupled dual ground back fed S-slot rectangular microstrip antenna (PCDSBFRMSA). In this figure, the radiating patch having a length L and width W is etched on top surface of substrate S_A. The S-shaped slot of width 3 mm is placed at the centre along the non radiating edges of the patch. The H-shaped slot of width 1 mm is etched on the bottom surface of the substrate S_B and placed such that the centers of this slot and the radiating patch coincide with each other. The microstripline feed of length L_{feed} and width W_{feed} is etched on the top surface of substrate S_B such that the tip of the feed line lies exactly at the middle of radiating patch. The additional ground plane is used around the feed line at gap of 3 mm which makes this antenna as a dual ground antenna. The SMA connector of 50Ω impedance is used at the tip of the microstripline feed for excitation. The thickness (h) and relative permittivity (ε_r) of substrates S_A and S_B are same. The S_H and S_V are the horizontal and vertical arm lengths of S-shaped slot. Similarly, the H_V and H_H are the vertical and horizontal arm lengths of H-shaped slot. All these dimensions are in terms of λ_0, where λ_0 is a free space wave length in cm corresponding to the designed frequency of 3.5 GHz. The proposed antenna is sketched using the computer software AUTOCAD-2007 version to achieve better accuracy. The antenna is etched using the photolithography process. Figure 2 and Table-1 show the photograph and design parameters of PCDSBFRMSA respectively.

International Journal of Electronics Engineering (ISSN: 0973-7383)

Volume 10 • Issue 1 pp. 96-100 Jan 2018-June 2018 www.csjournals.com

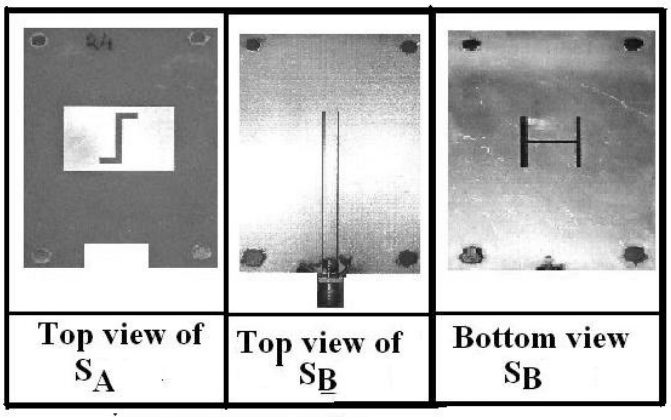

Figure- 2: The photograph of PCDSBFRMSA

Table 1. Design details of PCDSBFRMSA

Antenna Parameters	**Dimensions in (mm)**
W	26.6
L	20.4
L_{feed}	42.9
W_{feed}	3.2
S_H	$\lambda_0/30.6$
S_V	$\lambda_0/4.95$
H_V	$\lambda_0/5.22$
H_H	$\lambda_0/7.14$
$P_{Substrate}$	50
$Q_{Substrate}$	80

III. Results and Discussion

The Vector Network Analyzer (The Agilent N5230A: A.06.04.32) is used to measure the experimental return loss of PCDSBFRMSA.

International Journal of Electronics Engineering (ISSN: 0973-7383)

Volume 10 • Issue 1 pp. 96-100 Jan 2018-June 2018 www.csjournals.com

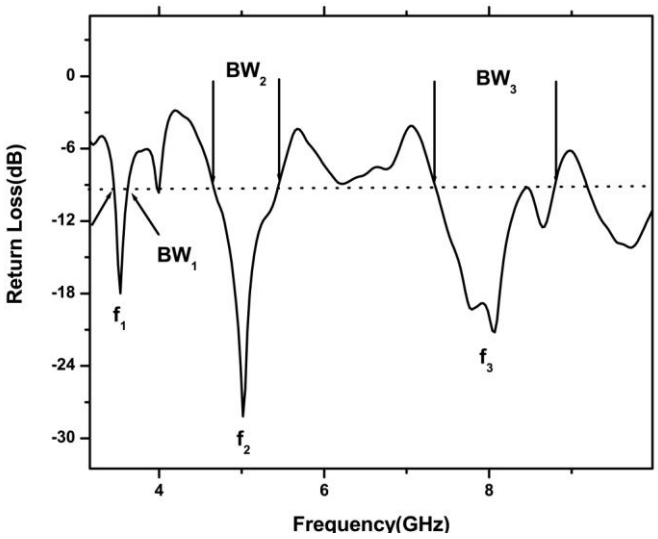

Figure- 3:Variation of return loss versus frequency of PCDSBFRMSA

Figure 3 shows the variation of return loss versus frequency of PCDSBFRMSA. It is clear from this figure that, the antenna operates for triple bands f_1, f_2 and f_3 with their respective bandwidths are BW_1 = 6 % (3.61-3.4 GHz) and BW_2 = 15.8 %.(5.44-4.65 GHz) and BW_3 = 18.12 %.(8.79-7.34 GHz) with minimum return loss of -28 dB at 5.10 GHz. The triple frequency operation is S shaped slot on the patch. The antenna gives a frequency ratio f_2 /f_1 of about 1.44 which indicates the better tunable action.

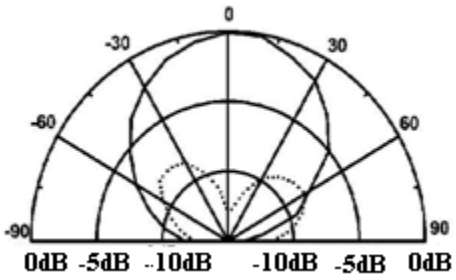

Figure- 4: Radiation pattern of PCDSBFRMSA measured at 5.12 GHz

The far field co-polar and cross-polar radiation patterns of the proposed antenna is measured in its operating band and is as shown in Figure .4. From this figure it is observed that, the pattern is broadsided and linearly polarized. The gain of the proposed antenna is calculated using absolute gain method given by the relation,

$$G\ (dB) = 10 \log\left(\frac{P_r}{P_t}\right) - (Gt)\ dB - 20 \log\left(\frac{\lambda_0}{4\pi R}\right) dB$$

where, P_t and P_r are transmitted and received powers respectively. R is the distance between transmitting antenna and antenna under test i.e. PCDSBFRMSA. The peak gain of PCDSBFRMSA measured in its operating band is found to be 3.58 dB.

IV. Conclusion

This study reveals that, the PCDSBFRMSA operates for triple frequencies with good frequency ratio of about 1.44. The antenna gives a maximum bandwidth of 15.8 % and peak gain of 3.58 dB which is comparable to the gain of conventional rectangular microstrip.. The antenna exhibits linearly polarized broadside radiation characteristics. The proposed antenna use low cost substrate material with simple design. This antenna may find applications in WiMax and C band frequency systems.

References

[1]. Constantine A. Balanis, "Antenna theory analysis and design", John Wiley, New York,1997.

[2]. Girish Kumar and K.P.Ray, "Broadband microstrip antennas", Artech House, Boston, London, 2003.

[3] . Sebastiano Barbarino, and Fabrizio Consoli, "Study of the effect of the Slot dimension on the Properties of a planar Ultra-wideband antenna Microwave and Opt. Technol. Lett. Vol.52, No. 8 , pp. 1813- 1817. Aug. 2010.

[4]. Wong, K. L., *Compact Broadband Microstrip Antenna*, John Wiley & Sons, New York, 2002.

[5]. Ge, Y., K. P. Esselle, and T. S. Bird, "E-shaped patch antennas for high-speed wireless networks," *IEEE Trans.on Antennas and Propagation*, Vol. 52, No. 12, 3213–3219, 2004.

[6] Ang, B. K. and B. K. Chung, "A wideband E-shaped microstrip patch antenna for 5–6 GHz wireless comunications," *Progress In Electormagnetics Research*, PIER 75, 397–407, 2007.

[7] Bahl, I. J. and P. Bhartia, "Microstrip Antennas", Artech house, New Delhi, 1980.

Dr. Nagraj Kulkarni received his M.Sc, M.Phil and Ph.D degree in Applied Electronics from Gulbarga University, Kalaburgi in the year 1995,1996 and 2014 respectively. He is working as a Assistant Professor in the Department of Electronics Government College(Autonomous)Kalaburgi. He is an active researcher in the field of Microwave Electronics with special emphasis to Microstrip Antennas.