International Conference on Advances in Materials, Computing and Communication Technologies
In Association withInternational Journal of Scientific Research in Science and Technology
Volume 9 | Issue 1 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)

Implementation of Defected Ground Structure for Microstrip Filtenna Design

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ABSTRACT

In this project, an antenna on substrate is presented for the filtenna.This is a wearable filtenna, which was formed on fabric substrate to reduce surface-wave losses. The proposed antenna design consists of a patch and a defected ground. To energize the wearable filtenna, a microstrip line feed technique is used in the design. Good impedance matching, reasonable gain and directivity will be achieved. The SAR value was calculated to observe the radiation effect and the SAR will be reduced less than 2 W/kg of 10gm tissue.The parametric study is performed for the validation of the proper functioning of the antenna. The design is simulated using EM simulation tool called CST software.

Keywords— Microstrip Filtenna, Low Effect

I. INTRODUCTION

In the era of modern wireless communication, the frequencies higher than 10 GHz are acquiring greater attention, resulting in new wireless devices, products, and services. The essential and leading components of transmission and reception system are antenna and filter. Generally, at higher frequencies the system exhibits larger subsystem components with independent characteristics and performance. Furthermore, high insertion losses have been found at interconnections resulting in less polarized current being produced in the radiating element. These portends for an inefficient communication system. So in this article, we have focused on a smaller, compact, lightweight, low cost, multifunctional, and efficient device rather than the earlier invented devices for higher frequencies. A compact module that can perform both radiation and filtration simultaneously is called as filtenna. In other words, a microstrip patch antenna with inbuilt filter is referred to as filtenna.

Etching or intentionally defecting is the best technique to improve or change the performance of any structure, as etched cells are inherently resonant in nature and can be applied to the radiating element and ground plane. The defect in the ground plane disorders the shield current distribution, resulting in modified values of capacitance and inductance of the transmission line and hence can be applied to the filter circuit and microstrip antenna.1 In the last few decades, many filter circuits have been reported using DGS and few of them have been listed in References 1-4. These reported designs use DGS for different range of frequencies, as low-pass, highpass, band-pass, and stop-band filters and caters to various applications in communication systems. Filtering antennas have achieved more concentration where in an antenna adds up to filtering performance and is reported in References 5-10. The filtering characteristics have been obtained mostly by etching or modifying the feed line, resulting in more spurious radiation.

II. ABBREVIATION AND ACRONYMS

WBAN-Wireless Body Area Network; WLAN-Wireless Local Area Network; VSWR-Voltage standing wave ratio; SAR- Specific Absorption Rate.

III. DERIVATION AND DESIGN OF ANTENNA

A. Calculation of the width:

$$W = \frac{c}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}}$$

where, W- Width of the patch

c - velocity of light

fr - resonance frequency of the patch

εr- relative permittivity of the dielectric substrate

B. Calculation of actual length of the patch:

$$L=\frac{C}{2f_r\sqrt{\varepsilon eff}} - (2\Delta L)$$

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where, **ε** eff – effective dielectric constant of the substrate

C. Calculation of the effective dielectric constant:

$$\varepsilon eff = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1+\frac{12h}{W}\right]^{-1/2}$$

where, h – thickness; This is based on the height, dielectric constant of the dielectric and the calculated width of the patch antenna.

D. Calculation of the actual length of the patch:

$$\Delta L = 0.412h\frac{(\varepsilon eff+0.3)}{(\varepsilon eff-0.258)}\frac{\left(\frac{W}{h}+0.264\right)}{\left(\frac{W}{h}+0.8\right)}$$

In Figure 1 Shows the structure of the proposed antenna a within paramters

This is a U shape antenna , we have used a substrate material by using the eletrical conductivity value of about .Then we design the patch , feed ,ground using copper (annealead).

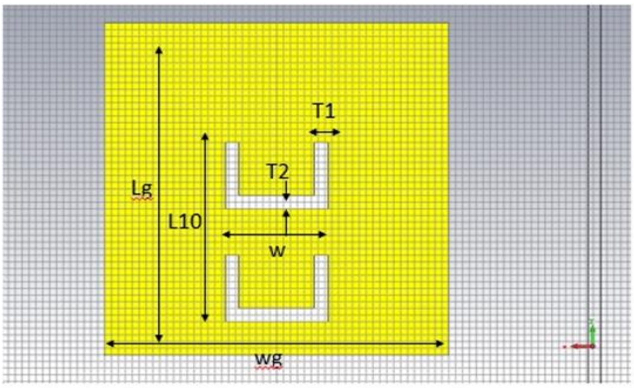

Figure 1. Back View of Filtenna

IV. PARAMETERS OF FILTENNA

TABLE 1

g	1
G1	5
l	28.45
L10	10
lg	50
w	15
wf	1.137
wg	50
f	9
C1	2
C1l	10
C1t	2
C1w	15
clw	15
t	0.035
h	1.6
W9	7.02
W10	3.47

V. EVOLUTION OF THE ANTENNA

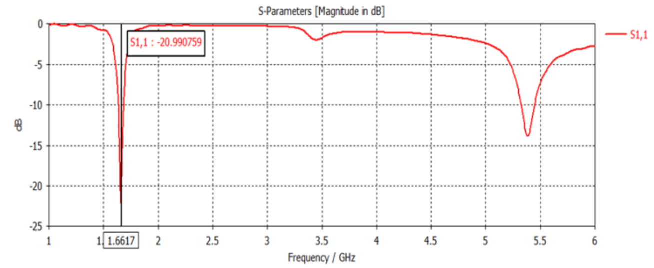

Figure 2 . S11 parameter

In Figure 2, The S-Parameter the S11 value is -25 and it having the resonant frequency of about 5.4 GHz

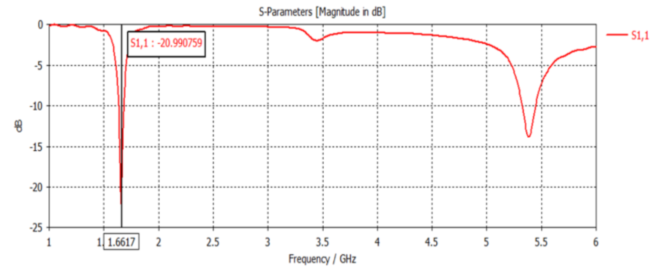

Figure 3 . Operating Frequency

In Figure 3. The given filtenna operating at the frequency range of 5.4 to 1.6617 GHz and having the Bandwidth of about 3.7 dB

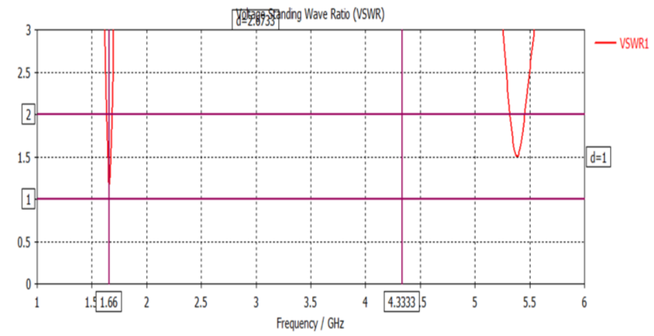

Figure 4. VSWR

In Figure 4. The VSWR value is 2.00 where the value is less than or equal to 2.

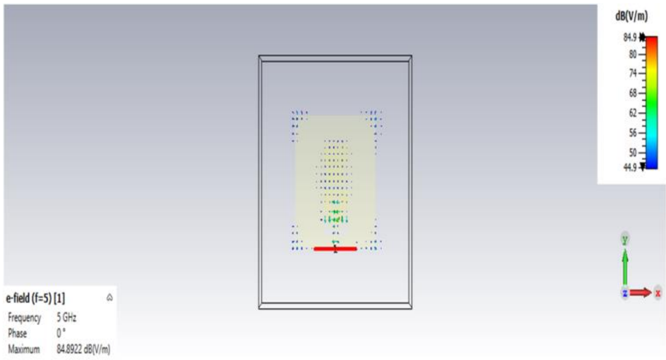

Figure 5. E-field

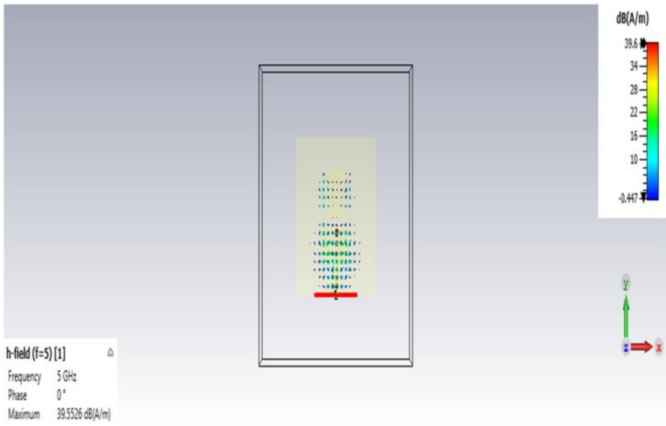

Figure 6. H-field

In the Figure 5,6- Depicts the textile antenna's E-field and H-field

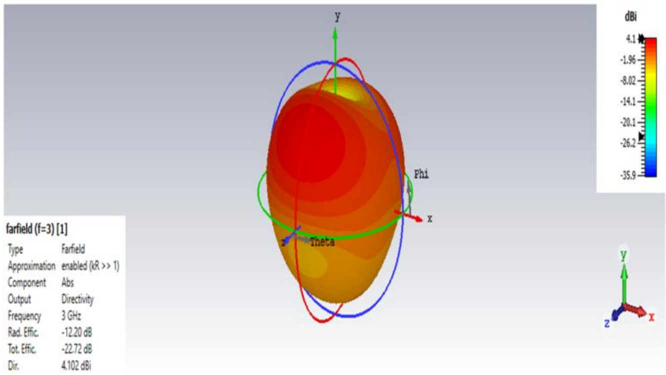

Figure 7. Far field region

In Figure 7 shows the far field region of the filtenna. The far field is a region in which the field acts as "normal" Electromagnetic radiation.

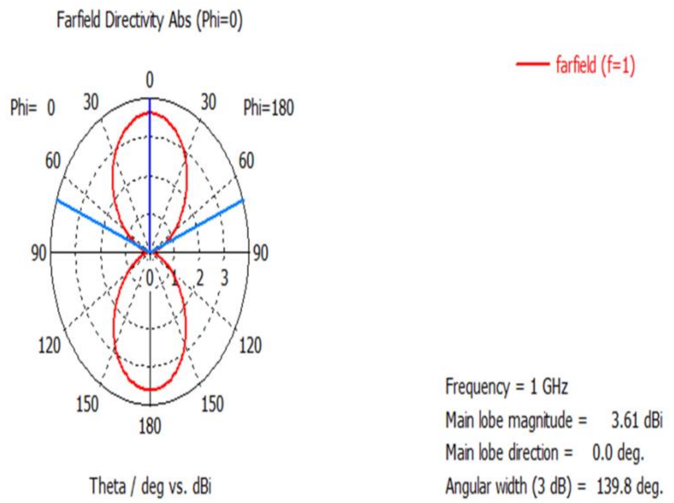

Figure 8. Far field directivity E-field

In Figure 8, the far field directivity of E-field depicts the phi value set to 0. Here the frequency given to the antenna is 1 GHz. Main lobe magnitude value is 3.61,main lobe direction is 0.0 deg and angular width (3 dB) is 139.8. deg.

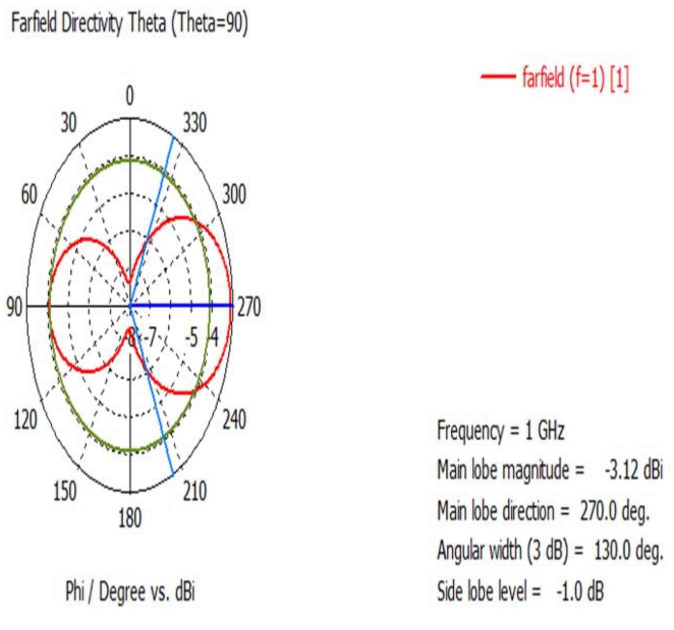

Figure 9. Far field directivity H-field

In Figure 9, The far field directivity of H-field depicts the phi value set to 90. Here the frequency given to the antenna is 1 GHz. Main lobe magnitude value is 3.12, main lobe direction is about 270.0 deg, Angular width(3 dB) is about 130.0 deg, side lobe level is -1.0 dB

VI. CONCLUSION

The proposed filtenna structure is helpful in reducing the cost, size, and losses of RF subsystem as compared to traditional filter and antenna combination. The proposed filtenna can be used for X and Ku-band application. The suppression of harmonics and the reduction of cross polarization would be an important task as a part of future work.

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