Characteristics and Performance of Microstrip Patch antenna for C Band and X Band

Sarabjeet Kaur, Bharti Chaurasia

Abstract- ***This article present a compact proposed patch antenna for impedance matched for simple two horizontal slot is placed in a active patch with a via hole in sandwiched between radiated patch and bottom plane of an microstrip patch antenna for a band of 4 to 12Ghz application. The planned antenna is synthesized by using glass reinforced epoxy laminated material (FR4) and electromagnetic 3D view (IE3D) software. The software based design is suitable for a band of 3.3//5.5 Wi-Max and 5.3/5.8 WLAN frequency band. It is also suitable for satellite application The ground and exciting patch is separated by 1.5mm thickness. The proposed antenna parameter is design for 10Ghz..For such design the achieved Bandwidth for an antenna is 53 % at a VSWR<2, acceptable return loss (S11) = - 22.5dB, and the directivity of an antenna is 6 dBi. The antenna is appropriate for an application of X band. The designs of an antenna and its result have been discussed in detail.***

Keywords—FR4, slotting technique,Via hole, compact antenna, MOM Software.

I. INTRODUCTION

For copper printed patch antenna is used in different wireless communication in concert, easy to carry in a mobility requirement and ultra wide band application. The first microstrip patch antenna is introduced in early seventies and researcher has been involved to improving their inherently narrow bandwidth.[1]. The patch antenna is one of the best solutions for tiny size, low profile and operated in multiband band antenna for current scenario is large. The printed antenna is one of the way for designing novel compact size antenna. conducting layer impressed on substrate. The antenna for an X band is investigated by using ESPAR(electronically steerable parasitic array radiator) technique to improve the gain as well as bandwidth. The bandwidth is less but gain has to be improve for X band application and WLAN communications [2] For reconfiguration the author used a two probes one for feeding and second for reconfiguration between ground and exciting patch and inverted U shape to enhance the bandwidth [1]. Some other technique which is used in a wireless communication is by using a reconfiguration of exciting patch and shorting pin between the ground and exciting patch of an antenna. The author described about the two transverse ™ modes that is TM_{10} and TM_{20}. By using a shorting pins in a proposed antenna one additional mode TM11 is obtained. [1-2][13]

The triangle and Inverted U shape slit, H shape slit is printed on a conducting layer of an antenna for a matching to reduces losses and improved bandwidth of an antenna.

The multi band is achieved by the author in use frequency band resulted in a UWB parameter. [1-3] [11-13]. Antenna is also appropriate for covered base station antennas for 5 to 6 GHz communication [3]. Slotting technique use for bandwidth enhancement for means of pervasive communications [5]–[6]. The wideband of an antennas is investigated that can be applicable in a selected frequency from of other parameter, like climate changing. For X band communications. Some other antennas is work on a parasitic element to improve gain as well as bandwidth but the bandwidth is not upto the mark[2-3] Recently wireless communication access in mobility environments are worked to the wireless standard IEEE 802.11p. A number of patch antennas are operated at L and C and X band operation [8]–[10][13].The approach is used for proposed design is used simple to horizontal slot in a exciting patch to improve bandwidth and drop in dimension for 4 to 12 GHz band function. The planned antenna is work on 6.9 GHz to 12GHZ. By simple alteration the slot length of a design the author can varied the different parameter of an structure design. Such structure design of an antenna bandwidth is 14.20% [2]-[3] similarly by changing, parasitic element or stacking the position and length of the slit or parasitic element investigator operated in different band [6]. The parasitic element used at a distance of a 0.5λ of an exciting patch the investigate to come close to a bandwidth of 52.8% [7]

II. ANTENNA ANALYSIS

Antenna Dimension:

The proposed structure is demonstrate to an antenna with a frequency of 10 GHz, here we used the FR4 substrate with ε_r=4.3, and height of the substrate (t) = 1.5mm, tangent loss (tanδ)=0.02. By used of expression, from 1 to 6. We find out the width and length of the reflector and radiating patch of the proposed design.[9]

$$We = \frac{0.5c}{f\sqrt{(\varepsilon_r + 1)/2}} \quad (1)$$

$$\varepsilon_e = 0.5\left(\frac{\varepsilon_r + 1}{}\right) + 0.5\left(\frac{\varepsilon_r - 1}{}\right)\left[1 + 12\frac{h}{We}\right]^{-1/2} \quad (2)$$

$$Leff = 0.412h\frac{(\varepsilon e + 0.3)\left(We/h + 0.264\right)}{(\varepsilon_e + 0.258)\left(We/h + 0.8\right)} \quad (3)$$

$$Le = \frac{0.5c}{f0\sqrt{\varepsilon_e}} - 2Leff \quad (4)$$

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L_g=Le + 6h (5)

W_g=We+6h (6)

where:

f_0 = frequency
ε_r = Permittivity of the substrate
ε_e = Effective permittivity of the Substrat
We = Patch width
Le = Patch length
t = height of the dielectric
L_0 = ground plane
W_0 = ground plane

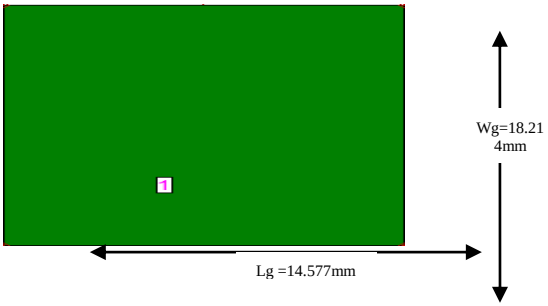

Figure.1(a) Radiator plane Dimension.

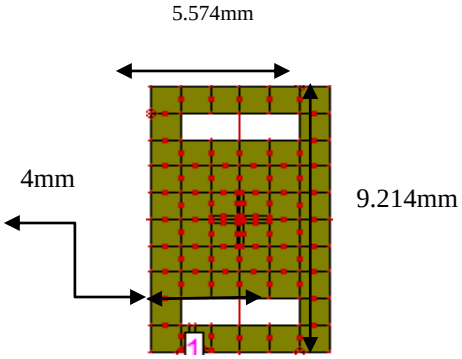

Figure.1 (b) Exciting patch with two horizontal slit.

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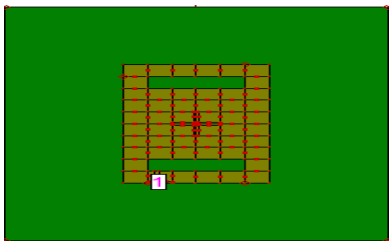

Figure.1(c) Top view of proposed antenna .

As shown in figure 1 (a) and (b) the Structure of ground plane and horizontal slit radiation plane antenna. The top view of an antenna consists of a loaded two horizontal slit extended up to 4mm in the radiating patch and the via hole is associated in between radiating patch and reflection plane is as shown in figure1 (c). From the earlier the rectangular, triangular or inverted U slot is introduce for a improved bandwidth enrichment as compares to further respect [1-3]. Our work we worked on improve the bandwidth of proposed structure attach a via hole or short the reflector and radiated patch.

Table Number-1:- Specification of the Structured antenna

S. N.	Assign parameter as per proposed design	Values for proposed Structure
1	frequency(f0)	10GHz
2	Substrate permittivity(ε_r)	4.3
3	Height of substrate(h)	1.54 mm
4	Loss tangent for Proposed substrate	0.02
5	Patch Width(We)	9.21442mm
6	Patch Length (Le)	5.5 mm
7	Width of Reflection plane (Wg)	18.2 mm
8	Length of Reflection pane(Lg)	14.5774mm
9	Feed location:	-1.50662 mm 4.6072mm
10	Shorting pin radius xf, yf	0.15mm

III. RESULT AND PARAMETERS STUDY

A. Designed and Study.

The Structured and principle of wide band proposed design is in a Flame Retardant 4 material for 18 x 14 x 1.5 mm^3 is studied. The parameter of a proposed antenna such as directivity, gain, bandwidth etc. has to be obtained by using the electromagnetic software. The Software based result are calculated the different component of a patch from given equation [9] From the equation the length and width of the proposed antenna are as shown in at Table No.1. The proposed antenna is appropriate for satellite communication, 4 to 12GHz band. The proposed structure consists of a two horizontal slit at the radiating patch to improving the band width and directivity of geometry. The design is very trouble-free and dense in size.

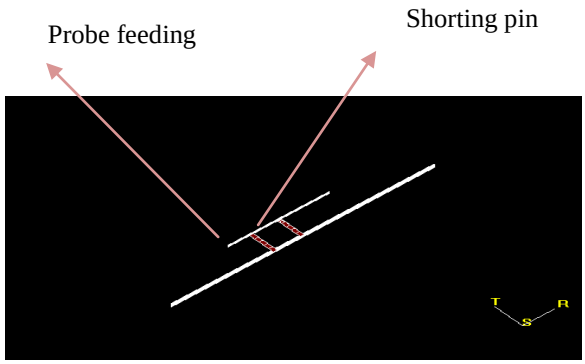

Figure2. Three Dimensional view proposed antenna

Fig 2 publicized the 3 Dimensional view of a proposed an antenna. The top is an radiated patch and the bottom plane is an reflection plane and it is linking coaxial feeding is given

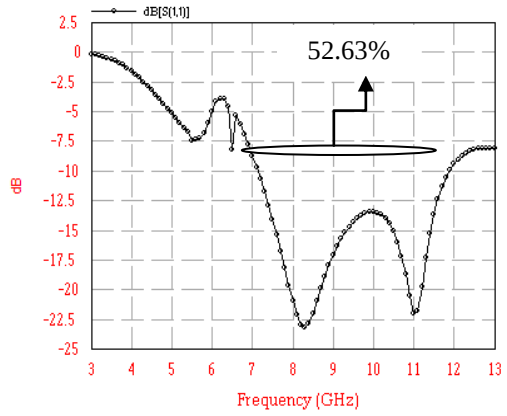

Fig.3 S11 curve (Return Loss) of an antenna among two horizontal slit and shorting pin

For a design structure have a single band from 7GHz to 12 GHz The Return Loss for indentation is effective between this two is 8.2 to 11GHz.

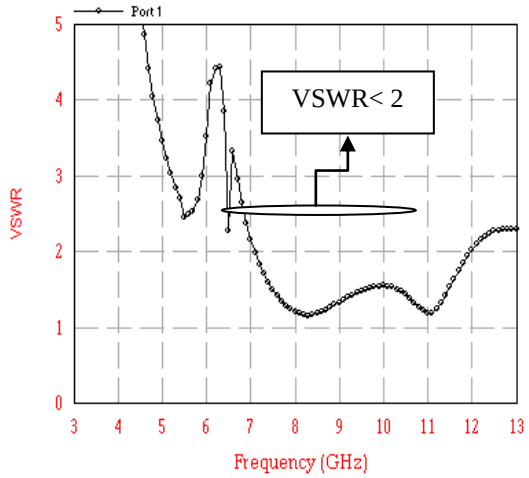

Figure.4 Simulated VSWR of proposed design.

The simulated and measured valued of VSWR is shown in figure 3. In this the impedance in terms of along the length and width feed and size of horizontal slit is proposed to match an real and imaginary part with 50 Ω to maximum radiation in a free space. The VSWR is effective in between 7 GHz to 12 GHz.

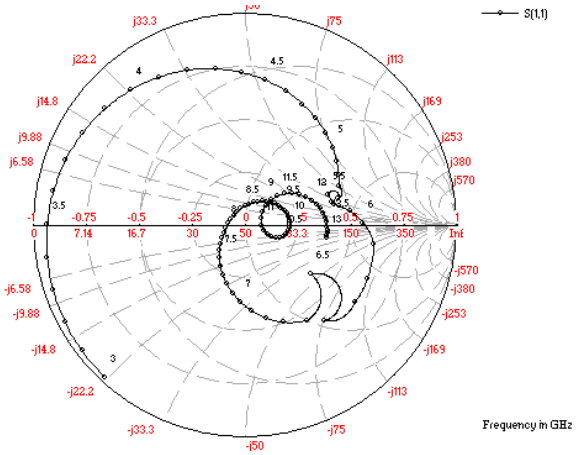

Figure.5 Smith chart of an antenna

As shown in figure 5. To find out the reactive and real part of the proposed antenna.

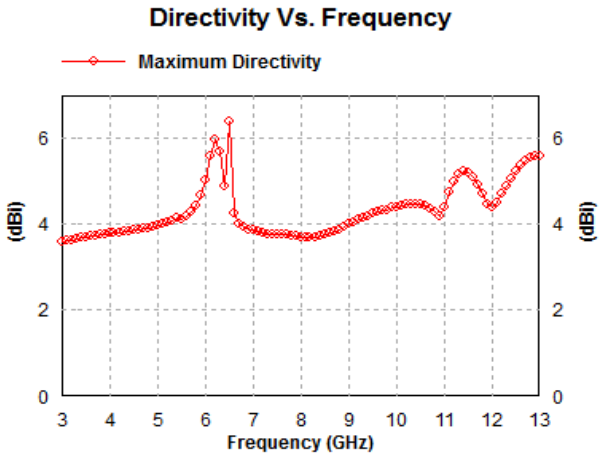

Fig.6 Simulated directivity of proposed structure

The Directivity of a proposed structure varied with frequency for a satisfactory band is shown in figure 6. The peak directivity of the proposed structure is 6.3 dBi.

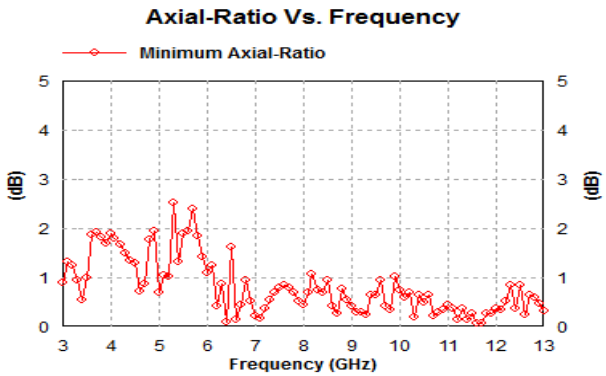

Figure.7 Simulated Axial Ratio with respect to frequency

The Figure 7 shows the simulated axial ratio of the Structure. The Figure represent the polarization of an antenna. As per curve the magnitude is below 3 dB for a satisfactory band so that is the antenna work as a circular polarization

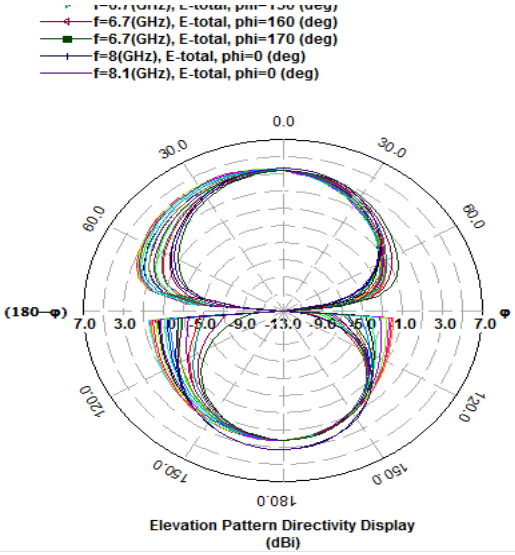

Fig.8 Field Pattern of a proposed structure for 7 to 12 GHz.

The filed pattern of Total E (Electric field with respect to azimuth and elevation) is shown in figure 8.

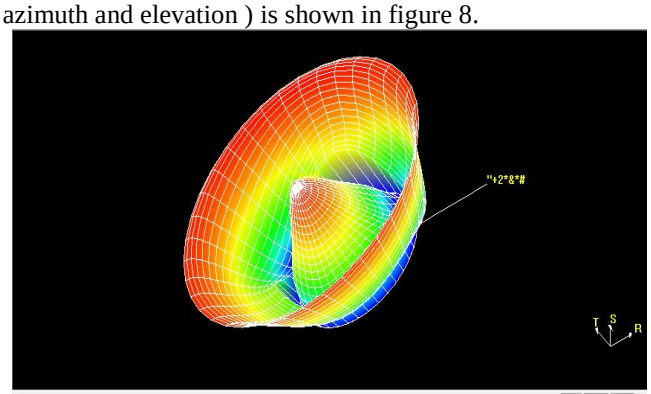

Figure 9. 3Dimensional radiation View of a proposed structure

The Simulated 3 dimensional view of radiation field shown in colored pattern is as showed in figure 9. It represented the radiation in the free space.

IV. CONCLUSION

In this article a simple horizontal slit structure is Investigated. The simulated radiation pattern and is a good agreement with respect to all parameter is accepted in term of C and X band application. By tuning a slit configuration, we varied the size and bandwidth of an antenna. By such technique we achieve good performance at the demonstrated frequency. By introducing shorting via hole in between the layers, we can have better return loss and hence bandwidth. Measured results are far better the simulated results 7 GHz to 12GHz. Comparison graph shows difference between simulated result, caused by the variation of slot in a exciting pacth antenna we can tuned the different band for different application.

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