January - February 2020
ISSN: 0193 - 4120 Page No. 2260 - 2263

Design of Narrowband Patch Antenna for Security Systems

Riyaz khan
Dept. of ECE, Jawaharlal Nehru Technological University, Hyderabad, India.

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Abstract:
This paper presented the design of a dense microstrip patch antenna at 30GHz. The proposed antenna offers the benefit of the low reflection coefficient of -36.05 dB and -45 dB. VSWR value of 1.16 by using a dielectric substrate Rogger03006(tm) which has a dielectric constant of 6.15. this antenna provides a better requirement to be used in next generation 5G devices. This paper gives shape and relative geometry of the microstrip antenna and achieves the best parameter requirement such as return loss plot, VSWR, radiation pattern plot.

Keywords:*Microstrip antenna, VSWR, Reflection coefficient, Dielectric constant.*

I. INTRODUCTION

Design an antenna having higher gain, good bandwidth, more efficient, small size is always the requirement. To reach this objective many researchers are presented with the design pointing out different applications at various frequencies. In various applications, such as in supervision security systems, narrow bandwidths are desirable. However, the performance of the antenna is change by varying in the component dimension such as the size of ground plate or changing in patch area. To illustrate, substrate height can be increased to get more efficiency to a maximum of 90 percent excluding surface wave, bandwidth also broadens up to 35percent or more [1]. In contrast, increased height brings surface wave into account, which is not desirable for superior execution, the reason is that it consumes power from the total present power for direct radiation (radio waves). There are a number of substrates available in the market which can be used to construct a microstrip patch antenna and their dielectric constants vary typically in the range of 2.2≤ ϵ_r ≤12. Among all FR4 dielectric is widely used because it is easilyavailable, and it has a dielectric constant value 4.4. The substrates are accessible in thick and meager structures, ones that are most alluring for execution are thick substrates whose dielectric constant is in the lower end of the range. It offers better productivity, large bandwidth, approximately headed fields for radiation into space, yet to the detriment of bigger component size [1]. On the other hand, thin substrate along with large dielectric value are the requirement of microwave circuits. The main objective attains with thin substrate and higher dielectric value is that under this circumstances field is tightly bound in order to reduce unnecessary radiation and coupling effect. In addition, it offers one more benefit of the smaller element size. However, this substrate is less popular because of their greater losses, they are less efficient and have relatively smaller bandwidth [1]. 28 GHz bands which are within range of 21.65 GHz to 29.5 GHz is allocated for the application in Ultra-Wide Band radar signal and system, also in other communication systems [2].

II. LITERATURE SURVEY

The proposed antenna is designed at 30 GHz frequency in HFSS software. To design microstrip patch antenna three essential assumptions are considered as the frequency of operation which is 30 Ghz. Second is the dielectric material chosen for

January - February 2020
ISSN: 0193 - 4120 Page No. 2260 - 2263

configuration is RoggerR03006 (tm) which has a dielectric steady (ϵ_r) of 6.15. A substrate which have high dielectric consistent is selected in structure since it lessens the elements of the receiving antenna. Equations used to calculate the dimensions of the microstrip patch antenna.

$$W = \frac{c}{2f_0\sqrt{\frac{\varepsilon_r+1}{2}}}$$

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r+1}{2}\left[1+12\frac{h}{W}\right]^{-\frac{1}{2}}$$

$$L_{eff} = \frac{c}{2f_0\sqrt{\varepsilon_{reff}}}$$

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

$$L = L_{eff} - 2\,\Delta L$$

Table 1. Antenna Design Parameter

Parameters	**(mm)**
Length of Antenna (L)	2
Width of Antenna (w)	2.4
Effective length (L_{eff})	2.109
Length Extension (ΔL)	0.057
Ground plane length	7
Ground plane width	7

The patch antenna is fed using 50 Ω microstrip line input impedance.

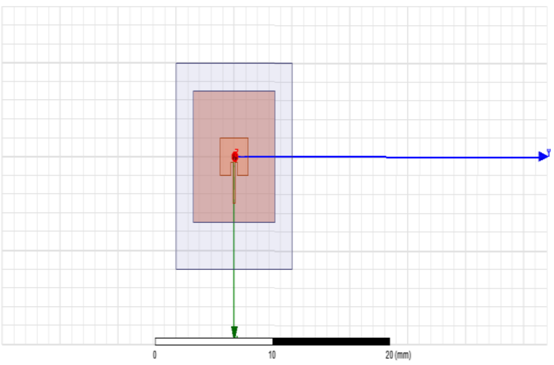

Fig. 1. 3D Model of a rectangular patch at 30 GHz

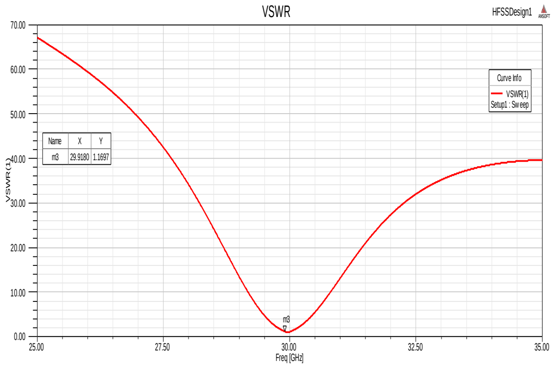

Fig. 4. VSWR vs Frequency

Gain of the antenna at 0 degrees and 90 degree

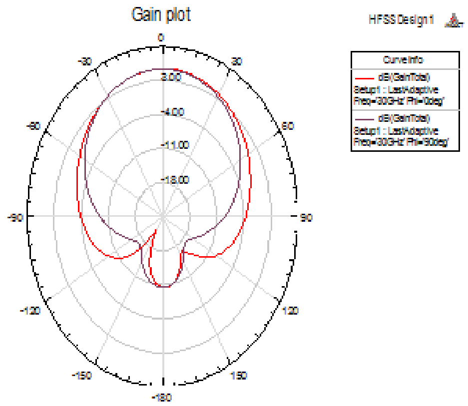

Fig. 5. Gain plot of design antenna.

The below figure shows a design antenna radiation pattern.

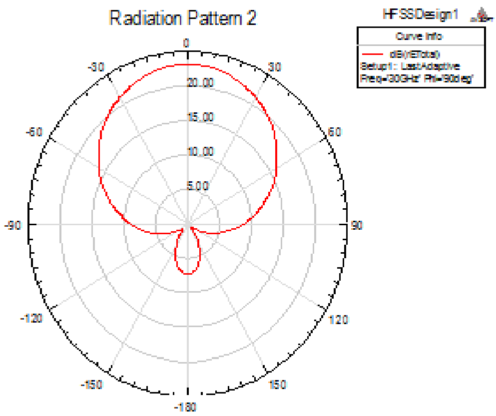

Fig. 6. Radiation pattern at 30 GHz

Antenna radiation pattern is used to measure the directivity. Better directivity is the benefit of the antenna, because of narrow or sharp tuning, then the one which has a broad main lobe.

January - February 2020
ISSN: 0193 - 4120 Page No. 2260 - 2263

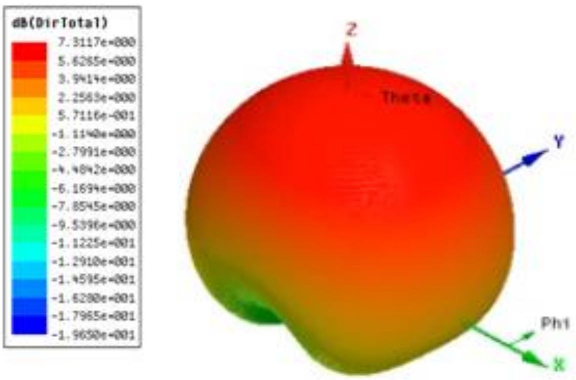

Fig. 7. Directivity 3D polar plot in HFSS software

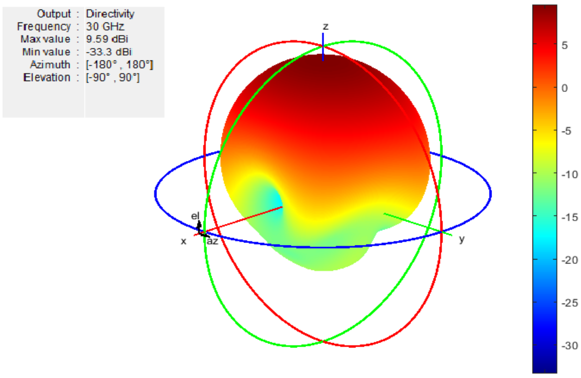

Fig. 8. Directivity plot of 30GHz frequency in MATLAB

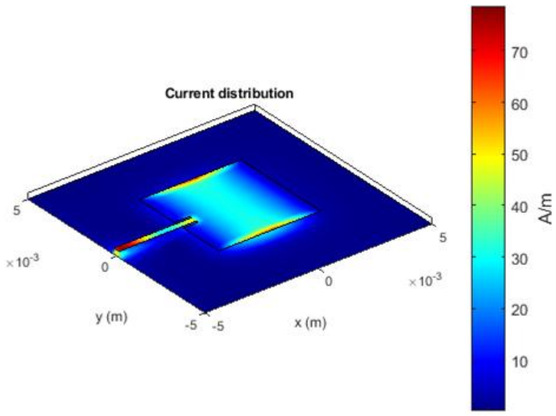

Fig. 9. current distribution of design antenna

III. Conclusion

As shown by the plan and the outcome got a minimized microstrip fix radio frequency has been effectively structured having a middle recurrence 30 GHz. Consequently, the planned reception apparatus is little enough to be set in a run of the mill phone. Lesser back-projection radiation parts are additionally an advantage accomplished by the planned receiving wire, this limits the measure of electromagnetic vitality emanated towards the client's head and keep from radiation impacts.

The reception apparatus structured in this paper is a uniband radio wire focused at one recurrence, future work is to broaden plan a dichroic (double band) and trichroic (tri-band) microstrip fix receiving wire which can work at a few frequencies to encourage various applications with a solitary receiving wire. At last, Smart receiving frequency frameworks give an answer for a large portion of the issues.

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January - February 2020
ISSN: 0193 - 4120 Page No. 2260 - 2263

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