TO STUDY ON BANDWIDTH ENHANCEMENT OF RECTANGULAR SLOTTED RECTANGULAR PATCH MICRO-STRIP ANTENNA FOR WIRELESS APPLICATION

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Abstract: - In this paper, a rectangular slotted micro-strip antenna with linear polarization has been used to analyzed and simulate structure for the wireless application. The proposed antenna has been simulated at the 1.87 GHz frequency. This compact antenna is fed by microstrip feed line. This antenna is simulated by IE3D zeland software. To analyze the proposed antenna, simulated results on return loss, Gain vs. frequency graph, radiation pattern, smith chart and VSWR graph is presented.

Keywords :- IE3D, VSWR, Microstip feed.

I. INTODUCTION

Microstrip antennas have wide applications especially in the field of missile application, military, mobile and satellite communications [1,2]. These antennas are low profile, conformable to planar and non-planar surfaces, simple and inexpensive to manufacture using modern printedcircuit technology [1]. As increasing the height of the substrate, increases the efficiency of antenna (to as large as 90 percent if surface waves are not included) and bandwidth (up to about 35 percent) [1,9]. But when the height increases, surface waves are introduced which usually are not desirable. A micro-strip antenna consists of conducting patch on a ground plane separated by dielectric substrate. This concept was come with the revolution in electronic circuit miniaturization and large-scale integration in 1970[1,9].

After that many writer have described the radiation from the ground plane by a dielectric substrate for different configurations. Initially the micro-strip antennas design for use as a low profile flush mounted antennas on rockets and missiles showed that this was a practical concept for use in many antenna system problems.

The micro strip antennas are the present day antenna designer's choice. Generally patch of the microstrip antenna are square, rectangular, circular, triangular, and elliptical [4,5]. Low dielectric constant substrates are generally preferred for maximum radiation. The conducting patch of microstrip antenna can take any shape but rectangular and circular configurations are the most commonly used. Other configurations are complex to analyze and require heavy numerical computations. A micro-strip antenna is characterized by its Length, Width, Input impedance, and Gain and radiation patterns.

The broadband antenna are required to be compact, low profile directive for high transmission efficiency and designed to be discreet, due to these well met requirements couple with the ease of manufacture and repeatability makes the micro strip patch antennas very well suited for broadband wireless applications.

The four most popular configurations to feed microstrip antennas are the microstrip line, coaxial probe, aperture coupling, and proximity coupling [8]. In this paper the microstrip line is fed for the antenna.

II. ANTENNA DESIGN AND SIMULATION

The design of the proposed antenna is shown in figure 2.1

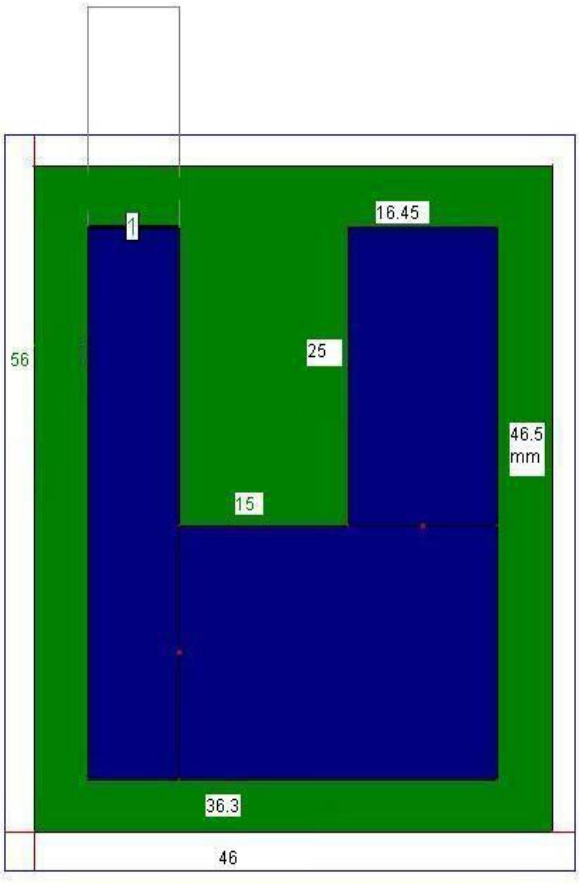


Figure 2.1: Geometry of the proposed antenna

The three essential parameters for the design of a rectangular Micro strip Patch Antenna are:
Frequency of operation (□□): The resonant frequency of the antenna is selected appropriately. The Mobile Communication Systems uses the frequency range from 1800- 5600MHz. Hence the antenna designed is able to operate in this frequency range.
Dielectric constant of the substrate (□□): The dielectric material selected for design has a dielectric constant of 4.2. A substrate with a high dielectric constant has been selected since it reduces the dimensions of the antenna.
Height of dielectric substrate (*h*): For the microstrip patch antenna to be used in cellular phones, it is essential that the antenna is not bulky [3]. Hence, the height of the dielectric substrate is selected 1.6 mm.

TABLE I. ANTENNA DIMENSIONS

S. NO	Antenna Dimension	Specification
1.	Antenna width (W)	46.5 mm
2.	Antenna Length (L)	36.3 mm
3.	Slot width (w)	25 mm
4.	Slot length (l)	15 mm

TABLE II. ANTENNA PARAMETER

S. NO	Antenna parameter	Specification
1.	Dielectric constant(ϵ_r)	4.2
2.	Maximum frequency	3 GHz
3.	Height of substrate(h)	1.6 mm
4.	Loss tangent(tanδ)	.0013
5.	Velocity of light(c)	3×10^8 ms^{-1}

Since this antenna is proposed the resonant frequency 1.87 GHz. Then we have to calculate the width and length of the micro-strip antenna at the resonant frequency 1.87 GHz. Since the patch is rectangular then the actual width of the antenna is given by [8]

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

Width for the simulated frequency 1.87 GHz W = 49 mm (calculated value) closed to the design width (46.50 mm).

And the actual length of antenna is given by **[1]**

$$L = \frac{c}{2f_r\sqrt{\epsilon_{reff}}} - 2\Delta L$$

And A very popular and practical approximate relation for the normalized extension of the length is **[7]**

$$\frac{\Delta L}{h} = 0.412\frac{(\epsilon_{reff}+0.3)(\frac{W}{h}+.264)}{(\epsilon_{reff}-.258)(\frac{W}{h}+0.8)}$$

Where ϵ_{reff} is given by..... **[6]**

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

Length for the simulated frequency 1.87 GHz L =39 mm (calculated value) closed to the design length (36.30 mm).

III. RESULTS

The analysis of the designed rectangular patch rectangular slotted micro-strip antenna was done by IE3D zeland software. The simulated plot of return loss against frequency is shown in Fig. 3.1. There is two band occur in this antenna, First band having bandwidth 1110 MHz(60.82%) at resonant frequency 1.87 GHz, the radiation of antenna depend on the minimum return loss and in this band there is the three minima occur at the frequencies 1.32GHz, 1.64GHz, 2.15GHz. since the frequency 1.32GHz have minimum return loss (-28dB) so antenna radiate maximum at 1.32 GHz.
The second band having the resonant frequency 2.74 GHz with the minimum return loss - 19db.The corresponding impedance bandwidth is 330 MHZ at 2.74GHz (12.02%) is obtained. -10 db line is used as a reference line for the bandwidth calculation. The figure 3.1 is shown the return loss vs. frequency plot.

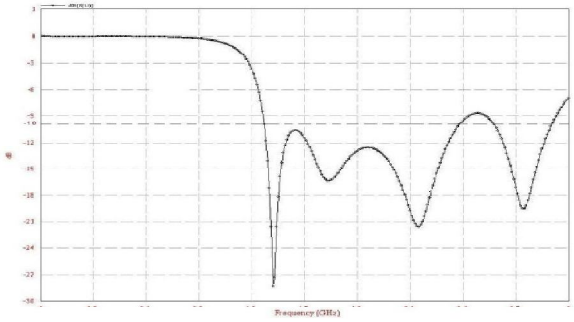


Figure 3.1: Return loss vs. frequency graph

The impedance matching between feed line and load is indicating by the VSWR ratio. The VSWR calculation shows the value of 1.61 and 1.23 at the frequency of 1.87 GHz and for 2.74 GHz. shown in Figure 3.2

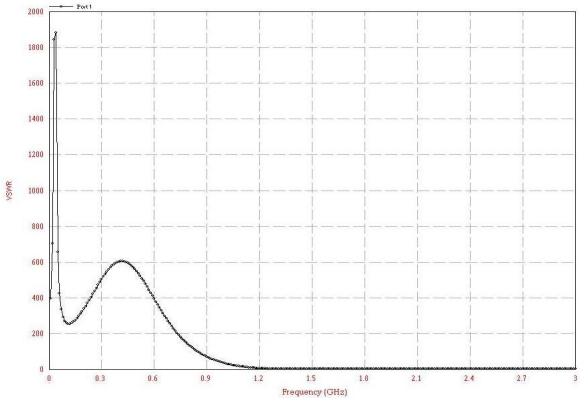


Figure 3.2: VSWR vs. frequency curve

The radiation pattern of the proposed antenna is bidirectional, which radiates equally well in either direction of maximum radiation. The 2D radiation pattern is shown in figure 3.3 at the frequencies 1.32 GHz, 1.64 GHz, 2.15 GHz.

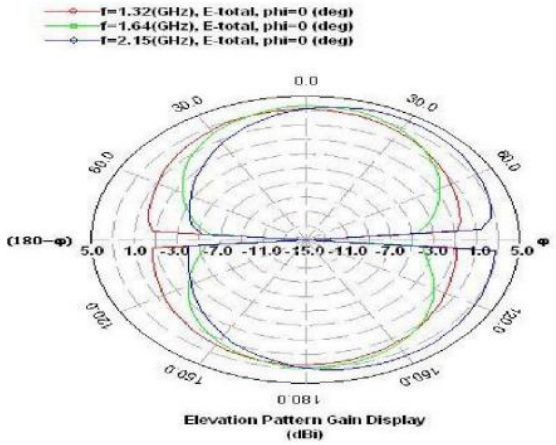


Figure 3.3: 2D radiation pattern of antenna

And the 3 D radiation pattern of the proposed microstrip antenna having gain 3.47 dBi is shown in the figure 3.4.

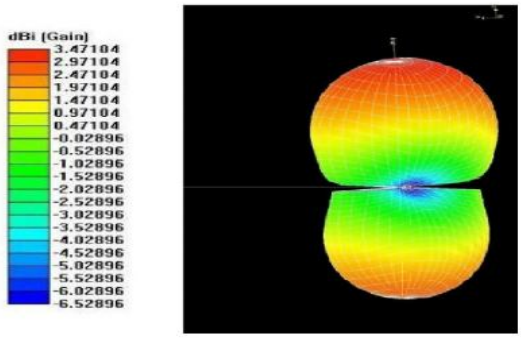


Figure 3.4: 3D radiation pattern of proposed antenna

The efficiency of the microstip antenna is very low. But this proposed antenna having efficiency at the resonant frequency 1.87GHz and 2.74GHz approximately equal to 95 % and 98% respectively.

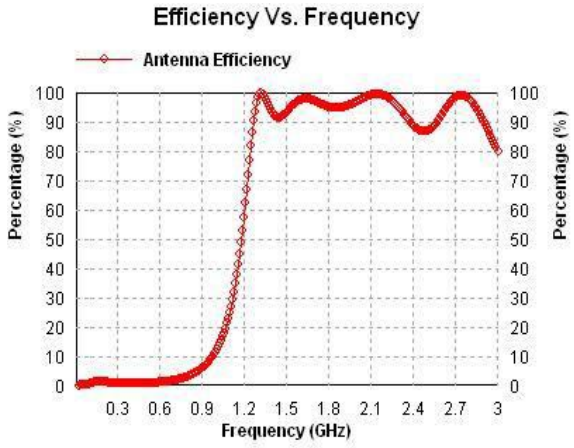


Figure 3.5: efficiency vs. frequency plot

CONCLUSION

This new patch antenna with the microstrip line feed having the two frequency bands in between 0 to 3 GHz range. For the first band length and width of antenna is approximately equal to the calculating length and width at the resonant frequency 1.87 GHz. As the calculating dimension is approximately equal to design antenna dimension which improve antenna performance in all field. Since frequency range 1800 -2380MHz occur between the first band, so this antenna is useful in mobile application. The Second band having bandwidth 330MHz (12.02%) at resonant frequency 2.74 GHz. And this narrow bandwidth is very important for the government security system [1].

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