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Design and Simulation of Wide-Band Square Microstrip Patch Antenna

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Abstract: In this, a square Micro Strip Patch Antenna is designed using MENTOR GRAPHICS IE3D TOOL. Communication between humans was first made by sound through voice. In initial days, devices such as drums, visual methods such as signal flags and smoke signals were used to communicate information. The so mentioned optical communication devices, utilize the light portion of the electromagnetic spectrum as carrier. It has been only very recent in human history that the electromagnetic spectrum, outside the visible region, has been employed for communication, through the use of radio. The aim of this is to design and fabricate an Micro Strip square patch by using feed line technique. Micro Strip Antenna and study the effect of Micro Strip line length dimension Length (L) on Radiation pattern ,directivity , gain and return loss. Low dielectric substrates are generally preferred for maximum radiation. The length of the square patch antenna is nearly half wavelength in the dielectric; it is a very critical parameter, which governs the resonant frequency of the antenna. In view of design, selection of the patch width or length is the major parameters along with the feed line depth. Desired Patch antenna design is initially simulated by using IE3D simulator and Patch antenna is realized as per design requirements.

Keywords: square patch, Micro Strip, Radiation pattern, dielectric substrates.

1. INTRODUCTION

A micro strip antenna consists of conducting patch on a ground plane separated by dielectric substrate. This concept was undeveloped until the revolution in electronic circuit miniaturization and large-scale integration in 1970. After that many authors have described the radiation from the ground plane by a dielectric substrate for different configurations. The early work of Munson on micro strip antennas 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. Various mathematical models were developed for this antenna and its applications were extended to many other fields. The micro strip antennas are the present day antenna designer's choice. Low dielectric constant substrates are generally preferred for maximum radiation. A micro strip antenna is characterized by its Length, Width, Input impedance, and Gain and radiation pattern Various parameters of the micro strip antenna and its design considerations were discussed. Patch Antennas can be fed by a variety of methods. These methods can be classified into two categories- contacting and non-contacting. In the contacting method, the RF power is fed directly to the radiating patch using a connecting element such as a Micro Strip line.

In the non-contacting scheme, electromagnetic field coupling is done to transfer power between the Micro Strip line and the radiating patch.

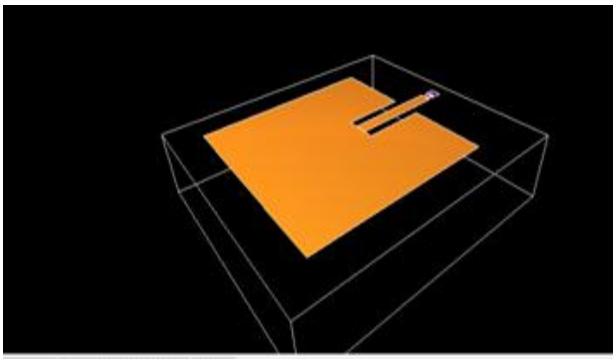

Fig1.1: Square Micro-Strip Patch Antenna

The most popular feed techniques used are the Micro Strip line. In Micro Strip Line Feed method**,** The conducting strip is smaller in width as compared to the patch and this kind of feed arrangement has the advantage that the feed can be etched on the same substrate to provide a planar structure.

The purpose of the inset cut in the patch is to match the impedance of the feed line to the patch without the need for any additional matching element. This is achieved by properly controlling the inset position. Hence this is an easy feeding scheme, since it provides ease of fabrication and simplicity in modeling as well as impedance matching.

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2. DESIGN SPECIFICATION

In this, the procedure for designing an effective micro strip patch antenna in IE3D software is explained. And result obtained from the simulations is demonstrated. The parameters of square patch antenna are calculated by using these formulas. The three essential parameters for the design of a rectangular Micro strip Patch Antenna are:

2.1. Frequency of operation (fo): The resonant frequency of the antenna must be selected appropriately. The Mobile Communication Systems uses the frequency range from 2-3GHZ. Hence the antenna designed must be able to operate in this frequency range. The resonant frequency selected for my design is 3.0 GHz.

2.2 Dielectric constant of the substrate (εr): The dielectric constant is 2.2. A substrate with a low dielectric constant has been selected since it increases the radiation of the antenna.

2.3Thickness Of Patch (t): The wall thickness, t is governed by:

$$t < \lambda / [20 \times (\varepsilon r)1/2]$$

Where λ is wavelength at highest frequency and εr is the dielectric constant of FRP and resin matrix. At 2 GHz the maximum thickness must be less 5mm. in this paper, the thickness, t=2mm used.

3. ANALYSIS OF SQUARE MICROSTRIP PATCH ANTENNA

Given specifications were,
1. Dielectric constant (εr) = 2.2
2. Frequency (fr) = 3.0 GHz.
3. Thick ness(t)=2 mm.
4 .Velocity of light (c) = 3×108 ms-1.
5. Practical length (L)=Practical Width (W) = 5mm.
6 .Loss Tangent (tan δ) = 0.001.
7. Cut width=1mm
8. Cut depth=1mm
9. Path Length=2mm
10.Path Start Length=Path End Length=0.5mm

4. PROCEDURE TO DESIGN IE3D

Procedure to simulate square patch antenna in IE3D

1. Designing a Square patch using ENTITY in IE3D.
2. Make a cut in the square patch with the help of CUT THE POLYGON FROM SELECTED EDGE in Adv Edit tab.
3. Then insert a Micro Strip line feed using CONTINUE STRAIGNT PATH in Adv Edit tab.
4. Number the port by using DEFINE PORT FROM EDGE GROUP.
5. Then the design can be simulated using SIMULATION in the process tab.
6. The output can be observed using either PATTERN VIEW or using WINDOW tab in M grid

5. RESULT

S – Parameters

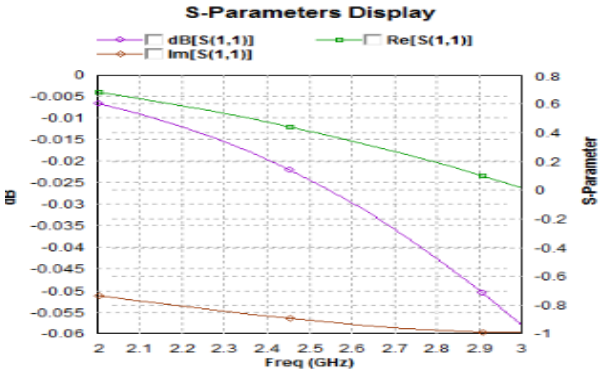

Fig5.1: s-parameters display

The input will be fed at input which acts as source and the other side acts as load. This relationship can be given by S- parameters. The graph is plot between return loss and frequency. Return loss is nothing but the power reflected back during the transmission. This should be as minimum as possible. In the figure the return loss is equal to -1dB.

Directivity Vs Frequency

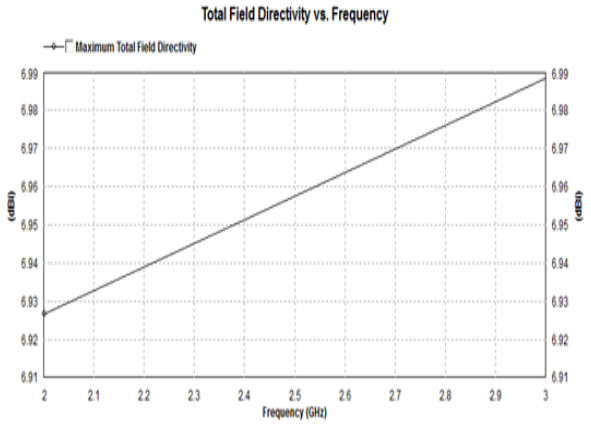

Fig5.2: Directivity Vs Frequency

The directivity of an antenna is equal to the ratio of the maximum power density to its average value over a sphere as observed in the far field of an antenna.The directivity versus frequency graph antenna is shown in figure. At 2.9 GHZ of frequency directivity of antenna is 6.99 dbi.

Gain Vs Frequency

The gain G of an antenna is an actual or realize quantity which is less than the directivity D due to ohmic losses in the antenna

At 3 GHz frequency the gain of antenna is maximum i.e G= --25. db.

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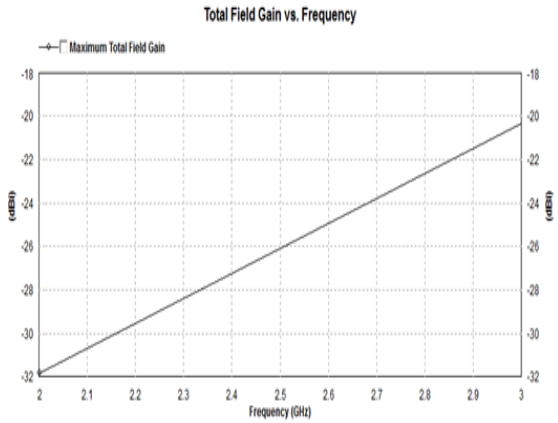

Figure5.3 : Gain versus frequency

Z-Parameters

The Z parameter is used to determine the quality factor of an antenna which can give you an insight about the attainable bandwidth. Z(ant)=R+jX, where R=R(rad)+R(Loss), so you can predict somehow the losses and the efficiency. It could also be useful for determining an equivalent circuit model of the antenna.

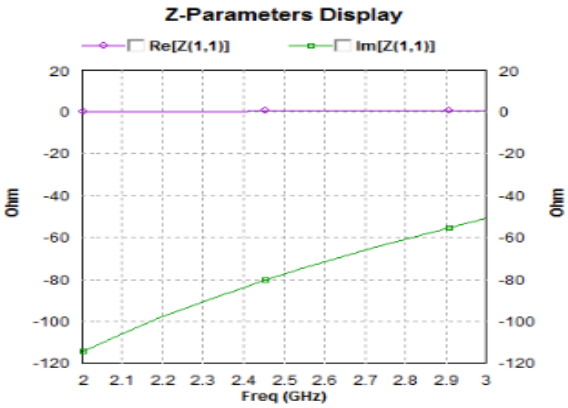

Fig5.4: Z-Parameters

Smith Chart

Smith chart is one of the most useful graphical tools for high frequency circuit applications. The chart provides a clever way to visualize complex functions and it continues to endure popularity decades after its original conception.

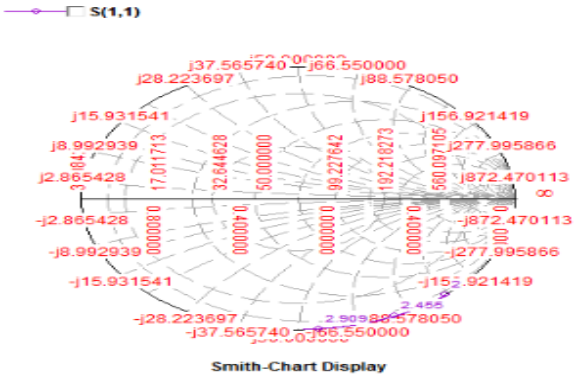

Fig5.5: Smith Chart

From a mathematical point of view, the Smith chart is simply a representation of all possible complex impedances with respect to coordinates defined by the reflection coefficient.

Antenna Efficiency & Radiation Efficiency

Antenna efficiency is the ratio of aperture effective area to its actual physical area. it describes the percentage of the physical aperture area which is actually capture radiofrequency energy. Radiation efficiency is defined as the measure of power radiated through the antenna as an electromagnetic wave to the power fed to antenna terminal. In square patch antenna as frequency increases, the efficiency of square patch antenna is also increases. At 3GHZ of frequency, the efficiency of antenna is0.06.

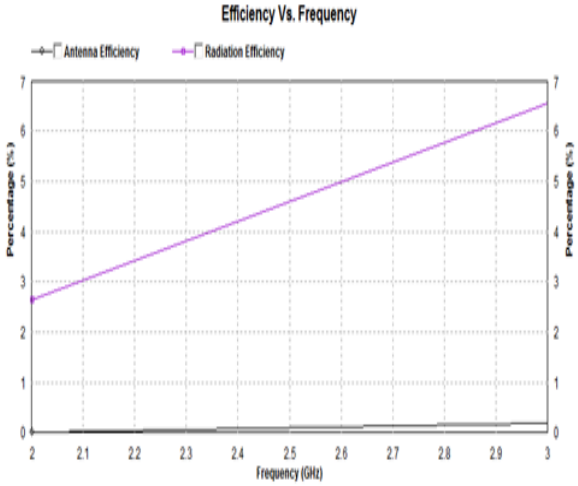

Fig5.6: Efficiency Vs Frequency

ANALYSIS OF PARAMETERS AT DIFFERENT FREQUENCIES

Table5.1

Frequency(GHZ)	2	2.5	3
Gain(dbi)	- 36.26	-31.3	-20.5
Directivity(dbi)	6.924	6.94	6.99
Voltage source gain(dbi)	-37.35	-31.44	-26
Antenna efficiency	.0028	0.0146	0.065
Radiation efficiency	2.9	3.5	6.5
VSWR	145	139	130
VSWR(db)	52	50	43

By increasing frequencies, gain, directivity, voltage source gain, antenna efficiency as well as radiation efficiency increases and VSWR, VSWR (db) decreases with respect of decreasing frequencies.

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6. LIMITATIONS

The design of square patch antenna is difficult to fabricate and also there is increase in overall thickness of an antenna.

7. CONCLUSION AND FUTURE SCOPE

The design has been successfully simulated in the IE3D tool. From the design concluded that as the length of Micro Strip line feed increases the parameters of the antenna changes. Directivity and Gain increases as we increase the frequency of antenna. Return loss decreases as the frequency increases. The proposed antenna is suitable for WIFI (2.4-2.48GHZ), wireless communication, etc.

The antenna can also be designed by varying dielectric. This software also helps in material realization of Micro Strip Patch Antenna with the help of PCB circuit board.

REFERENCES

[1] C. A. Balanis, "Antenna Theory, Analysis and Design", JOHN WILEY & SONS, INC, New York 1997.
[2] R. Garg, P. Bhartia, I. Bahl, A. Ittipiboon, "Micro strip Antenna Design Handbook", ARTECH HOUSE, Boston 2001.
[3] S. Silver, "Microwave Antenna Theory and Design", Mc GRAW-HILL BOOK COMPANY, INC, New York 1949.
[4] D. M. Pozar and D. H. Schau bert, Micro strip Antennas: The Analysis and Design of Micro strip Antennas and Arrays, IEEE Press, 1995.
[5] K. F. Lee, Ed., Advances in Micro strip and Printed Antennas, John Wiley, 1997.