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Design & Analysis of Square Microstrip Patch Antenna

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Abstract— ***This research aims at designing and analysis of Square Microstrip patch Antenna, Communication between humans was first by sound through voice. With the desire for slightly more distance communication came, devices such as drums, then, visual methods such as signal flags and smoke signals were used. These optical communication devices, of course, utilized the light portion of the electromagnetic spectrum. 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. One of humankind's greatest natural resources is the electromagnetic spectrum and the antenna has been instrumental in harnessing this resource. This paper provides a detailed study of how to design and fabricate a probe-fed Square Microstrip Patch Antenna using IE3D software and study the effect of antenna dimensions Length (L), and substrate parameters relative Dielectric constant (ε_r), substrate thickness (t) on the Radiation parameters of Bandwidth and Beam-width. The proposed antenna is designed at the height of 1.59mm from the ground plane and this design is operated at 3.0GHz.***

Index Terms— ***Square Patch Antenna, VSWR, Return Loss.***

I. INTRODUCTION

In the recent years the development in communication systems requires the development of low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a wide spectrum of frequencies. The future development of the personal communication devices will aim to provide image, speech and data communications at any time, and anywhere around the world. This indicates that the future communication terminal antennas must meet the requirements of multi-band or wideband operations to sufficiently cover the possible operating bands. The performance of the fabricated antenna was measured and compared with simulation results. In modern wireless communication systems, the microstrip patch antennas are commonly used in the wireless devices. Therefore the miniaturization of the antenna has become an important issue in reducing the volume of entire communication system.

In modern wireless communication systems, the microstrip patch antennas are commonly used in the wireless devices. The demand in commercial and military wireless systems is due to capabilities of proposed Antenna such as low weight, low profile, low cost, easily combined with de-sign and technology, and relatively simple fabrication.

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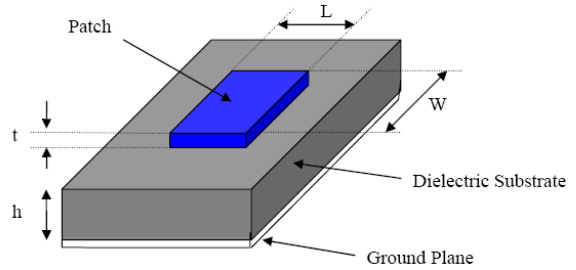

Figure1. Structure of Microstrip Patch Antenna

All these antennas can also fabricate using IE3D simulation software and get very sharp characteristics. Proposed RMPA can be largely used in many wireless communication systems because of their low profile and light weight Microstrip antennas are largely used in many wireless communication systems because of their low profile and light weight. The important parameters of any type antenna are impedance bandwidth and return loss. The impedance bandwidth depends on parameters related to the patch antenna element itself and feed used. The bandwidth is typically limited to a few percent.

II. DESIGN SPECIFICATION

In this chapter, the procedure for designing a square microstrip patch antenna in IE3D software is explained. And the results obtained from the simulations are demonstrated. The Square microstrip patch antenna parameters are calculated from the following formulas.

Hence, the essential parameters for the design are:

- f_0= 3.0 GHz
- ε_r= 2.55
- h = 1.59 mm

A. *Calculation of Width (W):*

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

Where

c =free space velocity of light

ε_r=Dielectric constant of substrate

B. *Calculation of the effective length:*

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

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C. *Calculation of length extension:*

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

D. *Actual length of the patch (L):*

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

III. ANALYSIS OF SQUARE MICROSTRIP PATCH ANTENNA

The Square Microstrip patch Antenna designed at 3.0 GHz frequency, dielectric constant ε_r =2.55 and height from the ground plane h= 1.59 mm. The parameter of square microstrip patch antenna are L=30mm, W=30 mm.
The simple Square Microstrip patch Antenna is designed at 3.0 GHz.

Table 1. Square Microstrip patch Antenna Specification

parameter	Dimension	unit
Dielectric constant (ε_r)	2.55	-
Frequency (f_r)	3.0	GHz
Height	1.59	mm
Practical width(W)	30	mm
Velocity of light(c)	3×10^8	ms-1
Loss Tangent (tan δ)	0.001	-
Practical Length (L)	30	mm

The optimum feed point is found to be at (1,1) the bandwidth of the antenna for this feed point location is calculated to be is obtained which is very close to the desired design frequency of 3.0GHz.Figure. 2 below shows the return loss plots for some of the feed point locations.

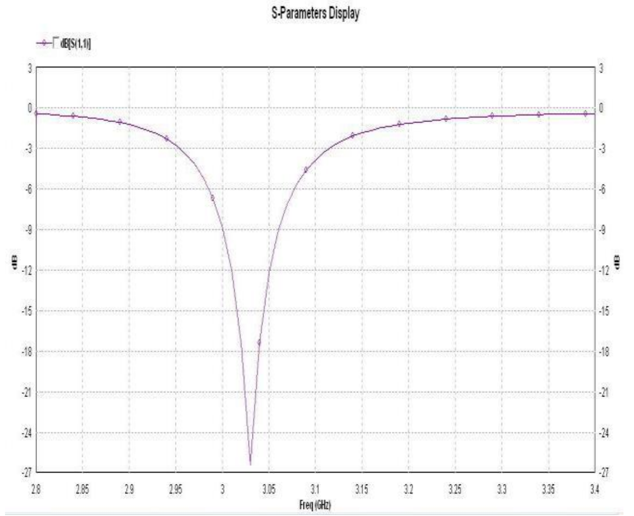

Figure2. Return loss for feed located at different locations using IE3D.It is observed from the table that, as the feed point location is moved away from the center of the patch, the center frequency.

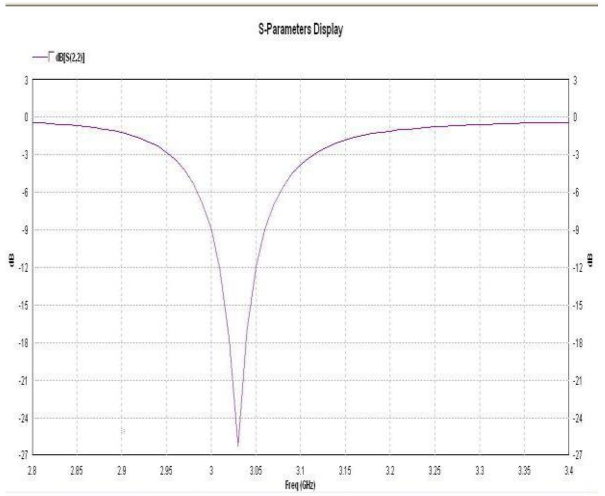

Figure3. S-Parameter Displays for S (1, 1)

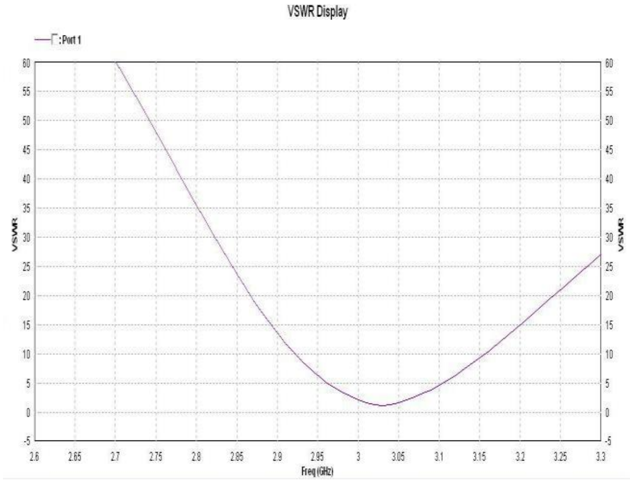

Figure4. S-Parameter Displays for S (2, 2) Voltage Standing Wave Ratio (VSWR)

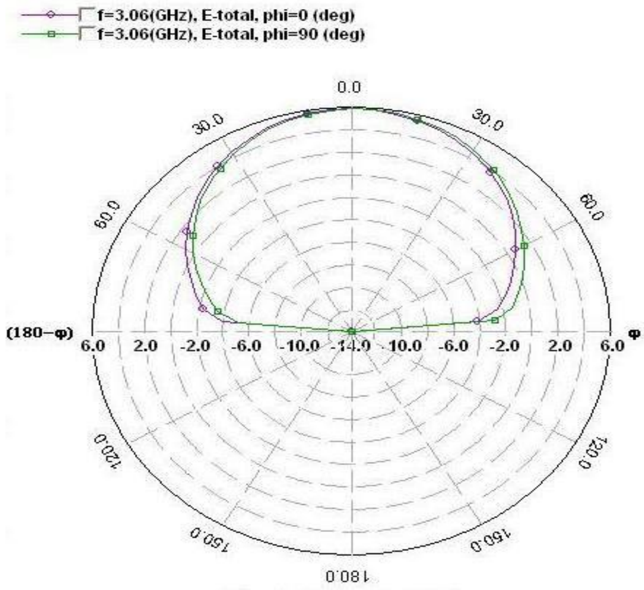

Figure5. Elevation Pattern for φ = 0 and φ = 90 degrees

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IV. CONCLUSION

The design of Square patch dual feed (Probe Feed) antenna for circular polarization has been completed using IE3D software. The simulation gave results good enough to satisfy our requirements to fabricate it on hardware which can be used wherever needed. The investigation has been limited mostly to theoretical studies and simulations due to lack of fabrication facilities. Detailed experimental studies can be taken up at a later stage to fabricate the antenna. Before going for fabrication we can optimize the parameters of antenna using one of the soft computing techniques.

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