Bandwidth improvement of rectangular patch antenna at frequency 2.3 GHz

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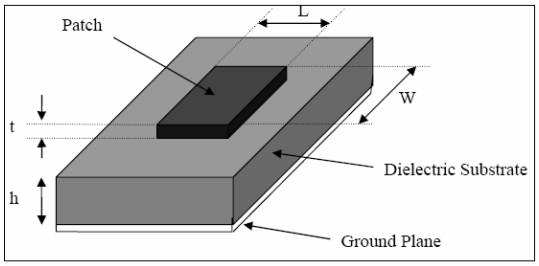
Abstract-: As per the electrical and mechanical behaviour microstrip patch antenna is use full for aircraft, missiles, satellites, ships, vehicle, base station etc. It is far better then conventional antenna with more advantages and better prospect such as planer, smaller in size, simple structure, and low in cost and easy to be fabricated, thus attractive for practical application. This paper introduces a different geometry of a rectangular microstrip patch antenna that resulting better then a conventional microstrip patch antenna. Parameters selected for design are frequency 2.3 MHz, Thickness 1.6mm, dielectric constant 4.4, loss tangent 0.012. Finally simulation of antenna is done using design software IE3D with feed point (38.3, 14.8) show the bandwidth 51%.

Index- Rectangular microstrip patch antenna, IE3D software, Gain, Bandwidth.

Introduction – According to new generation several changes noted in communication field the system requires a low cost ,less weight ,low profile antenna that are capable of maintaining high performance over a wide ranges of frequencies so on this behalf the microstrip patch antenna are commonly used in wireless devices by doing this volume of whole communication system is also reduce. It is perfect to classify antenna as the backbone and the driving force behind the recent advances in wireless communication technology. In radio telecommunication, among the antenna design, their are many different categories of microstrip antenna which are also know by the name printed antenna. The most common of which is microstrip patch antenna or patch antenna. A microstrip patch antenna consists of a very thin metallic patch of small wavelength above a conducting ground plane. Both are separated by a dielectric .copper is used as a patch design in any shape .but simple geometry are used and this simplifies the analysis and performance prediction .patch are photo etched on dielectric substrate .the substrate is usually non-magnetic. Dielectric constant lie between $2.2< \varepsilon r <12$ .which enhances the fringing fields that amount for radiation .by this specification mainly microstrip patch antenna are mostly used .it is characterised by its length L width W and thickness H



The simplest method of feeding the patch is by a coplanar microstrip line, also photo etched on the substrate. Coaxial feeds are also widely used .the inner conductor of coaxial line is connected to the radiating patch while the outer conductor is connected to the ground plane .the antenna are fabricated using IE3D simulate software and get useful characteristics ,important parameters are their impedance bandwidth and return loss. The impedance bandwidth depends on parameters related to the patch antenna elements itself and feed used. The bandwidth is typically limited to a few percentages. The drawback of this type of antenna is narrow bandwidth, low gain spurious feed radiation, limited power handling capacity. In this paper, an attempt has been made to design a single band microstrip antenna without any geometrical complexities and drawbacks.

ANTENNA DESIGN AND LAYOUT

The length and width of rectangular patch antenna are calculated from below equations. Where c is the velocity of light εr is the dielectric constant of substrate.

1: **Calculation of the Width (*W*):** The width of the Microstrip patch antenna is given by equation as:

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$$W = \frac{c}{2f\sqrt{[(\varepsilon_r+1)/2]^{1/2}}} \quad \text{.....(1)}$$

2: **Calculation of Effective dielectric constant (**εreff **):** The following equation gives the effective dielectric constant as:

$$\varepsilon_{re} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + \frac{12h}{W}\right)^{-\frac{1}{2}} \quad \text{..(2)}$$

3: **Calculation of the Effective length (**Leff **):** The following equation gives the Effective length as:

$$L_{eff} = \frac{c}{2 f_o (\varepsilon_{reff})^{1/2}} \quad \text{..... (3)}$$

4: **Calculation of the length extension (**Δ*L)*: The following equation gives the Length extension as:

$$\frac{\Delta l}{h} = 0.412 \frac{(\varepsilon_{reff}+0.300)(W/h+0.262)}{(\varepsilon_{reff}-0.258)(W/h+0.813)} \quad \text{..... (4)}$$

5: **Calculation of actual length of patch (**L**):** The actual length is obtained by The following equation-

$$L = L_{eff} - 2\Delta L \quad \text{..... (5)}$$

6: **Calculation of the ground plane Dimensions (Lg and Wg):** Ideally the Ground plane is assumed of infinite size In length and width but it is practically Impossible to make an infinite size Ground plane, so to calculate the length And width of a ground plane followings Equations are given as:

$Lg = L + 6h$

$Wg = W + 6h$

7: **Determination of feed point location (Xf, Yf):** A coaxial probe type feed is To be used in this design. The centre of The patch is taken as the origin and the Feed point location is given by the co-ordinates (Xf, Yf) from the origin. a trial and error method is used to locate the feed point. For different Locations of the feed point, the return Loss (R.L) is compared and that feed point is selected where the R.L is most negative.

Design of Micro strip patch antenna	**Software Desighn**	**Hardware Desighn**
Name of Pattern	plus Shape	plus Shape
Frequency of Operation (GHz)	2.3	2.3
Dielectric constant of substrate	4.4	4.4
Loss tangent	.0012	.0012
Height of the dielectric substrate	1.6mm	1.6mm
Feeding method (Probe feeding)	Point (x=38.3, y=14.8)	Point (x=38.3, y=14.8)
Width of the ground (W_g)	43.1mm	43.1mm
Length of the ground (L_g)	53.1mm	53.1mm
Width of the patch (W_p)	33.5mm	33.5mm
Length of the patch (L_p)	43.5mm	43.5mm

SIMULATION RESULTS AND DISCUSSION

After simulating the antenna design 1 and design 2 various results obtain are shown below.

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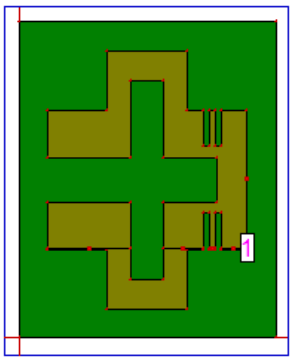
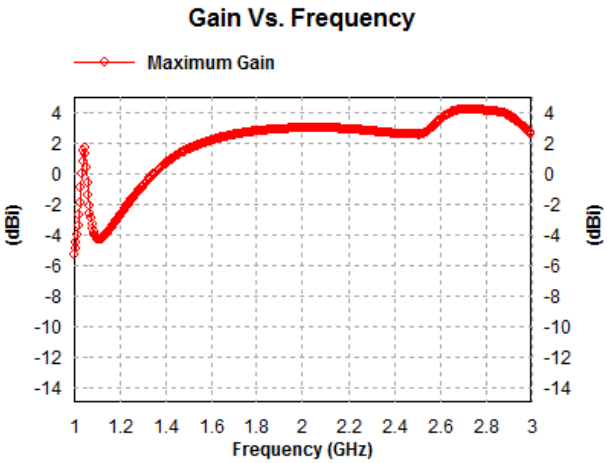
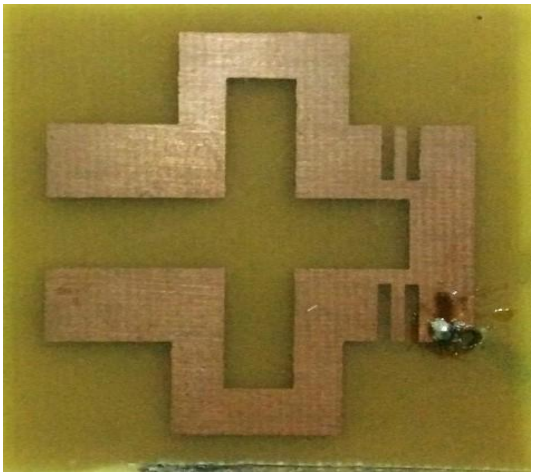
Desighn 1 on IE3d Software-:



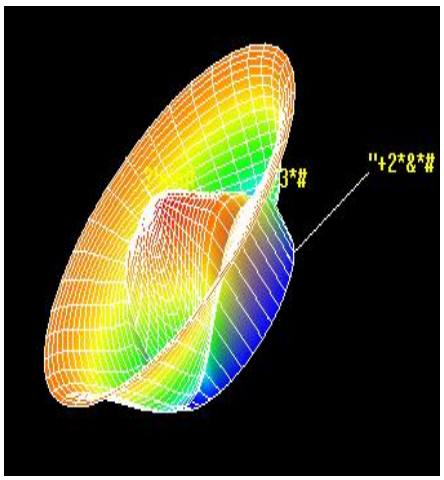
GAIN VS FREQUENCY



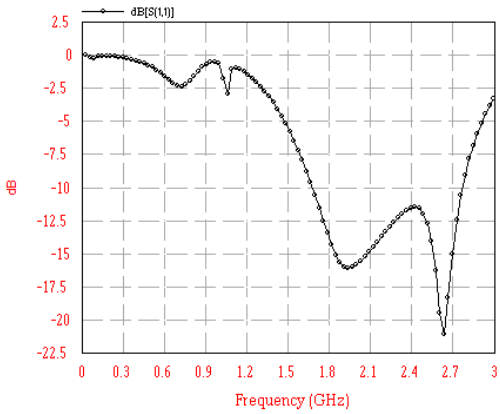
Desighn 2 on Hardware-:



RADIATION PATTERN



FREQUENCY VS RETURN LOSS



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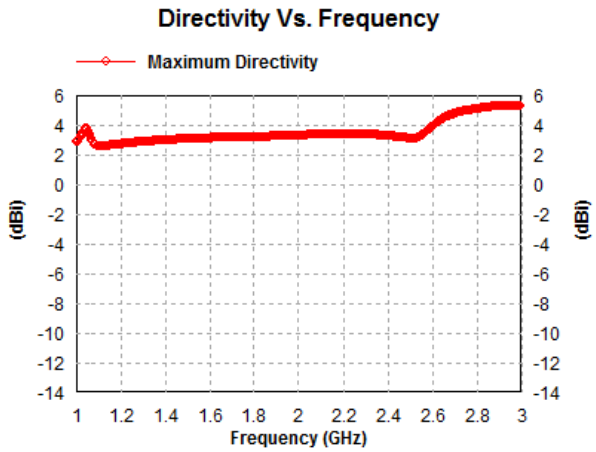
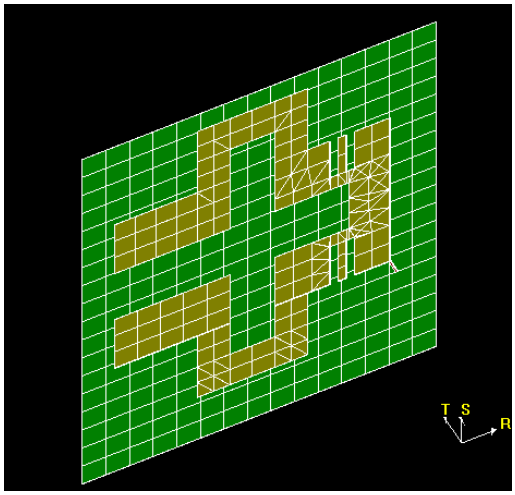
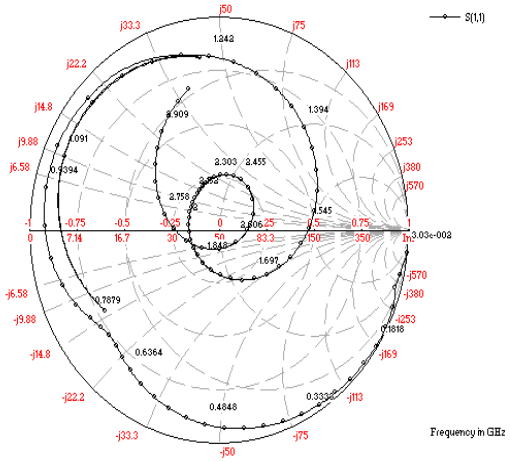
DIRECTIVITY VS FREQUENCY



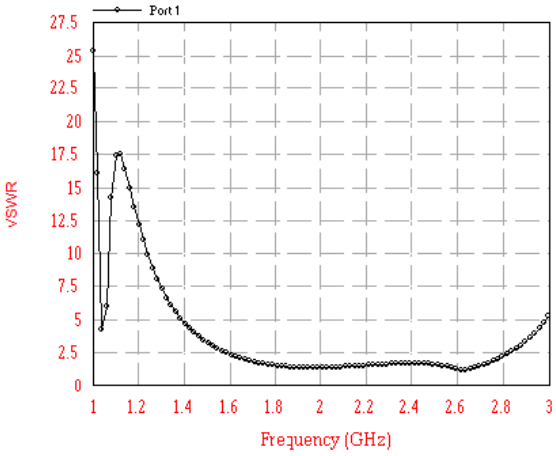
3D VIEW



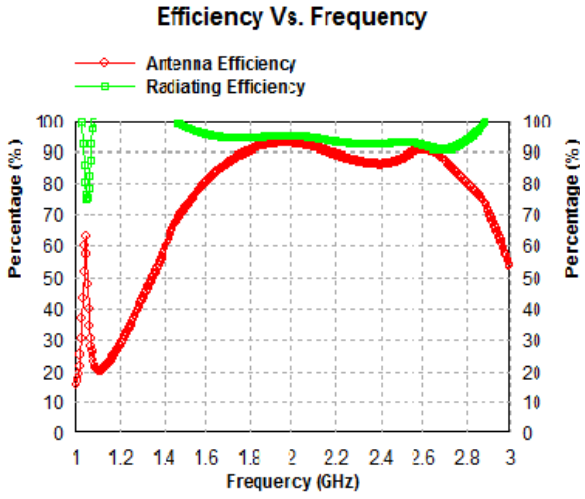
SMITH CHART



FREQUENCY VS VSWR



EFFICIENCY VS FREQUENCY



Hardware based results:-

Return Loss Vs Frequency

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Conclusion-:

In this paper, the design of a microstrip rectangular patch antenna for 2.3GHz frequency was noticed. The results for the designed antenna above shows that the coaxial probe fed rectangular microstrip patch antenna can be used for applications in cordless handset and for cellular application. The simulated results show that the rectangular microstrip patch antenna will be compact and low cost solution various application. Also since glass epoxy is used as the dielectric substrate, the cost of fabrication of the antenna would be less. Antenna design one shows 51% bandwidth antenna design two shows 30% bandwidth which is hardware based.

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