DESIGN AND SIMULATION A NOVEL MICROSTRIP PATCH ANTENNA FOR SATELLITE APPLICATION

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Abstract— **In this paper is focused on design and simulation of two element microstrip patch array with the use of inset feeding technique.** ***The each element of array is designed by microstrip patch antenna with a single slot at different positions in rectangular structure. The array antenna consists of two square patch antenna elements fabricated on RT/duroid 5880 substrate. It is transformed to single patch to 2×1 linear patch array and analyzed to directivity and increase gain, better radiation patterns. The measured frequencies of single band 2x1 linear patch array are observed at 28.5 GHz for a novel system. The CST microwave studio software is used for fabrication of simulated patch array antenna.***

Keywords- Rectangular micro strip patch Antenna, Inset feed, K_a- Band, Radiation Pattern, 3D Polar Plot.

I. INTRODUCTION

The micro strip antenna is used for satellite communication systems in which variousapplications are resultingin improved antenna performances due to its low profile and light weight. It is easy to fabricate and low cost of mass production. These antennas are designed for the Ka-band satellite applications due to the simplicity in structure, ease of fabrication, high gain and high efficiency. The substrate thickness and bandwidth specifications are quite stringent and difficult to achieve for conventional rectangular micro strip patch [1].This is a way to choose the effective feeding technique between the transmission lines and Micro strip patch antenna.
By comparing the other antenna parameters the best feeding technique will be selected for the design of micro strip patch array antenna are inset feed technique. Various parameters of the Micro strip patch antenna such as design considerations and feeding networks, as the feeding network and radiation array are printed on single layer by the ground plane. Micro strip patch antenna array which may be used for mobile satellite digital communication terminals [4].

II. FEED TECHNIQUES

The four most popular feed techniques are used for the Micro strip patch is given by-

a) Inset feed
b) Pin feed
c) Aperture coupling
d) Proximity coupling.

This antenna is a method for using an inset feed [5]. The Inset feed antenna provide a method to control impedance with a planar feeding configuration.
The feeding technique parameters like VSWR, Return loss, bandwidth are varied and effective feeding technique between the transmission lines & patch antenna. The input impedance Z_{in} can be altered by selection of the Z_1, So that $Z_{in}=Z_o$ and the antenna impedance matched. The quarter wave length line is [6].

$$Z_{in} = Z_o = Z^2_1/Z_A \quad (1)$$

The parameter Z_1 can be altered by changing the width of the quarter-wave length strip, it is wider strip line is used to increased the band width and decreased the characteristic impedance (Z_o) which is a section of line.

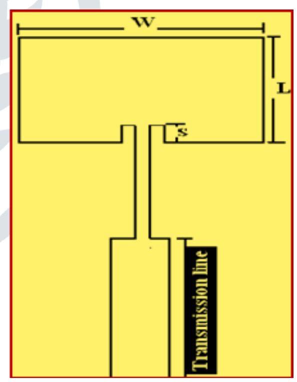


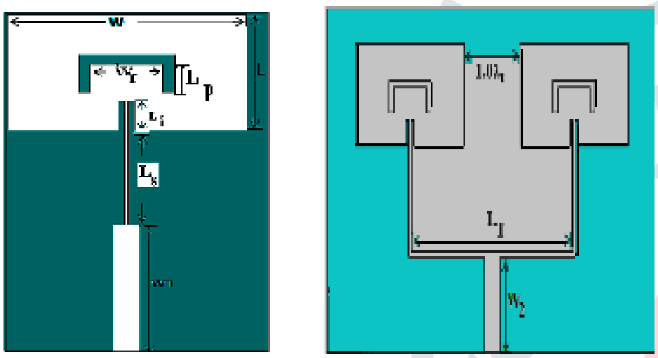
Fig.1: Rectangular Micro strip Patch Inset feed.

III. DESIGN OF SINGLE PATCH ELEMENT AND 2X1 MICROSTRIP PATCH ARRAY

Antenna element consists of a rectangular patch, substrates, a slotted ground plate, and a feeding circuit, as shown in Fig.1. The micros trip patch elements are arranged with equal spacing of $1.0\lambda_o$. Corporate networks are developed for feeding the micro strip patch elements [2]. It is a 2x1 rectangular patch array antenna with RT/duroid5880 substrate has been designed and simulated at 28.64-28.8 GHz frequency in. We have taken RT/ duroid5880 dielectric constant (ϵ_r) as 2.2 and height of the dielectric substrate h = 0.25 mm. As 50Ω quarter wave length transmission line is used normally, feed point is taken $Z_1 = Z_2$= 50Ω resistance.

TABLE 1
PHYSICAL DIMENSIONS

Parameter's		Dimensions(mm)
Microstrip Patch Antenna	W	6.6
	L	3.87
	W_r	2.6
	L_p	0.3
	L_i	0.95
	L_s	4.13
	W_1	4.63
	L_T	10.15
	W_2	3.60



(a) (b)

Fig.2: Inset feed patch antenna (a) Single (b) 2x1 Array Slot.

IV.SIMULATION RESULTS & ANALYSIS

The designed patch antenna is simulated using CST simulation software. The results obtained are mentioned below.

A.Return loss curve:

Return loss (S_{11}) is a measure of the effectiveness of power delivery from a transmission line to load the antenna. Return and insertion loss can be used to characterize the antenna and provide an immediate estimate for performance of the antenna. A return loss of single patch antenna is -16.00 dB which is obtained at 28.64 GHz and 2x1 arrays are -20.17dB at 28.8GHz frequency.

$$Return\ loss= 10log_{10}(P_{in}\backslash P_{ref}) \qquad (2)$$

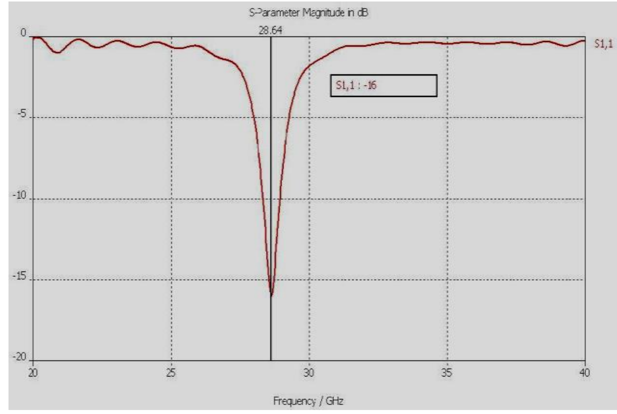


Fig.3: Single patch return loss (-16) at f=28.64GHz.

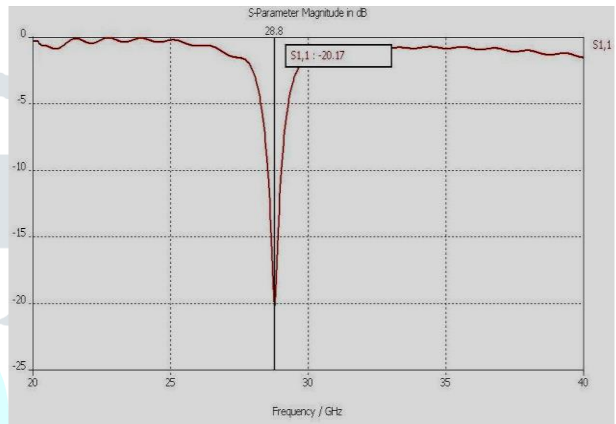


Fig.4: 2x1 Array patch return loss (-20.17) at f=28.8GHz.

B. Gain:

The intensity that would be measuring, if the power accepted by the antenna were radiated, For the single patch antenna model a 3D Gain of 5.95dB and 2X1 array Gain of 6.30 dB is obtained.

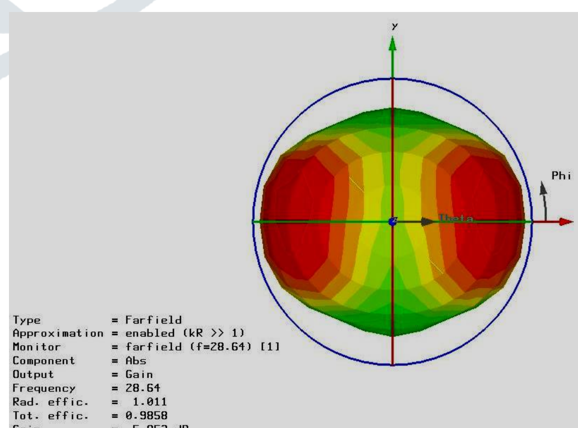


Fig. 5: Single patch antenna with Gain = 5.95dB.

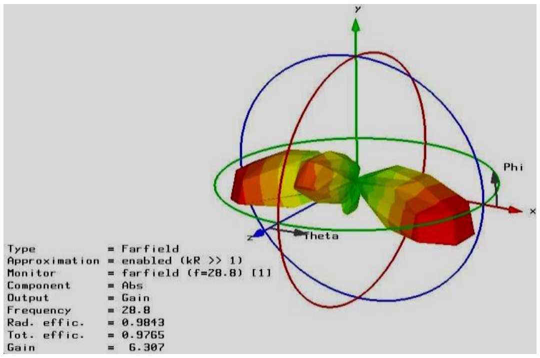


Fig.6: 2x1 Array antenna with Gain = 6.30 dB.

C. Radiation pattern:

The radiation field of the micro strip antenna may be determined using either an "electric current model" or a "magnetic current model". Radiation properties of the antenna can be represented by radiation pattern.

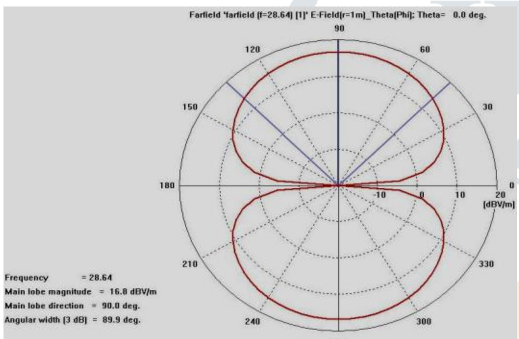


Fig.7: Single patch antenna with E-Field radiation pattern.

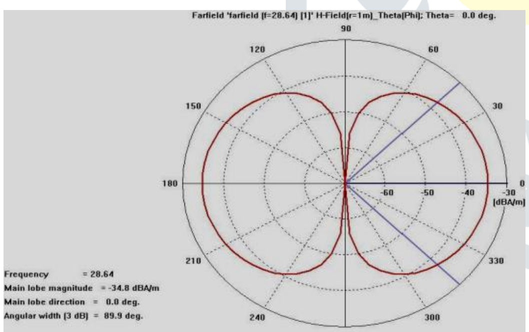


Fig.8: Single patch antenna with H-Field radiation pattern.

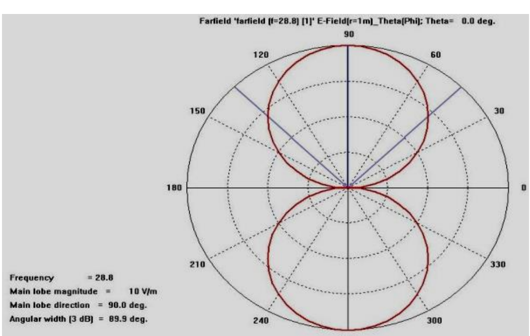


Fig.9: 2*1 Array antenna with E-Field radiation pattern.

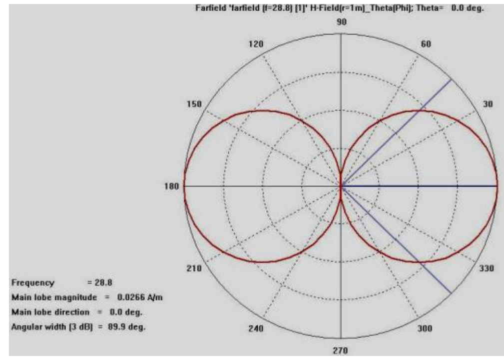


Fig.10: 2*1Array antenna with H-Field radiation pattern.

TABLE II
Comparisons of Simulated Results

Quantity	Single patch	2x 1 ARRAY
Patch Dimensions	12 x 10 mm	20 x 13 mm
Gain(dB)	5.95dB	6.30dB
Bandwidth	11.02 dB	15.29dB
Return loss (dB)	-16.00	-20.17
Directivity	5.90dBi	6.40dBi

V. CONCLUSIONS

The rectangular micro strip antenna is printed with RT/duroid5880 substrate and permittivity = 2.2 both models of inset feed antenna at frequency (f) =28.64 GHz for single patch antenna and -28.8 GHz for 2x1 array patch antenna are to be designed and simulated. The simulated 2x1 array models have better performance than single patch antenna which has been compared. The simulation predicts a slight improvement in the return loss & gain in designed 2x1 arrays.

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