A New Linear Micro strip Patch Antenna Array

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***Abstract*— In this paper the design of inset feed Linear Micro strip patch antenna array has been proposed. It has been observed for a printed antenna array at frequencies of 2.9GHz and 7.7GHz. The Ansoft HFSS 13.0 software is used to simulate the antenna array. The dimension of each patch antenna in the array of four antennas is 25mm×18mm. The characteristics of the antenna array are determined in terms of Return loss, VSWR and gain. The array produces a return loss of -15.70dB at 2.9GHz and a return loss of -18.92dB at 7.7GHz. The VSWR values are 1.39:1 at 2.9GHz & 1.25:1 at 7.7GHz.The overall obtained gain is around 3.8 dB.**

Keywords—Gain, Micro strip patch, Return loss, VSWR and Inset feed.

I.INTRODUCTION

In many of the modern applications like wireless communication system requires simple structure antennas with a low profile, light weight and high gain to give better reliability, mobility, and high efficiency characteristics [1, 2]

Micro strip antennas are easy to fabricate and are light weight with low profile. The applications are limited by poor efficiency, gain and narrow impedance bandwidth [3].these drawbacks occur due to the impedance mismatch and to overcome this feed should be given where the resonant resistance and feed-line resistance are equal. Micro strip structure design requires understanding of the mathematical relations and also its applications [3].

In many applications, in order to provide high efficiency the micro strip patch antenna is fed using either coaxial probe feed or insert micro strip line as both are direct contact methods [4]. If we consider a single antenna, it resembles a cavity backed antenna as proposed by saloon [5] which is nothing but a suspended antenna which is designed to get high bandwidth and gain. This proposed antenna suffers from impedance mismatch which can be overcome by the inset feed. The Inset-fed Micro strip antenna with a planar feed configuration provides a method for impedance control that is required. This antenna provides the advantages of printed circuit technology. These advantages of Micro strip antennas make them popular in many wireless communication applications such as satellite communication, radar, medical applications, etc. [6]

Here we use an array of antennas instead of a single antenna in order to improve its gain. An array is one in which the current is spitted up in between the antennas in the array and here we use an array of four antennas. In many of the cases like high gain arrays we use an inset feed which provides high efficiency where the input impedance is determined by the inset length.

In this paper we propose a method for designing the inset feed section of the array to reduce the mismatch between the patch and feed network. The input impedance of the inset feed micro strip patch antenna mainly depends on the inset distance ‘A’ and to some extent on the inset width [7] and in some cases the inset gap is taken the same width as the feed line [8].

II. ANTENNA DESIGN

The patch antenna was designed depending on the basics of the transmission line model (TLM). The width of the patch can be calculated by the formula

$$W = \frac{C}{2f\sqrt{\frac{\varepsilon_r + 1}{2}}}$$

Where 'ε_r' is the substrate dielectric constant, 'W' is the width of the patch and 'h' is the height of the substrate. An effective dielectric constant ε_{reff} is used which is defined as the dielectric constant of the uniform dielectric material and given by,

$$for\ \frac{W}{h} \geq 1$$

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{-\frac{1}{2}}$$

$$for\ \frac{W}{h} \leq 1$$

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{-\frac{1}{2}} + 0.041\left[1 - \sqrt{\frac{W}{h}}\right]$$

The patch used in our model is a square patch, so the length and width are same. The dimensions of the patch are extended to account the fringing effect; the extension is given by,

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

Since the length has been extended on each side of the patch, the effective length is given by

$$L_{eff} = \frac{C}{2f\sqrt{\varepsilon_{reff}}}$$

Patch resonant length L is given by,

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

The configuration of the double-band antenna is shown in figures 1(a) and 1(b). The array of rectangular patches is the radiating element shown in figure 1(a). We used a 1.6 mm-thick FR4 epoxy substrate and ε_r = 4.4. The partial ground plane is located on the backside of the dielectric substrate, as shown in Figure 1(b). The array along with the ground plane gives resonance in the 2.85 to 2.96 and 7.58 to 7.78 GHz bands. The combination of the array of rectangular patches and ground plane results in Double band resonating frequencies (2.9 and 7.7GHz) operating antenna. The proposed antenna is simulated using Ansoft HFSSv13 software and is shown in Figure 2.

The following table gives the dimensions of the designed antenna array,

Table: The antenna dimensions (in mm)

Parameter	Size (mm)	Parameter	Size (mm)
W	25	D	28.5
L	18	P	20
Wf	6	Q	15
A	5	R	16
B	7.5	Lg	25
C	75	Wg	150

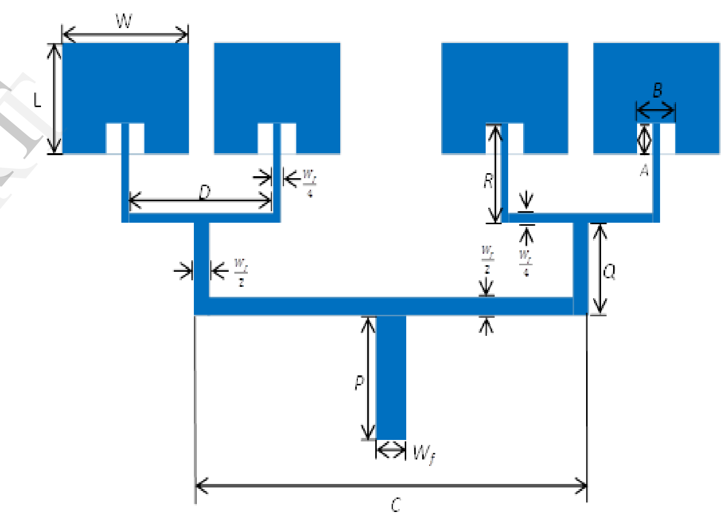

Figure 1(a): Patch

Figure 1(b): Ground

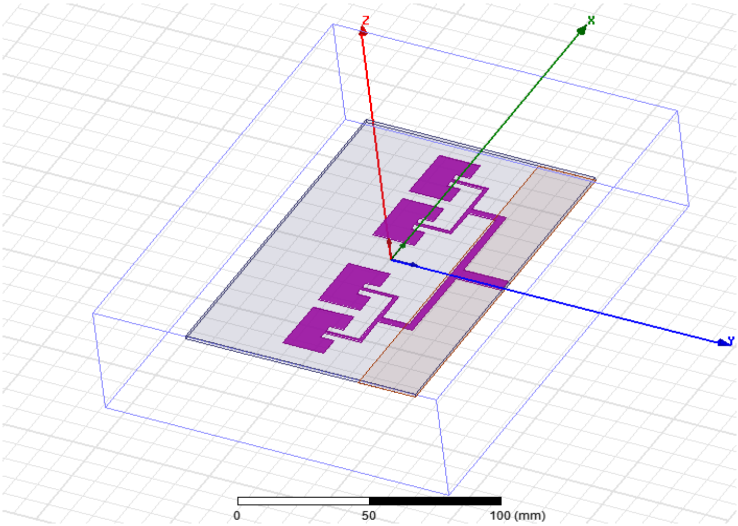

Figure 2: Simulated antenna using HFSS

III. SIMULATED RESULTS

The characteristics of patch antenna and arrays are determined in terms of Return loss, VSWR, Radiation pattern and Gain using HFSS. The gain obtained is 3.8dB. The return losses cross -10dB over 2.85 to 2.96 GHz and 7.58 to 7.78 GHz and the resonating frequencies are 2.9 and 7.7 GHz. The 2D-gain observed in the structure shows a maximum of 3.71dB and a minimum of -20.28 dB. VSWR obtained at 2.9 GHz and 7.7 GHz are 1.39:1 and 1.25:1 respectively. The characteristics can be observed from the simulated results as shown below

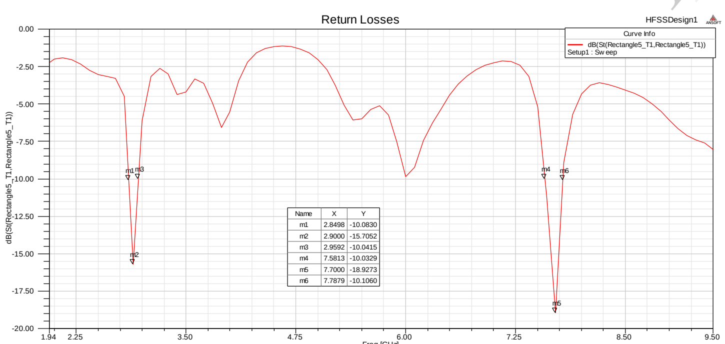

Figure 3: Return Losses

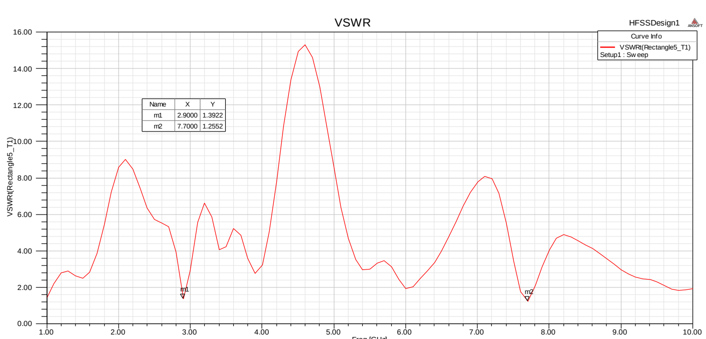

Figure 4: VSWR Curve

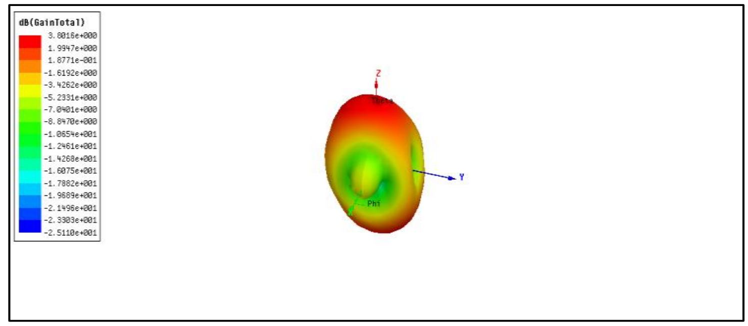

Figure 5: 3D Gain of the array

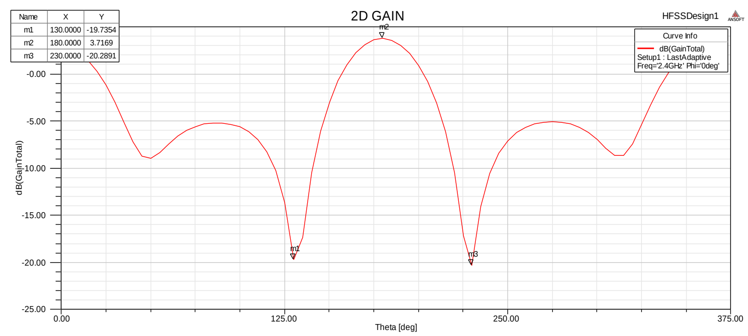

Figure 6: 2D- GAIN

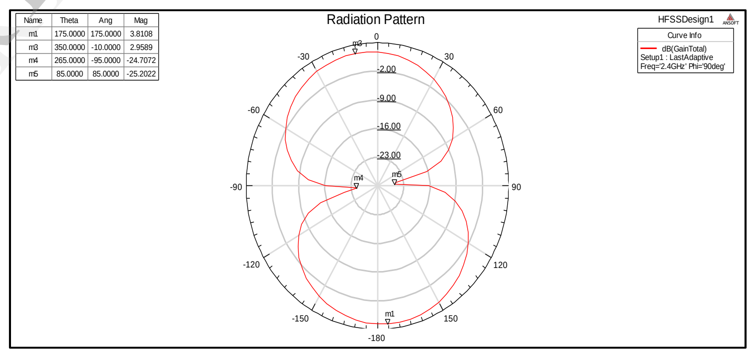

Figure 7: Radiation Pattern

IV. Conclusions

In this paper, the design of inset feed Linear Micro strip patch antenna array has been proposed. It has been observed for a printed antenna array at frequencies of 2.9GHz and 7.7GHz. The Ansoft HFSS 13.0 software is used to simulate the antenna array. The dimension of each patch antenna in the array of four antennas is 25mm×18mm. The characteristics of the antenna array are determined in terms of Return loss, VSWR and gain. The array produces a return loss of -15.70dB at 2.9GHz and a return loss of -18.92dB at 7.7GHz. The VSWR values are 1.39:1 at 2.9GHz & 1.25:1 at 7.7GHz.The overall obtained gain is around 3.8 db.

V. REFERENCES

[1] Kashwan K R, Rajesh Kumar V, Gunasegaram T and Shankar Kumar K R, "Design and Characterization of Pin Fed Micro strip Patch Antennae", IEEE proceedings of FSKD'2011

[2] M. T. I. Huque, et al., "Design and Simulation of a Low-cost and High Gain Micro strip Patch Antenna Arrays for the X-band Applications," in International Conference on Network Communication and Computer –ICNCC 2011, New Delhi, India., March 21-23, 2011.

[3] Ramesh Gharg, Prakash Bhartia, "Microstrip Antenna design Handbook", Artech House, 2000

[4] Rodney B Waterhouse, "Microstrip Patch Antennas, A Designers Guide".

[5] N.U. Lau' and R. Sloan, Suspended Microstrip Patch Antenna with Ground-shield Tapered Suspended Stripline Feed, 33rd European Microwave Conference IEEE - Munich 2003

[6] N. Kanniyappan, Dr.R. Indra Gandhi, "Design and Analysis of Micro strip Patch Antenna Feeding Techniques",IEEE proceedings of International Conference on Computational Intelligence and Computing Research'2011

[7] M. Ramesh and YIP KB, Design Formula for Inset Fed Microstrip Patch Antenna, Journal of Microwaves and Optoelectronics, Vol. 3, No 3, December 2003.

[8] Y.T.Lo, S. W. Lee, "Antenna Handbook", Vol 2

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