Design of 2-element Ultra Wide Band array antenna for satellite and radar communication

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***Abstract*— A single layer, dual co-axial feed microstrip array antenna is proposed for the above mentioned communication purposes. We achieve array antenna with a low gain and high -3db beam-width for the application for which it is intended. The magnitude for the above application is very high means it will work in the good manner i.e. there will be no inter symbol interference for the application for which it is intended. The maximum resonance is 99.75Ω at 0.81 GHz and average resonance is 84.75Ω. The minimum resonance gets at 3.83 GHz with 1Ω resonance. We achieve the maximum return loss of about -97.25 GHz and minimum return loss of about -27.5 dB with the bandwidth of 10 GHz. Finally we achieve the -3 dB beam-width of about 156.31^0 with absolute gain of -9.57 dBi.**

***Keywords*— Layer, Feed, Resonance, Absolute Gain, Return Loss**

I. INTRODUCTION

For new era of communication, design of compact microstrip antenna creates a lot of interest among the young engineers especially for microwaves engineer [1]. For the portability of microwave devices, we need small, light weight and compact antenna and on this ground Compact Microstrip Antenna is the most suitable device. The two operating frequencies are required mainly because most of the microwaves and wireless engineers use different communication bands and for uses of different bands different frequencies are used by the engineers. Therefore recently the engineers design antennas which has multiband characteristics. Another criteria needed to design the antenna is size reduction which is the new technique and in this method the size of the antenna is same for conventional as well as proposed antenna. For size reduction the most useful technique is to cut different structures in the proper position on the conventional microstrip antenna. Reducing the size of the antenna means the resonant frequency of slotted antenna is drastically reduced compared to conventional antenna [2-7]. There are so many antennas are used to reduce the size of proposed antenna like DRA (Dielectric Resonator Antenna), Fractal Antenna etc [8-10]. But the above mentioned antennas are very difficult to design compared to microstrip patch antenna. Now the structure of Fractal antennas are just like a Euclidean geometry structure and it is a combination of triangle, square and circles etc. So Fractal antennas are very much difficult to design and DRA requires high dielectric constant substrates (more than 20) which are not readily available [11-14]. Now a day's the size of the compact microstrip antenna is very small and miniaturization is possible so these antennas are increasing the demand of their application in various communications especially microwave and mobile communication. For size reduction of the antenna, we need dielectric constant with high values. The simulation has been carried out by IE3D [15] software which uses the MOM method and verified by measurements. This is applicable to C-Band microwave frequency band ranges from 4-8 GHz.

II. ANTENNA DESIGN

The configuration of the array antenna is shown in Figure 1 substrate (PTFE) thickness h =1.6 mm, dielectric constant εr = 4.4. Coaxial probe-feed (radius=0.5mm) is applied for getting the better result.

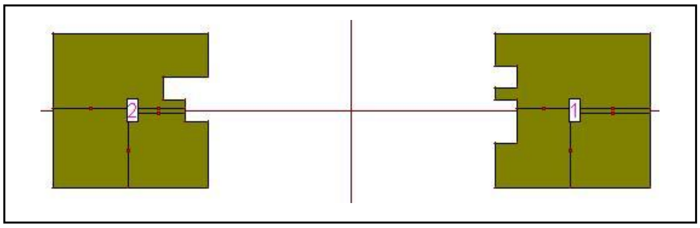

Figure 1: Two element array antenna

III. RESULTS AND DISCUSSION

Simulated (using IE3D [15]) results of return loss in array antenna structures are shown in Figure 2.

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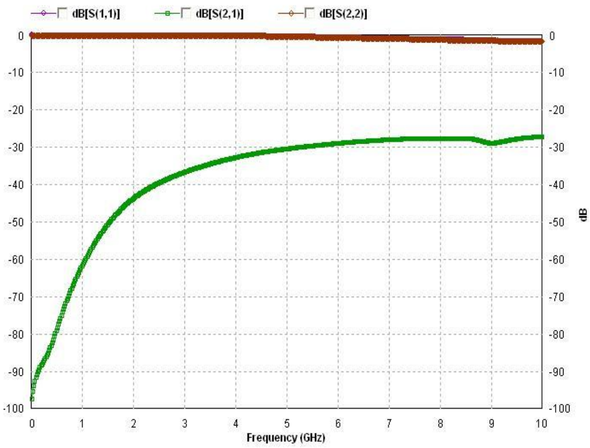

Figure 2: Return Loss of designed antenna

The simulated E plane and H-plane proposed antenna radiation patterns for all resonant frequencies are shown in Figure 3-11.

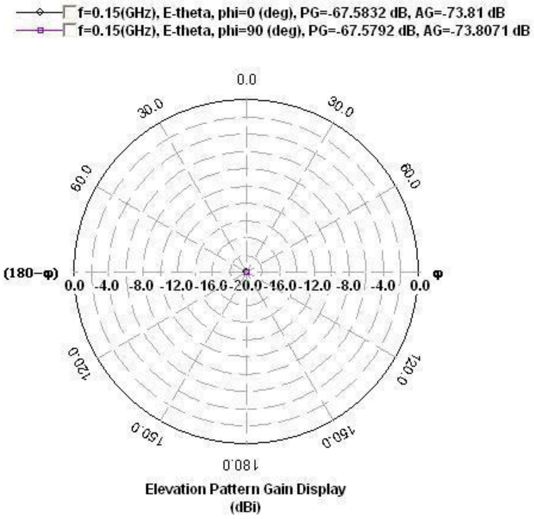

Figure 3: E-Plane Radiation Pattern for proposed antenna at 0.15 GHz

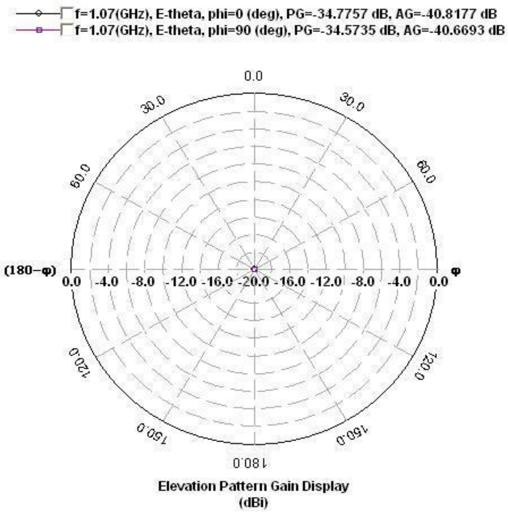

Figure 4: E-Plane Radiation Pattern for proposed antenna at 1.07 GHz

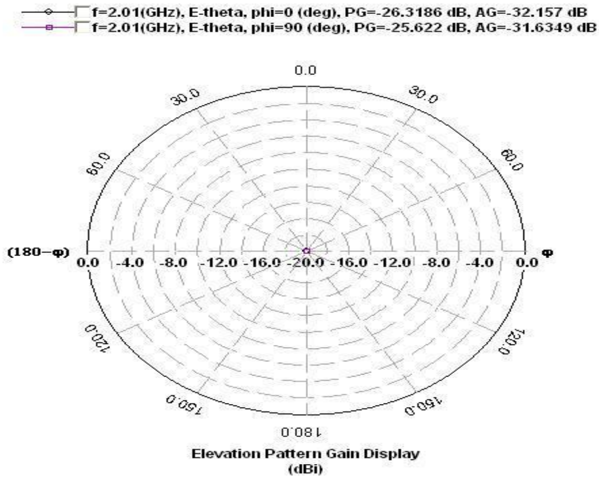

Figure 5: E-Plane Radiation Pattern for proposed antenna at 2.01 GHz

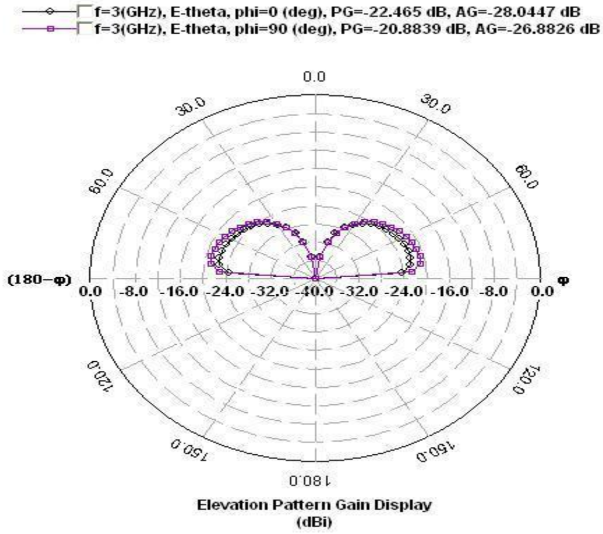

Figure 6: E-Plane Radiation Pattern for proposed antenna at 3 GHz

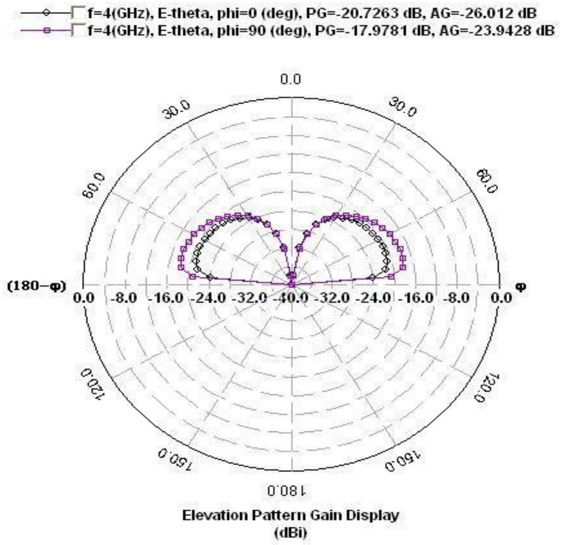

Figure 7: E-Plane Radiation Pattern for proposed antenna at 4 GHz

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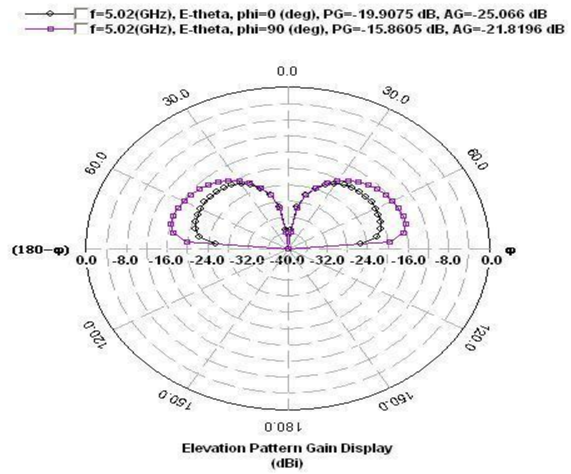

Figure 8: E-Plane Radiation Pattern for proposed antenna at 5.02 GHz

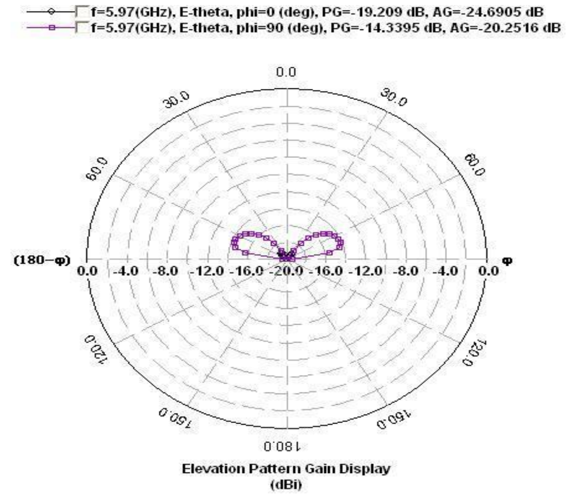

Figure 9: E-Plane Radiation Pattern for proposed antenna at 5.97 GHz

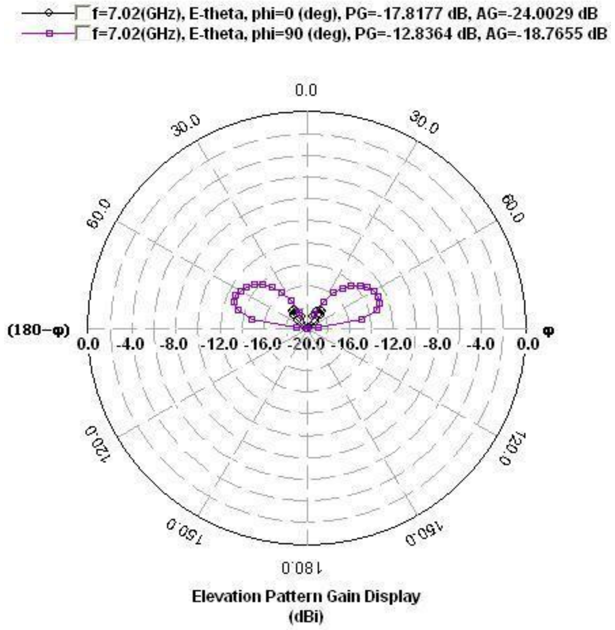

Figure 10: E-Plane Radiation Pattern for proposed antenna at 7.02 GHz

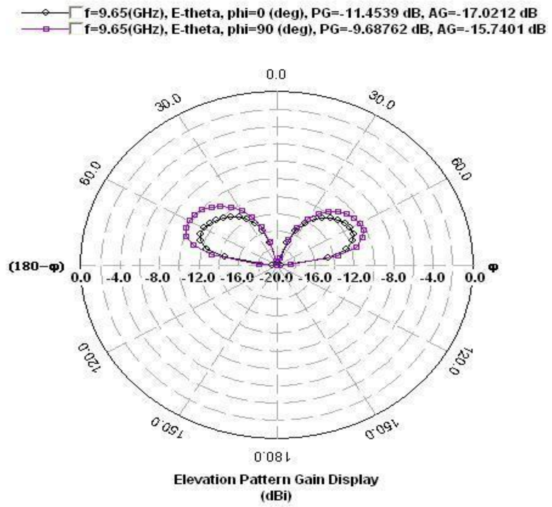

Figure 11: E-Plane Radiation Pattern for proposed antenna at 9.65 GHz

The simulated smith chart for array antenna is shown in Figure 12.

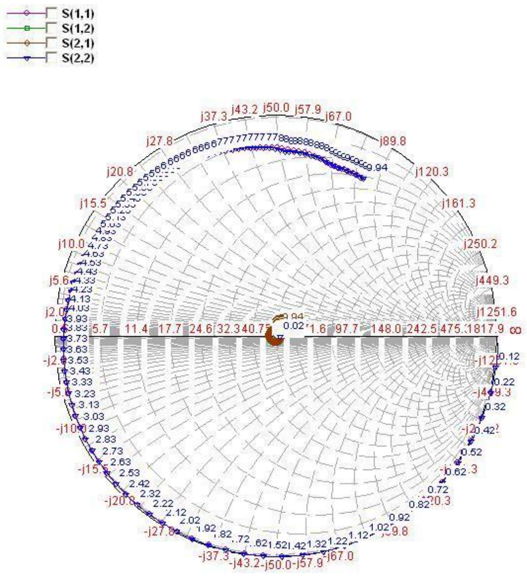

Figure 12: Smith chart for array antenna

The simulated resonance for array antenna is shown in Figure 13.

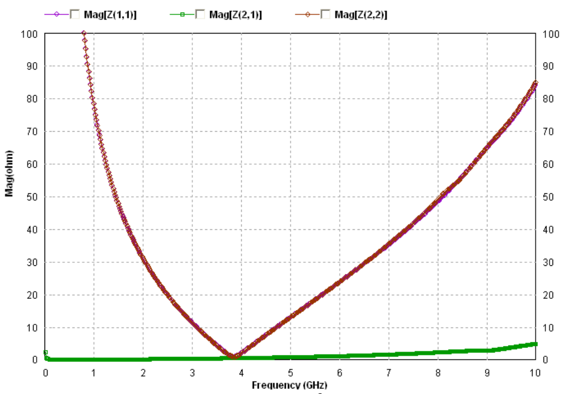

Figure 13: Resonance for array antenna

All the parameter values are summarized in the following table1, table2.

Table I: FREQUENCY Vs RETURN LOSS

FREQ (GHz)	RETURN LOSS (dB)
0.15	-97.25
9.65	-27.52
UW BAND WIDTH=10GHz(approx.)	

Table II: FREQUENCY Vs MAGNITUDE

FREQ (GHz)	MAGNITUDE (OHM)
0.81	99.75(Max)
3.83	1(Min)
9.99	84.75(Avg)

IV. CONCLUSION

Single layer, single feed compact array antenna with cutting slots at the edge of the patch on substrate which theoretical investigations have been carried out using Method of Moment based software IE3D. Introducing slots in right side at the edge of the patch, a significant improvement is achieved in return loss as well as bandwidth and we achieve approximately 10GHz band width which is same as that UWB Another result is also observed that for the proposed array antenna, the -3dB beam-width of the radiation pattern of about 156.313° with maximum gain of -9.57dBi is achieved which is sufficiently broad beam for the applications for which it is intended. The resonant frequency antenna presented in the paper for a particular location of feed point which is shown in figure 1 considering the centre as the origin was quite large as is evident from table-I. If we change the location of the feed point, then the results give narrower 10dB bandwidth and less sharp resonances.

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