E-Shape Micro strip Patch Antenna on Different Thickness for pervasive Wireless Communication

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***Abstract*—In this Paper Presents the result for different standard thickness values, and the result is performed by thickness of 31 mile, Ku- band frequency 12GHz are gives the best result. The antenna has become a necessity for many applications in recent wireless communications, such as Radar, Microwave and space communication. The proposed antenna design on different thickness and analyzed result of all thickness between 1GHz to 15GHz frequency, When the proposed antenna design on a 31 mil RT DUROID 5880 substrate from Rogers-Corp with dielectric constant of 2.2 and loss tangent of 0.0004. At 12GHz the verify and tested result on IE3D SIMULATOR are Return loss = -23.08dB, VSWR = 1.151, Directivity = 11dBi, Gain = 4dBi, 3 dB beam width = 35.5575 degrees, Mismatch loss= -0.0289842dB is very low, Efficiency= 65.3547%, All results shown in Simulation results. The Return losses and VSWR results shown in Table 1, Table2 respectively.**

Keywords- Micro strip antenna; IE3D SIMULATOR; Dielectric; Patch width; Patch Length; Losses; strip width; strip length.

I. INTRODUCTION

Ahmed H. Reja [1] proposed Study of Micro Strip Feed Line Patch Antenna experimentally increase the Return Loss -33.6dB at 2.5GHz frequency and VSWR is 1.5 by using CAD (Microwave office 2000 version 3.22) for RT DUROID 5880. Santanu Kumar Behera and Y. Choukiker [2] proposed Design and Optimization of Dual Band Micro Strip Antenna using Practical Swarm Optimization maximize the return loss for dual band Frequency at 2.4GHz is -43.95dB and at 3.08GHz is -27.4dB. A A Deshmukh and G Kumar [3] proposed compact L Shape patch broadband Microstrip antenna experimentally increase bandwidth up to 13.7%. Z M Chen [4] further increase bandwidth of this antenna up to 23.7% - 24.43%. K F Lee [5] proposed U Shape slot shorting post small size Microstrip Antenna and increase bandwidth up to 42%. S C Gao [6] used uniplanar photonic band gap structure for enhancing band width and gain. M Khodier[7] New wideband stacked microstrip antennas for enhancing band width. Major issue for micro strip antenna is narrow Bandwidth.

II. MATHMATICAL ANALYSIS

Theoretical analysis and calculations from of all dimensions will be obtained;

The width of the patch element (W) is given by.

$$W = \frac{c}{2f_o\sqrt{\frac{(\varepsilon_r + 1)}{2}}}$$

Substituting c = 3x10^8 m/s, ε r = 2.2, and f o = 5 GHz, then

W =2.3717cm or 933.74 mile.

The effective of the dielectric constant (εreff) depending on the same geometry (W, h) but is surrounded by a homogeneous dielectric of effective permittivity εreff, whose value is determined by evaluating the capacitance of the fringing field.

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

Substituting ε r = 2.2, W =2.3717cm, and h =0.1575cm, then

ε reff = 2.1074cm or 829.69mile.

The effective length (L eff) is given

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

Substituting c = 3x10^8 m/s, εreff = 2.0475cm, and f o = 5 GHz, then L_{eff}= 2.0665cm or 813.6 mile.

The length extension (ΔL) is given by:

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

Substituting E_{reff} = 2.1074cm, W= 2.3717cm, and h =0.0787cm, then ΔL= 0.041469cm or 16.3266mile.

The actual length (L) of patch is obtained by:

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

Substituting ΔL= 0.041469cm, and L_{eff} = 2.0665cm, then L=1.9835cm or 780.92mile.

III. Antenna Description

The results of proposed E-Shaped Multiband micro strip patch antenna verified in IE3D Simulator with optimization.

A. Proposed Antenna on 31mil RT DUROID 5880 substrate:

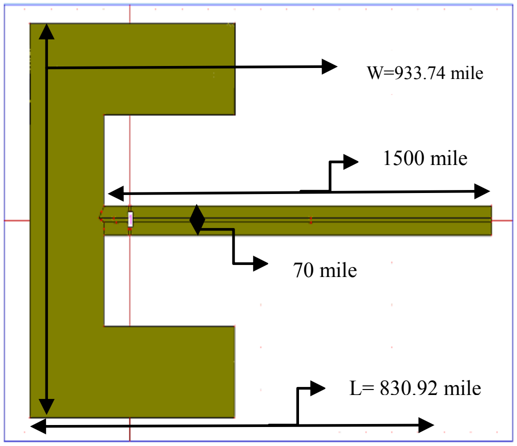

Fig. 1Block Diagram of Proposed Antenna

The Proposed antenna has:-
Proposed Patch length = 780.92+50miles
Proposed Patch Width = 933.74miles
Strip Path Length= 1500miles
Strip Path Width= 70miles
Cut width = 300miles
Cut depth = 300 miles

IV. Result and Disscussions

A. Comparison of Different Micro strip Patch Antenna in Different thickness by using optimization in IE3D Simulator for RT DUROID 5880 Substrate.

1) Thickness when h=15mile

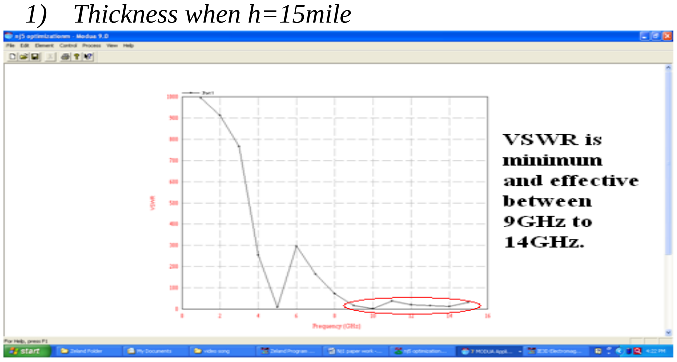

Fig. 2 VSWR Vs Frequency (in GHz)

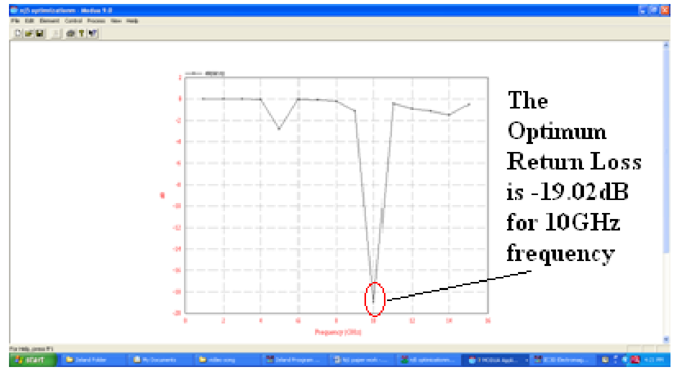

Fig. 3 Return Loss Vs Frequency (in GHz)

2) Thickness when h=20mile.

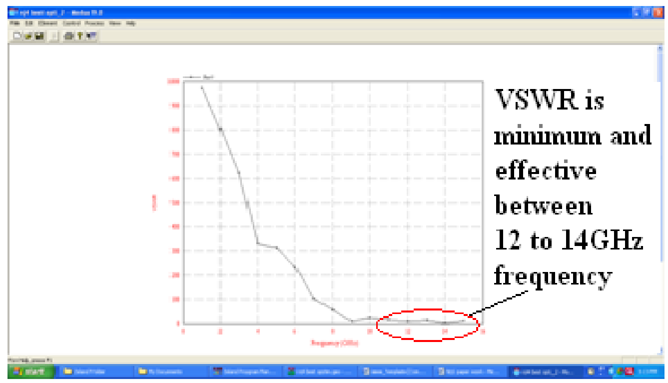

Fig. 4 VSWR Vs Frequency (in GHz)

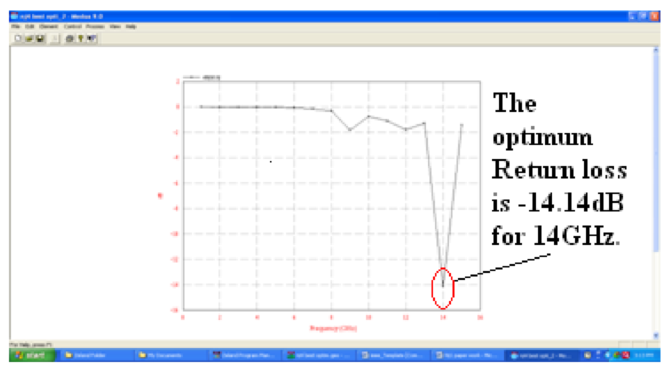

Fig. 5 Return Loss Vs Frequency (in GHz)

3) Thickness when h=31mile

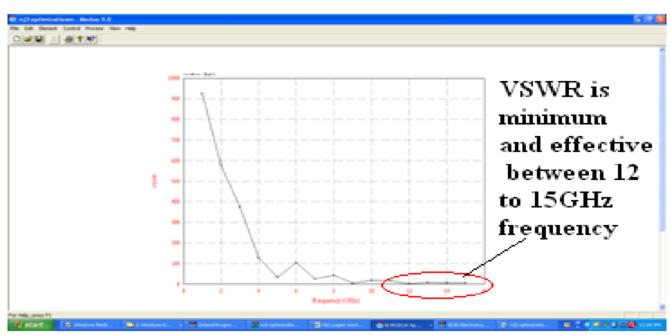

Fig. 6 VSWR Vs Frequency (in GHz)

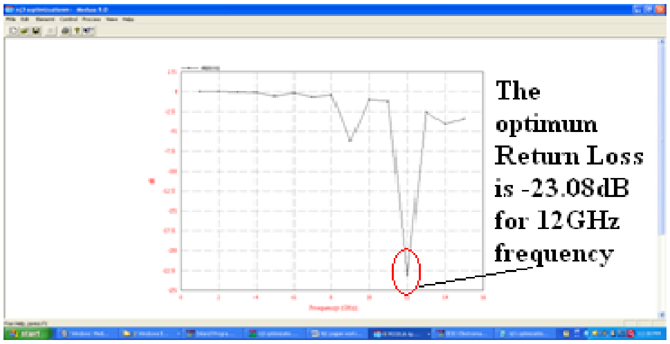

Fig. 7 Return Loss Vs Frequency (in GHz)

4) Thickness when h=62mile

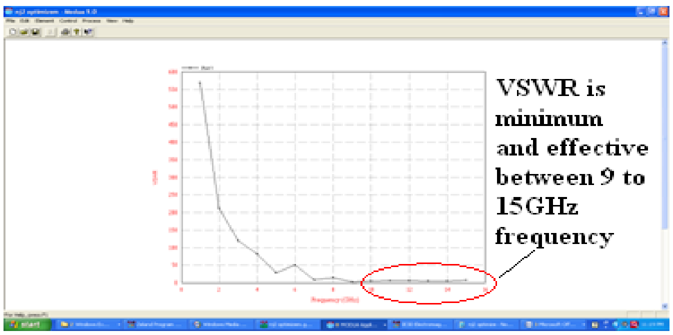

Fig. 8 VSWR Vs Frequency (in GHz)

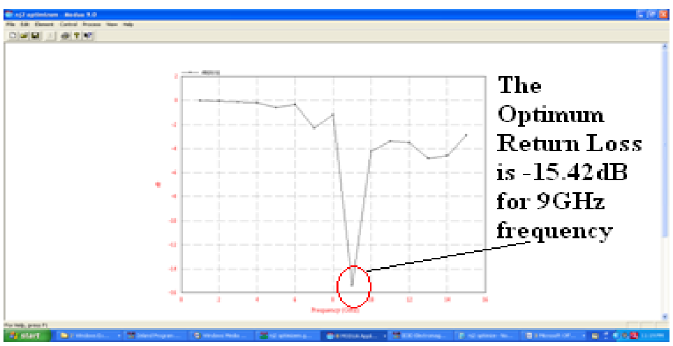

Fig. 9 Return Loss Vs Frequency (in GHz)

5) Thickness when h=125mile

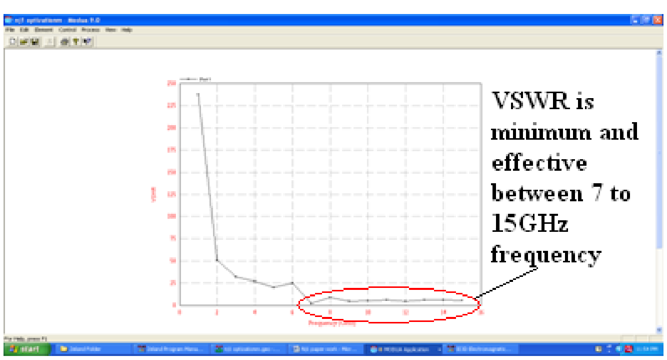

Fig. 10 VSWR Vs Frequency (in GHz)

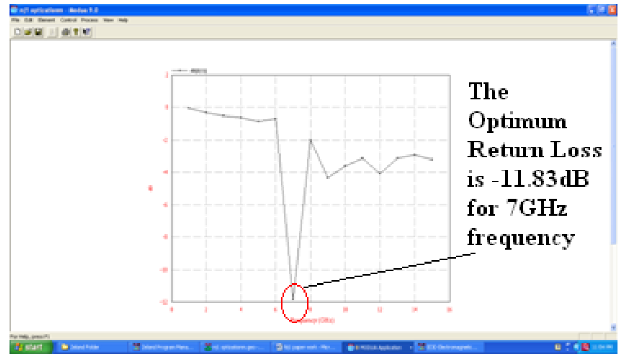

Fig. 11 Return Loss Vs Frequency (in GHz)

B. Best Result Simulated Micro strip Patch Antenna in IE3D Simulator for 31mil RT DUROID 5880 Substrate

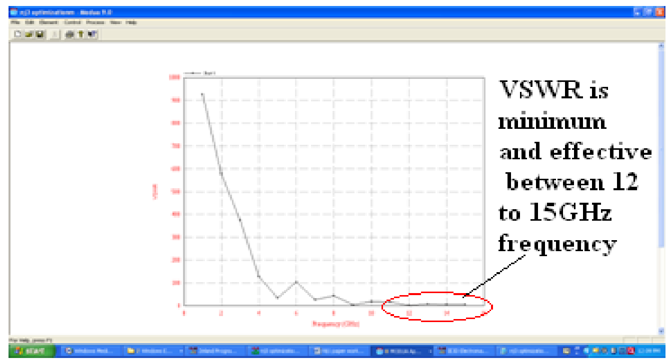

Fig. 12 VSWR Vs Frequency (in GHz)

For proposed design the value of VSWR is effective between 12GHz to 15GHz, for this value return loss is minimum. At 12GHz return loss is -23.08dB and VSWR is 1.151, At 9GHz VSWR is 2.909, 13GHz VSWR is 6.687, At 14GHz VSWR is 4.311, at 15GHz VSWR is 5.145.

Fig. 13 Return Loss Vs Frequency (in GHz)

The frequency at 10GHz return losses is -17.71, at 11GHz return losses is -1.222dB, and at 13GHz return losses reduce very significantly -23.08dB.

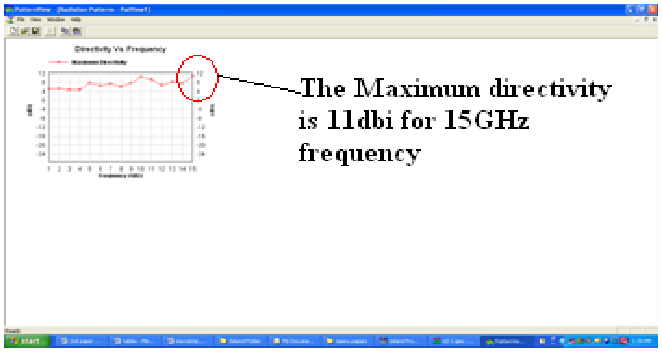

Fig. 14 Directivity Vs Frequency (in GHz)

At 10GHz frequency Directivity is 11dBi, at 12GHz Directivity is 7dBi, at 13GHz Directivity is 8dBi, and at 15 GHz Directivity is 11dBi.

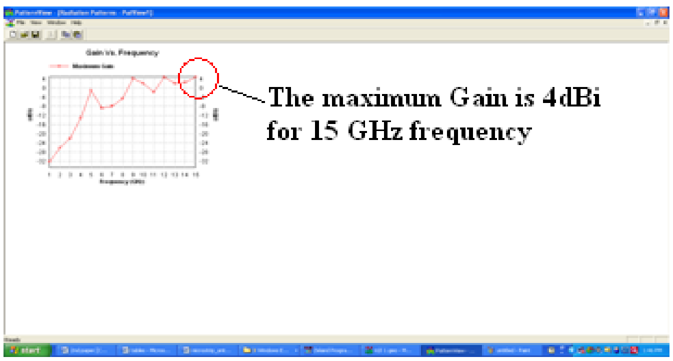

Fig. 15 Gain Vs Frequency (in GHz)

At 10GHz Frequency Gain is 3dBi, at 12GHz Gain is 5dBi, at 13GHz Gain is 2dBi, and at 15GHz Gain is 4dBi.

C. Radiation Pattern for 13GHz Frequency:

Study of different Azimuth pattern and Elevation pattern in IE3D. Analyzed radiation characteristic of antenna at 13 GHz shown in figure.

1) 2D Polar Radiation pattern

a) Elevation Pattern

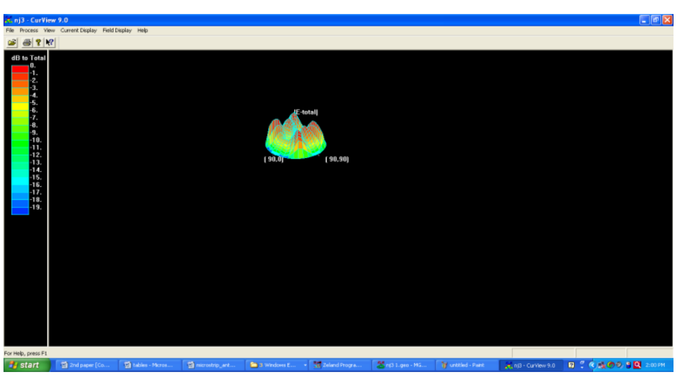

Fig. 16 Elevation Pattern of E Maximum

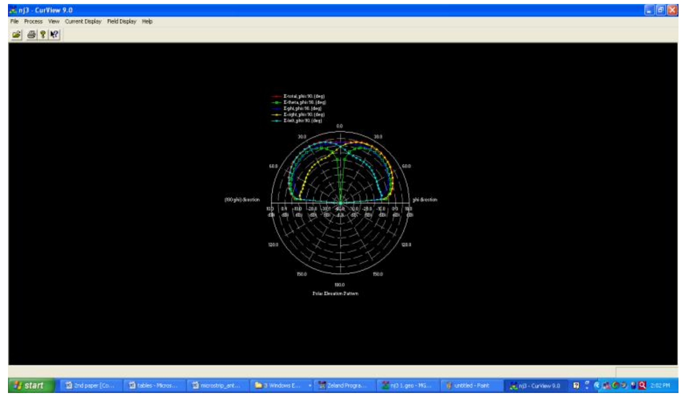

Fig. 17 Elevation Pattern of E Total, E Right, E Left, E Theta, E Phi at Phi=90 (deg)

b) Azimuth Pattern

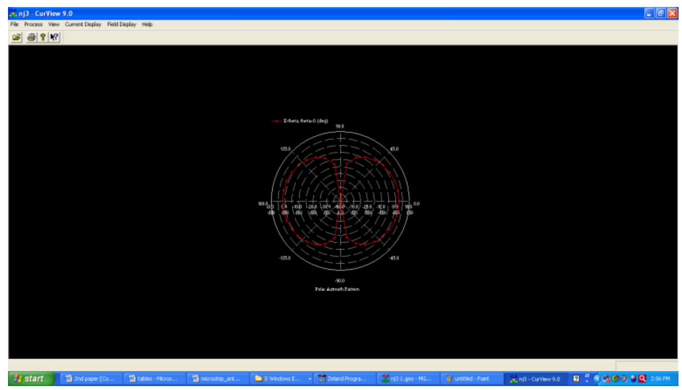

Fig. 18 Azimuth Pattern of E Theta=0(deg)

2) Axial Ratio Pattern

a) Elevation Pattern

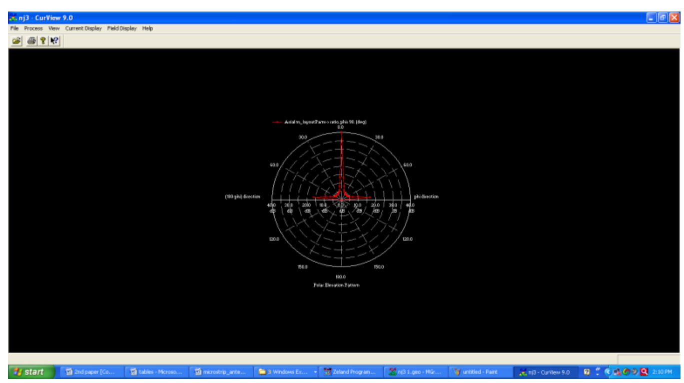

Fig. 19 Axial Pattern of Phi= 90(deg)

b) Azimuth Pattern

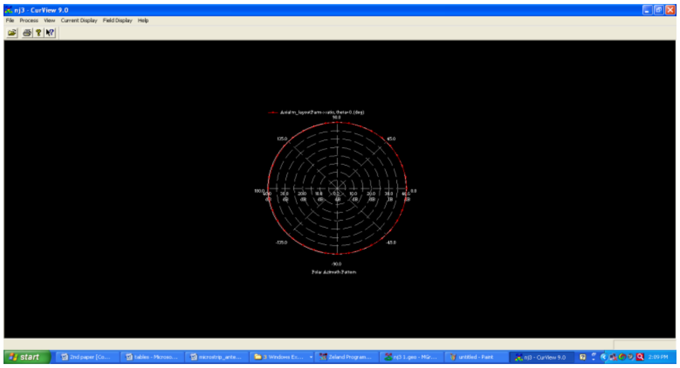

Fig. 20 Axial Pattern of theta = 0(deg)

3) 3D Pattern Display

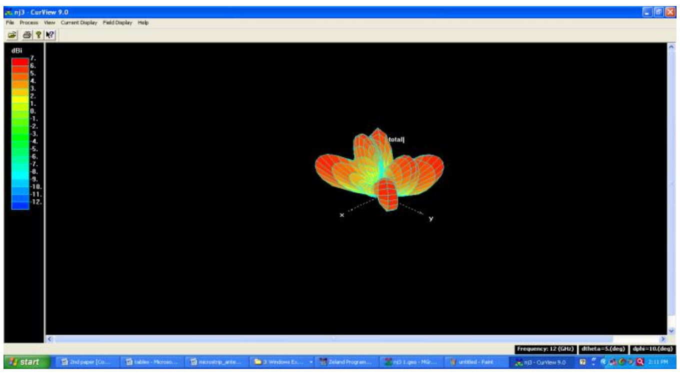

Fig. 21 Elevation Pattern at E-total

4) 2D Radiation Pattern

a) Elevation Pattern

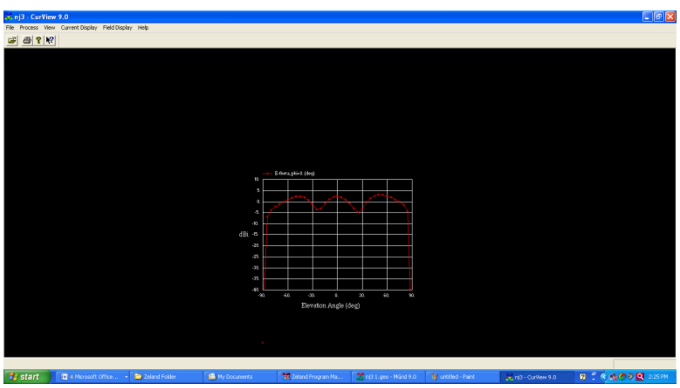

Fig. 22 Elevation Pattern at E-theta at phi=0(deg)

b) Azimuth Pattern

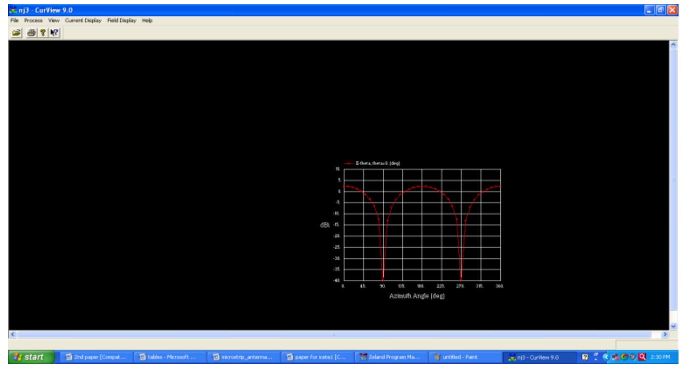

Fig. 23 Azimuth Pattern at E-total at theta=0(deg)

V. CONCLUSION

Micro strip antennas have become a rapidly growing area of research. Their potential applications are limitless, because of their light weight, compact size, and ease of manufacturing. One limitation is their inherently narrow bandwidth. However, recent studies and experiments have found ways of overcoming this obstacle. A variety of approaches have been taken, including modification of the patch shape, experimentation with substrate parameters, Most notably mobile communication systems where many frequency ranges could be accommodated by a single antenna. We here design simple and low costlier patch antenna for pervasive wireless communication by using different patch length. The transmission line model seems to be the most instructive in demonstrating the bandwidth effects of the changing the various parameters. When the proposed antenna design on a 31mil RT DUROID 5880 substrate from Rogers-Corp with dielectric constant of 2.2 and loss tangent of 0.0004. The proposed antenna give best result when antenna has standard thickness is 31 mile and after optimization addition of extra length is 50mile patch length and some little changes of patch width and more feed line length. The proposed frequency range 12GHz (Ku Band) and Analysis Radiation Characteristics of micro strip Antenna by IE3D Simulator. The results of proposed designing are effective between 1GHz-15GHz. proposed antenna simulated in IE3D Simulator. The optimum results of proposed antenna verify and tested in IE3D SIMULATOR. The simulated results of IE3D at 13GHz is Return loss = -23.08dB, VSWR = 1.151, Directivity = 11 dBi, Gain = 4dBi, 3 dB beam width = 35.5575degrees, Mismatch loss= -0.0289842dB is very low, Efficiency= 65.3547%, Total Radiated Power= 0.00649199W, Average Radiated Power= 0.000516616W/s and Input Radiated Power at ports= 0.009973348.The proposed 31mil RT DUROID 5880 substrate E-Shaped multiband micro strip antenna effective work on 12GHz(Ku Band) the proposed antenna work very effectively for pervasive wireless communication.

TABLE1: Frequency (in GHz) Vs Return Losses in dB[s(i j)] for Different Thickness

Freq GHz	dB[S(1,1)] for h=15mile	dB[S(1,1)] for h=20mile	dB[S(1,1)] for h=31mile	dB[S(1,1)] for h=62mile	dB[S(1,1)] for h=125mile
1	-1.748e-002	-1.784e-002	-1.88e-002	-3.056e-002	-7.317e-002
2	-1.909e-002	-2.163e-002	-3.011e-002	-8.247e-002	-0.3412
3	-2.273e-002	-2.793e-002	-4.655e-002	-0.1457	-0.5498
4	-6.832e-002	-5.278e-002	-0.1371	-0.2139	-0.6493
5	-2.835	-5.589e-002	-0.535	-0.6108	-0.8795
6	-5.886e-002	-7.422e-002	-0.1688	-0.3482	-0.6976
7	-0.1057	-0.1715	-0.6865	-2.329	-11.83
8	-0.2456	-0.309	-0.3989	-1.206	-2.023
9	-1.135	-1.828	-6.225	-15.42	-4.345
10	-19.02	-0.7607	-1.024	-4.22	-3.638
11	-0.4599	-1.109	-1.222	-3.419	-3.147
12	-0.9343	-1.808	-23.08	-3.531	-4.105
13	-1.149	-1.305	-2.617	-4.851	-3.142
14	-1.502	-14.14	-4.104	-4.615	-2.962
15	-0.5566	-1.461	-3.42	-2.908	-3.22

TABLE2: Frequency (in GHz) Vs. VSWR for Different Thickness

Freq GHz	VSWR for h=15mile	VSWR for h=20mile	VSWR for h=31mile	VSWR for h=62mile	VSWR for h=125mile
1	993.9	973.8	924.1	568.5	237.4
2	910.1	803.1	576.9	210.6	50.92
3	764.1	621.9	373.2	119.2	31.61
4	254.3	329.1	126.7	81.22	26.77
5	6.183	310.8	32.48	28.45	19.77
6	295.2	234.1	102.9	49.9	24.92
7	164.3	101.3	25.32	7.505	1.688
8	70.73	56.22	43.56	14.42	8.627
9	15.33	9.536	2.909	1.408	4.081
10	1.252	22.85	16.99	4.198	4.844
11	37.78	15.69	14.24	5.146	5.581
12	18.61	9.646	1.151	4.988	4.311
13	15.15	13.33	6.687	3.674	5.588
14	11.6	1.489	4.311	3.852	5.922
15	31.22	11.91	5.145	6.029	5.456

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