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E-Shaped microstrip antenna array with improved gain for wireless applications

JAGADEESHA S[1], BHARATRAJ M[2] MADHUSUDHANA.K[3] CHINTESH[4]
[1]Professor, Department of ECE, S.D.M.Institute of Technology,Ujire, India,
[2][3][4]Asst. Professors, Department of ECE, S.D.M. Institute of Technology, Ujire, India,

Jagadeesh.sd69@gmail.com, bharathraj100@gmail.com; madhusudhana.js@gmail.com, ckbrbemtech@gmail.com

ABSTRACT
E-shaped microstrip antenna array operating at 2.4 GHz. Design antenna is found to possess predictable high gain with different possible direction of radiation pattern. Comparative Analysis has made with single, Two and Four elemental array. Improvement in gain from 0, 2.5 and 5 dbi. Simulation is carried out using IE3D software and it is found that simulated results are in good agreement with experimental results.

***Keywords* –** E-shape Microstrip, Four Elemental array, wireless applications. Improved Gain

1. INTRODUCTION
Because of the booming demand in wireless communication system applications, micro strip patch antennas have attracted much interest due to their low profile, light weight, ease of fabrication and compatibility with printed circuits. However, they also have some drawbacks, ranging from narrow bandwidth to low gain [1]. In certain applications, desired antenna characteristics may be achieved with a single microstrip element. However, as in the case of conventional microwave antenna, characteristics such as high gain, beam scanning, or steering capability are possible only when discrete radiators are combined to form arrays. The elements of an array may be spatially distributed to form a linear, planar, or volume array. [2]. Different array configurations of microstrip antenna can give high gain, wide bandwidth and improved efficiency. The distribution of voltages among the elements of an array depends on feeding network. Suitable feeding network accumulates all of the induced voltages to feed into one point. The proper impedance matching throughout the corporate and series feeding array configurations provides high efficiency microstrip antenna. Power distribution among antenna elements can be modified by corporate feed network. The corporate feed network can steer beam by introducing phase change [3].

In terms of performance, single element microstrip antennas have limited performance and mostly do not fulfill the requirements of systems in which they are integrated because of certain demerits such as low gain, narrow bandwidth, high side lobe levels etc., but in real time applications, efficient performance is required which leads towards designing of microstrip antenna arrays. The significant advantages of microstrip antenna arrays are that they are highly directive and have higher performance in terms of bandwidth and gain. The most significant advantage of antenna arrays is that the direction of maximum radiation can be changed and thus they can be used in beam scanning capabilities [4].

Smart antenna systems comprise an array of multiple antenna elements and can dynamically generate multiple beams towards desired users while forming a null towards the interference. In order to achieve spatial electromagnetic power combining, smart antennas should distribute the signal into every antenna element with the correct phase and amplitude. Such antenna elements can either be active radiators or parasitic radiators [5].

Improved bandwidth radiation efficiency improved significantly by employing proposed (2x2) array antenna. In of single element it has been observed that the antenna gain is quite low. But while employing the array, gain increases significantly. This is one of the most advantages of the array structure [6].

2. DESIGN CONSIDERATION

Optimized geometry of E-Shaped Microstrip antenna with single element as shown in Fig. 1(a) which is considered as base antenna of size (28x38)mm^2 is printed on a top of a dielectric substrate of thickness 1.6mm and material used is glass epoxy with relative dielectric of permittivity $€_r$=4.4. They are mounted on ground plane of dimension (50x90) mm^2 whole structure is desired to operate 2.49 GHz. Photographic view of proposed fabricated E-shape antenna also shown in Fig. 1(b) & 1(c). The conventional E-Shaped Microstrip antenna with two element array using IE3D simulated software which is shown in Fig 2(a). Fabricated photograph of its two element array antenna as shown in Fig.2(b). Similarly Simulated designed of four elemental arrays as shown in Fig.3(a) and its fabricated photograph with top and bottom view as shown in Fig. 3(b) & 3(c). Optimized designed E-shaped antenna with base, Second and four elemental arrays with following parameters.

W=38, L=28, L_1=11.85, L_2=8, L_3=15.45, L_4=15.45, L_a=3, L_f=15.45, L_t=15.43, W_f=1.88, W_t=3.08, W_1=8, W_2=6, W_3=2.08, W_4=0.70, W_5=0.70.

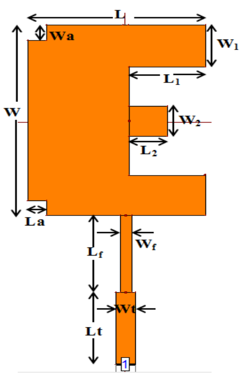

Fig. 1(a)

Fig. 1(b)

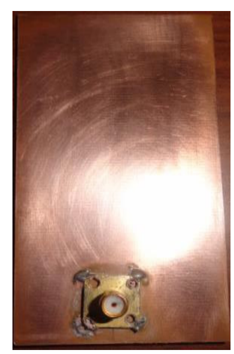

Fig. 1(c)

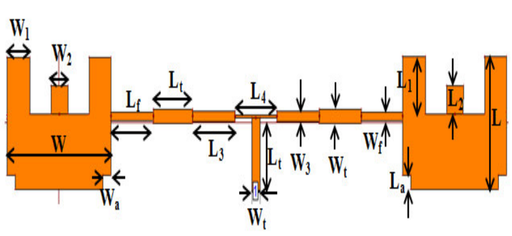

Fig. 2(a)

Fig.2(b)

Fig. 2(c)

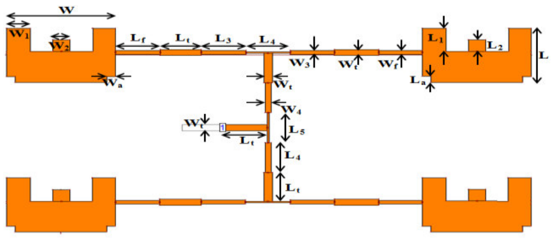

Fig. 3(a)

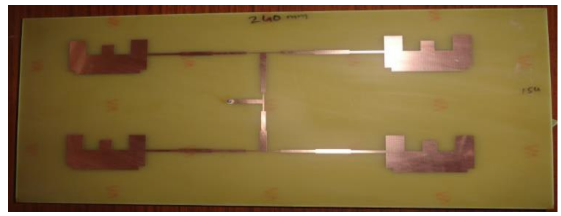

Fig. 3(b)

Fig. 3(c)

3. RESULTS AND DISCUSSIONS

The proposed E-Shaped antenna design has been simulated using zeland's simulation package i.e IE3D whose characteristic of above antenna with base, First and second elemental array is studied using simulated software. Also the results have been verified practically with by using vector network make Agilent technology E5062A (300 kHz to 3GHz) analyzer. Practical results are in good agreement with simulated results. Fig.4(a) shows variation of return loss characteristic of E-Shaped base antenna. Second element of E-shaped array whose return loss characteristic also shown in Fig.4(b). Similarly performance return loss characteristic of Third element array are depicted in Fig.4(c). Radiation characteristic of E-shaped base and its two element and fourth element array are also shown respectively in Fig.5(a), Fig.5(b) and 5(c). Results of above performance parameters with its gain improvement are summarized in Table.1. Gain improvement parameter of above design antennas are shown in Fig.6(a), 6(b) and Fig.6(c).Current distributions of E-shaped antenna arrays are also shown respectively in. Fig. 7(a), Fig.7(b) and Fig.7(c).

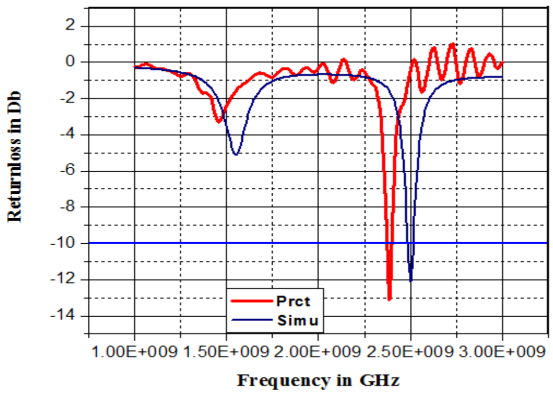

Fig.4(a)

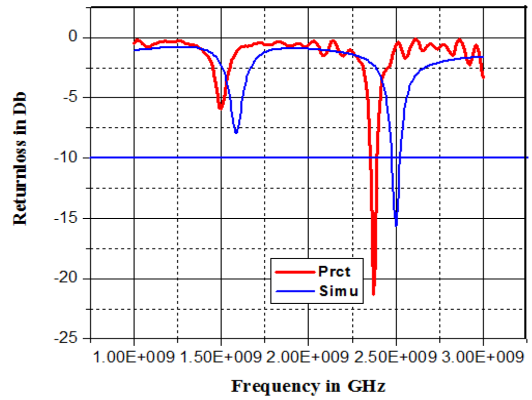

Fig.4(b)

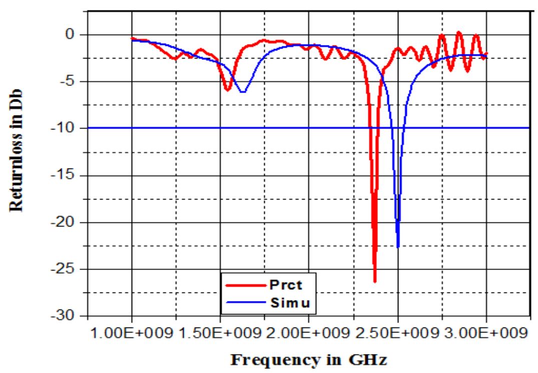

Fig.4(c)

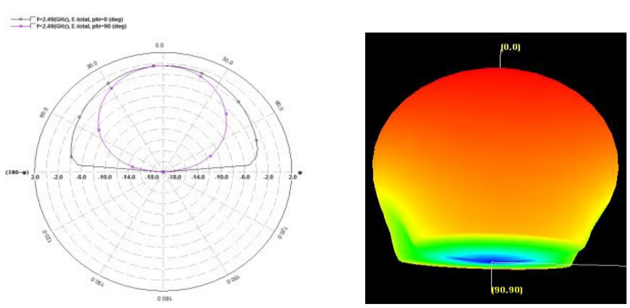

Fig.5(a): Radiation characteristic of E-shaped base antenna @ 2.49 GHz with 2D and 3D pattern.

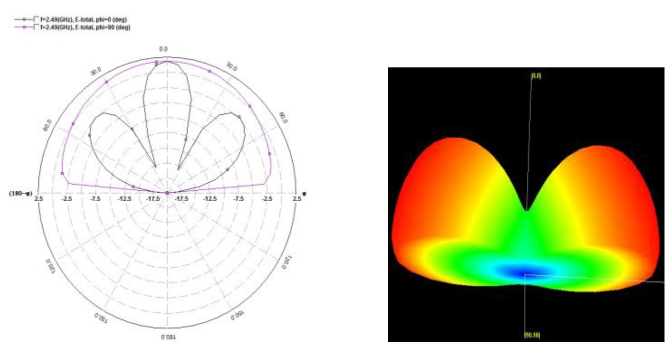

Fig.5(b): Radiation characteristic of 2 element E-shaped array @2.49GHz with 2D and 3D pattern.

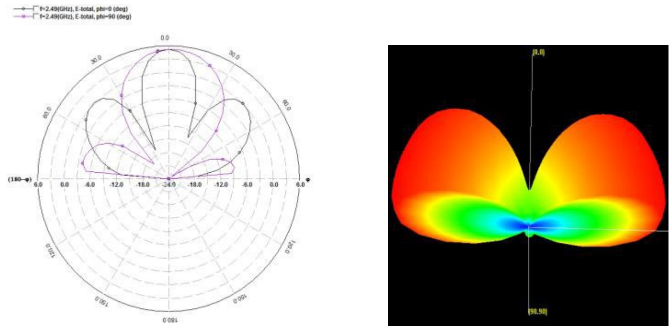

Fig.5(c): Radiation characteristic of 4 element E-shaped array @ 2.49GHz with 2D and 3D pattern

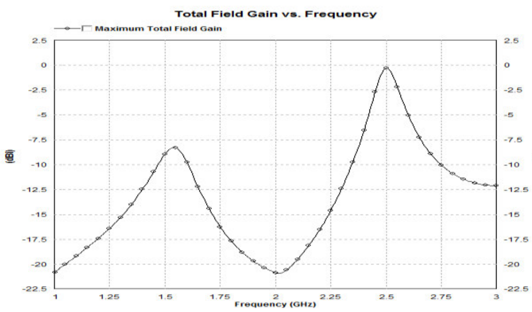

Fig.6(a)

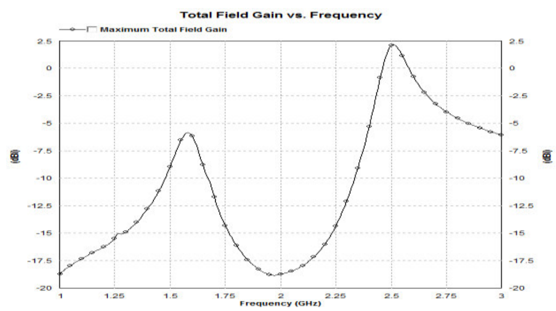

Fig.6(b)

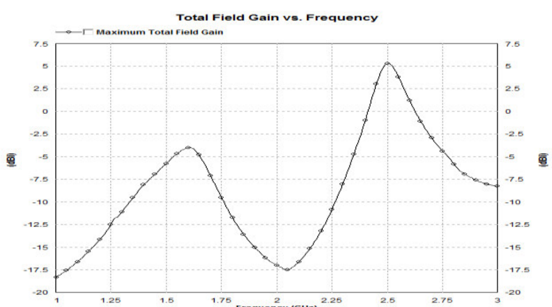

Fig.6(c)

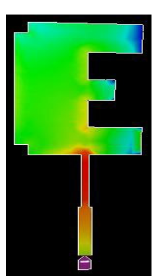

Fig.7(a)

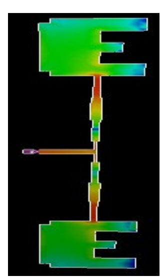

Fig.7(b)

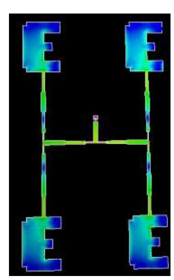

Fig.7(c)

Prototype Antenna	Resonant frequency in GHz		Returnloss in Dbs		Gain in Dbi
	Simu	Prct	Simu	Prct	Simu
E-shaped Reference Antenna	2.5	2.38	-12	-13	0
E-shaped two elemental array antenna	2.49	2.37	-15.6	-21.4	2.2
E-shaped Four elemental array antenna	2.59	2.37	-22.6	-25.4	5.3

From the above analysis practical results are in good agreement. The results obtained for the above table demonstrate that as the increasing the array numbers yields improvement in the gain. E-shaped array antenna exhibit splitting of the beam which will make direction of arrival of signal and sending a signal in desired direction.. Instrument used for measuring various parameters like Return loss, impedance matching using smith chart analyzed using vector network analyzer as shown in Fig.8

Fig.8 Vector network analyzer

4. CONCLUSION

This paper presents a new E-shaped antenna arrays concepts were designed and developed. This article outlines E-Shaped two and four elements were compared and analyzed. From the experimental results we can conclude that reference antenna whose resonating frequency operating at 2.4GHz as number of array increases equivalent gain also increases along with splitting of beam with higher gain in different possible direction. Thus practical results are good agreement with simulated results.

5. REFERENCE

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