ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 8, August 2013

Bandwidth and Gain Enhancement of S-Shaped Array Configuration

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Abstract: This paper gives an idea of increasing the bandwidth and gain of Microstrip patch antenna using array configuration. The design and analysis of this antenna is performed over IE3D software Ver.15.2.We have taken a ground plane of 50x70 mm and patch size of 40x60 mm. The substrate thickness is taken as 1.6 mm, dielectric constant of 4.2 and loss tangent of 0.0013. We have obtained the bandwidth in dual band-2.6527% at 1.002661 GHz band and 31.6939% at 1.94681 GHz band. The gain is quite good for many microwave applications which is 5.03926 dBi at 2.10568 GHz.

Keywords: S-shaped array configuration, Ground plane, Patch antenna, Dual Band.

1. INTRODUCTION

In communication systems there are many phases. Now a days microwave and wireless communication systems are at peak point. Microwave and wireless applications requires small antenna size, light weight, simple 2D structure etc. All these conditions are fulfilled with the help of Microstrip antenna. This antenna has some disadvantages also like low gain, narrow bandwidth, poor polarization etc. Various methods are used to overcome these problems like changing the thickness of substrate, changing the substrate material, using different patch shape etc.

In many applications it is desirable to design an antenna with large directive properties (high gain) for long distance communication. Thus a new antenna form by multielements is included which is known as array antenna. This paper presents a S-shaped array configuration for enhancement of both gain and bandwidth.

2. RESEARCH METHODOLOGY

Research methodology includes design and analysis of S-shaped array configuration. Each S-shape is obtained by cutting the notches in opposite direction. The array is completed with four S-shapes. All four S-shapes have equal size. For feeding this array configuration co-axial probe feed is used. We have given various feed points with this technique and the point where we get the optimum result is finally feed with co-axial probe feed. Then this design is simulated over IE3D software to obtain various curves like return loss curve, VSWR curve, Gain curve, Directivity curve etc.

3. ANTENNA DESIGN

The design of S-shaped array includes four S-shape patch antennas which are well connected to for an array. This design is shown below:

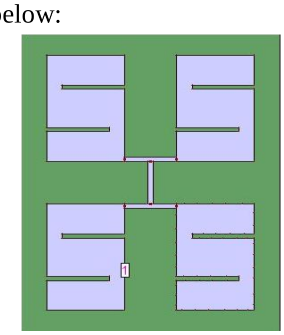

Figure.1: S-shaped array configuration

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4. RESULT AND DISCUSSION

First of all return loss curve is considered to determine the bandwidth. The curve is given below-

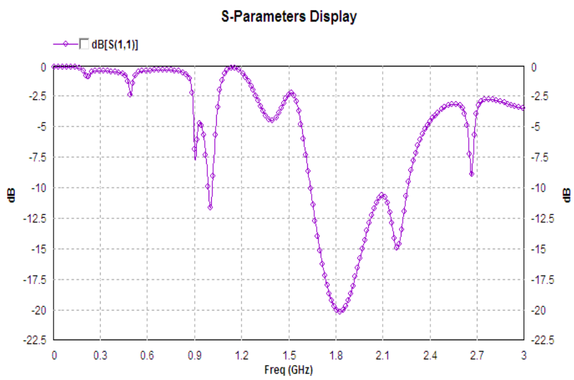

Figure.2: Return loss Vs Frequency curve

5. BANDWIDTH CALCULATION

The curve is crossing -10 dBi line twice so we have obtained the bandwidth in dual band.

f_{l1} = 0.989362 f_{h1} = 1.0196

f_{c1} = 1.002661

% fractional bandwidth$_1$ = $\frac{1.0196 - 0.989362}{1.002661}$ x100 = **2.6527%**

f_{l2} = 1.6383 f_{h2} = 2.25532 f_{c2} = 1.94681

% fractional Bandwidth$_2$ = $\frac{2.25532 - 1.6383}{1.94681}$ x100 = **31.6939%**

Next most important parameter of this configuration is VSWR which decides whether calculated bandwidth is useful or not. The curve is shown in the figure.

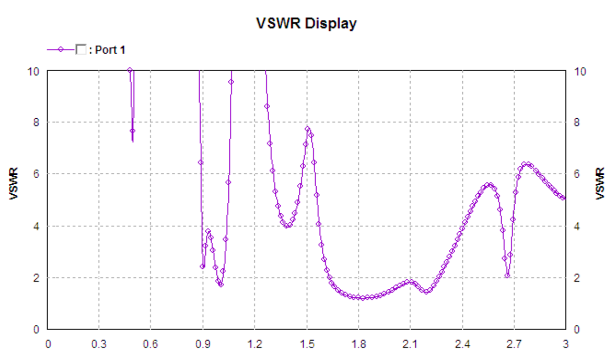

Figure.3: VSWR Vs Frequency curve

The VSWR is below 2 for both frequency range so obtained bandwidth is useful.

Next important curve is the gain. With the help of array configuration the gain is increased which is very good for long distance communication.

The gain curve is given as:

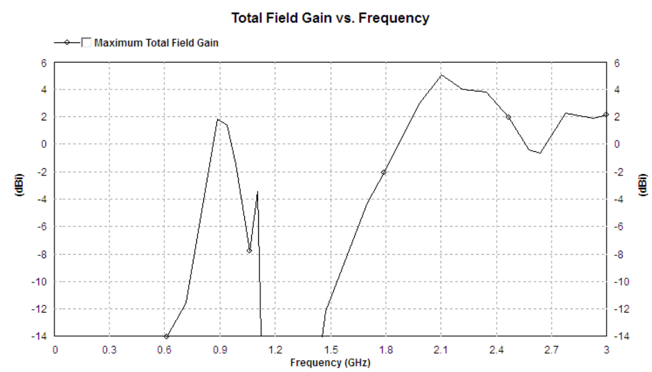

Figure.4: Gain Vs frequency curve

The obtained gain is 5.03926 dBi at 2.10568GHz which is vey good for wireless applications.

Next curve shows the directivity which is given in the figure -

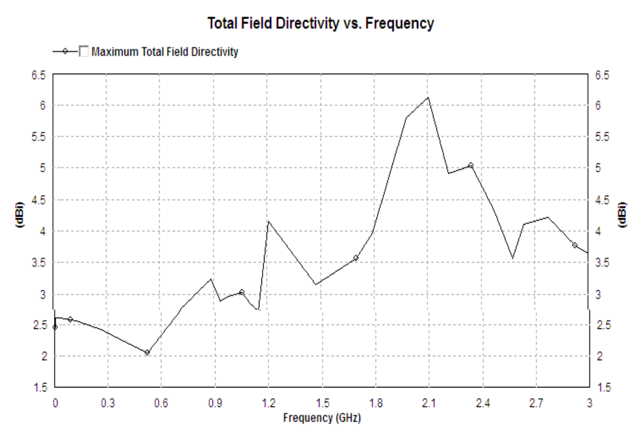

Figure.5: Directivity Vs Frequency curve

The directivity is 6.11013 dBi at 2.10568 GHz.

Next important curve is antenna efficiency which determines total power transmitted by this array configuration which is given as -

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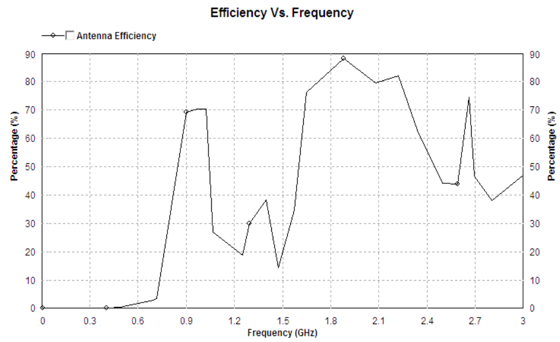

Figure.6: Antenna efficiency Vs frequency curve

The antenna efficiency is 88.0727 % at 1.88328 GHz.
The following graph shows the radiation efficiency which is given as –

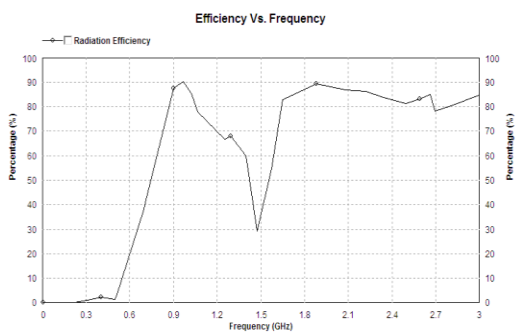

Figure.7: Radiation efficiency Vs Frequency curve

The radiation efficiency is 90.2836% at 0.9653 GHz.

6. CONCLUSION

The design and analysis of S-shaped array configuration is completed over IE3D software Ver.15.2.We have obtained the bandwidth in dual band – 2.6527% at 1.002661 GHz band and 31.6939% at 1.94681 GHz. We have also obtained good amount of gain value of 5.03926 dBi at 2.10568 GHz, a directivity of 6.11013 dBi at 2.10568 GHz, an antenna efficiency of 88.0727% at 1.88328 GHz and radiation efficiency of 90.2836% at 0.9653 GHz. The enhancement of gain and bandwidth of array shaped Microstrip patch antenna is still in progress.

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