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Design and comparison of 1x2 inverted diamond shaped microstrip antenna array with T and I slot having defected ground

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Abstract— The aim of this paper is to design an inverted diamond shaped microstrip antenna array with T and I slot. The defected ground structure is taken here. The results of the T slot array with defected ground and I slot with defected ground is studied and the comparison of the results is made. Both proposed antennas operate at 7GHz frequency. The structure is simulated on HFSSv10 software.

Keywords— HFSS (high frequency structure simulator), UWB (ultra-wide band), DGS (defected ground structure), MSA (microstrip antenna array), 3-D (3-dimenssion), Leff (effective length), GHz (giga hertz)

INTRODUCTION

There has been a flourishing prospect of UWB technology in recent years in both communication and other purposes like microwave imaging and radar application. Recent studies of UWB antenna structures are specially concentrated on microstrip slot [1] and planar monopole antennas [1].Among the different miniaturizing techniques such as cutting slots in patch [2], using shorting walls [3] or shorting pins [4] and folding the microstrip patch to create 3-D structures [5], the slots with various shapes and structures becomes a potential for candidate [6-8].

The effect of reduced ground plane and DGS improves the antenna radiation characteristics and they are used for effective antenna matching for better control on the radiation pattern for optimum performance [9-10].

The paper presents an inverted diamond shaped 1x2 MSA array with reduced ground. The reduced ground is further shaped to steps shape for better results.

ANTENNA DESIGN

The array is designed on a FR4 substrate placed 1mm above the ground.

Width of antenna is given by:-

$W = c/2f\sqrt{(\epsilon r + 1)/2}$ where f is operating frequency

And

ϵr is dielectric constant of substrate.

The effective dielectric constant:-

$\epsilon reff = (\epsilon r + 1)/2 + (\epsilon r - 1)/2 (1 + 12h/W)^{-0.5}$

The actual L, in meters is calculated using:-

$L = Leff - 2\Delta l$ where $Leff = c/2f\sqrt{(\epsilon reff/2)}$ and Δl is length extension

From the above equations the dimensions of the rectangular patch are calculated and rectangular patch is created. From this rectangular patch an inverted diamond patch is cut and an array is made with corporate feeding as shown in figures below.

The length of the ground plane is 3mm and width is 18mm.

The array feed by a 50Ω microstrip line.

Two designs are shown in the figures below. One is the inverted diamond 1x2 array with T slot and other with I slot. The figures below show the structure of the above mentioned designs.

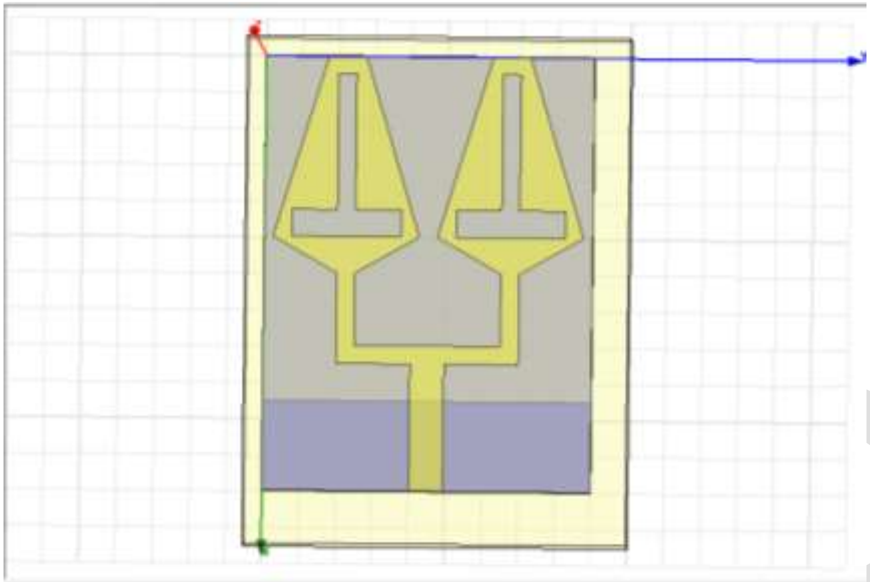

Figure 1 1x2 Inverted diamond array with T slot

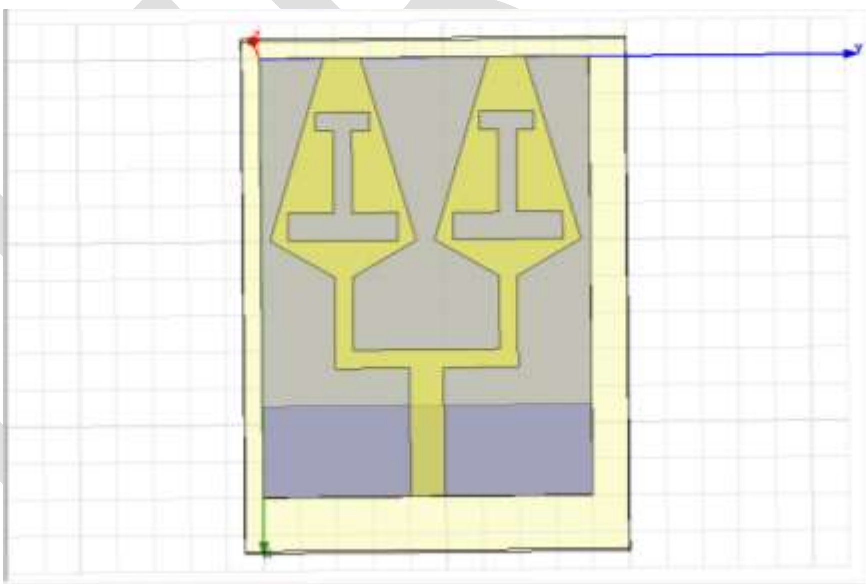

Figure 2 1x2 inverted diamond array with I slot

The above two designs are simulated using hfssv2 software. The results of these designs are as below. Both the designs are operated on 7GHz frequency.

SIMULATION AND RESULTS

The below figures, figure 3 and figure 4 shows the s-parameter of the two structures. The s parameter curve of both the designs shows that the design with T slot has -23.14 dB and for I slot is -21.81dB for the UWB range.

From the vswr curve of the two designs we can see that the antenna with T slot has 1.38dB and sharp peak is not obtained while the antenna with I slot has 1.44dB with sharp tip. These are shown in figures 5 and 6.

The figure 7 and 8 reflects the radiation pattern of both the designs. All these results are shown in the following figures.

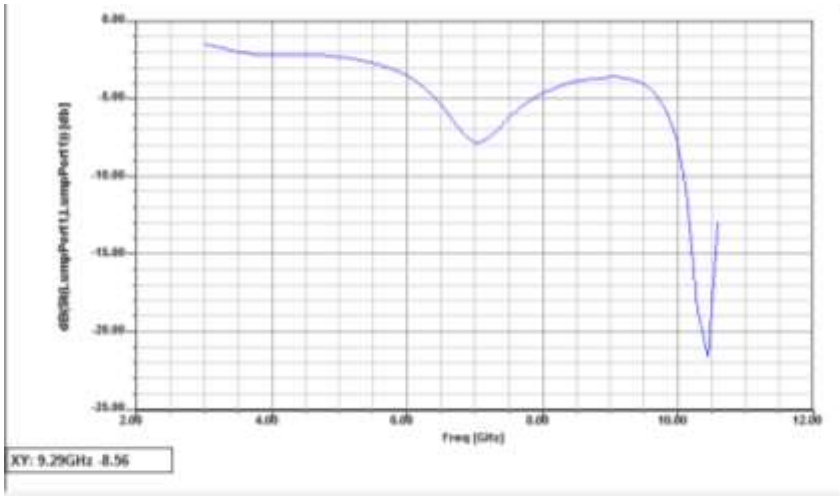

Figure 3 s parameter 1x2 inverted diamond array with T slot

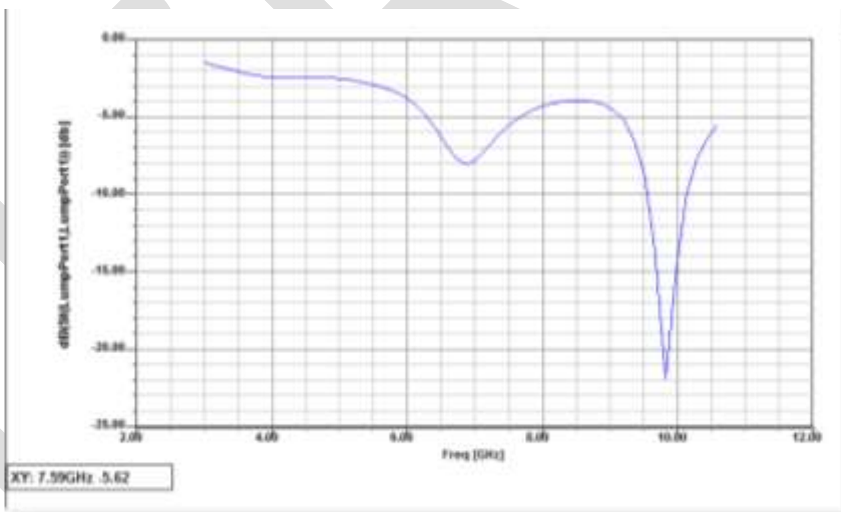

Figure 4 s parameter 1x2 inverted diamond array with I slot

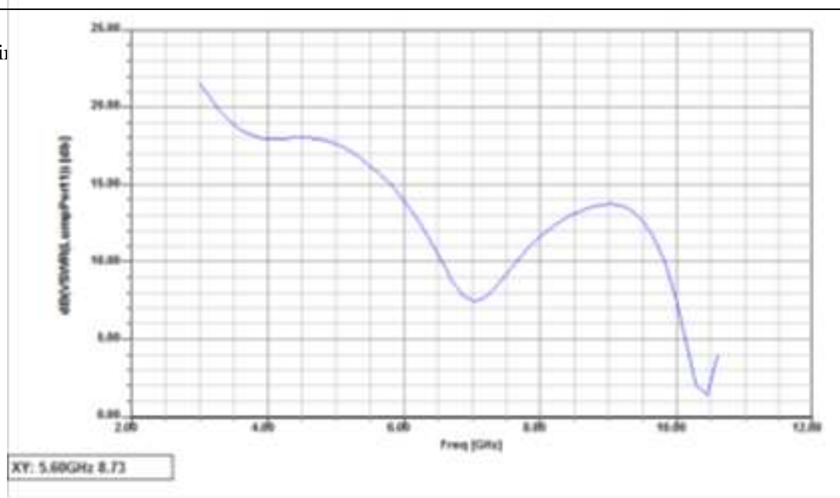

Figure 5 vswr 1x2 inverted diamond array with T slot

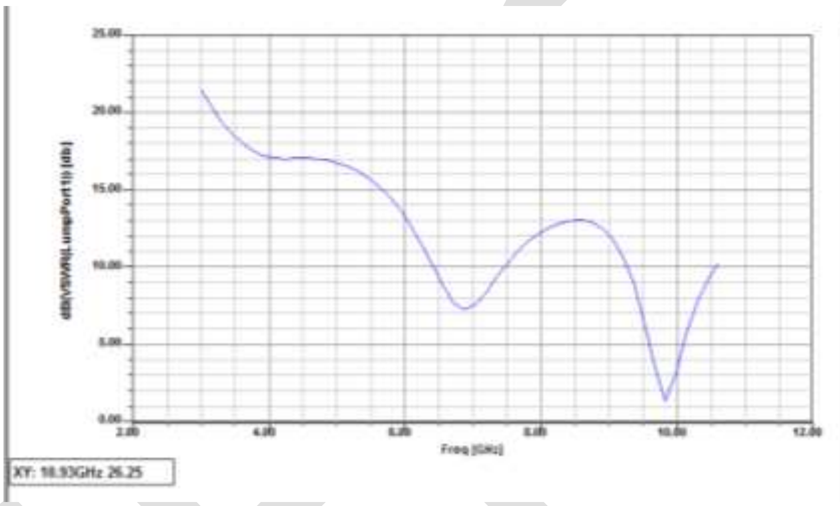

Figure 6 vswr 1x2 inverted diamond array with I slot

Figure 7 radiation pattern 1x2 inverted diamond array with T slot

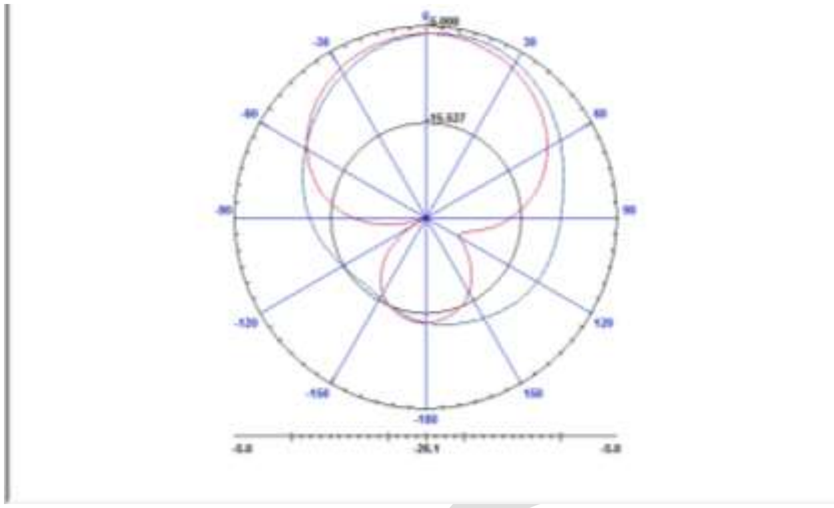

Figure 8 radiation pattern 1x2 inverted diamond array with I slot

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CONCLUSION

From the above results we can conclude that 1x2 inverted diamond array with I slot has better response over T slot structure for the ultra-wide band frequency range.

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