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DESIGNING OF FOUR ELEMENT MIMO ANTENNA FOR DUAL BAND APPLICATION

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ABSTRACT

The single input or single antenna is easy to design and simple but it does not fulfill the higher data rate demand. The multiple element antenna system or multiple input multiple output system provides good capacity and reliable communication. In this research work a four element based MIMO antenna system is design and simulated. The problem of isolation and antenna parameters are evaluated and presented. A four element MIMO antenna has been designed for dual band application. The MIMO antenna parameter like gain, bandwidth, S-Parameter, surface current, far field, and directivity has been evaluated. The proposed antenna resonates at 3.6 GHz and 5.3 GHz. The isolation at 3.6 GHz and 5.3 GHz are found less than -14 dB and -20 dB respectively while the bandwidth obtained as 110 MHz and 195 MHz. The gain of MIMO antenna has 3.95 dBi and 0.7 dBi at 3.6 GHz and 5.3 GHz respectively. The envelop correlation coefficient (ECC) found less than 0.1 in the whole band.

Keywords: ECC, MIMO antenna, VSWR, ECC, CST.

I. INTRODUCTION

The antenna is the technology which enables us to transmit the signals via air interface, in other word we can say that this is a independence matching device which math the impedance. The single antenna is not so reliable as compare to multiple antenna system. The multiple antenna system technology called multiple input multiple output which is most reliable, efficient and has more capacity than the traditional system. Varity of antennas are available in the market, the micro strip patch antenna is the low profile antenna , it can easily fabricated and design in any metallic surface. The MIMO antenna has a great advantages over the single antenna system but the problem of isolation is the prime factor. The isolation techniques [1] and solution of is discussed by various researchers in their research papers [2-3]. Different types of isolation techniques used for providing lesser mutual coupling among the antenna ports. Various types of shapes and design are available which can provide sufficient isolation. The rectangular patch antenna is a one wavelength long section of rectangular microstrip transmission line. When the air in the antenna substrate the length of the rectangular microstrip antenna is approximate one half of a free space wavelength. The antenna consists of a dielectric as its substrate the length of the antenna decreases as the relative dielectric constant of the substrate increases the proper miniaturized antenna will improve the transmission and reception [4].

II. ANTENNA DESIGN

Microstrip Patch Antenna Design consists of a rectangular patch with inset feed line power supply. Rectangular patch structure is simple and easy to design. Antenna is designed for dual band frequencies 3.6 GHz, and 5.3 GHz. Antennas are placed on dielectric layer and common ground plane made up of copper.

The Figure 1 shows the design of 4 element MIMO antenna front , back and prospective views. In this figure there are four patches having width Pw = 39 mm and length PL= 29 mm are mounted on a single substrate of width Sw= 42 mm and length SL=43 mm.

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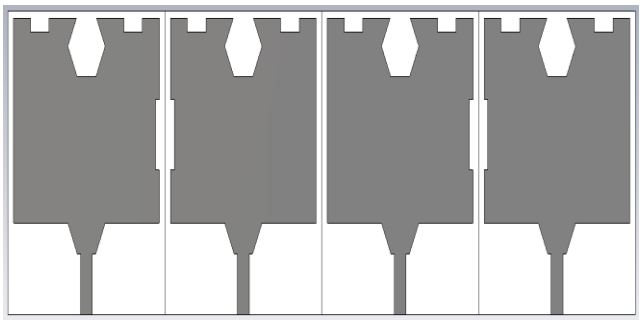

Fig.-1: Microstrip Patch Antenna Front

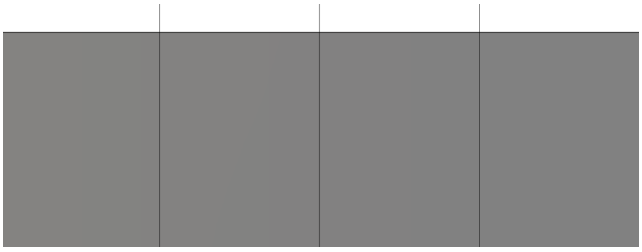

Fig.-2: Back View of MIMO antenna

Table 1: Dimension of antenna

meter List

Name	Expression	Value
sw	= 42	42
sl	= 43	43
sh	= 1.524	1.524
rw	= 1	1
rl	= 40	40
rect1	= 15	15
rect	= 1	1
rece3	= 10	10
rece2	= 1	1
pw	= 39	39
pl	= 29	29
iso	= 1	1
il	= 1	1
i1	= .5	.5
gw	= 42	42
gl	= 38	38
gh	= .07	.07
fw	= 3.18	3.18
fl	= 13	13
<new parameter>		

S-parameter

The S-parameters of the proposed MIMO antenna is presented in below figures. The antenna is resonates at dual frequencies i.e 3.6 GHz and 5.3 GHz. At 3.6 GHz the value of S11 is -14 dB while at S22 it is -39 dB. At 5.3 GHz the value of S11 and S22 is -20 dB. The isolation parameter S12=S21=S31=S13=S41=S41 etc are below -10 dB which is also considerable from MIMO antenna isolation point of view. The optimized result at port 1 and port 2 also presented in below graphs.

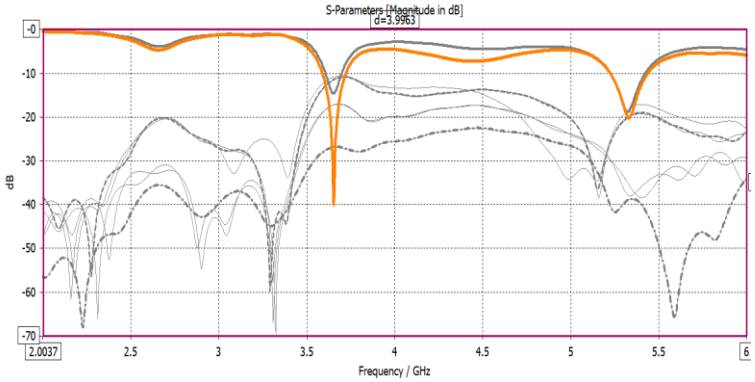

Fig.-3: S-parameters of MIMO antenna

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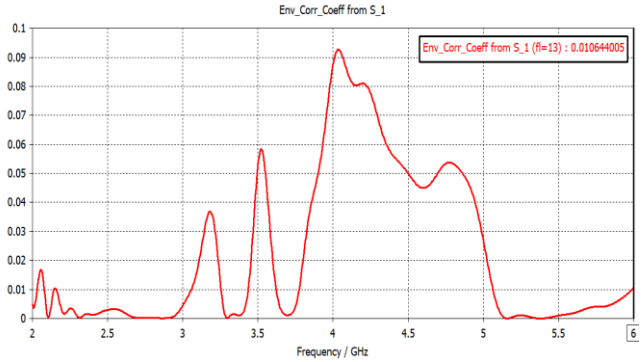

Fig.-4: Envelop correlation coefficient

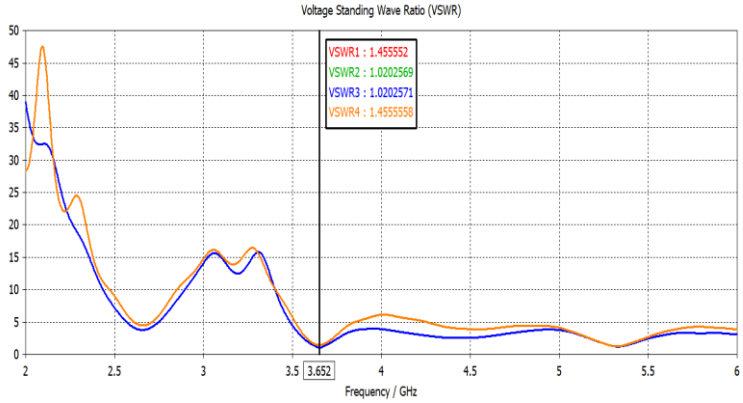

Fig.-5: Voltage standing wave ration

The gain of the antenna closely related to the directivity of the antenna. Gain is the measurement of antenna's ability to radiate or concentrate radio wave in particular direction. The gain of an antenna is "the ratio of the radiation intensity, in a particular direction, to the intensity that would be produced if the power acquired by the antenna were radiated in isotropically manner". The maximum value of gain is 3.95 dB and 0.74 dB at 3.6 GHz and 5.3 GHz respectively.

III. ANTENNA PERFORMANCE

Practically, an antenna cannot radiate equally in all direction. It is found that any realisable antenna will radiate more in some directions than other directions. The directivity D of an antenna can be defined as "the ratio of the radiation intensity to the average of radiation intensity over all directions. The directivity at 3.6 GHz and 5.3 GHz is 8.45 dBi and 4.63 dBi respectively.

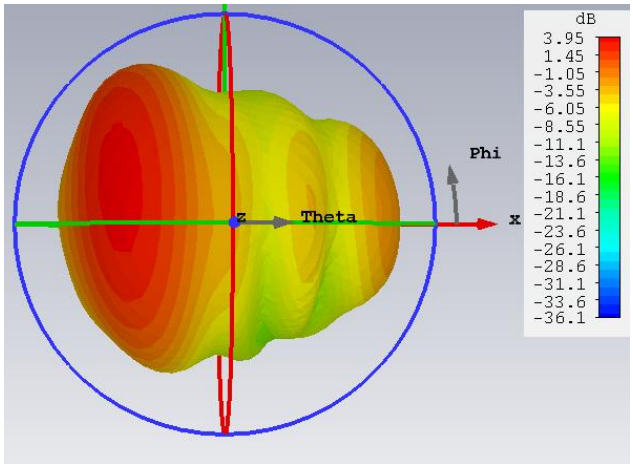

Fig.-6: Proposed MIMO antenna gain at 3.6 GHz.

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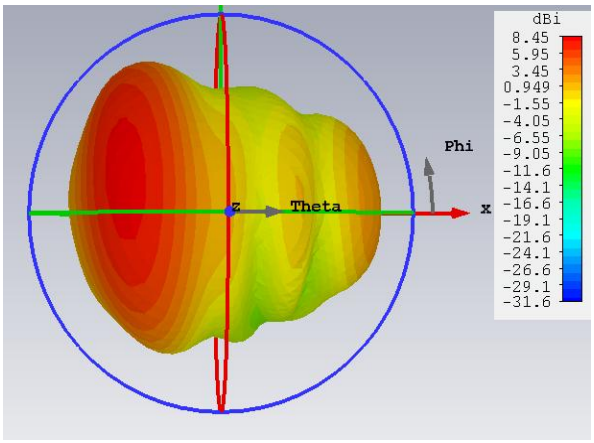

Fig.-7: Proposed MIMO antenna Directivity at 3.6 GHz

The E-field main lobe magnitude is 14.6 dBV/m at 3.6 GHz while the 13.4 dBV/m at 5.3 GHz. The H-field main lobe magnitude is 42.4 dBA/m and 36.1 dBA/m at 3.6 GHz and 5.3 GHz respectively.

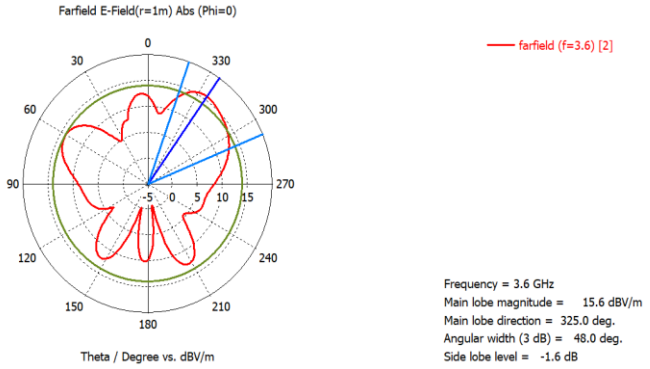

Fig.-8: Proposed MIMO antenna E-Field at 3.6 GHz.

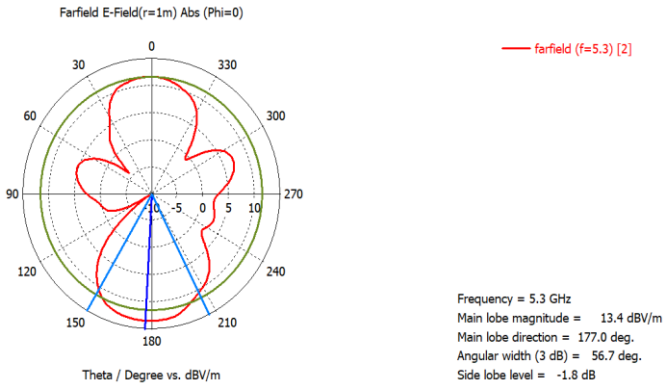

Fig.-9: Proposed MIMO antenna E-Field at 5.3 GHz.

IV. CONCLUSION

A rectangular microstrip antenna array design is introduced using the appropriate design formulas and is simulated using the CST Studio Suite software. The antenna is designed at dual band frequencies 3.6 GHz, and 5.3 GHz using FR-4 substrate (lossy) (Ɛr = 4.3), h = 1.6 mm and t = 0.07 mm. Even though the antenna is designed to operate at the above mentioned frequency, when simulated with CST it is found that, the resonating frequency is the dual band frequencies 3.6 GHz, and 5.3 GHz respectively.

The MIMO antenna has return value of -14 dB and -20 dB at 3.6 and 5.3 GHz respectively. The isolation of below -10 dB was found in both bands. The 110 MHz and 195 MHz bandwidth was obtained in first and

second band respectively. The antenna has good value of other MIMO antenna parameters. The gain of MIMO antenna is 3.95 dB and 0.7 dB with good directivity results is obtained in both band.

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