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Design of Microstrip MIMO antenna for S & C-band Applications

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Abstract*: In this paper, a compact MIMO with a size of 60 x 40 mm^2 is designed for C-band applications. This design make up of maintaining the reflection coefficient ≤ -10 dB and maintained the isolation ≤ -15 dB is achieved. In order to reducing the parameter of isolation consider the spacing between the antenna elements is 3 mm. By properly choosing this distance a large change the parameter of isolation and used in the applications of radar analysis and wireless communication system applications. This type of antenna arrangement producing good radiation patterns, peak gain, VSWR, diversity gain and group delay is observed.

Index Choice: Group delay, MIMO antenna, correlation coefficient, diversity gain.

I. INTRODUCTION

In the present wireless communication needs a higher data rates, low losses, rapid speed of transfer of information is required. To fulfilling these type of requirements one of the best option id to design multiple input multiple output (MIMO) technology is required. One of the main problem this technology is electromagnetic interference between the antenna systems. The different type of approaches like EBG, DGE, neutralization techniques and decoupling structures are used to reduce the mutual coupling. A F-shaped stubs in UWB system [1] having an area 56 x 45 mm^2 produces of S_{11} is -25 dB & S_{21} 0F -25 dB was obtained. Two element band notch MIMO antenna having uniform and high isolation around -17 dB was achieved in [2]. A good out band characteristics was obtained having an area of 3500 mm^2 [3] whose isolation is -25 dB was achieved and maintained envelope correlation coefficient < 0.05. A UWB MIMO system [4] produced dual-notch function having reflection coefficient -25 dB is achieved at the resonating frequency operating from 3.1 – 10.6 GHz. A circular polarized dual-band characteristics MIMO antenna was designed by an area of 75 x 56 mm^2 obtained the transmission coefficient ≤ -25 dB is maintained in the entire operating region [5]. Another design for circular polarization square MS antenna with an occupied area of 2400 mm^2 produced in the entire operating region VSWR ≤ 2 is maintained to reduce the effect of mutual coupling and also improves the return loss of the design [6] got a good arrangement of the system. In [7], arrow headed circular polarization antenna having symmetrical slit produces the value of S_{11} of -35 dB & S_{21} of -32.54 dB is achieved in the entire band of operation region of the desired system. Kotch fractal circularly polarized radiator was designed by an area of 45 mm x 58 mm produced isolation ≥ -25 dB is obtained at the resonating frequency [8] is observed. For wearable health care applications miniaturized slotted patches having a compact area of 45 mm x 65 mm [9] which is less than – 15 dB is achieved and ECC also less than 0.05 was observed. In [10], L-shape slot and fractal quad-band antenna occupied total area of 2400 mm^2 produced high isolation of -35 dB and return loss of -31 dB was achieved. In the applications of WiMAX and WLAN aperture coupled type stack antenna was designed with an area of 3500mm^2 produced ECC less than or equal to 0.25 and diversity gain around 8.99 dB was achieved. In [12], complementary SRR multi-band monopole antenna having an area of 58 mm x 85 mm was designed for the applications of WLAN and WiMAX of S_{11} of -33 dB & S_{21} of -22.54 dB is achieved in the resonant band of operation. The proposed design having a compact area of 60 x 40 mm^2 having S_{11} of -42 dB & S_{21} of -35.54 dB is obtained at the resonant band of frequency. Table 1 shows the dimensions of the proposed structure.

Parameter	L	W	L_p	W_p	a	b	c	d
Dimensions (mm)	60	40	25	30	15	4	6	3
Parameter	e	f	g	h	i	j	k	l
Dimensions (mm)	2.5	3	9	3	3	2	2	2

Table 1: Dimensions of MIMO structure

II. ANTENNA DESIGN & STRUCTURE

The proposed dual-band structure occupied an area of 60 mm x 40 mm with a substrate of FR-4 lossy and loss tangent of 0.0025. Here L_p= length of the patch, W_p= Width of the patch, a= spacing between the left and right side of both the patches, b= width of the patch reducing the from both left and right sides of the patch to decrease the isolation, c= width of the patch without reducing the on both left and right sides of the patch, d= the width in the bottom side of the patch from the total patch, e= the length of the patch cutting to formation of a new design on both sides of the antenna, f= remaining part after the removing both sides of the width, g= separation between the two sides of the patch after cutting ride side of the

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patches on both sides, h= separation between the two radiating patches which is the important parameter in the entire design of proposed structure which is considered as 3 mm to reduce the parameter of isolation, i= strip of the MS antenna to patch to provide waveguide port coupling, j, k= represents the parameter of remaining length after feeding the MS line and finally the parameter 'l' indicates that both sides of the left patch length consideration.

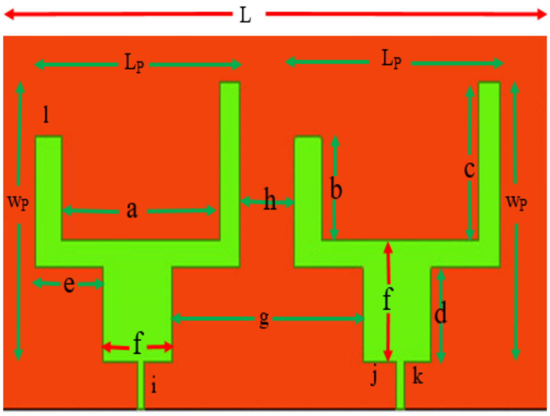

Fig.1: Proposed MIMO dual-band antenna

III. RESULTS DISCUSSION

The proposed structure indicates the evaluation of different type of antenna parameters and their results obtained better compared to existing system in the literature mentioned. The structure has a greater improvement in the all the parameters compared to literature mentioned reports earlier. Fig. 2 indicated the parameter of return loss (S_{11}) is resonant at a dual-band operation produces -20 dB & -42 dB at 4.1 and 6.2 GHz. Fig. 3 represents the transmission coefficient (S_{21}) is resonant at a dual-band operation produces -35 dB & -32 dB at 4.1 and 6.2 GHz which is the greater value compared to the previous existing systems.

These can be obtained by parametric study by varying the different distances and finally observed at h= 3 mm greatly reduces the mutual coupling. Fig. 4 indicates the measurement of VSWR value is less than or equal to 2 for the entire resonant band of frequencies of operation.

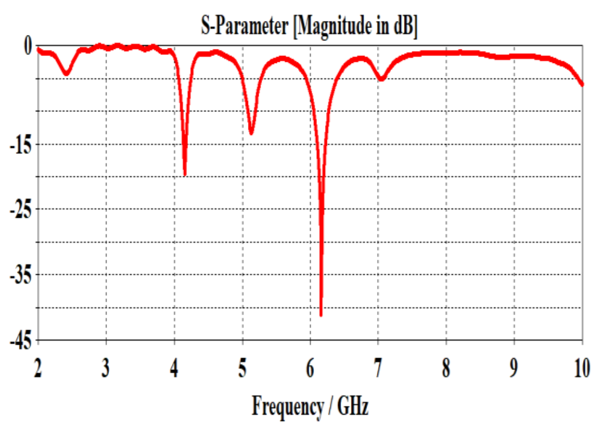

Fig.2: S_{11} Proposed MIMO dual-band antenna

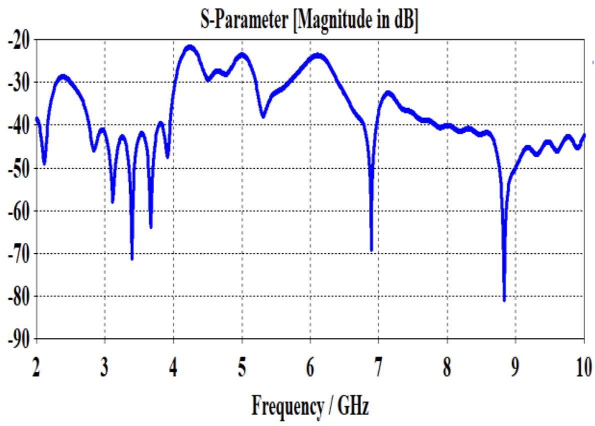

Fig.3: S_{21} Proposed MIMO dual-band antenna

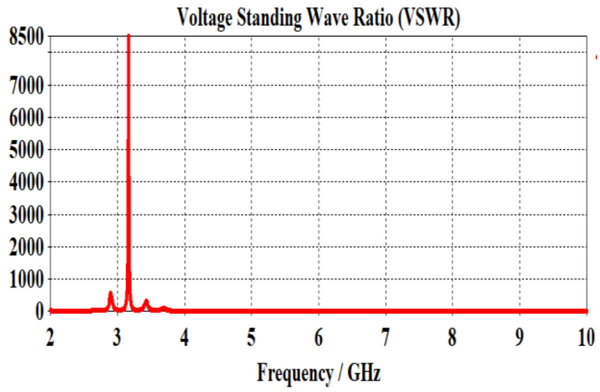

Fig.4: VSWR of MIMO dual-band antenna

Fig. 5 indicate the distribution of surface current when one port of the antenna is excited and other port of the antenna terminated with characteristic impedance, here port 1 is excite and port is terminated with impedance 50 ohms. Here more current is flows the middle of the patch and a small amount of current is flows through at the edges. Similarly from Fig. 6 represents the distribution current when port 1 is terminated with characteristic impedance and port 2 is terminated which observes that more current is created at bottom side of the microstrip patch wave guide port and a little bit amount of current is created at the middle of the patch is observed.

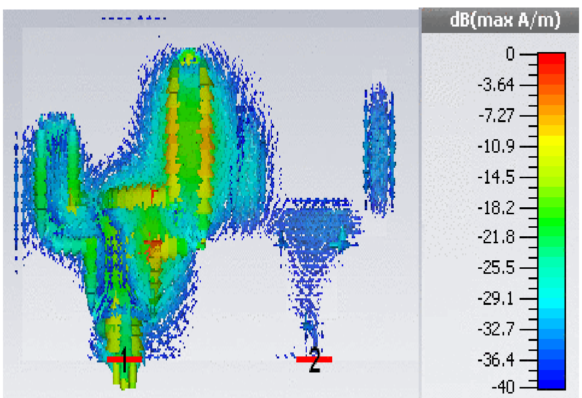

Fig.5: Surface current distribution port 1 is excited

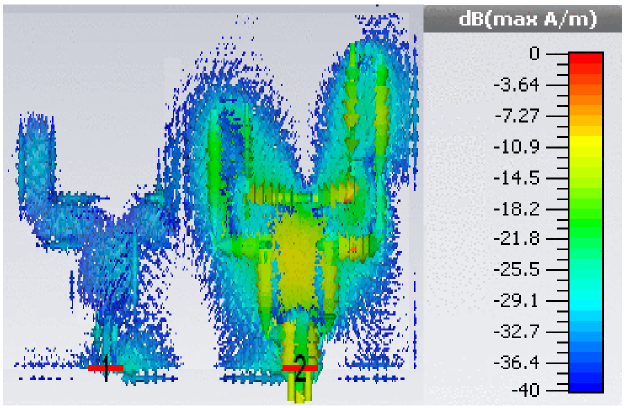

Fig. 6 Surface current distribution port 2 is excited

Fig.7 represents the radiation patterns of the dual-band structure at the resonating frequencies of 4.1 GHz & 6.1 GHz. The patterns at the two resonating frequencies of co-polarization and cross polarization are indicated. The co-polarization is always greater than the cross polarization is also indicated clearly in the figure. The two planes are simulated at xz-plane and yz-plane which represents the E-filed and H-field. Fig. 8 indicates that envelope correlation coefficient of the design which is lower than the 0.025. Fig. 9 indicates the diversity gain of the dual-band structure antenna which approximately equal to 9.99 at the two resonating frequencies. Finally the parameter of group delay is shown in the Fig. 10 which produces the value of 10 nsec at 4.1 GHz and 5.8 nsec at 6.2 GHz.

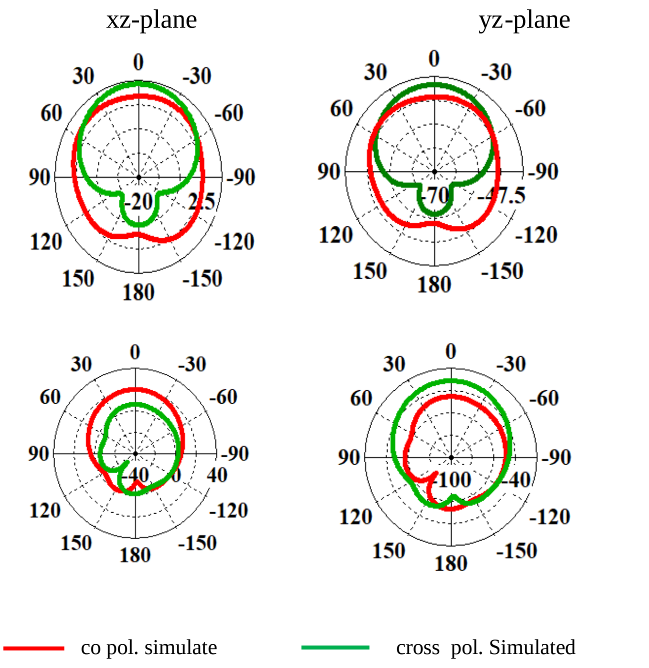

Fig.7: Radiation patterns of the MIMO design

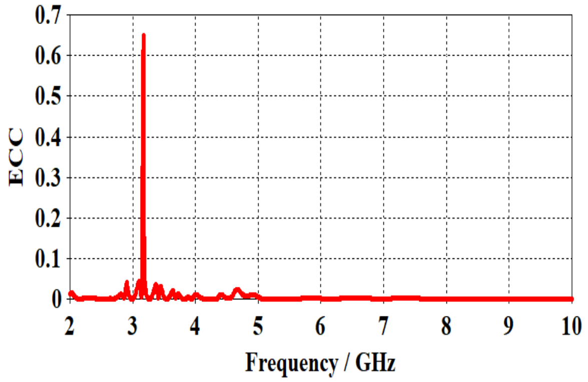

Fig.8: ECC of the MIMO design

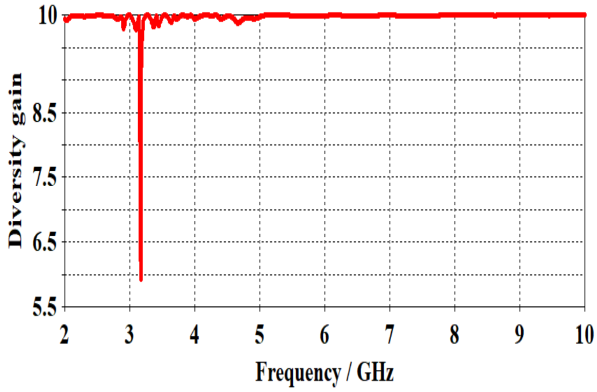

Fig.9: Diversity of the MIMO design

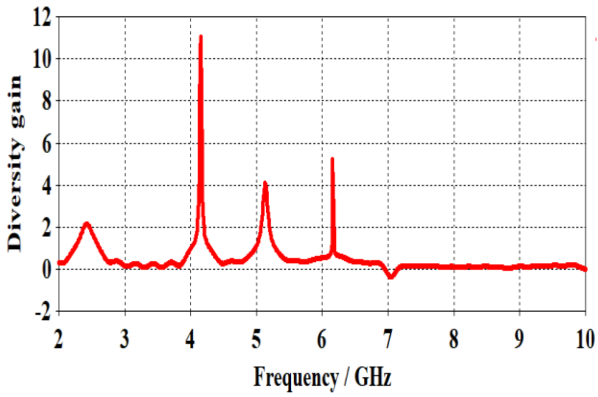

Fig.10: Group delay of the MIMO design

IV. CONCLUSION

A compact MIMO with a size of 60 x 40 mm^2 has been designed for the applications C-band. The proposed design has been observed that by maintaining the reflection coefficient ≤ -10 dB and maintained the isolation ≤ -15 dB has been achieved. To fulfilling the parameter separation between the patches has been considered 3 mm. By properly choosing this distance a large change the parameter of isolation has been used in the applications of radar analysis and wireless communication system applications. This structure also has been achieved the group delay parameter greater than the 3 nsec has been achieved.The proposed design antenna has been producing the good radiation patterns, diversity gain, group delay, peak gain and VSWR has been achieved.

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