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# A Multiband MIMO Antenna with Reduced Mutual Coupling using Defected Ground Structure

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***Abstract:*** ***In this paper, a MIMO antenna is presented with microstrip feed. This proposed antenna resonate at 0-3GHz, 3.46GHz ,4.2-7.6GHz and 9.26GHz. The proposed MIMO antenna has an impedance bandwidth of 150%(-10dB criteria). The important parameters like S parameters, VSWR, Diversity gain, ECC, E plane & H plane radiation patterns are presented. The proposed antenna suitable for S band, C band, X band applications.***
***Keywords: MIMO, Mutual Coupling, ECC, VSWR***

## I. INTRODUCTION

Microstrip Patch antennas are widely used in today's era. These are becoming very useful because they can be printed directly onto a circuit board. These antennas are also called as "Printed Antennas". These are low cost, have a low profile, light weight and are easily fabricated [1]. Microstrip antennas are designed to have many geometrical shapes and dimensions. Microstrip patch antenna works at different frequencies for the different applications [2].

Microstrip patch antennas are very useful for wireless applications for transmitting the data from one place to another [3]. Microstrip patch antennas are operate at microwave frequencies. Microwave frequencies ranges from 300MHz TO 300GHz. The microstrip patch antenna consists of conducting patch on a ground plane separated by dielectric substrate [4]. Now-a-days we need high performance in small size, so the microstrip antennas are perfect to use. If bandwidth of design is more applications of microstrip antenna are more [5].

Some applications of Microstrip patch antennas are GPS, WiMAX, Mobile satellite communication and space communications [6]. Micro strip antenna has different geometrical shapes and dimensions we mainly use rectangular and circular micro strip patches in many applications [7].

MIMO is an antenna technology for wireless communications in which multiple antennas are used at both the source and destination. The MIMO antennas are used mostly because of its wide range of advantages. As the demand of wireless communication increases the personal communication devices required to operate at different frequencies [8]. The purpose of MIMO systems is to use multiple transmitters and receivers. In MIMO systems the channel capacity is increased. Basically, a major problem will be caused due to the high mutual coupling between the two closely placed adjacent antennas.

We have different types of mutual coupling reducing techniques like Electromagnetic Band Gap structure, Split Ring Resonator Structure, Defected Ground Plane Structure etc [9 ] .

In this paper, a novel structure is designed with reduced mutual coupling between the two antennas. In this paper, first, a single slot antenna is designed and the parameters are observed. After modifying single antenna, a 2x2 MIMO antenna is designed and parameters of 2x2 antenna is modified. The DGS (Defective Ground Plane Structure) is used to reduce the mutual coupling between the antennas**.**

## II. ANTENNA DESIGN

The proposed MIMO antenna is as shown in Fig.1.The dimensions of the single antenna are 20.5×20 $mm^2$. The substrate is Rogers RT 5880 LZ (loss free). The substrate thickness is 1.6mm. the patch and ground plane are chosen as Copper. The MIMO dimensions are 41×20×1.6mm3. For the proposed MIMO antenna microstrip feed is used.

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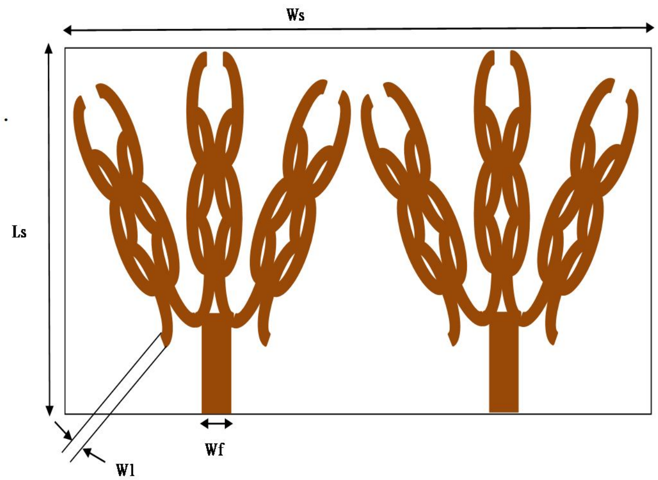


Fig.1.1: Front view of Proposed MIMO antenna

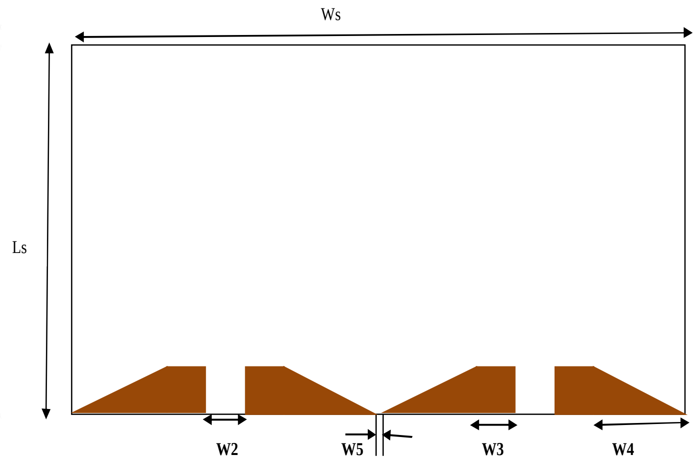


Fig.1.1: Back view of Proposed MIMO antenna

| |
|---|
| Ws= width of substrate=41mm Ls=length of substrate=20mm Wf=width of feed=3mm<br>W1=0.5mm W2=3mm W3=2mm W4=6.5mm W5=1mm |

## III.RESULTS AND DISCUSSION

The performance of the proposed MIMO antenna is evaluated in terms of return loss, voltage standing wave ratio (VSWR), Gain, Diversity Gain, ECC , Efficiency and radiation patterns are discussed below.

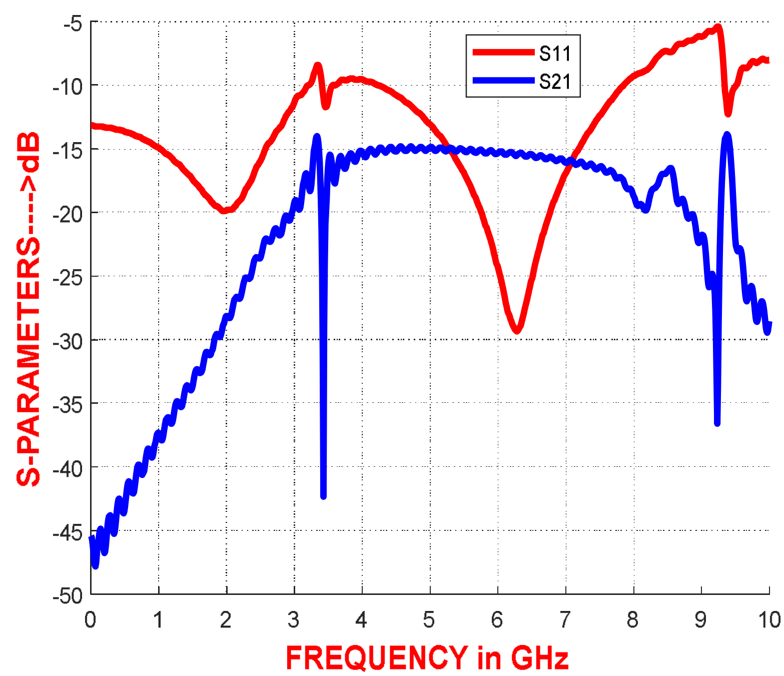


Fig 2. S parameters

The return loss and mutual coupling of the proposed MIMO antenna is as shown in Fig.2. The return loss(S11) curve shows that the antenna operates at 0-3GHz, 3.46GHz ,4.2-7.6GHz and 9.26GHz. The proposed MIMO antenna suitable for WLAN, Wi-Fi and satellite Applications. S21 indicates mutual coupling. The mutual coupling at 3.46GHz is greatly reduced by -43dB and at remaining operating bands it is maintained below -15dB.

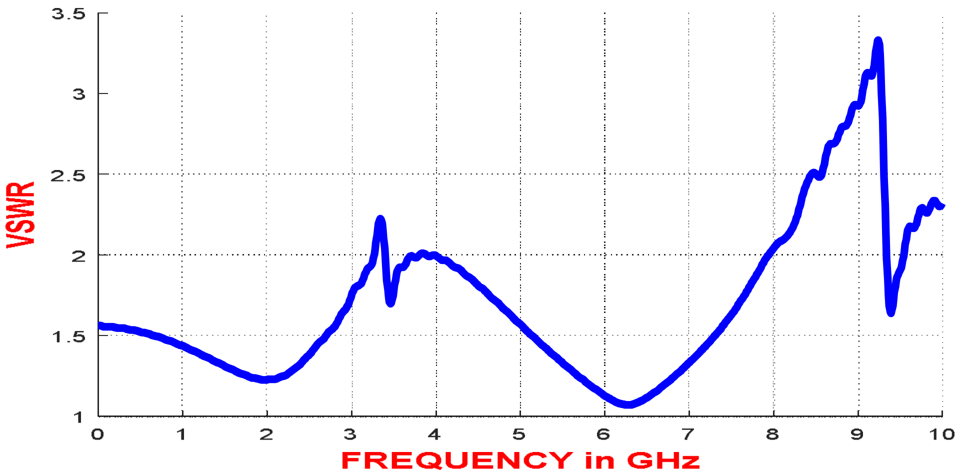

Fig 3. VSWR

The above figure shows the output of VSWR. It's typical value between 1 and 2. The Voltage Standing Wave Ratio is an indication of the amount of mismatch between an antenna and the feed line connecting to it. A VSWR value which is under 2 is considered as suitable for many of the antenna applications

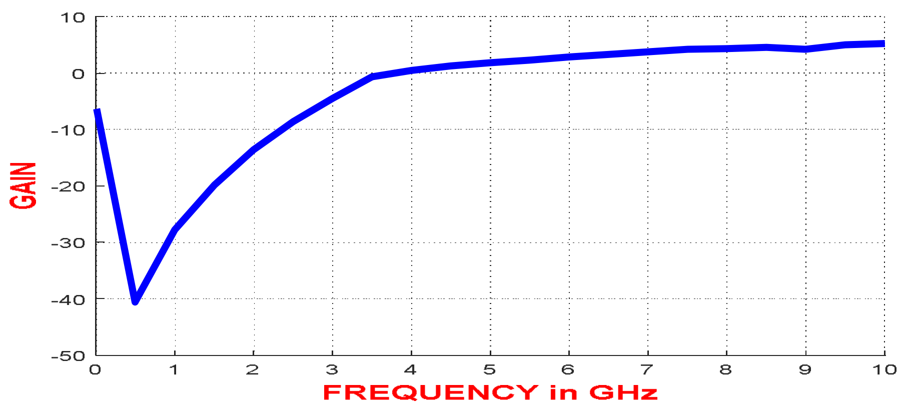

Fig 4. Gain

The above figure shows the output of Gain. In transmitting antenna, the gain describes how the antenna converts input power into radio waves headed in a specified direction. In receiving antenna, the gain describes how the antenna converts radio waves coming from a specified direction into electrical power.

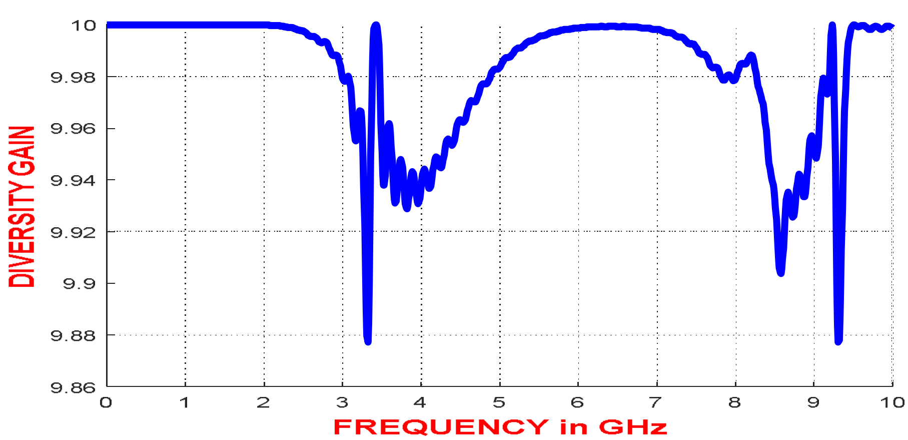

Fig.5. Diversity Gain

The above figure shows the diversity Gain, it is the increase in signal-to-interference ratio due to some diversity scheme, or how much the transmission power can be reduced when a diversity scheme is introduced, without a performance loss.

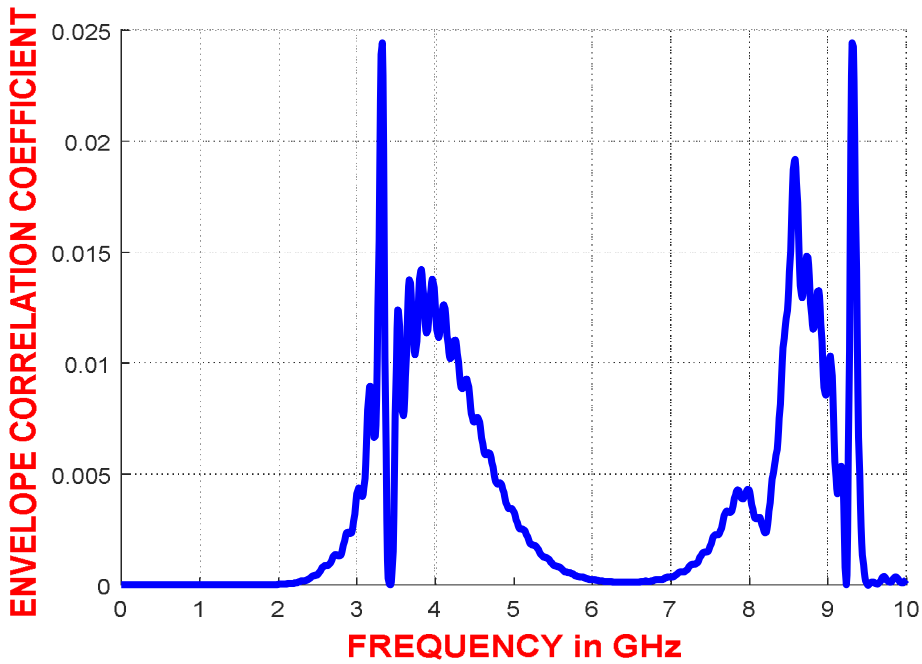


Fig.6. Envelope Correlation Coefficient

The above figure shows the output of envelope correlation coefficient, it tells how independent the two antennas radiation patterns are. So if one antenna was completely horizontally polarized, and other was completely vertically polarized, the two antennas would have correlation of zero. Hence it takes into account, the antennas radiation pattern, shape, polarization, and even the relative phase of the fields between the two antennas.

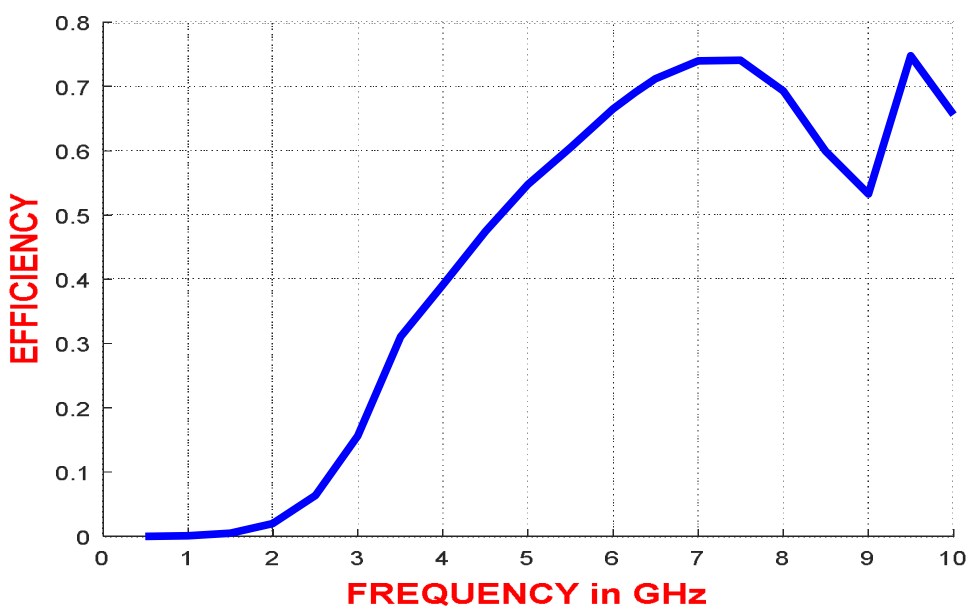


Fig.7. Efficiency

The above figure shows the output of efficiency, it is defined as the ratio of the aperture effective area to its actual physical area A. It describes the percentage of the physical aperture area which actually captures radio frequency energy.

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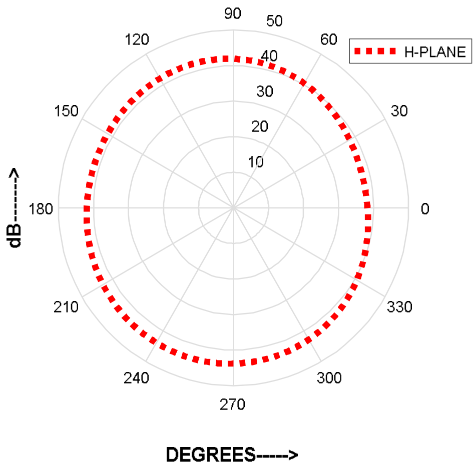


Fig.8.1 XZ-plane radiation pattern at 3.46GHz

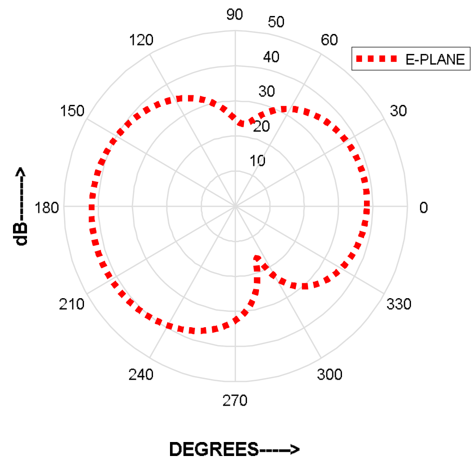


Fig.8.2 YZ-plane radiation pattern at 3.46GHz

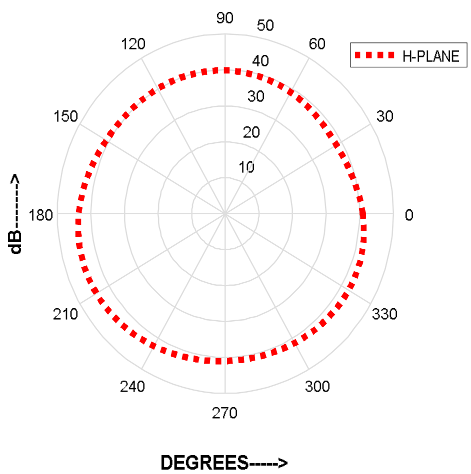


Fig.8.3 XZ-plane radiation pattern at 6.26 GHz

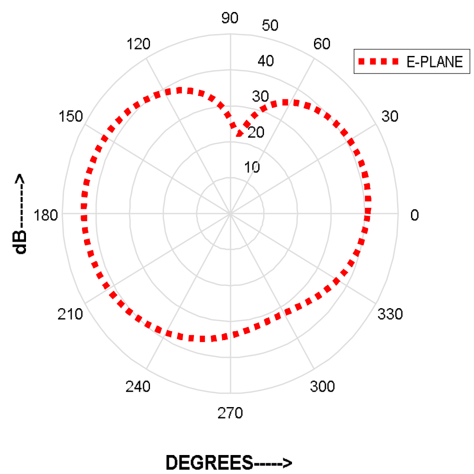


Fig.8.4 YZ-plane radiation pattern at 6.26 GHz

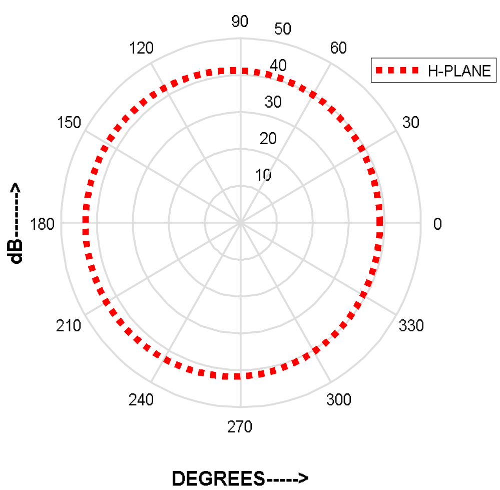


Fig.8.5 XZ-plane radiation pattern at 2 GHz

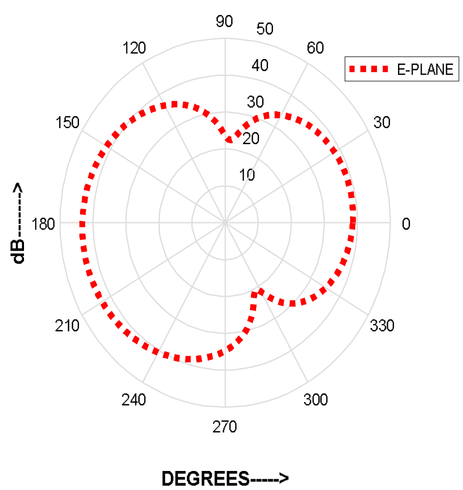


Fig.8.6 YZ-plane radiation pattern at 2 GHz

The above figure shows the simulated E-plane radiation patterns and H-plane radiation patterns at 3.46, 6.26 GHz and 2 GHz. Radiation pattern is the graphical representation which defines the radiating signal of the proposed antenna [10].

## IV. CONCLUSION

In this paper, Mutual Coupling reduction using Defected Ground Structure between two microstrip patch antennas has been demonstrated. For this proposed antenna, we got the high impedance Bandwidth and low mutual coupling. The Designed MIMO Antenna operates at four different frequencies is very useful for WLAN, Wi-Fi and satellite applications.

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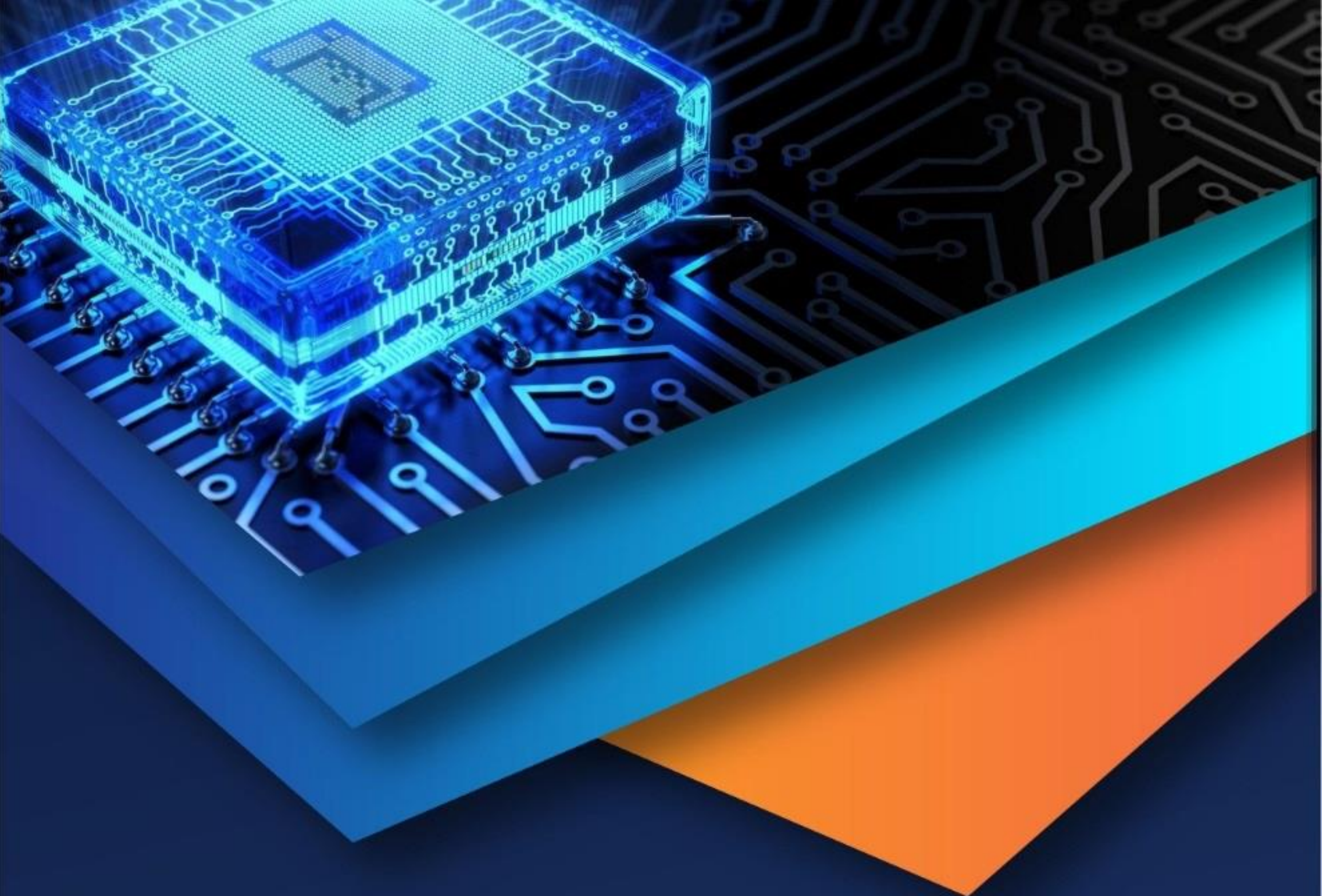


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