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DESIGN AND SIMULATION OF TWO ELEMENT MICROSTRIP MONO-POLE ARRAY ANTENNA FOR 5G AND WLAN APPLICATIONS

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Abstract: In present-time communication , we are in need of high speed networks and greater load capacity. Thus the fifth generation of wireless networks ,known as 5 G is employed for several purposes because of its longer range. during this paper, a compact dual band micro-strip mono pole antenna are proposed, designed, and presented. which may well be a decent candidate for 5G applications.Additionally it finds applications in WLAN.The two element mono-pole antenna is mounted on FR-4 substrate having a thickness of 1.6 mm.The antenna topology possesses a locality 32×32×1.6 mm3.Also the proposed antenna is simulated using ANSYS HFSS software(Version 19.2).From simulation, the antenna characteristics like return loss graph and VSWR are studied. The simulated results shows return loss value of -15.16 dB and -14.98 dB at operating frequency of 3.6 GHz and 5.1GHz respectively.Also,the proposed antenna achieved a moderate gain (2 dBi and a pair of dBi at 3.6 GHz and 5.1GHz respectively), a satisfying efficiency (86%), and a VSWR that's less than 2.

Keywords: Two element mono-pole antenna, FR-4 substrate, micro strip feed, HFSS software.

INTRODUCTION

In previous couple of years, economic and social development is greatly influenced by the advancements within the field of mobile communication. As a result, 5G technology has emerged as a pedestal of the long run 2020 generation. 5G technology is an emerging technology with evolutionary and revolutionary services. It's the subsequent generation of technology to supply ultra high data rates, very low latency, more capacity, and good quality of service.Over the past few years, software and hardware development of communication systems has been rapidly growth to hide many wireless applications. This includes broadband (BB), wide-band (WB), and ultra-wideband (UWB) microwave transceivers. Planar

multi-band antenna structures (micro-strip (MS), coplanar waveguide (CPW), and stripline (SL)) become highly regarded antennas because of their compact sizes, low cost, less weight, and straightforward to put in with this microwave wireless devices as compared to the standard wire antennas (helical, Yagi-Uda and spiral) [1]–[4]. There are several issues should be considered in designing an efficient multi band mono pole antenna. This includes overall antenna dimensions, average dBi gain, average efficiency and desired graph. Therefore, these parameters should be investigated and optimized to attain the desired application target.

In this paper dual band mono pole antenna is intended and simulated using Ansys HFSS Software. This dual band mono pole antenna resonates at 3.6GHz and 5.1 GHz frequency. Section 2 describes about the related work . Section 3 & 4 explains proposed antenna design and simulation results. Finally Section 5 concludes overall work.

2.RELATED WORK

M. Bank presented a novel modified mono pole antenna, which can be implemented in parallel to a ground plane. The gain of the proposed MB antenna is larger by 2.5dB compared to PIFA [5].

R. S. Kshetri mayum,have investigated printed mono pole antennas, which is basically a printed micro strip antenna with etched ground plane for multi-band applications. Printed mono pole antennas are less fragile, planar and can be integrated with the integrated circuits unlike mono pole antennas which have non-planar or protruded structures above the ground plane[6].

On the other hand And C. F. Tseng proposed a micro strip-fed mono pole antenna with a shorted parasitic element for achieving Bluetooth/ISM, 2.5/3.5 GHz WiMAX and 5.2/5.8 GHz WLAN bands.The antenna has a simple structure of an inverted-L mono pole and a square parasitic element that extends directly from the ground plane[7].

And P. Prabhu introduced a low profile printed mono pole antenna is proposed , designed for RFID coverage, This antenna is designed and resonant frequency is computed using ADS software, by varying the dimensions of the proposed antenna can achieve resonant frequency ,It achieves a desirable radiation characteristics with gain 3.8dBi for operating frequency 2.4GHz [8].

Moreover, Yogesh Kumar Choukiker proposed a concept for dual wide-band characteristics which cover the total WLAN band and other important bands.It gives a good prediction on the behavior of Sierpinski modified fractal antenna with different scale factors [9].

Jyoti Ranjan Panda proposed a new compact, 9-shaped and dual-band printed mono pole antenna is presented for RFID and WLAN. This antenna simultaneously resonates at 2.51 GHz and 5.18 GHz, which are the operating frequency bands for RFID and WLAN systems respectively[10].

Also Mohammad Tareq proposed a microstrip-fed planar mono pole antenna has been proposed for wideband applications. Three mono pole antenna have been designed and analyzed for improving antenna performance parameters.This antenna showed the resonance at 6.46 GHz and 10.49 GHz which shows return loss of about -19.77 dB and -13.45 dB respectively[11].

3.PROPOSED ANTENNA

In this paper, we proposed an antenna that works at 3.6 GHz and 5.1 GHz which may be a compact mono pole antenna. This antenna is mounted on FR-4 substrate having a thickness of 1.6 mm

which contains a tangential loss δ of 0.02, dielectric constant of 4.4.It is fed by a transmission line of 50ohm impedance.This dual band antenna contains a partial ground element and also the dimensions are mentioned within the table 1.The proposed mono pole antenna is easy to design and compact in size, and it may well be a decent candidate for several wireless applications including WiFi, LTE, and WiMax.This proposed antenna is verified employing a ANSYS high frequency structure simulator(HFSS).

3.1DESIGN METHODOLOGY

.The antenna is designed based on the following parameters given in the dimensions table1.It clearly tells about the size of the ground plane and the feed dimensions(length and width).All the dimensions are given in mm.Also the patch can be drawn into two elements(left and right(Inverted L-shape)). Both the left and right portions follow the same dimensions in the design.The explanations gives better understanding of the patch geometry.Firstly ,above the feed line a connecting rectangle(4.5*27mm) has to be drawn to connect the left and right part.Then a rectangle has to be drawn vertically with a dimension of 5*4mm(base) above the connecting rectangle.And a mono pole rectangle has to be build above the base .Its dimensions are 13.1*2 mm.Finally a horizontal rectangle(1*5.4mm) is to be drawn on the monopole rectangle .The same has to be done for the right side.Uniting all the rectangles gives the perfect patch which is given in the simulation diagram.

ANTENNA DESIGN

This section presents the dimension table, simulated design and fabricated design of the proposed mono pole antenna.High frequency structure simulator(ANSYS HFSS version. 2018) is used to simulate, investigate, and optimize the proposed mono pole antenna.The simulated antenna is shown in the figure 1.Also ,figure 2 represents the fabricated antenna in top and the bottom view.The bottom view represents the ground portion.The top view shows the patch geometry.

Antenna Parameters	**Dimensions(in mm)**
Substrate length	32
Substrate width	32
Substrate height	1.6
Ground length	22
Ground Width	32
Feed length	9.46
Feed width	2
Patch width	2
Patch length	13.1

Table1:Design Specifications

The below figures represents the simulation and the fabricated antenna geometry.

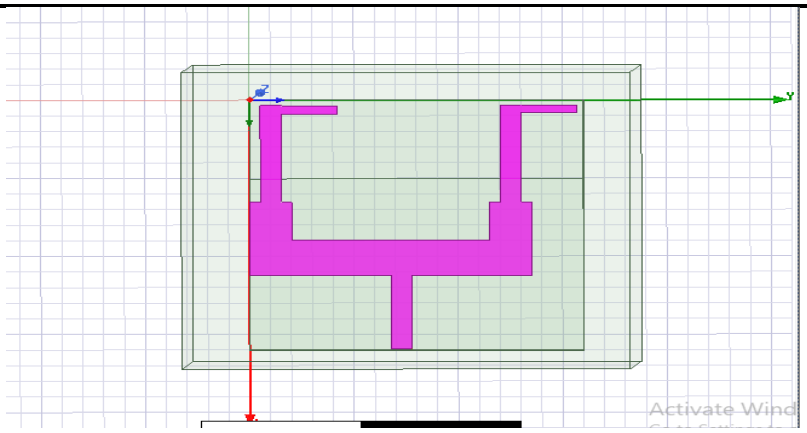

Figure 1: Simulated proposed antenna design

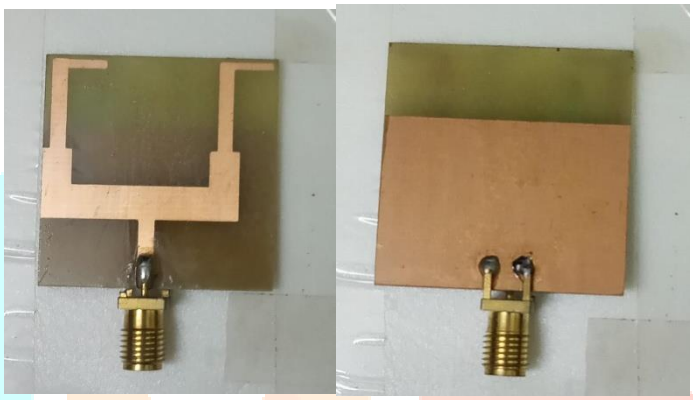

Figure 2: Top and bottom view of the fabricated antenna

4.SIMULATED RESULTS

This section clearly shows all the simulated results.The results include return loss plot,VSWR plot, radiation pattern,input impedance plot and all the field distributions.

RETURN LOSS PLOT

The figure 3 shows the S11 plot. Normally the return loss should be lesser than -10dB.This mono pole antenna achieves the return loss of about -15.16 dB and -14.98 dB at the operating frequencies of 3.6 GHz and 5.1 GHz respectively.

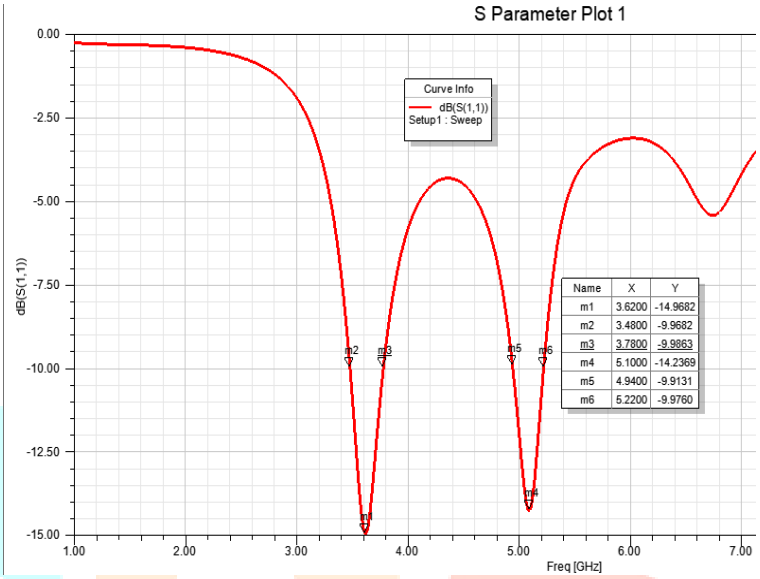

Figure 3: Return loss plot

GAIN PLOT

The gain of an antenna describes how well it converts the input power into the radio waves.Figure 4 shows an appropriate gain value at the operating frequency 3.6GHz.The gain of an antenna is 2.18 at 3.6GHz.

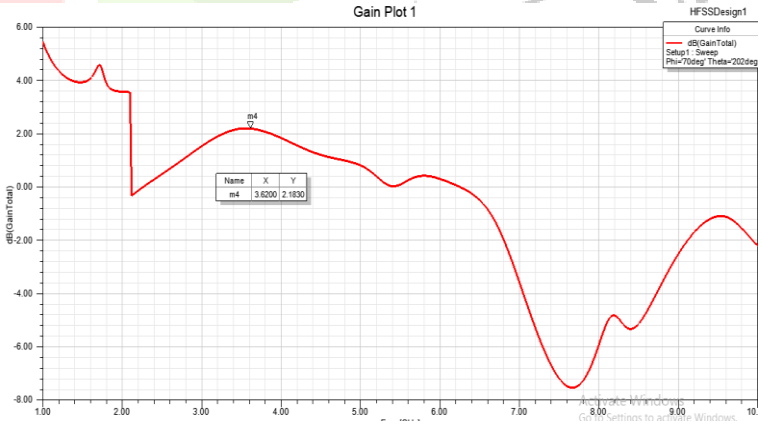

Figure 4:Gain plot

VSWR PLOT

VSWR plot is used to measure how efficiently the power is transmitted from the power source.If an antenna is said to be perfectly matched ,the VSWR should be lesser than 2.In this figure 5, the VSWR values are 1.44 and 1.48 at the frequencies of 3.6GHz and 5.1 GHz respectively.Thus the proposed mono pole antenna has less reflection.

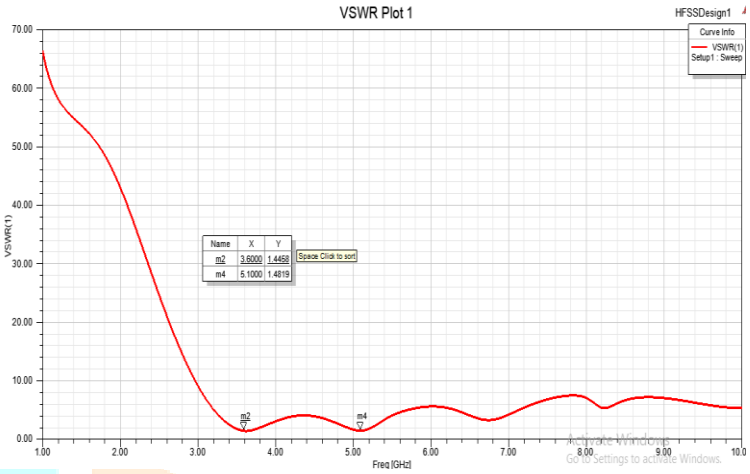

Figure 5: VSWR Plot

RADIATION PATTERN

Radiation pattern of an antenna tells about the variation of power in a specific direction.The radiation pattern of the proposed mono pole antenna is computed in E-Plane an H-Plane is presented in the figure 6. A desirable omni-directional pattern is achieved.However some distortion may occur due to finite ground plane.

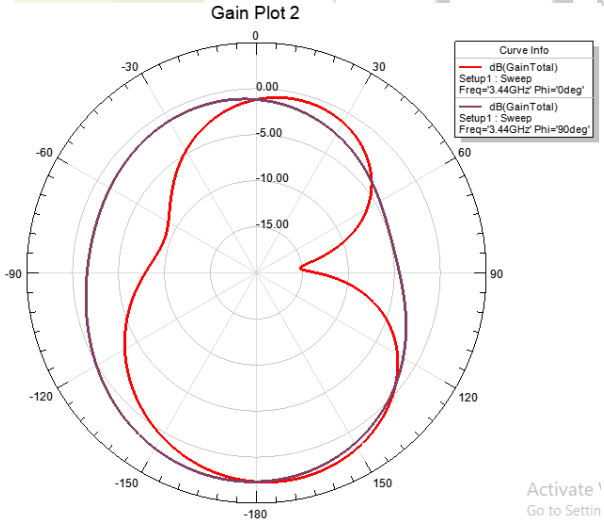

Figure 6: Radiation pattern in E plane and H-plane

DIRECTIVITY PLOT

Directivity of antenna specifies the concentration of radiated power in a particular direction.Th figure 7 describes the directivity plot for Phi =0 deg and 90 deg.

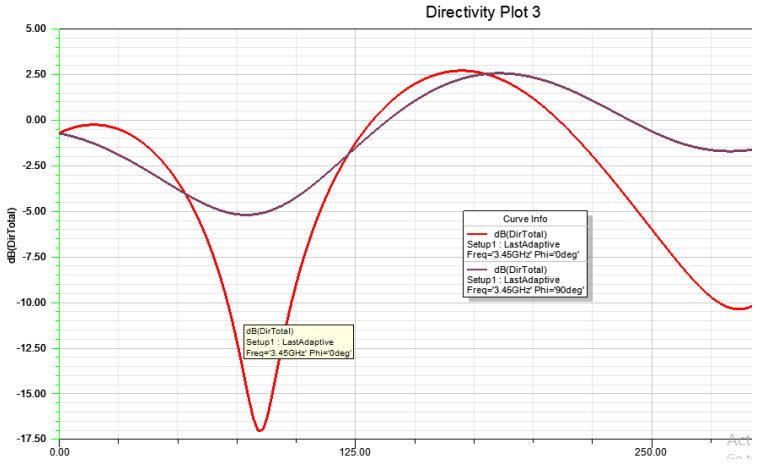

Figure 7:Directivity Plot

INPUT IMPEDANCE PLOT

Figure 8 is helpful to understand the input impedance i.e Z11 parameter.Z-parameter Z11 (im, re). Usually , real part is to around 50 and imaginary part should be around 0. In the proposed antenna this condition is satisfied . Therefore good impedance matching is achieved.

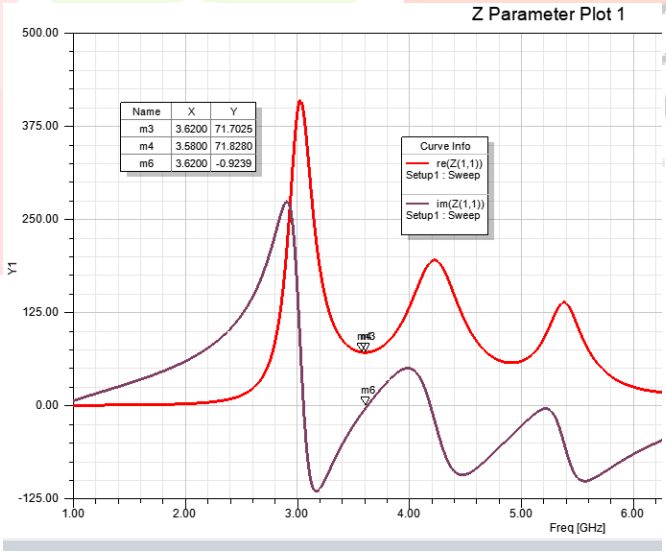

Figure 8: Input Impedance plot

FIELD DISTRIBUTION

The field distributions of the proposed antenna is clearly shown in the simulated form.The figure 9 tells about surface current distribution.Figure 10 and 11 represents the current and magnetic field distributions correspondingly.

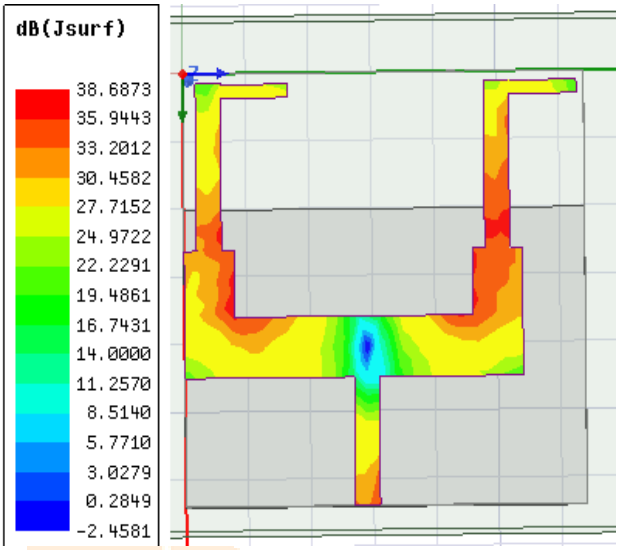

Figure 9: Surface current density distribution

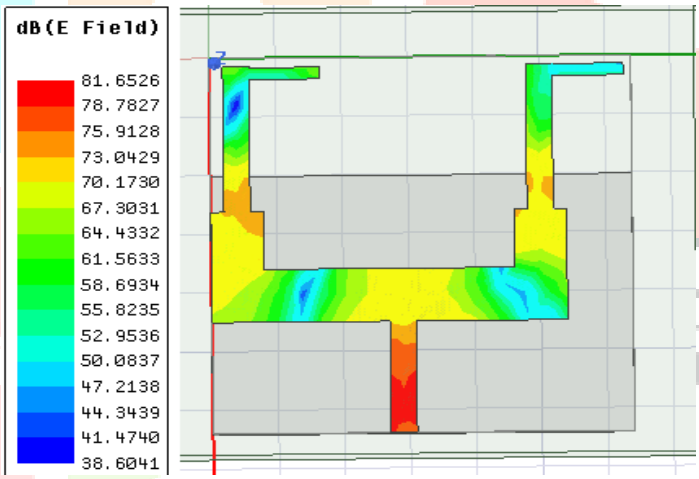

Figure 10: Current distribution of the proposed antenna

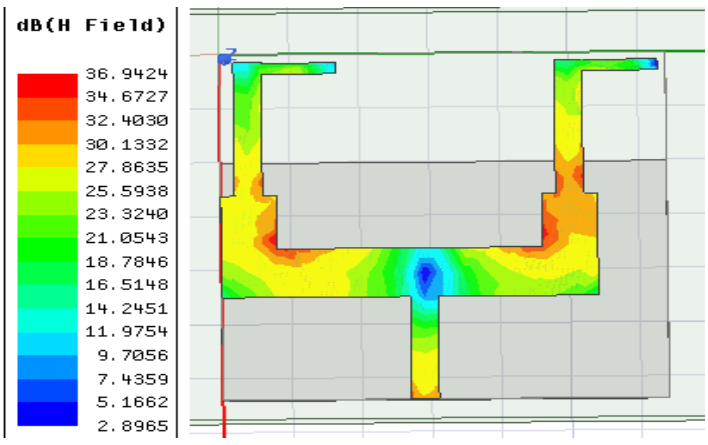

Figure11 : Magnetic field distribution of the proposed antenna

5.CONCLUSION

A dual band micro strip mono pole antenna has been proposed , designed fabricated and presented.Software HFSS is helpful to get all the performance parameters of this mono pole antenna.This novel antenna is tiny in size and simple to fabricate .The proposed antenna has achieved good efficiency(86%), a satisfying gain , low VSWR(lesser than 2) and also low return loss.In future this antenna may be tested and verified. The S11 may be analyzed by the Vector Network Analyzer(VNA).Also the proposed antenna might be a good candidate for 5 G Applications .Additionally it's also employed in WILAN applications thanks to its dual band nature.

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