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Design and Analysis of Circular Monopole antenna for WLAN and WI-Max Application in S band

Bhavna Sharma, Punam Rani, Prachi Gupta

Abstract: In today's existence, the technology for communication is continuously growing. The agile achievement in ultra-broadband antennas in wireless communication is increased. A circular monopole microstrip patch antenna has been developed in this research paper. The parameters grandiose by antenna perfmonance are researched. The design is designed to achieve desired gain and bandwidth at 2.4 GHz frequency, with a defected ground system (DGS). This antenna design has been effectuated using FR-4 as the dielectric substrate with 4.3 as dielectric constant. In computer simulation technology (CST) the model monopole circular microstrip patch antenna is simulated and the results needed are achieved. The S11 parameter is obtained as -17.28 decibels which is below -10 decibel. The gain obtained at 2.4 GHz frequency is 1.730 decibel. Application in S band devices, including Wi-Max, WLAN, radio altimeter, cordless phones, wireless headphones etc., were built in this research article.

Keywords: DGS, Monopole circular Microstrip patch antenna, CST, Gain

I. INTRODUCTION

In wireless electronic equipment market, the stipulation or demand of small size appliance is high because they require less space and the heat sinking is also easy due to advanced technology and availability of space. For a reduced size wireless system, we need to reduce the size of antenna used in that system. The antenna we are mainly designing in this research paper is used in Wi-MAX, WLAN, radio altimeter, cordless telephone and weather radar system. A number of antennas have been designed to meet the prerequisite of these systems [1]. For providing a perfect antenna for this requirement we study a no of publish papers to get the knowledge of design and measurements of antenna. The overall nature of antenna depends on our specific requirements, such as how we work or how we apply them. S band antennas have microwave, Nano satellite, missiles and GPS radar applications etc., [2-5]. In the field of wireless communications, Microstrip patch antennas are extensively used and satellite navigation because of their low profile properties , low weight lost, low weight, compliance and eas y integration into active devices[6-8].

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The employment of Microstrip antenna is an attainment in Wireless communication system and it is fulfilling the necessity of wireless communication in its new innovations using their planar structure and economic efficiency.

Microstrip patch antenna has a narrow operating bandwidth which imposes restrictions on its use in wireless communication system but propitiously many communication systems don't require larger bandwidth, therefore it's not a major problem. In our day to day life we need broadband applications and wireless devices to perform various tasks. These antenna persuades major prerequisite for mobile and satellite equipment, and many business demands are satisfied utilizing it [9-11]. Microstrip patch antenna have proven to be splendid and effectively used for 5g applications because of compact design and are easy to install [12-13]. The Microstrip Antenna is called the patch antenna because it is made of metal patch from one side of th e substratum and metallic floor plane from another side of th e substratum. The main part of the patch antenna is the metallic top patch used for antenna radiation. [14]. With respect to circuit theory, in order to allow maximum transfer of electric signal energy from source to spot, electrical resistance should correspond between spare and feedline. The electrical signals must have fed to patch either by contacting or non-contacting method. Microstrip line component is employed in contacting method to provide the electrical signal power to the patch. One the contrary, electrical signal power between the microstrip line and the patch can be supplied when is method is non-contacting. [15-16]. Antenna efficiency is calculated by the microstrip feedline. An excellent match between patch and feedline enhances antenna performance and therefore increases its bandwidth. An incomplete match impedes its efficiency and inevitably lowers the bandwidth information limit. One of the fundamental form of the Microstrip antenna can be assembled using dielectric substrate as a base material and a radiating conducting material itched on the upper side of the substrate. The shape of the radiating conducting material can be of any geometrical shape as a basic form or some other common shape for the simplification of the performance analysis of the antenna [17-18]. The antenna developed in this paper is circular monopole antenna working at 2.4 GHz which lies in S band; a defect in the ground is also added during the implementation of the system to expand the gain and bandwidth and to provide better S11 parameter.

In Defected ground structure (DGS) technique slots or defects are introduced on the ground plane of microwave planar circuits which aids to improvise various parameters of RMPA, including low gain, cross-polarization, tappering bandwidth, etc.

II. ANTENNA GEOMETRY AND DESIGNING

The recommended circular monopole antenna element is prepared for WLAN and WI-MAX applications by using FR-4 as a dielectric substratum material with a height of 0.8mm operating at 2.4 GHz , which is a millimeter wave frequency in the S band with relative permittivity Ɛr= 4.3 . The maximum size of the proposed microstrip patch anteena is 32 x 36 x 0.8 mm³.This compact antenna is fed with coaxial feed so that desired results can be obtained . Length of first feedline is L1 =4.1 mm and its width W1= 1 mm , whereas second feedline is used of length Lf =14.8mm and width Wf =4.2mm. Height of patch from the centre to the second feedline is S=8.8mm. This design is simulated on software for computer simulatio n technology (CST). The design was implemented at a frequ ency of 2.4GHz. This monopoly antenna part was designed a s the substratumwith a dielectric constant of 4.3 using FR4 (l ossy). Because the dielectric constant of FR-4 is utterly high, it has proven beneficial to reduce antenna size and thus make it robust and stable.

Table 1. Optimized dimension of the proposed antenna

Geometry Parameter in mm	Notation	Dimension of geometry
Radius of patch	R	8
Substrate length	L	36
Substrate width	W	32
Substrate height	h	0.8
Feed length	Lf	14.8
Feed width	Wf	4.2
Ground Length	L	36
Ground Width	W	3

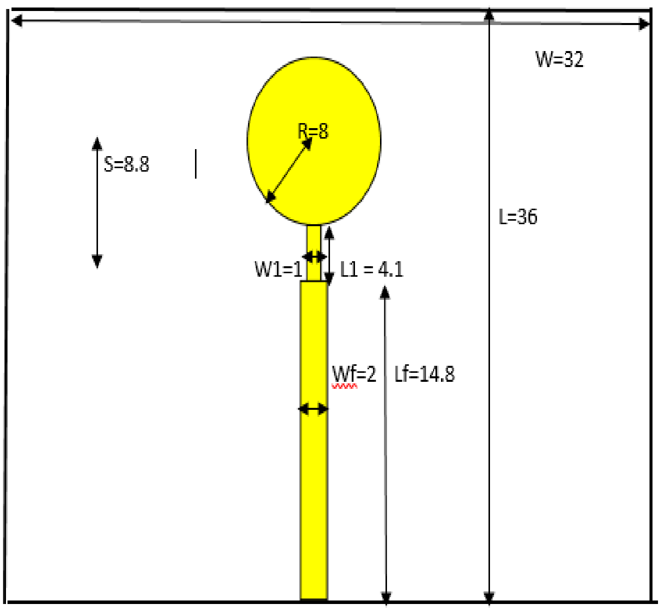

Fig 1 : Structure of Circular Monopole Antenna Proposed

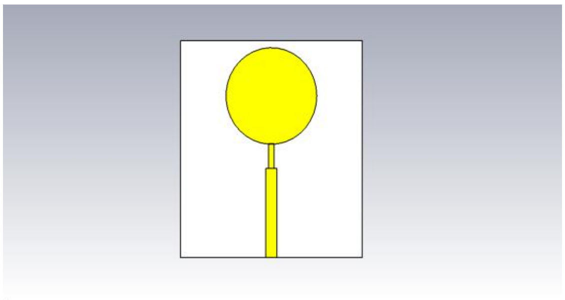

Fig 1a : Proposed Antenna Design (Front view)

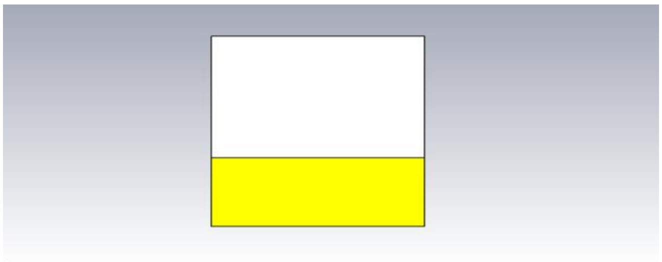

Fig 1b : Proposed Antenna Design (Back view)

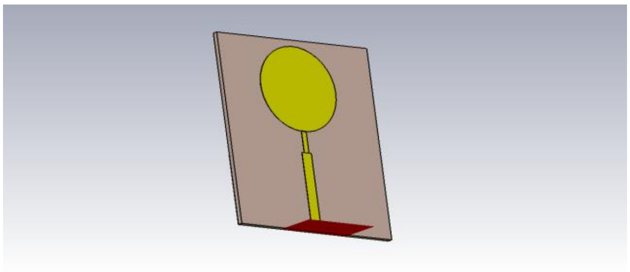

Fig 1c : Proposed Antenna Design (3d view)

III. PERFORMANCE OF THE ANTENNA AND DEBATE

1. S-Parameter

The coefficient of reflection or the parameter S11 explains the relation between the ports' input output power in an ante nna. When S11 = 0, it means antenna does not radiate at all and the S - parameter must be 10dB or less for antenna to resonate.

S11 appears to be -17.289267 decible at 2.403 GHz frequen cy in this proposed antenna configuration.

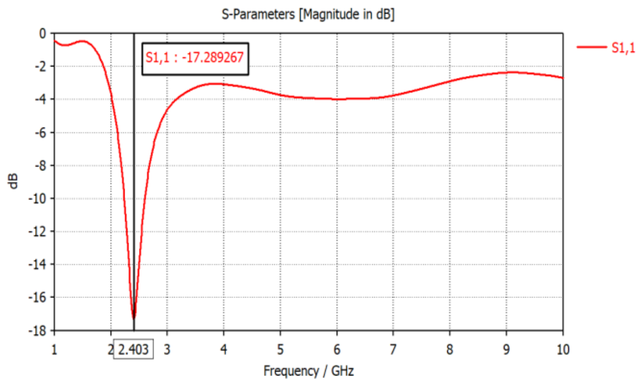

Fig.2 Reflection coefficient is -17.28 dB at 2.4 GHz frequency

2. . Voltage Standing Wave Ratio

In a RF system, VSWR gives impedance that matches the transmission line at the load. The designed antenna delivers VSWR at 2.4 GHz frequency as 1.31. The standing wave voltage diagram is shown in fig hereafter.

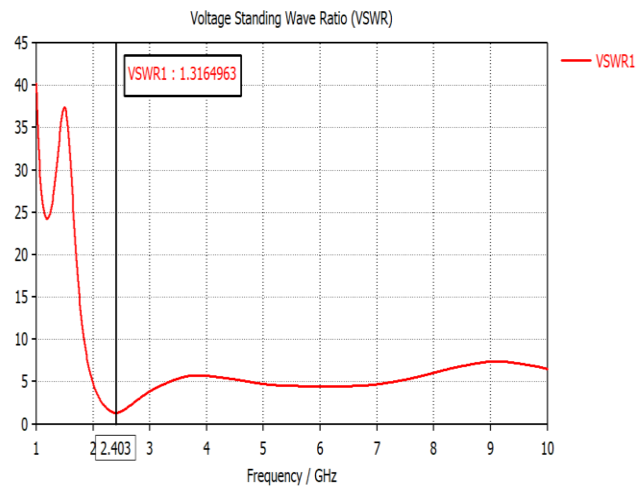

Fig 3: VSWR is about 1.31 at 2.4 GHz frequency

2. Gain

The antenna gain informs us how much power an antenna can deliever in the defined direction.

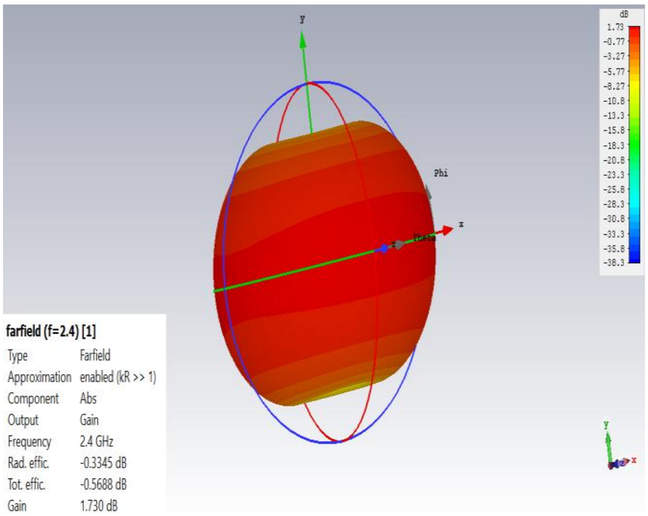

Fig 4: 3D Gain is 1.73 dB at 2.4 GHz

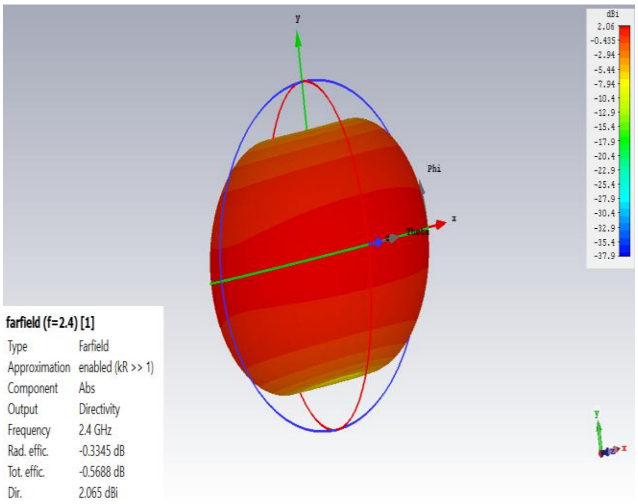

Fig.5: 3D Directivity is 2.065 dB at 2.4 GHz

3. Radiation Pattern

The radiation pattern obtained for the proposed antenna element design shown in fig 6,7 after simulation reflects the radiation pattern at 2.4 GHz frequency.

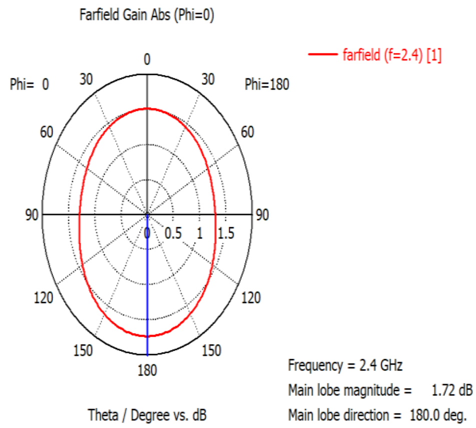

Fig 6: Radiation pattern at 2.4 GHz at 180.0 deg

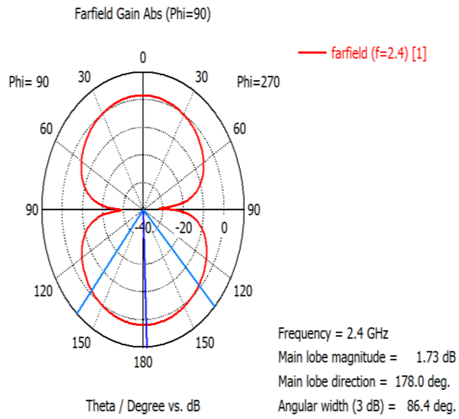

Fig 7: Radiation pattern at 2.4 GHz at 178.0 deg

4. Bandwidth

The bandwidth for the proposed antenna design comes out to be between 2.23 GHz – 2.59 GHz which lies in S band used for application like Wi-Max, WLAN, radio altimeter, cordless phones, wireless headphones.

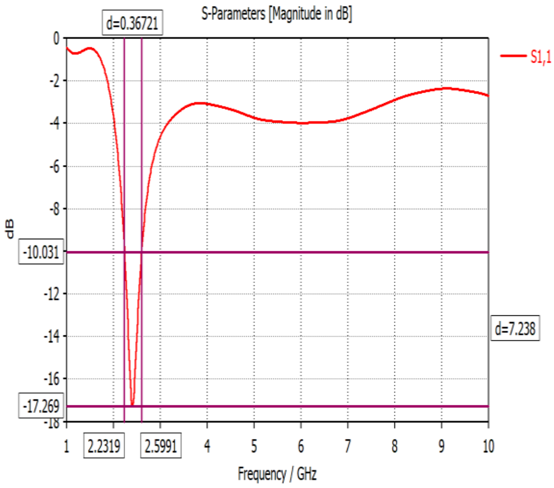

Fig 8 : Bandwidth is 0.36 GHz

IV. CONCLUSION

The designed antenna resonates at 2.4 GHz resonating frequency suitable for S band implementations. Theoretical research is conducted for the proposed circuit antenna. The theory and the findings agree well with modelling and design carried out using Computer Simulation Technology suite software (CST). The proposed antenna with superstate is relevant to applications for WLAN. The antenna structure suggested have good radiation characteristics with or without superstate. Since the optical transmission attribute S11 is less than −10dB value, we may infer that this is very useful in the S band, including Bluetooth, cordless phones, unlocking of car doors without key, and wireless headphones. Specific approaches such as slotting, array and recurring motifs can be used for future improvisation in order to strengthen antenna gain. By using a substratum with higher dielectric constant, the antenna size could be further reduced. However, if the dielectric material such as Rogers/Duroid is used instead of FR4 as that have relatively low dielectric constant and dielectric loss value, wider bandwidth and even higher gain could also be attained.

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