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RESEARCH ARTICLE

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EBG GROUND SURFACE WITH SLOTTED PATCH C-BAND MICROSTRIP ANTENNA

RAMKALESH SAKET[1], KAMAL NIWARIA[2]

[1]M.Tech. Scholar , RKDF IST BHOPAL

[2]Assistant Professor, RKDF IST BHOPAL

RAMKALESH SAKET

ABSTRACT

A circular patch with truncation and electromagnetic band gap ground structure by proximity coupling microstrip antenna is presented in this letter. Microstrip antenna has characteristic in 6.81 GHz C-Band which is obtained by truncation of circular patch. The simulated result shows the good agreement in utilizing the WLAN spectrum achieving the bandwidth of 135 MHz . The papers contains the return loss S11, VSWR and electric field results for this microstrip patch antenna analysis. The proposed antenna shows the solution for the reduction of antenna element simultaneously maintaining the good radiation pattern. The patch is effectively excited by the electromagnetic coupling feeding technique where electromagnetic band gap is etched on ground surface.

Keywords - Circular Monopole Antenna, Proximity coupling, Microstrip Antenna, Impedance Bandwidth, Gain, CST

INTRODUCTION

Microstrip technology has become very famous due to its numerous advantages and attractive features also low cost and smaller sizes. These antennas are have very reduced sizes can implemented with comfortably to miniaturized electronic devices, can also provide the high performance , these are fabricated very easily and cost for manufacturing is also incredibly very low , can be also designed for any frequency. Microstrip printed patches are basically used for the wireless systems owing to having smaller structures and shapes[1].

There are many techniques for the realizing the microstrip patch antenna like truncation of patch, or analysing the different type of substrate materials, shorting the pins, implementing the transistors, slotting the patch or ground , electromagnetic band gaps for surface waves etc[2]. Slots etching is better idea to achieve the bandwidth and also helps in shifting the frequency, substrates also have benefits to surface waves utilization, shorting the can be also benefits for size reductions. Now a day's application wireless systems has increased where radiation pattern with polarization of waves is required so these type of microstrip antennas are able to face such techniques.

Electromagnetic coupling [3] for microstrip antennas provides many advantages over the traditionally used feeding network like probe feeding and coplanar edge feeding which allows element to radiate with wider bandwidth. This feeding network does not have back radiation. Since by the discovery scientist are attracted towards the ebg structures and interest is growing very rapidly. The main property of electromagnetic band gap[4] is its ability to prohibiting the electromagnetic wave propagation for certain ranges of the frequency bands. Aim is to transmission of energy through band gaps to the specific frequency and enhancing the efficiency of antenna. The advantages addressed for the antennas for gain enhancement frequency allocation, suppression of surface waves and improving the efficiency. Radiating patches are mounted above the ebg to form the high impedances. The challenge was to built a compact size element for wireless communication system. All the simulation and analysis is performed using CST (Computer Simulation Technology) Microwave Studio software [5].

ANTENNA DESIGN

Further impedance matching is possible by the excitation of electromagnetic coupling which proximity feeding technique for antenna patch radiation. Figure. 1 shows the structure of electromagnetic coupling with ebg in ground plane and having the truncated patch above the substrate 4.4 permittivity value.

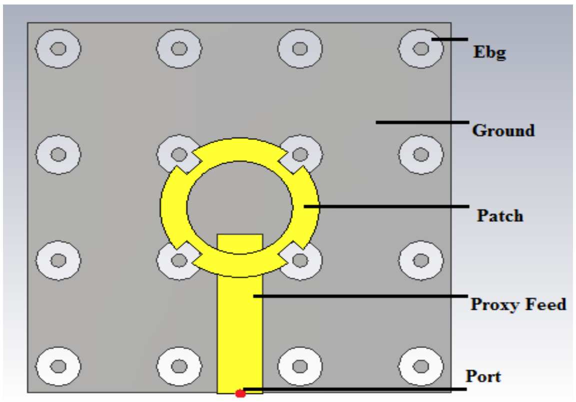


Figure 1: Diagram of four patch planar antenna array

The proxy feed had dimension of 3mm width and the length of 12mm which is 50 ohm matched to the feeding network. The feeding line is terminated at distance of 12mm which is engraved inside the substrate where after 50 ohm matching emits electromagnetic wave and excites the patch. The lossy metal material used for proxy feeding is Annealed copper which has perfect electric conductivity of 5.8e+007[s/m], also the perfect thermal conducting capability and Rho of 8930[kg/m^3].

The patch is mounted all the above of substrate which is also made up of annealed copper metal, the patch is excited by impedance matching of feeding network, after that electromagnetic wave is radiated through it. The patch is etched by truncation[6] by four sides inside of circular patch 'tl' length is 0.96mm and width 'tw' is1.41mm, the radius of patch is 5.25 mm and the circular patch slot cut from centre whose radius length of 3.5mm as shown in Figure 2. Substrate used for the antenna element is FR4 material permittivity value 4.4. having width of 28mm and length is also 28mm the height of the substrate is 2.2 mm. The substrate is a dielectric material which has very low value 4.4 permittivity[7] here used for utilization of surface waves for excitation of patch radiation which generally occurs as losses. The substrate material is placed between the patch and the ebg ground plane. EBG like structure ground plane[8] is placed below the substrate where ground plane is perfect electric conductor dimensions are 28mm width, 28mm length and ground layer negligible height. Ebg structure is in circular shape which is etched out by outer radius 1.5mm and .5mm inner radius having distance between each ebg is 8mm.

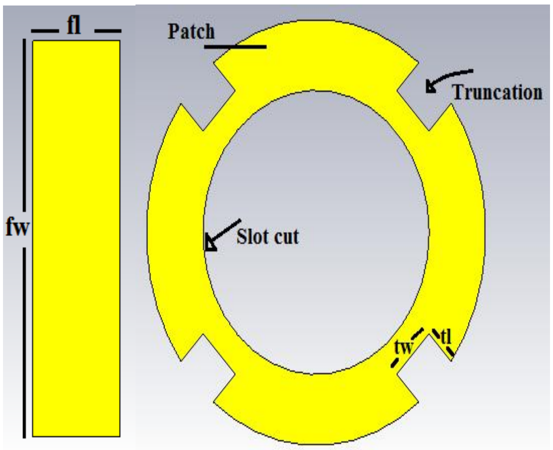


Figure 2: Diagram of Feed and Slotted Patch by truncation.

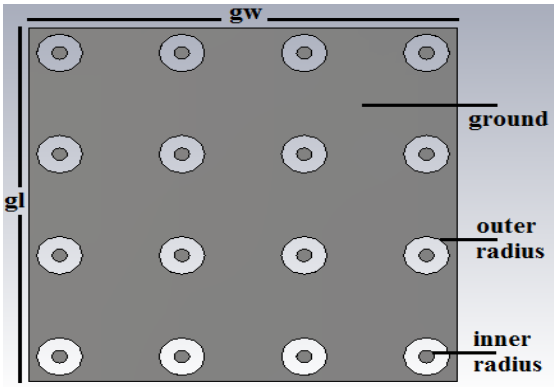
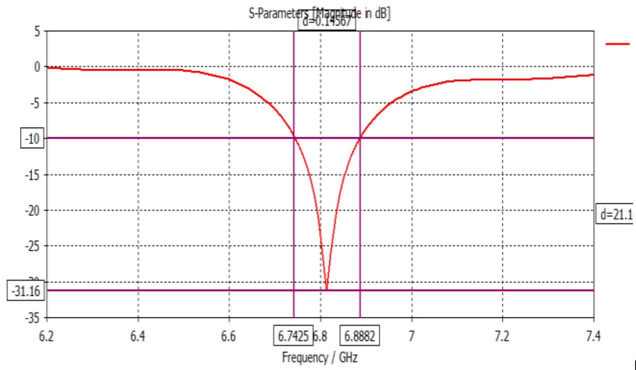


Figure 3: EBG ground plane.

SIMULATION RESULTS

Figure 4 shows the simulated result of return loss S11 of the proposed antenna design fabove 6.8GHz. It is clearly manifest that the simulated return loss dip of proposed antenna is -31dB maximum at a resonant frequency of 6.8GHz and antenna bandwidth is extremely very large like a high pass filter. The proposed antenna with ebg ground plane is simulated by the use of the CST Microwave Studio software. The radiation pattern of proposed antenna at a frequency of 6.8GHz is shown in figure 5. The directivity and gain of proposed antenna at a resonant frequency are 4.62 dB and 3.48dB respectively.



Fiureg4: Simulated return loss S11 of the proposed Monopole antenna

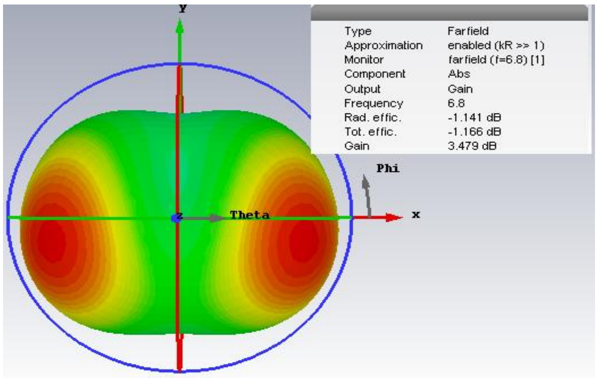


Figure 5: Simulated radiation pattern Gain 3.48dB of the proposed monopole antenna at 6.8GHz.

The antenna result VSWR of the proposed circular monopole antenna for ultra wide band applications is shown in figure 6. It is clearly seen from the figure 6 that the antenna VSWR is below .Figure 7 and figure 8 shows the respectively Simulated antenna E-field radiation pattern of proposed monopole antenna and Simulated antenna H-field radiation pattern of proposed monopole antenna.

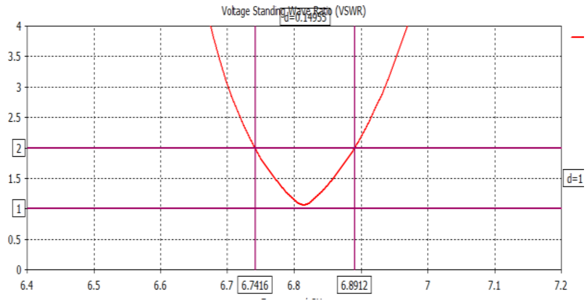


Figure 6: Simulated antenna VSWR of proposed monopole antenna

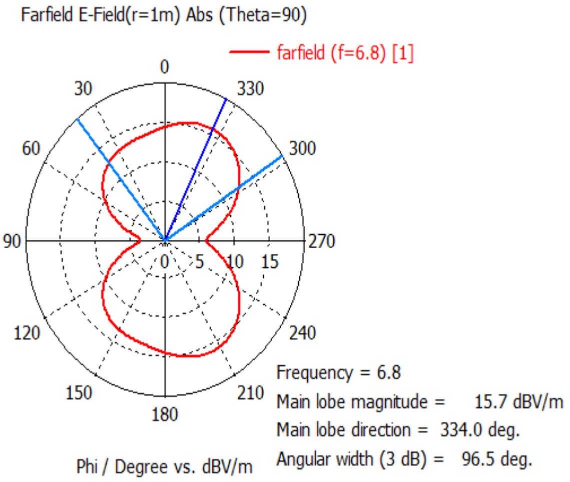


Figure 7: Simulated antenna E-field radiation pattern of proposed monopole antenna.

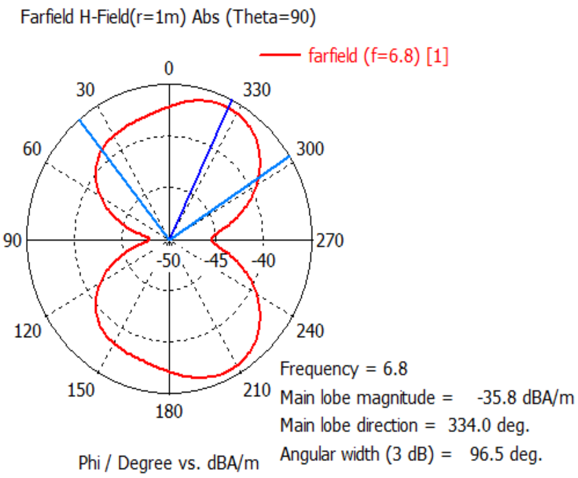


Figure 8: Simulated antenna H-field radiation pattern of proposed monopole antenna.

Table 1: Dimensions of proposed monopole antenna

Parameter		Dimension (mm)
Length of substrate	sl	28
Width of substrate	sw	28
Substrate Height	sh	2.32
Length of Ground Plane	gl	28
Width of Ground Plane	gw	28
Length of Feeding Strip	fl	12
Width of Feeding Strip	fw	3
Radius of Patch	R	5.25
Patch Slot Ring	r	3.5
Inner Radius of circular ebg	ir	.5
Outer Radius of circular ebg	or	1.5

The variations of parameters is studied which verified by results. The antenna dimensions were obtained for ultra wideband applications are shown in Table 1. Important Parameters at resonant frequency of Microstrip Antenna are shown in Table 2.

Table 2: Important Parameters at resonant frequency of Microstrip Antenna

Parameter	Results
Frequency	6.81 GHz
Bandwidth	145 MHz
Gain	3.48 dB
Directivity	4.62 dB
Return loss S11	31.16 dB
Wavelength	44.5 mm

CONCLUSION

The new ebg structure is designed by the parametric studies of antenna structures which operates at the frequency of 6.8 GHz. It is proved that the microstrip using the EBG has improved the performance of the antenna. The antenna is able to facilitate the services for wireless communication system in the S-Band which accommodate its frequency range in WLAN spectrum. Overall this paper demonstrates the utilization of proxy feed network and ebg with circular holes operates at single band at 6.8 GHz frequency and have accepted bandwidth, Gain and radiation pattern..All the results are simulated in CST (Computer Simulation Technology) Microwave Studio software[10].

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