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Design, simulation and analysis of Penta Band micro-strip patch Antenna for UNII &C Band Application

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Abstract

This paper attempt to introduce, a penta band, temple bell shape micro strip patch by coaxial probe technique. These band cover unlicensed spectrum of ISM band of (5.725-5.825) for the express purpose of supporting low power license-free spread spectrum data communication and four bands in c band range, Which can be used in military services, common carrier and satellite uplink, studio transmitter link, common carrier and satellite downlink. SONNET lite software is used as a tool for simulation.

Keywords: *Return Loss, Unlicensed National information infrastructure (UNNI) band, Voltage standing wave ratio (VSWR), Satellite communication.*

1. Introduction

The previous decades in telecommunication systems has seen a large development, which required a Multi band antenna in place of single band antenna for various applications in more than one communication system into a limited equipment space. so, for many antenna design with multiband or wide band capability to satisfy the wireless standard & application has been presented and developed[1-7].Among these antennas, Single-layer, single- patch, multi band antennas become very popular .The shape and size of radiating patch can be changed depend upon the application [1-3].the proposed penta-band Micro strip patch antenna have some special properties such as simple structure, single metallic structure, very low return loss, wide band-width, easy integration with WLAN integrated circuits.

The geometry parameters of the antenna including the patch dimensions, the size of the coplanar ground planes, and the space between the ground planes and the patch, the slots width are all optimized using SONNET LITE software to achieve good wideband & multiband operation. Details of the antenna design are described, simulation results and radiation features of proposed antenna is presented

2. Antenna Structure.

The shape of proposed antenna is a combination of special geometry of Donut [8] and Fan stub [8] (as fig-1 & fig-2). This is created (as show in fig-3) as a slot in a rectangular patch antenna with dimension of 28mm x37.08 mm. The substrate selected for this design is a Rogers RT5880 with dielectric constant (ϵ_r) =2.2 and height of substrate (h) =4.5 mm with dielectric loss of $9x10^{-9}$. To feed the suggested antenna, co-axial probe of characteristic impedance (Z_0) 50 ohms is used. Plane copper with thickness of 0.035 mm is used as a radiating element.

3. Tables and Figures

3.1 Tables and Figures

Table-1 Geometrical dimension of Donut slot

Parameters	***Units***
Outer radius	10 mm
Inner radius	3mm
Start Angle	30^0
End Angle	30^0
No of Sides	100

Geometry specification and its dimensions for used Donut structure and Fan stub structure are shown in table-1 &

table-2 respectively. The outer radius and opened end of donut have the same value as width and tapered angle of fan stub have. The head on combination of these two geometry results the shape of proposed antenna which makes the satisfactory result as per concerned application.

Table-2 Geometrical dimension of Fan stub slot

Parameters	***Units***
Width	10 mm
Length	18 mm
Angle	60^0

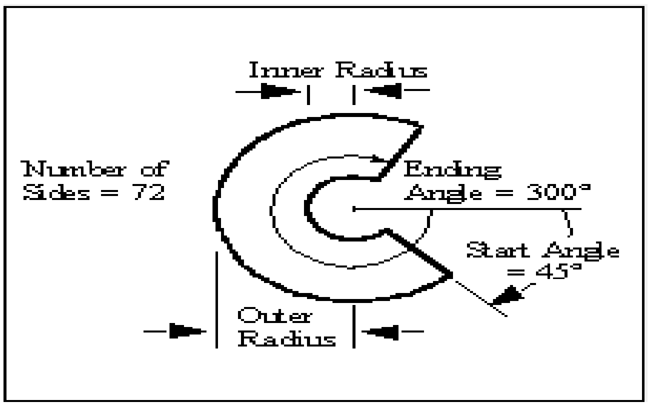

Fig-1- General geometry of Donut slot

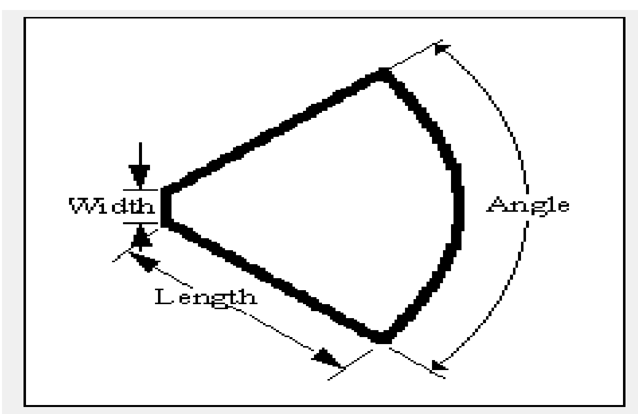

Fig-2-Genaral geometry of fan-stub slot

The no of turns in the proposed donut slot is 100, which can be increased up to 360 as per sonnet specification to give the smooth arc as per need.

Here total mouth angle of donut is 60^0, so it is easily mapped with central angle of the fan stub.

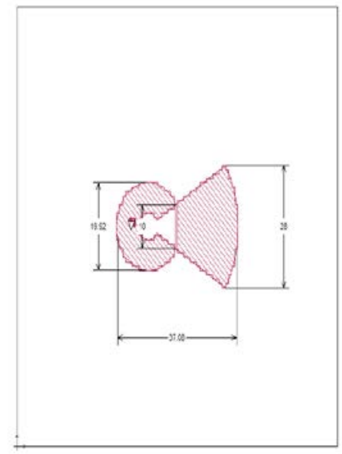

Fig-3- 2D geometry of proposed antenna

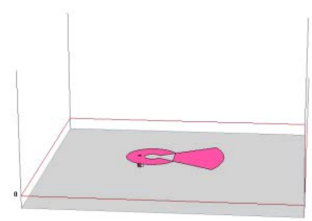

Fig-4- 3D geometry of proposed antenna

4. Simulation Results

The simulation and analysis is completed for penta band temple bell slot micro strip patch antenna by sonnet lite software. In this paper return loss, VSWR and current density is simulated and analyzed which is shown in fig-5,fig-6,& in fig-7 respectively. For proposed antenna resonant frequencies are 4.72 GHZ,5.73 GHZ,6.21 GHZ,7.06 GHZ,7.40 GHZ and their corresponding simulated return losses are -10.62 db,-51.70 db,-14.08db, -22.39 db and -21.82 db respectively . Simulated 10 db bandwidth at each resonance frequencies are 50 MHZ (4.68-4.73), 360 MHZ (5.57-5.93), 190 MHZ (6.16-6.35),40 MHZ(7.04-7.08) and 50MHZ(7.37-7.42) respectively. Almost all microwave applications are designed with input impedance of 50Ω.so matching the antenna to 50Ω is desire .Fig -8 shows the impedance plot

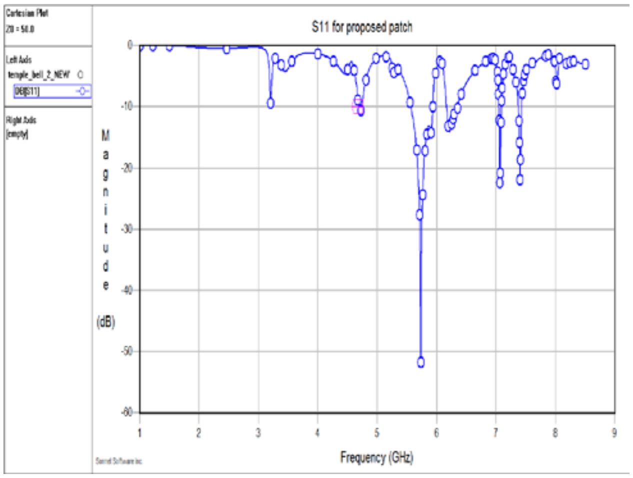

Fig-5 simulated return loss of proposed antenna

S11 is a measure of how much power is reflected back at the antenna port due to mismatch from the transmission line.

A VSWR of 1 is taken ideal; this reveals that there is no reflected power at the antenna port. When the antenna and transmission line are not perfectly matched, reflections at the antenna port travel back towards the source and generate a standing wave to form. A VSWR $\leq$ 2 is acceptable for an antenna. So, values of S11 $\leq$ 10 are considered as the margin for resonant peaks.

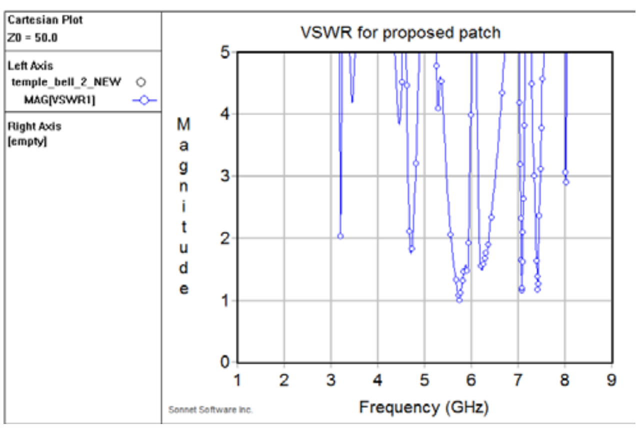

Fig-6 Simulated VSWR plot of proposed antenna

We can see from fig-6 that at five resonance frequencies of 4.72 GHZ, 5.73 GHZ, 6.21 GHZ, 7.06 GHZ, and 7.40 GHZ we get their corresponding simulated VSWR of 1.8062, 1.005, 1.4922, 1.1643 and 1.1763 respectively.

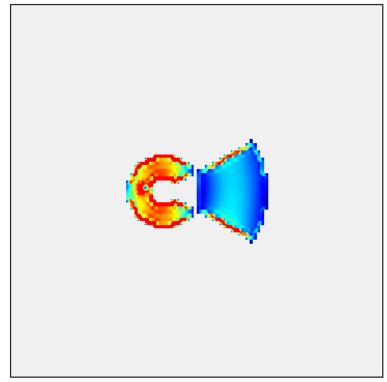

Fig-7 Current distribution of proposed antenna

The best matching is found at all resonance frequency, which is depicted in fig -8.By changing the feeding position as well as its technique we can change the resonance frequency, return loss and bandwidth of the proposed antenna. So, this type of special antenna has feasibility of modification as per application and use

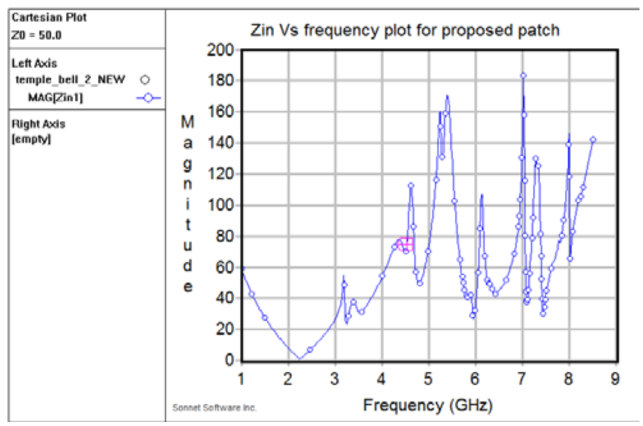

Fig-8 Input Impedance vs frequency for proposed antenna

4. Conclusions

The analysis of the different simulation results shows that the proposed antenna is capable of producing effective type of responses in the multiple frequency bands. At the five different operating frequencies the S_{11} parameter is always kept less than or almost equal to -10 dB and the VSWR is kept less than or at least equal to 2 since a VSWR of less than or equal to 2 is acceptable for an antenna. Multiband patch antenna is extremely important for today's and future's communication system. Multiband applications are possible by means of a single and portable radiating system. The future scope of this project is based on optimization of the patch dimensions for more effective type of responses.

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