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Research Article

Triple Frequency Micro Strip Patch Antenna Using Ground Slot Technique

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ABSTRACT

A micro strip patch antenna for wireless communications had proposed in this paper. The proposed antenna operates at three frequencies at 3.3GHz, 6.3GHz and 9 GHz which are mostly used for WLAN (C band) and radar, satellite communications (X band). Two rectangular slots are placed on the ground in order at achieve dual frequencies with good return loss less than -17dB and VSWR less than 1.4. The obtained results are simulated using ANSOFT HFSS software.

Keywords: Micro strip patch antenna, wireless communications, rectangular slots.

Introduction

The micro strip patch antennas are widely used in the present times because of their high flexibility, bandwidth, multi-band operations and they possess lite weight. As they have unique advantages like ease of fabrication and less fabrication cost which make them fundamental components of the wireless communication systems. [1]

Now a days the multi functioning antennas are preferred over single functioning antennas. As the multi functioning antenna can switch among single, double and triple frequencies which would be very helpful in satellite communications.

Although these antennas have many advantages, they also have some disadvantages as well like having narrow bandwidth, gain and efficiency.

In this paper, we mainly focused on the C-band and X-band which are having the bandwidth ranges of 4-8GHz and 8-12 GHz respectively. The proposed antenna will operate at a resonating frequency of 6.3GHz of C-band for WLAN applications and 9GHz of X-band for satellite communications.

Antenna Design

The designs of the proposed antenna are as shown in the figures. The antenna is having dimensions 40 x 40 mm^2 of FR-4 substrate having dielectric constant of 4.4 and having a thickness of 1.6 mm.

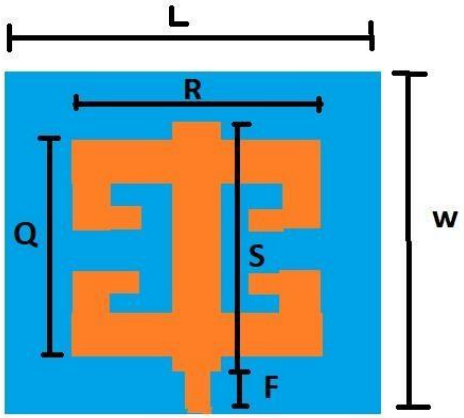

Fig.1: Front view of the antenna

The middle rectangle strip with width(S) 35mm and length of 3 mm and a feed line with width 1.75mm and length of 2.5mm are chosen to design the antenna.

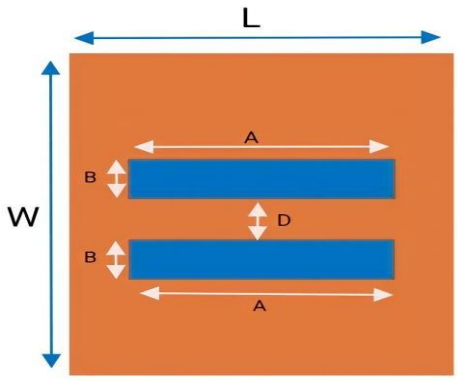

Fig.2: Bottom view of the antenna

Two rectangular ground slots are used in order to obtain the triple frequencies, the distance between the slots are placed in such a way that the antenna can radiate at three different frequencies.

Parameters	Description	Size (mm)
L	Length of substrate	40
W	Width of substrate	40
R	Length of patch	28
Q	Width of patch	28
Fl	Length of feed line	2.5
F	Width of feed line	1.75
S	Width of patch cut	35
A	Length of the ground slot	28
B	Width of the ground slot	4.5
D	Distance between the slots	3

Software Used

The software used for the simulation of antenna is ANSOFT HFSS (High Frequency Structural Simulator) It is standard software for simulating full wave, 3D and electro-magnetic fields. It is useful in the design of high speed electronic devices and high frequency used application due to its high computing performance.

Simulation Results

The proposed antenna will resonate at 3 different frequencies at 3.3GHz, 6.3 GHz and 9 GHz. The return loss occurs due to power reflections in transmission line due to discontinuity or mismatch or load.Firstly the antenna resonates at 3.3GHz with a return loss of -17.743dB, at 6.3GHz with a return loss of -18.021dB and finally at 9GHz frequency with a return loss of -17.004dB.The VSWR plot is as shown in the fig3.

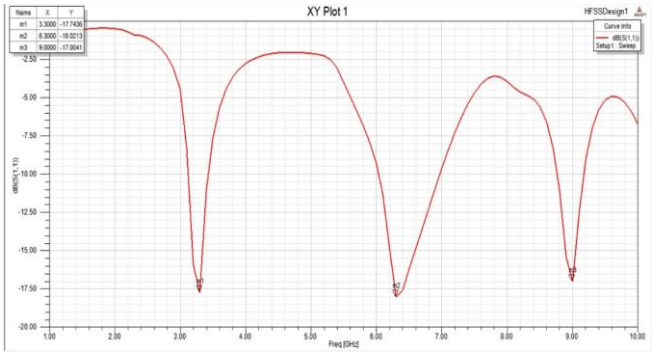

Fig.3: Return loss for the proposed antenna

The VSWR (Voltage Standing Wave Ratio) measures voltages of standing waves occurred due to mismatches in impedance matching to load in transmission lines. The VSWR values for 3.3GHz,6.3GHz and 9GHz are 1.298,1.287 and 1.328 respectively. The VSWR plot is as shown in the below fig.4

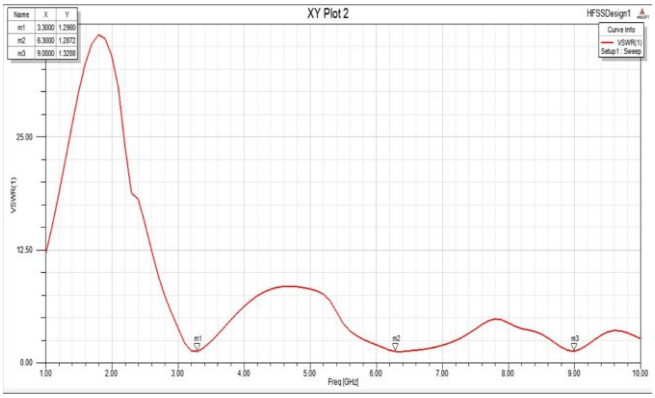

Fig.4: VSWR for the proposed antenna

The gain of the antenna is the ratio of power radiated from far field to power produced due to hypothetical losses in isotropic antenna on antenna beam axis. The gain of the antenna in terms of dB as a function of frequency is shown in Figure.5, Figure.6 and Figure.7 at frequencies 3.3GHz, 6.3GHz and 9GHz respectively.

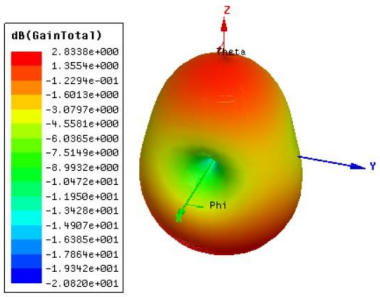

Fig.5: Polar plot of the antenna at 3.3GHz

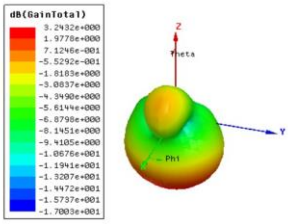

Fig.6: Polar plot of the antenna at 6.3GHz

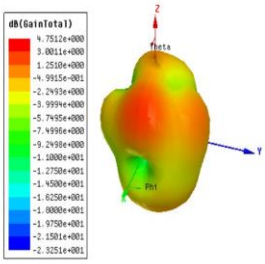

Fig.7: Polar plot of the antenna at 9GHz

The gain obtained uniformly at 3.3GHz with 2.83dB, at 6.3GHz with 3.24dB and at 9GHz with 4.75dB respectively. Radiation pattern refers to strength of fields in a particular direction of antenna. The radiation pattern of proposed antenna is shown in Figure.8, Figure.9 and Figure.10. The proposed antenna shows good gain in main lobe at three frequencies 3.3GHz, 6.3GHz and 9GHz with 2.8dB, 3.2dB and 4.7dB respectively.

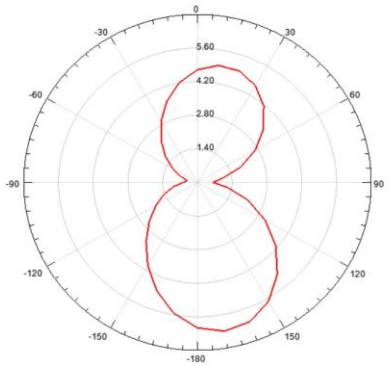

Fig.8: Radiation pattern of the antenna at 3.3GHz

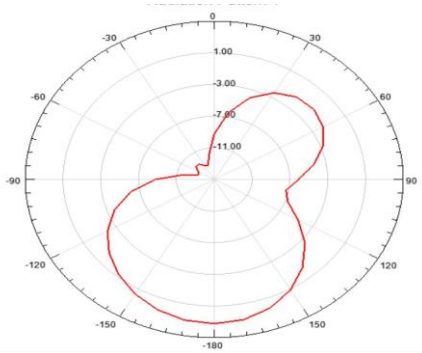

Fig.9: Radiation pattern of the antenna at 6.3GHz

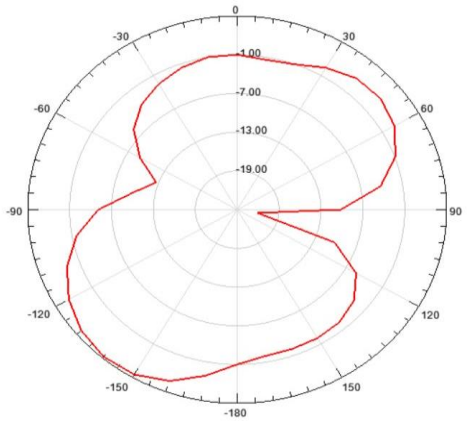

Fig.10: Radiation pattern of the antenna at 9GHz

Conclusion

Hence the proposed antenna is designed in three frequencies 3.3GHz in s-band and 6.3GHz frequency in c-band. The three frequencies are obtained by inserting slots in ground plane. The impedance matching is done using DGS structure in ground. The return loss values obtained in proposed antenna operating at three frequencies are -18dB, -20.4dB and -19.5dB respectively. The gain obtained uniformly at 3.3GHz with 2.8dB, at 6.3GHz with 3.2dB and at 9GHz with 4.7dB respectively.

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