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RECTANGULAR RING MICROSTRIP ANTENNA: AN IMPACT ON WIRELESS COMMUNICATIONS

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ABSTRACT:
In this paper, we have designed rectangular ring Microstrip antenna for UWB wireless applications. The beauty of this antenna is the use of single patch which make it easy to fabricate consequently cost of antenna becomes cheaper. It has no misalignment problem, Bandwidth enhancement is achieved due to employment of matching rectangular strips. Return loss at centre frequency is less than -15dB. It exhibits good radiation characteristics and moderate gain in the entire operating band. Details of the design along with simulation results are presented and discussed.

Keywords: Rectangular ring Microstrip patch, Capacitive feed, Bandwidth enhancement.

INTRODUCTION

The design of antenna in this regard becomes more acute and critical as it requires some special properties such as small size, broadband and Omni directionality. To meet these requirements printed microstrip antennas are the best candidates as they possess low profile and cost. In general, the impedance bandwidth of a traditional microstrip antenna is only a few percent, e.g., about 5%. Microstrip patch antennas are widely used because of their many merits such as the low profile, light weight, low cast and planar also. If the bandwidth of microstrip antenna could be widening, it would be very useful for commercial application such as 3G wireless system etc. Researchers have made many efforts to overcome this problem and many configurations have been presented to increase the bandwidth. Many configurations while increase the bandwidth but it also increase the production cost of antenna due to misalignment of stacked patches. To overcome misalignment problem, we have to use lesser number of patches. In this paper we have design antenna using only single radiation patch which make it easier to fabricate consequently antenna becomes cheaper. We have use coaxial probe feed technique which create inductive reactance to compensate inductive impedance, we use capacitive patch and coaxial probe are connected with capacitive patch.

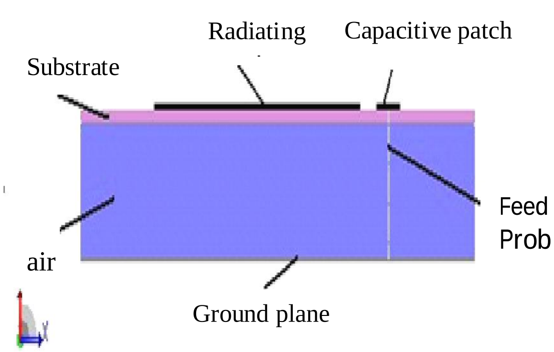
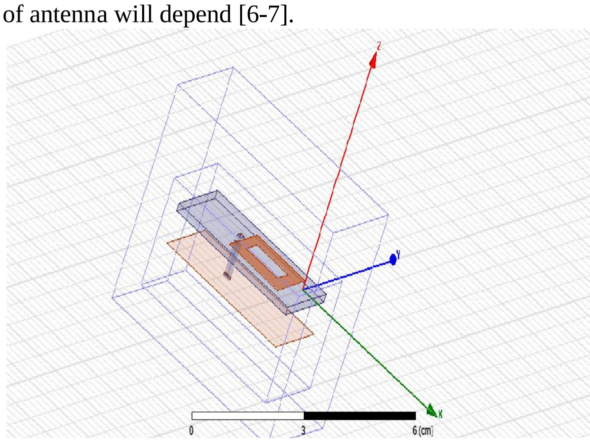


Fig 1: Geometry of the patch antenna

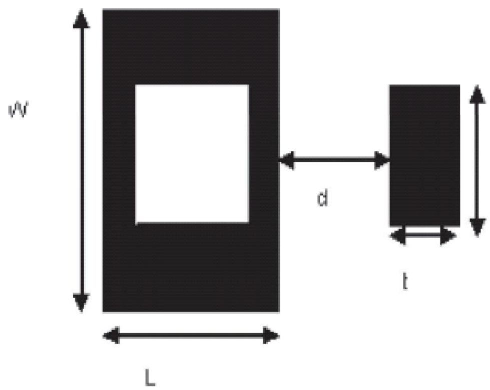
Single Layer Rectangular Microstrip Antennas with simple capacitive feed, offering impedance bandwidth up to 50% is designed in IISc., Bangalore, India 2007 [1-3]. The proposed antenna is modification of above antenna. In this antenna, we replace rectangular patch with rectangular ring patch which increases impedance bandwidth more than 66.44% having resonance frequency 6.05 GHZ.

ANTENNA DESIGN DISCUSSION

Here, two types of rectangular patches are used, one patch is rectangular ring and other is small rectangular patch. Rectangular ring patch is used for radiation and small rectangular patch is used for coaxial probe feed [4-5]. Coaxial probe feed is used for excitation of antenna. Above infinite ground plane, there is air gap of thickness which has dielectric constant and loss tangent. Over substrate rectangular ring patch and feed strip patch are sited. Separation of rectangular ring from feed is 0.5 mm. Figure 2 shows cross-sectional view and top view of Rectangular Ring Microstrip Antenna patch. Hole on the radiating patch will increase the bandwidth of antenna. It doesn't mean increasing more and more area of the hole, because at certain limiting area of the hole, antenna will go higher mode of propagation. Here according to Hole on the radiating patch design, maximum bandwidth increase of antenna will depend [6-7].



(a)



(b)

Fig 2: (a) Cross-sectional view (b) Top View of Patches

Patch antennas have become quite popular due to their low profile design and ease of manufacturing. Various methods exists by which to feed this type of antenna (line feed, pin feed, aperture coupling).Another way is by placing probe fed capacitor next to the patch antenna [8]. The advantage of using feeding technique is that inductive impedance of probe is effectively cancelled by the capacitive patch. As a result a high substrate can be used to increase the bandwidth.

Antenna Parameters

Quantity	Value	Units
Max U	0.0054511	W/Sr
Peak Diversity	6.3825	
Peak Gain	6.3448	
Peak Realized Gain	3.86	
Radiated Power	0.010733	W
Accepted Power	0.010797	W
Incident Power	0.017747	W
Radiation efficiency	0.99409	
Front To Back Ratio	27.601	

Table (1) Antenna Additional Parameters

Maximum Field Data:

E Field	Value	Units	At Phi	AT Theta
Total	2.0273	V	15 deg	-4 deg
X	2.0224	V	25 deg	-4 deg
Y	0.57026	V	45 deg	54 deg
Z	0.88891	V	180 deg	40 deg
Phi	2.0148	V	90 deg	-2 deg
Theta	2.0264	V	180 deg	4 deg
LHCP	1.4643	V	35 deg	-6 deg
RHCP	1.4046	V	170 deg	4 deg

Table (2) Maximum field data

RESULTS AND DISCUSSION:

The simulation and the experimental studies of the antenna are done using Ansoft HFSS, respectively. Fig. 3 shows the simulated return loss characteristics of the proposed antenna.

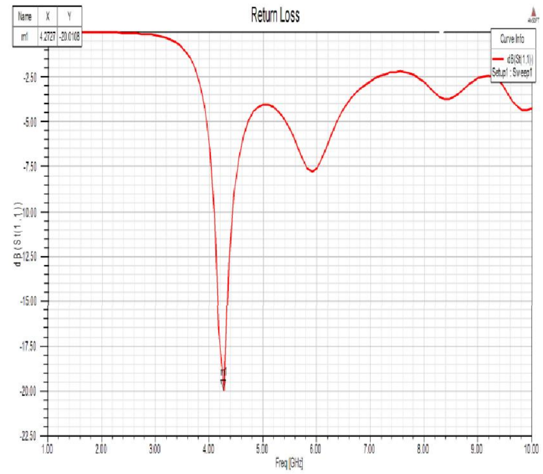


Fig 3: Return loss of the proposed antenna

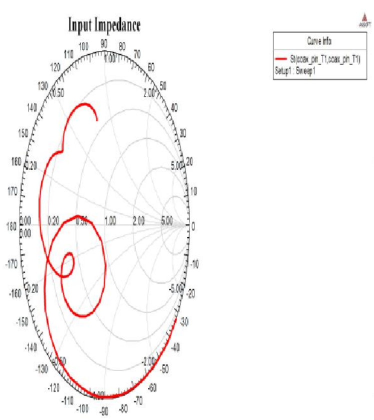


Fig 4: Input Impedance

Fig. 4 shows the simulated Input Impedance characteristics of the antenna. Fig. 5 shows the simulated Radiation Pattern of the antenna. The fringing fields at the radiating edges can be viewed as two radiating slots placed above a ground plane. Assuming all radiation occurs in one half of the hemisphere, this results in 3 dB directivity.

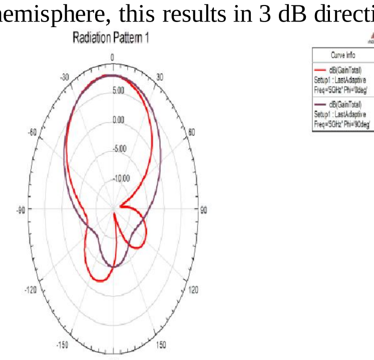


Fig 5: Radiation pattern of the antenna

Fig. 6 shows the simulated 2D Gain of the antenna. Antenna gain can also be specified using the total efficiency instead of the radiation efficiency only. This total efficiency is a combination of the radiation efficiency and efficiency linked to the impedance matching of the antenna.

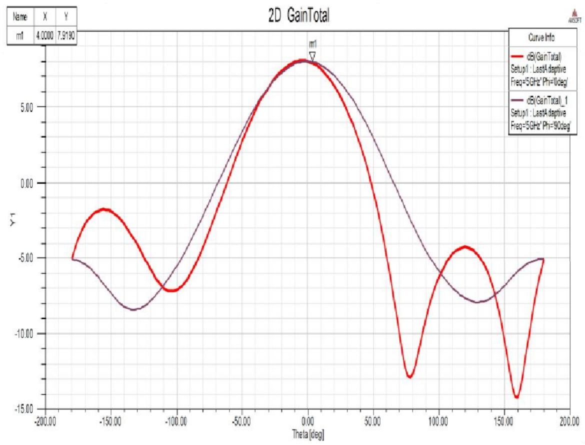


Fig 6: 2D Gain of the antenna

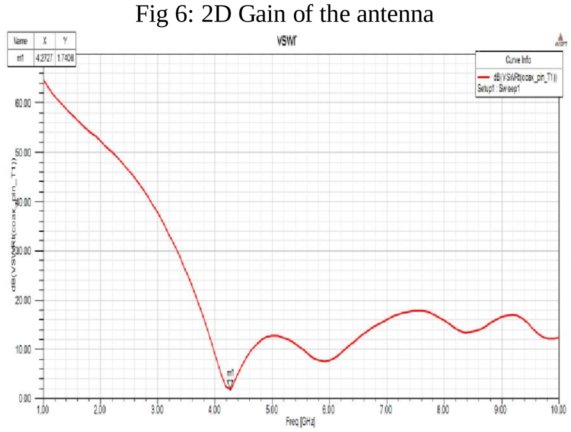


Fig 7: VSWR of the antenna

Fig. 8 shows the simulated 3D Gain of the antenna.

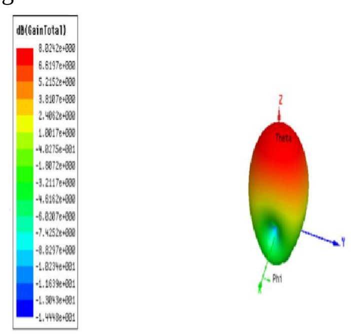


Fig 8: 3D gain Plot of the antenna

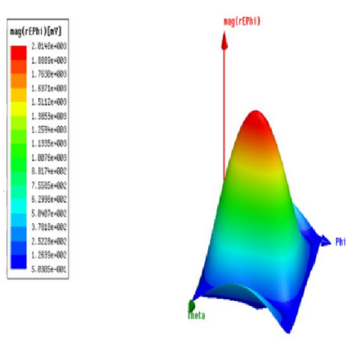


Fig 9: 3D mag (Phi) gain Plot of the antenna

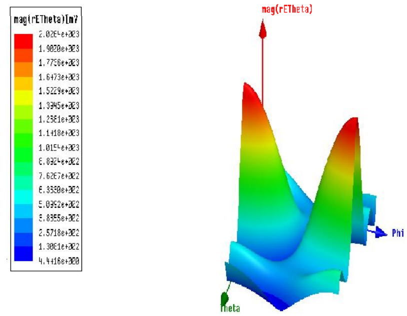


Fig 10: 3D mag (Theta) gain plot of antenna

We can see that return loss is less than -10 dB. Figure 5 shows Radiation pattern of antenna which also giving the satisfactory result. Figure 6 & 8 shows antenna gain with frequency. All above results are quite satisfactory for UWB wireless applications.

CONCLUSION

Here in this paper we designed a rectangular ring Microstrip antenna for UWB wireless applications. S-band of radio waves with frequencies ranging from 2 to 4 GHz & C-band ranging from 4 to 8 GHz crossing the conventional boundary between ultra high frequency and super high frequency at 3.0 GHz. We use rectangular ring micro strip patch antenna which increases impedance bandwidth and also it has no misalignment problem, Bandwidth enhancement is achieved due to employment of matching rectangular strips. Return loss is less than -15 dB. In future we can fabricate this design. We got the results accurately by using the antenna software ANSOFT HFSS.

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