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UWB Square Microstrip Patch Antenna for C-Band Applications

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Abstract- A square UWB microstrip patch antenna with reduced ground plane is designed for C-Band applications. Proposed antenna has basic square shape with microstrip feed line of 50 ohm. Ground plane has to be etched at the back side of FR-4 substrate with permittivity of 4.7 and 1.6 mm in height. Proposed antenna showed satisfied impedance bandwidth which is 85.7 % for return loss response below -10 dB starting from 3.23 GHz to 8.1 GHz, with VSWR<2 along the impedance bandwidth. Reduced ground plane was good tuning parameter for return loss. In Satellite communications both downlink (3.7 to 4.2 GHz) and uplink (5.925 to 6.425 GHz) have been covered. Proposed antenna is easy to fabricate with its compact and simple design. Beside that it offers reasonable gain and Fairfield radiation pattern. Design and evaluation process were simulated using CST Microwave Studio 2010.

Keywords: Impedance Bandwidth, Reduced Ground Plane, Satellite Communications.

1. INTRODUCTION

Microstrip patch antennas has a lot advantages i.e. low weight, low cost, easy to fabricate and aerodynamics, beside former benefits it has a narrow bandwidth which put limitations in modern wireless technologies that requires high impedance bandwidth to achieve higher data rate transmission [1-3]. Recently expanding impedance bandwidth attracts researchers due to their major effect on achieving higher data rate according to channel capacity theory [4-6]. In order to gain more data rate it have to increase the signal power which in turn harmfully affected the battery life, or increasing the bandwidth instead to overcome former limitation.

$$C = B.log_2(1 + SNR)$$

where C is the data rate, B is the bandwidth, and SNR is the signal to noise ratio.

Equation 1 it clearly shows that B is important parameter to tune up the data rate while saving the battery life. On the other hand reducing size of the antenna has been gain a wide attention of literature [7-15], because the size becomes challenging and one of the key-parameters that the modern market need.

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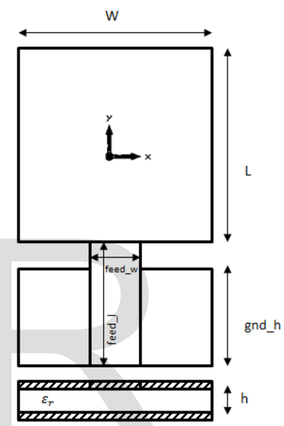

Figure 1: Antenna geometry

2. ANTENNA DESIGN

Proposed antenna has geometrical structure as shown in Figure 1. The proposed dimensions of the microstrip patch antenna is 13x13 mm^2 and the microstrip feed line 3x12.5 mm^2, it consider high compact and suitable for many handset devices that require small antenna dimensions that cover wide range of spectrum frequency. However reduced ground plane has been tested for different lengths and found to be a good return loss tuning parameter as illustrated in Figure 2. Ground plane is located at the opposite side of patch antenna in dimensions 20x10 mm^2 separated by FR-4 substrate of dimension 20x27x1.6 mm^3. The space filled ground plane 20x27 mm^2 lead to weak return loss response. The return loss is progressively enhanced as the ground plane height reduced. Obviously Table 1 parameters were fitted to those values after have been simulated and optimized by CST Microwave Studio 2010, and the simulation result as seen in figure 2 shown an ultrawide bandwidth with two resonant bands 3.8 GHz and

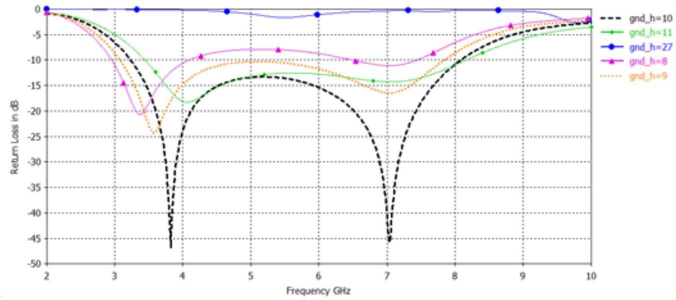

Figure 2: Simulated return loss in dB against frequency for different lengths of ground plane

7.02 GHz respectively. While feed line width is fixed to 3 mm to achieve 50 ohm characteristic impedance with the SMA connector.

Table 1: Design Parameters of proposed UWB microstrip antenna

Parameter	Value (mm)
L	13
W	13
feed_L	12.5
feed_w	3
gnd_h	10
h	1.6
ε_r	4.7

VSWR was varied according to change in ground height as seen in Figure 3, where the lowest VSWR was for 20x10 mm² ground plane dimensions along the impedance bandwidth.

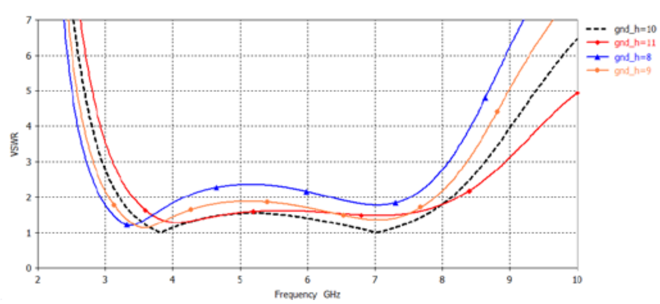

Figure 3: Simulated VSWR against frequency for different lengths of ground plane.

3. Result and Discussion

The performance of the proposed antenna such us impedance bandwidth, VSWR, and gain have been simulated using CST Microwave Studio 2010 and shows a good agreement with threshold of each parameter accordingly. Figure 4 point out the earning gain along the bandwidth increased gradually as the frequency rising up, starting from more than 2 to less than 4. Figure 5 illustrate the simulated 2D radiation pattern performance for different frequencies 3.4, 5.1, 6.5, 7, 7.5, and 8 GHz for both E- and H-planes. It's found that the proposed antenna has nearly like omnidirectional in *xy-plane* and *yz-plane* for chosen frequency samples, which makes the proposed antenna suitable for wide range wireless applications in C-Band spectrum.

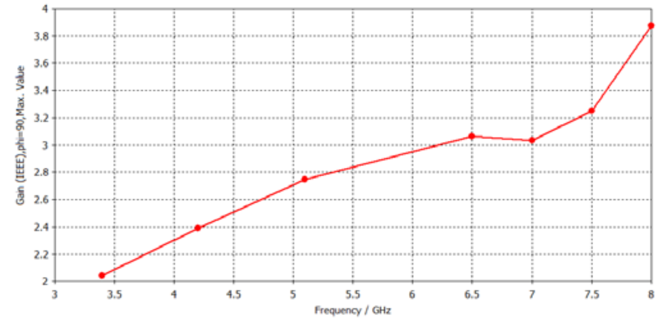

Figure 4: Gain against frequency in GHz

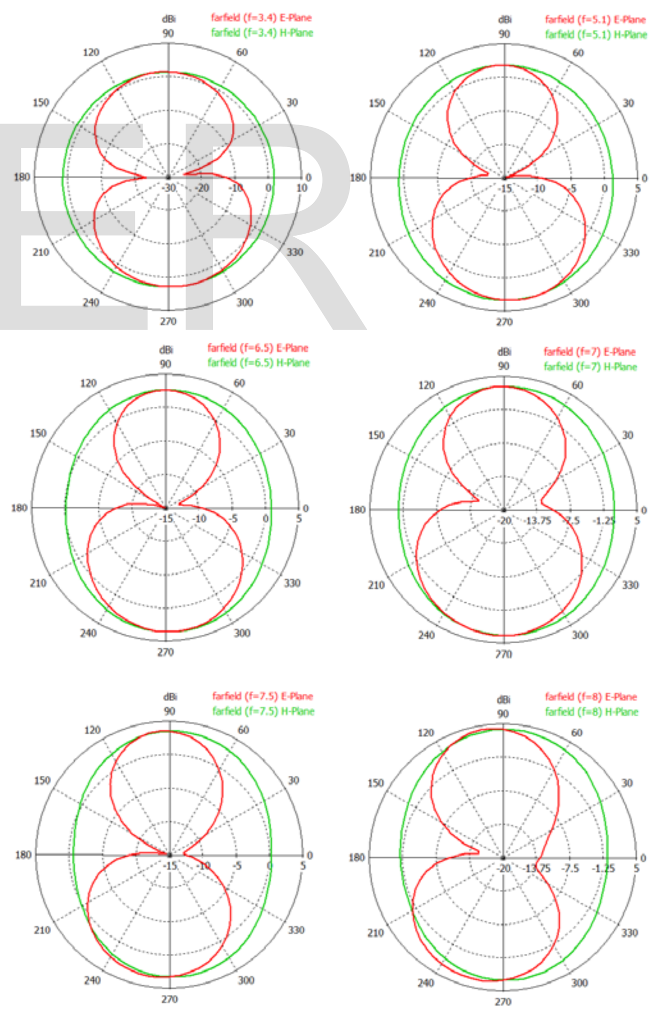

Figure 5: Radiation Pattern Performance for E- and H-Planes

4. Conclusion

A compact square UWB microstrip antenna is successfully designed with very simple geometry. The simulated outcomes of the antenna shows good impedance matching, ultrawide bandwidth 3.23-8.1 GHz, accepted gain, VSWR and radiation pattern for the entire operating bandwidth, As well as stable omnidirectional pattern almost along the entire operating bandwidth. This in turn makes the proposed antenna good competitor for UWB wireless applications.

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