The Impact of Ground Plane to A Capacitor Loaded Rectangular Patch Antenna

K. L. Lai, S. H. Wu, M. C. Liang
Department of Electrical Engineering
National University of KaoHsiung

***Abstract* - In this paper, the effect of varying the ground planes to the patch antenna bandwidth will be reported. In this study, a rectangular patch antenna with loaded capacitor will be studied.**

A capacitor loaded patch antenna can effectively reduce the needed size of the patch antenna. However, it usually accompanied with the loss of antenna efficiency due to the attraction of current into the capacitor. By varying the ground plane, antenna gain and usable bandwidth of the capacitor loaded patch antenna can be significantly improved.

***Index Terms* — Rectangular Microstrip Antenna, Patch, Capacitor Loaded, Ground Planes.**

1. Introduction

The capacitor loaded patch antenna [1-3] is one type of antenna that can allow the antenna to resonate with smaller size. This makes it suitable for small size mobile devices. Due to the current distribution, the radiator and the ground plane structure have significant influence to the antenna performance.

2. The Capacitor Loaded Patch Antenna

In general, a patch antenna is designed with the ground plane twice or triples the radiator size. This usually gives the best efficiency for normal patch antenna. However, it is different for a capacitor loaded patch antenna.

In the simulation, the radiator size of the antenna is chosen as 24mm by 48mm with central frequency at 2.35GHz. The original ground size is twice as large as the radiator. It is interesting to know that the optimized ground plane size for a normal patch antenna is not the same for capacitor loaded patch antenna.

3. The Experiment Ground Plane

The geometry of the designed patch antenna is shown in Figure1. The patch antenna to match the input impedance is 50Ω. For the simulated, operating frequency at 2.35GHz, FR4 (εr=4.4) substrate is used whose thickness is 1.6mm and has 2pF capacitance value on cylinder of copper sides. The width (W) and length (L) of the simulated ground plane is 64mm* 24mm, respectively.

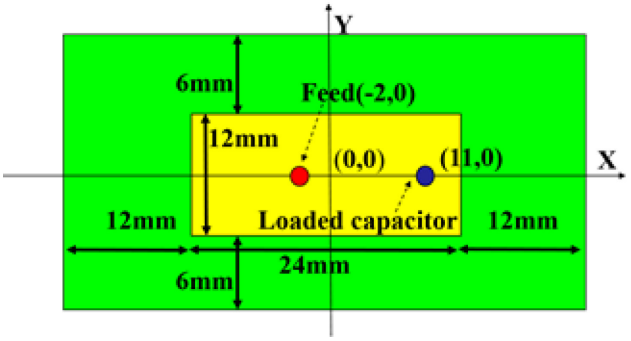

Figure. 1 : A capacitor loaded patch antenna design.

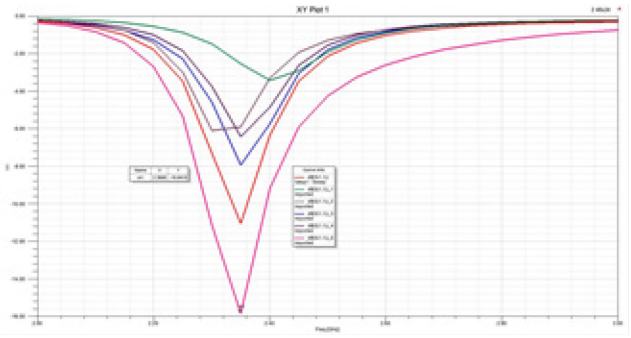

Figure. 2 : Varying the width of the ground plane

Simulation results in Figure 2 indicated that by changing the width of the ground plane does not affect the radiating frequency. However, the usable bandwidth has been changed significantly. Remove more than ground plane, not only did not affect the frequency position but also can reduce the overall of the area of the antenna.

On a ground plane will do the most appropriate adjustments, the ground plane is best about 47mm * 12mm (Figure 3), so that the traditional rectangular antenna is not the same. We need to find the edge of resection, the return loss of the entire antenna becomes better, bandwidth has improved, so the rectangular mount antenna, it does have to cut the edge of the antenna is good.

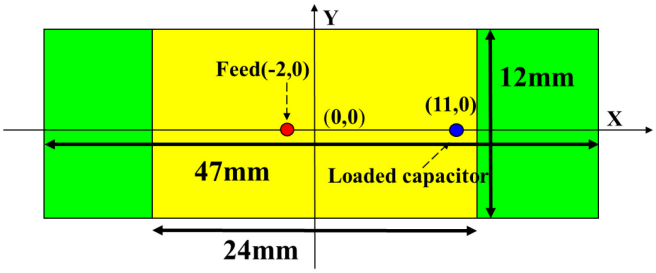

Figure3 : The radiation is better when the width becomes smaller

The .change of the ground length on the current resonant direction will significantly affect the antenna characteristics and even the radiation frequency as shown in Figure 4.

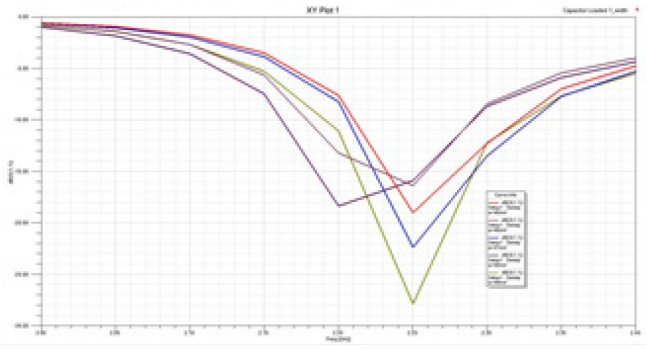

Figure. 4 : Varying the length of the ground plane

As used herein, the capacitance value of 2pF, tries to change the width . To observe bandwidth increased change from 45mm ~ 49mm.

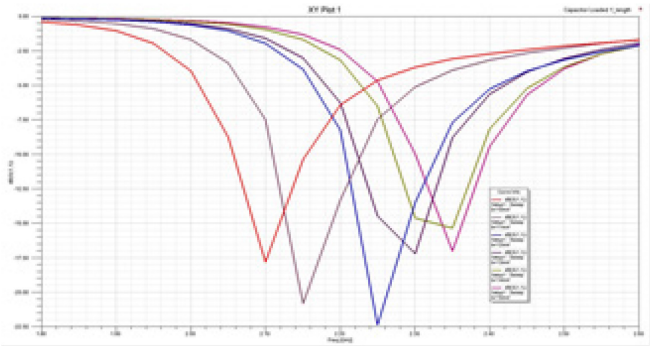

Figure. 5 : Return loss of length 10mm~15mm.

Finally experimental results, try changing the length to observe bandwidth increased change from 10mm ~ 15mm

TABLE I
Type Sizes of bandwidth for Figure. 4

Values		
Type size	dB(Y)	Bandwidth(MHz)
45mm	19.01	110
46mm	-16.38	130
47mm	-22.36	130
48mm	-18.36	140
49mm	-27.85	120

TABLE II
Type Sizes of bandwidth for Figure. 5

Values		
Type size	Frequency(GHz)(X)	Bandwidth(MHz)
10mm	2.1	100
11mm	2.15	120
12mm	2.25	150
13mm	2.3	130
14mm	2.35	130
15mm	2.35	100

4. Conclusion

In this paper, the dimensions of the ground plane were changed. After the simulation to find the appropriate length, can indeed improve the frequency band of the antenna, then, not only proves the excision of the unwanted ground plane, but also effective the area to the antenna miniaturized. The case where to add the capacitor-load , the resonance frequency can be adjusted more easily, often lose some of the features, however, the capacitor-load can be added to maintain the overall gain and more practicality.

References

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