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Comparison of Rectangular and Circular Patch with double L-Slot for WLAN and Wi-MAX applications

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***Abstract*— In this paper, we present a comparison between a double L- slot rectangular and circular microstrip patch antenna for worldwide interoperability for microwave access(WiMAX) 2.5/3.5/5.5 GHz and wireless local area network(WLAN) 2.4/5.2/5.8 GHz applications. The coplanar waveguide (CPW) fed microstrip patch antenna considered in our work. This design results in a reduction in size and weight and allows easy integration in hand-held devices. The parametric study of the considered design shows that the radiation pattern, return loss(S11), voltage standing wave ratio(VSWR) and gain are optimized within the band of operation. The results obtained with HFSS and CST.**

***Index Terms*—WiMAX, WLAN, L-slot, CPW, VSWR, S11**

I. Introduction

In recent years, the demand of multiband antennas with simple structure, small size and low cost has been increased for various type of applications such as WiMAX (2.5/3.5/5.5 GHz) and WLAN (2.4/5.2/5.8 GHz)[1]. CPW provides easy means of parallel and series connection with active and passive elements that are required for matching and gain improvement. Slot antennas exhibit wider band width, lower dispersion and lower radiation loss than the microstrip patch antenna with no slot.

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Thus in this paper feeding is provided by a coplanar waveguide (CPW) structure [2]. For size reduction and bandwidth improvement a monopole antenna is designed to generate multiple resonant modes in [4] an antenna with L shaped strip is designed for this purpose. A microstrip patch antenna with double L-slot for both WiMAX and WLAN application is reported in [5]. The aim of this paper is to establish a comparison statement between rectangular and circular patch with double L-Slot for Wi-MAX and WLAN application.

II. Antenna Design

At first the design of microstrip antenna with rectangular patch having two L-slots is considered. The dimensions required for the antenna design are given in the following table.

TABLE 1

Parameter	Value
L1	5.7
L2	7.5
W	19.27
L	19.3
GL	16.2
GW	10.5
SL	40
SW	26
G	3
D	1
FL	19.2
FW	3

TABLE 2

Then the design of microstrip antenna with circular patch having two L-slots is considered. The dimensions required for the antenna design are given in the following table.

Parameter	Value
L1	5.7
R	10
GL	16.2
GW	10.5
SL	40
SW	3
G	1
D	1
FL	19.2
FW	3

The proposed antenna is designed and fabricated on FR4 epoxy substrate with relative dielectric constant of 4.4 and loss tangent of 0.02. To meet the actual design requirements, i.e. operating frequency, bandwidth, radiation pattern, and some approximations are considered. The calculations are based on the transmission line model. The effective dielectric constant of the substrate is given as

$$\epsilon_{reff} = \frac{\epsilon_r+1}{2} + \frac{\epsilon_r-1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2} \quad \text{.....(1)}$$

The normalized extension of the length and width are calculated as

$$(L_{eff}) = L + 2\Delta L \quad \text{.....(2)}$$

$$\Delta L = 0.412h \times \frac{(\epsilon_{reff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\epsilon_{reff}-0.258)\left(\frac{W}{h}+0.8\right)} \quad \text{.....(3)}$$

$$W = \frac{C_0}{2f_r\sqrt{\frac{(\epsilon_r+1)}{2}}} \quad \text{.....(4)}$$

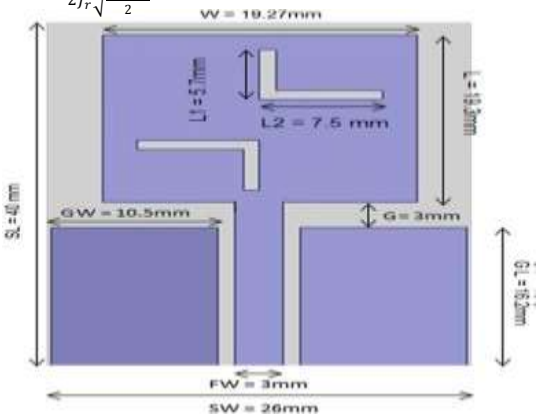

Figure. 1. The design of the Rectangular Patch with double L-Slot with CPW feed

Using the above equations and trials, the dimensions of the antenna is tabulated in the above table. In this paper CPW feed technique is implemented as it provides a better impedancebandwidth. The microstrip antenna fed by co-planar waveguide (CPW) microstrip feed line has unique characteristics such as lower radiation leakage, wider bandwidth and less dispersion than microstrip lines. Therefore, the CPW microstrip feed is a very promising technique. The design and simulation was carried out by using two software HFSS and CST. At first the design was done using HFSS (High Frequency Structure Simulator) and then it was done by CST (Computer Stimulated Technology). After that the comparison has been done.

III. SIMULATION AND RESULTS

For the simulation at first the HFSS software used and as per the parameters in table 1 the design was done

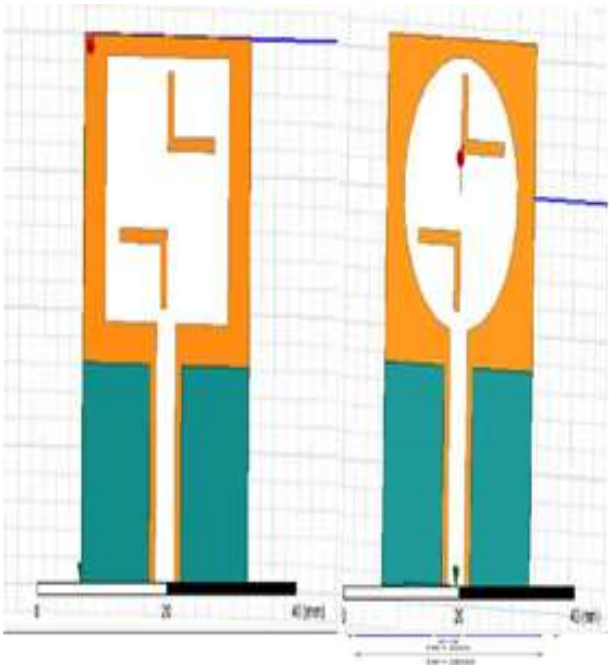

Figure. 2. The design of the Rectangular Patch (left) andCircular Patch (right) with double L- Slot with CPW feed using HFSS

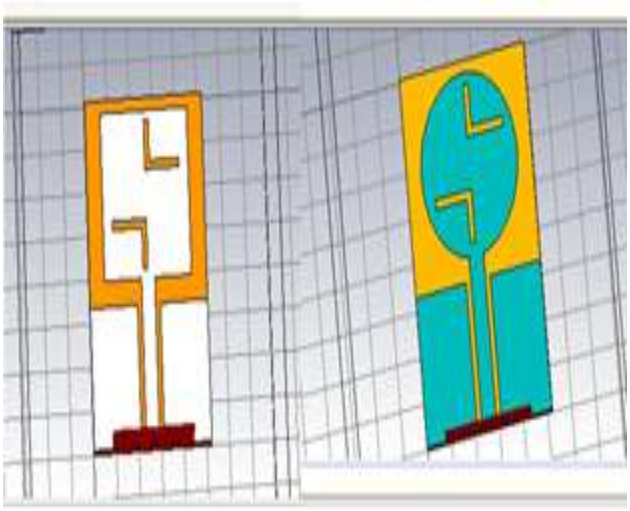

Figure. 3. The design of the Rectangular Patch (left) andCircular Patch (right) with double L- Slot with CPW feed using CST

Then the simulation was done and results were analyzed.

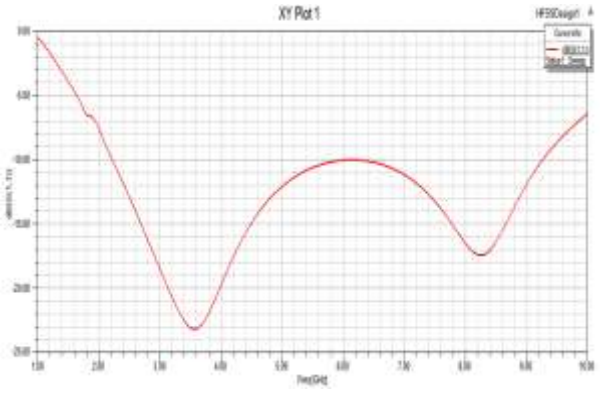

Figure. 4. S_{11}using HFSS for rectangular patch

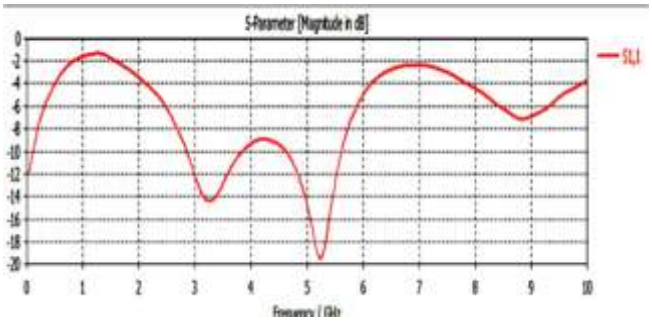

Figure. 5. S_{11}using CST for rectangular patch

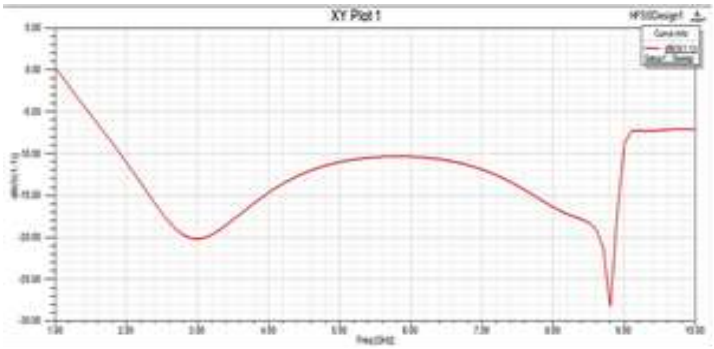

Figure 6 :S_{11}using HFSS for circular patch

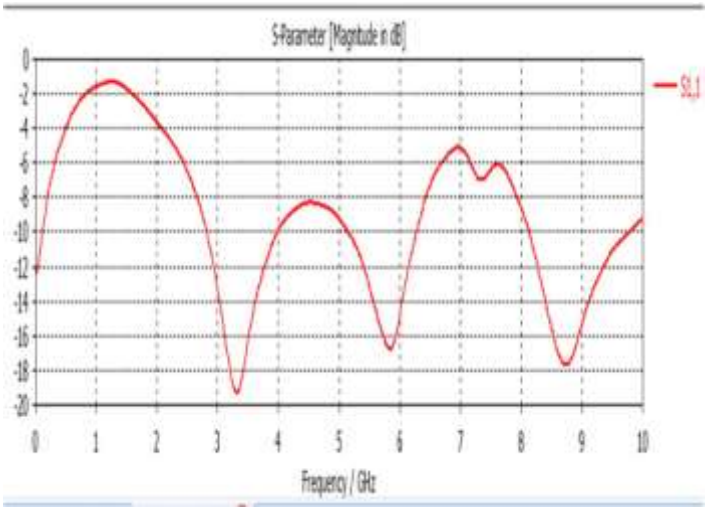

Figure7:S_{11}using CST for circular patch

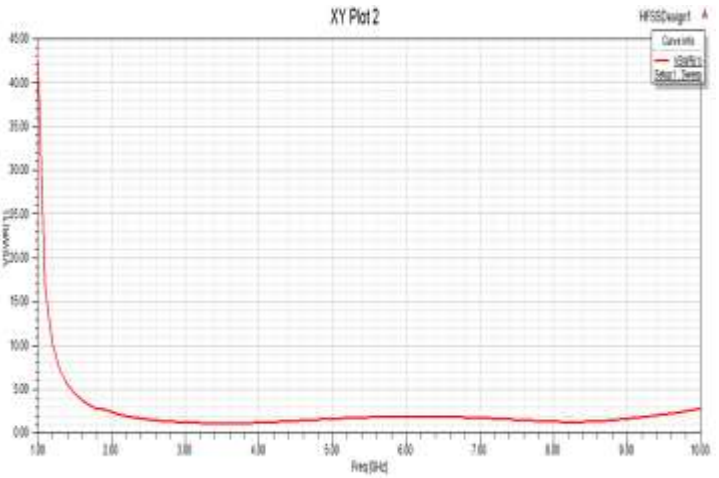

Figure8: VSWR using HFSS of Rectangular Patch

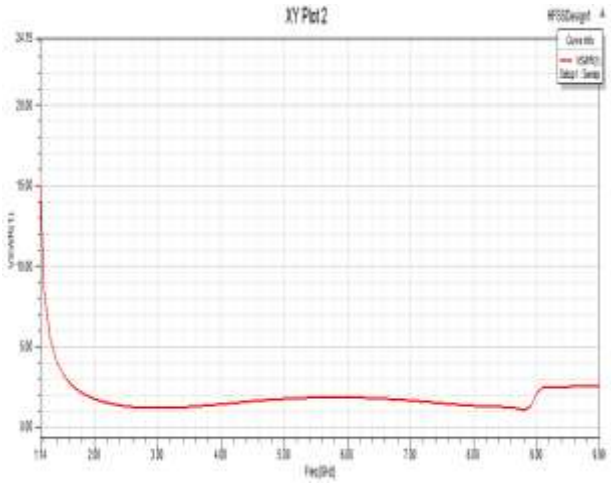

Figure9: VSWR using HFSS of Rectangular Patch

IV. ANALYSIS OF RESULT

From the return loss plot it can be analyzed that the resonant frequency is in the desired range and it can also be observed that the bandwidth of circular patch is more than that of the rectangular patch.

TABLE 3

Parameters measured for rectangular Patch	**HFSS**	**CST**
Resonant frequency	3.57 GHz	3.24 GHz
Return loss	-23.23 dB	-14.425 dB

TABLE 4

Parameters measured for Circular Patch	**HFSS**	**CST**
Resonant frequency	3.04 GHZ	3.32 GHz
Return loss	-20.04 dB	-19.25 dB

V. CONCLUSION

From the design and analysis of the proposed antennas it was found from the figure that the Circular Patch with double L-Slot has wider bandwidth which covers the desired range. So it is better to use the Circular Patch with double L-Slot for WLAN and Wi-MAX applications.

VI. REFERENCES

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