A Compact Ultra Wideband CPW-Fed Circular Polarized Slot Antenna

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Abstract—**In this paper a new Compact Ultra Wideband CPW-Fed Circularly Polarized Slot Antenna is presented. This antenna has a very small size of 15×15×0.76 mm^3, a new and easy design Based on previous works to realize the CP (Circular polarization). Two inverted-L stripe and two rectangular stripes are integrated in the ground plan to obtain a CP band width. The simulated IBW (impedance bandwidth) has a band of 14.9GHz between (4.1GHz-19GHz) where S_{11} is less than -10 dB and the 3dB ARBW (axial ratio bandwidth) with 5.65 GHz between (6.3GHz-11.95GHz). The realized gain has 2.7 dBi in the frequency center of ARBW.**

***Keywords*—Axial Ratio, coplanar waveguide (CPW), compact antenna, Ultra Wideband(UWB) , slot antenna.**

I. Introduction

In February 2002 the Federal Communications Commission (FCC) is licensed the ultra wideband (UWB) between 3.1 GHz and 10.6 GHz, to use in commercial applications [1].The compact planar antennas in UWB systems are characterized by small size, light weight, low cost and higher data rate [2].The UWB antennas have more difference between conventional antennas, such as a highly large instantaneous bandwidth and a relatively constant gain [3]. Coplanar waveguide type, coaxial, and microstrip are the deferent technical feeding structures in UWB antennas [4]. The coplanar waveguide (CPW) feed antennas are largely used in commercial and military applications, among the features of the CPW feed antennas, single metallic layer, wide impedance bandwidth and low profile [5].

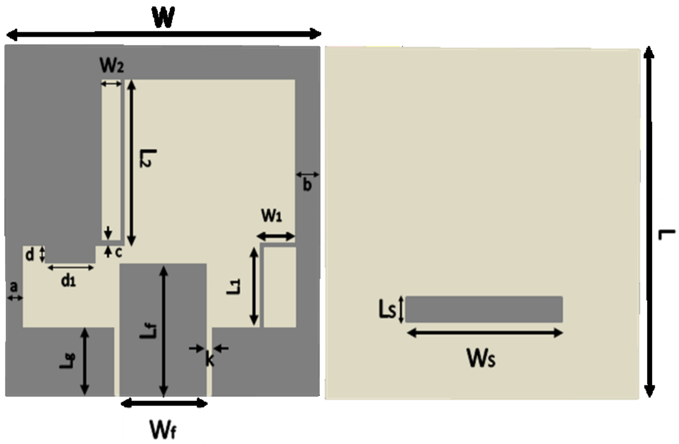
Circular polarization is widely used in wireless communication systems because it affords good mobility and weather penetration compared to linear polarization [6].

The fundamental operation principle to create a Circular polarization is to generate tow field components with an orthogonal radiation, equal amplitudes, an opposition phases (phase quadrature) and axial ratio less than 3dB[7].

The CPW square slot antenna can afford broad impedance and axial-ratio less than 3 dB bandwidths, by Different techniques [8]. Among these techniques: integrate a T-shaped grounded metallic strip and embedding two inverted-L grounded strips in [9] and [10] respectively.

In this paper a compact circularly polarized CPW square slot antenna is presented. Used a technique in [5] where we integrate two inverted-L strips and tow rectangular strips in the ground plan to create the circular polarization. The proposed antenna has super wide impedance bandwidth between (4.1GHz-19GHz) for the C-band applications and an axial ratio bandwidth between (6.3GHz-11.95GHz) this band cover the C-band (6.425-6.725GHz and 6.725-7.025GHz) and X-band (7.25-8.395GHz and 8.0-12GHz)[11],[12] where the axial ration is less than 3dB. The simulations are done by using Computer Simulation Technology (CST) [13].

II. Antenna Design



(a) **(b)**

Fig. 1 Geometry of proposed antenna (a) Top view, (b) Bottom view.

Fig.1. Represent the design and the geometry of UWB circular polarized antenna. The antenna is concepted by RO4350B substrate with thickness of 0.76 mm it has a very small size W×L (15×15mm^2). It contains a rectangular CPW feed line with width of Wf=4mm and length Lf=6.2 and a square ground plane with a deferent form dimension of rectangular and inverted L-shaped stripes to create improve the circular polarization. All the dimension of the proposed antenna illustrated in Tab.1.

Tab. 1 Dimensions of Proposed Antenna

paramètres	Values(mm)	paramètres	Values(mm)
W	15	L	15
Wf	4	Lf	6.2
W1	1.9	L1	3,9
W2	1	L2	6,85
Ws	0.8	Ls	7
a	0.6	Lg	2.6
b	1.4	d	0.95
c	0.3	d1	2.4
K	0.15		

III. Numerical Results and Discussion

The results are simulated by using Computer Simulation Technology (CST) to prove the performance of this antenna

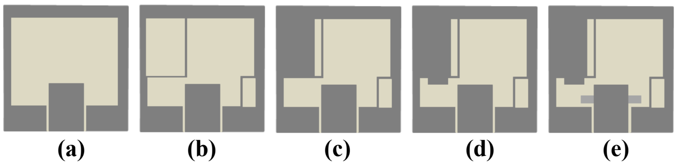


Fig. 2 Five Steps to achieve CPW-fed Circular Polarized antenna (a) antenna1 (b) antenna2(c) antenna3 (d) antenna4 (e) proposed antenna.

Fig. 2 illustrates the five steps of the parametric study to obtain a CPW-Fed circular polarized antenna. Antenna1 in Fig.2 (a) contains a ground plan and rectangular strip, the simulated reflection coefficient in Fig.3 for antenna1 has a resonance only in the frequency center in 5.05GHz and 10.26GHz with $S_{11} \leq$-10 dB. Antenna2 in Fig.2 (b) contains a ground plan with tow inverted-L strips and a rectangular strip, for Fig.2(c) (d) we add a deferent size of rectangular strips in the ground plane, we observe that the circular polarization is created in Fig.4 for antenna3 and antenna4 with axial-ratio bandwidths less than 3dB. The proposed antenna is clarified in Fig .2(e) it has a rectangular strip, tow inverted-L strips, tow rectangular strips attached with ground plan and a rectangular metallic strip in the bottom to get an UWB impedance band widths(IBW) and axial-ratio bandwidths(ARBW).

The simulated S_{11} of the five steps are presented in Fig.3, for the proposed antenna we obtain an IBW to 14.9GHz (4.1GHz-19GHz) for $S_{11} \leq$-10 dB. A wide ARBW is obtained in Fig.4 where the ARBW between 6.3GHz to 11.95GHz is less then 3dBand the C-band (6.425-6.725GHz and 6.725-7.025GHz) and X-band (7.25-8.395GHz and 8.0-12GHz) are covered, the tow inverted L and the rectangular stripes integrated in the ground plane are the responsible to create an ARBW.

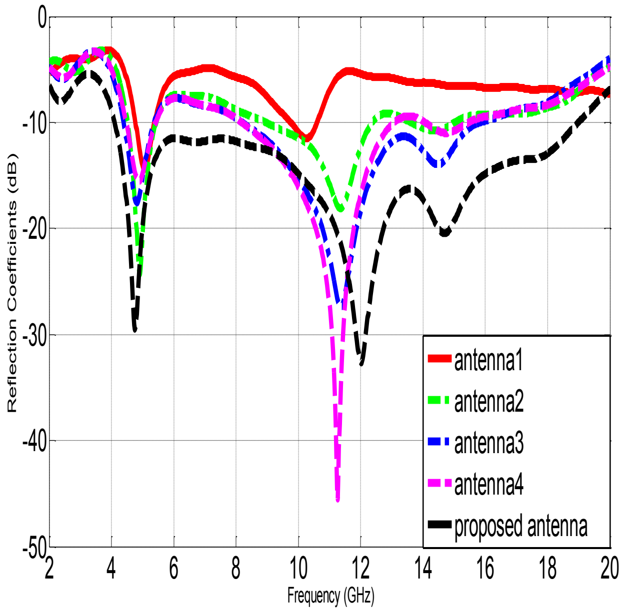


Fig. 3 Simulated S11 of five steps with CST

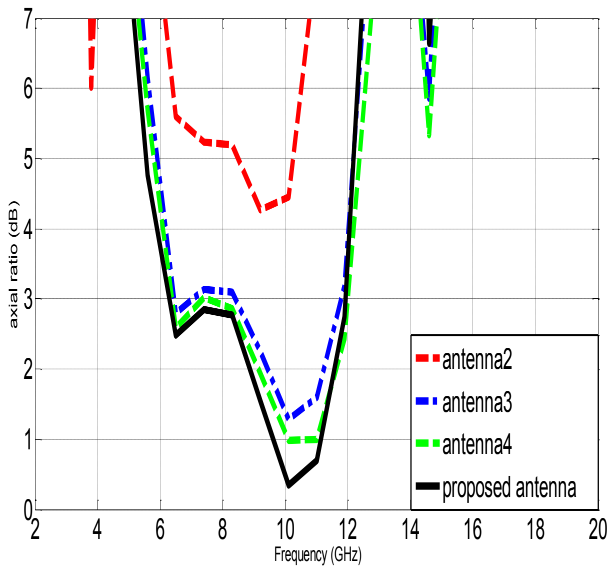


Fig. 4 Simulated axial ratio of last four steps with CST

The realized gain of proposed antenna is illustrated in Fig.5 where the maximum value is located in the frequency center of ARBW. Fig.6 presents The RHCP (right hand circular polarization) and LHCP (left hand circular polarization) radiation characteristic of proposed antenna in phi=0° and phi=90°at 8GHz and 11GHz respectively, for Z<0 the radiation pattern is right hand circular polarization RHCP and the radiation pattern is left hand circular polarization LHCP for Z>0.

Tab.2 illustrates the comparison in the IBW, ARBW and the size between proposed antenna and some other works is clearly noted the proposed antenna has a largest CP bandwidth to the other works; the proposed antenna has a small size comparing the other works cited in the Tab.2.

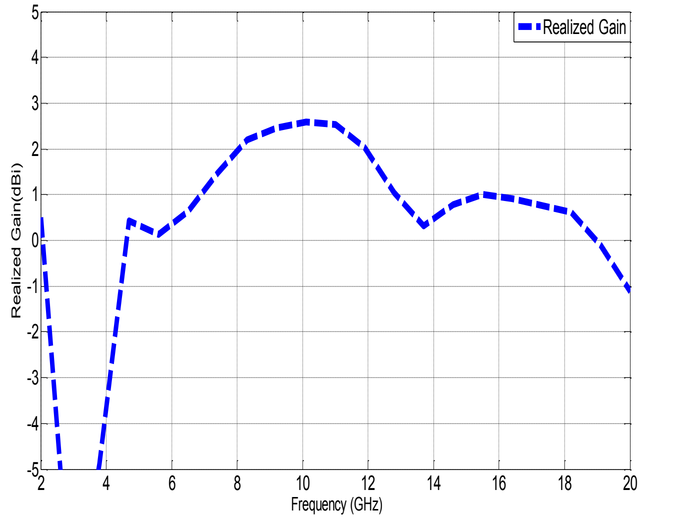


Fig. 5 Simulated realized gain of proposed antenna with CST

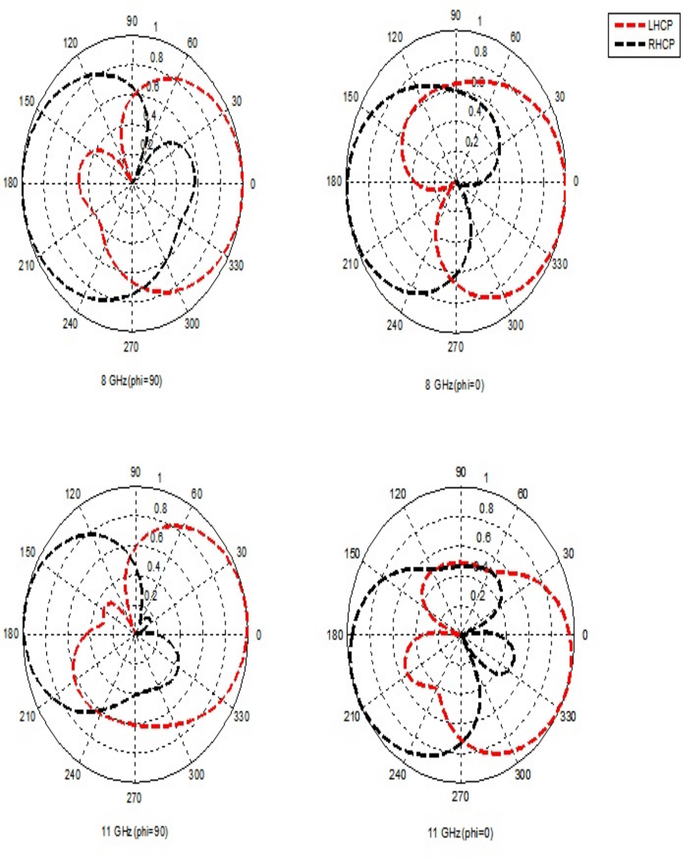


Fig. 6 Simulated RHCP and LHCP patterns of proposed antenna at 8 GHz and 11GHz.

Tab. 2 Comparison of Proposed Antenna with previous works

Ref.	IBW(GHz)	ARBW (GHz)	Size (mm^2)
[5]	**2.67-13**	**4.9-6.9**	**60×60**
[6]	**2.76-14.82**	**4.27-6.13**	**25×25**
[7]	**2.9- 11.2**	**5.3-6.7**	**25×25**
[8]	**3.5 - 9.25**	**4.6 - 6.9**	**25×25**
[9]	**2.95-14**	**3.729-7.1**	**20×20**
This work	**4.1-19**	**6.3-11.95**	**15×15**

IV. CONCLUSION

A Compact Ultra Wideband CPW-Fed Circular Polarized Slot Antenna is simulated and presented in this paper. The antenna has new and small design, the IBW of the antenna is obtained by a modification in the ground plan, two inverted-L strips and tow rectangular strips are responsible to create an ARBW less than 3dB. The antenna has a very small size with 15×15 mm^2.

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