CIRCULAR PATCH WITH CIRCULAR SLIT PATCH ANTENNA USED FOR ULTRA WIDE BAND APPLICATION

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Abstract - The proposed antenna is one of the best antenna structures, due to its low cost and compact design. In this paper, it was present a new approach to improve the radiation efficiency and the performance of antennas due to miniaturization of the size. Indeed, the performance of ultra wideband antenna which consists of a circular patches printed on an inexpensive FR-4 Epoxy substrate a dielectric constant (ε_r = 4.4) and high (h=1.5748mm), the design were presented on geometrical form . The idea was to develop new configurations by modifying Defect Ground Structure . The performance of the designed patch antenna is simulated with CST 2012 software. This study was made for the whole frequency band of UWB ranging 8.2 GHz (4.7- 13.1GHz) and corresponding VSWR is 1.29 < 2 for entire bandwidth range.

Keywords - Microstrip, Patch, Antenna, Planar, Broadband, Ultra Wide Band, Bandwidth Enhancement, Omni-directional patterns.

I. INTRODUCTION

Patch antennas play a very significant role in today's world of wireless communication systems. A Micro strip patch antenna is very simple in the construction using a conventional Micro strip fabrication technique. The most commonly used Micro strip patch antennas are rectangular and circular patch. Wireless communication technology has changed our lives during the past two decades. In countless homes and offices, the cordless phones free us from the short leash of handset cords. Cell phones give us even more freedom such that we can communicate with each other at any time and in any place. Wireless local area network ($WLAN$ 2) technology provides us access to the internet without suffering from managing yards of unsightly and expensive cable. In recent years, more interests have been put into wireless personal area network (WPAN) technology worldwide. The main aim of WPAN is to provide reliable wireless connections between computers, portable devices and consumer electronics within a short range. Furthermore, fast data storage and exchange between these devices will also be accomplished. This requires a data rate which is much higher than what can be achieved through currently existing wireless technologies. concentric ring slots have been used to design multi-band antennas.

II. GEOMETRY OF ANTENNA

The third design is circular patch antenna with partial ground plane structure . FR-4 Epoxy dielectric substrate is used with ε_r = 4.4. Characteristic impedance of 50 ohm microstrip feed line is used to fed to patch . the proposed antenna has the bandwidth (vswr=1.29) bandwidth of 8.1 GHz comes under the UWB band therefore the this is a good antenna to be used for the UWB application. Partial ground plane is used here. In order to increase the bandwidth as a ground plane.

2.1 Dimension of the Proposed Antenna

Table 1. Parameter and dimension of Antenna

Resonating Frequency	**8.1 GHz**
Length of Feed line(Lf)	**7mm**
Width of Feed(Wf)	**2mm**
Length of Substrate(Ls)	**18mm**
Width of Substrate(Ws)	**12mm**
Radius of Circular Patch(a)	**5mm**
Thickness of Substrate(h)	**1.58mm**
Thickness of Patch(Mt)	**0.07mm**
Outer Slit Radius (b)	**2mm**
Inner Slit Radius (c)	**1mm**

2.2 Model of Circular patch with Slit

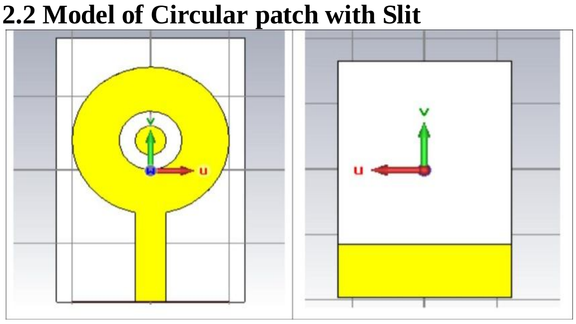


Fig. 1. Model of Circular Patch with circular slit feed line front and back view

III. SIMULATED RESULTS & DISCUSSION

The return loss, VSWR and gain for the designed antenna is shown in Fig 2. (a, b, c, d) respectively. The discussed design achieves the return loss of -17.88 dB and the bandwidth of 8.2 GHz (4.7-13.1GHz) and corresponding VSWR is 1.29 < 2 for entire bandwidth range. These result will be used in

UWB application. The position of deep curve in return loss plot at resonating frequency7.74 GHz, 8.2GHz and 11.57 GHz with Return Loss -18.18dB , -32.07 ,-38.63 dB and with VSWR 1.29, 1.29,1.04

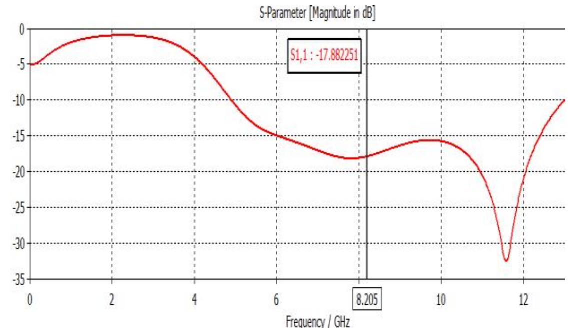


Fig. 2(a) Return Loss Plot = -17.88dB

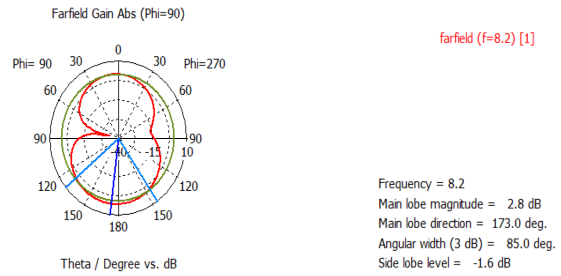


Fig. 2(b) Gain Plot = 2.83 dB

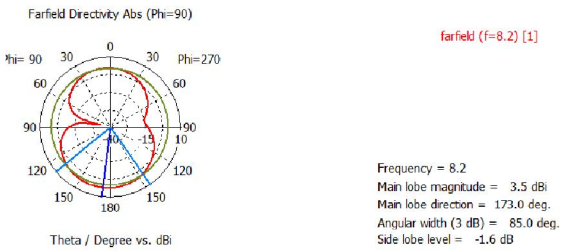


Fig. 2(c) Directivity Plot = 3.49 dB

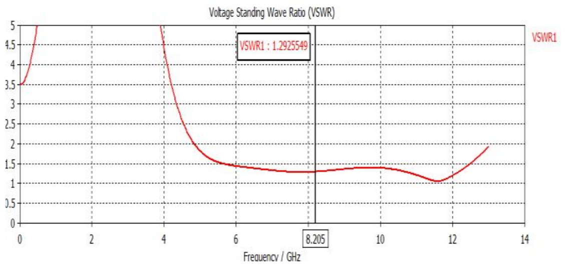


Fig. 2(d)VSWR Plot = 1.29

Fig 2(a,b,c,d) Pattern of Return Loss, VSWR, Gain, Directivity of Simple Circular Patch fr = 8.2 Ghz

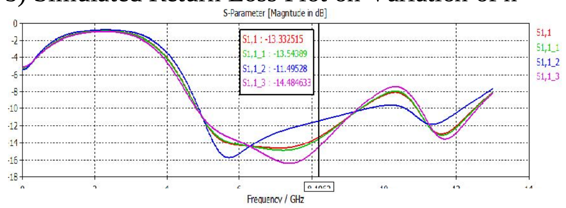
3.1 For Different variation of parameter Return Loss, VSWR, gain and Band width were changed shown in below Tables

a) If substrate thickness is changed at constant length of ground Lg= 4mm,

Table 2. Variation of thickness of substrate

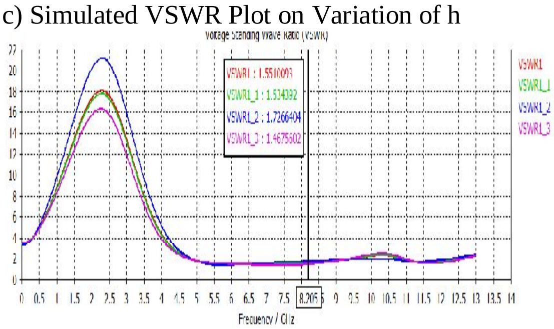
Sl.No.	Substrate Thickness	εr	BW (GHz)	Return loss(dB)	VSWR
1	1.4	4.4	4.6, 1.76	-11.48	1.72
2	1.58	4.4	4.5, 1.7	-13.3	1.55
3	1.6	4.4	4.5, 1.63	-13.5	1.53
4	1.8	4.4	4.8, 1.5	-14.4	1.46

b) Simulated Return Loss Plot on Variation of h



Red Line – h = 1.58mm , Green Line – h = 1.6 mm, Blue Line – h = 1.4 mm, Purple Line – h = 1.7mm
Fig. 3 Return Loss Plot wrt h

c) Simulated VSWR Plot on Variation of h



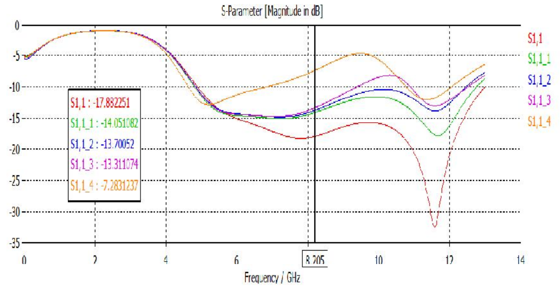
Red Line – h = 1.58mm , Green Line – h = 1.6 mm, Blue Line – h = 1.4 mm, Purple Line – h = 1.7mm
Fig. 4 VSWR Plot wrt h

d) If the inner and outer radius of slit i.e b, c value to obtain an optimize frequency band fr= 8.2GHz

Table 3. Variation Slit dimension

No.of Iteration.	Outer Slit radius (b)	Inner Slit radius (c)	Return loss(dB)	VSWR	Band Width(GHz)
1	2	1	-17.88	1.29	8.1
2	3	1	-14.0	1.49	7.93
3	3	2	-13.7	1.52	7.7
4	3	2.5	-13.31	1.55	4.6, 1.7
5	4	2	-7.28	2.5	1.4, 1.3

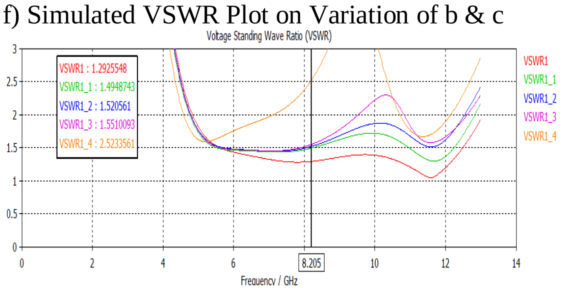
e) Simulated Return Loss Plot on Variation of b &c



S1,1(b= 2, c=1), S1,1_1 (3, 1), S1,1_2(3,2), S,1,1_3(3,2.5), S1,1_4(4,2)

Fig. 5 Return Loss Plot wrt to slit dimension

f) Simulated VSWR Plot on Variation of b & c



S1,1(b= 2, c=1), S1,1_1 (3, 1), S1,1_2(3,2), S,1,1_3(3,2.5), S1,1_4(4,2)

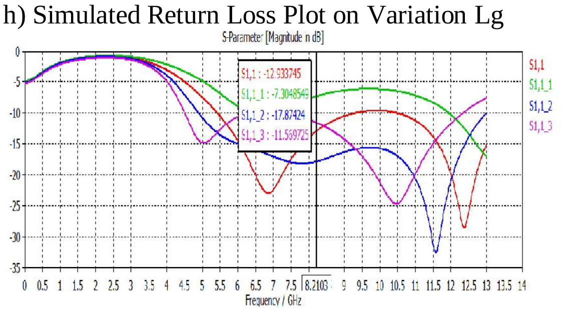
Fig. 6. VSWR Plot wrt dimension of slit

g) If Lg is varied at constant Slit Dimension

Table 4. Variation of Lg

SL. No.	L_g (mm)	Return Loss(dB)	VSWR	Directivity	Band Width(GHz)	Gain(dB)
1	3	-11.35	1.7	3.49	2.4, 3.87	2.89
2	4	-17.88	1.29	3.49	8.1	2.83
3	5	-12.95	1.58	3.58	3.72, 2.6	2.83
4	6	-7.3	2.51	3.72	0.62, 1	2.87

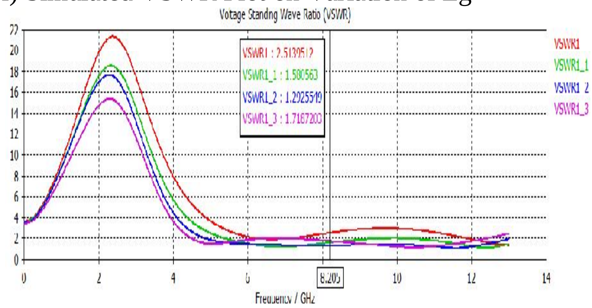
h) Simulated Return Loss Plot on Variation Lg



S1,1 (Lg = 5), S1,1_2(Lg= 4), S1,1_1(Lg= 6), S1,1_3(Lg= 3)

Fig. 7. Return Loss Plot wrt Lg

i) Simulated VSWR Plot on Variation of Lg



S1,1 (Lg = 5), S1,1_2(Lg= 4), S1,1_1(Lg= 6), S1,1_3(Lg= 3)

Fig. 8 VSWR Plot wrt Lg

IV. ANALYSIS OF CIRCULAR PATCH WITH CIRCULAR SLIT BY RLC CIRCUIT.

The Equivalent lumped circuit model of return loss plot for Microstrip patch antenna can be achieved effectively by using series RLC circuit. A series connection of R, L, C can be assumed as band pass filter which only pass certain frequency and reject rest. From the Return loss plot from the valley at which resonance takes place and frequency changed from that point the R, L, and C is calculated with the formula .Equivalent Circuit is shown in Fig. 9

$f = \frac{1}{2\pi\sqrt{LC}}$ ....(4.1)

f = resonating frequency = $\sqrt{\frac{1}{LC} - \left(\frac{R}{L}\right)^2}$ ....(4.2)

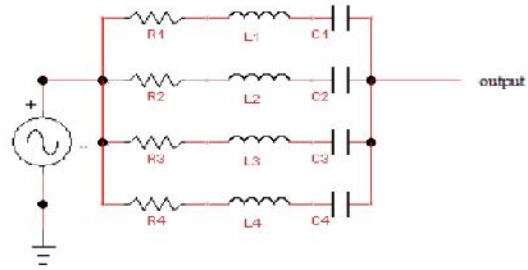


Fig. 9 Equivalent RLC Model of Proposed Antenna

The Parameter were calculated with the help of Z0 =50 ohm= $\sqrt{\left(\frac{L}{C}\right)}$, and the parameter were shown in table 5.

Table 5. RLC value for designed antenna

Sl. No.	Resonating Frequency	R (Ohm)	L (nH)	C (pf)
1	4.8	R_1 = 47.24	L_1 = 1.65	C_1 = 0.66
2	7.7	R_2 = 8.48	L_2 = 1.03	C_2 = 0.41
3	10.5	R_3 = 9.0	L_3 = 0.75	C_3 = 0.30
4	12	R_4 = 8.26	L_4= 0.66	C_4= 0.26

CONCLUSION

The above proposed antenna structure's were simulation carried out using the CST Microwave Studio software. The Simulated results are presented, shows the usefulness of the proposed antenna structure for UWB applications. The simulation results of band notch antenna indicate that the designed antenna fulfils UBW band characteristics for various frequency bands and showing the good return loss and radiation patters as well as bandwidth and gain is also enhance which was shown in above results :

This design achieves the return loss of -17.88 dB and the bandwidth of 8.1 GHz (4.7- 13.1GHz) and corresponding VSWR is 1.29 < 2 for entire bandwidth range

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