ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Design and Simulation of Multiband CPW feed Ring Shaped Antenna for Wireless Applications

R.Samson Daniel
[*] ECE, K.Ramakrishnan College of Engineering, India
samson.rapheal@gmail.com

Abstract

The aim of this paper is to design and simulation of Coplanar Waveguide (CPW) ring shaped antenna for multiple wireless applications. The antenna is designed by FR-4 substrate with dielectric constant of 4.4 and the substrate thickness of 1.6mm. The antenna occupies a compact size (L x W) 36mm x 36mm. The radiating patch is etched/cut with C-shaped slot to generate multiple frequencies for various wireless applications. Copper materiel used as a conducting material for radiating patch and ground. An introduced antenna design covers five frequency bands for GPS (1.63GHZ), WLAN (2.4 GHz), WIMAX (3.380GHZ), C-band (4.0450 GHz), and WIFI (5.0250GHZ) applications. The antenna is designed and all results are simulated by using High Frequency Structure Simulated (HFSS) simulation software. Return loss, VSWR and field pattern of the proposed antenna is plotted and all frequency bands are found to have return losses (s11) less than -10 dB and VSWR less than 2.

Keywords: CPW feed, VSWR, Returnloss, Multiband, Wireless Communication, C-slot.

Introduction

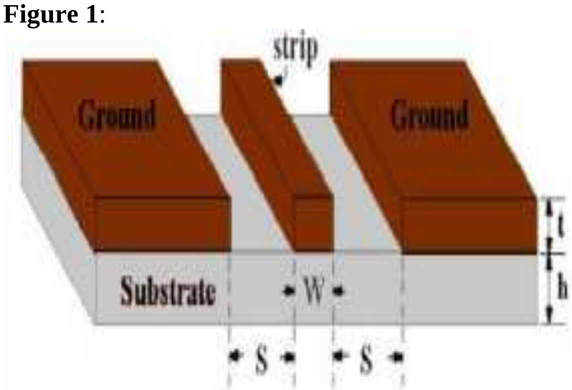
Antenna Plays major role in wireless communication systems. Without antenna, wireless communication is not possible to transmit and receive the signals. For this reason, antenna design becomes one of the most important fields in wireless technology. The microstrip antenna has several advantages such as small size, less weight, low cost of fabrication and low profile antenna. But general microstrip antenna suffers from narrow bandwidth, low gain, and tolerance problems. Recently, Coplanar Waveguide (CPW) feed antenna has been found because of their many attractive features such as wider bandwidth, better impendence matching, low radiation loss, no soldering point, and simple structure of single metallic layer and easy to integration with MMIC. So Coplanar Waveguide (CPW) transmission lines are becoming popular in MMIC fields due to lower radiation leakage and less dispersion than microstrip lines.

The advantage of the multiband antenna is, that can integrate several frequency bands on a single antenna. It makes several wireless applications such as WLAN, Wi-Fi, and Bluetooth etc. In this paper, a proposed antenna design with CPW feed has been used for wireless applications. The proposed antenna consists of ring shape patch element by cutting C- slot. Patch antenna with C-slot mainly used for bandwidth enhancement by intelligent placement of C-slot

Coplanar Waveguide Structure

Basic CPW structure as shown in Figure 1. The Coplanar Waveguide structure consists of three conductors namely two ground Planes and one radiating patch. The radiating patch is present between two ground planes, and all three conductors are placed on the same side of the substrate. These all three conductors are separated by small gap. This arrangement is called as CPW.

Figure 1:



Basic structure of CPW

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

Antenna Design

The Proposed CPW feed antenna has been developed with substrate of FR-4 having a dielectric constant (ε_r)=4.4 and height of the dielectric substrate (h) =1.6mm. The dimensions of the antenna obtained by using some basic formula which are represented here. The antenna dimensions are wavelength dependent. This can be determined from equation (1) and (2)

$$\lambda = \frac{c}{f} \quad (1)$$

$$\lambda_{g} = \frac{\lambda}{\sqrt{\varepsilon_{eff}}}; \quad \text{where } \varepsilon_{eff} = \frac{\varepsilon_{r+1}}{2} \quad (2)$$

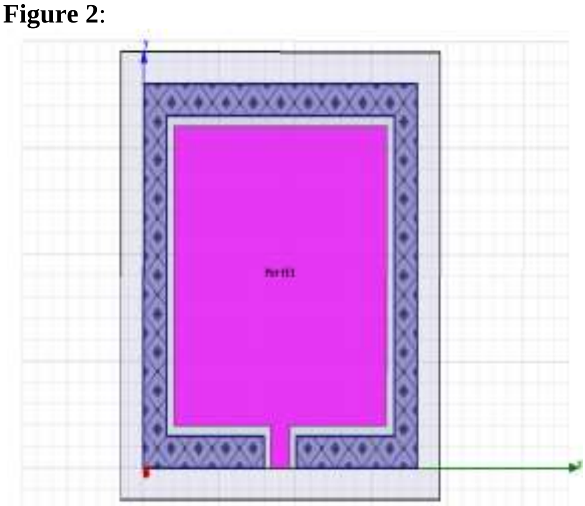
Where c is the velocity of the light and f is the resonant frequency. From this above equations, the resonant frequency increases when the size of the antenna is reduced. The square shaped patch antenna is normally designed at nearly half wavelength. The length and width of the square patch can be obtained using equation (3)

$$L = W = \frac{\lambda_g}{2} \quad (3)$$

The proposed CPW feed design started with the main patch, which can be calculated by using above equations. Since the length (L) and width (W) of the radiating patch is 28mm x 28mm. The antenna is simulated on an FR4_epoxy dielectric substrate of 36mm x 36mm with a dielectric constant (ε_r) =4.4. The thickness of the substrate is h=1.6mm. The length and width of the microstrip feed is 4mm and 2.6mm for obtained the better results.

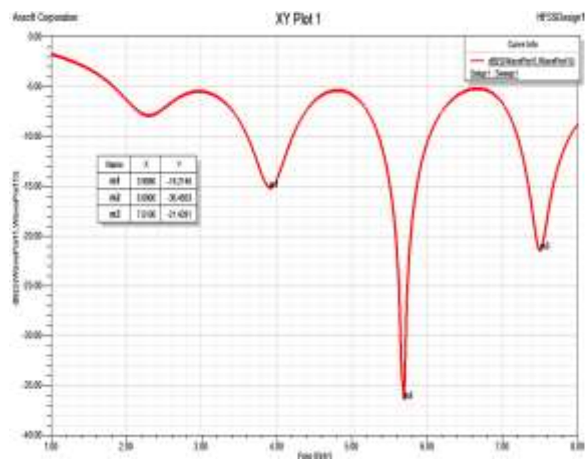
Design Structure

Figure 2:



(a) Radiating Square Patch

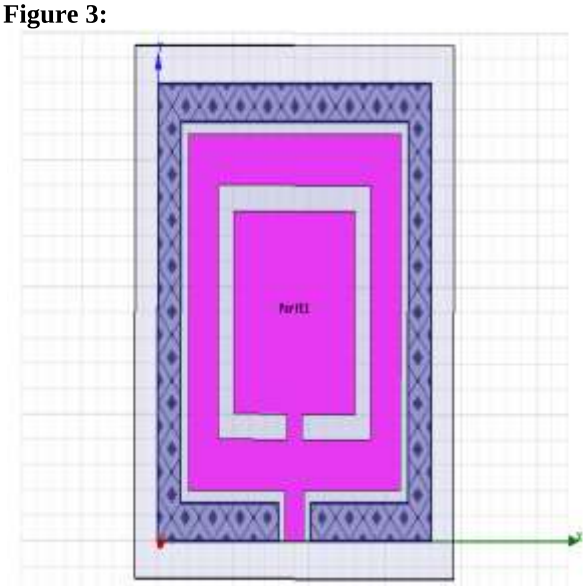
The CPW feed radiating patch 28mm x 28mm antenna structure as shown in Figure 2(a). There is no ground plane at the bottom of the substrate and hence, the radiation in the backward direction is unavoidable. These antenna structures produce omnidirectional radiation pattern.



(b) Simulated Result of Radiating Square Patch

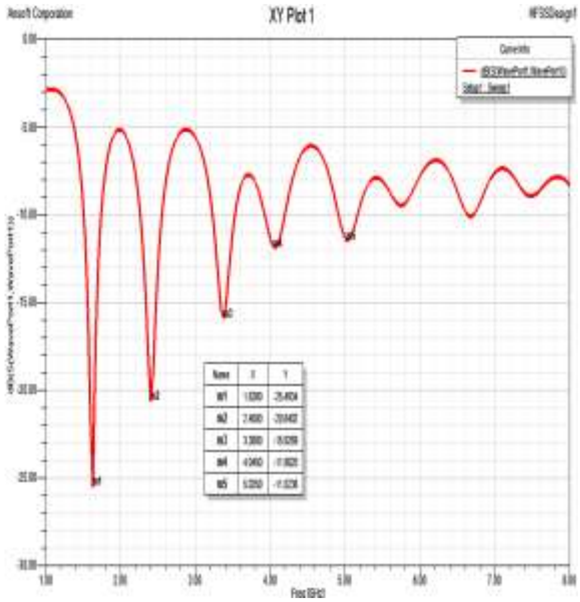
From this simulation result Figure 2(b), the radiating square patch resonates at triple frequencies such as 3.9050 GHz with return loss (-15.214 dB), 5.69 GHz with return loss (-36.4553 dB) and 7.510 GHz with return loss (-21.4281 dB). By cutting C-slot inside the radiating square patch, resulting is multiband antenna for wireless applications.

Figure 3:



(a) Proposed CPW feed Ring shaped antenna

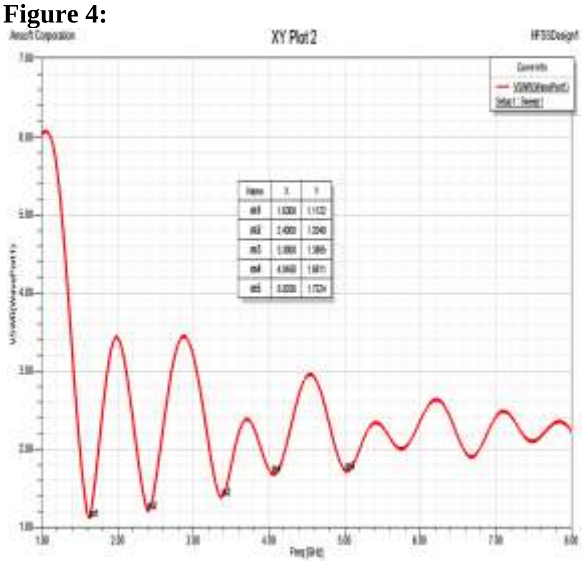
ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852



(b) Simulated Result of Proposed CPW Feed Ring Shaped Antenna

VSWR

Figure 4:



VSWR Vs frequency

From the above obtained results we can say, the proposed antenna resonates five bands of operations. Also Obtained return loss (S11) at all these frequencies. All frequencies are having a return loss values less then -10dB. Value of VSWR at all five resonating frequency bands are also less than 2 and greater than 1. So we can say the proposed CPW feed antenna is resonating at five different resonating frequencies. All these Frequencies are having its own operation.

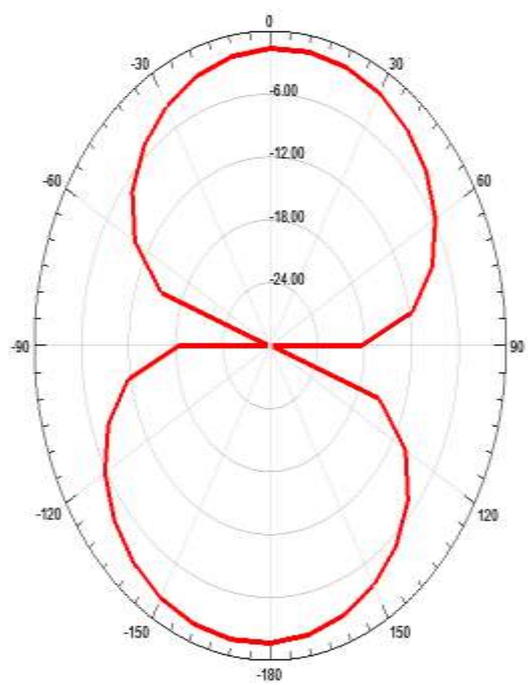
Table:

Table 1. Simulation results of proposed CPW feed antenna

S.NO	Frequency Obtained	Return loss	VSWR
1	1.63 GHz	-25.4934	1.1122
2	2.4 GHz	-20.6402	1.2048
3	3.38 GHz	-15.9269	1.3805
4	4.0450 GHz	-11.9020	1.6811
5	5.0250 GHz	-11.5236	1.7224

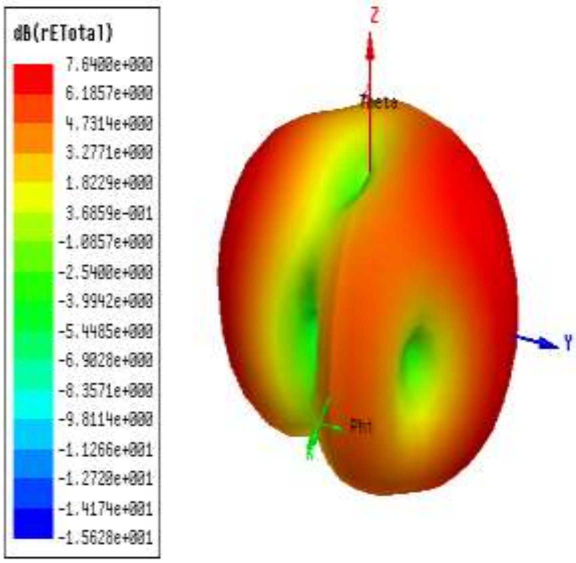
Radiation Pattern

Figure 5:



(a)

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852



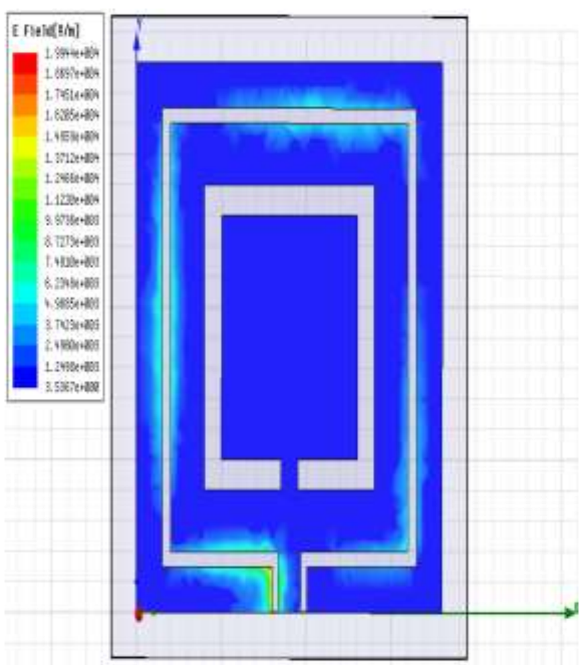
(b)

(a) 2D Radiation Pattern (b) Far field Gain

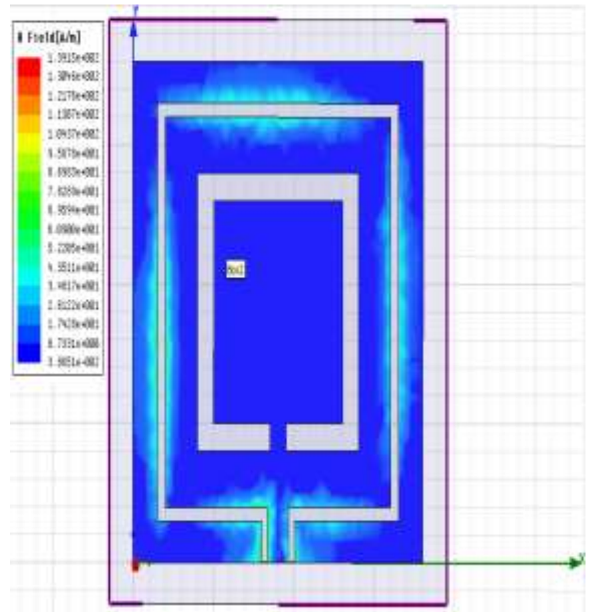
Figure 5(a) represents the radiation pattern of proposed CPW feed antenna. The maximum far field radiation occurs at θ=90 and φ=0 directions. The radiation pattern of the proposed antenna is bi-directional pattern, it can be used in wireless communications.

Field Distributions

Figure 6:



(a)



(b)

(a) E-field Distributions (b) H-field Distributions

Figure 6(a) indicates the electric field distribution. The maximum value of the E-filed is obtained as 2 V/m. Figure6(b) indicates the magnetic field of the CPW feed. The maximum value of H-field is obtained as 1.4 A/m.

Conclusion

The proposed CPW feed ring shaped antenna resonates at multiple frequencies with reduced return loss. It resonates at 1.63 GHz, 2.4 GHz, 3.38 GHz, 4.0450 GHz, 5.0250 GHz. Hence this antenna can be used for GPS, WLAN, Wi-MAX, C- band, and WiFi applications.

References

1. *Jasneet Kaur and Sushil Kumar Gargue, " Design of CPW-Fed U-Shaped Microstrip Antenna for Wireless Applications", INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY VOL. 2 ISSUE 9, SEPTEMBER – 2013.*
2. *J.William and R. Nakkeeran,"CPW-Fed UWB Slot Antenna with Triangular Tuning Stub", INTERNATIONAL JOURNAL OF COMPUTER AND ELECTRICAL ENGINEERING, VOL. 2, NO. 4, AUGUST, 2010.*
3. *J. William and R.Nakkeeran, "An Optimal Design of Compact CPW-Fed Slot Antenna*

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

forBroadbandApplications" INTERNATIONAL JOURNAL OF MICROWAVE AND OPTICAL TECHNOLOGY, VOL. 4, NO. 5, SEPTEMBER 2009.

4. *Hou Zhang and Jian Wang," Design and Analysis of Coplanar-waveguide-fed Dual-band Antenna by FDTD", PIERS Proceedings, Beijing, China, March 23–27, 2009..*
5. *Vepuri Niranjan, Alok Kumar Saxena, and Kumar Vaibhav Srivastava," CPW-fed Slot Patch Antenna for 5.2/5.8 GHz WLAN Application", PIERS Proceedings, Kuala Lumpur, MALAYSIA, March 27–30.*
6. *Sarawuth Chaimool and Prayoot Akkaraekthalin Chakravarthy." CPW-Fed Antennas for WiFi and WiMAX".*
7. *T. Shanmuganantham, K. Balamanikandan, and S. Raghavan," CPW-Fed Slot Antenna for Wideband Applications", INTERNATIONAL JOURNAL OF ANTENNASAND PROPAGATIONVOLUME 2008.*
8. *Jayarani Songa and Prateek Nigam, "CPW-fed Monopole Antenna with L shaped and stair shape slot for Dual-band WLAN/WiMAX Applications", INTERNATIONAL JOURNAL OF SCIENTIFIC ENGINEERING AND TECHNOLOGY VOLUME NO.3 FEB 2014.*
9. *S.-Y. Chen and P. Hsu," CPW-fed folded-slot antenna for 5.8 GHz RFID tags", ELECTRONICS LETTERS 25TH NOVEMBER 2004 VOL. 40 NO. 24.*
10. *X.Qing and Z.N.ChenIEEE, " Compact coplanar waveguide-fed ultra-wideband monopole-like slot antenna", Published in IET MICROWAVES, ANTENNAS & PROPAGATION RECEIVED ON 25TH FEBRUARY 2008.*
11. *Anvesh Rajput, Dharmendra Verma, Jai Kishan,and Tejbir Singh, "Design A Compact CPW-fed UWB Antenna With WLAN band notch characteristic", INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH VOLUME 3, ISSUE 7, JULY-2012.*
12. *Jai Kishan, Anvesh Rajput, and Tejbir Singh "Design of a CPW-fed Compact Dual Band (UWB/Bluetooth) Integrated Antenna with Single Band Notched Features", INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH VOLUME 3, ISSUE 6, JUNE-2012.*
13. *Shaowen Hu, Yiqiang Wu, Ye Zhang, and Huilin Zhou, "Design of a CPW-Fed Ultra Wide Band Antenna", OPEN JOURNAL OF ANTENNAS AND PROPAGATION, 2013.*

Author Biblography

R.samson Daniel
M.E final year student in the Department of ECE in K.Ramakrishnan College of Engineering Tiruchirappalli, India.

Email:samson.rapheal@gmail.com