International Journal of Engineering & Technology, 7 (2.7) (2018) 462-465

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research Paper



A Compact Circular Patch Antenna for Wireless Network Applications

L. Nageswara Rao[1]*, V. Santhosh Kumar[2], M. Basha[3]

[1]*Department of Electronics and Communication Engineering, CVR College of Engineering, Hyderabad, India*
[2]*Department of Electronics and Communication Engineering, St. Mary's Group of Institutions, Hyderabad, India*
[3]*Department of Electronics and Communication Engineering, Anurag Engineering College, Kodad, India*
**Corresponding author E-mail: lavurinagesh@gmail.com*

Abstract

The compact double-band circular microstrip patch (MPA) with the etched slot for WLAN architecture is designed. A double recurrence circular patch design along space opening slot sustained with a transmission model is intended to acquire double recurrence task. The designed antenna model comprises of circular patch and parasitic - slot resonator. The ground plane is arranged with a space opening resonator. By modifying structure parameters, the microstrip patch works at the upper band (5.2 GHz) and parasitic - opening works at bringing down band (2.4 GHz), the two resonators are emanating with two diverse radiation designs. Remembering the true objective to choose the execution of the designed model and the composed structure shows the arrival misfortune less than - 10 B and it is demonstrated with huge impedance coordinating, enhanced radiation example and great VSWR around 1 over the working groups. The investigated configuration is simulated and analyzed with HFSS. The suggested antenna model is reasonable for wireless LAN applications.

Keywords: *Circular patch; parasitic slot; dual band operation; miniaturization; WLAN.*

1. Introduction

With fast advancement in innovation, the modern technological world needs devices which can be utilized as a part of different frequency bands. Double band antenna assumes a fundamental part of wireless administration necessities and is utilized to conquer the request of double recurrence operation. Microstrip patch antennas [1]-[2] are generally used to perform different operations required by different wireless innovation systems. With the advancement in correspondence, little, good, double band, low profile, low-cost antennas are in demand. The Remote neighborhood architecture is utilized as a part of different specialized gadgets over a huge range. The different types MPAs such as circular, rectangular, squares and ring slot shapes [3]-[9] have been portrayed in literature. Circular and rectangular patch antennas are having appealing highlights over the square and ring space shapes. The most normally drew in microstrip receiving wire is circular patch [1] radio wire. The Patch receiving wire is the ability to have outflow assorted variety.

The double recurrence circular patch arrangement along space opening resonator [10]-[12] is intended and designed for wireless communication systems that can support the dual-band WLAN [13] applications. The intended antenna consists of a circular patch and parasitic slot that is etched on a ground plane to achieve dual-band operation. The intended configuration includes circular patch (MPA) and parasitic slot resonator [4]. Dual-band is obtained by designing slots on a ground plane. Circular patch is used to get the desired band [16]. The implemented model comprises of circular patch with space opening arrangement, such as a parasitic slot model. These two portions are relentlessly coupled and oscillate at both the recurrences. Their radiation designs have distinctive execution for remote correspondence applications.

Over the most recent couple of generations, an improvement in remote neighborhood represented to primary essential significance with immense data also correspondence range. An importance for remote neighborhood equipment has reached out in an incredible way. Remote mediums for recurrences working carriers of the emphasis on condition prerequisite analyzed before sketching out another remote neighborhood arrangement [14]. A 2.45 GHz space is sans permit, due to this scheme the superlative remote neighborhood gadgets experience the conflict effects of equipment's which use a comparable recurrence range. An ISM space is pertinent by IEEE 802.11b constraint.5.2 GHz is engaged by IEEE 802.11a [15] constraint and that is more wonderful help in huge speed WLAN.

The considered arrangement, keeping in mind the end goal to stay away from by means of openings, the microstrip line sustain MPA is suggested. It is the least complex strategy to invigorate MPAs. The arranged model has the transmission channel imprinted in a similar structure energizes a microstrip fix that could be set straightforwardly finished a transmission channel conversely close-by finished the periodic system [18]. The microstrip provided line has more adaptability and conservativeness than co hub encourages line. The acknowledgement of transmission structure is accessible to match and easy to compose. To assert the model, the proposed double band circular patch with slot opening is intended for wireless network applications (WLAN). It comprises of the secondary band (5.2 GHz) and primary band (2.4 GHz) frequencies of the double band reception apparatuses are basically sensible by the MPA and opening space separately. This model has the highlights of little in an estimate, clear outline also accomplish twofold recurrence task of various radiation designs[19-26].

Copyright © 2018 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

2. Antenna configuration

A compact double-band circular microstrip patch resonator with composed space sustained by a microstrip line is characterized to realize the double recurrence range. The suggested model comprises two different types of resonators; it consists of the circular patch resonator and opening space slot. The recommended dual-band model, the circular patch antenna oscillates at 5.2 GHz (UNII) and slot [2] oscillates at 2.4 GHz (ISM) which is suitable for wireless local area network applications. The indicated transmitting resonators are firmly integrated together and reverberate at numerous recurrences. By developing the disseminating resonators' point, an unyielding double frequency-tunable circular path can be implemented. The sustain line is set on the substrate at the midpoint. Figure 1 exhibits the suggested double recurrence alignment of a WLAN arrangement.

A described receiving wire has a minimized component and aggregate design is around 4 x 4 x 0.16 cm^3 and the expected radio wire is made with a substrate of FR4 with a thickness and relative permittivity is 0.16 cm and 4.4 subsequently. The explored model is imprinted on the two sides, one side is a ground plane with opening space and another side is round fix. The fix receiving wire resonators can be managed by a few models. The circular patch has a radius R=14 mm as shown in Figure 1. The degree of the 50-Ω coordinating matching line has the range of L_f =2.1 cm and W_f =0.3 cm. The analytical operating frequency for a circular patch component is examined [16] with resultant equation and analogous to 5.2 GHz which is applicable for wireless LAN applications.

$$a = \frac{F}{\left\{1+\frac{2h}{\pi F \varepsilon_r}\left[ln\left(\frac{\pi F}{2h}\right)+1.7726\right]\right\}^{1/2}} \quad (1)$$

Here,

$$F = \frac{8.791 \times 10^9}{f_r\sqrt{\varepsilon_r}} \quad (2)$$

a = circular microstrip patch radius
h = substrate height
ε_r = dielectric constant of substrate
f_r = resonant frequency

Despite that, another approach is being an opening space set in the ground plane is intended to acquire essential recurrence (ISM) range. An arrangement of opening space model is as illustrated in Figure 1 and it comprises various rectangular spaces of dimensions L_1, L_2, L_3 and W_s=0.05 cm, an outline of space opening in the ground plane with counterbalance separations S_2 and S_3. The lower range is accomplished by embracing an opening space. Likewise, the opening space estimation was seen to be effective in controlling the resounding recurrence of the opening space mode. In order to diminish trial cut-and-Endeavour setup cycles, a re-authorization programming HFSS is used for oversee manufacture.

The model for the lower empower opening space consolidates the three space openings incorporates different expansiveness and equivalent measurement W_S=0.05 cm in the purpose of Figure 1, an opening space on the ground plane design consideration is S_2 = 26 mm, S_3=11 mm, different rectangular slot lengths are L_1=1.8 cm, L_2=L_3=5 mm as exhibited in Figure 1. By calibrating the alignment specifications, a compact patch module and opening space elements are utilized at the essential range (5.21 GHz) and the secondary range (2.45 GHz) eventually.

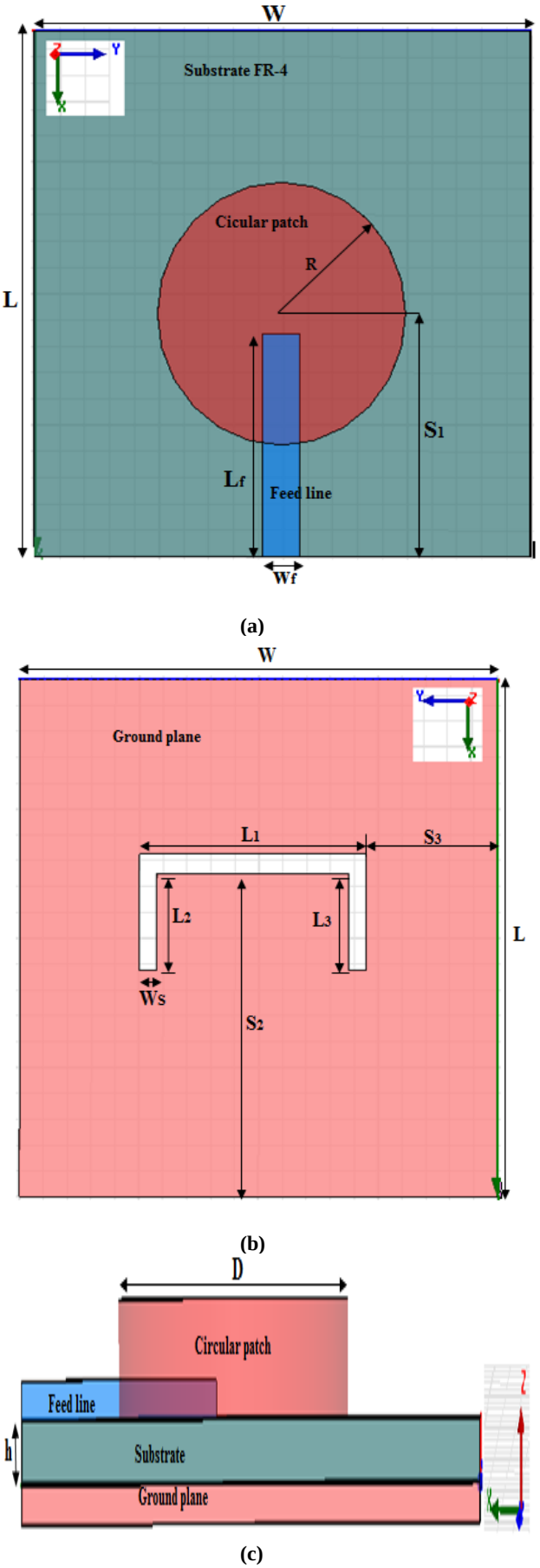


Fig. 1: Designed MPA with opening space element

3. Simulated results and discussions

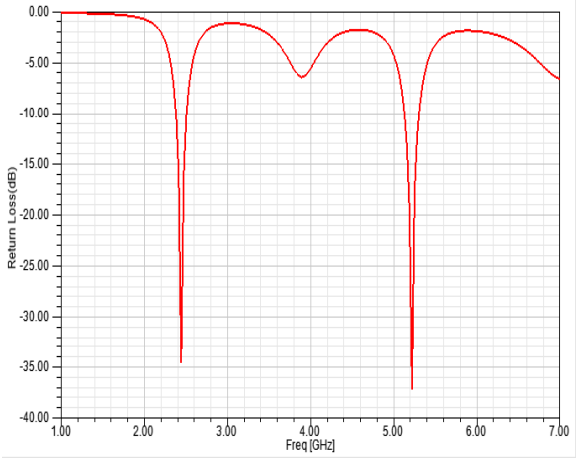
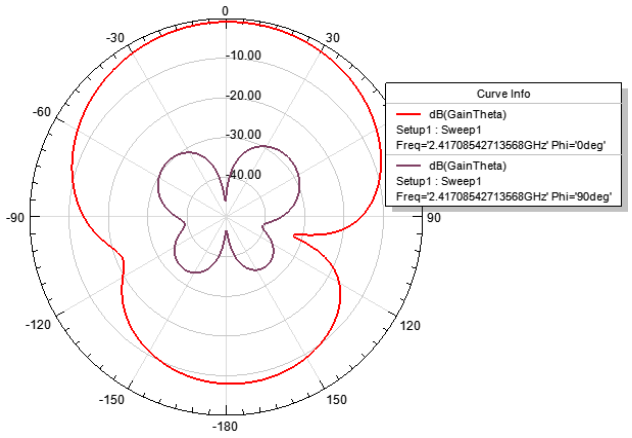
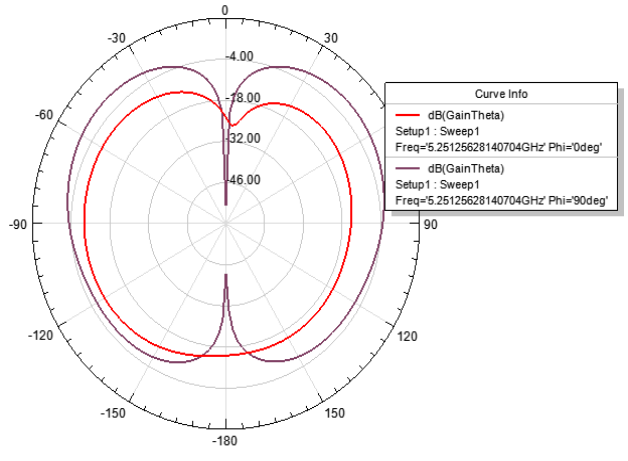


Fig. 2: Simulated return loss characteristics at ISM and UNII bands

Figure 2 demonstrates the return loss characteristics of the intended circular patch resonator. The roundabout resonator and an opening space component reverberate with discretionary and essential band subsequently. It is represented -37 dB and -34 return misfortunes at 5.21 GHz and 2.45 GHz consequently. The opening space oscillates as a result of a round resonator and there are no oscillations without patch arrangement.



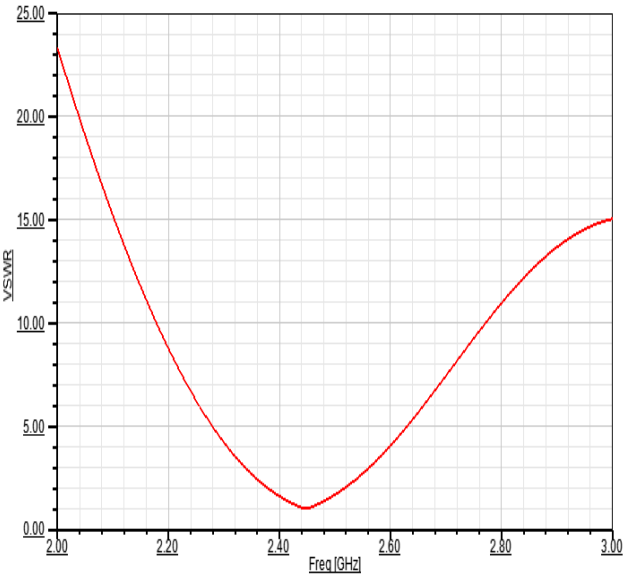
(a)



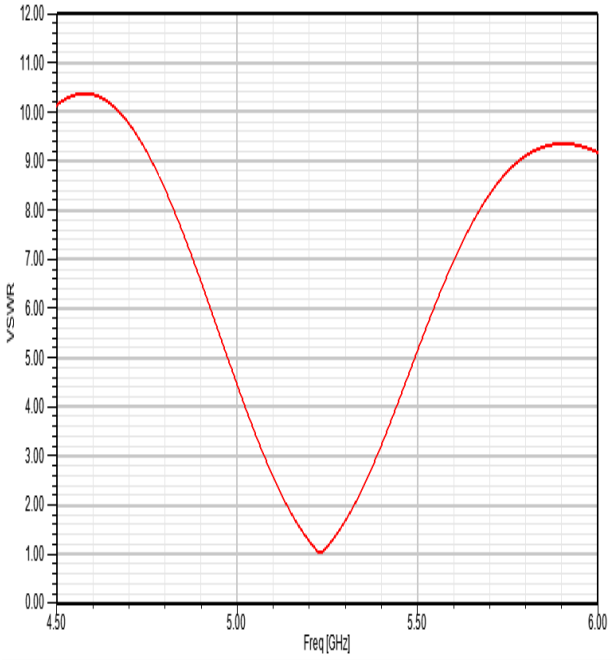
(b)

Fig. 3: Simulated radiation characteristics: (a) ISM; (b) UNII

The intended configuration radiation characteristics are exhibited in figure 3. The prescribed design emanates the most outrageous towards the greatest bearing at 5.21 GHz and space resonator is transmitting the patterns in bidirectional at 2.45 GHz. The radiation examples of a radio wire give the data that depicts how the reception apparatus coordinates the vitality it transmits. HYPERLAN and ISM recurrences are reasonable for wireless communications. All reception apparatuses, if 100% proficient emanate similar energy vitality for balanced proposal power little respect to design shape.
The designed model SWR is exhibited in Figure 4. It is depicted as the examination of the offence between the load and maintain line. For culminate case estimation of SWR is 1 and for good impedance coordinating. The VSWR of an investigated antenna is 1.1 at 2.4 GHz and 1.05 at 5.2 GHz. The VSWR demonstrate that how intently or productively a radio wire's terminal info impedance is coordinated to the trademark impedance of the feed line.



(a)



(b)

Fig. 5: Simulated VSWR characteristics at ISM and UNII

4. Conclusion

A compact double-band circular microstrip patch resonator with an etched space sustained by a microstrip line is described to realize dual recurrence service. The recommended circular patch model with opening space arrangement is realized to retrieve the elementary (5.21 GHz) and secondary (2.45 GHz) bands. The intended structure attainable and architecture parameters are realized by using characteristic analogy. An antenna contour has been a reproduced and it is watched that transmission capacity and return loss of 5.15%, 4.25% and -37 dB, -34 dB at the resonant recurrences of 5.21 GHz and 2.45 GHz correspondingly. The illustrated model takes a less volume, smaller size, basic shape and satisfactory operational data transfer capacity, with the end goal that it is appropriate for remote neighborhood applications.

References

[1] Sekhar M, S. N. Bhavanam, Dr. P. Siddaiah, "Triple Frequency Circular Patch Antenna",IEEE International Conference on Intelligence and computing Research, pp. 1-3, December 2014

[2] R. Srivastava, S. Ayub, V. K. Singh, J. P. Saini, "Dual Band Rectangular and Circular Slot Loaded Microstrip Antenna for WLAN/GPS/WiMax Applications",Fourth International Conference on Communication Systems and Network Technologies,pp. 45-48, April 2014

[3] S. I. Hussain Shah, S. Bashir, S. D. Hussain Shah, "Compact Multiband microstrip patch antenna using Defected Ground structure (DGS)",The 8th European Conference on Antennas and Propagation (EuCAP), pp. 2367-2370, April 2014

[4] M. I. Sabran, S. K. A. Rahim, M. F. M. Yusof, A. A. Eteng1, M. Z. M. Nor, I. M. Ibrahim ,"Miniaturized Proximity Coupled Antenna with Slot Ring as Defected Ground Structure", IEEE Symposium on Wireless Technology and Applications (ISWTA), pp.81-85, Sept-oct 2014

[5] Lakshmikanth, P., Takeshore, K., & Madhav, B. T. P. (2015). Printed log-periodic dipole antenna with notched filter at 2.45 GHz frequency for wireless communication applications. Journal of Engineering and Applied Sciences, 10(3), 40-44. doi:10.3923/jeasci.2015.40.44

[6] M. H. Tariq, S. Rashid, F. A. Bhatti,"Dual Band Microstrip PatchAntenna for WiMAX and WLAN Applications", International journal of Multidisciplinary and Currentresearch, vol.2,pp. 104-108, Jan/Feb 2014

[7] S. C. Gao, L. W. Li, T. S. Yeo, M. S. Leong,"Small Dual-Frequency Microstrip Antennas", IEEE Transactions on VehicularTechnology,vol.51,No.1,pp. 1916-1917, January 2002.

[8] H. A. Atallah, A. B. Abdel-Rahman, K.Yoshitomi, R. K.Pokharel,"Design of Dual Band-Notched CPW-Fed UWB Planar Monopole Antenna Using Microstrip Resonators", Progress In Electromagnetics Research Letters, vol. 59, pp.51–56, 2016

[9] M. Venkata Narayana, Govardhani.Immadi, Dr.Habibulla Khan, Y. Suraj, B. Hema Brahmani, P.S.V.S. Naveen Chowdary, M. Emmanuel Raju, "Enhancement Of Bandwidth Of Electrically SmallAntenna Using Spiral Resonator And Loop Feed", International Journal of Pure and Applied Mathematics, Volume 115 No. 7 2017, 471-476, ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version).

[10] Garima,D.Bhatangar,J.S.Saini,V.K.Saxena,L.M.Joshi, "Design of Broadband Circular Microstrip Patch Antenna With Diamond Shaped Slot",Indian Journal of Space And Physics,vol.40,pp.275-278,October 2011

[11] J. A. Ansari, A. Mishra, N. P. Yadav,P. Singh , "Dualband Slot Loaded Circular Disk Patch Antenna for WLAN Application", International Journal Of Microwave And Optical Technology, vol.5, No.3, pp. 124-129, May 2010

[12] G.P.Gao,M.Li,S.F.Niu,X.J.Li,B.N.Li,J.S.Zang, "Study Of Novel Wideband Circular Slot Antenna Having Frequency Band Notched Function",Progress In Electromagnetic Research(PIER)96, pp.141- 154,2009

[13] Kishan Kumar K., Prasanth, Edward Stephen, A novel design approach and simulation of frequency reconfigurable microstrip patch antenna for Wi-Fi, WLAN and GPS applications, IEEE, International Conference on Robotics, Automation, Control and Embedded Systems, India, pp. 1-4, Feb. 2015

[14] Xinghui Zhang, Dongya Shen, Lan Li, and Huiyun Liu., A Compact frequency reconfigurable antenna applied to WLAN/WiMAX, Shanghai, China , , pp. 1-7, Oct. 2011.

[15] Q. Zhong, Y. Li, H. Jiang, Y. Long,"Design of a Novel Dual-frequency Microstrip Patch Antenna for WLAN Applications",Antennas And Propogation Society International Symposium,vol.1, pp. 277-280,June 2004

[16] C. A. Balanis,"Antenna Theory, Analysis and Design", Second edition, John Wiley andSons, NewYork, 1997

[17] R. A. Kranenburg and S. A. Long, , "Microstrip Transmission Line Excitation of Dielectric Resonator Antennas," Electron. Lett. vol. 24, pp.1156-1157, 1988.

[18] Madhav, B. T. P., Kaza, H., Kartheek, T., Kaza, V. L., Prasanth, S., Chandra Sikakollu, K. S. S., .. Bhavani, K. V. L. (2015). Novel printed monopole trapezoidal notch antenna with S-band rejection. Journal of Theoretical and Applied Information Technology, 76(1), 42-49. Retrieved from www.scopus.com

[19] Madhav, B.T.P., Chhatkuli, S., Manikantaprasanth, A., Bhargav, Y., Dinesh Naga Venkata Sai, U. And Feeraz, S., 2014. Measurement Of Dimensional Characteristics Of Microstrip Antenna Based On Mathematical Formulation. International Journal Of Applied Engineering Research, 9(9), Pp. 1063-1074.

[20] Srinivas, M.S.S.S., Ramakrishna, T.V., Madhav, B.T.P., Bhagyalakshmi, N., Madhavi, S. And Venkateswarulu, K., 2015. A Novel Compact Cpw Fed Slot Antenna With Ebg Structure. Arpn Journal Of Engineering And Applied Sciences, 10(2), Pp. 835-841.

[21] Madhav, B.T.P., Pisipati, V.G.K.M., Madhavi Latha, D. And Dattaprasad, P.V., 2012. Planar Dipole Antenna On Liquid Crystal Polymer Substrate At 2.4 Ghz.

[22] Ramkiran, D.S., Madhav, B.T.P., Prasanth, A.M., Harsha, N.S., Vardhan, V., Avinash, K., Chaitanya, M.N. And Nagasai, U.S., 2015. Novel Compact Asymmetrical Fractal Aperture Notch Band Antenna. Leonardo Electronic Journal Of Practices And Technologies, 14(27), Pp. 1-12.

[23] Madhav, B.T.P., Khan, H., Ujwala, D., Bhavani Sankar, Y., Kandepi, M., Nagendra Reddy, A.S. And Nagajyothi, D., 2013. Cpw Fed Serrated Antenna Performance Based On Substrate Permittivity. International Journal Of Applied Engineering Research, 8(12), Pp. 1349-1354.

[24] Madhav, B.T.P., Ujwala, D., Khan, H., Tejaswani, A.L., Guntupalli, S. And Bala, A., 2013. Substrate Permittivity Effects On The Performance Of Slotted Aperture Stacked Patch Antenna. International Journal Of Applied Engineering Research, 8(8), Pp. 909-916.

[25] Sadasivarao, B. And Madhav, B.T.P., 2014. Analysis Of Hybrid Slot Antenna Based On Substrate Permittivity. Arpn Journal Of Engineering And Applied Sciences, 9(6), Pp. 885-890.

[26] Madhav, B.T.P., Kumar, K.V.V. And Manjusha, A.V., 2014. Analysis of CPW fed step serrated ultra wide band antenna on Rogers RT/duroid substrates. International Journal of Applied Engineering Research, 9(1), pp. 53-58.