PERFORMANCE ANALYSIS OF L SHAPED STRUCTURE FOR WIRELESS COMMUNICATION

A. Jemshia Miriam[1], P Kishor Kumar[2], B. Ramesh[3], M. P. Chitra[4], K. Praveena[5], R.Sathya Bama Krishna[6], R. Azhagumurugan[7]*

[Q1]Department of Computer Science and Engineering, Sathyabama Institute Of Science And Technology, Chennai, Tamil Nadu 600119, India. **jemshiamiriam@gmail.com**

[2]Department of Electronics and Communication Engineering, Ravindra College of Engineering for Women, Kurnool, Andhra Pradesh 518452, India. **kishor1661@gmail.com**

[3]Department of Electronics and Communication Engineering, Annapoorana Engineering College, Salem, Tamil Nadu 636308, India. **mailrameshece@gmail.com**

[4]Department of Electronics and Communication, Panimalar Engineering College, Chennai, Tamil Nadu 600123, India. **chi_mp2003@yahoo.co.in**

[5]Department of Electronics and Communication Engineering, Sree Vidyanikethan Engineering College, Mohan Babu University, Tirupati, Andhra Pradesh 517102, India. **praveena.k@vidyanikethan.edu**

[6]Department of Computer Science and Engineering, Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu 600119, India. **sathyabamar.cse@sathyabama.ac.in**

[7]Department of Electrical and Electronics Engineering, Sri Sai Ram Engineering College, Chennai - 600044, Tamil Nadu, India. **azhagumurugan.eee@sairam.edu.in**

Corresponding author: **azhagumurugan.eee@sairam.edu.in**

Abstract:- In this paper, the performance of an L-shaped microstrip patch antenna for WLAN applications is presented. An L-shaped structure has been etched onto a rectangular patch to create the proposed antenna. The suggested antenna is made using thick substrate FR4 and is intended to attain the specified bandwidth. The suggested design has a return loss of -28439dB, VSWR of 2, and a gain of 4.75dB at 5.16 GHz, according to CST simulation. The observed characteristics imply that the proposed antenna can be used in a contemporary communication system with size and weight restrictions.

Keywords:- L Shaped, VSWR, Gain and Radiation Pattern

1. INTRODUCTION

Microstrip patch antennas have more benefits and better prospects than conventional antennas. A probe-fed antenna with a microstrip patch design is presented for simultaneous Wireless Local Area Network use (WLAN). It is crucial to build broadband and high gain antennas to span a wide frequency range due to the development of wireless systems and the surge in demand for new wireless applications like WLAN (Wireless Local Area Network). For modern wireless applications, designing an effective broad band compact size antenna is a significant issue. The key limitations are compact size, low cost manufacturing, low profile, conformability, simplicity of installation, and integration with feed networks in applications including high performance aircraft, satellite, missile, mobile radio, and wireless communications. Additionally, as technology advances, multi-banding, or the ability of an antenna to resonate at several frequencies, is becoming more and more important. In this case, a microstrip patch antenna is the best option to meet all the criteria listed above. Additionally, a microstrip patch antenna has many benefits over other conventional antennas, including low fabrication costs and the ability to support both circular and linear polarisation. Additionally, there are some drawbacks to microstrip patch antennas, such as surface wave excitation and limited bandwidth [1]-[5].

However, there are several ways to increase the bandwidth of a microstrip patch antenna, including cutting the U-slot, raising the height of the substrate, lowering the substrate's refractive index, etc. The bandwidth can also be increased by using an antenna array. Here, a straightforward microstrip patch antenna with coaxial feed is designed as a starting point. In this feeding method, the coaxial connector's inner conductor extends from ground up to the substrate and is soldered to the radiating patch, while the outer conductor extends from substrate to ground so that the patch's input impedance can be properly matched. This feed method has little spurious radiation and is simple to manufacture. Its main disadvantage, however, is that it has a limited bandwidth and is challenging to model because a hole must be drilled in the substrate and the connector sticks out beyond the ground plane, preventing it from being perfectly planar for thick substrates. However, the bandwidth can be increased using the various strategies listed above. Numerous coaxial-feed microstrip patch antennas have recently been introduced for a variety of applications [6]-[10].

Microstrip antennas are adaptable to planar and non-planar surfaces and have a wide range of bandwidth, polarisation, and radiation patterns. It can be created for a variety of uses, including handheld mobile devices, satellites, aircraft, etc. Government and commercial applications use them today. A new technology, like WLAN & system in contemporary technology, has been implemented to facilitate human interaction. Many researchers attempt to reduce patch sizes using various techniques, such as adding multiple slots to the patch, meandering the patch, and shorting the pin between the ground plane and patch, in order to achieve compactness in the antenna. A small dual-band microstrip slot antenna with a pair of mirror-image L-shaped slots and slits etched on the patch resonator is proposed. A brand-new dual band CP slot antenna with a metallic strip was unveiled. An asymmetrical slot and two separate truncated corners are used to propose a dual band CP slot antenna.

The use of single layer coax fed U-slot patches, a compact H-shaped slot antenna, a hexagonal slot antenna with multiple L-slits, and two angular slots fed by an inverted h-shaped microstrip line have all been used to show triple band antennas. For triple band operation, a number of multilayered stacked patch antennas are suggested. Since CP antennas have numerous benefits over linear polarisation, including great penetration and the capacity to provide a trustworthy signal connection regardless of antenna orientation. As a result, CP provides greater connection for both stationary and mobile devices. A single layer triple band antenna with two linear polarisations (LP) and one circular polarisation (CP) has recently been developed. Its total dimensions are 60x60x1.5 mm3. In other instances, a triple band multi polarised planar antenna with two LP and one CP with an overall size of 55x55x3.175 mm3 has been used for WLAN/WiMAX applications [11]-[15].

2. PROPOSED ANTENNA

A multi-polarized triple band patch antenna for WLAN/WiMAX application is suggested in this research work. On the patch, there are four asymmetrical L-shaped slot etchings. The placement, the distance between the slots, the size of the arms of the slot, and three different operating frequencies may all be tuned separately. The suggested antenna's overall dimensions are 34x31x1.59 mm^3. According to the results of simulations, the proposed antenna can efficiently cover three separate S11bandwidths of 52 MHz (2.995-2.946 GHz), 62 MHz (4.8872-4.8251 GHz), and 86 MHz (5.2760-5.1906 GHz) with one LP & two CP bandwidths of 48 MHz (4.8699-4.8219 GHz) & 36 MHz (5.2013-5.2373 GHz), which satisfy the requirements of WLAN, Wi-Fi. The suggested receiving telegram is set to be constructed on a Fr-quaternary substrate with component dimensions of 30 by 27 mm^2 and substrate dimensions of 34 by 31 mm^2. Francium -4, a fibreglass material with an epoxy sap fastener and a dielectric constant of 4.4, offers low effort but high misfortune, so it is used less frequently for return over a few Gigacycles. The wireless wire was constructed using the Ansoft HFSS v-15.0 3D-Electromagnetic Test System.

The radio wire is stacked with exceptional blends of various L-SHAPE first steps. The reception apparatus's structure, as shown in Fig. 1, ranges from a single L-shaped opening to four L-shaped distances. One L-shaped opening does not produce any echo repeating, but the amount of working striation increases when more space is added. When two L-shaped scuttle are added, one reverberation recurrence occurs at 5.16 gigacycles, and when three base hits are added, two isthmus-like reverberation recurrences occur at 3.00 GHz and 5.05 GHz. The four L-material body distances at 2.95 GHz, 4.85 GHz, and 5.23 GHz are used to achieve the triple band of reverberation frequencies. The nature of all L-shaped spaces is topsy-turvy. Due to the excitation of two symmetrical ways with equal in adequacy by means of these unbalanced outer space brands, circular polarisation is produced.. The length and width of the L-material body opening have been improved over the long history of round polarisation radioactivity design, along with streamlining its placement of the spaces along the x and y-pivot. On the highest point of the fix, well-ordered L-shape spaces were carved in order to accommodate the proposed radio wire.

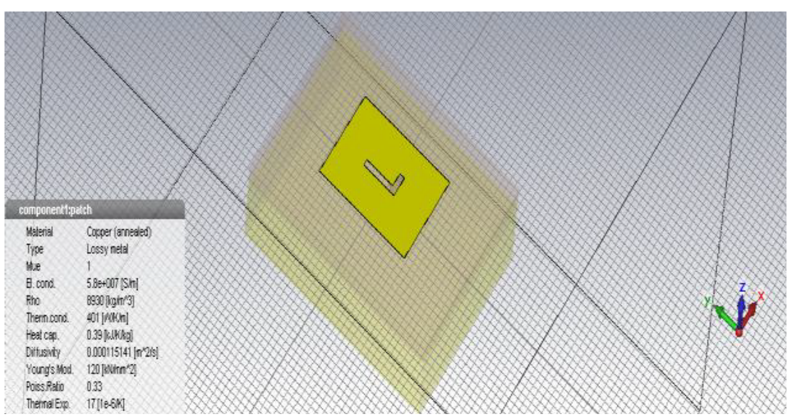

Figure.1. L Shaped Antenna

3. RESULTS AND DISCUSSION

Due to the coupling of the electric field & increase in the electric length of the bandage, the atomic number 7 quint onance oftenness is shifted towards the lower side when the issue of slot s increases from one to many. the four L-shaped slot proposed antenna's simulated restoration and public presentation. The critical intent parameters depend on the arm's length, width, interruption between consecutive L-shaped slots, and temporary hookup size of it, which all affect the antenna's characteristics. This figure illustrates how the patch radiator's current flows anticlockwise, which results in the excitation of right-handed circular polarisation (RHCP) radiation. The surface current distribution at 5.21 GHz. The mutant of S11 with oftenness for a variety of half a dozen senses of the length of the donkeywork aerowoodworking plane has been optimised from 29 mm to 35 mm to achieve the best result at 31 mm, As a result, the ground plane size of 31 mm is chosen as the ideal size for better multiband operation results. the variation in return going with frequency for various patch size values. The ringing frequency has been observed to shift toward a lower frequency as patch size increases, but we achieved the best results with a 27 mm patch size. The patch size has been optimised between 26 and 29 mm. the return loss variation with frequency for various values of crack between subsequent vertical weapons. The antenna's resonance frequency declines as the vertical arm gap widens.

However, compared to the space typically provided in a mobile wireless device, these antennas are large. In order to make an antenna smaller, scientists have been experimenting with slot structures. In [6], the author describes how to implement dual and multiband operations using U-slots and an L-probe feed. This study makes a proposal for an antenna that can only work in one frequency band. To accomplish singleband functioning in the suggested design, an L-shape is etched onto a rectangular patch. Additionally, it offers a more compact dimension and a simpler construction for mobile devices. By modelling the antenna's response in the CST Microwave studio programme, the performance of the antenna is evaluated. Depending on the application area under consideration, modern antenna technology enables the employment of many antenna kinds and models. It is desirable to construct compact, low-profile, wideband multifrequency planar antennas given the increasing expansion of wireless communications. Due to its compactness, inexpensive effectiveness, light weight, low profile, and conformability to any structure, microstrip antennas are currently widely utilised in a variety of communication systems. Their limited bandwidth is the fundamental disadvantage of using these antennas in several applications. However, increasing the bandwidth and gain is the most significant difficulty in microstrip antenna design. Recently , a number of methods that may be employed to create multi-band performances have been presented, including multilayer stacked patches, multiple resonators, and the insertion of slots and slits of different shapes and sizes in patch antennas. A microstrip patch antenna may exhibit tunable or dual frequency antenna properties when it is loaded with reactive components like slots, stubs, or shorting pins. The slots are introduced on a single patch, which is the most common method for producing dual-frequency behaviour. Since the slots are strategically positioned within the patch, they don't significantly alter the patch's radiation pattern or cause it to become larger. These slots come in a variety of configurations, including rectangular or square slots, step slots, toothbrush-shaped slots, V-slots, and Uslots, among others. The slot achieves dual frequency responsiveness and adds a second resonant mode close to the patch's fundamental mode. The return loss is shown in figure 2

A transducer known as an antenna converts electrical power into electromagnetic waves and the other way around. Georges Deschamps originally put up the concept of a Microstrip receiving equipment in the United States in 1953. An aircraft of a certain level that may be used in France's UHF region was authorised by Gutton and Baissinot in 1955. Beginning in the late 1970s, microstrip radio wire invention advanced quickly. By the middle of the 1980s, the fundamental microstrip radio wire had become ingrained in terms of demonstrating strategy, and experts were turning their attention to enhancing receiving wire execution features, such as data transfer capacity, and to upgrading applications in various fields by cutting one or more spaces. Microstrip Antenna features include minimal profile, light weight, and affordable assembly. Thus, where size, weight, and cost are constraints, the microstrip fix receiving wire can be used in radars, rockets, shuttles, robots, and mobiles. The leading patch of conventional microstrip fix radio wires is imprinted on the substrate. The reception apparatus's state of fix may be square, rectangular, oblong, triangular, curved, or of another explicit design. The VSWR is shown in figure 3.

This paper uses the coaxial bolstering method to design an L-shaped structure. An L-shaped base shape is then created, after which an initial rectangular shape fix is recreated and a return misfortune bend is followed. Finally, a surrendered ground structure is made after a rectangular state of a specific measurement is expelled from the base shape in this manner. The plan is carried out under recreation to achieve the desired result. After using, we further improved the arrival misfortune. At that point, parametric analysis of various radio wire parameters was also demonstrated. Here, we show signs of improved return misfortune compared to base shape. As can be seen, the final step has increased the bandwidth percentage from the base shape's 3.89 to 4.37%, which covers the frequency range of 5.705GHz to 5.960GHz with a return loss of -51.731dB. As the base shape is changed to an L-shaped patch antenna, the resonating frequency and return loss are also increased. The radiation pattern is shown in Figure 4. This makes it possible to use the suggested receiving device for simple radio and satellite communications. In the specified frequency range, the suggested antenna exhibits a good gain. With this design, we increased BW% from 4.48% to 6.68%. i.e. (4.48% BW was at base form antenna and climbs to 6.68% after optimization).

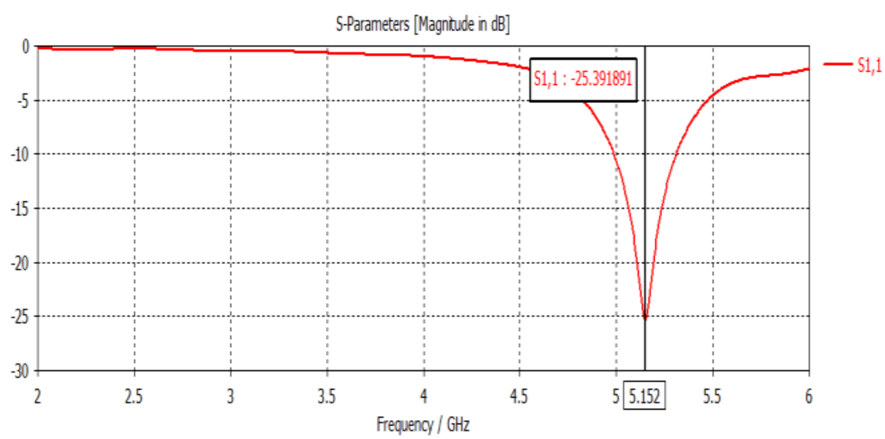

Figure.2. Return Loss of the Antenna

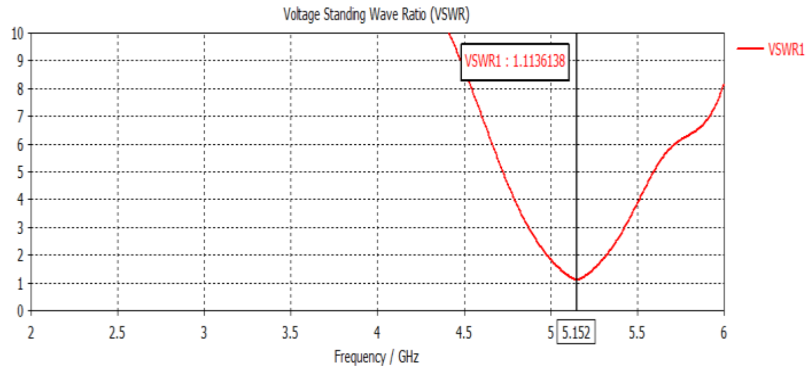

Figure.3. VSWR of the Antenna

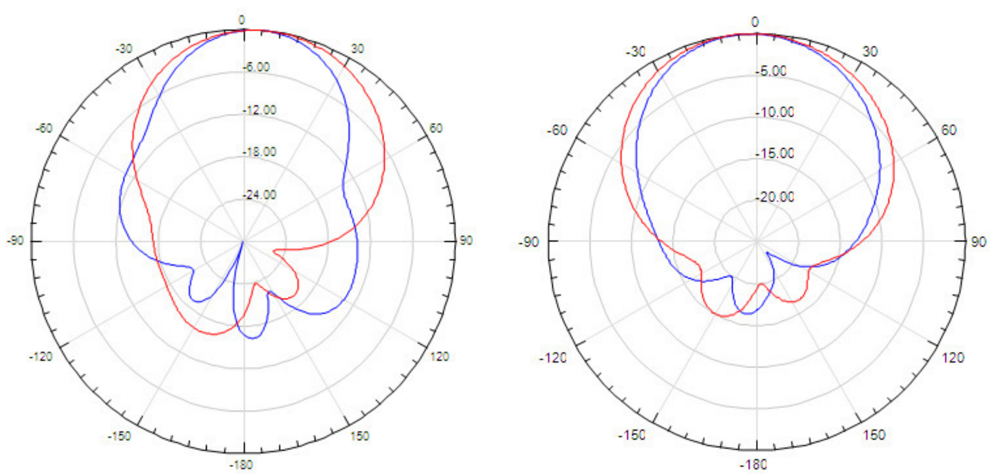

Figure.4. Radiation Pattern of the Antenna

By directing radio waves from one station to another, antennas allow wireless communication between two or more stations. A microstrip patch antenna (MPA) is made up of a metallic patch radiator on a dielectric substrate with a thin electrical layer and a ground made of a metal like copper or gold. The need for wireless communication has increased in recent years. Due to their nature as transportable systems, wireless systems must be discrete and compact. The main draw for researchers compared to earlier studies has been the microstrip patch antenna. The fabrication of the microstrip patch structures is presumably simple. In the twenty-first century, research on microstrip antennas focused on their tiny size, higher gain, wider bandwidth, and numerous functionality. The need for small, low-profile, and broadband antennas has grown dramatically in recent years as wireless communication technology has been more widely used. Because of its low profile, cheap cost, and compact size, the microstrip patch antenna has been suggested to suit such characteristics and needs. The components of a microstrip patch antenna are a rectangular patch that is a conductor by nature and has dimensions of L and W on one side of a dielectric substrate with dimensions of h and r and a base known as ground. Common microstrip antenna forms are square, rectangle, circle, and ellipse, however as shown in this study, any design is achievable utilising regular shapes. This study calculates variables such return losses, gain, and VSWR. When a device is inserted into a transmission line or optical fibre, return loss or reflection loss reflects the signal power. The greatest radiation intensity at the main beam's peak is compared to the maximum radiation intensity in the same direction generated by an isotropic radiator antenna using the same input power to determine antenna gain. The gain of an isotropic antenna is specified to be one. G,= p(,)Wt4 can be used to describe the gain function. Microstrip patch antennas are fed using a number of different feeding techniques. These approaches fall under the categories of contacting and non-contacting procedures. Microstrip line feeding and co-axial plane feeding are two common contacting techniques. Conversely, non-contacting methods include proximity linked feeding and aperture coupled feed.

4. CONCLUSION

The proposed L-shaped slot loaded semicircular patch structure is discovered to be operable at two resonance frequencies, allowing this proposed antenna to be used for dual band operation. Additionally, the effects of various physical parameters on the characteristics of this structure are investigated. In addition, the effect of the substrate on the band width and the return loss with lower and upper resonant frequencies is given. The proposed structure can be scaled to a variety of sizes. By carefully selecting the position of the feed point and the slots, two bands may be created and regulated. Numerical findings show that both the upper and lower resonant frequencies and the band widths rely on the size of the slot dimensions. The higher resonant frequencies and band widths, however, are significantly reliant on the notch dimensions, whilst the lower resonant frequencies and band widths are highly dependent on the slot dimensions as well as feed locations. Additionally, the suggested antennas' radiation patterns for their higher and lower resonant frequencies are shown in the main planes E and H. In this study, we examined a WLAN application-specific Micro Strip Patch Antenna with an L-shaped etched structure.

REFERENCES

[1] H.D. Chen, J.S. Chen and Y.T. Cheng" Modified inverted-L monopole antenna for 2.4/5GHz dual-band operations" Electronics Letters, Vol. 39, No. 22, October 2003.

[2] Z.H. Li, T.M. Xiang, SONG S. Xian" Study On Dual-Frequency Planar Monopole Antennas" IEEE International Symposium on Microwave, Antenna, Propagation and EMC Technologies for Wireless Communications Proceedings,2005

[3] G.H. Kim and T.Y. Yun "Compact UWB Monopole Antenna With an Inverted-L-Shaped Coupled Strip" IEEE Antennas And Wireless Propagation Letters, Vol.12 ,2013.

[4] N. Chang and J.H. Jiang" Meandered T-Shaped Monopole Antenna" IEEE Transactions On Antennas And Propagation, Vol. 57, No. 12, December 2009.

[5] S.B. Chen, Y.C. Jiao, W. Wang, and F.S. Zhang" Modified T-Shaped Planar Monopole Antennas for Multiband Operation" IEEE Transactions On Microwave Theory And Techniques, Vol. 54, No. 8, August 2006.

[6] V.vaid and S.Agarwal, "Bandwidth optimization using fractal geometry on rectangular microstrip patch antenna with DGS for wireless applications," International conference on medical Imaging, M-health and Emerging Communication Systems (MedCom), pp.162-167,2014.

[7] F.Daneshmandian, P.Dekhoda, and A.Tavakoli, "A miniaturization circularly polarized microstrip antenna for GPS applications," IEEE 22nd Iranian Conference on Electrical Engineering (ICEE), pp.1653-1656,2014

[8] K. V. Kumar, V. I. Nair, and V. Asokan, "Design of a microstrip fractal patch antenna for UWB applications," IEEE 2nd International Conference on Innovation in Information Embedded and Communication Systems (ICIIECS), 2015.

[9] M. M. M. Ali, A. M. Azmy and O. M. Haraz, "Design and implementation of reconfigurable quad-band microstrip antenna for MIMO wireless communication applications," IEEE 31st National Radio Science Conference (NRSC), pp. 27-34, 2014.

[10] VD.Raj, A.M.Prasad, M.Satyanarayana, and G.M.V. Prasad, "Implementation of printed microstrip Apollonian gasket fractal antenna for multiband wireless applications," IEEE, International Conference on SPACES, pp.200-204,2015.

[11] Manpreet Kaur and Er. Amandeep Singh, "Design of Fractal Antenna for RFID Applications" SSRG International Journal of Electronics and Communication Engineering 1.7 (2014): 13-18

[12] Mingqiang Bai; Jun Xing; Zhigang Wang; Bo Yan, "Design of an H-shape cross slotted aperture-coupled microstrip patch antenna", *IEEE Int. Workshop Electromagnetics Applications Student Innovation (iWEM)*, pp. 1 – 3, 2012.

[13] W. Afzal, U. Rafique, M. M. Ahmed, M. A. Khan, F. A. Mughal, " tri-band H-shaped microstrip patch antenna for DCS and WLAN applications," *19th Int. Conf. Microwave Radar and Wireless Communications (MIKON)*, Vol. 1 , pp 256 – 258, 2012.

[14] J. Anguera, L. Boada, C. Puente, C. Borja, J. Soler,"Stacked H shaped microstrip patch antenna," *IEEE Trans. Antennas Propagation*, Vol. 52 , Issue 4, pp 983 - 99, 2004.

[15] C. L. Mak, K. M. Luk, K. F. Lee, Y. L. Chow,"Experimental study of a microstrip patch antenna with an L-shaped probe" *IEEE Trans. Antennas Propagation*,Vol. 48, Issue 5, pp. 777 – 783, 2000.

[16] Tingqiang Wu, Hua Su, Liyun Gan, Huizhu Chen, Jingyao Huang, Huaiwu Zhang,"A Compact and Broadband Microstrip Stacked PatchAntenna With Circular Polarization for 2.45-GHz Mobile RFID Reader*", IEEE Lett. Antennas and Wireless Propagation*, Vol 12, pp 623 - 626,2013.

[17] I. J.Bahal, and P. Bhartia, *Microstrip Antennas*, Boston, MA, Artech House, 1985.

[18] V. K. Pandey, and B. R. Vishvakarma, "Theoretical analysis of linear array antenna of stacked patches," *Indian J Radio & space phys*, Vol. 3, pp.125-127, 2005.