MULTIBAND CIRCULAR PATCH ANTENNA FOR MOBILE HANDSET

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Abstract **:** Circular shaped microstrip patch antenna is investigated for multiband operation. To design an antenna, low cost FR-4 substrate is used and has good performance in terms of gain and efficiency. The frequency range of given antenna is from 2.4GHz up to 5.6GHz. The radiation pattern is nearly omnidirectional in both the planes .The given frequency range is good for WI-max, WLAN, bluetooth. It has high gain, high efficiency radiation beams at both the side of substrate.The aim to design this antenna is to achieve multiband applications which are required in today's scenario. The proposed antenna has the great potential for multiband mobile communication applications. The antenna is low cost, less weight and low profile with radiation efficiency more than 80%. This antenna satisfies all the performance parameters.

Keywords **- Multiband, Microstrip, Circular.**

I. INTRODUCTION

Modern mobile handsets are often required to operate at multiple frequency bands to meet the application for various communication need. The requirements for the mobile stations to be compact and light weight are also demanded. Due to emerging trends in mobile communication, novel antenna designs are needed. Various techniques have been used in the design to meet multiband requirement. It has been seen that a loop antenna can be difficult for achieving multiband operations in the mobile phone. Designing broadband antenna for different wireless standards is a difficult task and to cover large frequency range multiband antennas are preferred. A microstrip antenna consists of aa dielectric substrate which has metallic pattern of a and ground plane. Microstrip antennas have several advantages which are light weight, low cost, thin profile, conformal to a shaped surface so it can be used in several applications. As in aircraft, satellite and wireless communication, one of the most serious problems of microstrip antenna is its narrow bandwidth. Many techniques have been used to increase the bandwidth of microstrip antenna. The history of wireless communication systems and the mobile phone has come from the use of codeless phones to the latest mobile phones such as iPhone, Samsung Galaxy, etc. With the development of electronic technology, the antenna size began to reduce. Reducing antenna size has led to decrease in gain and bandwidth. The connectivity in mobile phone is sensitivity of its antenna. There are a number of methods to increase the bandwidth of antennas, including increase of the substrate thickness, the use of a low dielectric substrate, and the use of multiple resonators. Due to this, the interest in multiband antenna is increasing, specifically to reduce the number of antenna embedded in combining multiple application on a single antenna.

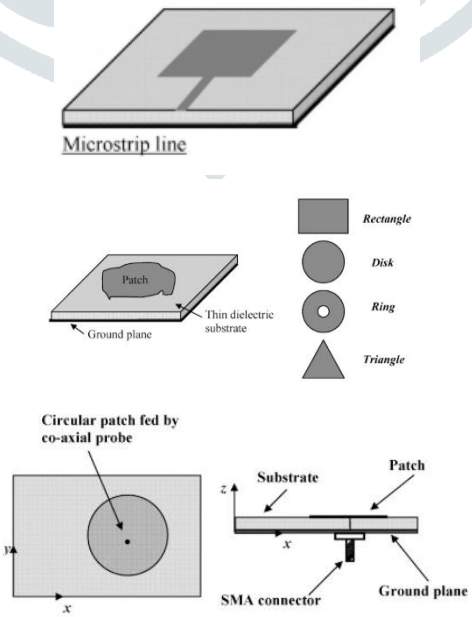

Fig.1. Different shapes of patch and it's feed point

The potential applications related to these antenna are limitless, because of their light weight, compact size, and easy to manufacture. Here Circular microstrip patch is designed for multiband applications. The proposed Circular microstrip antenna is nothing but a patch in which two slots are created to give the shape like ring. As per need for designing antenna , the dielectric, patch and ground plane materials should be used. The shape of the microstrip antenna can be any of rectangle, square, triangle etc. and the output parameters of the antenna is directly affected. Four components are needed to fabricate this microstrip patch antenna and they are Circular shaped microstrip patch, ground plate, feed line and dielectric substrate.

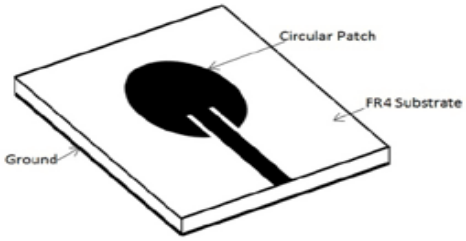

Fig.2. Basic Structure of Circular Shaped Patch Antenna.

II. PROPOSED TECHNOLOGY

An antenna converts radio frequency fields into alternating current or it converts alternating current into radio frequency fields. There are both antennas, transmission antenna for sending radio transmissions and receiving antennas for receiving radio transmissions. Antennas are very important for operation of all radio equipment, recently there is a sudden growth of data services, the conventional antenna could hardly be able to keep up these data demands, hence implementation of antenna fabricated using microstrip techniques on a printed circuit board (PCB) called as microstrip patch antenna is done. A microstrip patch antenna consists of trace of copper or any metal on one side of a standard PCB substrate and the other side is grounded. There are various feeding techniques like coaxial, strip line, aperture coupling or proximity coupling techniques to feed the antenna. There are various designs of antenna like circular, rectangular, square, semicircular, etc. These designs can be reshaped according to the need by adding slots, monopoles, arrays, etc. The patch antennas are used because they are light in weight, small in size and has low profile. These antennas can obtain both linear and circular polarization. These antennas can be made compact. It is easy for mass production using the printed circuit which makes them a cheaper option. These antennas can work in multiband of frequencies.

III. LITERATURE REVIEW

3.1 Multiband Microstrip Antenna for Mobile Wireless Communication

Microstrip line designs and feeds a multiband rectangular microstrip antenna. It has three radiating elements operating in three frequencies at 2.4 GHz, 3.6GHz and 5.6GHz. FR4-Epoxy dielectric substrate is used. It has relative permittivity of 3.38, substrate thickness of 1.52mm and dielectric loss tangent of 0.0027. The return loss is less than -10dB and voltage standing wave ratio is 2. Size of substrate is compact, it is operated in wireless local area network and worldwide inter operability for microwave access communication. Frequency band of WI-Fi, WiMAX, and WLAN can be coverd by the proposed antenna with values of VSWR at all these resonating frequencies less than 2 and greater than 1, ensures that more than 90% of the available power is delivered to the antenna. Antenna is resonating at three different frequencies. All these frequencies have their own operations. The proposed antenna can be manufactured in large quantities, since it is very compact and very easy to fabricate. A 50Ω microstrip line feeds it, which makes it very attractive for current and future cellular phones. The radiation pattern, the voltage standing wave ratio, return loss and the operating frequency are the parameters considered for the antenna design. Where the antenna has different characteristics like input impedance, radiation pattern, beam width, etc which have been obtained at the central frequency and are close to those values. The bandwidth is the ratio of upper frequency and the lower frequency known as broadband. Most of the times, the desired bandwidth is one of the major determining parameters used to decide upon an antenna. For instance, many antenna types have narrow bandwidths and cannot be used for wide band operation. Bandwidth is typically quoted in terms of VSWR. The term is often specified in fractional Bandwidth. The majority of the power delivered to the antenna is radiated because antennas are typically designed to be low loss.

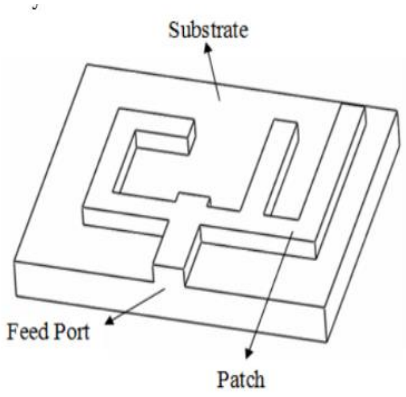

Fig.3. Geometry Of antenna

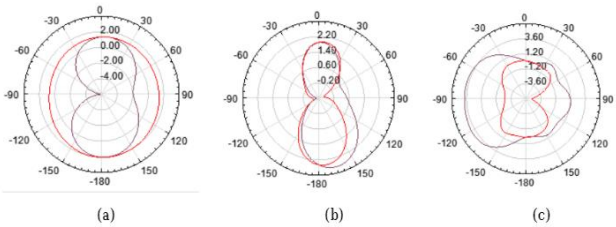

Fig.4. Radiation Pattern at different frequencies (a)2.4GHz,(b)3.6GHz,(c)5.6GHz

3.2 Multiband Microstrip Antenna for Wireless local Area Network with Circular Polarization

In this paper, a design of a low profile multiband square Microstrip patch antenna with Circular Polarization (CP) for WLAN applications. By simulation and fabrication, it is demonstrated that multiband operation with CP is achieved by various slots on the Microstrip patch. A single square patch is excited by using microstrip feed. It focuses on the fact that this antenna finds its application in WLAN where the antenna also produces circular polarization at frequency 2.39 GHz. The multiband, single-feed, circularly polarized, low-profile, low-cost and miniaturized patch antenna is configured, simulated, fabricated and measured. The use of the isosceles triangular slot generates the circular polarization at 2.39GHz and the multiband behavior is obtained due to the isosceles triangular slot and rectangular slot both. Both simulation and measurement results show multiband characteristics in the frequency bands from 2.31 GHz to 2.48 GHz, 3.88 GHz to 3.94 GHz and 4.41 GHz to 4.53 GHz with impedance bandwidths 3.5%, 2.9% and 10.6% respectively. The antenna which has been proposed can be used for various wireless communication applications.

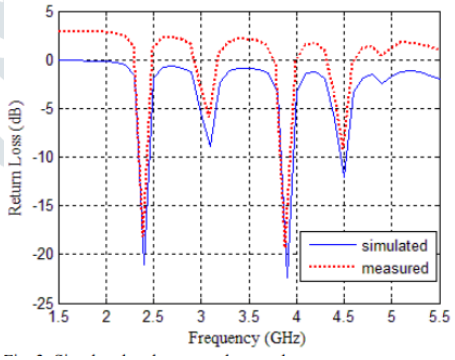

Fig.5. Return loss in terms of simulated and measured form

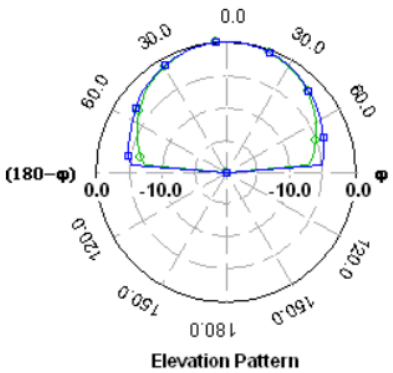

Fig.6. Radiation pattern of the proposed antenna

3.3 Microstrip Patch Antenna with High Bandwidth and Gain for Ultra wideband and Different Wireless Applications

A Microstrip Patch Antenna is designed with High Bandwidth and High Gain for UWB and Different Wireless Applications. In this research work, a square shape patch antenna is proposed. The work is done to obtain large bandwidth with compact ground plane for wireless applications. The proposed antenna is designed using dielectric material of FR4 substrate with height of 1.6 mm and to design a practical antenna. The antennas designed are having dual dimensional arrangements. They are normally identified as patch antennas. The common arrangement of patch antenna of 4.4. We simulated the proposed antenna in CST Microwave Studio. Simulation results show that the proposed antenna achieved bandwidth of 2.33GHz with radiation efficiency more than 90% in UWB range. The proposed antenna covers the range of ultra wideband of 3.1 GHz, the range of LAN, WAN , and also covers the range of satellite that can be made up of a radiator and ground plane on front side of the substrate and on the back side of patch antenna respectively. The proposed antenna has small geometrical size and is suitable for telecommunication applications.

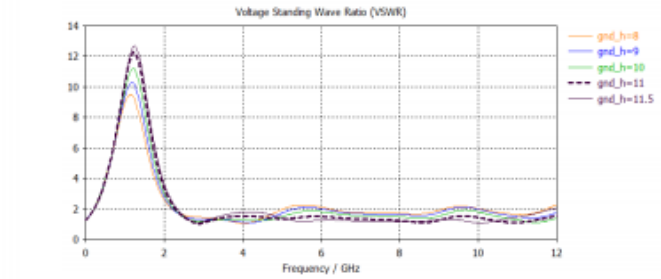

Fig.7. VSWR against frequency

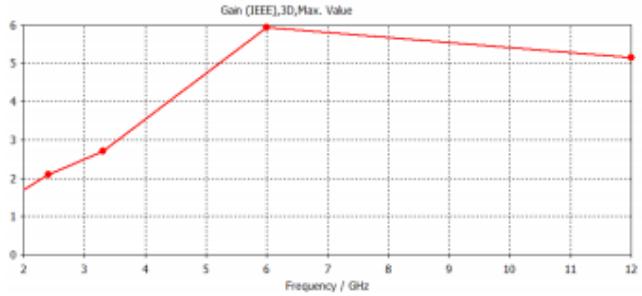

Fig.8. Gain vs frequency (GHz)

3.4 Compact Dual-Band Antenna With Omnidirectional Radiation Pattern

A Compact Dual-Band Antenna is designed with Omnidirectional Radiation Pattern. In this letter, a low-profile planar microstrip antenna is proposed which is operated at lower WLAN (2.4 GHz) and WiMAX (3.5 GHz) frequency bands. For both the bands, the antenna has good omnidirectional radiation pattern. The obtained result shows that the antenna has better impedance bandwidth and high radiation efficiency. For analysis and optimization, the proposed antenna is developed in CST Microwave Studio. The fabricated antenna and measured results are presented. In this letter, a dual band planar printed antenna has been proposed with stable omnidirectional radiation pattern in the azimuth plane for simultaneous lower WLAN-band (2.4 GHz) and WiMAX-band (3.5 GHz) operations. The omnidirectional pattern in the azimuth plane at both 2.4 and 3.5 GHz bands is obtained when mounted vertically on any device. It ensures better signal detection capability even at higher mobility. A lumped equivalent circuit model of the antenna is developed and simulated using Agilent ADS for scattering parameters. The measured return loss is almost equal to the simulated(CST MWS and ADS) resonance behavior.

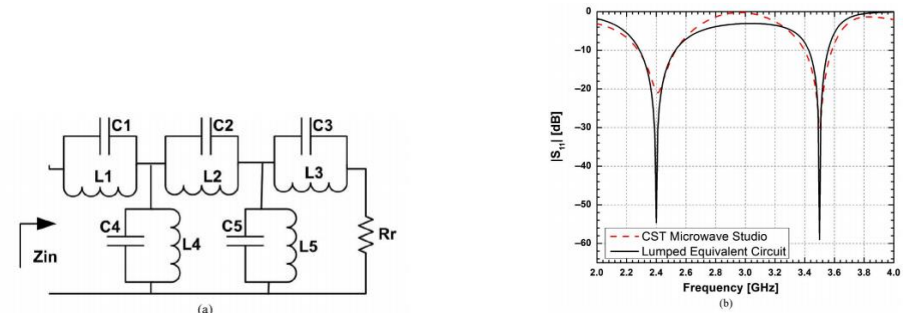

Fig.9. (a) Equivalent circuit model (b) Comparison of scattering parameters

3.5 Multiband Microstrip Antenna for Mobile Application (4G)

In this paper, the proposed work has been analyzed and designed on IE3D tools and we get different types of slot like Lslot, Z-slot and U-slot. The results obtained at our desired frequency is for 4G application at about 2300 MHz. In this research, we achieved multiband which is an essential parameter of wireless communication. The VSWR, Return loss, Bandwidth, Directivity, Gain is acceptable for this application. We have VSWR of 1.18 & Return loss of -21.5 dB at 2270MHZ. We are using RT Duroid as a substrate material which has dielectric constant of 2.2. The designed antenna is made suitable for 4G applications.The main concern of this project is to design an antenna for 4G mobile applications and it is consolidated as a multiband antenna for various purposes. We are successful in designing. As a result, user can use phones from one country to other countries to get this technology at desired frequency band. It is a multiband capable phone for roaming internationally. Like in Australia 4G is working at both frequency on which our result has come but in India, it is working on 2300MHz.

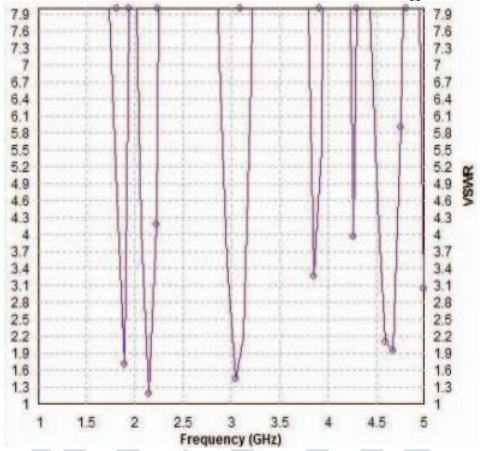

Fig.10. Multiband VSWR for L-shaped antenna

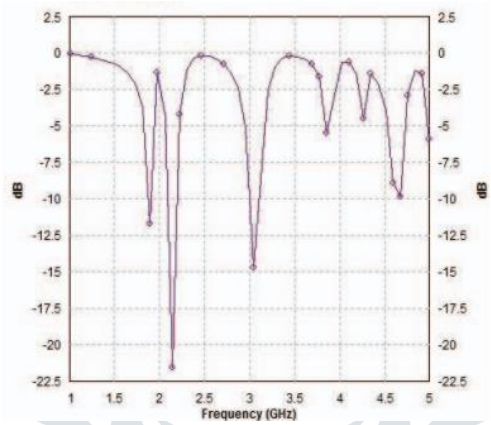

Fig.11. Return loss at three different frequencies (1.82 GHz ,2.221GHz& 3.132GHz)

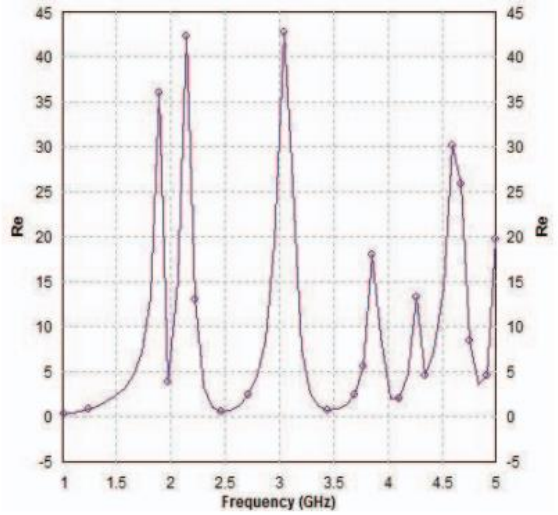

Fig.12. Characteristic impedance at 2.227 GHz

3.6 A Slot Antenna with Multiple Steps for Mobile Applications

A slot antenna is proposed for mobile phone applications. The antenna has two slots named Slot1 and Slot2, respectively. Slot1 has a hybrid shape of the combination of a circle and a rectangle with four steps located at the lower edge of the rectangle. Slot2 is of rectangular shape. At opposite edges of the system board, the two slots are opened. The antenna is fed with a folded shaped

with 50Ω microstrip which is connected to a circular patch and a rectangular patch. At the lower edge of the rectangular patch, four steps are located. The measured -6 dB bandwidths of the antenna are 0.67-1.03, 1.58- 2.13, 2.30-2.78, 3.48-6.8 GHz. A slot antenna with multiple steps in slot and feeding structure is proposed. The antenna has wide bandwidth at lower band of 0.67-1.03 GHz.

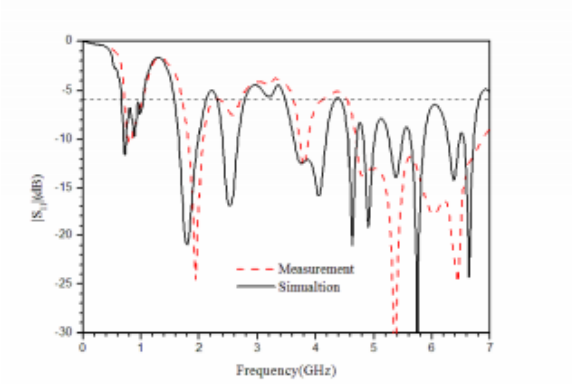

Fig.13. Simulated and measured |S11|

3.7 A multiband circular-annular ring shaped patch antenna for wireless applications

A circular annular-ring microstrip patch antenna with circular patch and L-shaped orthogonal strips, used for multiband applications is proposed. FR4 is the substrate material used with dielectric constant of 3.68 and the antenna is feed using 50Ÿ coaxial probe. Certain techniques and modified orthogonal L shaped strips are utilized to give resonator effects. At resonant frequencies of 2.4 GHz, 5.95 GHz, 7 GHz, 9.55 GHz and 11.35 GHz, the proposed antenna offers multiband response. The simulated results has good performance with a minimum reflection loss of -25 dB, gain within the range of 3-5 dB and VSWR at desired frequencies. The proposed antenna designs a compact and single-layered multiband microstrip antenna based on circular-ring patch and orthogonal L-shaped strips. The antenna resonates at 2.4GHz, 5.85 GHz, 7 GHz, 9.55 GHz and 11.35 GHz. The simulated results gives the accuracy and robustness of the proposed design with desired return loss, gain and VSWR. This antenna is used for Bluetooth, WLAN, WiFi, C-Band and X-band applications.

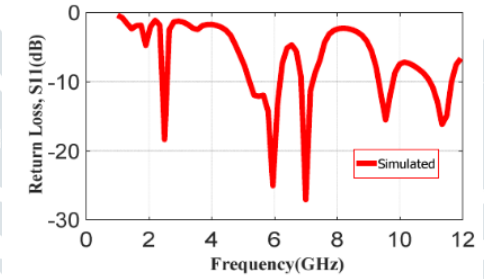

Fig.14. Return loss (dB).

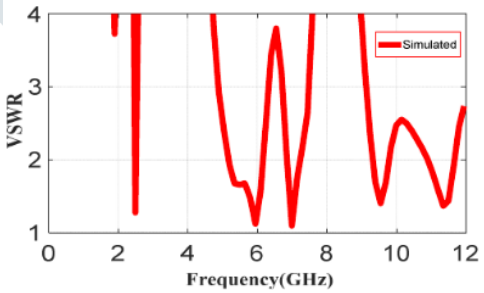

Fig.15. VSWR

3.8 Multiband Microstrip Antenna using Metamaterial Layer for WLAN and WiMAX Applications

Two multi-band microstrip antennas are designed for WLAN and WiMAX applications. Antenna 1 consists of a simple rectangle monopole radiator with a 2×3 complementary split ring resonator (CSRR) printed on its back ground. By using complementary split ring resonator technique, two frequency bands operating at 3.2-3.9 GHz and 5.65-5.8 GHz are achieved. Antenna 2 is composed of a rectangle patch with a CSRR slot and a conventional ground plane, which can provide a triple-band characteristic covering 2.4-2.48 GHz, 3.3-3.9 GHz and 5.15-5.7 GHz. Wimax at 2.5/3.5/5.5 and wlan at 2.4/5.2/5.8 GHz uses the operational bands of these two antennas and it shows omnidirectional radiation pattern which may be good for wimax and wlan applications.

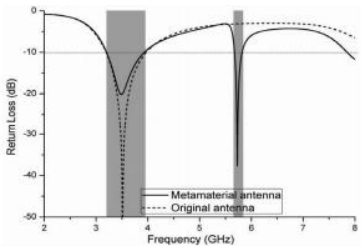

Fig.16. Return losses of original antenna and proposed metamaterial antenna

IV. CONCLUSION

It can be seen that the work demonstrated in this paper is mainly focused on designing the patch antenna for mobile handset application. This geometrical shape can be also used in other applications. Further design and optimization of the antenna system may require high efficiency (low loss), low power consumption, low profile, high speed tuning, and spurious free radiation in a particular application to meet the demands of the fast developing wireless and mobile services. The primary result shows that proposed may be useful for developing microstrip antennas with wide or multi band performance .

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