CIRCULAR MICRO STRIP ANTENNA DESIGN FOR ULTRA-WIDEBAND

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Abstract

In this paper, to encounter present requisite wireless applications we elicited a range of band in Ultra-wideband technology. To endure the research we also designed a low power monopole patch antenna with band-notched property. The results are simulated using High Frequency Structure Simulator (HFSS) software.

Keywords: *Ultra-wideband, band notched property, Wireless applications, band-notched, High Frequency Structure Simulator.*

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1. INTRODUCTION

The fundamental means of communication of information these days are through voice and internet. The broad band communications of wireless technologies have accelerated rapidly in our lives.The recent developments have carried out to present various wireless access technologies.All wireless communications signals travel over the air via radio frequency (RF). RF itself has becomethe synonymous with wireless frequency signals; characterizing anything from AM radio between 535 kHz and 1605 kHz to computer local area networks (LANs) at 2.4 GHz. Perceivably, RF has customarily defined frequencies from kHz to 300 GHz, if microwave frequencies are considered.The elementary principal in wireless communication is no two same frequency signals with same spectrumtransmit at the same time in the same area because they'd effectin interference.The Federal Communications Commission is the government agency that keeps trace of who's using which frequency spectrum. The FCCalso decides the frequencies of spectrum to be used for which wireless services. To facilitate FCC services, it divided the frequency spectrum into two: Licensed radio spectrum for example in cellular phones and

Unlicensed radio Spectrum for example ISM bands of ranges roughly150KHz-900MHz and 900MHz-5GHz respectively.

The important component in wireless systems is antenna as it performs the input and output interfence at wireless equipment.To execute the diverse wireless services, onedemands for different type of antennas with different sizes. This technique blocks the antenna efficiency in metrics like power, return loss etc. The proposed technique is "All Wireless communication services under a single antenna". The success of this refurbishing function would upgrade antenna efficiency issues for wireless communication. With these motivations the present work have been carried out the exertions to execute various wireless applications using a standardized wireless communication technologies , e.g. 3G/4G cellular, IEEE 802.16 based WiMAX, ZigBee based on IEEE 802.15, etc. in a single high efficiency antenna.

UWB technologies have been chosen to meet the partial fulfillment of the objective of this work.The further work is carried by utilizing a planar antenna design.

2.METHODOLOGY

Ultra-Wideband (UWB) is a communication method ,rapidly used in wireless networking to achieve high bandwidth connections with low power utilization.It is rapidly advancing as a high data rate wireless communication technology.The Federal communication commission (FCC) has released a bandwidth of 7.5GHz (from 3.1GHz to 10.6GHz) for ultra wideband wireless communications .Due to its high bandwidth and very short pulses ,UWB radio wave propagation provides very high date rate which may be up to several hundred Megabits per seconds(Mbps), and it is difficult to tract the transmitting data ,which highly ensures the data security .And for the same reason ,the transmitting power consumption of UWB systems is extremely as small as in order of 0.5mW according to the FCC spectral mask in comparison with that of traditional radio systems.These form of short pulses helps to avoid multipath fading effects ,which tells that UWB traditional technology is robust to interference.

The ideal targets for UWB systems are low power, low cost , high data rate ,precise positioning capability and extremely low interference.UWB provides dramatic channel capacity at short range that limits the occurrence of interference.

The low power transmission of the UWB is the key characteristic that might allow it to coexist with other wireless networking standards such as 802.11 LAN, 802.16 MAN and WAN.

The capabilities of UWB are
(i) Operates over an ultra-wide bandwidth
(ii) Satisfactory radiation properties over the entire frequency range
(iii) Good time domain performance
(iv) A good impulse response with minimal distortion
(v) Low power utilization.
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3. ANTENNA REQUIREMENTS

The UWB antenna must operate in the frequency range from 2 GHz to 10.6 GHz .Therefore, UWB antenna impedance much achieve 8.6 GHz bandwidth in order to promise a high data rate and to avoid a large return loss and matching problem.

The UWB antenna must have linear phase through frequency range and constant group delay for the given frequency range. This means that UWB antenna should have as less as possible dispersion of pulses.

An Omni directional radiation pattern is desirable because of user mobility and freedom in transmitter or receiver position. The meaning of Omni directional radiation pattern is that the signal waves passing through an antenna shall be able to travel in all directions. This implies minimizing UWB antenna gain and directivity for use in communication systems.

The designed antenna must be physically compact and low profile, preferably planar .The antenna size should be small and if possible not too heavy ,but in the other hand very compact and robust .This requirement is due to small size of UWB devices and required user mobility.

UWB supported antennas are Vivaldi antennas, conical antennas ,log periodic antennas ,spiral antenna and monopole antennas .Vivaldi antennas does not supports indoor wireless technology and portables devices . conical antennas are of two types bucolical and monotonically antennas but they don't support indoor wireless technology and it has a direction pattern .Log periodic antennas and spiral antennas are highly structured and has directional patterns .Monopole antennas are portable for cellular communications, broadcasting and also for wireless communications and they have good omnidirectional patterns .These is the main reason to choose monopole antenna.

4. ANTENNA DESIGN

In high-performance aircraft,spacecraft,satellite and missile applications ,where size,installation and aerodynamic profile are constraints and low profile antennas may be required.Presently there are many other government and commercial applications,such as mobile radio and wireless communications that have similar specifications.To meet these requirements ,microstrip antennas can be used .These antennas are having low profile ,conformable to planar and non-planar surfaces ,simple and inexpensive to manufacture using modern printed-circuit technology .

A micro strip antenna consists of conducting patch on a ground plane separated by dielectric substrate.Low dielectric constant substrates are generally preferred for maximum radiation.The conducting patch can take any shape but rectangular and circular configurations are the most commonly used configurations .Other configurations are very difficult and complex to analyze and require heavy numerical computations. Any microstrip antenna is characterized by its length

,width , input impedance ,gain and radiation patterns. The length of the antenna is nearly half wavelength in the dielectric; it is a very critical parameter, which governs the resonant frequency of the antenna .

The Figure 1 shows the geometry of the circular micro strip antenna design with its dimensions ,which is assembled on a Rogers RT/Duroid 5880™ with loss tangent =0.0009 and dielectric constant =4.4.These micro strip antenna consists of a 50 ohms strip line, conducting square patch of 12(L)*12(W) mm^2 ,circular micro strip of radius 2mm and ground plane separated with dielectric constant with a length of 13mm. A spacing between the slot patch and the ground plane ,generally called as feed gap(G) has been optimized to be about 1mm,so that a good impedance matching across the operating band can be seen.

For the simulation and analyzation of the electrical features and radiation performance of the proposed antenna ,an electromagnetic software package ,High Frequency Structure Simulator (HFSS) ,has been element methods(FEM) to simulate any arbitrary three utilized .The HFSS software which employs the finite dimensional structure by solving Maxwell's equations based on the specified boundary conditions ,port excitations, materials and the particular geometry of the structure.

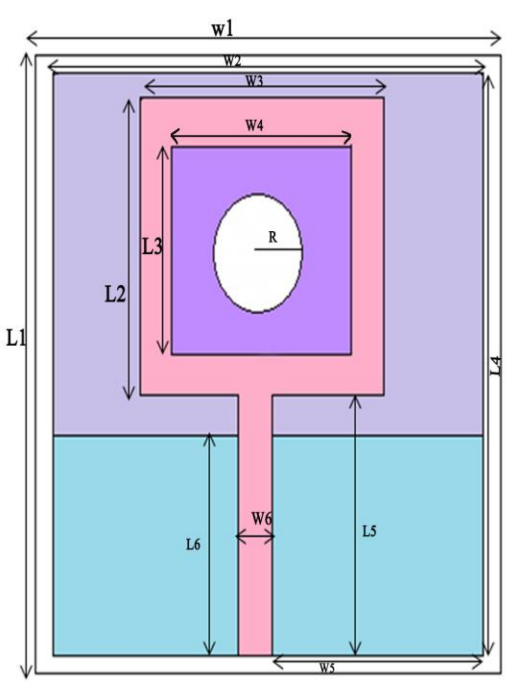

Fig 1: Geometry of the proposed UWB band notched antenna L1=40mm,W1=40mm, L2=35mm ,W2=30mm,L3=12mm,W3=12mm,L4=8mm,W4=8mm,L5=14mm,L6=13mm,W5=13.5mm,W6=3mm,G1=1mm,R=2mm.

The design parameters optimized for the proposed antenna were eventually determined with L1=40mm,W1=40mm,L2=35mm,W2=30mm,L3=12mm,W3=12mm,L4=8mm,W4=8mm,R=2mm,L5=14mm, L6=13mm,W5=13.5mm,W6=3mm,G1=1mm.The circular slot placed at the center of the patch can be devoted to generating desirable resonance for the stop band operation. The rectangular radiating patch antenna with steps, a partial ground plane, feed line and circular slot parameters was optimized to get desired response. Therefore, the geometric parameters of the proposed structure can be adjusted to tune the return loss and bandwidth over wide range of frequency.

5.RESULTS

The designed circular micro strip antenna is simulated in the HFSS software by varying various parameters.The value of the feed gap is one of the most important parameter for controlling the antenna performance besides the patch antenna dimensions and other parameters. Fig 2 illustrates the simulated and experimental return loss S11 against the frequency of the antenna .It is observed that the measured bandwidth with 10dB return loss for the proposed antenna is from 2.4 to 11.02 GHz, rejecting the frequency band of about 5.44 to 5.98 GHz, so the effects due to the frequency interference can be avoided.

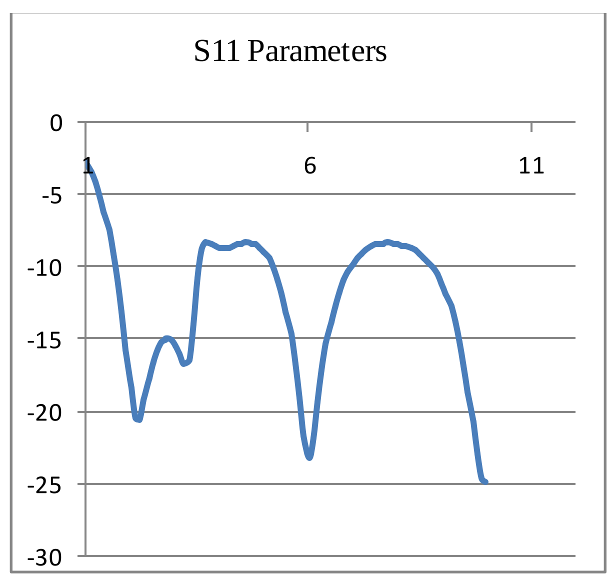

Fig.2: Simulated return loss of the proposed antenna.

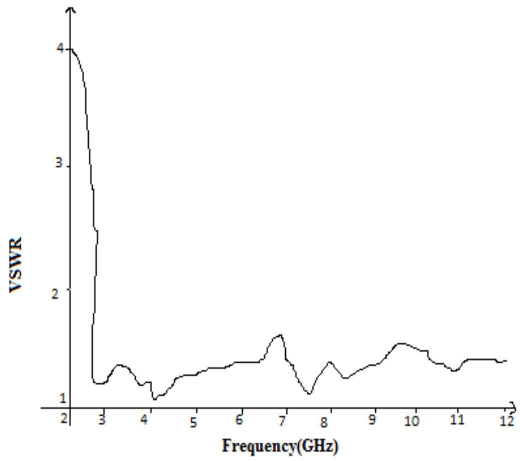

Fig 3: Simulated VSWR of the antenna with band notched behavior.

Fig. 3 shows the simulated VSWR plot of VSWR and frequency of the proposed antenna . As it is observed , the impedance matching and return loss are very good , as VSWR is less than or equal to 2 (VSWR < 2) through the UWB frequency range.

Fig.4 and Fig.5 illustrates the experimental radiation patterns of the proposed antenna in polar form and three dimensional patterns. They clearly gives the information that the radiation pattern is Omni directional, so the designed antenna is capable of transmitting or receiving signals in all directions .

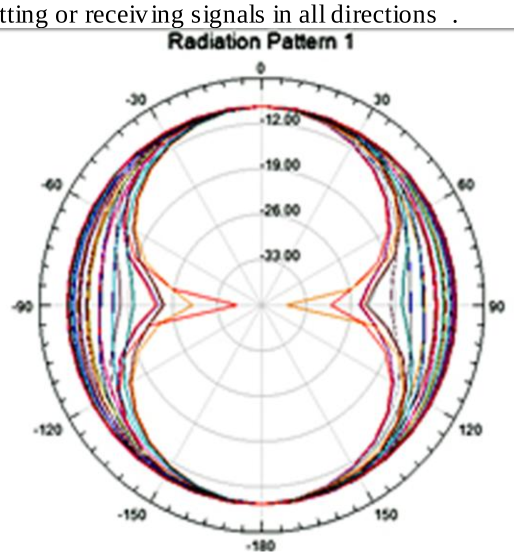

Fig4: Radiation pattern of the proposed antenna at 2.45GHz in polar form**.**

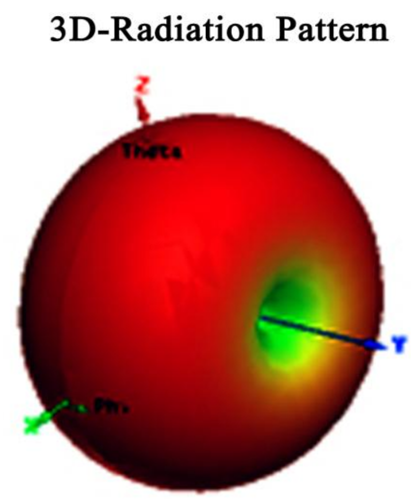

Fig5: Simulated radiation pattern at 2.45 GHz for the proposed antenna in 3D.

The current distributions are evaluated to understand the performance of the antenna.FIG.6 illustrates thesimulated surface current distribution at the frequency of 2.45GHz for the proposed antenna.

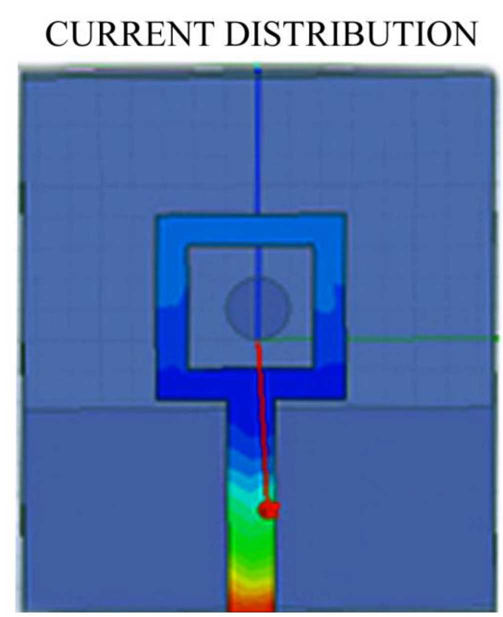

Fig5.Simulated currentdistribution at 2.45GHz

6.CONCLUSION

In this paper,a circular micro strip antenna with band notched property suitable for UWB operation is illustrated . Due to the witnessing of very rapid growth of wireless communication applications, antenna's with very large bandwidth are in demand, so that various applications are covered with a single antenna.The measured results show that the optimized antenna has $|s_{11}|$ <-10dB in the choose frequency band and good Omni-directional radiation patterns.The designed antenna is quite suitable for wireless communication applications .

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