NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 4, ISSUE 2, Feb.-2017

A SURVEY ANALYSIS ON COMPACT UWB CIRCULAR MONOPOLE ANTENNA WITH MULTIPLE NOTCHED BANDS

PRIYANKA GARGADE
Department of Electronics and Telecommunication Engineering, Saraswati College of Engineering, Plot No. - 46/46A, Sector No. -5, Behind MSEB Sub Station, Kharghar, Navi Mumbai, India,
priyankagargade@gmail.com

SONAL GAHANKARI
Department of Electronics and Telecommunication Engineering, Saraswati College of Engineering, Plot No. - 46/46A, Sector No. -5, Behind MSEB Sub Station, Kharghar, Navi Mumbai, India,
sonalgahankari@rediffmail.com

ABSTRACT
Evolution in high speed wireless communication technology triggers the necessity for wideband antennas in portable devices. Federal communication commission (FCC) has authorized 3.1 GHz to 10.6 GHz for ultra wideband applications and is considered as eminent solution for emerging wireless technology due to its enticing merits like high data rate, jamming resistance and improved throughput capabilities. In recent years, ultra wideband (UWB) system has been required for many applications because of its plenty of advantages, such as low complexity and low cost, resistant to severe multipath and jamming, etc. The increased growth of wireless technology has motivated researchers to design antennas. Ultra wideband (UWB) technologies have become very attractive due to the numerous advantages such as gigabit/second-level data rate, high security, and low cost. Interference between ultra wideband (UWB) antennas and other narrow band systems have spurred growth in designing UWB antennas with notch characteristics. Most of these UWB antennas are designed to meet the UWB specification and are suitable for practical implementation. However, the existing narrowband services such as WLAN (5.15~5.35 and 5.725~5.85 GHz) and WiMAX (3.4 ~ 3.6 GHz) may produce interference with the UWB spectrum. The use of a notch filter has put an additional constraint on antenna design. Therefore, a UWB antenna with band-notch characteristics can be an alternative method.
In this literature survey paper, we are discussing a simple and compact UWB Circular Monopole Antenna with Multiple Notched Bands. In this survey paper, a simple low cost planar circular monopole antenna for UWB communication is presented. The example antenna fed by using 50Ω microstripline feed and the parametric analysis. The parameters such as variation of height of partial conducting ground plane and width of partial conducting ground plane are studied to achieve the wide impedance bandwidth. Also by varying the length of the microstripline feed, the change of impedance bandwidth is observed. Moreover in this paper a low cost commercially available modified glass epoxy substrate material is used for antenna design.

KEYWORDS: UWB Antenna, Monopole Antenna, Notched bands, FCC based UWB communication, Micro strip

INTRODUCTION

Ultra wideband (also known as UWB or as digital pulse wireless) is a wireless technology for transmitting large amounts of digital data over a wide spectrum of frequency bands with very low power for a short distance. There are rapid developments in wireless communication systems to meet the growing demands for various communication services. However, the technologies for wireless communication still need to be improved further to satisfy the higher resolution and higher data rate requirements. Recently, UWB communication system covering from 3.1 to 10.6 GHz has been released by the FCC in 2002. UWB system requires a compact antenna providing wideband characteristic over the whole operating band. Due to their appealing features of wide bandwidth, simple structures, omnidirectional patterns and ease of construction, planar metal-plate monopole antennas have been proposed for such applications. A microstrip-fed planar monopole antenna is thus suitable for integration with handheld terminal owing to its attractive features such as low profile, low cost and light weight. Ultra-wideband is a clear example of all these technological

advances. It tries to mitigate the saturation of the spectrum, transmitting at very low power over a frequency band that is already occupied. Its low power characteristics make it invisible for the radio systems sharing the same spectrum. Its ultra-wideband spectrum allows transmitting information at high data rates, increasing with this the amount of information transmitted per second. However, its implementation is very complex, as the devices work with lower input power and have to be very fast. The antennas should also be able to receive and transmit the ultra-broad spectrum required and be of considerably small size.UWB is one of the wireless communication and positioning technologies.

The application of UWB is mainly used in RADAR communication. The UWB radio system occupies an UWB frequency band, i.e., 3.1–10.6 GHz approved by Federal Communications Commission (FCC), in which there might potentially exist several narrow band interferences caused by other wireless communication systems, such as IEEE 802.11a wireless local area network (WLAN) in the frequency band of 5.15–5.825 GHz, and fixed broad wideband access (FBWA) mainly around 3.5 GHz. Therefore, it is necessary for UWB antennas performing band-notched function in those frequency bands to avoid potential inferences.

METHODOLOGY

The example design is referred from [1], [2].To achieve band-notched characteristic, slots have been etched on UWB antenna patch. The etched slots would resonant in certain frequencies upon which the antenna performs band notched characteristics. According to this concept, the antenna with triple notched bands has been proposed two split ring slots and two arc slots have been etched on the patch to generate triple notched bands. Two split ring slots are used to generate notched bands with central frequency of 2.4 and 3.5 GHz, respectively, while the couple arc slots with the same radius are corresponding to the notched band cantered on 5.8 GHz.

The geometry of the proposed antenna is shown in Fig. 1. It is fed by a 50 ohm Microstrip line and fabricated on a 1.6 mm thick FR4 substrate with W=30mm and L=35 mm surface area. The antenna consists of simple circular monopole with R=11 mm. The relative permittivity and loss tangent of the substrate is 4.4 and 0.02 respectively as shown in figure 1. On one side of the board we have a 50- Ohm microstrip feeding line (width 4 mm and length is 12.7mm), The flow of the design is shown in Figure.2.

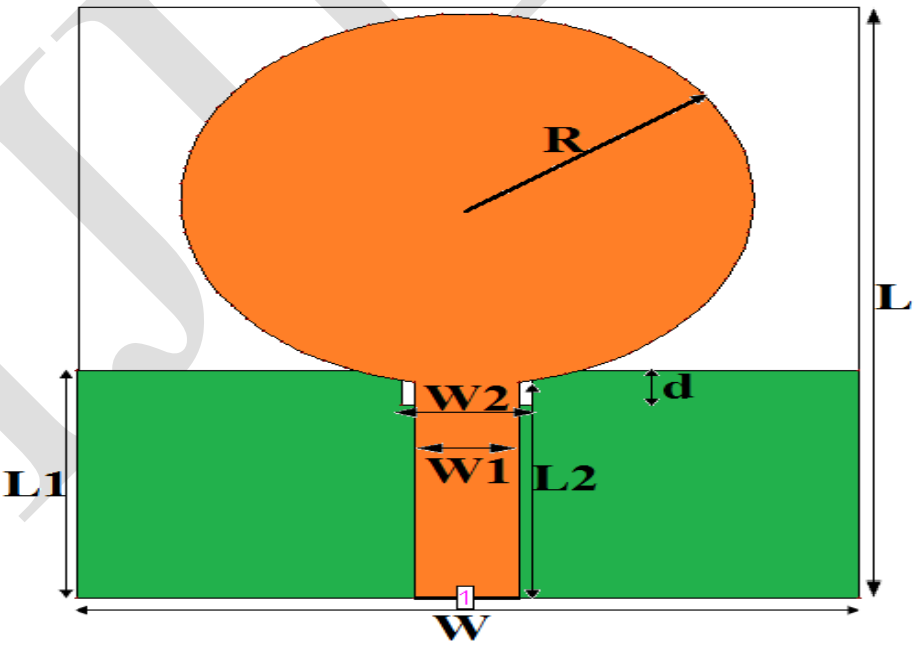

Figure 1.Geometry of antenna

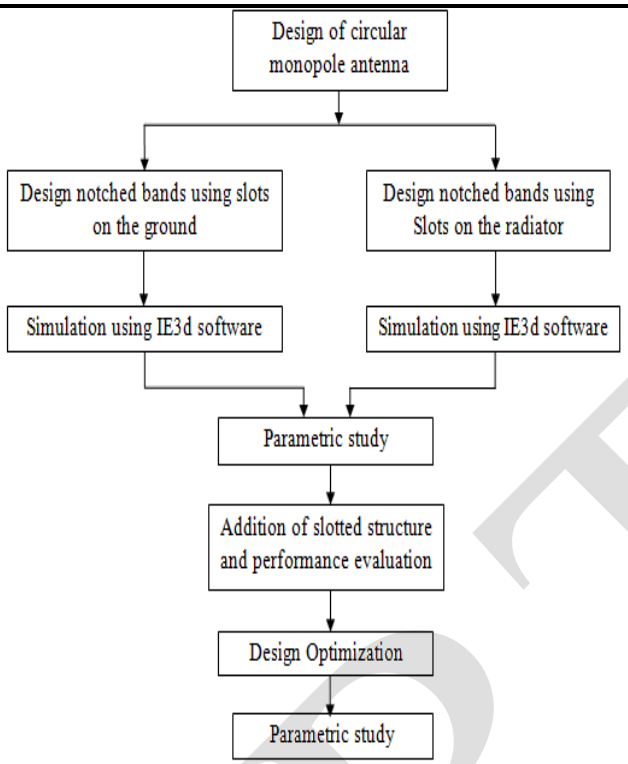

Figure 2.Flow of the design

METHOD AND COMPARISON

The increased growth of ultra wideband (UWB) wireless technology has motivated researchers to design UWB antennas. The interference between ultra wideband (UWB) antennas and other narrow band systems have spurred growth in designing UWB antennas with notch characteristics. Several design configurations have been proposed in the open literature using planar monopole antennas with modified radiator and ground plane to achieve these characteristic Notch characteristics with triple notch frequencies, dual notch frequencies and single notch frequency were achieved using various design configurations employed with planar monopole printed antennas.

In order to understand the challenges that UWB provides to antenna designers, a comprehensive background outlining several characterizing antenna parameters will be presented the most fundamental antenna parameters are impedance bandwidth, radiation pattern, directivity, efficiency and gain.

Y. Sung worked on "UWB Monopole Antenna with Two Notched Bands Based on the Folded Stepped Impedance Resonator" [1]2012.This research was related to UWB filter with dual notch-band characteristics at 6 and 8 GHz using a folded stepped impedance resonator (SIR) structure was published, because the size of the folded SIR used it was large, it is not appropriate for use as a notch filter for low-frequency bands. To overcome this problem, found solution that reduces the size of a conventional folded SIR and a UWB antenna with notch characteristics in the 3.5-GHz and 5.8 GHz (Wimax). This antenna consists of a circular-shaped radiating element; a 50- microstrip feed line, two short-circuited folded stepped impedance resonators (SIRs), and a partially truncated ground plane. The compact folded SIRs are located beside the feed line to achieve the band rejection characteristic.

Yan Zhang, Wei Hong, Chen Yu, Zhen-Qi Kuai, Yu-Dan Don, and Jian-Yi Zhou, "Planar Ultrawideband Antennas With Multiple Notched Bands Based on Etched Slots on the Patch and/or Split Ring Resonators on the Feed Line"[2]2008. Three types of ultrawideband (UWB) antennas with triple notched bands are proposed and investigated for UWB communication applications. The proposed antennas consist of a planar circular patch monopole UWB antenna and multiple etched slots on the patch and other split ring resonators (SRRs) coupled to the feed line. in a planar circular patch monopole(Type-I) it use Two split ring slots are used to generate notched bands with central frequency of 2.4 and 3.5 GHz, couple arc slots with the same radius are corresponding to the notched band centered on 5.8 GHz. Another antenna with rectangular split

ring resonators (SRRs) (Type-II &Type –III) Type-I with the smallest size shows narrower notched bands than that of other two types. In contrast, Type-II and III have stronger notches and the bandwidths of notched bands are a little wider. According to the measured VSWR, Type-II exhibits a better band-notched characteristic than other two types, whereas it has the largest size.

Jawad Yaseen Siddiqui, Chinmoy Saha and Yahia M. M. Antar worked on "Compact SRR Loaded UWB Circular Monopole Antenna with Frequency Notch Characteristics" [3]2014.In this using CPW fed with SRR Circular Monopole Antenna designed. Multiple resonance frequency with multiple pairs of SRR loading with varying geometrical dimensions can be employed to achieve multi notch characteristics in the antenna design. This antenna was designed for three different frequency 3.1GHz, 6.38GHz and 10 GHz. the notch frequency can be customized to the desired value by changing the SRR dimensions.

Majid Shokri, Hamed Shirzad, Sima Movagharnia, Bal Virdee, Member, IEEE, Zhale Amiri, and Somayeh Asiaban worked on "Planar Monopole Antenna With Dual Interference Suppression Functionality"[4]2013. A compact microstrip-fed ultrawideband (UWB) printed monopole antenna is described that possesses attributes of dual notched functionality, wide impedance bandwidth (IBW), and circular polarization (CP). The antenna consists of an annular- ring radiating patch with a pair of Y-shaped resonant elements that are embedded inside the patch. The antenna's ground plane is truncated in the shape of a trapezoidal structure resting on a rectangle to extend its IBW performance. Located above the truncated ground plane is an inverted U-shaped parasitic element, and a semi-circular notch is etched in the ground plane in the vicinity of the annular-ring patch to further enhance the antenna's IBW. Provides circular polarization (CP) bandwidth of 610 MHz (3.11–3.72 GHz) across the WiMAX. Band, without the notch band is just between 4.1–4.6 GHz, after adding semicircular notch got exact frequency band.

Ke Zhang, Yuanxin Li and Yunliang Long worked on "Band-Notched UWB Printed Monopole Antenna with a Novel Segmented Circular Patch" [5]2010.The Band-notched characteristic in the 5.7-GHz WLAN band is obtained by segmenting a circular monopole patch into three parts. The patch is divided into three segments: the center patch and two side patches. Practically, the side patches function as two parasitic elements and work as band stop filters. The segmenting method that brings on band-notched function is easy to accomplish.

Krittaya Chawanonphithak, Chuwong Phongcharoenpanich, Sompol Kosulvit and Monai Krairiksh, "5.8 GHz Notched UWB Bidirectional Elliptical Ring Antenna Excited by Circular Monopole with Curved Slot" [6] 2007. This was designed for avoid interfering with nearby WLAN. The antenna structure consists of two parts, a circular monopole with curved slot and an elliptical ring, a curved slot on circular monopole provides the band-notched characteristic. An elliptical ring is used for controlling bidirectional pattern, thus the gain can be improved. The characteristics of the antenna have many attractive features in both technically and economically, such as bidirectional radiation pattern, wide impedance bandwidth, moderate gain, small size, low cost, and easy fabrication.

Wen-Chung Liu, Chao-Ming Wu, and Yen-Jui Tseng worked on "Parasitically Loaded CPW-Fed Monopole Antenna for Broadband Operation"[7]2011. This antenna was designed for avoid interfering with nearby WLAN and WiMAX the basic antenna structure was a rectangle patch printed on one side. An open-end circular ring slot and an inverted-U-shaped slot were embedded into the rectangle patch, and thus resemble the antenna structure as a CPW-fed strip monopole parasitically loaded with a circular-hat patch and used ring slot. To examine the effects of parasitically loading a circular-hat patch to the monopole as well as embedding two short slots into the CPW ground, the results for the cases of without both the circular-hat patch and the two short slots, without the circular-hat patch only, and without the two short slots only.

The above literature review mainly pointed towered the UWB radio system occupies an UWB frequency band, i.e., 3.1–10.6 GHz approved by Federal Communications Commission (FCC), in which there might potentially exist several narrow band interferences caused by other wireless communication systems, such as IEEE 802.11a wireless local area network (WLAN) in the frequency band of 5.15–5.825 GHz, and WiMAX (3.3-3.6GHz). Therefore, it is necessary for UWB antennas performing band-notched function in those frequency bands to avoid potential inferences.

CONCLUSION

The survey gives importance of UWB based antenna. The UWB monopole antenna are employed effectively for notching unwanted frequency bands such as WiMAX (3.4~3.6 GHz) service and WLAN (5.15~5.35 and 5.725~5.85 GHz) service. This antenna has many advantages, such as compact size and simple structure. Therefore, it is suitable for UWB systems. Then notch band has been designed by adding few slots to this antenna for filtering the WLAN frequencies.

The final design is a dual-band antenna and supports wireless application WLAN (2.4–2.484 GHz), WiMAX (3.1–4.9 GHz) systems and downlinks of X-band satellite communication (7.25–7.75 GHz) systems. The effect of this filter for some evanescent frequencies is also investigated. The benefit of this novel feed line is designing multi-band and reconfigurable antenna by changing stub line parameters.

REFERENCES

1) Y. Sung, "*UWB Monopole Antenna with Two Notched Bands Based on the Folded Stepped Impedance Resonator" IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 11, pp. 500 – 502, 2012*

2) Yan Zhang, Wei Hong, Chen Yu, Zhen-Qi Kuai, Yu-Dan Don, and Jian-Yi Zhou, *"Planar Ultrawideband Antennas With Multiple Notched Bands Based on Etched Slots on the Patch and/or Split Ring Resonators on the Feed Line", IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 56, NO. 9, pp. 3063 - 3068 SEPTEMBER 2008.*

3) Jawad Yaseen Siddiqui, Chinmoy Saha and Yahia M. M. Antar, "*Compact SRR Loaded UWB Circular Monopole Antenna with Frequency Notch Characteristics", IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 62, NO. 8, pp. 4015 - 4020 AUGUST 2014.*

4) Majid Shokri, Hamed Shirzad, Sima Movagharnia, Bal Virdee, Zhale Amiri, and Somayeh Asiaban *,"Planar Monopole Antenna With Dual Interference Suppression Functionality", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 12, pp . 1554 – 1557, 2013.*

5) Ke Zhang, Yuanxin Li and Yunliang Long, *"Band-Notched UWB Printed Monopole Antenna with a Novel Segmented Circular Patch", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 9, pp. 1209 – 1212, 2010.*

6) Krittaya Chawanonphithak, Chuwong Phongcharoenpanich, Sompol Kosulvit and Monai Krairiksh, *"5.8 GHz Notched UWB Bidirectional Elliptical Ring Antenna Excited by Circular Monopole with Curved Slot", Proceedings of Asia-Pacific Microwave Conference, pp. 1 - 4, 2007.*

7) Wen-Chung Liu, Chao-Ming Wu, and Yen-Jui Tseng *"Parasitically Loaded CPW-Fed Monopole Antenna for Broadband Operation", IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 59, NO. 6, pp. 2415 - 2419, JUNE 2011.*

8) Junjun Wang, Xiaobing Sun, Kanzo Okada, *"UWB Circular Monopole Ominidirectional Antenna with a Slot for Radiation Pattern Improvement", IEEE International Conference on Ultra-Wideband, pp. 478 – 482, 2007.*

9) Tzyh -Ghuang Ma and Sung-Jung Wu, *"Ultrawideband Band-Notched Folded Strip Monopole Antenna", IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 55, NO. 9, pp. 2473 - 2479, SEPTEMBER 2007.*