CPW fed UWB antenna with enhanced bandwidth & dual band notch characteristics

K. G. Jangid, P. K. Jain, B. R. Sharma, V. K. Saxena, V. S. Kulhar, and D. Bhatnagar

Citation: AIP Conference Proceedings **1953**, 140127 (2018); doi: 10.1063/1.5033302
View online: https://doi.org/10.1063/1.5033302
View Table of Contents: http://aip.scitation.org/toc/apc/1953/1
Published by the American Institute of Physics

CPW Fed UWB Antenna with Enhanced Bandwidth & Dual Band Notch Characteristics

K. G. Jangid[1], P. K. Jain[2], B.R.Sharma[3], V. K. Saxena[4], V.S.Kulhar[5] and D. Bhatnagar[6,a)]

[1,5] *Department of Physics, Manipal University Jaipur,Jaipur-303007(India)*
[2,4,6] *Microwave Lab, Department of Physics, University of Rajasthan, Jaipur-302004(India)*
[3] *Department of Physics, SKIT & M, Jaipur-302017(India)*

[a)]Email: dbhatnagar_2000@rediffmail.com

Abstract. This paper reports the design and performance of CPW fed UWB antenna having two U–shaped slots etched in the radiating structure. UWB performance of proposed structure is obtained through the truncated shape of the patch and L-slits etched in ground plane. By applying two U- shaped slots in a radiating patch, we achieved dual notch band characteristics. The proposed antenna is simulated by applying CST Microwave Studio simulator. This antenna provides wide impedance bandwidth of 12.585 GHz (2.74GHz - 15.325 GHz) with dual notched band characteristics. This antenna may be proved as a useful structure for modern wireless communication systems including UWB band.

INTRODUCTION

Looking present day scenario, ultra-wideband (UWB) technology is widely preferred amongst the researchers due to its conceivable usage in communication systems [1]. The spread bandwidth of UWB technology is very useful for high speed data transmission and microwave imaging. For modern day communication systems; printed UWB antennas with favorable signal-to-noise ratio, acceptable unidirectional radiations patterns and high gain are preferred. The WIMAX bands 2.5 / 3.5 GHz (2.5 - 2.7 / 3.4 - 3.69 GHz), IEEE 802.11 WLAN band (5.15-5.825 GHz) bands used to provide electromagnetic interference with UWB communication systems [2-3] hence in practical applications, rejection of these bands is desired. Several efforts have been made to obtain band notch characteristics at these frequencies which include insertion of slots of various shapes on radiating patch and in feed line, planting of two slits on a circular monopole, E–shaped slot antenna for UWB band notch characteristics, adjustment of an H-shaped thin slot on the square ring slot antenna [4-8] etc. This paper reports the design and performance of a planar CPW fed edge truncated circular patch antenna. Two U-shaped slots in the radiating patch are introduced to obtain the desired dual band-notched characteristics for Wi-Max and WLAN bands.

ANTENNA DESIGN AND ANALYSIS

Initially a CPW fed circular patch (having patch radius 9.3 mm) is designed on glass epoxy FR4 substrate material having relative permittivity (ε_r) 4.4, substrate height (h) 1.59 mm and loss tangent = 0.025. The overall dimensions of considered antenna are 30 mm x 20 mm x 1.59 mm. The two edges of the circular patch parallel to feed line are truncated with truncation length T as shown in Fig. 1. Two L-Shaped slits are also introduced one by one in the ground plane to achieve desired UWB performance from this structure. The width of feed line, gap 'g' between feed line and ground plane, dimensions of inserted L- shaped slots in ground and truncation length 'T' of circular patch are then optimized to achieve UWB characteristics from this antenna. All the optimized design parameters of this antenna are reported as: size of the substrate (L × W) 30.0 mm × 20.0 mm; radius of the patch (R) 9.30 mm; truncated length parallel to Y-axis (T) 8.50 mm; length of the feed line (f_l) 10.80 mm; width of the feed line (f_w) 5 mm; gap between

2nd International Conference on Condensed Matter and Applied Physics (ICC 2017)
AIP Conf. Proc. 1953, 140127-1–140127-4; https://doi.org/10.1063/1.5033302
Published by AIP Publishing. 978-0-7354-1648-2/$30.00

Journal of Engineering Science and Technology
Vol. 13, No. 5 (2018) 1396 - 1410

U-SHAPED SLOTS LOADED PATCH ANTENNA WITH DEFECTED GROUND PLANE FOR MULTIBAND MODERN COMMUNICATION SYSTEMS

K. G. JANGID[1,*], P. K. JAIN[2], NEELAM CHOUDHARY[2], BRAJRAJ SHARMA[3], V. K. SAXENA[2], V. S. KULHAR[1], D. BHATNAGAR[2]

[1]Department of Physics, Manipal University, 303007, Jaipur, India
[2]Microwave Lab, University of Rajasthan, 302004, Jaipur, India
[3]Department of Physics, SKITM & G, 302017, Jaipur, India
*Corresponding Author: kgkris1980@rediffmail.com

Abstract

In this article, the design and performance of circular radiating patch element with two U-shaped slots and defected ground plane, comprising of a triangular notch monopole structure with rhomboid shape resonator, is reported. The proposed multiband antenna has a compact structure design for GSM 1800 MHz, WLAN, WiMAX and UWB communication systems. The antenna is designed on FR4 glass epoxy substrate of size 39 mm × 34 mm × 1.59 mm by using computer simulation tool CST Microwave Studio 2014. For confirmation of simulation results, prototypes are fabricated and their performance is tested in free space. Measured results demonstrate that fabricated antenna provides triple bands with impedance bandwidth of 157 MHz (1.733 GHz to 1.89 GHz), 3.2 GHz (2.29 GHz to 5.49 GHz) & 10.45 GHz (6.83 GHz to 17.28 GHz), almost flat high gain between 4 to 6 dBi and good radiation patterns in the desired frequency range. The maximum measured gain of proposed structure is close to 6.59 dBi at 4.40 GHz. The circular polarization is also realized in the frequency range 4.12 GHz to 5.20 GHz with axial impedance bandwidth 1.08 GHz. The specific absorption rate SAR values of proposed design are also evaluated at various frequency spots which are well within the SAR values specified by the FCC. Proposed design may be proved a useful structure for advance radio communications systems as well as for the present requirements in defence applications.

Keywords: Double U-shaped slots, Monopole structure, Multiband patch antenna, Rhomboid shape resonator, Specific absorption rate, UWB communication system, WLAN.

Wideband dual frequency modified ellipse shaped patch antenna for WLAN/Wi-MAX/ UWB application

P. K. Jain, K. G. Jangid, B. R. Sharma, V. K. Saxena, and D. Bhatnagar

Citation: AIP Conference Proceedings **1953**, 140128 (2018); doi: 10.1063/1.5033303
View online: https://doi.org/10.1063/1.5033303
View Table of Contents: http://aip.scitation.org/toc/apc/1953/1
Published by the American Institute of Physics

Wideband Dual Frequency Modified Ellipse Shaped Patch Antenna for WLAN/Wi-MAX/UWB Application

P. K. Jain[1], K. G. Jangid[2], B. R.Sharma[3], V. K. Saxena[4], D.Bhatnagar[5,a)]

[1,4,5] *Microwave Lab, Department of Physics, University of Rajasthan, Jaipur-302004(India)*
[2] *Department of Physics, Manipal University Jaipur,Jaipur-303007(India)*
[3] *Department of Physics, SKIT & M, Jaipur-302017(India)*

[a)]Email: dbhatnagar_2000@rediffmail.com, dbhatnagar2010@gmail.com

Abstract. This paper communicates the design and performance of microstrip line fed modified ellipses shaped radiating patch with defected ground structure. Wide impedance bandwidth performance is achieved by applying a pentagonal slot and T slot structure in ground plane. By inserting two semi ellipses shaped ring in ground, we obtained axial ratio bandwidth approx 600 MHz. The proposed antenna is simulated by utilizing CST Microwave Studio simulator 2014. This antenna furnishes wide impedance bandwidth approx. 4.23 GHz, which has spread into two bands 2.45 GHz - 5.73 GHz and 7.22 GHz – 8.17 GHz with nearly flat gain in operating frequency range. This antenna may be proved as a practicable structure for modern wireless communication systems including Wi-MAX, WLAN and lower band of UWB.

INTRODUCTION

In the last decennium, the radio communication i.e wireless local area network (WLAN), wireless interoperability for microwave access (Wi-MAX) and the digital communication system (DCS) have developed at incredible rate. The compact antenna structures with capability to operate in multi frequency bands simultaneously at a time, are in high demand [1-2]. The succeeding wireless communication systems also need wide impedance bandwidth for transfer data in very high speed. Various antenna structures such as wideband triangular monopole patch antenna [3], compact dual-band patch antenna using spiral shaped structure for high speed wireless networks [4], a triple band monopole patch antenna with a trapeziform ground for WI-MAX and WLAN applications [5], dual band X-shape patch antenna [6], ring slotted U-shaped patch antenna, are discussed in literature. In this paper, we communicate the design and performance of a modified ellipse shaped radiating patch with defected ground structure. Two semi ellipses ring is also introduced to pentagonal slot ground structure to achieve circular polarization bandwidth.

ANTENNA DESIGN AND ANALYSIS

Antenna Configuration

The front and back view of ellipse shaped patch antenna with defected ground structure is depicted in Fig. 1. The proposed structure is printed on glass epoxy FR4 substrate with relative permittivity (ε_r) =4.4, substrate height (h) = 1.59 mm and loss tangent = 0.025. The comprehensive dimension of reported antenna is 32 mm x 28 mm x 1.59 mm. A 50 ohm microstrip feed line etched on the radiating patch structure with dimension of 16.1 mm and 20mm. The optimized dimensions of the proposed patch design are achieved by applying 3D electromagnetic simulator CST 2014. Four rectangular shaped slits are also introduced one by one in the radiating patch structure to obtain coveted wideband performance. The simulated variation of reflection coefficient of this antenna with frequency is shown in Fig. 2. The obtained results provide a dual wide band impedance bandwidth covered between frequency range 2.45 GHz to 5.73 GHz and 7.22 GHz to 8.17 GHz for VSWR < 2. Nice matching between radiating element and feed are also detected

2nd International Conference on Condensed Matter and Applied Physics (ICC 2017)
AIP Conf. Proc. 1953, 140128-1–140128-4; https://doi.org/10.1063/1.5033303
Published by AIP Publishing. 978-0-7354-1648-2/$30.00

International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 7 (2018) pp. 4975-4981

A UWB Fractal Slot Patch Antenna with Ground Optimization

Shubhi Jain
Department of Electronics and Communication
[1]VGU University, Jagatpura, Jaipur, India
[2]Swami Keshvanand Institute of Technology, Management & Gramothan Jaipur

R. K. Khanna
Department of Electronics
VGU University, Jagatpura, Jaipur

Deepak Bhatnagar
Department of Physics
University of Rajasthan, Jaipur

Pankaj K. Goswami
Department of Electronics and Communication
JNU University, Jagatpura, Jaipur

Abstract

A miniaturized patch monopole ultra-wideband (UWB) antenna of size 18mm x 12mm x1.6mm on commercially available FR4 material with dielectric constant 4.4 is proposed. The antenna consists of insertion of fractal slot geometries to obtain the desired very large band characteristics. While the modification in the various patch length provides perfect match of impedance bandwidth. Therefore, it provides a very ultra wide band from 1.55 to 12.0 GHz inclusive of all associated applications released by FCC. Choice of suitable filter makes the antenna widely useful for particular band of operation. The proposed structure consists of several half wave length slots interconnected with each other. In this article, the variation of ground geometry with respect to slot insertion is depicted. The design validation is made through successive simulation and proposed antenna is fabricated for measurement of return loss and VSWR parameters. The radiation properties are also found consistent over the ultra wide band.

Keywords: Ground defects, UWB, fractal, resonant frequency, slotted antenna.

INTRODUCTION

The Federal Communication Commission has declared an unlicensed band of frequency from 3.1 to 10.6 GHz for UWB wireless communications. This has enticed many researchers to put their efforts in this field. A typical UWB is defined in principal to occupy more than 500 MHz bandwidth [1]. Interestingly UWB systems has a sequence of short pulses of several pulses per second, results in wide bandwidth with extremely low power transmitted enabling UWB systems to be suitable with extensive low power applications.

Several methods have been employed by which an UWB antenna can be obtained. The widely used method is to create shaped slots in the radiating patch and to ground base. Multiple geometries have been reported like U, H or C-shaped slots [2]–[6]. While, few of them have been developed for one or more notched band. UWB device has become the key factor for market for high-bit-rate, short-range wireless products for home networking, wearable computing and wireless desktop [7]. Microstrip antennas are becoming more interesting due to their advantages for simple structure, ease of design and cheap in cost. While, a certain frequency range for UWB systems may cause interference to the existing frequency range from 5.15-5.35 GHz and 5.75-5.85 GHz which is for Wireless Local Area Network (WLAN). This can be stopped by band filters and can be added to eliminate interference. Therefore it is always the main course to design a compact antenna having stable radiation property with good wideband characteristics for the complete operating range. This paper introduces fractal symmetry over the radiating structure along with optimized ground geometry to design a compact UWB antenna. The slot is so sequenced to obtain the resonance of antenna in much lowered frequency of operation. The ground is stepped in multiple folds to achieve desirable performance of the antenna. It is also observed that the loading of parasitic patch works as band stop filter in [8]–[11], additionally also causes to significant decrease to the lower edge frequency of the radiating element and justifies the impedance bandwidth as reported in [12]–[15]. In the proposed antenna, the main resonating structure can significantly resonate at the fundamental frequency and the slotted fractal symmetry of patch is used as a main resonator, which is mutually coupled to the slotted structure of the patch. With respect to the physical structure of an antenna, in principle, the electric or magnetic field causes effective changes in the actual electric length of the antenna due to inductive or capacitive loading. The same phenomenon also persists in parasitic loading but may cause to over coupling between patches may result in decrease in lower edge of bandwidth [16]-[20]. Hence, by avoiding the above discussed effect, the mutual coupling is controlled by introducing slot geometry to change overall electrical length of the radiating