IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

ISSN PRINT 2319 1775 Online 2320 7876

Research paper **Volume 11, Sp.Iss 6 , 2022**

A SHARP EDGE FORK SHAPED DUAL BAND MICROP STRIP PATCH ANTENNA FOR UWB APPLICATIONS

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DOI : 10.48047/IJFANS/11/S6/008

Abstract. The Dual Band Micro Strip Antenna was presented in this paper. The present work deals with the design of a sharp-edged fork shaped Micro strip patch antenna that can be used for various applications. The proposed antenna resonates at a double band of 4.1GHz and 7.7GHz giving an impedance bandwidth of 18.83%. The dual band Micro strip antenna is excited by a micro strip fed line.

Keywords: Micro strip Antenna, Dual band, UWB, MIMO.

1. Introduction

Conventional Micro strip fabrication technique w An antenna is an electrical conductor or a system of conductors which is "that part of a transmitting or receiving system that is designed to radiate or receive electromagnetic waves"[1]. A Micro strip antenna consists of a thin metallic conductor which is bonded to thin grounded dielectric substrates. The size miniaturization of Micro strip patch antenna is crucial in many of the modern day practical applications, like that of Wireless local area networks(WLAN's), mobile cellular handsets, global position satellites (GPS) and other upcoming wireless terminals. Patch antennas play a very significant role in today's world of wireless communication systems. A Micro strip patch antenna [3] is relatively simple in construction and makes use of a conventional Micro strip fabrication technique comprises of the etching of the antenna element pattern in a metal trace which is bonded to an insulating dielectric substrate, such as a printed circuit board (PCB), with a continuous metal layer bonded to the opposite side of the substrate which acts as the ground plane. The most used Micro strip patch antennas are rectangular patch antennas, and even circular patch antennas are widely used.

Micro strip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation [4],[5].

The purpose for pursuing a wider bandwidth is increased functionality, including applications for ultra wideband and spread spectrum systems. The bandwidth limitation is regulated by the input impedance of the antenna and the radiation pattern.

In the present work, a sharp-edged fork shaped patch antenna is designed, which is suitable for UWB (Ultra wide band) applications. The designed antenna resonates at a double band frequency of 4.1GHz and 7.7GHz giving an impedance bandwidth of 18.83%.

2. ANTENNA DESIGN

The micro strip patch antennas have many advantages such as small size, low-cost fabrication, low profile, light weight, conformability, ease of installation and integration with feed networks but it has one serious limitations i.e. these antennas have very narrow bandwidth characteristics as it limits the frequency ranges over which the antenna can perform satisfactorily [2]. These features of patch antennas are major designing considerations of practical patch antenna.

The patch of the antenna is being excited by feed which is done by edge feed. When the patch is excited by feed a charge distribution is being established between the ground plane and

ISSN PRINT 2319 1775 Online 2320 7876

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the underneath of the patch. The underneath of the patch is charged to positive and the ground plane is charged to negative after the excitation by feed.[6],[7]

Dimensions: The size of proposed micro strip patch antenna is of 50 mm length and 40 mm width. Here, the material used for the substrate has a low dielectric permittivity of 2.2 with a thickness of 0.286mm. The entire antenna system is fed with a micro strip fed.

The methodology of study is first mathematical analysis, then numerical computer simulations, and finally experimental work. Once the numerical solutions have been shown to be accurate many of the conclusions will be derived using this method.

The present work deals with the design of a sharp edged fork shaped Micro strip patch antenna that can be used for various applications. The proposed antenna resonates at a double band of 4.1GHz and 7.7GHz giving an impedance bandwidth of 18.83%.The dual band Micro strip antenna is excited by a micro strip fed line.

The structure of the proposed Fork Shaped antenna is shown in Fig.3.1. The dimensions of the geometry are given in the Table.1. For better performance, a thick dielectric substrate having a low dielectric constant is desirable as it provides better efficiency, larger bandwidth and better radiation. Here, the substrate selected for the design of the proposed antenna is RT/duroid®5880 of thickness 3.2 mm and with low permittivity (εr=2.2). The dimensions of the substrate are taken as 100 × 100 × 3.2 mm3.

The area of the proposed antenna is 50 × 40 mm2. The left and right arms have same dimensions. L1 is the length of the arm and H1 is the width of the arm, L4 and H4 are the length and width of the center arm respectively. L6 is the distance between the left and right arms. Four rectangular slits were placed on each side of patch, which are responsible for the improved bandwidth. The length of the slit is L2 and the width of the slit is H5. There are two slits added on each side as shown in Fig.1 and the length of the slit is L3 and the width of the slot is H3. The return loss of the proposed antenna is shown in Fig.3.10 , giving an impedance bandwidth of 33.8 % between the frequencies 9 GHz to 12.7 GHz, resonating at 4.2 GHz, 5.96 GHz, 7 GHz, 7.46 GHz, 9.93 GHz and 11.49 GHz frequencies.

All the micro strip antennas designed in this paper are simulated with Ansoft High Frequency Structure Simulatorv13.0 (HFSS). The antenna is simulated with a 50 [mm]*40[mm] perfect electric conductor (PEC) ground plane radiating in a rectangular shaped cavity. Perfectly matched layers (PML) are used at the space boundary. Symmetry is used to decrease the solve time of the solutions. The micro strip feed-port is modeled as a standard wave port.

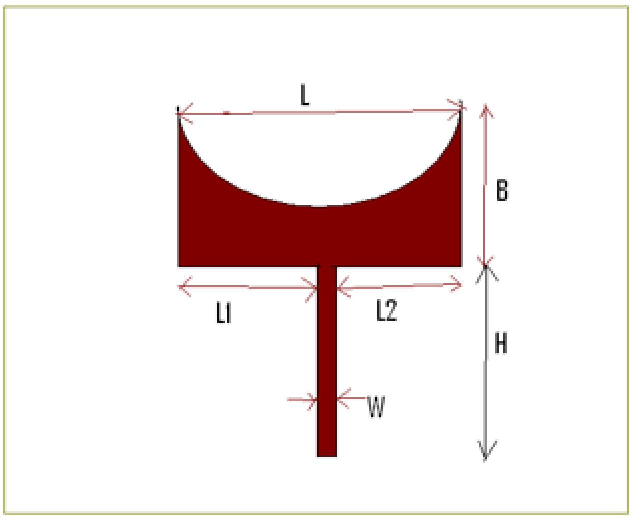

Figure 1 Sharp Edged Fork Shaped Antenna

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Table 1 Dimensions of Proposed Antenna

parameter	*L*	*B*	*H*
Units(mm)	*50*	*40*	*60*
Parameter	*L1*	*L2*	*W*
Units(mm)	*25*	*3*	*22*
parameter	*L*	*B*	*H*

3. Results and Discussion

The simulation results of return loss for the sharp edged fork shaped micro strip patch antenna are shown in the Fig.2. The antenna resonates at a dual band of frequencies at 4.1GHz and 7.7GHz , with a return loss of -22 dB, and -37 dB respectively giving an impedance bandwidth of 18.83%. Hence the proposed shape is much suitable for MIMO systems and WiMAX applications. The above bandwidth is obtained for VSWR ≤1.14. The VSWR plot of the proposed antenna is shown in Fig.3. The radiation patterns at both resonating frequencies are shown in the Fig.4 and in Fig.5.

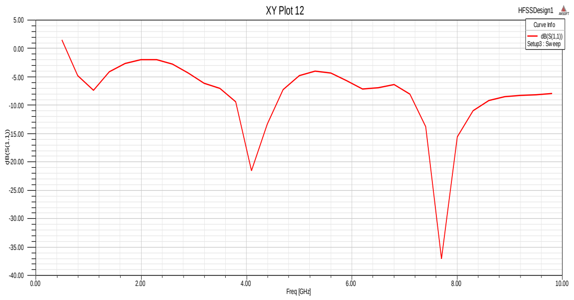

Figure 3 Return Loss of proposed Antenna

The VSWR plot of the proposed Microstrip patch antenna is presented in the Fig.4. The plot gives the desired values of VSWR at the resonant frequencies, which are less than 2. The VSWR value is observed as 1.82, and 0.6 at the resonant frequencies of 4.1GHz and 7.7GHz respectively, indicating improved matching conditions. The Fig.5 shows the obtained radiation Patterns of the proposed antenna. The Fig. 6 shows the gain plot of the proposed antenna.

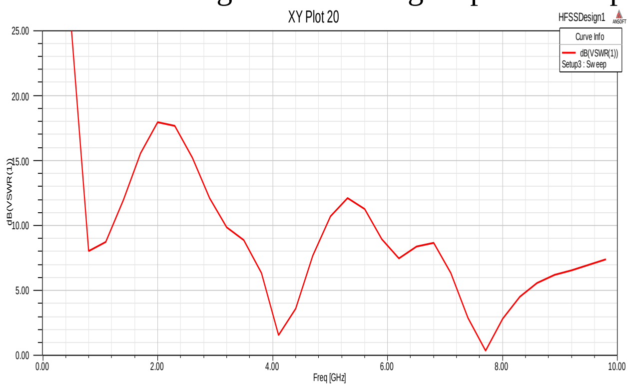

Figure 4 VSWR plot of proposed Antenna

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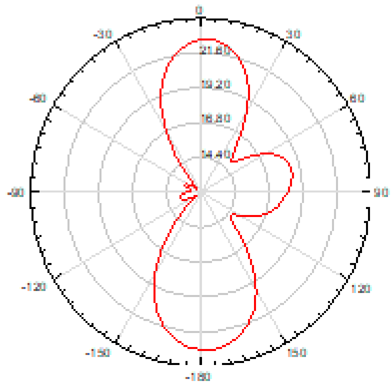

Figure 5 Radiation pattern at 4.1GHz.

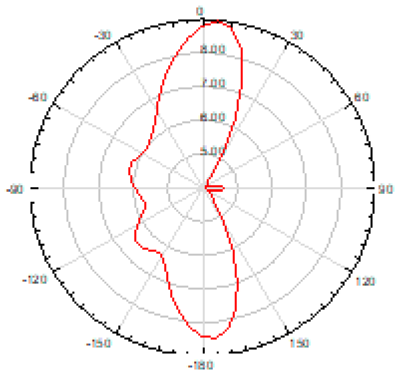

Figure 6 Radiation pattern at 7.7GHz

4. Conclusions

In this work, a sharp-edged fork shaped micro strip antenna fed by a micro strip feed line is designed. The proposed antenna resonates at a dual band giving an impedance bandwidth of 18.83%. Hence, the proposed system can be used in many MIMO systems, where higher bandwidth and isolation is desired.

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