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(Research article)

T Slot Three Steps Stair Wideband Antenna for WiMax and WLAN Applications

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Abstract

In this paper design of microstrip line fed three step stairs with T shape notch wideband antenna for wireless applications is proposed. This antenna operates in single wideband frequency ranging from 3.36GHz to7.15GHz covering WLAN bands and WiMAX applications with a total bandwidth of 3.8GHz. Effects of varying the dimension of T notch on the antenna performance have been studied. This compact antenna fed by 50ohm microstrip line is low profile and very easy to manufacture.

Keywords: *Wide-band, Microstrip, WiMAX, WLAN*

1. Introduction

Antenna is one of the important elements in the RF system for receiving or transmitting the radio wave signals from and into the air as the medium [3]. With the modernization and miniaturization in the field of communication technologies the size reduction of antenna with wide bandwidth and multiple band operation have become most important design considerations for practical applications [2]. Wireless technology provides less expensive alternative and a flexible way for communication. Among the various types of antenna the microstrip patch antennas appear to provoke great interest in the engineers. A microstrip patch antenna is a low profile antenna along with the numerous advantages such as light weight, low cost of fabrication, easy to integrate, low volume, capable of multiband frequency operations and some of the disadvantages such as low gain and narrow bandwidth [2].

The wireless networks include wireless local area networks (WLAN). The IEEE 802.11 group has been responsible for setting the standards in WLAN. One major technology exists in the industrial ISM bands: 2.4-2GHz.4835 GHz, 5.15 GHz -5.35 GHz, and 5.725 GHz - 5.825GHz [1-4]. On the other hand, WiMAX technology has emerged as a feasible solution, because of its inherent features that holds great promise for the future of wireless communications. Worldwide Interoperability for Microwave Access is the next stage to a broadband as well as a wireless world, extending broadband wireless access to new locations and over longer distances, as well as considerably reducing the cost of bringing broadband to new areas [3]. WiMAX (802.16) technology offers greater range and bandwidth than the other available or forthcoming broadband wireless technologies such as Wireless Fidelity (Wi-Fi) and Ultra-wideband (UWB) [3].Therefore the antenna is required to operate at two or more frequency bands for WiMAX and WLAN systems. Some of the desired features for these antennas include broad bandwidth, simple impedance matching to the feed line and low profile. In this paper, design of the Wideband microstrip antenna for wireless commutation applications in 3.35 GHz to 7.15 GHz (ISM band) bands is proposed. This range of frequency covers WiMax (3.5 GHz (3.4 - 3.6 GHz), 3.6 - 3.8) and WLAN application (5.2/5.8 GHz bands)[1-3].

In this paper, we demonstrate a novel and simple wide band design of the printed monopole antenna. Simply by designing the three stepped stairs embedded with a T shape notch, wideband operations for a printed monopole antenna can be easily obtained. Details of the antenna design are described.

2. Antenna design and simulation results

The design of the proposed antenna is shown in Fig.1. The fabrication of the proposed antenna is done using a conventional FR4 substrate of dimensions 30*30 sq. mm

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often used to make printed circuit boards with thickness (*h*) of 1.6mm and relative permittivity of 4.4, which makes it easy and inexpensive to manufacture. The `FR4' is a fire electrical grade dielectric made with epoxy material reinforced with a woven fibreglass material. FR4 means flame retardant and type 4 indicates woven glass reinforced epoxy resin [2]. The antenna is excited by a 50Ω microstrip line.

The dimension of ground plane is taken L2*W1 (18*30) sq. mm. The width of the microstrip line is W2=4mm and length L3 is 6mm.The first stair is of length L4=6mm and width W3=10mm, second stair is of length L5=6mm and width W4=14mm and the third stair is of length L6=2mm and width W6=18mm, L7 is 10mm. The horizontal leg of T slot is of the dimension L9*W5 (2*8) sq.mm and the vertical leg is of the dimension L8*W7 (2*0.25) sq.mm.

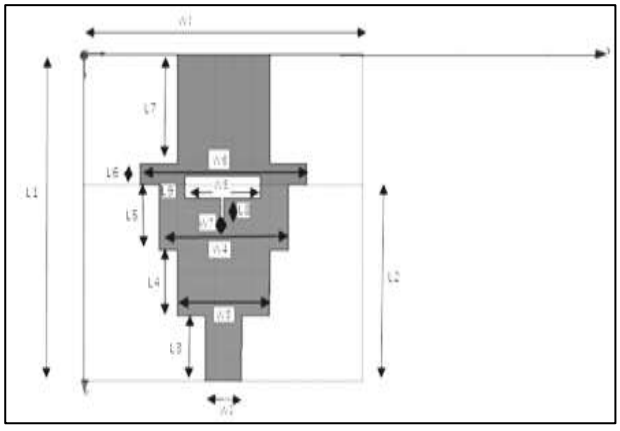

Figure.1 Dimensional specification of the proposed structure

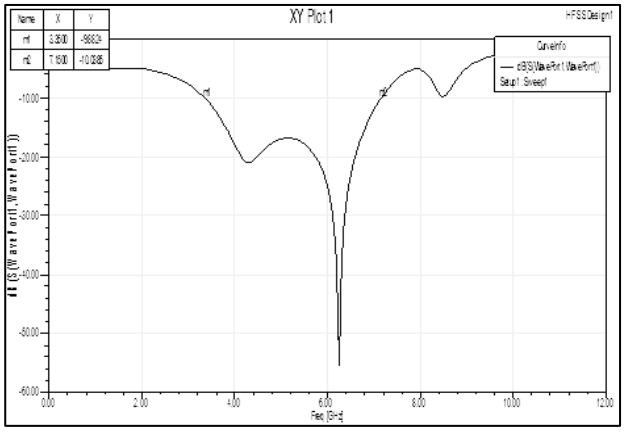

Figure.2 Return loss V/S frequency Graph

The Antenna Characteristics with different length and width of vertical leg of T slot is studied [3] as shown in the Figure.3 in accordance with the following Table 1.

Table 1 Characteristics of the proposed antennas

Antennas	L8,W7 in mm	Freq. Range
Antenna 1	2,0.25	3.355-7.15 GHz
Antenna 2	8,0.5	3.25-6.45 GHz
Antenna 3	4,0.5	3.4-7.4 GHz
Antenna 4	2,0.5	3.35-7.15 GHz

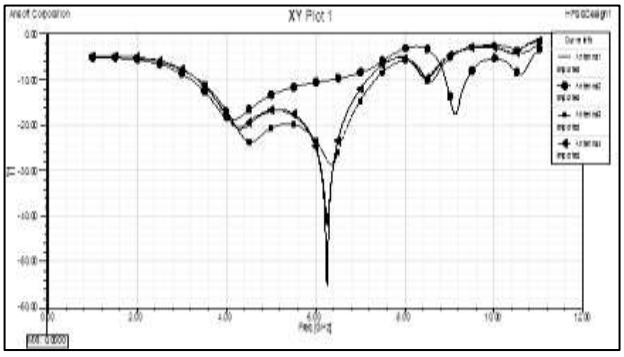

Fig. 3 Variation of return loss with frequency for the proposed antenna

The electric field distribution and the corresponding 3D polar plots are shown in Figure 4 and Figure 5.

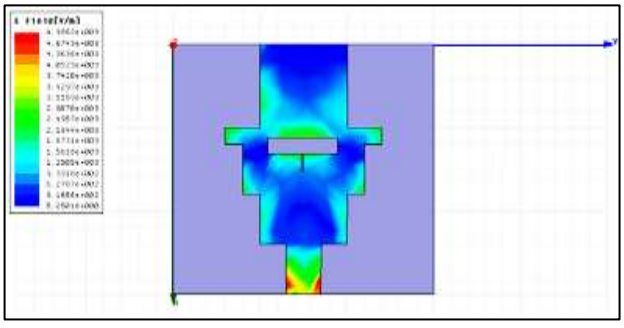

Fig.4. E-Field distribution of the proposed antenna

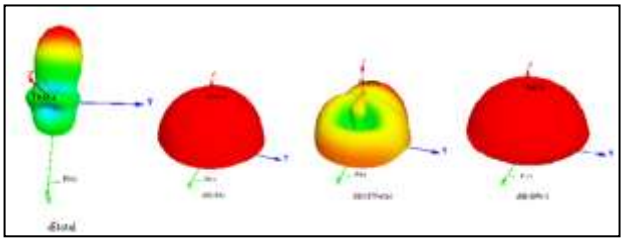

Figure 5 3D Polar Plot

Therefore the antenna design described in this paper cover the 5GHz band which is subdivided into three 100MHz sub bands a lower band (5.15-5.25 GHz) a middle band (5.25-5.35GHz) and an upper band (5.725-5.825GHz) and 3.5 GHz band(3.4-3.6 GHz and 3.6-3.8 GHz).On the other hand the radiation patterns in 2D plot are shown in the figure 6

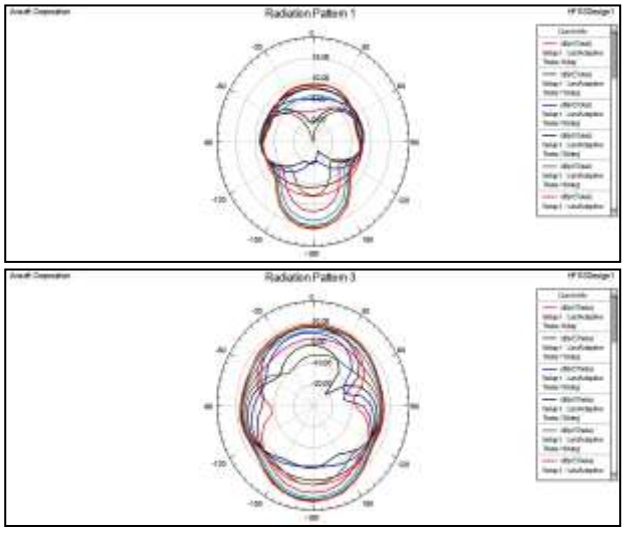

Figure .6

Ansoft HFSS 11.0 software was used as an evaluation and design tool for the majority of the work carried out in this paper. HFSS utilizes a 3D full-wave Finite Element Method to compute the electrical behavior of high-frequency and high speed components. Models can be created with different materials, boundaries and geometries.

Conclusions

An optimum microstrip line fed three stepped stair antenna embedded with a T slot for WLAN and WiMax applications is proposed and simulated. This antenna operates in single wideband frequency ranging from 3.35GHz to7.15GHz with a total bandwidth of 3.8GHz.Effect of varying dimensions of T slot on the performance have also been studied.

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