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# Design of Dual Band Double T- monopole Antenna for WLAN Operation

D.S.Jadhav[1], Dr. S.B.Deosarkar[2], Prof.P.K.Kadbe[3]

[1]*Department of Electronics, VPCOE Baramati, Pune Maharashtra*
[2] *Department of Electronics Engg. VPCOE Baramati, Pune Maharashtra, India.*
[3] *Department of Electronics Engg. VPCOE Baramati, Pune Maharashtra, India.*

**Abstract —** *Antenna is a device which convert electrical power into electromagnetic waves and vice versa. It is used with a radio transmitter or radio receiver. Microstrip patch antennas are attractive and popular antenna due to their advantages such as light weight, conformability and low costs. A novel and simple printed dual band double T- monopole antenna is proposed. An antenna will comprises two stacked T shaped monopoles of different sizes, which will generate two separate modes for desired dual band operation. The proposed antenna will have low profile and can easily fed by co axial feeding techniques. Prototypes of proposed antenna will be used for WLAN operation in the 2.4 and 5.2 GHz bands.*

*Keywords-: Antenna, monople Antenna, Dual band, Co-axial feed.*

## I. INTRODUCTION

Antenna is defined as a device or a transducer which transforms an RF signal into electromagnetic waves and acts as a means to transmit and receive radio waves. Microstrip antennas have gained a lot of popularity due to their salient features such as low profile, simple and inexpensive to design and manufacture, flexible in terms of configuration, polarization, pattern, resonant frequency and impedance when a particular shape and mode are selected . These antennas are used in various applications for example, in satellite communication, in handsets and base stations for mobile communication, in telemetry antennas for missiles and so on. Microstrip antennas cover a broad frequency spectrum from 100 MHz to 100 GHz, thus possess several advantages as compared to conventional antennas .A microstrip antenna consists of a conducting patch of any geometry on a ground plane and separated by a dielectric substrate. The rectangular and circular patches are most common geometry used in microstrip antennas. Rectangular patches are chosen as they are very simple to analyze and circular patches are chosen due to their symmetric radiation pattern.

Recently, there is rapid development in wireless communication system, and in order to satisfy the IEEE 802.11 WLAN standards in the 2.4 GHz the printed monopole antennas are required. A double L-slot microstrip patch antenna [1] array with CPW feed technology has been proposed for microwave access and wireless local area network applications. This paper results in compact antenna with good omnidirectional radiation characteristics for proposed operating frequencies. A Broadband patch antenna [2] for WiMAX and WLAN is developed, this gives characteristics that depend on various parameters such as U-slot dimensions, circular probe –fed patch A microstrip slot antenna [3] fed by a microstrip line has been proposed in a rectangular slot with transactions improved bandwidth paper used for WLAN and satellite application. Dual band L-shaped Microstrip patch antenna [4] is printed on a FR-4 substrate for WLAN systems, and achieves a frequency range from 5.0GHz to 6.0 GHz. A compact rectangular patch antenna [5] has been presented for Wi-MAX and WLAN application. This antenna has compact, cost effective, simple structure and suitable for all frequency bands of Wi-MAX and WLAN applications. Design of coaxial fed microstrip patch antenna for 2.4 GHz Bluetooth Applications [6] describes various feeding techniques. In this a circular polarized patch antenna of shape similar to alphabet I on FR4 substrate for BLUETOOTH applications has been investigated.

In this proposed paper, a novel and simple dual band design of printed double T monopole antenna is presented. The proposed monopole antenna looks like T-shaped monopole. The prototypes of proposed antenna for WLAN operation in the 2.4 and 5.2 GHz have been simulated.

## II. DESIGN CONSIDERATION

The proposed antenna can be considered as T-shaped monopoles, operated as quarter wavelength structures, and is easily fed by a coaxial feeding technique. The T- shaped monopoles is printed on the same side of the dielectric substrate (FR4 substrate of thickness 1.6 mm and relative permittivity 4.4 was used.).

In this design, the larger T-shaped monopole comprises a vertical strip (width w and height h2) in the center and a horizontal strip (width w1 and length 2l1+w) on the top. This larger T-shaped monopole controls the first or lower operating band of the proposed antenna. On the other hand, a lower horizontal strip of width w2 and length l21+w+l22 and a portion (length h1 ) of the vertical strip form the smaller T-shaped monopole, which controls the antenna’s second or upper operating band. Notice that the two portions of the lower horizontal strip protruded from the vertical strip have unequal lengths of l21 and l22.

 

To achieve the desired dual band for the WLAN operations in the 2.4 and 5.2 GHz we can adjust the parameters (h1, L1, w1, w, h2, L2, w2) of the T-shaped monopoles for controlling. In addition, it should be noted that the ground-plane dimensions can also affect the resonant frequencies and operating bandwidths of the two operating bands. Thus, the ground-plane dimensions should also be taken into account in determining the proper parameters for the proposed design to achieve the desired band operation.

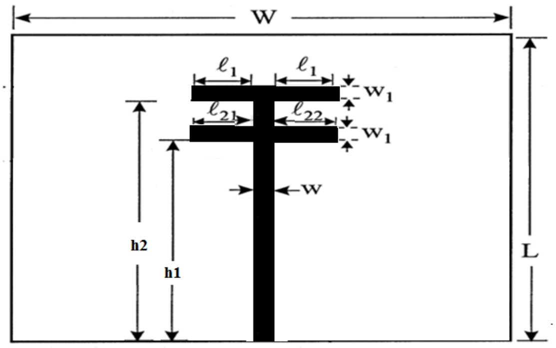


figure1.Geometry of Double T-monopole Antenna

The three essential parameters for the design of a Double C Slot Microstrip Patch Antenna are:

a) Frequency of operation (*fo)*: The resonant frequency of the antenna must be selected appropriately. The antenna designed must be able to operate in this frequency range. The resonant frequency selected for design is 2.4 and 5.2 GHz.
b) Dielectric constant of the substrate (εr): The dielectric material selected for our design is FR4 with glass epoxy substrate which has a dielectric constant of 4.4. A substrate with a high dielectric constant has been selected since it reduces the dimensions of the antenna.
c) Height of dielectric substrate (h*)*: For the microstrip patch antenna to be used in cellular phones, it is essential that the antenna is not bulky. Hence, the height of the dielectric substrate is selected as 1.6 mm.

## III. SIMULATED RESULT AND DISCUSSION

A reference antenna (the antenna shown in Fig. 1 without the lower horizontal strip, that is l21=l22=0) was first simulated. This is called as single T monopole Antenna for single band operation only. The simulated result gives 2.4 GHz with return lass of -17.55dB.The plot of return loss for single T monopole Antenna is shown in figure 2. By adding a lower horizontal strip with (l21=l22=7.5mm) and width (w2=1.5mm) to the reference antenna, an additional resonant mode at about 5.2 GHz is obtained. Now, the antenna looks like double T shaped which gives 2.4 and 5.2 GHz dual band used for WLAN application. The simulated result for double T monopole Antenna is discussed as below.

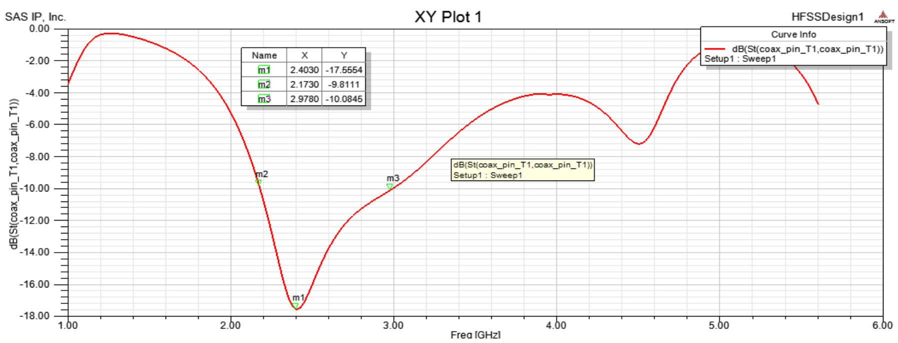


figure2. Return loss of single T monopole Antenna

 

### 3.1. Return Loss

The return loss is a variable in which the power does not return in the form of reflection and is lost to the load. The designed antenna resonates at 2.4 and 5.2 GHz frequency. The return loss for 2.4 and 5.2 GHz is -28.10dB and -24.15dB which covers the minimum required value of return loss of -10 dB. The plot for Return Loss is shown in below Figure 3.

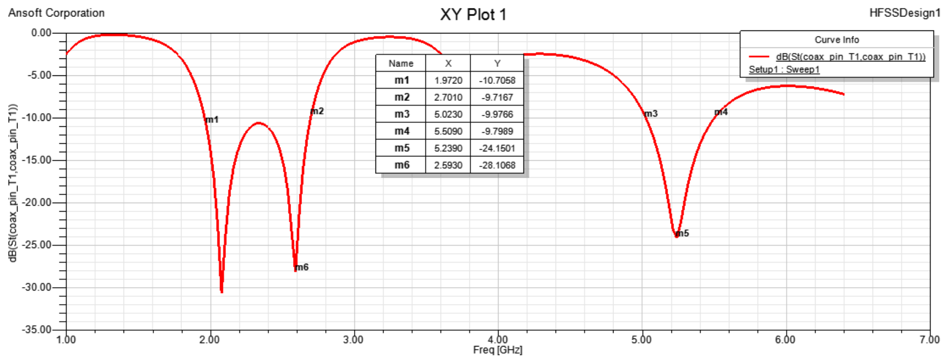


figure3. Return Loss of Double T monopole Antenna

### 3.2. VSWR

The VSWR (voltage standing wave ratio) plot for the design antenna (Microstrip feed) is shown in Figure 4. The value of VSWR is 1.7 and 1.13 at resonating frequency 2.4 and 5.2 GHz respectively. A VSWR of 1:1 means that there is no power being reflected back to the source. At a VSWR of 2.0, approximately 10% of the power is reflected back to the source.

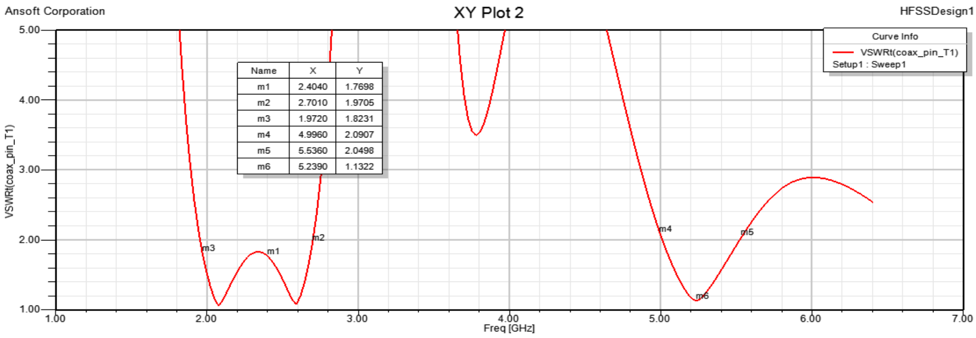


figure4. VSWR

### 3.3. Smith Chart

The Smith Chart plot represents that how the antenna impedance varies with frequency. The value of impedance should lie near 50 ohms in order to perfectly match the port with the antenna. The Smith Chart for the proposed antenna is given in Figure 5.

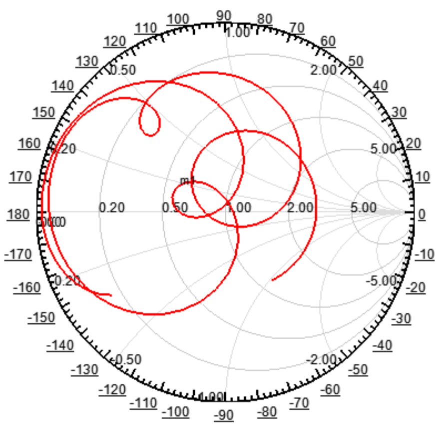

figure5.Smith Chart

 

### 3.4. Radiation Pattern

The antenna radiates more in both direction as shown in polar plot, as compared to the isotropic antenna which radiates equally in all directions.

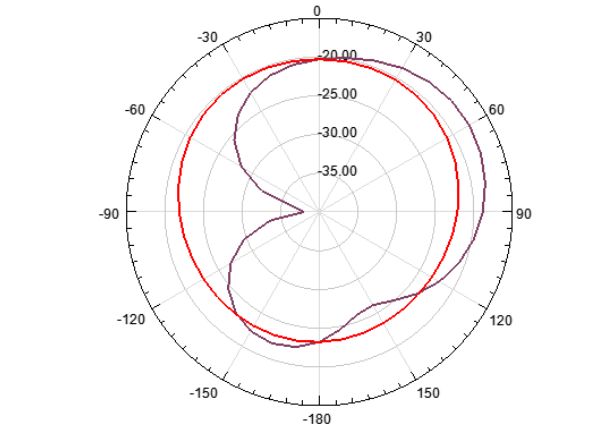


figure6.Radiation Pattern

## IV. MEASURED RESULTS

The measured return loss for 2.4 and 5.2 GHz is -17.83 dB and -19.29 dB which cover the minimum required value of return loss of -10 dB. The plot for Return Loss is shown in below Figure 7.

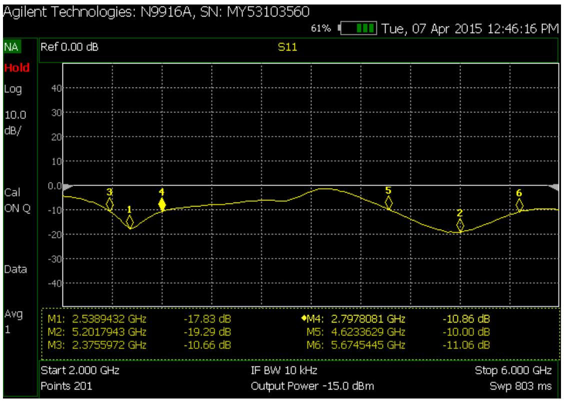


figure7.Measured Return Loss of Double T monopole Antenna

The VSWR (voltage standing wave ratio) plot for the design antenna (Microstrip feed) is shown in Figure 8. The value of VSWR is 1.29 and 1.24 at resonating frequency 2.4 and 5.2 GHz respectively.

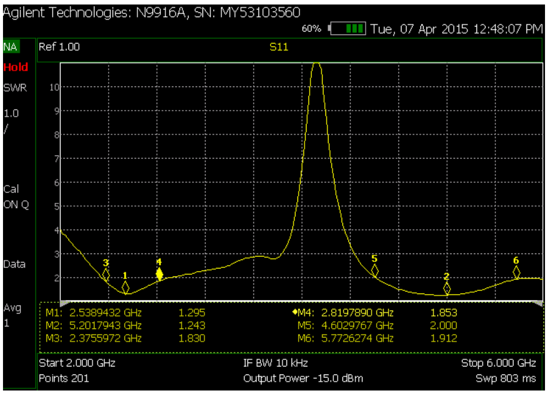


 

figure7.Measured VSWR of Double T monopole Antenna

## IV. CONCLUSION

A novel compact T monopole antenna for wireless communications systems has been designed and simulated. The simulation result obtained by HFSS shows good results. It is shown that the proposed antenna have return loss -28.10 dB and -24.15 dB for 2.4 and 5.2 GHz respectively. The VSWR are 1.7 and 1.13 for 2.4 and 5.2 GHz resp. The proposed antenna gives directivity 4.03.

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