

A Novel Multi Frequency Rectangular Microstrip Antenna with Dual T Shaped Slots for UWB Applications

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Abstract: This paper presents the design and simulation of rectangular microstrip antenna with Dual T-shaped slots for wireless communications with frequency standards 3.1GHz to 10.6GHz specified by IEEE 802.15.3a. The shape will provide the bandwidth which is required in various applications like remote sensing, mobile radio, etc. The antenna design is an improvement from previous research with single T slot and it is simulated. Microstrip line edge feeding technique is used in the design analysis. The performance of the designed antenna was analyzed in terms of bandwidth, gain, return loss, VSWR, and radiation pattern. Substrate used here is DUROID which has a dielectric loss tangent of 0.0009. The results show that the antenna is able to operate at 4.84 GHz and 6.81 GHz frequency band with operating frequency at 5 GHz.

Keywords: multi frequency, microstrip,

I. Introduction

Microstrip antennas consist of a very thin metallic strip (patch) on a grounded substrate found extensive applications in different fields due to their attractive features. These antennas are low profile, low weight, low cost, compact and comfortable structure and easy to fabricate. These antennas have drawn attentions of scientific community over the past decades. These antennas can be easily put on any surfaces and may be easily coupled with MIC Components. However their low gain values and bandwidth constraints limit their usage in Commercial Applications.

Microstrip antennas are characterized by a larger number of physical parameters than conventional microwave antennas. They can be designed to have many geometrical shapes and dimensions but rectangular and circular Microstrip resonant patches have been used extensively in many applications. Nowadays scientific community is deeply involved in improving their performance so that these may replace other antenna structures in modern communication systems. In the present communication we have presented a rectangular patch microstrip antenna with dual T shaped slot using microstrip edge feeding technique. The simulation analysis of this antenna is carried out on Ansoft High Frequency structured Simulation software (HFSS).

1.1 Microstrip Edge Feed:

In this type of feed technique, a conducting strip is connected directly to the edge of the microstrip patch. The conducting strip is smaller in width as compared to the patch and this kind of feed arrangement has the advantage that the feed can be etched on the same substrate to provide a planar structure.

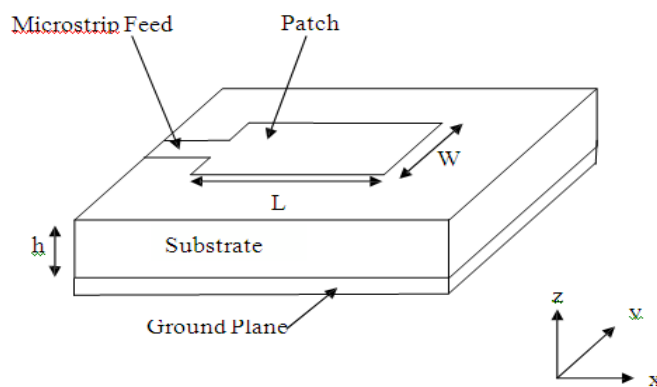


Fig 1 :Microstrip edge feed

II. Antenna Design Specifications

2.1 Antenna Design:

The antenna showed in Fig 2 consists of a rectangular patch on Duroid substrate with two T-shaped slots in order to have the drastic variations in the pattern resonance frequencies. The dimensions of the proposed antenna are summarized by accepting these conditions $W > L$, $W < 2L$.

1: Calculation of Width (W)

For an efficient radiators, practical width that leads to good radiation efficiencies.

$$W = \frac{1}{2f_r \sqrt{\mu_0 \epsilon_0}} \sqrt{\frac{2}{\epsilon_r + 1}} = \frac{C}{2f_r} \sqrt{\frac{2}{\epsilon_r + 1}} \quad (1)$$

C= Velocity of light

ϵ_r = dielectric constant of substrate

2: Calculation of the Effective Dielectric Constant (ϵ_{eff})

The effective dielectric constant is

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left(\frac{1}{\sqrt{1 + \frac{12h}{w}}} \right) \quad (2)$$

3: Calculation of Effective Length

The Effective length is

$$L_{eff} = \frac{C}{2f_r \sqrt{\epsilon_{eff}}} \quad (3)$$

4: Calculation of actual Length of Patch (L)

The actual length of radiating patch is obtained by

$$L = L_{eff} - 2\Delta L \quad (4)$$

III. Analysis of Antenna Geometry

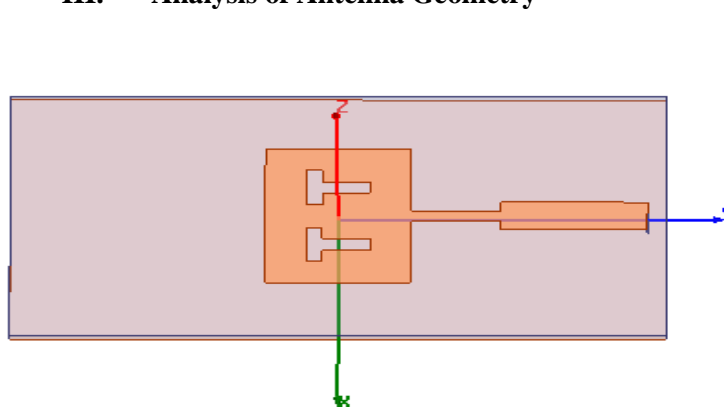


Fig 2: Model of Antenna

3.1 Patch dimensions:

X (cm)	2.34
Y (cm)	1.82

3.2 Substrate parameters

Relative permittivity	2.2
Relative permeability	1
Dielectric loss tangent	0.0009
Height (mil)	70
X (cm)	4.2
Y (cm)	8.2

3.3 Making “T” slot on patch

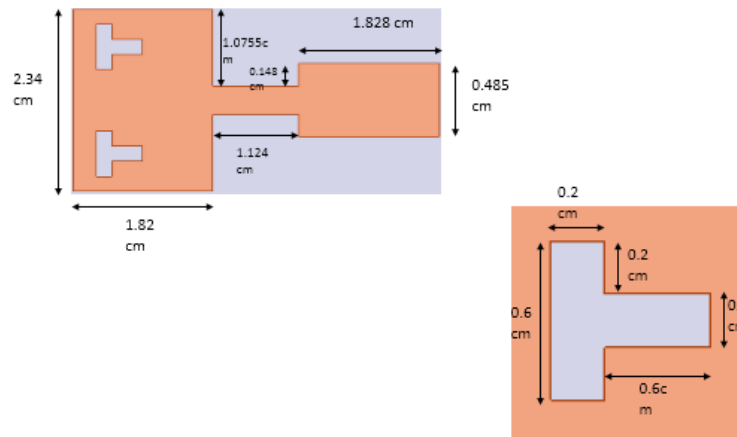


Fig 3:Dimensions

When T shaped slots as shown in Fig 3, introduced on the patch geometry, the antenna now resonates at different frequencies.

IV. Results and Discussions

The simulated results for this modified antenna are optimized by varying position, length and width of T shaped slot.

Fig 4 shows the return loss for the designed antenna. This indicates that the antenna operates at 4.8GHz and 6.8GHz frequencies.

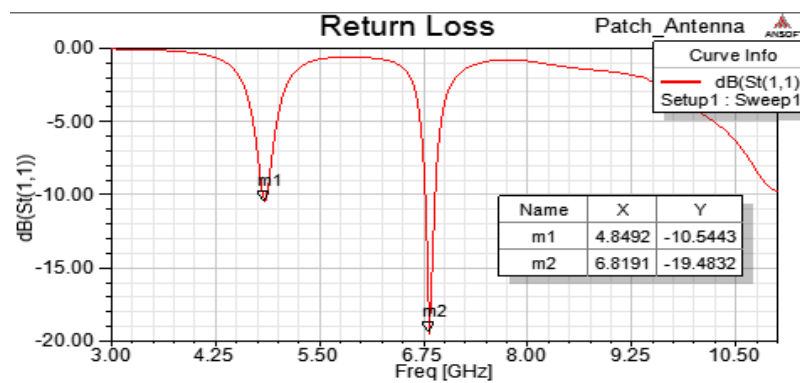


Fig 4: Return loss

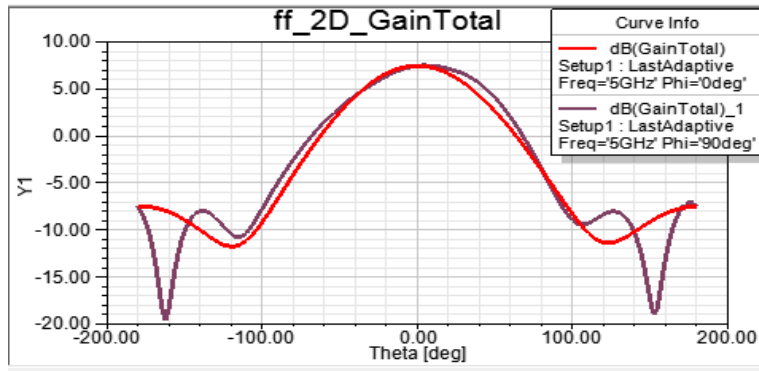


Fig 5: 2d gain plot

Radiation Pattern:

Fig 6 shows the simulation results of the radiation patterns for the proposed patch on DUROID substrate along *E* and *H*-planes.

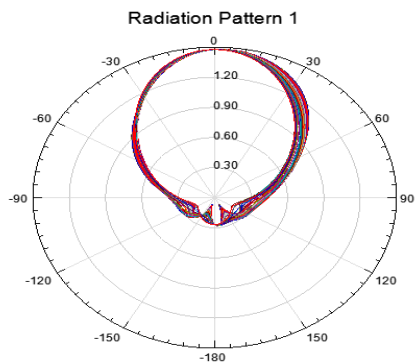


Fig 6: Radiation pattern

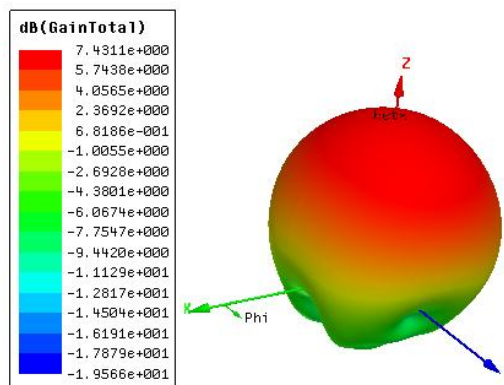


Fig 7: 3d gain

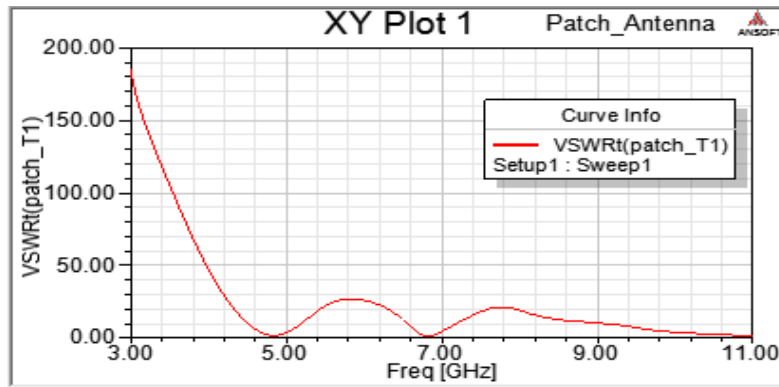


Fig 8 : VSWR plot

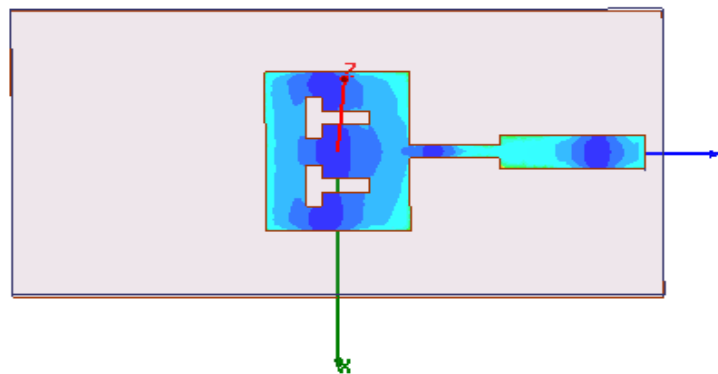


Fig 9: Electric field distribution pattern

V. Conclusion

The paper presents A Multi Frequency Rectangular microstrip Antenna with dual T Shaped Slots for Ultra wide band (UWB) applications with frequency ranging from 3.1GHz to 10.6GHz which is specified by IEEE standards 802.15.3a. The analysis is carried out by considering duroid substrate material using HFSS. The results show that the antenna is able to operate at 4.84 GHz and 6.81 GHz frequencies with operating frequency at 5 GHz.

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