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Design and Analysis of Multiband Microstrip Antenna with Two Paristic Patches

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ABSTRACT

The accessibility and enlargement in development of economical, less weight, highly reliable antennas are required for wireless communication, it poses new challenges for the design of antenna in wireless communication. The microstrip patch antenna used for these communication, because they will provide high frequency and less bandwidth. A corner cut microstrip patch antenna having T-slot with small microstrip line feed is presented here. Different design parameters with their effects are studied using v11 An soft HFSS for the different operating frequencies and obtained maximum return loss bandwidth. The results demonstrates the proposed antenna with T-slot and corner cuts at special position can generate steady radiation patterns and is capable of wrapping the frequencies demanded by Wireless Applications.

Keywords- High Frequency Structure Simulator (HFSS),Microstrip Patch Antenna,T-Slot.

I. INTRODUCTION

Current wireless communication systems utilize several different radio communication standards and separate at many different parts of the frequency spectrum. In this fractured service environment, terminals operating in multiple systems and frequency bands can offer a better service coverage than single band and single-system terminals. Multiband antennas are essential components of multiband terminals.

Generally, there seems to be an increasing trend in the number of radios in a mobile terminal, which translates into an increase in the number of antennas or antenna functions. Integrated antennas have become very popular due to the advantages they provide with respect to the aesthetical design of mobile phones. It has been shown in many papers that the maximum bandwidth of an antenna of a given size depends strongly on the dimensions of the mobile phone in which the antenna is installed. Multiband operation, which nowadays is almost a common standard, requires the use of enhanced radiating elements. Moreover, other aspects such as small size, weight, and integration have a great relevance for the final design, and material and assembling costs must be kept as low as possible. The preferred solution is the use of radiating patches with multiple resonances, covering different bands, which are easily adapted to the shape of the handset, and can therefore be integrated within the back cover. This solution has a number of advantages: terminal designers can forget about the antenna when designing the external cover, the phone becomes more robust as there are no external radiating elements that could break off and the antennas can be produced in a more cost effective way.

Multiband antennas are very suitable in such applications since they are compact, low profile and easy to manufacture. However, several techniques applied simultaneously are necessary to reduce the size of these antennas while maintaining good multiband/wideband performances. Starting with the main quarter wavelength element, these techniques are: addition of parasitic shorted patches, capacitive loads and slots on the resonators. The designed antennas are expected to function properly in the GSM (global system for mobile communications, 890-960MHz), DCS (Digital Communication System, 1710- 1880MHz), PCS (Personal Communication Services, 1850-1990MHz), and UMTS (Universal Mobile Telecommunication System, 1920-2170 MHz).

A considerable number of antennas designed for mobile phones have been published recently, enough to be organized into a book. A short overview of existing shorted microstrip patch antenna type internal multiband antennas and their design techniques is presented to illustrate the recent progress in the field.

Omnidirectional Microstrip antenna is already available in different shapes and feeds. The major hurdle in this is inability to produce high frequency. In this scheme creating ripple along the substrate plane lead to changing antenna behavior. So this problem overcome to use the Multi band Microstrip Antenna with different slots especially with T-slot using. A corner cut microstrip patch antenna having T-slot with small microstrip line feed is presented here. Different design parameters with their effects are studied using v11 An soft HFSS for the different operating frequencies and obtained maximum return loss bandwidth. The results demonstrates the proposed antenna with T-slot and corner cuts at special position can generate steady radiation patterns and is capable of wrapping the frequencies demanded by Wireless Applications.

II. METHODOLOGY

H slot Microstrip antenna is used in different shapes and feeds. The major hurdle in this is inability to produce high frequency. Occurrence of radiation and Electromagnetic Interference is more. So, to overcome this problem thus using the Multi band Microstrip Antenna with T-slot. A corner cut microstrip patch antenna having T-slot with small microstrip line feed is presented here.

A. Antenna design

For designing of a microstrip patch antenna, we have to select the resonant frequency and a dielectric medium for which antenna is to be designed. HFSS Software used for simulation of the antenna.

Step 1: Calculation of the Width (W):

The width of the Microstrip patch antenna is given as

w = c

$2f\ \varepsilon r + 1$

2

Where c is the velocity of light in free space Fo is the Resonance Frequency

Step 2: Calculation of the Effective Dielectric Constant.

This is based on the height, dielectric constant and the calculated width of the patch antenna. The microstrip patch antenna is designed with known value of substrate and height.

εr = 4.4, h = 1.6 mm

$1\ \varepsilon + 1$

$\varepsilon - 1$

$12h -$

$\varepsilon \quad = r \quad + r \quad 1 + \quad 2$

$reff \quad 2 \quad 2 \quad w$

Step 3: Calculation of the Effective length The effective length is given as

c

Leff = $2f0\ \varepsilon\gamma eff$

Step 4: Calculation of the length extension ΔL The length extension is given as

$\varepsilon e + 0.3\ w + 0.264$

$\Delta L = 0.412h \quad ff \quad h$

εe

ff

$-0.258\ w + 0.8$

Step 5:Calculation of actual length of the patch

L=$Leff$ - 2ΔL

Therefore, to design a rectangular microtsrip patch antenna, three main parameters needs to be defined which are the dielectric material (the substrate), thickness of the substrate, and the operating frequency of the antenna. The dielectric material that is proposed to be used is FR_4, which is a widely used dielectric material with a relative permittivity εr of 4.4. The main reason for choosing this material is the availability and the wide utilization of this material in microstrip patch antennas.

Operating Frequency (GHz)	Fo	2.35	3.71	4.12	4.75	9.00
Width (cm)	w	2.697	1.7085	1.5385	1.3344	0.70429
Effective dielectric Constant	Ee	8.7322	8.33627	8.2435	8.1177	7.5741
Effective Length	Leff	2.160	1.40	1.27	1.108	0.605
Length Extension (cm)	ΔL	0.10869	0.1062	0.1055	0.9743	0.9118

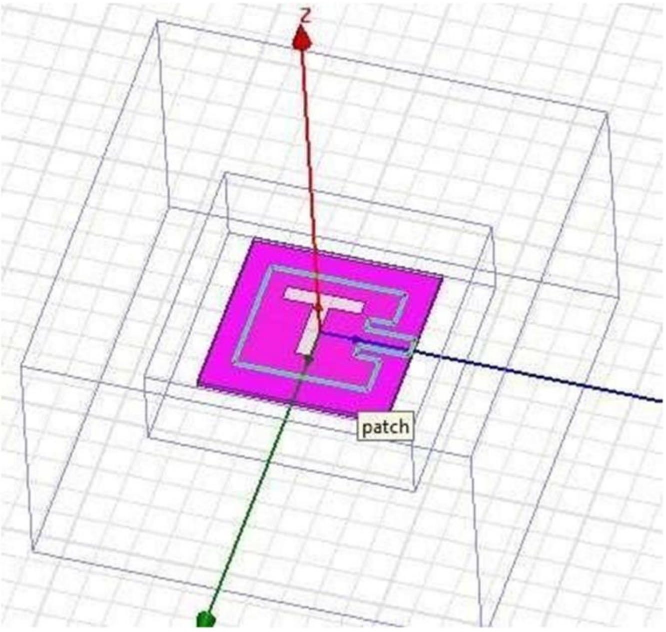
B. Design Aspects

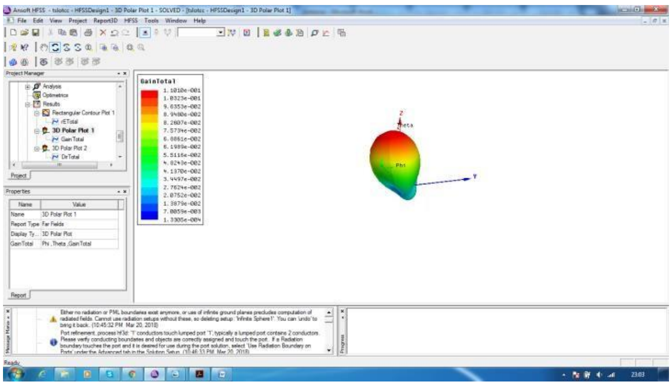
The designed structures of different microstrip patch antennas for multiple applications are designed thing HFSS tool using their corresponding dimensions as shown below in their respective tabular form. These are the dimensions which are used for the design of T-Slot microstrip patch antenna

Parameter	**Size(mm)**
Substrate (ROGERS 3210)	22*31*2.6
Infinite Ground	22*31
Patch	16*23*2.6
Corner cut	2*3
Air	22*31*2.6
Feed	3*2
T-Slot	10*1.5
T-Slot	1.5*15

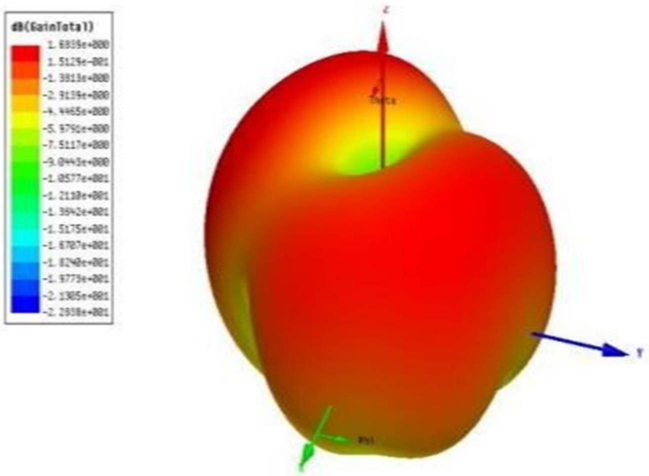
III. RESULTS AND DISCUSSIONS

By designing our antenna following the five steps the antenna was designed and constructed using HFSS





After simulation in the HFSS simulator the gain of the T-Slot corner cut is generated. The gain obtained for the simulated antenna is 5.4533



After simulation in the HFSS simulator the 3D Radiation pattern of T-Slot is generated. The resonance frequency is chosen at 2.44 GHz which is suitable for industrial scientific and medical (ISM) band applications. In addition, rectangular patch antenna has improved gain value of 5.4533 dB.

IV. CONCLUSION

The antenna has been designed for multiple frequency bands to use the same antenna for different applications. The operating frequencies of the T-Slot are 1.675GHz, 3.97GHz, and 7.93GHz, minimum return loss up to -28.1171dB and maximum gain of 5.4533dB. These can be future used to design arrays to increase gain and bandwidth. The major applications of all our designed antennas are Wi-Fi satellite, Radio, Microwave relay and RADAR. In this project multiband T-Slot antennas have been designed and simulated observations are made on the radiation pattern. From the results of the simulation, it has been observed that the influencing parameters of the antenna are the relative permittivity of the dielectric under the patch, the feed location, the position of the parasitic patch, and the length and width of the patch. The antenna has been designed for multiple frequency bands to use the same antenna for different applications.

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