



Single Feed Dual band dual Polarized Micro-strip Patch antenna

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Abstract : This paper covers some aspects of Microstrip antenna designs. The design and analysis of single feed Dual band and Dual polarized rectangular Microstrip antenna which operates at the central frequency of 2.23 GHz & 2.78 GHz. Radiation at frequency 2.23 GHz is Linear polarized & at frequency 2.78 GHz is circular polarized . . Basically, transmission line and cavity model have been used to model both antennas. First, the design parameters for dual band and dual polarized of rectangular patch antenna have been calculated from the transmission line model equation. The antenna design is extended to enhancement of bandwidth of multi- frequency and multi-polarization rectangular Microstrip patch antenna using the slots at radiating edges.

INTRODUCTION

In recent years the demand for broad-band antennas has increased for use in high frequency and high speed data communication. Printed antenna's are economical and can be accommodated in the device package. Microstrip antennas are best form of printed antennas because they are light weight, low profile, low cost, ease to analyze and fabricate and are compatible with the integrated circuit. In this paper, dual-polarized and dual frequency design of a single-feed rectangular microstrip antenna with a rectangular slots i.e approximate to square slot is placed Close to its probe feeding point. The two operating frequencies, having different radiation characteristics and different polarization planes i.e. one is linear polarization and other is circular polarization. Here dual-polarized radiation can be obtained with a reduced antenna size at a fixed operating frequency. Many prototypes of the proposed compact dual polarized by exciting the patch using a coaxial probe feed along the diagonal line of the rectangular patch, it is seen that dual-frequency operation [1,2] based on the two resonant frequencies f_1 and f_2 of the perturbed TM_{10} and TM_{01} modes can be generated. Linear polarization is used for mobile communication and circular polarization used for satellite communication. The dual-polarized patch antenna has been a popular research topic during recent years, the proposed antenna can double the capacity of Communication systems by means of the frequency reuse, and reduce the multipath fading of received signals in land-based mobile-communication systems by means of the polarization diversity. The new proposed design has a greater area reduction compared to the placard-shaped[5], arrow-shaped [6], slotted square shaped [7] antennas reported earlier. Two parameters affect the resonant frequency of the antenna, the slot width and slot length structure and changes vswr position. Here, the low-frequency ratio and area reduction mainly depended on the slot parameters. The design has been successfully implemented, and simulated results are presented.

PARAMETER DESIGN

The three essential parameters for the design of a rectangular Microstrip Patch Antenna are

- Frequency of operation (f_0): The resonant frequency of the antenna must be selected appropriately. The Mobile Communication Systems uses the frequency range from 1800-5600 MHz. Hence the antenna designed must be able to operate in this frequency range. The operating frequency selected for my design is 3.0 GH.
- Dielectric constant of substrate (ϵ_r): The dielectric material selected for my design is FR4 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
- Height of dielectric substrate (h): For the microstrip patch antenna to be used in cellular phones, it is essential that the antenna is not substrate is selected as 1.59 mm.

To design the rectangular MSA that operates at frequency around 3 GHz, the optimal **width** can be found using [7]:

$$W = \frac{1}{2f_0} \sqrt{\epsilon_0 \mu_0 (\sqrt{2} / \epsilon_r - 1)}$$

$$W = 30.44 \text{ mm}$$

The effective length found by using[8]

$$L = \frac{c}{2f_0} \sqrt{\epsilon_r \text{ref}}$$

$$L = 23.40 \text{ mm}$$

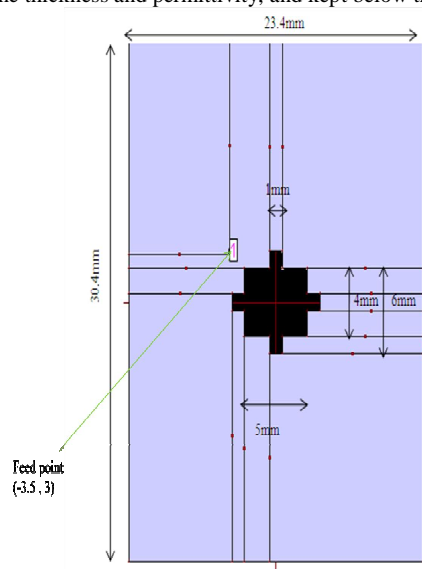
Calculation of microstrip patch antenna results

L	Length of the Patch	23.4mm
W	Width of the Patch	30.4mm
LS	Length of Square slot	5mm
WS	Width of Square slot	4mm
Rp	Probe radius	.25mm
LSR	Slot arm Length	2mm
WS	Slot arm Width	1mm

Shape	Dual band and dual polarized antenna
Dielectric constant	4.4
Frequency of operation	2.5 GHz
Height of the dielectric	1.588mm
Feeding method	Probe
Polarization	Dual Polarization

GEOMETRY OF PURPOSED ANTENNA

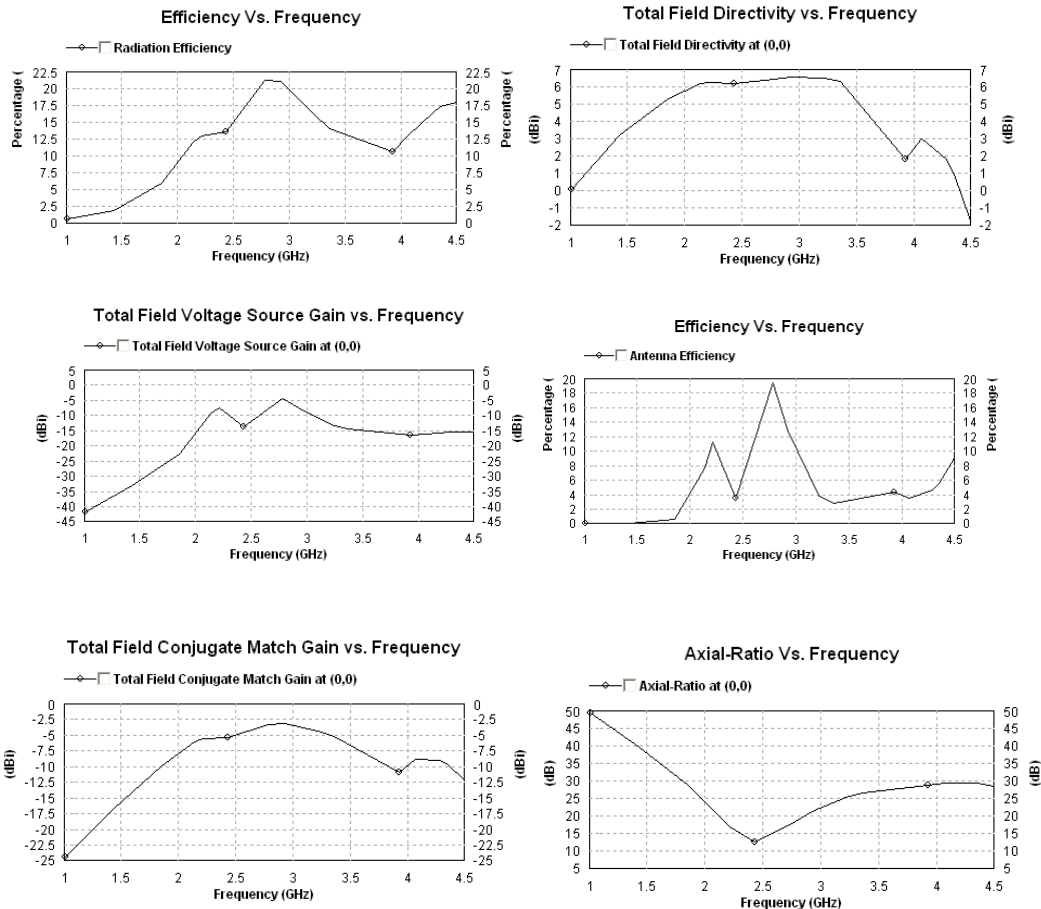
The geometry of the proposed antenna is shown in fig.4.2. The rectangular patch of dimensions L x W separated from the ground plane with a foam substrate of ϵ_r , thickness h and the rectangular slot (approximate square slot) placed at the center. The location of the approximate square slot on the patch can be specified by parameter W_S and L_S . The width and length of the slots are denoted by W_s and L_s . The rectangular patch is fed using 50Ω probe feed with radius is 0.25mm. A typical proposed antenna is implemented and investigated. It has dimensions L=23.4mm, W=30.4mm, $L_s=5mm$, $W_s=4mm$ and is simulated on a substrate of $\epsilon_r = 4.4$ and $h=1.6$ mm. A good impedance matching of the two operating frequencies can be obtained by using a microstrip feedline of length with arm length L_{sr} and width W_{sr} etched on a substrate of the same thickness and permittivity, and kept below the antenna to provide electromagnetic coupling.



Simulated Result and Analysis

In order to evaluate the performance of the proposed antenna, the antenna is simulated through the simulation tool IE3DTM. The analysis of the antenna for different physical parameter values has been done by varying one of them and keeping others as constant

Simulated radiation efficiency:



Simulated axial ratio

CONCLUSION

In this paper, A simple and efficient technique of probe feeding and line feeding method has been introduced for an impedance matching improvement of the antennas. Main concern of the thesis is to study of Dual band and dual polarization patch antenna using different techniques and frequency ratio of the Microstrip antenna. The dual band and dual polarized Microstrip antenna is a more conventional approach for the implementation of a broadband antenna and for satellite communication where the low frequency ratio is used. Dual polarization antenna are used in weather radar. In general weather radar transmit and receive microwave at one polarization usually horizontal polarization but additional information that can be obtained from nature of the target, it requires more than one polarization . First, proposed dual band & dual polarized rectangular Microstrip antenna is designed to operate at frequency 2.28 GHz is Linearly polarized and at frequency 2.78 GHz is circularly polarized.

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